

GREEN Grid

Future Proofing New Zealand's Electricity Supply

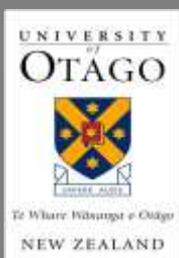
A report from the GREEN Grid
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Keen on EVs:

**Kiwi perspectives on electric vehicles,
and opportunities to stimulate uptake**

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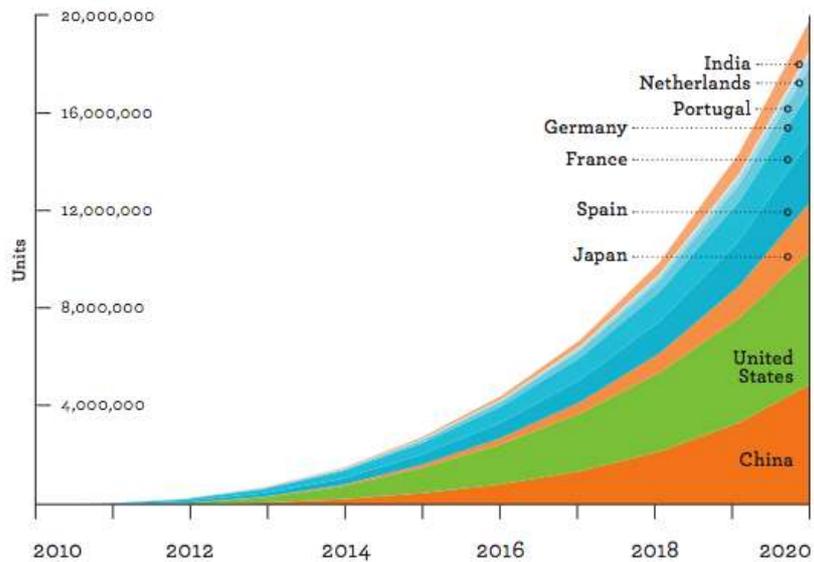


1. Transport in New Zealand and Electric Vehicle Potential

Kiwis love their cars, and their cars use a lot of energy. New Zealand has nearly the highest ownership of cars in the world - around 700 light passenger vehicles per 1000 people¹. The transport sector consumes almost 40% of the energy used in NZ². Because almost all of this energy comes from petrol and diesel, transport use accounts for around 45% of New Zealand's energy-related greenhouse gas (GHG) emissions³, and road transport is the biggest contributor (approx. 90%).

Electric vehicles (EVs) may have an important role to play in New Zealand's transport future. EVs are more cost-effective to run than cars that use diesel or petrol. They also produce far less GHG emissions due to the fact that our electricity is largely generated from renewable sources. EVs are also well aligned with the Government intentions to develop a more energy efficient transport system, with a "greater diversity of fuels and alternative energy technologies"⁴. Although there were only 660 EVs in New Zealand as of May 2015⁵, the global predictions are that the falling cost of EVs together with technological advancements (including improving battery storage) will lead to exponential uptake internationally over the next couple of decades⁶.

Figure 1: Projected EV stock in the global market⁷



Understanding the potential growth of EVs in the New Zealand market is of great interest to a wide range of stakeholders. Aside from the direct impact on the new and used car markets, it could also reduce NZ's dependence on oil imports, increase demand for electricity, and offer new opportunities for managing electricity demand in distribution networks. It is important for businesses, the energy sector, and national and local governments to be able to plan for EV uptake.

This report provides insights into Kiwi appetite for EVs and barriers to uptake. We draw from four pieces of research undertaken as part of the GREEN Grid (GG) and Energy Cultures (EC) research projects:

1. Dr Scott carried out interviews with 23 people who have already purchased, who have a strong interest to purchase, or have rejected EVs (GG)
2. Dr Williams ran an online survey and choice modelling experiment⁸ with 2000 people (500 of whom we questioned about EVs specifically) (GG)
3. Associate Professor Wooliscroft ran a national survey of 2278 households which included questions about interest in EVs (EC)
4. Dr Rees carried out Systems Dynamics (SD) modelling⁹ using these findings and insights from transport experts to explore influences on the rate of growth of EVs in the light vehicle fleet (GG)

2. Participants in the studies

The people who answered our surveys and interviews were, on average, older and with higher incomes than the NZ population as a whole (see Table 1). This was a result of self-selection, and can be corrected for in our later analysis. Based on international data on EV purchasing patterns we might assume that this demographic (older people with higher net worth and disposable cash flow) would be the most likely to buy EVs under current prices. However, the NZ national survey indicated no correlations between interest in EVs and age, income, region, household size, or employment status. There was a very weak positive correlation between interest in EVs and level of education.

Table 1: Age distribution of research participants

Age range	Interviews	Choice experiment and survey	National survey	2013 Census Data
18-24	0%	6%	10%	13%
25-34	0%	9%	12%	17%
35-44	21%	18%	16%	17%
45-54	29%	23%	21%	19%
55-64	29%	23%	19%	15%
65+	21%	21%	22%	19%

3. What people said in the interviews

A scan of the international literature suggests that the main motivations for EV uptake are environmental concern, saving money and energy, interest in trialling new technologies, and being able to afford them.

We found similar motivations when we interviewed early adopters of EVs in New Zealand. Environmental concern was a motivation for most people. They were keen to reduce their dependence on fossil fuels and *“wanted something less damaging to the environment”*. This finding was supported by the national survey, which found that those with stronger environmental concerns tended to be more interested in EVs. Financial and fuel efficiency considerations were also a motivator for those who could afford the upfront cost. The low running costs were seen as very good value for money.

For some, the performance of EVs was important. An industry representative said: *“High net worth individuals are buying these because of performance, not necessarily running costs...probably one of the biggest drivers is performance”*. Over recent years the performance of EVs has continued to improve. Combined with the predicted decrease in battery cost, this sets the basis for EVs to be a disruptive technology⁷.

Financial incentives from energy companies also helped to increase the attractiveness of EVs by offering price reductions for charging at particular times of the day. One EV owner said their energy company was *“offering a 30% discount if I charge my car between 11pm and 7am”*.

Some also had solar panels and found good synergies between the two technologies, *“We have solar PV on the roof as well...if we are driving the [electric vehicle] during the day and it's still sunny, we'll charge it when we get home and we can charge right off the roof, otherwise we'll tend to charge overnight”*. This overlap of interest was also found in the national household survey responses, which saw a moderate positive correlation between interest in PV and interest in electric vehicles.

The novelty of the electric vehicle technology was also a factor for some people interviewed: *“I was keen to be one of the first in New Zealand to get one of these, the early adopter approach I guess”*.

For one participant this meant doing it himself; “we wanted to convert a practical vehicle that most New Zealanders would use, to show that it can be done. A lot of people said we couldn’t convert bigger vehicles and that they wouldn’t be powerful enough”. This person did successfully convert their own vehicle.

Following the purchase of their EV some interviewees changed the way they drove. For some this meant driving more efficiently “We tend to drive more efficiently because we’re aware of the energy that we’re using”. Others tried to reduce the number of trips taken; “I’m more conscious of the trips I do because I think more about if I have to get an extra top up charge during the day”. Although this could indicate the potential for the purchase of EVs to stimulate more efficient driving, it may also be the nature of those people interested in buying EVs; the national survey revealed a weak positive correlation between efficient driving and interest in EVs.

The main barriers to uptake that people mentioned were upfront cost and concern about range. Interviewees who had decided not to buy an EV felt that the reduced cost of fuelling the car was not enough of an incentive to purchase, at least at this stage. Some were also worried that EVs would not have enough range to meet their mobility needs. Due to lack of charging points, long trips were considered not viable with a purely electrically powered vehicle. Even if there were more charging points, the time taken to charge the vehicle was also a concern.

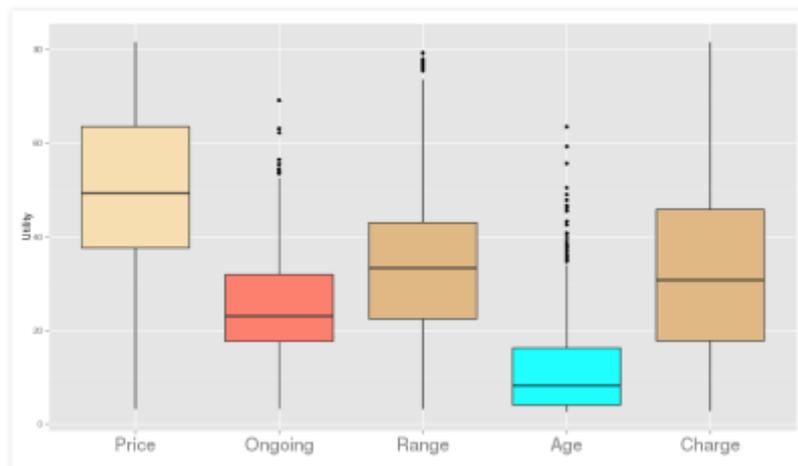
Some interviewees thought the Government could be doing more to support uptake, “The government seems to be very focused on oil, gas and coal and not on renewables, they’re not interested in carbon taxes...until they start showing interest in those areas, you’re not going to see as fast uptake here as in other countries....incentives include free public charging, the ability to drive in bus lanes...exemptions on taxes for cars”.

4. What the surveys showed

The surveys and choice experiment showed similar results, and helped us to put some figures on things people were telling us in the interviews.

The choice experiment showed that the price of EVs was the most important consideration for people considering EV purchase (see Figure 2). After that, the vehicle range and charge time were the next most important considerations. These were both more important than the ongoing costs. The age of the vehicle was least important, which suggests that New Zealanders may be happy to buy secondhand EVs.

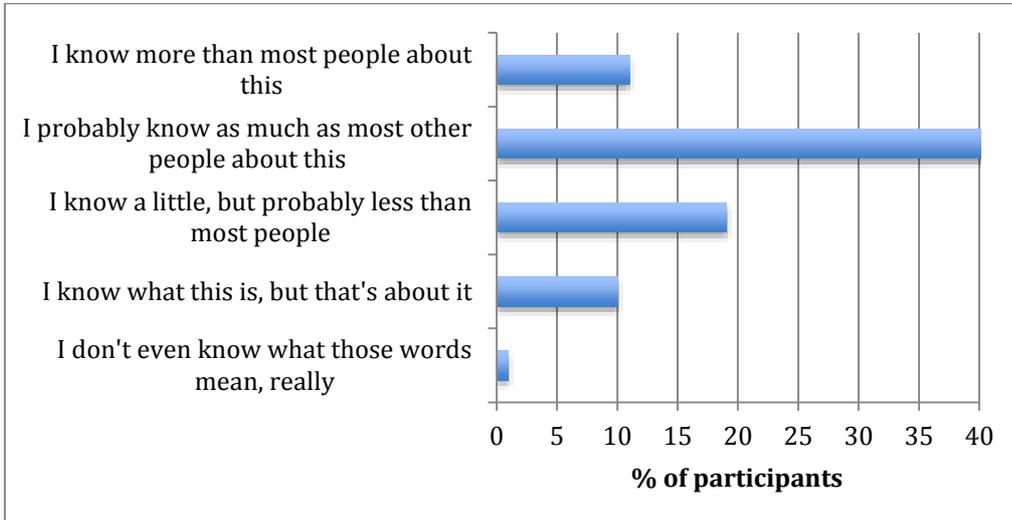
Figure 2: Relative importance of different attributes of EVs



Knowledge

Before people are able to make a decision about whether or not to purchase an EV, they must have some knowledge about them. In the survey administered alongside the choice modelling exercise we asked people about their knowledge regarding EVs.

Figure 3: Reported knowledge levels about EVs

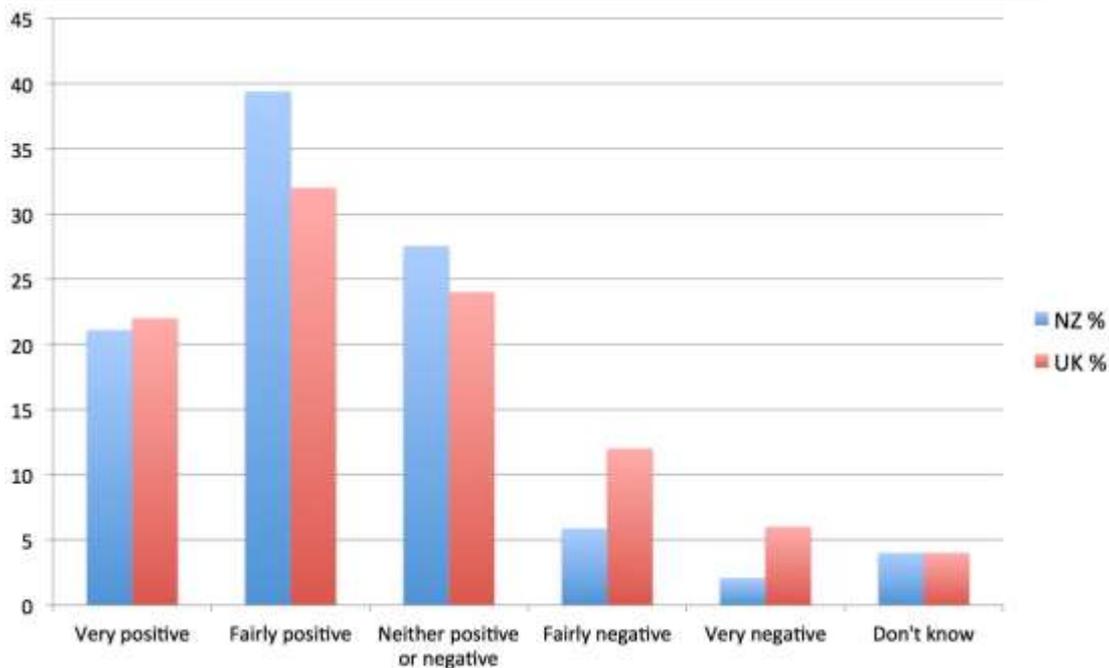


Approximately 40% of participants felt they knew as much as most people, and another 10% felt they knew more than most (Figure 3). This result does not mean that these people necessarily had a good level of knowledge about EVs: merely that they thought they did. Further research would be required to find out what actual levels of knowledge exist across the population.

Feeling positive about EVs

The majority of people who answered the national household survey felt positive about driving an EV (Figure 4). This question was the same as one in a UK survey, and it suggests that New Zealanders on average feel more positive about EVs than people in the UK.

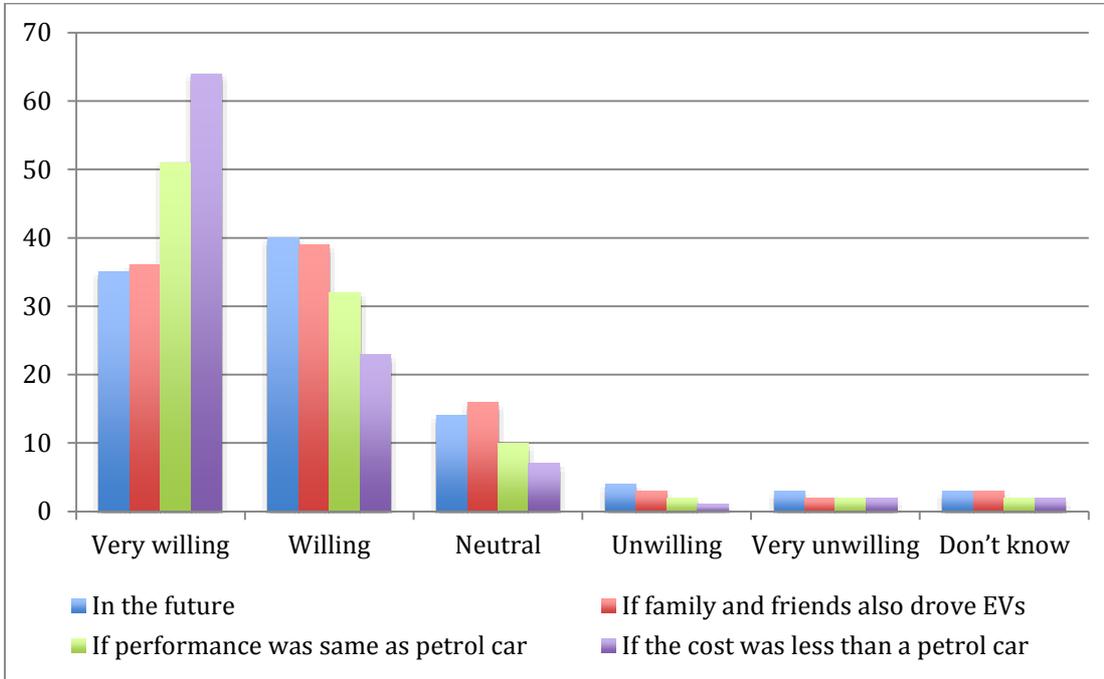
Figure 4: Percentage of people who feel positive about driving an EV (compared to the UK)



Willingness to drive an EV

In the same survey, most people also indicated that they were willing or very willing to drive an EV in the future, particularly if the performance of an EV was comparable to a petrol car, and the cost was less (Figure 5).

Figure 5: Willingness to drive an EV in the future under different circumstances



Willingness to buy an EV

We asked people about their interest in actually purchasing an EV (Table 2). When asked about readiness to purchase only about 6% stated that they were ready, or almost ready to purchase, or already owned one. Nearly 30% said they were still thinking about it, and an equal number had thought about it but had rejected the idea.

Table 2: Interest in purchasing EV (Choice Modelling Survey results)

Interest in purchasing EV	% of survey respondents
I've never considered purchase	38.1
I've thought about it but rejected the idea	27.2
I'm still thinking about it	28.1
I'm almost ready to buy	3.5
I'm ready to buy	2.0
I already have one	0.5
I've got one, and am thinking of buying another	0.3

Because we knew that upfront cost was one of the most important factors affecting the uptake of EVs, we also asked people to “Imagine that you have been given \$100,000 but you could only spend it on a new car (and could not keep the change!). How likely is it that you'd buy an electric vehicle?” Under this scenario, 10% said they definitely would, 16% said it was likely, 35% said they would seriously consider it, and 31% thought maybe. Only 8% rejected the idea of purchase under this scenario.

What will happen if the market changes?

Global trends suggest that oil prices will continue to fluctuate and generally trend upwards, that the cost of purchasing EVs will continue to drop, and that the range of EVs will continue to improve^{6,7}. In the household survey, we asked people whether the likelihood of them purchasing an EV would change under those circumstances.

A hypothetical doubling of the price of fuel at the pump (Figure 6) certainly increased the number of people who felt they would 'definitely' purchase an EV. They responded similarly to hypothetical increases in the range of EVs to about the same as a petrol or diesel car (Figure 7)

Figure 6: Likelihood to purchase an EV under different fuel cost scenarios

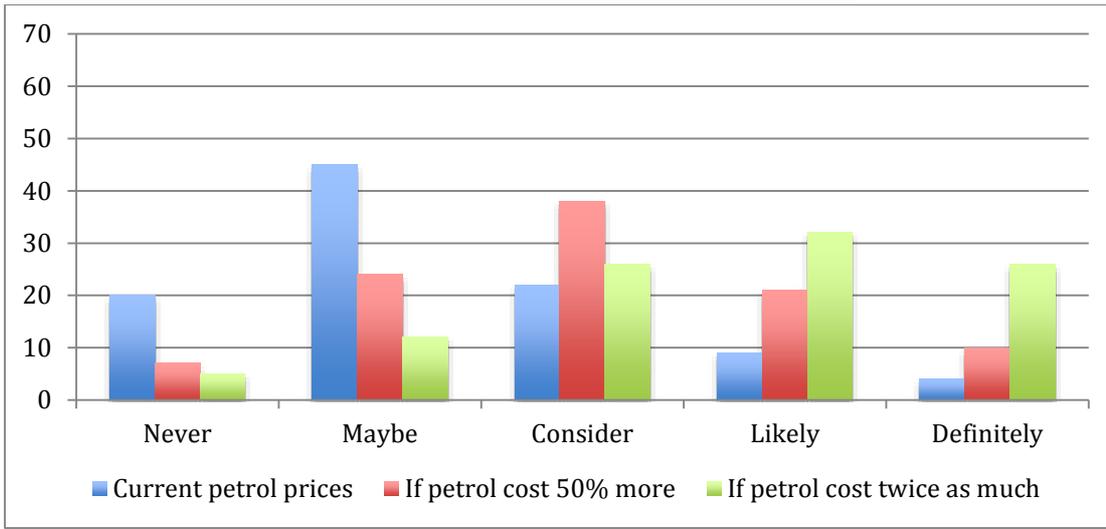
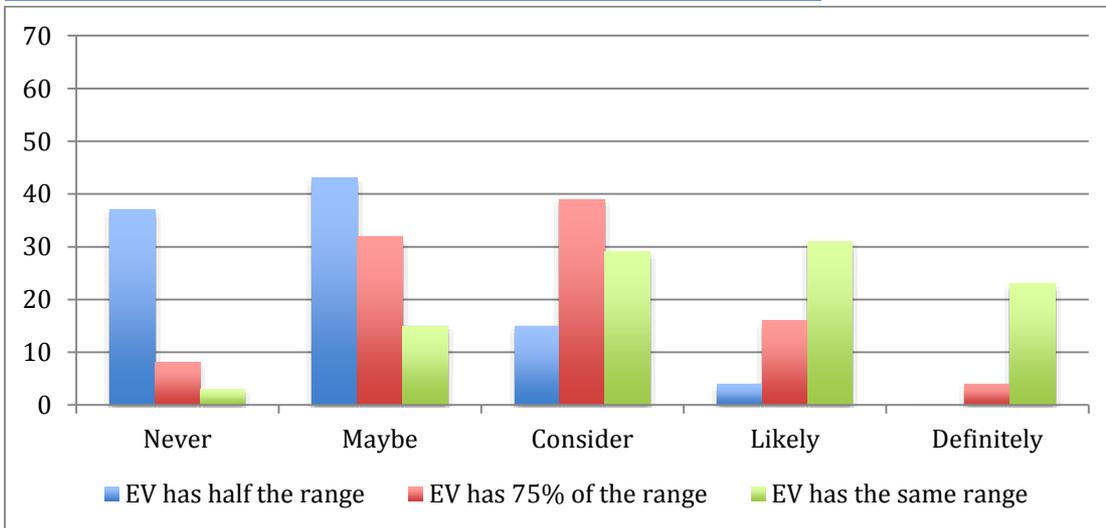
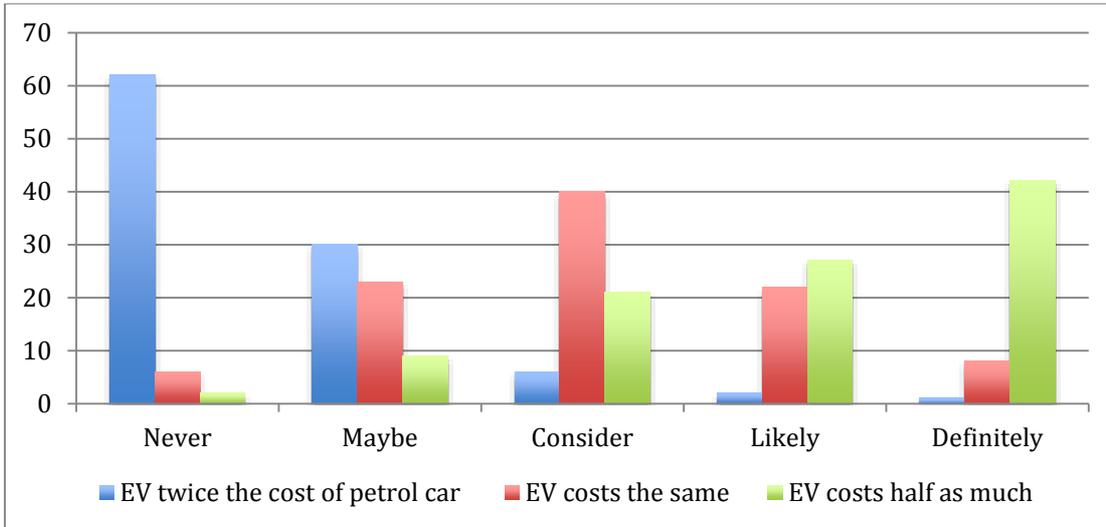


Figure 7: Likelihood to purchase an EV under different range scenarios



The scenario of the cost of EVs dropping to half as much as a petrol car had the biggest impact, with over 65% saying they would 'likely' or 'definitely' purchase one (Figure 8).

Figure 8: Likelihood to purchase an EV under different upfront cost scenarios



5. What does all this mean?

There are many factors to consider if the goal was to stimulate an uptake of EVs in New Zealand. Our findings suggest that addressing one or more of the three most significant barriers – price, range and charge time – would help.

The upfront cost and battery storage are likely to improve over time, and second-hand EVs are likely to come into the NZ market in due course. So eventually, NZ will end up with more EVs on the road than we have right now, even if nothing changes. But what if NZ wants to get more EVs on the road more quickly than this?

One of the most obvious actions would be to reduce the barriers of range and charge time through setting up charging stations at regular intervals, with fast charging technologies, so that people can be certain that they can get where they want to go.

Concerns about the cost of EVs can in part be addressed by better information about the whole-of-life cost, as the price of running an EV is far less than a petrol or diesel car. Also, as Kiwis tend to buy second hand cars, and seem happy with the idea of second-hand EVs (Figure 2), it would help if government and commercial fleets purchased EVs, so that these would come on to the market as second hand in a few years' time.

In many other countries, where governments have wanted to stimulate EV uptake, they have put incentives in place to reduce the relative cost of purchase, or simply to make it easier to have an EV. In Norway, for example, a country with a similar sized population to NZ, and with close to 100% renewable electricity, the uptake of EVs has taken off since 2011. There are now over 50,000 registered EVs in the country, and one fifth of all new cars sold over Jan-May 2015 were EVs¹⁰. Norway currently subsidises EVs, as well as having many charging stations, and incentives like letting EVs use bus lanes. The figures give an indication of how a lower price (whether artificial or real) and charging availability can lead to rapid uptake.

But there are many other factors to consider, and they are all interrelated in some way. Figure 9 shows some of the interconnections between different factors that may come together to drive or inhibit EV uptake. Blue arrows indicate positive causal relationships; e.g., a decrease in the cost of batteries will lead to decrease in the price of EVs, leading to a decrease in the relative price of EVs when compared to other vehicles. Red arrows indicate negative causal relationships; e.g., an increase in the number of second hand EVs available will lead to a decrease in the cost of EVs compared to other vehicles, which will lead to an increase in the number of EV sales.

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⁴ New Zealand Government (2011). The New Zealand Energy Strategy 2011-2021

⁵ <http://www.transport.govt.nz/assets/Uploads/Research/Documents/Monthly-light-vehicle-registrations-to-May-2015.pdf>

⁶ <http://www.carbonbrief.org/blog/2015/03/electric-vehicle-batteries-already-cheaper-than-2020-projections/>

⁷ International Energy Agency (April, 2013). Global EC Outlook: Understanding the Electric Vehicle Landscape to 2020. https://www.iea.org/publications/globalevoutlook_2013.pdf

⁸ Choice modelling attempts to model the decision process of an individual in a particular context. Our work included a choice experiment in which individuals had to make trade-offs between levels of attributes, e.g. lower installation cost vs. greater grid independence.

⁹ System dynamics (SD) modelling takes a whole-systems approach, exploring how different parts of a system impact on each other, how feedback loops develop, and how change in one part of the system may lead to changes in other parts.

¹⁰ <http://www.reuters.com/article/2015/04/20/us-norway-autos-idUSKBN0NB1T520150420>

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