



# The future is *Electric*

October 2017

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## About the NRMA

Better road and transport infrastructure has been a core focus of the NRMA since 1920 when our founders lobbied for improvements to the condition of Parramatta Road in Sydney. Independent advocacy was our foundation activity, and it remains critical to who we are as we approach our first centenary.

We've grown to represent over 2.4 million Australians, principally from New South Wales and the Australian Capital Territory. We provide motoring, mobility and tourism services to our Members and the community.

Today, we work with policy makers and industry leaders, advocating for increased investment in road infrastructure and transport solutions to make mobility safer, provide access for all, and deliver sustainable communities. By working together with all levels of government to deliver integrated transport options, we give motorists real choice about how they get around.

We firmly believe that integrated transport networks, including efficient roads, high-quality public transport and improved facilities for cyclists and pedestrians, are essential in addressing the challenge of growing congestion and providing for the future growth of our communities.

## Comments and queries

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## About the Electric Vehicle Council

The Electric Vehicle Council is the national body representing the electric vehicle industry in Australia. Representing companies involved in providing, powering and supporting electric vehicles, our mission is to accelerate the electrification of road transport for a sustainable and prosperous Australia.

As the world's largest vehicle markets and companies set their course for a future where road transport is powered by zero emissions vehicles, the Electric Vehicle Council works to highlight the important role and opportunities for Australia in this global transition.

In an exponentially growing sector, today the Electric Vehicle Council represents 30 companies from across Australian industry.

Working to overcome the current challenges in Australia's electric vehicle market through policy and industry development, the Electric Vehicle Council recognises electrification is a milestone in the future mobility ecosystem, enabling advances in sharing, connectivity and autonomy.

By bringing the Australian market up to speed with the global transition in road transport, we firmly believe Australian consumers and industry can be leaders in the future of mobility.

## Comments and queries

### **Mr Behyad Jafari**

Chief Executive Officer

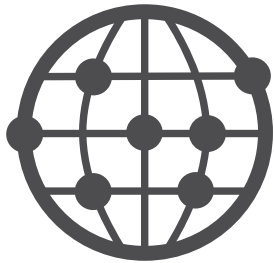
### **Electric Vehicle Council**

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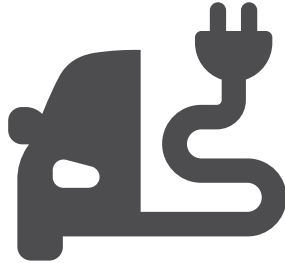
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# The move towards an electric vehicle future



**7** countries want fossil fuel-based cars banned



New DC fast charging stations will encourage electric vehicle uptake

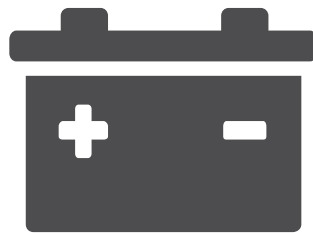


Every Volvo from **2019** will have an electric motor



General Motors is transitioning to a zero emissions future

**20** new electric models are on the way

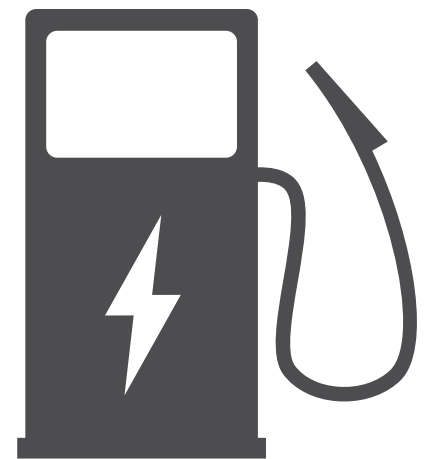


Battery technology is rapidly improving – and electric vehicles are becoming cheaper



Volkswagen will electrify its entire fleet by

**2030**



Running cost

**fuel vs electric**

**\$1.23 vs \$0.30**

per litre equivalent

Volkswagen, Daimler & BMW Groups have committed



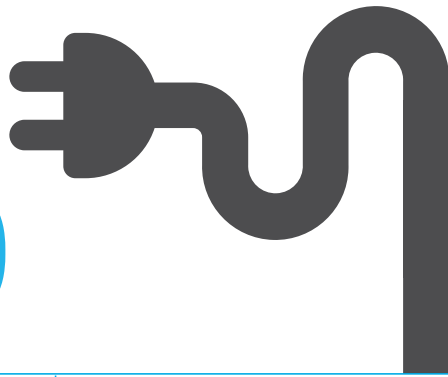
**\$75 billion** to electric cars



Electric vehicle uptake will improve Australia's fuel security by reducing demand for imported fuels

Every new model line from Jaguar Land Rover will be electric from

# 2020



China is leading the world's boom in electric vehicles with

# 140

battery makers and a ban on petrol and diesel looming



Ford is shifting focus away from internal combustion engines to electric cars

Electric vehicle batteries will become a

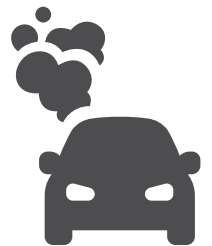
# \$240 billion

industry within two decades



CO2 emissions from vehicles could be reduced by

# 90%



Over **750,000**

electric vehicles were sold worldwide in

# 2016



Dyson will launch an electric car by **2020**

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# Recommendations

The looming transition to electric vehicles demands that Australian governments provide a clear demonstration of support to consumers and industry. These recommendations are intended to encourage the adoption and availability of electric vehicles for all Australians.

## 1. To support electric vehicle uptake, a rollout of charging infrastructure should be prioritised.

Consumers are unlikely to commit to the mass uptake of electric vehicles until they can be confident that access to adequate charging opportunities exist. Investment in widespread charging infrastructure should be prioritised to encourage electric vehicle uptake, especially in rural and regional areas.

## 2. The Australian Government should remove impediments to the purchasing of electric vehicles.

Australia has a low uptake of electric vehicles compared with our global counterparts. Less than one per cent of Australian vehicles currently possess electric drive-train technology. The Australian Government should provide a short-term exemption to Fringe Benefits Tax and abolish the Luxury Car Tax for electric vehicles and associated infrastructure to encourage mass adoption.

## 3. The Australian Government should put in place policies to prioritise domestic electricity generation.

Australia's reliance on imported liquid fuels has increased significantly over the past two decades. With an abundance of diverse energy resources and the transport sector moving towards an electric future, the Australian Government should prioritise domestic electricity generation to improve Australia's fuel security and bring forward the benefits of electric and automated vehicles.

## 4. Electric vehicle fleet targets should be adopted.

Governments and companies across Australia should demonstrate leadership in the transition to sustainable, zero emissions road transport by setting fleet targets for electric vehicle integration.

## 5. An inter-governmental working group to co-ordinate the transition to electric road transport should be established.

The transition to electric vehicles will provide significant benefits across energy, transport, public health, infrastructure and industry development.

The Australian Government should establish an inter-governmental working group, representing governments, industry and consumers, tasked with establishing a roadmap for the co-ordinated transition to electric road transport, including the deployment of associated infrastructure.

## 6. Australian governments should encourage research and development in electric vehicle batteries and other technologies to support the transition to an electric vehicle future.

With an innovative and entrepreneurial culture and one of the world's largest supplies of mineral resources required for battery production, Australia is well suited to developing industries to support the global market for electric vehicles.

Australian governments should incentivise research and development in electric vehicle batteries and other associated technologies through the provision of grant funding and taxation exemptions.

# The age of the internal combustion engine is coming to an end

The humble car is undergoing a major paradigm shift. Manufacturers and technology companies are rapidly moving the automotive industry towards an electric and automated future. As trends around the world point to increasing numbers of electric vehicles, jurisdictions have begun to put in place strategies to phase out petrol and diesel propulsion.

In 2016, the Dutch Parliament supported banning the sale of petrol and diesel cars from 2025.<sup>1</sup> The Norwegian government followed suit and, in June of this year, India announced it would no longer allow the sale of new petrol or diesel cars by 2030.<sup>2</sup>

Even the German Bundesrat – the federal legislative body representing the sixteen federated states of Germany, one of the world’s largest vehicle producers – passed a resolution calling on the European Commission to ban the sale of petrol and diesel vehicles by no later than 2030.<sup>3</sup>

In July, both France and the UK announced that petrol and diesel vehicles would be banned from sale by 2040. With several jurisdictions around the world having put in place zero emissions targets, it is evident that petrol and diesel vehicle bans will become more widespread.

Perhaps the most significant development in this realm comes from China, the world’s largest car market. Recently, the Chinese government signalled that it would join the line of jurisdictions putting in place measures to phase out petrol and diesel cars over the coming years.<sup>4</sup>

While some of these announcements could hypothetically be scuttled by future governments, the message is loud and clear – the future is electric.

Even major industry players are supporting an electric

vehicle future. In July, Volvo announced that every one of its cars launched from 2019 would have an electric motor, marking a historic end to its fleet relying solely on the internal combustion engine. Volvo’s announcement clearly places electrification at the core of its future business.<sup>5</sup>

Similarly, Jaguar Land Rover has pledged that every new model line will be electric from 2020.<sup>6</sup> Virtually all major vehicle manufacturers are increasing their investment in electric vehicles and are planning to launch upcoming models alongside electric variants.

In recent announcements, the Volkswagen Group, Daimler Group and BMW Group have committed investments in excess of \$75 billion to develop electric cars. Under its “TOGETHER – Strategy 2025” policy, Volkswagen, the world’s largest car maker, declared at this year’s Frankfurt Motor Show that it intends on being the largest electric vehicle maker by 2025.<sup>7</sup>

*Manufacturers and technology companies are rapidly moving the automotive industry towards an electric and automated future*

General Motors and Ford Motor Co. have also announced plans to go electric. In October, General Motors publicised its “zero emissions future” transitioning plans. By 2023, the largest car manufacturer in the United States intends to launch at least 20 new all-electric models based on learnings from the Chevrolet Bolt EV.<sup>8</sup> Also in October, Ford announced it would shift capital investment away from internal combustion engines to electric cars in an effort to slash \$14 billion in costs over the next five years.<sup>9</sup>

1. <http://insideevs.com/netherlands-moves-to-allow-only-all-evs-by-2025-no-more-gas-diesel-sales/>

2. <http://trak.in/tags/business/2017/05/01/govt-ban-petrol-diesel-cars-electric-vehicles-niti-aayog-jobs/>

3. <https://arstechnica.com/cars/2016/10/germanys-bundesrat-votes-to-ban-the-internal-combustion-engine-by-2030/>

4. [http://www.cetusnews.com/business/China-mulls-going-electric-with-aim-to-ban-petrol-and-diesel-cars.Sy\\_SY5etQX9-.html](http://www.cetusnews.com/business/China-mulls-going-electric-with-aim-to-ban-petrol-and-diesel-cars.Sy_SY5etQX9-.html)

5. <https://www.media.volvocars.com/global/en-gb/media/pressreleases/210058/volvo-cars-to-go-all-electric>

6. <http://www.jaguarlandrover.com/news/2017/09/every-jaguar-and-land-rover-launched-2020-will-be-electrified>

7. <http://economictimes.indiatimes.com/industry/auto/news/industry/electric-is-the-future-for-german-car-majors-with-50-billion-euros-investments/articleshow/60704939.cms>

8. <http://www.gm.com/mol/m-2017-oct-1002-electric.html>

9. <http://auto.economictimes.indiatimes.com/news/industry/ford-to-cut-costs-14-bln-invest-in-trucks-electric-cars-ceo/60951667>





As part of its global electrification commitment, Ford has invested \$4.5 billion into electric vehicle manufacturing, and plans to introduce 13 new models over the next five years, including an electric SUV to be sold in the US, Asia and Europe.<sup>10</sup>

Not to be left out, Shell, one of the world's largest oil and gas companies, recently announced the purchase of NewMotion, a company that specialises in converting parking spaces into electric charging points for electric vehicles. In addition to the purchase, Shell will start deploying its own electric vehicle charging stations throughout Britain and the Netherlands later this year.<sup>11</sup> Shell's CEO, Ben Van Beurden, even stated publicly that his next personal car would be electric.<sup>12</sup>

*It's important that we plan and prepare for an expanded electric vehicle fleet in Australia*

It's clear that the significant pressures faced by petrol and diesel powered vehicles is not limited to a single source. The rise of electric and hybrid demand is supported by governments seeking to reduce emissions, as well as improving energy storage technology. While lower running costs also factor, falling vehicle prices and greater model supply will add further significance to the price element, making electric vehicles as a mobility option more attractive to consumers.

With Australian commercial vehicle manufacturing now ceased, we are fully reliant on importing vehicles for personal and commercial use. With such a significant emphasis on electrification worldwide, particularly among major vehicle manufacturers and markets, it's important that we plan and prepare for an expanded electric vehicle fleet in Australia.

10. <https://media.ford.com/content/fordmedia/fna/us/en/news/2017/08/22/ford-further-globally-electrification-expansion.html>

11. <https://electrek.co/2017/02/01/shell-electric-vehicle-chargers-gas-stations/>

12. <http://news.mit.edu/2017/shell-executive-describes-transition-carbon-free-energy-0907>

# Electric vehicle pricing and supply

Due to international crude oil pricing, constrained supply, importation and government duty, the cost of running a vehicle today on fuel is \$1.23 per litre<sup>13</sup> – the per litre equivalent of running an electric vehicle is \$0.30.<sup>14</sup> With far fewer moving parts, maintaining an electric vehicle also costs significantly less.

Analysis by Canstar Blue shows that fuel savings from an electric vehicle amount to \$1881 per year.<sup>15</sup>

While running costs do not take the purchase price of a vehicle into consideration, there is significant evidence available suggesting that electric vehicles will continue to become more cost competitive. A report published in May by investment bank UBS predicts that

adoption and the expansion of the electric vehicle fleet. Consequently, with most electric models currently available in Australia largely priced for the prestige segment, some of the best-selling global electric cars are not being made available.

International evidence suggests a strong correlation between cumulative electric vehicle sales and the number of vehicle models being offered. A greater number of models available across a range of market segments can increase consumer choice and sales.

While there are currently 16 electric vehicle models available in Australia, 13 are priced at more than \$60,000.<sup>17</sup>

## What if Australia Mirrored Norway's Electric Vehicle Market Share?



the cost of electric vehicles will match that of regular internal combustion engine vehicles by 2018. The cost of making electric vehicles could become cheaper too, increasing profits for manufacturers.<sup>16</sup>

Although electric vehicles are currently priced higher than conventional vehicles, several forces are changing this, including more efficient batteries that are being produced in greater quantities. Governments around the world are addressing this cost premium in the short term by providing consumers with incentives to purchase electric powered vehicle alternatives.

Without similar support in place in Australia, manufacturers have been hesitant to bring electric vehicles to our domestic market, which has restricted

## Case study: Norway

Norway currently has the highest per capita number of electric cars in the world. With a long history of promoting the use of zero-emissions vehicles, Norway's market share of new electric vehicle sales in 2007 equaled Australia's in 2016.

Purchasers are encouraged to go electric with an exemption from levied taxes, road tolls and parking costs; electric vehicles are also provided with access to special lanes to optimise journey times.

In 2016, Norway announced the ban of petrol and diesel car sales by 2025. In the same year, electric vehicles made up 28.76% of all new sales.<sup>18</sup>

13. <https://www.fuelcheck.nsw.gov.au/app/FuelPrice/Trend?fuelTypeCode=E10> (Fuel Check NSW 12-month average)

14. <http://electricvehiclecouncil.com.au/>

15. <https://www.canstarblue.com.au/energy/electricity/much-can-electric-cars-save/>

16. <https://futurism.com/investment-bank-report-predicts-the-cost-of-electric-vehicles-will-match-regular-cars-by-2018/>

17. <https://climatemworks.com.au/publication/report/state-electric-vehicles-australia>

18. Global EV Outlook 2017 – Two million and counting

## Electric vehicle pricing and supply (continued)

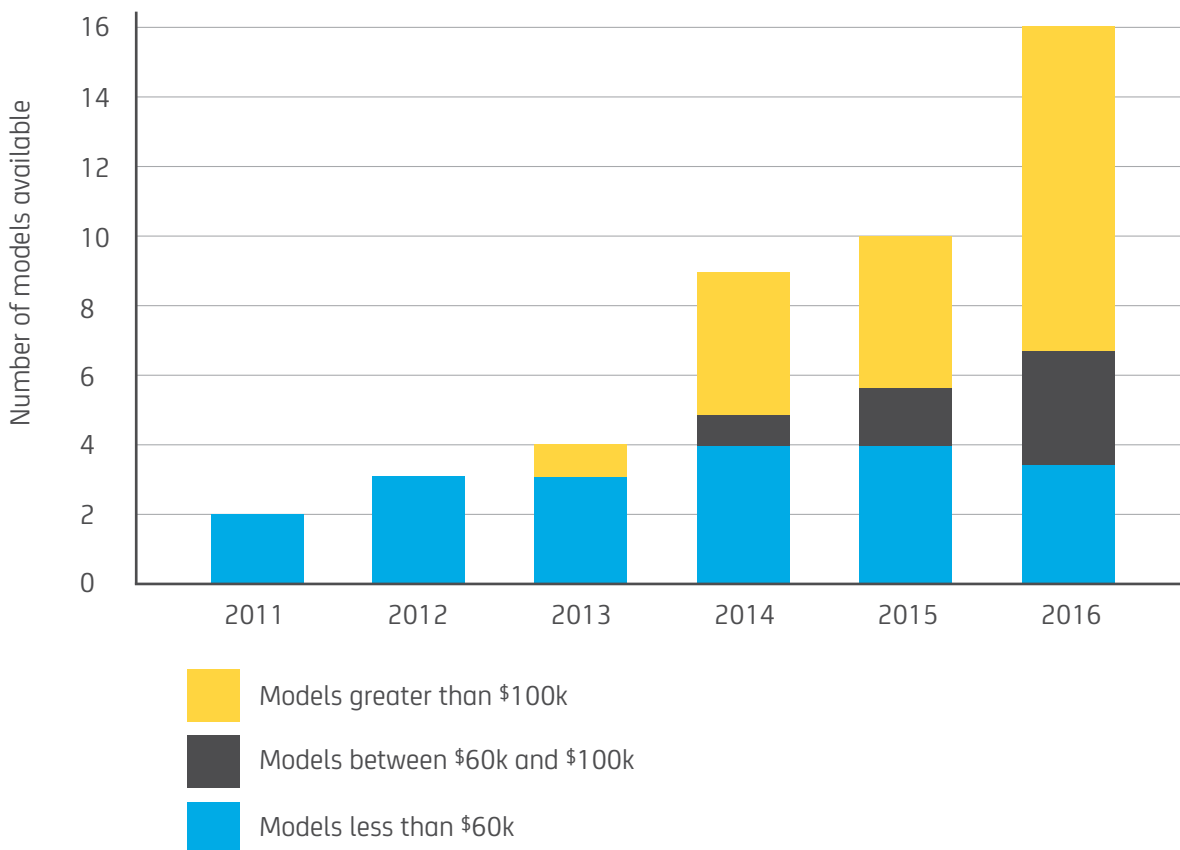
By not adopting electric vehicles at the rate of Norway, our analysis shows that from 2010 to 2016, Australians missed out on at least \$1.1 billion in fuel savings – this excludes savings derived from lower maintenance costs and special electricity pricing that is available in the market for electric vehicles.

The possible 880,580 electric vehicles on the road (ignoring future sales) would save Australians over \$550 million in fuel costs every year.

At a time when close to all of our oil supply is reliant on importation, transitioning our road fleet to run on domestically-generated energy would significantly improve our national fuel security.

With a low uptake of electric vehicles, the Australian Government should provide a short-term exemption to Fringe Benefits Tax and abolish the Luxury Car Tax for electric vehicles and associated infrastructure to encourage mass adoption.

### AUSTRALIAN ELECTRIC VEHICLE MODEL PRICING



Source: ClimateWorks Australia and the Electric Vehicle Council

# Battery provision and technology

As worldwide demand for electric vehicles increases, battery production will need to increase significantly.

It's expected that the manufacture and sale of electric vehicle batteries will become a \$240 billion industry within two decades. By as early as 2020, the electric vehicle battery market alone could reach \$25 billion.<sup>19</sup>

With the world's fourth largest reserves of lithium,<sup>20</sup> Australia is well placed to attract investment and jobs in the manufacture of batteries and other components.

China has already begun to cement itself as a leader in electric vehicle battery production – there are 140 electric vehicle battery makers in China alone, which is significant given that China is the world's largest car market. Over the next two decades, China will likely reap the rewards of early electric adoption according to a recent electric vehicle report by Forbes.<sup>21</sup>

## *The Volkswagen Group will electrify its entire vehicle fleet by 2030 at the latest*

In January, Tesla and Panasonic began mass production of lithium-ion battery cells in a new “Gigafactory” in Nevada. The Gigafactory, which is designed to optimise manufacturing performance while keeping production costs as low as possible, is being built in phases – once complete, Tesla expects the Gigafactory to be the largest building in the world.<sup>22</sup>

The most revealing progression, however, arguably comes from the Volkswagen Group, the world's largest car manufacturer. Recently, the Group announced its “Roadmap E” policy, which will bring a total of more than 80 new electric models to market by 2025 and electrify the entire Group fleet by 2030 at the latest.

Volkswagen's policy means that there will be at least one electric version of each of the 300 or so Group models across all brands and markets. This makes Volkswagen the first major group to put a date on the electrification of its entire fleet. To meet increasing battery demand and to satisfy this policy, Volkswagen has put one of the largest procurement volumes in the industry's history out to tender: a total order of more than \$75 billion just for the Group's future volume vehicles.<sup>23</sup>

This staggering investment alone points to an electric vehicle future, and Australia must not be left behind with insufficient supporting infrastructure.

## Solid-state batteries and wireless charging

While battery production and storage technology has improved significantly over the past decade, there are several concepts currently being tested that will further progress and refine electric vehicle energy production and storage.

Most electric vehicles on the road today are capable of achieving a range of several hundred kilometres on a single charge. Despite this, “range anxiety” is still seen as a major barrier to the broad acceptance of electric vehicles by consumers. This barrier is of particular importance to many Australians given that our rural, regional and urban areas are dispersed across vast distances.

Fortunately, solid-state batteries and wireless charging are two major concepts that have been identified as providing significant benefits towards the uptake of electric vehicles.

Solid-state batteries, which contain solid electrodes and solid electrolytes, considerably improve on the rechargeable lithium-ion battery of the 1980s.

19. [https://www.bcgperspectives.com/content/articles/sustainability\\_automotive\\_batteries\\_for\\_electric\\_cars/?chapter=2](https://www.bcgperspectives.com/content/articles/sustainability_automotive_batteries_for_electric_cars/?chapter=2)

20. <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/ResourcesandEnergyQuarterlyJune2017/documents/Resources-and-Energy-Quarterly-June-2017.pdf>

21. [http://www.greencarreports.com/news/1112878\\_china-to-build-many-gigafactories-worth-of-electric-car-battery-plants](http://www.greencarreports.com/news/1112878_china-to-build-many-gigafactories-worth-of-electric-car-battery-plants)

22. <https://www.tesla.com/blog/battery-cell-production-begins-gigafactory>



According to Ilika Technologies, a leading materials innovation and solid-state battery technology company with operations in the US, Germany and Japan, the benefits of solid-state batteries include faster charging, increased energy density, longer cycle life, low leakage currents, reduced battery size and non-flammability.<sup>24</sup>

Toyota and Dyson have officially announced plans to launch vehicles with solid-state batteries from 2020, and many other manufacturers have hinted a shift towards this improved battery technology.

Wireless charging is another concept set to improve the feasibility and uptake of electric vehicles. In a recent demonstration close to Paris, Qualcomm Technologies, a leading communications and connectivity company, showcased real-world wireless charging technology by transferring energy between a test track and several electric Renault vehicles in motion.

The demonstration by Qualcomm Technologies and Renault was achieved under FABRIC, a \$13.5 million project mostly funded by the European Commission to address the technological feasibility, economic viability, and socio-environmental sustainability of wireless electric vehicle charging.<sup>25</sup>

In an encouraging early sign of the role Australian businesses can play in the growing electric vehicle market, an Australian company, Lumen, have been awarded a contract to develop, manufacture and supply Qualcomm's wireless electric vehicle charging technology.<sup>26</sup>

*Solid-state batteries and wireless charging will intensify electric vehicle uptake*



23. [https://www.volkswagenag.com/en/news/2017/09/Roadmap\\_E.html](https://www.volkswagenag.com/en/news/2017/09/Roadmap_E.html)

24. <http://www.ilika.com/>

25. <https://www.qualcomm.com/news/releases/2017/05/18/qualcomm-demonstrates-dynamic-electric-vehicle-charging>

26. <https://www.qualcomm.com/news/releases/2016/10/28/qualcomm-and-lumen-sign-commercial-wireless-electric-vehicle-charging>

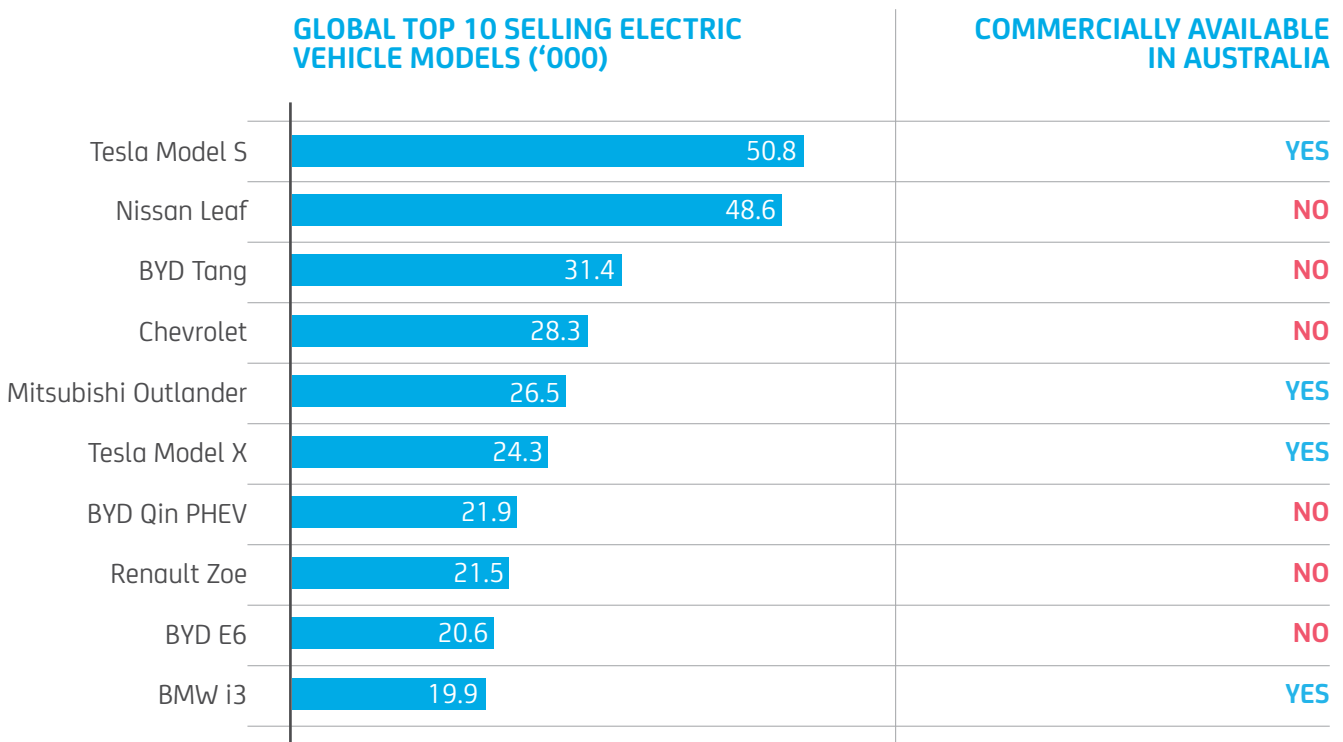
# New electric models are on the way

The availability of a range of electric vehicle models in Australia is expected to increase in the near future. As vehicle manufacturers increase their investment in new models, the next generation of electric cars will compete in cost with the average family vehicle.

Each year, as technology becomes more efficient, the cost of the battery packs that power electric vehicles are

going down. As a result, electric vehicles are becoming cheaper to own – all while their driving ranges increase.

Due to government support not keeping pace with many international jurisdictions, there are a number of electric vehicle models that are not currently available for purchase in Australia, despite accounting for the majority of global sales.



Source: Bloomberg New Energy Finance

## ELECTRIC VEHICLES POTENTIALLY COMING TO AUSTRALIA

Model	Battery range (km)
Tesla Model 3	350-500
Nissan Leaf	400
Jaguar I-Pace	500
Audi E-tron Quattro	500
Renault Zoe	400

Model	Battery range (km)
Renault Kangoo ZE	270
Hyundai Ioniq Electric	280
BMW i3s	300
Mercedes-Benz EQ	500
VW e-golf (PHEV)	50

Note: Not all specifications are final

# Australia's electric vehicle charging network

Perceptions around the availability of public charging infrastructure can be crucial. Deloitte's *Unplugged: Electric vehicle realities versus consumer expectations* survey conducted across 17 countries revealed that consumers have significant anxiety relating to range, vehicle charge time and access to fast charging locations. These findings have been subsequently supported in surveys undertaken by the Electric Vehicle Council in Australia.

While a significant portion of electric vehicle charging could occur at home or in the workplace, widespread public infrastructure is needed to mitigate range anxiety on the part of prospective purchasers. Accessible public infrastructure is also crucial for connecting rural and regional centres.

Charging infrastructure comes in a variety of forms. Currently, the majority of chargers available in Australia are AC chargers. AC charging is used primarily for locations where an electric vehicle will be parked for more than an hour. AC Charging power levels range from 2.4kW to 22kW, with an average installation of 11kW charging a vehicle at approximately 50km of range per hour. In contrast, DC chargers provide much faster charging, and are thus more useful for travelling long distances between rural and regional towns and cities. With less than 50 DC charging stations in Australia, significant issues relating to accessibility currently exist.

## PUBLIC DC FAST CHARGING STATIONS IN AUSTRALIA (NON-TESLA)



## DC Fast Charging Stations in Australia



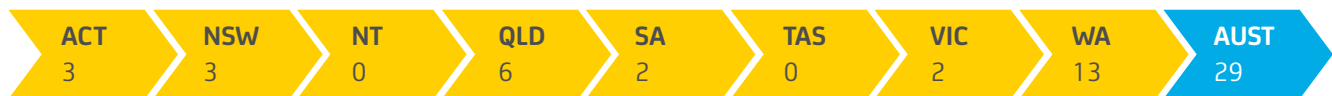
Source: PlugShare

## Tesla DC Fast Charging Stations in Australia



Source: PlugShare

## Non-Tesla DC Fast Charging Stations in Australia



Source: PlugShare

### Charging types

**Level 1** – Plugging the car into a regular wall socket. This is the slowest charging type, requiring 16 to 20 hours to fully charge an average vehicle. The benefit of Level 1 charging is that it can be carried out anywhere at any time.

**Level 2** – Provides approximately 50km of range per hour. Level 2 charging is the most common type of electric vehicle charging. Level 2 chargers are intended for locations where vehicles will be parked for more than one hour (home, work, shopping centres and hotels).

**DC Fast Charging** – Fully recharges an average vehicle in 20 to 30 minutes. DC charging is convenient and useful for longer drives between rural and regional centres.

### Plug types

**AC Type 1** – This is the plug standard used by most vehicles currently in Australia. It is also the standard in the US and Japan.

**AC Type 2** – Already used in Australia by Tesla and Renault. Many car manufacturers have signalled that they will move to this standard in future models.

**CCS (Combined Charging System)** – Available in AC Type 1 or AC Type 2 depending on the plug a particular vehicle uses. CCS plugs support AC and DC charging power levels.

**CHAdEMO** – Developed in Japan, the CHAdEMO plug supports DC charging.

**DC** – As the public fast charging option, DC chargers often come with two plugs to cater for vehicles that use either CCS or CHAdEMO plugs.



# Powering an electric vehicle fleet

As the world's ninth-largest energy producer and one of only three net energy exporters in the OECD, Australia possesses an abundance of diverse energy resources.<sup>27</sup> Despite this, we are heavily dependent on imports of refined petroleum products and crude oil to meet our liquid fuel demand.

Australia's fuel stocks are small and declining, and our dependency on crude and fuel imports for transport has grown from around 60 per cent in 2000 to over 90 per cent today.<sup>28</sup> Almost all of our transport needs are met by oil-derived products (petrol, diesel, jet fuel and LPG),<sup>29</sup>

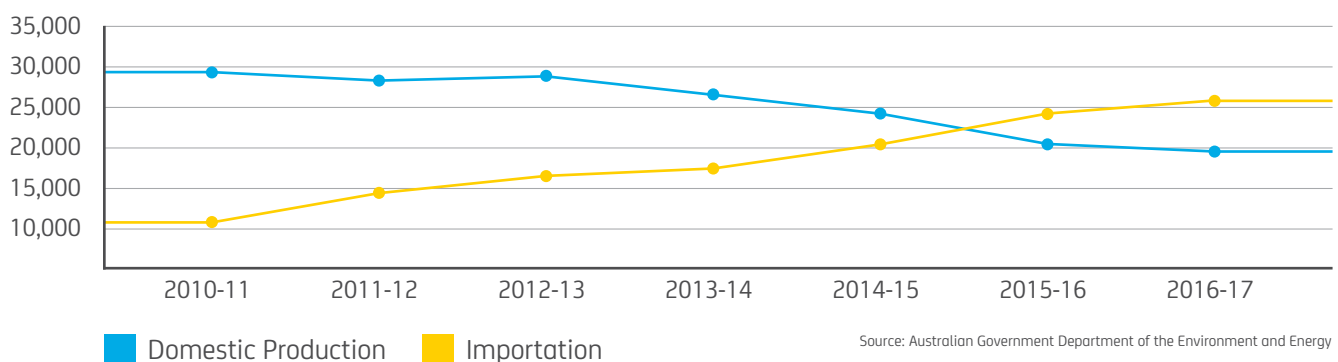
as 2030 if fuel production and stockholding projections are correct.<sup>30</sup>

The good news for Australians is that we are in a position to improve our power provision and security.

One way we can help to alter our current liquid fuel projection is through the use of more efficient vehicles in the transport sector, which is the second largest energy consumer in Australia.<sup>31</sup>

An obvious barrier to the adoption of alternative transport power sources is the lack of delivery

## PETROL AND DIESEL DOMESTIC PRODUCTION VS IMPORTATION (ML)



which creates major risk should supply be interrupted due to overseas issues or conflicts – the overwhelming majority of our imported petroleum products are shipped via the South China Sea.

The Australian economy is dependent on extensive transport networks to move around people, goods and resources, and with domestic refineries continuing to close, supply and stock needs will quickly become unsustainable if Australians persist with liquid fuels and remain dependent on importation.

If we take no corrective action and continue to place additional pressure on the liquid fuel supply and demand mix, we could be presented with a dire situation as early

infrastructure for non-oil based options (e.g. electric vehicle charging points). The provision of useable and reliable delivery infrastructure for non-oil based power could make a significant contribution to reducing our demand for oil.

As noted in the 2013 Energy White Paper Issues Paper, changes in energy sources offer the potential to both increase the productivity of energy use and reduce reliance on petroleum-based liquid fuels.

With Australia's reliance on imported fuels increasing significantly over the past two decades, the Australian Government should prioritise domestic electricity generation to improve Australia's fuel security and bring forward the benefits of electric and automated vehicles.

27. <https://www.iea.org/publications/freepublications/publication/energy-policies-of-iea-countries---australia-2012-review.html>

28. Adapted from Australian Petroleum Statistics Table 2 and Table 4, BREE 2014

29. [http://www.aph.gov.au/Parliamentary\\_Business/Committees/Senate/Rural\\_and\\_Regional\\_Affairs\\_and\\_Transport/Transport\\_energy\\_resilience/Report/c02](http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Rural_and_Regional_Affairs_and_Transport/Transport_energy_resilience/Report/c02)

30. Blackburn, J 2014, Australia's Liquid Fuel Security Part 2

31. <https://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/aes/2016-australian-energy-statistics.pdf>



## Electricity consumption

Electric vehicle uptake will be reliant on the capacity of the electricity grid to support electric vehicle usage patterns. With the availability and cost of electricity a critical component of cost of living considerations for many Australians, it is important to consider the significance of electrical requirements and the capacity within the electricity market to meet demand. It is also important to consider potential implications on retail electricity costs.

Electricity consumption by electric vehicles is estimated to be less than four per cent of total electricity demand by 2036.<sup>32</sup> With the Australian Energy Market Operator recently forecasting that consumption will remain flat for the next 20 years, this demand projection is small relative to the impact of other changes expected to take place, such as investment in renewable energy technologies, restructuring of the Australian economy, and energy efficiency improvements of major appliances.<sup>33</sup>

Due to the fact that a significant amount of vehicle charging will take place overnight, electric vehicles will

not compete on the electricity grid during the peak. Despite an increase in overnight demand, it is forecast that electric vehicles will not cause a significant change to maximum demand.<sup>34</sup>

If properly managed, electric vehicle charging could deliver additional capacity to the electrical grid by providing stored energy that could be distributed across the grid when required.<sup>35</sup> Through the use of smart meters and similar devices, electric vehicle owners could actively manage their vehicle charging to ensure it occurs at periods of low electricity (spot) prices; during periods of high (spot) prices, surplus electricity stored within the vehicle's battery could be returned to the grid. If this practice were to be incentivised and widely adopted, electric vehicles could potentially relieve pressure from the national electricity grid during the peak, making energy usage more efficient and reliable.

With the electric vehicle revolution looming, the role of electric vehicles in the future electricity grid should be explored, particularly their potential contribution to the network to address power security, efficiency and reliability.

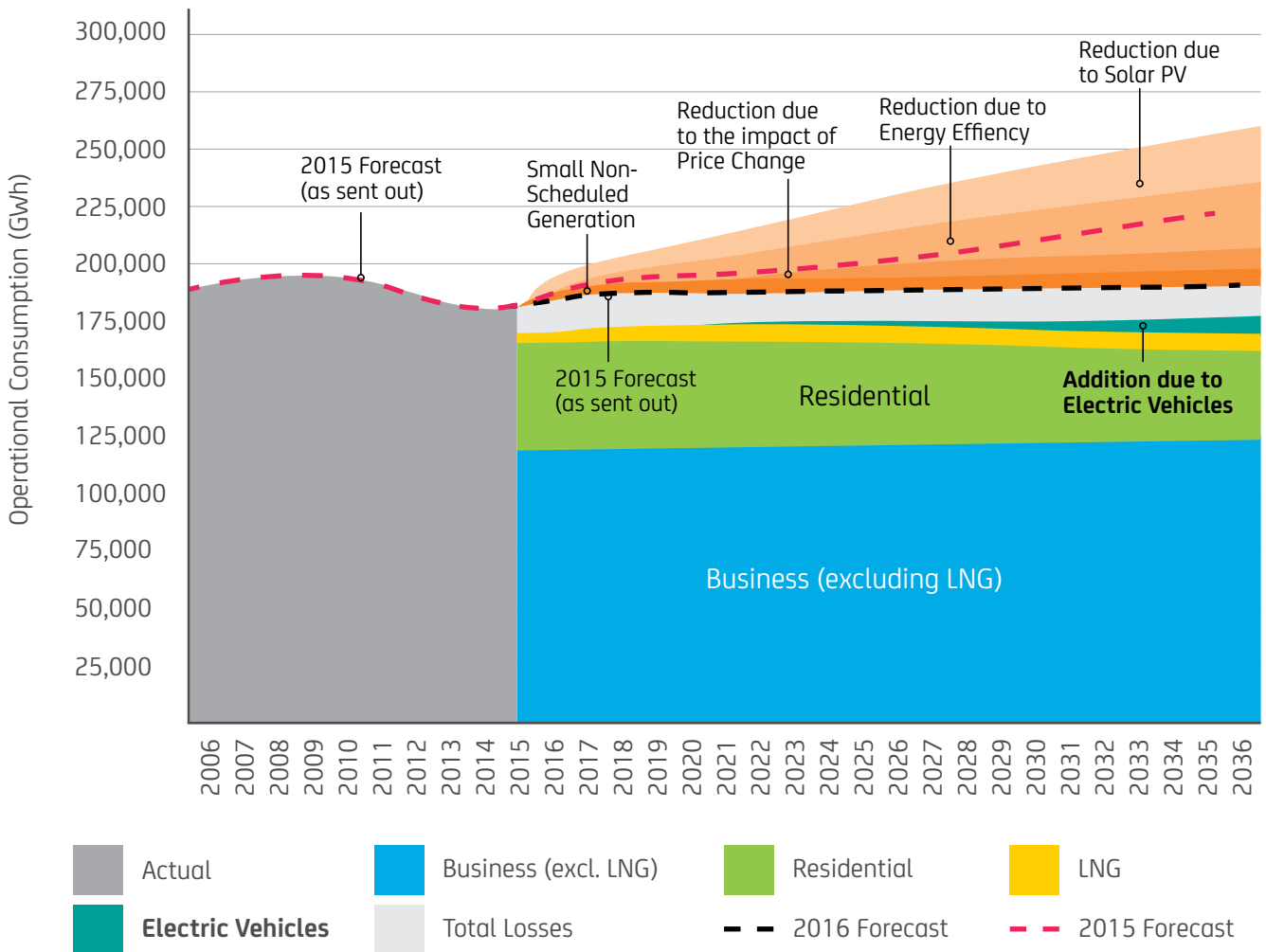
32. <https://www.aemo.com.au/Media-Centre/AEMO-Insights---Electric-Vehicles>

33. <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Electricity-Forecasting-Insights>

34. <https://www.aemo.com.au/Media-Centre/AEMO-Insights---Electric-Vehicles>

35. Finkel, A 2017, Independent Review into the Future Security of the National Electricity Market – Blueprint for the Future

## NATIONAL ELECTRICITY MARKET CONSUMPTION FORECAST



Source: Australian Energy Market Operator

## Emissions

Vehicle and transport emissions have gained attention over recent times due to the Paris Agreement and Euro 6 emissions standards. Air quality has become a significant issue for many urbanised cities around the world, as the quality of the air we breathe affects our health – even

small improvements in air quality can achieve benefits for human health and wellbeing.<sup>36</sup>

According to the OECD, air pollution cost the Australian economy \$5.8 billion in health expenses in 2010. The number of deaths attributable to air pollution rose 68 per cent between 2005 and 2010.<sup>37</sup>

36. <http://www.environment.gov.au/protection/publications/factsheet-national-standards-criteria-air-pollutants-australia>

37. <http://www.oecd.org/environment/the-cost-of-air-pollution-9789264210448-en.htm>

Regrettably, Australia's vehicle emissions are at a record high, recently surpassing the previous emissions peak seen in 2009. Diesel emissions mainly led this increase, accounting for 55 per cent of all emissions from the consumption of petroleum fuels in Australia.<sup>38</sup>

Australia has had road vehicle emission standards for new vehicles in place since the early 1970s and these have been progressively tightened over the past 40 years. Current emissions standards are generally based on Euro standards, with equivalent US or Japanese standards accepted as alternatives.<sup>39</sup>

The aim of Euro emissions standards is to reduce the levels of harmful exhaust emissions, namely:

- Nitrogen oxides (NOx)
- Carbon monoxide (CO)
- Hydrocarbons (HC)
- Particulate matter (PM)<sup>40</sup>

Since 1992, Euro standards have been imposed on new cars manufactured in Europe, with the aim of improving air quality. Since being established, there have been six Euro standards produced, each of which places greater constraints on pollutant levels that can be expelled from a vehicle.

In 2015, the Australian Government announced its commitment to an emissions reduction target of 26 to 28 per cent below 2005 levels by 2030; this commitment, known as the "Paris Agreement," was ratified in 2016 following the United Nations Framework Convention on Climate Change.

The Australian Government has put in place several measures aimed at meeting this agreement, including the announcement of a Ministerial forum to commence work on improving the fuel efficiency of Australia's vehicle fleet.

Work has commenced to investigate the implementation of Euro 6 standards (the sixth and current incarnation of the Euro emissions standard), improved fuel quality standards and new measures to address the fuel efficiency of vehicles.<sup>41</sup>

The Australian Government will also examine measures to encourage the purchase of more fuel efficient vehicles.

This package of reforms will deliver marginal changes in emissions at a high cost to consumers, while an increased uptake of electric vehicles could drive vehicle emissions reductions by up to 90 per cent with potentially lower costs to consumers.<sup>42</sup>

## *Australia's vehicle emissions are currently at a record high*

With significantly lower lifetime CO2 emissions compared to internal combustion engine vehicles, a major shift towards electric vehicles can assist us in meeting the Paris Agreement.

One of the primary environmental benefits of switching to an electric transport system is the reduction of CO2 emissions. The emissions improvement factors are threefold: vehicle production, vehicle expulsion, and lifecycle emissions, including those from recycling/disposal.

With the right mix of incentives for the uptake of electric vehicles, we could help to achieve significant emissions reductions in Australia's transport sector, which in 2015 accounted for about 18 per cent of Australia's total emissions.<sup>43</sup>

38. <http://www.tai.org.au/sites/default/files/NEEA%20complete%20AUDIT%20-%20202017-09%20FINAL.pdf>

39. <https://infrastructure.gov.au/roads/environment/emission/>

40. <https://www.roc.co.uk/drive/advice/know-how/euro-emissions-standards/>

41. <http://www.environment.gov.au/system/files/resources/f8f337c2-2d58-4d70-a1fd-acc71254a137/files/factsheet-2030-emissions-reduction-target.pdf>

42. Seba, T & Arbib, J 2017, Rethinking Transportation 2020-2030 – The Disruption of Transportation and the Collapse of the Internal-Combustion Vehicle and Oil Industries

43. Finkel, A 2017, Independent Review into the Future Security of the National Electricity Market – Blueprint for the Future



# The arrival of electric vehicles is imminent

The world's major automotive markets have made it clear – the future is electric.

Globally, the number of electric vehicles sold each year is growing rapidly. Sales volumes exceeded 750,000 in 2016, representing a 40 per cent increase on the previous year. There are now more than two million electric vehicles on the road.<sup>44</sup> BHP believes this figure could rise to 140 million by 2035.<sup>45</sup> Shell also believes electric vehicles are the future, recently announcing a forthcoming roll-out of electric vehicle charging stations through Britain and the Netherlands.<sup>46</sup>

Australia must now decide what role it wants to play in the new electric environment.

With one of the world's largest supplies of mineral resources required for battery production and an innovative, entrepreneurial and well-educated population, Australia is well suited to developing industries that support the global market for electric vehicles. However, our current position dissuades major investment.

Technological and manufacturing advances are improving the range and efficiency of electric vehicles while reducing pricing. Markets that have provided early support for electric vehicle adoption have shifted their thinking from 'why' to 'why not,' announcing the total ban of petrol and diesel vehicles after witnessing the benefits of transitioning to electric propulsion.

Reducing emissions, eliminating reliance on imported fossil fuels, improving public health and growing new and innovative industries are all strengthening the resolve of nations and companies in disrupting a process that has more or less remain unchanged since the early 1900s.

With the looming transition to electric vehicles in Australia expected to provide significant benefits across energy, transport, public health, infrastructure and industry development, we must now embrace the future and co-ordinate efforts across government and industry in preparation for this exciting revolution.



44. <http://www.iea.org/publications/freepublications/publication/TrackingCleanEnergyProgress2017.pdf>

45. <http://www.mining.com/bhp-says-2017-tipping-point-electric-cars/>

46. <https://electrek.co/2017/09/27/shell-new-electric-car-charging-gas-stations/>



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