

# new zealand electric car guide



By Sigurd Magnusson, Wellington, NZ. 5 May 2016. Updated monthly. Download latest from [www.electriceaven.nz](http://www.electriceaven.nz)

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## FULLY ELECTRIC CARS

These are cars that move using a large electric battery powering an electric motor. They do not take any petrol. Also called Battery Electric Vehicles (BEVs), they produce no exhaust, which is far kinder to the environment – petrol and diesel transport produce 20% of New Zealand’s greenhouse gases.<sup>2</sup> 80% of New Zealand electricity is generated by rain (hydro dams), geothermal, and wind<sup>3</sup>, so the *source* of the car’s fuel is environmentally friendly, and inexpensive, and produced locally (We import over a billion dollars of petrol and three billion dollars of crude oil from overseas each year<sup>4</sup> and local electricity generation is cheaper). A 2015 government study shows electric cars also have environmental benefits versus petrol cars when the full lifecycle of manufacture, use, and disposal are assessed, and that the ingredients like lithium in batteries, aren’t scarce.<sup>5</sup> Having no exhaust, fully electric cars produce no poisonous carbon monoxide fumes.

Electric cars have no clutch or gears, and accelerate more quickly and smoothly, in a “sporty” way, and climb hills easier than petrol cars. A fully electric motor has fewer moving parts, no spark plugs or engine oil, and requires less maintenance than a petrol equivalent. Such cars are extremely quiet and reduce noise pollution. Travelling down hills or braking recharges the batteries, and is known as regenerative braking. The motor uses no energy when the car is still.

Electric cars are safe, reliable, manufactured by large brands, and are beginning to be sold in high volume overseas. Norway, with a similar population and size to New Zealand, has over 80,000 fully electric cars, and they now account for more than 20% of all new car purchases<sup>6</sup>.

Entry-level electric cars have a shorter range (100km+) than petrol cars. High-end cars with large batteries (400km+ range) cost more. Battery prices are dropping significantly, making long range fully electric cars cheaper every year<sup>7</sup>. On average New Zealand drivers travel 28km per day<sup>8</sup>, and electric cars can be charged at home overnight and be ‘full’ in the morning, so affordable electric cars remain practical for most daily journeys. The census shows over half of New Zealand households have two or more cars<sup>9</sup>, suggesting many can drive electric but have a conventional car as a backup. The dashboard displays how far you can drive with remaining battery.

In New Zealand the vast majority of fully electric cars are short-range Nissan Leaf hatchbacks. Some full sized, long-range, high performance cars by Tesla Motors are found here and are very popular overseas. The upcoming Tesla Model 3 will provide the first medium range and cost electric vehicle in New Zealand, though its popularity will create long delivery times (400,000 were pre-ordered globally within three weeks of launch). Over 2016, the introduction of electric cars by Tesla, Renault, and VW into New Zealand will broaden the selection of electric cars we can buy.

<sup>1</sup> This document is released under the Creative Commons Attributions license at <http://creativecommons.org/licenses/by/3.0/nz/>

<sup>2</sup> [transport.govt.nz/ourwork/climatechange/](http://transport.govt.nz/ourwork/climatechange/) cites a 2009 report: [mfe.govt.nz/publications/climate/greenhouse-gas-inventory-2011/](http://mfe.govt.nz/publications/climate/greenhouse-gas-inventory-2011/)

<sup>3</sup> 2015 MBIE report [mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/publications/energy-in-new-zealand](http://mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/publications/energy-in-new-zealand)

<sup>4</sup> [stats.govt.nz/browse\\_for\\_stats/industry\\_sectors/imports\\_and\\_exports/OverseasMerchandiseTrade\\_HOTPFeb16.aspx](http://stats.govt.nz/browse_for_stats/industry_sectors/imports_and_exports/OverseasMerchandiseTrade_HOTPFeb16.aspx)

<sup>5</sup> ECCA Life Cycle Assessment of EVs [eeca.govt.nz/assets/Resources-EECA/ev-lca-final-report-nov-2015.pdf](http://eeca.govt.nz/assets/Resources-EECA/ev-lca-final-report-nov-2015.pdf)

<sup>6</sup> [https://en.wikipedia.org/wiki/Plug-in\\_electric\\_vehicles\\_in\\_Norway](https://en.wikipedia.org/wiki/Plug-in_electric_vehicles_in_Norway)

<sup>7</sup> [slate.com/articles/business/the\\_juice/2016/02/electric\\_cars\\_are\\_no\\_longer\\_held\\_back\\_by\\_crappy\\_expensive\\_batteries.html](http://slate.com/articles/business/the_juice/2016/02/electric_cars_are_no_longer_held_back_by_crappy_expensive_batteries.html)

<sup>8</sup> 2010-2013 Distance per driver trends [transport.govt.nz/assets/Uploads/Research/Documents/Drivers-2014-y911-Final-v3.pdf](http://transport.govt.nz/assets/Uploads/Research/Documents/Drivers-2014-y911-Final-v3.pdf)

<sup>9</sup> [stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-transport-comms/number-motor-vehicles.aspx](http://stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-transport-comms/number-motor-vehicles.aspx)

## PLUG-IN HYBRIDS

These are cars that have both an electric and petrol motor. These cars are sometimes abbreviated as PHEVs (Plug-in Hybrid Electric Vehicles).

The electric battery can be recharged at home or wherever you find an electrical socket, and the fuel tank can be filled up at petrol stations. The purpose of this is to allow you to drive short distances electrically, at low cost and without pollution, and long distances using petrol, avoiding the need to recharge frequently for long trips. These vehicles also have regenerative braking, which captures energy that would be wasted as braking heat. They cost somewhere in the middle between affordable (short range) and expensive (long range) fully electric cars. The drawback of plug-in hybrids is a more complicated engine requiring maintenance, the petrol refueling costs, air pollution, and noise of a petrol engine. Depending on the model, the vehicle either has a petrol engine that also turns the wheels ("parallel PHEV"), or has a petrol generator which recharges the batteries that powers an electric motor to turn the wheels ("series PHEV"). Some vehicles allow you to switch between these two modes. In time, these types of vehicles are likely to be replaced by full electrics when battery prices drop enough in price.

The most purchased vehicle in this category in New Zealand is the Mitsubishi Outlander SUV. The BMW i3 hatchback (over 100km electric range) and the Audi A3 e-tron hatchback (under 30km) are other cars available here. For a time, the Holden Volt sedan (76km range) was sold here.

## CONVENTIONAL HYBRIDS NO LONGER COUNT

Cars such as the *conventional* Toyota Prius Hybrid found in this country<sup>10</sup> over the past decade are different -- they can not be plugged into an electric socket to recharge. They can only fill up on petrol, and use the petrol motor and regenerative braking to recharge a small battery that gives a short (1-2 km) electric range. This does significantly reduce fuel consumption and emissions, but plug-in electric cars are vastly superior.

## WHAT ABOUT HYDROGEN?

A visible debate is forming about whether the long-term future of cars would use hydrogen fuel cells or stored electricity (i.e. batteries) for energy.

Hydrogen does not occur on earth naturally, and must be created, either from fossil energy resources (which would release greenhouse gases), or by using electricity. The hydrogen must then be pressurised, transported, and converted back into electricity inside the car, to power its electric motor. The car produces exhaust in the form of water (about a litre per 16km driven).

By comparison it is cleaner and more energy efficient, and only 25% of the cost, to generate electricity, send it through transmission wires, and recharge batteries in fully electric cars.

No hydrogen fuel cell electric vehicles (HFCVs) are available in New Zealand, and they are produced in very limited quantities globally.<sup>11</sup>

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<sup>10</sup>Toyota Prius introduced a Plug-in Hybrid (PHEV) model in 2009; in NZ it is rare and only available imported. In 2016 Toyota released the Prius Prime, which improves electric range to over 30km, but there is no word on when it might come to NZ.









<sup>11</sup>More information and sources about the hydrogen section: [en.wikipedia.org/wiki/Hydrogen\\_vehicle#All-electric\\_vehicles](https://en.wikipedia.org/wiki/Hydrogen_vehicle#All-electric_vehicles)


A test-drive of a hydrogen versus electric car is contrasted at

[transportevolved.com/2015/08/25/first-drive-report-2016-toyota-mirai-hydrogen-fuel-cell-sedan/](https://transportevolved.com/2015/08/25/first-drive-report-2016-toyota-mirai-hydrogen-fuel-cell-sedan/)




Essay by hydrogen race-car builder has published essay at [ssj3gohan.tweakblogs.net/blog/11470/why-fuel-cell-cars-dont-work-part-1](https://ssj3gohan.tweakblogs.net/blog/11470/why-fuel-cell-cars-dont-work-part-1)

# FULLY electric cars in New Zealand

Car (and whether electric or hybrid)	Seats	Electric Range	Battery (kWh)	0-100, Power	Fast Charge	Cost (\$000) used - new	# in NZ
<b>Nissan Leaf (Fully electric)</b> 	5	Generation 1 117 km  Generation 2 135 km 172 km	24  24 30	9 secs  80kW (110hp)	Yes	\$20 - \$45k  <i>(NZ-new cars sold out. Dealers import from UK &amp; Japan)</i>	487
<b>Mitsubishi i-Miev (Fully electric)</b> 	4	100 km	16	13 secs  49 kW (66 hp)	Yes	\$15k+  <i>(No longer sold by Mitsubishi NZ. Import only)</i>	36
<b>Tesla Motors Model S (Fully Electric)</b> 	5  (plus 2 kids)	386 km or 473 km	70 or 90	3.0 secs  568 kW (762 hp)	Yes	\$130-\$150k  <i>(Tesla to open in NZ. Import from Australia in meantime.)</i>	34
<b>Nissan e-NV200 (Fully Electric)</b> 	2, 5, or 7	121 km	24	11 secs  80kW (110hp)	Yes	\$40k+  <i>(Imports only)</i>	9
<b>Tesla Motors Model X (Fully Electric)</b> 	7	413 km	90	3.4 secs  568 kW (762 hp)	Yes	\$150 - \$200  <i>(Tesla to open in NZ. Import from Australia in meantime.)</i>	3
<b>Renault Zoe (Fully Electric) COMING MID 2016</b> 	5	115-170km <i>Winter vs Summer claimed by Renault. No EPA range figure given.</i>	22	13.5 secs  65 kW (88hp)	No	\$75k  60 min to 80% recharge available	2  Sales expected 2016
<b>VW e-Golf (Fully Electric) COMING LATE 2016</b> 	5	133 km	24	10 secs  85kW (115 hp)	Yes	\$60-70k  <i>(Reported)</i>	None  UK Import now or buy in NZ late 2016
<b>Tesla Motors Model 3 (Fully Electric) COMING LATE 2017</b> 	5	346 km	TBC	4 secs <i>(high spec)</i>  6 secs <i>(base model)</i>	Yes	USD 35k+ From March 2016 NZers can pay USD1000 deposit online	None  First shipments from late 2017

	2 or 5	80 - 120km <i>Winter vs Summer claimed by Renault. No EPA range figure given.</i>	22	44 kW (60 hp)	No	TBC	2  <i>Sales expected 2016</i>
<b>Total fully electric cars in NZ</b> (including small numbers of other makes and models, including home-conversions):							<b>663</b>

## PLUGIN HYBRID electric cars in New Zealand<sup>12</sup>

Car (and whether electric or hybrid)	Seats	Electric Range	Battery (kWh)	0-100, Power	Fast Charge	Cost (\$000) used - new	# in NZ <sup>13</sup>
	5	40km  +700 km petrol  (Approx)	12	11 secs  120 kW (180hp) + 2L engine.	Only if imported	\$39 - 60	400
	4	130 km  (+116 km petrol if hybrid)	22  <i>50% larger battery, longer range later this year.</i>	7 secs  125kW (168hp)	Optional Extra.	\$60 - \$85	64
	5	27km  (+ typical petrol car range)	8	7 secs  75 kW (100 hp)  +1.4L engine	No	\$75	35
<b>Total Plugin Hybrid Electric cars in NZ</b> (including small numbers of other makes and models, incl. home-conversions):							<b>553</b>

The Electric Range of a car can be overstated in marketing material. A US government agency measures the range of all electric vehicles for sale using a standardised test and publishes this information at [fuelconomy.gov](http://fuelconomy.gov). This is known as “EPA range”, and is shown in the table above, as it provides a useful comparison between models and vehicles. This test assumes a mixture of road speeds (highway and suburban) to reflect a typical journey.

A number of situations will result in a car using up its battery before reaching the EPA range. For example (and particularly if combined) frequent strong acceleration, climbing significant hills, constant high speeds, use of air conditioning or heaters, towing a trailer, and battery age. Conversely, travelling slowly or staying on flat terrain can enable you to exceed EPA ratings.

The European electric car range test (NEDC) is less useful as it gives overly generous figures.

<sup>12</sup> Costs from TradeMe and dealers, likely to fluctuate. Range rated by U.S. EPA, sourced from [fuelconomy.gov](http://fuelconomy.gov) (except Outlander from [mmnz.co.nz/plug-in-hybrid/options/4wd-hybrid-specifications/](http://mmnz.co.nz/plug-in-hybrid/options/4wd-hybrid-specifications/) and [nbr.co.nz/outlander](http://nbr.co.nz/outlander), and Renault by figures supplied).

<sup>13</sup> NZ Vehicle quantities from [transport.govt.nz/research/newzealandvehiclefleetstatistics/](http://transport.govt.nz/research/newzealandvehiclefleetstatistics/)

# COSTS & SUBSIDIES

## BUYING THE CAR

The primary expense associated with an electric car is its upfront purchase. Electric cars remain relatively expensive to purchase brand new. The main force reducing electric car costs in New Zealand is that a growing number of used cars are being imported from Japan and UK.

## ELECTRIC CARS CHEAPER THAN PETROL CARS WHEN YOU FACTOR RUNNING COSTS

The cost of travelling by electricity is cheaper than petrol. EECA calculates an electric car is typically equivalent to 30 cents a litre to drive, about 7 times cheaper than petrol.<sup>14</sup> Over the course of a year, an electric car owner can save a few thousand dollars, quickly paying off the higher initial car purchase price. Fewer moving parts means electric cars have less maintenance costs.

EECA have released a tool for individuals and fleet managers to calculate total savings at [eecabusiness.govt.nz/tools/vehicle-total-cost-of-ownership-tool/](http://eecabusiness.govt.nz/tools/vehicle-total-cost-of-ownership-tool/)

The cost of electricity varies more than petrol. Recharging with electricity can be free (if your employer or a friendly business or council is paying instead of you!), low cost (overnight off-peak electricity rates are cheaper than daytime, if you select a good plan or provider), or higher cost (if you recharge during the day, or are paying to use a fast-charging station).

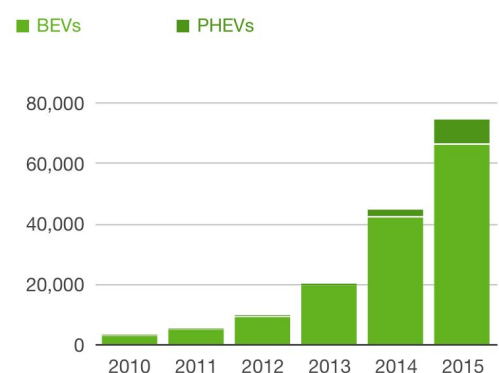
Assuming you commute 40km a day, you would probably need about 8 units of electricity (kWh) to recharge, which at a low overnight rate of 11 cents per kWh would equate to \$0.88 a day for driving. Overnight charging is good for the national electricity grid because it is at its lowest demand, meaning the power is more likely to be generated with renewables and not coal and gas.

## SUBSIDIES AND FINANCIAL INCENTIVES

Many countries provide electric car buyers with discounts off the purchase price or offer other incentives. These help governments to achieve international climate change commitments by encouraging car owners to shift from petrol to electric cars, which reduces carbon dioxide emissions. A typical petrol car emits more than its weight in CO<sub>2</sub> per year, i.e. about 2 tonnes.

Norway has the greatest level of incentives, and has a similar population, land size, vehicle count, and a higher proportion of renewable electricity generation as NZ. Electric cars there cost significantly less to purchase (no 25% sales tax, and no emissions fee saving a further ~\$20,000), halved fringe benefit tax, and free use of bus lanes, toll roads, urban street parking, and charging stations. This has led to rapid adoption: about 105,000 vehicles (80% fully electric) and 7000 charging points in 4 years<sup>15</sup>. Norway's government is considering stopping petrol car sales in 2025<sup>16</sup>. Germany, U.K., California and New York intend to do the same before 2050 (see [zevalliance.org](http://zevalliance.org)). Denmark has similar incentives to Norway but only 4000 electric cars, likely due to the perceived (but untrue) assumption that the high proportion of coal-based electricity generation there makes petrol cars cleaner than electric.

Norwegian electric car adoption:



<sup>14</sup> [energywise.govt.nz/on-the-road/electric-vehicles/](http://energywise.govt.nz/on-the-road/electric-vehicles/)

<sup>15</sup> [en.wikipedia.org/wiki/Plug-in\\_electric\\_vehicles\\_in\\_Norway](http://en.wikipedia.org/wiki/Plug-in_electric_vehicles_in_Norway). Norway graphs and pie charts: [gronnbil.no/statistikk/](http://gronnbil.no/statistikk/)

<sup>16</sup> <http://www.hybridcars.com/norway-aiming-for-100-percent-zero-emission-vehicle-sales-by-2025/>



The New Zealand government supports electric cars with a publicly stated target (a doubling of electric vehicles every year to 64,000 by 2021, about 2% of all vehicles), a one million dollar per year nationwide education and promotion campaign (for 5 years), offering money to fund projects that aid electric car adoption (from a fund of \$6 million per year), making it legal to decide to put electric vehicles in bus lanes and high-occupancy vehicle lanes on the State Highway network and local roads, and coordination efforts across government agencies and business to support: bulk purchase, public charging infrastructure, and decision-making. A review of tax depreciation rates and the method for calculating fringe benefit tax for electric vehicles has also been announced. These measures were announced in May 2016 (for details see [www.transport.govt.nz/ev](http://www.transport.govt.nz/ev)).

Some further assistance comes through the government not charging road user charges (RUCs) on electric vehicles. The RUC exemption began 2009, and will be extended until light vehicles reach 2% of the fleet. These save an electric car owner \$620 versus a small diesel car if driving 10,000km a year. In 2016 the exemption was expanded to include electric vehicles weighing over 3 tons (buses and trucks) and will extend until 2025 or until 2% of heavy vehicles are electric.

Fully electrics and plug-in hybrids currently cost about \$230 a year in vehicle licensing<sup>17</sup>. This is about \$100 more than petrol cars, due to ACC levies. Some of the cost of petrol pays ACC. When you buy electricity, you are not funding ACC, and so this is substituted with a higher "non petrol driven car" ACC vehicle levy. Conventional hybrids, despite having batteries, gain all of their energy via petrol purchases, so use the cheaper "petrol driven car" ACC levy.<sup>18</sup>

A 2015 research report on electric car policy was published by Barry Barton at University of Waikato<sup>19</sup>. This compared successes and challenges of countries in accelerating electric vehicle growth, and concluded electric car growth here would be best supported by introducing a cost-neutral "feebate" scheme. Used overseas, this is where the government adds a cost to buying "dirty" cars and uses that money to reduce the cost of electric and fuel-efficient cars. The report noted New Zealand is one of very few countries globally to have no fuel efficiency standards, which place costs or restrictions on buying cars with high greenhouse gas emissions. The Green Party has proposed Fringe Benefit Tax exemptions, investment in public chargers, and electrifying the Crown limousine fleet<sup>20</sup>.

## KEY ORGANISATIONS SUPPORTING ELECTRIC CARS

The key New Zealand organisations who would play a natural role to do with electric cars are in the early stages of supporting their adoption. The New Zealand government has officially stated it is a "fan" of electric cars and expects them to be common in future years<sup>21</sup>. Ministry of Transport, New Zealand Transit Agency, Energy Efficiency Conservation Agency (EECA)<sup>22</sup>, the AA, councils, and power companies have begun to educate the public to the existence and financial savings associated with electric cars, and some are buying small numbers of electric cars for use by staff. No car brands have yet carried out any large scale promotions to create buyer awareness of their electric cars in New Zealand. Other bodies supporting the sector include Drive Electric ([DriveElectric.org.nz](http://DriveElectric.org.nz)) and the Better NZ Trust ([www.betternz.org.nz](http://www.betternz.org.nz)).

Globally, the greatest amount of leadership in generating large-scale electric car adoption is Tesla Motors and its charismatic and detail-obsessed founder and leader Elon Musk.<sup>23</sup>

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<sup>17</sup> Nissan Leaf BEV, Outlander PHEV, Toyota traditional hybrid, Toyota Corolla (petrol) price checked at [rightcar.govt.nz](http://rightcar.govt.nz)

<sup>18</sup> <http://www.acc.co.nz/for-individuals/other-motorists/WPC137732>

<sup>19</sup> [http://www.waikato.ac.nz/\\_data/assets/pdf\\_file/0007/278080/Electric-Vehicle-Policy-New-Zealand-in-a-Comparative-Context.pdf](http://www.waikato.ac.nz/_data/assets/pdf_file/0007/278080/Electric-Vehicle-Policy-New-Zealand-in-a-Comparative-Context.pdf)

<sup>20</sup> [greens.org.nz/policy/smarter-economy/business-tax-breaks-clean-transport-options](http://greens.org.nz/policy/smarter-economy/business-tax-breaks-clean-transport-options)

<sup>21</sup> Several sources, e.g. [national.org.nz/news/news/speeches/detail/2015/10/20/Opportunities-to-cut-NZ-s-road-transport-emissions-](http://national.org.nz/news/news/speeches/detail/2015/10/20/Opportunities-to-cut-NZ-s-road-transport-emissions-)

<sup>22</sup> Of the organisations listed, EECA has the most complete guide: [eecabusiness.govt.nz/technologies/electric-vehicles/](http://eecabusiness.govt.nz/technologies/electric-vehicles/)

<sup>23</sup> [waitbutwhy.com/2015/06/how-tesla-will-change-your-life.html](http://waitbutwhy.com/2015/06/how-tesla-will-change-your-life.html) provides a very comprehensive look at Elon Musk and Tesla Motors, and the history and rationale of the electric car, and his spacecraft business, solar energy, and battery technology.

# CHARGING your car



## A new unit of measurement

We use kilowatt-hours (kWh) not litres to measure electricity, so you're unlikely to talk to electric car drivers about dollars per litre, and instead hear them discuss:

- cents per kWh, the cost of electricity; determines the cost of travelling and charging
- km per kWh, similar to 'miles per gallon', or how far you're driving for a unit of electricity
- kWh as a size of battery, which gives you an idea of how far you can drive (range)
- kW as a speed of charging, which gives you an idea of how quick to recharge

Depending on driving style and car, you can usually expect to travel around 5 to 6km per kWh. Most car charging happens overnight. A study of 8000 U.S. electric car owners showed 85% of charging was at home, much of the remainder at work, and occasionally elsewhere.<sup>24</sup>

The regular 230 volt AC electricity in our homes, and the regular socket we use for all household appliances is all you need to recharge your car. You may see U.S. or other websites describe "Level 1" or "Level 2" charging. Level 1 describes the ~100 voltage found in USA and Japan, which is half what we have in New Zealand. This is very slow and has no relevance in New Zealand. Level 2 describes the 230 volts found in New Zealand. Level 3 is very high current fast charging.

<p><b>Normal 3 pin socket (S3112)</b> 8-10 amps, single phase AC 230V 1.8 - 2.3 kW</p> <p><b>10km+ per hour recharging</b> <b>100km takes 10 hours</b><sup>25</sup></p> 	<p>This is what you find throughout New Zealand homes and offices. For most people, it is sufficient to charge their cars overnight during low-cost off peak hours (11pm-7am), but is too slow to be very useful for daytime recharging. This socket is probably what you already have inside your garage at home.</p> <p>If your car doesn't come with a connector for this socket, you can purchase a portable 8 amp unit at <a href="http://JuicePoint.co.nz">JuicePoint.co.nz</a>.</p> <p><i>Note: A larger 15 amp version of this 3-pin plug/socket is available, however is not recommended for continual use; the higher current warms the small metal pins, posing a fire risk.</i></p>
<p><b>Blue Commando (IEC 60309)</b> 16 amps, single phase AC 230V 3.7 kW</p> <p><b>18km+ per hour recharging</b> <b>100km takes 5 hours</b></p> 	<p>These are the plugs found in campgrounds all over the country, used by campervans. Having an connector for this socket lets you recharge in many locations around the country, and allows a higher current, faster charge. You can get an electrician to fit this socket at home. The thick metal pins are well suited to repeated, prolonged use and rugged outdoor conditions, and won't heat up as easily, reducing fire risk. One supplier of Blue Commando based equipment is <a href="http://www.BlueCars.nz">www.BlueCars.nz</a>.</p> <p>Unless a car is parked for many hours, this is rather slow for daytime recharging, but it does provide a very low cost solution.</p>

<sup>24</sup> See 0h50m on EVTV show <https://www.youtube.com/watch?v=7NlmTiaR1Zg> and various other research papers at <http://avt.inl.gov> (Advanced Vehicle Testing Activity, Idaho National Laboratory, USA)

<sup>25</sup> km/hour charging on this and next page is a rough guide on the basis of 5 km per kW; you'll go a little further in flat/urban driving.

<p><b>Dedicated “slow chargers”</b></p> <p>15-40 amps, single phase AC 230V 3-9kW (Type 1 or 2 connector) <b>18-45km per hour recharging</b> <b>100km takes 2-5 hours</b></p> <p><b>Or</b></p> <p>32 amps, three phase AC 415V 22kW (Type 2 connector) <b>110km per hour recharging</b> <b>100km takes just under an hour</b></p> 	<p>For around \$800 or more, you can buy a dedicated wall-mounted charger. These reduce the time it takes to start and stop charging; you don't have to grab or stow the charging cable in your car.</p> <p>Fancier units able to take payment from users, draw much higher current, display information on your smartphone<sup>26</sup>, or in the future, return electricity from your car back into your home.</p> <p>The cable is permanently attached on most units. The cable has a specific connector at the end which fits into your car. Pay attention to get the one that your car needs. (Cable adapters do exist to convert between types). Because the connector is specific to electric cars, it deters others using the equipment, potentially helpful in public locations.</p> <p>Cars have a maximum pace of charging; e.g. older Nissan Leafs can charge up to 3.6 kW and newer Leafs up to 6.6 kW, so while a dedicated 22 kW charger will work, it will charge only as fast as the car supports. On the other hand, a Renault Zoe and Tesla Motors cars can charge up to 22 kW, and drivers might be impatient when using a lower-rated unit.</p> <p>These units (especially 3phase 22kW) provide fast enough speeds to suit users parked at destinations (e.g. workplaces, supermarkets), without the cost of fast chargers (below). Public destinations should offer multiple connector types.</p>
<p><b>Fast Chargers</b></p> <p>80+ amps, 415V, 3 phase input, inverted and supplied to car as DC. (50kW and higher<sup>27</sup>)</p> <p><b>250km per hour recharging</b> <b>100km takes 25 minutes<sup>28</sup></b></p> 	<p>All of the earlier options take hours for a car to recharge. Fast chargers by comparison take only around 25 minutes for cars with small batteries, and do this by providing a much greater amount of electricity (at least 20 times the amount found in your regular residential socket). Like petrol, you can choose just to ‘top up’ your car and put in a few minutes’ worth of power.</p> <p>This type of charging equipment is expensive to purchase and install (tens of thousands of dollars). They are purchased by organisations and put in key locations where a high volume of car owners can drive to, such as supermarkets or petrol stations. They are ill-suited to locations where people intend to park for hours; a slower charger would be more appropriate there.</p> <p>Fast chargers are useful to enable electric cars to tour the country, or for drivers unable to wait for or access a slow charger.</p>

Your car will normally come with a portable cable for only *one* of the two wall-sockets pictured on the previous page. Consider owning your car for a few weeks so you can confirm whether you actually need to buy another cable, socket, or charging unit. Do not allow a car dealer to sell you a cable for a Japanese shaped wall socket; this will be unsafe. It must be designed for NZ use.

<sup>26</sup> Pictured EVSE: JuiceBox 40 by eMotorWerks, crowd-funded via Kickstarter, available via [juicepoint.co.nz](http://juicepoint.co.nz).

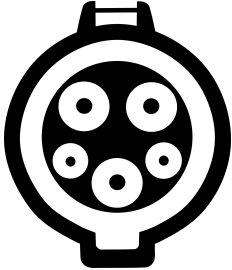
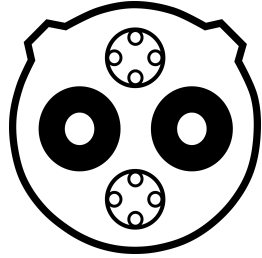
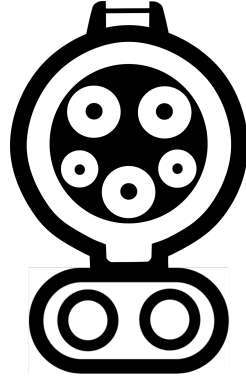
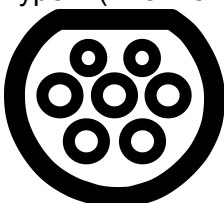

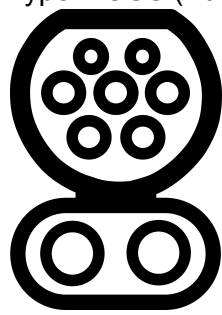
<sup>27</sup> 50kW is typical in NZ. Tesla “SuperChargers” charge as high as 135kW. See [teslamotors.com/supercharger](http://teslamotors.com/supercharger)

<sup>28</sup> Assuming your battery is large enough and you travel 5km per kWh; you could go further with urban/flat driving.



# car connectors and inlets

The connector/inlet on the car is designed specifically to be durable for continuous use and to be safe. There are multiple standards based on manufacturer, country, and charging speed. The following is based on typical configuration for cars in New Zealand<sup>29</sup>:

Slow (AC)	Fast (DC)	Combo (slow AC and fast DC)
<p>Type 1 (“J1772”) (Japan / US)</p>  <p>Nissan Leaf and eNV200 Mitsubishi iMiev and Outlander Holden Volt Audi A3 e-tron BMW i3</p>	<p>CHAdEMO (Japan / US)</p>  <p>Nissan Leaf and eNV200 Mitsubishi iMiev and some Outlander BMW i3 imported from Japan</p>	<p>Type 1 CCS (Japan / US)</p>  <p>BMW i3 bought in NZ</p>
<p>Type 2 (“Mennekes”) (Europe)</p>  <p>Renault Zoe, Kangoo Tesla (see note right on Supercharger)</p>	<p>Tesla Supercharger (Japan/US)</p>  <p><i>Unlikely to be found on a Tesla in NZ. Tesla bought in Australia and Europe can fast charge using Type 2 (without CCS) due to a special use of the connector.</i></p>	<p>Type 2 CCS (Europe)</p>  <p>BMW i3 and VW eGolf bought in UK (Uncommon in NZ)</p>

Adapters can be used (e.g. to allow a CHAdEMO fast charge connector to fit the Type 2-shaped inlet on a Tesla car, or to convert between Type 1 and 2 slow charging connectors for any car).

Overseas, wireless charging (also known as induction) is becoming available, avoiding the need to connect a cable to the car.



Adapter between Type 1 (left) to Type 2 (right)

## CALCULATING RECHARGING TIMES

Charging speed is rated in kW and battery capacity in kWh. For example, a 7kW charger takes 10 hours to recharge a 70kWh battery. In practice, the times vary slightly because a little energy is lost to heat, and the last 10% or so of a battery is charged less quickly to preserve battery health.

<sup>29</sup> Vector diagrams for the sockets available [commons.wikimedia.org/wiki/EV\\_Charger\\_Gallery](https://commons.wikimedia.org/wiki/EV_Charger_Gallery)

# Where can I charge?

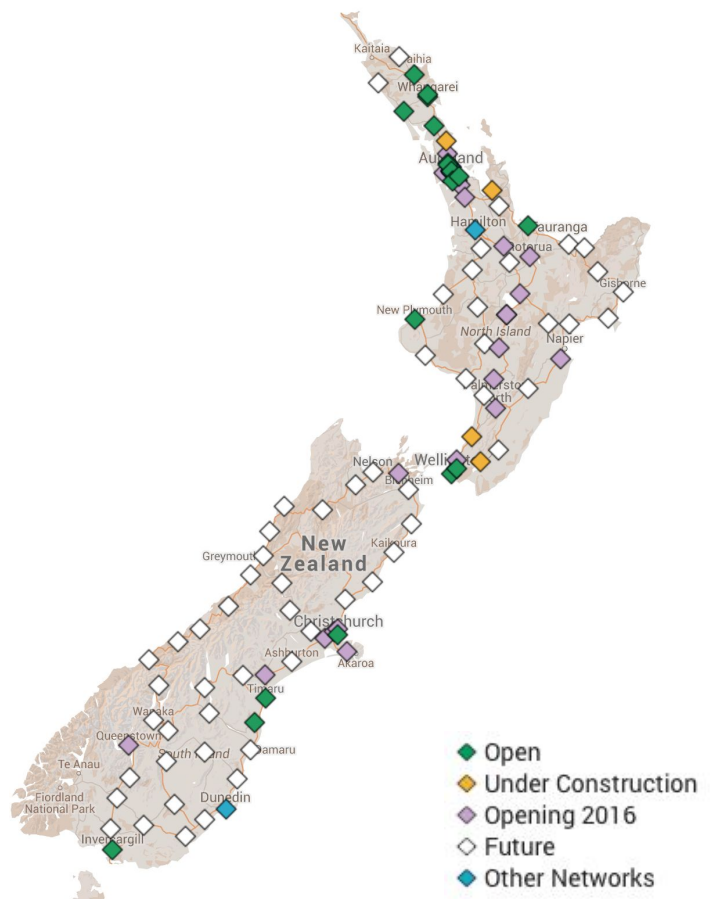
Besides home, which is where the majority of charging takes place, some employers are providing slow charging sockets in staff car parks. There are also public charging locations:

- A national network of nearly 100 fast chargers being installed by [www.charge.net.nz](http://www.charge.net.nz) enabling long distance electric car travel along state highways. The first stations were installed in 2015 and the network is growing month to month. (Map below right)
- Fast and slow chargers provided by electricity companies, currently concentrated to Whangarei, Auckland, Hamilton, and Dunedin.
- A nationwide coverage of hotels, motels and campervan grounds where you can plug in at powered car parks for slow charging. These often require a Blue Commando plug.
- Tesla is expected to build its own charging network but have not given timelines.

## Slow Charging (for destinations)



## Fast Charging Network



Visit [www.plugshare.com](http://www.plugshare.com) (pictured left) or use the PlugShare smartphone app for a map of charging locations, complete with costs and other details.

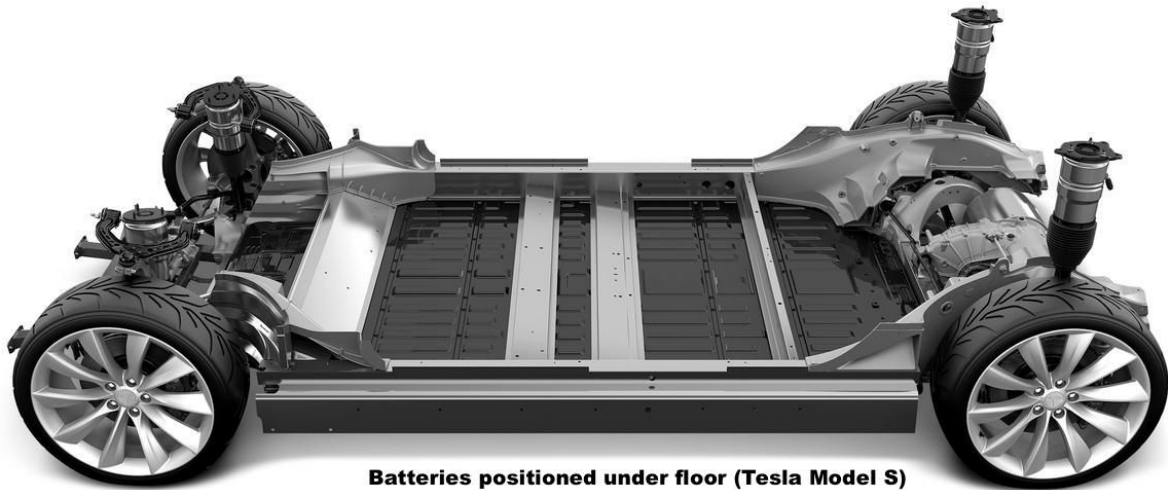
If you offer car charging to staff, customers, or the public, you should certainly list it on PlugShare (it's free). Include a description on whether charging is free to the public, free to customers, or paid, or restricted to employees, the hours of operation (hopefully 24/7!), connector types and electrical power, and upload photos to promote your listing. Add signage to the physical space (e.g. "Electric car charging only"), to increase public awareness of electric cars, and to avoid petrol cars blocking the park.

Right: Official NZ electric vehicle sign (download design from [nzta.govt.nz](http://nzta.govt.nz))



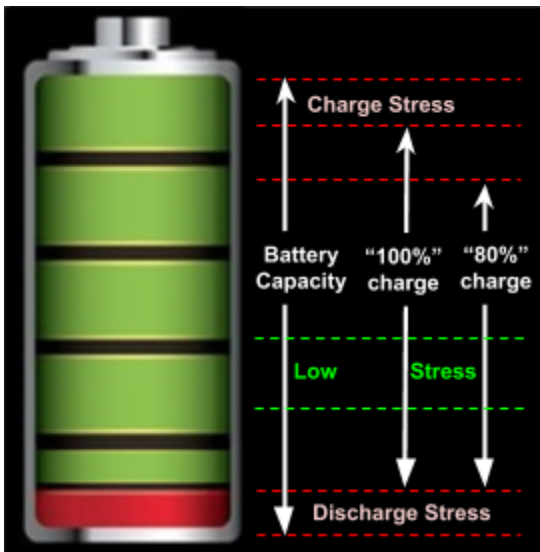
## BATTERIES: SIZE, LIFE, REPLACEMENT

Electric car batteries weigh several hundred kilograms and sit in the floor of the car. This gives the cars a low centre of gravity, adding stability when cornering and accelerating.



**Batteries positioned under floor (Tesla Model S)**

Battery size is measured in kilowatt-hours, or kWh. Lower priced electric cars have ~24 kWh batteries and the high-end Tesla Motors cars come close to 100 kWh. This affects range and cost.



The life of a battery is reduced when at extreme high or low levels of charge<sup>30</sup>. To avoid cars reaching either end, not all of the battery capacity is made available.

You can lengthen the life of your battery by fully charging it only on occasion (hence the “80% charge” option on most cars) and by avoiding the car being left too long at a high or low level of charge (e.g. finishing your charge at 7am is ideal, but if it gets totally flat, recharge a bit straight away). The battery will last longer if it is generally around a third to half charged. Hot temperatures (particularly over 30°C) reduce battery life. Excessive (more than daily, for years) fast-charging will slightly reduce battery life<sup>31</sup>.

Nissan state expected battery capacity to reduce to 80% after 5 years and 70% at 10 years, assuming 20,000km of annual driving in a Los Angeles climate (10-30°C, average ~20°C)<sup>32</sup>. Car manufacturers use different battery chemistries which may offer different lifespans. You can assess battery capacity on the dashboard or smartphone app when you test drive a car<sup>33</sup>. While minor loss of capacity is typical in a used vehicle (e.g. 10%), you might be saving half or a third of the cost of a new car, and the range will be still be higher than a typical daily drive. Car batteries have warranties, but conditions vary. Only some dealers provide warranties with used imports.

Eventually the battery will need replacement. It can then be recycled or, reused, for example by homeowners who want to store electricity from solar panels or overnight off-peak power.

- You may be able to buy a battery with more capacity than the car initially came with.
- You may need to replace only individual dead cells, at lower price than a full replacement.
- A new Nissan Leaf battery costs little under \$10,000 (2015); prices are quickly falling.

<sup>30</sup> Wealth of battery information at [batteryuniversity.com](http://batteryuniversity.com); Dalhousie Uni lecture by Jeff Dahn [youtube.com/watch?v=9qi03QawZEK](https://www.youtube.com/watch?v=9qi03QawZEK)

<sup>31</sup> US government study on slow vs fast charging: [avt.inl.gov/pdf/energystorage/FastChargeEffects.pdf](https://www.avt.inl.gov/pdf/energystorage/FastChargeEffects.pdf)

<sup>32</sup> [www.electricvehiclewiki.com/Battery\\_Capacity\\_Loss#Nissan.27s\\_Responses\\_and\\_Actions](https://www.electricvehiclewiki.com/Battery_Capacity_Loss#Nissan.27s_Responses_and_Actions)

<sup>33</sup> Nissan Leaf shows health on dashboard; LeafSpy is an iOS / Android app showing more detail. Similar tools exist for other cars.

## GO FOR A TEST DRIVE!

The experience of test-driving an electric car is what commonly gives buyers the confidence to proceed with the purchase. You can test drive an electric car by asking a dealer, asking existing owners if they're prepared to let you drive theirs, or rent some by the day from [www.bluecars.nz](http://www.bluecars.nz).

## WHERE TO BUY AND GET SERVICE?

Used and new car dealers throughout New Zealand sell electric vehicles. You will find many listings by selecting "Fuel Type: Electric" in the *Advanced Car Search* at [trademe.co.nz/motors](http://trademe.co.nz/motors).

Tesla sells direct from their website. Cars bought in the Japan or the U.K. are eligible for electric car incentives and these can reduce the price of imports by thousands of dollars.

If buying a used car from Japan, the dashboard consoles are usually not in English, but some dealers replace these with English systems but this can reduce dashboard features. Official local support and service is found for the models above (except Tesla, which is coming soon).

## WHAT ABOUT OTHER TYPES OF VEHICLES?

- Bicycles: commonly sold in local bicycle shops, with 40-100km "pedal assisted" range.
- Motorbikes: [ubcobikes.com](http://ubcobikes.com) (kiwi made, off-road) or [zeromotorcycles.com](http://zeromotorcycles.com) (import, for road).
- Small "tuk tuks" are used for tourism<sup>34</sup> and one-seat delivery buggies are used by NZ Post.<sup>35</sup>
- Electric Buses are mass produced by [BYD.com](http://BYD.com); London has begun buying hundreds<sup>36</sup>.
- Trucks are locally made by [zevnz.com](http://zevnz.com); hybrid utes and SUVs by US-based [viamotors.com](http://viamotors.com), and [wrightspeed.com](http://wrightspeed.com) (with an ex Tesla, kiwi founder) is building hybrid heavy trucks<sup>37</sup>.
- The world's first battery powered electric ferry was built in 2015 by Siemens in Norway<sup>38</sup>.

## COMMUNITY GROUPS AND EVENTS

Several events and active Facebook groups are run and organised by electric car owners, e.g.:

**EVelocity**, the largest annual national electric vehicle event, including test drives, demonstrations, workshops, competitions between petrol and electric race cars, and a high-school competition in which teams design and build their own electric vehicles. (Last was Nov 2015). [evolocity.co.nz](http://evolocity.co.nz)

**Leading the Charge**, an annual roadtrip of Tesla and other electric cars from the north to the south of New Zealand, stopping in towns for display. [facebook.com/LeadingTheCharge/](https://facebook.com/LeadingTheCharge/) Organised by the Better New Zealand Trust ([betternz.org.nz](http://betternz.org.nz)) (Last: April 2016)

### Facebook "EV Owner" groups

- NZ EV Owners: [facebook.com/groups/NZEVOwners/](https://facebook.com/groups/NZEVOwners/) (*lots of discussion*)
- Whangarei: [facebook.com/WhangareiElectricVehicleMeetup/](https://facebook.com/WhangareiElectricVehicleMeetup/) and [facebook.com/revupnz/](https://facebook.com/revupnz/)
- Wellington: [facebook.com/groups/WellyEV/](https://facebook.com/groups/WellyEV/)
- Christchurch: [facebook.com/groups/ChristchurchEVGroup/](https://facebook.com/groups/ChristchurchEVGroup/)

<sup>34</sup> [stuff.co.nz/travel/destinations/nz/77235562/tuktuks-taking-to-the-streets-of-wellington](http://stuff.co.nz/travel/destinations/nz/77235562/tuktuks-taking-to-the-streets-of-wellington)

<sup>35</sup> [nzpost.co.nz/about-us/media-centre/media-release/eco-vehicles-confirmed-as-way-of-future-for-new-zealand-post](http://nzpost.co.nz/about-us/media-centre/media-release/eco-vehicles-confirmed-as-way-of-future-for-new-zealand-post)

<sup>36</sup> [tfl.gov.uk/info-for/media/press-releases/2015/july/more-than-50-all-electric-buses-to-enter-service-in-london](http://tfl.gov.uk/info-for/media/press-releases/2015/july/more-than-50-all-electric-buses-to-enter-service-in-london)

<sup>37</sup> [www.sfgate.com/business/article/Tesla-co-founder-Ian-Wright-snags-FedEx-for-new-5792082.php](http://www.sfgate.com/business/article/Tesla-co-founder-Ian-Wright-snags-FedEx-for-new-5792082.php)

<sup>38</sup> [cleantechnica.com/2015/06/13/worlds-first-electric-battery-powered-ferry/](http://cleantechnica.com/2015/06/13/worlds-first-electric-battery-powered-ferry/)