Australian Institute for Progress

Fact Bite #3

An occasional brief issues brief

EVs not such a smart way to reduce emissions at the moment

April 8, 2019

www.aip.asn.au

The Australian Institute for Progress exists to advance the discussion, development and implementation of public policy for Australia's future, from its base in Brisbane. The future does not look after itself.

The ALP recently released its Plan for more renewable energy and cheaper power[i] which includes a promise to have 50% of new car sales made up of electric vehicles (EVs). This is an undertaking on a scale unlike anything promised in Australia before. The cost of new generation to electrify the entre transportation system alone will be 12 times the investment in the NBN without allowing for upgrades to the transmission network etc.

It is extremely ambitious, compared with other international schemes like EV30@30, which sees 30% of new vehicles being electric by 2030 and comes without costings. Our estimates put the cost of constructing new electricity generation to electrify the transport sector at an indicative $614 billion as it will involve doubling electricity capacity using renewables only.

When considering the policy here are some considerations that should be weighed.

1. There is a shortage of key materials required for the manufacture of key components for electric vehicles, such as rare earths. As other countries electrify their transport sector these materials will be in shorter supply and increase in cost, working against any projected decrease in the cost for EVs.
2. Many of the critical components for EVs come from China, including rare earths. Australia's transport system therefore depends on a country that is a strategic geo-political competitor, with an authoritarian and oppressive government.
3. If electric vehicles are introduced to Australia's current electricity generating network they will actually increase CO2 emissions, because they will be fuelled substantially by black and brown coal. Lower emission forms of generation need to become more widespread before it makes any sense to introduce EVs. Mining and refining of rare earths involves environmental issues, including radioactive waste. This could stop treatment in some countries, including Australia.
4. The cost of electrifying the transport sector will be somewhere in the range between $436 Billion (100% wind) and $791 Billion (100% solar), without counting network upgrades which will be substantial, but more difficult to quantify. With a 50/50 mix of wind and solar the cost would be $614 Billion
5. The electrification cost will be borne by the whole of the community via increased electricity prices, irrespective of whether they own an EV or not, because network and generation charges will be spread across the whole of the network, not just that part being built specifically to meet the increased demand caused by the transport sector.
6. The Opposition doesn't spell-out how it will meet the 50% target, but it could be done by paying a subsidy to purchasers to encourage them to purchase a new EV, or it could be done via quotas imposed on car manufacturers or by raising emissions standards on new cars. This should at the least be modelled and explained.
7. The policy will wreck the market for used cars, making it expensive for users to change over, and increasing the likelihood they will keep petrol and diesel driven cars operating even longer. So 50% of new cars might be EV, but the overall car fleet may change much more slowly as a result.
8. $0.41 per litre is taken in Federal excise to fund road construction. There is no explanation as to whether this will be compensated for with an EV user charge. On average fuel consumption the average motorist pays $548 per annum towards roads. Across the entire transport sector the federal government earns $17 Bn plus each year.

Material constraints

The ALP policy is part of a worldwide movement to electrify the transport sector. So ALP policy will have domestic cost implications as households replace their existing cars with new ones, but this will occur in an environment where the cost of electric vehicles will be set by international factors that will tend to make them more expensive than they would otherwise be because of a shortage of materials to manufacture key components.

EVs consume minerals that are not in high supply, like cobalt and nickel, as well as rare earths. On the basis of the EV30@30 target[ii] (a less ambitious target of 30% of the world's EVs being electric by 2030) the world will need to build 228 million EVs by 2030, which is a 7600% increase on the 3 million or so in existence. That will require a quantum leap in manufacturing and materials. The manufacturing should be catered for in mostly existing factories, but the materials required for parts of the vehicles, the batteries and magnets in particular, will not be so easy to extract in the volumes required. This will lead to cost pressures due to minerals being in short supply that will tend to counteract efficiencies of scale or design.

- 60% of the world's cobalt comes from the Democratic Republic of the Congo[iii]. There is potential for supply shocks from shortages, as well as political instability. The price of cobalt is likely to rise significantly.
- Nickel is widely distributed, but there has been a drawdown of stocks on the LME, meaning that demand exceeds supply. There is plenty of potential nickel around for current needs, but prices are likely to rise medium term[iv]. It is also used in the manufacture of a large number of other products, for example stainless steel, so there will be plenty of competition for it. Whether mines can be ramped up to deal with 20 or 30 million EVs each year is an open question.
- The price of lithium is depressed, partly as a result of new supply, and lack of demand. Many industry participants are predicting this to change in 20/21[v]. If demand from EVs grows as predicted can mines be brought into production quickly enough? Will we need new discoveries, and if so, how long will these take to be brought into production.
- Rare earths are not particularly rare, but profitable producers of them are. Australian company Lynas has 10% of the market for NdPr and is the only substantial producer outside China. NdPr is two elements, Neodymium and Praseodymium, which are used in the strong magnets required for wind turbines and electrical vehicles. Forecasts for NdPr demand see volume increasing around 6% per annum. That's another Lynas being brought into production every second year. Lynas is currently experiencing problems in Malaysia where it processes its minerals because one of the by-products is naturally radioactive[vi]. Green NGOs have been campaigning against them. The Malaysian government is demanding that the radioactive by-product be returned to Australia. Lynas has also considered the possibility of relocating the refining process to Australia. Will the same green activists, which include Greenpeace[vii], campaign against this as well, and how might this constrain NdPr production?
- A good demonstration of the difficulties of bringing mines into production is provided by Arafura Resources Limited, another Australian rare earth miner with a similar-sized deposit to Lynas, which has spent 10 years developing the business case for its resource. It is still not in production. This demonstrates the difficulties of bringing on enough supply in any reasonable timescale, indicating that costs for the materials are likely to rise substantially, increasing the relative costs of EVs.

Power supply constraints

- Australia generated 927 Peta Joules of electricity in 2015-16[viii] (257,500 GWh) and road transport consumed 1,189 Peta Joules (equivalent to 330,280 GWh) in the same period. If we are to electrify our entire vehicle fleet we will need to more than double our electricity generation capacity. Australia currently has approximately 50 GW of electricity generation capacity. If the road transport need is to be met using wind and solar, we will need to build somewhere between 140 and 250 GW of generation capacity because of the low capacity utilisation of wind (35%) and solar (20%) coupled with some form of storage and perhaps another 50 GW of gas-fired power as ultimate backup. (This scenario is conservative with respect to storage and allows just enough to back-up wind and solar on average, filling all other non-average gaps with gas. If batteries were to be used to provide 100% back-up the cost would be much higher again). On this basis, and excluding projects like Snowy 2.0, which is also a form of electricity storage, we will need between 23 and 50 GW to store the excess power generated by the renewables for use when they are not available.

  This table calculates the upper and lower bounds as all wind (cheapest) and all solar (most expensive). In reality the result will be somewhere between. Costs are based on 2019 analysis by the US Energy Information Administration[ix] which contains construction figures for all types of generation, and storage, and is converted into Australian dollars at a rate of USD $0.75 to AUD $1.00

Cost of additional generation			
	$Billions	$Billions	$Billions
Technology	Wind	Solar	50/50 Mix
Turbines	309	594	452
Storage	60	130	95
Gas	66	66	67
	436	790	614

  At the same time we will be spending a similar amount replacing existing generating infrastructure to make it emissions free as well as an unspecified amount on transmission lines to take electricity from where it is generated to where it is used.
- Irrespective of where vehicles are charged we will need to significantly upgrade electricity networks in the suburbs as well as the CBD. Three phase power will be mandatory to every house.
- We will need a significant network of charging stations. The demands they will make on the local network will be an order of magnitude greater than required in suburbs and the CBD. Because of the way network charges are calculated, the cost of this will be borne by electricity users in general, increasing the cost of power.

Battery constraints

- Models used to forecast high take-up of EVs are based on the assumption that costs will fall and EVs will become price competitive with internal combustion motor vehicles. While there has been rapid increase in the efficiency of batteries, this cannot continue indefinitely.

Politicians and journalists erroneously make comparisons between the improvement in computers and improvement in renewable energy technologies, but this is to compare walnuts with watermelons.

- Computers manipulate information, batteries provide energy. Computers have got faster and cheaper by doing more with less: more computations using less power. But there are physical laws which dictate the limits to moving objects. They have mass, and the force to accelerate a given mass at a certain rate increases in a straight line with increase in either mass or acceleration. The only way batteries can become cheaper is to become more efficient, but this is limited by the chemical processes involved.

An increase in EVs in Australia will lead to an increase in CO2 emissions

- This is counterintuitive, but true, at least in the short term, and depending on what country you are living in. EVs are a good option for reducing emissions in Paraguay, with almost 100% of its power provided by hydro, but not in Australia, where most power is still generated by coal as per this study by Shrink This Footprint[x]. This may change under Labor, although how close they will get to their target of meeting 50% of electricity generation by 2030 has yet to be seen. Mandating electric vehicles may make this a little easier on the basis that total generation will increase, and most of the new generation will be solar or wind, however, battery storage is lagging, and coal and gas will be needed to fill the gaps when wind is blowing and sun isn't shining.
- Manufacture of EVs also requires a lot of electricity, most of which, again depending on country of manufacture, will emit CO2. While this is true for all automobiles, there is likely to be a bring-forward element in EV car purchases. Because of the likely decay in resale prices for petrol vehicles some purchasers will decide to bring forward the purchase so that they can still sell their old car at a reasonable price. The longer they delay, EVs may get cheaper, but the value of their existing combustion vehicle deteriorate even faster, so increasing change-over cost. So there should be an early surge in manufacture of EVs.
- Sequencing is the key to achieving reductions in CO2 emissions using EVs. You need to change the composition of your power generation fleet, before you change your vehicle fleet.
- Consumers could take emissions into their own hands, and charge the car at home using solar energy. This is feasible, but will increase the effective cost of the car because batteries and panels will need to be purchased in addition to the vehicle. An EV will use somewhere around 4 KWh of electricity per day on average usage (electricity consumption of 10 KWh per 80 Km, travelling 242 Km per week), and the average house uses 18 KWh in the same period[xi]. To ensure none of this is sourced from the grid you would need two 5 KW solar panels generating a combined 30 KWh each per day at the depth of winter[xii] to meet demand, and you would have additional electricity to sell to the grid. However, should the car need fully charging, then you will need in the vicinity of 56 KWh. If the car is to be charged overnight (car with 450 Km range using previous fuel efficiency criteria), then that amount of power will need to be stored in batteries. One Tesla battery contains 13.5 KWh of usable electricity[xiii]. So you would need 5 of them, and it would take 5 days for your system to charge them all up with the 8 KWh of spare capacity left from the household system each day. A Powerwall costs $12,350 before installation, so it is likely your batteries would cost more than your car!

EVs don't pay for road usage

All petrol and diesel cars pay $0.41 a litre excise which is hypothecated towards road construction and maintenance. This is $20.50 per 50 litres. If the government adopts a road user charge for EVs this will erode their economics versus petrol and diesel motor vehicles.

- For the average motorist who travels 12,600 kms in a car with average 10.6 litres per 100 kms fuel efficiency this amounts to $547.60 per annum (somewhere around $17 Bn a year across the entire economy).
- For an EV with 450 km range and a battery capacity of 56.25 KWh (fuel efficiency of 10 KWh per 80 km), it would cost $15.54 in Queensland (the cheapest) to power it and $24.12 in South Australia (the most expensive). The equivalent fuel for the average car would be 47.70 litres, which at $1.50 a litre would cost $71.55 to fill, of which $19.56 would be excise. So the actual power cost difference between the two is only $36.54 in Queensland, dropping to $27.87 in South Australia. As renewable power replaces fossil fuel the Queensland figure will converge on the South Australian figure, or higher.

---

[i] https://www.laborsclimatechangeactionplan.org.au/

[ii] https://www.iea.org/media/topics/transport/3030CampaignDocumentFinal.pdf

[iii] https://www.globalenergymetals.com/cobalt/cobalt-supply/

[iv] https://investingnews.com/daily/resource-investing/base-metals-investing/nickel-investing/nickel-outlook-price-gains/

[v] https://investingnews.com/daily/resource-investing/battery-metals-investing/lithium-investing/lithium-outlook/

[vi] https://www.smh.com.au/business/companies/malaysian-pm-adds-to-woes-for-aussie-miner-lynas-20190406-p51bgk.html

[vii] http://www.greenpeace.org/seasia/Press-Centre/publications/Report-Lynas/

[viii] https://www.energy.gov.au/sites/g/files/net3411/f/energy-update-report-2017.pdf

[ix] https://www.eia.gov/outlooks/aeo/assumptions/pdf/table_8.2.pdf

[x] http://shrinkthatfootprint.com/electric-car-emissions

[xi] https://abcdiamond.com.au/average-household-electricity-consumption/

[xii] https://www.solarchoice.net.au/blog/5kw-solar-system-price-output-return/

[xiii] https://www.tesla.com/en_AU/powerwall