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Te Whakahiko i ngā Marae

A blueprint for resilience, savings
and energy mana motuhake



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Kupu takamua | Foreword



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E ngā mana, e ngā reo, e ngā marae maha o te motu, tēnā koutou katoa.

For generations our marae have been the beating heart of our communities. They are where we gather to celebrate, to grieve, to learn, to feed one another, and to uphold the tikanga that define us. They are places of manaakitanga, whanaungatanga and resilience. As our communities grow and the challenges before us become more complex, our marae must be supported to thrive for the generations still to come.

Across Aotearoa, our marae are under growing pressure from rising energy costs, ageing infrastructure and the deepening impacts of climate change. The prices of electricity, LPG, petrol and diesel keep climbing, driven largely by international markets and events far beyond our shores. Every dollar lost to those costs is a dollar our mostly volunteer-led marae cannot invest in our people, our reo, our tikanga and our future.

Electrification offers us a different path, one grounded in tino rangatiratanga. We cannot control global fuel prices or the conflicts of other nations, but we can choose to invest in technologies that draw on the energy gifted to us here in Aotearoa: the light of Tama-nui-te-rā, the winds of Tāwhirimātea, our waters and the warmth of the whenua. By generating, storing and using our own electricity, our marae reduce their dependence on imported fossil fuels, secure their energy supply and build lasting resilience.

The opportunity reaches well beyond lower power bills. Electrification strengthens mana motuhake by giving our marae control over the energy that sustains their daily life. It upholds kaitiakitanga by reducing emissions and caring for Papatūānuku for those who come after us. It deepens manaakitanga by creating warm, healthy and welcoming spaces for whānau and manuhiri alike. And it builds economic strength, lowering operating costs so that scarce resources can be returned to the kaupapa that uplift our people, our language, our culture and our communities.

Above all, electrification strengthens our marae as places of refuge. In every crisis our marae have stepped forward to care for their communities. With renewable energy and battery storage, a marae can keep providing warmth, shelter, kai,

communications and support through power cuts and natural disasters, remaining a place of safety and hope when it is needed most.

This report shows that electrification is an investment in the long-term wellbeing of our people. It is an exercise of rangatiratanga over our future: embracing innovation while standing firmly in our values, so that our marae continue to flourish as vibrant centres of culture, connection and community.

Toitū te marae a Tāne, toitū te marae a Tangaroa, toitū te iwi māori e.

Marama Royal MNZM.

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Mō Rewiring Aotearoa | 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. Its team brings together energy, policy, and community outreach expertise, with a shared commitment to building an energy system that benefits all who call Aotearoa home.

Rewiring Aotearoa's work is primarily funded by New Zealand philanthropists, with a smaller share coming from specific projects and donations from supporters in the community. It is fiercely independent and self-determining in its work.

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Te whakarāpopototanga |

Executive summary

Electrifying our marae is a practical, affordable pathway to energy security, mana motuhake, resilience and lower emissions. However, due to the unique and highly variable nature of marae, it can be difficult to generalise on whether the economics always stack up. This report outlines current energy challenges facing marae, as well as the benefits of electrification that reach well beyond the power bill to our whānau, our communities and te taiao. We analyse patterns in marae energy behaviour and model potential economic and emissions savings benefits. Finally, we share practical advice on how to get started if you are considering electrification.

Our marae face rising electricity and gas prices, irregular demand, ageing buildings, and an energy market that is complex to navigate. At the same time, over two-thirds of our marae sit in the path of at least one significant natural hazard, and our communities turn to them first when disaster strikes.

An electric marae replaces its fossil fuel machines (heating, hot water, cooking, vehicles and tools) with efficient electric alternatives, and pairs them with rooftop solar and battery storage while usually staying connected to the grid. Electric machines perform the same functions while using a fraction of the energy compared to fossil fuel equivalents due to their higher efficiency, which means lower energy bills. What's more, solar generated on the marae roof is the lowest-cost electricity available to marae in Aotearoa today.

The benefits come in five forms:

- 1. Lower operating costs that free up pūtea for our people.** Our modelling based on six marae profiles of varying sizes and usage found that electrifying the LPG heating, water heating, and cooking in a marae could save between \$5,000 and \$21,000 per year in energy bills. While electric appliances can cost more upfront, this initial premium is predicted to pay for itself within the lifespan of the appliance. However, the upfront cost remains a real barrier for many marae, and access to capital or funding support is key to unlocking these savings.
- 2. Lower emissions and cleaner air, in keeping with our role as kaitiaki.** While lowering bills, switching from gas to electric also cuts a marae's emissions by around 90%. It also removes toxic indoor air pollution caused by burning gas inside the wharekai, protecting the health of the kaimahi and whānau who gather there.
- 3. A marae that keeps the lights on and the kai cooking when the grid goes down.** Rooftop solar paired with a battery can keep essential marae functions running during outages, including lighting, refrigeration, cooking and communications. New technology is making marae even more resilient. As vehicle-to-load (V2L) and vehicle-to-grid (V2G) technology rolls out, an EV parked at the marae will be able to act as a large mobile battery. It could power the marae through an outage, or carry energy to whānau where it's needed. This strengthens the marae's role as a hub for the community.
- 4. Mana motuhake over the energy we rely on.** Aotearoa is facing an energy crisis. Our electricity is mostly renewable, but electricity is only part of the energy we use. In 2025,

just 31% of New Zealand's total energy consumption came from renewable sources, which means most of the energy we use still comes from fossil fuels. Our petrol and diesel come entirely from overseas and the majority of our economy relies on this fuel. At home, gas supply has been falling as fields are depleted. This leaves our people exposed to global price shocks and supply disruptions we have no control over.

- 5. A stronger, more distributed energy system for all of Aotearoa.** Marae that stay connected to the grid can export their surplus solar, ease pressure on local networks by using batteries to limit peaks in demand, and give rural communities at the end of single lines a source of power they control. In the future, energy sharing will let marae pass their excess solar on to the surrounding community and lower power bills for whānau directly.

While our marae profile modelling provides an indication of the kinds of savings possible, actual costs and savings will depend on each marae's unique energy needs, location, and existing energy infrastructure. A smart, deliberate system design during the upgrading and installation process can help to avoid unnecessary, costly infrastructure overhauls. Particularly given the commercial (as opposed to residential) scale of most marae, good design is critical for ensuring that you get the most economic benefits out of electrification.

Every marae can begin today, one decision at a time, by choosing the electric option whenever an appliance, hot water system or vehicle reaches the end of its life. Realising the full opportunity also calls on the Crown to back the shift with dedicated funding and technical guidance, fair rules for exporting and sharing energy, and recognition of marae and iwi as partners in the energy system.

Part I

Te Horopaki Context

In Part I, we lay the foundation for marae electrification by connecting cultural values with practical energy realities. We explore how local, renewable energy aligns with mātauranga Māori to strengthen mana motuhake, kaitiakitanga, and community resilience.

We then examine the unique energy profiles and demand patterns of marae, outline the economic and efficiency benefits of shifting away from fossil fuels, and unpack the primary energy challenges facing marae today as well as offering practical pathways to overcome them.

1 – Kupu whakataki |

Introduction

Rewiring Aotearoa's previous reports, *Electric Homes and Vehicles*, *Electric Farms and Investing in Tomorrow*, have shown that electrification delivers significant economic, environmental and social benefits for households, for the rural sector and for the nation.

Across our kōrero with marae throughout the motu, two clear priorities have emerged: **independence** and **resilience**. Energy independence is the ability for a marae to generate and hold its own power, reducing its reliance on centralised suppliers, imported fuels and volatile global prices. Energy resilience is the ability to keep essential services running when the grid goes down, so a marae can keep caring for its people through outages and emergencies. Electrification delivers on both.

The most affordable pathway to renewable energy will look different for every marae. The right solution reflects the energy resources of the rohe, its climate and infrastructure, and the tikanga, energy needs and priorities of the hapū. Depending on the rohe, that may be solar and battery storage, geothermal energy, hydro or wind generation, or a combination of these. Put simply, the best pathway is the one that powers the machines of your marae with Aotearoa-made energy drawn from your own rohe.

1.1 Ngā marae o Aotearoa | Marae in Aotearoa

The word marae refers first to the marae ātea, the open space in front of the wharenui or whare tūpuna. It is the hub of our communities, where we gather in times of celebration and success, and in times of sorrow and hardship. Today the whole complex of buildings is commonly known as the marae. As Professor Paul Tapsell writes, "The marae is the anchor stone of tribal identity, tying every Māori to their wider communities of origin, genealogically connecting the past to the future and journeying us back into a deep Pacific history of common ancestral origins over 3,000 years old."¹

At the centre of the marae stands the wharenui, the ancestral meeting house, usually named for a tupuna and often the largest building on site. It is the embodiment of that tupuna for the people who belong there. Around it are the other spaces: the wharekai, where we cook and dine; the paepae, where our kaikōrero sit during whaikōrero at pōwhiri and tangihanga; and the wharepaku, with its ablutions and showers. Many marae also have a kōhanga reo, kaumātua flats, māra kai, a kāuta, maintenance sheds and other buildings.

Every marae is unique. From the whakairo and tukutuku panels to the pūrākau and the photographs of our tūpuna that hang on the walls of the wharenui, every feature of a marae belongs to its hapū. What every marae shares is its purpose. The marae is where hui and wānanga are held, where we learn, where we celebrate milestones, and where we gather to grieve and farewell our dead through tangihanga. More and more, it is also where our

¹ "Tribal Marae: Crisis? What Crisis?" in *Maranga Mail Te Reo and Marae in Crisis?*, ed. Merata Kawharu (Auckland University Press, 2014)

communities turn in a civil defence emergency, a flood, a storm or a long power cut, when the marae becomes the place that holds everyone at once.

1.2 Ngā painga o te whakahiko | Benefits of electrification

Like our homes, most of our marae run on a mix of energy sources. Many appliances (lights, dishwashers, fridges) run on electricity, while others, often the ones that use the most energy for heating and cooking, run on gas, LPG, wood, or even coal and diesel. Vehicles used by marae are mostly petrol or diesel, with some hybrids and plug-in hybrids in the mix.

1.2.1 Efficiency of electric machines

As technology has evolved, electric alternatives to these fuels have become far more efficient: typically 3 to 4 times more efficient for heat pumps, 2 to 3 times for induction cooktops and around 3 to 4 times for electric vehicles.

The upfront cost of electric appliances, vehicles, rooftop solar and batteries has fallen sharply over the past decade through competition, lower production costs and economies of scale. Electric vehicles, for example, are now mass produced and in many cases cost the same as their fossil-fuelled equivalents, which means the fuel savings begin from day one.

The efficiency of modern electric machines means lower running costs and lower lifetime costs than fossil fuel machines. A petrol vehicle uses only about 16% to 25% of the energy in its fuel to move the car; the rest is lost as heat, noise and vibration from the thousands of small explosions that drive the engine. An electric vehicle converts about 87% to 91% of the electricity it uses into motion at the wheels. Heat pumps tell the same story, delivering about 3 to 4 times as much heat as a gas heater from the same amount of energy.

1.2.2 Cost savings through electrification

Efficiency drives much of the savings that electrification offers. Gas or petrol might cost less per unit than electricity from the grid, but when an electric machine is three to four times more efficient, the real cost of getting the job done is far lower. What matters is the cost of the energy each machine needs to do its work. Electrification will lift the electricity use of a marae while lowering its total energy use, again because electric machines need far less energy to do the same job.

As electric machines have become more efficient and cheaper to run, the cost of solar generation has also fallen sharply, with the prices of solar modules and battery cells plummeting. Meanwhile, the delivered cost of every other energy type, including gas, petrol and grid electricity, has been rising faster than inflation.

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.

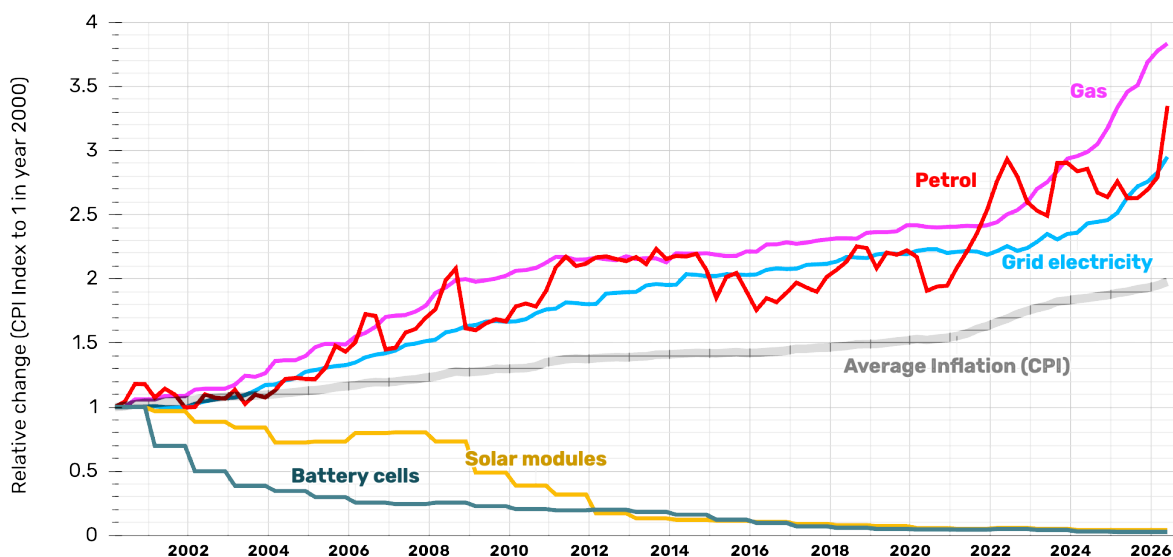


Figure 1: Historic price index of consumer energy alongside general inflation (CPI), and the price index of solar modules and battery cells.

While Figure 1 shows price indices, Figure 2 below shows the actual price of each energy source, measured as cost per kWh. Solar is now the cheapest form of energy per kWh, even when financed at 5.5% (yellow line). Once the upfront cost of solar and a battery is included, also financed at 5.5%, a mix of solar, battery and grid electricity (green) is still cheaper than grid electricity alone (blue).

Solar is now the cheapest form of energy per kWh

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

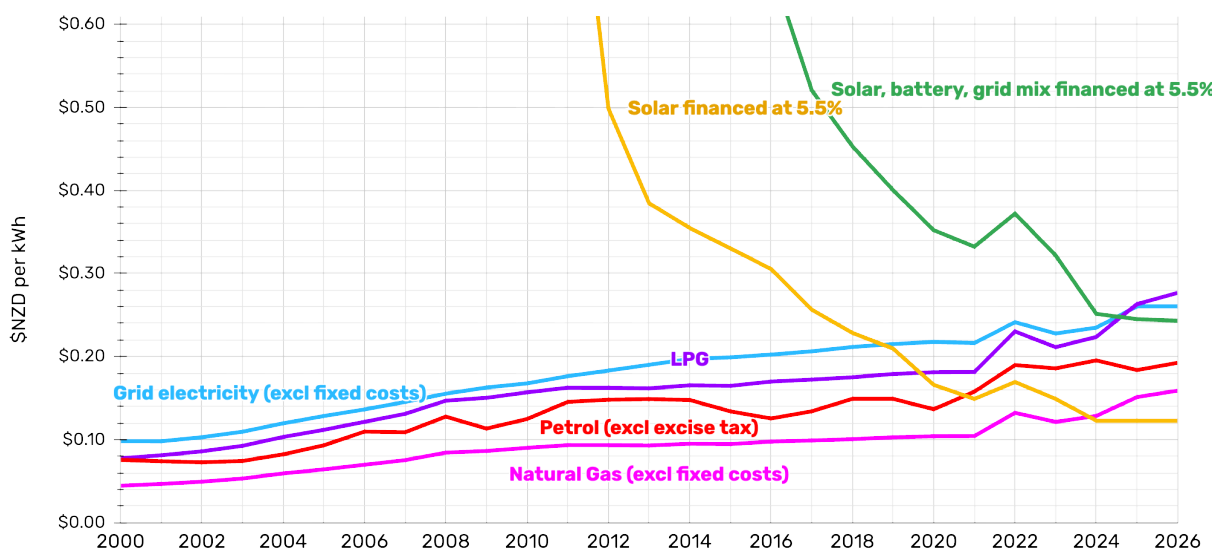


Figure 2: Historical energy costs per kWh in New Zealand

The solar, battery and grid mix remains more expensive per kWh than natural gas. This chart shows only the price of energy, though. Because electric machines produce far more output from each unit of energy, their running costs are lower, as shown in Figure 3 below.

EVs cost less per unit of useful energy due to their greater energy efficiency

Assumes vehicle energy efficiencies of 20.5% for a petrol engine and 89% for electric engine (FuelEconomy.gov). Excludes petrol excise tax & RUCs.

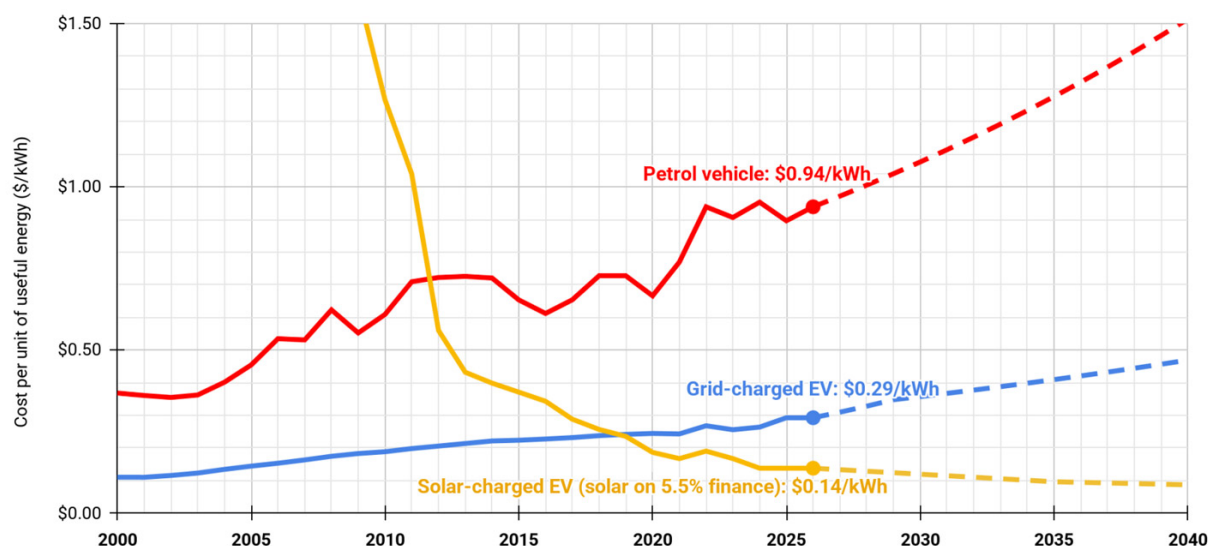


Figure 3: Useful energy comparison between EVs charged with grid and solar, and a petrol vehicle

1.2.3 Resilience improvements

Generating and storing power on site also brings our marae resilience. When a storm, earthquake or infrastructure failure takes down the grid, a marae reliant on centralised supply goes dark, and gas appliances such as califonts fail with it. Solar and batteries keep the essentials running (lighting, heating, refrigeration, communications and medical equipment), so the marae can care for its people when they need it most. If the roads are closed, fuel may not be available, but electric vehicles add another layer of resilience: solar can charge them back up and vehicle-to-load (V2L) and vehicle-to-grid (V2G) technology lets an EV power appliances or buildings, making the marae car park a fleet of backup batteries on wheels. V2G trials are underway in Aotearoa, and marae can prepare now by choosing V2G-ready equipment when they invest (see Section 2.7.4).

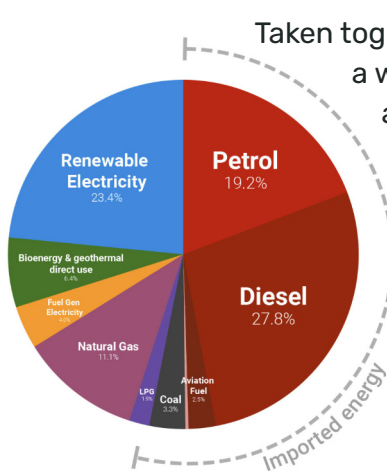
1.2.4 Emissions reduction

Electrification is also a major opportunity to reduce emissions. Because the electricity grid in Aotearoa is already highly renewable, electric machines produce far fewer emissions over their lifetime than fossil fuel machines, even once the emissions from manufacturing are included.

In the home, for example, a gas cooktop produces around six times the emissions of an electric cooktop over a 15-year lifetime. An LPG water heater and an LPG space heater produce around 13 and 16 times more emissions respectively over the same period than their

most efficient electric counterparts, the hot water heat pump and the heat pump. An electric vehicle has the highest manufacturing emissions of these electric machines, yet over the 20 or more years it is driven in Aotearoa it produces a fraction of the lifetime emissions of a petrol or diesel vehicle, thanks to not burning fuel. As seen in our vehicle modelling in Section 2.7.4, switching to an EV cuts vehicle operating emissions by more than 90%.

Electrifying our marae also contributes to decarbonising the nation. Around 25% of the emissions of Aotearoa come from small fossil fuel machines that could be replaced today, with technology that already exists and economics that stack up in almost every case. As shown below, around 70% of the energy used in Aotearoa comes from fossil fuels, and over half is imported. Electrification is a tangible pathway to reducing our reliance on these fuels and the emissions they produce.



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

Taken together, the electric opportunity for our marae, and for Aotearoa as a whole, is clear. By replacing fossil fuel machines with electric alternatives and pairing them with solar and battery storage, our marae can greatly reduce their energy bills, stand strong through outages and emergencies, and dramatically cut their emissions.

Figure 4: 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. Source: MBIE

Connection between mātauranga Māori and energy

Commentary by Dr. Will Edwards
MNZM

Mātauranga Māori guides our decision making. When we face the great issues of our time, we look first to whakapapa, to the relationships that bind te ira tangata to our atua. We descend from Ranginui and Papatūānuku, and from their children, whose presence surrounds us in the natural world and in the energy it holds:

- Ranginui, the sky father, who holds the heavens above us
- Papatūānuku, the earth mother, who sustains all life and from whose body come the minerals and materials our technologies are built from
- Tama-nui-te-rā, the sun, whose light and warmth give us solar energy
- Tāwhirimātea, atua of the winds and weather, from whom we draw wind energy
- Tangaroa, atua of the oceans, whose tides and waves hold vast energy
- Parawhenuamea, who embodies the fresh waters that flow from Papatūānuku and fill the rivers and lakes that drive our hydro generation
- Rūaumoko, atua of earthquakes and volcanoes, source of the geothermal heat beneath us.
- Mahuika, atua of fire, who gave fire to Māui and through him to us

- Tāne Mahuta, atua of the forests and birds, from whose realm come our wood and biomass
- Tūmataurangi, atua of people and human endeavour, who reminds us that our use of these gifts carries responsibility

Each iwi and hapū holds its own kōrero about these atua, and we honour those differences. Each atua is expressed in our physical world. People and atua, people and te taiao, are bound together in one whakapapa.

Our tūpuna understood that drawing on the elemental forces of wind, sun, water and the heat of the earth is an expression of our relationship with te taiao. We may use these forces for the wellbeing of our people, always with care for the environment that sustains us. Woven through our pūrākau and our whakapapa are reciprocity, respect, humility and awe before the power of nature, and the understanding that we are one strand in a much wider web of relationships. Te taiao sustains us, and we owe it care in return. Ours is a relationship of respect.

Today Aotearoa is beginning to embrace Matariki as a nation, and through it to rediscover the awe of the natural world and our place within the wider cosmos, knowledge our tūpuna always held. Kaitiakitanga and te reo Māori are gaining recognition here and around the world. Now is the time for Aotearoa to view its relationship with energy, with the forces of nature and with our place in the environment through that same lens.

Our marae stand across the length of Aotearoa as places of refuge whenever nature reminds us of its power. They are

places of reciprocity and care, where we gather in times of joy and celebration, of debate, of deep sorrow and of mobilisation. Whakahiko i te marae, electrifying our marae, is a pathway for our collectives to secure mana motuhake: authority over our own lives, our own wellbeing and our own spaces in the modern world. It also opens opportunities for commercial benefit within the wider community.

Electrifying our marae is a step towards Māori community energy precincts, where our marae, papakāinga, kōhanga reo and kura, small businesses, and food and fibre producers all draw on shared, locally generated energy. Energy is central to reclaiming our places and spaces: to be Māori, to determine our own futures as Māori, and to live as Māori in contemporary society, in the local economy and in the global economy, on our own terms. Our marae are woven into everyday life. Trade and commerce have always happened on our marae, continue today, and will grow again into the future. Food and fibre industries and other enterprises have long been run, locally and internationally, from our marae, providing products, services and experiences. Our marae have always been sites of tauhokohoko, of exchange and trade, long before the word commercial entered our vocabulary, and they will remain so long after.

Mātauranga Māori is observed, lived and handed down. It grows from generations of relationship with te taiao: with Tāne Mahuta and te ngahere, with Tāwhirimātea, with te moana and te whenua. It is knowing how to draw on

them and how to live alongside them, and carrying that knowledge forward as lived experience. Our language, our philosophies, our toi and our kai all grow from that relationship. We are an expression of te taiao, and the closer we hold to that relationship of kinship and care, the stronger we stand. Science asks us to test and prove; mātauranga asks us to watch, to listen, to remember and to stay connected. Electrifying our marae sits where these two ways of knowing meet: the science of solar, wind and geothermal technology guided by a mātauranga that has always placed us within the natural world. Returning to our roots in a contemporary setting is itself a form of tauhokohoko, commercial and monetised yet grounded in kinship and reciprocity. It is Māori being Māori, on our own terms, in a modern world.

1.3 Te whakamahinga o te pūngao i ngā marae | Energy practices in marae

Most of our marae use grid electricity for lighting, fridges and general power, and LPG bottles for hot water and cooking. A number still rely on wood-fired boilers to heat water and wood burners to heat spaces, and some still cook over an open fire in the kāuta. At the other end of the spectrum, many marae now run commercial-sized kitchens built to feed hundreds at short notice. A small but growing number have added solar and batteries to lower their bills as electricity prices climb.

Solar on marae has mostly been funded from external sources, through targeted government grants such as the Māori Housing Renewable Energy Fund, the Māori Climate Platform and other bespoke funds which have supported solar and battery installations at kaumātua housing, papakāinga and marae, or through investment from iwi. Without that support, the upfront cost has historically put solar beyond the reach of most marae committees. This is a large part of why diesel, gas and wood have remained the default, offering lower upfront costs at the expense of higher ongoing costs to operate.

A marae at the end of a long rural road often depends on a single, thin power line, where one fault cuts power to the whole community at once, and outages happen far more often than in the city. Many marae in this position invest in a petrol or diesel generator, which brings vulnerabilities of its own. When the roads are cut or fuel supply is disrupted at the same time as the outage, exactly the kind of compounding failure a real weather event can produce, the generator cannot be refuelled and the marae is left without power.

A marae in the heart of a city is usually on a well-supplied part of the grid, close to substations, with several lines feeding the area, so outages tend to be shorter, rarer and quicker to restore. An urban marae faces a different challenge: its risk of losing power is lower, but it pays for a great deal of power every day, running a kōhanga reo, a clinic or an office on top of the usual tangihanga peaks. Rural marae feel the impact of losing power most; urban marae feel the impact of its cost.

1.3.1 Energy profiles at marae differ

This variation is why the energy use of a marae is so hard to forecast, budget for and plan infrastructure around. Two marae can look almost identical on paper, with the same buildings, the same rohe and the same size of community, and yet have completely different relationships with energy. Some marae are busy every day, drawing steady, predictable energy like any workplace. Others hold open capacity for much of the year, with no daily programme and no kaimahi on site, drawing little beyond a fridge and a security light. Then a tangihanga arrives, and for three or four days that same marae runs at full capacity: the kitchen going non-stop, the ablutions full, the lights and hot water running around the clock, feeding and housing everyone who comes from near and far. These peaks fall just as heavily on gas bottles and LPG deliveries as on the electricity bill.

A marae pays a fixed daily line charge whether it draws power on one day of the month or on thirty. The fixed daily fee, charged by the local electricity lines company, is typically determined by the size of the connection (how much electricity the marae could use), and for larger commercial connections there can be a peak demand charge (typically based on the maximum use by the marae in the past year). As electricity use spikes during an event it can lead to higher charges that a household or small business would rarely see.

This pattern poses a challenge for anyone planning energy infrastructure for a marae. Sized for the quiet months, a system falls short exactly when it is needed most. Sized for the peaks, it sits underused for most of the year and fixed and peak charges can increase the average cost of electricity. What a marae needs is infrastructure that absorbs the peak without carrying its cost through every quiet month in between. Getting this design right from the start is important to minimise ongoing energy bills.

Case Studies

Ōnuku Marae: Using solar-generated electricity during the day before exporting it, or finding other ways to self-consume, is the surest way to gain maximum returns on investment. **See full case study on page 80**

Whakatū Marae: For a marae that is busy every day, solar plus a battery works hard all year round. Daytime solar powers the offices and services, while the battery stores the surplus and keeps the marae running for the community when the grid goes down. **See full case study on page 84**

Waikāretu Marae: For remote marae, solar and batteries are about more than saving money. Designing a system that can run the marae when the power lines go down has turned Waikāretu into a lifeline for the whole community. **See full case study on page 89**

1.4 Ngā wero pūngao o ngā marae | Current energy challenges for marae

Manaakitanga is the core purpose of our marae, and to fulfil it a marae must function well: the wharenuī warm enough to sleep in, the wharekai able to feed hundreds at a moment's notice, and hot water flowing for manuhiri who have travelled far. In te ao hurihuri, energy underpins every function of the marae. Energy is part of the foundation on which our manaakitanga stands.

The challenges below are best understood in that light. Rising electricity and gas costs strain the ability of our marae to keep their doors open. Unreliable and costly energy supply limits our marae in fulfilling their role in civil defence and disaster response, right when their communities depend on them most. Beneath both sits a deeper tension with tikanga: the carbon footprint of fossil fuel dependence weighs against kaitiakitanga, our responsibility to protect and sustain Papatūānuku for future generations. Each of these challenges also has a way forward, set out below.

1.4.1 Grid electricity prices are increasing

Electricity prices in Aotearoa have risen sharply in recent years and are expected to continue doing so, mostly driven by increasing charges for electricity lines.² Since 2020, commercial electricity costs have increased by almost 50% based on MBIE's reported prices.³ Power bills are made up of the energy charge (the generation of the electricity itself); the lines charges (the fees for the national grid and local poles, wires and infrastructure that transport electricity to marae across the motu); the retail cost (billing and operating cost from the power company) and other charges (metering, GST and levies). Lines charges usually make up more than 30% of the average power bill. Recently lines charges have increased and are a key driver for increasing bills. This increase in the short term mostly reflects inflation and higher interest recovery on existing assets. Over the next 20 years investment in networks is expected and will continue to put upwards pressure on electricity bills.

Overcoming this challenge

While using New Zealand's highly renewable grid to run electric machines will deliver savings over less efficient fossil fuel energy sources (gas, petrol, diesel), adding onsite solar to a marae will reduce the impacts of rising grid electricity costs for marae.

Understanding the delivered cost of energy and what electricity actually costs once it reaches the marae (as shown in Figure 5 below for a household) illustrates the case for rooftop solar. It is the lowest cost delivered electricity available to households in New Zealand and many larger businesses and farms are also investing in solar to avoid rising commercial rates. While electricity requires layers of distribution in order to transport energy from its generation source to the end point, onsite solar does not.

A typical residential 9kW solar system, costing around \$21,900 over its 30-year life, produces electricity at around \$0.06–\$0.12/kWh depending on financing. Small and medium commercial variable charges for grid electricity average around \$0.22–\$0.24/kWh delivered (plus a fixed fee). However, these vary significantly and some marae have variable charges that are higher than this. For marae, generating power on-site is one of the few ways to step outside the cost structure described above, rather than simply absorbing it each year.

² Commerce Commission, <https://www.comcom.govt.nz/regulated-industries/electricity-lines/understanding-why-changes-to-lines-charges-may-impact-your-electricity-bill/>

³ <https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-prices>

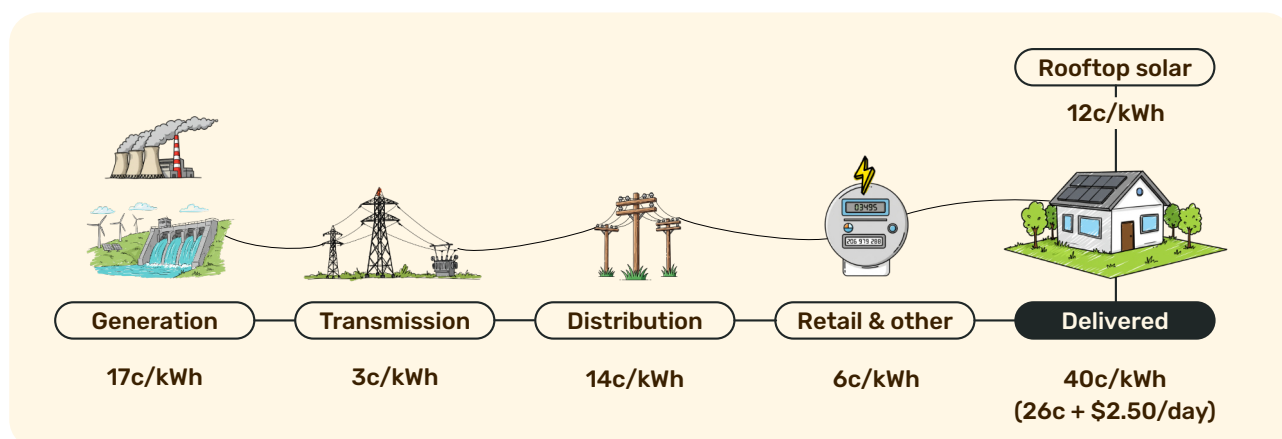


Figure 5: The delivered cost of energy for an average New Zealand household from the grid versus rooftop solar, broken into its cost components. Rewiring Aotearoa analysis. Generation price based on 3 year inflation adjusted demand weighted average from EMI. Transmission, distribution, retail and other from MBIQ QSDEP February 2026. Solar pricing based on \$2,000/kW, 30 year panel lifetime, average NZ sunlight capacity factor of 16.4% including inverter losses, one replacement inverter over lifetime, financed at 5.5% interest.

1.4.2 Matching system design to energy needs

Our energy system has to be sized to deliver energy at times when demand is highest, and the way charges are set, especially for electricity distribution lines, reflects this with higher fixed charges for customers with larger connections and higher peaks in demand. This can work against our marae. Standard efficiency measures aimed at cutting everyday consumption do little to address a key cost driver for some marae, the intensity of demand during the large events and the fixed and peak charges that result.

The size of the connection a marae needs is also determined by the supply needed at these peak times. Many marae need a large three-phase connection to run the equipment of a commercial-sized kitchen during large gatherings. Having a larger connection size can mean marae fall into commercial rates where they pay higher daily fixed charges. These types of commercial rates can also include peak demand charges calculated on the single highest peak of consumption recorded in any 30-minute window, instead of on how much electricity they use over the month. For a business with steady use this is manageable. For a marae that draws heavily during a tangihanga or large hui and then returns to near-zero use for weeks, a single weekend of manaakitanga can set the rate, and the bill, for the next year.

Meeting peaks in marae demand solely through investment in onsite solar and batteries would be very expensive. A system built to cover peak demand entirely off-grid would need far more solar and battery capacity than everyday use could justify. That capacity would sit idle for weeks at a time, and in many cases the savings would not repay the extra upfront cost, making full independence uneconomic even where it is technically possible.

Overcoming this challenge

Sensible design of electrification projects including investing in batteries, avoiding oversizing connections and optimising how battery systems operate to limit some of the peaks in demand can help marae avoid unnecessarily high fixed charges.

Good system design can help minimise ongoing charges. As we discuss in the section below on navigating the energy system, having support to get the best solution in place is important. When engaging with experts, retailers and local distribution networks marae should ask for a design that:

- Avoids over-specifying connection size
- Utilises batteries sensibly to minimise peaks
- Maintains grid connection in almost all cases

Staying connected lets a marae design its battery and solar system to minimise energy bills, where the investment pays for itself, export its surplus energy, and draw on the grid as needed. Grid connection carries fixed line charges but in most cases a well designed solar and battery system combined with a grid connection will be a lower cost solution for marae. It will in the future allow marae to share excess solar generation with the local community and help lower energy bills for whānau directly. See section 1.5.1 on energy sharing and trading for more details.

Accordingly, all modelling in this report assumes marae stay connected to the local network and national grid, and includes fixed daily charges as an ongoing cost alongside any solar and battery investment.

1.4.3 Navigating the energy system

The energy system our marae must navigate is complex, and it does not always serve them well. There are documented cases of marae being given incorrect tariff advice, resulting in higher bills than their use should attract, or being left on plans that do not reflect how the marae actually operates. Because these errors sit inside technical billing structures, they can go unnoticed for years.

The same complexity affects growth and development. When a marae secures funding to upgrade its infrastructure, that development can trigger network costs, such as new transformers, line capacity or connection charges, that are not always visible when the funding is secured. A grant covering construction may not cover connecting that construction to the grid, leaving the marae with a second, unplanned funding gap just to use the capital it has already raised. Funding conditions and compliance requirements can add further hurdles, however good their intent.

Solar and batteries carry their own version of this challenge. Some of the first marae to install solar did so when the technology was more expensive and less capable than it is today. These

early adopters are not always in a position to upgrade or expand their systems to capture what newer technology offers, having already committed their capital.

Beneath all of this is a competitive sales environment that does not always understand how a marae operates. Installers and retailers are generally set up to sell to households and businesses with steady demand, and less so to a facility that sits quiet for weeks and then serves hundreds of people overnight. Without that understanding, a marae risks being sold a system sized, priced or structured in a way that does not fit its needs. This may be yet another case of a marae committee needing more specialist knowledge than it can reasonably be expected to hold just to get a fair deal.

Even where the right information exists, acting on it (chasing retailers, comparing plans, understanding tariffs) demands ongoing effort that is hard to sustain for a volunteer-led organisation already stretched across fundraising and maintenance.

Overcoming this challenge

Our marae should not have to navigate the energy system alone. Support can look like independent, trusted advice from energy professionals and auditors who understand how a marae operates. An energy audit can confirm the right tariff and connection, identify savings, and size any solar and battery system to the real pattern of use. That advice carries an upfront cost, but it is small beside the cost of a wrong decision locked in for decades, and funding is available to help meet it.

Marae are also growing this expertise from within. As electrification gathers pace, marae across the motu are building real skill and experience with solar, batteries and electric machines, and a collective of marae is forming around that knowledge. Shared between marae, hapū and iwi, from the questions to ask an installer to the lessons of those who have gone before, it makes each new journey easier than the last. This is whanaungatanga at work: our marae lifting one another as they go.

The energy system has its part to play too. Lines companies, retailers and others across the system share responsibility for helping our marae understand their options, from clear tariff advice to early guidance on network costs.

1.4.4 Rising gas costs

Many marae rely on bottled LPG for cooking, water heating and sometimes space heating. Bottled LPG is generally more expensive than reticulated natural gas. All gas prices are projected to increase faster than inflation due to depletion of domestic supply. Residential gas prices, including bottled LPG, rose over 30% from June 2025 to June 2026, and annual average commercial gas prices were up 24% from 2024 to 2025.⁴ For marae, this means the cost of powering commercial kitchens and hot water systems that run on gas is likely to keep climbing, compounding the electricity cost pressures already described above.

⁴ Stats NZ Consumer Price Index history, accessed September 2026

While marae on the reticulated gas network don't pay the LPG bottle delivery/subscription fee, they pay an additional fixed daily connection charge regardless of how much gas is actually used. These charges plus other fixed charges are around \$825 a year for connections classed as residential. Connection charges are higher for commercial customers and scale based on the size of the gas connection. As more households and businesses move off gas, the network connection charges are likely to increase as there are fewer customers to pay for the costs of maintaining the gas network. Vector, the country's largest gas network, is forecasting no new residential gas connections after 2028.⁵

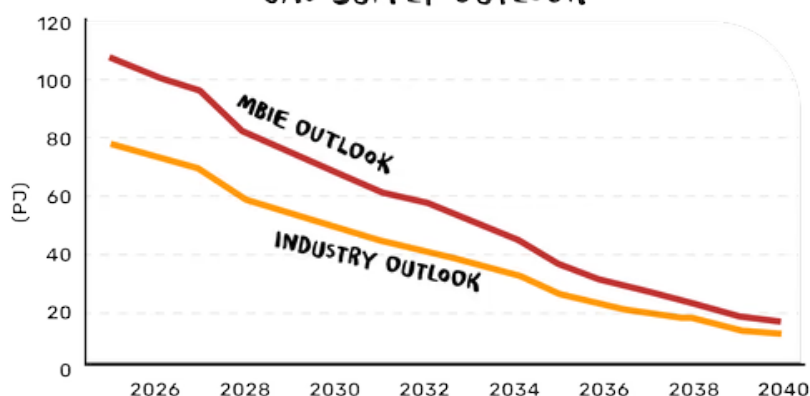
Excluding inflation, this increase is due to a shortage of supply. New Zealand's gas reserves were 27% lower as of January 2025 than the year before with the Ministry of Business, Innovation and Employment (MBIE) noting reserves "continue to reduce faster and sooner than previously forecast". Ultimately, gas is not a renewable resource, and it is running out.

GAS RESERVES ARE ...



**27% LOWER
THAN LAST YEAR**

GAS SUPPLY OUTLOOK



"[RESERVES] CONTINUE TO REDUCE FASTER & SOONER THAN PREVIOUSLY FORECAST" - MBIE

Overcoming this challenge

The best way to mitigate the economic impacts of rising gas costs is to avoid them entirely by getting off gas. Most often, this involves replacing gas appliances with electric alternatives. This is the same for both marae on LPG or on reticulated gas.

In the case of the reticulated gas network, systemic change is needed to avoid households, businesses, and marae being stranded on not only increasing gas usage costs, but also increasing fixed connection costs. Marae can publicly support and call for a planned, smooth wind down of gas networks that minimises the costs of the inevitable transition. More on this in Section 8 (Pathways for collective action).

⁵ <https://newsroom.co.nz/2025/12/09/no-new-gas-connections-from-2029-vector/>

1.4.5 Ageing buildings and appliances

Government funding for marae, through agencies such as Te Puni Kōkiri and various regional and central government grants, has supported meaningful upgrades for many marae over recent decades. That funding is typically contestable, project-specific and limited relative to the scale of need: a new roof here, a kitchen upgrade there, in place of the reliable, ongoing capital base most commercial or public buildings can draw on. Alongside it, and often filling the gaps it leaves, our marae continue to rely on what has always sustained them: hapū fundraising, koha and volunteer labour, from working bees repairing the roof, to committees running raffles and events to cover a shortfall, to tradespeople within the hapū giving their time and skills.

Many marae buildings, including the roofs that would carry solar, are ageing, and some are in poor condition. A comprehensive upgrade covering roofing, wiring, appliances and generation all at once comes at great expense. Wiring and switchboards installed decades ago are often not rated for the loads of a modern commercial kitchen, hot water system or solar and battery installation, and upgrading them competes for the same limited pool of grants, fundraising and volunteer hours as every other priority a marae committee is balancing.

Much of the cost of installing solar sits in labour rather than the panels themselves, so removing and reinstalling an array to repair or replace the roof partway through its life is costly and disruptive. If a roof is nearing the end of its life, it may pay to replace it before the solar goes on.

Overcoming this challenge

Our marae can make this transition step by step. The most achievable path is a series of good decisions, and planning, over time: whenever an appliance, wiring system or roof reaches the end of its life, choose the electric alternative over the fossil fuel option. The replacement cost was already unavoidable; the only choice is which technology takes its place. Made consistently, one replacement at a time, these decisions shift the entire energy footprint of a marae without adding extra large capital outlays (see Section 7).

For rural marae, ageing infrastructure extends beyond the marae gate to the single lines that serve them (see Section 4). Solar and batteries on site give these marae a source of power they control, whatever happens to that line.

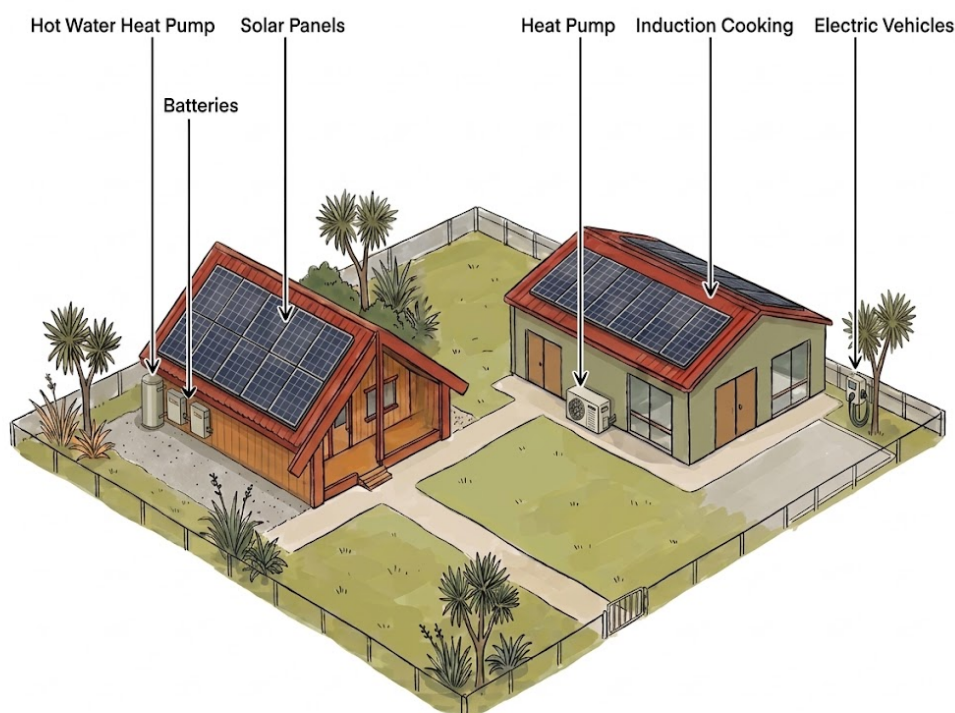
1.5 Te whai wāhitanga o ngā marae hiko | The opportunity for an 'electric marae'

Marae can reduce their dependence on fossil fuels by becoming an electric marae. In practice, this means replacing fossil fuel machines, including those used for space heating, water heating and cooking, with electric equivalents. Where possible, an electric marae also has solar and battery storage, giving it access to low-cost and highly resilient energy made in Aotearoa: electricity generated and stored on site, on their own whenua. In most cases an electric marae with solar and batteries stays connected to the grid, to support peak demand, to export surplus electricity and as backup supply.

Many of our marae are already on their electrification journey. Across the country, marae are lowering their energy bills with solar and batteries, keeping their wharenui comfortable with heat pumps and improving the air quality in their wharekai with electric cooktops.

Where an electric marae runs its own vehicles, they are electric too, and the marae may have EV chargers for its own fleet and for whānau vehicles. Some marae have gone further still: offering low-cost or free EV charging to their communities, sharing surplus energy with nearby whānau and neighbouring papakāinga, or selling it back to the grid to fund community kaupapa.

An electric marae also stands far stronger through grid outages and emergencies. Generating and holding its own energy frees it from volatile fuel prices and fragile supply chains shaped by events far beyond our shores, placing control of its energy back in the hands of the marae.



1.5.1 Wider opportunities

There are also wider opportunities that go along with the electrification of our marae:

Employment and training

Electrifying marae creates employment installing and maintaining solar, batteries, heat pumps and other technology. Iwi entities have set up kaupapa Māori solar and electrical businesses to do this work for their own and neighbouring communities, bringing an understanding both of specific usage and tikanga that outside contractors may lack. Each time a marae seeks to electrify its buildings is also a chance to train rangatahi as electricians, solar installers and technicians, keeping both income and expertise close to home.

Energy sharing

Advances in technology and falling costs mean customer-owned solar and batteries can play a critical role in New Zealand's energy system, making it more affordable, resilient and sustainable. Marae or other energy users with rooftop solar could gift or sell their excess generation to other customers. This needs some changes to the current electricity rules to enable customers to buy and sell electricity from more than one party (multiple trading relationships, MTR) and to be able to sell electricity to other customers (peer-to-peer trading). Once in place, these changes will unlock significant benefits.

Local peer-to-peer trading benefits both sides: sellers get more for their surplus generation, and buyers pay less than retail prices. It could also encourage people to use more electricity when local solar is in plentiful supply, easing pressure on local networks and getting more value from the infrastructure already in place.

Enabling industry

Marae are already set up for the creation of business with land, buildings and people. Cheap, self-generated electricity removes one of the biggest ongoing costs a business carries, lowering the barrier to starting one. A business idea that couldn't make the numbers work with high energy prices may well work with lower and more stable ones. Marae that occasionally support whānau business initiatives could become home to several small-medium enterprises.

Public & rural EV charging

Public & rural EV charging is another economic opportunity, with most marae already sitting on exactly what it needs: off-road parking, a sizable network connection and a location that people frequently pass by, particularly in rural areas. Hosting a fast charger could turn a marae's excess energy into an income stream. Proposed changes to the National Environmental Standards for Electricity Network activities would mean marae could install EV chargers for public use without needing resource consent. With the Government's target of

10,000 public chargers by 2030, marae are in a key position to fill the current gaps in EV charging.

Connected communities

For rural and isolated communities especially, a marae with abundant energy becomes a place people come for everyday needs, not only for hui and tangihanga. It can offer a community laundry, hot showers, freezers and chillers for kai from hunting, fishing and the māra, space for processing and preserving food, EV and e-bike charging, or simply somewhere warm and dry to gather.

1.5.2 Māori values in electrification

Beyond these economic, environmental, and resilience benefits, the electric marae can also be a living expression of core Māori values.

Mana motuhake

By generating and storing its own power with solar and batteries, a marae greatly reduces its reliance on centralised energy companies, on volatile global fossil fuel prices, and on a grid that can fail in an outage or emergency. Our marae decide how their energy is made, stored and used.

Rangatiratanga and kaitiakitanga

An electric marae is an act of rangatiratanga: hapū and iwi exercising leadership through decisions that lift the wellbeing of their people, their whenua and the generations to come. By choosing to cut emissions, harness renewable energy and reduce the reliance of our whānau on fossil fuels, we fulfil our role as kaitiaki and restore our relationship of kinship with Papatūānuku.

Funds freed from power bills can go wherever the hapū decides they matter most, from supporting whānau to long-deferred marae maintenance. That is rangatiratanga in practice, and because a marae stands across generations, those savings keep giving for as long as it stands. When whānau see their own marae running warm and well on their own power, many are inspired to make the same switch at home.

Manaakitanga and whanaungatanga

Electrification directly enhances manaakitanga by keeping the wharehau and wharekai comfortable all year round, warm in winter and cool in summer, and healthy for every whānau member and manuhiri who walks through the door. The savings from lower energy bills can be returned to the community, supporting hauora, education and cultural programmes.

1.5.3 Other buildings on marae

The electric opportunity extends beyond the core marae buildings. Many marae are also home to papakāinga, kaumātua flats and kōhanga reo, and electrification brings the same economic, environmental and resilience benefits to each of them.

Papakāinga and kaumātua flats have energy profiles much like any home, but the opportunity is greater than for a standalone house. Where several homes sit within the marae footprint, they can share energy infrastructure and draw directly on solar generated at the marae itself. The marae becomes a local energy source for its people, lowering costs for whānau and kaumātua and making the most of the solar already on site. Kōhanga reo are especially well suited to solar, running during daylight hours five days a week, right when solar generation peaks.

Part II

Ngā Painga Benefits

In Part II, we dive into the benefits of electrification, covering economic, emissions, broader environmental, and resilience advantages. This includes modelling that estimates the economic and emissions savings for six archetypal marae profiles.

We also talk about how energy sovereignty can contribute to Mana Motuhake and also the strengthening of the broader New Zealand energy system.

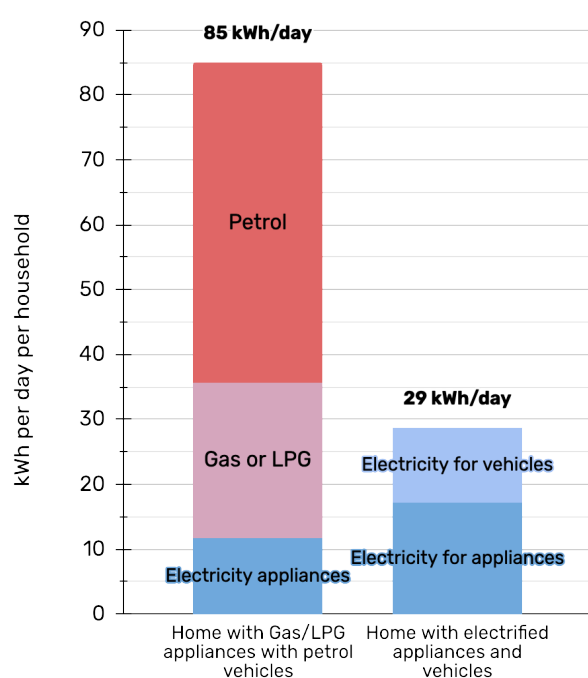
2 – Ngā painga ki te ōhanga me ngā tukunga | Economic & emissions benefits

In this section, we first give background on the economic and emissions benefits of electrification, and discuss the savings potential from solar and batteries. Then, we model the economic and emissions savings for six marae profiles, covering two broad size categories and three usage scenarios. These are generalised examples to illustrate how savings might look for different types of marae.

We also show savings estimates for each individual appliance and vehicle, as well as other common fossil-fuel machines you may use around the marae and may consider electrifying. We acknowledge that marae vary widely. We hope these provide useful comparison scales along which you may compare your own marae's energy needs and the potential savings from electrification.

2.1 Te whāmotanga pūngao | Energy efficiency

First and foremost, much of the benefit of electrification are derived from the higher efficiency of electric machines. Electric machines are more efficient than ones that involve burning fuels, using less energy to do the same job. Heat pumps are 3 to 4 times more efficient than gas or LPG heating (including water heating), induction cooktops 2 to 3 times more efficient than gas, and electric vehicles 3 to 4 times more efficient than petrol or diesel equivalents. While



electrifying a marae will increase total electricity consumption, total *energy* consumption goes down. This is illustrated in Figure 6 which shows the energy consumption for an average New Zealand household running on fossil fuels (gas and petrol) versus electricity (electric heating & cooking, and electric vehicles). Electrification allows us to maintain our current standards of living with much less energy than fossil fuels.

Figure 6: 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.

2.2 Te penapena i ngā utu whakahaere | Operating cost savings

Since electric machines consume less energy, they tend to be cheaper to run. This is the case when powered by Aotearoa-made renewable electricity from the grid, even more so when using electricity generated off our own roofs. The more heavily a machine is used, the higher the operating costs, and therefore the higher the potential savings from electrification. For example, a marae that uses a lot of hot water will save more when moving from a gas califont to an electric hot water heat pump, than a marae that uses less hot water.

For this reason, when considering the replacement of a gas appliance, it is important to look beyond the purchase price at the total lifetime cost of an appliance or vehicle. Currently, a hot water heat pump costs more upfront than a gas water heater, an electric mower costs more than a petrol one, an electric van more than an equivalent diesel van. However, this upfront cost difference may be paid off by the operating cost savings (and the prices of electric equivalents continue to drop and in some cases have reached parity).

Estimates of operating cost savings are modelled in Sections 2.6 and 2.7 below. **We have not modelled upfront costs for appliances, because the commercial-scale appliances that most marae use vary significantly in purchase price and installation costs.** We do include upfront costs and full lifetime cost comparisons for vehicles in Section 2.7.4 as the models and purchase prices do not vary as much between residential and commercial settings.⁶

For residential-size appliances which are much more predictable in upfront cost (purchase price + installation cost), we have charts comparing lifetime costs and net bill savings on our Electric Homes and Vehicles 2026 report page⁷ and our regional reports website.⁸ Please note these use residential energy prices, which may be different to what your marae pays if you are on commercial rates.

2.3 Te mauru i ngā tukunga pūmau | Permanent emissions reductions

Electric machines also produce fewer emissions during their lifetime of operation compared to their fossil fuel counterparts, partly due to their aforementioned lower energy consumption, but also because the form of energy used – electricity, generated in our highly renewable grid – is lower emissions than fossil fuels. The further our national grid continues to decarbonise, or if the marae uses its own solar energy, the emissions of using an electric machine reduce even further.

For a marae deciding whether to replace a dying gas califont or a worn-out petrol mower, it is important to remember that replacing like-for-like with a new gas califont or another petrol mower locks the marae into another 10 to 20 years of high emissions, as well as rising fuel

⁶ Although, fleet pricing may be available for bulk vehicle purchases.

⁷ <https://www.rewiring.nz/electric-homes-report>

⁸ <https://www.rewiring.nz/regional-reports/>

costs. Replacing it with the electric equivalent instead takes that fossil fuel machine out of circulation, and permanently reduces the operating emissions of your marae.

The emissions benefits are not limited to the machine itself. When a fossil fuel machine is retired (and not replaced with another fossil fuel model), we also eliminate the emissions involved in the extraction, refining, and distribution of the fossil fuels that it would have consumed.

2.4 Ngā papahiko me ngā pūhiko | Solar & batteries

Most marae buy all of their electricity from the grid, and are exposed to the rising prices and lines charges that we explored earlier. A small but growing number of marae across Aotearoa have added solar and batteries. Solar panels on the roof, or on whenua around the marae, turn sunlight into electricity that the marae can use directly, store in a battery to use when needed or export to the grid to offset bills or earn revenue.

Solar is the lowest cost electricity for most homes in Aotearoa, and for marae, it's likely to be the lowest cost electricity in most circumstances too. Here we will explore solar and batteries on marae in a few different ways.

2.4.1 Understanding basic solar savings and economics

One of the most important things to understand about solar economics is how the costs are spread over time. Solar panels are generally warrantied for about 30 years, and when purchasing them, it is to some degree an upfront purchase of all those years of energy. First we'll look at solar alone, and then solar with batteries.

For example, a typical household size solar installation might cost \$17,500 for 9 kW of solar.⁹ Over one year, that solar system (depending on where you are in New Zealand) might produce about 12,000 kWh of energy. Therefore, if the solar system only lasted one year, you would be buying 12,000 kWh of energy for \$17,500, which is about \$1.50 per kWh (i.e. per unit of electricity). But over 30 years, that solar system is likely to generate around 360,000 kWh of energy, split over that time the cost per unit of solar becomes about \$0.05 per kWh, or 5 cents per unit. This is lower than what most, if not all, marae and homes pay for their electricity.

This is where the savings come from with solar. They come from the energy you get from the purchase of solar panels being cheaper over its life than what you can buy from the grid.

Over that lifetime, you will likely need to replace the inverter of the solar system once or twice. As an assumption, that could cost around \$4,400 for a system this size for a replacement

⁹ This means that the system's maximum generation is about 9kW in perfect sunlight, which is very rare. Real-world generation fluctuates throughout the day. For example, it may ramp up to 5 kW in late morning, peaking around 8 kW at midday, then taper to zero at sunset. Total daily generation is the sum of all these hourly variations.

inverter. So the combined lifetime cost is \$21,900, and the cost per kWh with that included is around 6.1 cents per unit (\$0.06 /kWh, not including a small amount of panel degradation over the 30 year warranty period).

The system example here is quite small, and many marae could install much larger systems which may be more suitable to them, for example \$50,000 or \$200,000 systems that produce far more energy. The reason we use this simple example above is to show how the economics spread over time and calculate unit prices. The way this breakdown works does not change much based on size, the end cost per unit might be a little different based on installation specifics, but the general principles remain the same.

As systems get larger, the price per unit usually falls as well. A larger scale system costing \$200,000 might settle out at a cost per unit closer to 4 cents. Again this depends on many individual building installation factors.

There is more nuance to solar economics, for example the loan cost if the system is financed, and the economics of the energy sold back to the grid. These we will explore further below.

2.4.2 Understanding solar financing and borrowing costs

Most homes and marae don't just have \$20,000 or \$100,000 that could be spent on a solar system. There is an opportunity cost to using that money. For example, if it was in a bank account or investment, it may earn interest. For this reason it's also good to understand solar economics *after* financing costs, as this is a way to understand how savings can be unlocked from day one.

If we start with that same system size we mentioned above, a 9kW household scale system for \$21,900, we can then look at the cost of borrowing that capital and repaying it over time.

Different marae, just like different homes, have access to different financing rates. If we use an average mortgage rate of about 5.5% per year interest, and pay back the solar system over its 30 year life, the interest costs are also about 6 cents per unit, so combined the system ends up costing about 13 cents per unit after finance. At a household level, we estimate this often saves about \$500 - \$1000 per year net.

A larger system lowers both the capital per unit, and the interest too because of the cost benefits of scale. A lower interest rate can lower these repayment costs too.

The most important thing to consider about the finance option is that it often enables savings from day one. So there is no cost or cashflow hit, and the bill savings are higher than the repayments. But if marae have access to capital to pay for the systems themselves, then it's also possible to avoid paying that interest cost.

2.4.3 Solar usage and export

Solar you don't use is exported to the grid (assuming the marae is connected), and you are paid an amount per unit of electricity by your energy company for what you provide back. Generally the cost to buy electricity is higher than the cost paid by an energy company to the user, so it's important to take this into consideration when sizing a system.

Usually what will produce the most savings is maximising the amount of solar "self-consumed" or used by your own buildings and appliances, with only the remainder or sometimes none being exported to the grid. This is where batteries can also help by soaking up any excess, to use later.

The size of your solar system should take these considerations into account. A solar installer will be able to advise on options here based on your bills and energy consumption behaviour.

As an example, if a marae self-consumes 50% of the solar it generates, then the savings are determined by a mix of *buying less* energy from the grid, and earnings from *selling excess* energy to the grid. While energy prices will be different for each region and marae electricity contract, an example would be a marae paying 25 cents for electricity being purchased from the grid, and being paid 12 cents for what it sends back. In this case, it is worth twice as much to the marae to use the solar it generates itself than to sell it back. Often with a large system there will still be excess, so the end economics and savings are a mix of those two prices. A marae self-consuming 100% of its solar energy would be saving 25 cents for every unit, another marae with a mix of self generation and export might save an average of those two at 18 cents or so.

2.4.4 System sizing

System sizing impacts both the economics of the system and its ability to provide useful resilience and enough energy through all seasons. The main determinants of system size for your own marae are likely a mix of these factors:

- A. Amount of energy consumption** - How much energy your marae is consuming will change the size of the solar system which makes the most sense. A marae with rare, seasonal energy spikes and not much energy use in between may only be suitable for a small system from an economic perspective, though may still prefer to invest in a larger system for the resilience benefits it can bring. How well this consumption aligns to the solar window (daytime peak sunlight hours) also impacts this. A marae with large regular energy use can likely financially justify a much larger solar system because of the financial benefits of doing so - there are more energy bills to avoid and therefore save more.
- B. Seasonal generation importance** - In winter solar generation is lower than in summer. This will be changed by panel angle and location, but can be only about 40% of what is generated normally. While a certain size system might be right on average throughout the year, that can leave a shortfall in winter. A marae may want to install a larger system so that in winter it still has enough or more than enough.

C. Resilience value - When combined with a battery, solar can provide a large amount of resilience value to marae. It means the lights can be kept on, the fridge and heaters running, and it can be a place of energy refuge in an emergency. This resilience consideration is a strong reason that many marae may want to size the system much larger to provide this safety. When joined with a battery, the excess solar can go into charging that battery. The size of both the solar and battery system can be based on how much resilience is desired. It could be enough resilience for a 1 hour blackout, or enough for 3 days or a week of energy independence in an emergency. Most of that is determined by the battery size which we will go into in the next section.

When getting quotes for a solar system, explain your aims to the different installers (we recommend going to at least 3 or 4 to compare), and have them walk you through the different ways to meet the needs you are aiming for, be they saving money, or providing long duration resilience and shelter, or both.

2.4.5 Batteries

It's important to note that a solar system by itself does not necessarily provide any backup or resilience. When the grid goes down, most buildings with a solar system and no battery will automatically turn off the solar system. This is to keep our electricity system safe and to not have energy flowing back into the grid while workers may be trying to fix it.

This is where having a battery changes things. It can be set up to store enough electricity to power parts of or the entire marae itself, and in a blackout be set to automatically turn on and back them up for a period of time. There are some homes around the country that don't even notice blackouts because this functionality has been set up, having a level of energy resilience that makes short term disruptions hard to notice.

A battery can also store energy till later in the day and sell it back to the system at a higher price, which can help the battery pay for some of its cost, so a battery with resilience value can earn back significant value in selling electricity at a higher cost to the market. There are dual benefits here. Generally today in 2026, batteries often do not by themselves make economic sense, once combined with solar they do, but only up to a certain size. So choosing battery size is a question of how much resilience a marae is looking to achieve with the battery more so than one of economics.

It's important to specify to installers when asking for quotes that backup functionality is something you are looking for. Not all batteries do this by default, and it is generally more expensive to set up. When a small battery is chosen, it's likely only a few specific building circuits can be backed up, for example lighting and kitchen. A large battery can also be installed to back up every circuit and device in the building, but will come at higher costs.

2.4.6 Installing and looking after solar

Most marae will start with solar on the roof. Panels can go on any existing roof in good condition, and because most marae roofs are corrugated or long-run iron, installation is usually simple and affordable. For marae with land that sits unused, or could be put to better

use, a ground-mount system is another option. Here the panels sit on purpose-built frames in the ground. These systems cost more to install, but they can hold a much larger array than a roof and make productive use of whenua that might otherwise sit idle. The land underneath can often still be grazed.

It is recommended to get multiple quotes, usually three or four, then you can compare the options and see what will work best for you. There is more information on getting quotes in Section 6, Step 4.

It's important you don't get stuck at this step, which is one of the places many people get stuck. They get a few quotes, and the information is overwhelming so they move it to the side and prioritise everything else in their busy lives. This is the stage to push through and make a decision. Reach out to homes, marae, and local businesses who have got solar and chat to them about the decision you're looking to make. People are usually happy to share their solar story, and it can be incredibly helpful to hear from a trusted local voice.

A common worry is that solar is a burden to look after once it's in. It isn't. There are no moving parts, no fuel to buy and nothing to refill, and rain does most of the cleaning. Once a year, check the panels for lichen, bird droppings, dust or, on coastal marae, salt spray, and clean them with plain water and a soft brush. Avoid harsh chemicals or anything abrasive, which can damage the panels and void the warranty. If there's a Rewiring community group in your area, they can likely support you too with advice: <https://www.rewiring.nz/communities>

2.5 Ngā kōtaha marae | Marae profiles

Unlike residential households, marae have a lot of variance in size and energy profile, making a single “average marae” not very representative. To capture this diversity, we have built six composite marae profiles based on real data and conversations with marae across the country. There are two size categories, which contribute to factors such as heating energy needs and peak loads, and three usage levels (i.e. how actively the buildings are occupied each week) which determines appliance requirements (e.g. how much hot water do they need at a given time?) and overall energy demand.

We include energy consumption from indoor space heating, water heating, and cooking. The assumption is that all of the marae are currently running on gas, and we then model the bills and emissions savings potential from electrifying these gas appliances. We recognise that marae usually have many more machines that use energy, such as commercial ovens, chillers, lighting, etc. However, they have been excluded from the scope of this report as many of these are already electric therefore don’t have as much to “gain” in terms of benefits from electrification, or they are not significant energy users. We have also not modelled savings from solar & batteries due to high variability of commercial scale installs¹⁰. Vehicles and machines used in taiao work – mowers, ATVs, and power tools – are modelled separately in Section 2.7.4 and Section 2.7.5.

Table 1 shows a summary of these profiles. Below is a brief summary of the three usage characteristics:

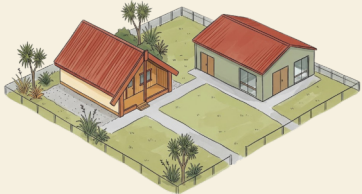
- **Lower use:** Predominantly used during weekends and tangihanga. Long quiet stretches with little activity.
- **Medium use:** Staffed during the day, wānanga during the week, plus support services. A mix of predictable daily use and event-driven spikes.
- **Higher use:** Activity seven days a week. All appliances running close to constantly given the daily staff, services and visitors on site.

In addition to this usual level of activity, we assume 1 tangihanga per month for all marae sizes and usage levels.

These six profiles are used throughout the next two sections 2.6 and 2.7 to illustrate the economic and emissions advantages of running a marae on electric machines rather than ones that require fossil fuels. Our intention is for these profiles to provide a simplified comparison point for marae looking to understand the opportunity as it relates to them, by looking at examples similar to their own.

¹⁰ Benefits of solar & batteries are discussed in Section 2.4 and Section 4.

Table 1: Example marae profiles and their main machines

Marae profile	Smaller marae			Larger marae		
	Single hapū, often rural, usually with a whare nui, wharekai and ablutions block. Run by hau kāinga, mostly on a volunteer basis, with few or no paid kaimahi. Serves a close, local community, with numbers swelling for tangihanga and large hui. Hot water, cooking and heating are closer to household scale, apart from commercial cooktops in the wharekai. 			Pan-iwi, multiple buildings and services under one roof, from a kōhanga reo, iwi entity office or Whānau Ora services. Often kaimahi are employed for the running and maintenance of the marae. Serves a wide, often scattered community rather than one hapū. Hot water, cooking, and heating are all commercial scale. 		
	Lower use	Medium use	Higher use	Lower use	Medium use	Higher use
Indoor area	132 m ² of whare nui, 200 m ² of whare kai			250 m ² of whare nui, 400 m ² of whare kai		
Heaters	1 large gas flued convection heater in whare nui 2 large gas flued convection heaters in whare kai			2 large gas flued convection heaters in whare nui 3 large gas flued convection heaters in whare kai		
How often the marae is occupied	1 day per week, 8 hours total	2 days, 1 night per week, 36 hours total	4 days, 3 nights per week, 84 hours total	1 day per week, 8 hours total	2 days, 1 night per week, 36 hours total	4 days, 3 nights per week, 84 hours a week total
	Tangihanga: 3 days/month of 24 hours of heating a day, 72 hours per month total.					
Water heaters	3 x residential-sized instant gas water califonts			5 x larger instant gas water califonts		
Water heating usage	1 day per week of use in the kitchen only	2 days per week of kitchen use, 1 overnight of showers	4 days per week of kitchen use, 3 overnights of showers	1 day per week of use in the kitchen only	2 days per week of kitchen use, 1 overnight of showers	4 days per week of kitchen use, 3 overnights of showers
	Tangihanga: 3 days/month of kitchens on for three meals a day, ablutions water being used nonstop throughout.					
Cooktops	2 x commercial four-burner hobs			4 x commercial six-burner hobs		
Cooktop usage	2 of 4 burners on both hobs at 50% power, 6 hours a day, 1 day a week.	2 of 4 burners on both hobs at 50% power, 6 hours a day, 2 days a week.	2 of 4 burners on both hobs at 50% power, 6 hours a day, 4 days a week.	3 of 6 burners on all 4 hobs at 50% power, 6 hours a day 1 day a week.	3 of 6 burners on all 4 hobs at 50% power, 6 hours a day, 2 days a week.	3 of 6 burners on all 4 hobs at 50% power, 6 hours a day, 4 days a week.
	Tangihanga: 3 days/month, 3 of 4 and 4 of 6 burners respectively on all cooktops at 50% power, 6 hours/day.					

While these six profiles may cover a range of sizes and energy demand, there is still the question of location which impacts the following:

- **Gas type:** Your marae may be connected to a reticulated natural gas network, although the vast majority use LPG bottles. We have modelled for both savings when switching from natural gas or LPG. LPG tends to cost more per unit of energy, so the bill savings are usually higher unless overall usage is very low. Natural gas has a yearly connection cost which can be a significant proportion, especially if you are already on your electrification journey so the cost of this connection is not spread across as many appliances.
- **Regional heating needs:** Colder regions will have higher heating needs, and usually get more savings as a result. You can compare your region's heating needs with the rest of the motu in Figure 21 in Section 2.7.1.
- **Energy price:** The price of gas, wood, and electricity will vary across distribution networks and regions. Electricity in particular can vary quite a lot; it is generally cheaper in more urban areas. It is also cheaper per kWh for larger marae on larger connections. We use 23.7 c/kWh for the smaller marae profiles, and 21.2 c/kWh for the larger marae profiles.

There may of course be additional nuance that is not captured within these profiles, such as local topography (e.g. nestled in a cold valley or on top of a sunny hillside), or the age of existing electricity infrastructure. However, these profiles should give a baseline against which you may compare your own marae's current standpoint.

2.6 Te whakatauirā i ngā penapenatanga a ētahi marae tauira | Modelling of example marae savings

The following charts illustrate the potential bill and emissions reductions for the six marae profiles if all gas cooking, water heating, and space heating are replaced with electric options. We assume the gas type is LPG bottles, as this is the most common gas type in marae throughout the motu. We have assumed the following conversions:

- Gas flued convection heater to heat pump
- Gas instant water califont to hot water heat pump
- Gas cooktop to electric resistive cooktop¹¹

Due to the unique characteristics of each marae, these figures serve as indicative examples only to assist marae in exploring feasibility for their own unique energy profiles.

¹¹ We chose this over induction for pragmatic reasons, so that marae can continue using its existing pots and pans as induction requires magnetic cookware with perfectly flat bases, which may rule out well-loved cookware. While peak electricity draw remains a consideration for the cost of installing commercial-scale resistive cooktops, the extreme speed and temperature precision of induction are assumed to not be as critical in a whare kai as they would be in a high-end commercial restaurant, making resistive cooktops a fit-for-purpose and cost-effective alternative to gas.

2.6.1 Yearly bill savings

Figure 7 to Figure 12 show the estimated bill savings from electrifying all of the gas appliances in each marae profile from Table 1. For the “smaller, lower-use” marae (Figure 7), moving from LPG heating and cooking to heat pumps and electric cooking could save around \$5,000 per year in bills. At the other end of the scale, the “larger, higher-use” marae could save up to \$21,000 annually (Figure 12).

When considering electrification, it is helpful to weigh these yearly bill savings against the upfront purchase and install costs (capex). Buying new electric appliances generally requires a higher initial investment than buying new gas equivalents.¹² However, because electric appliances are much more efficient and therefore usually cost less to run, that upfront price difference pays itself off over time. Given that commercial appliances typically last around 15 years, the savings estimated for our marae profiles show a strong economic case for going electric.

To provide a rough order of magnitude, we compared the cost of buying an entirely new gas setup versus an entirely new electric setup. Worst-case pricing refers to if the gas appliances are at the cheapest end of the price range, and the electric ones at their most expensive; best-case pricing, vice versa.

Smaller marae (approx. \$5,000 yearly bill savings)

- 3 x heaters, 3 x water heaters, 2 commercial 4-burner cooktops
- **Worst-case pricing:** A new gas setup costs ~\$30k, while a new electric setup costs ~\$75k. The \$45k capex premium to go electric pays for itself in about 9 years.
- **Best-case pricing:** A new gas setup costs ~\$35k, while a new electric setup costs ~\$45k. The \$10k premium pays for itself in about 2 years.

Larger marae (approx. \$21,000 yearly bill savings)

- 5 x heaters, 5 x water heaters, 4 commercial 6-burner cooktops
- **Worst-case pricing:** A new gas setup costs ~\$50k, while a new electric setup ~\$140k. The \$90k premium pays for itself in under 5 years.
- **Best-case pricing:** A new gas setup costs ~\$65k, while a new electric setup ~\$80k. The \$15k premium pays for itself in under a year.

While these profiles may provide a useful baseline, actual upgrade costs at your marae will depend on several real-world factors:

- **Appliance efficiency and sizing:** Our estimates conservatively assume a one-to-one appliance swap. In reality, modern electric appliances are highly efficient; a single well-

¹² Except in the case of space heaters where heat pumps are actually cheaper than flued convection gas heaters.

placed heat pump might comfortably replace two older gas heaters, which would lower the total upfront cost.

- **Installation and infrastructure:** Electrifying a marae increases its peak electricity demand. Depending on the age and size of your existing infrastructure, you may face additional installation costs to upgrade your switchboard, increase your connection size, or upgrade local transformer capacity.

Smaller, lower-use marae: yearly bills & savings

1 busy day a week + 1 tangi per month. Excludes upfront costs. Based on 2026 dollars.

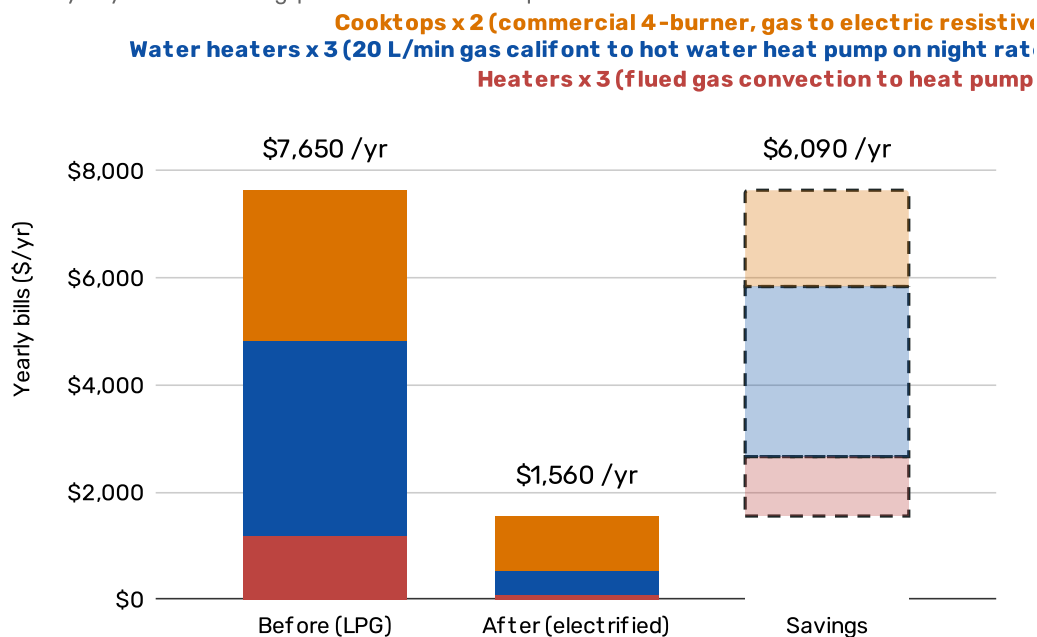


Figure 7: Comparing yearly bills for a “smaller, lower-use” marae with all LPG appliances vs. all electric

Smaller, medium-use marae: yearly bills & savings

2 busy days a week + 1 tangi per month. Excludes upfront costs. Based on 2026 dollars.

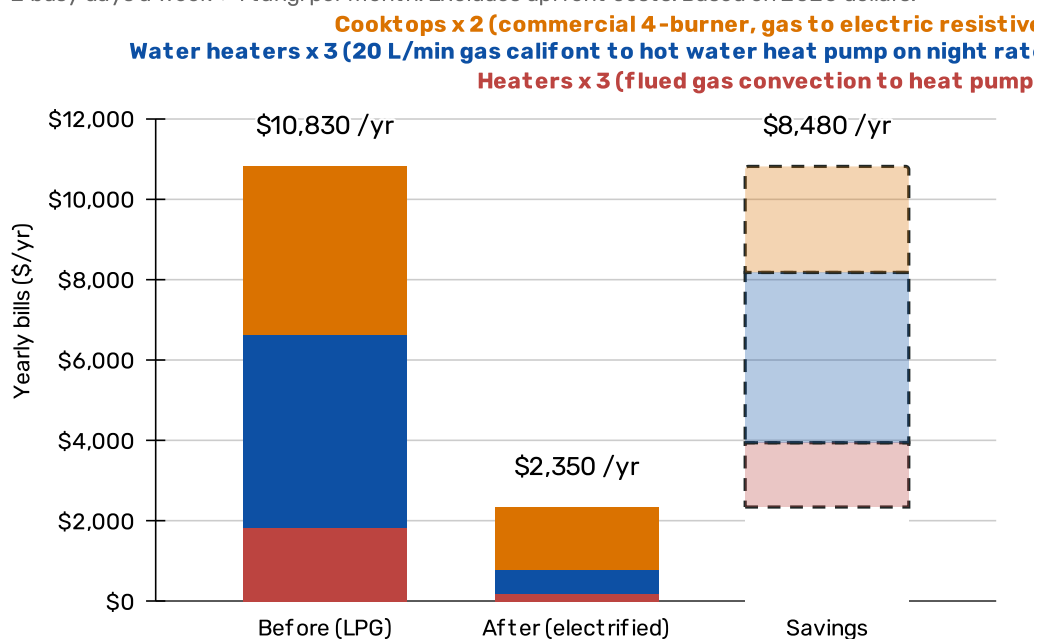


Figure 8: Comparing yearly bills for a “smaller, medium-use” marae with all LPG appliances vs. all electric

Smaller, higher-use marae: yearly bills & savings

4 busy days a week + 1 tangi per month. Excludes upfront costs. Based on 2026 dollars.

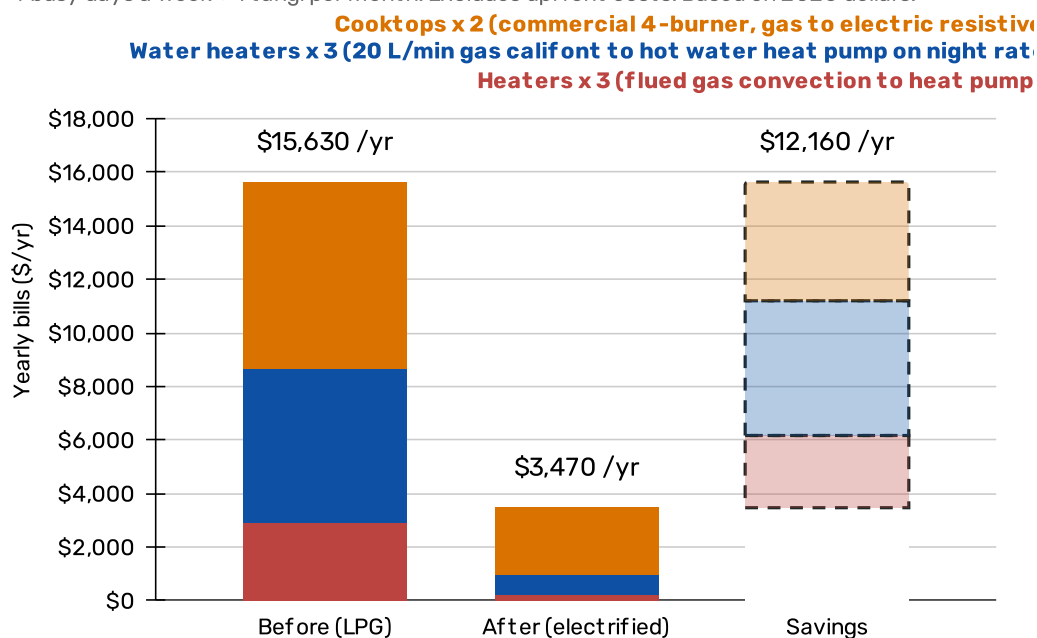


Figure 9: Comparing yearly bills for a “smaller, higher-use” marae with all LPG appliances vs. all electric

Larger, lower-use marae: yearly bills & savings

1 busy day a week + 1 tangi per month. Excludes upfront costs. Based on 2026 dollars.

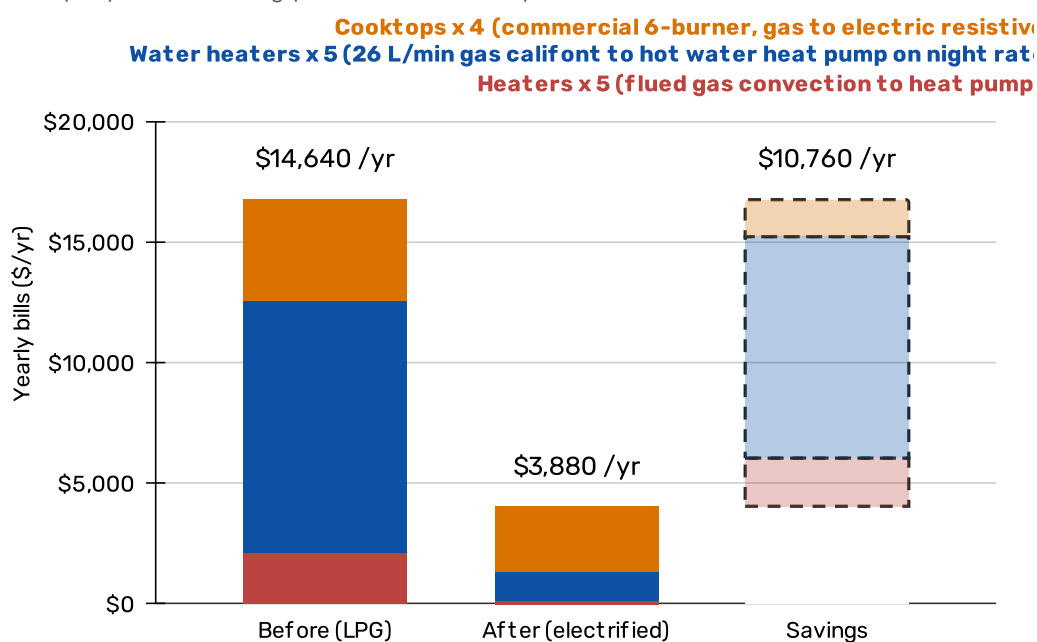


Figure 10: Comparing yearly bills for a “larger, lower-use” marae with all LPG appliances vs. all electric

Larger, medium-use marae: yearly bills & savings

2 busy days a week + 1 tangi per month. Excludes upfront costs. Based on 2026 dollars.

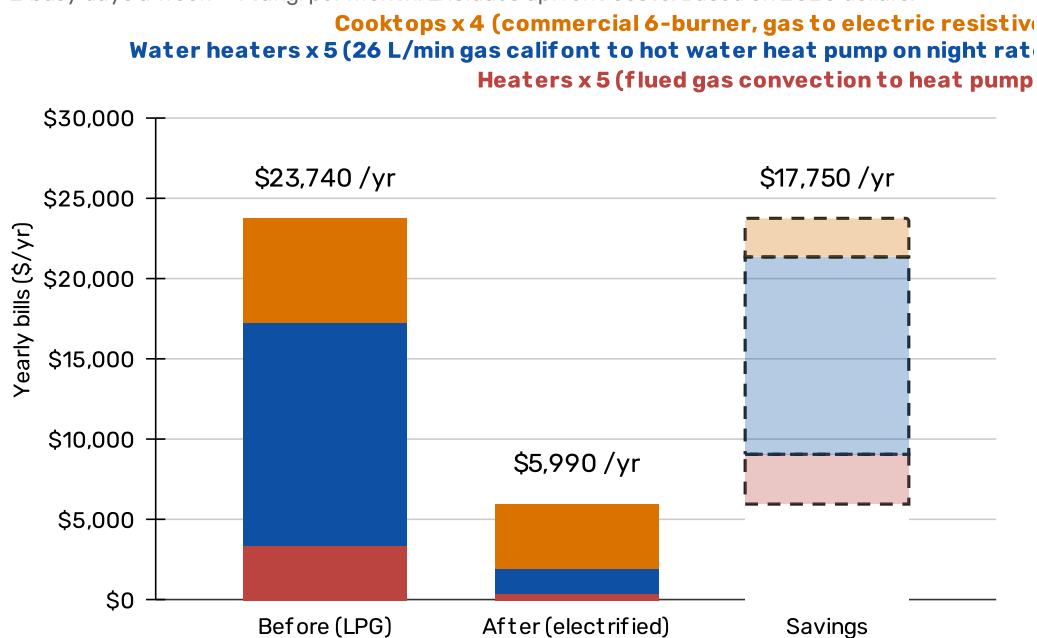


Figure 11: Comparing yearly bills for a “larger, medium-use” marae with all LPG appliances vs. all electric

Larger, higher-use marae: yearly bills & savings

4 busy days a week + 1 tangi per month. Excludes upfront costs. Based on 2026 dollars.

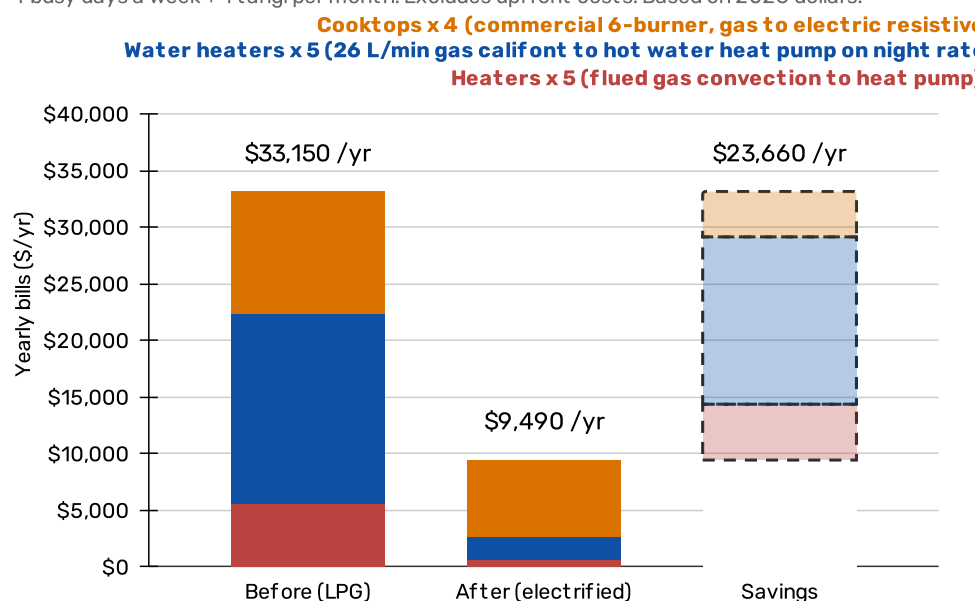


Figure 12: Comparing yearly bills for a “larger, higher-use” marae with all LPG appliances vs. all electric

2.6.2 Yearly emissions savings

Figure 13 to Figure 18 show the estimated greenhouse gas emissions savings from electrifying all of the gas appliances in each marae profile from Table 1. For a “smaller, lower-use” marae (Figure 13), replacing LPG appliances with electric alternatives cuts yearly emissions from 2,340 kgCO₂e down to 260 kgCO₂e, a saving of over 2 tonnes of CO₂e per year. At the highest end of our scale, the largest and busiest marae profile (Figure 18) could save around 7.6 tonnes of CO₂e every year. This is around a 90% reduction.

These reductions occur because New Zealand’s electricity grid is highly renewable and electric machines are more efficient. On the other hand, burning gas like LPG or natural gas is less efficient and it releases warming pollution into the atmosphere, contributing to climate change. A further benefit of electrification is the health benefits from the toxins produced during indoor gas cooking in particular; health impacts are discussed further in Section 3.2.2.

Smaller, lower-use marae: yearly emissions savings

Electrifying 2 x commercial cooktops, 3 x water califonts, 3 x flued convection heaters

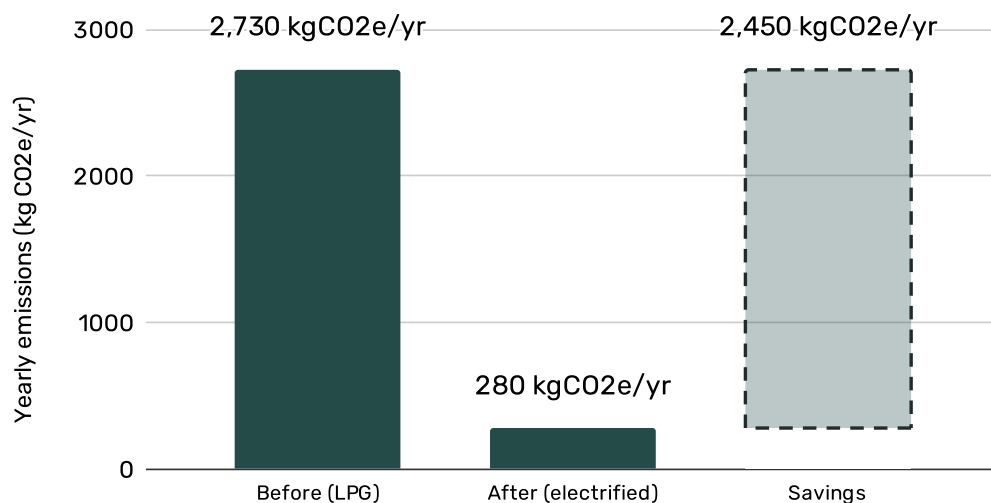


Figure 13: Comparing yearly emissions for a “smaller, lower-use” marae with all LPG appliances vs. all electric

Smaller, medium-use marae: yearly emissions savings

Electrifying 2 x commercial cooktops, 3 x water califonts, 3 x flued convection heaters

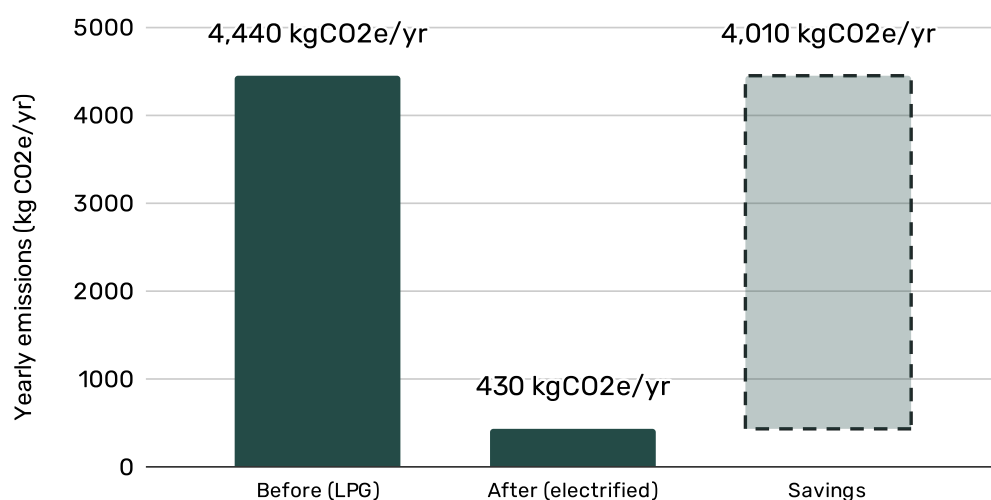


Figure 14: Comparing yearly emissions for a “smaller, medium-use” marae with all LPG appliances vs. all electric

Smaller, higher-use marae: yearly emissions savings

Electrifying 2 x commercial cooktops, 3 x water califonts, 3 x flued convection heaters

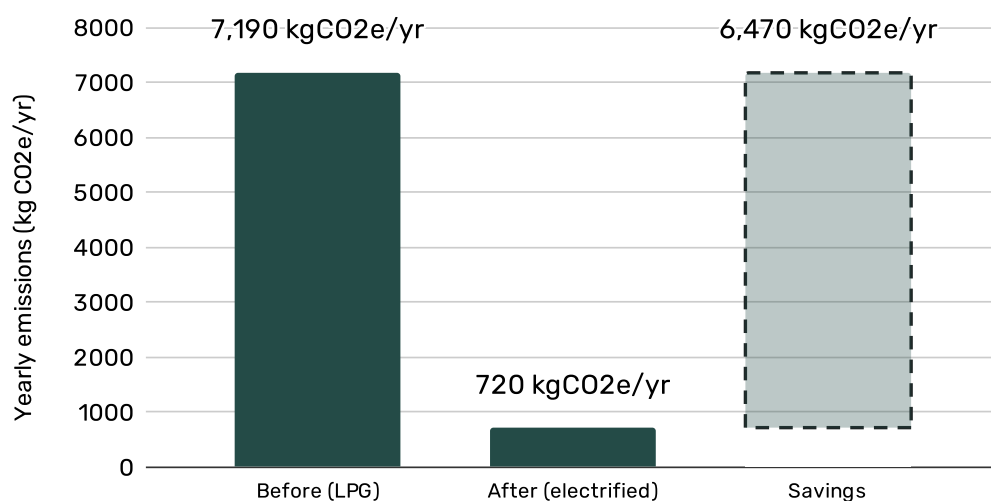


Figure 15: Comparing yearly emissions for a “smaller, higher-use” marae with all LPG appliances vs. all electric

Larger, lower-use marae: yearly emissions savings

Electrifying 4 x commercial cooktops, 5 x water califonts, 5 x flued convection heaters

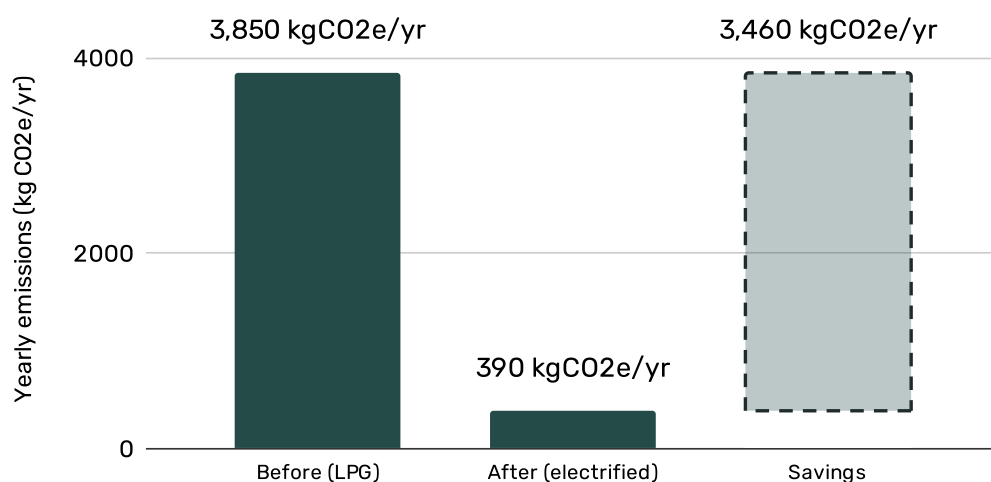


Figure 16: Comparing yearly emissions for a “larger, lower-use” marae with all LPG appliances vs. all electric

Larger, medium-use marae: yearly emissions savings

Electrifying 4 x commercial cooktops, 5 x water califonts, 5 x flued convection heaters

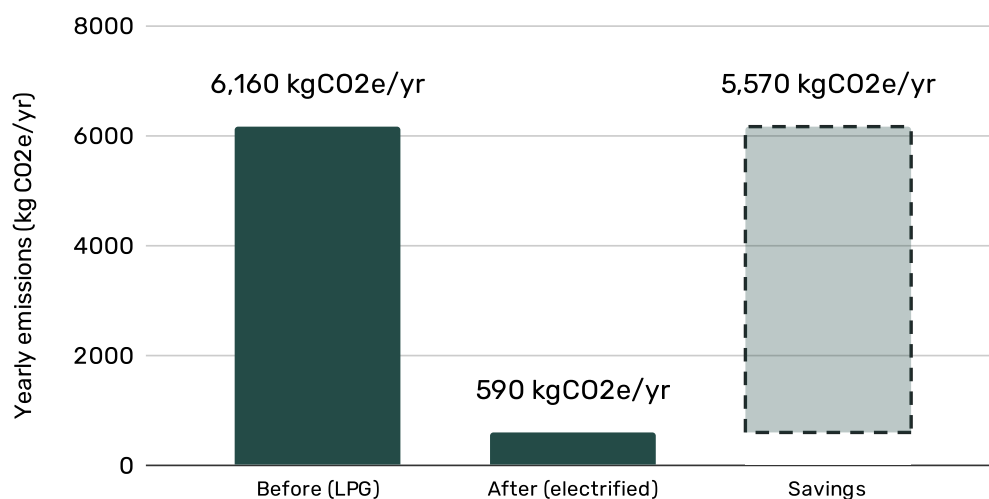


Figure 17: Comparing yearly emissions for a “larger, medium-use” marae with all LPG appliances vs. all electric

Larger, higher-use marae: yearly emissions savings

Electrifying 4 x commercial cooktops, 5 x water califonts, 5 x flued convection heaters

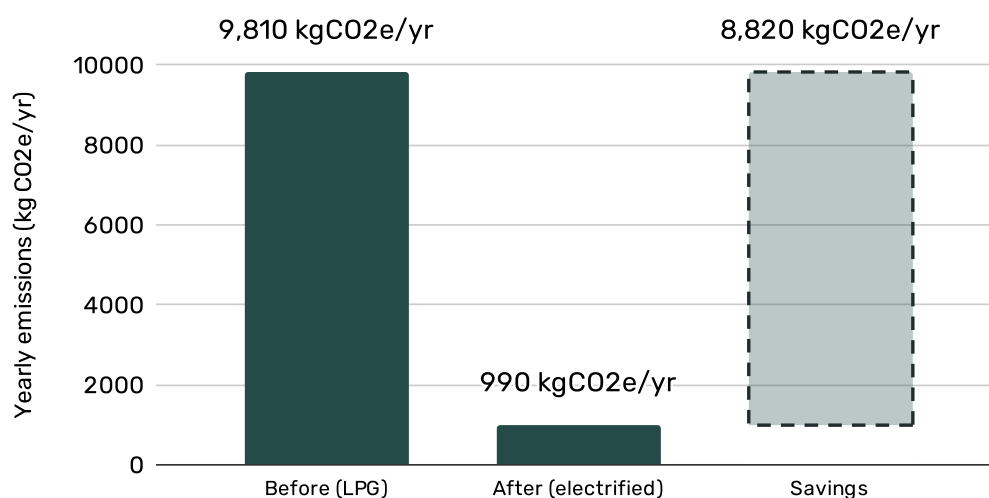


Figure 18: Comparing yearly emissions for a “larger, higher-use” marae with all LPG appliances vs. all electric

2.7 Te whakatauirā i ngā penapenatanga a tēnā mīhini, a tēnā mīhini | Modelling of individual machine savings

Below, we show the potential operating cost and emissions savings for single machines that use significant energy on the marae:

- space heating (how we heat our rooms)
- water heating (hot water)
- cooktops
- vehicles
- other machines like lawn mowers and ATVs

This is to individually show the building blocks that make up savings from electrification. It allows you to get a rough idea of how much you can save from sequencing your upgrades, for example if you wish to start out by swapping just one gas cooktop out of the four that you have in the wharekai.

How we account for fixed gas connection costs

In our yearly bills modelling for each appliance, we account for the yearly fixed gas connection costs. For the reticulated natural gas network, we very conservatively estimate this to be \$825/year total (residential NZ average). This will likely be higher for larger marae, as it scales with the maximum rate of gas supply to the site. For bottled LPG, the subscription/bottle delivery fee is once again conservatively estimated using residential pricing at \$138/year. We include this because once you completely electrify, you will no longer need to pay this cost, and therefore it forms part of the potential savings from electrification.

For each of the natural gas and LPG appliances in the sections below, we include a portion of this fixed cost, in proportion to the energy use of the given appliance compared to all other gas appliances in a typical New Zealand household that runs entirely on gas.¹³ While a marae's energy profile is not exactly like a household, by splitting up this fixed cost, we are able to at least price in some of the true cost of a gas subscription.

¹³ [2021 Residential Baseline Study for Australia and New Zealand for 2000 to 2040](#)

2.7.1 Space heating

Many marae heat their wharehau and other spaces with gas burners (usually flued convection), electric resistive radiant heaters, or wood fires. These come with the same exposure to increasing energy costs, higher emissions, and the ongoing hassle of gas bottle deliveries or wood supply.

The electric alternative is a heat pump. Heat pumps are around three to four times more efficient in comparison to their gas or traditional electric resistive counterparts. The other benefit with heat pumps is their air conditioning function. Many marae discussed using air conditioning during tangihanga to preserve tūpāpaku, particularly during the heat of summer. Heat pumps offer this versatility.

Figure 19 and Figure 20 compare the yearly bills for heating marae with gas, wood, and electric options. Not only are heat pumps cheaper to run, but they usually cost less up front than an equivalent gas convection heater. A large heat pump may cost around \$3400 including install, while a large flued gas convection heater may cost on average \$4,900 including install; **the heat pump is around \$1500 cheaper upfront, while also being cheaper to run.** Over a 15 year operational lifetime, the **total bill savings could be between \$8,200** for the smaller marae low-use scenario, **and \$44,600** for the larger marae high-use scenario.

It should also be noted that due to the energy efficiency of heat pumps, they can sometimes replace more than one gas or electric resistive heater. For example, one large heat pump may do the job of multiple wall-mounted panel heaters. If you have a very large wharehau or a complex of buildings, you may consider a ducted system. This would increase the upfront costs, but not the yearly bills which are only dependent on your energy demand.

Yearly bills (2026) per heater at a smaller marae with 3 large gas heaters

Includes gas fixed bills portion, \$432/yr for natural gas, \$207/yr for LPG. Include 1 tangi per month.

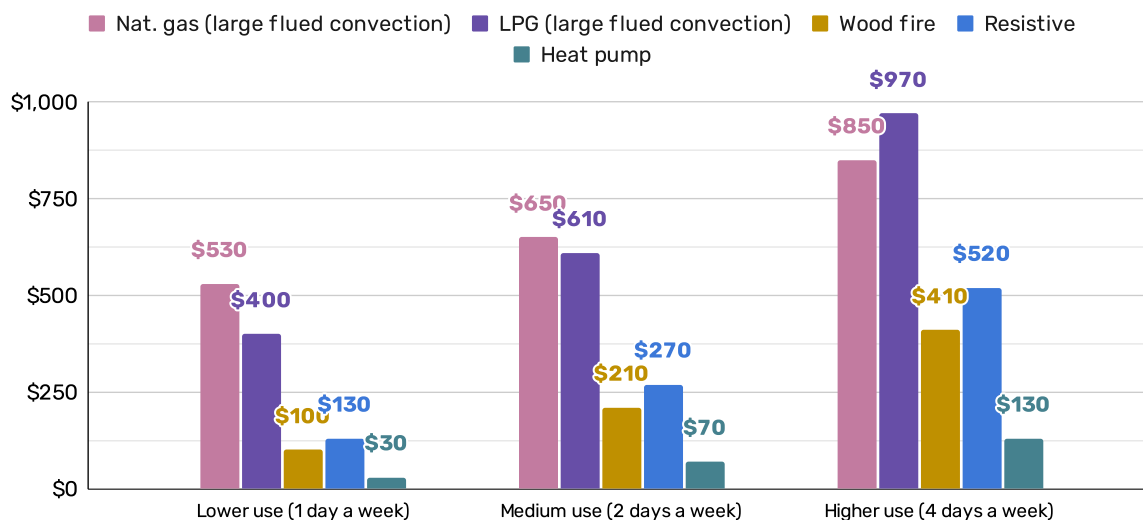


Figure 19: Comparison of energy bills (2026) per space heater. Usage is based on the “smaller marae” profiles.

Yearly bills (2026) per large heater at a larger marae with 5 large gas heaters

Includes gas fixed bills portion, \$432/yr for natural gas, \$207/yr for LPG. Include 1 tangi per month.

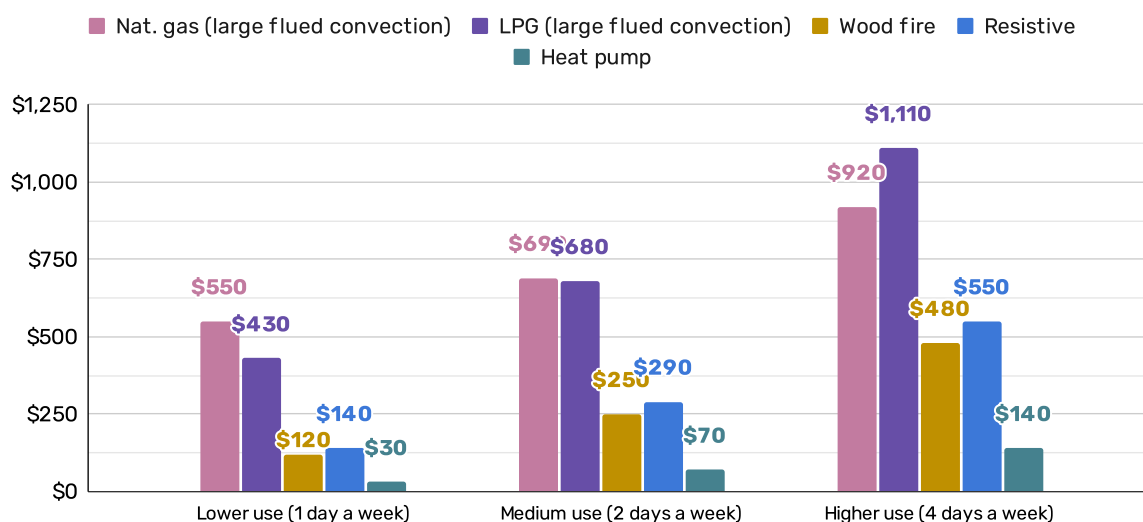


Figure 20: Comparison of energy bills (2026) per space heater. Usage is based on the “larger marae” profiles.

Heating needs across regions

Regional space heating energy needs

Based on RBS 2021 energy baselines adjusted to COP of each device and regional heating hours from EECA.

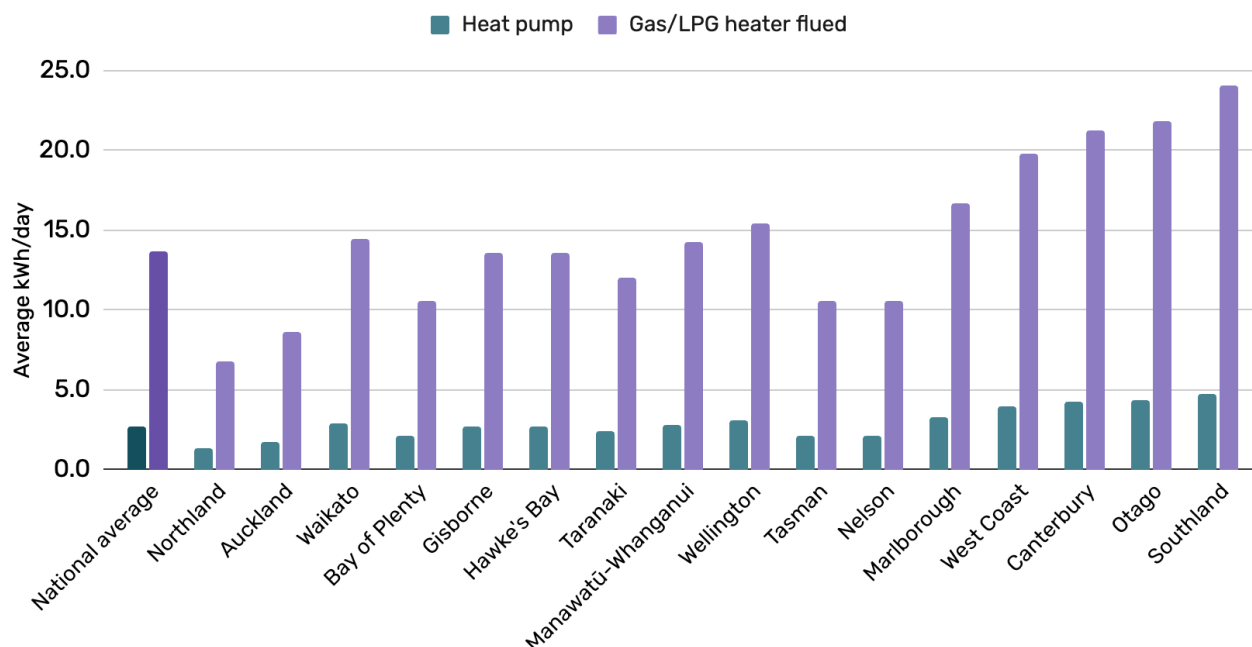


Figure 21: Average daily residential household heating needs per region

The extent of a marae's space heating needs varies with local climate, building condition, and how warm a marae likes to keep its spaces. We have not modelled for these variables, and instead have used national averages in our modelling above. Figure 21 compares how much space heating is required across different regions. Find your region, and if your region has higher heating needs than the national average, then your savings are likely to be higher than those shown in our modelling. For example, if your marae is in Murihiku/Southland, the heating needs are almost twice as high as the NZ average, and therefore if you're using LPG, you will be paying more to heat your marae, and therefore will save more from electrification.

Heat pump efficiency differences between regions

Heat pump (room/air heating) efficiency per region

Source: EECA Home Energy Savings Calculator

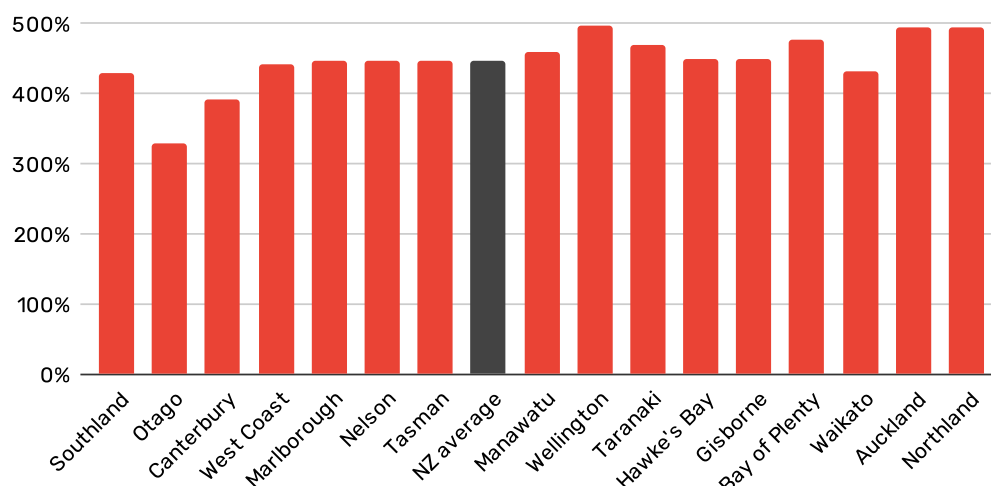


Figure 22: Heat pump efficiency values per region

Heat pumps work well in cold conditions. They have been tested down to -30°C and continued to outperform gas, wood, and resistance heaters, remaining at least twice as efficient even in extreme cold conditions far harsher than anything experienced in Aotearoa.¹⁴ Having said that, efficiency does decrease slightly in colder climates.¹⁵ You can find where your region sits compared to the NZ average efficiency in Figure 22. If your region's heat pump efficiency is lower than the average, you can assume that the yearly bill savings will be slightly less than the ones modelled in Figure 19 and Figure 20.

Emissions impact

A lot of the energy used in a marae goes towards heating. Therefore, heating can be a major source of the marae's emissions when powered by non-renewable sources like natural gas or LPG. Figure 23 shows a comparison of the yearly 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, their operating emissions are zero.

¹⁴ 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.

¹⁵ We have not modelled savings for different regions to avoid length duplication.

Yearly emissions for a space heater at a marae

All usage levels include 1 x 3-day tangi per month.

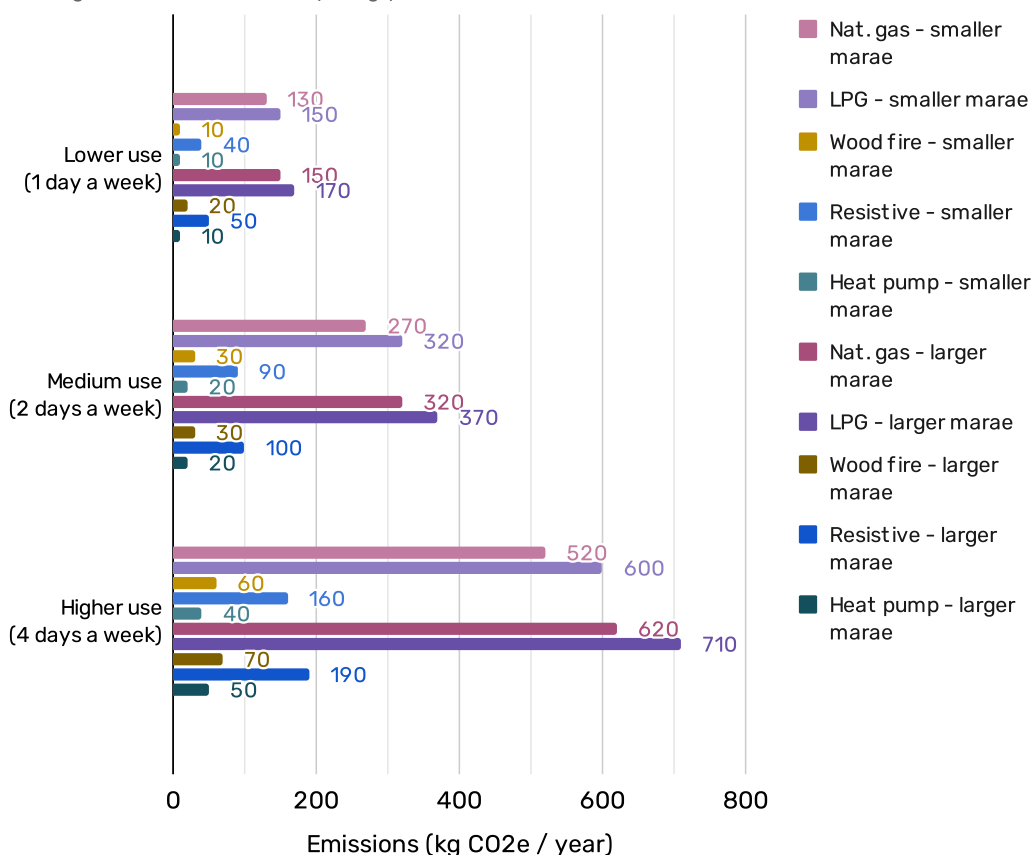


Figure 23: Comparison of emissions per year for one heater across marae profiles.

2.7.2 Water heating

Water heating is one of the biggest energy uses on any marae. Most marae heat water using califonts fuelled by LPG bottles. This has advantages of being on-demand especially for peak usage times, but it is also one of the most expensive ways to heat water, with energy prices that are exposed to global fuel prices, high emissions, added costs around bottle subscription/replacement, and low energy efficiency. A typical gas water heater runs at about 80% efficiency, meaning a fifth of the gas burned is wasted.

The electric alternatives are traditional resistance electric water heaters, which are a lower-cost upfront alternative, and the newer **hot water heat pumps (HWHPs)**. Both involve an insulated tank that holds hot water for later use. We have modelled the yearly savings for electrifying one gas water califont. Figure 24 shows the savings for the three smaller marae profiles where we assume a 20 L/min gas califont (about the size that you might install in a 2-3 person home), while Figure 25 shows the larger marae profiles with a 26 L/min gas califont (4-5 person home). Here we focus on the savings from electrifying just one, but our marae profiles in Section 2.5 assume multiple califonts per marae. The whole-of-marae-profile

modelling in Section 2.6 shows the savings impact of electrifying all the gas califonts in the marae. Regardless of marae size, the savings are in the hundreds per water heater for lower- and medium use marae, and in the thousands for higher use marae.

A large 250 L - 315 L HWHP may cost around \$8,000 to purchase and install, around \$4,000 more than a typical instant LPG water califont. However, over a 15 year operational lifetime, the **total bill savings could be between \$5,700** for the smaller marae low-use scenario, **and \$30,000** for the larger marae high-use scenario. So even for smaller, quieter marae, the operational cost savings are likely to make up any upfront cost difference.

Yearly bills (2026) per water heater at a smaller marae

Based on 3 x 20 L/min califonts. Includes gas fixed bills portion, \$381/yr for natural gas, \$102/yr for LPG. Assumes 20 people per active day and 1 tangi/month.

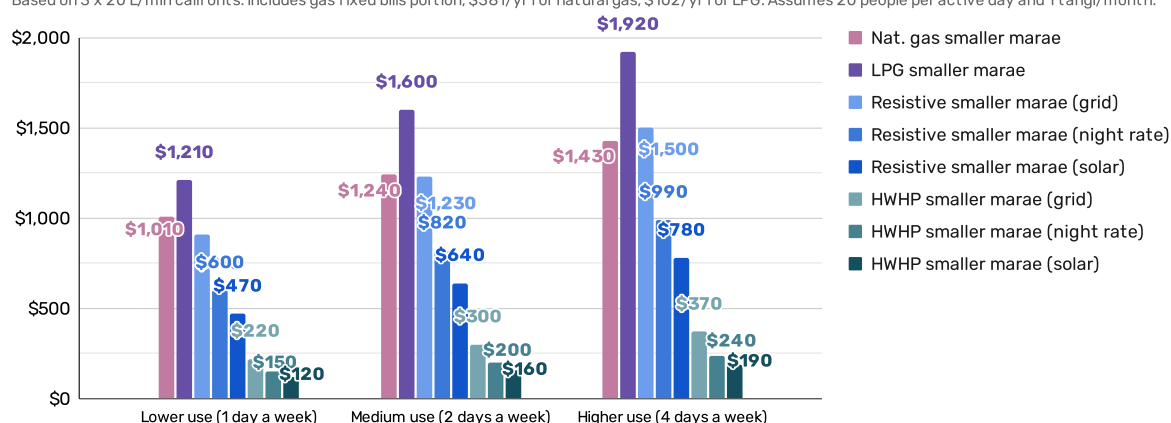


Figure 24: Comparison of energy bills (2026) per water heater. Sizes are equivalent to a 20 L/min gas califont, usage is based on the “smaller marae” profiles.

Yearly bills (2026) per water heater at a larger marae

Based on 5 x 26 L/min califonts. Includes gas fixed bills portion, \$381/yr for natural gas, \$102/yr for LPG. Assumes 50 people per active day and 1 tangi/month.

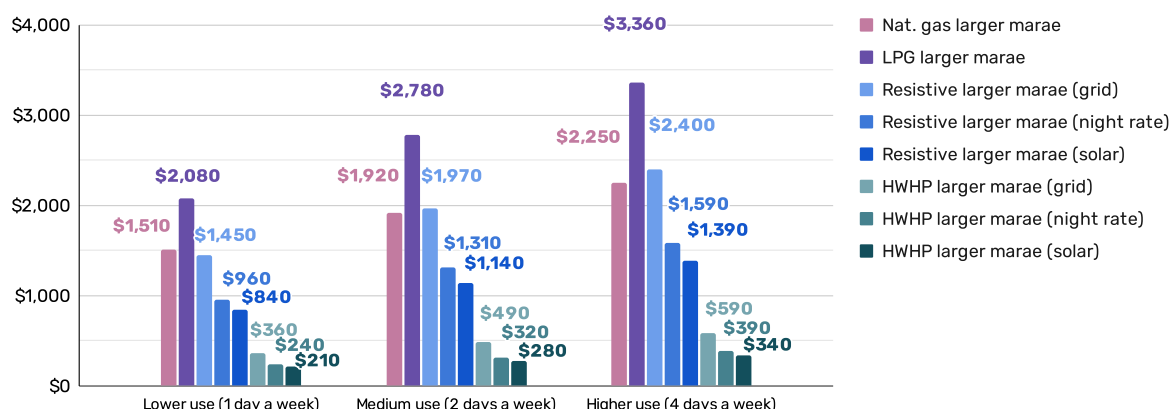


Figure 25: Comparison of energy bills (2026) per water heater. Sizes are equivalent to a 26 L/min gas califont, usage is based on the “larger marae” profiles.

Heating water with night rates and solar

As seen in the yearly savings charts above, even once you’re on an electric water heater, you can achieve more savings depending on how you get the electricity. Powering electric water heaters at night with Time-of-Use plans will reduce bills again. The cheapest is using the solar generated off your own roof. In this case, the water heater can act as a kind of thermal battery, soaking up the solar energy during the sunniest part of the day to pre-heat the water, then keeping it insulated until evening showers and dinnertime use. This helps make the most of the free self-generated electricity,¹⁶ and avoids the need to buy as much electricity from the grid during the evenings when the national grid is at its most busy and wholesale prices are highest.

Hot water heat pump efficiency differences between regions

Like gas water heaters, resistance electric water heaters also have relatively low efficiency of around 80%, although they use electricity which is not as dependent on volatile global prices, and can also be generated yourself with solar. HWHPs have much higher upfront costs, but the lowest ongoing energy bills as they run at around 275% efficiency depending on climate, i.e. they are around three times as efficient as a gas or electric resistive water heater.

HWHPs become slightly less efficient in colder locations, although it is still many times more efficient than gas or resistive. For example, HWHP efficiency is 268% in Southland and 308% in Northland. You can find where your region sits on HWHP efficiency in Figure 26. If your region’s HWHP efficiency is lower than the NZ average, you can assume that the savings will be slightly less than the ones modelled in Figure 24 and Figure 25.¹⁷

¹⁶ The cost of solar water heating is based on the residential price of a 9 kW solar install when financed at 5.5%, which is around 13 c/kWh. Marae may be able to get bulk pricing for larger installs.

¹⁷ As with space heating, we have not modelled the savings if the six marae profiles were in different locations around the country to avoid length overcomplication.

Hot Water Heat Pump efficiency per region

Source: EECA Home Energy Savings Calculator

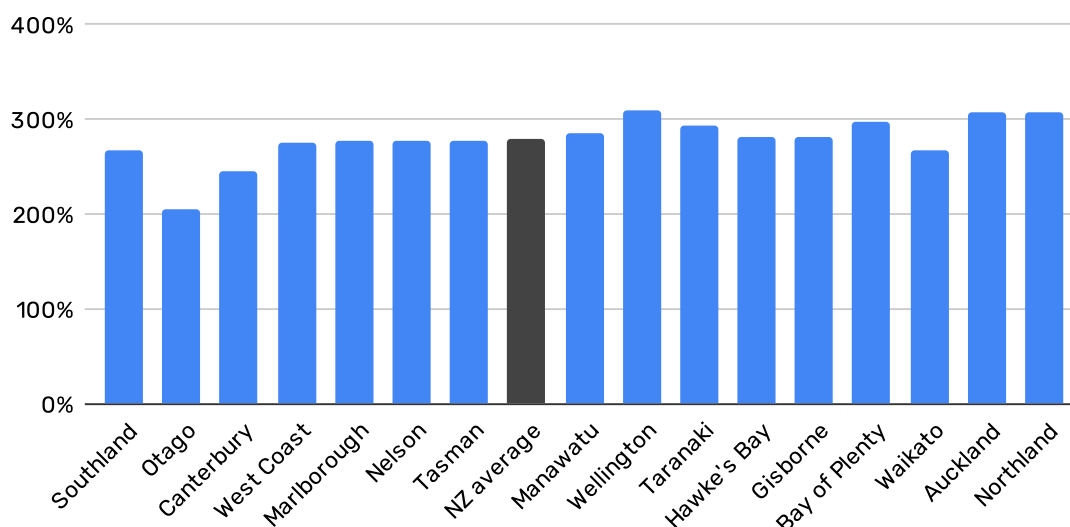


Figure 26: Hot water heat pump efficiency values per region

Emissions impact

Emissions are proportional to energy consumption and the emissions intensity of the energy type. Therefore, it is no surprise that natural gas and LPG water heaters have much higher emissions than electric resistive heaters, and much higher than the highly efficient electric HWHPs. Further, if you are powering your hot water off rooftop solar, your operating emissions are zero. Figure 27 compares the yearly emissions for different water heater types for the six marae profiles.

Yearly emissions for a water heater at a marae

Include 1 x 3-day tangi per month.

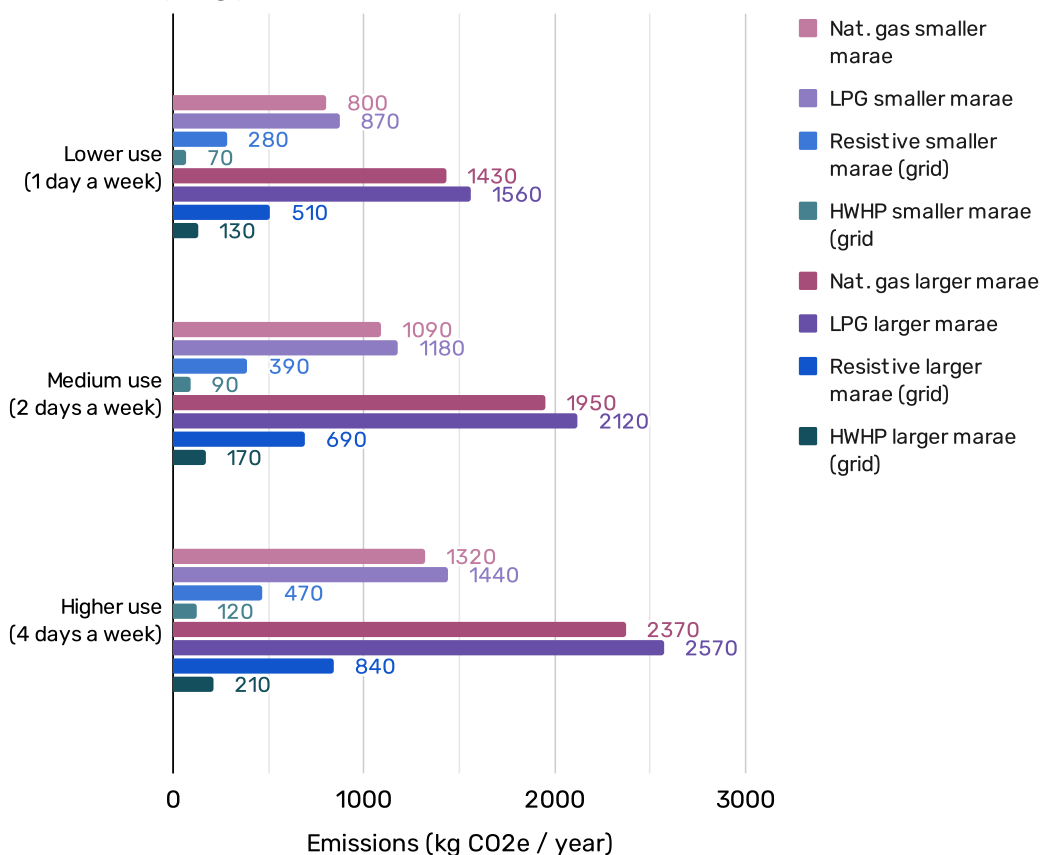


Figure 27: Comparison of emissions per year for one water heater across marae profiles. Assumes a load of 20 people per active day for a smaller marae spread across 3 x 20 L/min gas califonts, and 50 for larger marae across 5 x 26 L/min gas califonts, as well as one 3-day tangi per month.

Swapping multiple gas califonts for one large electric system

The modelling in this section shows a 1-to-1 comparison between a gas water califont and an equivalent electric hot water heater. However, since most marae will have multiple gas califonts, another option would be to swap all the gas califonts for one single large electric system. At commercial scales like this, electric hot water systems can be much more expensive upfront. The most economical option will depend on the marae, so it would be generally recommended to engage in some energy monitoring. This will see how much gas is being used for a typical month, and look at electric options that will meet that demand without paying a lot more for a system that is more powerful than required, especially if the proposed system's electricity demand may impact your marae's connection size limits. Also, the water volume that is likely to be used in one go should also be monitored and considered, as electric options tend to be tank-based rather than in-line instant. However, it is relatively low-cost to size up the tank size, compared to sizing up the power rating/heating capacity. Once sized correctly and installed, the reduction in bills and further economic potential of being able to make the most of any solar generation will be significant.

2.7.3 Cooktops

The cost of replacing a commercial gas cooktop with a commercial electric cooktop, whether resistive or induction, is highly variable, especially based on the required connection size to draw enough electricity. As a very rough ballpark, the purchase price for a commercial 4-burner induction cooktop may be in the realm of \$5,000 to \$20,000, with installation costs on top, compared to \$2,000 to \$5,000 for a commercial gas 4-burner. However, because of the number of people that marae tend to host on the regular (many more, and more frequently than a typical residential household), gas use in the whare kai can be a surprisingly expensive line item. Over a 15 year operational appliance lifetime, the **total bill savings could be between \$14,100** for the smaller marae low-use scenario, **and \$46,900** for the larger marae high-use scenario.

Yearly bills (2026) for a commercial stove at a marae

Includes an allocation of gas fixed bills, \$13/yr for natural gas, \$1/yr for LPG. All usage levels include 1 x 3-day tangi per month.

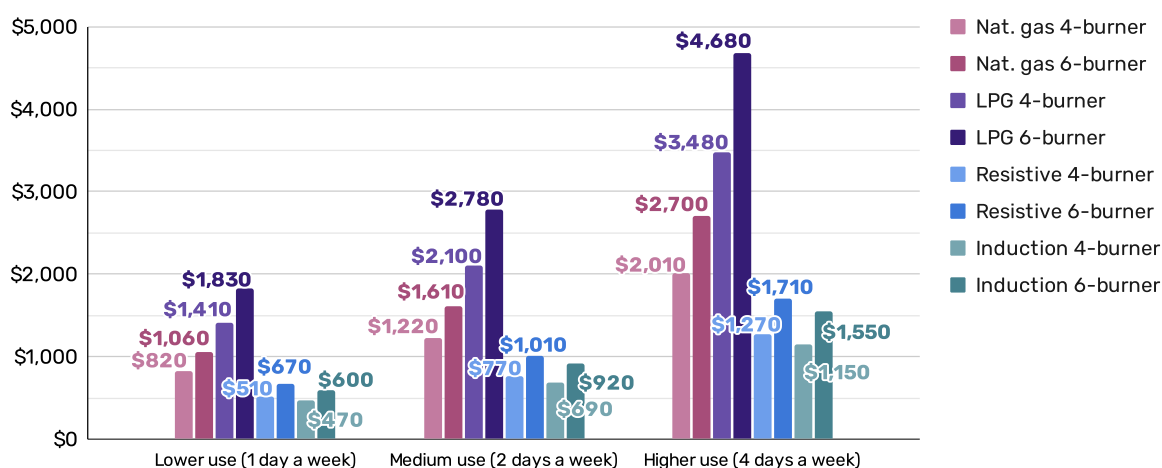


Figure 28: Comparison of commercial cooktop bills per year for marae profiles with 2026 energy prices

From an economic perspective, switching from gas cooktops to electric resistive or induction will save on yearly gas bills as seen in Figure 28, although likely to a lesser extent than water or space heating. The major benefits will be around indoor air pollution and the related health impacts (more in Section 3.2.2), and of course emissions savings (Figure 29).

However, there is anecdotal evidence from other commercial-scale kitchens that have electrified of additional savings coming from:

- Reduced insurance costs, due to the elimination of naked flames and combustible gas in the kitchen
- Reduced ventilation loads and costs
- Gas network disconnection: If you are on the reticulated gas network and these cooktops are the last gas appliances on-site, by removing these, you can disconnect and no longer need to pay the yearly connection fee. We have used the residential average of around \$825 per year for a conservative estimate, but this will be likely higher for larger marae which are on commercial connections.

If your whare kai uses large commercial stoves (e.g. 6-burners), upgrading to an electric resistive or induction commercial stove will likely require 3-phase power, with induction usually drawing more power at peak. This can really increase installation costs. Even if 3-phase already exists on-site, there may still be further costs depending on the location of the existing circuit setup.

Yearly emissions for a commercial stove at a marae

All usage levels include 1 x 3-day tangi per month.

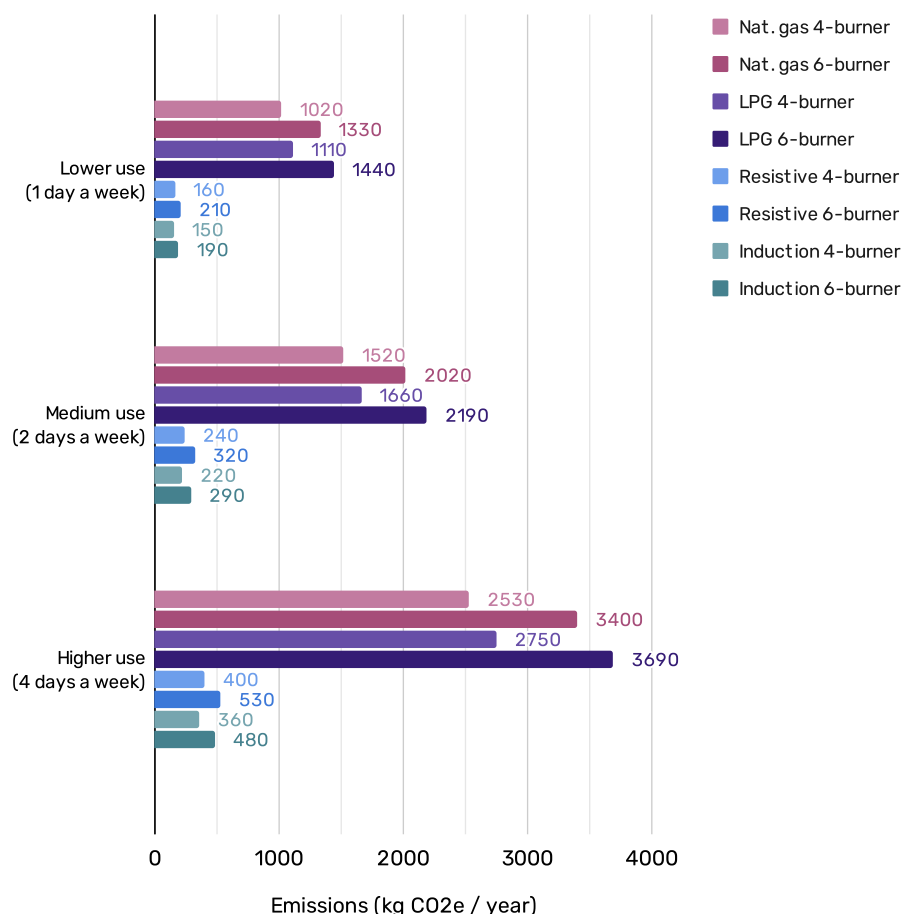


Figure 29: Comparison of commercial cooktop emissions per year for marae profiles

2.7.4 Vehicles

Vehicles don't often come up when we talk about a marae's energy needs, but right across our marae, iwi entities, hauora services, and taiao kaupapa, fuel often makes up a major portion of the bills. One way to reduce the fuel bill is to opt for a more energy efficient vehicle.

There are four main types¹⁸ of vehicle drivetrains in the light vehicle market today, each with different energy efficiencies:

¹⁸ While alternative fuels like hydrogen and biodiesel exist, they are unlikely to be economical at the light vehicle level (neither passenger nor commercial).

- **Internal Combustion Engine (ICE):** Runs exclusively on petrol or diesel. These remain common across Aotearoa but are the least efficient option, converting only a fraction of their fuel into movement while the rest is lost to heat and noise.
 - *Examples:* Suzuki Swift, Toyota Corolla, Mazda CX-5, Toyota Hilux, Ford Ranger.
- **Hybrid Electric Vehicle (HEV):** The vehicle runs largely on a petrol/diesel engine with a small internal battery. This makes it slightly more efficient than a pure ICE, although it is still usually the second least efficient overall. Like the ICE, it relies completely on petrol or diesel, as it is not able to be plugged in and charged.
 - *Examples:* Toyota RAV4 Hybrid, Toyota Aqua, Toyota Prius, Toyota Corolla Hybrid.
- **Plug-in Hybrid Electric Vehicle (PHEV):** Combines a fuel engine with a larger rechargeable battery that can be used for short, pure-electric trips. While flexible and more fuel-efficient, real-world testing shows PHEVs often consume significantly more fuel than official manufacturer estimates¹⁹ if not charged consistently and driven often beyond its battery-only range.
 - *Examples:* Mitsubishi Outlander PHEV, BYD Sealion 6, Ford Ranger PHEV.
- **Battery Electric Vehicle (BEV, a.k.a. EV):** Powered 100% by electricity stored in a large battery and charged via a plug. Since electric motors can convert most of their energy into motion, losing relatively very little to heat and noise, EVs are the most energy-efficient vehicle type available.
 - *Examples:* BYD Atto 3, Tesla Model Y, Nissan Leaf.

Due to the efficiency of electric motors, an EV will consume much less energy to do the same job. Regardless of whether the vehicle is a small car or a ute, ICE vehicles require about 4x the energy to drive the same distance as an EV; HEVs about 3x; PHEVs still 2x. This is illustrated in Figure 30 below.

EVs use much less energy than any other vehicle type, including hybrids

Assumes 10,500 km/yr (NZ national average). US EPA Fuel Economy database, NZ Ministry of Transport fleet statistics 2026.

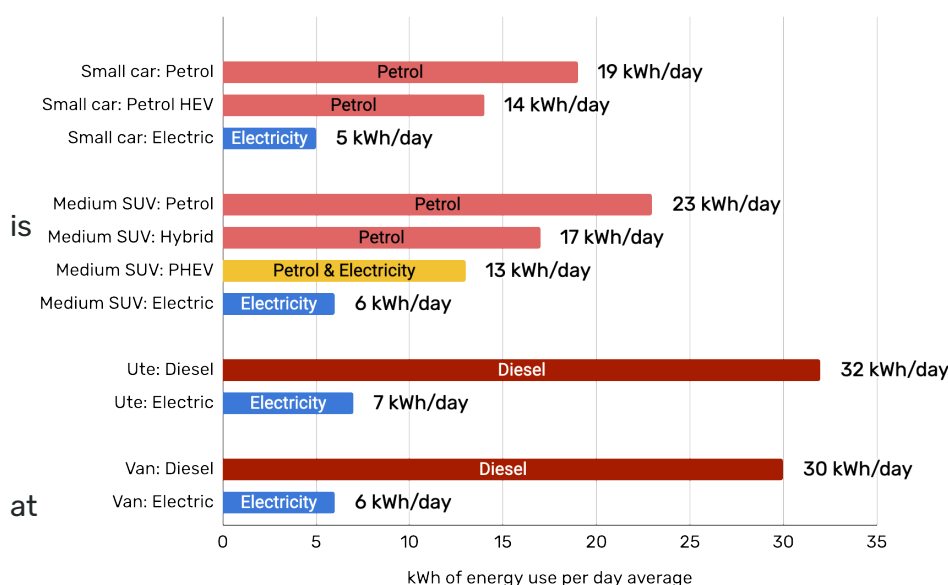


Figure 30: Comparing energy consumption for different vehicle types

What's more, electricity an energy type that can be generated locally. It is not as vulnerable to global supply chain issues like petrol and diesel are. If the electricity is generated the marae from rooftop solar, this brings down the cost of driving further still and insulates

¹⁹ Official fuel/energy efficiency ratings usually show best-case scenarios. In the real world, petrol cars use more fuel and EVs get less range than manufacturers claim. We use the US's Environmental Protection Agency (EPA) data whose testing procedures better reflect real world driving for our modelling.

the marae from the kinds of price spikes that we have seen with petrol and diesel over the years.

Alongside fuel/energy type and engine efficiency, there are several other factors that will influence a vehicle's **economic costs**. We account for all of these factors in our modelling.

- **Driving distance:** While light commercial vehicles like utes and vans drive more on average each year than smaller cars, how much vehicles are used varies for every marae and whānau. The more you drive, the higher your fuel bills, and therefore the more you will save from moving to an EV.
- **Maintenance costs:** Internal combustion engines have hundreds of moving parts that require servicing, wear down individually, and eventually fail. Electric motors have far fewer parts, which on the whole result in lower maintenance costs.
- **Road User Charges (RUCs):** In 2026, all BEVs, PHEVs, and diesel vehicles pay RUCs on top of their charging and maintenance costs. Petrol vehicles do not pay RUCs, since they already pay their road taxes via the petrol excise duty that forms a portion of the \$/L paid at the pump. The Government has however proposed moving all light vehicles to the RUC system ("universal RUCs"). In practice, this means that petrol vehicles will pay slightly more than they currently do, in particular hybrids, while the cost for BEVs and diesel vehicles will remain the same.

As for the **operating emissions** of EVs, alongside energy efficiency, the other factor is **the type of energy used**. For every unit of energy used, electricity generated from our highly renewable grid is less emissions-intensive than energy from burning fossil fuels like petrol or diesel. If your vehicle can be charged off rooftop solar, the operating emissions are zero.

However, there are also the emissions from manufacturing to consider. These are called **embodied emissions**. All vehicles involve manufacturing emissions, from the factory machines used to produce them and global shipping to distribute them, since these heavy machines are yet to be electrified themselves. EVs carry larger batteries than other vehicle types, which adds to their embodied emissions. The purple bars in Figure 31 illustrate these embodied emissions from manufacturing the battery and the rest of the vehicle.

However, because Aotearoa's electricity grid is predominantly renewable, driving an EV charged from the grid generates very few emissions. This results in significantly lower total lifetime emissions than any petrol or hybrid vehicle. For the average household, and for most commercial/community fleets (which tend to drive more than household vehicles), an EV will "pay back" its initial manufacturing footprint within 2-3 years for a new car. This is even the case when comparing the embodied emissions cost of buying a new EV versus keeping on driving an old fossil fuel car - if the fuel-based car is likely to drive for another 5-6 years, it is better to buy a new EV from an emissions perspective.²⁰ As global manufacturing and mining continue to electrify, the emissions required to build EVs will drop even further.

²⁰ Rewiring Aotearoa analysis, <https://www.rewiring.nz/watt-now/why-going-electric-wins-on-emissions>

The operating emissions of ICE and HEV vehicles are so high compared to BEVs that even buying or keeping on driving a secondhand petrol car where we treat its manufacturing emissions as zero, burning petrol over its remaining years on the road (assumed 7.5 years) will still emit significantly more than building and driving a brand new BEV over its entire lifetime (assumed 15 years).

Lifetime manufacturing & operating emissions of EVs and ICE cars

EVs tend to have higher manufacturing emissions, but much lower operating emissions.

■ Total operating emissions (15 years for new, 7.5 for used) ■ Battery manufacture ■ Vehicle manufacture

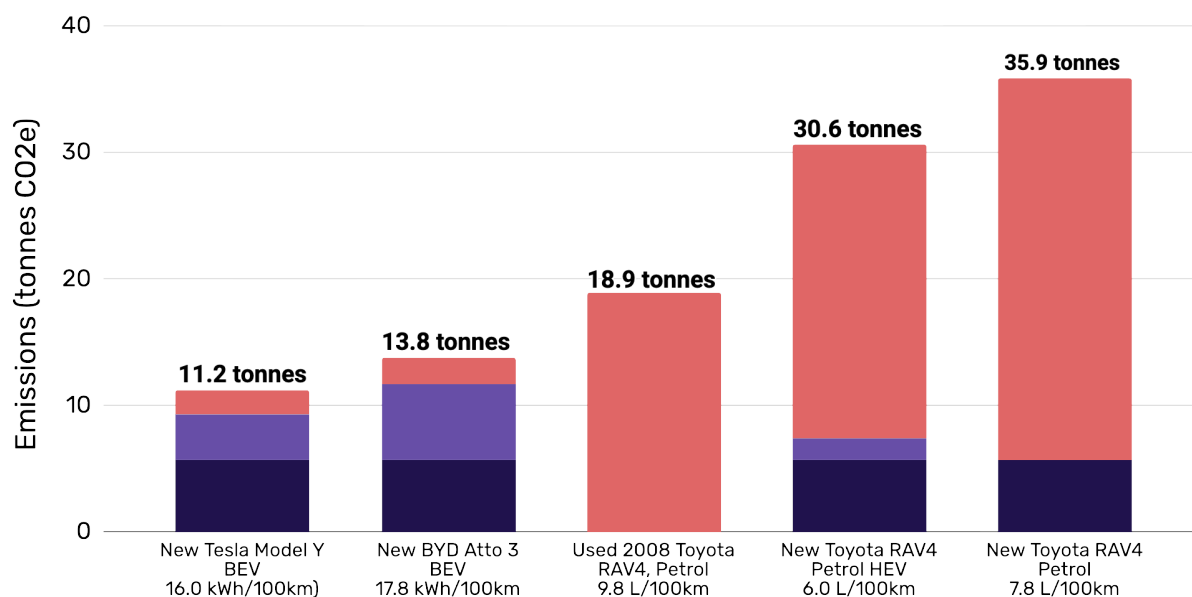


Figure 31: Comparison of manufacturing & operating emissions for popular medium SUVs

To illustrate economic and emissions savings from vehicle electrification, we have modelled three vehicle types and typical usage scenarios on marae. We have used this approach rather than using the marae profiles above, as vehicle usage varies widely even between marae of similar size. You can mix and match these examples to weave together a picture of your own fleet and its electrification plan.

Since each example is a community fleet vehicle, we have chosen distances that are higher than the national average, starting at 350 km/week for the small hatchback example. If your marae's vehicles drive less than the examples, your savings will be lower. However, even at the lower national average driving distance of 210 km/week or 11,000 km/year,²¹ it is still usually cheaper to choose electric when replacing a vehicle.²²

²¹ Ministry of Transport Fleet Statistics 2024

²² See [Electric Homes and Vehicles 2026](#) by Rewiring Aotearoa for national average savings.

Example 1: Small hatchback

For small cars, HEVs may have similar or sometimes even lower operating costs to small EVs with normal fuel prices, mostly due to the way that Road User Charges (RUCs) are currently set up. However, during fuel spikes this small edge is overturned due to higher prices at the pump, depending on how much it drives. We will assume that a community vehicle like one at a marae will drive more than the average household vehicle.



This small hatchback is out on the road daily with Whānau Ora and healthcare workers visiting whānau across the rohe. Travelling around 350 km a week with a mix of urban and rural driving, it drives more than the average New Zealand vehicle and represents the daily engine of community outreach.

Let's say this marae's hatchback is due for replacement. Figure 32 compares the yearly operating costs and emissions for different drivetrain options. If we ignore the fuel crisis premium that we are currently paying at the pump in 2026 (orange), the new Toyota Yaris hybrid costs less than the EVs to run due to RUCs (grey). However, when we include the fuel crisis premium, even the fuel-efficient hybrid hatchback costs more than the EVs.

What is also not pictured here is the impact of the upcoming policy change towards universal RUCs. This will result in higher bills overall for both petrol ICE and hybrid cars on average, as they pay more in RUCs than they did in fuel excise duty. For this particular hatchback which drives more than the national average,²³ the policy change may increase its yearly operating costs by between ~\$300 for an ICE like the Honda Jazz and ~\$900 if it is a HEV like a new Toyota Yaris.

²³ The average New Zealand vehicle drives 210 km/wk; this hatchback example drives 350 km/wk.

Small hatchback: 2026 annual vehicle operating costs & emissions

BAU prices: \$2.60/L for petrol, \$0.26/kWh for grid electricity. Fuel shock prices: \$3.30/L for petrol, \$3/L for diesel.

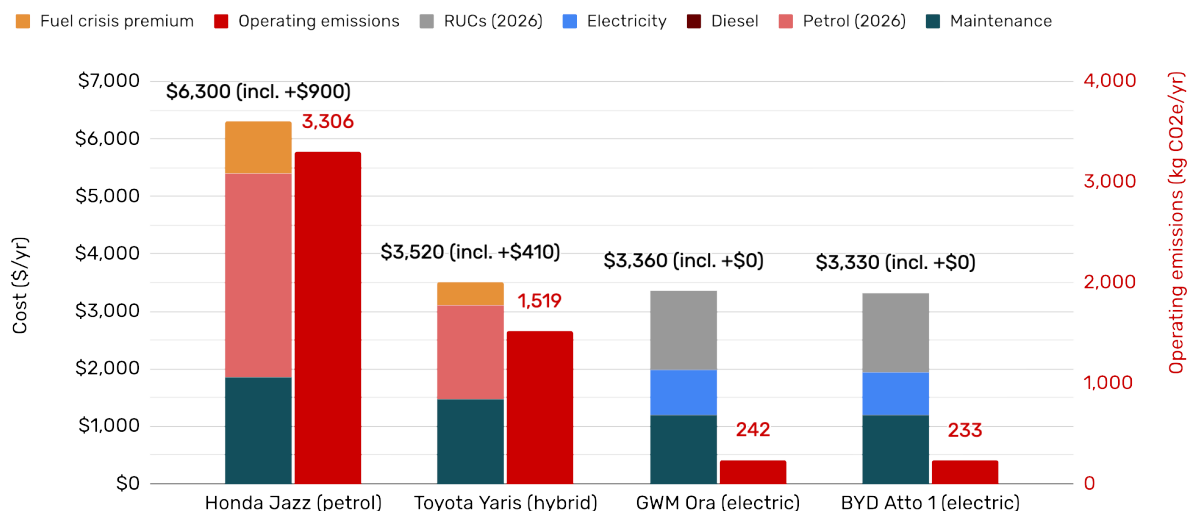


Figure 32: 2026 vehicle operating costs for a new marae hatchback driving 350 km/wk, including difference made by fuel crisis premium.

In Figure 33 where we compare the total cost of ownership and the operating emissions over a 15 year vehicle lifetime, we can see the impact of RUCs on the petrol and hybrid models (assumed to be applied from 2028 onwards). Fully electric vehicles are cheaper overall over their lifetime, especially for this usage scenario where it is driving a significant distance each week. We can see, for example, that the GWM ORA is \$37,889 when bought new, more expensive than the Honda Jazz (\$31,576) or the Toyota Yaris hybrid (\$33,590). However, the savings from lower operating costs, energy bills (electricity vs. petrol), and the increase in RUCs beyond 2028 overtaking the removal of fuel excise duty means that the upfront cost difference is paid off.

In both Figure 32 and Figure 33, what is also clear is the significant difference in operating emissions, with hybrids and ICE models producing much more pollution than the electric models.²⁴ Even for these small vehicles, purchasing a new petrol hatchback means locking in over a decade of high emissions. By opting for an EV instead of a petrol ICE in this scenario, the marae avoids over 35 tonnes of emissions over the car's lifetime.

²⁴ In all these models, it is also assumed that the BEVs are charged from the grid. If they are charged from rooftop solar, the operating emissions are zero.

Small hatchback: Total cost of ownership & operating emissions over 15 years

Drives 350 km/wk. Excludes 2026 fuel price shocks. Average petrol, diesel, electricity prices over 15 years use yearly real inflation since 2010. Universal RUCs start 2028.

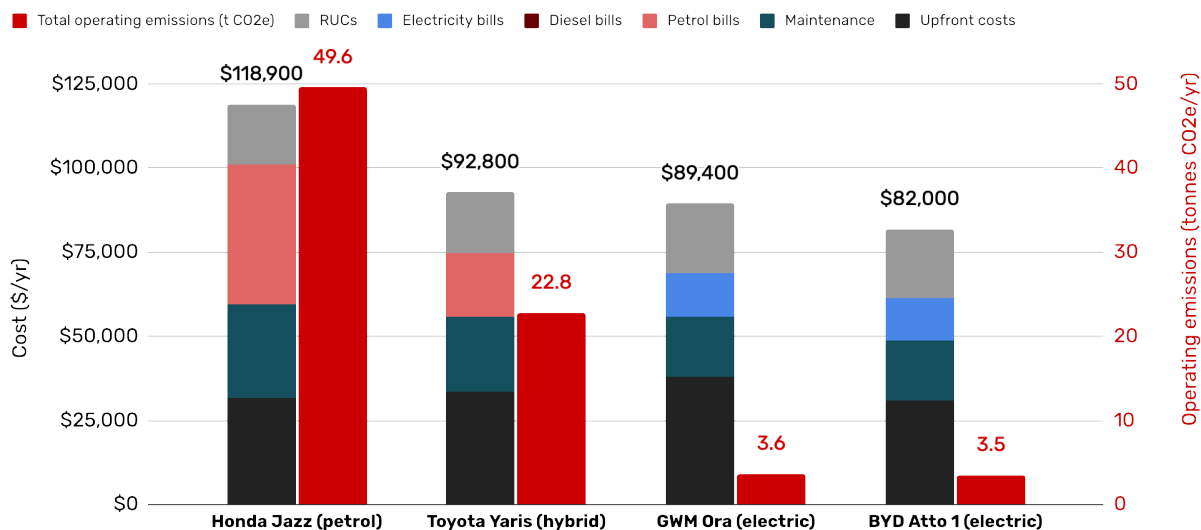
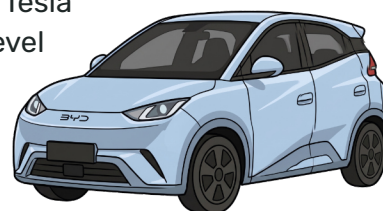


Figure 33: Lifetime economic and emissions costs of a new marae hatchback driving 350 km/wk

While our analysis compares new vehicles, secondhand cars offer a growing range of affordable options, available at most car dealerships. The Nissan Leaf remains the most popular used EV in this size category, alongside models like the Tesla Model 3, MG 4, Hyundai Ioniq, and Polestar 2. That said, entry-level new EV hatchbacks have also recently dropped in price, starting as low as \$29,990 for the Dongfeng Box or \$30,889 for the BYD Atto 1.



Example 2: Van

Light commercial vehicles like vans usually travel longer distances and have heavier loads. They can consume a lot of fuel and therefore can cost a lot in money and emissions to run. Since most of them run on diesel, exposure to price volatility may also be a concern.



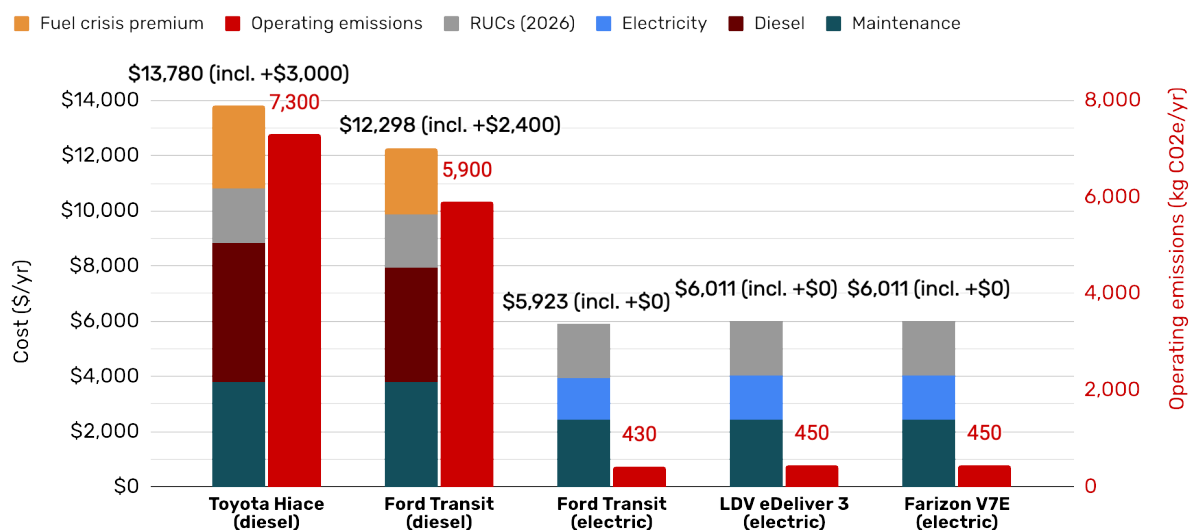
From morning kōhanga reo runs to taking kaumātua to events, this van is central to marae life. It covers around 500 km each week. Its trips fall mostly in the mornings and afternoons.

The range of electric passenger vans in Aotearoa is currently very limited, but it is increasing. For this example we compare three electric van models at different price points, compared against the two most common vans currently in New Zealand: the Toyota Hiace and Ford Transit. Note that these are lower-roofed cargo vans which can be outfitted with passenger seats, as these are a popular option; 12-seater high-roof minibuses will have similar economics, but fewer options for electrification.

Figure 34 shows the yearly operating costs & emissions, and Figure 35 shows the lifetime values. The three electric vans, despite their widely varying upfront costs, have similar fuel efficiencies that are significantly more cost-effective than their diesel counterparts, resulting in a much lower yearly operating cost. The maintenance costs of EV vans being about half that of diesel vans also contributes to this. For lifetime costs, the variation in purchase price across the brands and models starts to make a big difference to the overall picture, but they are still cheaper overall than the popular fuel-based models.

Van: 2026 annual vehicle operating costs & emissions

Drives 500 km/wk. BAU prices: \$1.90/L for diesel, \$0.26/kWh for grid electricity. Fuel shock prices: \$3/L for diesel.



Fig

Figure 34: 2026 vehicle operating costs for a new marae van driving 500 km/wk, including difference made by fuel crisis premium

Vans: Total cost of ownership & operating emissions over 15 years

Drives 500 km/wk. Excludes 2026 fuel price shocks. Average diesel & electricity prices over 15 years use yearly real inflation since 2010.

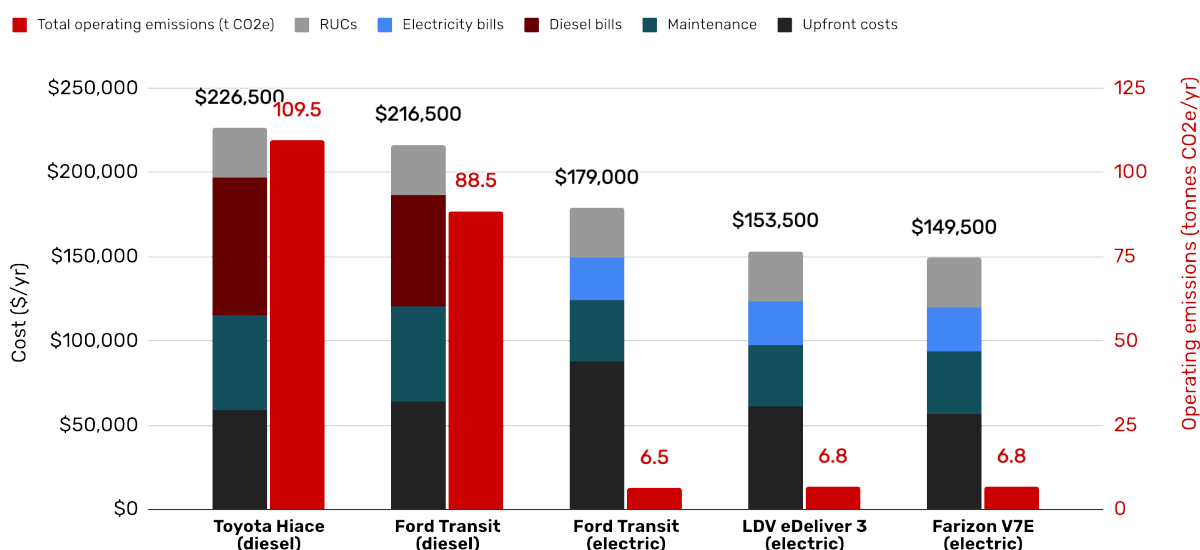


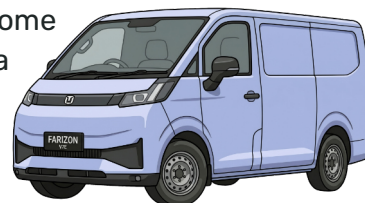
Figure 35: Lifetime economic and emissions costs of a new marae van based on 500 km/wk driving, excluding the impact of fuel price shocks.

Popular models of electric van in New Zealand include the LDV eDeliver series (eDeliver 3, eDeliver 9), Farizon V7E, Farizon SuperVan, Ford Transit series (E-Transit, E-Transit Custom, Transit City) and Kia PV5. In Aotearoa, these vehicles are currently all sold as cargo vans. Overseas, some models are offered in passenger variants, and aftermarket companies exist that can install passenger seats. Passenger-specific electric peplemovers are available

including the Volkswagen ID.Buzz, Zeekr 009 and Xpeng X9, but these are premium models and have only 7 seats.

In this example, the marae van's schedule typically leaves it parked during the day between the morning and late-afternoon runs. This means if there is already solar generation on-site, it can charge for free during midday peak sun hours, reducing the payback time on both the solar and the EV van.

When assessing the feasibility of electrifying a van, the resilience benefits should also be considered. Most EVs have Vehicle-to-Load (V2L) capability, meaning that you can plug in electric tools and appliances and run it off the battery, providing an energy backup. What's more, most modern EV vans go one step further with Vehicle-to-Home (V2H, powering your home or building) and Vehicle-to-Grid (V2G, exporting back to the grid). While V2G is not yet available to the mainstream in New Zealand, there are trials underway around the country. EV vans have huge batteries - for example, the Farizon V7E's standard pack is 50 kWh, and the extended range is 66kWh. Compare this to a typical residential home battery which is around 13 kWh. With V2H or V2G, EVs double as a high-capacity mobile battery that can power essential marae loads during power outages or emergencies, enhancing community resilience while saving money and emissions.



Example 3: Ute



Built for the heavy lifting, this ute supports taiao environmental work and supply runs. It covers a lot of distance, around 700 km a week including long highway stretches and some rough tracks. It is typically the most fuel-intensive vehicle in the fleet.

Fully electric utes are now available in New Zealand, with the release of models like the Geely Riddara, MG U9 EV, and Toyota Hilux BEV. Due to their size and less aerodynamic profile, utes are inherently less efficient than electric passenger cars (up to 360km range on a Riddara ute, compared with up to 800km range on a passenger EV). More models of electric utes are coming to market and becoming available.

A ute is similar to a van in that they are mostly run on diesel, tend to drive further distances and carry heavier loads, resulting in a hefty fuel bill and emissions impact.

Figure 36 and Figure 37 show the yearly and lifetime costs and emissions if the example ute above used for taiao work is diesel vs. electric. While the upfront cost of an electric ute might be significantly higher, the operational costs are going to be much lower than that of a diesel ute in most cases, including hybrids. This is certainly the case for this example where the ute is driving significant distances. This is further illustrated in Figure 38.



Ute: 2026 annual vehicle operating costs & emissions

Drives 700 km/wk. BAU prices: \$1.90/L for diesel, \$0.26/kWh for grid electricity. Fuel shock prices: \$3/L for diesel.

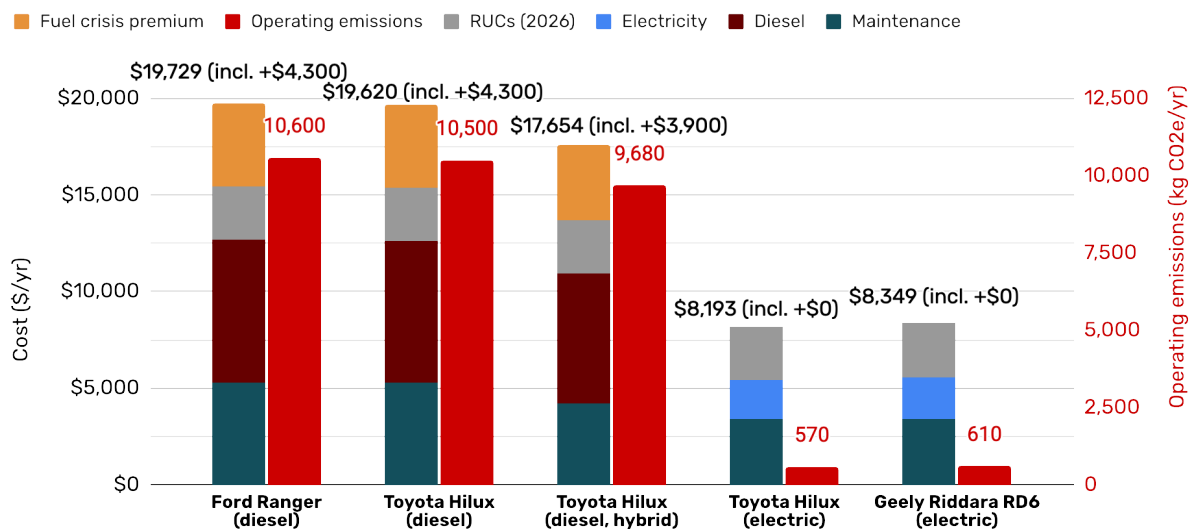


Figure 36: 2026 vehicle operating costs for a new marae ute driving 700 km/wk, including difference made by fuel crisis premium.

Utes: Total cost of ownership & operating emissions over 15 years

Drives 700 km/wk. Excludes 2026 fuel price shocks. Average diesel & electricity prices over 15 years use yearly real inflation since 2010.

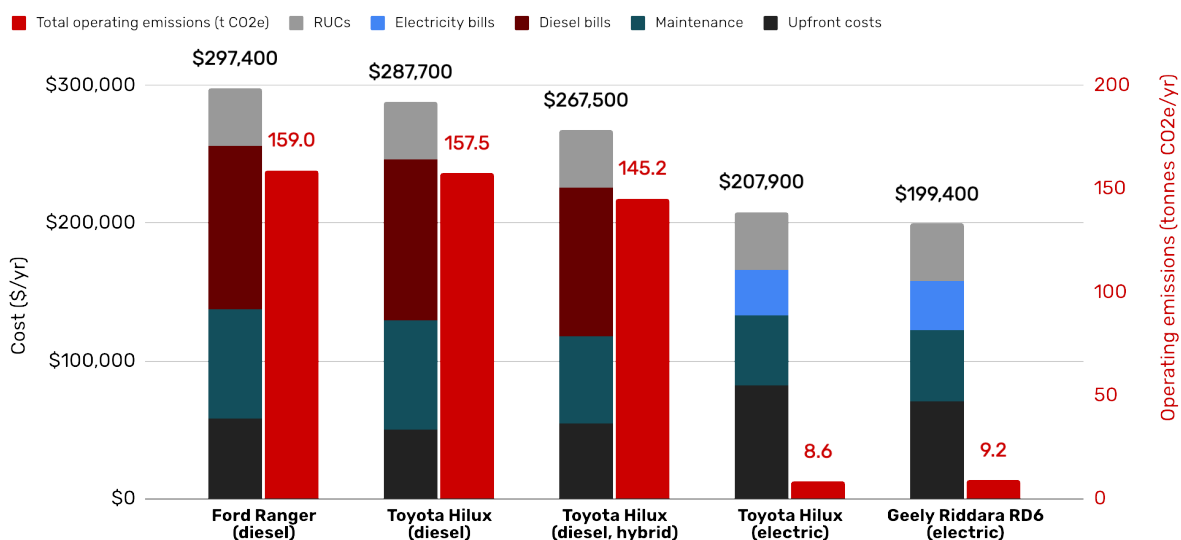


Figure 37: Lifetime economic and emissions costs of a new marae ute based on 700 km/wk driving, excluding the impact of fuel price shocks.

Upfront cost vs. Lifetime cost of a heavy-usage marae ute (700 km/wk)



Ford Ranger (diesel)

~~\$58,600~~ **\$297,400**

3500 kg towing,
1412 kg payload



Geely Riddara RD6 (electric)

~~\$70,900~~ **\$199,400**

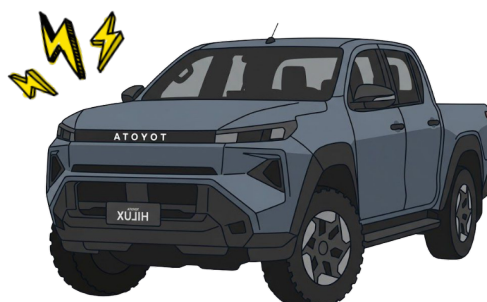
360 km range, 3000 kg towing,
1300 kg payload



Toyota Hilux (diesel hybrid)

~~\$60,990~~ **\$273,500**

3500 kg towing,
1000 kg payload



Toyota Hilux (electric)

~~\$81,990~~ **\$207,990**

~240 km range, 2000 kg
towing, ~700-800 kg payload

Figure 38: Comparing upfront and lifetime costs for ute models. Assumes 15 year operational lifetime. Does not include 2026 fuel price shocks. Diesel price of \$1.90/L, electricity \$0.29/kWh, averaged over 15 year historic inflation projection. Includes maintenance costs and road user charges. Excludes emissions pricing.

2.7.5 Other machines

Some marae may have extensive grounds and surrounding whenua that needs maintenance with the help of powered tools. This section covers some of the most common outdoor machines that may use fossil fuels, and may therefore benefit from electrification for savings, emissions reduction, less pollution/fumes, and other benefits like quieter operation and improved safety for the kaimahi.

It should be noted that for all total cost of ownership (TCO) comparisons in this section where we take into account both the upfront cost and the operating costs over the lifetime of the machines, we have not included:

- Maintenance costs, which are likely to be lower for electric
- Cheaper charging options, such as charging off rooftop solar. The modelling in this section assumes charging off grid electricity, using the national average commercial grid price for smaller marae, projected over the next 15 years (the assumed lifetime of the machines) according to historic inflation rates of, which comes to 26 c/kWh. Larger marae have lower commercial rates, around 23 c/kWh averaged over the next 15 years.

Ride-on mowers

For push mowers to maintain smaller lawns around the wharenui or nearby papakāinga, electric push mowers (including self-propelled models) are already similar in price to their petrol equivalents. While a marae with a petrol push mower might not use it heavily enough to see massive financial savings from electrifying, the secondary benefits of electric mowing are significant:

- Quieter operations that reduce noise pollution in residential areas, around papakāinga, and the general serenity of the marae
- No exhaust fumes, eliminating air pollution
- Lower operational costs from less maintenance due to fewer moving parts, and much lower energy costs from avoided fuel.

Financial savings can begin to stack up for marae with extensive whenua that currently rely on petrol or diesel ride-on mowers. Traditional ride-ons can consume a substantial amount of fuel, and with the high & volatile cost of petrol and diesel, ongoing operating costs can become significant. Because of this, larger ride-on mowers can be good candidates for electrification.

In just the past few years, the electric mower market has expanded considerably in Aotearoa. Where there were once only a handful of options, there is now choice in battery capacities, size, comfort, and price points to suit any marae's needs. Distributors now offer everything from compact models designed for an hour or two of work in one session, right up to heavy-duty contractor machines with massive 72" to 96" cutting decks that can run for a full eight-hour day on a single charge.

To give an example comparison of the total lifetime costs, we modelled the costs of mid-range mid-sized zero-turn ride-ons (48" to 54" cutting widths) operating for roughly 50 hours a year. This averages about two hours a fortnight, with more in summer and less in winter. There are more premium models available, both petrol (e.g. Hustler) and electric (e.g. Mean Green Rival, Worldlawn Diamondback), but these have been excluded as they are more targeted at heavy duty contractors using them for hundreds, if not thousands, of hours per year.

As shown in Figure 39, the results highlight the major recent shift: electric mowers no longer automatically carry a hefty upfront cost premium. While some premium electric models are significantly more expensive, others are now actually cheaper than comparable petrol models. Even in cases where the upfront cost of an electric model is higher, this difference is sometimes recovered over the assumed 15 year lifetime by the drastically lower operating costs of charging with electricity versus fueling.

Lifetime cost comparison of 48" - 54" zero-turn ride-on mowers

Low usage of 50 hrs/year - heavier users will mean bigger savings.

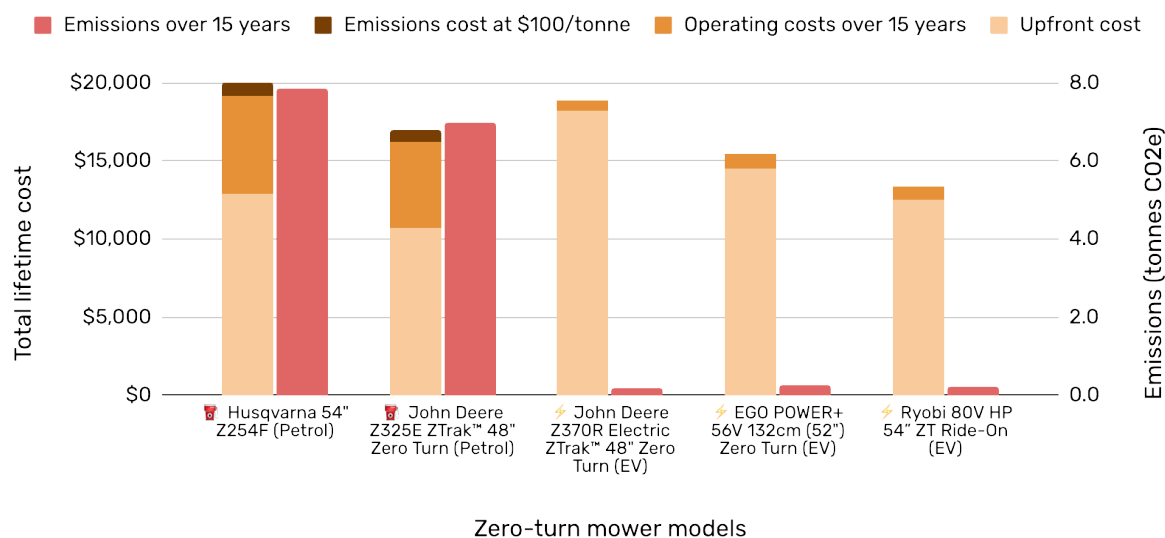


Figure 39: Lifetime cost and emissions comparisons for mid-size zero-turn ride-on mowers.²⁵

Marae can achieve further savings by exploring pricing options with local dealers. Asking about "fleet pricing" for larger marae that require more than one machine, or looking for ex-demo models (often hardly used and still carry full warranties) can significantly lower the initial purchase price, locking in a very affordable Total Cost of Ownership (TCO) when compared to petrol or diesel alternatives.

Beyond financials, there is a lot of kōrero from farmers, groundskeepers, and rural kaimahi who have made the switch to electric mowing and are loving it. The transition to a smoother, cleaner, and much quieter machine makes the mahi far more enjoyable, and significantly reduces fatigue from engine vibrations and health risks from exhaust fumes.

²⁵ Petrol price of \$1.95/L averaged over 15 year lifetime using historic inflation, excludes fuel excise duty. Cost is 2026 pre-fuel shocks. Electricity \$0.29/kWh.

All-Terrain Vehicles (ATVs)

ATVs and side-by-sides (UTVs) are useful for heavy-duty tasks like moving landscaping equipment, managing community māra kai, and navigating steep or uneven terrain. They also tend to use a lot of fuel, and therefore upgrading to an electric ATV or UTV offers several advantages over petrol (or in rare cases, diesel) options much like ride-on mowers mentioned above, such as quieter operations, zero fumes, and lower maintenance costs, as well as instant torque from the electric powertrain making it easy to haul heavy loads up steep inclines.

While electric ATVs used to have higher upfront costs, this is no longer always the case due to cheaper new models entering the market. In cases where the upfront cost is higher, the difference is paid off by the much lower operating costs, resulting in a lower lifetime cost for electric models. A chart of this comparison can be seen in Figure 40, where we have assumed moderate usage of around 4 hours a week, 208 hours a year, with an average speed of 30 km/hr (6240 km/yr). We can see that while a premium EV model like the Polaris Ranger XP (which has almost double the towing capacity of the Honda 700-2p) may not pay itself off in terms of cost, other electric models can save between \$13,000 (when going from a Honda 520-2p to an eTuatara) and \$44,000 (going from a Honda 700-2p to a HDK Turfman golf cart) in upfront costs and operational costs over a 15 year operational lifetime. These savings numbers do not include emissions pricing, which are shown in Figure 40 as a rough indication.

Lifetime cost comparison of ATVs and side-by-sides

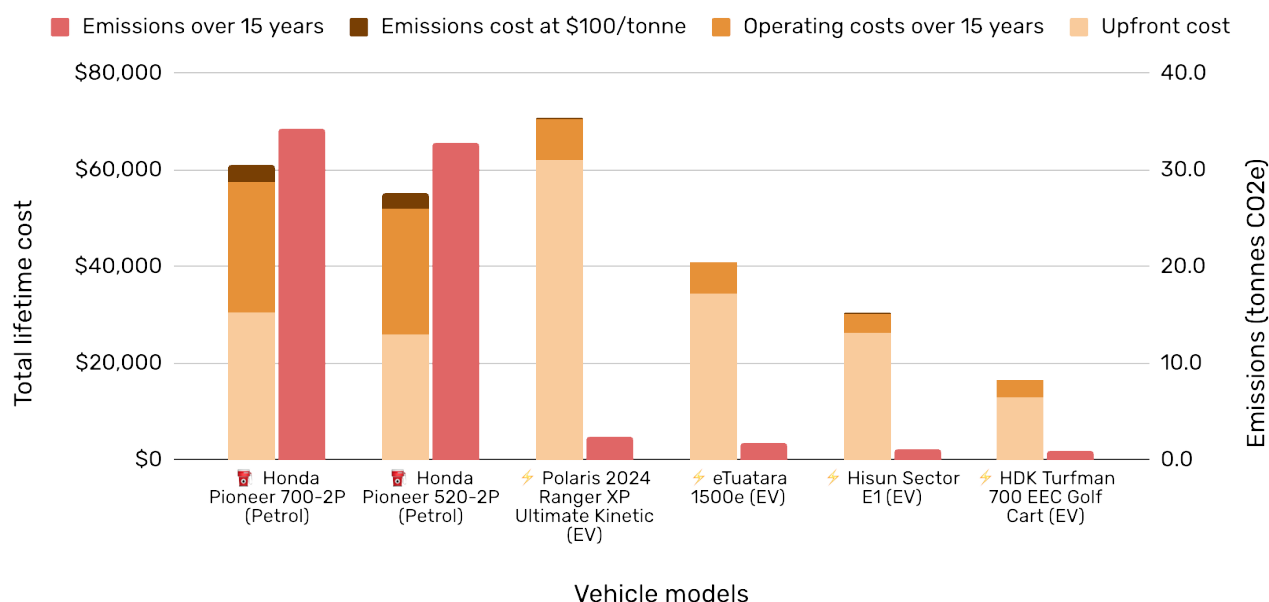


Figure 40: Lifetime cost and emissions comparisons for popular petrol and electric ATV models.²⁶

While there isn't a massive range of electric models available on the market, there are still several price points and capabilities to choose from, such as range and towing capacity.

²⁶ Petrol price of \$1.95/L averaged over 15 year lifetime using historic inflation, excludes fuel excise duty. Cost is 2026 pre-fuel shocks. Electricity \$0.29/kWh.

Figure 41 below illustrates the common models compared in Figure 40 above, and also shows some of their core features such as range and towing capacity.

Upfront cost vs. Lifetime cost of ATVs



Figure 41: Comparing upfront and lifetime costs of popular petrol and electric ATV models. Assumes 15 year operational lifetime. Petrol price of \$1.95/L (assumes off-road use only, excludes fuel excise duty; does not include 2026 fuel shock). Averages 15 year inflation projection using historic inflation rates. Electricity \$0.29/kWh also averaged over 15 year historic inflation projection. Excludes emissions pricing.

Chainsaws & other power tools for groundskeeping

Chainsaws are a common tool for ongoing marae maintenance. Many marae will own one or more, including some that are already electric. Although the financial and emissions savings from reduced petrol use may be modest compared to larger equipment, the secondary benefits of electrifying chainsaws and other handheld outdoor power tools (leaf blowers, line trimmers, etc.) are considerable particularly in a marae environment. Electric tools are quieter and therefore less disruptive. They have no toxic fumes and have less vibration, making these tools safer and more pleasant to work with than petrol equivalents. Carrying spare batteries is also often cleaner and more convenient than transporting and storing jerry cans of petrol around the marae. These tangible benefits to user safety and comfort are key factors driving the increasing popularity of electric gardening tools.

Electric gardening tools are already available at mainstream hardware and outdoor power equipment stores. While line trimmers and leaf blowers are already mostly electric, chainsaws are one example where petrol options still dominate the wider market despite there being a wide range of small to medium sizes (up to 20 inch in bar length) available in electric. This small-to-medium size range is generally suitable for typical taiao tasks, such as trimming branches and clearing brush. Most electric chainsaws can run for half an hour to an hour on a single battery charge, but kaimahi can easily carry extra batteries to extend working time during busy working bees. Additionally, backpack battery options are available; these shift the weight off the tool itself, providing much longer runtimes and easier handling.

Electric chainsaws are not readily available for heavy industrial work yet, such as forestry. However, these larger sizes are rarely needed for everyday marae operations. Given the growing momentum toward electrification, we can expect more electric models and sizes to become available over time.

Regarding costs, electric chainsaws cost about 10% to 15% more upfront than comparable mid-range petrol models. From a review of models on the market within the 18-20" size bracket, we found that the average price for a petrol chainsaw was around \$900 while an electric equivalent (including batteries and a charger) cost around \$1000. It is worth noting that the batteries and chargers are often cross-compatible with other electric outdoor tools from the same brand, so that cost can be spread across multiple devices.

Case study

Ōnuku Marae

Rohe	Te Waipounamu
Iwi	Ngāi Tahu
Waka	Takitimu
Hapū	Ngāi Tarewa and Ngāti Irekēhu
Maunga	Ōteaheke
Moana	Akaroa

Solar	20kW (Wharekai roof)
Heating	Heat pumps



Ōnuku is a large and very busy Ngāi Tahu marae that is constantly holding hui, wānanga and functions throughout the week. It has a huge commercial kitchen (rumoured to be one of the biggest in Te Waipounamu!), which is mainly powered by LPG. It is a very high energy user because of the combination of its large spatial footprint, heavy commercial catering equipment and high manuhiri numbers. It has really high energy bills; however, to mitigate these bills, Ōnuku installed 20 kW of solar (about 60 panels) on the roof of its wharekai. This power is used throughout the day to power the heaters, chillers, freezers and ovens. Because the marae is busy in the daytime, it uses its solar power as it is made, giving it the best value for that period. There have been significant savings for the marae.

Ōnuku is preparing to build a new seaweed industry at the marae, harvesting wakame (an invasive seaweed) from Akaroa Harbour and turning it into an organic food ingredient. More solar would allow the marae to power the drying process using the cheapest energy possible during the daytime solar window. This industry would soak up the summer surplus of generated electricity that is currently exported cheaply, and lower-cost power makes the new industry more viable.

Lesson: Using your solar-generated electricity during the day before exporting it, or finding other ways to self-consume, is a guaranteed way to gain maximum returns on your solar investment.



3 – Ngā painga ki te taiao | Other environmental benefits

3.1 Te maina, ngā matū, me te āmiomiotanga | Mining, materials, and circularity

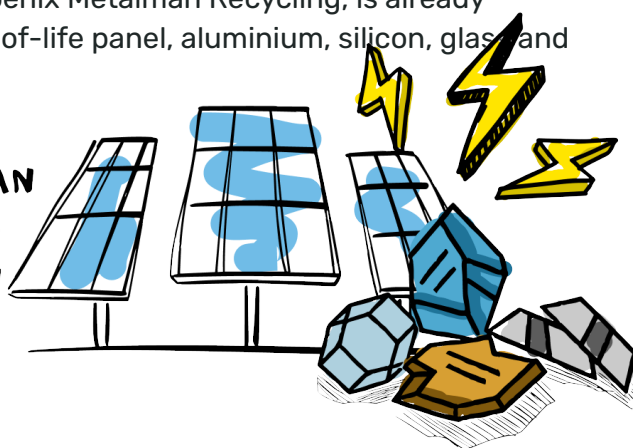
Some make the argument that adopting technologies such as solar panels and batteries simply shifts the emissions problem into the mining and manufacturing rather than emissions from a tailpipe or a chimney flue. The truth is that there is an embodied cost to this technology, but it is not a comparable one to fossil fuels.

An energy system built on renewable sources indeed still takes materials and energy to build, but it is dwarfed by the sheer scale of extraction, consumption and wastefulness of fossil energy. A solar panel will produce 32x the energy needed to manufacture it over its lifetime. Compare that to a gas or diesel system that needs a consistent supply of fossil fuels to be extracted from the earth, refined and then delivered to Aotearoa for every hour it operates, for its entire life. The embodied emissions of an electric system are a one-off cost paid at the start. The embodied emissions of a fossil fuel system are a cost paid over and over, for as long as the machine keeps burning fuel.

The treatment of a solar or battery system at its end of life may be seen as an opportunity rather than a liability to manage. Recovery rates for the materials in a solar panel are already well over 90%, and a New Zealand company, Phoenix Metalman Recycling, is already recovering up to 98% of the materials in an end-of-life panel, aluminium, silicon, glass and more, for return to manufacturing.²⁷

>90%
MATERIAL
RECOVERY FROM
SOLAR PANELS

LOCAL COMPANY
PHOENIX METALMAN
RECOVERS 98% OF
THE MATERIALS IN
SOLAR PANELS



Batteries are similar. An EV or storage battery typically holds 70 to 80% of its original capacity at the end of its guarantee, more than enough for a second life in less demanding roles like static home or community storage, rather than being scrapped outright. We are already seeing

²⁷ <https://www.phoenixrecycling.co.nz/solar-panels>

this here in Aotearoa. In the Waikato, Counties Energy partnered with Relectrify to turn retired EV batteries into a 240kWh second-life system, the first unit deployed at Mercer to recharge other EVs.²⁸ Recycling batteries at end of life can already recover more than 90% of key materials inside them including cobalt and nickel, materials that can go straight back into building the next battery rather than requiring fresh extraction.

The whakapapa-centred logic of Māori culture already carries a circular quality, one that sits in real contrast to the fossil fuel economy. A solar panel returned to the manufacturing cycle, a battery given a second life powering a community system before its materials are finally recovered, these aren't new values being asked of marae, they're a fairly direct expression of ones already there. The scale of what's coming makes this worth planning for properly. Electrifying New Zealand's private vehicle fleet alone is expected to require importing around 760,000 tonnes of battery-related material, including 150,000 tonnes of nickel and 75,000 tonnes of copper.²⁹ Getting that material back into circulation once it reaches end of life, rather than into landfill, is the kind of supply chain a cluster of marae, or an iwi entity overseeing several, could realistically have a stake in as this technology scales, turning what looks like a waste problem into a resource one.

3.2 Te parahanga hau | Air pollution

3.2.1 Outdoor

Replacing fossil fuel machines **and reducing combustion cuts the local air pollution a marae and its immediate surroundings are exposed to, particularly relevant for marae that run generators regularly, or sit close to housing, a kōhanga reo, or other buildings where people spend extended time. The same applies to every petrol or diesel vehicle coming and going from the marae, and to the small machines used to keep the grounds themselves, the mowers, chainsaws, and weed eaters running day to day. These are easy to overlook because they're small and used briefly, but small two-stroke engines in particular are disproportionately dirty for the amount of fuel they burn, and a marae mowing a large grounds area or clearing land for an event can have someone running one for hours at a stretch.**

3.2.2 Indoor

Gas stoves, gas heaters and wood burners produce nitrogen dioxide and fine particulate matter: pollutants that accumulate indoors, particularly when ventilation is poor. In a wharehau or wharekai where large numbers of people gather and sleep, that exposure is amplified.

The scale of the health harm in New Zealand homes is now well documented. Research commissioned by the Energy Efficiency & Conservation Authority (EECA) and published in 2025 estimated the total social cost of indoor air pollution from combustion appliances at around \$5 billion per year.³⁰ Gas cooking was linked to more than 1,000 hospital admissions, 200+ early deaths and more than 3,000 new cases of childhood asthma annually. The Cardiac

²⁸ <https://countiesenergy.co.nz/media-centre/counties-energy-repurposes-end-of-life-ev-batteries-to-recharge-new-ev-cars/>

²⁹ Rewiring Aotearoa analysis, Ministry of Transport Fleet Statistics, from <https://www.rewiring.nz/watt-now/closing-the-loop>

³⁰ <https://www.eeca.govt.nz/insights/eeca-insights/indoor-combustion-in-new-zealand-homes-health-effects-and-costs/>

and Respiratory Foundation noted that asthma already affects one in eight children in New Zealand, accounting for more than 360,000 lost school days each year.³¹ and that indoor air pollution can both trigger new cases and worsen existing symptoms.

These findings are based on residential homes. Marae are larger spaces, used more intensively during events, with cooking equipment running for hours at a time and people sleeping overnight in the same buildings. The exposure risk during a tangihanga, when a wharekai may be cooking for hundreds of people across multiple days in an enclosed space, is significant. Switching to electric cooking and heating eliminates these pollutants at the source, with no exhaust, no combustion and no ongoing exposure risk for the whānau and manuhiri gathered there.

³¹ <https://cardiacandrespiratory.org.nz/news/asthma-hospitalisations-to-rise-as-kids-return-to-school/>

Case study

Whakatū Marae

Rohe Te Te Tau Ihu o Te Waka, Te Waipounamu
Iwi Ngāti Tama, Ngāti Rārua, Te Ātiawa, Ngāti Koata, Ngāti Toa Rangatira and Ngāti Kuia

Waka Takitimu
Maunga Maungatapu and Tuao Wharepapa
Moana Maitahi

Solar 34 panels, 15 kW

Battery 20.5 kWh

Water heating Electric resistive

Heating Heat pumps



Whakatū is a busy urban marae in the middle of Nelson. Alongside Kākāti (whare tupuna) and Mauriora (wharekai), the site has multiple buildings for social work, kōhanga reo, Whānau Ora, kaumātua services and other health services. This is a real community marae.

With around 40 kaimahi on site every day and tamariki at the kōhanga, the marae uses power all day, every day, not just during hui. Its three-phase 14.96 kW solar array (34 panels) powers the offices, heating and cooling, and daily operations, keeping working conditions comfortable for staff. The 20.48 kWh battery stores surplus solar so it isn't exported cheaply. Being in the middle of Nelson, the marae also wants to lead by example, cutting its environmental impact and showing the wider city what clean energy can look like. Its space heating and water heating are all electric, to make the most of the low-cost energy it generates itself.

The battery also makes Whakatū more resilient. Marae are often the first place people turn to in an emergency, and Whakatū Marae is a civil defence emergency centre. With batteries and stored solar power, Whakatū can keep running during a power cut, supporting the wider community during disaster relief.

Lesson: For a marae that is busy every day, solar plus a battery works hard all year round. Daytime solar powers the offices and services, while the battery stores the surplus and keeps the marae running for the community when the grid goes down.

4 – Te manawaroa | Resilience

Electrification significantly enhances the resilience of marae, enabling them to better withstand natural disasters, power outages, and support communities through growing climate emergencies. When disaster strikes, marae are where communities turn. Marae are often formally designated as civil defence hubs for communities, and even those without an 'official' civil defence status open their doors, take in the displaced and hold their communities together, often at their own expense³².

Some of the most devastating disasters in recent history have required marae to become evacuation centres and welfare hubs, often without any warning. During Cyclone Gabrielle in 2023, marae across Te Tairāwhiti and Te Matau-a-Mauī opened their doors offering shelter, food, information and care³³. Because of their deep local connections and knowledge of surrounding whenua, marae also become vital community intelligence and service hubs³⁴. When the floods of January 2026 struck Te Tai Tokerau and Cyclone Vaianu struck the Bay of Plenty in April, the pattern repeated³⁵. As states of emergency are declared across regions, marae open their doors, mobilising faster than centralised agencies and without waiting to be asked.

This role is only becoming more important, and more often called upon. National research assessing the exposure of marae found that over two-thirds of marae across Aotearoa are exposed to at least one significant hazard, with 45 per cent sitting within flood zones, 40 per cent experiencing potentially damaging shaking in a major earthquake and a number exposed to as many as four hazards at once.³⁶ In other words, many marae are both the place their community shelters in a disaster and a place directly in harm's way. Research also tells us that Māori communities are among the most exposed to the impacts of climate change with



³² <https://www.auckland.ac.nz/en/news/2025/08/25/marae-resilience-global-stage.html>

³³ <https://www.police.govt.nz/news/ten-one-magazine/helping-many-not-just-few>

³⁴ <https://www.hbemergency.govt.nz/assets/Uploads/HBCDEM-Response-to-Cyclone-Gabrielle-Final-Report.pdf>

³⁵ <https://newsbeat.tauranga.govt.nz/news-article/artmid/24836/articleid/15049/cyclone-vaianu-marae-open-tonight-for-self-evacuation>

³⁶ <https://www.auckland.ac.nz/en/news/2025/08/25/marae-resilience-global-stage.html>

increasing exposure to marae and papakāinga from flooding, coastal erosion and storms to the extent that communities are now actively deciding to relocate to mitigate these ever-increasing climate effects³⁷.

Solar and batteries can significantly strengthen a marae's resilience in these situations. The very events that make marae so essential are also the events most likely to cut their power. Many gas appliances fail too, since califonts and similar systems need electricity to run. A marae cannot shelter, warm and feed a hundred people, or keep vital medical equipment running, if it has no power to do it with. Solar panels paired with battery storage change this. It enables a marae to generate and hold its own power, independent of the grid. When the lines come down, an electrified marae can keep the lights on, the wharenuī warm, the wharekai cooking, the fridges running, phones and radios charged, and medical equipment powered. Electric vehicles add a further layer, acting as batteries on wheels that can power a building, through a process called two-way charging, or move people and supplies when fuel deliveries fail to arrive. The stakes are highest for isolated and remote communities where a single storm can take out the road, the power lines and the phone network at once, and when that infrastructure is damaged in a remote area it can take weeks, sometimes months, to repair. In the meantime, help from outside is slow to arrive and often cannot get through at all. It is in these places that electrification matters most, because when the outside world is cut off, a marae that can power and provision itself becomes the one place for miles that can still function. In these communities they are often hubs not only for hapori Māori but for the whole district.

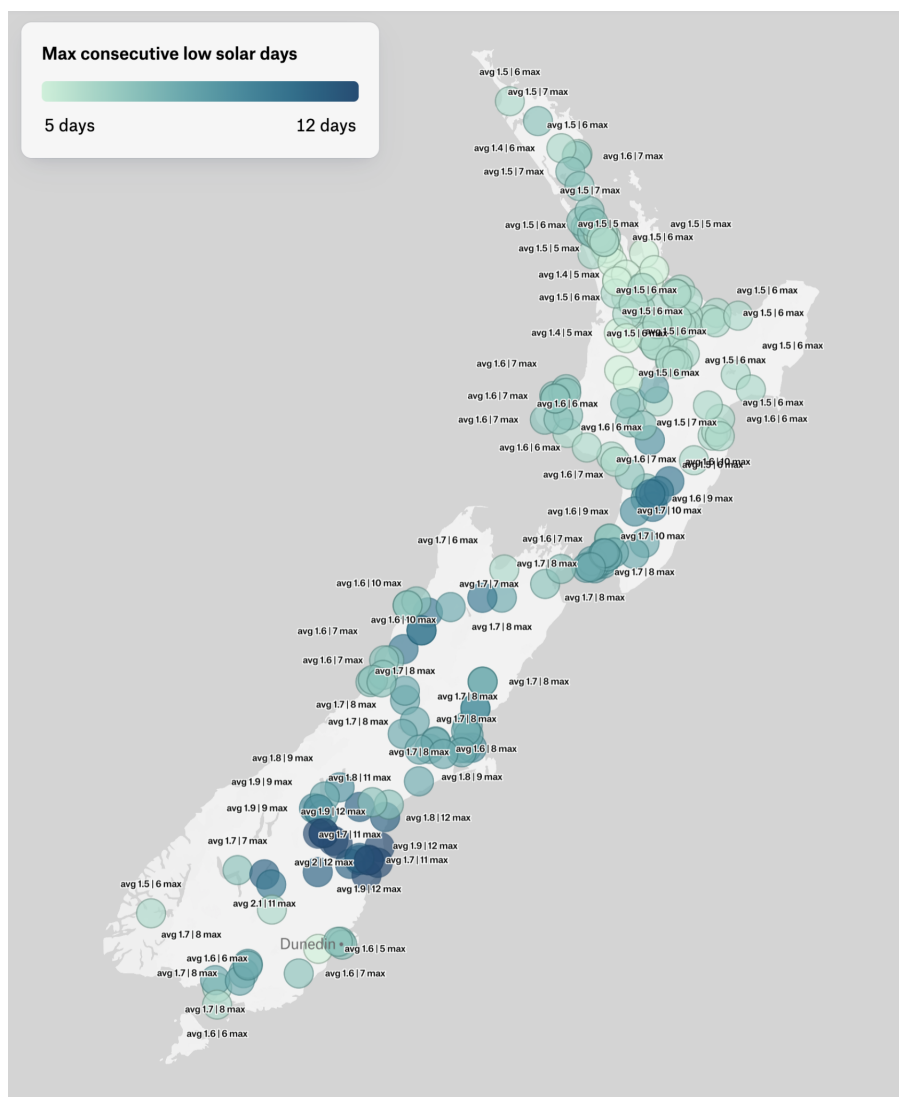
Resilience of this kind strengthens mana motuhake. A marae that holds its own energy is not waiting on the power company or the fuel truck. It can act on their own terms, at the moment of greatest need, and continue to deliver its kaupapa through the most uncertain times. This is manaakitanga and kaitiakitanga in their fullest sense, the marae accepting responsibility not only for its own people but for all who come to its gates when the next emergency arrives. In building its own energy resilience, a marae is not only protecting itself. It is safeguarding the whole community that depends on it.

4.1 Ka whiti tonu te rā ki Aotearoa | It's (almost) always sunny in Aotearoa

A common concern regarding solar power is that "the sun doesn't always shine". To evaluate this risk empirically, we partnered with the University of Canterbury to analyse 10 years of solar irradiance data across New Zealand's Grid Exit Points (GXPs), measuring consecutive days where generation fell below 10% of average yield.³⁸ As shown in Figure 42, periods of low sunlight are on average around two days long. Across the 10-year dataset, the maximum duration of consecutive low-generation days was roughly one week in most regions. Given that New Zealand's hydro lakes hold several weeks of generating capacity, this data highlights

³⁷ https://www.researchgate.net/publication/353760997_He_huringa_ahuarangi_he_huringa_ao_a_changing_climate_a_changing_world

³⁸ Thank you to the University of Canterbury for their support in this research.



the potential for distributed solar to complement the country's existing energy storage assets if we were to use it effectively.

Figure 42: Consecutive low-solar days per GXP across New Zealand³⁹

³⁹ This is publicly available online: <https://felt.com/map/Its-always-sunny-in-Aotearoa-almost-z9B9CnbbaNRoCCdxrQ4XbtCA>

4.2 Te whakamauru me te urutau | Mitigation and Adaptation

Many of our marae stand beside rivers, estuaries and the coast, placed there by our tūpuna for access to transport and kai. They chose ground known to be safe through generations of mātauranga, and adapting to natural hazards has always been part of our whakapapa. Climate change is now accelerating those hazards. Inland and coastal flooding, landslides, wildfire and rising seas are all projected to become more frequent and severe, and an unprecedented number of marae now face hard decisions about their future. Marae are responding in three ways: protecting, accommodating and retreating.

For some, retreat is already happening. After Cyclone Gabrielle, five marae in Te Tairāwhiti (Puketawai, Hinemaurea ki Mangatuna, Okuri, Takipū and Rangatira) began relocating to safer ground,⁴⁰ and marae in Te Tai Tokerau are starting to follow. No hapū makes this decision lightly. A marae is far more than its buildings; it is where whakapapa, history and identity come together. Alongside the loss of whenua, hapū must negotiate with councils and insurers and secure new land. Funding alone is not enough. Hapū also need trusted information and technical

expertise, such as flood modelling and geotechnical advice, and both are often hard to reach.

Electrification answers both sides of this challenge. As mitigation, it cuts the emissions driving these changes. As adaptation, it keeps a marae powered when lines, roads and fuel supplies fail.

Relocation also offers a once-in-generations chance to rebuild well. A marae rising on new ground can be electric from day one, with solar, batteries and efficient appliances designed in, free of the fossil-fuel dependence of the old site.

Regional | Cyclone

No 'peace of mind' until managed retreat from vulnerable areas - iwi leader

Wednesday, 15 April 2026 • By RNZ News



A slip blocks State Highway 2 in January. Photo: Supplied/NZTA

⁴⁰ <https://www.1news.co.nz/2025/05/15/five-gisborne-marae-to-move-to-safer-ground-with-govt-support/>

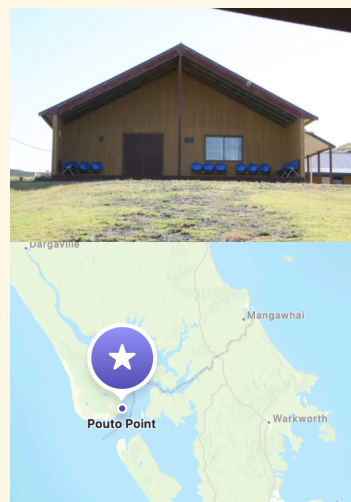
Case study

Waikāretu Marae

Rohe Te Tai Tokerau
Iwi Ngāti Whātua
Waka Māhuhu-ki-te-rangi
Hapū Te Uri o Hau
Maunga Muarangi
Moana Kaipara

Solar 24 kW (48 panels)
Batteries Battery storage integrated with 45kVA generator

Heating Heat pumps



Waikāretu is an isolated marae on the Pouto Peninsula, overlooking the Kaipara Harbour. It is mostly used for tangihanga and by the small community that lives around it. With only one road in and out, and one power line, the marae can be cut off for days when storms or flooding bring the lines down. Severe weather is becoming more frequent, and these outages are becoming more common.

To improve energy security and keep the marae running during outages, the marae decided to install a three-phase hybrid solar and battery system. While Waikāretu is a quieter marae, it can accommodate a significant number of people and has large commercial equipment in its wharekai. The system has been designed to run this three-phase equipment on the energy generated by the panels on the roof.

Because Waikāretu can now operate off-grid, the wider Pouto community knows that when storms or flooding hit, there will always be somewhere warm to shelter, cook kai and charge phones. For a marae that so often hosts tangihanga, it also means whānau can carry on with their mourning without worrying about the power.

Lesson: For remote marae, solar is about more than saving money. Designing a system that can run the marae when the power lines go down has turned Waikāretu into a lifeline for the whole community.

5 – Te mana motuhake mā te tino rangatiratanga pūngao | Mana motuhake through energy sovereignty

Nearly every litre of petrol and diesel, and most of the LPG a marae burns for cooking, hot water, heat and mowing lawns, generators and everything else comes from overseas. The fuel a marae depends on to care for its people is controlled by others, priced by others, and shipped in from the other side of the world, and that leaves marae exposed to costs and disruptions it has no role in and no ability to change.

The scale of that dependence is not limited to marae. Around two-thirds of New Zealand's total energy comes from fossil fuels, most of it imported, and the country spends around \$20 billion a year, or \$55 million a day, on fuel that flows straight offshore to markets we have no say over.⁴¹ The one significant fuel we do produce at home, natural gas, is running out, with production from the Taranaki fields modelled to keep declining sharply through the coming decade.⁴² That exposure runs deeper than the price of any one fuel, because the fuel reaches us only at the end of a long and fragile chain.

Since the Marsden Point refinery closed in 2022, New Zealand no longer refines its own fuel. Where we once imported crude oil and refined most of our petrol and diesel here, we now import almost every drop as a finished product, shipped in from refineries in Asia. Every litre depends on oil being extracted in one part of the world, refined in another, and carried thousands of kilometres to a handful of terminals on a small number of ships. Each stage is a point where things can break, and as we have seen recently, it will. This vulnerability is real enough that the Government has had to build a strategic diesel reserve and keep close watch on supply, at times counting fuel still on ships heading here toward the country's emergency reserves. When we as a nation are reduced to counting the tankers on the water to know whether we will have enough fuel to continue powering our world, the fragility of our position is plain.

The events that break this chain are neither rare nor predictable. They are a recurring feature of the geopolitical environment beyond our shores and beyond our control. The war in Ukraine sent global energy prices surging. Conflict in the Middle East and the threat to shipping through the Strait of Hormuz, the narrow channel through which a fifth of the world's oil supply passes, did the same again, with fuel tanker traffic there falling to almost nothing at the height of the crisis. While these events happen thousands of kilometres away, their impact is felt by marae within weeks in the increased price of a gas bottle and a tank of petrol. These events are not simply one-offs. They are a permanent condition of relying on fuel from the other side of the world.

⁴¹ Investing in Tomorrow report, 2025, Rewiring Aotearoa, <https://www.rewiring.nz/tomorrow>

⁴² Energy in New Zealand 2026, 2025, MBIE, <https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-publications-and-technical-papers/energy-in-new-zealand/energy-in-new-zealand-2026/gas>

This active decision of transitioning our energy system to one that champions Aotearoa Made Energy is a direct act of rangatiratanga and is our pathway out of dependency on foreign-sourced fossil fuels. Aotearoa is very good at making renewable electricity, and the solar opportunity means that marae can generate their own energy, on their own whenua and on their own terms. Its cost is set by the local price of generating and storing it, not by distant geopolitics or supply chains of overseas suppliers. This is the stability of energy made at home compared to the volatility of energy shipped in: clean power drawn from the sun rather than fuel that harms the taiao and the people gathered around it. For more on how electrification can help our collective energy future, read our explainers on the solving the dry year problem,⁴³ how solar can improve our energy security,⁴⁴ and how we can help homes and businesses become less dependent on gas.⁴⁵

⁴³ <https://www.rewiring.nz/watt-now/solving-the-dry-year>

⁴⁴ <https://www.rewiring.nz/watt-now/why-solar-makes-sense>

⁴⁵ <https://www.rewiring.nz/watt-now/a-bad-case-of-gas>

Part III

Te Tīmatanga

Getting started

In Part III, we outline practical steps for electrification at both the local and systemic scale. This includes:

- Steps to get started on electrifying your own community
- Pathways for financing this investment
- Pathways for collective action, changing the systems and policies so that we can drive marae electrification at the national level and enable iwi to exercise mana motuhake over their energy infrastructure.

6 – Me pēhea te whakahiko i tō marae | How to electrify your marae

The shift toward an electric future is a journey that can unfold over time rather than all at once. By first gaining a clear picture of how a marae currently uses its energy, leadership can pinpoint the most immediate opportunities and build a staged roadmap. This allows for a transition that is perfectly aligned with the marae's specific infrastructure needs, available financial support, and long-term aspirations for its people, community and te taiao.

Kaupae 1: Whakatauhia ngā whāinga o te marae Step 1: Establish the marae's goals

The first step is for the marae to define its core objectives for the electrification journey. What are the main priorities? These may include:

- alleviating energy hardship by lowering bills
- eliminating reliance on imported fossil fuels
- supporting kaitiakitanga through emissions reduction
- enhancing manaakitanga by creating warmer spaces for manuhiri
- strengthening resilience against grid outages and functioning as a community energy hub through EV charging and civil defence support.

By establishing these clear goals early on, leadership ensures that every technical decision remains grounded in the wider kaupapa and intergenerational goals of the marae, rather than being driven by the technology itself.

Kaupae 2: Kia mārama ki ō nama pūngao o nāiane Step 2: Understand your current energy bills

Before you begin seeking quotes, it is essential to build a clear picture of both your current and future energy usage. Start by reviewing a full year of electricity, LPG and fuel invoices to identify where your energy goes.

Consider your future aspirations for the marae, its buildings and usage. You should also account for your marae's vital role as a resilience hub during emergencies which is becoming more prevalent.

With these insights in hand, collaborate with a trusted energy expert to draft a preferred system architecture. A future-ready design should address:

- Existing and long-term electricity consumption
- Maximum demand during major community gatherings
- Anticipated growth of marae facilities
- Rooftop solar generation and orientation
- Battery storage capacity and critical backup duration
- Identifying essential loads to keep running during outages
- Supporting expanded services
- A phased approach for steady, manageable upgrades

By embedding this intergenerational perspective into your initial planning, you avoid the cost of reworking infrastructure later and ensure your investment delivers mana motuhake for generations to come.

Kaupae 3: Whakatauhia me mātua whakahiko i te aha

Step 3: Decide what to electrify first

Once you know where your biggest costs and savings are, factor in timing. A re-roof is a good moment for solar, and a bathroom refit is a good moment for hot water. Then decide what to electrify first.

Part of this may include evaluating the physical and practical limitations of your marae. It may include factors such as:

- The total load capability of the current grid connection
- Existing phase configuration (single vs. three-phase supply)
- The integrity and age of switchboards and wiring
- Usable roof area and its overall structural health
- Solar potential, including orientation and any nearby shading
- Sufficient room for housing the battery, hot water tanks, and exterior heat pump units
- Availability of kaimahi or volunteer time to own the renovation process

Engage a qualified energy expert or electrician early on to ensure that any necessary infrastructure upgrades are identified well before solar, storage, or new electric machines are purchased.

Once you've got a clear idea of where your biggest costs are, where the biggest potential savings are, and any practical barriers or advantages you may have (e.g. an upcoming re-roof, a kitchen renovation), decide what machines you will electrify first.

Kaupae 4: Tonoa kia maha ngā tuku utu

Step 4: Get multiple quotes

Shop around for the model/specs of the electric machine you are purchasing and installing. Get at least three or four quotes from providers, whether that's a solar installer, a heat pump installer, or a plumber. To ensure clarity for your committee, each proposal should explicitly detail:

- Hardware specifications, including brand and model
- Design capacity and forecasted energy yield
- Comprehensive costs for professional installation
- Necessary switchboard or building structural remediation
- Protection through manufacturer and workmanship warranties
- Ongoing servicing and upkeep protocols
- Integrated software for performance tracking
- Anticipated reductions in annual operating spend
- Projected timeline for financial return
- Functionality for critical battery backup
- Grid connection and energy export approvals
- Any specific exclusions from the total price

When evaluating these options, prioritise overall value, component quality, and long-term local support rather than focusing solely on the initial capital outlay.

In the case of vehicle electrification, shop around – look at a few different models that may meet your needs, and compare prices across multiple different dealers. There are independent resources online that can help you choose a model that suits your marae's needs, such as [EVDB.nz](https://evdb.nz).

Kaupae 5: Te pūtea me ngā ara ahumoni

Step 5: Funding and financial pathways

Determine how your marae will meet the capital requirements of the required upgrades. These are discussed in more detail in Section 7. When assessing these options, it's important to weigh the immediate capital outlay against the intergenerational savings. A more significant initial investment in durable, high-efficiency technology often yields far greater value and reliability over the lifetime of the system.

Kaupae 6: Whakapakarihia ngā pūkenga o te whānau

Step 6: Build capability within whānau

Marae electrification is an opportunity to anchor new expertise and capability within the hapū. Identify whānau members who will serve as kaitiaki of this new system, building their confidence in managing the marae's energy needs on a day-to-day basis. It can also be a demonstration project for others and give them confidence to make use of this knowledge in their own lives.

This capability building should focus on:

- Gaining a clear technical overview of how solar generation and battery storage function together.
- Monitoring real-time generation data, storage levels, and overall energy consumption patterns.
- Aligning high-demand activities - such as water heating, laundry, and vehicle charging - with the solar window to maximise the use of Aotearoa-made energy.
- Navigating electricity tariffs and time-of-use pricing to ensure the lowest possible operating costs.
- Determining the most beneficial times to export surplus power versus storing it for evening use or resilience.
- Undertaking basic maintenance, from keeping solar modules clean to ensuring monitoring software remains online.
- Recognising common faults and knowing when to resolve an issue locally versus calling a certified installer.
- Maintaining records for system performance, warranties, and intergenerational maintenance schedules.

By embedding this knowledge within whānau, the marae reduces its dependence on outside contractors and ensures that the full economic and resilience benefits of electrification are captured. This pathway also empowers rangatahi with practical skills in renewable technology, furthering the marae's energy sovereignty and its role as a leader in the community's energy transition.

7 – Te ahumoni | Financing

Electrification is an investment for marae. The savings are real, and the resilience and emissions benefits compound over time. Often the barrier is not willingness but, for many marae, upfront cost, particularly if careful design consultation has concluded that infrastructure upgrades are indeed required. Some financing pathways exist, and marae across the motu are using them to get started, but they are not sufficient in scale or accessibility to meet the opportunity. Expanding the range of financing options available to marae, and making them easier to access, is a high-return investment for a lender, council or government agency. The savings from electrification flow back to the marae and its community for decades, and a marae that controls its own energy is more financially stable, more resilient and better placed to serve its people.

7.1 Ko ēhea ngā huarahi ahumoni e wātea ana? | What financing solutions exist?

The upfront cost of electrification can be significant and is the main barrier to us electrifying marae across the motu. This expense is greater where a marae must upgrade its roof, wiring, switchboard or grid connection before installing solar, batteries or new electric machines. However, marae do not necessarily need to fund the entire transition at once or from a single source. Electrification can be staged over time and financed through a combination of grants, existing reserves, fundraising, iwi support and, where appropriate, affordable long-term lending. Electrifying can also be timed with other planned renovations. Replacing a roof, upgrading a kitchen or rewiring a building creates a natural window to add solar, swap out a gas califont or install a heat pump at lower additional cost than doing it as a standalone project. Financing a renovation and electrification together, rather than separately, can make both more achievable.

Options available will differ between marae. Access to capital may be influenced by central and local government relationships and priorities, settlement status, existing income and reserves, the condition of buildings and the ability to take on debt.

Central government funding

Contestable funding from government agencies supporting Māori development, energy efficiency, climate resilience, regional development and community infrastructure. Funding may cover feasibility work, building upgrades, renewable generation, batteries or electric equipment, depending on the purpose of the fund. Historically, government agencies have directly funded marae electrification and energy resilience through a range of programmes. These have included EECA (via the Community Renewable Energy Fund), the Ministry for the Environment (via the Māori Climate Platform Fund), MBIE (via the Māori and Public Housing Renewable Energy Fund and the Regional Infrastructure Fund), Te Puni Kōkiri, and the Department of Internal Affairs (via the Civil Defence Emergency Management (CDEM)

Resilience Fund and Lottery Community grants). Current funding availability shifts frequently, requiring marae to conduct some research on which fund best fits the scope and scale of a specific project.

Regional and local council funding

Councils may provide climate action, resilience, community development or infrastructure grants. For example, Auckland Council's Cultural Initiatives Fund includes energy efficiency as a funded category for marae, and has previously delivered solar and battery storage to Papakura Marae in partnership with Entrust and Vector. While these funds are often limited, they can support specific elements of a wider electrification project or provide co-funding for a larger application. Council support is especially aligned with marae electrification projects particularly where councils have climate commitments and existing relationships with marae in their rohe.

Philanthropic and community funding

Community trusts, energy trusts, foundations and other philanthropic funders may support projects that reduce hardship, improve resilience, strengthen Māori communities or deliver environmental benefits. In Tairāwhiti, a marae solar project provides an example: 22 marae across the rohe had solar and battery systems installed, with a combined \$2.6 million funded through a coalition of the Todd Foundation, Eastern & Central Community Trust, EECA, Te Puni Kōkiri, the Department of Internal Affairs Lottery and Trust Tairāwhiti.

Marae and hapū resources

Marae may contribute existing reserves, koha, fundraising proceeds, hire revenue or other locally generated income. These sources can help meet co-funding requirements or pay for early steps such as an energy assessment or feasibility study.

Iwi investment

Where resources and governance arrangements allow, iwi entities may provide grants, direct investment, guarantees, shared procurement or access to specialist expertise. Post-settlement entities may also be able to use commercial income or investment returns to support marae electrification.

7.2 Ko ēhea ngā huarahi ahumoni me whakatū? | What financing solutions need to exist?

The financing options available today have supported meaningful progress, but they fall short of what is needed to bring electrification within reach of every marae that wants it.

A dedicated government fund specifically for marae would accelerate electrification significantly. Existing grants are contestable and fragmented across agencies. A purpose-built fund, one that covers the full suite of electric machines, wiring upgrades, and feasibility work, would remove the single biggest barrier most marae face: upfront cost.

Feasibility work in particular has been traditionally underfunded. Before a marae can apply for capital grants or approach a lender, it often needs an energy audit, system design, and professional advice to understand what it actually needs and what it will save. That work costs money that most marae committees do not have, and without it, the larger investment never gets off the ground. Dedicated funding for feasibility studies would unlock the pipeline of marae ready to act.

As with households, increasing the availability of lending products would increase the funding pathways for marae looking to electrify. Financing, in the form of low-interest, long-term loans, could have a significant impact in accelerating electrification. In many cases, the savings from the upgrade may mean the investment pays itself back over time. Patient, affordable finance makes the upfront cost manageable without requiring grant funding to cover the full amount. Whether enabled via government, banks or iwi lending arms, the key question is that of access so that all marae, regardless of size, resources or settlement status, can access the cashflow needed to invest in electrification.

More philanthropic and council funding could go a long way to increasing uptake across the motu. Reducing any perceived risk of investment would expand the support available, smooth the path to commitment, and accelerate the pace at which marae can find, access and secure funding. This may be achieved through government co-funding, feasibility studies, and by drawing on the evidence provided in this report. Furthermore, marae that have electrified and are able to share their journey (their savings, their experience through outages, the freed-up pūtea reinvested in their community) help to grow the funding pool by increasing confidence for investors. Every documented case study makes the next funding conversation easier, and every marae that goes electric is, in effect, building the case for the ones that follow.

Finally, lower-cost procurement mechanisms such as group discounts via bulk purchases can reduce the per-unit cost of solar, batteries and electric appliances significantly, making the economics work for marae that would otherwise be priced out. Iwi or rūnanga may be able to act as aggregators for marae to support the development of such programmes.

8 – Ngā ara mō te mahi ngātahi | Pathways for collective action

Our marae and iwi are well placed to lead their own electrification journeys, and many across the motu are already doing so, funding the work through iwi entities, their own reserves, or the finance and support pathways set out in this report. These decisions sit squarely with our marae.

Electrification also happens within a wider system. A marae generates, stores and uses its electricity within a national energy system governed by a range of regulators, legislation and policy. Realising the full opportunity requires a shift in how that system sees marae. Our grid has long been built around large-scale, centralised generation, treating marae as consumers at the end of the line. An Electric Marae is both a consumer and a contributor: it draws from the grid, and it generates, stores and shares electricity of its own. Central government, including its regulators, sets the regulatory and policy conditions that decide whether electrification is straightforward or difficult, affordable or out of reach, and whether a marae can connect, export and share power freely. A marae can fund its own solar and batteries and still be held back by rules made far beyond the marae gate.

Making the most of electrification for every marae in Aotearoa therefore calls for action on three fronts: advocating to central government to improve the conditions the energy system operates within, supporting the marae and whānau within our reach directly, and, over the longer term, investing in the energy system itself.

8.1 Te whakahou i te pūnaha pūngao | Transform the energy system

Because the Government sets the regulatory conditions and policy direction that make electrification easy or hard, advocacy to the central Government is a critical lever, and one where marae and iwi carry real weight. The following are key actions the Government could be encouraged to take.

Back a national energy strategy built on Aotearoa-made energy

For too long the national conversation has centred on large-scale, centralised generation and on managing our exposure to imported fuels. There is a better path. An energy strategy with locally generated and stored power at its heart drives affordability, because solar is now the cheapest form of delivered electricity available in Aotearoa. It also drives resilience, because energy made and held on site is shielded from the volatile global prices and long supply chains that push bills up year after year. The strategy should treat marae as part of the energy infrastructure of the nation.

Provide funding and finance suited to what a marae is

For most marae, the will to electrify is already there; the barrier is the upfront cost. Our marae are community institutions, many held in charitable or community trusts with modest and irregular income, and that shapes what support fits. Grant funding is the most important lever, because it meets costs a marae cannot be expected to repay from savings alone, and it has already shown what it can achieve. The Māori Climate Platform supported solar and other climate resilience infrastructure at more than sixty marae, strengthening their ability to serve as safe gathering places and emergency hubs in severe weather. That funding is now coming to an end. Sustaining and expanding platforms of this kind would allow far more marae to begin their journey, and would recognise the immense role marae play in keeping their communities safe, often while highly exposed to climate change themselves. Alongside grants, accessible, low-cost, long-term finance has a role for marae and iwi entities in a position to use it, letting them meet the upfront cost and repay it over time from the savings generated. Together, grants and finance will carry electrification to every marae that wants it.

Focus funding on the machines, not just the roof

Getting solar onto the roofs of marae has been a valuable first step, but solar only generates the energy. The savings, the emissions reductions and the resilience are realised by the machines that use it. A marae with solar on the roof but gas in the kitchen and califonts on the wall captures only a fraction of the benefit available to it. Funding should therefore extend beyond generation to the electric machines that replace fossil fuel use, so that the energy a marae generates is matched by the appliances that put it to work.

Set fair rules for local and shared energy

The bodies that regulate the energy system should be making decisions in the long-term interest of the people who live here, not the incumbents whose interests do not always align with those of marae and communities. Several practical changes would make an immediate difference. Fair pricing for exports is chief among them: when a marae sends surplus solar power back to the grid, it should be paid a price that reflects the true value of clean, local energy, not the token rate too often on offer today. Marae should also be able to share the power they generate without facing a wall of regulatory burden, since the rules as they stand can make it difficult and costly to move energy between connections or out to nearby whānau, even when the willingness and the wires are there. Two reforms in particular would open this up. Multiple Trading Relationships, as noted earlier in this report, would let a marae direct its surplus power where it chooses rather than handing it back to a retailer for little in return. Peer-to-peer energy trading is the natural next step, allowing a marae to sell or gift its surplus directly to the homes and papakāinga around it. Together these turn a marae into a genuine local energy hub, keeping the value of locally generated renewable energy within the community that produced it.

Recognise the role marae and iwi play in the energy system

Marae already act as resilience hubs for their communities, and post-settlement iwi are already significant asset holders and long-term investors whose capability across the energy system is growing. The system should be designed to bring that capability in, not leave it on the outside. Government should better recognise and value the role marae and iwi can play as partners in generation, distribution and resilience. Iwi think intergenerationally, not in electoral cycles, which makes them natural long-term custodians of the kind of infrastructure the

country needs. Recognising this properly, in policy and in practice, would strengthen the energy system.

8.2 Te whakahiko i ngā marae me ngā whānau ināiane | Electrifying marae and whānau

Alongside advocacy, there is action that rūnanga, iwi leadership and marae committees can take directly, within their rohe and without waiting on any change in Government policy.

Make your next decision an electric one

The most effective thing a marae can do is act on the opportunity this report has set out. Electrification does not need to happen all at once. As appliances, heating, hot water systems and vehicles reach the end of their working lives, each replacement is a chance to choose the electric option, and a marae that makes its next decision an electric one, and the one after that, will electrify steadily over time without a single large outlay. Rūnanga and iwi leadership with the means to support these decisions can help marae bring them forward.

Empower marae and whānau with information

Many marae and whānau are ready to act and simply need a trusted, plain language picture of what electrification involves and what it delivers: what the options are, what they cost, what they save, and how to begin. Sharing the journeys of marae that have already electrified is especially powerful, because it turns an abstract idea into a proven example that others can follow.

Support whānau to lower their bills and lift their resilience

The benefits of electrification need not stop at the marae gate. An electrified marae becomes an example for whānau around it, and there is a direct role in helping them follow. One-off contributions toward solar, batteries and electric machines can help whānau permanently lower their energy bills and lift their own resilience. More durable still is the creation of funding pathways that whānau can draw on over time, whether a revolving fund that recycles repayments to help the next household, a bulk-buy arrangement that lowers the cost of installations across the papakāinga, or a dedicated pool that rūnanga and iwi entities set aside for whānau electrification. These pay themselves back over time through the savings they unlock, and leave whānau better protected against rising prices and power cuts for years to come.

8.3 Te haumi mō ngā whakatupuranga e heke mai nei | Investing for generations to come

For iwi and hapū with the capacity to invest, there is a longer term opportunity that reaches beyond any single marae: to hold a genuine stake in the energy system that serves marae and their communities. This is the furthest reaching action of the three, and the longest in horizon.

It is mana motuhake at its fullest, ownership of the infrastructure itself, and it ties the security of a marae's energy to the people it belongs to rather than to distant or overseas shareholders.

Invest in electricity generation that powers marae and communities

Some iwi are already major players in generation, delivering both a long-term return and a lasting stake in how energy is made. Investment in renewable generation, at whatever scale fits an iwi's resources and priorities, contributes to the country's renewable supply and can directly serve the marae, papakāinga and whānau connected to it as well as affordably power industries that provide employment.

Invest in the networks that carry energy to and from marae

The opportunity is not limited to generation; there is significant investment potential across the wider energy system. Distribution in particular (the lines and networks that carry electricity to every marae and home across the motu) is an area where iwi ownership can make a lasting difference. Shares in lines companies come to market from time to time, and holdings of this kind are long-term, secure, low return assets, the sort of steady infrastructure suited to an investor thinking intergenerationally. Owning the assets can enable iwi to ensure they are best working for the community, with rates as affordable as possible.

Glossary

Te Reo Māori

Aotearoa	New Zealand
atua	Ancestral deities and the forces of the natural world
hapori Māori	Māori communities
hapū	Subtribe; the kinship group a marae usually belongs to
hauora	Health and wellbeing
hiko	Electricity
hui	Gathering or meeting
iwi	Tribe; a larger kinship group made up of several hapū
kai	Food
kaikōrero	Speakers or orators, particularly on the paepae
kaimahi	Workers or staff
kaitiaki	Guardian or steward
kaitiakitanga	Guardianship and care for the natural world and its resources for future generations
kaumātua	Elders
kaupapa	Purpose, cause or collective initiative
kāuta	Cooking shelter, often with an open fire
koha	Gift or contribution
kōhanga reo	Māori-language early childhood centre
kōrero	Discussion, conversation or account
kura	School
mahi	Work
Mahuika	Atua of fire
mana motuhake	Self-determination; authority over one's own life, wellbeing and future
manaakitanga	Hospitality, generosity and care for others, especially manuhiri
manuhiri	Visitors or guests
māra kai	Food garden
marae	The open space in front of the wharenui, and more commonly the whole complex of buildings; the heart of hapū and community life
marae ātea	Open courtyard in front of the wharenui
Matariki	Known more commonly around the world as the Pleiades star cluster, whose rising marks the Māori new year
mātauranga Māori	Māori knowledge systems

Māui	Demigod and ancestor who brought fire from Mahuika
motu	The country, as in “across the motu”
paepae	Seating area for speakers during formal welcomes
papakāinga	Housing on Māori land, often near or around a marae
Papatūānuku	Earth mother
Parawhenuamea	Atua of fresh water
Pou Take Āhuarangi	Climate change portfolio of the National Iwi Chairs Forum
pōwhiri	Formal welcome ceremony
pūngao	Energy
pūrākau	Traditional stories
pūtea	Funds or money
rangatahi	Young people
rangatiratanga	Leadership, authority and the right to exercise it
Ranginui	Referred to as the sky father who, with Papatūānuku, begat many other atua
rohe	Region or tribal area
rōpū	Group
Rūaumoko	Atua of earthquakes and volcanoes
rūnanga	Tribal council or governing body
taiao	The natural world and environment
Tama-nui-te-rā	The sun
Tāmaki Makaurau	Auckland
Tāne Mahuta	Atua of forests and its inhabitants
Tangaroa	Atua of the oceans
tangihanga	Funeral rites; the gathering to mourn and farewell the dead
tauhokohoko	Trade and exchange
Tāwhirimātea	Atua of winds and weather
te ao hurihuri	The modern, ever-changing world
te ira tangata	Humankind
Te Matau-a-Māui	Hawke’s Bay

Energy

BEV / EV	Battery electric vehicle; a vehicle powered only by electricity stored in a large battery and charged by plugging in
capex	Capital expenditure; the upfront cost of buying and installing equipment
CO2e (carbon dioxide equivalent)	A standard unit for measuring greenhouse gas emissions, combining different gases by their warming effect; often given in kilograms (kg CO2e) or tonnes (t CO2e)
connection size	The maximum amount of electricity a site's grid connection is built to supply; larger connections usually carry higher fixed charges
delivered cost of energy	The full cost of energy once it reaches the user, including generation, lines, retail and other charges
distribution network	The local poles, wires and transformers that carry electricity from the national grid to homes, marae and businesses
electric resistive (resistance) heating	Heating that passes electricity through an element, such as a standard hot water cylinder, panel heater or radiant cooktop; less efficient than a heat pump
embodied emissions	Emissions created in mining materials, manufacturing and shipping a product, before the product is used
fixed daily charge	A set daily fee for being connected to the electricity or gas network, paid regardless of how much energy is used
fuel excise duty	A tax built into the price of petrol at the pump that funds roads; petrol vehicles pay this instead of road user charges
grid (national grid)	The national network of high-voltage transmission lines that carries electricity from power stations around the country
GXP (grid exit point)	A point where the national grid connects to a local distribution network
heat pump	An electric machine that moves heat from outside air into a building (or out, for cooling); typically 3 to 4 times more efficient than gas heating
HEV	Hybrid electric vehicle; a petrol or diesel vehicle with a small battery charged by the engine, which cannot be plugged in
HWHP (hot water heat pump)	A water heater that uses heat pump technology to heat water stored in an insulated tank; the most efficient way to heat water
ICE	Internal combustion engine; a vehicle or machine that runs only on petrol or diesel
induction cooktop	An electric cooktop that heats the pot directly using a magnetic field; faster and more efficient than gas
inverter	The device that converts electricity from solar panels or batteries (DC) into the form used by buildings and the grid (AC)
kW (kilowatt)	A unit of power; the rate at which electricity is produced or used at a given moment; also used to describe the size of a solar system
kWh (kilowatt-hour)	A unit of energy; the amount used or produced over time, and the "volume" charged on a power bill
kVA (kilovolt-ampere)	A unit used to rate the capacity of generators, transformers and connections
lines charges	Fees on a power bill that pay for the national grid and local network

lines company	The business that owns and operates the local electricity distribution network, the poles and wires
LPG	Liquefied petroleum gas, usually comes in a bottle
MTR (multiple trading relationships)	A proposed rule change allowing a customer to buy and sell electricity with more than one company
peak demand	The highest rate of electricity use at a site over a period, such as during a tangihanga or large hui
peak demand charge	A charge based on a site's single highest period of electricity use, common on commercial plans
peer-to-peer trading	Selling or gifting electricity directly to other customers, rather than only to a power company
PHEV	Plug-in hybrid electric vehicle; combines a fuel engine with a rechargeable battery which allows short electric-only trips
reticulated gas	Natural gas piped to buildings through a gas network, rather than delivered in bottles
retail cost	The part of a power bill covering the power company's billing and operating costs
RUCs (road user charges)	Charges paid per kilometre by diesel and electric vehicles to fund roads; the proposed "universal RUCs" policy would extend these to all light vehicles while removing fuel excise duty from petrol
second-life battery	A used battery, often from an EV, given a new role such as static storage once it no longer suits its first use
self-consumption	Using the solar electricity you generate on site rather than exporting it; usually gives the greatest savings
single-phase / three-phase	Types of electricity supply. Most homes are single-phase; three-phase supplies more power and is often needed for commercial kitchens and large equipment
solar irradiance	The amount of sunlight energy reaching a surface, which determines how much a solar panel can generate
solar PV	Photovoltaic panels that convert sunlight into electricity; a group of panels working together is called an array
tariff	The pricing plan a power company charges a customer
TCO (total cost of ownership)	The full lifetime cost of a machine or vehicle, including purchase, energy, maintenance and other running costs
thermal battery	Storing energy as heat, such as heating water with daytime solar for use in the evening
time-of-use (TOU) pricing	A tariff where electricity costs different amounts at different times of day, often cheaper at night
V2G (vehicle-to-grid)	Technology allowing an EV to send electricity from its battery back to the grid
V2H (vehicle-to-home)	Technology allowing an EV to power a home or building from its battery
V2L (vehicle-to-load)	Technology allowing appliances and tools to be plugged into and run from an EV's battery
wholesale price	The price at which electricity is traded between generators and retailers, which rises when demand on the grid is highest

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