

NSW ELECTRIC AND HYBRID VEHICLE PLAN



Contents

Ministers' foreword	3
Executive summary	4
Key actions	5
1. Introduction	7
1.1 A global transport trend	8
1.2 NSW context	9
1.3 How we developed the Plan	10
1.4 What is an Electric Vehicle?	10
2. Current and new actions to support EVs	12
2.1 Priority 1 - Vehicle availability	13
2.2 Priority 2 - Charging points	15
2.3 Priority 3 - Customer information	22
3. Strategic context	24
4. Benefits and safeguarding the community	27
4.1 Benefits	28
4.2 Safeguarding the community	34
5. The EV experience internationally	35
6. The EV experience in Australia	38
6.1 EV model availability	40

6.2 Charging infrastructure	41
6.3 Consumer access to accurate information	43
6.4 Future outlook	43
6.5 Hydrogen fuel cell technology	45
7. Implementing our Plan	46
7.1 What are the next steps?	47
References	48

Ministers' foreword

NSW's Electric and Hybrid Vehicle Plan reflects our growing focus on future mobility and technology innovations which will modernise transport for the community and businesses across New South Wales. As a Government, we want to embrace the growing availability of alternative transport such as electric and hybrid vehicles.

Transport has changed significantly in recent years and technology innovations are constantly improving the transport experience. People have more options in the vehicles they use – what used to be a choice between petrol or diesel has now expanded to include electric, hybrid and hydrogen fuel cell vehicles.

This Plan will maximise the benefits of a transition to more electric and hybrid vehicles for NSW. Electric vehicles offer significant economic and environmental benefits as well as contributing to a modern and cleaner energy future. They can reduce the cost of living and are cleaner and quieter – features which are essential in our growing cities and towns.

We know the transition to electric vehicles is a major transformation which brings many opportunities, including new industry development and employment growth in the transport, energy and technology sectors.

It will take time but adopting electric and hybrid vehicles opens up incredible opportunities for entrepreneurs and businesses to develop new and innovative vehicles, components, infrastructure and services.

NSW's diversified economy and highly skilled workforce are well positioned to take full advantage of these new opportunities and we stand ready and open for business.

We look forward to partnering with industry to meet the evolving needs of our community and deliver the future transport services for our state.



The Hon Andrew Constance MP
Minister for Transport
and Infrastructure



The Hon Melinda Pavey MP
Minister for Roads, Maritime
and Freight



The Hon Don Harwin MLC
Minister for Energy
and Utilities

Executive summary

A major global transformation is taking place in transport - from traditional cars, buses and trucks using petrol, diesel and gas in internal combustion engines to electric, hybrid and hydrogen fuel cell vehicles (EVs).

Vehicle manufacturers and charging providers are rapidly developing EV technologies to prepare for this transition and to be well positioned for future market growth in passenger and freight mobility.

Governments around the world are also taking action to prepare for and accelerate the adoption of EV technologies, in recognition of the economic, social and environmental benefits.

In NSW, we are committed to supporting households and communities, and empowering businesses with accessible and safe transport choices that shape a competitive, clean and prosperous future for NSW. With industry experts and communities, we have monitored global trends with EVs and their transformative opportunities for NSW businesses and households.

Action is needed now for NSW to take full advantage of this opportunity to improve outcomes for transport customers, communities and industry, and in turn the economy and our environment.

NSW is already well advanced in adopting new technologies, with the [Future Transport Technology Roadmap](#) setting a vision to make transport a technology business. This is reinforced in the NSW Government's [Future Transport 2056](#), our 40-year strategy to deliver customer-focused, technology-driven services to improve the productivity, liveability and sustainability of communities across the state. It also aligns transport with NSW's overarching infrastructure and land use planning strategies.

NSW supports the transformation of transport through technology, and we recognise the need for a clear direction forward to guide government and industry actions on EVs. This Electric and Hybrid Vehicle Plan presents a comprehensive approach to how NSW is preparing for this transition.

Actions within the Plan are identified for the next five years, and are focussed on three key priority areas:

- ▶ vehicle availability;
- ▶ charging points; and
- ▶ customer information.

This Plan will be updated to keep pace with changing fuel technologies, markets and services, so that we continue to deliver for NSW communities and provide a more certain environment for market investment and business development.

Key actions

NSW is committing to the following actions in three priority areas:

1. Vehicle availability



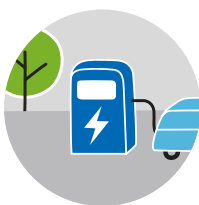
We will:

- › set a 10 per cent target for new NSW Government general purpose passenger fleet cars from 2020/21 – with 10 per cent of new vehicles purchased or leased by agencies to be electric or hybrid vehicles
- › integrate NSW's first fully electric bus trial into a regular route service - to be trialled in Sydney's Inner West from July 2019
- › assess the feasibility of transitioning one or more bus depots to partial or full electric operations.

We will also investigate:

- › expanding trials of electric bus technologies – enabling large numbers of customers to experience the many benefits of electric buses
- › facilitating car-share or ride-share trials using EVs – supporting new passenger transport services to share the benefits of EVs.

2. Charging points



We will:

- › co-invest in fast chargers in regional NSW – on major regional corridors, in partnership with charging suppliers and councils
- › co-invest in charging points in commuter car parks - and investigate commercial models for operation
- › adopt preferred charging standards - to guide councils, companies and investment
- › develop guidelines for installation of charging points in roadside service centres
- › support EV charging through strategic land use planning and guides – helping councils prepare for EV charging

- › commission EV charging infrastructure mapping - making more information available for private sector investment in public charging infrastructure.

We will also investigate:

- › measures to make buildings 'EV ready' - ensuring that new buildings cater for EV charging
- › the use of National Construction Code and Wiring Rules - to provide guidance on options to retrofit charging points in existing buildings
- › further streamline approval processes for installing charging points - to make the installation of charging points quicker and cheaper.

3. Customer information



We will:

- › invest in the development of a digital platform - to provide convenient and accessible vehicle and charging information
- › develop and standardise roadside wayfinding signage - to help guide motorists to charging locations.

CHAPTER

1

Introduction

1.1 A global transport trend

Electric vehicles (EVs) are already transforming the global market for passengers and freight vehicles. This transition is providing major benefits across transport, energy, public health, infrastructure and industry development, as well as helping to pave the way for automated vehicles and new forms of mobility services.

While vehicles powered by internal combustion engines (ICEs) have dominated road transport for many years, we are now entering a major transition to electric motors, batteries and hydrogen fuel cells, which offer cleaner, quieter and cheaper to operate transport. In this, electric and hybrid vehicles are a key part of the four related 'ACES' mega-trends in transport, along with automated and connected vehicles and shared mobility.

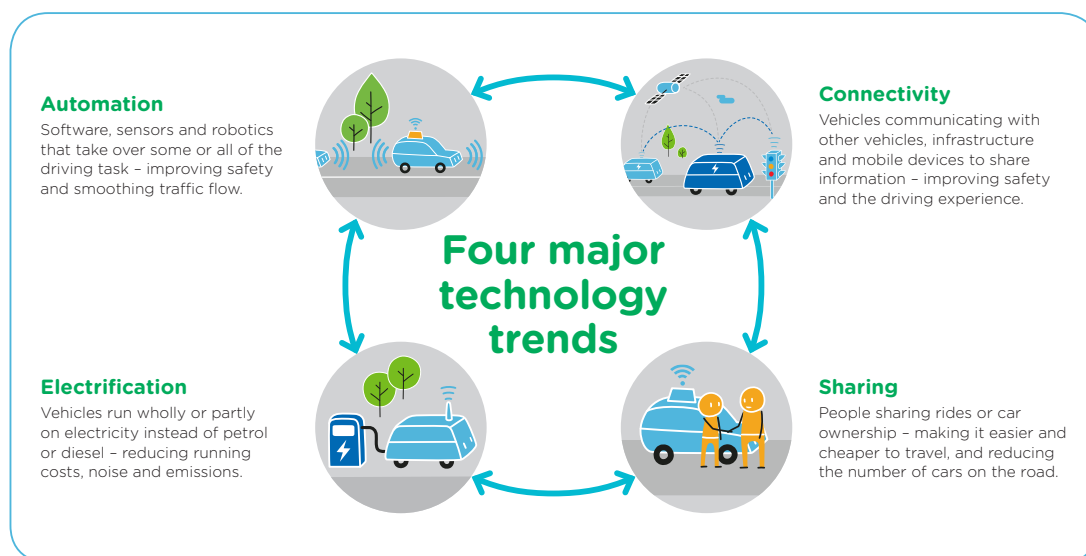


Figure 1 - The four major technology trends shaping the future of mobility

Although vehicle electrification has started slowly in Australia, the global transition to EVs is advancing rapidly driven by improving technologies, falling battery costs and government policies, meaning opportunities are closer than ever locally.

EVs offer major benefits over conventional vehicles. For motorists and fleet operators, there are significantly lower fuel and maintenance costs, with charging costs only 25 – 35 per cent that of petrol costs for the average passenger car. These cost of living savings and productivity benefits will flow to households and businesses, and to the wider economy.

EVs also benefit the community through cleaner and quieter operation that supports more liveable residential and commercial precincts, as well as providing health benefits from reduced vehicle emissions and improved air quality. The transition to EVs will increase fuel security by reducing our dependence on imported fuels, and using domestically generated electricity rather than imported fuels will improve Australia's and NSW's balance of payments.

Finally, EVs help address the growing challenge of greenhouse gas emissions, with the transport sector currently the second largest and fastest growing emitter in NSW and Australia. EVs are an effective way to reduce emissions and will become more effective as more renewable power is added to the grid, or if owners use a rooftop solar energy source.

The health, air quality and emissions benefits of EVs will become increasingly important as NSW's population grows from 7.7 million people in 2016 to 9.9 million people in 2036.¹

EVs are also a vital foundation for future automated vehicles, as electric motors are easier for automated systems to control. Equally important are charging infrastructure, smart charging and meter technologies that interact with energy networks so charging occurs when surplus energy is available and electricity prices are lower.

According to several expert studies including Bloomberg NEF, the adoption of EVs will accelerate as two tipping points are reached – cost parity and price parity. As soon as 2020/21, EVs in Australia are expected to reach cost parity, when EVs' total cost of operation, including purchase price and running costs, is comparable with conventional vehicles.

In relation to price parity, when EV prices become equal to comparable ICE models, this is forecast to be achieved as soon as the mid-2020s for smaller passenger cars and in the late 2020s for SUVs.

This demonstrates the need to prepare and be ready to make the most of these opportunities.

1.2 NSW context

In line with the rest of Australia, there are relatively few EVs in NSW. The NSW light passenger vehicle fleet of 2.95 million vehicles includes 1,700 battery EVs and 28,000 petrol-electric hybrid vehicles (as at September 2018).

About 390 public charging points, including 21 fast chargers, serve the electric and plug-in hybrid EVs, but these numbers are growing steadily as commercial charging providers are starting to install charge points on major roads and highways.

1.3 How we developed the Plan

This Plan is the result of a partnership approach with the community, industry and government agencies.

Community input in 2017 to the development of Future Transport 2056 highlighted strong community interest in EVs across metropolitan and regional NSW. There were high levels of awareness and support, including for clearer factual information and direction. This is consistent with wider research of customer attitudes, particularly showing strong interest in cost savings and environmental benefits.

Because it is also important to understand the opportunities for industries and local businesses, we consulted with a cross section of key industry stakeholders and peak bodies from the vehicle industry, vehicle manufacturers and suppliers, energy companies, charging infrastructure suppliers, fleet managers and passenger and freight services. The valuable contribution of the stakeholder reference group included two collaborative co-design events to inform the major priorities for action in this Plan.

This Plan was also developed with input from a range of government agencies across transport, planning, energy, environment, industry, finance and other sectors to ensure that actions and directions are well aligned.

1.4 What is an electric vehicle?

EVs are vehicles with electric motors and include: battery EVs, plug-in hybrid, hybrid EVs and hydrogen fuel cell vehicles.

Battery electric vehicles (BEVs)

Have an electric motor and a large battery that recharges by plug connection to external power. BEVs are fully electric and have zero “tailpipe” emissions. Because of their simplicity and the reliability of the electric motor, they have lower running costs.

Plug-in hybrid electric vehicles (PHEVs)

Use an electric motor coupled with a petrol or diesel engine, and can be plugged in to charge the battery. They have a longer driving range than BEVs and, because electric power is prioritised, save between 28 and 82 per cent on fuel compared with conventional vehicles.

Hybrid electric vehicles (HEVs)

Are the most common EV in Australia and use an electric motor coupled with a petrol or diesel engine, and smaller batteries that are recharged by the engine. They typically offer fuel savings of up to 33 per cent compared with conventional vehicles and are already price competitive.

Hydrogen fuel cell vehicles (HFCEVs)

Convert compressed hydrogen into electricity to power an electric motor and, like BEVs, have zero tailpipe emissions. HFCEVs are not yet on sale in Australia² and are only a small proportion of EV fleets in other countries. They are generally more expensive but offer the advantages of longer operating ranges, lighter weight and rapid refuelling capability, which may suit long distance freight operation, once available.














	Conventional	Hybrid	Plug-in hybrid	Battery electric	Hydrogen fuel cell
Sources of Energy					
Consumption					
Tailpipe Emissions					
Examples		Toyota Prius C Honda Civic Hybrid Honda Accord Toyota Corolla Hybrid Toyota Camry Hybrid Lexus CT200h	Mitsubishi Outlander PHEV BMW i8 Volvo XC90 T8 Audi A3 e-tron PHEV	Renault Zoe BMW i3 Tesla Model S Nissan Leaf	Toyota Mirai Hyundai ix35 Fuel Cell Honda Clarity Fuel Cell

Figure 2 – Conventional cars and different types of EVs

CHAPTER

2

Current and
new actions to
support EVs

The NSW Government has identified three priority areas where government action, in collaboration with industry, local councils and community organisations, can leverage the opportunities that EVs present.

2.1 Priority 1 – Vehicle availability

Existing actions

The transition to EVs and other fuel efficient, low-emission vehicles, is already supported through a number of initiatives, including:



- › offering a [lower rate of motor vehicle tax](#) for hybrid and EVs in line with the Federal Government's Green Vehicle Guide
- › trialling [EVs in the Department of Primary Industry's fleet](#), with six Mitsubishi Outlander PHEVs deployed in Orange to evaluate their performance, reliability and economy
- › supporting the Federal Government's proposals for strengthened fuel efficiency, vehicle emissions and fuel quality standards. If adopted, these standards should support vehicle suppliers to offer increased EV affordability and choice into the Australian market.

New actions

NSW will go further to support the availability of EV models by:

- › **Setting a 10 per cent target for new NSW Government general purpose passenger fleet cars from 2020/21 – with 10 per cent of new vehicles purchased or leased by agencies to be electric or hybrid vehicles**

NSW Government agencies operate one of Australia's largest fleets, including 13,000 general purpose passenger vehicles, and government's purchasing power will help to provide market confidence to supply more affordable EV models into the market. This action will also help provide more affordable second hand EVs to the public through the used car market.

› Integrating NSW's first fully electric bus trial as part of the public transport network

Electric buses deliver a quieter and cleaner service that improves urban amenity for passengers, neighbouring residents and businesses. The trial will be undertaken by bus operator Transit Systems and will test four battery electric buses over two years beginning in July 2019 in Sydney's Inner West region.

› Investigating expanded trials of electric bus technologies, in partnership with industry

Transport for NSW will investigate expanding trials that will enable large numbers of customers to experience electric buses, with around 150,000 passengers able to ride each bus per year. The proposed larger scale trials would test the operational, technical, financial, customer-experience and environmental performance of battery electric and possibly hydrogen fuel cell bus technologies. The trials will provide valuable data and operational insights to inform business cases for future decisions to transition some bus depots to partial or full electric bus operations.

› Assessing the feasibility of transitioning one or more bus depots to partial or full electric operations

Concurrent with the expanded electric bus trials, we will conduct a feasibility study of transitioning one or more Sydney bus depots to partial or full electric operations. The study would include consideration of power supply needs, charging infrastructure requirements and other operational factors.

› Investigating support for EV car-sharing by partnering with car-share and rental operators

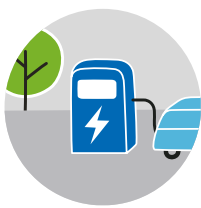
NSW is seeing rapid growth of new mobility services, including ridesharing and car-sharing. A trial of EVs by a car-share service would help gather insights into customer acceptance of EVs.

While the average private car is not used 90 per cent of the time, rideshare and carshare vehicles are often used much more. The additional distances travelled favours EVs, by increasing the benefits of cost savings and, since operators maintain large fleets, switching to EVs would also help to reach 'critical mass' for vehicle supply.

2.2 Priority 2 – Charging points

Existing actions

NSW has already acted to support and streamline installation of EV charging points. The NSW Department of Planning and Environment has:



- › updated the [Apartment Design Guide](#) to provide guidance for developers and councils for charging stations to be included into apartment designs
- › amended the [Infrastructure State Environmental Planning Policy](#) to streamline approval pathways for installing charging infrastructure on certain land. This reduces red tape and makes it easier for charging companies and service providers to provide electric vehicle infrastructure, such as EV chargers
- › commenced modelling the future uptake of EVs in NSW and impacts on the energy system. Energeia has been engaged to model EV adoption in NSW in the short and longer term, and to highlight key drivers and barriers.

Transport for NSW is building new commuter carparks that are EV-ready, by installing electrical conduits for easy future installation of EV chargers.

NSW is also actively promoting better national outcomes through the:

- › Council of Australian Governments' (COAG) Transport and Infrastructure Council to support clear national policies towards low and zero emissions vehicles; and
- › COAG Energy Council to ensure that national energy rules support EVs. For example, how networks can send signals to customers to incentivise charging of EVs at non-peak times and minimise impacts on the electricity network.

Working with COAG Energy Council to prepare the electricity system

EVs will be a key driver of change in the national electricity market. EVs are expected to impact patterns of electricity consumption and can store electricity to feed back to the grid. These impacts are already being considered and addressed.

The energy market is governed by national energy laws and rules, agreed by state, territory and Commonwealth ministers through the COAG Energy Council.

A significant work program is already underway to understand the impacts of projected increases in Distributed Energy Resources (DERs) on the national electricity market, including electric vehicles, and to ensure that the regulatory framework accommodates these changes. This includes:

Data

Mapping where and what DERs are in the system. Recent changes to national rules require the Australian Energy Market Operator to maintain a register of DER devices. The DER register information guideline will be published by 1 June 2019, and the rule will commence on 1 December 2019. This will promote better investment decisions, improve the operation of the power system and help policy makers and market participants have better knowledge about DERs in the electricity system, including electric vehicle chargers.

Incentives

Since 2017, national rules have required networks to phase in prices that reflect the efficient cost of providing network services to individual consumers. Ultimately, this should send signals to customers to incentivise charging at non-peak time, including for EVs. This can maximise the potential of changing customer consumption patterns as an alternative to network investment, and gives customers clearer information about the value of their choices. These reforms should mean EV drivers are offered electricity prices that encourage them to charge their cars in a way that minimises impacts on the electricity network.

Trials

Trials to manage the impact of Distributed Energy Resources (DER) on electricity networks. There is a limit to the amount of DER that networks can manage on their systems while maintaining network stability. The NSW Government is supporting trials to investigate how advanced grid technologies can be used to maintain network stability. This is complemented by significant investment in information technology systems being proposed by NSW networks as part of their upcoming network revenue determination.

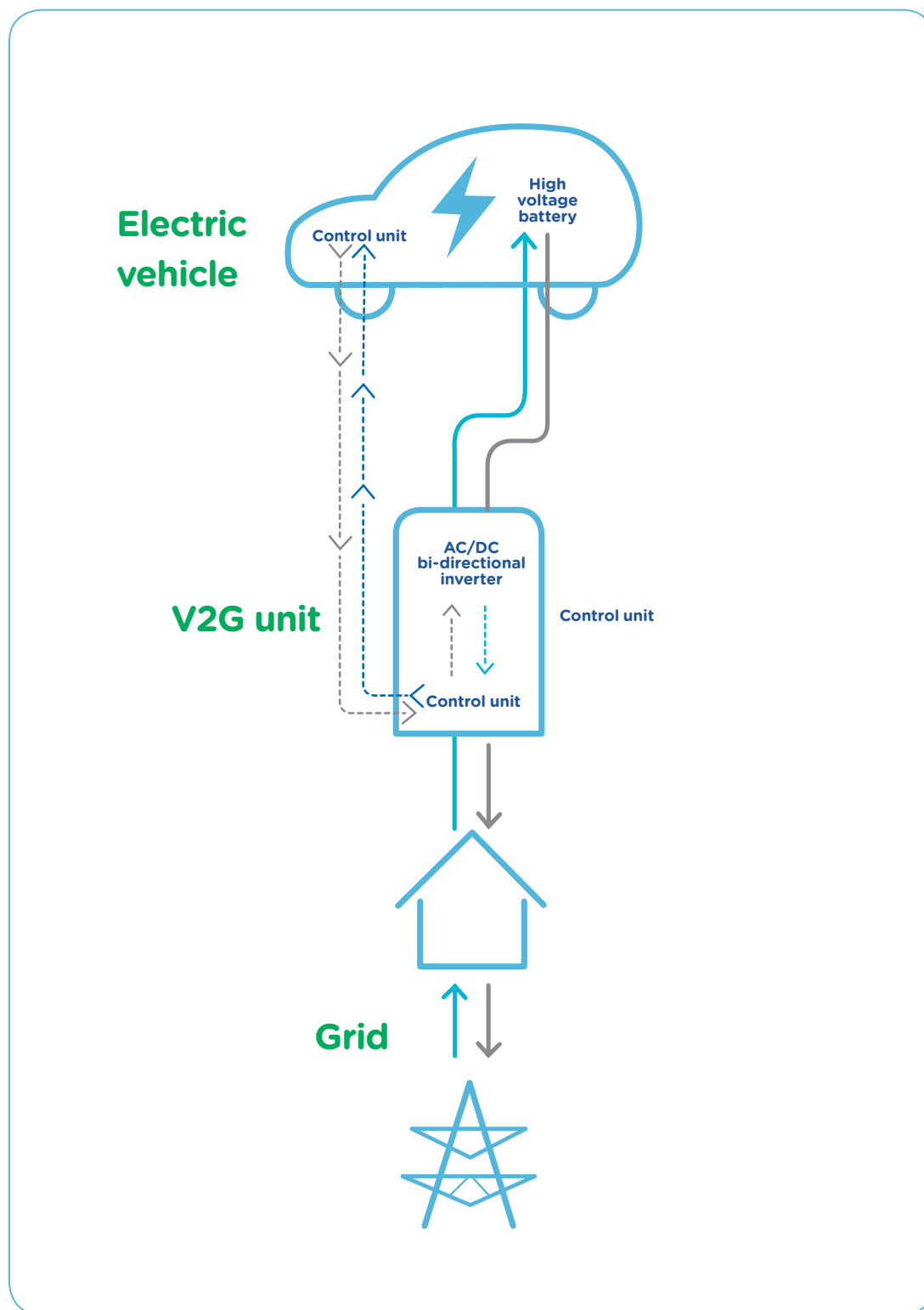


Figure 3 – Vehicle-to-Grid charging Source: Forbes

New actions

NSW will further prepare its transport and road network by:

› Co-investing in fast chargers on major regional corridors - in partnership with charging suppliers and councils

This program will work with councils, communities and commercial partners to target key regional routes and destinations where charging points are less likely to be provided on a fully commercial basis.

This will help regional residents and businesses to share in the cost savings and other benefits of EVs, improve access to regional NSW by EV owners including freight operators, and reinforces the regional tourism economy. It also supports local investment in regional centres, consistent with the [20-Year Economic Vision for Regional NSW](#).

Locations for regional fast chargers will be carefully chosen to complement (and not duplicate) current and proposed charger locations, as well as the significance of the route, availability of electricity supply and proximity to services.

Regional fast chargers - target corridors



Figure 4 - Target corridors for co-investment with industry and local partners

► **Co-investing in charging points in commuter car parks - and investigate commercial models for operation**

This trial will pilot industry partnerships and investigate commercial models to operate low-power chargers in commuter car parks that support access to public transport services, including NSW's recently constructed commuter car parks that are designed for easy addition of charging. These car parks are suited to low-power slow charging, given vehicles will be plugged in for long periods of time. These chargers will benefit EV owners who lack access to home-charging and will also support commuting journeys by encouraging travel by public transport. Nearly 30 per cent of vehicle owners live in dwellings where parking is not provided or where parking spaces lack access to power.

► **Adopting preferred charging standards and principles**

Australia is a national vehicle market and EV owners and operators are best served by broadly agreed standards that allow for technical compatibility, public access, flexible payment options, clear wayfinding information and options of energy and tariff choices.

Until national standards can be formally agreed, NSW will adopt and recommend the following charging infrastructure principles and standards to help guide charging suppliers, operators and councils. These standards are consistent with those advocated by peak industry bodies including the Electric Vehicle Council and the Federal Chamber of Automotive Industries.

NSW preferred EV charging standards and principles

Technical standards

- › Consistent standards for charging connections based on European CCS2 and CHAdeMO for DC fast chargers, and Type 2 for AC charging.
- › Preference for connected and smart chargers, to allow the most efficient energy use for both consumers and network operators.

Accessibility

- › Public access and open payment options platforms (credit/debit cards).
- › Charging funded and operated by the private sector where feasible, but governments may be co-investors to allow access equity in regional areas.
- › Encourage availability of public slow chargers to service residents with limited access to off-street parking.

Safety

- › Careful siting of charging infrastructure that puts road safety first.

Energy choices

- › Charging that provides an option to choose renewable power, where this is feasible.

Wayfinding

- › Consistent signage and electronic wayfinding systems to make chargers as easy to locate as possible.

› **Developing guidelines for installation of charging points in roadside service centres**

Guidelines for charging points will be provided for Roads and Maritime Services managed highway service centres and rest areas. The guidance would be for public and private providers of charge points, and guide placement and road safety considerations. It will inform future developments, such as updates to the Highway Service Centres along the Pacific Highway.

› **Supporting EV charging through strategic land use planning and guides**

With the release of NSW's Regional Plans, a strategic planning framework will guide councils to prepare Local Strategic Planning Statements that link regional and local planning objectives, including guidance for EV charging.

This may include providing directions for local government and Transport for NSW to work with charging service providers and community organisations to facilitate regional EV fast charging.

› **Investigating measures to make buildings 'EV ready'**

We will assess state and national level actions to ensure that new residential and commercial buildings cater for EV charging, including:

- **Investigate use of National Construction Code and Wiring Rules for new buildings**
Providing guidance to body corporates, strata managers and building managers on options to retrofit charging points in existing commercial and residential buildings, and consult with other jurisdictions on a nationally consistent approach.
- **Further streamline approval processes for installing charging points**
Current planning legislation will be reviewed and possible amendments to the NSW Codes State Environment Planning Policy (SEPP) will be investigated with a view to classifying the installation of EV charging points as exempt or complying development. This has the potential to make the installation of charging points quicker and cheaper.
- **Commissioning EV charging infrastructure mapping**
The private sector is investing in public charging infrastructure in NSW, but we will improve information on locations that are convenient for EV drivers and where it is cheaper to connect very fast charging infrastructure to the electricity network.

The NSW Government will work with distribution network businesses and other stakeholders to make more information available about low cost locations for public fast charging infrastructure.

2.3 Priority 3 - Customer information

Existing actions

Research by the NRMA and others (detailed in section 8.3 below) indicates that the lack of convenient and accurate information is an important factor influencing consumer support. This results in lack of consumer confidence and points to the need for the Government to work with industry and community partners to improve information and provide opportunities to experience EVs.

NSW has started trials of electric and automated vehicles which will give customers the chance to ride in and experience an electric ride, with:



- › NSW's first electric and automated Smart Shuttle being trialled at Sydney Olympic Park in partnership with industry. The trial is testing the operation of an automated vehicle, and also provides the public with an opportunity to experience the cleaner, quieter and smoother ride of an EV
- › further regional trials of electric and automated passenger shuttles are underway in Coffs Harbour and Armidale and a further trial announced in Dubbo.



Figure 5 – Transport for NSW's first automated, electric Smart Shuttle trial at Sydney Olympic Park *Source: TfNSW*

New actions

To further improve availability of reliable information and opportunities to ride in EVs, we will:

- ▶ **Invest in development of a digital customer information platform to provide convenient and accessible vehicle and charging information**

Transport for NSW and the Department of Planning and Environment will co-invest in a digital platform to provide market information, support EV purchasers and dealers, and share insights with government and commercial partners.

The project will focus on:

Fleet purchasers – supporting commercial passenger and freight fleet operators by providing a total cost of operation (TCO) calculator and provide charging station information.

Private vehicle purchasers – supporting private vehicle owners with integrated information on total cost of operation (TCO) calculator, trip planner, test drives and then purchasing into one seamless customer journey.

- ▶ **Standardise wayfinding and signage for EV charging stations**

Roads and Maritime will develop wayfinding signage that helps motorists locate charging points, to complement digital mapping via apps, in case mobile phone coverage is not available.

CHAPTER

3

Strategic context

Future Transport 2056 identifies EVs and transport powered by alternative fuels as key emerging technologies. It also highlights the importance of bold, new ideas that ensure the productivity, liveability and sustainability of our communities.

The NSW Government's *Future Transport 2056* provides an integrated vision for passenger and freight transport in NSW. The strategy was developed in conjunction with the Greater Sydney Commission's Greater Sydney Region Plan, Infrastructure NSW's State Infrastructure Strategy, and the Department of Planning and Environment's regional plans, to provide an integrated vision and guide investment over the longer term. These strategies are aligned in their shared objective to improve NSW's productivity, liveability and sustainability.

NSW strategic objectives: Productivity, Liveability and Sustainability

State Infrastructure Strategy 2018-2038: Building Momentum	Greater Sydney Region Plan	Future Transport 2056
	 	
Advice from Infrastructure NSW on current and planned NSW infrastructure, covering the next 20 years.	A vision for a metropolis of three cities that will rebalance growth and deliver benefits more equitably to residents across Greater Sydney.	A vision for how transport and land-use planning can support growth and the NSW economy.

Figure 6 - Strategic alignment with other NSW plans and strategies

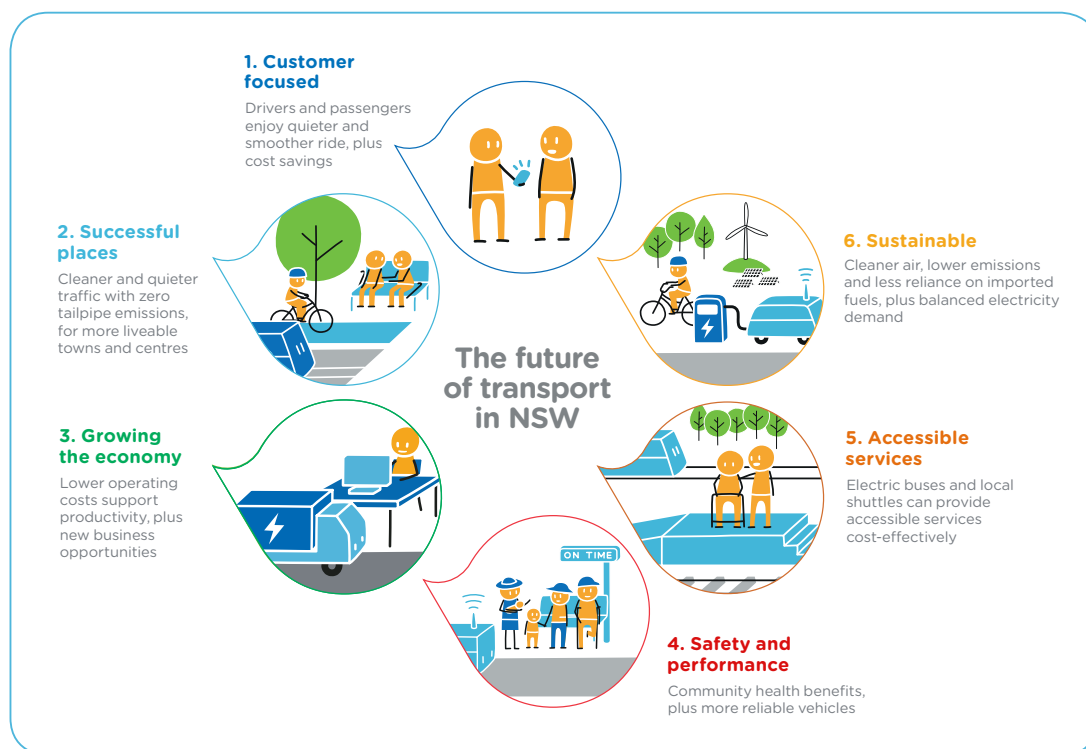


Figure 7 - The six transport outcomes identified in Future Transport 2056

[Future Transport 2056](#) identifies the need to develop a strategic approach to EVs, and commits to delivery of this Electric and Hybrid Vehicle Plan, that outlines NSW Government actions to facilitate the take up of low emission, fuel efficient vehicles and maximise their benefits for passenger and freight mobility, productivity and liveable communities.³

Infrastructure NSW's [State Infrastructure Strategy 2018-2038](#) anticipates a strong increase in EV uptake over the next two decades and stresses the importance of managing the transition to a larger EV fleet without disrupting the ability of the electricity network to function reliably and affordably for other users.⁴ The Strategy notes the potential of EVs to offer electricity network load balancing opportunities, by charging during off peak periods, and that a network of publically accessible charge points is critical to the uptake of EVs.

The Greater Sydney Commission's [Greater Sydney Regional Plan](#) presents a vision and actions for managing Greater Sydney's growth for the best outcomes. One objective of the Plan is to promote infrastructure to adapt to meet future needs, including designing places for EV charging.

In addition, the NSW Government's [Climate Change Policy Framework \(2016\)](#) sets an aspirational goal of net zero carbon emissions by 2050.⁵ The Framework notes there are a number of pathways to reducing emissions, involving action on renewable energy, energy efficiency, carbon sequestration and emissions savings.

CHAPTER

4

Benefits and
safeguarding the
community

Operating EVs offers many compelling benefits for households, businesses, the community, economy and the environment.

4.1 EV Benefits



Figure 8: The many benefits of EVs

Lower cost of operation

EVs are significantly cheaper to operate, including fuel cost savings of around 70 per cent and maintenance savings of around 40 per cent⁶, which means major benefits for households and businesses.

For an average private car travelling 13,700 kms a year⁷, this could amount to an annual fuel saving of \$1,000, or \$1,200 if the EV is able to charge overnight on an off peak tariff. People who drive longer distances, such as 25,000 kms per annum, could save up to \$2,200 each year.

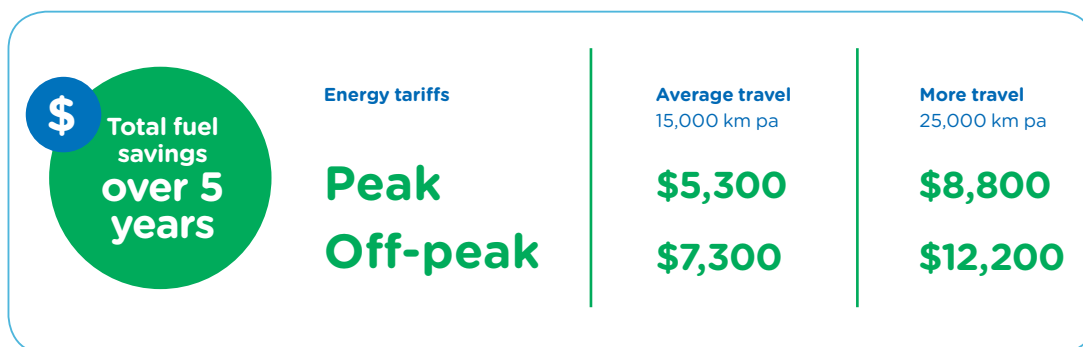


Figure 9 - Fuel costs of common ICEVs and BEVs, based on distances travelled and on electricity tariff

Fleet and commercial vehicle operators should benefit the most, because fuel and maintenance savings increase in proportion to distances travelled. For example, taxis in NSW travel around 110,000 kms each year, which means that a taxi fleet operator could save at least \$8,000 a year in fuel costs by using an EV rather than a conventional car. NSW can expect a strong uptake in BEVs because of their much lower operating costs, as well as the quieter, cleaner and smoother ride they offer their passengers.

In NSW, Sydney Airport has been a leader and has been operating six 'Electric Blu Emu' buses for moving passengers from its long stay car park to its terminals. The vehicles supplied by Carbridge have improved Sydney Airport's environmental performance and welcomed by customers because of their smooth and quiet operation. Sydney Airport reports that the electric buses' lower fuel and maintenance costs meant that operating the buses has been a good business decision as well as an environmental benefit.⁸

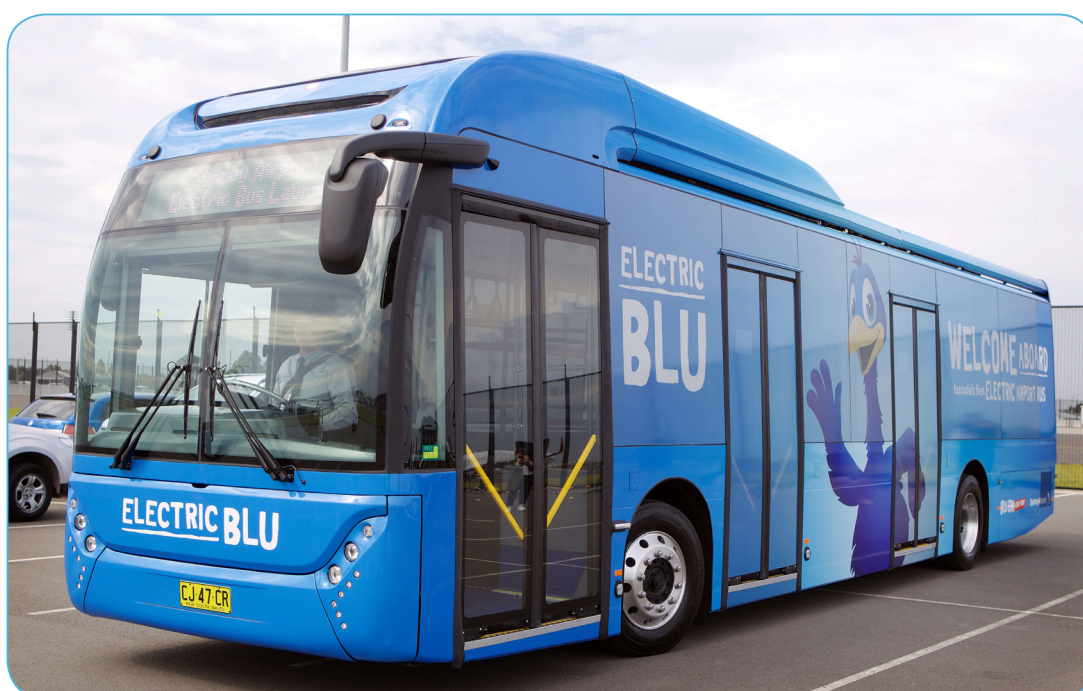


Figure 10 - Sydney Airport's 'Electric Blu' buses offer operating cost savings and a cleaner, smoother ride for passengers Source: Carbridge

Case study: Opportunities for electric buses

Cities around the world are introducing electric buses to their fleet to simultaneously improve air quality, reduce carbon emissions and lower operating costs. In 2017, there were already around 385,000 electric buses on the world's roads, with 99 per cent operating in China.⁹

Electric buses offer a smoother ride for passengers and cleaner, quieter running. This is why the NSW Government is partnering with bus operator, Transit Systems, to trial four electric buses in Sydney's Inner West starting in 2019, to demonstrate and test these benefits.¹⁰

Battery electric buses have zero tailpipe emissions and therefore are able to operate in tunnels and underground interchanges while dramatically reducing nitrous oxides and fine particulates.

Although electric buses have a higher purchase price than standard diesel buses (around \$240,000 more), they are already competitive on total operating costs, with the price offset by significant operational savings generated over their service lifetime.

Better customer experience

EVs offer a cleaner, quieter and smoother ride for passengers, without engine noise or vibration. A survey of 6,500 Nissan Leaf owners in the United Kingdom revealed that 95 per cent would recommend one to a friend and 64 per cent said they find their Leaf better to drive than a conventional petrol or diesel car.¹¹ Electric motors have high torque at low speed and do not need clutches or gear boxes, resulting in a responsive but smooth driving experience.

NRMA members reported that environmental benefits, low running costs, low maintenance costs, and quietness of the vehicle were the key advantages of owning an EV.¹²

Electric buses also provide a cleaner, quieter and smoother ride for passengers and those at bus stops, as there is no noise, exhaust or heat from the engine. Sydney Airport has also reported strong positive customer feedback on their electric shuttle buses.¹³

Improved local amenity

Because EVs are much quieter and cleaner, they contribute to more liveable urban centres and places that are pleasant to live and work in. In high streets and local neighbourhoods, improved amenity makes it much more pleasant to visit and operate vibrant local businesses like cafes and restaurants. Quieter operation may also allow urban freight deliveries to be made outside of busier peak periods.



Figure 11 - Renault Kangoo ZE, trialled by Australia Post Source: Car Advice

NSW's Road Noise Policy (2011) found that traffic noise is the most prevalent source of noise in NSW¹⁴ and any reduction will have benefits for community amenity and health.¹⁵ The report identified that some of the most significant gains to reduce noise impacts include take-up of EVs with their quieter electric motors.

Health benefits

Air quality is important for everyone. As NSW continues to grow, we are committed to maintaining high air quality standards, noting that average vehicle emissions have fallen significantly since 2003 as newer, cleaner models replace older vehicles. The transition to EVs, with their low or zero tailpipe emissions, can further help improve air quality.

Environmental benefits

EVs can significantly reduce greenhouse gas (GHG) emissions from road transport and emissions from EVs will fall further as more renewable power that is planned, approved or in construction comes on line in the National Energy Market.¹⁶

Road transport emissions are the second largest source of emissions (after the electricity sector) and the fastest growing source.¹⁷ Vehicle electrification has been found to be one of the "lowest cost opportunities to reduce emissions".¹⁸

Energy benefits

EVs also offer an important market for off-peak electricity that can help balance energy network demand. Power generators have significant spare supply capacity outside peak periods and with the right incentives in place (including for off-peak charging), EVs can use spare capacity, thereby minimising pressure on the grid.

In the future, there is also potential for EV batteries to become part of a distributed electricity storage network that can feed surplus power back into household supply or the grid.¹⁹

The transition to EVs will also increase our fuel security by reducing the state's reliance on imported liquid fuels and vulnerability to fuel price variations and potential supply disruptions.²⁰ About 90 per cent of Australia's liquid fuels are imported from overseas, and NSW is reliant on overseas or interstate oil refining capacity.²¹

Opportunities for freight

EV technology has the potential to provide significant benefits to operators of freight vehicles, including light commercial vans and heavy trucks. The freight logistics industry is servicing a growing demand for road freight, and the cost efficiency and environmental performance of freight operators will help improve freight productivity.

In 2018, Australian automotive manufacturer SEA Electric released Australia's first battery electric 23.5 tonne rigid delivery truck with a range of up to 400km.²²



Figure 12 - King Transport delivers IKEA products on two EV10s - 10T electric trucks *Source: SEA Electric*

In 2018, SEA Electric also launched its first fully electric, zero emission delivery van and has received Federal Government support for its production facility.

Electric trucks' quieter operation is important for many businesses such as supermarket operators, who may not be able deliver produce to their stores at night due to noise-related curfews enforced by local governments.

Economic benefits

Besides the cost savings benefits to the productivity of passenger and freight fleets and their downstream markets, EVs and their associated industries also offer new opportunities for growing local businesses and employment. These include companies supplying and installing charging stations, EV components and systems, in research and development, through to those using EVs in new transport services. Battery repurposing and recycling are emerging industries that will benefit from EV growth. A PwC economic impact assessment concludes that, by accelerating Australia's EV uptake growth to that of Norway, Australia could increase real GDP by \$2.9 billion; increase net employment by 13,400 jobs; and induce \$3.2 billion cumulative net investment in charging infrastructure from 2018 to 2030.²³

Opportunities for NSW industry

The major change from conventional vehicles to EVs creates opportunities for NSW businesses to implement new, innovative services in sales, servicing, digital monitoring and charging, as well as local or small scale renewable energy. It is important for industry to harness growth opportunities in new businesses and skills, to prepare for transition from existing ICE-related services and to prepare for the future.

Sydney and NSW are strongly positioned in knowledge-based industries, including advanced manufacturing and service industries, meaning that NSW businesses are well positioned to compete in key areas of the global EV marketplace.

4.2 Safeguarding the community

Pedestrian safety

One of the primary benefits of EVs is their quiet operation in urban environments. However, at speeds less than 20 km/h, they produce so little road noise that they may potentially pose a risk to vulnerable road users, especially blind or visually impaired pedestrians.

To address this, it has been suggested that EVs should generate an artificial sound when travelling below 20 km/h, while maintaining the benefits of quieter operation. This requirement has been adopted in Europe, US and Japan, with requirements for these warning devices also included in United Nations Economic Commission for Europe (UNECE) vehicle regulations. NSW will work with the Federal Government to update Australian Design Rules, where required, to improve the safety of vulnerable road users.

Emergency services

In a post-crash scenario, EVs may present a risk of electrocution to emergency service workers, due to the presence of high voltage cables. In order to reduce this risk, emergency services need access to technical advice from vehicle manufacturers on how to safely extricate the occupants of crashed vehicles.

It is also essential that electric and hybrid vehicles can be easily identified. To this end, recent amendments to the Australian Light Vehicle Standards will require electric and hybrid vehicles to be fitted with an “EV” sticker on their registration plates for vehicles manufactured after 1 January 2019.

CHAPTER

5

The EV
experience
internationally

The global transition to EVs has begun, evident in rapid growth in sales from almost zero in 2010, to 1.22 million in 2017.²⁴ This has mainly been a reflection of strong government action in China, Europe and parts of North America, accelerating uptake and, in turn, causing vehicle prices to fall, and an increase in vehicle choice and broader EV awareness.

Improved battery technology has also increased vehicle range and reduced costs. Momentum is expected to continue, with some experts estimating that EVs will account for 3 per cent of global sales by 2020, 28 per cent by 2030 and 55 per cent by 2040.²⁵

Global EV uptake

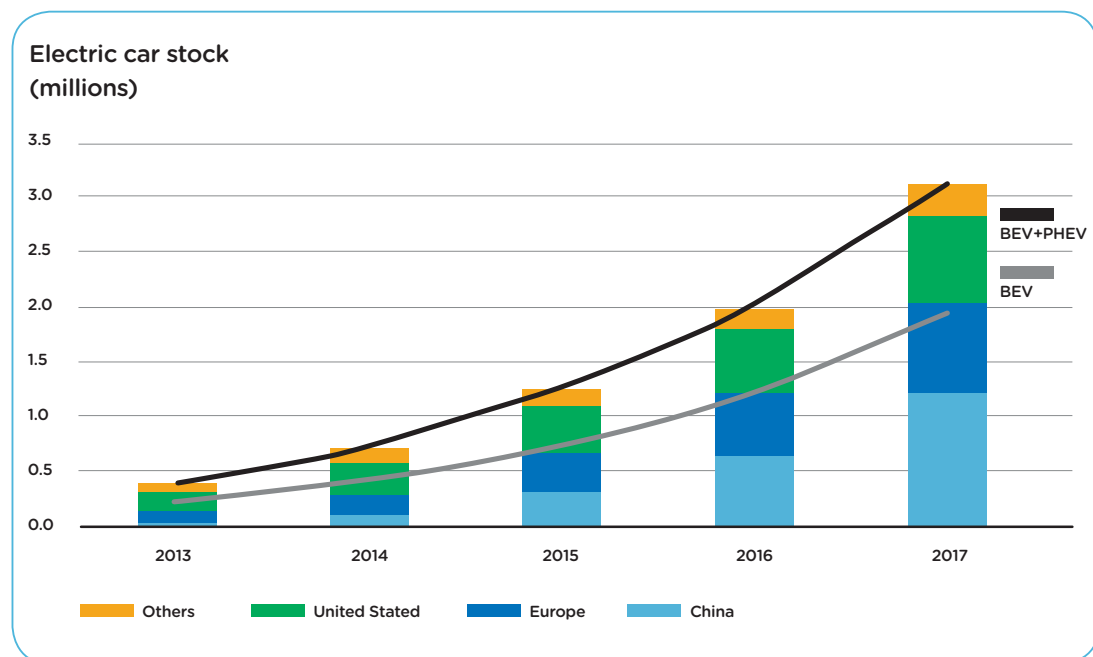


Figure 13 – Global EV growth Source: International Energy Agency, 2018

Although EVs accounted for just 1.3 per cent of global vehicle sales in 2017, leading jurisdictions have seen much higher rates of uptake: 39 per cent in Norway, 6 per cent in Sweden and 4.8 per cent in California.²⁶ There were more than three million EVs on the road in 2017, an increase of 59 per cent from 2016 levels. China and the US are the largest single-country EV markets, with Europe as a whole representing the second largest market after China.²⁷

The UK's [The Road to Zero strategy](#) outlines a number of measures including:

- ▶ increasing the number of on- and off-street EV charging points
- ▶ launching a £100m Charging Infrastructure Investment, to fund companies wanting to install charge points
- ▶ establishment of a £40m program for developing and trialling new, cheaper wireless and on-street charging technologies
- ▶ an extensive grants program for low emission vehicles.²⁸

In 2016, the New Zealand Government announced a [suite of measures](#) to support growth in the national EV fleet to reach 64,000 vehicles (or 1.6 per cent of the fleet) by 2021, including:²⁹

- ▶ extending road user charge exemptions for EVs
- ▶ working across government and private sectors to investigate bulk EV purchase
- ▶ publishing guidelines to support installation of public charging infrastructure
- ▶ launching a \$5 million fund for an EV information and promotion campaign
- ▶ establishing a \$6 million per year contestable fund to encourage and support innovative electric and low emission vehicle projects.

The United States Federal Government provides a [tax rebate](#) between \$2,500 and \$7,500 to purchasers of EVs. The size of the tax credit depends on the size of the vehicle and its battery capacity.³⁰ California's '[Zero Emission Vehicle](#)' program provides additional support including:³¹

- ▶ a requirement that 4.5 per cent of new vehicle sales are electric
- ▶ a further \$2,500 rebate for consumers purchasing EVs
- ▶ access to high occupancy vehicle lanes, toll exemptions and a sales tax waiver for manufacturers.

Some countries have also committed to completely phasing out sales of ICE vehicles by various dates. This includes Norway (by 2025); The Netherlands and India (both by 2030); Scotland (by 2032); China, France, UK and the US State of New Jersey (all by 2040); and California (by 2050). Other countries like Germany are currently considering such a phase-out.

CHAPTER

6

The EV
experience in
Australia

EV sales in Australia are currently very low compared with other comparable countries. This reflects current challenges with limited model choice, lack of affordable models and limited public charging infrastructure in the Australian market.

EV global market share, 2017

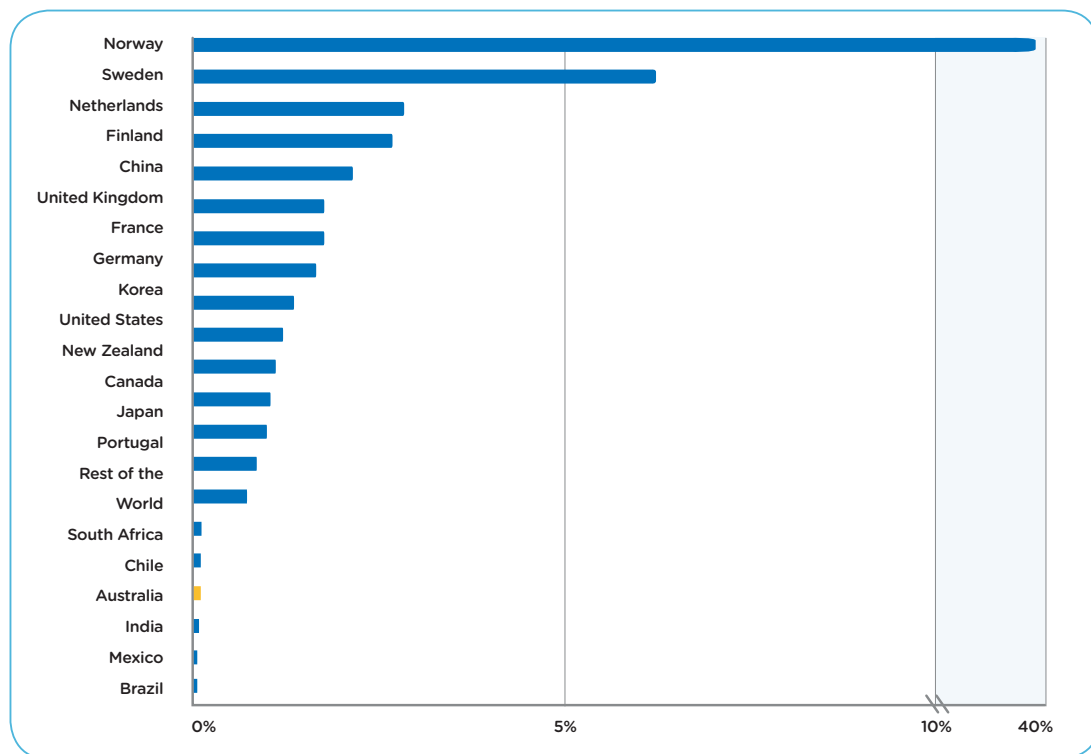


Figure 14 - Australia's EV market share is far behind most other developed countries *Source: International Energy Agency and OECD, 2018*

6.1 EV availability

Currently there are fewer EV models for sale in Australia compared with Europe or the United States, with most models concentrated in the luxury price category. While prices are falling, the lowest-cost BEV currently offered in Australia (Hyundai Ioniq BEV) costs \$45,000 and least expensive PHEV is the Mitsubishi Outlander at \$46,000 – beyond the budget of many consumers.

The graph below highlights the top-selling EV models in the US priced below US\$50,000 but not available in Australia. The key insight is that affordable EVs are available overseas but need to be attracted to the Australian market to lower the purchase price barrier for consumers.

EV affordability and choice

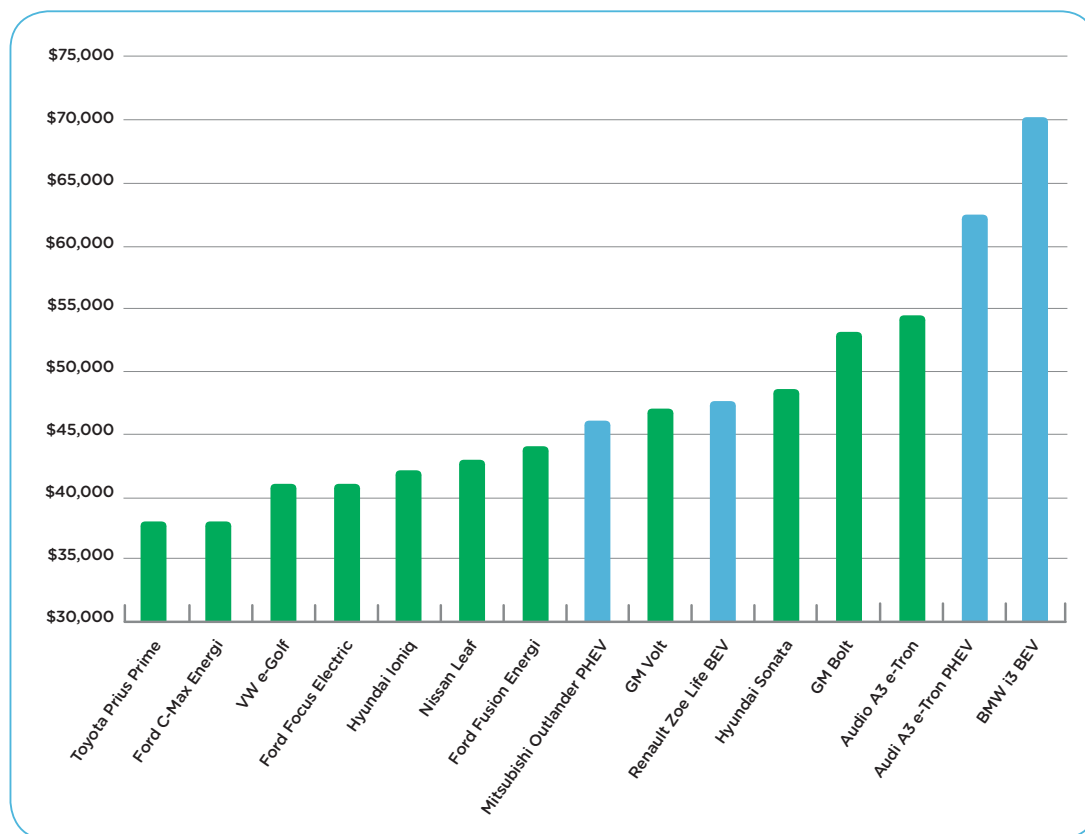


Figure 15 - Top-selling EV models in the US priced below US\$50,000 and EVs available in Australia

Source: Electric Vehicle Council, 2018

6.2 Charging infrastructure

Availability of public charging infrastructure in Australia has been limited compared with similar countries however, it is starting to accelerate. Although most charging is done at home, access to public fast chargers is essential to overcome 'range anxiety' – the perceived risk that a vehicle may run out of charge before a charging point is reached.

All EV drivers will need access to fast charging when they travel long distances. There are currently around 800 public charging locations available in Australia.³² This is a charging station density of one per 31,635 people. In comparison, there are around 14,000 public charge points across the UK, a density of one charge-point per 4,717 people.³³

Some people living in apartments may be discouraged from owning an EV if there is inadequate access to charging points. About 28 per cent of Australian households do not have access to a garage or parking-space power point, and would need to rely on access to public charging.

There are several types of chargers for a range of purposes, ranging from slow overnight charging and to fast, top-up charging.

	 Power	 Range added per hour	 Charging time	 Typical application
Level 1 – single phase (domestic)	2.4-3.7kW	10-20km range / hour	5-16 hours	Home
Level 2 slow – single phase (domestic or public)	7 kW	30-45km range / hour	2-5 hours	Home, work, shopping centres, car parks
Level 2 fast – three-phase (public)	11-22kW	50-130km range / hour	30mins – 2 hours	Urban roadside
Level 3 – fast charge (public)	50kW	250-300km range / hour	20-60 mins	Regional near highways, motorways and key routes
Level 4 – super-fast charge (public)	120kW	400-500km range / hour	20-40 mins	Regional near highways, motorways and key routes
Ultra-fast charge (public)	350kW	1000+ km range / hour	10-15 mins	Highways and motorways

Figure 16 - Electric vehicle charging types³⁴

In NSW, publicly accessible fast-chargers are starting to emerge. The NRMA is investing \$10 million in more than 40 fast chargers across NSW and the ACT. This is an example of an industry-led solution. There is also scope for governments and the private sector to collaborate to providing charging points, particularly in regional or other areas where access to public charging would otherwise be limited. For example, the Federal Government recently co-invested through the Australian Renewable Energy Agency in a network of 21 ultra-fast chargers to be operated by Chargefox across NSW, Victoria and Queensland.

While options for EV charging are increasing for passenger vehicles, more work is required to provide the necessary EV support infrastructure for commercial freight operations at strategic locations along key freight corridors, including major interstate corridors. A future NSW freight charging network should connect to existing networks in Queensland and Victoria to enable a seamless freight journey.

The adoption of national standards and principles for charging is supported by NSW, which is working through the Transport and Infrastructure Council and other intergovernmental bodies to achieve national agreement.

6.3 Consumer access to accurate information

Given the relative scarcity of EVs on NSW roads, it is not surprising that many consumers find it difficult to access easy to understand information on EVs' availability and performance.

Research conducted by the NRMA suggests that the lack of easy access to accurate and reliable information about EVs is a factor influencing consumer support. "There appeared to be a lack of education around EVs and their capabilities amongst the wider population. Qualitatively, there was a feeling that people considering one would need to do a lot of research about them, and that there wasn't a lot of really good consolidated information about them."³⁵ Information is fragmented, from a range of sources like individual vehicle manufacturers, peak industry bodies, automotive journals and motoring clubs.

The confusion and lack of convenient information noted by NRMA points to the need for better consumer access to consolidated, accurate information about EVs' capabilities.

6.4 Future outlook

While EV sales in Australia are still small (0.2 per cent of passenger vehicles), there are early signs that an EV wave is coming³⁶. The most recent data (2017) shows stronger growth in Australian EV sales, to an annual total of 2,284, a 67 per cent increase on the previous year.

The number of EV models available in Australia increased by 44 per cent in 2017, although most of the new models were in the luxury category. Nine new plug-in EVs are expected to be introduced to the Australian market over the next 18 months, five of which will be priced below \$60,000. In 2017, there was also a 64 per cent increase in the number of charging stations, albeit from a low base.

Two tipping points

Two critical tipping points are expected to be reached in the next few years. The total cost of ownership (TCO) of an EV is predicted to reach total-cost parity with conventional vehicles about 2020/21 and purchase-price parity between 2025 and 2027.

These tipping points are expected to accelerate EVs' share of Australian new passenger vehicle sales from their current level of 0.2 per cent to 1 per cent by 2020. This share is forecast to rise to 6 per cent by 2025, 28 per cent by 2030, and 60 per cent by 2040.³⁷

This growth will be driven by a number of factors including falling EV prices, changing consumer preferences, public policies and global trends. Australia's Clean Energy Finance Corporation (CEFC) predicts all new cars will be EVs by 2044 without incentives – or by the 2030s, if incentives are provided.

EV uptake and tipping points in Australia and NSW

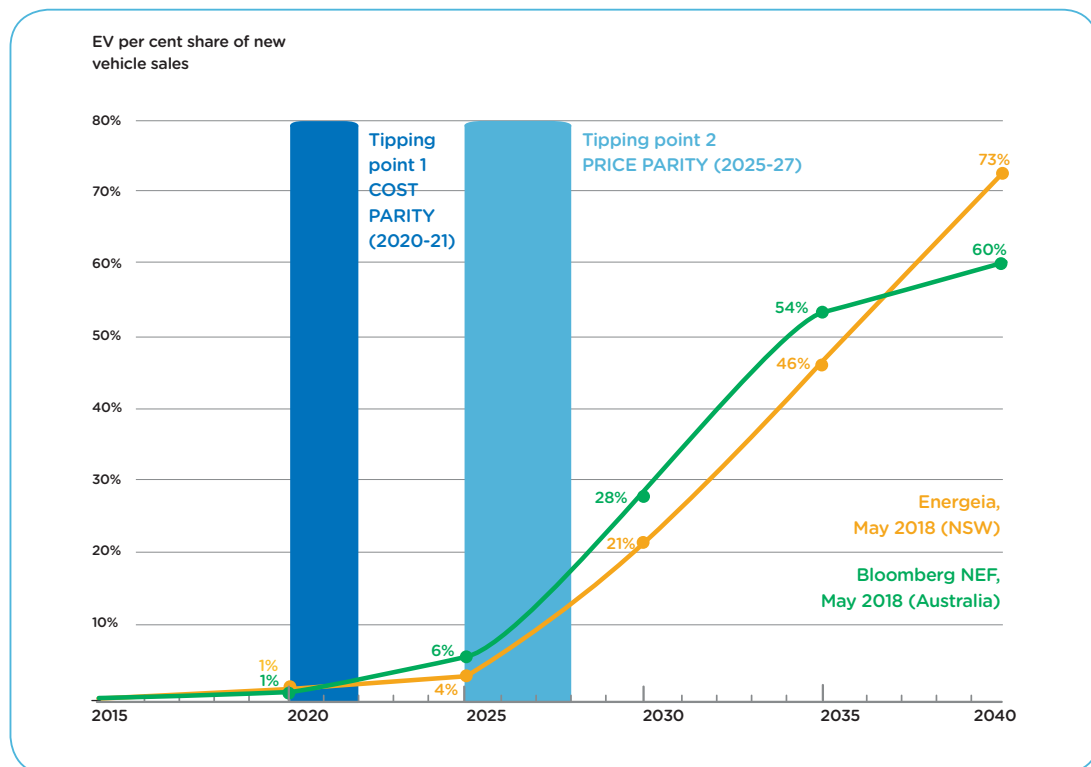


Figure 17 – Projected growth of Australian EV market (with cost and price parity points) Source: Bloomberg NEF

The actual rate of uptake depends on availability and affordability of EVs in Australia, the availability of charging points and availability of convenient and accurate customer information.

6.5 Hydrogen fuel cell technology

The development of hydrogen fuel cell electric vehicle (HFCEV) technology is advancing more slowly than BEVs and hybrids, but has the potential to achieve similar operational and environmental benefits, as well as longer ranges and shorter refuelling times.

Until recently, HFC technology in Australia has been restricted to forklift trucks and other specialised vehicles. More recently, both Hyundai and Toyota have been testing prototypes on the NSW road network, and Hyundai has constructed the state's first hydrogen refuelling station at its Sydney headquarters at Macquarie Park. It is likely that at least one vehicle manufacturer will announce the launch of an HFCEV into the Australian market in early 2019.

HFC technology has some advantages over battery technology for longer-distance, heavy freight vehicles as they potentially benefit most from its lighter weight, shorter refuelling times and longer ranges. Based on their successful introduction overseas, particularly in Korea, HFC buses may also make an appearance in the Australian market in the near future.

CHAPTER

7

Implementing our Plan

7.1 What are the next steps?

This Plan is intended to be a catalyst for positive change that will benefit communities and businesses. The actions in the Plan will help support the EV transition over the next five years, by moving ahead with our partners in communities, councils, site owners, vehicle suppliers, charging providers, energy suppliers and others.

The Government is ensuring that NSW is well placed and prepared for EVs and to capitalise on their many benefits.

This Plan is the result of successful partnerships and collaboration. It has been co-designed with government, community and industry partners, and we will continue that approach as we roll out the initiatives. We are keen to hear from communities, businesses, innovators and researchers about how the transition to EVs can be best facilitated and managed in NSW.

We have the capacity to facilitate EV technology trials and want to partner with industry and researchers, to better understand EV benefits, requirements and performance, as well as what EVs will mean for our transport and road network. We will also engage further with customers on what these technologies will mean for them. We are always open to new ideas and partnerships, so please contact us if you are interested in collaborating with us.

Email: electricvehicles@transport.nsw.gov.au

References

- 1 The Department of Planning and Environment (2016) [“NSW population projections”](#)
- 2 Hydrogen Mobility Australia anticipates that the first HFCEV will be available in the Australian market by the end of 2018.
- 3 [Future Transport 2056](#)
- 4 [The NSW State Infrastructure Strategy 2018-2038](#)
- 5 [NSW Climate Change Policy Framework](#)
- 6 AECOM (2011), [Forecast Uptake and Economic Evaluation of Electric Vehicles in Victoria](#), p. 27-28
- 7 ABS, Motor vehicle census, Australia, 31 Jan 2016
- 8 Personal testimony: meeting with Sydney Airport and Carbridge, 11 November 2016
- 9 Linda Poon (2018), [“How China Took Charge of the Electric Bus Revolution”](#)
- 10 [TfNSW and Transit Systems electric bus trial](#)
- 11 <http://www.econnectcars.com/customer-satisfaction-with-electric-vehicles-now-high>
- 12 NRMA unpublished research (2018)
- 13 Ibid
- 14 NSW Environment Protection Authority, [“Transport noise”](#) information page
- 15 NSW Environment, Climate Change and Water (2011), [NSW Road Noise Policy](#), p.1
- 16 Ken Baldwin et al (2018), [“At its current rate, Australia is on track for 50% renewable electricity in 2025”](#)
- 17 Department of Environment and Energy (2017), [Quarterly Update of Australia’s National Greenhouse Gas Inventory: March 2017](#), p. 39; Department of Environment and Energy (2016), [Australia’s emissions projections](#)
- 18 Climate Change Authority (2018), [“Opportunities to reduce light vehicle emissions in Australia”](#)
- 19 <http://www.v2g.com.au/> Constance Douris (2017), [Electric Vehicle-To-Grid Services Can Feed, Stabilize Power Supply](#)
- 20 Malcolm Sutton (2016), [“Defence White Paper 2016: Dependency on fuel imports ‘a risk’ amid South China Sea tensions”](#)
- 21 Parliament of Australia (2015), [“Australia’s Transport Energy Resilience and Sustainability”](#), Point 2.11; House Standing Committee on Economics (2012), [“Inquiry into Australia’s Oil Refinery Industry”](#), Point 2.6
- 22 Bridie Schmidt (2018), [First all-electric delivery van available to Aussie freight operators](#)
- 23 [Recharging the economy: The economic impact of accelerating electric vehicle adoption](#) (2015) p. 6
- 24 International Energy Agency, [Global EV Outlook 2017](#)
- 25 Bloomberg New Energy Finance (2018)
- 26 International Energy Agency, [Global EV Outlook 2018](#)
- 27 EV volumes.com, [Global Plug-in Vehicle Sales for 2017 – Final Results](#)
- 28 United Kingdom Government, [Low-emission vehicles eligible for a plug-in grant](#)
- 29 New Zealand Ministry of Transport, [Electric vehicles information page; National Vehicle Fleet status](#)
- 30 Office of Energy Efficiency and Renewable Energy, [Electric Vehicles: Tax Credits and Other Incentives](#)
- 31 The US National Conference of State Legislature (2017) [State Efforts To Promote Hybrid and Electric Vehicles](#)
- 32 [The State of Electric Vehicles in Australia Second Report \(2018\)](#), p. 13
- 33 [UK Office for national statistics](#); UK Department of Transport (2018), [The Road to Zero](#)
- 34 Adapted from “Feasibility of providing charging infrastructure for electric vehicles and bicycles at public transport nodes, Queensland Transport and Main Roads (TMR), August 2017 (not publicly available)
- 35 NRMA unpublished research (2018)
- 36 [The State of Electric Vehicles in Australia Second Report \(2018\)](#), p. 3
- 37 Bloomberg New Energy Finance (2018)



NSW Electric and Hybrid Vehicle Plan

© January 2019 Transport for NSW
ISBN: 978-1-925891-11-9

Disclaimer

While all care is taken in producing and publishing this work, no responsibility is taken or warranty made with respect to the accuracy of any information, data or representation. The authors (including copyright owners) and publishers expressly disclaim all liability in respect of anything done or omitted to be done and the consequences upon reliance of the contents of this publication.

Transport for NSW
18 Lee Street
Chippendale NSW 2008

transport.nsw.gov.au

