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Future Smart Strategies Overview on Electric Vehicles

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Submission to Senate Select Committee on Electric Vehicles

Inquiry into the use and manufacture of electric vehicles in Australia

Future Smart Strategies
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About the authors

Professor Ray Wills wide-ranging career as researcher, academic, planner, consultant, adviser, manager, executive and futurist brings diverse experience and an exceptional understanding of business, commerce and industry, the environment, policy and government, sustainability, and technology across all sectors including the built environment, cleantech, energy infrastructure, industrials, manufacturing, resources, transport and water. Since 2011, Ray has been internationally recognised as one of the Top 100 Global Leaders in Sustainability.

Howard Buckley has an extensive professional career spanning accounting, ICT, executive management, and management consulting. He has delivered sustainable, cross-functional business improvement in Australia, Asia, the UK and the USA in multiple sectors. Since 2008, Howard has been focused on business strategy and how to implement it sustainably for commercial start-ups, business transformations and technological disruptors.

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Overview of electric vehicles

Future Smart Strategies see a number of key emerging global and local trends that are consistent across multiple evident and emerging tech disruptions:

- Renewable electrification – including of transport driving up demand for electrical energy, while bolstering the case for renewable supply and improving environmental measures - and simultaneously reducing overall energy demand;
- Digitalisation – automatic and dynamic, predictive and adaptive integration between all nodes of the economy including optimisation costs and efficiency in transport;
- Decentralisation – the capability to deploy transit solutions regionally;
- Customer engagement – their choices and voices help drive innovation and value.
- Decarbonisation – past investments in technology growth has resulted in economic advantages for renewable energy generation;

Rapid developments in clean technologies (which are non-linear and exponential in development and uptake) and even more rapid reductions in clean technology pricing mean the nature of the global energy market, and in particular the electricity market, is changing both off-grid and on-grid around the world right now.

Adapting to, and taking advantage of, these changes will be imperative for economic competitiveness and social development as commercial and domestic customers change the way they acquire and consume energy. Within the next few years, smart energy management technology in the home, including from vehicles, will be used to balance demand on the grid. This translates that less generating capacity will be needed for spikes and thus the overall cost of generation per MWh will decline, increasing the competitiveness of electric vehicles. This will also be driven by fossil fuel price variability compared to less variable electricity markets, and advances in generating and distribution efficiency due to technology advances, most of which will be based on smart systems such as machine-learning and adaptive-learning technologies.

Traditional transport solutions (that are currently trapped in the model of sweating assets) will need to adapt or face declining profitability, with energy efficiency and self-generation from distributed renewables eroding the old models of fuel supply, and new clean tech-based business models with new approaches to market management quickly becoming the new normal.

This strategic overview summarises relevant global, Australian issues and outlines a range of measures that can assist in understanding, and planning for, the future of electric vehicles.

The Future Smart overview narrative on future energy, and in particular in context of transport, describes:

- Continuous increase in energy efficiency with a decline in per capita energy consumption, an effect which is most evident in OECD countries. Electric-powered vehicles are more efficient than combustion engine vehicles¹²³, and a reduction in energy consumption in an economy translates to improved productivity.
- Rapid, non-linear growth of emerging technology including clean tech and especially renewables - readily seen in the data, with technology succession in generation now also obvious (wind to solar)⁴⁵ – including in Australia⁶.
- These factors – efficiency intersecting the new energy source of renewables – combined with growing policy measures to act on climate change are impacting traditional energy markets, including for vehicles, and will lead to the redundancy of internal combustion engine technology for transport⁷ including ICE-electric hybrids⁸. Hybrid vehicles have now been available for almost two decades, but the technology has remained niche and has not ‘broken out’, so logically will soon be replaced by the next wave of changing in vehicles⁹¹⁰.
- The efficiency and cost savings in electric vehicles are not just theoretical, but demonstrated in real world use¹¹. The potential savings for commercial uses and fleet owners is the greatest¹², and such economies in operations will reduce costs, improve profitability and grow productivity.
- Global announcements in the year to date to the end of Q3 2018, the world has announced more than 370GWh new lithium battery factory capacity, to be in production by 2022. On trend, it seems likely that the total will be 460GWh by year's end. Factories expansions usually require two to three years of lead time to deliver. So, if same expansion 2019, global capacity is likely to be greater than 1TWh by 2022¹³.

¹ *Note that most tweet references following have additional references embedded.*

² UCSUSA (2018) *How Clean is Your Electric Vehicle?* Union of Concerned Scientists

<https://www.ucsusa.org/clean-vehicles/electric-vehicles/ev-emissions-tool>

³ Hanley S (2018) *Electric Car Myth Buster – Efficiency* <https://cleantechnica.com/2018/03/10/electric-car-myth-buster-efficiency/>

⁴ Wills R (2018) *BNEF highlight tumbling Levelized Cost of Electricity*

<https://twitter.com/ProfRayWills/status/983331507203751936>

⁵ Lazard (2018) *Levelized Cost of Energy (LCOE) and Storage (LCOS) Analyses*

<https://twitter.com/Lazard/status/1060620615860842496>

⁶ Wills R (2018) *Rooftop solar in Australia* <https://twitter.com/ProfRayWills/status/1057824252018094080>

⁷ Wills R (2018) *Why Lexus and Toyota Motor Corp are trying to convince us hybrids are sexy like electric cars*

<https://twitter.com/ProfRayWills/status/1049675133541994496>

⁸ Wills R (2018) *Anticipating demise of hybrids along with full ICE cars*

<https://twitter.com/ProfRayWills/status/1061200049349189633>

⁹ Wills R (2018) *EV growth ramping fast: simpler tech, simpler build than hybrids*

<https://twitter.com/ProfRayWills/status/1057775073757515776>

¹⁰ Wills R (2018) *Electricricker: In the future you won't say 'electric car', you will just say 'car'. It will only be electric.*

<https://twitter.com/ProfRayWills/status/1044385933926129664>

¹¹ Wills R (2018) *Drive your electric car around Australia on <\$1000 electricity?*

<https://twitter.com/ProfRayWills/status/1061518199366201345>

¹² Wills R (2018) *Commercial use of electric vehicles gives largest savings*

<https://twitter.com/ProfRayWills/status/994398838499651584>

¹³ Wills R (2018) *370GWh new lithium battery factory capacity in production by 2022*

<https://twitter.com/ProfRayWills/status/1043673127966785536>

- To the end of Q3 2018, the world has sold 1 million electric vehicles, with the global fleet now reaching 4 million electric vehicles. Car makers have in the space of nine months announced more than \$250b investment in electric car manufacturing to 2023¹⁴.
- The rate of change in China in the past decade has been extraordinary. China has a bus fleet of about 800,000 strong, and now more than 50% are electric. Globally 420,000 fully electric buses in the world, and as at September 2018, close to 99% are in China. Shenzhen is the first city in the world to have a 100% electric public bus fleet, updating more than 16,000 electric buses in less than 8 years¹⁵. China will sell around 75,000 electric buses this year.
- Rapid emergence of the electrification of transport is at the same time being met with the development of self-driving vehicles and autonomous vehicles that appear likely to bring new mobility models through ridesharing and carsharing, and erode vehicle ownership models, especially as Millennials become influential in the consumer economy^{16 17}.
- This coincidental but synchronous changes in autonomy alongside a move to electrification of vehicles will be more impactful on the commercial fleet than the private motor car fleet¹⁸¹⁹, as the cost of a paid driver represents savings in vehicle autonomy that are not reflected in choices in private use of a car. Telematics, platooning, robotization, and autonomy and other digitalisation combined with electrification will lead to gains in efficiency and declining demand in vehicles – and savings on road transport that should be highly sought after for big distances facing Australia and in particular regional and remote communities.
- Accepting that the rate in change in technology is not only fast, but also disruptive, it is simply not possible for the market design to stay the same as it was in the 1990s - nor indeed the last decade - and stay functional. In these circumstances, it is not simply an option to 'modernise' our regulatory and market systems, we must reform and restructure how we make use of and trade commodities – including energy and transport.
- Electrification of transport is not simply the domain of emissions reduction - though this will be significant - but also about pollution reduction, clean air strategies²⁰, solutions to road congestion through integrated transit²¹, road safety²², and so 'smart

¹⁴ Wills R (2018) *Electricity: In the future you won't say 'electric car', you will just say 'car'. It will only be electric.* <https://twitter.com/ProfRayWills/status/1044385933926129664>

¹⁵ Wills R (2018) *Some updated fun facts on electric buses and China* <https://twitter.com/ProfRayWills/status/1056022830213525504>

¹⁶ Parkinson G (2017): *When battery storage gets a grip on the grid* <https://reneweconomy.com.au/2018-when-battery-storage-gets-a-grip-on-the-grid-37990/>

¹⁷ Wills R (2018) *Future for cars all electric* <https://twitter.com/ProfRayWills/status/984580404152713217>

¹⁸ Wills R (2018) *Underground electric movement* <https://twitter.com/ProfRayWills/status/1056812765954768896>

¹⁹ Wills R (2018) *Some updated fun facts on electric buses and China* <https://twitter.com/ProfRayWills/status/1056022830213525504>

²⁰ Wills R (2018) *Best way to reduce vehicle air pollution, carbon emissions?* <https://twitter.com/ProfRayWills/status/988988681598914560>

²¹ Wills R (2018) *Do you loosen your belt to fight obesity?* <https://twitter.com/i/moments/988994248329515009>

²² Wills R (2018) *Driver experience: our youngest drivers die regardless of type of car.* <https://twitter.com/ProfRayWills/status/1045819310562672640>

cities' are all delivering additionality to momentum for change. And electric solutions will not be limited to ground-based transport – water and air-based transport will also be quickly transformed²³²⁴.

- Further, for oil importing nations, electrification is linked to improving balance of trade from imported energy to indigenous sources of electricity generation to power an electric fleet²⁵²⁶.
- While perhaps on the periphery of the terms of reference, a critical question for whole of government is the enormous cross-economy changes that digitalisation will bring²⁷. The trend of the 21st Century is about distributed everything, Uber, AirBnB, and solar are all offer the example. These new business models are enabled through outputs of the digital economy and digitalisation – changes that will deliver substantive reductions in the cost of living that largely go unrecognised not only in energy, transport and infrastructure, but also in services including health and education. While that needs to be a separate discussion, it is one that is related and must not be seen as a separate issue or outcome.
- All new technology is iterating faster, being produced quicker and easier to integrate due to the potential of interconnectedness of end users, devices and producers via Internet of Things (“IoT”) enabled technologies – a future of all (IoT) things distributed²⁸²⁹, including manufacturing through the convergence of robotics and 3D printing powered by distributed renewables will, in our assessment, be extraordinary for remote and regional communities, including those in Australia.
- New technology will do things we don't expect – leap frogging old solutions for the new (e.g. mobile phones in Africa bypassing copper networks) and creating unexpected adaptive new enterprise models and solutions. Non-OECD countries, with India and Africa in particular, are positioning to jump straight to new energy technology, relying on distributed energy generation models without the constraints of a centralized distribution grid and utilizing indigenous, renewable energy sources, and ultimately consuming some of this energy for efficiently and economically powering transportation. Anticipated reduced transport cost is an outcome equally attractive to remote – and often disadvantaged – communities in Australia as well.
- While most of the change in the future of technology, including the future of vehicles, will be determined by markets far larger than Australia, nevertheless, policy will be equally important in removing lag and delivering rapid transitions in these sectors to the benefit of the Commonwealth of Australia. Responses from and action by governments to significant controversies such as 'dieselgate' have seen announcements by some governments to prepare for the banning of combustion

²³ Wills R (2018) *Electric viking ship* <https://twitter.com/ProfRayWills/status/981318416882528256>

²⁴ Wills R (2018) *Electrification of everything* <https://twitter.com/ProfRayWills/status/1061518815459074049>

²⁵ Wills R (2015) *Solar displaces diesel on mines – Australia imports \$10bn+ diesel, 3/4 used by mining* <https://twitter.com/ProfRayWills/status/648705783002083329>

²⁶ Wills R (2018) *Some updated fun facts on electric buses and China* <https://twitter.com/ProfRayWills/status/1056022830213525504>

²⁷ Wills R (2018) *Largest disruption when the thing that changes is changed by more than just one thing* <https://twitter.com/ProfRayWills/status/1049455069546962944>

²⁸ Wills R (2016) *21 Century will be distributed 'Suggest & Choose', not centralised 'Command & Control'* <https://twitter.com/ProfRayWills/status/795422569398575105>

²⁹ Wills R (2018) *FutureSmart mining - autonomy and robotization* <https://twitter.com/ProfRayWills/status/1002014428563357696>

engines, and likely similar or stronger actions by other governments to come - and consequently faster change to markets, not slower. In the meanwhile, poor policy shackled to inadequate visioning will prevent decision makers from taking the best advantage of opportunities arising in the impending global tech disruption³⁰.

- Planners in traditional energy technology in particular seem unprepared for, or most resistant to, the change – the evidence of ‘strategic drift’ is overwhelming that forecasts of future energy markets dominated by renewables is not based on knowledge of change witnessed in past perturbations in energy markets³¹. Nor on contemporary data revealing the currency of change.
- Big data will be key to progress in liveable and sustainable, smart cities - improved service delivery and convenience, and greater (more efficient) infrastructure utilisation, all linked to the management of transit and mobility.
- There are multiple agents of change, not just government, but also business taking ever stronger stands on corporate social responsibility and sustainability including supply chain custodianship^{32 33 34}, and with community drivers bringing together individual consumers to take united action through social campaigns such as the divest movement, campaigns for clean energy or electric vehicles³⁵, and much political pressure arising through social media channels.
- However some of these commercial elements of change will also be blockers to adoption in Australia – manufacturers already make decisions about their latest electric vehicle being released – albeit for rational commercial decisions - in to larger markets, there by delaying release in Australia to the detriment of Australian consumers³⁶³⁷.
- Further, some fossil fuels may be losing their social license to operate on all levels – individuals through action, businesses through supply chain, and government through policy - and new upstream extraction technologies, such as CSG and shale gas, face broad and consistent resistance from communities in which they operate due to the potential or perceived long term environmental damage.

Innovation and the future

³⁰ Wills R (2018) *The future whatever regulators allow*

<https://twitter.com/ProfRayWills/status/974884285374111745>

³¹ Wills R (2018) *The least wrong – rapid change in the energy station difficult to predict* <https://www.pv-magazine-australia.com/2018/10/01/the-least-wrong-rapid-change-in-the-energy-station-difficult-to-predict/>

³² Piper J (2017) *How Corporations ‘Bypassed the Politics’ to Lead on Clean Energy in 2017*
<http://sgq.io/F7MvQVY>

³³ Wills R (2018) *Apple now powered 100% by renewables*

<https://twitter.com/ProfRayWills/status/983633205063368704>

³⁴ Bloomberg New Energy Finance (2018) *Corporations Already Purchased Record Clean Energy Volumes in 2018, and It’s Not an Anomaly* <https://about.bnef.com/blog/corporations-already-purchased-record-clean-energy-volumes-2018-not-anomaly/>

³⁵ Wills R (2018) *Electric circuit Australia’s electric highway first phase.*

<https://twitter.com/ProfRayWills/status/977356881810243584>

³⁶ Wills R (2018) *Nissan LEAF 100,000 sales in Japan*

<https://twitter.com/ProfRayWills/status/987524807699841025>

³⁷ Wills R (2018) *Car manufacturers deciding Australia’s electric future*

<https://twitter.com/ProfRayWills/status/1058301608381960192>

Innovation and technological change is getting faster - as predicted - but not anticipated by much of the traditional energy sector. Almost all models for future energy demand have been linear, whereas we contend the power and impact of non-linear, exponential growth in technology has always been the most probable outcome, yet following a predictable model of 'strategic drift'³⁸ will always have the appearance of taking people by surprise.

A key reason to anticipate this change as faster and more aggressive than others previously witnessed in the motor vehicle market is the additionality being rendered by complementary rapid technological and social changes as well as newly evolving business models which have the potential to significantly change how transport services are delivered, traded and used. Due to the complexity of these factors modellers forecasting future vehicle scenarios almost never address these issues and thus all models have increasing uncertainty the further into the future they try to predict. Furthermore, unanticipated changes in the underlying economy (e.g. political changes such as OPEC production and price wars, financial market disruptions, such as the GFC, have also had significant short and long-term impacts on these predictions.

The number of announcements of intent to change energy policy by multiple nations, jurisdictions, businesses and communities accelerates as rapidly as the growth of the technologies themselves.

But, prediction is indeed difficult, especially about the future! And note, projection is not prophesy.

Our Future Smart observations and assumptions reflect the most recent growth data on emerging tech already available and growing in the market, and for the most part looked to avoid speculative predictions on emergent technologies (such as hydrogen fuel cells) in the absence of growth trends.

Projections dealing with imagined and prototyped, but yet to be created tech are fraught, and while anticipating the arrival of yet imagined tech is a necessary exercise, it can be of course completely unreliable and misleading. Yet, failing to anticipate change is more dangerous - as experienced by Kodak and Nokia.

The rate of change in the emerging clean tech and renewables space has, in no forecast to date, been substantively overstated nor overplayed. But the opposite is true for almost all projections – most forecasts have dramatically understated and underestimated the potential for change³⁹, and in so doing, poorly guided decision makers through ill-informed policy.

The key goal of good futurism is to be the least wrong.

Brief responses to terms of reference

a. the potential economic, environmental and social benefits of widespread electric vehicle uptake in Australia;

Economic benefits will be a reduction of transport costs, increased liveability of cities facilitated by increasing mobility and more economic activity from higher discretionary spends improved health through lower pollution,

b. opportunities for electric vehicle manufacturing and electric vehicle supply and value chain services in Australia, and related economic benefits;

³⁸ Greiner LE (1972) *Evolution and revolution as organizations grow*. Harvard Business Review, 50(4), 37-46

³⁹ Wills R (2018) *BNEF highlight tumbling Levelized Cost of Electricity*
<https://twitter.com/ProfRayWills/status/983331507203751936>

Australia has the opportunity to influence things it manufactures, such as coach and bus construction, or has a substantive impact in global markets it has a role in, such as mining and so in mining equipment. Further, the comprehensive report “Lithium Valley: establishing the Case for Energy Metals and Battery Manufacturing in West Australia” is equally applicable across Australia⁴⁰.

c. measures to support the acceleration of electric vehicle uptake;

The simplest measures are regulating both efficiency and emissions outcomes – given Australia no longer builds motor cars, and the bespoke commercial motor vehicle assembly industry in Australia is naturally already moving quickly to electric drivetrains, measures that drive volume in the market will bring economies of scale and ensure competitive pricing.

d. measures to attract electric vehicle manufacturing and electric vehicle supply and value chain manufacturing to Australia;

While we would argue attracting car manufacturing is fraught, equally there is great merit in commercial vehicle manufacturing, and so as with accelerating vehicle uptake in c. above, promotion of manufacturing could easily be tied to Australian content requirements for large projects.

e. how federal, state and territory Governments could work together to support electric vehicle uptake and manufacturing, supply, and value chain activities; and

COAG must be engaged in improving electrification of all forms of transport, not just land based vehicles including public transit, but also marine and air solutions. Efforts must bring in local government jurisdictions as well, because regulatory reform and public support is best enabled where people live⁴¹.

f. any other related matters.

A key challenge for Australia is to make the most of the opportunity of electrification of transport - and just as challenging, to avoid decisions that lock in old technology that will then create an expensive legacy that may prove a burden for many decades.

Economically we know freeing up discretionary spending is an important driver of a healthy economy. If some of the savings from reduced non-discretionary spend on ‘hygiene’ spend on transport arrives as discretionary spending within the local economy, this is highly likely to provide a valuable stimulus to local growth, especially in the regions.

In relation to transport and electric vehicles, while Australia has the opportunity to influence things it manufactures, such as coach and bus construction, or has a substantive impact in global markets it has a role in, such as mining and so in mining equipment. However, for the most part we will be a technology taker – if the world transitions to electric cars, then Australia has no choice but to follow what the world produces and it does not (Figure 1).

⁴⁰ RDA (2018) *Lithium Valley: establishing the Case for Energy Metals and Battery Manufacturing in West Australia* <https://www.rdaperth.org/rda-projects/lithium-valley>

⁴¹ Wills R (2018) *Cities more important than nations* <https://twitter.com/ProfRayWills/status/1061044234533273600>

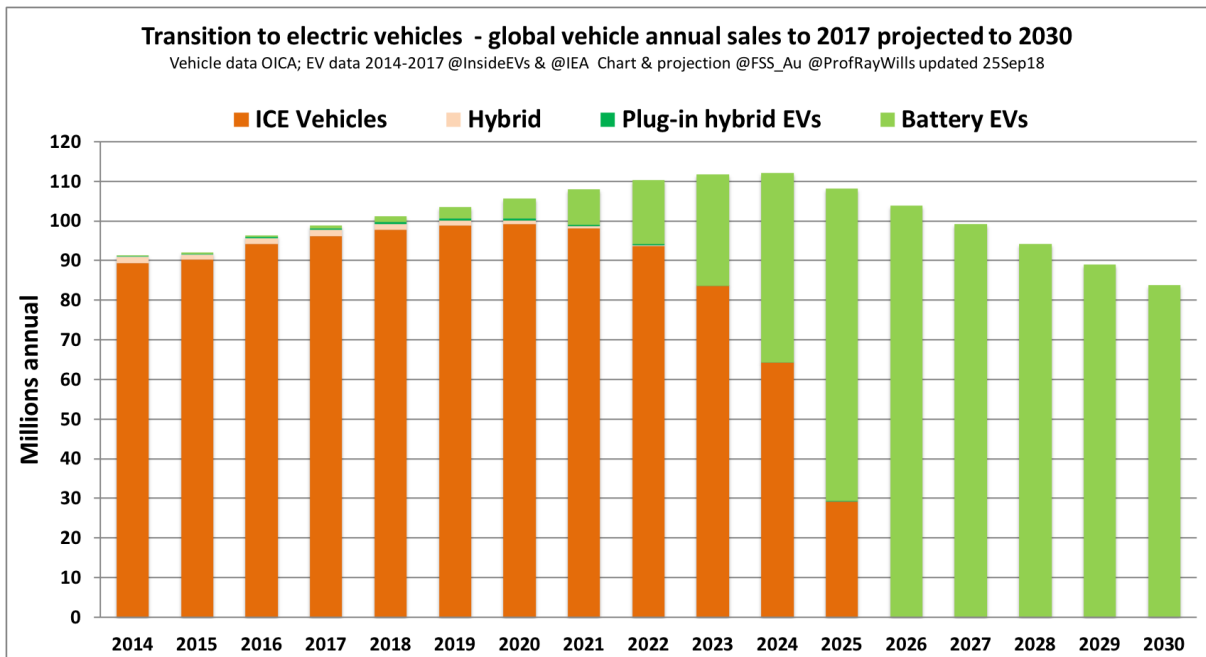


Figure 1 Future Smart global model for transition to electric vehicles

If the Future Smart global model for electrification of the world vehicle fleet plays out (Figure 1), Australia will also default to 100% electric vehicle sales (Figure 4), with final ICE sales by 2026 (we anticipate Australia may receive vehicles built in 2025 made available for sale in Australia in 2026). With the current average age of the Australian fleet at just over 10 years (Figure 2, 3), it is plausible for an accelerated fleet transition starting in 2026 to take less eight years to replace have the fleet.

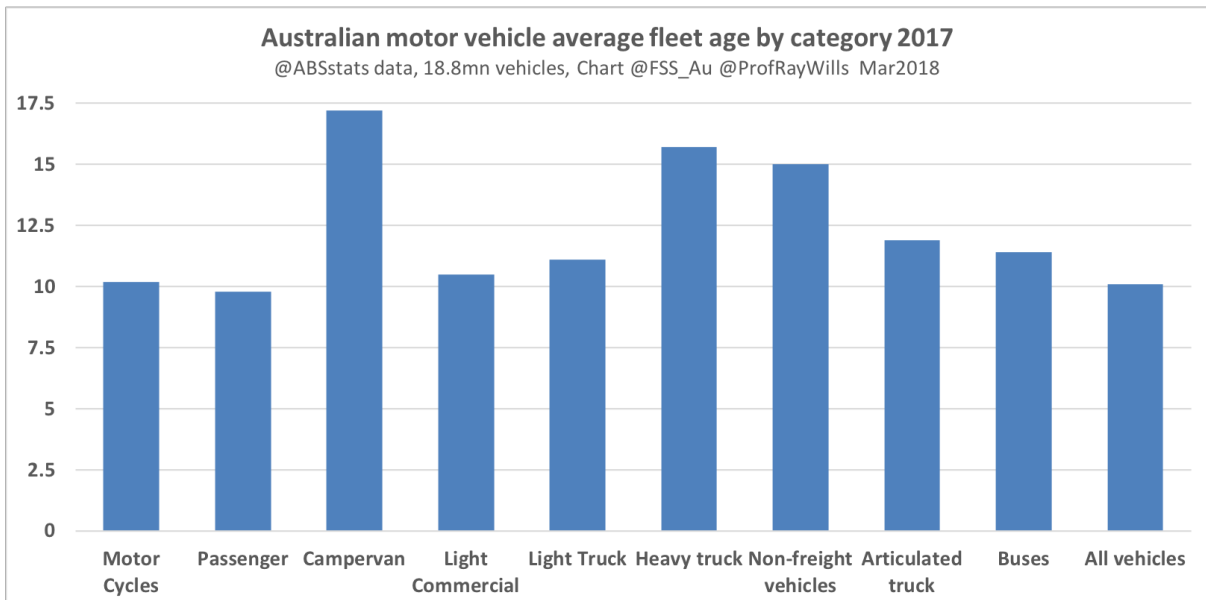


Figure 2 Australian current vehicle fleet age by category

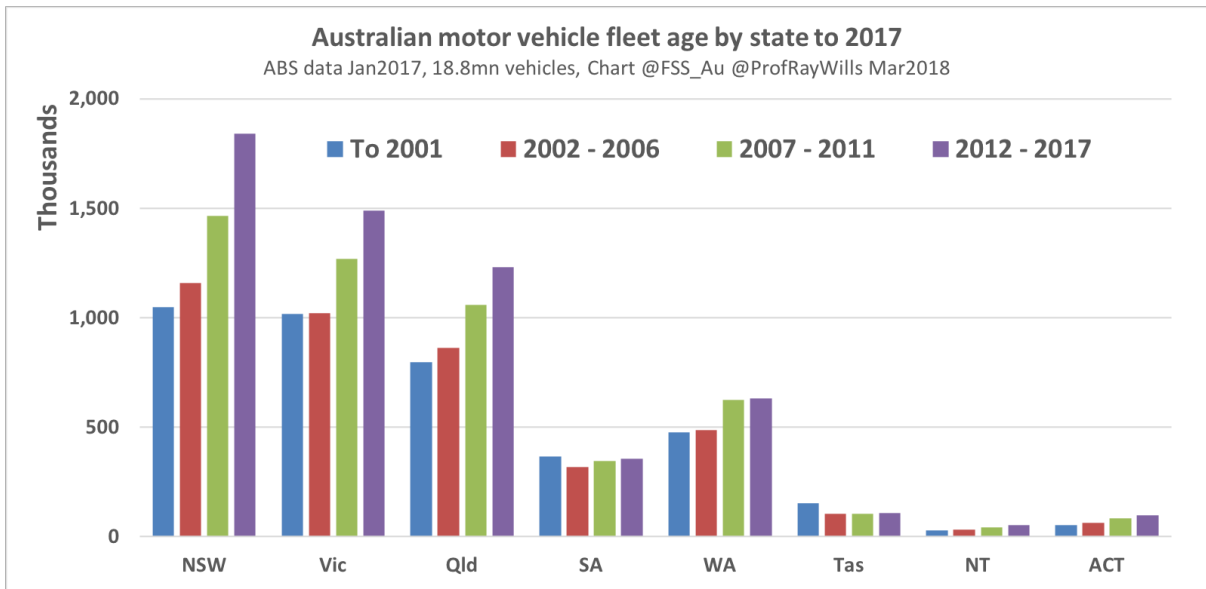


Figure 3 Australian current vehicle fleet age by state

We see an estimated 20 TWh increase in annual consumption arising from electric motor vehicles, or around 10% higher electricity demand in Australia by 2026, displacing around 16 million litres of imported fuel per day (Figure 5) otherwise consumed by combustion engine vehicles, reducing both carbon emissions and air pollution through electrics, and in particular through utilising indigenous, renewable energy generation for our renewed vehicle fleet. A move to electrification would also address recent concerns of Australia reserve supplies of fuel.

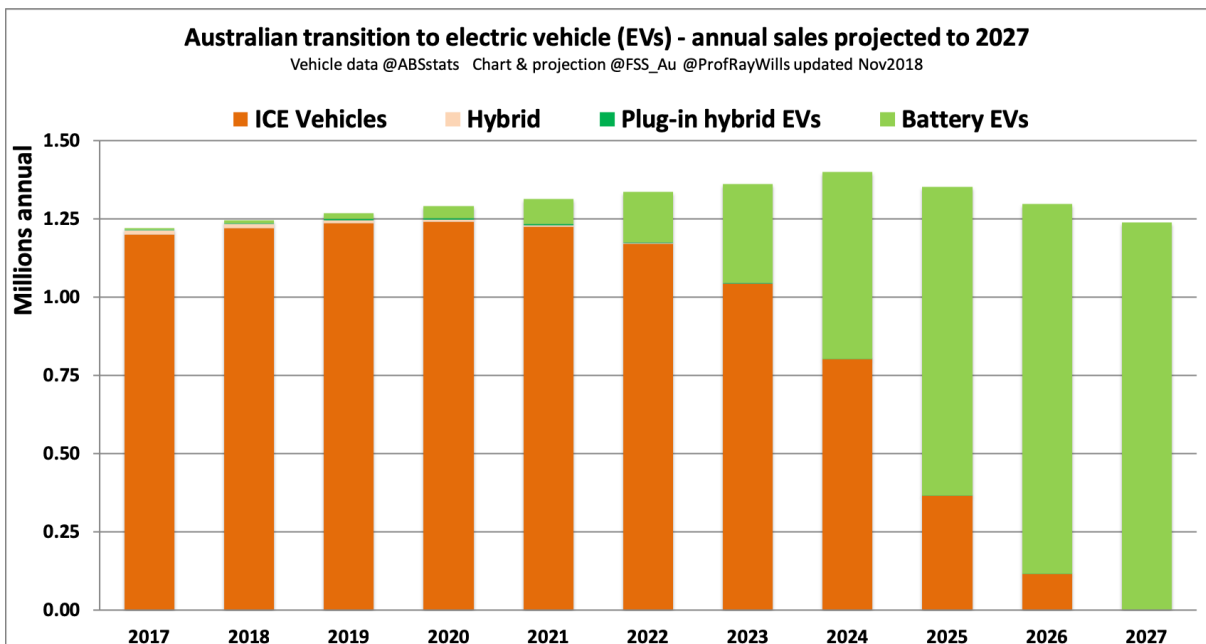


Figure 4 Future Smart model for Australian transition to electric vehicles

As Australia’s combustion fleet is replaced over time, and the nation’s 18.8 million vehicle fleet transitions to 100% electric, demand for electricity will increase, but the insertion of autonomy, car sharing and ridesharing will also erode the size of the fleet, reducing car dependency⁴².

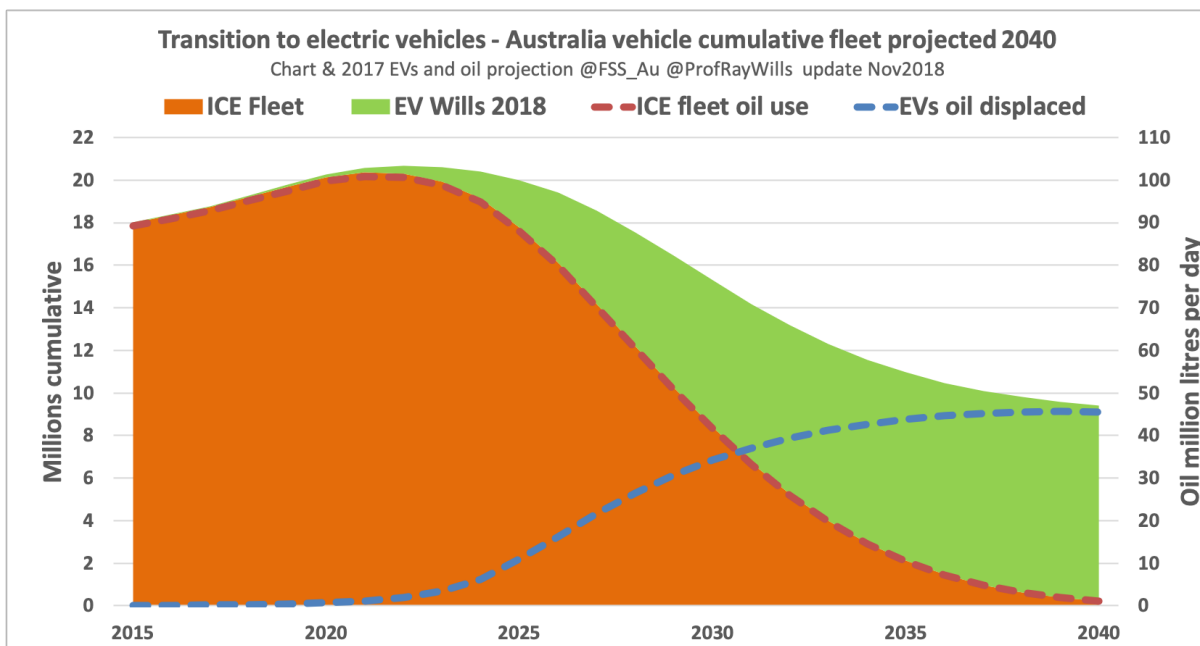


Figure 5 Future Smart model for global transition to electric vehicles

⁴² Wills R (2018) Future for cars all electric <https://twitter.com/ProfRayWills/status/984580404152713217>