Rewiring Aotearoa

June 2026

Electric Homes & Vehicles

The opportunity of running on New Zealand-made energy

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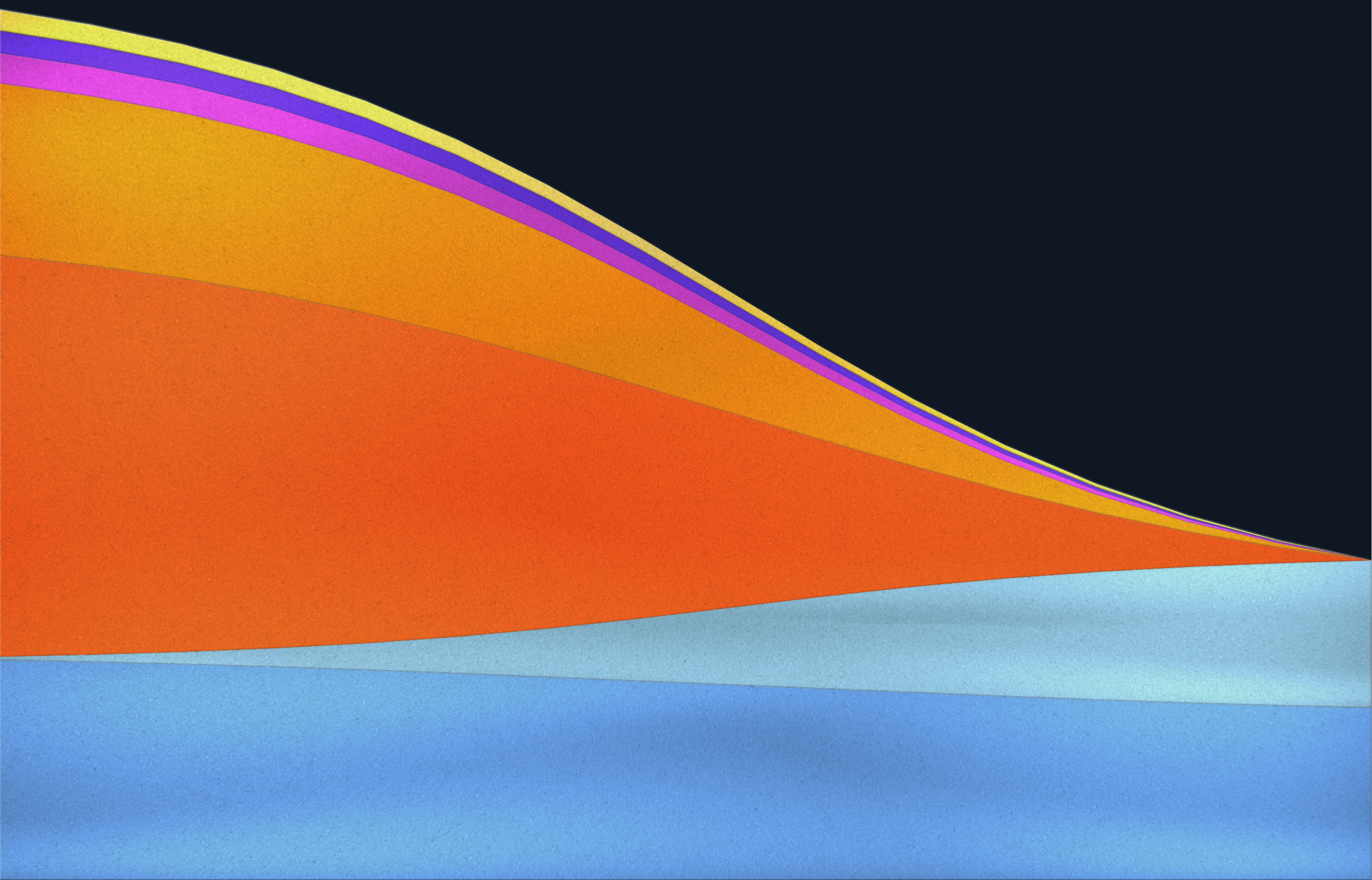

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ABOUT REWIRING AOTEAROA

Rewiring Aotearoa is an independent non-partisan non-profit. It is a registered charity working on energy, climate, and electrification research, and supporting communities through the energy transition. The team consists of New Zealand energy, policy, and community outreach experts who are passionate about building a better energy system that benefits New Zealanders. Rewiring Aotearoa's work is primarily funded by New Zealand philanthropists, with a small amount of funding generated through specific projects and donations from supporters in the community. It is fiercely independent, and completely self-determining in its work.

EXECUTIVE SUMMARY

- **The net savings gap has doubled** for electrifying households in New Zealand. **Homes can save thousands** each year, **communities can save millions**, and **the nation can save billions** by replacing fuel-based machines with electric alternatives and powering them with New Zealand-made electricity.
- This work builds a granular household energy economics model to compare the status quo of current household energy mixes to replacing appliances and vehicles with electric alternatives. For long term representation, **the volatile fuel price rises seen in 2026 have not been included**.
- A home with average energy use that chooses electrified appliances rather than gas, electric rather than petrol vehicles, and installs a solar & battery system **can save $7,600 per year on bills**. When including the financed additional upfront costs of the electric options, that home **will net $3,000 per year in savings**.
- Over a 15 year time horizon, these electric decisions will **save $114,000 on bills, and net $45,000**, including capital cost differences. When compared to LPG (bottled gas) rather than piped gas, these **savings increase to $120,000 and $51,000** respectively, or **$3,400 per year net** and **$8,000 on bills**.
- Electric heat pumps are **2 - 4 times more efficient** than gas heating (or water heating) in New Zealand homes. Electric induction cooktops are **2 - 3 times more efficient** than gas cooktops. Electric vehicles are **2 - 4 times more efficient** than petrol or diesel counterparts, including hybrids.
- Homes are often not in a binary position of electrified or not. Some already have solar, but drive petrol vehicles; others have heat pumps for space heating, but use gas for water heating. By counting the appliance and vehicle stock nationwide, we then estimate community and nationwide savings.
- In an example **community of 10,000 homes**, electrification would create **bill savings of $66 million per year**, and net savings, including capital costs, over 15 years to 2040 of **$320 million**.
- At a national level, the bill savings are **$12.9 billion per year**, while net savings including capital costs are **$9.1 billion per year** in 2040, and **$61 billion** over 15 years to 2040, as homes electrify over time.[1]
- The additional installation labour (e.g heat pumps, solar, EV chargers) and the community savings would create an estimated **58,000 jobs** and positive economic feedback loops in New Zealand communities.
- Homes can now install solar and battery systems at a net economic gain of tens of thousands over their lifetime. If 80% of our homes installed these systems, it would provide ~46% additional electricity, nearly doubling what we currently get from hydro dam generation. These systems would have a nameplate capacity **larger than all power plants combined**, of 14.8GW (max), and the batteries would provide a peaking capacity of 8.2GW, approximately **six times more instant output than Huntly**.
- The electric vehicles purchased in this scenario would have a combined battery output capacity around **three times larger than all power stations in New Zealand combined**. Note, we do not model vehicle-to-grid savings in this work.
- There is a **clear market failure in accessibility of these electrification savings**, caused by financial products, energy system regulation, policy, and information asymmetry. **Recommendations to remedy this are detailed in the report.**
- Household electrification will have a significant positive impact on New Zealand's energy security and resilience, removing around half of imported fossil fuels and providing a level of community energy resilience greater than New Zealand has ever had.
- Electrification in this scenario will remove around **10 million tonnes of New Zealand's emissions at a net economic gain**. This is about one third of gross CO2 emissions, and one eighth of all GHG emissions.

[1] The savings in this model are considered conservative, for a range of reasons including long interest repayment terms, full depreciation of machines before their end of possible useful life, minimal battery arbitrage savings, no vehicle-to-grid savings, fuel prices based on historic averages without any forward volatility, and other reasons further detailed in the methodology.

Peer Reviewer Quotes

> “Post the second oil shock of the 1970s, energy policy shifted massively around the globe. I am anticipating a repeat in the coming years, as energy security becomes paramount. Households are dealing with cost of living pressures, with energy costs one component. New Zealand must be a good global citizen and meet environmental responsibilities; our trade access to many countries depends on it. At the same time, pricing signals have shifted in solar’s favour and society is going to hear the word electrification a lot over the coming years. Rewiring Aotearoa’s work shows a path forward. There will be more paths. The status quo’s time has passed.”

— Cameron Bagrie, Independent Economist

Cameron also provides a quote on page 8 about the strategic context for the New Zealand economy.

> "The learning curve has spoken: Rewiring Aotearoa has run the latest numbers to show that electrification is now economically compelling for households with access to capital. The robust and consumer-centric approach in Rewiring's latest report - ‘Electric Homes and Vehicles 2026’ - reveals that we stand on the cusp of a profound energy transition that will lower living costs, strengthen resilience, and deliver environmental benefits to boot. The challenge is no longer making it happen, but whether everyone will have the opportunity to participate. Without deliberate action, the households least able to invest will remain locked into increasingly expensive and less resilient energy systems.”

— Professor Shaun Hendy, Physicist

SUMMARY SECTION

The gap has doubled: homes can save thousands every year when they electrify

In 2024, we built a granular model of household energy economics. This showed New Zealand had crossed an electrification tipping point. Switching home appliances and vehicles to electric alternatives and adding a solar and battery system could create combined net savings for homes with all upfront and ongoing costs included. This model has now been updated and expanded with price changes in energy and product costs, and the savings gap has doubled. Note: for long term representation, the volatile fuel price rises seen in 2026 have not been included.

A New Zealand home consuming an average amount of energy while using gas appliances and petrol vehicles is losing out on $7,600 in savings on its energy bills per year when compared to a home with electrified appliances and vehicles with a solar and battery system. With upfront costs and loan repayments included, **the all-electric home is $3,000 net better off per year, and a net $45,000 better off over 15 years** (Figure 1).[2] These comparisons use homes at either end of the spectrum (fossil fuels vs fully electric) to illustrate the gap between the two. Savings will also be impacted by the amount of energy the home uses - with higher savings for higher energy use.

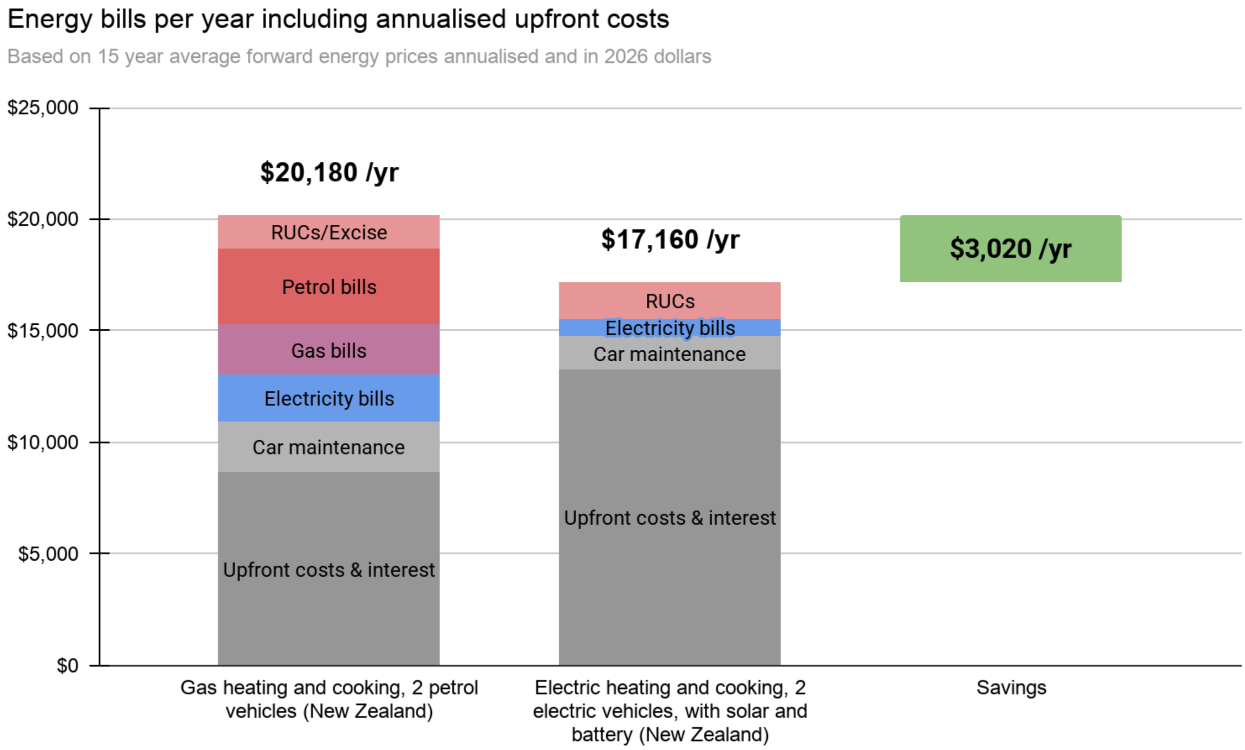

Figure 1: Gas appliances and petrol vehicles compared to electrified appliances and vehicles with solar and battery. The annualised amount that a household spends on energy combined with annualised upfront capital costs and interest costs of financing over asset lifetime. Section 2 provides more details on the economics at a household level.

[2]These comparisons use two households with average energy use, and national average solar generation and electricity price. The average energy use is for a 2.7 person home. It assumes one home uses gas for space and water heating and cooking and electricity for lighting and other appliances, and has two petrol vehicles. The other home has all electric appliances, including heat pumps for space and water heating, induction cooktop and two electric vehicles. Savings will vary by home, for example some homes already have heat pumps, electric vehicles, and solar installs. This example represents both ends of the spectrum, for an average energy using home, so is not the max or minimum.

We can also look at the bill savings created by these investments in electrifying energy use. Figure 2 shows the bill savings (excluding capital costs) each year for the electrified home shown above. Running more efficient electric homes and vehicles on a combination of rooftop solar-generated electricity and grid electricity can provide $7,600 a year in ongoing bill savings. This is not the maximum; it is based on a home with typical energy consumption. A large home, with higher consumption or longer commuting distances than average will save even more.

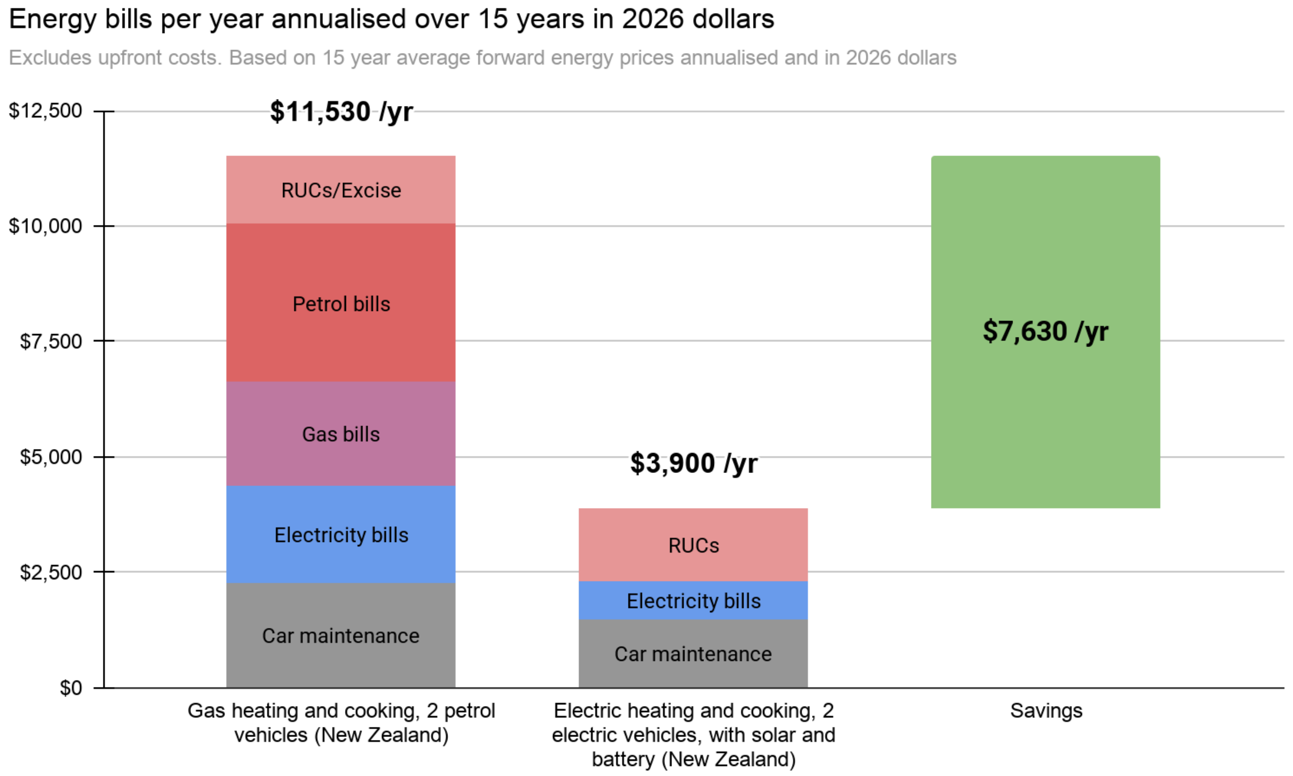

Figure 2: shows the annual energy bills for a typical New Zealand household that uses gas heating and petrol vehicles compared to one that uses electric heating and EVs with solar and batteries. Note: most households are not using all gas appliances and all petrol vehicles. For example, some homes already have heat pumps, solar or electric vehicles. Therefore the savings across the country average at lower per household than shown here. *Section 1 provides more details.*

This savings gap shows that everyone in New Zealand technically can afford to electrify and they can save/earn money through doing so. The problem is that not everyone can access those savings because they need access to the capital to make the electrification decisions. There is a clear accessibility gap.

Mortgages exist so that more people can buy houses without having to pay upfront. Similarly, how fast we electrify is in large part a question of access to finance so that more people can get past the upfront cost barrier and make the early investment decisions that will create far more value over time. Some households will already be able to do this because they have the money or can access finance. But a large portion of society cannot and, in many cases, the ones who are currently missing out on these savings would benefit most from them. If we can address the accessibility gap, we can rapidly accelerate lower bills for homes, a more productive energy economy, and an unprecedented level of community energy resilience. Solving this problem is not about subsidies, it is about accessibility and making it easy for households to co-invest in an energy system that will benefit them, their community, and the nation.

Communities can save millions

The model built for this work investigates the energy economics for many different communities throughout New Zealand, with different energy prices, sunlight hours, heating needs and driving patterns. Here we look at the savings for an example North Island community of 10,000 households, roughly the size of Kerikeri, Taupō township, Pukekohe, Blenheim, Timaru, or Queenstown.

Bill savings per year:	**$66 million**
Net savings over 15 years:	**$320 million**
Net savings per year in 2040:	**$47 million**
Jobs created:	**300**

These household savings add up. For this example community, making the switch could save $66 million per year on bills, $320 million in cumulative net savings over 15 years including the capex of electrification, and create an estimated 300 jobs from the installation labour and savings flowing through the community. Community electrification economics is explored in further detail in Section 3.

The nation can save billions

Bill savings per year:	**$12.9 billion**
Net savings over 15 years:	**$61 billion**
Net savings per year in 2040:	**$9.1 billion**
Jobs created:	**58,000**

At a national level, the savings on the table are $12.9 billion per year on bills, a net of $9.1 billion per year in 2040, and cumulative savings of $61 billion. The job creation opportunity nationally from this is 58,000, driven by a combination of savings flowing through the economy and local installation tradework. National electrification economics are explored in Section 4.

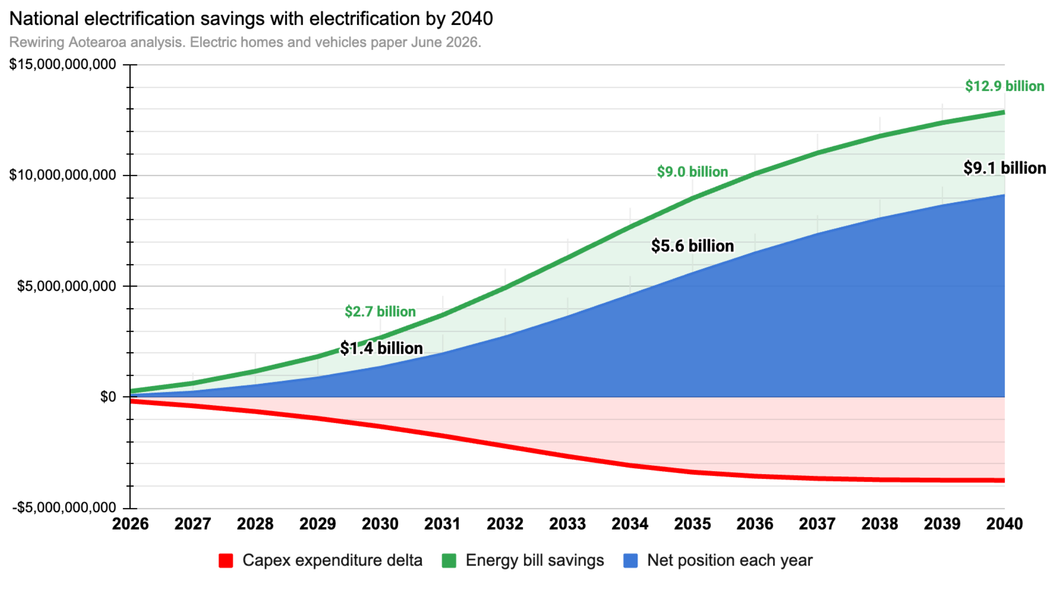

Figure 3: Shows the combined energy bill savings (green line), additional capex spending (red line), and net result from electrification over time (net savings).

Strategic context for New Zealand

"As I write this, the situation around Hormuz remains uncertain. Do we have a deal or not? The surge in oil, petrol, diesel and derivative products have highlighted a key point of vulnerability for many countries, including New Zealand. Petroleum and related product imports exceeded $10 billion in the past 12 months. New Zealand is vulnerable to price movements, and that petroleum bill weighs on the trade balance and current account (our national cheque-book) as it literally siphons money out of pockets.

Pre-Hormuz, the world was already shifting. The rules-based system was being challenged with countries exercising power. Security had become a major theme; security in food, energy and technology. New Zealand's point of vulnerability is energy. Households, businesses and the entire economy depend on energy.

New Zealand has benefitted from improvements in our terms of trade in recent decades as the world globalised and trade with China increased. When export prices for dairy, meat, and wool exceed what we pay for imports, national income grows even without productivity gains. This foundation is under growing pressure from two structural forces.

Geopolitical instability and a shift to onshoring as opposed to offshoring mean increasingly volatile and potentially shifting commodity and manufacturing markets. The recent trend in the terms of trade may change. New Zealand has a chronic dependence on imported fossil fuels. The 2026 Iran War fuel shock illustrates the economic risk this dependence creates. Energy price spikes propagate through every household and business in the economy, widening the trade deficit, adding to inflation and business costs, compressing growth and hitting living standards.

With many economically and politically powerful countries around the world actively moving away from globalisation and looking inward, to maintain and improve our standards of living New Zealand must build resilience back into terms of trade, reducing unnecessary reliance on expensive and volatile imports and look for sustainable and cost-effective energy alternatives.

Electrifying New Zealand's homes and vehicles is one mechanism that can help address this vulnerability. At a macroeconomic level, electrification improves New Zealand's balance of trade, reduces exposure to global price shocks, and improves the economic foundations that declining terms of trade and rising import costs are currently eroding.

We are currently facing a cost of living crisis, but the bigger problem is an income crisis, a by-product of weak productivity growth over a sustained period. The income and productivity crisis has magnified the cost of living crisis.

Electrification can help both with short term cost of living problems, and also assist in building a more productive energy system underlying a more productive economy in the long term.

We have passed a key inflection point, where the economics of solar have become compelling.

Households represent the country's largest energy-consuming sector, and shifting that consumption onto domestically generated renewable electricity reduces the import bill, keeps spending within the New Zealand economy, and delivers further savings through the inherent efficiency of electric machines.

Electrification is not the sole answer. More change is needed as New Zealand's economy is literally 're-wired'. Electrification offers the potential to take a major step forward."

— Cameron Bagrie, Independent Economist

New Zealand spends around $30 billion on energy each year

New Zealand spends around $30 billion on energy consumption per year. In 2025, it spent around $19.5 billion on fossil fuels[3], most of which were imported. It spent another $11 billion on electricity, and half a billion dollars on bioenergy such as wood and biogas.[4]

Table 1: What New Zealand spent on energy consumption in 2025

Energy type	Energy use *(Petajoules)	Retail cost (NZ$)	Price per unit*** ($/kWh)
Electricity	142.9	$11 billion	$0.22 - $0.37
Gas	105.5	$1.9 billion	$0.04 - $0.23
LPG	9.6	$0.6 billion	$0.16 - $0.28
Wood/Bioenergy	25.8	$0.5 billion	$0.04 - $0.12
Petrol	100.3	$7.6 billion	$0.22 - $0.28
Diesel	149.8	$7.0 billion	$0.14 - $0.18
Coal	42.8	$0.6 billion	$0.04 - $0.07
Other (aviation+fuel oil)	71.0	$1.8 billion	$0.09
Total**		**$30.2 billion**	

* These numbers are fuel use for both direct consumption and coal and gas use for transformation, electricity generation and gas use for non-energy. If included this would add an extra 50.2 PJ of gas use and 28.5 PJ of coal use and cost an extra $0.9 billion in 2025.

** The cost of fossil fuel use for generation, transformation and non-energy use is not added to the total fuel consumption cost in the table.

*** Prices for 2025 and vary by sector so the range of prices is shown

Households and their cars are the largest energy user

Note: the above energy use is for all of New Zealand, including households, businesses, farms and industry. This report primarily focuses on residential energy and the potential savings available from electrifying that energy use both at an individual household level and larger community and national scales. The household part of New Zealand's energy system is larger than often recognised and it is likely the largest energy consuming sector in the country, when household transport is captured. The transport sector is used as an umbrella category for energy use that moves and is not attributed to who uses that energy. Of the approximately five million vehicles on New Zealand roads, around four million park at households. Once this is taken into account, it becomes clear that household decision making is responsible for the largest proportion of energy use. Households can also influence other energy use with their decisions. For example, a home using bottled gas often has those bottles delivered via a diesel truck and that energy is not counted as related to the household. If gas use is swapped for electricity, it also saves that transport energy. The fuel filled up at the pump by household vehicles has to be delivered vast distances in petrol tanker trucks, but the diesel they burn while delivering that fuel is also not counted on households, even though if they switched to an electric vehicle they would not need that truck delivery.

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[3] This includes the cost of gas and coal used for electricity generation, transformation and non-energy uses. Fossil fuels that were consumed directly cost approximately 18.6 million in 2025.
[4] Prices are based on MBIE fuel use data and prices for 2025. These costs do not include any of the spike in fuel prices due to the closure of the Strait of Hormuz in 2026.

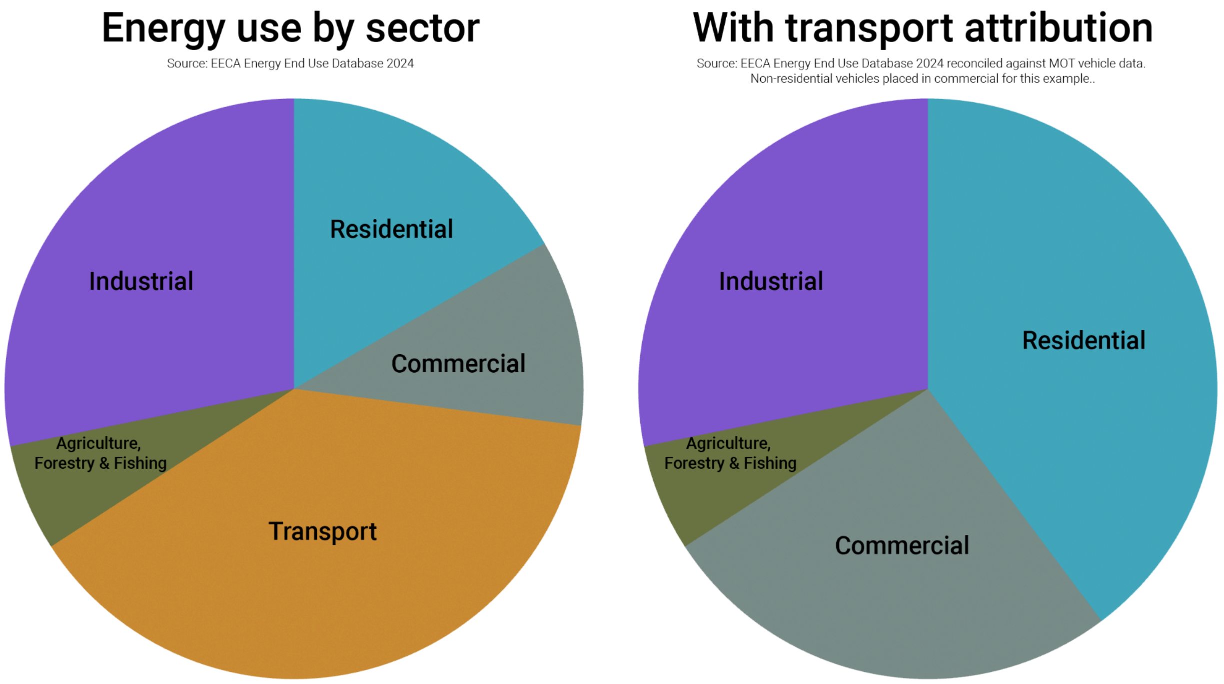
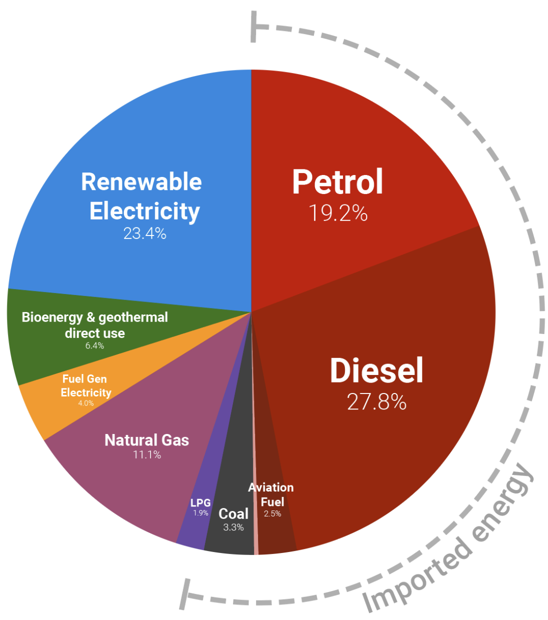


Figure 4: On the left is the conventional approach to looking at energy consumption by sector, where transport is its own sector. On the right, that transport is attributed to who uses it. For this example, non-residential transport is placed under commercial.

Households generally pay the highest prices per unit for their energy and are the first to have the technology available to them to switch their energy use to electricity. Manufacturing economies of scale have driven down the costs of heat pumps, electric vehicles, solar panels and batteries faster than many commercial and industrial electrification opportunities (trucks, boats, process heat). This places households at the forefront of the transformation happening in the energy system.



NZ Energy Consumption 2024 & Import Proportion
Source: MBIE Energy Balance Tables 2024

New Zealand is exposed to imported energy

While the electricity system is mostly renewable, hovering around 85%, the energy system as a whole is mostly not renewable, and not made in New Zealand. Around 70% of our energy consumption is fossil fuels[5]. 75% of New Zealand's fossil fuel energy use is imported.

Figure 5: New Zealand's energy consumption in 2024, and the proportion of it that is imported. Note: over 50% is imported, and only around 30% is renewable energy.

This dependence on foreign sourced oil, mostly from the Middle East (via refineries in South Korea and Singapore), places New Zealand at a strategic risk for energy price volatility that can propagate through the entire economy negatively.

[5] 66% of energy consumption is from fossil fuels + 4% of fossil fuel used for electricity generation.

In June 2026, New Zealand was still feeling the impacts from the fuel crisis which began when the Iran War started at the end of February. This has combined with the cost of living pressure already being experienced by the country. It is not New Zealand's first oil crisis. Figure 6 below shows the historic quarterly energy price index going back 26 years and petrol is the most volatile fuel source in the mix, with a previous recent spike caused by the Ukraine War, and more volatility going back further.

Figure 6 also shows that energy prices for New Zealand have been rising faster than inflation, and while the cost of buying energy has increased year on year, the technology costs for producing energy have fallen, as shown in the solar module and battery cell indexes. Solar and battery energy reliance also has stabilising effects on future energy costs. As the energy has been paid for upfront, they help flatten and de-risk future costs of electricity for the proportion of energy they provide to a home or vehicle. Note: all of the values shown here are index values, not price values, which we explore later on in this report.

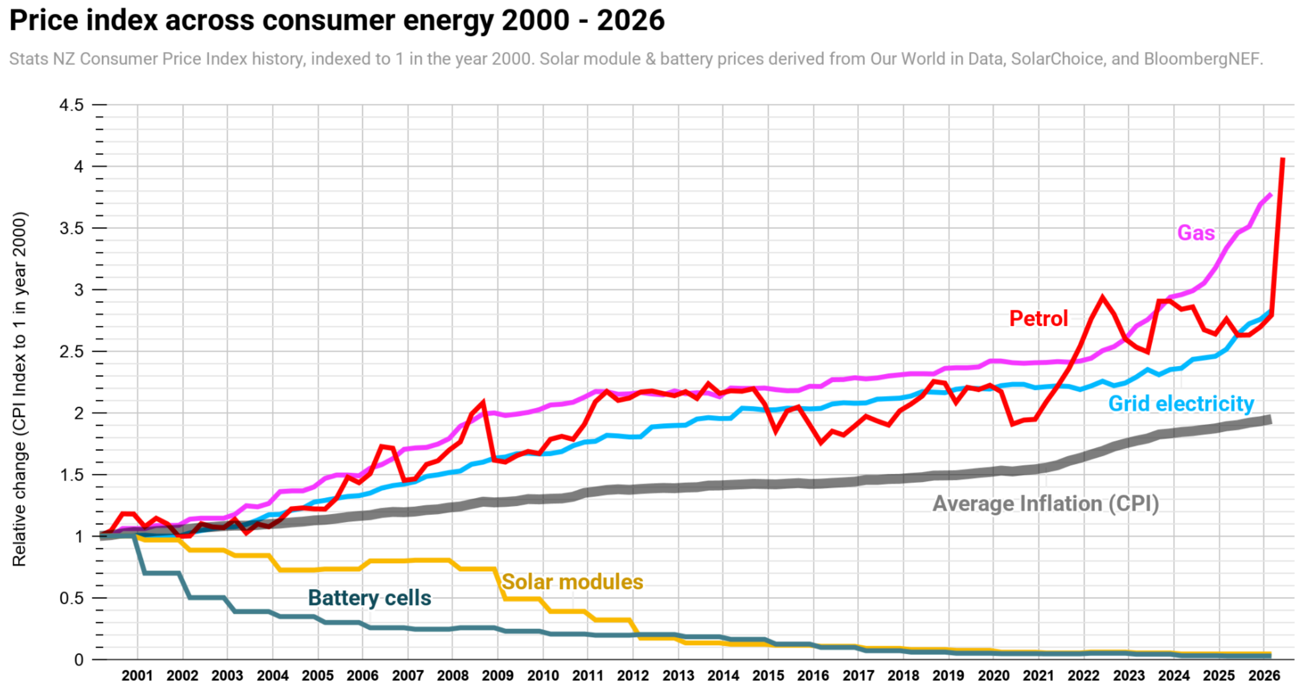


Figure 6: Shows the historic price index of consumer energy, alongside general inflation (CPI), and the price index of solar modules and battery cells. The cost of all main forms of consumer energy have risen faster than inflation, some like petrol have been volatile, while the capital cost of solar and batteries have fallen significantly in the other direction through manufacturing economies of scale (learning rates).

Energy is a fundamental input cost into nearly everything in the economy. For example, a large proportion of the cost of making aluminium is the energy that goes into making it. Whether that aluminium is turned into window frames or cans of drink, the energy cost impacts the overall cost of those goods. The same is true of fertiliser, steel, farming, transport and most physical products in society. The freezers and lighting at a local supermarket and the air conditioning costs of a local office all impact the cost New Zealanders pay for products and services. This means the ramifications of an expensive energy system are not limited to just that system; they cause negative impacts throughout the economy.

Electrifying the machines that we use in our homes (appliances & vehicles) to run on New Zealand-made electricity would prepare and protect our economy and people from fuel security and price shock events.

Balance of trade: reliance on imported energy is a drain and risk

There are balance of trade ramifications as a result of New Zealand's import dependence on expensive energy. Figure 7 shows imports and exports for 2024. The impact of New Zealand's imported energy dependence becomes clear and contrasted against exports. In 2024 the largest single export product sector was concentrated milk, at $10.2 billion. The largest single import product was refined petrol and diesel at $9.6 billion (Petroleum on the chart). It should be emphasised that product export revenue is not the same as import cost. For example, the price that products are sold for requires those products to be produced at considerable expense. Therefore the profit from exports is much lower than the total figure.

For imports, near the opposite is the case. The import cost is just the beginning of what New Zealanders pay for a product. For example, the $9.6 billion in refined petroleum products we import are around $15 billion when paid for at the pump by consumers. The import cost generally represents significantly less than what is paid at the pump, with importer profit margins, taxes and levies added.[6] This then brings into contrast that what we pay for imported fossil fuels is near the size of one of our biggest export industries. Running the country on more New Zealand-made electricity could shift this balance of trade more in the nation's favour.

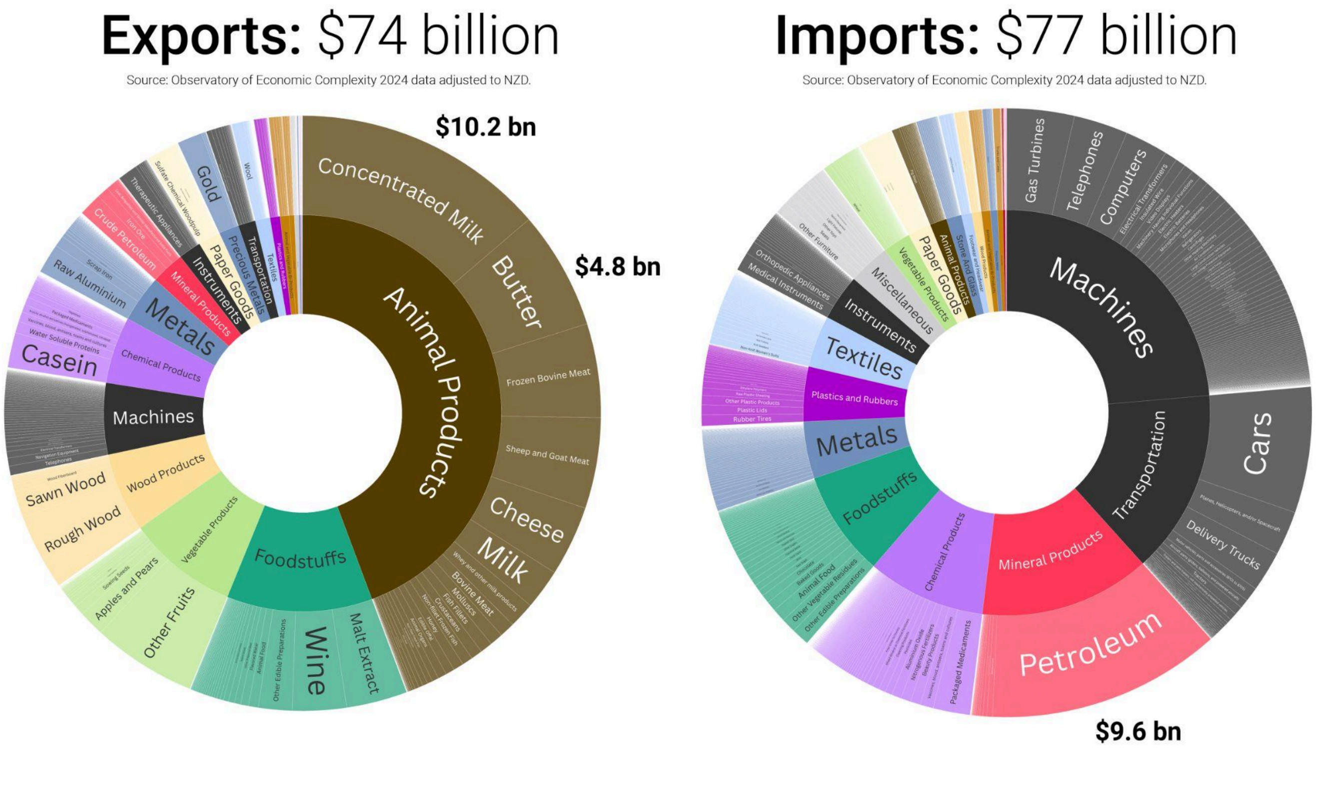
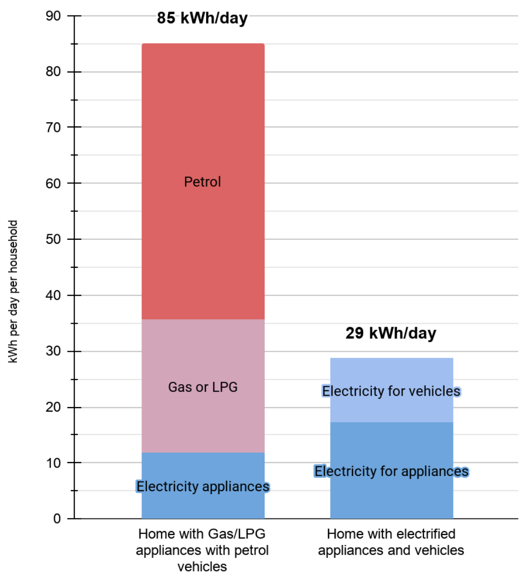


Figure 7: Comparing New Zealand's exported products on the left, versus imported products on the right.

[6] mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/weekly-fuel-price-monitoring

Electrification as fundamental energy and economic efficiency

The possible energy future this report sets out for households, communities and the country is not wishful thinking. It is economically viable with technology that exists today and is being adopted by communities around New Zealand. These savings come from the thermodynamic efficiency of electric machines like EVs and heat pumps and the lowered cost of energy now available through rooftop solar and batteries. It should be transparently reconcilable for policymakers to check this work.



Heat pumps for heating and water heating are around 2-4 times more efficient than gas and LPG heating systems, even down to the coldest temperatures reached in New Zealand.[7] Electric vehicles are about 2-4 times more efficient at converting energy into motion than their petrol and diesel equivalents, and still around twice as efficient as hybrids.[8] [9] For household energy consumption including vehicles, which together are the largest energy consumption 'sector' in New Zealand, we could be getting the same lifestyle results for less than half the energy. Figures 8 and 9 show this.

Figure 8: Daily energy needs for a typical New Zealand household using all gas or LPG appliances and petrol vehicles, compared to one with all electric appliances and electric vehicles. Note: the 'average' household is somewhere in between this.

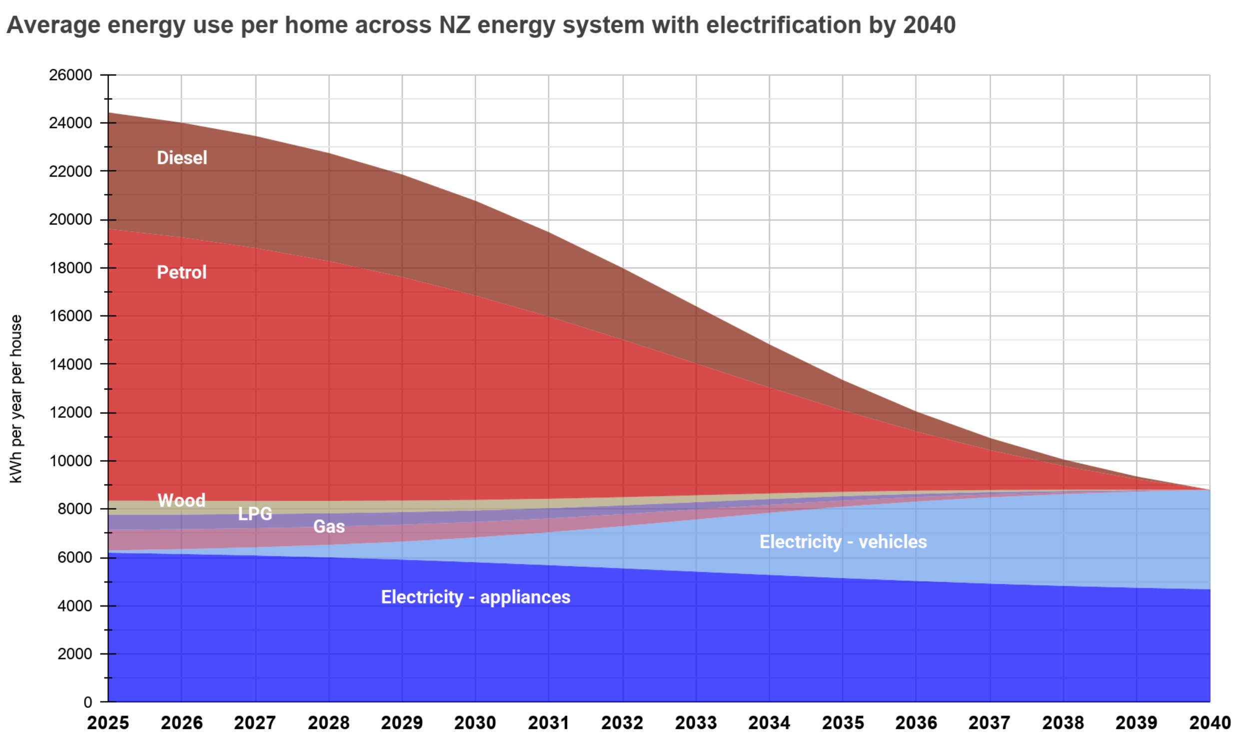


Figure 9: Household energy flows with accelerated electrification of vehicles and appliances, heating the same amount and driving the same distance with less than half the energy required.

[7] Duncan Gibb, Jan Rosenow, Richard Lowes, Neil J. Hewitt, Heat pump efficiency at low temperatures, Joule, Volume 7, Issue 9, 2023, Pages 1939-1942, ISSN 2542-4351,
[8] US DOE Gasoline Vehicle Efficiency 12%-30% | US DOE Hybrid Vehicle Efficiency 24%-38%
[9] US DOE Electric Vehicle Efficiency 87%-91%

There are significant resilience and energy system benefits

In the face of natural disasters, locally generated electricity and storage can keep lights on and homes warm. If 80% of homes had a 9kW solar system and a 10 kWh battery, this would provide an unprecedented level of energy resilience for communities. These homes combined would amount to a distributed 'power plant' larger than any in New Zealand today. With solar capacity from rooftops of 14.8 GW (max) and annual generation capacity of 20,000 GWh, adding an additional approximately 46% of renewable electricity generation to the national mix, resulting in a near doubling of the 24,000 GWh we get from hydro dams today. **The batteries would have a combined peaking output capacity of 8.2GW, around six times larger than the 1.2GW Huntly power plant, the biggest in the country today**. They would by no means replace the need for our national grid and distribution networks; instead, they would strengthen it, and significantly lower its costs through greater flexibility and more efficient utilisation.

A new electric car with a 60kWh battery can store about three days of average home electricity use. If the four million household cars we have at New Zealand households today were electric, they would have the equivalent energy storage of running all current power plants combined at average capacity for around 50 days. If those vehicles were used for vehicle-to-grid - where a car discharges its energy back into a home or business and the grid - they would have the equivalent power-output capacity of about 28GW, nearly three times all power plants running at full capacity today. They could effectively eliminate most, if not all, electricity network peaks at relatively low cost given that cars are purchased to be used as cars primarily. If our community distribution networks are configured for it, these vehicles combined with local solar generation could provide near continuous and reliable energy resilience for communities in the face of a disaster. Note: in this work we do not model the benefits of vehicle-to-grid at all, which we consider conservative. We model the purchasing of the vehicles and their charging, but no discharging.

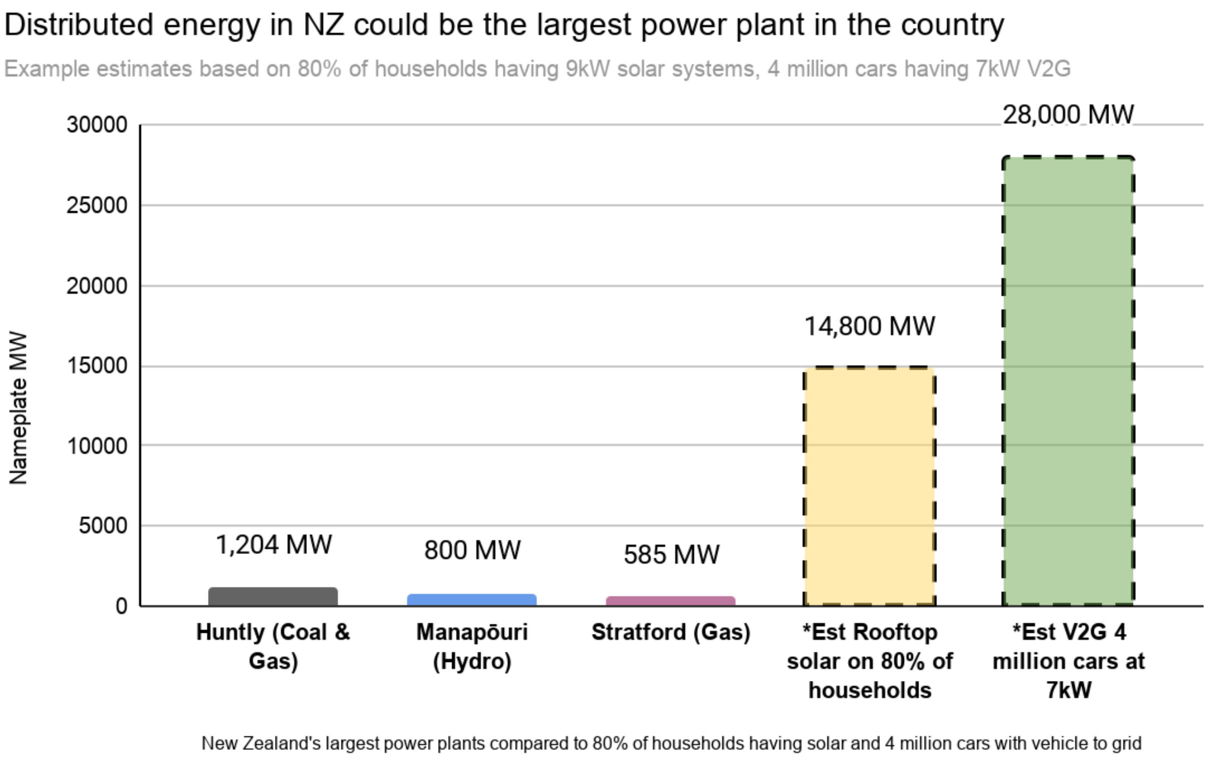


Figure 10: New Zealand's largest power plants compared for example against the nameplate capacity of the combined solar output if 80% of homes had a solar system, and the combined output of four million cars in the vehicle fleet doing vehicle to grid.

Australia provides a relevant example of the benefits from customer solar and batteries. With approximately 30 GW of rooftop solar, and almost 3 GW of batteries, customer investment is now a major contributor to the energy system. This has helped stabilise demand[10], reduce reliance on gas generation[11], and is putting downwards pressure on electricity prices[12].

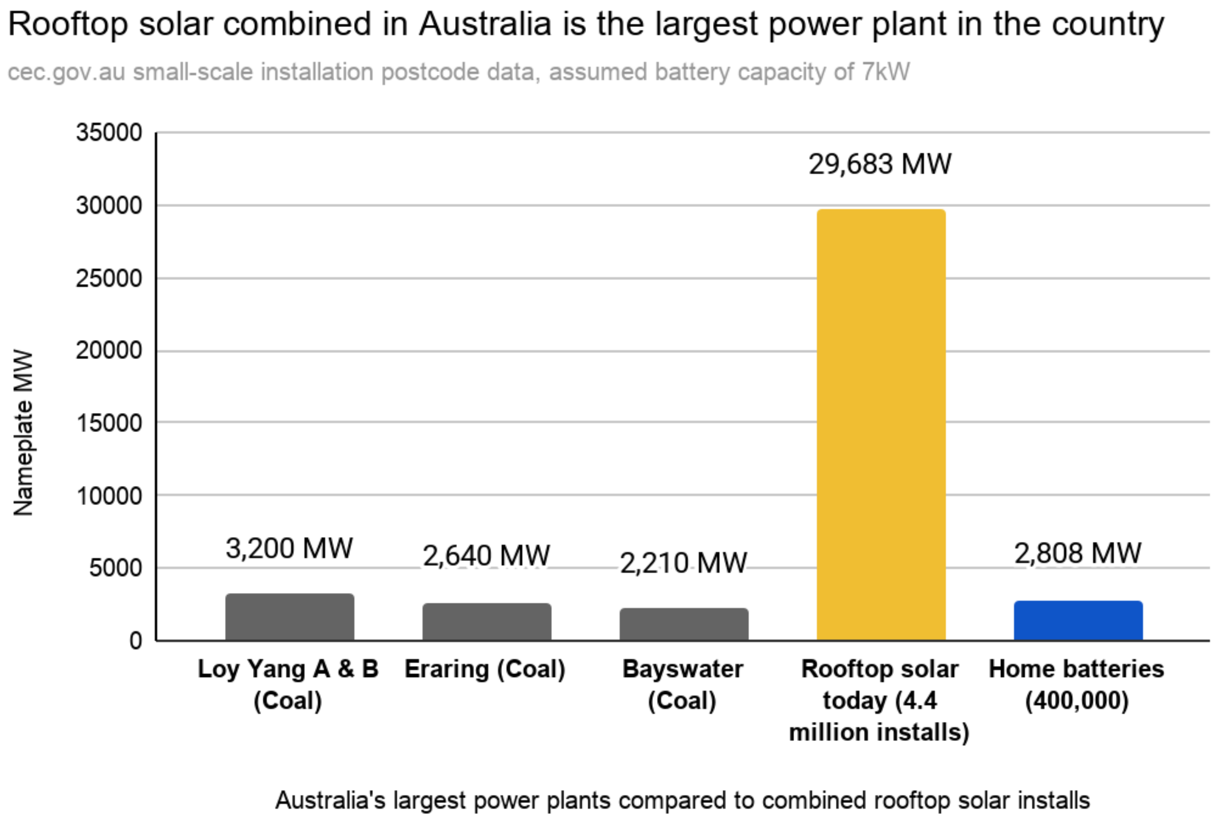


Figure 11: Australia's largest power stations compared to the combined size of rooftop solar generation capacity in Australia, and home battery peak capacity.

Note: solar nameplate generation and vehicle to grid nameplate generation are not the same as the nameplate generation of a continuously operating power plant. For example, solar will reach peak output on a sunny day in summer, and will not produce energy when the sun goes down, and will produce less in winter with less sun. Other power plants do not always operate at nameplate capacity, so their max is not necessarily what they run at in the system.

Similarly, home and electric vehicle batteries, while having high power output (instantaneously), do not store as much energy over time as a hydro reservoir. These considerations are important when planning energy systems. New Zealand is generally in an advantageous position for this type of distributed generation due to existing hydro storage. As more generation like solar comes into the system, the need for long duration storage falls as it is rare for prolonged periods without sunlight over a large geographic area, as we show with the GXP map in the solar section.

With all of this accounted for, it is more than possible that, in time, the largest combined power plants in the country will be the rooftops of households and the vehicles parked in their driveways.

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[10] Growth in rooftop solar supply has kept pace with a surge in electricity demand since 2022. https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/data-nem/operational-demand-data

[11] https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information

[12] https://www.aemo.com.au/-/media/files/major-publications/qed/2026/qed-q1-2026.pdf

More with less: electrification is a productivity opportunity

One of the clear benefits of electrification is productivity. Electric machines are in most cases fundamentally more efficient at achieving the same outcome or task. The amount you pay to do a task - like driving a car or heating your water - is made up of two fundamental components: the cost of the energy and the amount of energy the machine uses, i.e. its efficiency at converting input energy into output task.

Figures 12 and 13 below demonstrate this. They look at the historic cost per unit of the energy in question, multiplied by the efficiency of the machine it is put through. This is an important concept when it comes to understanding energy economics. For example, gas or diesel could be half the price of electricity per unit, but if electric machines are three to four times more efficient, the actual productive cost of energy to do the same task is lower in the electric case. It's not just about the cost of energy, but the cost of energy to run a machine. Electric machines are more efficient, so less energy is needed overall.

Example 1: Gas water heater versus heat pump water heater

A typical gas water heater has an efficiency of about 80%, so 20% of the energy in the consumed gas does not go into heating the water and is lost. A typical heat pump water heater, after tank losses, is about 325% efficient. Note: this can vary by device type, age, temperature, and location

A typical cost of gas per unit is about $0.16 per kWh, or if it's bottled gas (LPG) about $0.28 per kWh. After this goes through the water heater, and some energy is lost through the combustion process, the cost per kWh of water heated is $0.21 per kWh for gas and $0.36 for LPG. In comparison, the variable cost of electricity per unit is about $0.26 per kWh, but since a hot water heat pump's efficiency is high, when it is divided by the efficiency of 325% it ends up costing around $0.08 per kWh to achieve the same water heating. Water heating with electricity is also often done at lower cost times, like night rates or with ripple control. In this example we exclude this nuance. It would only increase the savings, though we show an example of heating the water with financed rooftop solar, often referred to using heated water as a "thermal battery".

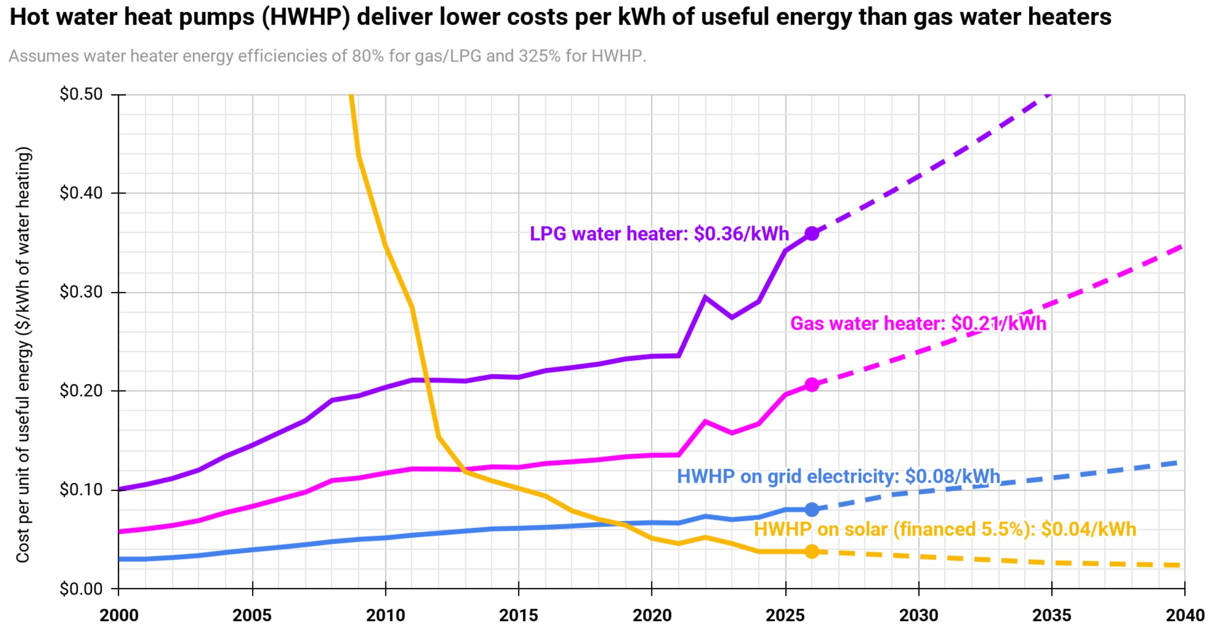


Figure 12: Energy productivity comparison for water heaters based on $ per kWh of useful energy. With forecast prices going forward.

Example 2: Diesel ute versus electric ute

A diesel ute consumes about 10 L of fuel per 100km in realistic driving[13]. In each litre of diesel there is about 10.7kWh of energy, so to travel 100km it needs around 107 kWh units of diesel. An electric ute consumes about 23 kWh of electricity per 100km, less than a quarter of the energy for the same distance. This is because much of the energy consumed by a diesel engine is lost during the combustion process.

If diesel is $1.90 /Litre, this is equivalent to about $0.18 per kWh. The price of electricity from the grid might be higher, $0.26 per kWh for example. But even so, because a diesel ute requires much more energy to drive the same distance as an electric ute, the overall cost per 100km is cheaper in an electric ute due to the fundamental efficiency difference between the engines. This is what gives electric vehicles their greater energy productivity.[14]

An electric ute costs much less to drive than a diesel ute, due to higher engine efficiency

Fuel efficiencies of 10.2 L/100km for diesel and 22.8 kWh/100km for electric ute. Diesel cost of $1.90/L and electricity price of $0.26/kWh from MBIE Energy Prices (2026). Excludes RUCs for both diesel and EV.

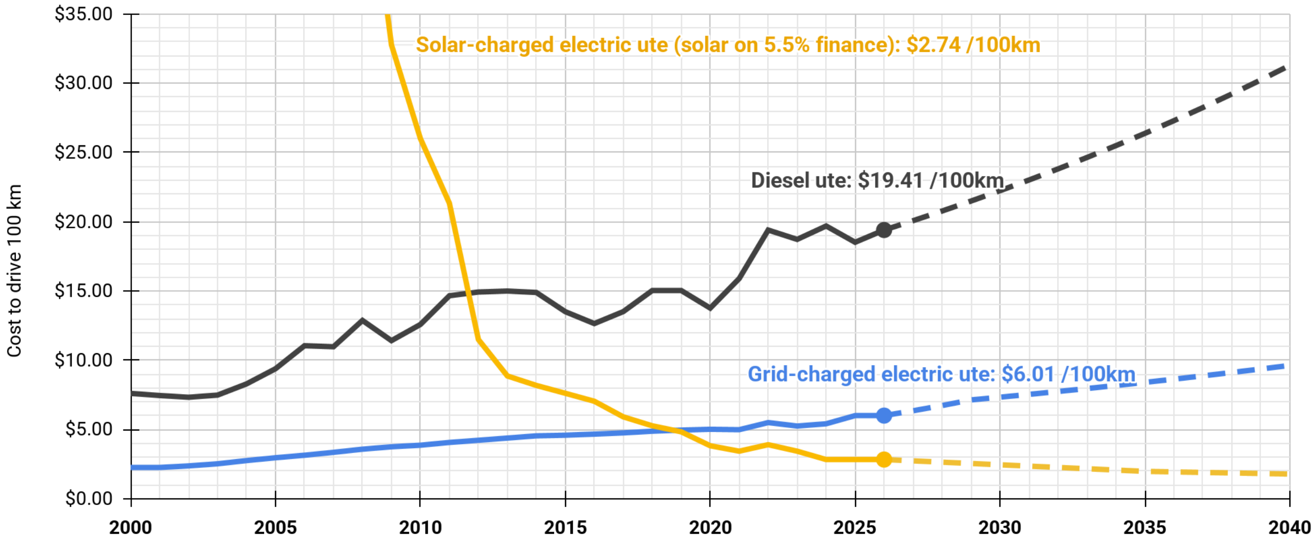


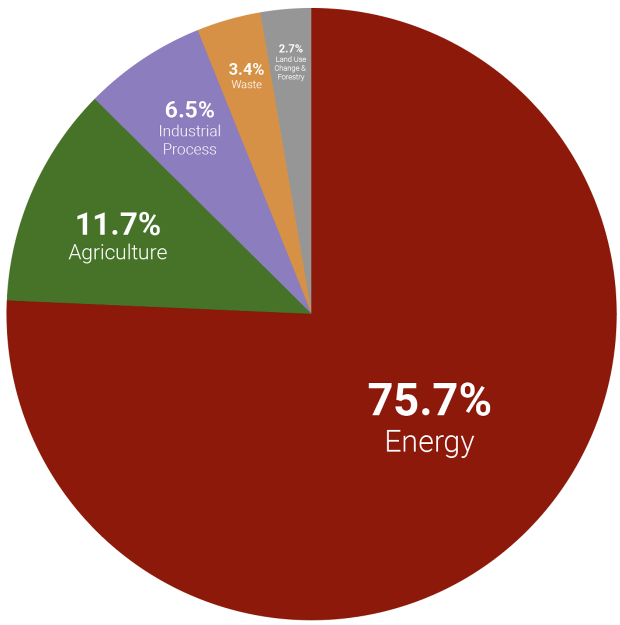
Figure 13: Energy productivity comparison for utes shown as cost per 100km driven

[13] While manufacturers advertise certain levels of efficiency, it is consistently proven that these are an underestimate for real world driving. On all cars including electric, we use a real world efficiency estimate for consumption detailed in methodology rather than manufacturer claims.
[14] Currently diesel utes can often tow heavier weights and have longer range than electric equivalents available in New Zealand today. For example, a diesel Toyota Hilux has braked towing capacity of 3,500kg, and the Geely Riddara electric ute has a braked towing capacity of 3,000kg. However, battery technology improvements mean it is likely this gap will close. For example, the US made Rivian R1T electric ute can tow approximately 5,000kg. There are other nuances, for example electric vehicles generally offer the ability to provide high power electricity output, to power tools or even backup homes, so the comparison is not exactly like for like on features.

Energy emissions are crucial to addressing climate

Around 75% of the world's emissions come from energy use. While New Zealand's emissions are also heavily influenced by agriculture, electrification offers a win-win opportunity to reduce energy emissions while saving money at an accelerated pace today.

While New Zealand is occasionally celebrated for its renewable electricity supply, only about 30% of the nation's actual energy usage is renewable. 70% of the energy we consume comes from fossil fuels (this includes oil consumption and the fuels burnt to make electricity). Oil (petrol, diesel, aviation fuel etc.) makes up about 50%. The electrification by 2040 scenario modelled in this work would deliver about 8.7 million tonnes of CO2e reduced per year by 2040, excluding the zero emissions electricity generated by the solar panels and batteries in the model which would reduce emissions further.

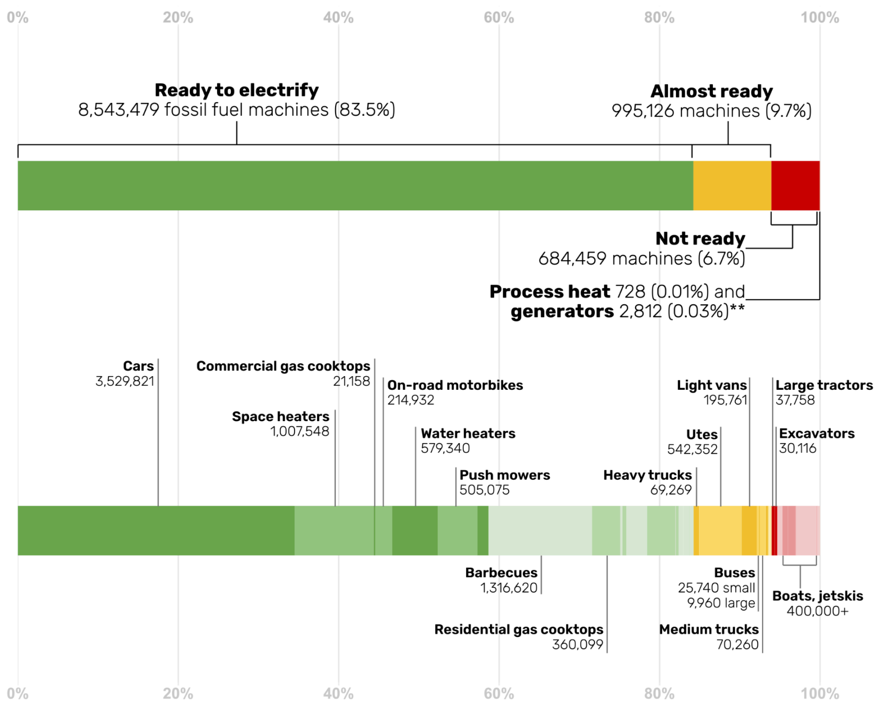


Global greenhouse gas emissions by sector 2023
Source: Climate Watch & World Resources Institute

Figure 14: Global emissions by high level sector. 75.7% of global emissions came from energy in 2023.

In our Machine Count (2025) report, we looked at our energy emissions in much greater detail. While there might be debate about how emissions are counted at the national border level, one thing is clear: swapping out machines in our country that make up our fossil fuel use for electric alternatives is a major opportunity for fast, feasible emissions reduction that will have long-lasting cumulative effects on mitigating climate change.

For around 8.5 million of the 10 million fuel-based machines in New Zealand, the savings from replacing them with electric will more than pay back any additional upfront costs. For the majority of machines, the economics now stack up to go electric while significantly reducing our country's emissions. The argument that it is too expensive to address climate change no longer holds.



Darker colours indicate priority machines in each electrifiability category based on emissions impact.
*Machines with low counts have been moved to the end of each category for better visibility of alternating larger machine segments.
**While these makes up a small proportion of the total *number* of machines, they are a significant proportion of our total emissions.

Figure 15: Economic feasibility of machine electrification across the economy, from The Machine Count, Rewiring Aotearoa and Ara Ake, 2025.

How to get there: Practical policy for NZ energy

This national upgrade to our appliance and vehicle asset stock may seem like a difficult task, but these are already natural decisions made by households every day. All household appliances and vehicles are gradually replaced over time, as they break, get old, or are upgraded. These many small 'dinner-table decisions' make up the largest portion of energy consumption in New Zealand. Empowering New Zealanders to opt for an electric model in their upcoming replacement decisions can naturally deliver the outcomes discussed here over time. Government policy and regulatory settings can accelerate this future or hinder it. Innovative policy, and removing some of the historical red tape in the energy system, can also help speed up the process and make it easier for everyday New Zealanders to go electric. **Specific recommendations are provided at the end of each section below.**

These upgrades will in time require additional electricity, and the next question is where to get it from. New Zealand has historically been a leader in building innovative energy solutions for its people. But in recent years it has been left in the wake of other nations as they add large quantities of distributed energy resources - namely solar and batteries - to their energy systems and reduce their dependence on conventional power sources and fuels.

An average household in New Zealand can now install a solar and battery system that will, in combination with their connection to the grid, save significantly more money than it costs over its lifetime. Put another way, if these upgrades are financed and costs are spread over time with the savings, the upfront cost barrier disappears. The household will be paying less each month in repayments, interest, and reduced bills combined, than they had already been paying for their monthly power and petrol bills. However, our energy system does not make this easy for households.

When new poles and wires are built, their costs are spread over long asset lifetimes and added to consumer bills, appearing as a bill increase. Policymakers and regulators made sure building the infrastructure that is the backbone of modern economies - the electricity grid - was easy and scalable, and ensured that households weren't burdened with massive upfront costs by enabling consumers to pay small contributions over time in the form of their fixed connection fee and monthly bills.

Yet when a household purchases a solar and battery system - serving the same purpose as a modern form of energy infrastructure and contributing back to that national grid - they are not granted an easy way to spread those costs over the useful lifetimes of the assets they purchase. This is an example of how energy market policy and regulations have not kept pace with technological progress, which has left biases that slow down what should be a natural uptake of modern energy assets.

As evidenced by this work, that same economic reality applies to electric vehicle purchasing decisions and heat pump purchasing decisions as well. The disconnection of our energy strategy and policy from technological progress causes unnecessary bill increases and costs New Zealand households every day that it is not fixed. It costs households on bills. It costs households through price shocks from volatility. It costs households through a lack of resilience to emergencies. It costs the nation through lack of achievable emissions reduction.

Key barriers to efficient household electrification and uptake of solar and batteries

- **Energy market and energy system failures** - energy policy and regulation has not kept pace with technology, leaving structural bias towards large scale centralised energy solutions. This is slowing efficient investment by households that could lower electricity bills for everyone.

    - Customers lack efficient price signals for solar and battery exports (including innovative regulation to allow new ways to share and trade distributed energy)
    - Solar suppliers lack economies of scale in New Zealand and red tape adds cost compared to more mature markets like Australia
    - There is a lack of clear unbiased information for consumers. For example, this new customer price comparison tool[15] does not include solar and batteries or appliance and EV electrification savings even though they are likely to far exceed the savings from switching retailers. Time of use retail electricity price plans are often not transparent and clearly explained, and in general retail electricity companies have an interest against a consumer using less electricity or generating their own.
    - There is a high perceived transaction cost. The real or perceived effort and risks required to invest in electrification may be limiting uptake.
- **Finance market failures.** The positive externalities of electrification are not reflected by banks or energy incumbents; green loans do not reach many households (especially seniors who may be asset-rich but income-poor), and EV finance is harder still because the asset is not linked to a property.
- **Lack of innovative policy measures to avoid an equity gap.** Low-income households facing energy hardship and renters - who make up around one-third of households – are largely locked out of the lowest-cost energy available in New Zealand.

We need an energy strategy that stands in the shoes of New Zealanders

Part of the disconnect between New Zealand's broader policy, regulatory work and the technological reality of today is caused by siloed thinking and **a disconnect to how these decisions impact consumers.** This covers not just planning, but even how modelling is done by policymakers and industry[16], how prices are looked at, and how regulatory consultations happen. For policy makers the focus remains on how to deliver the lowest cost electricity system based on large scale industry investment. It largely ignores the savings directly to homes and ways to lower system costs for everyone through customers investing in solar, batteries and smart devices (increasing grid utilisation). We recommend that an energy strategy is considered from the ground up, and continually reconciled against first principles and the everyday energy experience of New Zealanders. Without this, the system risks continuing to miss the forest for the trees when it comes to identifying energy opportunities available to the nation.

The following changes could help:

- **Consider evidence that captures the impact of household investment on energy bills**. As far as the authors are aware, there are no energy models in use by policymakers or regulators in New Zealand that can accurately understand the household level dynamics of energy and how they flow back up into the system. For example, the underlying difference between an investment in grid scale solar, or an investment in household rooftop solar and batteries. Very different infrastructure would need to be built in each scenario, likely far less in the household scenario, but no models we have seen currently even consider this prospect in detail.

[15] https://billy.govt.nz/
[16] Delivered Cost of Energy Report

- **Energy strategy should account for modern innovation.** Considering an average home, business, or farm can now invest in energy infrastructure through advances in solar and batteries, this now forms a fundamental part of how our energy planning is done. Taking into account how easy it is for these new energy players to invest, contribute, and operate and the additional impacts that different energy futures can provide, for example resilience and security through locally-produced energy.
- **Everyday New Zealanders need strong, fair, unbiased representation in the energy system**. This is not provided today by the regulators or government agencies who oversee the energy system. This leads to a bias where incumbent energy companies have easier and more representative access to energy strategy and planning decisions, even if the decisions they encourage would lead to a worse outcome and increase energy bills for homes and industries. The people most affected by energy decisions (consumers) should be adequately and strongly represented in the system.

Make energy financing easy and accessible to enable mass investment by consumers

As this work demonstrates in detail, consumers now have the opportunity to invest in technology that has clear financial, environmental, and resilience benefits. Yet because of the upfront cost barrier in these investments, access to personal loans is now intrinsically linked to lower energy bills, which has not been the case historically. This access (or lack of) is made difficult by outdated policy, meaning the system is getting less consumer co-investment than it could be if designed to maximise benefits to customers.

As vehicles change to electric over time and investment in distributed energy increases, it is likely that households will be one of the largest investors in energy generation and storage infrastructure. One of the ways to enable this for more households is through accessible energy financing mechanisms, so the upfront costs of energy decisions can be spread over longer time periods, much like our conventional energy infrastructure is. This enables the savings from the investment to both pay the assets off and deliver lower bills immediately to the home. This could be done in multiple ways, and having more than one would be both sensible and competitive. Current finance offerings, in not reaching many households and in their design, demonstrate that there are market failures. In practice this means a large amount of net cost savings and a lower cost energy system are being held back by unnecessary barriers to consumer investment.

One of the most significant market failures is that current markets (including finance and energy) do not reflect the significant positive externalities of electrification and solar, with no incentive for banks or big energy incumbents to change this. Energy incumbents see solar and battery investment as a significant risk to their existing business models. As a result, we are not seeing efficient allocation of resources to unlock the significant private and public benefits. Green loans from banks can work well for those who qualify, but most people do not - and there's a clear need for more options that work for everyone. This is particularly important for:

- low income households who struggle more to access affordable finance
- those without existing mortgages, or smaller mortgages where green loans don’t apply
- seniors - many of whom are asset rish and income poor.

Banks and energy providers, while acting rationally within their mandates, don't adequately reflect the wider benefits of household electrification in their offerings. These benefits include the savings the consumer would themselves unlock - to some degree as income - from the investment, the additional electricity generation that can be delivered quickly, the lowered grid infrastructure investment needed by the system, improved household and community energy resilience, support with diminishing gas supplies, enhanced energy and fuel security, reduced emissions and related liabilities, and more.

These market and system failures, and the public good that can flow from mass electrification of households, warrant Government action to enable and derisk loans where the cost of derisking is lower than the positive externalities that are currently lost out on. With upfront capital costs a major barrier for many households to unlock the savings and energy productivity offered by electric machines, accessible finance is critical.

Access to finance is the gateway to electrification for property owners, and needs to be as open as reasonably possible.

Linking finance for household upgrades to the property it is being installed on (sometimes known as "running with the land") helps maximise access. Loans linked to the property rather than individual are also important to give some households the confidence to upgrade even if they are unsure whether they will remain in the property for long durations, as they only need to repay the loan for upgrades while they are benefitting from it.

Loan duration is critical in enabling bill savings to repay loans each month and provide extra cash for households. A loan term matched to the expected life of the electric upgrade maximises the overall savings accessible from day one, enabling the household to pay as they save, while saving more than they pay. The longer the finance period, the greater the savings available in the short-term, while those who can afford to pay off their loan quickly (or purchasing outright at the start) will save more in the long-term. Flexibility to repay early without penalty removes a concern some households have in taking out a loan for electrification because they are more confident they will only be responsible for repaying the loan for the time they are benefitting from the upgrade(s).

Interest rates have a material impact on how much households can save from electrification upgrades. Households value predictable stable interest rates and low interest rates, which, given electrification saves more than it costs, should be possible to provide if the energy economics and externalities are adequately taken into account.

Government could, immediately, enable long-term, low interest rate loans through establishing the Ratepayer Assistance Scheme (RAS). This is secured by the homeowner's property and with a form of underwriting by central and local government. As such, the Government does not directly subsidise the price of solar panels, or installation.

Government could also do more to enable broader long-term energy financing by banks, and explore requiring EDBs to provide financing for household electrification in similar ways to conventional infrastructure.[17] For any finance offering, the Government could require electricity retailers to be the billing mechanism for this, providing consumers the benefits of seeing in one place their full 'energy' bill.

Financing EVs is more difficult than other household upgrades as security is more challenging with such a mobile asset. But the same principles around access, duration, flexibility and interest rate apply, and EVs save more over their lifetime than the additional upfront cost of buying them. For example, if people could pay off the additional upfront cost of an electric vehicle at the same frequency they would have visited a petrol station, then many more people could afford to make the upfront investment that would lead to the longer term benefits. This could be implemented through different mechanisms, like finance linked to RUC repayments that are done per 1000km of

[17] While the weighted cost of capital (WACC) is likely to be 6 to 6.5%+ for EDB financing, there is the potential for certain household assets to feature on the registered asset bases of EDBs with some of the costs met by the EDB directly.

driving or novated leasing[18]. This would enable longer term payments while the savings happen from driving the vehicle. While innovative finance for EVs is required to increase adoption, households can also benefit from innovative access arrangements, such as through novated leasing schemes which are successful in Australia. Work on innovative EV financing and alternative ownership models is required to unlock EVs for all households, given the significant savings opportunity they provide. For many lower income homes this will mean finance needs to be applicable to second hand EVs as supply in the market increases, which is made possible by accelerating early uptake of new EVs to provide a growing supply in the second hand market.

Figure 16 shows the difference financing terms make for a household purchasing solar. The vertical axis shows the cumulative savings over time for a solar installation, depending on how it is financed, either on a five year term, 15 year term, or 30 year term. A five year term requires the household to lose money for five years, before then recouping savings that result in a net positive position after about nine years, and then the highest cumulative savings. This is similar to buying outright. In contrast, both 15 year and 30 year financing terms enable net positive savings from day one. The savings exceed the repayments, enabling mass cost of living savings on energy bills while unlocking energy system co-investment that benefits the whole system. The scale and speed of Australia's rooftop solar and home battery roll out, which is majority funded by household investment, is an example of the energy system advancement that can be enabled with policy for distributed energy resources.

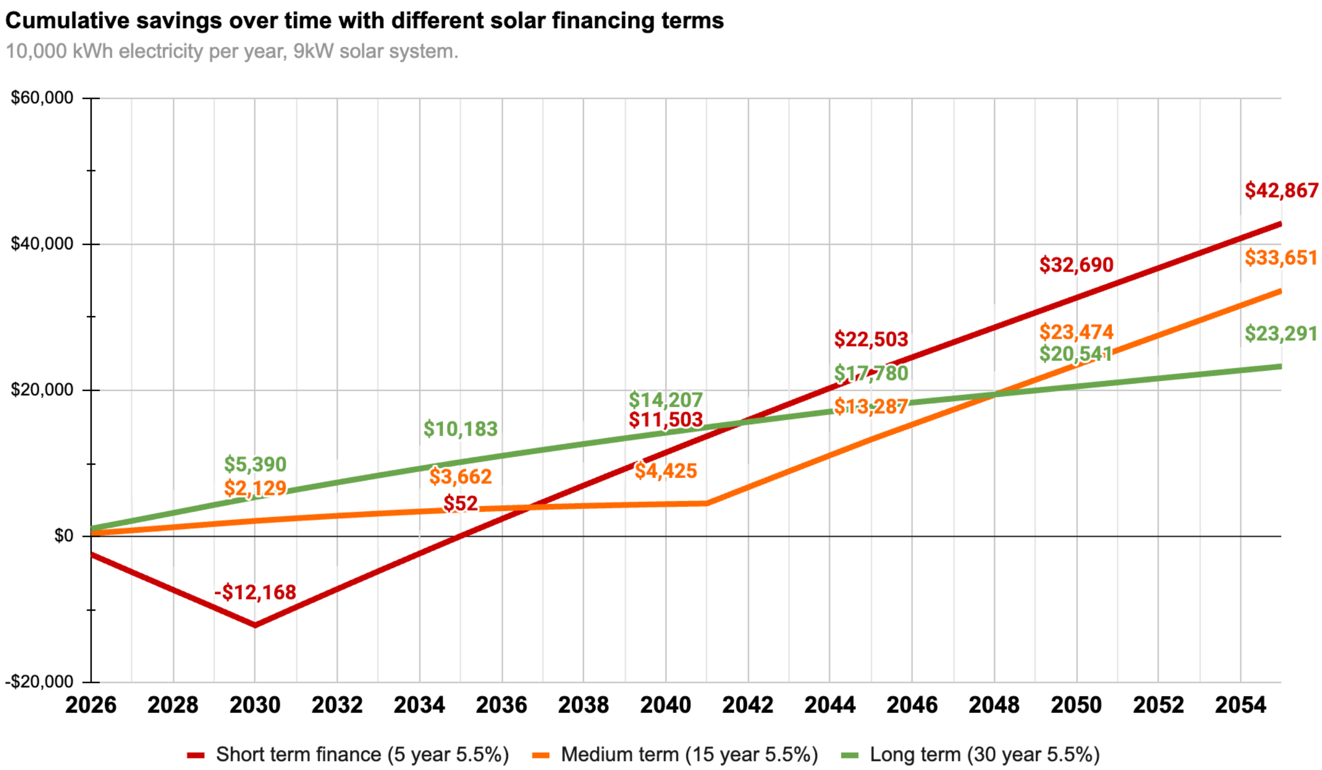


Figure 16: Cumulative solar savings compared with different financing terms. A longer term enables day one savings from the household so it is never out of pocket, and the solar acts as an income source rather than cost. A shorter financing term requires the household to be out of pocket for the early years of the investment, in exchange for higher cumulative savings later because they pay less interest overall.

[18] A novated lease is a three-way agreement between an individual, their employer, and a finance company. It allows a car lease to be secured through the employer and can unlock a significantly better finance rate.

Recommendations

- Establish a Ratepayer Assistance Scheme (RAS) offering long-term, low-interest loans for electric upgrades secured against the property and underwritten by central and local government, without subsidising panel or installation prices.
  - This can provide the option to match loan terms to the expected life of the upgrade to maximise savings from day one
- Build the policy and regulatory settings that enable consumer investment in energy systems to be as simple and easy as it is for regulated energy companies to build infrastructure and put it on consumer bills. A level playing field in the energy system, and a more innovative system, requires making energy financing easy.
- Develop innovative EV finance and access arrangements – for example repayments linked to RUC per 1,000km and novated leasing arrangements.

Leave no home behind

Energy system failures and lack of progress in lowering bills impacts vulnerable homes even more than most. From the Stats NZ Household Economics Survey in 2023, the households with the lowest 20% of income spent five times more of their disposable income on home energy than the 20% of homes with the highest income, and three times more (330%) than what the average New Zealand home spends. This is also while spending less on energy overall.

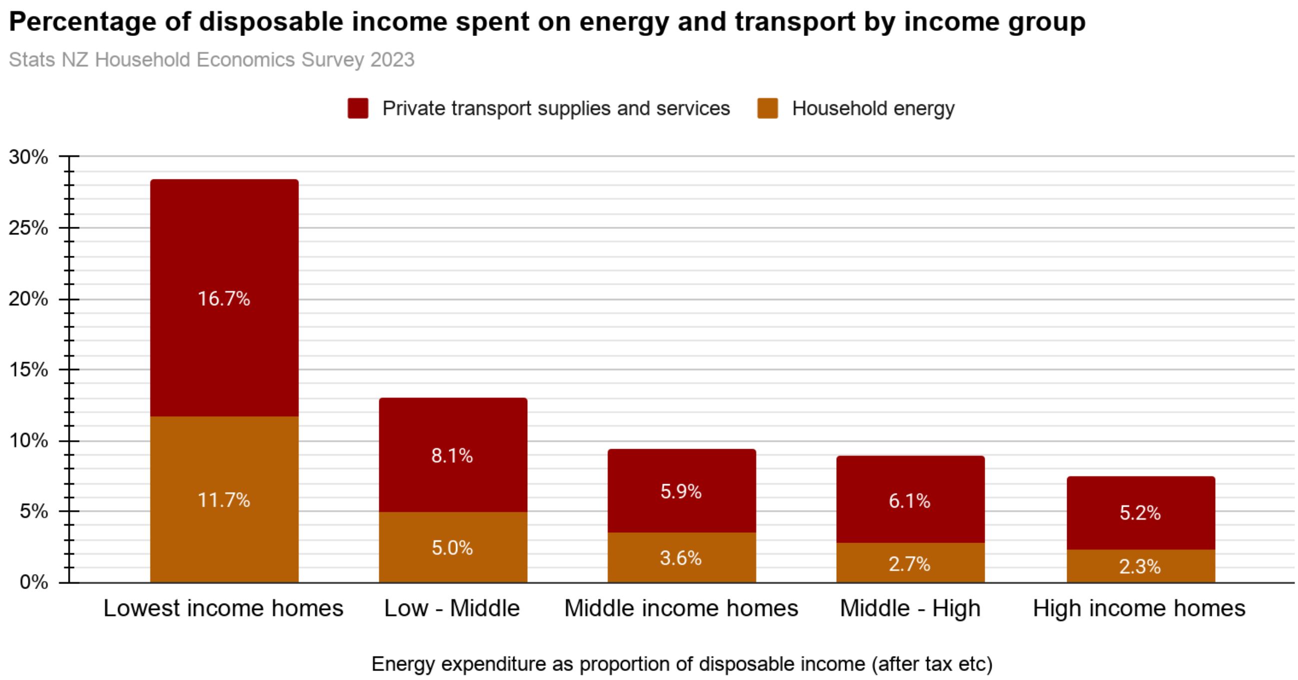


Figure 17: Percentage of disposable income spent on energy and transport by the five household income quintiles. Low income homes spend a significantly higher portion of their income on energy, meaning savings on energy can have more impact on these households' daily cost of living.

The benefits of electrification are there for all households, yet benefits will have even more impact on households in energy hardship and on lower incomes. Energy policy and strategy should leave no home behind. It is clear our current upfront purchasing and financing environment for the decisions that deliver the largest bill savings (solar and electric vehicles) are not easily accessible for these homes.

One of the most commonly heard criticisms of electrification and solar is along the lines of "it's nice for those homes that can afford it, but it drives up prices for those who cannot". As we show, the average property can "afford" to electrify economically, they may just not have access to the finance mechanisms they need to make the purchase affordable. That is, the purchase would still save them more money than it costs, but they do not have the upfront capital or loan products to do it. This is the role of finance.

While it may not be in the interest of energy companies to solve this problem, it is well within the power - and in the best interests - of the Government and the private sector to ensure every property can have access to finance to electrify. Without action, energy affordability and access will increase polarisation within society rather than creating greater equity. Rising energy bills will continue to impact and worry households over time if it is not resolved. The tools are ready and available to be used, and it will be a failure of government energy policy if many homes are left out. The energy economics are undeniable and already underway all across the country. How accessible the savings will be is an energy policy and regulatory choice.

The notion of electrification driving up bills for others will only be the case if system settings are not designed to take into account modern technology. With efficient pricing, more solar generation will drive down wholesale electricity prices, and more batteries distributed will avoid the need for many costly upgrades to transmission and distribution networks. Alongside more large-scale renewables in the system, this will reduce the need to use expensive fossil fuel generation. Solar and batteries in the energy system can and should lead to a lower cost energy system for all who use it, and it is only policy/regulatory failures that would prevent this from occurring.

Electrification for Renters

Finance, discussed above, needs to be a priority, and with solar on rooftops now the cheapest energy for consumers, access for all needs to be ensured. This includes making sure renters can access these savings.

Once the required finance for property owners is in place, there is currently no impetus or easy mechanism for renters to benefit. Renters make up around one-third of households and they are unable to unilaterally install solar and are often not in a property for long enough to fully recoup the cost. Landlords do not receive the bill savings from solar or resilience benefits from batteries. Given this reality, action is required to make available the various mechanisms for renters to benefit. If this is not fixed, renters will continue to be locked out from the lowest cost energy available.

Given any renter living in a property with solar on the roof could be paying lower energy bills (including repaying the system) than if it did not have solar, this is clearly an energy policy and regulation problem. We need the energy purchasing mechanisms in place that enable the lowest cost source of energy (rooftop solar) to be accessible to all New Zealanders. There are multiple trials underway for solar for renters, and suggested implementation mechanisms could include retailers being regulated to reconcile the bills (e.g. add solar repayments onto the bill and spread the benefits between landlord and tenant) or the same function through EDBs, who already invest in community energy infrastructure but are artificially constrained by the line in the sand that has been created at the electricity meter. Renters could also be provided with a "right to sunlight" which, outside of reasonable grounds, would encourage landlords to install solar on their behalf if it can be done where the savings to the tenant more than pay back the system and it therefore can be done at net financial gain for the tenant and landlord.

Electrification also needs to be easy, so that those who are time poor with busy lives are not held back from electrification. In many cases, various aspects of the electrification process can be more confusing or inefficient than they need to be, and both the private sector and government are critical in making purchase decisions and installations as seamless and easy as possible.

Energy regulation that delivers for customers

The electricity industry and policymakers need to recalibrate ambition away from notions of slowly incrementally changing the system and actually deliver on the real potential, today, to meaningfully lower energy bills for households. It is clear this method of incremental regulation has failed New Zealanders in the energy system by not keeping pace with technology.

If many of the problems with electricity regulation and pricing were solved, it would unlock what is likely to be the largest investment in our energy system and energy security in history; investment from every household and business in a more productive future anchored in New Zealand-made energy.

This requires smarter regulations to require Transpower and EDBs to pursue and prefer lower cost non-network solutions[19] over network upgrades, and regulatory innovation that keeps ahead of technology, including better mechanisms for consumers to share electricity. It requires pricing that encourages users to move their energy use and contribution to delay and remove unnecessary costs, and provides opportunities for innovators.

It also requires electricity market rules that work better for everyday New Zealanders, including by encouraging renewable generation development and making better use of our existing energy resources, especially hydro storage. The deep-rooted bias towards the supply side needs to be removed to reflect the reality that a lot of a little is a lot, and the demand side will play an increasingly important role into the future of the energy system.

There is a clear need for policy makers and industry to begin viewing household energy costs and household transport costs as part of the same bucket rather than separate buckets. EVs enable transport energy to come from electricity, which can include rooftop solar, while two-way charging means vehicles themselves can become energy storage for a household to bring down their bills and lower the peak of the local electricity network. This simultaneously lowers bills, while creating more room on the network for higher utilisation, leading to assets providing lower costs per unit of electricity. The more household energy and transport is viewed together, the greater the opportunities that become visible for cost of living savings and household energy productivity.

Recommendations

- Prioritise finance and access mechanisms for low-income and energy-hardship households, who spend a disproportionate share of income on energy and gain the most from savings.
- Ensure every property can access electrification finance regardless of income, recognising that the average property can electrify economically with the right finance in place. This is an accessibility problem.
- Design pricing and incentives so that high uptake of solar and batteries lowers prices for everyone, rather than shifting costs onto those who cannot yet electrify.

[19] Networks have the option to help households finance investments in solar and batteries and provide fair payments for peak exports from consumer batteries. Uptake of distributed batteries can help flatten peak demand which offsets investment in network upgrades to supply growing peak demands, essentially providing a line service for lower cost than building a line.

- Introduce mechanisms that let renters – around one-third of households – benefit from rooftop solar, such as retailers or EDBs reconciling bills and sharing the benefit between landlord and tenant.
- Remove the regulatory 'line at the meter' that prevents EDBs from developing the capability to deliver behind the meter solutions where these are cheaper than upgrading lines. Without this there is a bias toward spending on poles and wires instead of distributed community energy generation and storage.
- Make the electrification process simpler and more seamless, with both the government and the private sector reducing friction in purchasing and installation.

Introduction

The report is split into the following sections that provide detailed findings:

Section 1	Covers electrification economics for individual household appliances (space heaters, water heaters, and cooktops), vehicles, rooftop solar and home battery systems.
Section 2	Covers electrification at the whole-of-household level, how all the appliance and vehicle decisions combine, and various types of household electrification examples.
Section 3	Looks at electrification at a community level.
Section 4	Looks at electrification nationwide.
Appendix 1	Is methodology and source notes.

What are electrified appliances and homes?

Most households today run on a mix of energy sources. While many appliances (lights, fridges, computers, etc.) run on electricity, others often run on fuels like gas, LPG, wood, or even coal and diesel. Vehicles used by homes are most commonly petrol or diesel, with some hybrids and plug-in hybrids in the mix. As technology has evolved, electric alternatives to these fuel options have innovated to be significantly more efficient, usually 2-4 times for heat pumps, 2-3 times for induction cooktops, and around 2-4 times for electric vehicles. As technological learning rates have progressed, manufacturing economies of scale have made these alternatives more affordable. For example, electric vehicles have only recently become a feasible mass-market option through a rapid drop in prices, driven by these learning rates.

When we refer to electrifying appliances, we refer to switching fuel-using appliances and vehicles to electric alternatives. For example, switching a gas water heater to an electric hot water heat pump, or switching a petrol vehicle to an electric vehicle.

In addition to this electrification of appliances and vehicles, electrification often refers to installing solar and battery systems for homes. These are electricity generation sources that make the home to some degree its own power plant, and able to lower its input costs for electricity.

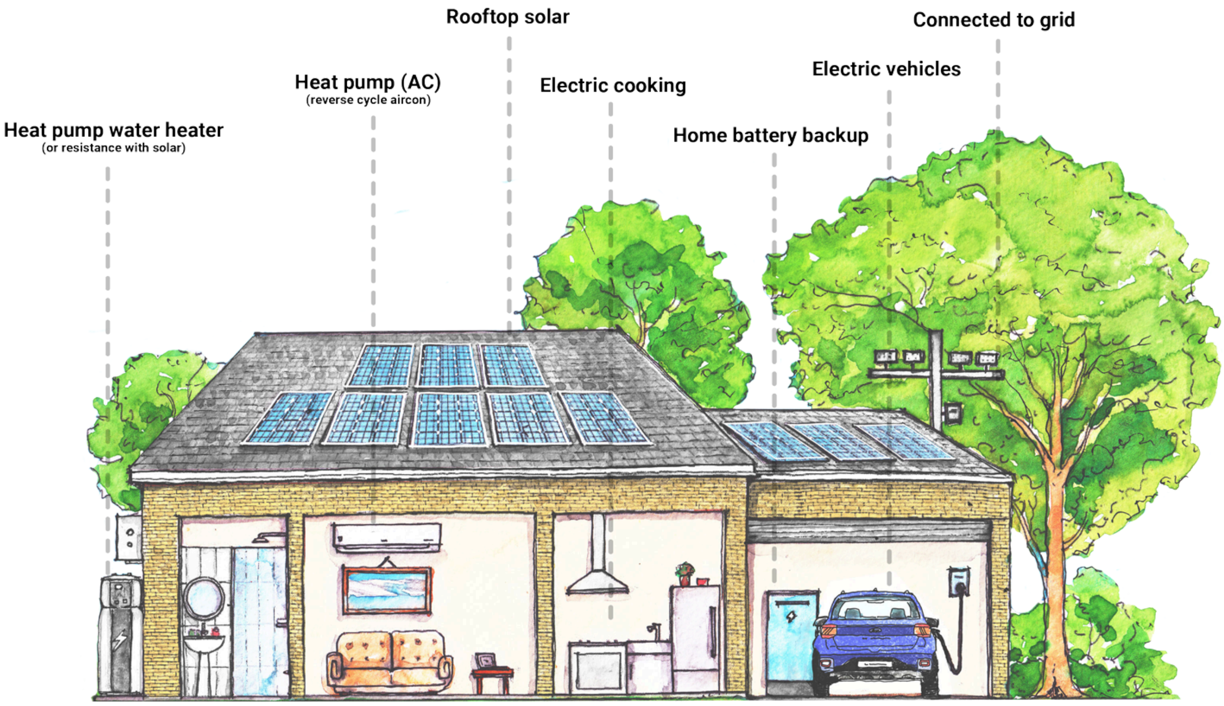


Figure 18: Illustration of an electrified home

Notes on average energy use in homes

Most of the comparisons between appliances and vehicles in this report are based on average energy usage statistics. This means the energy consumption for an average home or vehicle. For example, the average room heating or water heating needs of a home, or the average kilometres driven by a vehicle.

These energy needs change with behaviour, location, season, and more. For example, a home in a colder part of the country will consume more energy for space heating than an average home nationwide. A home with a long commuting distance will drive more kilometres per year than the average and therefore use more energy in their vehicle.

As energy economics are built around upfront costs of appliances and vehicles combined with operational costs from energy usage, consuming more or less energy changes these lifetime economics. In general, homes consuming more energy than average or vehicles driving more than average kilometres will save more from electrification than those consuming less energy. This is because as usage increases, the operating cost (and therefore the potential saving) increases, while the capital cost of electrifying the machine stays the same. For example, a home that has lots of showers still only (for the most part) needs one water heater, so the capital cost difference between a shower-heavy and shower-light home upgrading its water heating to electric is minimal. A car that drives 5,000km, 10,000km, or 20,000km per year still costs the same upfront.

This is useful to consider when looking at energy economics, and how they might suit specific situations. For some helpful context, here are some examples of average energy use:

1. An average home has about 2.7 people in it.
2. An average car drives about 10,500km per year, or around 200km per week

SECTION 1

Electrification economics at an appliance and vehicle level

Here we compare the underlying machine economics for homes, including space heating, water heating, cooktops, solar, battery, and vehicles. We have a summary to start, and then below that we dive into more detail on specific appliance and vehicle types.

Using heat pumps to heat an average New Zealand household is $520 lower on bills per year than doing the same with gas, and $1,100 lower than doing it with LPG. Over 15 years, the net savings from using heat pumps including their upfront costs is $16,300 and $20,700 respectively, taking into account price inflation of the various energy types.

Using a hot water heat pump saves $320 per year on bills compared to gas, and $720 per year compared to LPG. Over a 15 year lifetime, including upfront costs of each, the net savings are $7,100 and $9,300 respectively. Note electric water heaters can also be paired with solar, or with night rate electricity, to deliver even lower running costs, the examples here use average grid volume prices, and in the water heating section we provide more comparisons.

Note both gas and LPG also have fixed costs (daily charges) and when including a proportion of those, the savings are higher, we show this in more detail in the section for each appliance.

Electric vehicles can save $1,890 (medium SUV) per year on bills (fuel, maintenance, and RUCs), using average fuel prices before 2026 projected forward. Over 15 years these savings amount to $28,350, which now places electric vehicles at a point where their economics stack up including upfront costs as these savings are significantly larger than the usual difference in upfront costs of electric cars today. If charged from solar or on lower overnight electricity rates, these bill savings are higher again. If charged only on public fast chargers which are more expensive, then these economics can also be worse.

A solar and battery install for an New Zealand household with electrified appliances and vehicles consuming about 10,000kWh per year, can save about $2,370 per year on bills by lowering the cost of all electricity in the home running through appliances and vehicles. A solar system that costs $21,900 (9kW), financed at 5.5% interest can save around $23,000 to $43,000 net over its lifetime depending if financed for a 30 year term or 5 year term respectively. Solar is now at a point where it can be financed to enable lower bills from day one with all cost included.

In this section we explore these economics in greater detail across the different primary energy uses in the home.

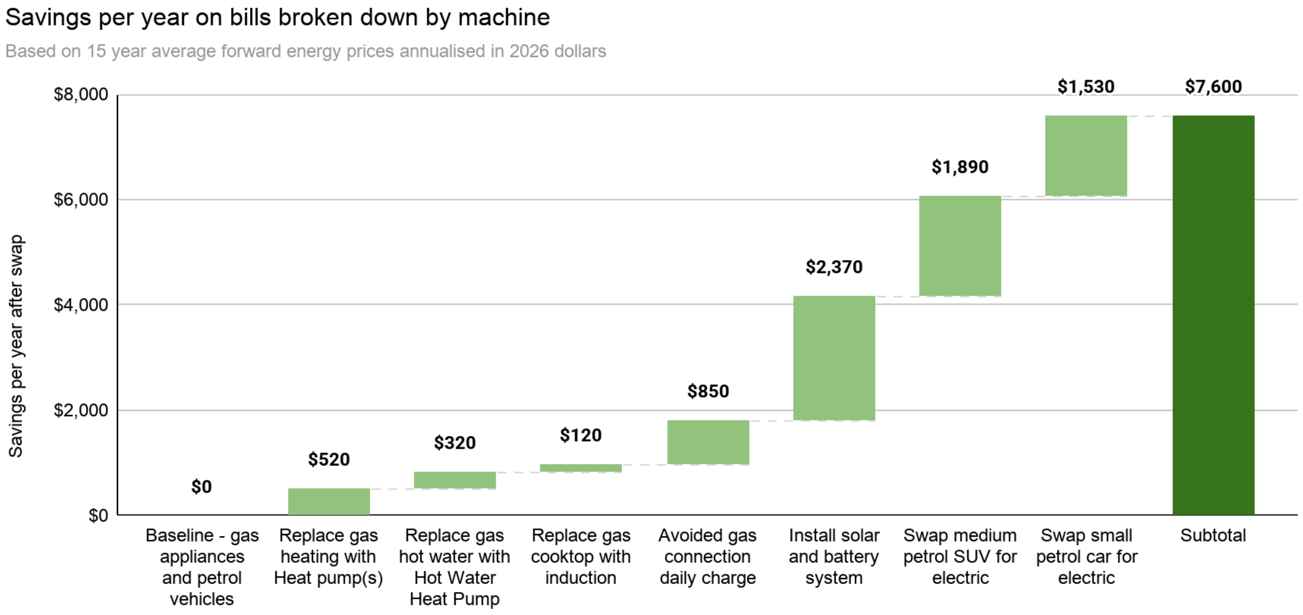


Figure 19: The yearly bill savings from electrifying each major energy use in a home with average New Zealand energy usage that is using gas (piped natural gas) appliances and petrol vehicles.

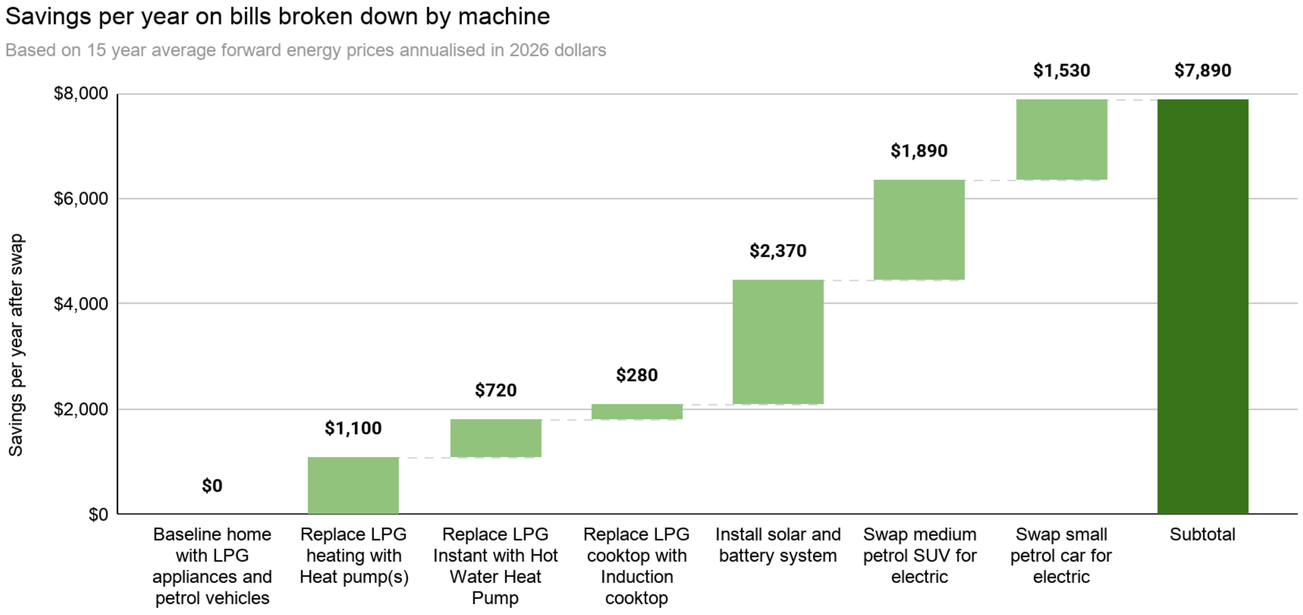


Figure 20: The yearly bill savings from electrifying each major energy use in a home with average New Zealand energy usage that is using LPG (bottled gas) appliances and petrol vehicles.

Space heating

Space heating is the largest use of energy in most homes, excluding vehicle use. This space heating or room heating energy use changes significantly by region, with homes in warmer climates needing less heating than homes in colder climates on the South Island. Similarly, space heating needs are impacted by behaviour and home conditions. Some homes may prefer a warmer standard temperature, and others may prefer colder. Some homes will have better insulation and thermal retention than others so some require more heat output to reach the same internal temperature consistently. We base the comparisons below on average home heating needs in New Zealand.

Heat pumps in cold weather

One question often raised about heat pumps is their performance in cold weather. Heat pump efficiency does decrease as temperature decreases, but the notion that they do not work in cold weather has at this point been clearly proven false.[20] The study linked below in the footnote (and here) looked at performance at temperatures as low as -30 degrees Celsius, far below any average temperatures reached in New Zealand. In general, the trend showed that average COP was above 3.0 at +5 degrees Celcius, meaning over 3 times as efficient as a gas heater, wood fire, or electric resistive heater. Testing included in Alaska, where the COP of heat pumps was 2.0 in -25 degrees and 1.8 in -30 degrees.

Ducted gas replacement notes

Through real world experience we recognise replacing ducted gas with heat pumps can be higher cost than individual gas heater replacement costs. While the energy usage can be similar to smaller gas heaters, the upfront cost can have a significant impact on economics. For the broader machine model for community and national numbers, we replace ducted gas with full install of a ducted heat pump system, including new ducting. It is worth noting that a replacement mechanism also used by installers is to replace a ducted gas system with multiple split system heat pumps across multiple rooms, as this can be lower cost to install than a new ducted system. For this paper, we do not model this different replacement mechanism and instead assume the higher cost new ducted system is installed, which we expect to be conservative.

[20] Gibb, D., Rosenow, J., Lowes, R., & Hewitt, N. J. (2023). Coming in from the cold: Heat pump efficiency at low temperatures. Joule, 7(9), 1939-1942.

Energy comparison of space heating options

Below in Figure 21 we compare the underlying energy use for different space heating options than can be chosen by a household. This assumes the entire home is heated with that option. It is worth noting that many homes use multiple heating sources, for example a heat pump, a wood fire, and small resistive bar heaters. Homes using a mix would therefore see a mix of the options shown. Homes also often have a main/primary heating source, which is likely to be the highest heating energy source in the home. We can see that heat pumps are significantly more energy efficient than all other heating options. This has flow-on effects for their impact on bills and emissions.

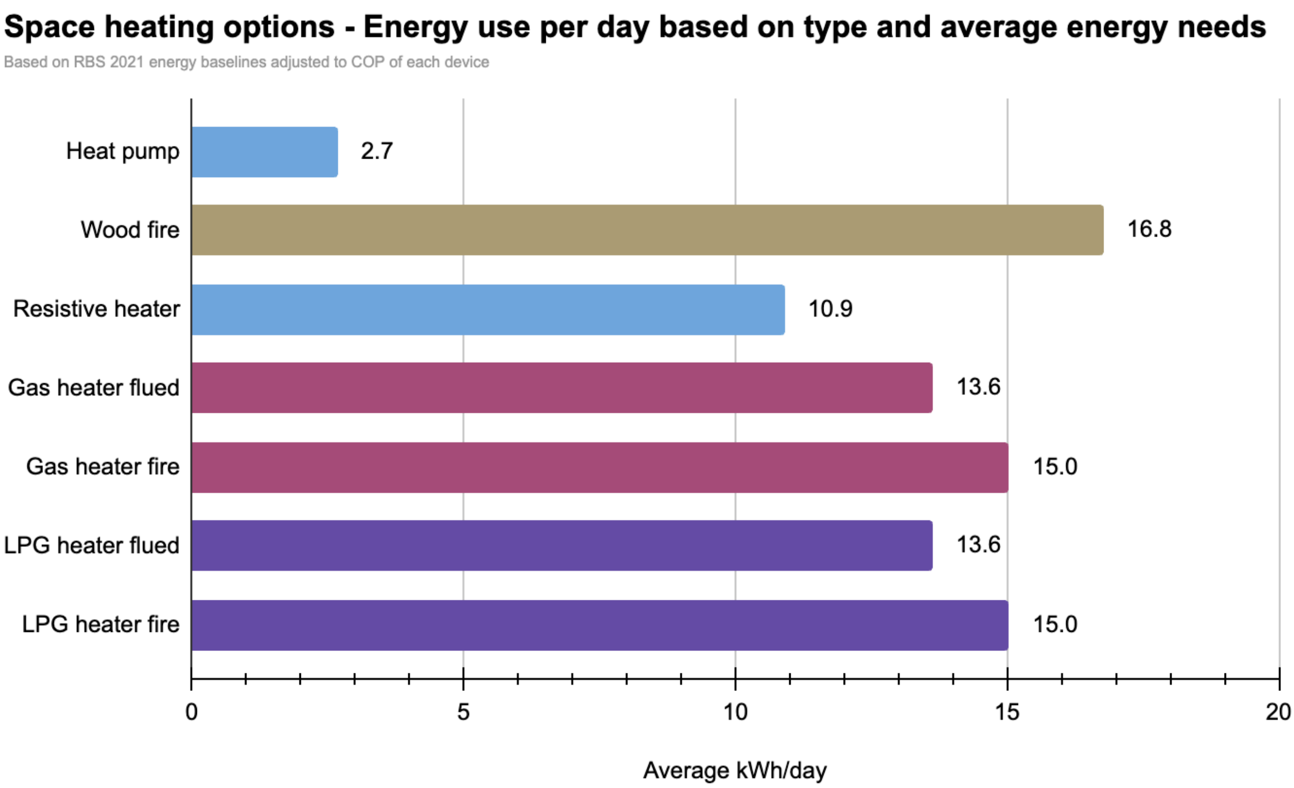


Figure 21: Comparison of space heating energy use per day for the average New Zealand home based on which method they use to heat. Assumes average home heating energy use.

While our machine-level comparison above assumes average New Zealand home heating needs, our community- and country-level modelling (Sections 3 and 4) take into account the varying heating needs across regions, shown in Figure 22.

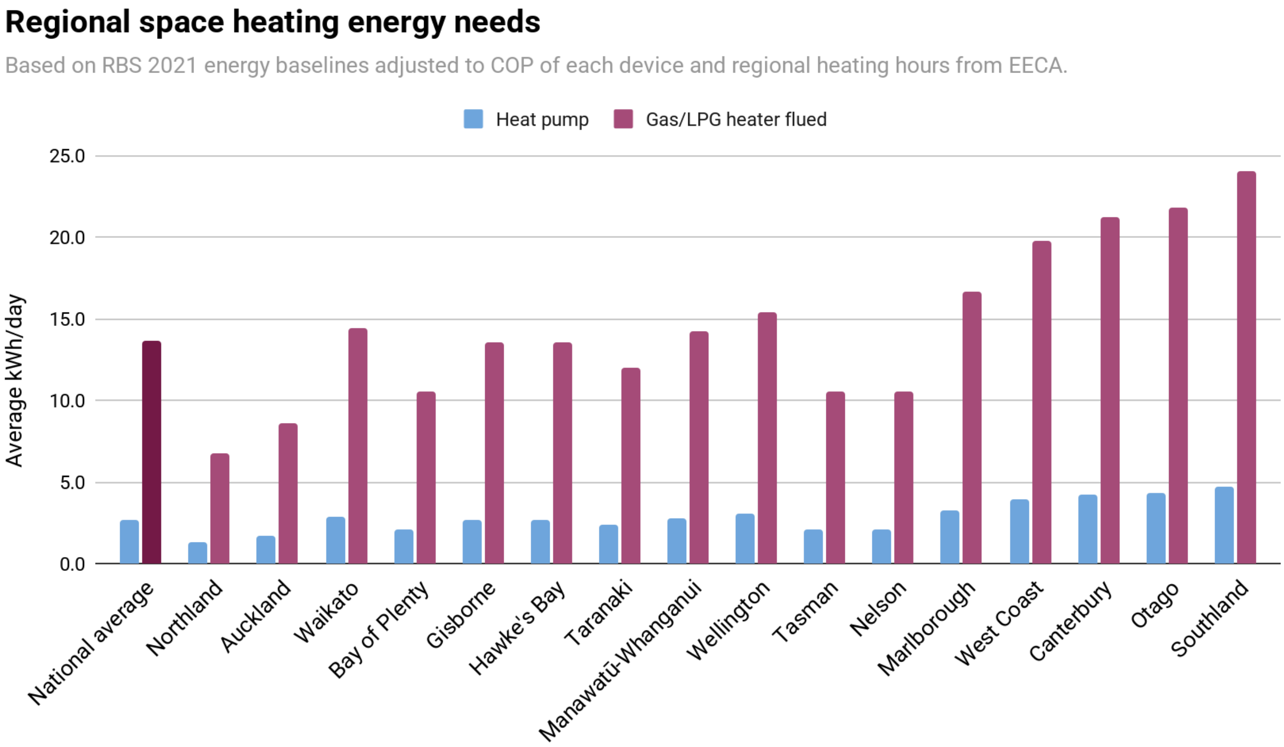


Figure 22: Average daily heating needs per region for an average size home.

Bill comparison

In Figure 23, we compare the yearly bills at 2026 prices for heating a home with each option based on average energy use. Please note, these prices exclude any increases from the recent (2026) fuel crisis.

For gas appliances, we include the average heating proportion of fixed daily chargers as a lighter coloured bar. Pipeline distributed natural gas and bottled gas (LPG) are priced in different ways. LPG is primarily priced per bottle, and therefore per unit of LPG energy used. Distributed natural gas, in large parts of the North Island, is charged with both a volume fee per energy portion, and a relatively high (compared to LPG) daily charge that stays the same regardless of how much gas is consumed. As the gas connection serves any gas appliances in the home, it is a flat rate which applies to all, though it does not need to be paid if the appliances are removed. We estimate that this is conservative, as it is based on space heating, water heating, and cooking appliances in the home being gas and sharing the fixed costs. In practice, many homes have only one or two gas appliances, which would make the proportion higher. For example, if they only have gas water heating, the entire gas fixed cost would be applied to that alone.

In full household modelling later in this report, we model the gas fixed cost for the home and a gas disconnection fee as well. For individual appliances, this is not feasible, hence the approach discussed above. For LPG, fixed daily charges are done in the same way but are relatively small and appear at the end with a lighter coloured bar.

Electricity fixed costs are not included in the comparisons of appliances, though they are included in the full home comparisons shown later in the report. This is because it is highly impractical for any home to not use electricity, as they power their lights, fridge, TV, etc with electricity. In contrast, after stopping using gas appliances, it is common and economic for a home to disconnect from the gas network in order to save on the daily costs of remaining connected.

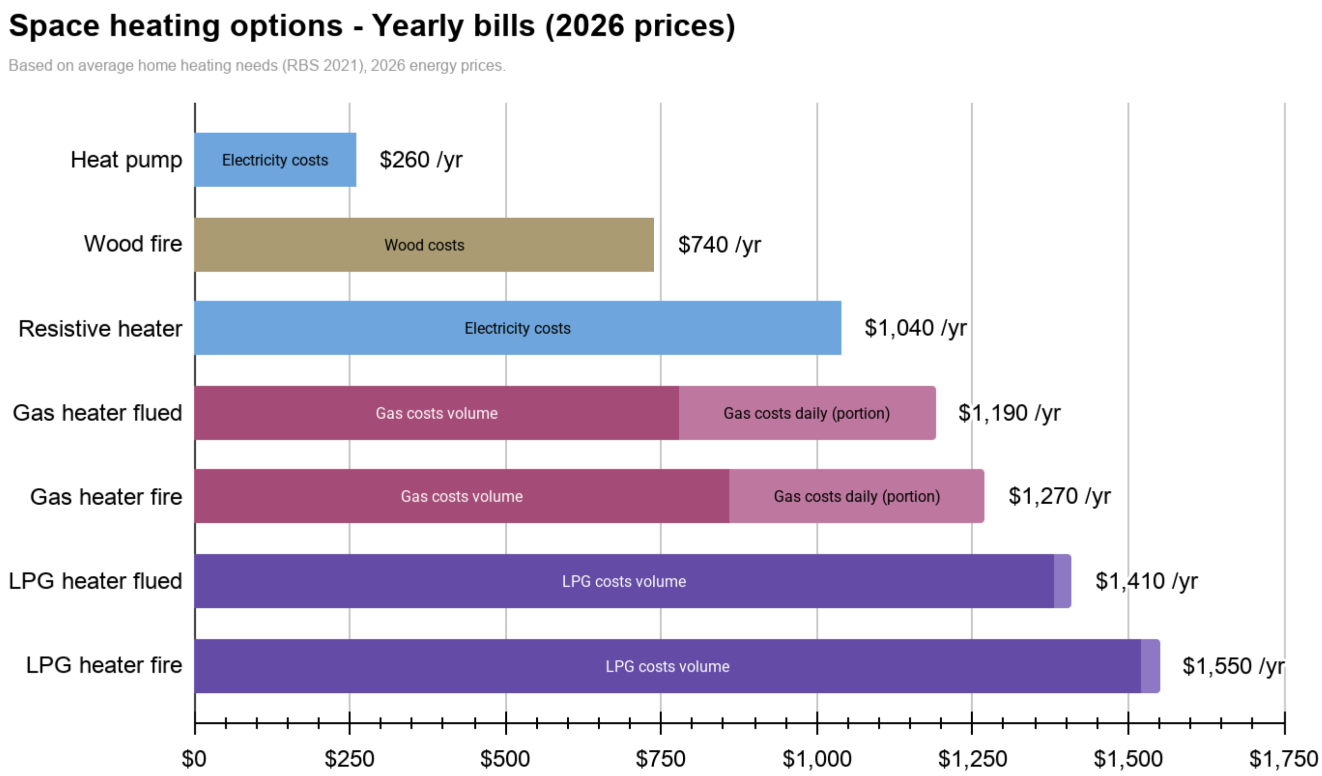


Figure 23: Comparison of space heating energy bills per year for an average home's heating needs based on which method they choose to heat the home with. This comparison looks at 2026 energy prices alone.

Emissions comparison

Space heating represents a substantial portion of residential energy use, and therefore a household's energy emissions if it is powered by non-renewable sources like natural gas or LPG. Figure 24 shows a comparison of the annual operating emissions across various heating methods. We assume that electric appliances are powered via the grid in these comparisons; if they are powered by solar and battery, their operating emissions are zero.

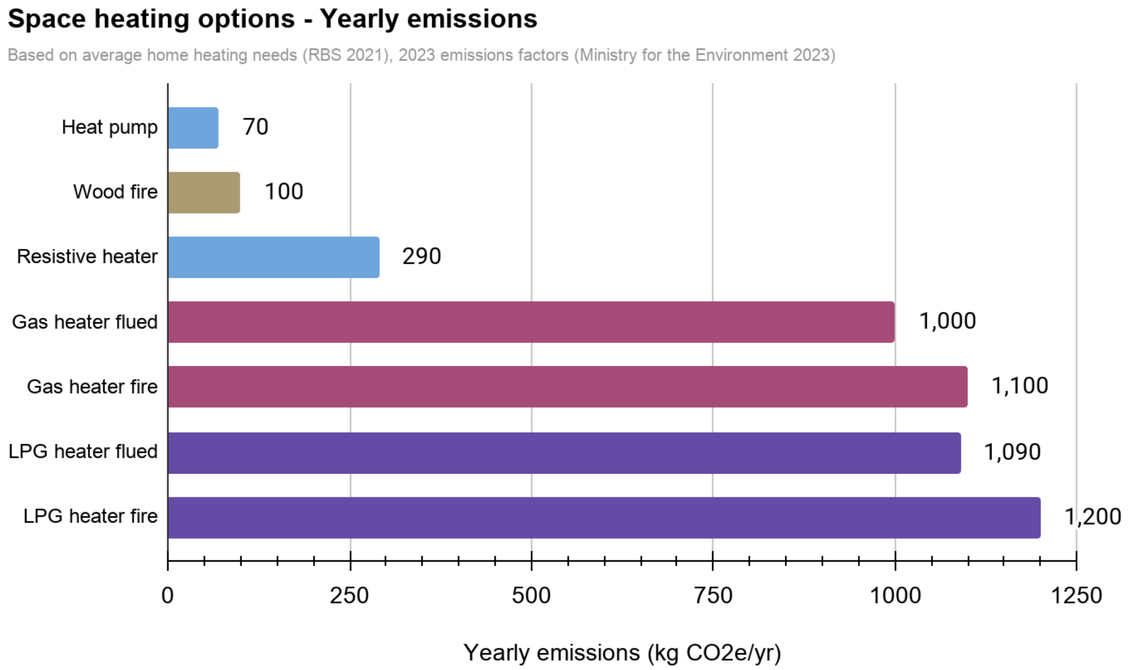


Figure 24: Comparison of space heating emissions per year for the average New Zealand home based on which method they use to heat.

Lifetime cost comparison

To compare the full costs we need to also account for the upfront costs of each appliance choice, including both the product and its installation. We compare this with operational costs over an assumed appliance lifetime of 15 years (Figure 25).

Note: in these direct appliance comparisons, we use the full installation costs if the appliance was being installed new. Later in this work, where we look at replacing machines in the economy or across communities, we use a like-for-like installation cost which is lower for business as usual scenarios where, for example, an old gas appliance is replaced with a new gas appliance, and then we use a high energy swapping installation cost for the electric replacement. This is explained in more detail in the methodology appendix. Because the operational cost over the lifetime of a product is often much higher than the product cost, this does not usually significantly impact the lifetime economics of these choices, but still is relevant enough for us to include in our community wide and nationwide economics of electrification. We note installation can vary significantly based on household conditions and the work that is chosen to be undertaken by the home at the time of installation.

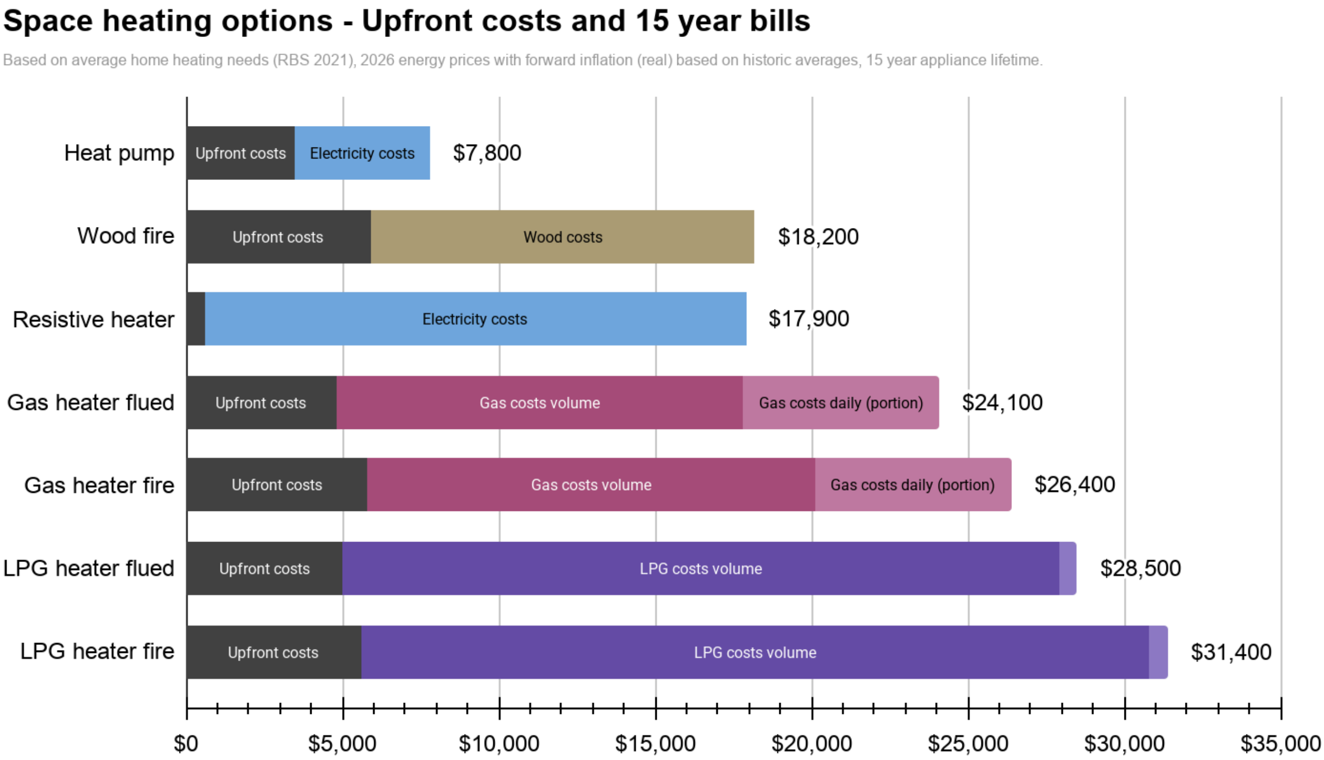


Figure 25: Comparison of space heating lifetime cost over 15 years for the average New Zealand home's heating needs based on which method they choose to heat with.

Water heating

Water heating is one of the largest energy uses in the average New Zealand home. It is similar in size to space heating energy use, though we note that location temperature and behaviour of households will impact whether water heating or space heating is a larger energy user.

Energy comparison of water heating options

Figure 26 compares the energy use per day for water heating in an average home, comparing different choices of water heater.

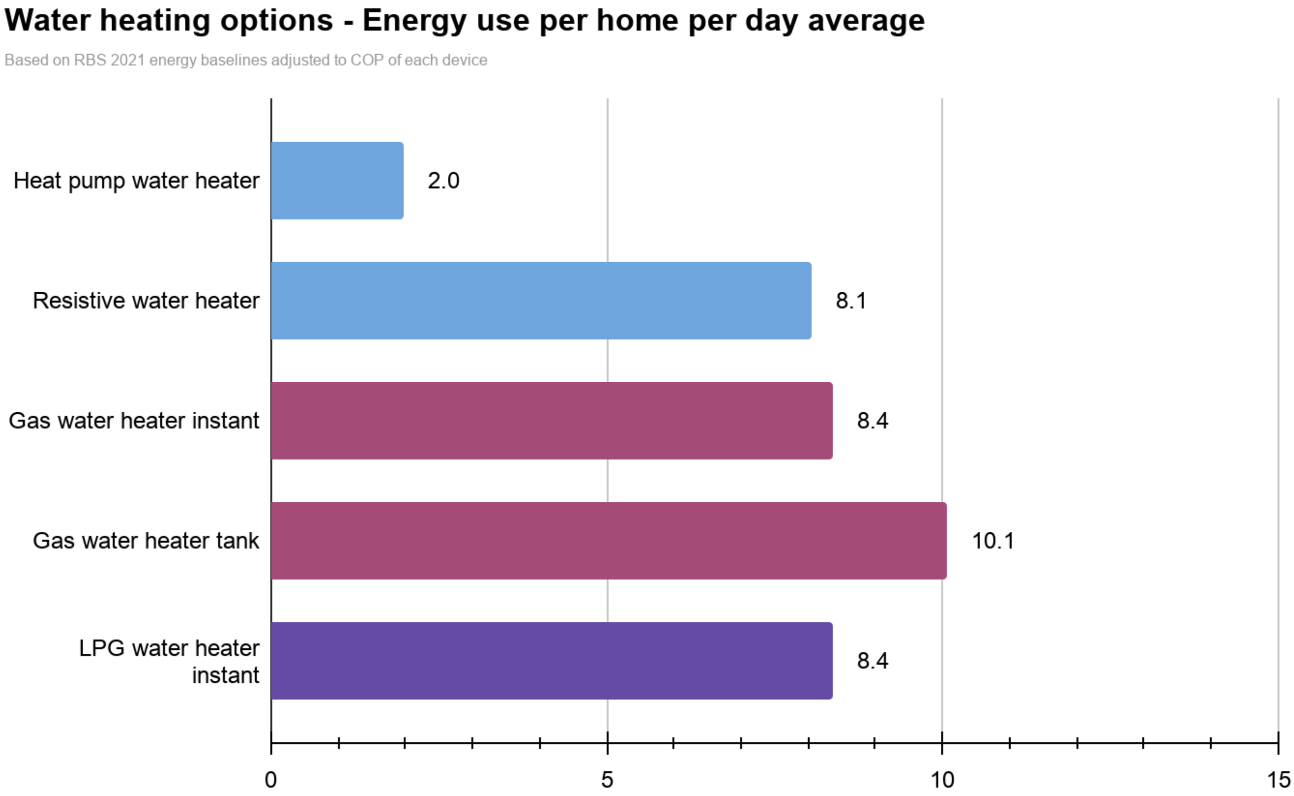


Figure 26: Comparison of water heating energy use per day for the average New Zealand home based on which water heater type they choose to use.

Bill comparison

Here we compare water heating bills per year. Water heating cost comparisons go into more detail than space heating because water heating is a much more shiftable energy load. New Zealand's most popular current form of water heating, resistive electric tanks, are often controlled by a system called Ripple Control, where electricity networks can turn off the water heater via a signal sent along electricity lines. This enables the water heater to reduce its costs of operation, by reducing or eliminating the amount of time it spends running at peak electricity usage times, which are the most expensive times. It is therefore often given a lower electricity price. Unlike space heating, which is harder to move around, water heating with a tank can be moved to other parts of the day because the insulated tank keeps the water heated over time, to be used later (there are some heat losses but not enough to discount the benefits). This is known as using the water heater as a thermal battery. A common way to do this is with solar panels, where the water is heated during sunlight hours from solar, to be used later once the sun has gone down.

To reflect this shiftable load, with both ripple control and solar diversion heating, we show multiple examples of the electric water heating costs in Figure 27 below. As with the space heating description provided above, a portion of gas and LPG fixed costs are included as a lighter coloured bar.

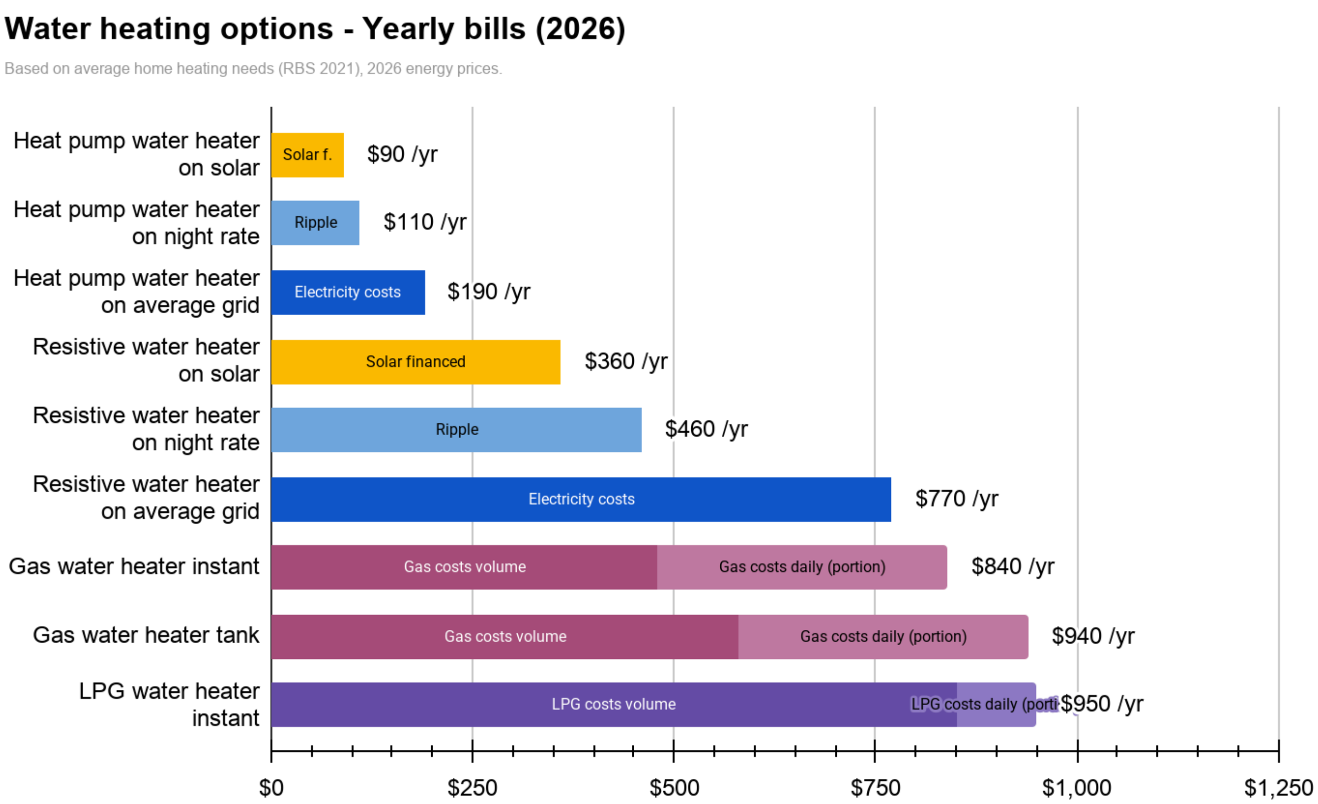


Figure 27: Comparison of water heating energy bills per year for the average New Zealand home based on which water heater type they choose to use and 2026 prices.

Emissions comparison

In Figure 28, we compare the operating emissions per year for water heating in an average home, comparing different choices of water heater. The energy efficiency of electric water heaters, and particularly heat pump technology, is once again reflected in the significantly lower emissions.

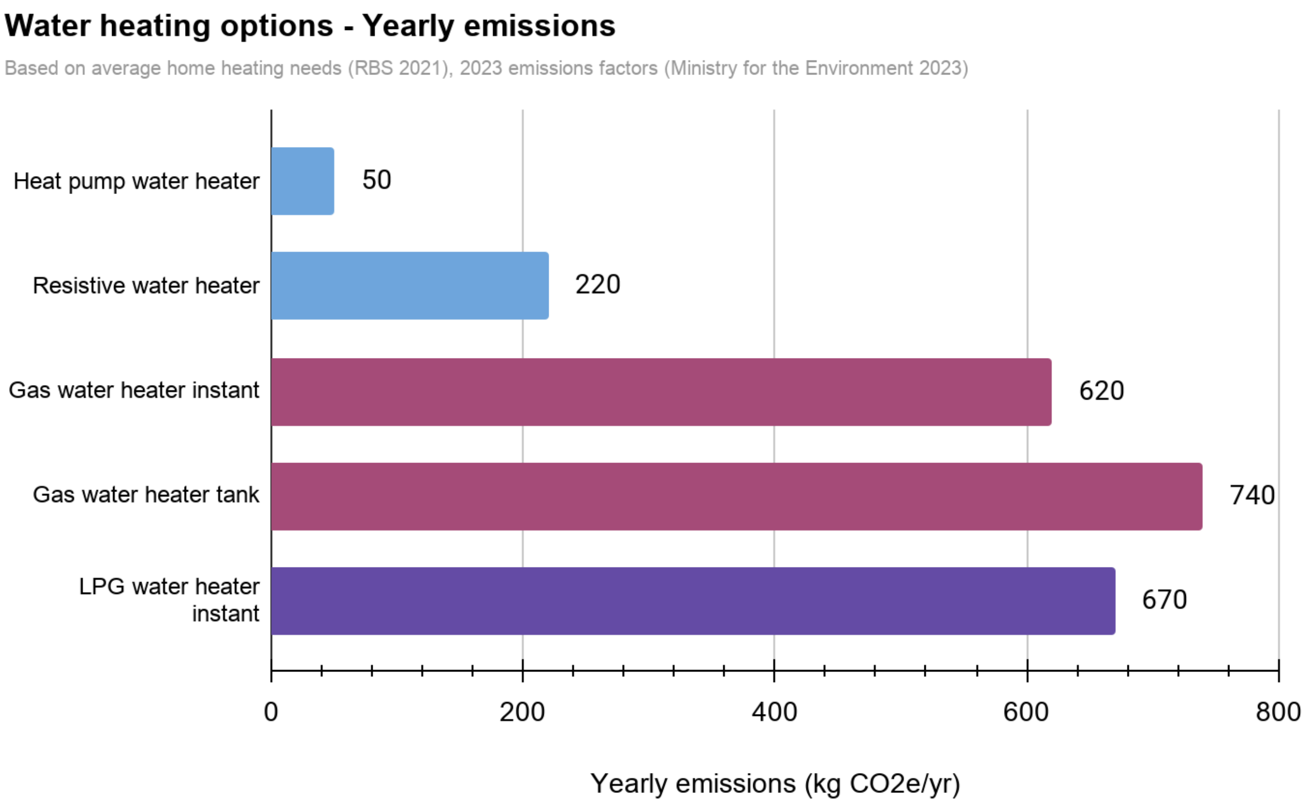


Figure 28: Comparison of water heating emissions per year for the average New Zealand home based on which water heater type they choose to use.

Lifetime cost comparison

Below we compare water heating costs over 15 years including the upfront costs of each option. This is especially important with water heating comparisons because hot water heat pumps are significantly more expensive upfront than most other water heating options. As discussed in the space heating section, here we show total install costs for a new install, and in the model for replacement of machines across communities and national, we use lower like-for-like install costs for BAU scenarios and higher installation costs for replacement of these BAU appliances by their replacement device (for example, replacement with a heat pump hot water heater).

Something especially relevant which is highlighted by Figure 29, is that the higher cost option upfront can sometimes be significantly lower cost, and lower emission, over its lifetime. However the purchasing process for these devices, for example energy star rating systems, do not generally acknowledge this adequately. For example, when purchasing a gas water heater, a household is not only paying the upfront cost, but locking itself into many thousands in gas that needs to be paid over the useful lifetime of that water heater.

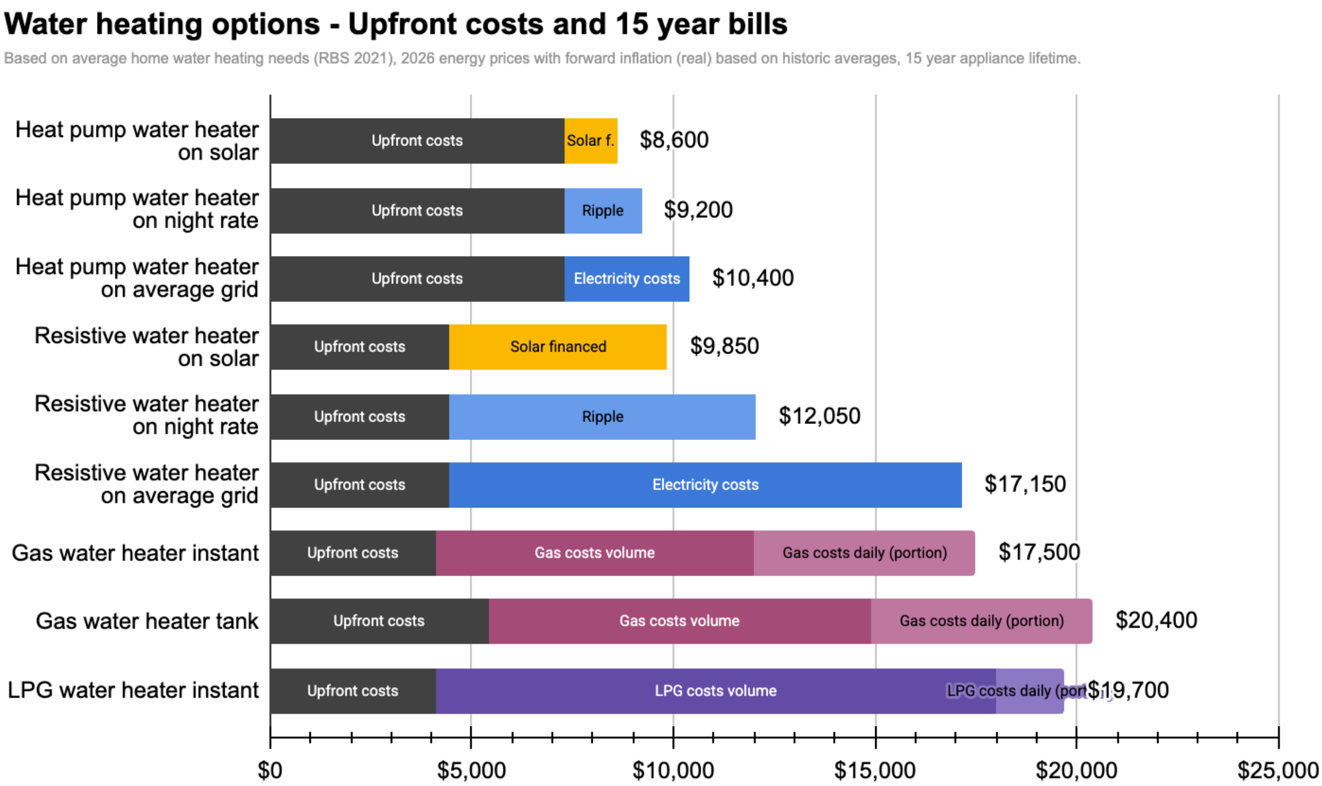


Figure 29: Comparison of water heating lifetime cost over 15 years for the average New Zealand home based on which water heater type they choose to use and 15 years of energy bills adjusted for inflation to real 2026 dollars.

Cooktops

While the majority of cooktops in New Zealand are already electric, whether resistive or induction, there are still over 360,000 that are powered by gas or LPG. These are still important to electrify for several reasons.

Electric induction cooktops have improved in technology and cost over recent years, and now represent a significant energy efficiency improvement over incumbent technologies. While the energy use is relatively low, if a natural gas cooktop is the last device left to be replaced before a home can disconnect from the gas network, then it can save the household hundreds every year in gas network daily connection charges that they must pay if any appliance still relies on gas. Therefore while low in energy consumption and therefore having a low impact on consumption bills, cooktops are important to show for their ability to unlock savings from gas disconnection.

Outside of the direct economics, cooktop electrification is also important to explore for health reasons. A 2025 study commissioned by EECA found that the resulting air quality reduction caused by gas cooking in the home poses significant health risks to humans.[21] This is well supported by international studies. These health risks may for some people provide enough reason alone to electrify, regardless of the economics. For policy makers, it is worth noting the broader health system costs of gas cooking in the home, which were estimated at $3.3 billion per year by the study. The indoor air pollution from gas stoves alone was linked to more than 200 premature deaths, 775 respiratory hospitalisations, and 3,200 childhood asthma cases per year in New Zealand.

Lastly, electric cooktops can offer an alternative, perhaps preferential cooking experience. They are easier to clean, for example.

[21] Metcalfe J, Kuschel G, Wickham L, and Denne T (2025). 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. Accessed at https://www.eeca.govt.nz/assets/EECA-Resources/Research-papers-guides/EIL-Indoor-Combustion-Study.pdf

Energy comparison

Cooktop energy usage depends on how cooking is done and what is being cooked, so it is worth noting that individual cooking behaviour can vary this usage significantly. A home that cooks large meals regularly on the cooktop may use more energy than average; a home that orders takeaway often less than average. The numbers shown in Figure 30 are calculated based on average energy consumption.

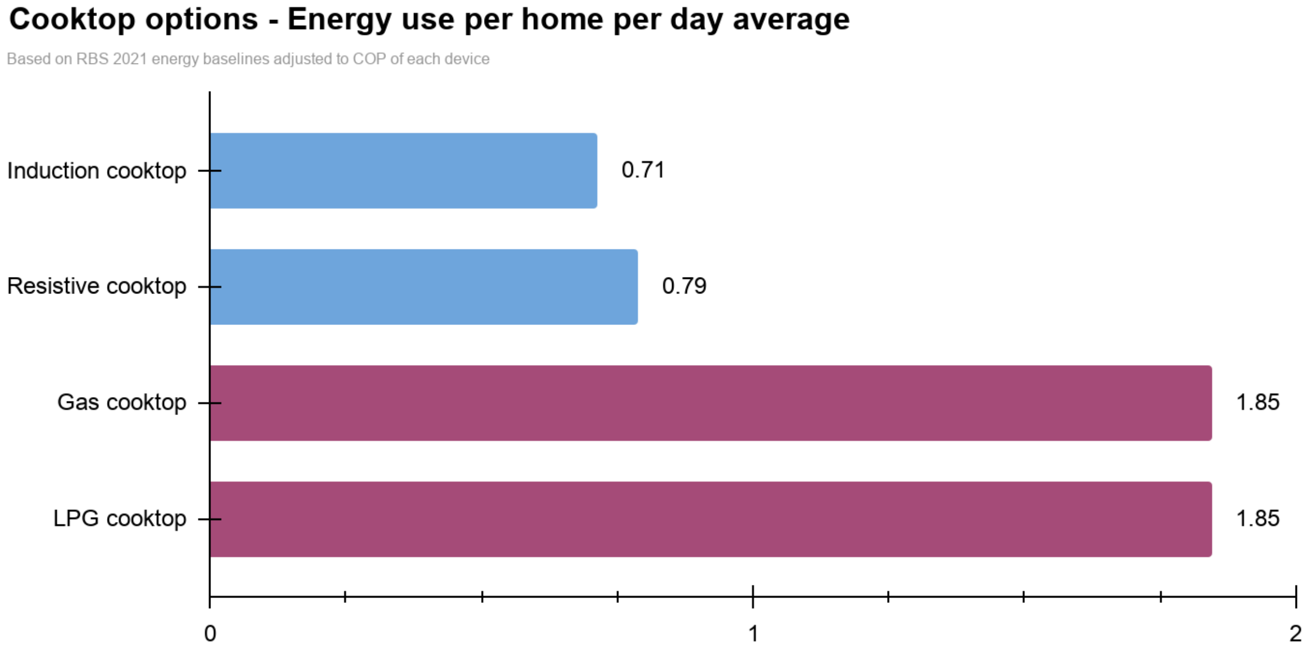
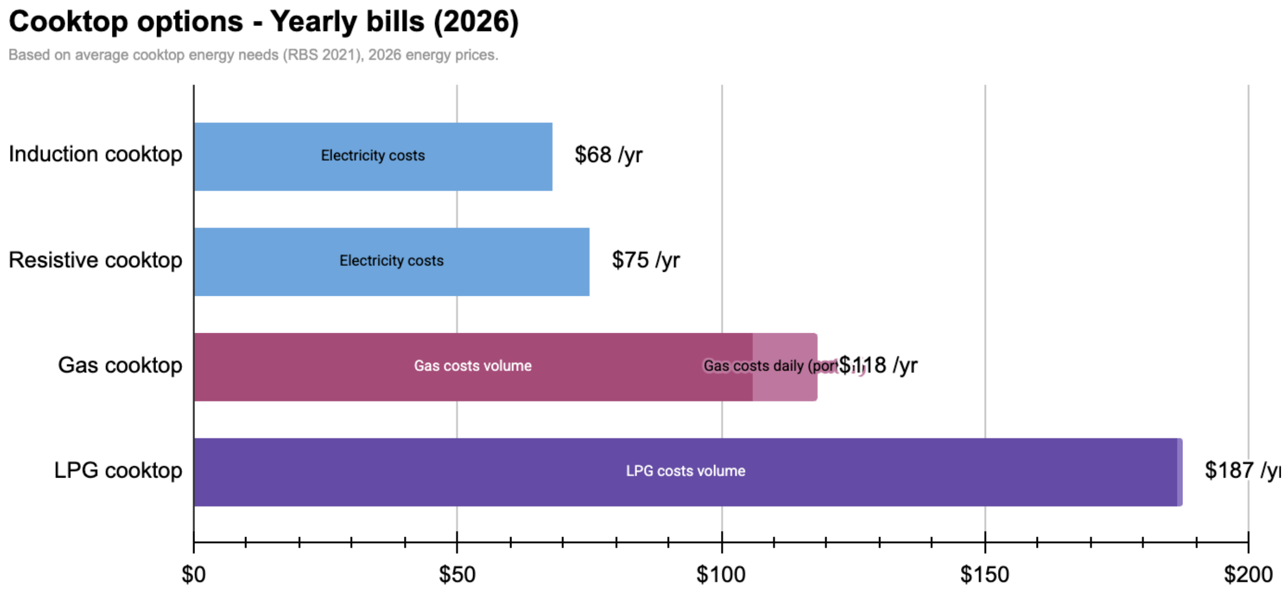


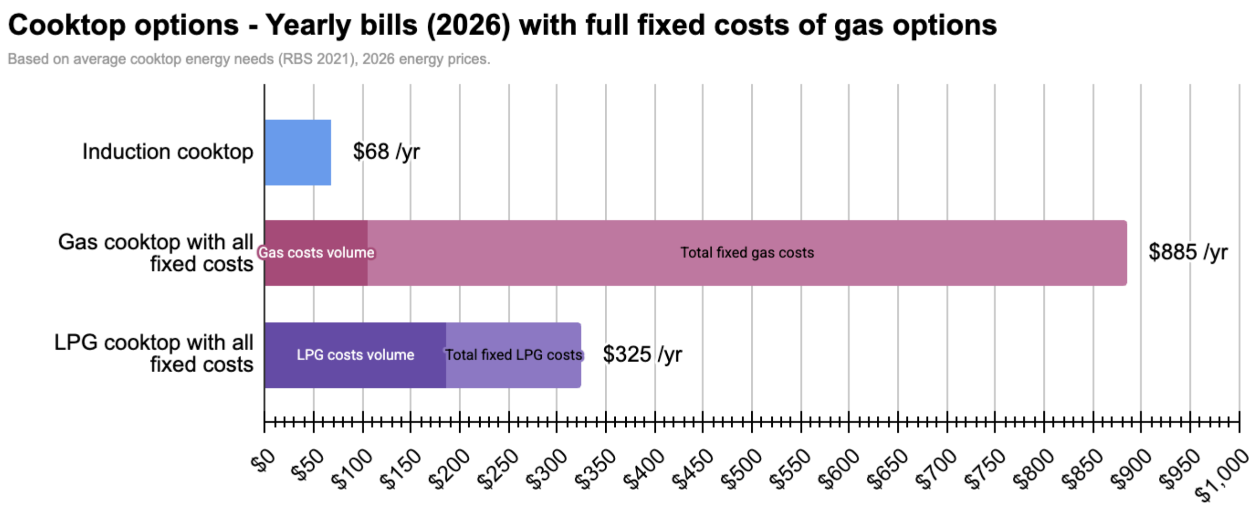
Figure 30: Comparison of cooktop energy use per day for the average New Zealand home based on which cooktop type they use.

Bill comparison

In the cost comparison for cooktop options, we show two versions of the gas and LPG options in order to demonstrate the cost relationship with fixed daily charges for gas connections (Figures 31 and 32). As discussed earlier in this section, we include by default the proportion of fixed charges applied to the usage of the appliance as a lighter coloured bar because gas costs, especially through distribution networks, come with two price components, one for the connection itself and another for volume consumption of the fuel.

With cooktops, it is worth exploring both the proportion method, and the total fixed costs. This is because once the other two energy uses (space heating and water heating) are electrified and off gas, the one remaining gas user in the home can often be the cooktop. At this point, the gas connection daily charges are all applying to the one remaining gas appliance in the home, the cooktop. While each home will likely take its own unique electrification journey, and could have the water heater or the space heater as the last gas appliance, this fixed cost perspective is important to explore as it shows the economic incentive seen by the home at this point of replacement.





Figures 31 and 32: Comparison of cooktop energy bills per year for the average New Zealand home based on which cooktop type they choose and 2026 energy prices.

Emissions comparison

In Figure 33, we compare the operating emissions per year for different cooktops in an average home, including both gas options which have differing emissions factors even if the appliance itself has similar efficiency.

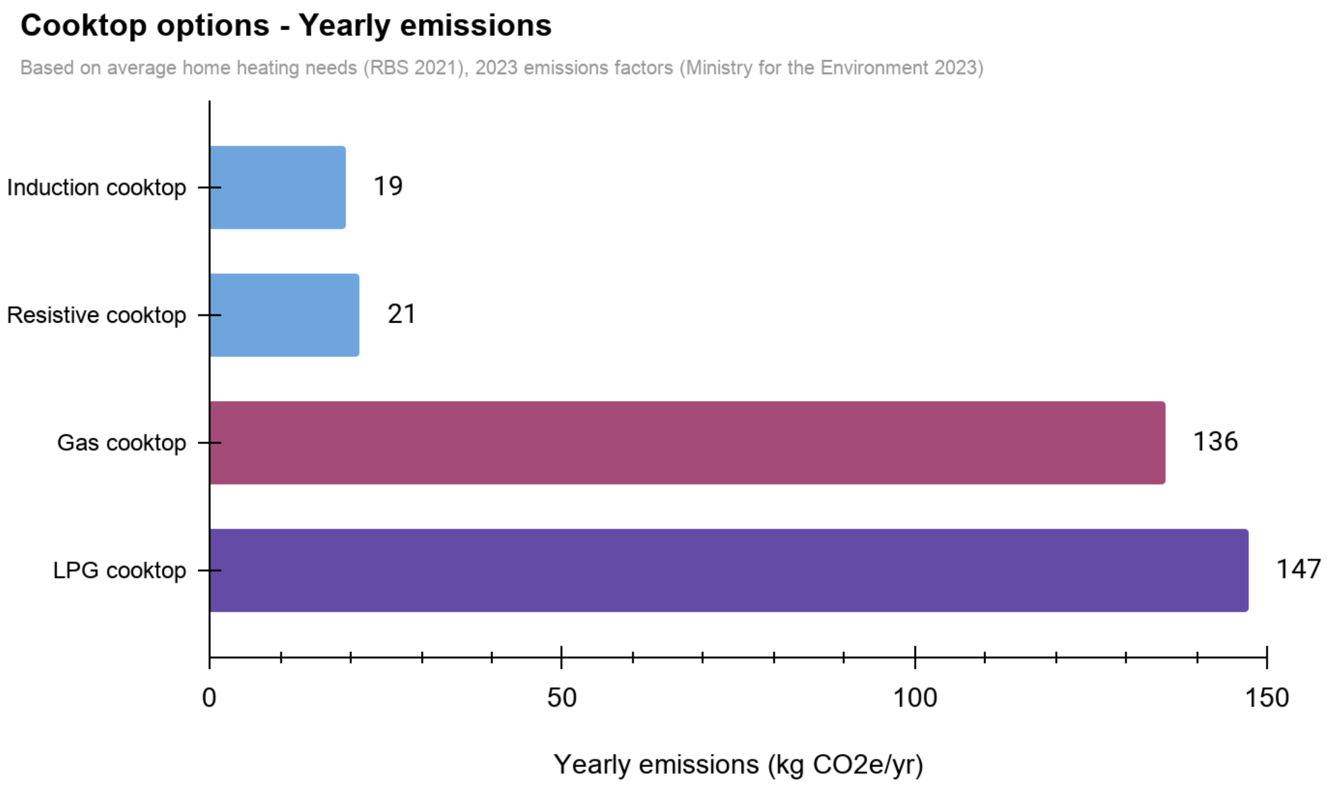


Figure 33: Comparison of cooktop emissions per year for the average New Zealand home based on which cooktop type they choose to use.

Lifetime cost comparison

In Figure 34, we show the cooktop cost comparison including the upfront costs of the product and its installation. As noted in the space heating and water heating sections, the upfront costs used here are for the full installation costs of a new device, whereas in the community and national numbers when replacing machines the BAU scenario uses like for like replacement installation costs, which are lower for gas and LPG cooktops, and uses the higher replacement installation costs for induction.

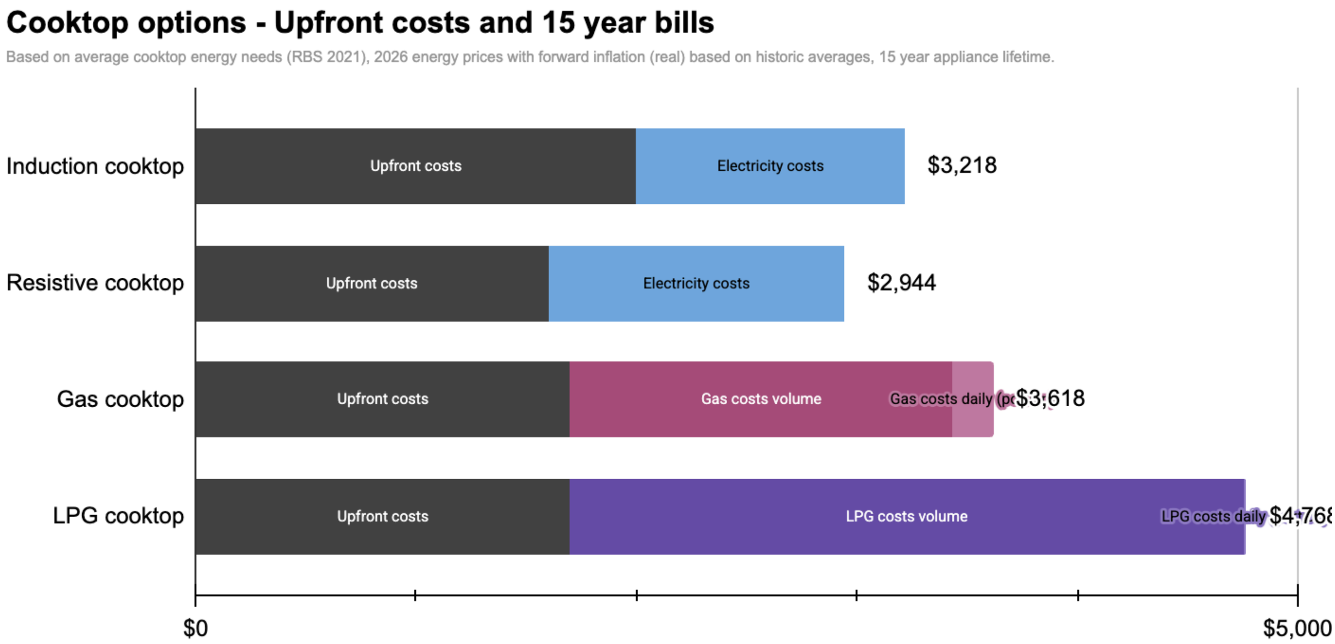


Figure 34: Comparison of cooktop lifetime cost over 15 years for the average New Zealand home based on which cooktop type they choose to use, and 15 years of energy bills adjusted to real 2026 dollars.

Vehicles

Vehicles are the largest energy use for the average home, and therefore usually responsible for the highest yearly energy bill, though not often conventionally seen as household energy even though it is the households making the decisions, and with electric vehicles the energy is often coming from the home.

Differences between drivetrains

There are four main types of light vehicle drivetrains today: Combustion (ICE), Hybrid Combustion (HEV), Plug-in Hybrid (PHEV), and Battery Electric (BEV, sometimes simplified to EV). While there are some more unique drivetrain options, like biodiesel and hydrogen, they are not deployed at scale and are unlikely to be due to cost. For clarity we present a short description of each drivetrain below:

Internal Combustion Engine (ICE)

Combustion vehicles use an internal combustion engine, which usually runs on either petrol or diesel. These are the most common vehicles in the New Zealand fleet today, though they are the least efficient form of vehicles.

Example vehicles include: Mazda CX-5, Toyota Hilux, Kia Stonic, Ford Ranger

Hybrid Electric Vehicle (HEV)

HEVs use an internal combustion engine paired with a small battery and electric motor. Exact implementations vary, but the general principle is the vehicle is propelled mostly by an electric motor, which is powered by electricity generated by the petrol/diesel engine and stored in a small battery. This is done to improve the efficiency of the vehicle compared to running on combustion alone. The car cannot be charged with electricity directly, so it 100% runs on petrol or diesel from an energy perspective. Hybrid combustion vehicles often include a mode where the engine directly powers the wheels when the car needs more power or speed than the electric motor can provide. In general hybrid electric vehicles are the second least efficient ahead of ICE vehicles.

Example vehicles include: Toyota RAV4 Hybrid, Toyota Yaris Hybrid, Toyota Aqua, Toyota Prius

Plug-in Hybrid Electric Vehicle (PHEV)

PHEVs combine an internal combustion engine with an electric drivetrain similar to Hybrid Combustion vehicles, though they generally have a bigger battery than hybrid vehicles and smaller battery than electric vehicles. They can be charged with electricity directly using an electric vehicle charger, and can often be run in an EV mode, where they consume only electricity and no fuel. They then have an internal combustion engine that turns on when they run out of range or need the extra power, as generally the electric motors used in PHEVs will be lower power than in battery electric vehicles. The energy usage of PHEV vehicles varies significantly based on behaviour, mainly the proportion of distance travelled that was powered by the electric engine instead of the internal combustion engine. For example, a user who charges regularly and never drives long distances may achieve a similar energy efficiency to a BEV, though with significantly less range due to the smaller battery. In contrast, a user who does not charge regularly or who goes on longer trips may consume similar amounts of energy to a HEV because the system is primarily operating as a fuel powered generator, not in BEV-only mode. Recent studies have shown real world fuel consumption for PHEVs is significantly higher than manufacturer claims.[22] [23] For example, an analysis of 9,000 private and business fleet PHEVs found that the average real-world fuel consumption of PHEVs in Europe was 4.0-4.4 L/100 km for private vehicles and 7.6-8.4 L/100 km for company cars, much higher than the average of 1.6-1.7 L/100 km cited in the Worldwide Harmonised Light-Duty Vehicles Test Procedure (WLTP) results that are often used in official advertising and specifications.[24] We take these discrepancies into account in our modelling, as explained below..

Example vehicles include: Mitsubishi Outlander PHEV, Ford Ranger PHEV

Battery Electric Vehicle (BEV a.k.a. EV)

Electric vehicles run entirely on electricity, using a bigger battery and bigger electric motor(s) than seen in HEV and PHEV vehicles in general. For this reason they are the most energy efficient vehicles as electric motors are significantly more energy efficient than combustion engines.

Example vehicles include: Tesla Model Y, BYD Atto 3, Nissan Leaf, Toyota BZ4x, Ford Mustang Mach-E

Vehicle efficiency

The real world efficiency of vehicles is known to be different from manufacturer claims. There are multiple vehicle testing procedures in use around the world to come up with fuel efficiency claims. The Worldwide Harmonised Light-Duty Vehicles Test Procedure (WLTP) is often used for vehicles in New Zealand. We note that real world usage appears to be higher than this. For example, real world electric vehicle range (how far it can go on one full charge) is lower than claimed in WLTP. The same often goes for the L/100km figures given for ICE, HEV, and PHEV cars. For this reason, we use the US EPA database's efficiency values instead, whose testing procedure appears to give estimates closer to real world driving. We then reconcile the total consumption of vehicles against MBIE energy balance data and the EECA Energy End Use Database. For cars that are not part of the US EPA vehicle database, we use an adjustment factor based on the comparison between US EPA and WLTP figures for cars with efficiency values available in both formats.

For aggregated figures like "Petrol Hybrid" we use an average of popular petrol hybrid vehicles on sale today and their efficiencies. Further down, we compare exact vehicle types for more detail.

Average driving distance

Every household can drive different distances with their cars, and it is worth noting that we use an nationwide average distance of 10,500 km per year for calculating yearly bills for driving.[25] Note that throughout a car's ownership life, on average it drives more kilometres when new and less when old. For our calculations we use an average across the car's lifetime, with the assumption that the household still commutes/travels the same distances by car each year. Some cars travel more than others on average. For example, utes and vans travel further each year on average than small cars. This is taken into account in the larger community/nationwide machine replacement models, where we use the average distance travelled for each vehicle type. However, in the

[22] Transport & Environment (2025). *Smoke screen: the growing PHEV emissions scandal*. Accessed from https://www.transportenvironment.org/articles/smoke-screen-the-growing-phev-emissions-scandal
[23] Raghavan, S. S., & Tal, G. (2022). Plug-in hybrid electric vehicle observed utility factor: Why the observed electrification performance differ from expectations. International Journal of Sustainable Transportation, 16(2), 105-136. Accessed from https://www.sciencedirect.com/org/science/article/pii/S1556831822004269
[24] Plötz, P., Link, S., Ringelschwendner, H., Keller, M., Moll, C., Bieker, G., ... & Mock, P. (2022). Real-world usage of plug-in hybrid vehicles in Europe. ICCT White Paper. Accessed from https://theicct.org/publication/real-world-phev-use-jun22
[25] Derived from Ministry of Transport Fleet Statistics (2026)

single-machine-level comparisons below we assume the same distance is driven by each vehicle for consistency.

Energy comparison

In Figure 35 below, we compare the average energy consumption per day for each type of drivetrain with common vehicle types available in New Zealand and average daily driving distances. For this example we use the same distance for each vehicle type to make it a clearer comparison, 10,500km per year per vehicle, or about 29km per day. We can see that ICE vehicles require about four times the energy to drive the same distance.[26] This is the same for light passenger vehicles as well as utes. HEVs require about three times the energy, and PHEVs still require about twice the energy of EVs.

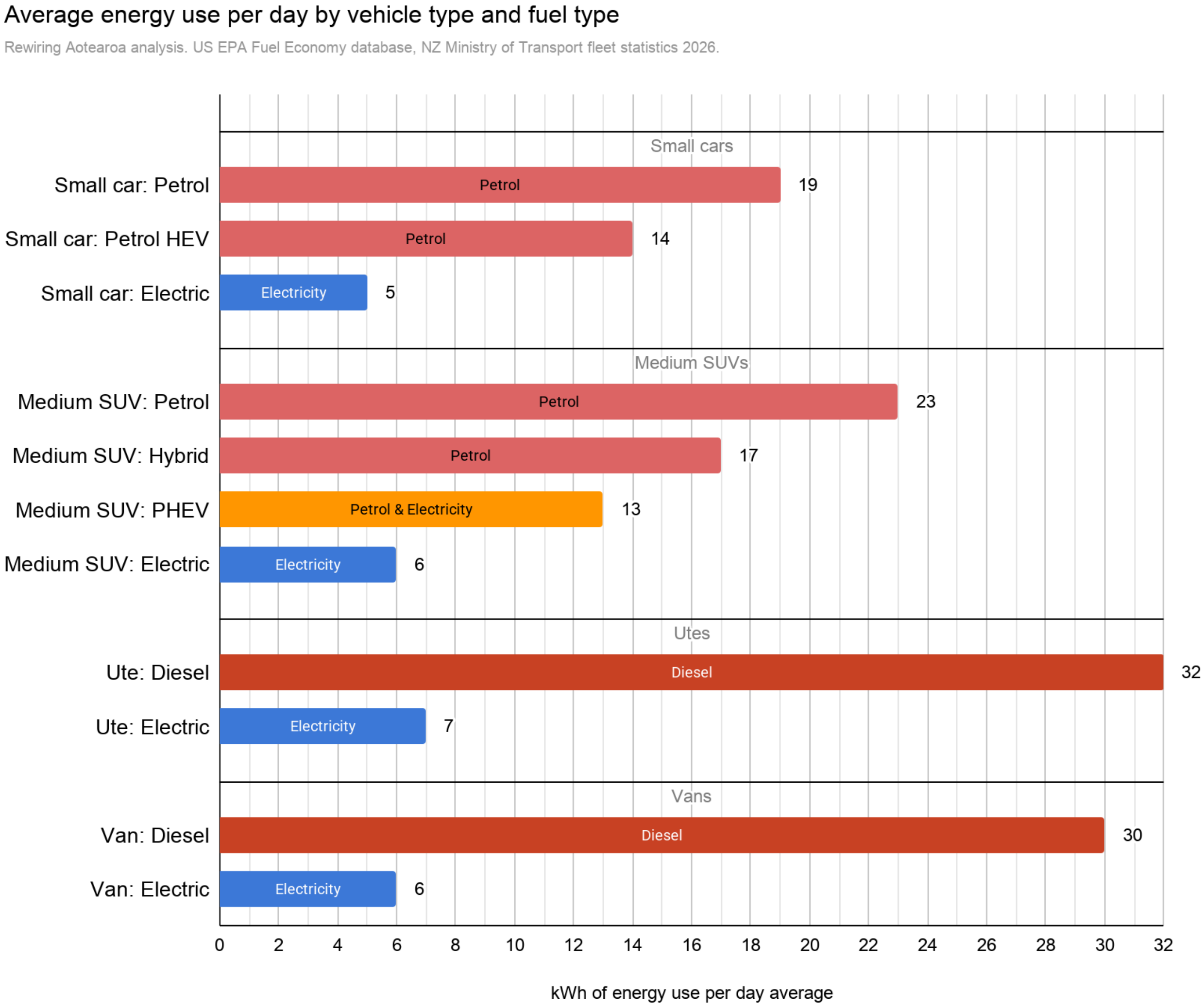


Figure 35: Comparison of vehicle energy use per day based on average New Zealand driving distances and modelled fuel efficiencies of different common vehicles and drivetrains in New Zealand.

[26] Based on a national average of 10,500 km per year according to Ministry of Transport Fleet Statistics 2026.

Bill comparison

In Figure 36 we compare the yearly costs between these vehicle types. Reflecting their relative energy efficiency, and also their slightly lower maintenance costs, electric vehicles tend to have the lowest yearly operating costs. For small cars, petrol hybrids may be slightly cheaper to run on occasion because they are receiving a tax subsidy through current RUC/excise methodology. While diesel vehicles do not see any difference from a change to universal RUCs, petrol cars will. For petrol and hybrid petrol cars of average-or-higher fuel efficiency and driving distance, the total operating cost will go up, as the decrease in fuel excise tax paid will be less than the increase paid in RUCs. Maintenance costs are derived from an analysis of the 2025 AA Motoring report of vehicle ownership costs.[27] It is worth noting these maintenance costs are generally for newer vehicles, so may be an underestimate of lifetime maintenance costs. It is relatively well established that electric vehicles have lower maintenance costs than internal combustion engine vehicles including hybrids, due in large part because they have significantly fewer moving parts that require regular maintenance in comparison to the high complexity of internal combustion engines and their transmissions.[28]

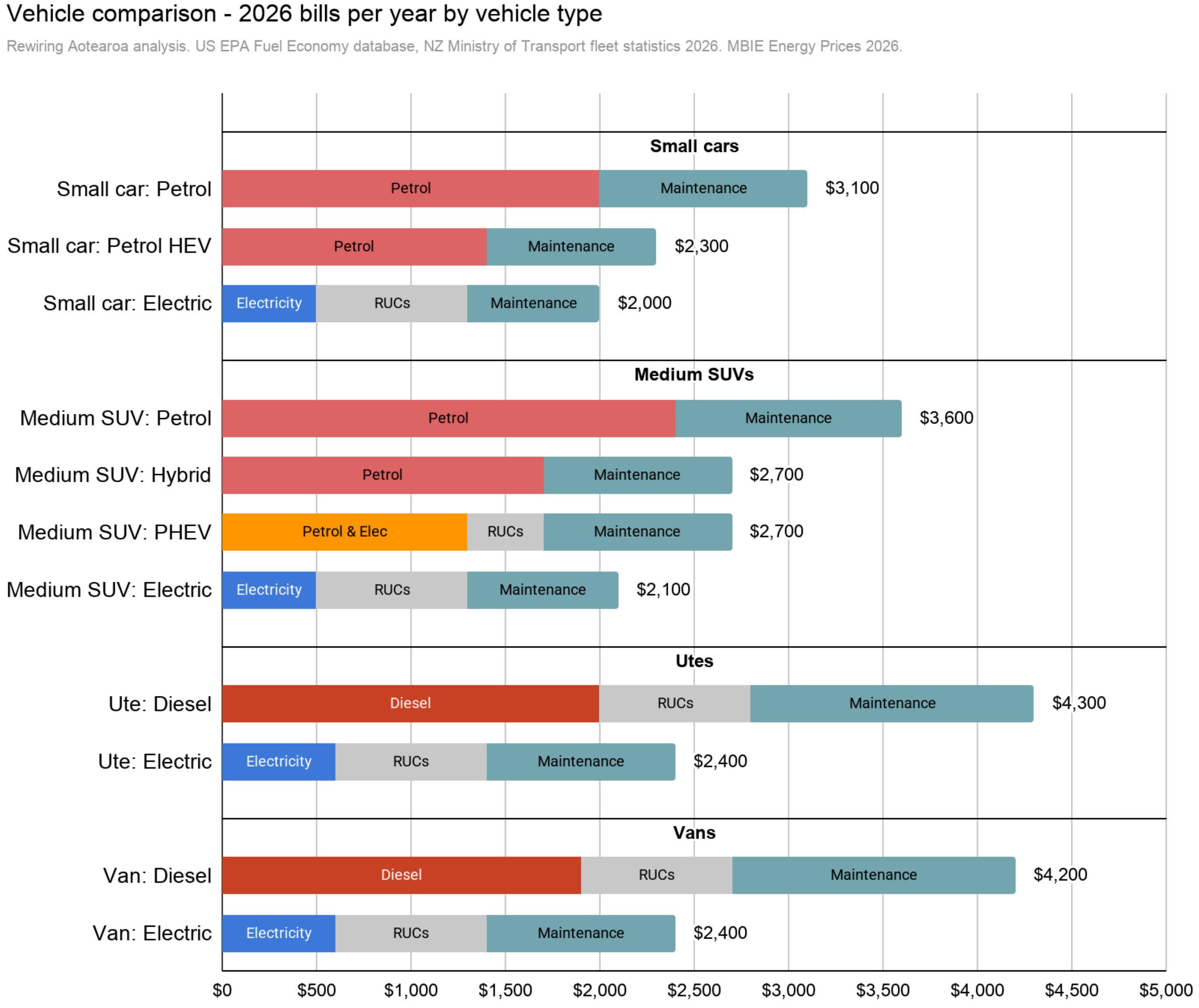


Figure 36: Comparison of vehicle operating costs per year based on average driving distances.

[27] https://www.aa.co.nz/cars/buying-and-selling/running-cost-reports/
[28] Burnham, A. et al. Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains Report 1780970 (Argonne National Laboratory, 2021); https://doi.org/10.2172/1780970

Charging cost comparison

Electric vehicles can be charged in different ways, and those charging methods have different costs. While charging at home is most common, sometimes that charging at home is done on night rate lower cost electricity or with solar, and sometimes EVs use more expensive public charging.

Below in Figure 37 we show a comparison using the medium SUV vehicle type between the different charging options. Most cars will use a mix of charging over their operational lifetime, and this cost is up to the driver to choose. It is important to note though, that while public charging is usually only a small fraction of the energy used in electric vehicles, if public charging is the only source of charging then it can significantly lower the savings economics of electric vehicles, where in some cases the economics no longer stack up over the vehicles lifetime. However, it is important to note this is not the usual practical use case of electric vehicles, as for example they can be plugged in at home overnight in what is often behaviourally more convenient than visiting public charging stations. Most new EV's come with one or two weeks of average driving range in their battery (for example 400km is around two weeks of average NZ driving). This means they can be plugged in at home and overnight get more range even with a slow trickle charger than they are likely to drive the next day. For this example, the excise cost on petrol has been removed so it's a more direct energy cost comparison to electricity.

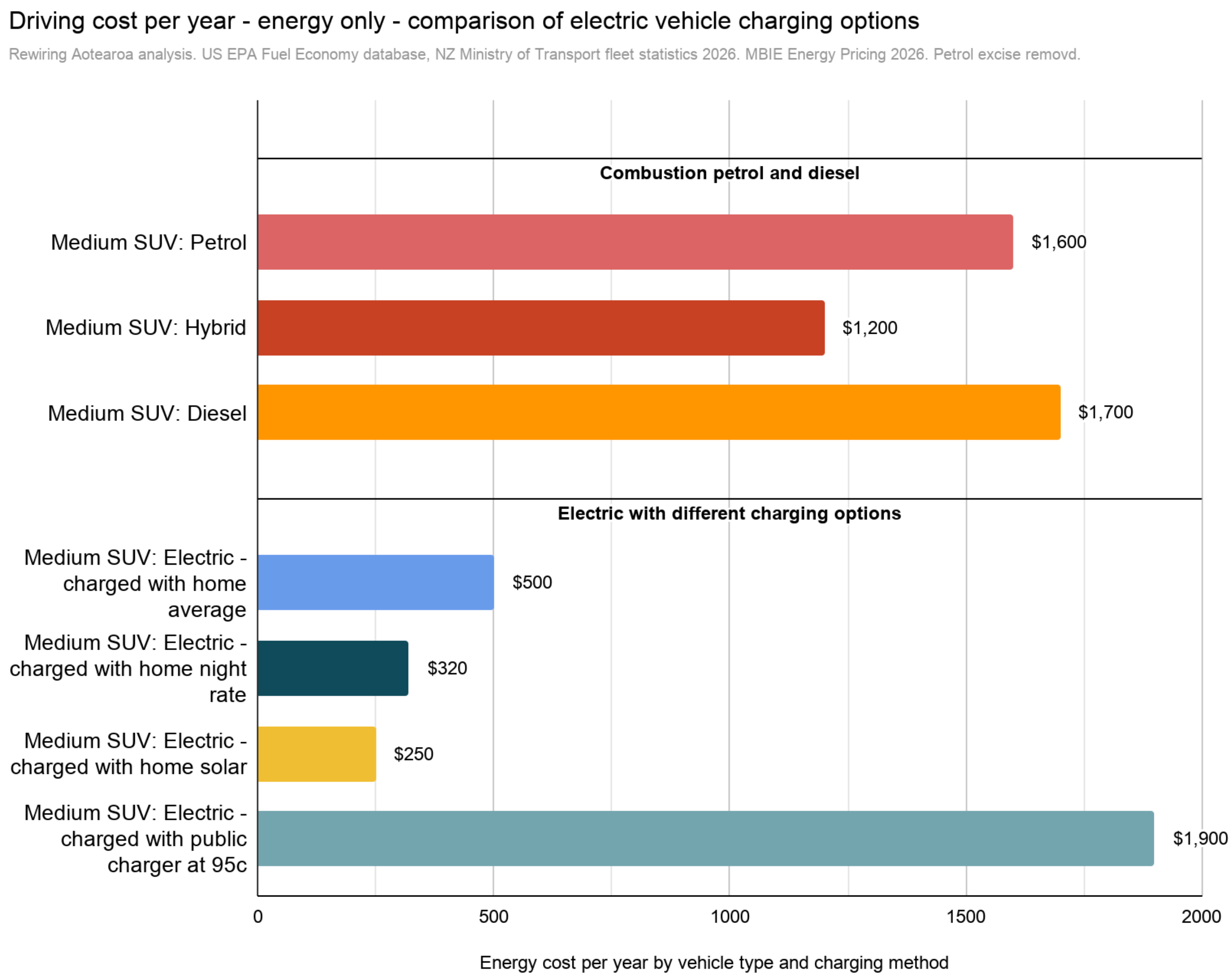


Figure 37: Electric vehicle charging cost comparison based on the type of charging used. A medium SUV is used as the vehicle example here, with yearly fuelling/charging costs. Note excise has been removed from the petrol price.

Emissions comparison

Vehicles make up a significant proportion of our household energy use as well as the nation's fuel demand. Therefore, vehicles are also a significant source of potential emissions savings. Figure 38 shows a comparison of the yearly operating emissions from the various vehicle types and drivetrains. In all cases, EVs have much lower emissions both due to their energy efficiency, and because the type of electricity they consume is mostly renewably sourced in New Zealand. These emissions savings are also based on the assumption that all charging is done via the grid, which is highly renewable but still has operational emissions. EVs charged with 100% renewable electricity such as rooftop solar or hydro have virtually no operating emissions.

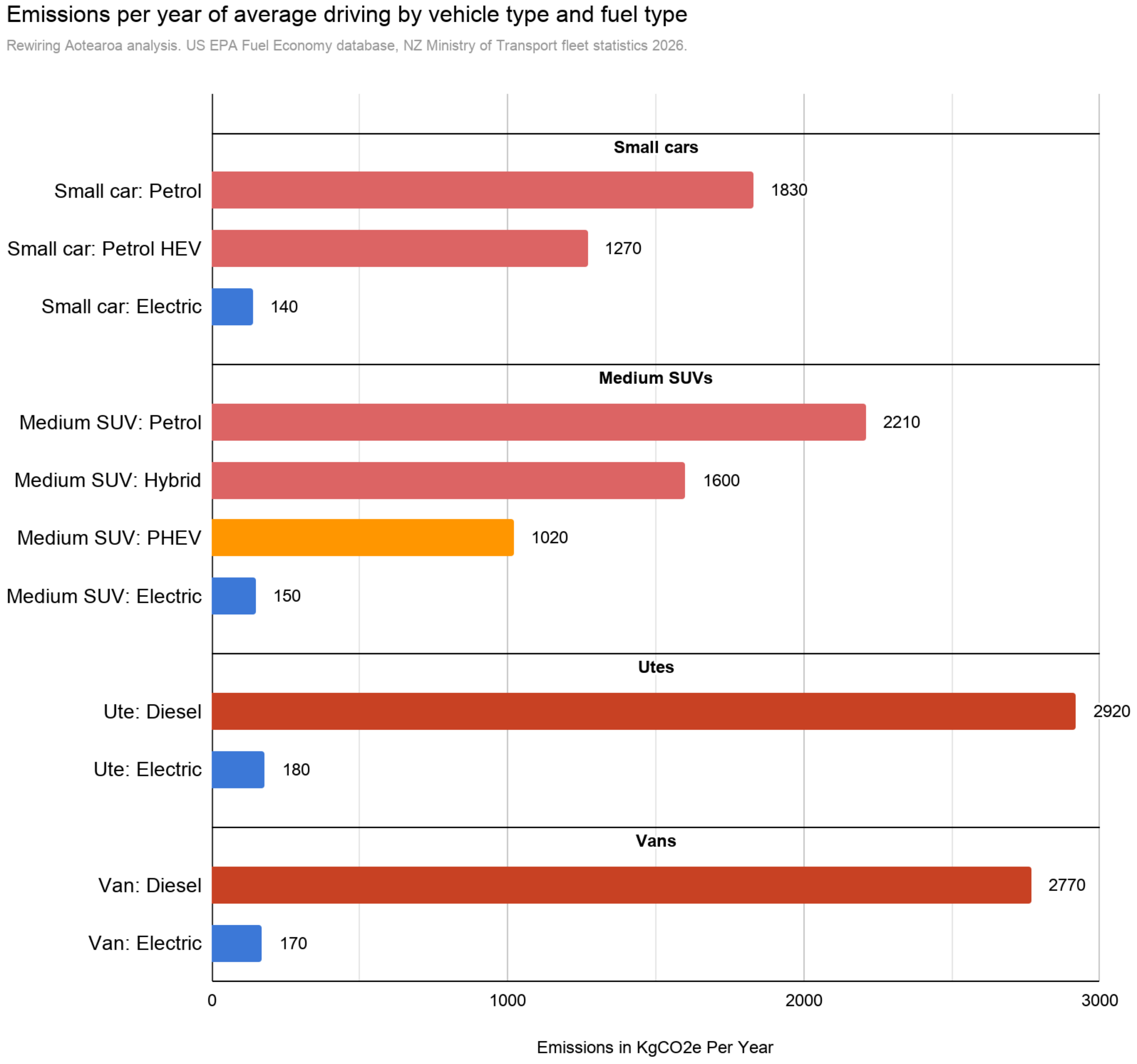


Figure 38: Vehicle operating emissions comparison

Currently, the manufacturing process for EVs and particularly their batteries initially result in higher embodied (production) emissions compared to ICE vehicles. It is important to note that these supply chain emissions are a result of a non-electrified supply chain, for example diesel trucks, ships, and mining equipment. As that supply chain becomes more electrified, those embodied emissions will also fall significantly, yet the path of technological progress has led to the smaller machines (like vehicles) being possible to economically electrify before the supply chain machines that make them. It makes sense to move as fast as possible with what can reduce emissions today and then expand as technology develops. The 'carbon debt' of making an electric vehicle today is usually paid off early in the vehicle's operational lifetime for the average New Zealand driver, which results in significantly lower total emissions than driving a fuel-based car.

Figure 39 below illustrates this with three popular car models as examples, including one older used model that is already manufactured and halfway through its 15 year assumed life. The Tesla Model Y EV has manufacturing emissions of around 3.6 tonnes CO_2e for its 60 kWh battery, produced at a solar-powered factory in the USA. The BYD Atto 3 EV can also come with a 60 kWh battery produced in China, which currently has a higher estimated manufacturing emissions of around 6 tonnes CO_2e. It should be noted that China is rapidly electrifying its economy, including its industries, so the embodied carbon of the goods that they manufacture are also decreasing. The rest of the vehicle manufacturing process takes around 5.7 t CO_2e, which also applies to the petrol Toyota RAV4.[29] The petrol hybrid requires a small battery, which adds an estimated 1.7 t CO_2e.[30] The chart below shows that despite the higher initial manufacturing emissions of EVs, the operating emissions are much lower than that of petrol/diesel/ice vehicles and also hybrid vehicles. This is still the case for a used ICE car that is halfway through its life. Even if we count its manufacturing emissions as zero when bought secondhand, and only 7.5 years of operating emissions rather than 15, it would still emit more just from the driving it does over its remaining life than a newly bought EV.[31]

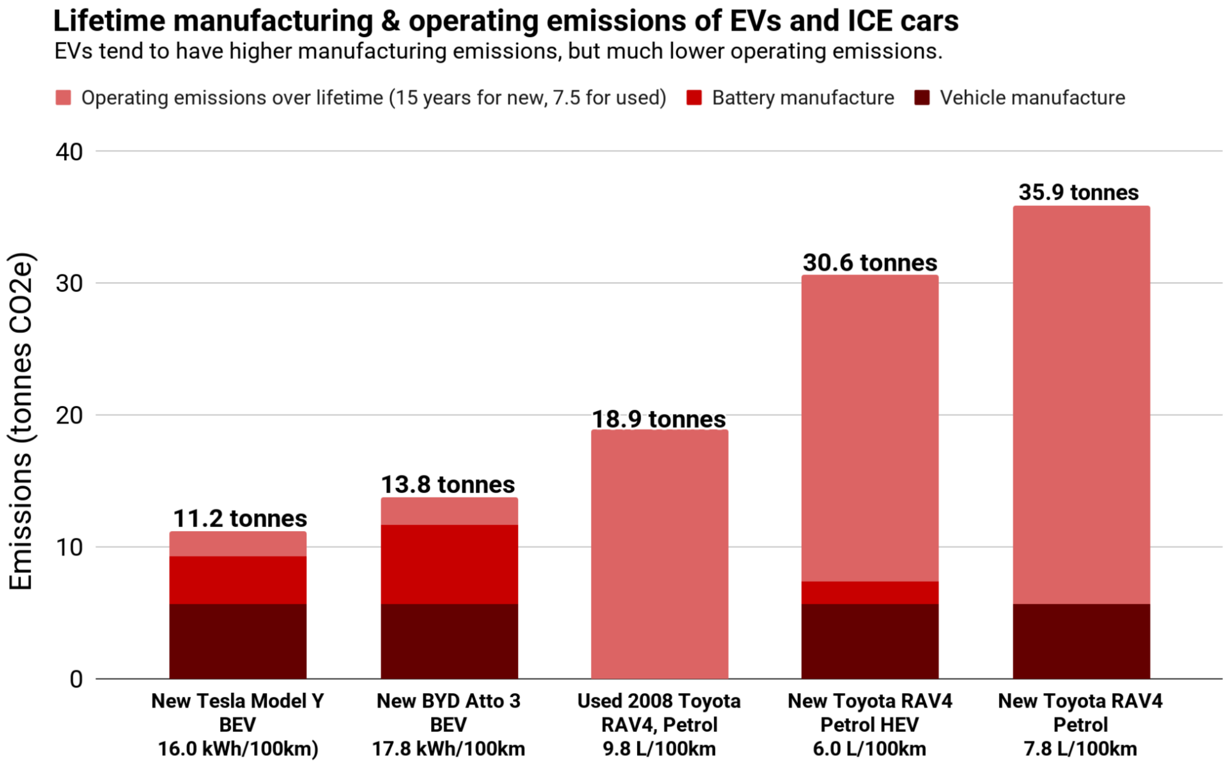


Figure 39: Vehicle manufacturing & operating emissions example across a few different models

[29] https://www.rewiring.nz/watt-now/why-going-electric-wins-on-emissions
[30] Value derived by scaling the 5.7 t CO_2e embodied carbon of the ICE RAV4 using total manufacturing emissions values for ICE and HEVs from Table 4.2 in https://energy.mit.edu/wp-content/uploads/2019/11/Insights-into-Future-Mobility.pdf
[31] The assumed fuel efficiency for the used RAV4 is higher than that of a new RAV4 because vehicles have become more fuel efficient in recent years. Efficiency values are from https://www.fueleconomy.gov/feg/Find.do?action=sbs&id=25008

Lifetime cost comparison

In Figure 40 we show the average total cost of a vehicle over a 15 year lifetime, combining upfront cost of purchase, maintenance/servicing, energy bills (petrol, diesel, and/or electricity), and road user charges (RUCs). For petrol prices and RUCs, we use the current system for 2026 and 2027 (petrol cars pay a fuel excise tax on the petrol price, but no RUCs), and then assume a change to universal RUCs from 2028 (no more fuel excise tax on petrol, but RUCs are introduced). While we assume 15 years for the lifetime of the vehicle, it's worth noting that vehicles can definitely last longer than this, both electric and fuel based. Longer vehicle lifetimes lead to even more savings from the electrified vehicles, so we consider this approach conservative. Anecdotally, recently a Ford Mustang EV was noted having driven around 500,000 kilometres, with only 8% battery degradation and no major maintenance.[32] This is around 50 years of average New Zealand driving. As electric vehicles are relatively new, they have less lifetime data available than ICE vehicles and the lifetime data available is for early models, though a recent Nature Energy paper suggests they will last as long as or longer than ICE vehicles.[33] As electric vehicle batteries continue to develop, these lifetimes are expected to increase.

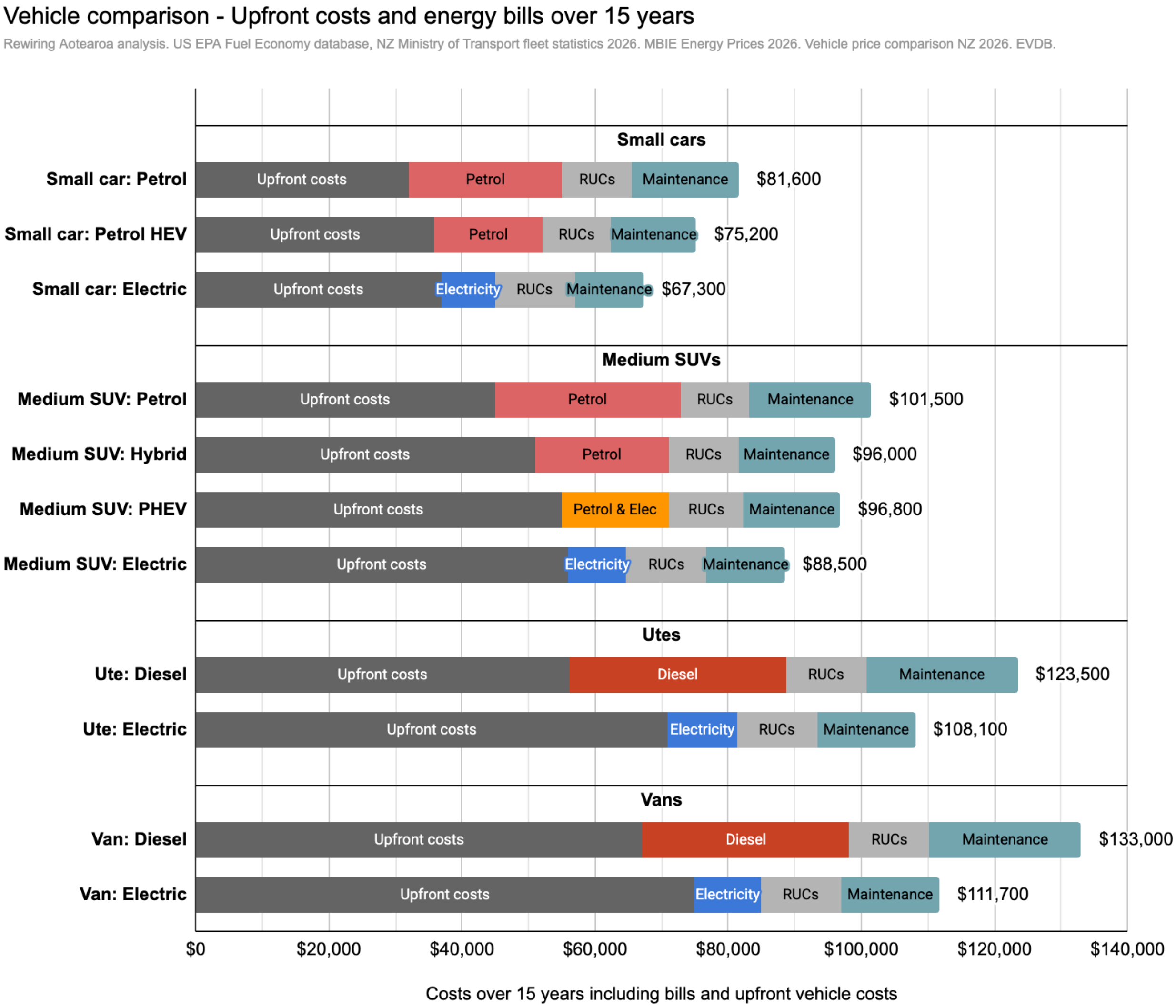


Figure 40: Comparison of vehicle costs including energy, RUCs, and maintenance over 15 years on top of upfront costs.

[32] https://www.fromtheroad.ford.com/us/en/articles/2025/250-000-miles-and-counting-mustang-mach-e
[33] Nguyen-Tien, V., Zhang, C., Strobl, E. et al. The closing longevity gap between battery electric vehicles and internal combustion vehicles in Great Britain. Nat Energy 10, 354–364 (2025). https://doi.org/10.1038/s41560-024-01698-1

Example model comparisons

Here we compare a range of vehicles on sale today in New Zealand, using their specific efficiency data and specific upfront costs, combined with general estimates on maintenance. All electric vehicle charging is assumed to be 100% from the grid at average rates. Charging overnight on off-peak night rates will mean lower operating costs.[34] Charging via rooftop solar will mean lower operating costs still, and zero operating emissions. Charging via fast chargers will be significantly more expensive, but in reality this is usually only done on occasion.

Small cars

Figure 41 shows that as of 2026, small hybrid combustion vehicles may have similar or sometimes lower operating costs to small EVs, mostly due to Road User Charges (RUCs) providing a tax break because of their current structure. However, Figure 42 demonstrates how upcoming policy change towards universal RUCs[35] will result in higher bills overall for both petrol ICE and hybrid cars.

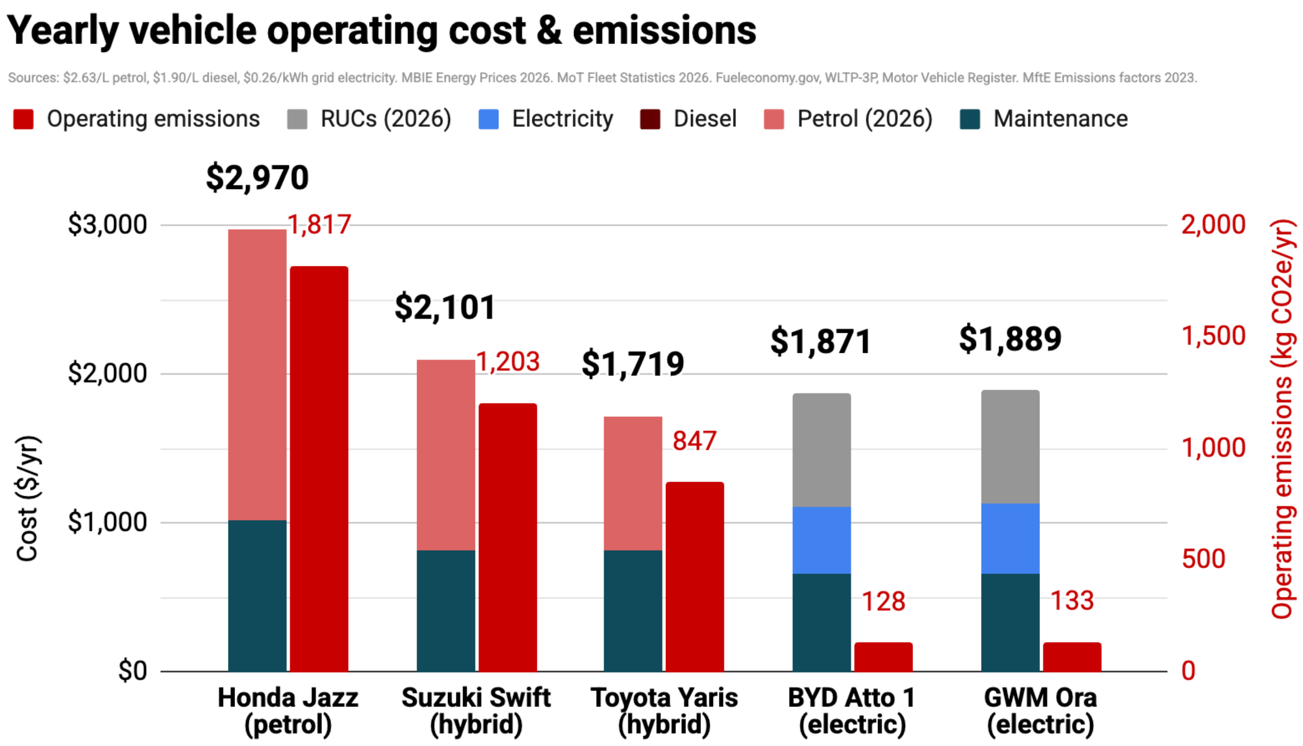


Figure 41: Comparison of vehicle operating costs & emissions for popular small car models

[34] https://www.powerswitch.org.nz/the-best-power-plans-for-charging-your-ev
[35] Where fuel excise tax will be removed from petrol prices at the pump, and petrol cars will be required to pay Road User Charges

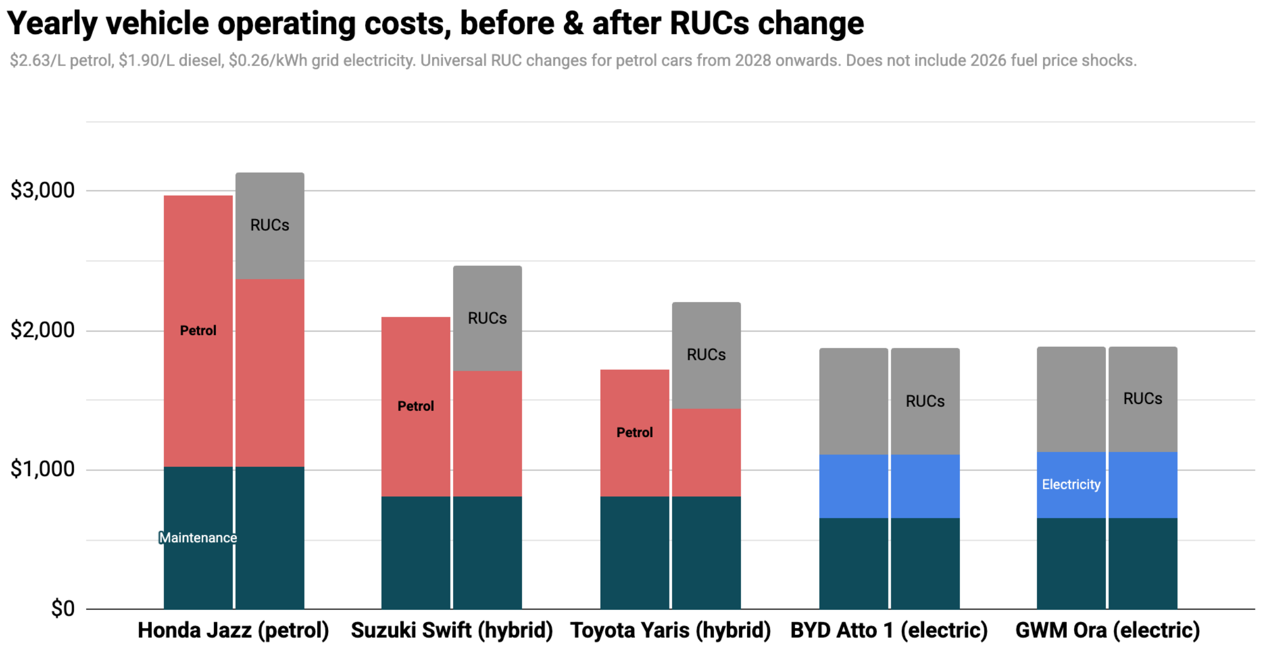


Figure 42: Operating costs of small cars before & after the introduction of the universal RUCs policy

Fully electric vehicles may be cheaper overall over their lifetime depending on the upfront cost difference (Figure 43). For example, the BYD Atto 1 has the cheapest lifetime cost of the options shown (RRP $29,990 when bought new), while the upfront cost of the GWM Ora (RRP $36,990 new) is not quite made up by the energy bill savings. Among small cars, EVs have slightly lower maintenance costs and significantly lower emissions than equivalent combustion models.

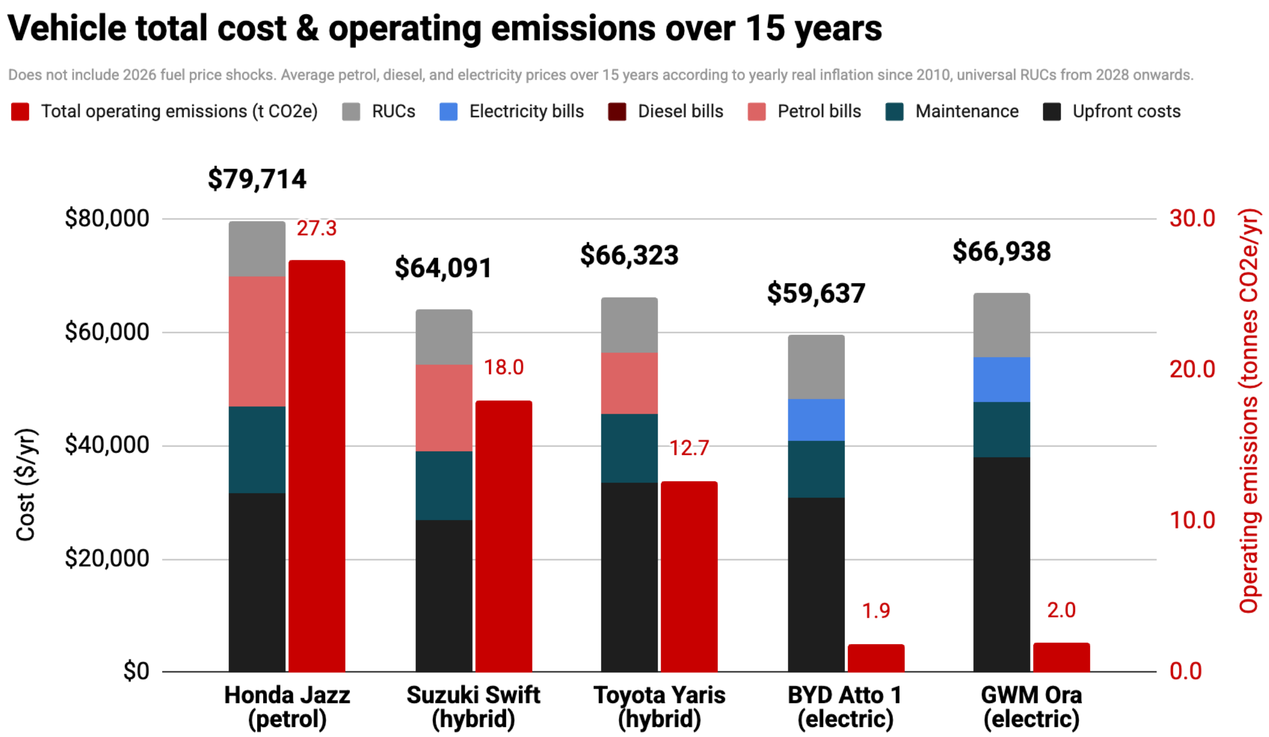


Figure 43: Total cost & operating emissions over 15 years for small cars

Small second-hand cars

While most of our analyses are based on new vehicle purchases since we are wanting to model whole-of-fleet dynamics, at a practical level, many New Zealand households purchase used cars, not new ones. Figures 44 and 45 show comparisons for popular used car models in this size range over an assumed 10 remaining years of life.[36] The secondhand market has older, more affordable models available such as the Nissan Leaf. In buying an EV secondhand, it is easier to achieve a lower lifetime cost than the most fuel efficient hybrids. While the Nissan Leaf is still the most popular small used car according to the Motor Vehicle Register, there are some other secondhand EVs available in this size.

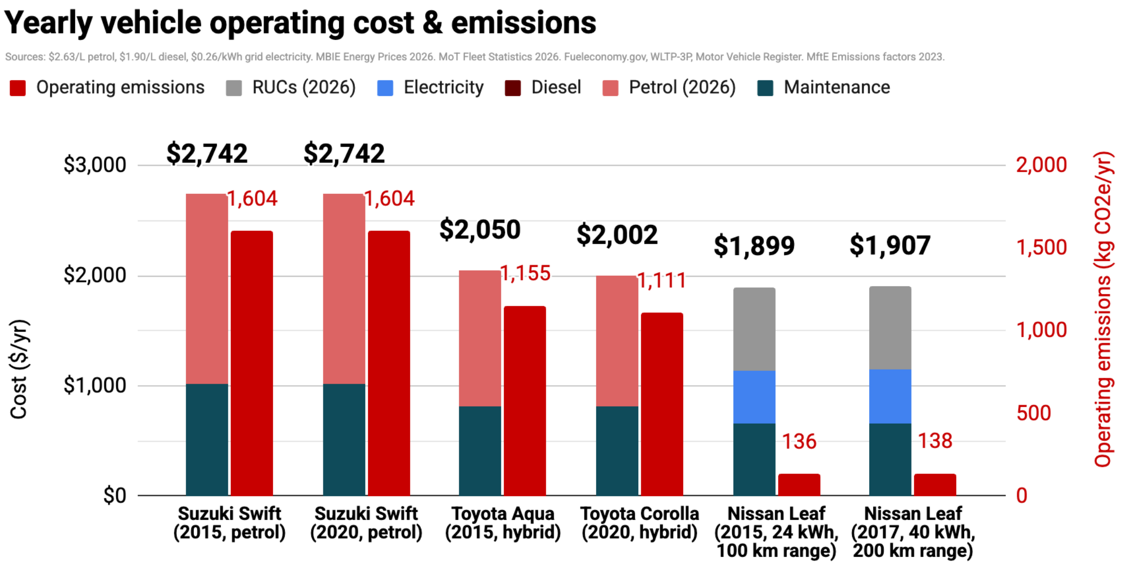


Figure 44: Comparison of vehicle operating costs & emissions for popular used small car models.

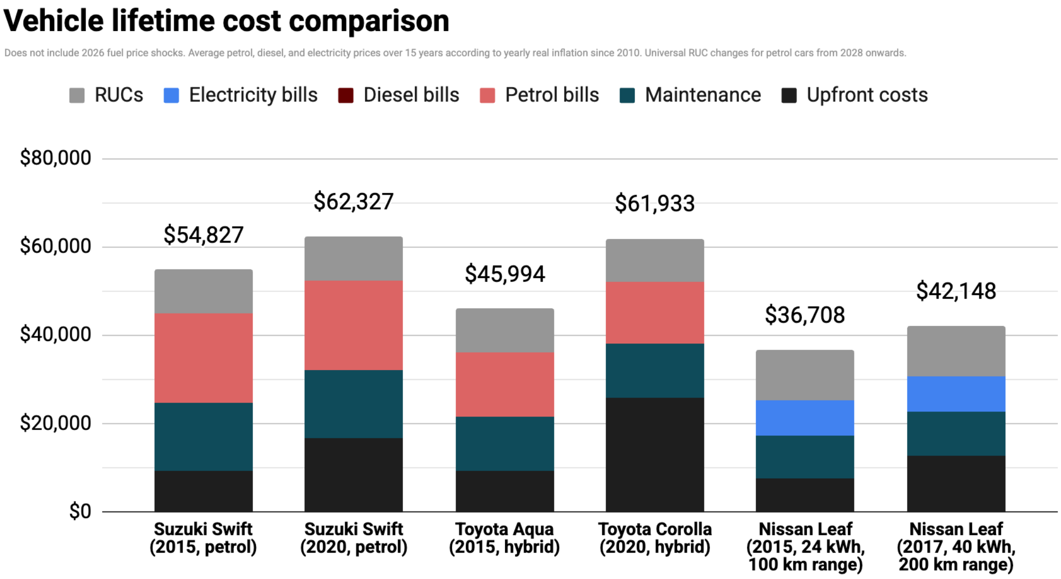


Figure 45: Total cost over 10 remaining years for small used cars

[36] The average age that a car in New Zealand gets scrapped is 18 years. The 2015 examples are already 11 years old as of 2026, while the 2020 models are six years old, so we are assuming 10 years of remaining life for simplicity.

Medium SUVs

Among medium-sized SUV models, there is a bigger difference between the operating cost and emissions savings, both per year and over the lifetime of the vehicles (Figures 46 and 47). We particularly note that while the plug-in hybrid example may have slightly lower operating costs than a hybrid, it is still more expensive to run on average than a fully electric BEV. Typical PHEV utility factors (the % of driving that is done in pure EV mode) are much lower than often stated in advertising and WLTP-3P fuel efficiency estimates.[37] The operating cost savings of PHEVs may also be negated by the often higher upfront cost, as seen in Figure 47.

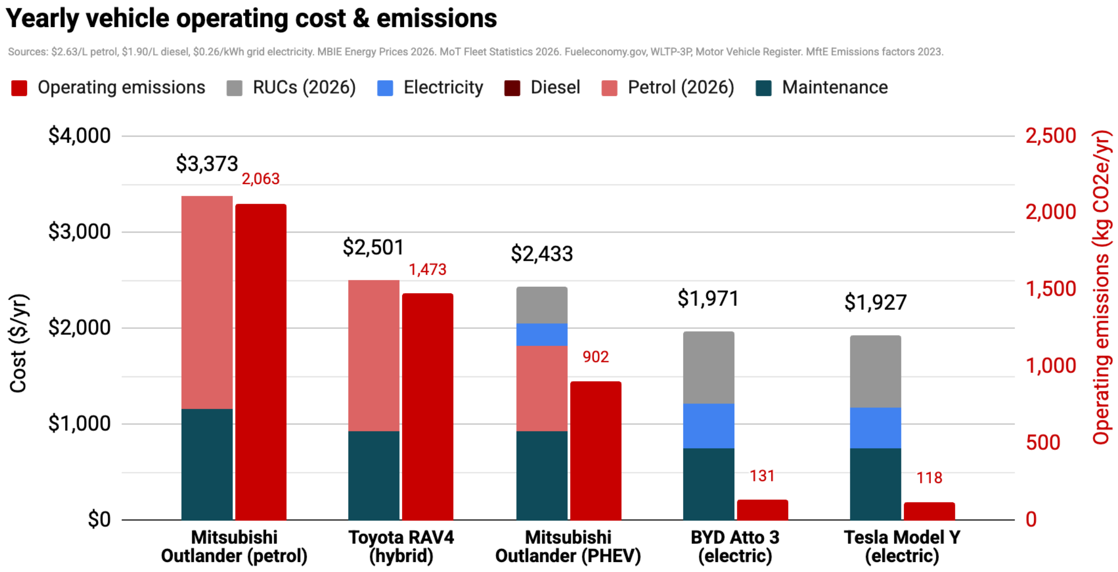


Figure 46: Comparison of vehicle operating costs & emissions for popular medium SUV models

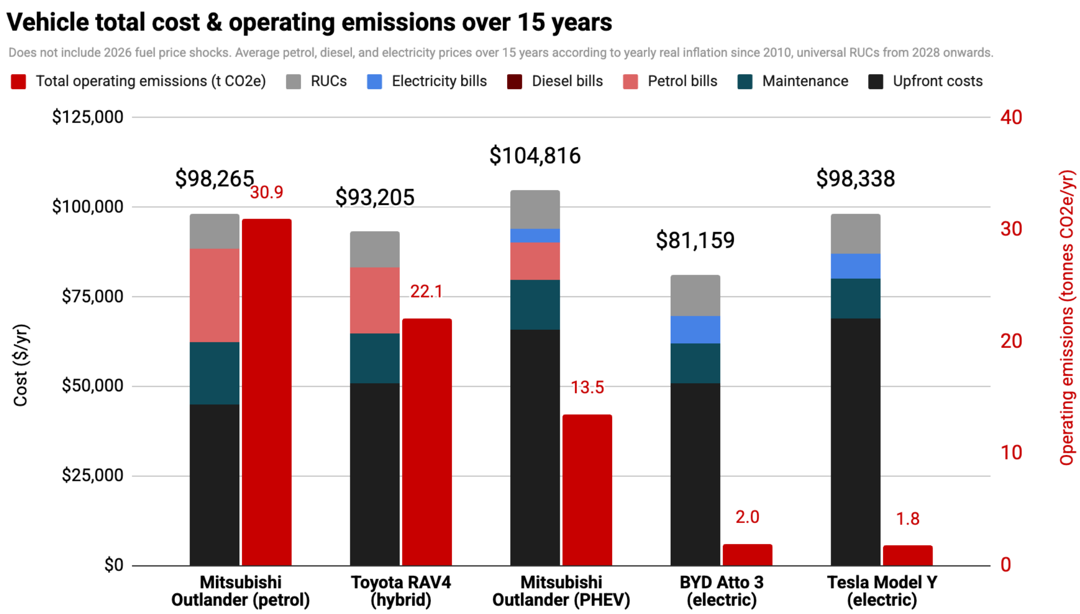


Figure 47: Total cost & operating emissions over 15 years for medium SUVs

[37] See "Vehicle efficiency" section above for more detail on plug-in hybrid efficiency.

Second-hand small & medium SUVs

Figures 48 and 49 show comparisons between popular petrol hybrid and electric SUVs in the secondhand market. The Toyota RAV4 hybrid and Tesla Model Y are the most popular medium SUVs in their respective drivetrain categories. The Hyundai Kona is a slightly more compact SUV, but noted for its 450 km range in typical driving conditions, which was uniquely high for its size category when it was first released, and remains a popular secondhand EV today. As we did for used small cars, we assume 10 years for the remaining lifetime costs & emissions given that we are using 2021 model examples which are already five years old (for an assumed vehicle lifetime of 15 years).

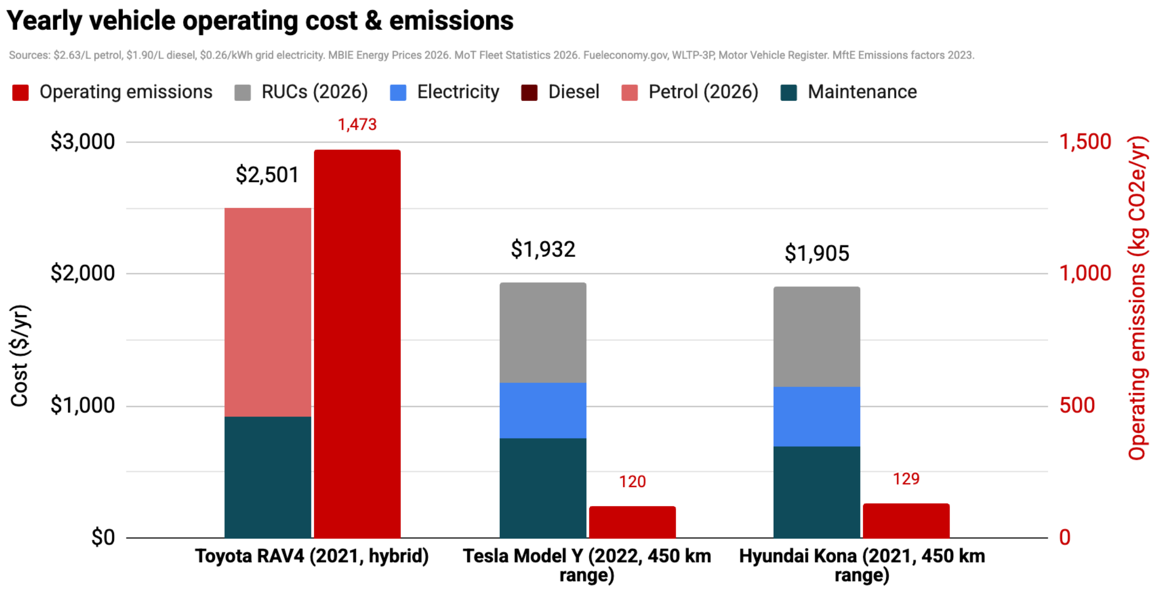


Figure 48: Comparison of vehicle operating costs & emissions for popular used SUV small & medium models

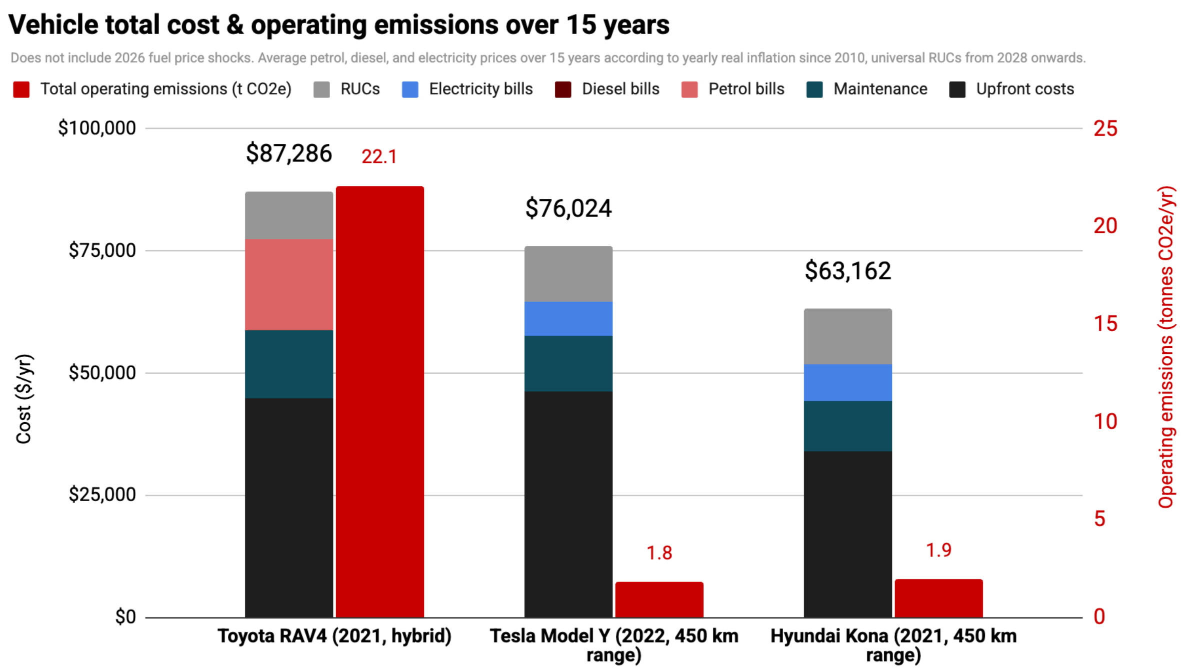


Figure 49: Total cost & operating emissions over the assumed 10 remaining years for used small & medium SUVs

Utes

Figures 50 and 51 show the yearly and lifetime costs and emissions for diesel and electric utes. While electric ute options are limited in New Zealand, recent releases such as the Riddara RD6 (3000 kg towing and 1030 kg payload capacity) has meant that going fully electric is now a possibility for many commercial use cases. We use the average yearly driving distance for diesel light commercial vehicles of 14,318 km/yr across all models for comparison. As with all other comparisons, this does not include 2026 fuel price shocks.

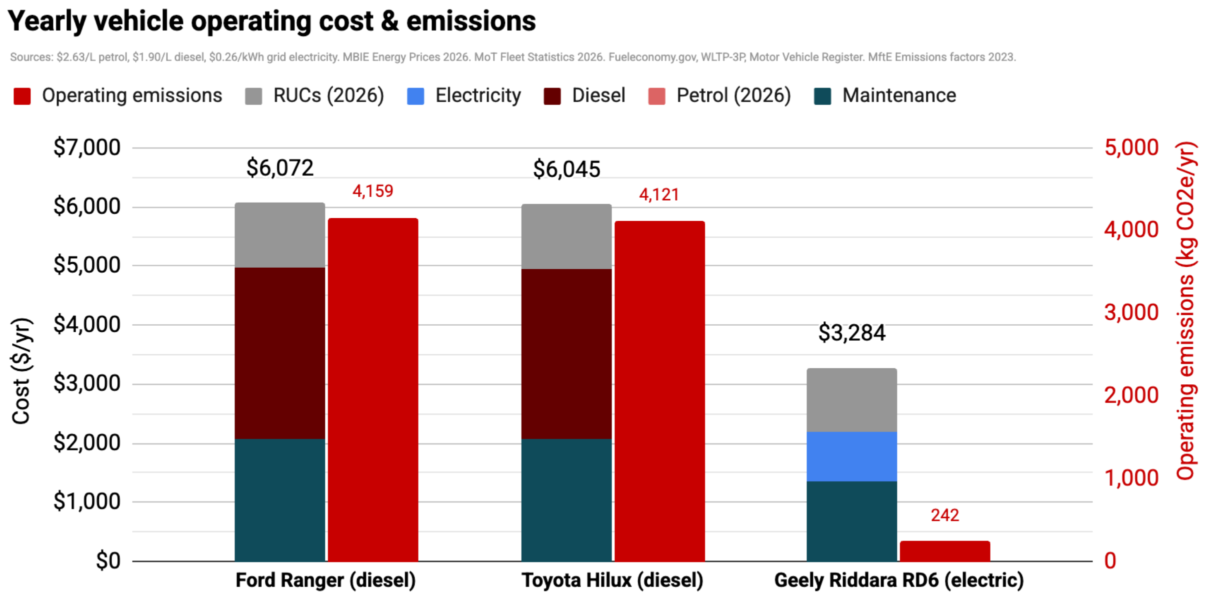


Figure 50: Comparison of vehicle operating costs & emissions for popular ute models

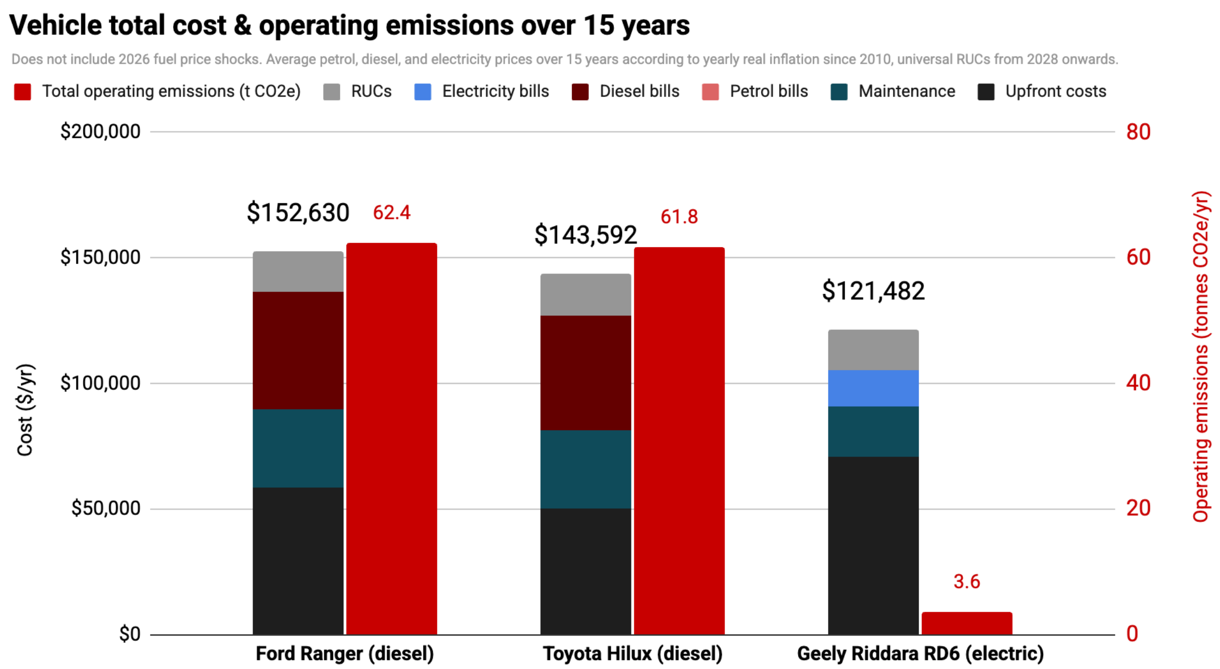


Figure 51: Total cost & operating emissions over 15 years for utes

Vans

Figures 52 and 53 show the yearly and lifetime costs and emissions for diesel and electric vans. The range of electric vans in New Zealand is increasing, with several different models available now for commercial uses. In this comparison, we have selected three models across a range of price points. Alongside the Ford Transit EV, LDV eDeliver series, and Farizon's V7E and SuperVan, there are other brands which produce EV vans, including the Mercedes-Benz Vito, Peugeot e-Partner, and Peugeot e-Expert. We have focused on work vans here, but EV people-movers also exist, like the Volkswagen ID. Buzz. The energy efficiency of the three electric van models shown are quite similar, resulting in similar operating costs and emissions, but significantly less than those of their diesel counterparts. When it comes to lifetime cost however, we can see that there can be large variations in upfront cost.

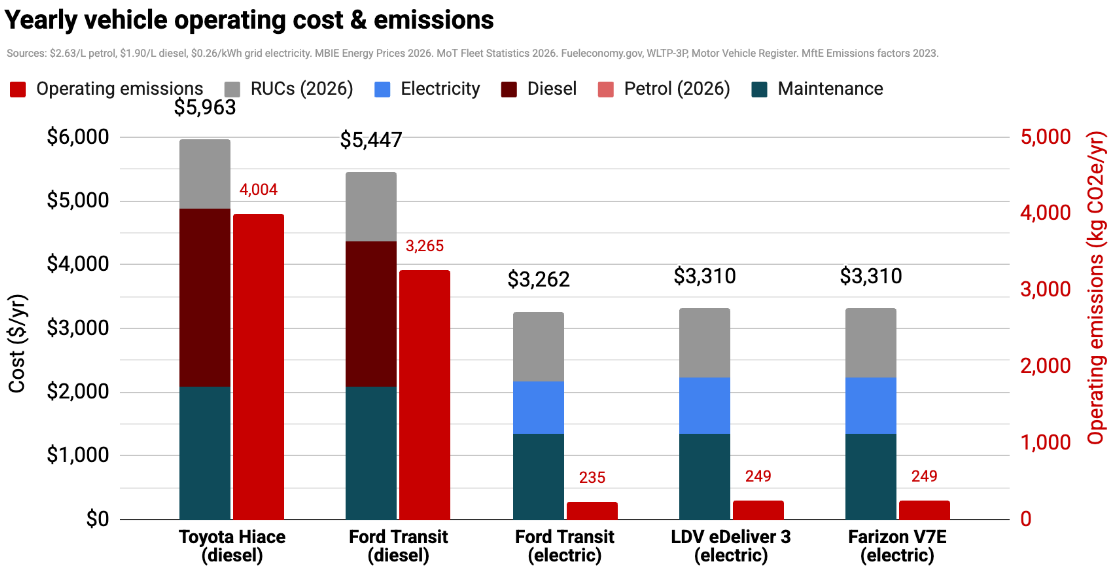


Figure 52: Comparison of vehicle operating costs & emissions for popular van models

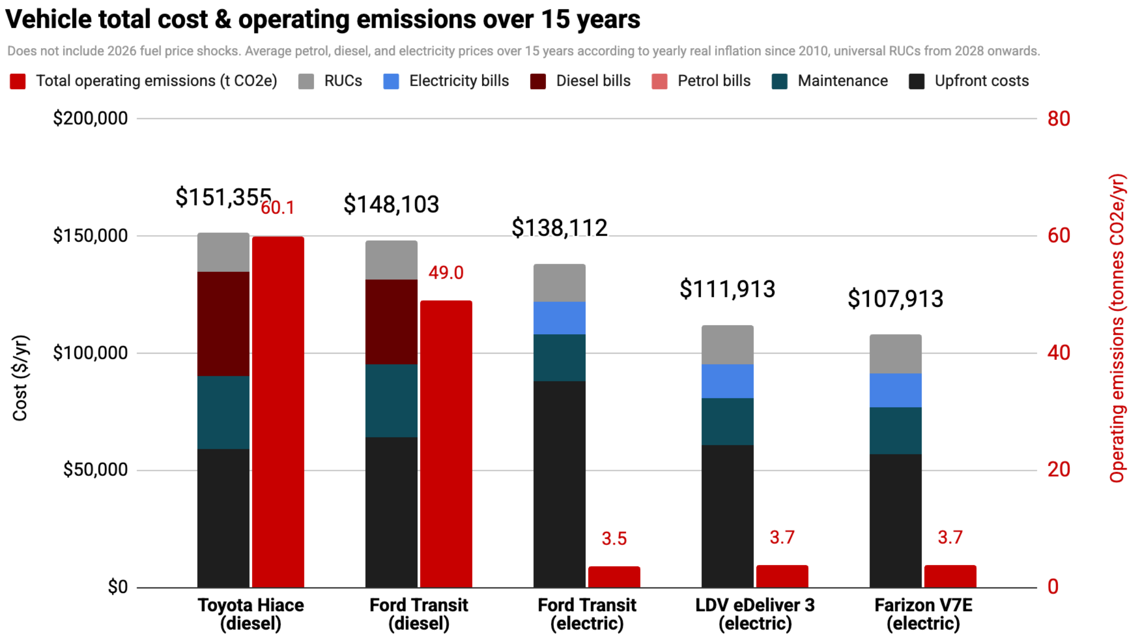


Figure 53: Total cost & operating emissions over 15 years for vans

Energy prices, Solar and battery

Energy prices

The price of conventional energy sources for households has been increasing for decades. We show these price rises in Figure 54 which is based on the Stats NZ Consumer Price Index over the years for each energy type shown. The cause of these rises in petrol (red), gas (pink), and grid electricity (blue) are numerous and nuanced. For example, the petrol price spike in 2022-2023 was caused by the escalation of the Russia-Ukraine war, the recent petrol spike was caused by the 2026 US-Iran War. The recent gas price spike is driven by falling domestic gas supplies. The recent electricity price rises are driven by a combination of increased wholesale electricity prices and increased network prices under the Default Price-Quality Path (DPP4) regulatory period. The key takeaway is that consumer energy prices have been rising relentlessly in recent times. In contrast, two modern household energy sources have been plummeting in price. Solar modules (yellow) and battery cells (teal) have been falling in price because of manufacturing economies of scale. Note the prices shown in Figure 54 are indexes, showing the amount the price has changed since the year 2000 not the current price, which is shown in other graphs later.

Please note, our analysis and modelled savings outputs do not include the price spikes of 2026 caused by the Iran War, instead we use average price data projected forward.

Price index across consumer energy 2000 - 2026

Stats NZ Consumer Price Index history, indexed to 1 in the year 2000. Solar module & battery prices derived from Our World in Data, SolarChoice, and BloombergNEF.

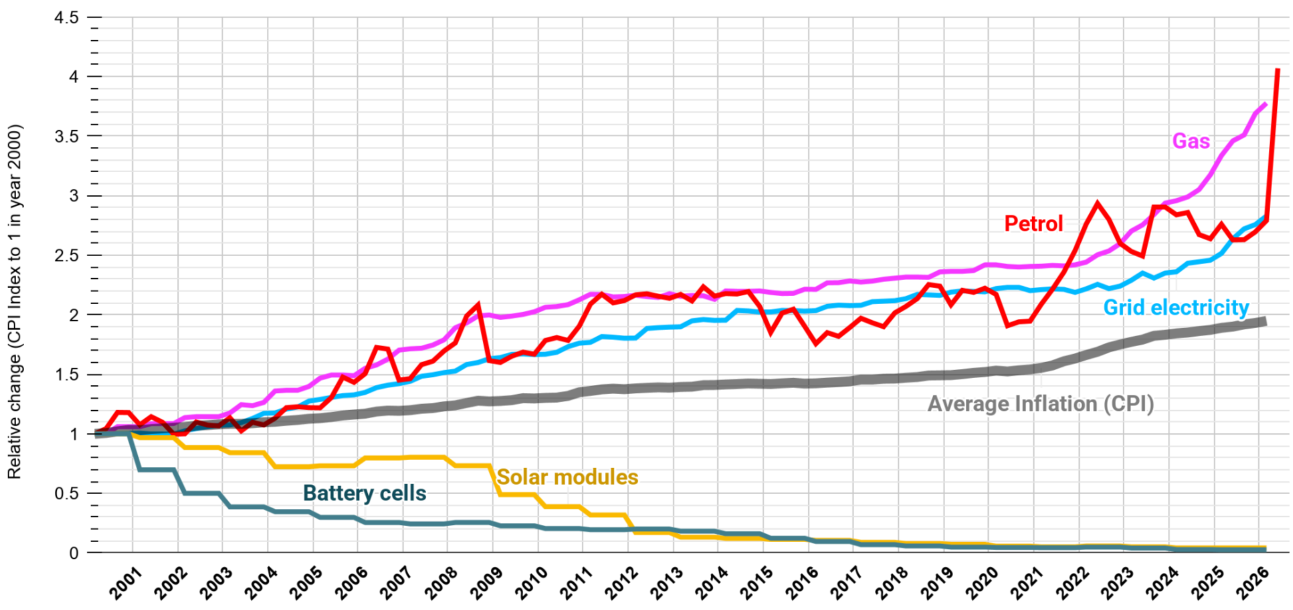


Figure 54: Historical relative energy costs based on the Consumer Price index for New Zealand, indexed to 1 in the year 2000

While Figure 54 shows indexes, Figure 55 below shows the actual price data for each energy source. This is the cost per kWh of energy. We see that solar is now the cheapest form of energy per kWh for households, even when it's financed at 5.5% (yellow line). When taking into account the upfront cost of solar *and* a battery, on 5.5% finance, powering a home using solar, battery, and grid electricity (green) is still cheaper than just using grid electricity (blue). There is important nuance here around whether the home is entirely reliant on solar and battery or not, with entire reliance being significantly more expensive. In this example (the green line) the home continues to pay fixed connection charges and volumetric charges for grid electricity for a portion of their use.

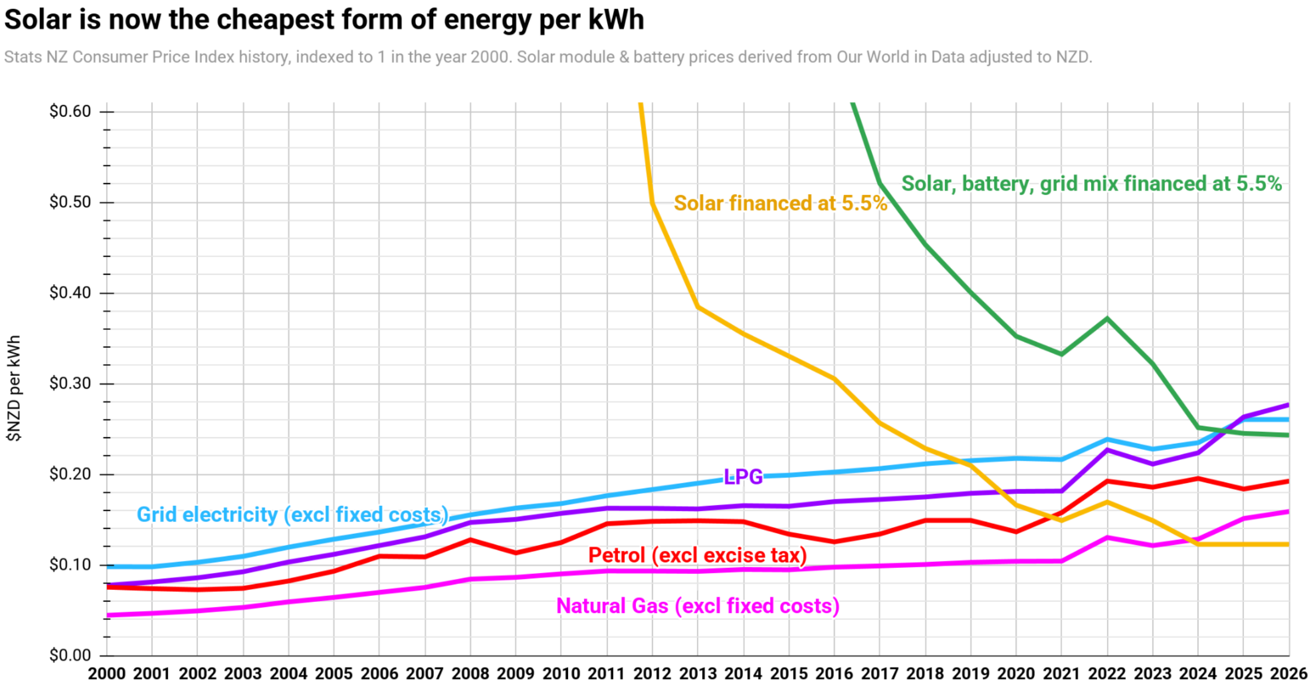


Figure 55: Historical energy costs per kWh in New Zealand

Reaching this point where both financed solar, and a financed solar and battery system is lower cost than average grid electricity prices per kWh is a significant milestone with important ramifications for the future energy system. Installing a solar and battery system has significant positive externalities not accounted for in the price difference. For example it lowers the peak, and therefore increases the utilisation of electricity networks. Increasing the utilisation of electricity networks can lower the cost per unit of electricity by increasing the throughput of assets, and enabling more homes to be connected to the network for lower cost. A solar and battery system also provides resilience, the ability to keep lights on the home warm in the face of outages or a disaster. While this is rarely given an economic value, it quite clearly has value to people in emergency situations.

These economics enable significant co-investment into the energy system by households, who otherwise would not directly have been purchasing energy infrastructure, and who do value the other benefits associated with solar and battery systems making them more likely to invest more than a third party who does not see the direct benefits of resilience for example.

You may note that the solar, battery, and grid mix is not cheaper per kWh than natural gas. However, this chart still does not convey the full picture of energy economics. While Figure 55 above looks at the price of energy, it does not account for the greater energy efficiencies of electric machines. It does not account for how much “useful” energy is received, energy that actually goes towards completing the machine’s task (whether that is heating the room, or moving a car forward). Figures 56 and 57 below show the useful price of energy across a range of use cases. Because energy bills are based on energy costs per unit of energy combined with how much energy an appliance or vehicle consumes, it is important to account for this machine efficiency by looking at the cost per unit of “useful” energy. For example, a heat pump is about four times more efficient than a gas heater, meaning the heat pump would cost the same as a gas heater to heat the same home if electricity was about four times more expensive than gas. If the electricity price per kWh was less than four times the cost of gas per kWh, then a heat pump would be cheaper to run even if the gas price is below the electricity price. Note there is nuance to heat pump efficiency discussed in the heating section.

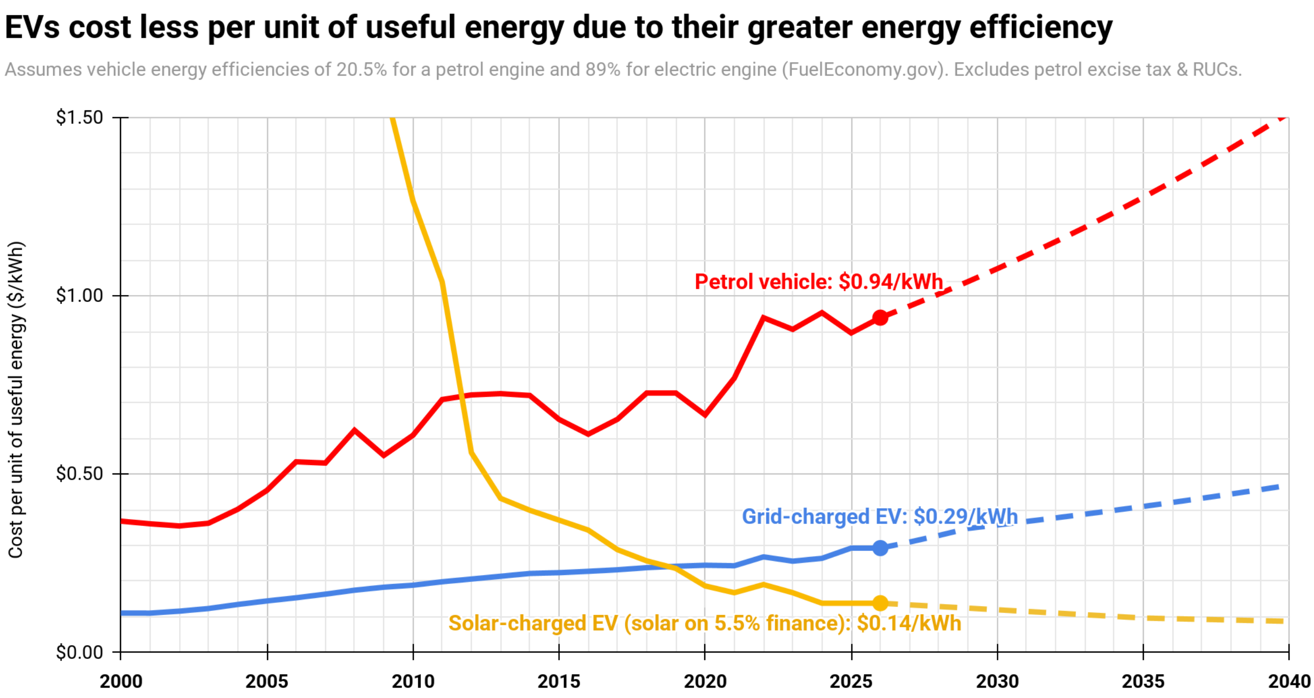


Figure 56: Energy productivity comparison for vehicles based on $ per kWh of useful energy (forward motion)

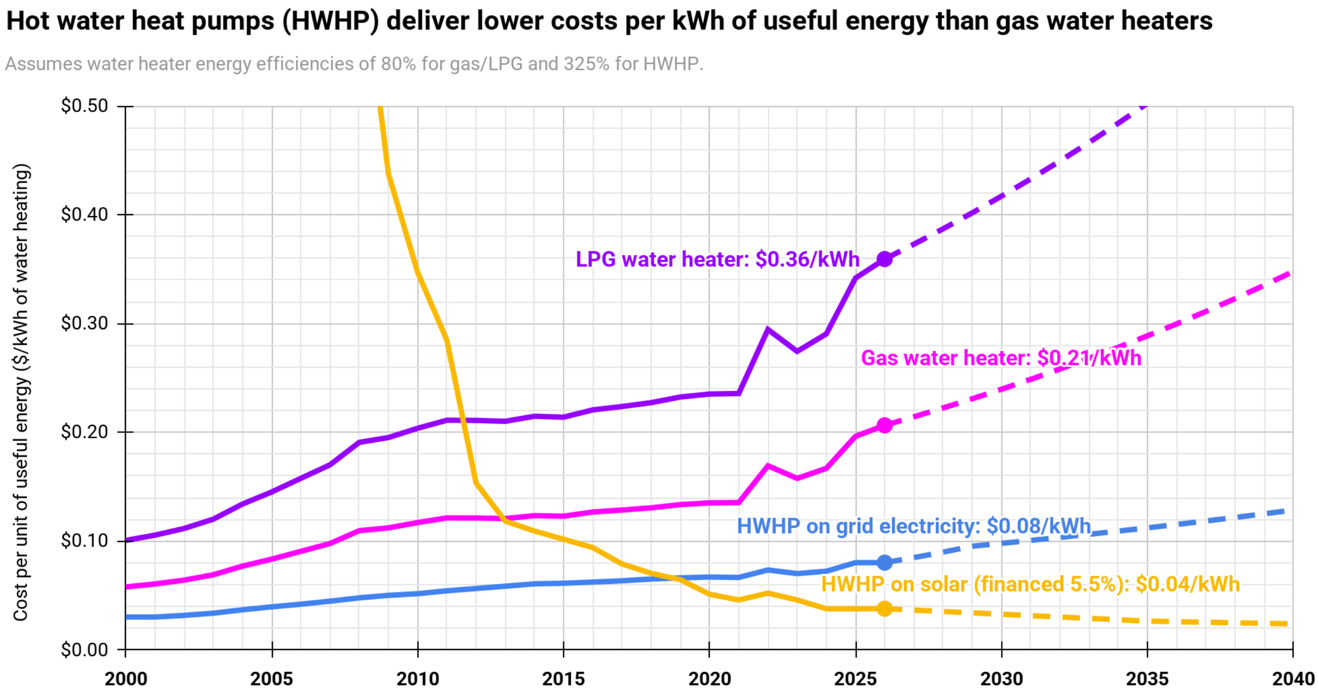


Figure 57: Energy productivity comparison for hot water heaters based on $ per kWh of useful energy (water heating)

These charts showcase the significantly better operational energy economics of electrification, which only become most apparent once price and also machine efficiency are taken into account. The trends are also clear, that electrification is also less volatile, and is unlikely to increase in cost as fast as the other options do.

Learning rates

The price falls in solar and battery prices historically have been driven by what are called "learning rates", or economies of scale. This is a phenomenon where as the manufacturing of a product increases, the price per unit of that product decreases. This has been seen in many products all around the world, from the Ford Model T, to computers, solar panels, and batteries.[38] [39] A simplified way to understand learning rates is that manufacturing is a process where a machine (or industrial process) is created to produce a product. Once that process has been created, the incremental cost of producing more of that product is relatively low. The more of those products being made, the lower the proportion of cost needs to be added to each product to cover the costs of building the manufacturing process or paying for the research and development that led to the product's creation. This alongside continual innovation in manufacturing process and product specifications, and increased competition, drive down the cost per unit over time.

The manufacturing learning rates of solar and batteries are in contrast to other parts of energy pricing. While these learning rates can have benefits to energy generation, for example a company building a solar farm, it does not necessarily work for labour, or standard industry costs. For example, constructing poles and wires is a combination of material costs, labour costs, and service costs, all of which often rise with inflation. This is part of what has driven newer technologies like household solar and batteries to cross tipping points with the prices of older energy sources that rely heavily on inflation-tied components.[40]

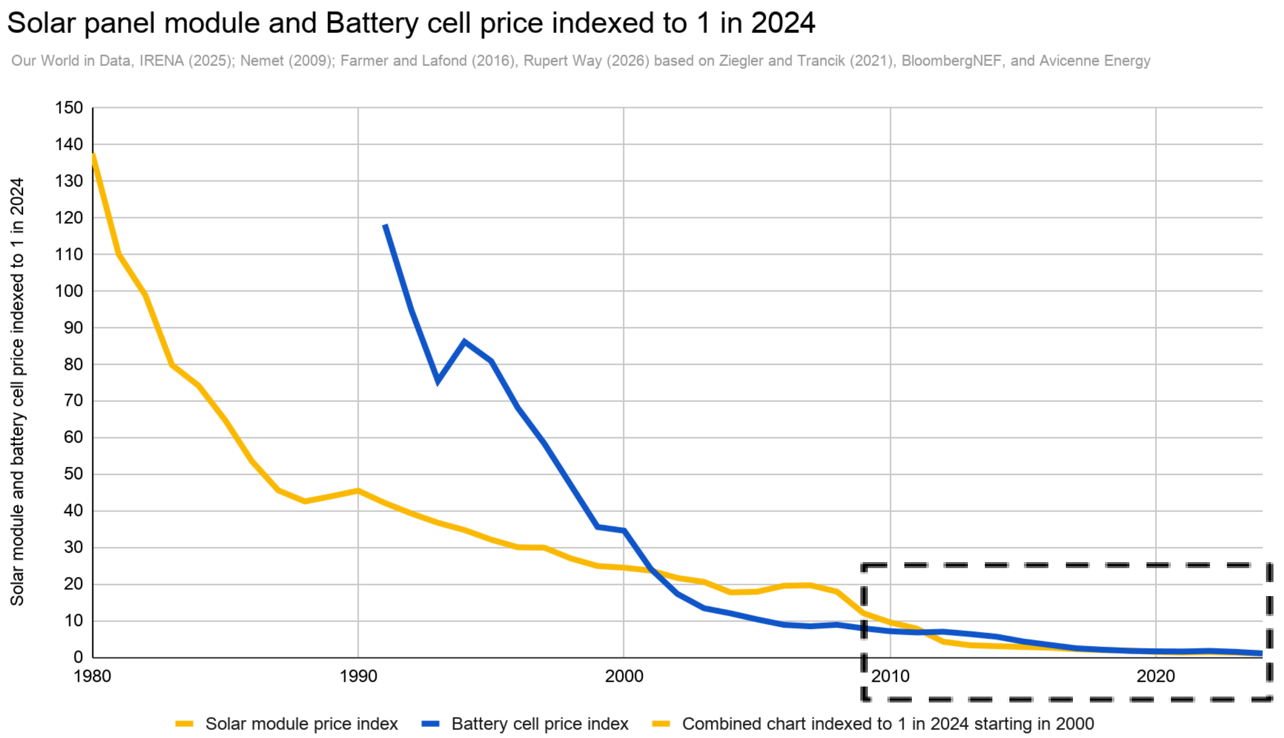


Figure 58: historic pricing of solar modules and battery cells over time as their scale of deployment and manufacture has increased.

[38] https://ourworldindata.org/grapher/costs-of-66-different-technologies-over-time?country=Monochrome+television~Polyester+fiber~Automotive+%28US%29~Photovoltaics~Polystyrene~DRAM
[39] J. Doyne Farmer, François Lafond, How predictable is technological progress?,Research Policy, Volume 45, Issue 3, 2016, Pages 647-665, ISSN 0048-7333, https://doi.org/10.1016/j.respol.2015.11.001.
[40] Battery historic learning rate from Rupert Way (2026) based on Ziegler and Trancik (2021), BloombergNEF, and Avicenne Energy – with minor processing by Our World in Data.

Zooming all the way into the small bottom right section of Figure 58 above from 2010 to 2024, we can see in Figure 59 below that these price reductions are continuing, and less flat than they may seem in the chart that goes all the way back to 1980. These products have also been far less susceptible to disruptions than the oil supply chain for example.

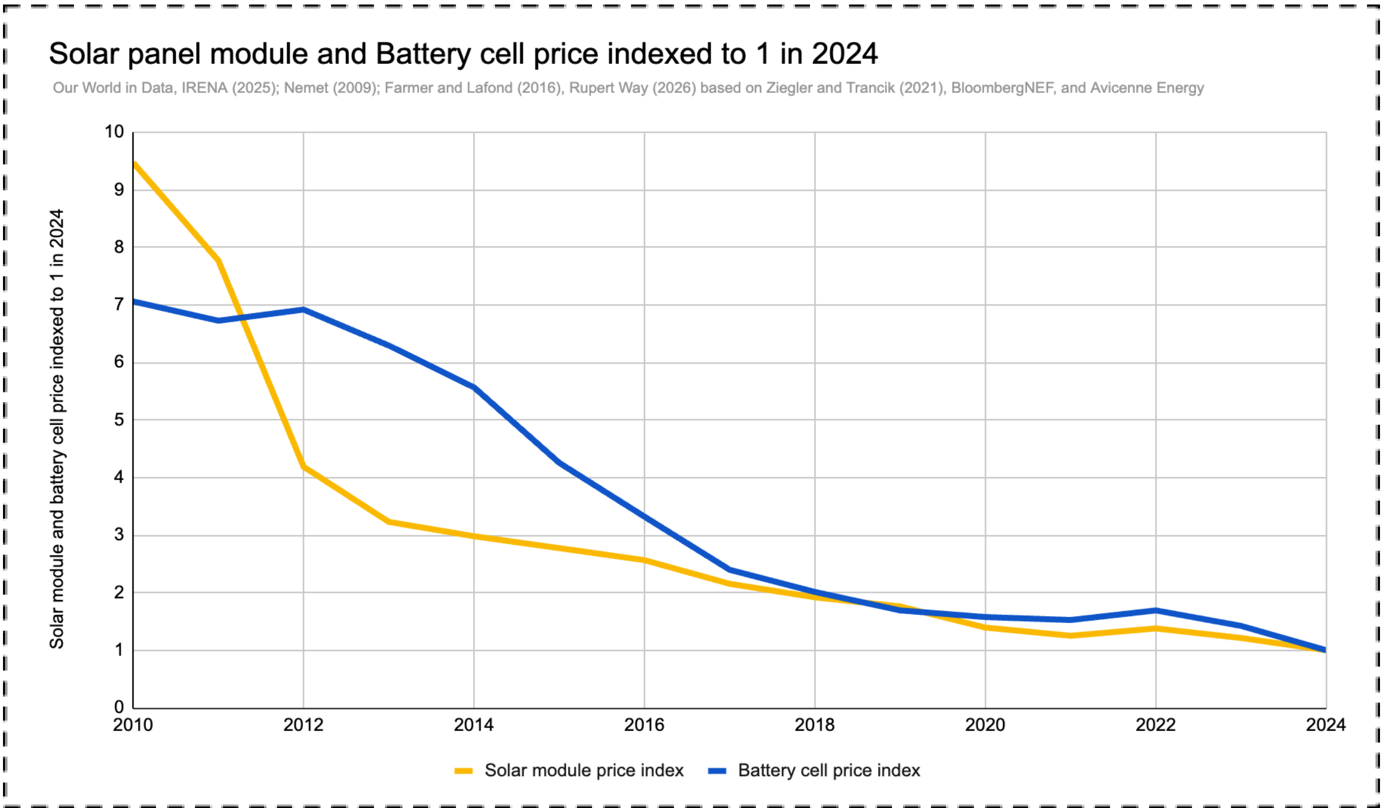


Figure 59: A more zoomed in version of Figure 58, showing the recent cost reductions in solar modules and battery cells.

Delivered cost of energy (DCOE)

An important concept to take into account when comparing distributed behind the meter solar and battery costs to conventional grid-delivered electricity costs is the concept of Delivered Cost of Energy. This is the actual price of electricity paid by consumers, which is very different to the wholesale price of electricity often used in policy and planning. For example, grid scale solar is often proposed as lower cost to install than household rooftop solar, but that does not include the costs of transporting that solar from the solar farm through transmission lines and distribution networks to consumers. The costs of that delivery is paid for by consumers in addition to margins from retailers, and other services like metering. Once these are accounted for, it is often more expensive for consumers to buy energy from a solar farm than buy it themselves through solar panels on their own rooftop (Figure 60).

For example, a household might pay around $17,500 for a 9kW solar installation, with panel performance warrantied for 30 years. The inverter will likely need replacement over that time, so including one inverter replacement at an estimated cost of $4,400, total system cost is $21,900. Over its lifetime with average New Zealand sunshine, assuming a starting panel efficiency of 23% degrading over time and inverter losses of 3%, that system will produce an average of 12,078 kWh per year or 362,352 kWh over its lifetime. From an upfront cost perspective, that divides down into $0.06 per kWh of energy produced by the panels (6 cents per unit). However, we could also include financing costs assuming the household does not have $17,500 available, and in general considering the cost of capital over time. A 5.5% interest rate over a 30 year term, similar to the home putting it on their mortgage, results in a finance cost per kWh of $0.12 per kWh. Households may also opt to pay the system off over a shorter time period paying less interest and resulting in a lower cost per kWh. For example a household financing over a 15 year term might pay a cost of $0.09 per kWh.

The average price of grid electricity today is around $0.40 per kWh, noting however that this does include fixed daily charges. The volumetric average price is around $0.26 per kWh delivered, with solar still a fraction of this. There is plenty of nuance in electricity pricing and solar, which we will go into more below, though the point remains important that as far as we are aware, there are zero energy companies offering 30 year contracts for electricity at $0.12/kWh while the sun is shining. Adding a battery to this means using more of that energy, and avoiding peak electricity charges as well, though for now we will continue exploring solar.

This delivered cost of energy is the actual experienced cost of energy for households, and our energy modelling, policy, and regulations need to accurately reflect this. This may change over time as pricing evolves, but the delivered cost of energy no matter what it is should always be accurately understood.

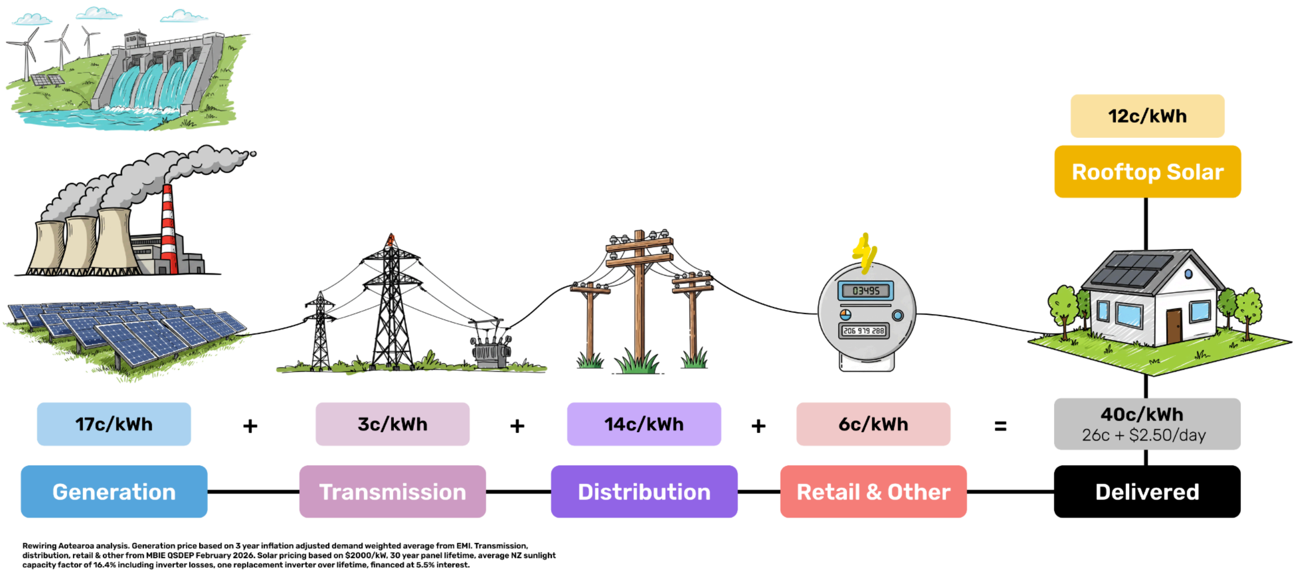


Figure 60: The cost components that make up the electricity units purchased by an average New Zealand household, and how financed rooftop solar compares to that.

Price flattening impacts of solar and batteries

When a home purchases solar panels, they are effectively buying the 30-year, future energy output of the panels, and fixing the repayment costs. They are buying 30 years worth of energy at today's solar prices. So while the price of other electricity rises with inflation, the price of energy coming from solar panels remains the same as when they were first purchased, that is, a flat line. The same is true of batteries, which store the energy at a flat cost dictated by their utilisation and serviceable lifetime. While not all energy for the home is likely to come from solar and batteries, this flattening effect from the energy that does helps reduce the speed of inflation of energy costs for the home.

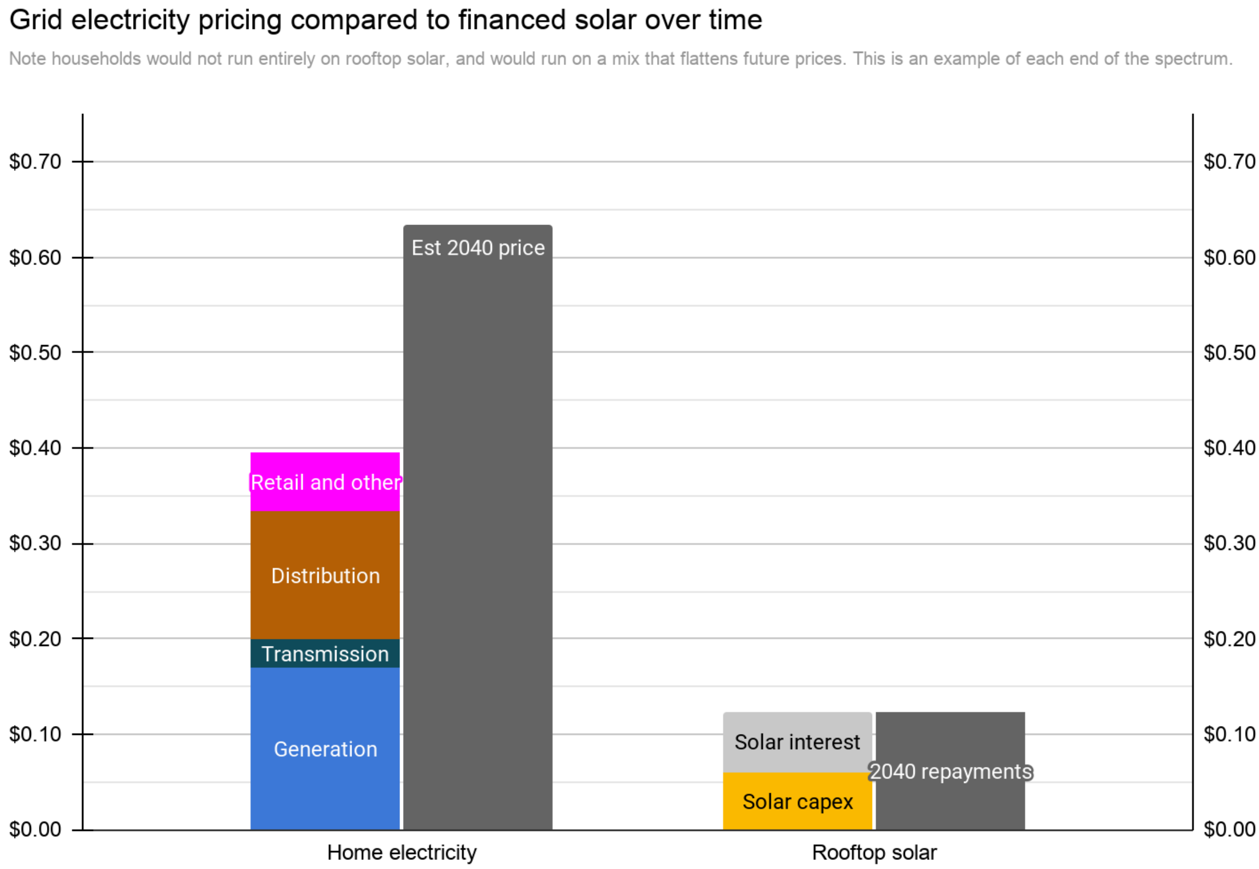


Figure 61: The cost components that make up the electricity units purchased by an average New Zealand household, estimate 2040 nominal price, and the estimated rooftop solar finance repayments both today and in 2040. This shows that while the nominal price of electricity inflates, solar purchased today is effectively buying future energy at today's prices, leading to a price flattening effect. Note: a realistic household will use a mix of solar, the grid, and even batteries, so this is showing an example of solar alone to illustrate the price flattening.

The same phenomenon shown simply in Figure 61 above can also be expressed as a time series, including the price reductions in solar over previous years, and the price flattening effects on bill rises over time. Figure 62 below shows electricity price comparisons forecast into the future as costs per unit.

You can see the price bill flattening impacts of the solar and battery system in the solid green line going into the solid black line to represent a system being purchased in 2026. While bills still rise each year based on the fixed and volume based grid electricity costs paid by the home, the bills rise at a significantly lower rate than the home that relies on grid electricity alone.

Delivered electricity price comparison over time and into the future

Based on StatsNZ Quarterly CPI History 2025, MBIE Energy Prices 2025, Solar module & battery prices derived from Our World in Data adjusted to NZD. Rewiring Aotearoa analysis.

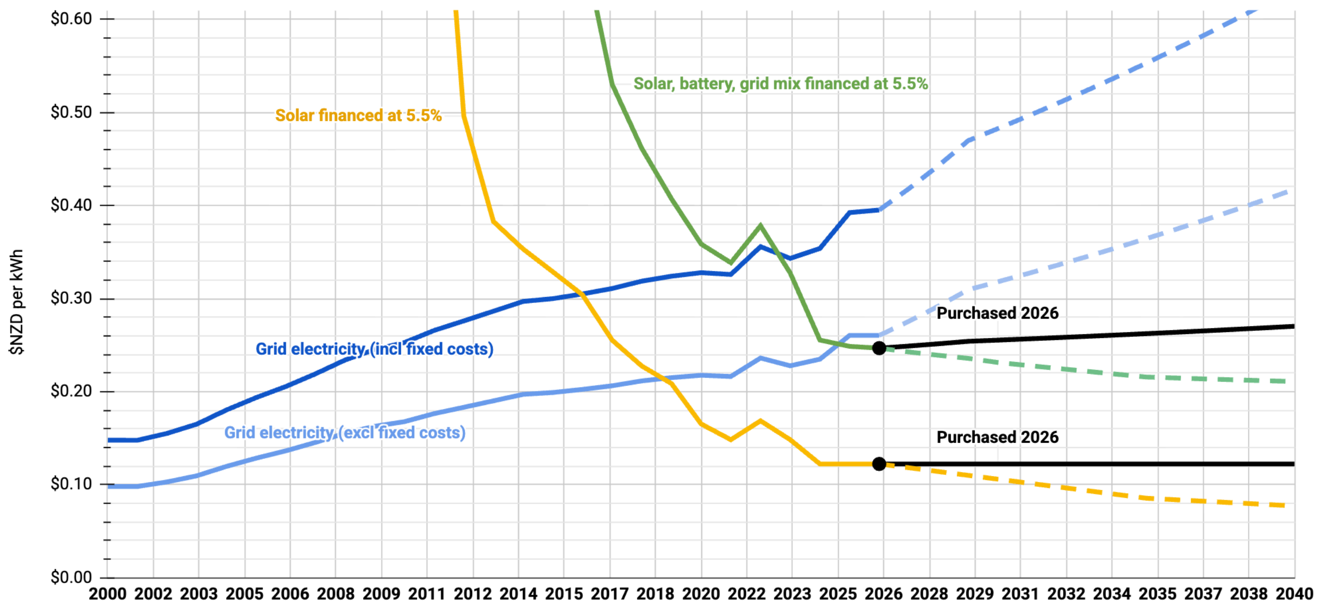


Figure 62: Historic and forecast costs per unit of electricity on the grid compared to financed rooftop solar, and a home using a mix of rooftop solar, battery, and the grid. The black flat lines represent a system purchased in 2026, and how it interacts with ongoing bills in the case of the grid mix. The solar example is there for demonstration purposes that solar does not inflate at all once purchased, but no home is likely to run off 100% solar in most cases. The dotted lines for solar and batteries are forecast pricing for purchasing the same system again in future years based on learning rates.

Why has solar adoption not happened faster?

The economic tipping point for residential solar, where lifetime savings exceed the full cost of the system including financing, was likely reached three to five years ago. Yet adoption has not accelerated as would be expected in a well-functioning market. There are multiple possible explanations for this, which we expect to some degree combine. Note that solar installs are accelerating from around 250 a month in 2014, to around 900 per month in 2026 to date.

Main energy market actors have vested interests

While one may expect energy generators and retailers in an efficient market would themselves install solar on their customers' rooftops as it is the lowest cost source of delivered electricity for the home, they do not do this today. They sometimes even note the risk that this type of adoption poses to their own business models. While there is possibly an opportunity for these conventional energy companies to expand into financing or underwriting the investment on the demand side of the energy system, it would require a case of incumbent energy innovation which as yet in New Zealand we have not seen. Accelerating this future would also likely result in a gradual if not rapid reduction in market power of the nation's biggest energy companies, which they may attempt to protect against.

Limited access to capital

As discussed in the finance section earlier in the report, part of the problem is the limited access to energy financing by households. While a small portion of households have access to green loans, New Zealand's banks have largely failed to provide equitable access to energy financing that does not discriminate based on income or mortgage conditions. An energy investment like solar which is likely to save many times more than its cost over its lifetime, will be treated similar to a jet ski in financing terms and debt limits. While the regulated monopoly of the electricity networks enables investment into the energy system that is relatively seamless for consumers (they see 50 year assets installed on their street as small bill rises paid off gradually), this same amortisation has not been expanded to innovative energy infrastructure that sits behind the electricity meter of a home or business.

Regulators have not levelled the playing field

The regulators that are meant to regulate the energy system and its participants for the benefit of the long term interests of energy consumers, they have not kept pace with technology leading to outdated regulatory settings for the high tech distributed energy system we now have. There has been no evident concerted effort to democratise energy investment to make the most of the ability for consumers to now be part of the energy system.

Price signals are distorted and consumers lack access to some information

As households invest in more distributed energy systems, it is likely in time they will become the largest combined power plant in the country. This is already the case in Australia, where rooftop solar combined is about 30GW in (max) capacity, and the largest power plant is about 3.2GW. Residential battery storage is now around 2.7GW after most adoption happening in the last few years alone. This is important context to set, when it must be acknowledged that the prices received by households for their exported solar or batteries into the system is set by companies with a vested interest against them - to some degree their competitors. In New Zealand's case, it could be argued the largest power plant in the country is currently being built and it does not have access to efficient market signals, its direct competitors are in control of its market signals, a situation that would be shocking in most other circumstances. There have been cases where retailers would pay 8 cents per unit for electricity exported by households while the value of that electricity to the retailer has been about double that price. An example where retailers are effectively profiting off a private investment through the use of their market access control.

Despite most households likely being able to significantly lower their bills with a rooftop solar installation, there is little to no mention of this in retail communications yet things like having shorter showers or boiling less water in the kettle are mentioned. Again here, the direct competitors against consumer energy generation have a degree of control over their access to energy information. The two principal electricity comparison platforms, Powerswitch and Billy, similarly omit installing solar from their retailer comparisons.

Market friction adds further drag

The installation process carries unnecessary regulatory burden, including application requirements and mandatory independent inspections, and the industry itself has yet to reach the operational maturity seen in Australia. Some New Zealand households report difficulty even securing a response from installers. These conditions, poor information flows and an immature installation market, have allowed some solar installers to earn returns well above what a competitive market would sustain. The leading industry body uses an illustrative profit figure of $5,000 on a $15,000 system, a margin of 33% more than double the upper end of what would be considered reasonable in a mature, competitive trade.

Nonetheless adoption is accelerating

Despite these headwinds, as shown in Figure 63 shows that adoption is accelerating for rooftop solar in New Zealand, and if this acceleration continues as adoption curves generally do, we can expect a significant and growing impact on the energy system. It can be seen in Australia that some communities have already reached 70% of households with solar installations, and on average the country is over 40% already. New Zealand today is at about 4% adoption.

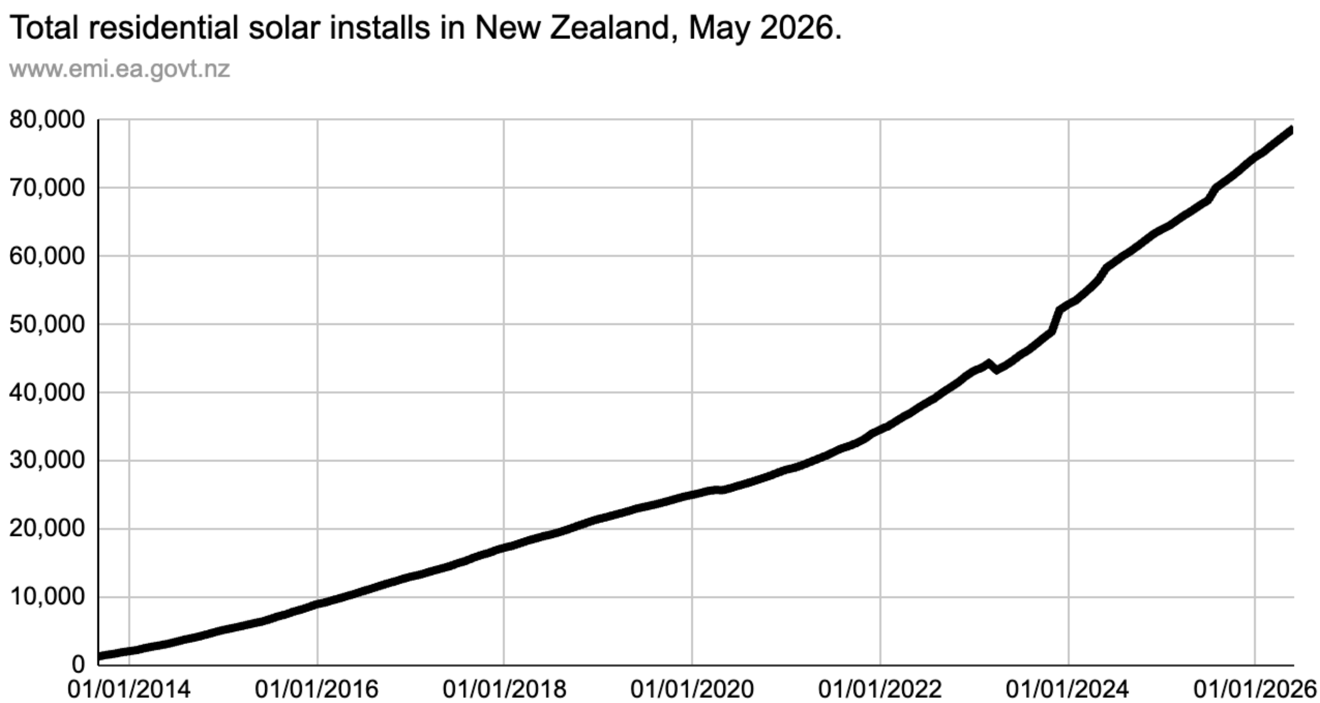


Figure 63: Residential solar installations in New Zealand as of May 2026

Nuance around time of use, fixed costs, network cost recovery and more.

In our solar modelling, we assume the household continues to pay fixed connection costs at standard user (not low user) rates, and continues to consume electricity from the grid. We assume solar export rates reduce over time, and that only 50% of a household electricity load comes from self generated solar. 50% of the standard electricity load, not 50% of the solar production. For example if the load is 7000 kWh and the production per year 12,000 kWh, the self consumption would be 3500 kWh and the rest exported unless a battery is used, in which case the house will self consume more than 50%, based on the size of battery storage available to soak up additional generation. We recognise there is an abundance of nuance in how electricity is priced, both today and into the future, and this paper is not where that nuance will be explored exhaustively. Though we will explore a few areas of this nuance below. When a household generates and consumes its own electricity, it usually buys less electricity from retailers, which means less money flows through to the various energy companies that make up the price of delivered electricity (wholesale, transmission, distribution, and more). For the wholesale electricity market, household generated electricity acts as another generation source, beneficial for pushing down the price of energy on the wholesale market which can have flow on benefits to wider households and industries alike. This, for example, is seen in Australia with falling daytime prices now accessible to homes and businesses without solar.

Increasingly we are seeing real world demonstration of how household and business investment in solar and batteries can offset and lower network investment costs - benefiting the whole community with lower energy bills. Projects like Ausgrid's Community Power Network (CPN) pilot are designed to lower energy costs by using shared batteries and rooftop solar to benefit all customers, including renters. The trial aims to provide $22.9 million in savings over five years, potentially saving households $150–$200 annually, in New South Wales communities. However, a concern that more solar production and self consumption will increase distribution costs for households without solar and battery systems in the short term has been raised. This has been framed as an equity issue because lower income homes are less likely to have access to invest in solar and battery systems. Revenue recovery for privately owned distributors is regulated to encourage efficiency by allowing companies to keep savings temporarily, with the goal of reducing prices over the long term, rather than immediately. This means there can be a lag between cost savings associated with battery and solar uptake and reduced prices for all customers under current regulation. Distribution networks and regulators therefore have a key role to play to leverage and allocate the benefits from solar and batteries for all customers. As we can see from the AusGrid example above - benefits from solar and batteries can be shared with the whole community. Other mechanisms such as energy sharing and multiple trading relationships with peer to peer trading where excess solar can be allocated to local customers at low or zero cost will also help. Regulation of network cost recovery, and how it is split in future pricing models will need to evolve to keep pace with technology. For example, decisions on fixed vs. variable costs need to consider fixed cost being too high and incentivising customers to go off grid (with increased battery and solar investment) and consideration of changes to distribution pricing such as charges for peak midday exports could be needed for equitable outcomes.

The argument that we should not enable solar and battery uptake due to equity concerns seems irresponsible. It is economically inefficient to encourage a more expensive electricity system to prevent short term equity concerns that are very solvable, as such a system would lead to higher bills for all involved over time otherwise. Instead we should fairly allocate benefits to all customers and address the access problem ensuring low income homes to access solar and batteries and the associated bill savings that will benefit them proportionally more than other households. We explore this in the solar and battery financing for low income homes discussed above, and would encourage energy companies, regulators, and policymakers to enable access to the lowest cost energy for households that need it most rather than using them as an excuse to defend a more expensive status quo energy system.

It’s (almost) always sunny in Aotearoa

A common “critique” of solar power is that the sun does not always shine. While this is obviously true, these statements can be used to imply solar is therefore not a reliable energy source. To provide some clear data to this question, we looked at the last 10 years of solar irradiance data for New Zealand at each GXP location, and the spells of low sunlight days in a row (<10% average generation), with the support of the University of Canterbury.[41] The map in Figure 64 and linked in the caption is the result. It shows that the average days in a row of low sunlight is about 2 days, and in most regions of New Zealand the maximum days in a row of low sunlight in the last 10 years was about one week. This is important context, given New Zealand's hydro lakes already store many weeks worth of generating power. Understanding the relationship between distributed mass solar generation and how it can be complimentary and interact collaboratively with New Zealand’s energy storage is important.

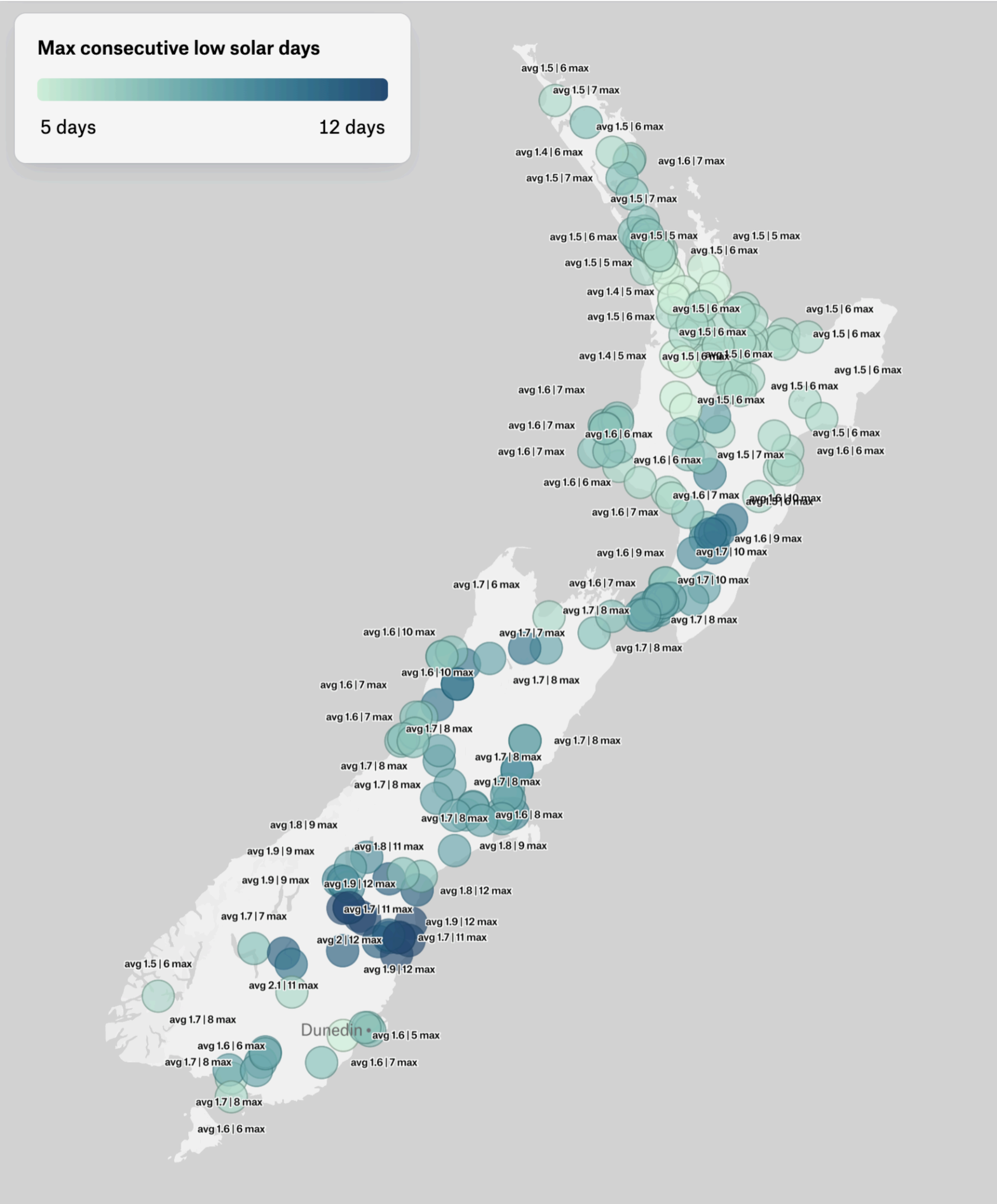


Figure 64: Openly available map showing consecutive low solar days by GXP
https://felt.com/map/Its-always-sunny-in-Aotearoa-almost-z9B9CnbbaNRoCCdxrQ4XbtCA

[41] Thank you!

Electrification economics at a household level

At a household level the gap continues to widen, with an average energy-using home that chooses gas appliances with petrol vehicles paying an extra $7,600 per year on bills, and a net including upfront costs of $3,000 per year or $45,000 extra over 15 years.

As natural gas is not available in the South Island, we can also look at the savings for a bottled gas (LPG) home with petrol vehicles. This pays an extra $7,900 per year on bills, and a net including upfront costs of $3,400 per year or $51,000 extra over 15 years.

Households are all different, whether in building design, energy usage, location, and more. It is useful to contextualise that when we refer to an "average" household, we refer to a household which on average has 2.7 people living in it. A larger household may consume more energy, depending on the behaviour of the home. A smaller household may consume less. The savings from electrification are built around a capex to opex differential, which changes based on consumption of energy in the home or vehicle.

The chart below in Figure 65 shows the average yearly savings annualised over a 15 year period for a home with gas appliances and petrol vehicles compared to an electrified home.

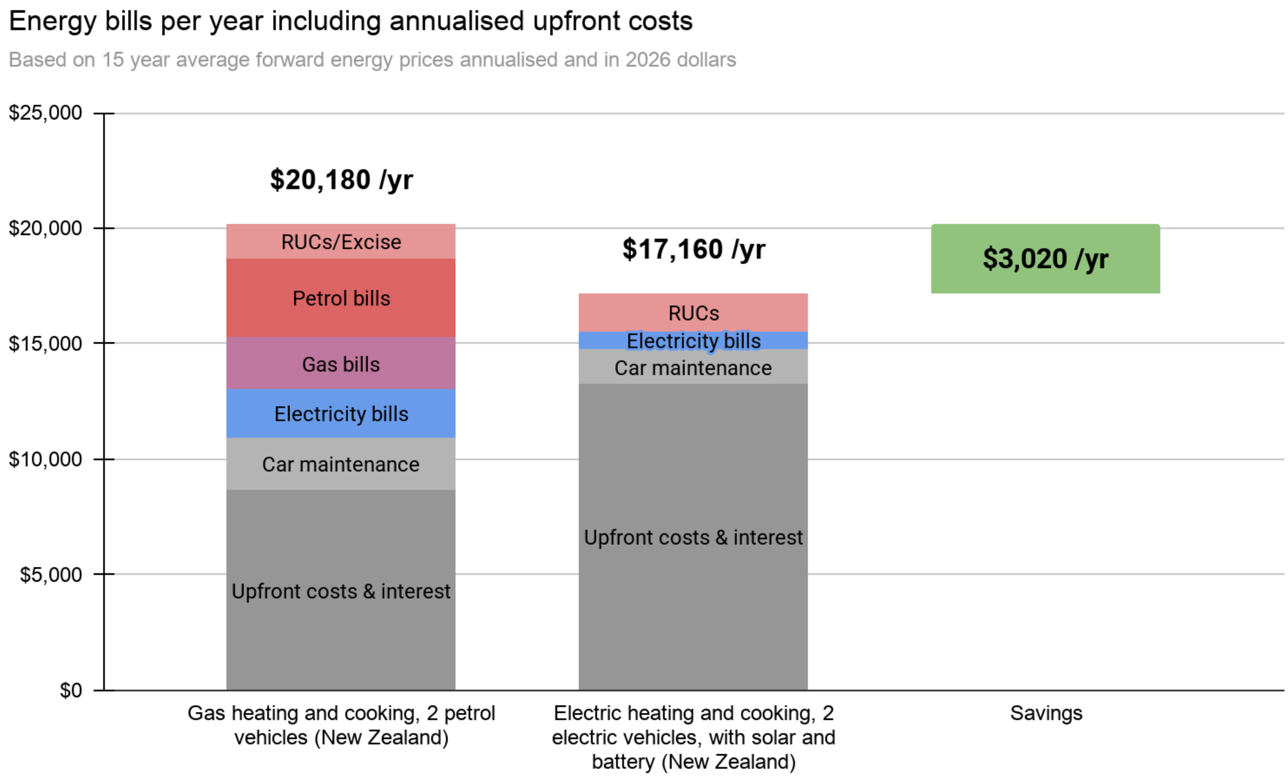


Figure 65: Gas appliances and petrol vehicles compared to electrified appliances and vehicles with solar and battery. The annualised amount that a household spends on energy combined with annualised upfront capital costs and interest costs of financing over the asset lifetime.

Figure 66 below shows the same thing for an LPG (bottled gas) powered home with petrol vehicles.

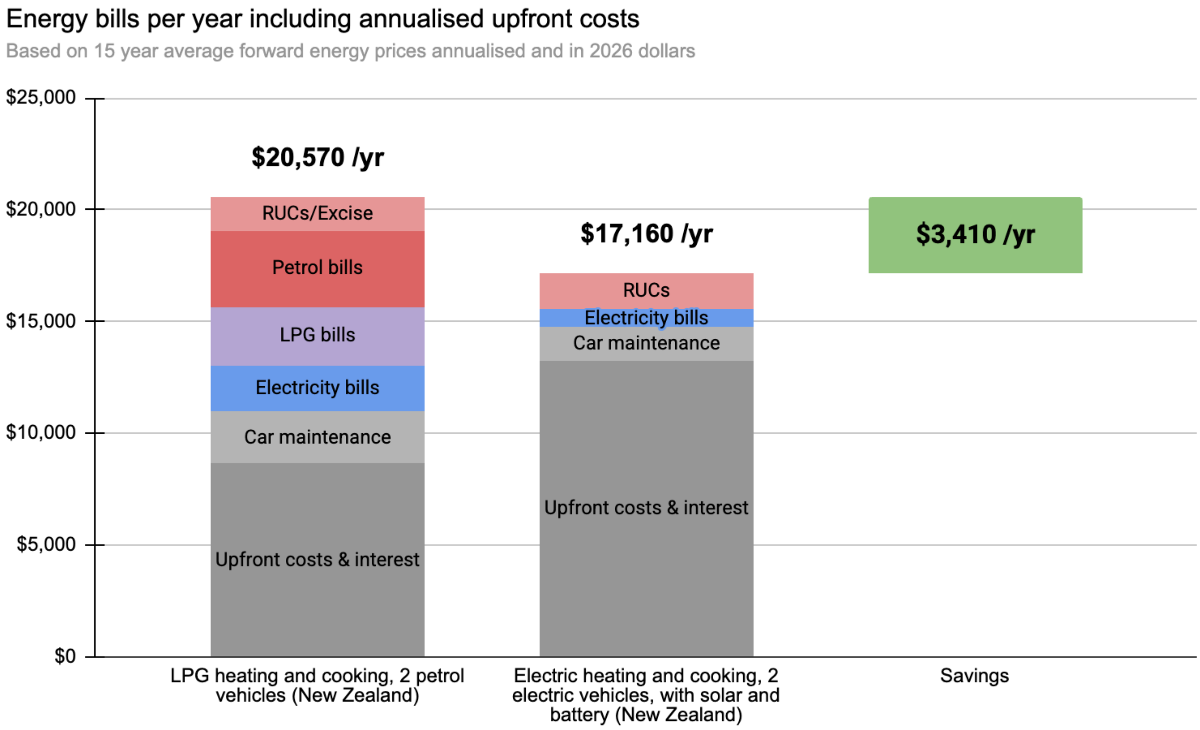


Figure 66: LPG appliances and petrol vehicles compared to electrified appliances and vehicles with solar and battery. The annualised amount that a household spends on energy combined with annualised upfront capital costs and interest costs of financing over the asset lifetime.

In Figure 67, we remove the vehicles to show the appliance only context for electrification savings for a gas home compared to an electrified home.

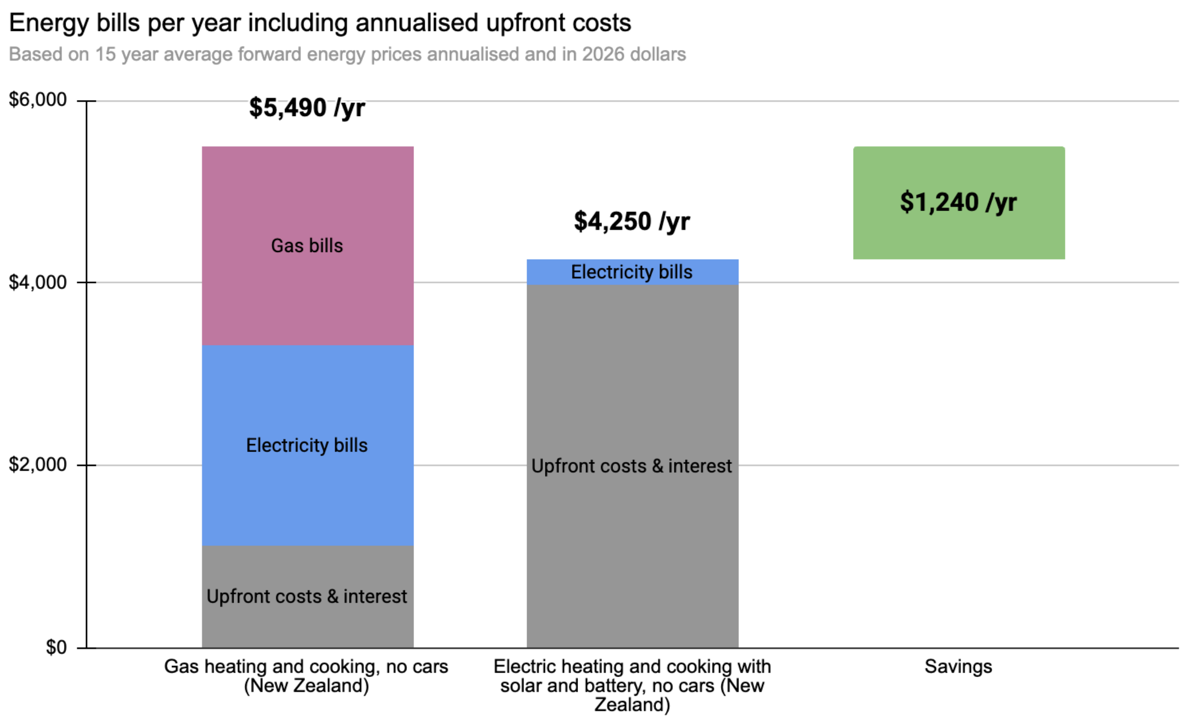


Figure 67: Appliance only savings per year gas versus electrified home with solar and battery system.

In Figure 68, we show the same appliance only example as above but with a house using bottled gas (LPG) instead of pipeline distributed gas.

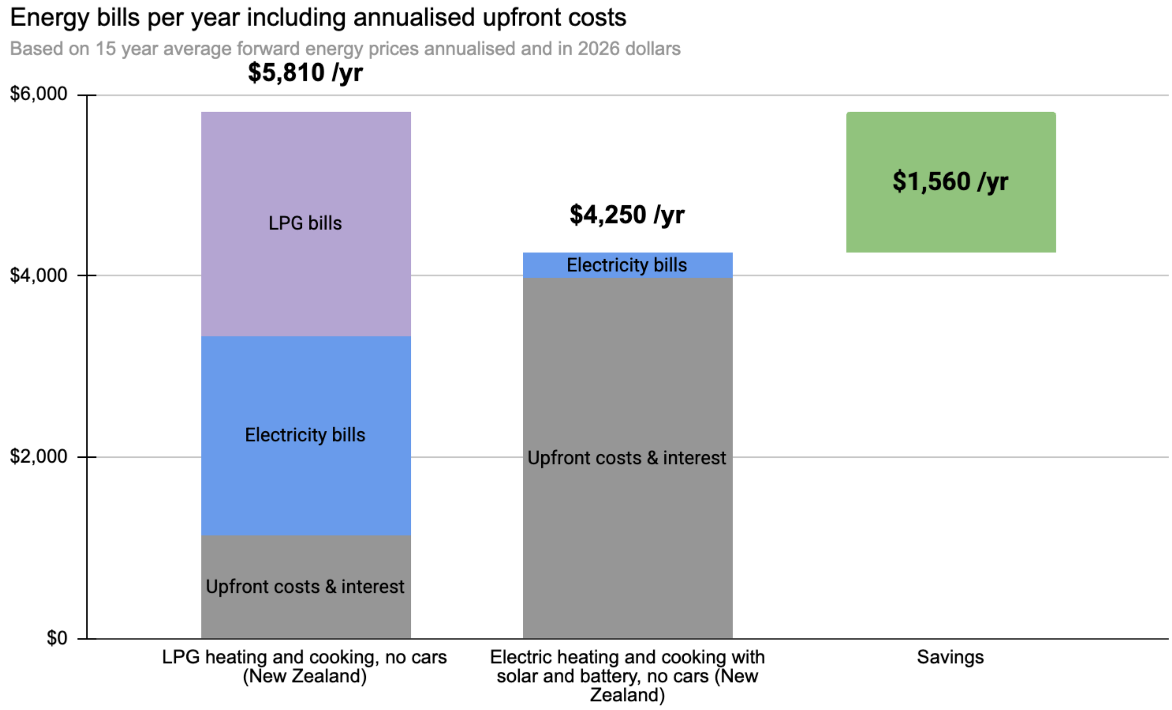


Figure 68: Appliance only savings per year LPG versus electrified home with solar and battery system.

We can also look at the bill savings alone, without the capital costs associated. These bill savings are shown in Figures 69 to 72 below with each of the same scenarios we showed in the above figures.

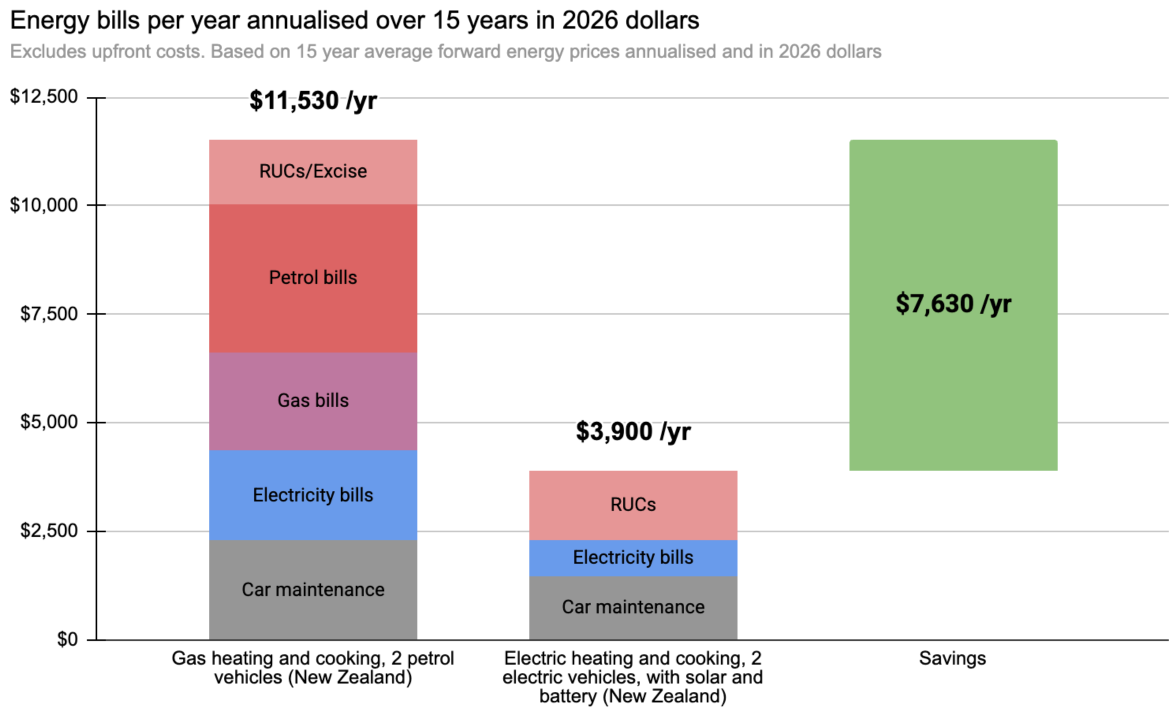


Figure 69: Gas appliances and vehicles compared to electrified, bill difference excluding upfront costs.

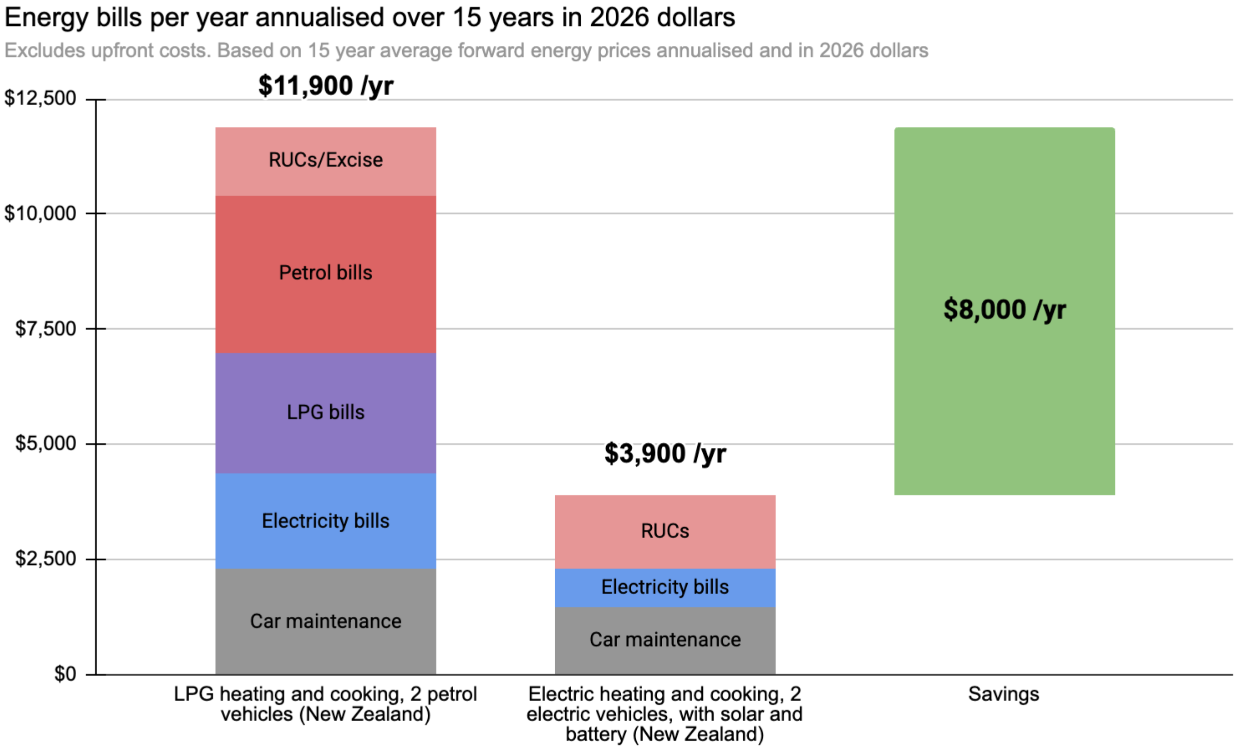


Figure 70: LPG appliances and vehicles compared to electrified, bill difference excluding upfront costs.

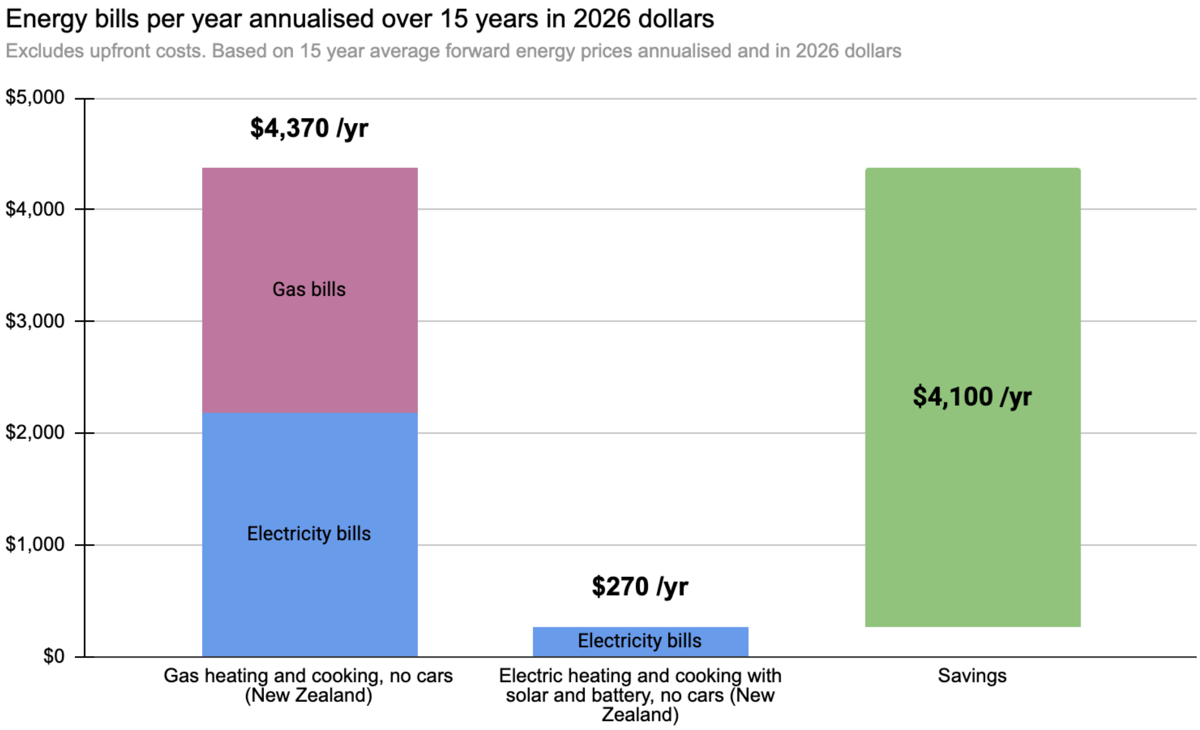


Figure 71: Gas appliances compared to electrified, bill difference excluding upfront costs.

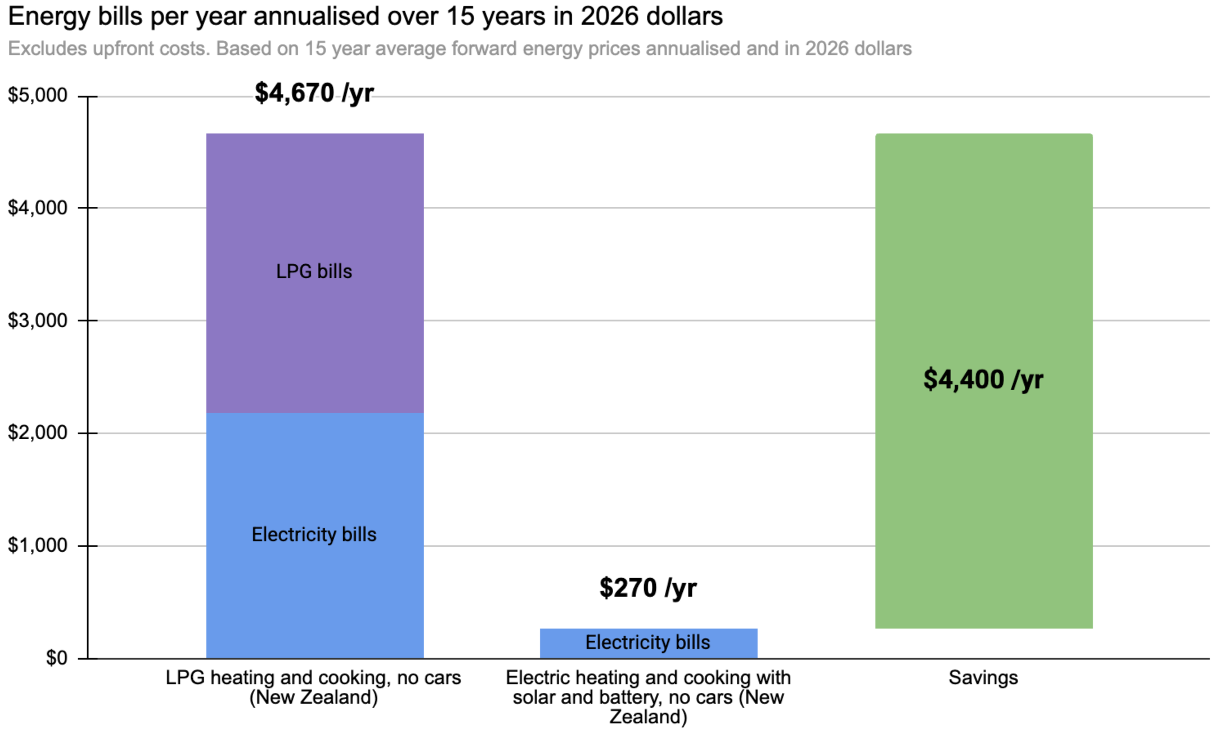


Figure 72: LPG appliances compared to electrified, bill difference excluding upfront costs.

Household economics without solar and battery

The charts above and the primary scenarios in this model assume solar and battery systems for most homes. This has numerous benefits including bill reduction, energy resilience, and reduced strain and increased utilisation for distribution network infrastructure. However, as a scenario we can also demonstrate the same thing using the grid alone. Note that over time this option would require significant grid infrastructure upgrades, and would be more likely to increase electricity prices than the solar and battery scenario.

The largest difference, as seen in Figure 73, is the lower capital costs and repayments, and the higher electricity bills, which are both unsurprising.

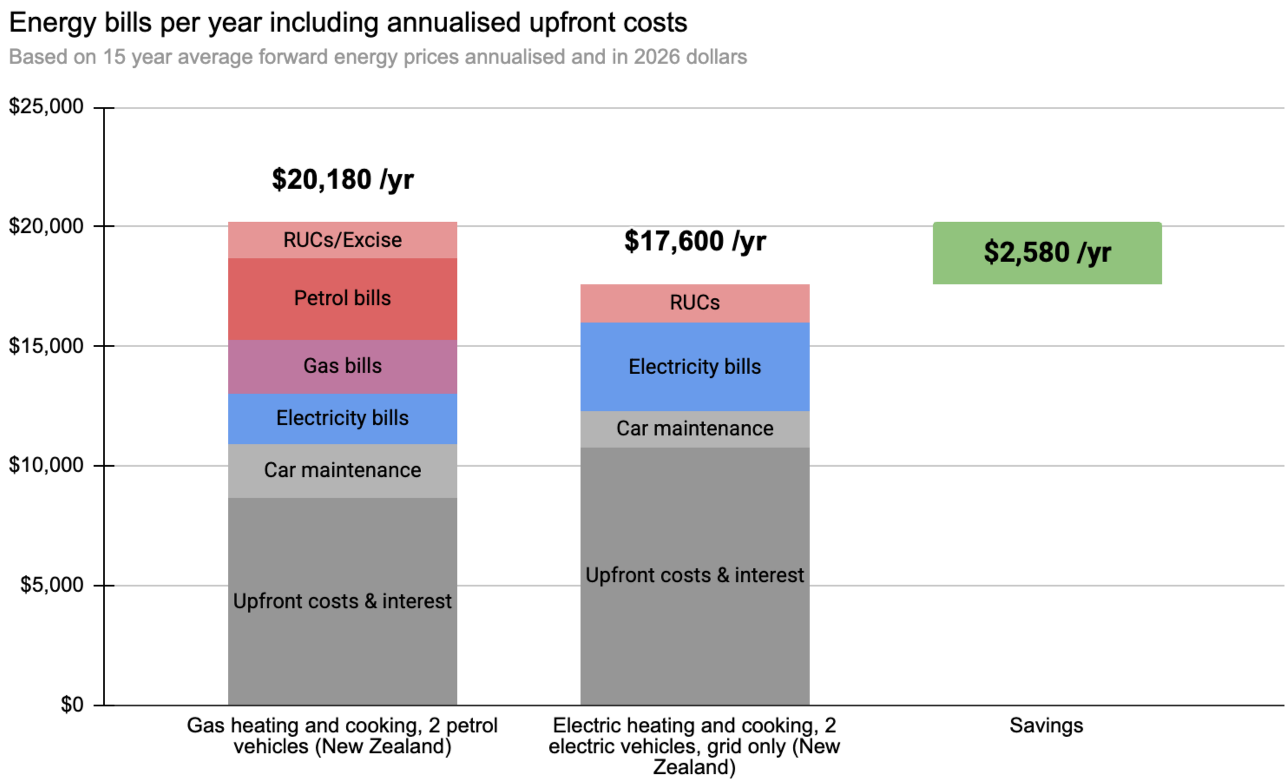


Figure 73: Gas appliances and petrol vehicles compared to electrified appliances and vehicles without solar and battery, using grid electricity alone. The annualised amount that a household spends on energy combined with annualised upfront capital costs and interest costs of financing over the asset lifetime.

This highlights that the savings on offer are not reliant on solar and battery systems. We note that it is our view that battery savings in this model are quite conservative, and show the solar and battery system can be installed with net savings. The savings from the battery especially are expected to increase over time as the pricing on the grid because more cost reflective, with more time of use tariffs, as the batteries value is to some extent determined by the value of moving energy from one period of the day to the other. The larger the delta between those points, the better the economics are for the battery.

Figure 74 highlights the bill savings alone from this scenario. However we note electricity prices continue to increase, and the solar and battery option provided in earlier scenarios not only provides greater savings, but also greater certainty of the price of energy over time as the solar and battery systems are a finance purchase that provides reliable energy output over many years, as a opposed to primarily operational grid electricity cost purchase with less direct control by the home.

Either way, it is clear that large savings are on offer by electrifying homes and their vehicles.

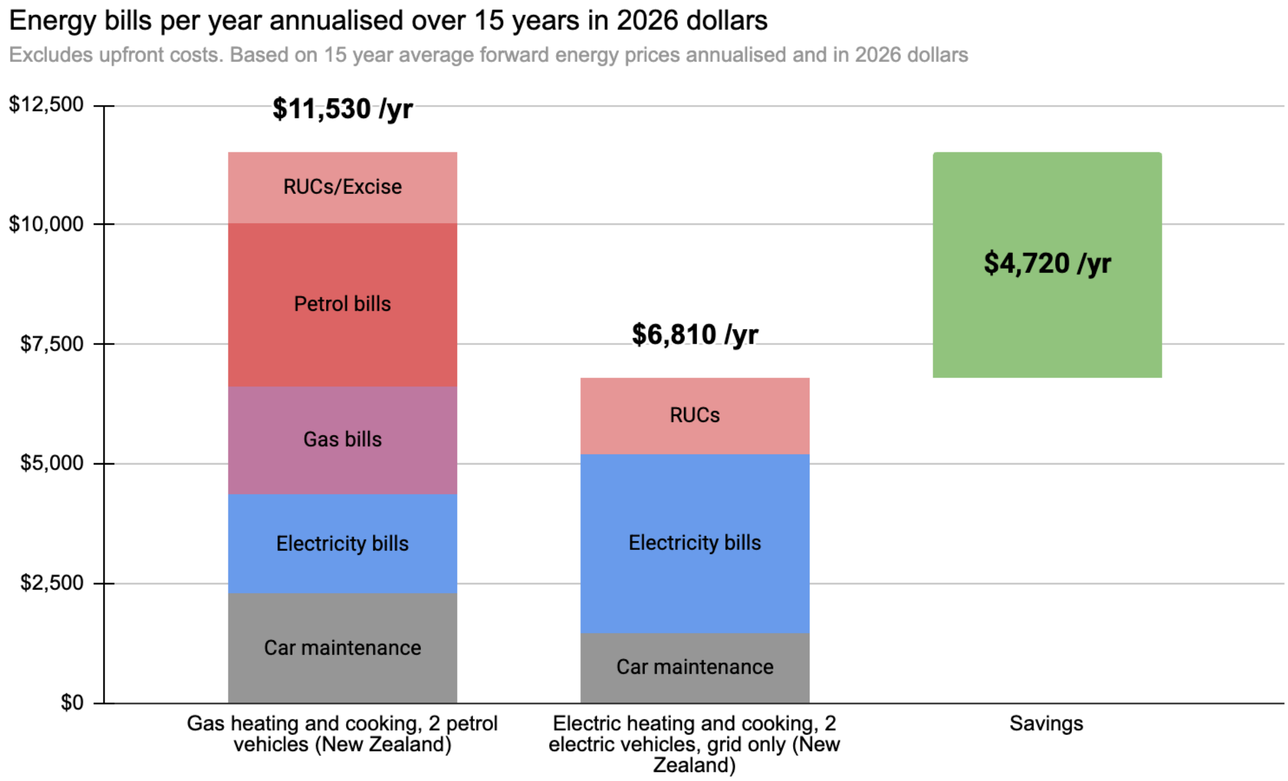


Figure 74: Gas appliances and petrol vehicles compared to electrified appliances and vehicles without solar and battery, using grid electricity alone. The annualised amount that a household spends on energy and savings.

Electrification economics at a community level

Communities vary in size, number of vehicles, energy usage in homes (e.g. heating needs, average commute distances). In this work we build community models by using national energy consumption data adjusted to regional specifics and appliance and vehicle numbers. We use electricity prices specific to each network region, adjusting for community differences, however the other energy pricing used in the model is based on national averages. If anything, this is likely to lead to conservative outcomes for specific communities, as the national average energy prices will be weighted more heavily by denser regions that often have lower energy prices than more remote regions.

In Table 2, we show six example communities: a roughly median-sized town, district, and a "neighbourhood",[42] two examples in each island with the North Island communities using the gas distribution network, and the South Island communities using bottled gas (LPG) with higher heating needs. We have created these examples rather than selecting specific towns or districts, as each town/district can be quite unique and their insights are often not easily generalisable.

Table 2: Example communities and their energy consumption characteristics

Example communities	North Island			South Island		
	Town	District	Neighbourhood	Town	District	Neighbourhood
Heating needs	4% higher than national average (using Manawatū-Whanganui as example)			56% higher than national average (using Canterbury as example)		
Driving distance	National average[43]	10% higher than national average (assuming rural setting)	National average	National average	10% higher than national average (assuming rural setting)	National average
Gas type	Natural gas			LPG		
Population	120,000	30,000	2000	98,000	24,000	2000
Households	44,000	13,000	1000	41,000	11,000	1000
Example of a similar population	A bit bigger than New Plymouth, a bit smaller than Tauranga. Similar to Lower Hutt City.	South Taranaki district, Manawatū district.	An average secondary school plus their families.	Twice the size of Nelson, a bit bigger than Dunedin, a quarter the size of Christchurch.	Similar to Central Otago district, smaller than Ashburton district, half the size of Tasman district.	An average secondary school plus their families.

[42] For the town examples, the size is the median out of all city councils in each island, rounded. For district, it is the median of all the district councils in each island. The neighbourhood size is an arbitrary smaller number that may be easier for readers to compare to their lived experience.
[43] These are specific to each vehicle type (e.g. petrol vs. diesel vs. EV, light passenger vehicle vs. light commercial vehicle), but are roughly 10,000 - 11,500 km/yr for LPVs and 13,000 - 14,500 km/yr for LCVs.

The modelled impacts of electrification on these communities is shown in Table 3. Take the example of the North Island neighbourhood in the right-most column. This is a community of 1,000 households; roughly the size of an average high school plus their families. They have average heating needs, and many households are still heated with gas. 98% of their vehicles run on petrol or diesel, and only 3% of homes have rooftop solar (similar to national averages). If all the households in this community were to electrify their heating, water heating, cooking, and household vehicles, and 80% of them got rooftop solar and batteries over the next 15 years, by 2040 the community:

- Saves $6.6 million per year in bills compared to what bills would have been without electrification
- Saves $4.8 million overall per year after taking into account the upfront cost of purchasing new electric alternatives
- Has cumulatively saved $33 million net over 15 years
- Created 30 jobs from the installation labour and the household savings on bills.
- Reduced their yearly emissions by 4,300 tonnes of CO2e, a 87% reduction of their household energy emissions.[44]

These savings can largely stay in the community. Electrifying a household involves installing heat pumps, solar panels, batteries, and more. These are inherently local jobs; people have to be in the local area to perform the job. As the community hires more tradies and buys from appliance and vehicle suppliers to electrify their homes, the money flowing to these services drive further work in other services in the community, be they accountants or marketing companies. Further, before electrification, many households in this community were bound to expensive energy subscriptions to imported fuels to heat their homes and power their cars, a lot of this money going offshore. After electrification, the savings are now in the pockets of community members who can choose where to spend it. This may be on local or domestic products, services, and investments, rather than sending as much of it offshore or to an overseas company. Through these two mechanisms, electrification contributes to local job growth and a feedback loop of local savings and higher energy productivity. In Table 3 we provide a range of example community savings modelled, to make it possible to scale an idea of savings for your own region, community, or town.

Table 3: Impact of electrification on example communities

Impact of electrification	Chart	North Island			South Island		
		Town	District	Neighbourhood	Town	District	Neighbourhood
Households	N/A	44,000	13,000	1000	41,000	11,000	1000
Bill savings per year (2040)	Fig. 75	$289 Million	$90 Million	$6.6 Million	$271 Million	$76 Million	$6.3 Million
Net savings per year after capex (2040)	Fig. 76	$207 Million	$66 Million	$4.7 Million	$198 Million	$56 Million	$4.6 Million
Cumulative net savings from 2026 to 2040	Fig. 77	$1.4 Billion	$445 Million	$32 Million	$1.3 Billion	$383 Million	$31 Million
Jobs created	Fig. 77	1,312	413	30	1,243	352	29
Yearly emissions saved (2040)	Fig. 78	188.5 Kilotons	60.7 Kilotons	4.3 Kilotons	179.0 Kilotons	52.3 Kilotons	4.3 Kilotons

[44] Counts avoided machine emissions through electrifying fossil fuel household machines only, excludes further emissions reductions from solar & batteries avoiding grid emissions which would reduce emissions even further. Does not include other machines/activities like lawnmowers, boats, flights, shopping, or food.

This could be the story of every town, district, and neighbourhood in New Zealand. As shown in Table 3 and visualised in the following figures, communities of every size could create significant savings, jobs, and emissions reductions through electrification. Because we are using household energy installation costs and averages, we do not directly account for some unique situations like apartments with centralised water heating. In practice, we assume the cost of replacing a water heater in an apartment is the same as that in a household. This likely over estimates water heating replacement costs in aggregate for apartments. For solar and batteries, we assume 80% of households get these over time, which accounts for some apartments being difficult to install solar, and some homes not being feasible. We note there are communities in Australia already approaching this 80% figure[45]. In New Zealand, only approximately 2-3% of dwellings are in four-or-more-storey buildings,[46] and while there are also 2-3 storey joined dwellings that may also share a roof space, these are still a minority and unlikely to make a big dent in New Zealand's residential rooftop solar capacity. Solar can of course still be installed on apartment buildings, and some already have it.

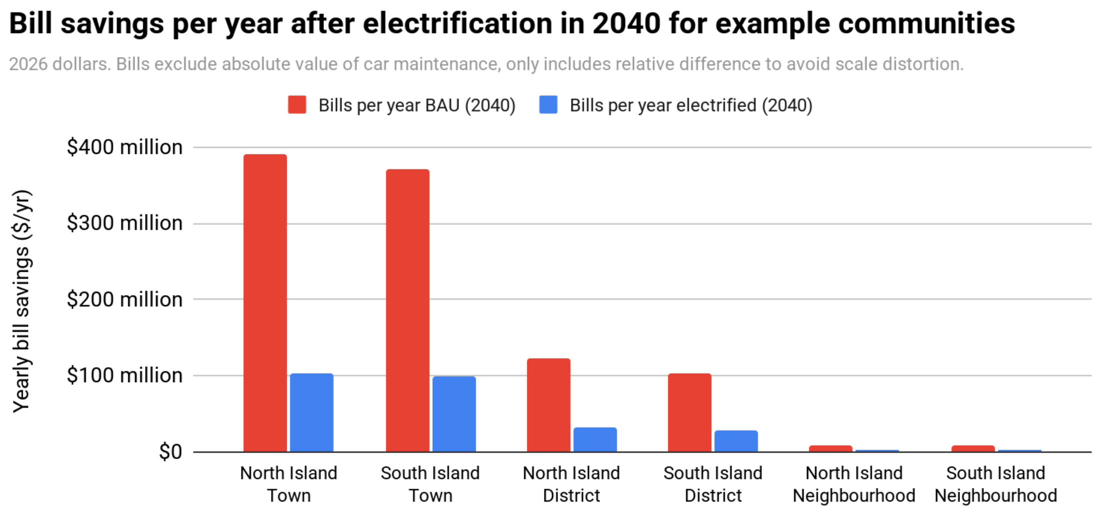


Figure 75: Yearly bills before & after electrification (2040) for example communities

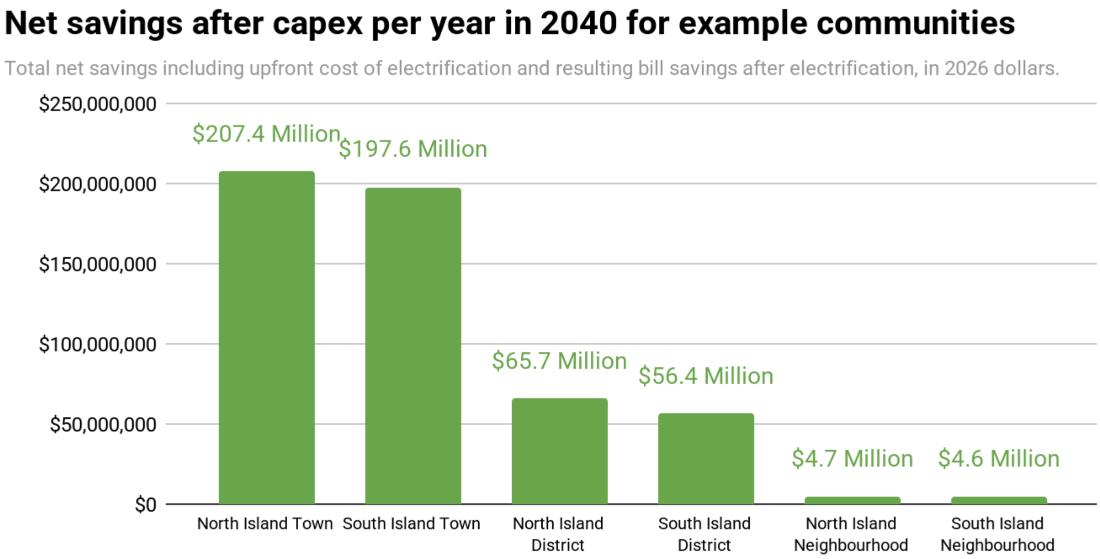


Figure 76: Net savings per year including upfront costs of electrification (2040) for example communities

[45] https://pv-map.apvi.org.au/historical#10/-27.6266/153.0758
[46] This is the closest approximation to apartments in Census data. This was around 44,000 dwellings in 2023. https://www.stats.govt.nz/reports/housing-in-aotearoa-new-zealand-2025/

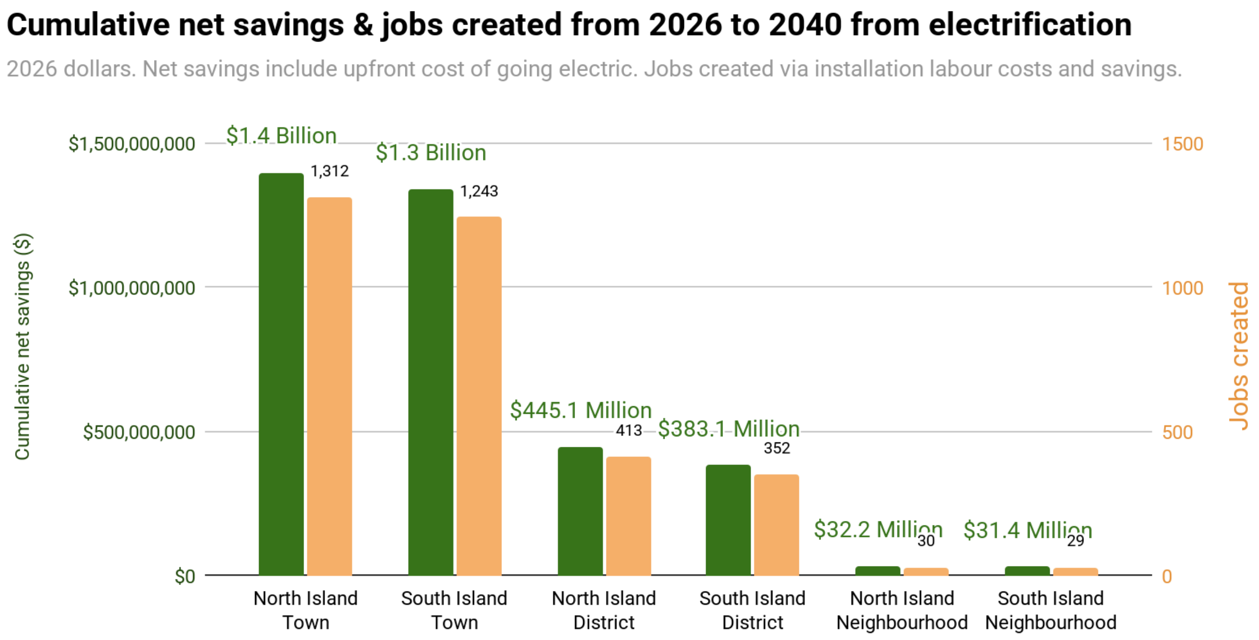


Figure 77: Cumulative net savings & jobs created over 15 years from electrification for example communities

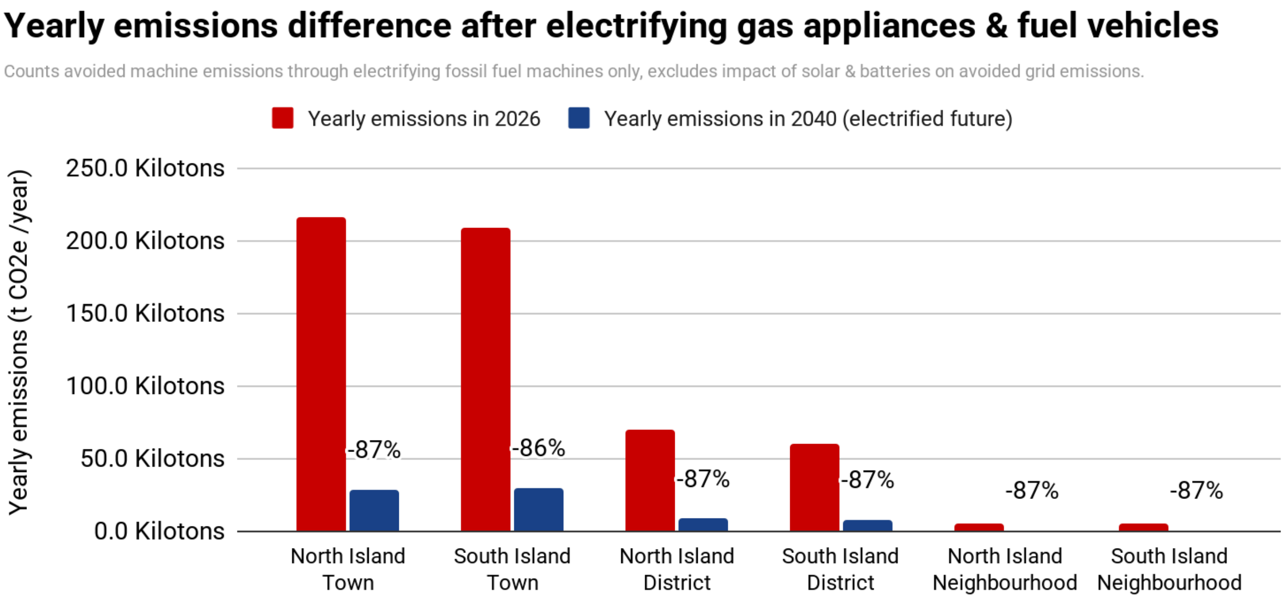


Figure 78: Yearly emissions before & after electrification (2040) for example communities

Electrification economics at a national level

At a national level, a lot of small decisions by households add up to significant savings.

Households today spend around $15.4 billion on energy, made up of the following components:

Table 4: Current household energy cost, consumption, and emissions for New Zealand

Energy use residential	Cost per year 2026	BAU cost per year 2040 (in 2026 dollars)	Energy (PJ)	Emissions (Million Tonnes CO2e)
Electricity	$5.3 Billion	$6.1 Billion	47.0	0.97
Gas	$493 Million	$587 Million	6.3	0.35
LPG	$387 Million	$461 Million	4.6	0.28
Wood	$145 Million	$175 Million	4.3	0.02
Petrol	$6.4 Billion	$5.1 Billion	83.4	5.98
Diesel	$1.8 Billion	$2.0 Billion	35.7	2.51
RUCs	$894 Million	$3.3 Billion		
Subtotal	$15.4 Billion	$17.7 Billion		
Vehicle maintenance	$4.9 Billion	$4.9 Billion		
Total	$20.3 Billion	$22.6 Billion	181.4	10.12

Note we include RUCs as part of the energy costs above, because fuel excise is charged within petrol prices. The 2040 numbers are based on historic real inflation, shown in 2026 dollars using a universal RUCs system for all vehicles assuming the same vehicle stock as today. We include vehicle maintenance for reference as a small amount of savings come from saving on vehicle maintenance in electric cars. If we could magically convert all fuel burning residential machines into electrified alternatives overnight, and install solar and battery systems, this is how that same table would look. Keep in mind this is an energy bills only perspective, further down we will add the capital costs into the analysis.

Table 5: Hypothetical household energy cost, consumption, and emissions for New Zealand if fully electrified

Energy use residential	Cost per year 2026	Cost per year 2040 (in 2026 dollars)	Energy (PJ)	Emissions (Million Tonnes CO2e)
Electricity	$2.3 Billion	$3.2 Billion	65.2	1.34
RUCs	$3.3 Billion	$3.3 Billion		
Subtotals	$5.6 Billion	$6.5 Billion	65.2	
Vehicle maintenance	$3.2 Billion	$3.2 Billion		
Total	$8.8 Billion	$9.8 Billion		
Savings	$11.5 Billion	$12.9 Billion		86.76%

Appliances and vehicles are replaced every day as they end their useful life cycles, or people make upgrade decisions. To build a national electrification picture, we look at the machine stock of today, and then combine that with adoption curves for the replacement of each machine with an electrified alternative (Figure 79). The BAU scenario replaces each with a like-for-like fossil fuel machine of the same type. We use similar adoption curves for the rate of solar and battery uptake, and assume 80% of households get a solar and battery system by 2040.

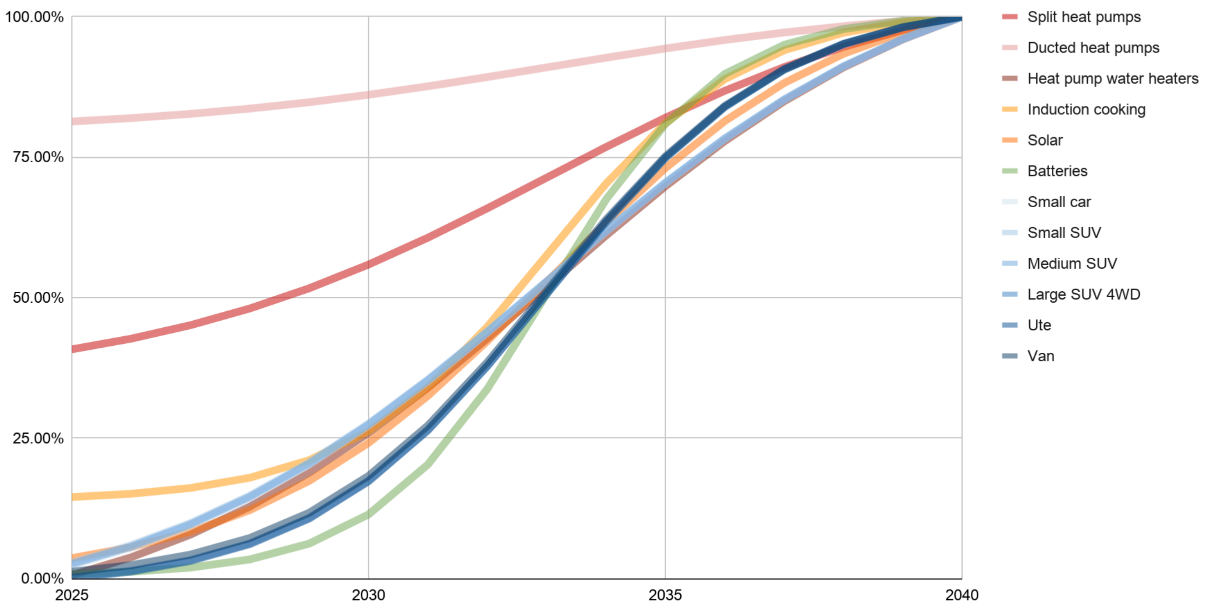


Figure 79: Adoption curves used in modelling for the replacement of each household machine

Another way to look at the energy picture discussed above is through the energy use curves that these adoption curves create (Figure 80):

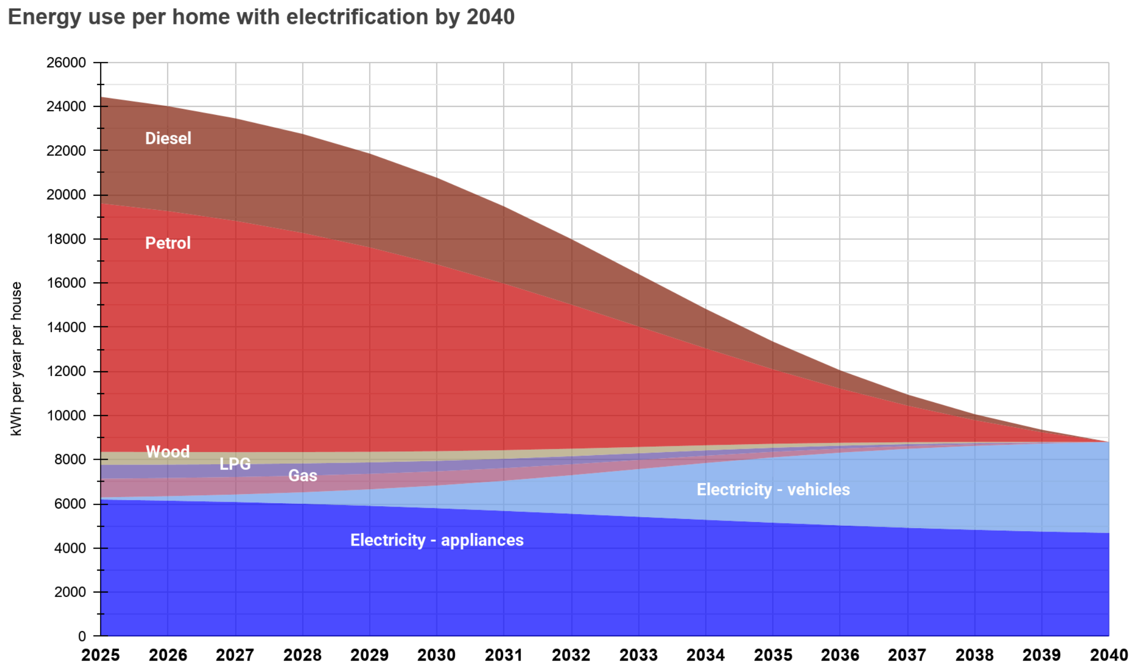


Figure 80: Average energy use per household over 15 years with electrification adoption curves.

Each machine replaced unlocks ongoing bill savings, through a decrease in fuel consumption and an increase in electricity consumption. Because of the thermodynamic efficiencies discussed earlier in this report, the same energy outcome can be achieved by an electric machine with significantly less input energy requirements than an equivalent fuel machine.

These savings over time as the energy system shifts are shown in the curve of Figure 81 below, which shows the cumulative yearly savings as more of the economy electrifies compared to if it had continued with the status quo.

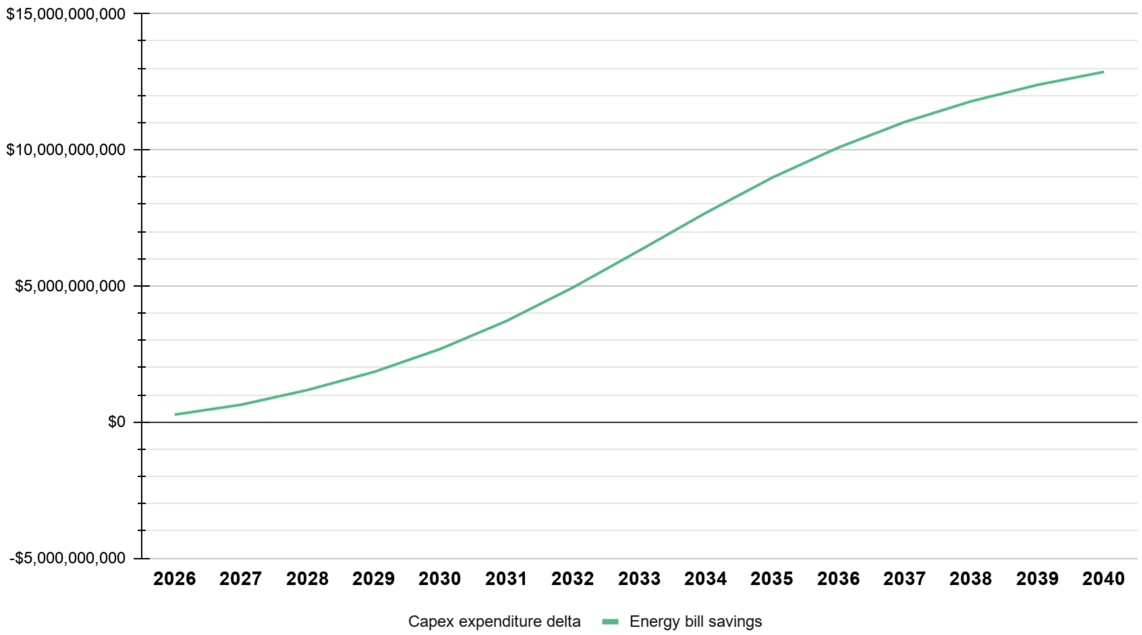


Figure 81: Nationwide energy bill savings as electrification progresses along adoption curves

As we have done earlier with appliances, vehicles, and homes, we must also consider the upfront costs of making these purchase decisions. We consider the additional upfront capital cost of each decision compared to the business as usual replacement. The business as usual replacement for appliances uses a lower like-for-like installation cost, and electrified appliances use a higher replacement installation cost. We apply forecast learning rates for the electrified decisions where applicable, for example with electric vehicles which are predicted to continue to fall in cost over time through economics of scale, and have already been demonstrating this function over the past few years. For the purchases made each year, we count the full capital cost, with a 5.5% interest rate split into repayments that need to be made each year. Both these repayments added each year and the bill savings unlocked each year are cumulative in nature and add up over time.

Figure 82 below shows the cumulative annual savings in the green curve, and the cumulative annual additional capital cost repayments in the red curve. Homes are making more capital cost repayments, for example for solar systems, in exchange for lower energy bills, where the savings exceeds the additional finance repayments.

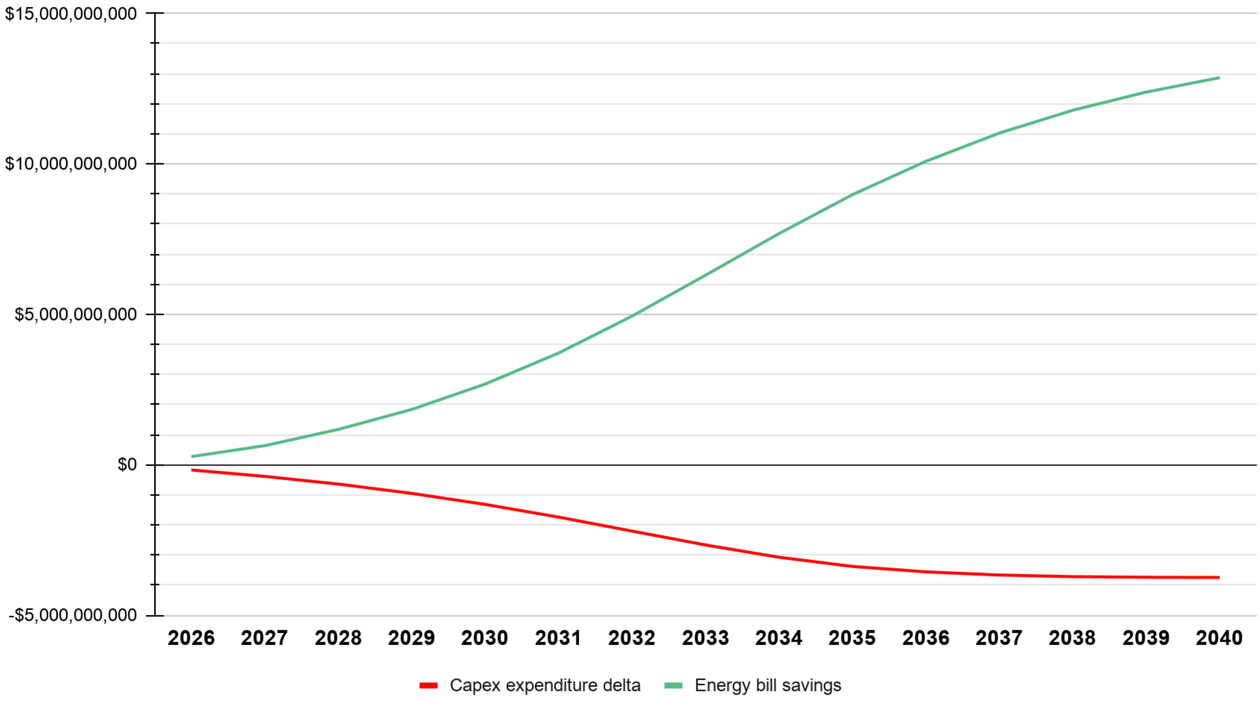


Figure 82: Cumulative annual savings from electrification over time and annual capex delta

Figure 83 combines these to show the net savings from electrification. The additional savings with the additional capital expenditure (and interest) minused off.

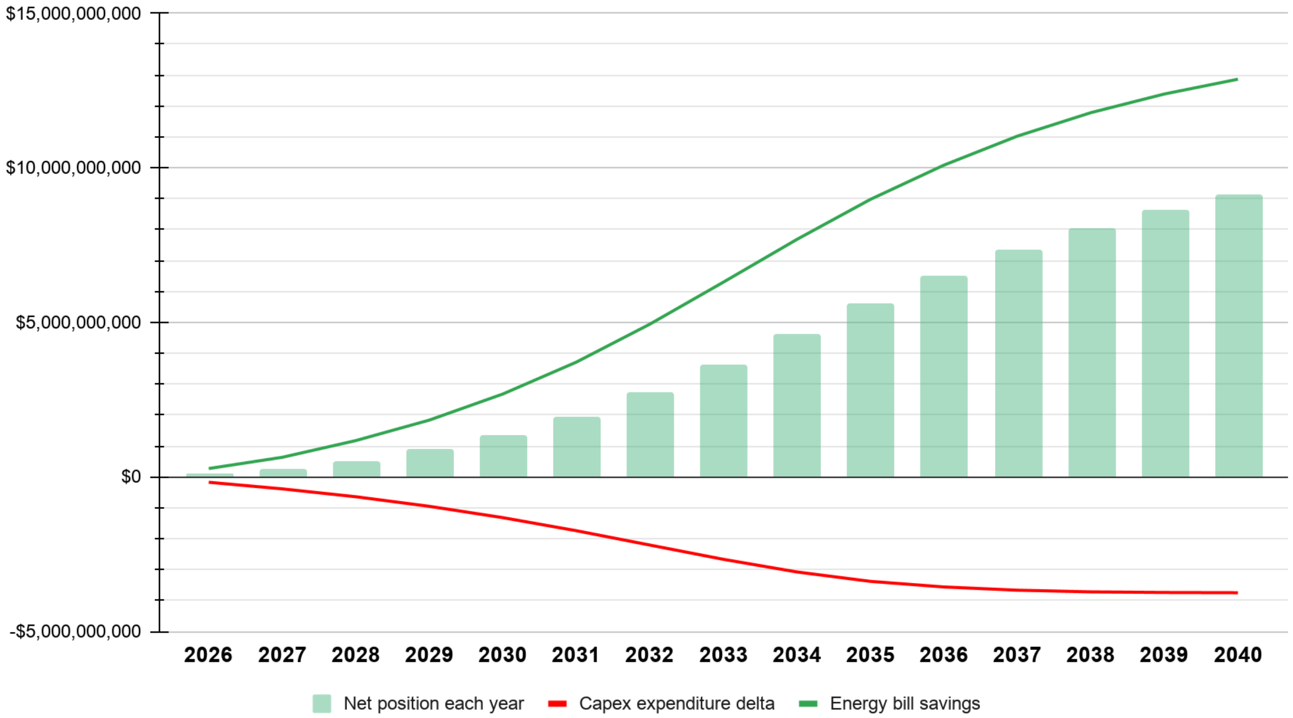


Figure 83: Combined energy bill savings, capex difference, and net result from electrification over time

There is significant nuance that can be explored in the rate of electrification. For example, slower electrification would mean more homes pay lower capex as learning rates accelerate, though would prevent many homes from accessing the thousands in savings available today (and billions nationwide). A faster electrification rate would bring forward these savings at a higher capital cost, and likely create higher net savings. In this report we assume a relatively standard rate of replacement, though add some sigmoid curve to the adoption rates to signify the reality that adoption of technology normally happens in this way.

It is clear there is a significant and important opportunity for electrification in New Zealand's economy. We have provided detailed and transparent methodological notes, and as always are open to making all modelling transparently available to policy makers. In our view, it is in the New Zealand people's best interests to have transparent energy modelling that is rigorously and independently worked through. This will enable the energy system to better plan for and serve the people of our nation.

APPENDIX 1 - Methodology and assumptions

Summary of modelling approach

The model used in this paper includes the following analytical steps, which are described in more detail (including references/links) below this summary section: \

Energy consumption:

1. We derive average per home and per appliance energy usage based on the Residential Baseline Study, reconciled against government and industry consumption data.
2. We use appliance thermodynamic efficiency factors from multiple sources (EECA, government testing, appliance manufacturers, studies) to estimate individual machine consumption for direct comparison of appliance choices.
3. We estimate vehicle energy consumption based on government datasets of vehicles in the economy (MOT) combined with estimates on the fuel efficiency of each type of vehicle. We adjust manufacturer claimed efficiency of vehicles to closer to real world estimates by using the US Department of Energy EPA MPG testing cycle data for vehicles where it is available, and use an average scaling factor for vehicles where it is not.
4. We reconcile this total consumption against multiple government and industry datasets, MBIE Energy Balance tables, EMI Electricity Consumption data, Gas industry estimates.

Energy generation and storage (solar and batteries):

5. Solar generation is estimated based on a capacity factor derived from NIWA solar irradiance data from nationwide locations, weighted by population in each location.
6. Solar degradation is based on 1% degradation in year 1, and 0.4% degradation cumulatively each year for the following 29 years. This is a common warrantied maximum degradation rate.
7. Battery storage is based on a single cycle per day with accelerating degradation over each year. The full battery capacity is never used in a day, a single cycle starts at using 90% of capacity (e.g. a 10kWh battery uses only 9kWh) in year 1 and this amount degrades over time.

Energy and operational pricing:

8. We use average energy prices from MBIE's quarterly price monitoring, reconciled with industry data to separate fixed and variable costs for gas and electricity which each have two cost components (fixed and variable) when paid by consumers but are only reported as a combined cost by MBIE. For prices MBIE does not have available, LPG and Wood, we use industry data on the cost for consumers.
9. For modelling electricity price changes, we use the DPP4 (Default Price Path 4) inflation for distribution and transmission to 2030, and then return to historical averages. For fuel prices, we model averages that exclude the price shocks that began in March 2026. For

modelling other future energy prices, we model historical nominal inflation adjusted to real 2026 prices for each forward year.

10. Road user chargers are included for vehicles. For electric, PHEV, and diesel vehicles, they are included in all years. For petrol vehicles, they are excluded for 2026 and 2027 (with fuel excise included in petrol pricing), and then are included from 2028 with fuel excise removed from the petrol price. Exact pricing assumptions are listed below in the detailed section.
11. Vehicle maintenance costs are estimated as an average from the AA survey of vehicle ownership costs.

Appliance and vehicle pricing:

12. Appliance pricing, including capital costs and installation costs, is derived from a combination of online pricing, interviews with tradespeople, and direct quotations provided by consumers. Over 300 different prices are compared for this across space heaters, water heaters, and cooktops. For comparison of machine choices, the total pricing for a new or replacement install is used. For national/regional adoption models, the like for like install cost is used in business as usual scenarios and the more expensive fuel replacement installation pricing used for electrification.
13. Vehicle pricing is based on a comparison of some of the most popular vehicles sold in each vehicle category, their current market pricing with on road costs included. This includes vehicle pricing for around 100 different vehicles. We generally use the base model pricing for vehicles, the lowest cost variant, and we exclude luxury vehicles. This is considered relatively conservative, as electric vehicle replacements often have base models which have more premium features than base model petrol and diesel vehicles. We note in practice people often buy cars with many different features and costs added, and our goal with this pricing methodology is to create a fair comparison between drivetrain options, not extensively model which features people choose to purchase in their car. Vehicle maintenance costs include repairs & maintenance, cost of oil/consumables, and tyres.
14. Solar and battery pricing is based on a combination of online available quote comparison data, checked against broader industry data. We include a replacement inverter in the cost of the solar installation.

Finance rates and terms:

15. Purchasing decisions on appliances and vehicles, and how they are financed, vary greatly. Some households purchase items outright and would consider they have minimal cost of capital, others choose short term financing, others long term financing. The rates and terms of these finance products vary greatly, and as such so does the possible interest paid. To provide what we consider a generalised approach to interest and cost of capital, in finance scenarios we assume all purchases have a 5.5% rate over the entire operational term of the product. For appliances, vehicles, and batteries, this is 15 years. For solar, this is 30 years. We recognise that many households choose to pay off products on much shorter timescales, resulting in less interest being paid than a full 15 or 30 years, and we also recognise that both lower and higher interest rates are available on finance products in

the market today. Our approach aims to represent a cost of capital that is consistent and generalised to make sure it is accounted for. 5.5% has been chosen informed by historic fixed mortgage rates over the last decade, and noting banks offer lower rate green loans for three to five years.

16. Solar panels often have 25–30-year performance warranties, some up to 40 years, and the assumption is that products will not die the moment the warranty ends. Batteries often have 10-year warranties for capacity, e.g. the Tesla Powerwall 2 has a 70% capacity warranty of 10 years, and some have 15 year warranties. The assumption is that capacity will continue to degrade increasingly, and the battery will still remain functional (at lower capacity) for 15 years. Electric vehicles often come with 8-year warranties (and/or around 160,000km) for the battery and drivetrain, and it is assumed the vehicles will last longer than their warranties as most cars significantly outlast their warranty (e.g. a 15 year old car did not have a 15 year warranty). Heat pumps, water heaters, and stovetops are assumed to last 15 years, noting that the quality of device impacts this lifetime, and this study has purposely avoided choosing only the cheapest options, instead aiming for common expected pricing in the middle of the cost spectrum for appliance choices.

Learning rates and economies of scale:

17. It is well established that through economies of scale (also known as learning rates) products reduce in cost over time and that electrification technology is currently making its way down these industrial learning rates. E.g. electric vehicles, solar, and batteries are reducing in cost each year as manufacturing scale ramps up and, where relevant, local installers become more efficient. We model forward price curves based on national and international estimates, outlined in more detail below.

Regional and national calculations:

18. Machine numbers are estimated for the whole region or nation, depending on the model setting chosen. For appliances this is based on the Residential Baseline Study machine estimates for 2025 and for regional data this is estimated and reconciled against industry data (for example on gas connections). For vehicles this is based on the Ministry of Transport database reconciled based on the number of vehicles estimated to park at homes (e.g. excluding taxis and rental cars as this model is estimating household energy).

19. We model forward adoption rates based on fuel machines at end of life being replaced with electric machines. For example, gas water heaters being replaced with heat pump water heaters, and petrol/diesel vehicles being replaced with electric alternatives of a similar type. We model different scenarios of adoption rates, both straight line and sigmoid. While straight line adoption will produce more consistent numbers for intervening years in the dataset, we acknowledge that behaviourally adoption of any technology normally takes the shape of a sigmoid curve and this is used as our default for that reason. Solar and battery installations, though not “machine replacements” also have an adoption curve shown. These curves determine how many of each machine is replaced or installed each year across the economy.

20. Regional and total numbers for future years using these adoption rates are presented as the cumulative repayments accumulated each year as machines are replaced and financed, alongside the ongoing energy bills across all machine stock. By the full adoption point, 2040, we are therefore showing the combined total capital repayments required

each year combined with the total energy bill savings available. In future years as machines are replaced again, for example a higher cost electric vehicle is replaced by a lower cost electric vehicle in 15 years time, these savings may increase but we do not model this secondary replacement cycle.

21. We do not model new build houses entering housing stock or new vehicles entering the fleet. This is because this model is built around energy saving opportunity nationwide, and assuming new stock in this way would only increase the savings. We conservatively assume that new households install electric appliances, purchase electric vehicles, and often install solar and batteries. For this reason they net out as not adding additional savings. To assume otherwise would mean assuming that economically irrational decisions are made into the future and then corrected later, and while this may be the case, we chose to make the modelling more conservative by assuming future replacement decisions are electric.

Detailed modelling sources and assumptions

Energy consumption of appliances and homes:

Household appliance energy consumption is based on the 2025 data year estimate for the 2021 Residential Baseline Study, which is a Trans-Tasman collaborative study on energy appliance efficiency and machines with datasets specific to both nations.[47]

For vehicle energy consumption we use a ground-up approach based on the vehicle stock from the Ministry of Transport fleet statistics data with each vehicle assigned a fuel efficiency value based on one of multiple methods.[48] First it is based on their U.S. EPA MPG rating (adjusted to Litres per 100km). The US EPA MPG database is the official U.S. Government source for fuel economy testing data for vehicles sold.[49]. The efficiency in these tests appears to be closer to real-world driving estimates than the efficiency advertised by manufacturers or obtained as part of the Worldwide Harmonised Light-Duty Vehicles Test Procedure (WLTP). If EPA MPG is not available for the vehicle, then their WLTP efficiency estimate is used with an adjustment factor based on average the difference between US EPA MPG and WLTP on common vehicles. The reason for this is that it is well known that vehicle manufacturers' reported efficiency is an underestimate of real world consumption data.[50]

For the small number of Plug-in Hybrid Electric Vehicles (PHEVs) in the model, we apply a realistic Utility Factor (UF, the portion of distance travelled on electric power) that reflects real world consumption which is often much higher than advertised.[51] Firstly, we assume that PHEVs consume 0 L/100km in electric mode. This is an underestimate: PHEVs still engage the combustion engine under heavy loads. In combustion mode, we use the official stated L/100km if available, with an EPA-based adjustment factor applied as above. The overall fuel economy is the vehicle's adjusted combustion mode efficiency multiplied by (1 - UF). Assumed UFs were based on empirical data showing that fleet usage and that lower battery ranges significantly suppress UF.[52] [53] We have not modelled UF curves, predicting how UF will increase over time as PHEV models improve, as modelled by the German government.[54]

Vehicle category	Assumed PHEV utility factor
SUV - Medium	50% if model's claimed electric range is >60km, 30% if <= 60km
Ute	30%

[47] https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040
[48] https://www.transport.govt.nz/statistics-and-insights/fleet-statistics
[49] https://fueleconomy.gov/feg/Find.do?action=sbsSelect
[50] https://climate-energy.eea.europa.eu/topics/transport/real-world-emissions/data
[51] https://www.transportenvironment.org/articles/smoke-screen-the-growing-phev-emissions-scandal
[52] Raghavan, S. S., & Tal, G. (2022). Plug-in hybrid electric vehicle observed utility factor: Why the observed electrification performance differ from expectations. International Journal of Sustainable Transportation, 16(2), 105-136. Accessed 30 Jan 2026. https://www.sciencedirect.com/org/science/article/pii/S1556831822004269
[53] https://theicct.org/publication/real-world-phev-use-jun22
[54] https://ariadneprojekt.de/en/publication/analysis-real-world-fuel-consumption-and-potential-future-regulation-of-plug-in-hybrid-electric-vehicles-in-europe-an-empirical-analysis/

Energy consumption reconciliation:

For total energy consumption data we reconcile this against MBIE's energy balance tables[55] and specific energy type consumption statistics available from the same data source.[56]

For electricity consumption we also reconcile this against consumption data from the Electricity Authority, on the EMI platform[57] noting this is being replaced currently with a new data & insights platform.[58]

Our national total energy consumption data reconciles as below. Note as the energy data from MBIE is historic, for example the balance tables most recent data being 2024, we would expect some difference as machine stock and home numbers are different in the 2026 year we start our model on.

Energy type	MBIE data 2024 (PJ)	Model outcome 2026 (PJ)	Notes
Electricity residential	50.65	47.0	
Gas residential	7.28	6.3	
LPG residential	3.90	4.6	
Wood residential	7.44 (all solid biofuels)	4.3	
Petrol usage transport	83.32	83.4	
Diesel usage transport	103.51	35.7	Residential is not all diesel usage, large portion is trucking. See EECA EEUD

Energy generation and storage (solar and batteries):

Solar generation is estimated based on a capacity factor derived from NIWA solar irradiance data from nationwide locations, weighted by population in each location. This irradiance data is then adjusted by assuming a panel efficiency of 23%, and inverter losses of 97%. This results in different capacity factors for each region that the model can simulate, and for national averages this capacity factor is 16.38%.

Solar degradation is based on 1% degradation in year 1, and 0.4% degradation cumulatively each year for the following 29 years. This is a common warrantied maximum degradation rate, including examples from local installers[59] and suppliers spec sheets[60] [61].

Solar self consumption is assumed at 50% of household electricity consumption, including when they have electric vehicles in the home. This is 50% of consumption not of generation, so for example if the solar system is generating 10,000 kWh, and the home is consuming 7,000 kWh, only 3,500 will be counted as self consumed from the solar. We recognise there is nuance behind this number, because water heating is a shiftable energy load, it is possible homes to achieve more than 50% self consumption through a timer or solar diverter on the water heater, and by choosing to use or schedule other appliances during daylight hours like dishwashers and washing

[55] https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-balances
[56] https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics
[57] https://www.emi.ea.govt.nz/Retail/Reports/0YUCE0?_si=v|3
[58] https://www.ea.govt.nz/data-and-insights/
[59] https://lightforce.co.nz/wp-content/uploads/2025/04/Trina-500W-all-black-solar-panel-TSM-500NEG18R.25.pdf
[60] https://cdn.prod.website-files.com/639a9c1473952646284ea6ac/699613a748d88846521761a6_AIKO%20INFINITE%20NEW%20Nov%202025_lo-res%20-%20updated%2018112025_compressed%20(1).pdf
[61] https://ts-pz.b-cdn.net/200/SunPower-Performance-7.pdf

machines. We also recognise electric vehicle charging is an entirely shiftable energy load, because new electric vehicles come with about 300km - 500km of range, which is about 1 - 2 weeks of average driving for a vehicle. This means the home can choose to charge the vehicle during daylight hours on the weekend, or if they are home during the day, or in summer in later sunlight hours. We chose the 50% number to represent a middle ground, and recognise it's possible to have higher or lower self consumption than this.

Battery storage is based on a single cycle per day with accelerating degradation over each year. The full battery capacity is never used in a day, a single cycle starts at using 90% of capacity (e.g. a 10kWh battery uses only 9kWh) in year 1 and this amount degrades over time. In year 10 only 75% is used, and by year 15, only 56% is used. Many battery warranties are for greater than 70% of capacity available at year 10, so that is seen as a minimum otherwise the battery will be replaced by the manufacturer. Some batteries have 15 year warranties. A detailed comparison table is available here on the Solarquates Australia website [62].

Energy and operational pricing:

Electricity pricing specifically varies significantly by location based on local network prices. For regional modelling outputs, we take into account these regional electricity price differences. For the rest of the energy prices, we use national averages. In this section we will describe the national averages used for primary model outputs.

Electricity

Electricity pricing is reported from multiple sources, the Electricity Authority reports data based on network region, with the most recent data based on July 2025 and including a split between volume rate for electricity and fixed daily charges.[63]

MBIE reports electricity pricing in multiple ways, including the Quarterly Survey of Domestic Electricity Prices, which reports electricity prices as a combined cost per unit of electricity delivered, merging fixed and variable costs.[64] Another is the MBIE sales-based data, which also merges these costs. We reconcile these different data sources and consumption data to build up an average cost per volume unit and cost per day connection charge to use in the model. These specific values are shown below in the pricing table.

Future electricity pricing is based on a combination of forecast inflation to prices and historical average inflation. All forward pricing is used as real 2026 dollars. These average inflation rates we get from MBIE historical pricing split by energy and other, distribution, and transmission pricing. Each uses their own respective historic inflation rate. Due to the significant increase in network prices under the current default price path (DPP4) for the remaining years of DPP4, distribution and transmission pricing receives a 10% inflation rate (nominal, adjusted back to real using historic CPI inflation average). After DPP4 (2030 onwards) the historic inflation rate is used again. Examples of the prices this results in are shown in the pricing table below.

Electricity export rates

Export rates for solar are based on publicly available export rate data from PowerSwitch.[65] The starting year export rate is set at 16 cents per kWh, which is lower than some of the plans already available to solar customers today, with the assumption being in general solar customers will

[62] https://www.solarquotes.com.au/battery-storage/comparison-table/
[63] https://www.ea.govt.nz/data-and-insights/charts-and-dashboards/regional-power-prices/
[64] https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-prices/electricity-cost-and-price-monitoring
[65] https://www.powerswitch.org.nz/solar-rates

choose a plan with a good export rate. We then model dropping export rates into the future, under the assumption that as solar adoption increases, the value of daytime solar exports will fall as has been seen in Australia for example. It should be noted that unlike in Australia, where solar was adopted before electric vehicles and batteries were ready for mass market usage, New Zealand is adopting solar at a time when batteries are often purchased with the system (currently approximately 50% of new solar installations include a battery, according to EA's EMI and this has been increasing over time), and electric vehicles are often adopted by solar users as well. For this reason it's possible less of a drop will occur over time in comparison to Australia. The rates used for forward years are shown in the pricing table below.

Gas

As with electricity pricing, gas pricing data is available from multiple sources each with its own limitations. MBIE's energy pricing data, in the same method as its electricity pricing data, includes gas as a combined cost paid per unit of gas by consumers.[66] However that is not how consumers experience gas prices, which have a volumetric rate and also a fixed daily charge rate. We use ConsumerNZ PowerSwitch data on gas plans to build a split between average consumption volume rates of gas prices, and average fixed daily charge rates for gas connections.

Future prices reflect historical inflation from CPI gas price index adjusted to real 2026 prices for each forward year. This is considered very conservative given recent and anticipated increases in domestic gas prices, and the potential for future gas prices to be tied to global LNG prices.

LPG

LPG pricing data is not as publicly available as gas, electricity, petrol and diesel pricing data, which is published by MBIE. For LPG pricing we use a comparison of bottled gas prices available and then adjust that with an energy density assumption of 614.4kWh per bottle to build a cost per kWh. We note there may be LPG left in the bottle during swap out so this could be an overestimate of energy density, which would make the LPG price slightly lower than it may otherwise be in real world usage. We use the bottle and fixed price from Genesis public bottled LPG pricing of $170 per bottle and a fixed price per year of $138 for two bottles.[67]

Future prices reflect historical inflation from CPI gas price index adjusted to real 2026 prices for each forward year. This is considered very conservative given recent and anticipated increases in domestic gas prices, and the potential for future gas prices to be tied to global LNG prices.

Wood

Wood pricing is based on a comparison of online wood ordering websites across New Zealand, and energy density assumptions on the wood ordered of 4.4 kWh per kg and 300kg per cubic metre at an average price of $160 per cubic metre delivered.

Future prices reflect historical nominal inflation for solid fuels from CPI adjusted to real 2026 prices for each forward year.

Petrol and diesel

Petrol and diesel pricing is based on the 2025 last four quarter average from MBIEs energy price data using the weighted average mix.[68] Note we do not use 2026 prices for petrol, and prices are based on historic averages not based on the fuel crisis in 2026. This is done to preserve long term consistency in modelled prices of energy. For future years when RUCs are applied to all vehicles

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[66] https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-prices
[67] https://www.genesisenergy.co.nz/for-home/products/explore-pricing/bottled-gas)
[68] https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-prices

(explored in more detail in the RUCs section below), we remove the fuel excise from petrol prices to get a standard petrol price and adjust GST to reflect this new lower petrol price. Future prices reflect historical inflation from CPI petrol index adjusted to real 2026 prices for each forward year.

RUCs

RUCs are modelled on vehicles and included in calculations. For 2026 and 2027, RUCs are modelled on Diesel, Electric, and PHEV vehicles and are excluded from petrol vehicles which pay fuel excise tax instead. As the government has signified a shift to universal RUCs for all vehicles, from 2028 we model petrol prices without this excise and then apply RUCs to all vehicles evenly.

Vehicle maintenance

Vehicle maintenance costs are based on analysis of the 2025 AA vehicle running cost reporting[69] and are set at:

Per km maintenance costs	Petrol/diesel	Hybrid	PHEV	BEV
Small car	$0.102	$0.081	$0.081	$0.066
Small SUV	$0.107	$0.085	$0.085	$0.069
Medium SUV	$0.116	$0.092	$0.092	$0.075
Large SUV	$0.131	$0.104	$0.104	$0.085
Ute	$0.145	$0.115	$0.115	$0.094
Van	$0.145	$0.115	$0.115	$0.094

[69] https://www.aa.co.nz/cars/buying-and-selling/running-cost-reports/

Energy price table

As the model uses both historic, current, and forecast pricing for energy sources, below we display a table of those prices in a few representative years for clarity. Note the years in between these are also modeled. These prices are based on real 2026 dollars rather than nominal future prices.

Energy price	**2026**	**2033** (real not nominal)	**2040** (real not nominal)
Electricity volume (kwh)	$0.26/kWh	$0.29/kWh	$0.29/kWh
Electricity fixed (day)	$2.60/day	$3.02/day	$3.05/day
Solar export rate (kwh)	$0.16/kWh	$0.13/kWh	$0.11/kWh
Gas volume rate (kwh)	$0.16/kWh	$0.17/kWh	$0.19/kWh
Gas fixed rate (day)	$2.26/day	$2.46/day	$2.68/day
LPG volume rate (kwh)	$0.28/kWh	$0.30/kWh	$0.33/kWh
LPG fixed rate (day)	$0.38/day	$0.41/day	$0.45/day
Wood volume rate (kWh)	$0.12/kWh	$0.13/kWh	$0.15/kWh
Petrol volume rate (before RUCs changes) (litre)	$2.63/Litre	na	na
Petrol volume rate (with excise removed) (litre)	$1.83/Litre	$1.96/Litre	$2.09/Litre
Diesel volume rate (litre)	$1.90/Litre	$1.96/Litre	$2.16/Litre

Appliance pricing

Appliance pricing is based on a comparison of over 300 different prices including product costs, installation costs for fuel switching and installation costs for like for like switching. These costs come from online comparisons, interviews with installers, and direct quote data provided by industry and consumers conducted at the end of 2025 and start of 2026.

For appliance comparisons and home comparisons, we use the total installation cost of each option (not a like for like swap out). For the national and regional machine based replacement models, we use a like for like installation cost for BAU scenarios, and a fuel replacement installation price for electrification scenarios.

The aggregated average installation prices we use for the base year are displayed in the table below:

Space heating	**Product cost**	**Install cost** (like for like)	**Install cost** (replacing other fuel)
Heat pump	$2,400	$900	$1,100
Resistive heater	$200	$0	$0
Gas heater flued	$3,500	$1,300	$1,300
Gas heater fire	$4,400	$1,400	$1,400
LPG heater flued	$3,700	$1,300	$1,300
LPG heater fire	$4,200	$1,400	$1,400
Wood fire	$2,600	$1,200	$3,300
Ducted gas	$7,600	Not enough data	$8,400
Ducted heat pump	$5,100	Not enough data	$7,300

Water heating	**Product cost**	**Install cost** (like for like)	**Install cost** (replacing other fuel)
Heat pump water heater	$4,700	$1,800	$2,600
Resistive water heater	$1,950	$1,750	$2,500
Gas water heater instant	$1,600	$900	$2,500
Gas water heater tank	$2,800	$2,500	$2,600
LPG water heater instant	$1,600	$1,300	$2,500
Solar water heater	$5,300	Not enough data	$4,500

Cooktops	**Product cost**	**Install cost** (like for like)	**Install cost** (replacing other fuel)
Induction cooktop	$1,000	$300	$1,000
Resistive cooktop	$800	$300	$800
Gas cooktop	$1,000	$600	$700
LPG cooktop	$1,000	$600	$700

Solar and battery pricing

Solar pricing is based on publicly available pricing data from My Solar Quotes NZ, updated April 2026, which has then been reconciled against industry offers and some direct industry installation records.[70] The price for a replacement inverter to be installed is assumed by size from industry quotes. The system size used in the primary model for national/regional adoption is 9kW. The system size used for household comparison scenarios varies based on the home.

Solar size	Upfront cost	Replacement inverter	Total price
3kW	$7,000	$1,900	$8,900
5kW	$10,000	$3,000	$13,000
7kW	$14,000	$3,500	$17,500
9kW	$17,500	$4,400	$21,900
10kW	$19,000	$4,800	$23,800
12kW	$22,000	$5,500	$27,500
15kW	$26,000	$5,800	$31,800

Vehicle pricing

Vehicle pricing is based on a comparison of popular vehicle models on sale in early 2026. The model compares exact car types, their costs and their efficiencies, and then creates a weighted average based on popular cars and the similar electric cars that could replace them. For this weighting and finding popular vehicles we use the Ministry of Transport fleet statistics data.[71]

It is worth noting that for one group of vehicles - Large 4×4 SUVs - there are not many electric alternatives available today. This means there is less price certainty about replacement in these cases, and that will only come as the market evolves. These are not the majority of vehicles in the fleet, so we do not expect this to change values significantly and from international vehicle markets the prices we have used are consistent with more vehicles that are expected to be available in New Zealand in the coming years.

Vehicle type	Petrol	Diesel	Hybrid	PHEV	Electric
Small car	$31,900	$31,900	$35,900	$38,900	$36,900
SUV - Small	$32,900	$37,000	$42,900	$39,900	$40,900
SUV - Medium	$44,900	$45,000	$50,900	$54,900	$55,900
SUV - Large 4×4	$69,000	$89,100	$73,000	$84,000	$100,900
Ute	$43,500	$56,100	$49,000	$72,000	$70,900
Van	$49,000	$67,100	$86,000	$99,000	$74,900

[70] https://www.aa.co.nz/cars/buying-and-selling/running-cost-reports/
[71] https://www.transport.govt.nz/statistics-and-insights/fleet-statistics

Finance rates and terms

Purchasing decisions on appliances and vehicles and how they are financed vary greatly. Some households purchase items outright and would consider they have minimal cost of capital, others choose short term financing, others long term financing. Some people may use money that would have otherwise been spent on paying down their mortgage to buy home upgrades, others may spend money that was going to be spent on a holiday. The rates and terms of finance products vary greatly, and as such so does the possible interest paid. To provide what we consider a generalised approach to interest and cost of capital, in finance scenarios we assume all purchases have a 5.5% rate over the entire operational term of the product. For appliances, vehicles, and batteries, this is 15 years. For solar, this is 30 years. We recognise that many households choose to pay off products on shorter timescales, resulting in less interest being paid than a full 15 or 30 years, and we also recognise that both lower and higher interest rates are available on finance products in the market today. Our approach aims to represent a cost of capital that is consistent and generalised to make sure it is accounted for.

Inflation rates

Energy inflation rates are determined by the respective category rate of inflation in the New Zealand CPI history between 2010 and 2026, with gas at 3.77%, petrol and diesel at 3.43%, and solid fuels at 3.91%. The real inflation rates used for energy are the nominal value minus the All CPI groups rate over the same period of time of 2.54% pa (All Groups CPI). So in practice, the rates used are: 1.23% for gas and LPG, 0.89% for petrol and diesel, and solid fuels at 1.37%. As mentioned in the electricity section, electricity inflation rates are based on MBIE data combined with DPP4 for the period between 2025 and 2030, and then return to historical rates. The primary numbers presented are based on 2026 dollars and use these real inflation rates.

Item	Nominal (for calculation)	Real (used)
Electricity	2.73%	0.22%
Gas	6%	1.23%
LPG	3.77%	1.23%
Wood	3.91% (solid fuels inflation rate)	1.37%
Petrol	3.43%	0.89%
Diesel	3.43% (uses petrol inflation rate)	0.89% (uses petrol inflation rate)

Learning rates and economies of scale

It is well known that learning rates reduce the cost of manufactured goods over time, and that electrified technologies especially are going through their learning curves at the moment.[72] [73] Solar, battery, and electric vehicle prices have continued to fall over recent years and are expected to continue to do so according to forecasting from energy and financial organisations around the world.[74] [75] [76]. These price reductions are also evident in the New Zealand market directly, especially with the cost of electric vehicles. For historic battery learning rates used in

[72] https://ourworldindata.org/cheap-renewables-growth
[73] https://ourworldindata.org/battery-price-decline
[74] https://www.goldmansachs.com/insights/articles/electric-vehicle-battery-prices-are-expected-to-fall-almost-50-percent-by-2025
[75] https://www.iea.org/reports/global-ev-outlook-2025
[76] https://about.bnef.com/insights/clean-transport/electric-vehicle-outlook/#overview

some charts, we use data compiled by Our World In Data as an index adjusted to local New Zealand prices for batteries.[77]

For solar historic learning rates and prices, we also use data from Our World in Data as an index adjusted to local New Zealand prices for solar.[78]

For the capital costs of electrified products into the future, we assume learning rates based on multiple sources. For residential solar prices, we use the NREL Annual Technology Baseline 2024 estimate of forward price years as an index adjusted to NZ rooftop solar prices.[79] For residential battery prices, we use the NREL Annual Technology Baseline 2024 estimate of forward price years as an index adjusted to NZ prices of residential batteries.[80] We use multiple scenarios in modelling, and use the middle "moderate" scenario in outputs.

For electric vehicle learning rates we use the New Zealand Climate Change Commission ENZ model learning rates as an index for 2026 updated vehicle prices detailed in our vehicle pricing methodology.[81] Electric vehicle learning rates are also very apparent in the direct New Zealand vehicle market, which has seen significant new electric vehicle price reductions in recent years.

For hot water heat pumps there is less data available, and they are relatively new technology although a combination of two existing technologies. It is clear there is room for price reduction in New Zealand compared to Australian installation cost data (with subsidies removed) and heat pumps in general are expected to continue on their learning rate curve over time. For hot water heat pumps we assume a learning rate from the International Energy Agencies SDS heat pump cost curve forecast.[82]

Efficiency learning rates are not included in the model. It is well known that solar, electric vehicles, and heat pumps have been increasing in their energy efficiency over time, for example getting more heat energy out of a heat pump per unit of electricity, or more kilometres out of the same amount of electricity put into the car. To be conservative, we do not include any rates of machine efficiency improvements over time. If anything, this would be likely to increase savings.

Item	2026	2033	2040
Solar	97%	74%	61%
Batteries	97%	84%	76%
Electric vehicles	97%	79%	71%
Hot water heat pumps	99.3%	95%	91%

[77] Rupert Way (2026) based on Ziegler & Trancik (2021), BloombergNEF, and Avicenne Energy – with minor processing by Our World in Data. "Price of lithium-ion battery cells" [dataset]. Rupert Way, "Historical battery costs and production" [original data]. Retrieved April 7, 2026 from https://archive.ourworldindata.org/20260327-083734/grapher/price-of-lithium-ion-battery-cells.html (archived on March 27, 2026).
[78] Sourced from IRENA (2025); Nemet (2009); Farmer and Lafond (2016) – with major processing by Our World in Data. "Solar photovoltaic module price" [dataset]. IRENA, "Renewable Power Generation Costs in 2024"; Nemet, "Interim monitoring of cost dynamics for publicly supported energy technologies"; Farmer and Lafond, "How predictable is technological progress?" [original data]. Retrieved April 7, 2026 from https://archive.ourworldindata.org/20260304-094028/grapher/solar-pv-prices.html (archived on March 4, 2026).
[79] https://atb.nrel.gov/electricity/2024/residential_pv
[80] https://atb.nrel.gov/electricity/2024/residential_battery_storage
[81] https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/inaia-tonu-nei-a-low-emissions-future-for-aotearoa/modelling
[82] https://www.iea.org/data-and-statistics/charts/cumulative-capacity-and-capital-cost-learning-curve-for-vapour-compression-applications-in-the-sustainable-development-scenario-2019-2070

Regional and national calculations

To build regional and national models, we combined individual machine data with the estimated number of machines in each region. For the energy usage by machine, instead of the household baseline approach done in comparisons between machine choices and homes, we base the energy use on the total energy use from RBS divided by the reported machines. This gives a representation of total energy consumption, which unlike in direct machine comparisons, is made up of fractional energy use from many different sources. For example, some homes may use a wood fire, a gas heater, and electric resistive heaters. This machine based approach reconciled against national consumption provides a way to build granular, scaleable machine based approaches for both regions and the national economy as a whole.

For vehicles, this is based on the number of vehicles of each fuel and body type in the region, with the average km driven by each type from Ministry of Transport statistics used in combination with estimated fuel consumption of each vehicle to build a total energy consumption.

We then use an adoption rate curve for machine replacement. This adoption rate curve is configurable to either sigmoid or straight line adoption. The straight line mode represents a static replacement rate of machines each year, and the sigmoid rate represents slower adoption in earlier years, followed by faster adoption in the middle, and slower adoption in the final years. In the final presented data, the sigmoid curve is used as we believe it represents a more realistic behavioural trajectory for adoption.

To model the capital cost differences between a business as usual (BAU) scenario and an Electrified (E) scenario, we model the replacement of the existing machine with the same type of machine again, using a lower like-for-like installation replacement cost, and we compare this against at the same replacement rate installing an electrified alternative, using the electric product cost and a higher fuel-replacement installation cost.

> For example (a):
>
> A gas water heater in a BAU scenario is replaced by another gas water heater, at a cost of $1,600 for the product, and $900 for the installation.
>
> In the electrified scenario, a heat pump water heater is installed in its place, with a product cost of $4,700 and installation cost of $2,600.
>
> The difference between these two is the additional capital costs spent in an electrified scenario.
>
> For example (b):
>
> A petrol vehicle in a BAU scenario is replaced by another petrol vehicle, at a cost of $32,900 for a small SUV.
>
> In the electrified scenario, the petrol vehicle is replaced by an electric vehicle of a similar class, for example a small SUV would be replaced with a small electric SUV at a cost of $40,900.
>
> The difference between these two is the additional capital costs spent in an electrified scenario. Separately an electric vehicle charger is installed for many of the homes at an additional cost, noting some homes will choose to use trickle chargers. The cost of the electric vehicle charger is added to the total capex cost in the electrified scenario.

In modelling this difference in cost, we also include interest repayments for the capital cost spent. As mentioned above in the finance section, we finance all products over their operational lifetime at an interest rate of 5.5%. See the finance section for more details on this.

The capital costs are modelled as total capital costs, plus interest payments, for each year and the number of machines replaced that year in either BAU or Electrified scenarios. The electrified capital cost values adjust each year by the learning rates already discussed earlier in the methodology.

This combined value of capital cost and interest cost each year is then split into yearly repayments for both the BAU and Electrified scenarios by dividing by the finance term used for each item. This then builds a cumulative repayment schedule and value each year for each scenario, the BAU which is then compared to the electrified scenario to create a repayment delta between the two. This is then combined with the savings delta to compare net savings in the electrified scenario of capital costs, interest costs, and energy bills.

As the adoption rates finish in 2040, all the machine replacements for electrification have been purchased, and the cumulative repayments represent all of the annual repayments needed to facilitate the energy bill savings each year. It's worth noting that beyond 2040, these savings are only likely to increase as electric machine stock is replaced at lower costs later in the learning rate cycle. In this model, we only consider one replacement cycle of the machines, so the capital costs are based on a spread of adoption throughout the years to 2040.

Job creation numbers are estimated at:

- 5.6 (4.06 direct and 1.54 indirect) per $1 million of additional household saving/spending
- 8.15 (6.01 direct and 2.14 indirect) per $1 million of spending on electrification (e.g. capex on buying & installing new electric machines, including labour, appliance/equipment purchase, and one EV per household)
- 6.25 (2.5 direct and 3.75 indirect) per million dollars of additional spending on only electrification installation labour costs (exclude capex of products)

Job creation figures have been created using Insight Economic's employment multipliers,[83] derived from the StatsNZ national accounts input-output tables.[84] As electrification activities and household spending do not map perfectly to the sector classes used for employment multipliers, a "best fit" approach was taken, and expected spending and reduced spending spread across all relevant sectors.

Figures for job creation from household savings are informed by the latest Stats NZ household spending figures[85] and research on discretionary spending trends, and deduct expected jobs lost from reduced fossil fuel expenditure (2.68 per $1million).

Note these numbers are based on the "additional" installation work required compared to business as usual (for example gas appliances being installed). It does not attribute all installation costs, just the delta, and the savings the home receives on bills.

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83 https://www.insighteconomics.co.nz/service/input-output-tables/
84 https://www.stats.govt.nz/information-releases/national-accounts-input-output-tables-year-ended-march-2020
85 https://www.stats.govt.nz/information-releases/household-expenditure-statistics-year-ended-june-2023/