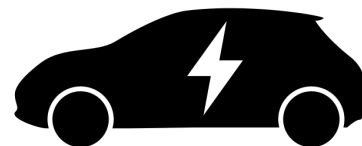


new zealand electric car guide



By Sigurd Magnusson, Wellington, NZ. 4 May 2017. Updated monthly. Download latest from www.electriceaven.nz

Questions, corrections, feedback to sigurdmagnusson@gmail.com or 021 42 12 08. Please share this document.¹

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 17% of New Zealand's greenhouse gases.² 80% of New Zealand electricity is generated by rain (hydro dams), geothermal, and wind³, 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 year⁴ 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.⁵ Each year, an estimated 256 New Zealanders prematurely die from harmful diesel and other vehicle emissions⁶; this is close to the number who die in crashes and would be reduced by driving electric vehicles.

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 globally. Norway, with a similar population and size to New Zealand, is a global leader, with over a third of new car sales now fully or plug-in hybrid (a further third sold are hybrid).

Entry-level electric cars have a shorter range (100km+) than petrol cars. High-end cars with large batteries (500km+ range) cost more. The dashboard displays how far you can drive with remaining battery. Battery prices are dropping significantly (80% drop from 2010 to 2016⁷), making electric cars steadily cheaper. On average New Zealand drivers travel 28km per day⁸, and 95% of days within 125km⁵. Electric cars can be charged at home overnight and be 'full' in the morning, so affordable electric cars are practical for most daily journeys. The census shows over half of New Zealand households have two or more cars⁹, suggesting many could drive electric but keep a backup fuel car.

Since 2016, electric car prices and models in NZ have improved. The majority of fully electric cars here are short-range Nissan Leaf hatchbacks. Full sized, long-range, high performance cars by Tesla, Inc are also popular here and 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).

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

² MfE carbon inventory May 2016 mfe.govt.nz/publications/climate-change/new-zealand-greenhouse-gas-inventory-1990-2014

³ 2015 MBIE report mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/publications/energy-in-new-zealand

⁴ stats.govt.nz/browse_for_stats/industry_sectors/imports_and_exports/OverseasMerchandiseTrade_HOTPFeb16.aspx

⁵ ECEA Life Cycle Assessment of EVs eeca.govt.nz/assets/Resources-ECEA/ev-lca-final-report-nov-2015.pdf

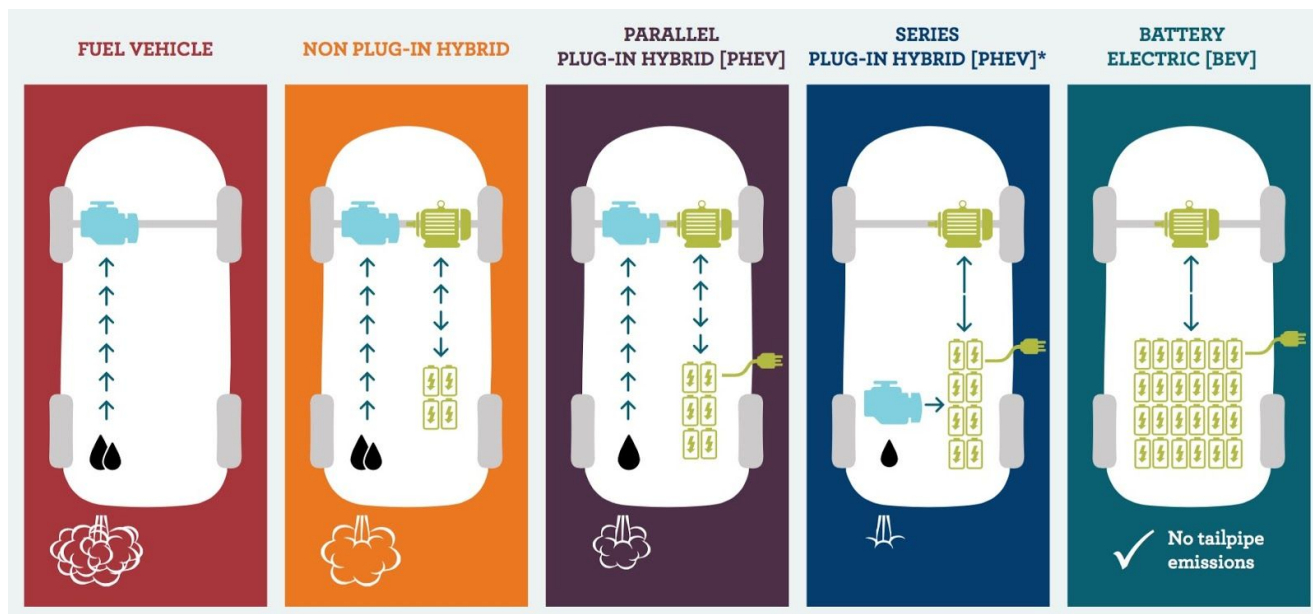
⁶ NZTA links to 2012 Health and Air Pollution in New Zealand Study hapinz.org.nz/HAPINZ%20Update_Vol%201%20Summary%20Report.pdf

⁷ mckinsey.com/industries/automotive-and-assembly/our-insights/electrifying-insights-how-automakers-can-drive-electrified-vehicle-sales-and-profitability (Exhibit 4)

⁸ 2010-2013 Distance per driver trends transport.govt.nz/assets/Uploads/Research/Documents/Drivers-2014-y911-Final-v3.pdf

⁹ stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-transport-comms/number-motor-vehicles.aspx

TYPES OF VEHICLES



* Some manufacturers also call this a Range-Extended Battery Electric Vehicle or REX.

PLUG-IN HYBRID ELECTRIC VEHICLES (PHEVS)

These have both an electric and petrol motor, but with the added feature that they can be plugged in at home or wherever there is an electrical socket. This lets you drive short distances electrically, at low cost and without pollution, and long distances using petrol, avoiding the need to frequently recharge. These vehicles also have regenerative braking, which captures some 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 complicated engine requiring maintenance, petrol refueling costs, air pollution, and engine noise.

Depending on the model, the petrol engine will either help the electric motor turn the wheels ("parallel PHEV") or only recharge the battery ("series PHEV") but some can do both. A few can drive a reasonable distance electrically; most have very small batteries that don't drive far. As battery prices drop, plug-in hybrids will be replaced by full battery electrics.

WHAT WE USED TO CALL HYBRIDS NO LONGER COUNT









Cars such as the *non-plug-in* Toyota Prius Hybrid found in this country 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 engine and regenerative braking to recharge a small battery that gives a short (1-2 km) electric range. A plug-in vehicle has many more benefits.

WHAT ABOUT HYDROGEN?

There is an ongoing debate about whether the long-term future of cars would use hydrogen fuel cells or stored electricity (i.e. batteries). While hydrogen vehicles can recharge quickly and drive long distances, the challenge is that hydrogen is made by splitting it out of natural gas (which releases greenhouse gases) or water (which requires vast amounts of electricity) and the hydrogen then needs to be pressurised, stored, and transported, even though the vehicle still has an electric motor. Battery electric cars by contrast are safer (no explosive gas), simpler, use less energy, and it is a quarter of the cost to generate electricity, send it through the electrical grid, and recharge batteries. Hydrogen cars are not sold here, and are very limited globally.¹⁰






¹⁰ More information and sources about the hydrogen section: 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/. Essay by hydrogen race-car builder has published essay at ssj3gohan.tweakblogs.net/blog/11470/why-fuel-cell-cars-dont-work-part-1

common electric cars in New Zealand¹¹

Car (and if battery electric or plug-in hybrid)	Seats	Electric Range	Battery (kWh)	0-100, Power	Fast Charge	Cost (\$000) used - new	# in NZ
Nissan Leaf (Fully electric) 	5	Generation 1 117 km Generation 2 135 km 172 km Large increase coming end 2017	24 24 30	9 secs 80kW (110hp)	Yes	\$12k - \$40k <i>(NZ-new cars sold out. Used imports from Japan & UK abundant)</i>	1396
Mitsubishi Outlander (Plug-in Hybrid) 	5	40km electric + 700km petrol	12	11 secs 120 kW (180hp) + 2L engine.	Yes <i>(but is an optional extra)</i>	\$32 - 60k	611
BMW i3 (Full Electric OR Plug-In Hybrid) 	4	Generation 1 130km Generation 2 183 km (+116 km petrol range if plugin hybrid)	22 33	7 secs 125kW (168hp)	Yes <i>(but is an optional extra)</i>	\$50 - \$85k	188 (44 are BEV)
Tesla Motors Model S (Fully Electric) 	5 (plus 2 kids)	416 km to 507 km	75, 90 or 100	2.7 secs 568 kW (762 hp) <i>(Ludicrous upgrade)</i>	Yes	\$119k + optional upgrades <i>(Buy from NZ section of www.tesla.com)</i>	87
Mitsubishi i-Miev / Peugeot iOn (Fully electric) 	4	100 km	16	13 secs 49 kW (66 hp)	Yes	\$12k+ <i>(No longer sold new; import only. The Peugeot is higher spec.)</i>	54
Nissan e-NV200 (Fully Electric) 	2, 5, or 7	121 km	24	11 secs 80kW (110hp)	Yes	\$35k+ <i>(Imports only)</i>	44
Renault Kangoo (Fully Electric) 	2 or 5	Generation 1 ~100 km Generation 2 ~150 km (Manufacturer claim, not EPA)	22 33 (late 2017)	44 kW (60 hp)	No	\$75k	35
Hyundai Ioniq (Full Electric OR Plug-In Hybrid) 	5	219 km (Or, if PHEV, then 30km electric range + hundreds of km petrol range)	28	10 secs 88 kW (118 hp)	Yes	\$60k	35

¹¹ Costs from TradeMe and aa.co.nz/cars/buy-sell/new-cars/new-car-prices/.

Range is U.S. EPA, sourced from fuelconomy.gov (except where supplied by dealers to cover gaps).

VW e-Golf (Fully Electric) 	5	Generation 1 133 km Generation 2 201 km	24 36	10 secs 85kW (115 hp)	Yes	\$42 - 60~70k <i>(UK Import now or buy new in NZ late 2017)</i>	13
Tesla Motors Model X (Fully Electric) 	7	383 km to 465 km	75, 90, and 100	3.1 secs 568 kW (762 hp) <i>(Ludicrous upgrade)</i>	Yes	\$136k+ optional upgrades <i>(Buy from NZ section of www.tesla.com)</i>	13
Renault Zoe (Fully Electric) 	5	Generation 1 ~ 140 km Generation 2 ~ 280 km (Manufacturer claim, not EPA)	22 41	13.5 secs 65 kW (88hp)	No	\$27 - 75k <i>(41kWh avail as UK import at present)</i>	9
Kia Soul EV (Fully Electric) 	5	150 km	31	11 secs 81 kW (109 hp)	Yes	\$35k+ <i>(Imported. Not sold new in NZ)</i>	9
Tesla Motors Model 3 (Fully Electric) COMING 	5	346 km	TBC	4 secs <i>(high spec)</i> 6 secs <i>(base model)</i>	Yes	USD 35k+ Since March 2016 NZers can pay USD1000 deposit online	None <i>First NZ shipments 2018</i>

The following **plugin hybrids** are available for purchase in NZ and offer less than 30km average electric range:

Audi A3 Sportback e-tron (Hatch)	\$75k	65
BMW 225xe (Hatch/SUV)	\$68k	22
BMW 330e (Sedan)	\$90k	7
BMW 740e (Sedan)	\$199k	3
BMW X5 xDrive40e (SUV)	\$149k	10
BMW i8 (Sports)	\$276k	21
Mercedes Benz C 350 e (Sedan or Wagon)	\$96k or \$99k	12
Mercedes Benz E 350 e (Sedan)	\$143k	-
Mercedes Benz GLE 500 e (SUV)	\$150k	7
Mercedes Benz S 500 e (Sedan)	\$255k	-
Porsche Cayenne S e-hybrid (SUV)	\$175k	17
Toyota Plug-In Prius (Hatch)	\$40k (used)	29
Volvo XC90 T8 (SUV)	\$134k	28
2224 full electric + 1006 plug-in hybrid + 70 heavy electric vehicles		= 3300 total
<i>(Includes small numbers of other makes and models, and home-conversions, and ~400 Paxster full electric buggies used by NZ Post)</i>		

The Motor Industry Association surveyed manufacturers and found 16 new full electric models and 28 new plug-in hybrid models are expected to come to New Zealand between 2016 and 2020¹².

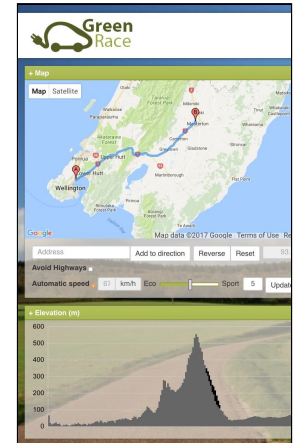
¹² Full survey breakdown: mia.org.nz/Portals/0/MIA%20Public%20Documents/Environment/EV%20and%20PHEV%20model%20availability.pdf

HOW FAR CAN YOU DRIVE BEFORE RECHARGING?

Automakers and dealers advertise the distance cars can drive, however these can be exaggerated. A good information source is the “EPA Range” (fuelconomy.gov). The US government test-drives cars in a consistent manner to determine how far the battery lasts on a typical journey mixing highway and suburban driving. (A similar European “NEDC” electric car range test is less useful because it states long distances that can never be achieved with normal driving.)

Several situations will result in a car using up its battery before reaching the EPA range: e.g. frequent acceleration, big hill climbs, high speeds, air conditioning or heaters, headwinds, towing a trailer, and an old battery. Conversely, travelling slowly or staying on flat terrain can often let you drive further than the EPA figure.

When planning road trips, talk to other owners of your car model about how mountains, headwinds, and other factors drain your battery along your specific route, and how much battery you need to confidently reach destinations. The pictured GreenRace tool at jurassicstest.ch/GR/ can give you an rough idea (although it can be a bit optimistic).



EXPENSIVE UPFRONT; CHEAPER OVERALL

Electric cars are currently more expensive to buy new than fuel vehicles, largely due to high battery prices and low production volume. These factors are expected to change within a decade, at which point it will be cheaper for car manufacturers to build electric cars than fuel cars.¹³

Travelling by electricity is cheaper than petrol: EECA calculates it is equivalent to 30 cents a litre, about 7 times cheaper than petrol.¹⁴ An electric car owner can save a few thousand dollars a year, quickly paying off the higher car purchase price. Fewer moving parts means electric cars have less maintenance cost. See calculator: 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. At a low overnight rate of 11 cents per kWh this is \$0.88 a day. Overnight charging is good for the national electricity grid because it is at its lowest demand, meaning the power is likely generated with renewables, not coal and gas. If your car has a smart timer, set the ‘End charging time’ to just before 7am, so your battery isn’t full for long, and so it randomises the start time, which makes managing overall electricity demand easier for the power companies.

GLOBAL LEADERS & GOVERNMENT POLICY

Regulations in America, Europe and China force car companies to sell cleaner cars every year. Norway and The Netherlands have goals that from 2025 all new vehicle sales will be electric. US states including New York and California will require 22% of car sales from 2025 to be electric. Other countries have similar goals (see zevalliance.org). Over 200 European cities have low emission zones where fuel vehicles are prevented entry or pay fees (e.g. Paris, London). These help governments to achieve international climate change commitments by encouraging car owners to shift to electric cars, reducing carbon dioxide and cancer-causing diesel emissions. A typical petrol

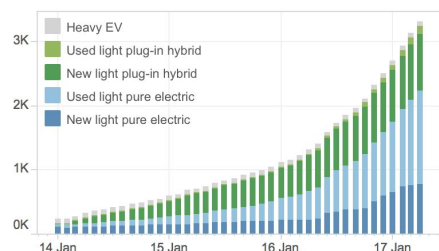
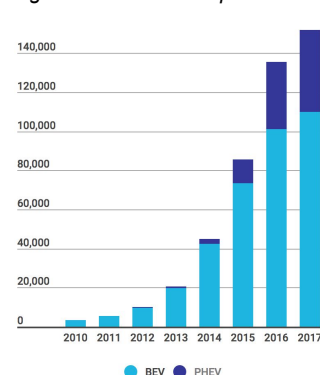
¹³ Malcolm McCulloch (Oxford University, UK), radionz.co.nz/news/national/307388/electric-cars-close-to-price-parity-conference-told

¹⁴ energywise.govt.nz/on-the-road/electric-vehicles/

car emits more than its weight in CO₂ a year (2 tonnes). Global leadership in generating electric car adoption comes from Tesla and its visionary leader Elon Musk.¹⁵

Norway has the greatest incentives globally, and has a similar population, land size, and vehicle count as NZ, but higher proportion of renewable electricity. Norway charges a purchase tax on fuel vehicles (up to \$40,000, based on emissions and weight) and a discount on electrics (-\$10,000). Electrics also don't pay any 25% sales tax, and have halved fringe benefit tax, free use of bus lanes, toll roads, urban street parking, and charging stations. This led to 135,000 vehicles (100,000 fully electric) and 7000 charging points in 5 years. This is much better than its neighbours, e.g. Danish sales plummeted in 2016 after introducing a tax on electric vehicles.

Norwegian electric car adoption¹⁶



NZ POLICIES AND GROWTH

Electric car numbers here are low but are doubling each year. When all our three million vehicles are electric this will demand 10% more electricity, which can be met with renewable power stations that have consent to be built.¹⁷

The 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, and about one in eight cars entering NZ being electric), a \$1M/year (for 5 years) nationwide education and promotion campaign led by EECA, offering money to co-fund projects that aid electric car adoption (fund pool is \$6M/year; next applications opens late 2017), considering electric vehicles to drive in specific bus or high-occupancy vehicle lanes, and efforts across government agencies and business to support: bulk purchase, public charging infrastructure, and decision-making. A review of tax depreciation and fringe benefit tax for electric vehicles is underway. This was announced in May 2016. From July 2017 the motor vehicle registration fee for electric (and plug in hybrid) cars will reduce to about \$75 per year, which will be less than fuel vehicles.¹⁸ See www.electricvehicles.govt.nz.



The government does not charge road user charges (RUCs) on electric vehicles. These save an electric car owner \$620 versus a small diesel car if driving 10,000km a year. This exemption began in 2009 for light vehicles, and will be continue until light vehicles reach 2% of the fleet. For electric vehicles over 3 tons (buses and trucks), a RUC exemption is expected to be introduced mid 2017 through to 2025 or until 2% of heavy vehicles are electric.

A 2015 report on electric car policy was published by Barry Barton at University of Waikato¹⁹. It compared electric vehicle growth in different countries, and determined New Zealand would benefit from a cost-neutral "feebate" scheme, used today in France. 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 the only countries to have no fuel efficiency standards, which place costs or restrictions on buying high emission cars. Other parties have proposed policies.²⁰ Electric vehicle adoption is supported by an electric vehicle-specific industry association (DriveElectric.org.nz) and owner association (BetterNZ.org).

¹⁵ waitbutwhy.com/2015/06/how-tesla-will-change-your-life.html provides a comprehensive look at Elon Musk, Tesla, and SpaceX.

¹⁶ European policies: icct.org/sites/default/files/publications/ICCT_EVpolicies-Europe-201605.pdf Norway graph & facts: elbil.no/english/

¹⁷ transport.govt.nz/assets/Uploads/Our-Work/Documents/Electric-Vehicles-Package-of-Measures-to-Encourage-Uptake.pdf

¹⁸ \$18 ACC levy + \$52 NZTA licensing + admin fee: nzta.govt.nz/vehicles/licensing-rego/vehicle-fees/licensing-fees/

¹⁹ Barry Barton Paper: waikato.ac.nz/data/assets/pdf_file/0007/278080/Electric-Vehicle-Policy-New-Zealand-in-a-Comparative-Context.pdf

²⁰ E.g. Green Party: greens.org.nz/policy/smarter-economy/business-tax-breaks-clean-transport-options and United Future radiolive.co.nz/tabid/615/articleID/127842/Default.aspx

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.²¹



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, though dedicated equipment is faster and safer. The electrical safety regulator, WorkSafe, has guidelines on its website about what is required and recommended for domestic and public electric vehicle charging equipment, sockets and wiring.²²

<p>Normal 3 pin socket (S3112) 8-10 amps, single phase AC 230V 1.8 - 2.3 kW</p> <p>10km+ per hour recharging 100km takes 10 hours²³</p> 	<p>This is what you find throughout New Zealand homes. 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 JuicePoint.co.nz.</p> <p><i>Note: Read WorkSafe guidelines for restrictions about this socket outside of a domestic environment, and restrictions from using the 15 amp variant of this socket (which can get too hot).</i></p>
<p>Blue Commando (IEC 60309) 16 amps, single phase AC 230V 3.7 kW</p> <p>18km+ per hour recharging 100km takes 5 hours</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 www.BlueCars.nz.</p> <p>Unless a car is parked for many hours, this is rather slow for daytime recharging, but it is a very low cost solution.</p> <p><i>Note: Read WorkSafe guidelines for restrictions about installing this socket outside of a domestic environment.</i></p>

²¹ See 0h50m on EVTV show [youtube.com/watch?v=7NlmTiaR1Zg](https://www.youtube.com/watch?v=7NlmTiaR1Zg) and various other research papers at avt.inl.gov

²² energysafety.govt.nz/legislation-policy/electricity-acts-regulations-codes/regulatory-guidance-notes/electric-vehicle-charging-safety-guidelines

²³ km/hour charging on this and next page is a rough guide on the basis of 5 km per kWh; you'll go a little further in flat/urban driving.

<p>Dedicated “slow” charging station</p> <p>15-40 amps, single phase AC 230V 3-9kW 18-45km per hour recharging 100km takes 2-5 hours</p> <p>Or</p> <p>32 amps, three phase AC 415V 22kW 110km per hour recharging 100km takes just under an hour</p> 	<p>For around \$800 or more, you can buy a dedicated wall-mounted charging station²⁴. They are safer and more robust compared to regular wall sockets, and charge your car faster. WorkSafe guidelines indicate standards you should look for in a product. Some take payment, can connect to a smartphone, or return electricity from your car back to your home or the power grid.</p> <p>The unit will either come with an attached cable, or just a socket. A unit with just a socket is compatible with all car types and thus is the approach recommended by NZTA for public stations. Units with attached cables are limited to specific cars (okay for home or fleets). Either way the connectors are specific to electric cars, deterring others from using them.</p> <p>Cars limit the maximum pace of AC charging; e.g. older Nissan Leafs only charge up to 3.6 kW, and the newest BMW i3 charge up to 11 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 some Tesla cars can charge up to 22 kW, and drivers could feel impatient using a lower-rated unit.</p> <p>These units (especially 3-phase 22kW) provide fast enough speeds to suit users parked at day-time destinations (e.g. workplaces, malls), without the cost of fast DC chargers (below).</p>
<p>Fast DC Chargers 16-800 amps, 415-480V, 3 phase, inverted and supplied to car as DC</p> <p>Medium speed: 12-25 kW Adding 100km takes 1-2 hours.</p> <p>Fast: 50 kW (Common in NZ) Adding 100km takes 25 minutes</p> <p>Faster: 120 kW (Rare in NZ²⁵) Adding 100km takes 10 minutes</p> <p>Ultra Fast: 400 kW (No car yet supports charging this quickly²⁶) Adding 100km takes 3 minutes²⁷</p> 	<p>The earlier options take hours for a car to recharge. Fast chargers by comparison take much less time, and make long distance road trips practical. They work by providing a much greater amount of electricity and by changing it into <i>direct current</i> meaning it can be fed straight into the battery. Like petrol, you can choose just to ‘top up’ your car and put in a few minutes’ worth of power.</p> <p>25 minutes typically adds 100km, however much shorter recharge times will become possible when New Zealand gains higher power charging stations and cars that support them. This type of charging equipment comes in a large range of speeds and therefore costs (under \$10,000 to over \$100,000; a 50kW device is in the middle of this range.) They are purchased by organisations and put in key locations where a high volume of car owners can drive to, such as town centers, supermarkets or petrol stations, or workplace fleet carparks. They are overkill in locations where people intend to park for hours; a slower charger would be more appropriate there.</p> <p>Cars only support being fast-charged to between 85-95% full.</p>

Your car will normally come with a portable cable for only *one* of the two wall-sockets pictured on the previous page, and might come with a cable to plug into a “Type 2” wall socket. Pick carefully when buying a cable, socket, or charging unit. Do not allow a car dealer to sell you a cable for a Japanese shaped wall socket or 100V electricity; this is unsafe and not permitted.

²⁴ Pictured EVSE: Type 2 socketed wall-mounted device with an untethered cable (as per NZTA guidance)

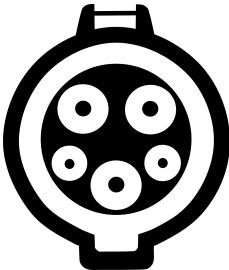
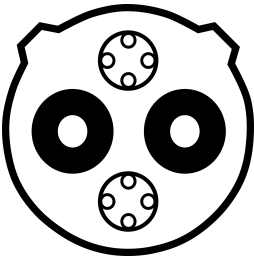
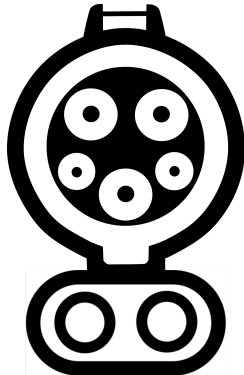
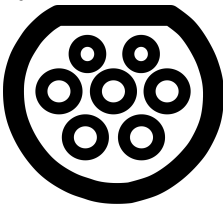
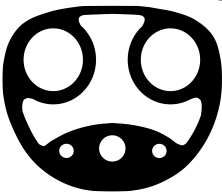
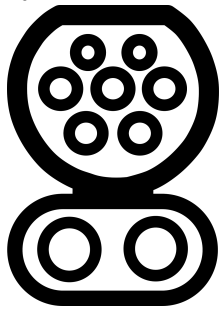
²⁵ Tesla’s SuperChargers run at 120kW and go higher still in the future. 120kW Delta DC chargers are sold in NZ by yhipower.co.nz.

²⁶ In 2017, 400kW chargers are being installed in USA (chargepoint.com/products/commercial/express-plus) and 350kW chargers across Europe.

²⁷ 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 Zealand²⁸:

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 bought in NZ (historically) Kia Soul</p>	<p>CHAdemo (Japan / US)</p>  <p>Nissan Leaf and eNV200 Mitsubishi iMiev and some Outlander BMW i3 imported from Japan Kia Soul Tesla (with CHAdemo cable from Tesla)</p>	<p>Type 1 CCS (Japan / US)</p>  <p>BMW i3 bought in NZ (historically) <u>NOT supported by NZ charging stations</u></p>
<p>Type 2 (“Mennekes”) (Europe)</p>  <p>Hyundai Ioniq Renault Zoe, Kangoo VW eGolf BMW (from mid 2017) Tesla (Uniquely, supports both slow AC and fast DC via this Type 2 socket)</p>	<p>Tesla Supercharger (Japan/US)</p>  <p><i>This socket isn't found on Tesla cars in NZ. Here, Tesla cars use CHAdemo (with special cable supplied by Tesla) and Type 2 (both AC and DC).</i></p> <p><u>NOT supported by NZ charging stations</u></p>	<p>Type 2 CCS (Europe)</p>  <p>Hyundai Ioniq BMW (mid 2017 onwards) VW eGolf (Will become common in NZ over time)</p>

NZTA issued guidelines²⁹ in September 2016 on the socket types to install at public stations:

- **AC:** Socketed Type 2 (with drivers bringing a cable like that pictured, to fit their car).
- **DC:** CHAdemo and Type 2 CCS (cabled), supplemented with an AC Type 2 socket.

Overseas, wireless charging (also known as induction) is available.



Example Type 1 (left, into car) to Type 2 (right, into wall) AC charging cable

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 slowly to preserve battery health. This tapering-off is noticeable when using fast charging stations.

²⁸ Vector diagrams for the sockets available commons.wikimedia.org/wiki/EV_Charger_Gallery

²⁹ See “charging point connectors” under www.nzta.govt.nz/ev

Where can I charge?

Home is where the majority of charging takes place. Some New Zealand employers are providing workplace charging to staff. (This is popular in the USA where workplace chargers are available to over 1 million workers; a charger makes employees six times more likely to own an electric car³⁰).

A national network of over 100 public fast chargers are being installed by charge.net.nz in cities and every 50-100 km along major state highways (*Map below right*). The first stations were installed in 2015 and the network will be largely complete by the end of 2017, assisted by BMW. An access card and a website application offered by Charge Net NZ allows drivers to pay for charging across both their network and many (but not all) stations installed by others.

- Tesla is also installing SuperChargers for road trips, and slower chargers at destinations.
- Some electricity companies are also installing charging stations (e.g. Vector in Auckland).
- Phoneboxes are being upgraded to provide slow charging (see spark.co.nz/plug)
- 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.
- A number of tourism destinations and retailers are adding slow chargers for customers.

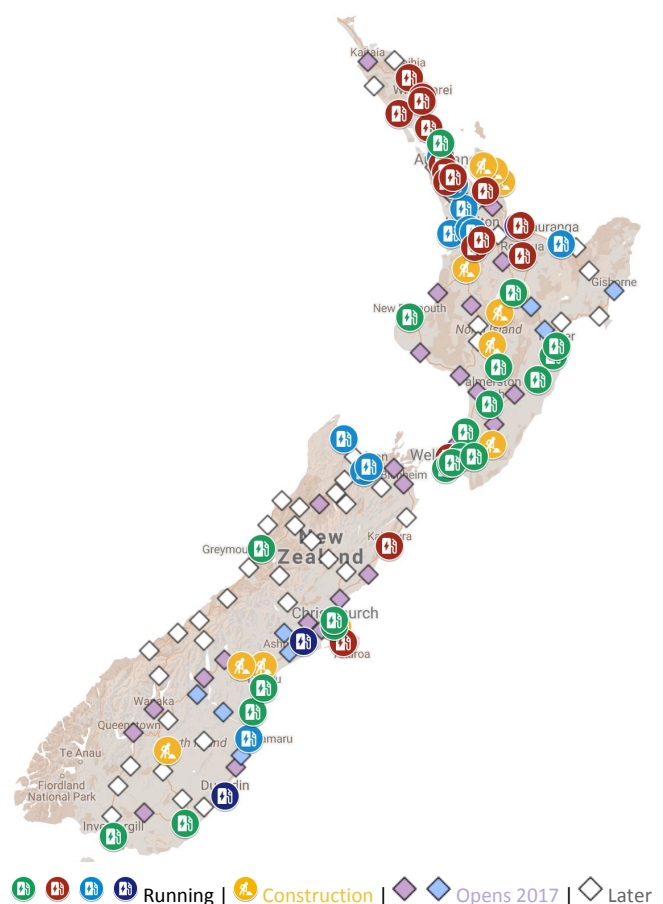
Use plugshare.com (pictured left) or the PlugShare smartphone app for a map of where to charge.

Slow Charging (for destinations)



All of the above slow chargers are operating today.

Fast Charging Network (for road trips)



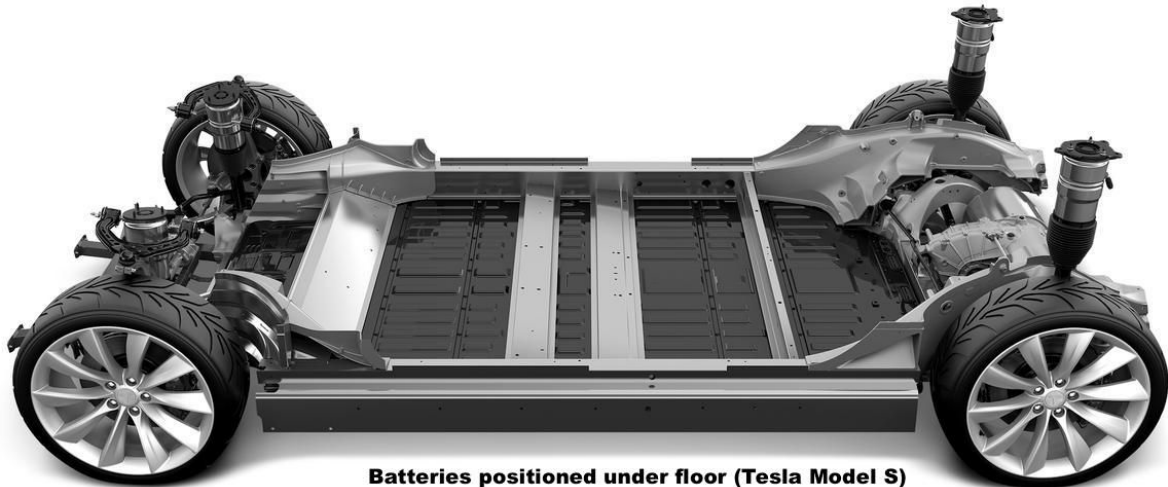
Offering car charging to staff, customers, or the public? You should certainly list it on PlugShare (it's free). Describe whether charging is free to the public, free to customers, or paid, or restricted to employees, the hours of operation (hopefully 24/7!), connector types and electrical power, and upload photos to promote your listing. Add signage to the physical space (e.g. "Electric car charging only") and use NZTA's official [symbol](http://nzta.govt.nz/ev), to increase public awareness of electric cars, and to avoid petrol cars blocking the park. NZTA has guidance on installing public charging infrastructure at nzta.govt.nz/ev.



³⁰ A wealth of statistics and information on workplace charging is found at energy.gov/eere/vehicles/workplace-charging

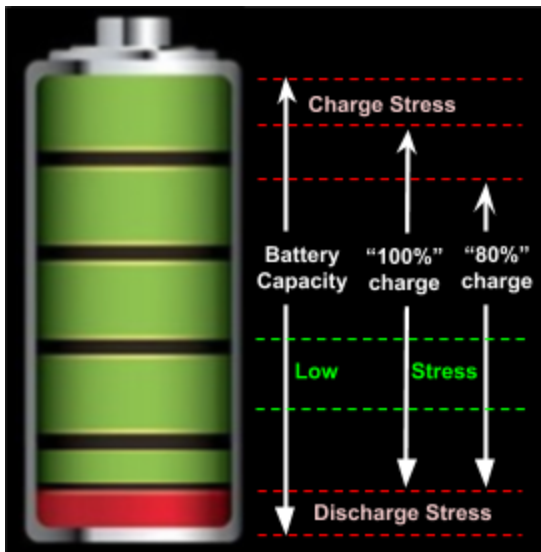
BATTERIES: SIZE, LIFE, REPLACEMENT

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 have 100 kWh. This affects range and cost.



The life of a battery is reduced when at extreme high or low levels of charge³¹. 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 life³².

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)³³. 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 car³⁴. 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, although the [Consumer Guarantees Act](#) standard of "fit for purpose" applies to all sales to private individuals.

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. (e.g. BMW i3 is upgradable from 22 to 33kWh; Renault Zoe from 22 to 44kWh).
- You may need to replace only individual dead cells, at a lower price than a full replacement.
- A new Nissan Leaf battery costs little under \$10,000 (2015); prices are quickly falling.

³¹ Wealth of battery information at batteryuniversity.com; Dalhousie Uni lecture by Jeff Dahn [youtube.com/watch?v=9qi03QawZEK](https://www.youtube.com/watch?v=9qi03QawZEK)

³² US government study on slow vs fast charging: [aet.inl.gov/pdf/energystorage/FastChargeEffects.pdf](https://www.eia.gov/energy-storage/fast-charging-effects.pdf)

³³ www.electricvehiclewiki.com/Battery_Capacity_Loss#Nissan.27s_Responses_and_Actions

³⁴ 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 from bluecars.nz and mevo.co.nz.

WHERE TO BUY AND GET SERVICE?

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

WHAT ABOUT OTHER TYPES OF VEHICLES?

- **Bicycles:** commonly sold in local bicycle shops, with 40-100km "pedal assisted" range.
- **Motorbikes:** ubcobikes.com (kiwi made, off-road); zeromotorcycles.com (import, for road).
- Formula **racing** cars now compete in "Formula E", a global tournament (fiaFormulaE.com).
- Over 400 one-seat "Paxster" fully electric delivery buggies are used by NZ Post.³⁵
- **Trucks** are made by zevnz.com and Waste Management locally. Hybrid utes, SUVs and heavy trucks are being developed by viamotors.com, wrightspeed.com and Tesla.³⁶
- Fully electric **buses** are mass produced by BYD.com; London is buying hundreds³⁷. New Zealand may gain hundreds of plug-in hybrid buses by Wrightspeed from 2017³⁸, and fully electric buses will be trialed in New Zealand during 2017.
- The world's first electric **ferry** launched in 2015 in Norway (carries 300 people, 120 cars)³⁹.
- Prototype electric **airplanes** exist. In 2016 the *Solar Impulse 2* flew around the entire globe.

COMMUNITY GROUPS AND EVENTS

EVolocity, annual electric vehicle event, including test drives, workshops, and high-school teams building and competing with their own electric vehicles. evolocity.co.nz (Christchurch late 2017)

Leading the Charge, an annual 2500km electric car roadtrip the length of New Zealand, stopping in multiple towns for public display and rides. leadingthecharge.org.nz (April-May 2017)

EVWorld, public and industry conference. www.evworld.nz (Auckland 8-9 September)

International Drive Electric Week, September 10-18: locations host parades, displays, and events to help people to see, ride, or drive electric vehicles. See driveelectricweek.org

Facebook "EV Owner" groups

- NZ EV Owners: facebook.com/groups/NZEVOwners/ (*lots of discussion*)
- Northland: facebook.com/groups/1472323112818001/ and facebook.com/revupnz/
- Auckland: facebook.com/groups/291373964545996/
- Wellington: facebook.com/groups/WellyEV/
- Christchurch: facebook.com/groups/ChristchurchEVGroup/
- Dunedin: facebook.com/Dunedin-EV-Owners-919185271451575/

³⁵ nzpost.co.nz/about-us/media-centre/media-release/eco-vehicles-confirmed-as-way-of-future-for-new-zealand-post

³⁶ www.sfgate.com/business/article/Tesla-co-founder-Ian-Wright-snags-FedEx-for-new-5792082.php

³⁷ tfl.gov.uk/info-for/media/press-releases/2015/july/more-than-50-all-electric-buses-to-enter-service-in-london

³⁸ nzbus.co.nz/news-from-nzbus/media-release-nz-bus-investing-in-electric-powered-vehicles

³⁹ cleantechnica.com/2015/06/13/worlds-first-electric-battery-powered-ferry/