Will electricity save the car?

November 29 2013, by Peter Pudney

The 2011 Tesla Roadster Sports could hit 100 km/h in less than four seconds and be charged from a standard power point.

Cars defined the 20th century … [They] shaped the wars that were fought, the way cities developed and how people and goods were moved around … [As] we look to alternative technologies to fuel more than a billion cars and trucks on the world's roads, the most efficient transport solutions are more likely to re-power these vehicles rather than replace

them.—*Sparking an Electric Vehicle Debate in Australia*, by the Energy Supply Association of Australia.

It is undeniable that cars played an important role in shaping life in the last century. But is the Energy Supply Association - the peak lobby group for Australia's big electricity and gas generators and suppliers - right to assume that will continue?

Will cars, even electric ones, survive the 21st century?

Sparking debate

Released today, the ESAA's Sparking an Electric Vehicle Debate paper explores the potential of plug-in electric vehicles to contribute to the transformation of transport in Australia. (A forthcoming paper will consider the potential for natural gas vehicles.)

The paper gives a comprehensive summary of the potential benefits of electric vehicles, and the barriers to adoption.

Some of the compelling benefits of electric vehicles include:

- no CO2 emissions from driving, when charged from renewable energy sources (more on that shortly)
- no smog-producing exhaust
- smooth, quiet acceleration
- significantly lower energy costs, even when charged using renewable energy
- lower maintenance costs.

The paper goes on to describe why we need to look beyond internal combustion engines to power our cars - including to save money on fuel, noting that "electric cars have equivalent fuel costs of approximately 3

cents per kilometre, compared to 10 cents per kilometre for conventional cars".

What's holding back the electric car?

Electric vehicles have their advantages, but do these outweigh the disadvantages? Buyers are still hesitant. According to the report:

plug-in vehicles still only represent around 0.2 per cent of the global car fleet

the 'tipping point' for adoption may be two decades away.

The barriers to the adoption of electric vehicles include high purchase price, "range anxiety", long recharge times, lack of charging infrastructure and uncertainty of resale value. Some of these barriers are problems of perception.

But a massive shift is needed, given there are 16.6 million vehicles in Australia alone.

What could drive major change?

The ESAA paper suggests several options for encouraging the uptake of electric vehicles, including:

- subsidies
- use of transit lanes and dedicated parking spaces
- support for infrastructure providers
- partnerships with long-distance travel providers, such as airlines, railways and car hire companies
- partnerships with electricity companies, which could use electric

vehicles to help stabilise the electricity grid.

Mandatory vehicle CO2 standards would also help. Since 2011, the previous federal Labor government had been discussing mandatory CO2 emissions standards for cars, to apply from 2015, but that plan wasn't enacted before the election.

Financial incentives such as purchase price subsidies, discounts on registration costs and tax incentives are possible, but unlikely. If they are used, the value of incentives should be commensurate with the benefit to society of each electric vehicle.

Plugging cars into the power grid

Members of the ESAA - which include major electricity and gas companies such as AGL and Origin Energy - would benefit from the ability to sell more electricity during off-peak times.

Directly controlling when cars are charged would also allow electricity system operators to improve reliability without having to increase the capacity of transmission and distribution systems. These two factors combined would reduce the network costs per kilowatt-hour of electricity delivered.

But we would need to change the way we use and pay for electricity, including needing all states to start allowing time-of-use pricing of electricity (that is, paying more when demand is highest, and less when it's lower), as well as incentives for participating in demand management schemes.

International standards that would allow transfer of energy from vehicles back to the electricity grid are progressing, but slowly.

Ultimately, more flexible pricing of electricity and more flexible control of electrical loads such as electric vehicle chargers would enable greater use of electricity generated from renewable energy sources.

Electricity emissions

Electric vehicles have no CO2 emissions when recharged from renewable energy sources. But determining CO2 emissions when electric vehicles are charged from non-renewable energy sources is not so straightforward.

CO2 emissions from conventional cars are measured as a sample car is driven on a dynamometer, following a standard speed cycle. Electric cars are evaluated using the same test cycle, but the energy required to recharge the car is measured instead of CO2.

To determine CO2 emissions, you need to take into account both the emissions from the car and the upstream emissions used to produce the generator fuels.

The National Transport Commission's Information Paper on CO2 emissions from new Australian vehicles 2012 reports that the average CO2 emissions for new cars in 2013 was 199 g/km. You need to add about 8% to this to account for CO2 emissions from the production of petrol or diesel fuel, giving a total of 215 g/km.

The emissions associated with the use of electricity in Australia can be found in the National Greenhouse Accounts Factors, July 2013. The average for Australia is easy to remember: one kilogram of CO2 for each kilowatt-hour of electricity delivered.

Emissions vary across Australia because of the different mixes of energy sources used: for instance, they're highest in Victoria, which relies

heavily on burning high-emission brown coal, and lowest in Tasmania, which can draw on more hydro-electric power.

The following compares the CO2 emissions for a fully electric Nissan Leaf and more conventional cars in different parts of Australia.

Grams of CO2 per kilometre

228 Nissan Leaf in Victoria
215 2012 new car average
182 Nissan Leaf in New South Wales
164 Nissan Leaf in Queensland
145 Nissan Leaf in Western Australia
133 Nissan Leaf in Northern Territory
129 2012 "best in class" average
126 Nissan Leaf in South Australia
38 Nissan Leaf in Tasmania

Cars in Australia are subdivided in to fifteen market classes based on vehicle type and size. If each car sold in Australia in 2012 was replaced by the best performer in its class, the average new car emissions would have dropped from 215 g/km to 129 g/km, which is lower than electric vehicle emissions everywhere except South Australia and Tasmania.

Clearly, if we want to do better than conventional fuels, we must use renewable energy to recharge our electric vehicles.

Beyond cars

Replacing combustion engines with electric motors in vehicles can reduce emissions, but it will not solve the other problems associated with cars: high energy use, congestion, and road trauma.

You can't solve mobility problems by giving everyone a car. For instance, in crowded Beijing, vehicle licence plates must be won in a lottery. Even if you win a plate, there are restrictions on which days you may drive.

The ESAA paper gives a good overview of the issues surrounding the adoption of electric vehicles, and will spark some useful discussions. But the report also concedes that it will take three or four decades for widespread adoption of electric vehicles. Can we wait that long?

Electric cars solve only some the problems associated with cars. Change is slow. We also need to start thinking now about what will come after the car, and whether we want cars to define this century as much as they did the last.

Source: The Conversation