

The Senate

Select Committee on
Electric Vehicles

Report

January 2019

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Acronyms and abbreviations

AC	alternating current
ACTU	Australian Council of Trade Unions
AEMO	Australian Energy Market Operator
AEVA	Australian Electric Vehicle Association
ALC	Australian Logistics Council
AMWU	Australian Manufacturing Workers Union
ARENA	Australian Renewable Energy Agency
ATO	Australian Taxation Office
ATS	Automotive Transformation Scheme
AV	Autonomous vehicles
BEV	A battery electric vehicle is a fully electric vehicle that is propelled by one or more electric motors and has a battery which is charged using electricity from the grid or renewable energy sources.
CEEM UNSW	Centre for Energy and Environmental Markets at the University of NSW
CEFC	Clean Energy Finance Corporation
CFP	Common flexible platform
CKD	Completely knocked down packs
CO ₂	carbon dioxide
COAG	Council of Australian Governments
CPI	Consumer Price Index
DC	direct current
DER	Distributed energy resources

DLWP	Victorian Department of Environment, Land, Water and Planning
DTMR	Queensland Department of Transport and Main Roads
ECCA	New Zealand Energy Efficiency and Conservation Authority
ENA	Energy Networks Australia
ETU	Electrical Trades Union
EV	Electric vehicle
EVSE	Electric vehicle supply equipment
FCAI	Federal Chamber of Automotive Industries
FCEV	A fuel cell electric vehicle is an electric vehicle that is powered by an on-board energy source such as hydrogen.
FOI	Freedom of Information
GHG	Greenhouse gas
GM	General Motors
GVG	Green Vehicle Guide
GVM	Gross Vehicle Mass
HEV	A hybrid electric vehicle is an electric vehicle that has an electric motor and batteries, and an internal combustion engine.
HMA	Hydrogen Mobility Australia
IA	Infrastructure Australia
ICE	Internal combustion engine
IEA	International Energy Agency
km	kilometre
kW	kilowatt
LCT	Luxury Car Tax
MTAQ	Motor Trades Association of Queensland

NCAP	Nissan Casting Plant Australia
NO _x	nitrogen oxides
OEM	Original Equipment Manufacturer
OLEV	United Kingdom Office for Low Emission Vehicles
PEV	Plug-in electric vehicle is an EV (either PHEV or BEV) that plugs into a charger
PHEV	A Plug-in hybrid electric vehicle is an electric vehicle that can be plugged-in to charge and drive shorter distances on electricity, however, also have a liquid fuel range extender/internal combustion engine (ICE) that provides additional driving range for longer trips.
PMG	Pilbara Metals Group
PM	Particulate matter
PTUA	Public Transport Users Association
PV	Photovoltaic
QESH	Queensland Government Electric Super Highway
RACV	Royal Automobile Club of Victoria
RACWA	Royal Automobile Club of WA
R&D	Research and development
RVS	Road Vehicle Standards
REE	Rare earth elements
STEM	Science, technology, engineering and mathematics
TAI	The Australia Institute
TIC	Transport and Infrastructure Council (COAG)
TISOC	Transport and Infrastructure Senior Officials Committee

TOC	Tesla Owners Club of Australia
TPS	Toyota Production System
VACC	Victorian Automobile Chamber of Commerce
VAT	Value added tax
WHO	World Health Organisation
ZEV	Zero emission vehicle

Recommendations

Recommendation 1

6.14 The Committee recommends that the Australian Government develop a national EV strategy to facilitate and accelerate EV uptake and ensure Australia takes advantage of the opportunities, and manages the risks and challenges, of the transition to EVs.

Addressing these risks and challenges will require effective national standards and regulation in regards to charging infrastructure and electricity grid integration, building and construction, public safety, consumer protection, processes for disposal and/or re-use of batteries, and skills training.

Recommendation 2

6.15 The Committee recommends that the Australian Government should take a national leadership position in establishing an inter-governmental taskforce to lead the development and implementation of a national EV strategy.

Recommendation 3

6.18 The Committee recommends that the Australian Government consider establishing national EV targets for light passenger vehicles, light commercial vehicles and metropolitan buses.

Recommendation 4

6.20 The Committee recommends that the Australian Government consider establishing a national EV target for the Government fleet.

Recommendation 5

6.28 The Committee recommends that the Australian Government coordinate with operators in the charging infrastructure industry to develop a comprehensive plan for the rollout of a national public charging network.

Recommendation 6

6.31 The Committee recommends that the Australian Government introduce more stringent vehicle emissions standards, and establish a new CO₂ standard, informed by those implemented in other developed countries and the findings of the Ministerial Forum on Vehicle Emissions.

Recommendation 7

6.34 The Committee recommends that any national strategy by the Australian Government should develop a consumer education campaign to raise awareness of the capabilities and benefits of EVs.

Recommendation 8

6.37 The Committee recommends that the Australian Government work with the state and territory governments to bring a Formula-E Championship race to Australia.

Recommendation 9

6.39 The Committee recommends that the Australian Government develop and implement a comprehensive 10-year EV manufacturing roadmap, also covering research and development, vehicle and system design and manufacture batteries, telematics, supply chain and component manufacturing.

Recommendation 10

6.43 The Committee recommends the Australian Government coordinate federal, state and local government EV fleet, truck and electric bus procurement through the inter-governmental EV taskforce (Recommendation 2).

Recommendation 11

6.47 The Committee recommends that the Australian Government works with state and territory governments through the COAG Industry and Skills Council to establish national training arrangements for automotive service technicians in relation to electric vehicles.

Recommendation 12

6.48 The Committee recommends that the Australian Government, in conjunction with industry stakeholders, fund apprenticeships and traineeships in the local EV and associated manufacturing sector.

Recommendation 13

6.50 The Committee recommends that the Australian Government work closely with electricity market agencies, states and other relevant stakeholders to prepare a 10-year plan detailing priority electricity network infrastructure upgrades needed to manage demand from EVs.

Recommendation 14

6.55 The Committee recommends that the Australian Government work closely with the Australian Energy Market Operator (AEMO) to:

- Expedite the establishment of a register of distributed energy resources (DER);
- Develop a strategy for AEMO to access and direct the DER to charge or provide electricity to the grid to meet operational requirements.

Recommendation 15

6.59 The Committee recommends that the Australian Government work with state and territory governments, through COAG and the Building Ministers Forum, to explore necessary amendments to the National Construction Code to render all new dwellings 'electric vehicle charger ready'.

Recommendation 16

6.60 The Committee recommends that the Australian Government work with Standards Australia to amend AS/NZS3000:2018 *Electrical installations: Wiring Rules* to the following effect:

Where a smart load management system is not implemented, assume all the electric vehicle chargers will be running at full capacity all the time. Where a smart load management system is implemented, assume electric vehicle charging load will be effectively limited by the parameters of this system.

Recommendation 17

6.62 The Committee recommends that the Australian Government work closely with Standards Australia to establish a series of national standards in relation to EVs.

Executive Summary

Electric vehicles (EVs) are at the forefront of a major transformation of the world's transport sector. Global EV sales are growing rapidly, driven by government policy in large consumer markets in Europe, Asia and North America. Vehicle manufacturers are leading the transition, investing heavily to expand their EV offerings and improve EV driving range and performance. The technological disruption is also providing opportunities for new business models and companies to emerge.

EV uptake in Australia lags behind that of other comparable countries due to a relative absence of overarching policy direction from Australian Governments. The higher upfront cost of EVs, concerns about driving range, lack of recharging infrastructure, and limited model availability are key factors hindering consumer uptake.

In the Committee's view, widespread use of EVs in the Australian transportation fleet would deliver significant economic, environmental and health benefits to Australian consumers and society. It would also create new opportunities for Australian industry. There would be challenges associated with increasing EV uptake, but they can be managed with well calibrated regulatory settings.

The Committee heard evidence that traditional automotive businesses are already pursuing opportunities in EV component manufacturing and assembly. New industries, such as charging infrastructure manufacturing and installation, battery manufacturing, recycling, repurposing and related mining and processing activities, and EV research and development are also emerging as growth sectors for the Australian economy.

The Committee received a wealth of information and evidence throughout the inquiry and thanks all those who participated. The Committee has made 17 recommendations which aim to help Australia accelerate EV uptake, while also managing the risks, and support Australian industry to capitalise on the significant opportunities presented by a transition to EVs.

Australian Governments should prioritise the development of a national EV strategy and an inter-governmental taskforce to lead its implementation. National EV sales targets could be set to deliver certainty to business and consumers, and careful examination should be given to policies that may be introduced to reduce the upfront cost of EVs and improve their price competitiveness with internal combustion engine vehicles.

The Australian Government should set EV targets for the Australian Government Fleet and work with state and local government to coordinate fleet procurement. It should partner with business to manage and facilitate the roll out of charging infrastructure, establish consistent national standards, and ensure new developments and the electricity grid are 'EV charger ready'. Government could actively assist

industry to develop its domestic EV manufacturing and supply and value-chain capabilities.

In the absence of appropriate regulatory settings, Australia's near term EV uptake is likely to be modest. Slow uptake will continue to result in EV manufacturers not prioritising the Australian market and fewer EV models being available to Australian motorists. It will also delay the realisation of substantial economic, environmental and health benefits, and risk seeing opportunities for economic development pass by.

Chapter 1

Introduction

Establishment of the Committee

1.1 On 27 June 2018, the Senate established the Senate Select Committee on Electric Vehicles (Committee) to inquire into the use and manufacture of electric vehicles (EV) in Australia by 17 October 2018.¹ In particular, the Committee was to inquire into and report on the following matters:

- a) the potential economic, environmental and social benefits of widespread electric vehicle uptake in Australia;
- b) opportunities for electric vehicle manufacturing and electric vehicle supply and value chain services in Australia, and related economic benefits;
- c) measures to support the acceleration of electric vehicle uptake;
- d) measures to attract electric vehicle manufacturing and electric vehicle supply and value chain manufacturing to Australia;
- e) how federal, state and territory Governments could work together to support electric vehicle uptake and manufacturing, supply, and value chain activities; and
- f) any other related matters.²

1.2 The Senate granted an extension of time for reporting until 4 December 2018³ and 30 January 2019.⁴

Conduct of the inquiry

1.3 The inquiry was advertised on the Committee's website and by media release. The Committee invited submissions from over 200 individuals and organisations by 27 July 2018. Submissions continued to be accepted after this date. The Committee received 137 submissions which are listed at Appendix 1.

1.4 The Committee held public hearings in Adelaide on 10 August 2018; Canberra on 17 August 2018; Melbourne on 31 August 2018; Brisbane on 27 September 2018; and Canberra on 18 October 2018. A list of the witnesses who gave evidence at the public hearings is available at Appendix 2.

1.5 The Committee also conducted site visits to Precision Buses on 9 August 2018 (Adelaide, South Australia); Nissan Casting Australia Plant and SEA Electric on 30 August 2018 (Dandenong, Victoria); and Tritium on

1 *Journals of the Senate*, No. 104—27 June 2018, pp. 3336–3337.

2 *Journals of the Senate*, No. 104—27 June 2018, pp. 3336–3337.

3 *Journals of the Senate*, No. 110—20 August 2018, p. 3534.

4 *Journals of the Senate*, No. 135—4 December 2018, p. 4397.

27 September 2018 (Murrarie, Queensland). Summaries of the site visits can be found in Appendix 3.

1.6 Submissions, additional information and the Hansard transcripts of evidence may be accessed through the committee website at: https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Electric_Vehicles.

1.7 The Committee thanks those who made submissions to the Committee and appeared as witnesses at public hearings. The Committee extends its sincere appreciation to hosts at the site visits from Precision Buses, Nissan Casting Australia Plant, SEA Electric and Tritium.

Structure of the report

1.8 Chapter 1 is an introductory chapter which outlines the administrative details of the Committee's inquiry. The remainder of the report is structured as follows:

- Chapter 2 focuses on the background and projections for EVs in Australia and globally.
- Chapter 3 examines the benefits and challenges of increased EV uptake and use in Australia.
- Chapter 4 considers the opportunities for Australian industry in manufacturing EVs, EV components and supporting infrastructure.
- Chapter 5 explores ways to seize the opportunity and manage the risks of increasing EV uptake.
- Chapter 6 draws together the Committee's conclusions and recommendations.

Chapter 2

Electric vehicles—Definitions, background and projections

Introduction

2.1 This chapter provides a background to the electric vehicle (EV) industry and projections about the industry's future focusing on:

- Definition of an EV;
- EV statistics and projections;
- Hydrogen, hybrid and electric cars;
- Autonomous vehicles; and
- Public and active transport.

What is an EV?

2.2 There are a broad range of views on what constitutes an EV. Some submissions proposed a narrow approach, defining electric vehicles as vehicles propelled by one or more electric motors, and that can be plugged-in to charge.¹ A similar definition was adopted by the Victorian Parliament in its *Inquiry into electric vehicles*.²

2.3 Two categories of vehicles fit within this definition:

- **Battery-Electric Vehicles (BEVs)**—vehicles propelled by one or more electric motors, with batteries that require recharging from an external electricity source. Examples: Nissan Leaf, Tesla Model S, and Jaguar I-Pace; and
- **Plug-in Hybrid Electric Vehicles (PHEVs)**—vehicles powered by one or more electric motors with batteries that can be recharged using an external electric source, and a liquid fuel range extender/internal combustion engine (ICE). Examples: Mitsubishi Outlander PHEV, Mercedes-Benz C350e, BMW 330e, and Audi A3 e-tron.³

2.4 The Committee also received evidence that the following categories of vehicles should be included in the definition of EVs:

- **Hydrogen Fuel Cell Vehicles or Fuel Cell Electric Vehicles (FCEVs)**—vehicles propelled by one or more electric motors powered by electricity

1 Dr Jake Whitehead, *Submission 49*, p. 5. See also: Royal Automobile Club of WA, *Submission 117*, p. [3].

2 Parliament of Victoria, *Inquiry into electric vehicles*, May 2018, p. 3.

3 Dr Jake Whitehead, *Submission 49*, p. 5.

generated on-board by a hydrogen fuel cell, and that require refuelling with hydrogen gas. Examples: Toyota Mirai, Hyundai Nexo;⁴

- **Hybrid Electric Vehicles (HEVs)**—combine an ICE with one or more electric motors and batteries, but cannot be plugged-in to an external electricity source to recharge. Example: Toyota Camry Hybrid.⁵

2.5 In its submission, the Department of the Environment and Energy stated that 'the term "Electric Vehicle" commonly includes PHEVs, BEVs and FCEVs'.⁶

2.6 Throughout this inquiry and for the purposes of this report, the Committee has been inclined to accept a definition of EVs that includes BEVs, PHEVs and FCEVs.

Background—current uptake, projections, and policy initiatives

Global uptake, projections and policies

2.7 Worldwide, in 2017, there has been a 57 per cent increase of new EV sales from the previous year to 3.1 million electric passenger cars sold. More than half of global sales of EVs were in China, where electric cars hold a market share of 2.2 per cent. Sales of EVs in China were more than double that of the United States, the next largest market.⁷ In 2017, the highest proportion of new EV car sales were in the following jurisdictions:

- Norway with 39 per cent of new car sales (560 000 units);
- Iceland with 11.7 per cent; and
- Sweden with 6.3 per cent.⁸

2.8 The Department of the Environment and Energy stated in their submission that:

Over one million new EVs have been added to the global fleet each year for the past three years. By 2030, the International Energy Agency expects between 125 million and 220 million EVs on the road globally and that EVs will comprise up to 12 per cent of light vehicle sales. Bloomberg New Energy Finance forecasts around 28 per cent of global new vehicle sales will be EVs in 2030, close to 30 million sales a year. Major vehicle manufacturers have committed to scaling up investments in EV technology in coming years.⁹

4 Hyundai Australia, *Submission 103*, p. [3].

5 NSW Parliamentary Research Service, *Electric Vehicles in NSW*, May 2018, pp. 1–2, <https://www.parliament.nsw.gov.au/researchpapers/Documents/electric%20vehicles%20in%20NSW.pdf> (accessed 15 August 2018).

6 Department of the Environment and Energy, *Submission 72*, p. 2. See also: Department of Infrastructure, Regional Development and Cities, *Submission 111*, pp. 3–4.

7 International Energy Agency, 'Global EV Outlook 2018', May 2018, pp. 20–21, <https://webstore.iea.org/global-ev-outlook-2018> (accessed 24 September 2018).

8 International Energy Agency, 'Global EV Outlook 2018', May 2018, p. 21.

9 Department of the Environment and Energy, *Submission 72*, p. 3.

2.9 The Electric Vehicle Council pointed towards the EV targets established by other nations. Some countries such as the UK and France have set a target of 100 per cent of new car purchases being EV by 2040, whilst others like the Netherlands and Norway aim to achieve the same target by 2025.¹⁰

Table 2.1: Electric Vehicle targets of selected markets¹¹

Country	Target	Date
China	100%	'near future'
UK	100%	2040
France	100%	2040
Norway	100%	2025
Netherlands	100%	2025
Japan	20–30%	2030
India	30%	2030
New Zealand	64,000	2021
USA	3.3 million	2025
Germany	6 million	2030
Taiwan	100%	2040
Ireland	100%	2030

2.10 The Electric Vehicle Council emphasised the exponential rise in new global EV sales from 47 000 in 2011 to over 1.1 million in 2017 and the automotive sector's intentions to invest '\$150 billion in electric vehicles by 2025'.¹² Many mainstream automotive manufacturers have established their own targets for EV sales ranging from 15–50 per cent of all sales by 2025 with the VW Group expected to offer 80 EV models. Whilst two Chinese automotive companies have set 100 per cent of sales as their benchmark within the same timeframe.¹³

2.11 In addition to targets, many jurisdictions are offering a range of other incentives to EV owners:

10 Electric Vehicle Council, *Submission 100*, p. 14.

11 Electric Vehicle Council, *Submission 100*, p. 14.

12 Electric Vehicle Council, *Submission 100*, p. 13.

13 Bloomberg New Energy Finance, *Submission 127*, pp. 8–9.

- New Zealand's Electric Vehicle Programme; which includes a target of 64,000 EVs by 2021, tax exemptions until EVs reach 2% of fleet, government fleet purchasing, an annual \$6m grant fund and \$1m annual funding for a consumer awareness campaign.
- The United Kingdom's Road to Zero Strategy; a target of 50-70% by 2030 and 100% by 2040, government fleet target of 25% by 2022 and 100% by 2030, financial incentives of up to £4,500 for cars, £7,500 for taxis and £8,000 for vans, and grant funding for R&D and charging infrastructure.¹⁴

2.12 One jurisdiction has seen a fall in EV uptake as a result of withdrawal of incentives. The Victorian Automobile Chamber of Commerce (VACC) observed:

...the dramatic fall of EV sales in Denmark, dropping 60.5 percent in the first quarter of 2017 following the phasing out of its tax incentives on EVs in 2016. This dramatic reduction suggests clean-energy vehicles are not currently attractive enough to compete against ICEs, without some form of subsidy.¹⁵

Price parity

2.13 The point when an EV purchase price reaches parity with ICE equivalents is a critical economic precursor to cost competitiveness and to higher levels of EV uptake. Bloomberg New Energy Finance submitted that price parity would be reached from the year 2024 up to 2040 in different segments of the market (for example, light passenger vehicle, commercial vehicles) in different countries.¹⁶ Mr Steve Bletsos of VACC agreed that EV sales would increase once price parity was achieved.¹⁷

Table 2.2: Year of EV up-front price parity with ICE vehicles in selected markets¹⁸

Segment	US	EU	China	Japan
Small	2027	2028	2030	2040
Medium	2025	2024	2024	2029
Large	2026	2025	2029	2027
SUV	2024	2026	2040	2025

¹⁴ Electric Vehicle Council, *Submission 100*, p. 1.

¹⁵ VACC, *Submission 26*, p. 12.

¹⁶ Bloomberg New Energy Finance, *Submission 127*, p. 6.

¹⁷ Mr Steve Bletsos, Senior Research Analyst, VACC, *Committee Hansard*, 31 August 2018, p. 77.

¹⁸ Bloomberg New Energy Finance, *Submission 127*, p. 6.

Australian uptake, projections and policies

2.14 The most recent data shows that EVs are a relatively small segment of the total Australian new car market and total vehicle fleet. Of the approximately 17 million light passenger vehicles in Australia, around 7 300 of these are BEVs and PHEVs.¹⁹ Recent annual sales figures show that of over a million cars purchased in 2017, around 2 300 were BEVs or PHEVs, about 0.2 per cent market share.²⁰

2.15 In a joint report by ClimateWorks and the Electric Vehicle Council, it is stated that in 2017, business bought 63 per cent of EVs, private buyers purchased 34 per cent whilst government bought only 3 per cent.²¹ This same report provided a state and territory breakdown of new EV purchases:

Australia's states and territories differ in their rate of electric vehicle uptake...In the last seven years, Victorians have purchased the highest number of electric vehicles, with 1,324 vehicles purchased between 2011 and 2017 (excluding Tesla vehicle numbers). When taking into account market size however, the ACT continues to outperform other jurisdictions: in 2017, ACT residents purchased 21 electric vehicles for every 10,000 vehicles sold.²²

2.16 Notwithstanding the recent increase in EV models, the Australian EV market is characterised by a relatively low number of models that are generally more expensive than overseas markets:

The number of electric vehicle models available in Australia increased 44 per cent in the same period, from 16 models in 2016 to 24 in 2017. Twenty of the 24 electric vehicle models available are in the luxury vehicle category, priced at over \$60 000. The cheapest electric vehicle currently available in Australia is the Renault Zoe priced at under \$50 000.²³

19 ClimateWorks Australia and Electric Vehicle Council, *The state of electric vehicles in Australia, Second Report: Driving Momentum in Electric Mobility*, (ClimateWorks Submission 46.1), June 2018, p. 6, <https://www.climateworksaustralia.org/story/media-release/australias-electric-vehicle-industry-gains-momentum-report> (accessed 25 July 2018).

20 Federal Chamber of Automotive Industries (FCAI), *Submission 119*, p. 4 & ClimateWorks, *Submission 46.1*, p. 6. See also: Electric Vehicle Council, *Submission 100*, p. 13; Department of Infrastructure, Regional Development and Cities, *Submission 111*, p. 5.

21 ClimateWorks, *Submission 46.1*, p. 7.

22 ClimateWorks, *Submission 46.1*, p. 7. See also: Mr Sam McLean, Senior Manager, Tesla, *Committee Hansard*, 10 August 2018, p. 3. Tesla do not provide annual sales figures to the FCAI Vendor Field Analytical and Characterization Technologies System (VFACTS) database.

23 Department of Infrastructure, Regional Development and Cities, *Submission 111*, p. 5. See also, for example: Mr Ali Asghar, Senior Associate, Bloomberg New Energy Finance, *Committee Hansard*, 31 August 2018, p. 11. Ms Sarah Fumei, Project Manager, ClimateWorks Australia, *Committee Hansard*, 17 August 2018, p. 59; The Australia Institute, *Submission 1.1*, p. 6.

2.17 The Committee heard that there are a variety of reasons for this, including less stringent Australian vehicle emission standards,²⁴ a lack of direct incentives for consumers to choose EVs,²⁵ and the absence of clear Federal Government policy.²⁶

2.18 In its submission, the Department of Infrastructure, Regional Development and Cities outlined some of the current Australian Government policies supporting the uptake of EVs:

The Australian Government currently offers a discount on the Luxury Car Tax (LCT) threshold for fuel efficient vehicles, such as electric vehicles. The 2017-18 threshold for fuel efficient vehicles of \$75,526 is \$10,432 higher than for other vehicles. At an LCT rate of 33 per cent, this effectively translates to a tax saving of up to \$3,442.

The Department also administers two measures providing information to consumers; the mandatory fuel consumption label for new light vehicles and the Green Vehicle Guide (GVG) website. Both the label and the GVG help consumers choose more efficient vehicles. All of the top 20 performing vehicle models currently listed on the GVG are electric or plug-in hybrid vehicles.²⁷

2.19 The Department of the Environment and Energy noted other Australian Government initiatives supporting EV uptake:

The Australian Renewable Energy Agency [ARENA] is funding research into consumer preferences for EVs. The Clean Energy Finance Corporation [CEFC] has made up to \$950 million in capital (debt and equity) available to assist business with investment in low emissions vehicles. The CEFC and ARENA recently commissioned Energeia to complete an Australian market study on electric vehicles, helping new businesses understand Australia's unique market needs.²⁸

2.20 The Department of the Environment and Energy also highlighted the work of the Ministerial Forum on Vehicle Emissions:

The Forum was established to provide a coordinated, whole-of-government approach to addressing vehicle emissions. It is consulting on ways to reduce vehicle emissions, including by supporting uptake of low emissions vehicles.

The Ministerial Forum brings together the Commonwealth Ministerial members of the [Council of Australian Governments' (COAG)] Energy Council and COAG Transport and Infrastructure Council. The COAG

24 Mr Ali Asghar, Senior Associate, Bloomberg New Energy Finance, *Committee Hansard*, 31 August 2018, p. 11.

25 Mr David Magill, Director, Government Relations and Public Policy, GM Holden, *Committee Hansard*, 31 August 2018, p. 65.

26 Australian Electric Vehicle Association, *Submission 8*, p. 2.

27 Department of Infrastructure, Regional Development and Cities, *Submission 111*, p. 6.

28 Department of the Environment and Energy, *Submission*, 72, p. 7.

Energy Council can coordinate and pursue the regulatory and governance reforms needed to prepare the electricity system for widespread EV uptake.²⁹

2.21 In addition to Australian Government initiatives, ClimateWorks and the Electric Vehicle Council observed there had been notable policy developments in Australia over the past 12 months, occurring mainly at a state, territory and local government levels:

The majority of state and territory governments across Australia have either announced or are developing an overarching electric vehicle policy framework or strategy, the ACT Government recently released their Transition to Zero Emissions Vehicles Action Plan 2018-21; the Queensland Government has released their electric vehicle strategy *The Future is Electric*; the Tasmanian Government outlines a range of electric vehicle action items in *Climate Action 21: Tasmania's Climate Change Action Plan 2017-2021*; and the New South Wales Government's *Future Transport Strategy* has been released for public consultation. The South Australian Government is also developing an electric vehicle strategy and the Northern Territory Government is considering a climate change framework.³⁰

2.22 The ACT Minister for Climate Change and Sustainability, Mr Shane Rattenbury, explained the key elements of the ACT Government's plan:

Our action plan is very short term—it's only a three-year plan—partly because we wanted to make sure we'd put something in place that we just got on with...

The key focus in the three-year action plan is a number of specific measures. The leading one, we believe, is that the ACT government have committed to transform our government fleet to 100 per cent electric vehicles over a three-year cycle...

Our action plan also includes the requirement for the installation of vehicle-charging infrastructure in new mixed-use and multiunit developments...it's very expensive to retrofit electric charging points into the basement of a large multiunit building because if you build it in at construction point the marginal cost is almost zero. So we've decided to mandate that into our planning laws so that we essentially future-proof these buildings that are going up at the moment in Canberra; we are seeing a significant number of new buildings.³¹

29 Department of the Environment and Energy, *Submission*, 72, p. 6.

30 ClimateWorks, *Submission 46.1*, p. 25. The NSW Government's released its Electric and Hybrid Vehicle Plan on 21 January 2019, see: NSW Government, *Future Transport 2056: Electric and Hybrid Vehicle Plan*, January 2019, available at: https://www.future.transport.nsw.gov.au/sites/default/files/media/documents/2019/Future_Transport_NSW_Electric_and_Hybrid_vehicle_plan.pdf (accessed 21 January 2019).

31 Mr Shane Rattenbury, MLA, ACT Minister for Climate Change and Sustainability, *Committee Hansard*, 17 August 2018, pp. 1–2.

2.23 Mr Rattenbury also referred to financial incentives provided by the ACT Government to consumers:

We have what I believe are currently the most generous concessions in Australia for electric vehicles. We have zero stamp duty at the time of purchase and then an ongoing 20 per cent discount for registration. We have been very conscious of how we provide subsidies.³²

2.24 Ms Sally Noonan, Chief Economist, Queensland Department of Transport and Main Roads (DTMR), explained the approach the Queensland Government is taking to support EV uptake and noted 'The Future is Electric: Queensland Electric Vehicle Strategy':

To accelerate the adoption of EVs, effort is needed from across multiple and diverse stakeholders, from the energy sector to tourism, fleet operators and industry development leaders. To raise awareness, [DTMR] has participated in multiple community events across Queensland, including showcasing the benefits of EVs and the electric superhighway at the recent Royal Queensland Show in Brisbane...

The Queensland government has committed a further \$2.5 million to build additional charging stations at new sites along the Queensland electric superhighway. Queensland now has the highest number of fast chargers in any state of Australia. The number of slower charging sites has also increased.³³

2.25 Ms Noonan also noted registration concessions that the Queensland Government offers for EVs.³⁴

2.26 Table 2.3 is a summary provided by ClimateWorks and the Electric Vehicle Council of the current policy approaches of Australian federal, state and territory governments that support EV uptake.

32 Mr Shane Rattenbury, MLA, ACT Minister for Climate Change and Sustainability, *Committee Hansard*, 17 August 2018, p. 3.

33 Ms Sally Noonan, Chief Economist, Queensland Department of Transport and Main Roads, *Committee Hansard*, 27 September 2018, p. 31.

34 Ms Sally Noonan, Chief Economist, Queensland Department of Transport and Main Roads, *Committee Hansard*, 27 September 2018, p. 31.

Table 2.3: Overview of federal, state and territory government policy³⁵

		ACT	NSW	NT	QLD	SA	TAS	VIC	WA	Cwth
Uptake	EV purchases 2011 - 2017	165	1238	13	688	957	61	1324	375	4821
	EV sales per 10,000 vehicles (2017)	21	10	1	6	22	3	10	8	7
Regulation	Vehicle CO ₂ emissions standards									•
Financial incentives	Stamp duty, registration and tax discounts	✓	✓	✓	✓	•		✓		✓
	Direct vehicle subsidy									•
	Fleet incentive									✓
	Charging infrastructure incentive	✓		•	✓		✓			•
	Toll and parking discounts				✓					
Non financial incentives	Vehicle lane and parking privileges	✓								
	Electric vehicle public transport trials	✓		✓		✓				
	Government fleet policy	✓	✓			✓	✓			
	Information and education programs	✓	✓		✓	✓	✓	✓		✓

Table notes: Policies that are in place are marked ✓, and policies under consideration are marked •. This table was compiled through a survey of Australia's state, territory and federal governments on their electric vehicle policies. The Australian Capital Territory, New South Wales, the Northern Territory, Queensland, South Australia, Tasmania, Victoria and Western Australia provided a response to our survey. For the Commonwealth Government we used the response provided for the previous report and we undertook additional desktop research study. Vehicle purchase numbers do not include Teslas.

2.27 Some submitters were optimistic about the future of EVs in Australia. The Australia Institute noted the Australian Energy Market Operator's forecasts that there will be between 526 000 and 3.9 million EVs on Australian roads by 2030.³⁶ Bloomberg New Energy Finance projected by 2025 that 6 per cent of new passenger vehicles will be EVs rising to 28 per cent by 2030, and 60 per cent by 2040.³⁷ The Department of the Environment and Energy observed:

EV uptake has been slower in Australia but is expected to increase as technology becomes more affordable and evolves to suit consumer requirements.³⁸

2.28 In a 2018 report commissioned by the ARENA, Energeia modelled three EV uptake scenarios for the Australian market—no intervention, moderate intervention and accelerated intervention. Energeia forecast by 2030 that yearly EV sales could range from 22 per cent of new passenger vehicles under a no intervention scenario to 49 per cent (moderate intervention), and up to 64 per cent (accelerated intervention).

2.29 Energeia stated its assumptions for the moderate and accelerated scenarios:

Moderate Intervention Scenario: assumes an unco-ordinated mix of policy support, across several layers of government, including potential federal policy changes to luxury car tax, fringe benefits tax and vehicle emissions standards, and a mix of the most likely state and local government [plug-in electric vehicle (PEV)]³⁹ support from the list below. This scenario assumes no long-term decarbonisation target.

- Australian states with net-zero targets and a history of policy action to support this in power generation introduce policies to support PEV uptake in their states. Policies include stamp duty and registration exemptions.
- Local and state government fleets are pushed to increase fleet purchases of PEVs where there is a comparable PEV in the class.
- Removal of restrictions on import of second-hand PEVs drives a larger second-hand market.
- Preferential parking and use of transit lanes.
- Assumes that a range of actors (governments, motoring associations, private companies) accelerate the roll-out of charging infrastructure which removes range anxiety, e.g. [Queensland] Superhighway and the NRMA network.

36 The Australia Institute, *Submission 1.1*, p. 1.

37 Bloomberg New Energy Finance, *Submission 127*, p. 17.

38 Department of the Environment and Energy, *Submission 72*, p. 3.

39 Energeia defines a PEV or plug-in electric vehicle as either a plug-in hybrid electric vehicle (PHEV) or battery electric vehicle (BEV).

- Assumes [Original Equipment Manufacturers] react to this policy support by increasing PEV model availability.⁴⁰

Accelerated Intervention Scenario: assumes the unco-ordinated policy and OEM actions in the Moderate Intervention scenario occur earlier and to a higher level of support, representing a more aggressive push to support PEVs. In addition, it is assumed that as foreign-produced ICEs model availability decreases that a total ban in ICE sales is implemented towards the end of the projection period.

2.30 Energeia described the likely trajectory of EV uptake under a moderate and no intervention scenario:

In the No Intervention scenario, PEV sales increase slower over time due to a reduced decline in PEV price premiums and model availability. Under the No Intervention scenario, the first PEVs to reach the two-year pay-back do so in 2027, three years later than the Moderate Intervention scenario. As a result, forecast PEV stock in the No Intervention scenario reaches almost 832,000 vehicles by 2030, 3.6 times smaller than the Moderate Intervention scenario. Looking further ahead, the PEV stock under the No Intervention scenario reaches 6.78 million vehicles by 2040, 48% smaller than the Moderate Intervention scenario.⁴¹

2.31 Table 2.4 provides a summary of the forecast model.

Table 2.4: EV uptake by scenario⁴²

Scenario	2018			2020			2030			2040		
	Yrly Sales (%)	Yrly Sales (000s)	Stock (000s)	Yrly Sales (%)	Yrly Sales (000s)	Stock (000s)	Yrly Sales (%)	Yrly Sales (000s)	Stock (000s)	Yrly Sales (%)	Yrly Sales (000s)	Stock (000s)
No Intervention	0%	3	10	1%	12	30	22%	257	832	73%	1,045	6,775
Moderate Intervention	0%	3	10	1%	12	31	49%	612	3,010	100%	1,895	13,078
Accelerated Intervention	0%	3	10	4%	44	79	64%	857	4,927	100%	2,247	17,315

2.32 Notwithstanding the projected increasing uptake of EVs, the Federal Chamber of Automotive Industries (FCAI) remained more circumspect, submitting its research findings that ICEs will 'remain the predominate [drivetrain] for Australia light vehicles out to 2030':

The internal combustion engine (ICE) will be the dominant source of power in passenger cars through to 2030. Hybrids will expand significantly (but they still have ICEs in them). Pure EVs will be niche.⁴³

40 Energeia, *Australian Electric Vehicle Market Study*, May 2018, p. 6.

41 Energeia, *Australian Electric Vehicle Market Study*, May 2018, p. 70, prepared for Australian Renewable Energy Agency and Clean Energy Finance Corporation.

42 Energeia, *Australian Electric Vehicle Market Study*, May 2018, p. 70.

43 FCAI, *Submission 119*, p. 8.

2.33 FCAI also noted that the 'incremental transition to low-emission power trains' would be a function of the relatively low replacement rate of the large Australian light passenger car fleet and that as annual new vehicle sales currently only represent 6.75 per cent of this fleet (and that new EV sales represent 0.2 per cent of this) that this would be a gradual process.⁴⁴

Charging infrastructure

2.34 There is a variety of charging infrastructure or electric vehicle supply equipment (EVSE). Typically, these fall into three categories that are determined by the amount of charge that can be delivered in a set period of time which in turn determines how quickly an EV battery can be charged. First, is the standard household plug (less than 3.7 kilowatts (kW)). Second, is a slow charger (3.7kW to 22kW). Lastly, there are the fast chargers which can range from 22kW to 43kW. All of these chargers use alternating current (AC).⁴⁵

2.35 There is now a range of DC chargers with up to 350kW, with higher levels currently under development.⁴⁶ The benefit of these chargers with a faster charging capacity is that an EV with a 60kW battery can be recharged in about 15 minutes, with new higher capacity chargers (up to 475kW) likely to reduce this time further.⁴⁷ Public charging infrastructure generally falls into two categories—fast/ultra-fast chargers for long-haul applications and slower chargers for destination or convenience charging, such as at supermarkets or parking stations.

2.36 ClimateWorks and the Electric Vehicle Council observed that in 2018 there were 783 public charging sites in Australia—an increase of 64 per cent from 476 in 2017—equating to 'one charging station for every six EVs'. The vast majority of these—714 chargers—are AC chargers.⁴⁸ These public chargers are in addition to chargers found in homes (which in most countries is estimated to be about one private charger—home or work—per electric car).⁴⁹

2.37 Figure 2.1 shows the total number of chargers found worldwide with China being the dominant in terms of EV units sold and publicly accessible chargers. China has nearly three-quarters of the publicly accessible fast chargers despite holding 40 per cent of EV stock.

44 FCAI, *Submission 119*, pp. 4 & 6.

45 International Energy Agency, 'Global EV Outlook 2018', May 2018, p. 42.

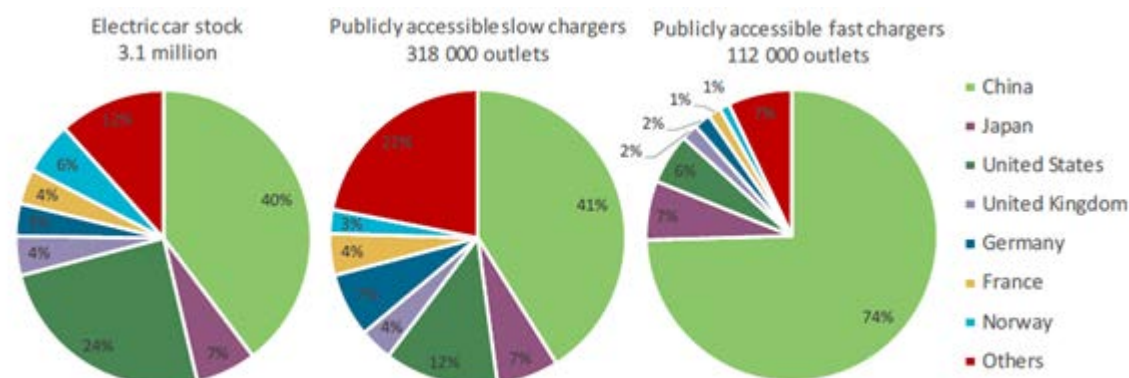
46 International Energy Agency, 'Global EV Outlook 2018', May 2018, p. 42. See also: Mark Kane, 'Chargefox launches first ABB Ultra-Fast Chargers in Australia', *InsideEVs*, 25 October 2018, <https://insideevs.com/chargefox-abb-ultra-fast-chargers-australia/> (accessed 26 November 2018).

47 See, for example: Dr Paul Sernia, Chief Product Officer, Tritium, *Committee Hansard*, 27 September 2018, p. 8; Tritium, <https://www.tritium.com.au/veefillpk> (accessed 26 November 2018).

48 ClimateWorks, *Submission 46.1*, p. 13.

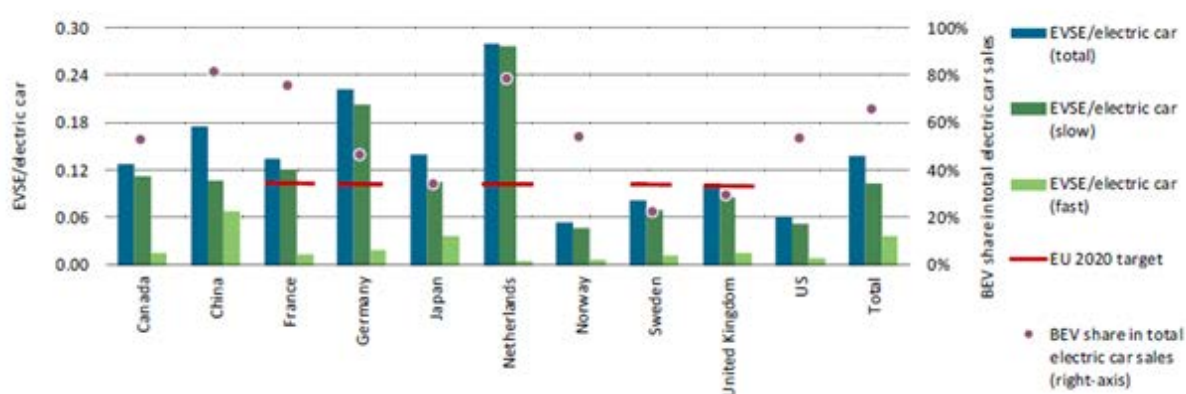
49 ClimateWorks, *Submission 46.1*, p. 13.

Figure 2.1: Electric car stock and publicly accessible charging outlets by type and country, 2017⁵⁰



2.38 The Australian ratio of about one charger to every six EVs compares favourably with other countries, but also reflects the relatively low numbers of EVs in Australia. A comparison of the ratio of EV chargers to EVs in other countries with a higher proportion of EVs can be found below in Figure 2.2.

Figure 2.2: Ratio of publicly available charging outlets per electric car for selected countries⁵¹



2.39 Charging infrastructure and its interaction with the electricity grid will be discussed later in the report.

Diverse range of EVs—light passenger, commercial and public transport

2.40 The Committee notes that there is a wide diversity of EV transport types, from light passenger vehicles, to commercial vehicles, buses, boats, planes, bikes, and trackless trams. While the Committee received evidence in relation to a range of EVs,

⁵⁰ International Energy Agency, 'Global EV Outlook 2018', May 2018, p. 46.

⁵¹ International Energy Agency, 'Global EV Outlook 2018', May 2018, p. 47.

the discussion focussed primarily on light passenger vehicles, followed by commercial vehicles and buses.

Hydrogen, hybrids or electric only

2.41 Earlier in the chapter, the different types of EVs including BEVs, PHEVs, and FCEVs (or hydrogen powered vehicles) were described. There were a range of views put forward as to what the transport fleet of the future would and should look like, and how this will influence the choices of consumers.

Hydrogen fuel cell vehicles

2.42 Ms Claire Johnson, Chief Executive Officer of Hydrogen Mobility Australia (HMA) made the following observation about hydrogen as a fuel source:

The use of hydrogen in the mobility sector is being recognised globally as a solution to reducing greenhouse gas emissions and the world's reliance upon fossil fuels...

With Australia's competitive advantages in renewable energies, combined with our automotive expertise from the ongoing R&D post local manufacturing in the country, we are really well placed to optimise the electric revolution taking place in the transport sector from both the hydrogen electric and battery electric perspective. However, in relation to hydrogen transport, the opportunity is even more significant. Australia is increasingly being recognised as a potential large-scale exporter of hydrogen to the world, and the CSIRO technology launched just this week in Brisbane represents a stepping stone towards fulfilling this exciting objective.⁵²

2.43 Ms Johnson explained how hydrogen can be produced on-site at a service station with an energy source and water. Hydrogen can also be transported and stored using existing infrastructure:

You can make your own hydrogen on site with an electrolyser—so generating hydrogen from water—or, alternatively, that hydrogen can be delivered via a pipeline or via a tube trailer. They are really the three methods by which the hydrogen is getting to the stations.⁵³

2.44 Associate Professor Nerimi Ertugrul, from the School of Electrical and Electronic Engineering at the University of Adelaide, observed that 'based on the technical aspects, hydrogen has a future in big trucks, in long distance travel'.⁵⁴

52 Ms Claire Johnson, Chief Executive Officer, Hydrogen Mobility Australia, *Committee Hansard*, 10 August 2018, p. 26.

53 Ms Claire Johnson, Chief Executive Officer, Hydrogen Mobility Australia, *Committee Hansard*, 10 August 2018, p. 26.

54 Associate Professor Nerimi Ertugrul, School of Electrical and Electronic Engineering, University of Adelaide, *Committee Hansard*, 10 August 2018, p. 44.

2.45 Dr Jake Whitehead of the University of Queensland affirmed that hydrogen FCEVs could play a role in this space, whilst also acknowledging that there are other non-electric solutions available:

The big challenge, I'll openly admit, is longer-haul travel. When we're talking about semitrailers that do 2,500 kilometres at the moment, current battery technology is just not feasible for reaching that distance in terms of the energy density. So, that's where we've got to try to understand what other technology's out there. Hydrogen's one option that may make sense, recognising that it's going to have a pretty high cost for fuel but also for infrastructure.⁵⁵

2.46 In an answer to a question taken on notice, HMA noted that 'the tank to wheel efficiency of a hydrogen fuel cell vehicle is less efficient' than a lithium battery powered EV.⁵⁶ However, Ms Johnson noted that refuelling a FCEV is comparable with a diesel or petrol vehicle.⁵⁷ Dr Whitehead quantified the difference in efficiency between FCEVs and other types of EVs such as BEVs and PHEVs:

Every time you change the molecules, you require energy, so in that process of extracting water, applying electricity to split it and compress it, transport it and run it through a hydrogen fuel cell vehicle, there are many more steps, and so, across those steps, there's a far greater loss. We talk about well-to-wheel efficiencies, and, with hydrogen fuel cell vehicles, they're a little bit better than petrol and diesel vehicles, but only by a magnitude of a couple of per cent, whereas electric vehicles are much higher. That's because you can use that electricity to directly charge a battery.

2.47 Dr Whitehead also commented on the likely cost differential between the two technologies:

Based on the current projections of improvements in both technologies, we expect that EVs are going to stay around \$3 per 100 kilometres, whereas hydrogen fuel cell vehicles will be \$14 to \$16 per 100 kilometres, so that is a significant price differential for consumers as well.⁵⁸

2.48 Dr Whitehead extrapolated on the impact a fully hydrogen powered fleet versus a fully electric fleet would have on electricity demand:

Let's just play out a hypothetical here where we're talking about 100 per cent of the passenger vehicle fleet in Australia being based on hydrogen. That's 14 million cars. That would result in about a 60 to 70 per cent increase in the national consumption of electricity. That's a major, major

55 Dr Jake Whitehead, Research Fellow, School of Civil Engineering, University of Queensland, *Committee Hansard*, 27 September 2018, p. 53.

56 Hydrogen Mobility Australia - answers to questions on notice from public hearing in Adelaide on 10 August 2018 (received 11 September 2018).

57 Ms Claire Johnson, Chief Executive Officer, Hydrogen Mobility Australia, *Committee Hansard*, 10 August 2018, p. 28.

58 Dr Jake Whitehead, Research Fellow, School of Civil Engineering, University of Queensland, *Committee Hansard*, 27 September 2018, p. 51.

energy increase required for the country to be able to go through. If we compare that to EVs, we're talking about something around 15 per cent.⁵⁹

2.49 In response to a question on the risks and dangers of using and storing hydrogen, Ms Johnson said:

Hydrogen fuel cell cars are on sale around the world, and the regulations, codes and standards have been developed for the handling of hydrogen gas from a transport perspective. The tanks themselves have been tested. They are tested in a fire bath, they are dropped from significant heights and they even do a gunshot test. They're actually made of carbon fibre that is inches thick.

There have been no issues to date with the number of fuel cell cars on the roads. As I mentioned, there are regulations in place overseas, and we see the handling of hydrogen gas as no less safe than petrol or diesel. Because hydrogen is actually lighter than air, if there is to be a hydrogen leak, what will occur is that the hydrogen will actually dissipate into the air itself, unlike LPG, for instance, which is heavier than air, so that can pool in particular areas. Hydrogen does have some risks, of course, but they're all manageable, and they've been addressed overseas.⁶⁰

2.50 Energeia acknowledged that FCEVs are seen as a potential challenger to plug-in electric vehicles, however noted the following downsides with FCEVs:

FCEVs might require an entirely new hydrogen infrastructure to be developed, compared to PEV's which can rely on the existing electricity network for energy delivery.⁶¹

2.51 Energeia continued:

It is worth noting that FCEV development has progressed at a slower pace than PEVs, and model availability is limited.

The key question for FCEVs then is when FCEV costs, model availability and refuelling time will come down to benchmark levels, keeping in mind the rate of PEV improvement in driving range and refuelling time. In Energeia's view, recent PEV announcements by FCEV stalwarts including Toyota and Honda signals that even they are finally accepting that PEVs may become the dominant technology longer-term.⁶²

2.52 Table 2.5 sets out plug-in electric vehicle and FCEV performance relative to ICE.

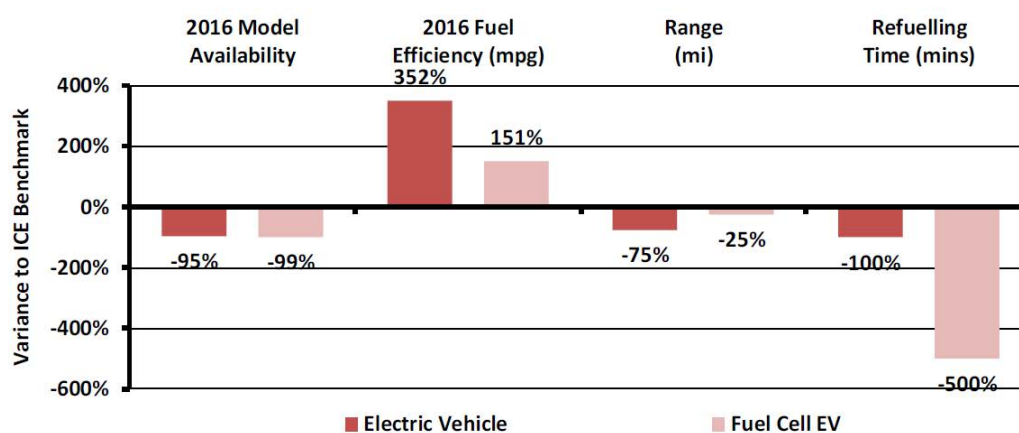
59 Dr Jake Whitehead, Research Fellow, School of Civil Engineering, University of Queensland, *Committee Hansard*, 27 September 2018, p. 51.

60 Ms Claire Johnson, Chief Executive Officer, Hydrogen Mobility Australia, *Committee Hansard*, 10 August 2018, p. 29.

61 Energeia, *Australian Electric Vehicle Market Study*, May 2018, p. 47, <https://arena.gov.au/assets/2018/06/australian-ev-market-study-report.pdf> (accessed 29 November 2018).

62 Energeia, *Australian Electric Vehicle Market Study*, May 2018, p. 48.

Table 2.5: Plug-in Electric Vehicle and FCEV performance relative to ICE⁶³



2.53 HMA argued in its submission that 'any discussion pitching one clean technology against another limits the world's ability to achieve meaningful emission reductions'.⁶⁴

2.54 Woodside Energy provided the following summary of the global uptake of hydrogen FCEVs (HFCEVs):

Hydrogen is being used successfully as a fuel in California where half of the world's private HFCEVs have been adopted. California has 30 refuelling stations that service 3,430 cars, and plans to build 200 stations by 2025.

In Japan, there are currently 100 hydrogen refuelling stations. By May 2021, Japan aims to have 160 hydrogen refuelling stations and 40,000 HFCEVs on the country's roads. By 2030, it aims to have 900 stations to service some 800,000 HFCEVs including buses and forklifts.

...Korea currently has 12 hydrogen refuelling stations with 310 planned for operation by 2022. The Korean government has ordered 5000 Hyundai Nexa HFCEVs.

Hydrogen vehicle uptake has increased in European countries such as Germany, Italy, France, and the UK. Hydrogen buses are a core part of their clean air strategy.⁶⁵

Plug-in hybrid electric vehicles

2.55 Range anxiety was highlighted as a barrier to EV uptake, particularly in a large country such as Australia. A number of witnesses flagged the role that PHEVs could play in providing greater certainty for long distance or more remote trips

63 Energeia, *Australian Electric Vehicle Market Study*, May 2018, p. 48.

64 Hydrogen Mobility Australia, *Submission 73*, p. [5].

65 Woodside Energy, *Submission 42*, p. [2].

through maintaining a traditional ICE as a back-up propulsion system.⁶⁶ Mr David Magill, Director of Government Relations and Policy at General Motors (GM) Holden told the Committee about a recent plug-in hybrid model and the benefits it provided in relation to alleviating range anxiety:

In 2012 we had the Holden Volt, which was an electric vehicle with a [petrol] range extender. You could drive that vehicle permanently on battery, if you charged it up within the range of about 110 kilometres of driving on the battery. If you wanted to go further, the vehicle annulled range anxiety because it had a little generator that you could put some petrol in and extend the range to 650-odd kilometres.⁶⁷

2.56 Mr Bernard Nadal, Senior Manager, Product Planning and Pricing at Toyota Australia expressed a similar view, supporting plug-in hybrids as an interim measure bridging the gap between conventional ICEs and fully electric vehicles:

...ultimately, the push to an electrified environment won't happen overnight, and the purpose of plug-in [hybrids] is to allow people to experience the technology, become familiar with it and render the benefits of not just a hybrid system but also the extension of an increased battery range within the vehicle.⁶⁸

Autonomous vehicles

2.57 The Committee has also heard that the development of autonomous vehicle technology will occur in parallel with the increased uptake of EVs. The recent Victorian Parliamentary report on EVs stated that the four pillars underpinning the future of transport are electric, connected, automated and shared.⁶⁹ Mr Daniel Hilson, Founder and Managing Director at Evenergi put the future of the transport and energy sectors into context:

In a world where mobility and energy markets are being completely disrupted, we need to ask ourselves now if we want to be part of a backwater where old technology and old mobility solutions come to die or we want to be leading the world in which autonomous, connected, electric shared vehicles are implemented alongside and integrated with a renewable-powered and smart grid.⁷⁰

66 See, for example: Mr Craig Norris, National PHEV Sales Manager, Fleet, Mitsubishi Motors Australia Ltd, *Committee Hansard*, 10 August 2018, p. 2.

67 Mr David Magill, Director of Government Relations and Policy at GM Holden, *Committee Hansard*, 31 August 2018, p. 62.

68 Mr Bernard Nadal, Senior Manager, Product Planning and Pricing, Toyota Australia, *Committee Hansard*, 31 August 2018, p. 66.

69 La Trobe University, *Submission 18*, p. 1.

70 Mr Daniel Hilson, Founder and Managing Director, Evenergi, *Committee Hansard*, 31 August 2018, p. 57.

2.58 Mr Tony Wood, Director of the Energy Program at the Grattan Institute warned that the future of transportation would be characterised by automation and that must be considered as part of any policy development with respect to EVs:

the potential for autonomous vehicles is a very different dimension that adds significantly to the social consequences of transport. The way in which electric vehicles would then be operated, charged, managed and owned may very well be different. Again, we need to be careful that we don't commit our policy to a specific assumption about what the future might hold.⁷¹

2.59 Mr Wood elaborated:

The consequences of autonomous vehicles which may be owned not by individuals but rather by companies, from whom we would use the vehicle, is a completely different paradigm. We'd have fewer vehicles on the road, but they'd be doing many more kilometres, and their usage and the way they would be charged and recharged would be completely different to if we had personal vehicles.⁷²

2.60 In Adelaide, the Committee heard from a panel of private companies that are currently developing and rolling out autonomous vehicle technology both here in Australia and internationally. Mr Simon Pearce, Head of EasyMile Asia Pacific told the Committee about the work that his company have been involved in:

EasyMile, as an organisation, is around 4½ years old. We have introduced over 260 autonomous electric vehicles around the world. Of those, we currently have nine in Australia, two from last year and seven this year. We are continuing to see an expansion in the autonomous electric vehicle market, which is shared autonomous public transport. To complement that we have recently partnered with the Transit Australia Group for automation of their larger electric vehicle, the XDi bus, within Adelaide, for production here. We'll continue to support not only the EZ10 shuttle but also other electric vehicles with other original equipment manufacturers, from an automation perspective, and 95 per cent of our vehicles are electric vehicles which do not have combustion engines.⁷³

2.61 The Committee were told that there are a number of regulatory challenges with autonomous vehicles, specifically relating to operating driverless vehicles in public spaces such as roads, and that these vehicles are legally required to have a driver's seat and dashboard despite their being no operational requirement for either.⁷⁴

71 Mr Tony Wood, Director, Energy Program, Grattan Institute, *Committee Hansard*, 31 August 2018, p. 13.

72 Mr Tony Wood, Director, Energy Program, Grattan Institute, *Committee Hansard*, 31 August 2018, p. 15.

73 Mr Simon Pearce, Head, EasyMile Asia-Pacific, *Committee Hansard*, 10 August 2018, p. 12.

74 Mr Simon Pearce, Head, EasyMile Asia-Pacific, *Committee Hansard*, 10 August 2018, p. 13.

The Committee also heard about a number of other constraints that would impede the uptake of autonomous vehicles including issues around legal liability and insurance.⁷⁵

2.62 Mr Christian Reynolds, Director of bus manufacturer, Precision Buses pointed out that automation offers an opportunity to prevent accidents rather than simply mitigating the consequences of one:

I think, over the term, product design and architecture has been led towards management of crash or management of an event. Technology within autonomous has moved us more towards prevention, which then leaves the gap in how you engineer a product between and the classifications of product between. I think that's going to be the interesting place, because autonomous pods don't have the ANCAP five-star rating that passenger cars would have, but it prevents more than a historic vehicle would prevent.⁷⁶

2.63 Although automation is starting to become more visible in controlled environments such as airports, witnesses acknowledged that full automation is still a number of years away:

A level 5 vehicle, which is fully autonomous—eyes-off, hands-off—that's at least seven to 10 years away at this stage.⁷⁷

First mile and last mile transport solutions

2.64 A number of submitters commented on the role that autonomous EVs would play in delivering first mile and last mile transportation solutions in concert with a broader public transport network. Sage Automation described the benefits of this type of transport solution:

Providing enhanced mobility for those with disabilities and the aged by extending public transport to include the first mile / last mile of a journey. For example, providing transport from a car park to a hospital entrance or from a train station to a university.⁷⁸

2.65 In its submission, La Trobe University described how first mile and last mile transportation augments public transport:

Automated and electric vehicles, particularly when providing connectivity to public transport for what is referred to as 'first and last mile connectivity solutions', have the potential to substantially shift attitudes to mass transit. If an automated vehicle can bridge the gap between the source (e.g. one's home), the destination (e.g. La Trobe University) and the closest mass transit transportation hubs already (e.g. train stations or bus interchanges),

75 Mr Adrian Fahey, Chief Executive Officer, SAGE Automation & Mr Roger Van der Lee, Director, Autonomous Programs, Aurigo Ltd, *Committee Hansard*, 10 August 2018, p. 14.

76 Mr Christian Reynolds, Director, Fusion Capital and Director, Precision Buses, *Committee Hansard*, 10 August 2018, p. 25. See also: Associate Professor Jeremy Wooley, Director, Centre for Automotive Safety Research, University of Adelaide, *Committee Hansard*, 10 August 2018, p. 41.

77 Mr Simon Pearce, Head, EasyMile Asia-Pacific, *Committee Hansard*, 10 August 2018, p. 15.

78 Sage Automation, *Submission 84*, p. [6].

then people would be more likely to use the public transport already on offer.⁷⁹

2.66 The issue of familiarising and educating people on the use of EVs and AVs is examined further in Chapter 5.

Public and active transport

2.67 Internationally, there is an increased demand for electric buses. The Bus Industry Federation explained:

Shenzhen, with its fleet of more than 16 300 buses, is the world's largest and only all-electric bus fleet. Electric bus technologies featured prominently in Shenzhen Bus Group's Bukit Merah bus contract bid in Singapore. Volvo has announced that it will only launch electric and hybrid models starting from 2019. France and the UK have announced plans to ban sales of diesel and petrol cars by 2040, with local air quality again a key driver of this change but [greenhouse gas] emission reduction is also important. The Netherlands and Norway plan earlier phase out dates.⁸⁰

2.68 In its submission, Doctors for the Environment cited projections from Bloomberg New Energy Finance which suggested that sales of new electric buses could be as high as 84 per cent of all new buses by 2030. This trend would be driven by 'the total cost of electric buses being lower than conventional buses as early as next year'.⁸¹

2.69 A number of witnesses highlighted the need to promote an increased use of public transport and active transport.⁸² Whilst acknowledging the benefits of increased uptake of EVs, the Public Transport Users Association (PTUA) has advocated for a focus on a 'greater role for public EVs and active transport' in order to reduce some of the negative impacts of vehicle use such as traffic congestion.⁸³ Public transport and active transport requires significantly less land for travel and parking than private

79 La Trobe University, *Submission 18*, p. 3.

80 Bus Industry Confederation, *Submission 68*, pp. 3–5. See also: Queensland Conservation Council, *Submission 83*, p. 1.

81 Doctors for the Environment, *Submission 50*, p. 5. See also: Bloomberg New Energy Finance, *E-buses to surge even faster than EVs as conventional vehicles fade*, 12 July 2018, <https://www.bloomberg.com/professional/blog/e-buses-surge-even-faster-evs-conventional-vehicles-fade/> (accessed 10 October 2018).

82 See, for example: Dr Ingrid Johnston, Senior Policy Officer, Public Health Association of Australia, *Committee Hansard*, 17 August 2018, p. 40. Mr Shane Rattenbury, Minister for Climate Change and Sustainability, Australian Capital Territory Parliament, *Committee Hansard*, 17 August 2018, p. 2; Ms Michelle English, Associate Director, Sustainability, City of Adelaide, *Committee Hansard*, 10 August 2018, p. 48.

83 Public Transport User Association, *Submission 45*, p. 1.

vehicles.⁸⁴ The PTUA expressed the opinion that 'the benefits of EVs don't come from EV use *per se*, but from the non-use of private ICEVs'.⁸⁵

2.70 Notwithstanding these views on public transport, Mr Shane Rattenbury MLA, the ACT Minister for Climate Change and Sustainability advised the Committee of the overwhelming Australian trend to use private vehicles as the primary means of transport:

Certainly, in this city, we have the lowest public transport usage of the large cities in Australia, in terms of people getting to work, and a very dominant use of the private motor vehicle for transport around town. Ninety-five per cent of those transport emissions come from private motor vehicle use.⁸⁶

2.71 Ms Sally Noonan, Chief Economist at the Queensland Department of Transport and Main Roads reported that the Queensland Government was currently trialling the rollout of eleven electric buses in the Brisbane airport precinct as part of a collaboration with local government.⁸⁷ The South Australian Government is trialling electric buses⁸⁸ as too is the ACT Government which has recently purchased two fully electric buses and one hybrid bus.⁸⁹ As a result of a recent hybrid bus trial, which concluded that hybrid buses use 30 per cent less fuel than a standard diesel bus, the Victorian Government has committed to procuring 50 hybrid electric buses to be delivered by 2022.⁹⁰

2.72 Ms Noonan also described the Queensland government's partnership with organisations such as James Cook University, Queensland Rail and local governments to co-locate public charging infrastructure with public transport.⁹¹

Electric buses

2.73 In its submission, the Sassafras Group was quite supportive of electrifying buses and heavy vehicles:

The time tables and daily driving distances are well understood, and the vehicles and charging infrastructure can be readily configured to meet operational requirements. These vehicles will also provide the greatest public good as their have high annual driving distances therefore abating

84 Public Transport User Association, *Submission 45*, pp. 4 & 5.

85 Public Transport User Association, *Submission 45*, p. 13. Emphasis in original.

86 Mr Shane Rattenbury, Minister for Climate Change and Sustainability, Australian Capital Territory Parliament, *Committee Hansard*, 17 August 2018, p. 2.

87 Ms Sally Noonan, Chief Economist, Queensland Department of Transport and Main Roads, *Committee Hansard*, 27 September 2018, pp. 34–35.

88 Mr Christian Reynolds, Director, Precision Buses, *Committee Hansard*, 10 August 2018, p. 20.

89 Mr Shane Rattenbury, Minister for Climate Change and Sustainability, Australian Capital Territory Parliament, *Committee Hansard*, 17 August 2018, p. 3.

90 Bus Industry Confederation, *Submission 68*, p. 4. See also: Volvo, *Submission 70*, p. 1.

91 Ms Sally Noonan, Chief Economist, Queensland Department of Transport and Main Roads, *Committee Hansard*, 27 September 2018, p. 35.

more CO₂ and harmful exhaust emissions and their low operating cost will either reduce the cost of public transport subsidisation or lower the cost for commuters.⁹²

2.74 Mr Reynolds also noted that buses can, if needed, be charged very quickly. Notwithstanding some safety and engineering issues to be worked through, it is technically possible to charge an electric bus in about 10 minutes.⁹³ NHP reasoned that the usage pattern of buses is suited to night charging:

Buses form an integral part of the public transport networks in our cities, with thousands of them on the road every day. Fuel for these buses is typically diesel. The average bus in Melbourne does around 200km of stop-start driving in a 24 hour period, with a long period parked at a depot every night. This usage profile makes buses, especially the ones on shorter routes, a perfect candidate for transitioning to electric immediately.⁹⁴

2.75 The PTUA also noted that an increased use of public transport would result in significantly fewer road fatalities, indicating that use of private EVs would not change the number of fatalities associated with private internal combustion engine vehicle use.⁹⁵

2.76 The Bus Industry Confederation remarked on some of the challenges for electric buses including 'road infrastructure impacts of increased bus gross vehicle mass as a result of batteries'.⁹⁶ Volvo also noted that longevity remains an ongoing issue that manufacturers are working to resolve:

Our experience shows us that some electric buses last for 3 years—some last for 7 years, but none last for 15 to 20 years yet. Volvo's philosophy is that the bus we offer must achieve the same levels of reliability, longevity and service delivery as the diesel bus we replace. In the electromobility segment, the same principles apply as diesel in relation to reliability of the driveline, body life, parts support, dealer support and technical expertise.⁹⁷

2.77 Volvo also highlighted the role that hybrid electric buses could play as an interim measure on the journey to fully electric buses:

In operation, the Volvo diesel hybrid has proven over many years to be as reliable, or better than standard diesel buses. The design of the Volvo hybrid driveline enables the diesel engine to power the bus independently of the hybrid system if required. In addition, the fact the Volvo diesel hybrid does not rely on external electricity supply also ensures transport

92 Sassafras Group, *Submission 106*, p. 6.

93 Mr Christian Reynolds, Director, Precision Buses, *Committee Hansard*, 10 August 2018, p. 25.

94 NHP, *Submission 95*, p. [5].

95 Public Transport User Association, *Submission 45*, pp. 4–6.

96 Bus Industry Confederation, *Submission 68*, p. 5.

97 Volvo, *Submission 70*, p. 1.

security in case of power outage, which becomes a critical issue to consider in the move to full electric buses.⁹⁸

Trackless electric trams

2.78 An emerging type of electrified transport are trackless trams. Professor Peter Newman AO, Professor of Sustainability at Curtin University described trackless trams technology in a recent media article:

Trackless trams are neither a tram nor a bus, though they have rubber wheels and run on streets. The high-speed rail innovations have transformed a bus into something with all the best features of light rail and none of its worst features.

It replaces the noise and emissions of buses with electric traction from batteries recharged at stations in 30 seconds or at the end of the line in 10 minutes. That could just be an electric bus, but the [autonomous rail transit] is much more than that. It has all the speed (70kph), capacity and ride quality of light rail with its autonomous optical guidance system, train-like bogies with double axles and special hydraulics and tyres.

It can slide into the station with millimetre accuracy and enable smooth disability access. It passed the ride quality test when I saw kids running up and down while it was going at 70kph – you never see this on a bus due to the sway.⁹⁹

2.79 Professor Newman added that:

The autonomous features mean it is programmed, optically guided with GPS and LIDAR [Light detection and ranging remote sensing technology], into moving very precisely along an invisible track. If an accident happens in the right of way a "driver" can override the steering and go around. It can also be driven to a normal bus depot for overnight storage and deep battery recharge.

The standard [autonomous rail transit (ART)] system is three carriages that can carry 300 people, but it can take five carriages and 500 people if needed. In three years of trials no impact on road surfaces has been found.¹⁰⁰

2.80 Trackless trams can be delivered at a fraction of the cost of conventional light rail or tram systems—\$6–8 million per kilometre as opposed to \$80–120 million for recent projects undertaken in Sydney, Canberra and the Gold Coast.¹⁰¹

98 Volvo, *Submission 70*, p. 1.

99 Professor Peter Newman, 'Forget light rail, Perth: it's time to look at trackless trams', *WA Today*, 29 September 2018, <https://www.watoday.com.au/national/western-australia/forget-light-rail-perth-it-s-time-to-look-at-trackless-trams-20180928-p506qj.html> (accessed 15 October 2018).

100 Professor Peter Newman, 'Forget light rail, Perth: it's time to look at trackless trams', *WA Today*, 29 September 2018.

101 Professor Peter Newman, 'Forget light rail, Perth: it's time to look at trackless trams', *WA Today*, 29 September 2018.

Chapter 3

Increased EV uptake and use—benefits and challenges

Introduction

3.1 This chapter outlines the benefits and challenges associated with increased uptake in electric vehicles (EVs) and manufacturing opportunities in Australia.

Benefits

3.2 There are a range of economic, environment and social benefits that would result from an increased uptake in EVs that are widely known and have been canvassed in a number of recent reports.¹ These impacts are briefly summarised below.

Economic

3.3 A number of submissions highlighted the broad economic benefits of an increased uptake in EVs for both owner-operators of EVs, and the mining and manufacturing sectors.² A report titled *Recharging the economy: the economic impact of accelerating electric vehicle adoption* (PwC Analysis) was recently completed by PwC on behalf of the Electric Vehicle Council, NRMA and the St Baker Innovation Fund. This report found that if EVs made up 57 per cent of new car sales by 2030 there could be an increase in real GDP of \$2.9 billion and an increase in net employment of 13 400 jobs, and an additional investment of \$3.2 billion in charging infrastructure. These projections were based primarily on consumer savings and the rollout of charging infrastructure; however, the report did not consider the economic benefits to local manufacturing or investment in Australian electricity generation and transmission assets.³

3.4 The Australian Electric Vehicle Association (AEVA) of Victoria also claimed that significant savings would be made available to the economy as a reduction in liquid fuel costs:

1 See, for example: International Energy Agency, *Global EV Outlook 2018*, May 2018, <https://webstore.iea.org/global-ev-outlook-2018>; PwC, *Recharging the economy: The economic impact of accelerating electric vehicle adoption*, March 2018, (PwC, 'Recharging the economy', March 2018), <http://electricvehiclecouncil.com.au/wp-content/uploads/2015/05/Recharging-the-economy.pdf>; Victorian Legislative Council Economy and Infrastructure Committee, *Inquiry into electric vehicles*, (May 2018), <https://www.parliament.vic.gov.au/eic/inquiries/article/3507>; NSW Parliamentary Research Service, *Electric Vehicles in NSW*, May 2018, <https://www.parliament.nsw.gov.au/researchpapers/Documents/electric%20vehicles%20in%20NSW.pdf> (accessed 15 August 2018).

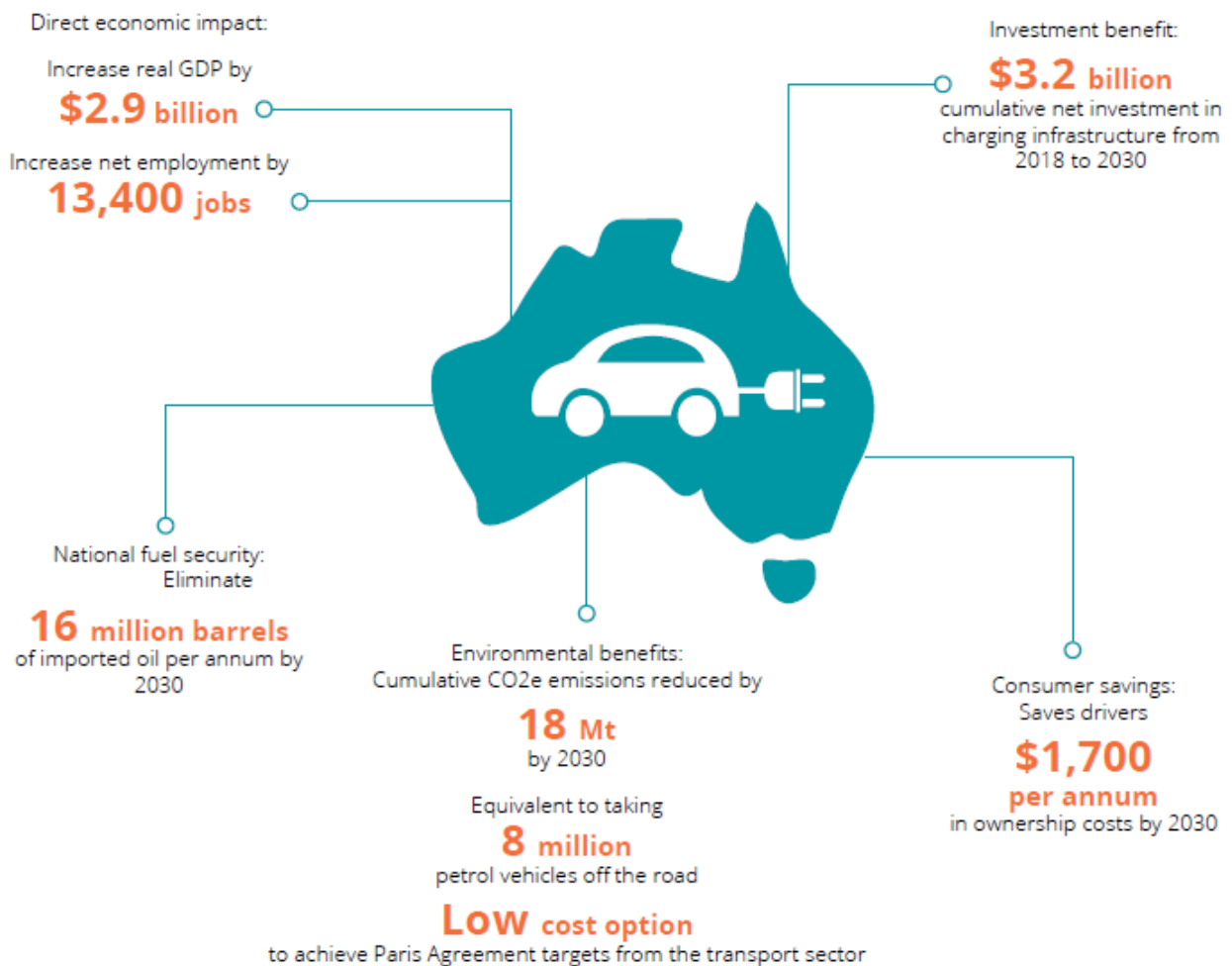
2 For example: Associate Professor Tim Nelson, Chief Economist, AGL Energy Ltd, *Committee Hansard*, 31 August 2018, p. 79; Ms Sarah Fumei, Project Manager, ClimateWorks Australia, *Committee Hansard*, 17 August 2018, pp. 60–61.

3 PwC, 'Recharging the economy', March 2018, p. 6. See also: AGL Energy, *Submission 55*, p. 3.

Direct fuel cost savings of \$500M per year and \$100M in maintenance costs for every 1 million electric cars in the national fleet. A potential \$7.8 billion per year saving for 80% penetration. Up to \$15 billion per year in fuel import replacement and benefit to the balance of payments, with \$8 billion transferred to the local economy, and a subsequent improvement to fuel security against disruption.⁴

3.5 The economic impacts associated with an increased uptake of EVs, as projected by the PwC Analysis, are summarised in Figure 3.1.

Figure 3.1: Projected economic benefits of high EV uptake in Australia between 2018 and 2030⁵



3.6 The Queensland Government cited the opportunities for 'new green jobs' such as those created at local Queensland EV charging infrastructure manufacturer, Tritium.⁶

4 PwC, 'Recharging the economy', March 2018. See also: AEVA (Victoria), *Submission 9*, p. 2.

5 PwC, 'Recharging the economy', March 2018, p. 4.

The EV owner-operator

3.7 There are also a number of economic impacts at the EV owner-operator level. Currently, the upfront cost of an electric car exceeds the cost of an internal combustion engine (ICE) equivalent. The Victorian Department of Environment, Land, Water and Planning (DELWP) acknowledged the comparatively high upfront cost as a significant barrier to EV sales.⁷ Mr Daniel Hilson, Founder and Managing Director at Everergi, explained his company's research on the cost of owning and operating an EV:

Our research has shown that there's about a \$5,000 gap in terms of the total cost of ownership of electric vehicles over five years, and that's based on quite an extensive model that we've built.⁸

3.8 Notwithstanding this, the purchase price of EVs is expected to fall in line with expected decreases in the costs of lithium-ion batteries.⁹ The Victorian Automobile Chamber of Commerce (VACC) reasoned that on current trends in battery pricing, consumers could expect price parity by 2025 and could be 'up to 15 per cent cheaper than equivalent' ICE vehicles by 2030¹⁰ based on EVs 'having a lower cost to produce based on raw materials and a less complex drivetrain'.¹¹ Bloomberg New Energy Finance projected that EVs would reach price parity with ICE by 2024.¹²

3.9 In their recent report, the Electric Vehicle Council made the following observation in relation to projected purchase prices of EVs:

Over the coming year, Nissan, Renault and Hyundai will join Tesla in introducing new electric vehicle models in Australia priced between \$35 000 and \$50 000. While a new car is not affordable for many Australians, the increased availability of vehicles at these prices will broaden the market, with fleet vehicles then entering the secondary market.¹³

3.10 The Committee also heard evidence that EVs are subject to greater depreciation of value than their ICE counterparts because of concerns about rapid

6 Queensland Department of Transport and Main Roads, *Submission 43*, p. [2].

7 Victorian Government Department of Environment, Land, Water and Planning, *Submission 129*, p. 7. See also: Queensland Department of Transport and Main Roads, *Submission 43*, p. [2].

8 Mr Daniel Hilson, Founder and Managing Director, Everergi, *Committee Hansard*, 31 August 2018, p. 57.

9 Dr Jacek Jasieniak and Prof. Mainak Majumder, Monash Energy Materials and Systems Institute, Monash University, *Submission 128*, p. 2.

10 VACC, *Submission 26*, p. 9.

11 Victorian Government Department of Environment, Land, Water and Planning, *Submission 129*, p. 7.

12 Bloomberg New Energy Finance, *Submission 127*, p. 5.

13 PwC, 'Recharging the economy', March 2018, p. 10.

technological development rendering older models obsolete and concerns about the longevity of battery life.¹⁴ Mr Behyad Jafari, Chief Executive Officer of the Electric Vehicle Council stated that the global experience is that these issues are resolved with increased EV uptake:

Depreciation is an issue because there's not a lot of data available, and people are asking questions like: what is the risk associated with reselling an electric vehicle? These are things that are being overcome globally that haven't been overcome in Australia.¹⁵

3.11 However, once a motorist has purchased a vehicle, the on-going operation and maintenance costs of an EV are significantly less than that of an ICE vehicle. The Tesla Owners Club of Australia noted that an EV has 'around 20 moving parts' as opposed to closer to 2000 in an ICE vehicle.¹⁶

3.12 The Electric Vehicle Council found that drivers could save \$2 326 per annum in ownership costs as 'EVs are less costly to maintain and run'.¹⁷ Associate Professor Tim Nelson, Chief Economist at AGL Energy remarked:

Over a 10-year ownership period, UBS estimate the total cost of ownership to be \$5,000 less for EVs relative to internal combustion engine vehicles by 2021, and \$11,000 less by 2025 as battery prices fall. This translates to projected savings of \$1,700 per annum by 2030. Total consumer savings over the entire period are estimated to reach \$14 billion.¹⁸

3.13 Fuel costs are a significant driver of the savings—an EV will cost around 3 cents per kilometre compared to around 10 cents per kilometre for an ICE equivalent (see Figure 3.2 below for more costs). Depending on the electricity price sensitivity (low to high pricing) and based on current petrol prices, the savings can range from \$4.72/100km (high electricity price) to \$11.04/100km (low electricity price) or the equivalent of \$0.50 per litre.¹⁹

14 See, for example: Bus Industry Confederation, *Submission 68*, p. 3. Professor Mainak Majumder, Department of Mechanical and Aerospace Engineering, Monash University, *Committee Hansard*, 31 August 2018, p. 41.

15 Mr Behyad Jafari, Chief Executive Officer, Electric Vehicle Council, *Committee Hansard*, 17 August 2018, p. 21.

16 Tesla Owners Club of Australia, *Submission 28*, p. 4. See also: Department of the Environment and Energy, *Submission 72*, p. 3.

17 Associate Professor Tim Nelson, Chief Economist, AGL Energy Ltd, *Committee Hansard*, 31 August 2018, p. 79.

18 Associate Professor Tim Nelson, Chief Economist, AGL Energy Ltd, *Committee Hansard*, 31 August 2018, p. 79.

19 Queensland Department of Transport and Main Roads, *Submission 43*, p. 2. See also: NSW Parliamentary Research Service, *Electric Vehicles in NSW*, May 2018, p. 5, <https://www.parliament.nsw.gov.au/researchpapers/Documents/electric%20vehicles%20in%20NSW.pdf> (accessed 15 August 2018).

3.14 Regenerative braking also brings about operating and cost efficiencies for EV owners as the car is able to recover battery charge through braking.²⁰ Mr Karl Gehling, Head of Corporate Communications and Government Relations at Mitsubishi Motors Australia explained:

Basically what happens is, if the car is ever on a downhill descent or in a coastal situation, then it collects the kinetic energy from the electric motors and puts that back into the batteries. That increases the EV driving range, which is amazing technology.²¹

3.15 Although these vehicle operating savings flow to the consumer, it does result in less business for automotive service and fuel retailers, which is discussed later in the chapter.

3.16 The Committee also heard that EV owners and drivers were being penalised through the application of additional demand charges on the use of public charging infrastructure. Mr Rodger Whitby, Chief Executive Officer of St Baker Energy Innovation Fund argued that if an EV 'plugs in at home versus down the street, it should aggregate to only one payment and not be two separate payments'.²² Furthermore, Fast Cities Australia reasoned that a demand charge exemption for public chargers would assist in encouraging EV uptake.²³

20 Resonant Solutions, *Submission 61*, p. 4.

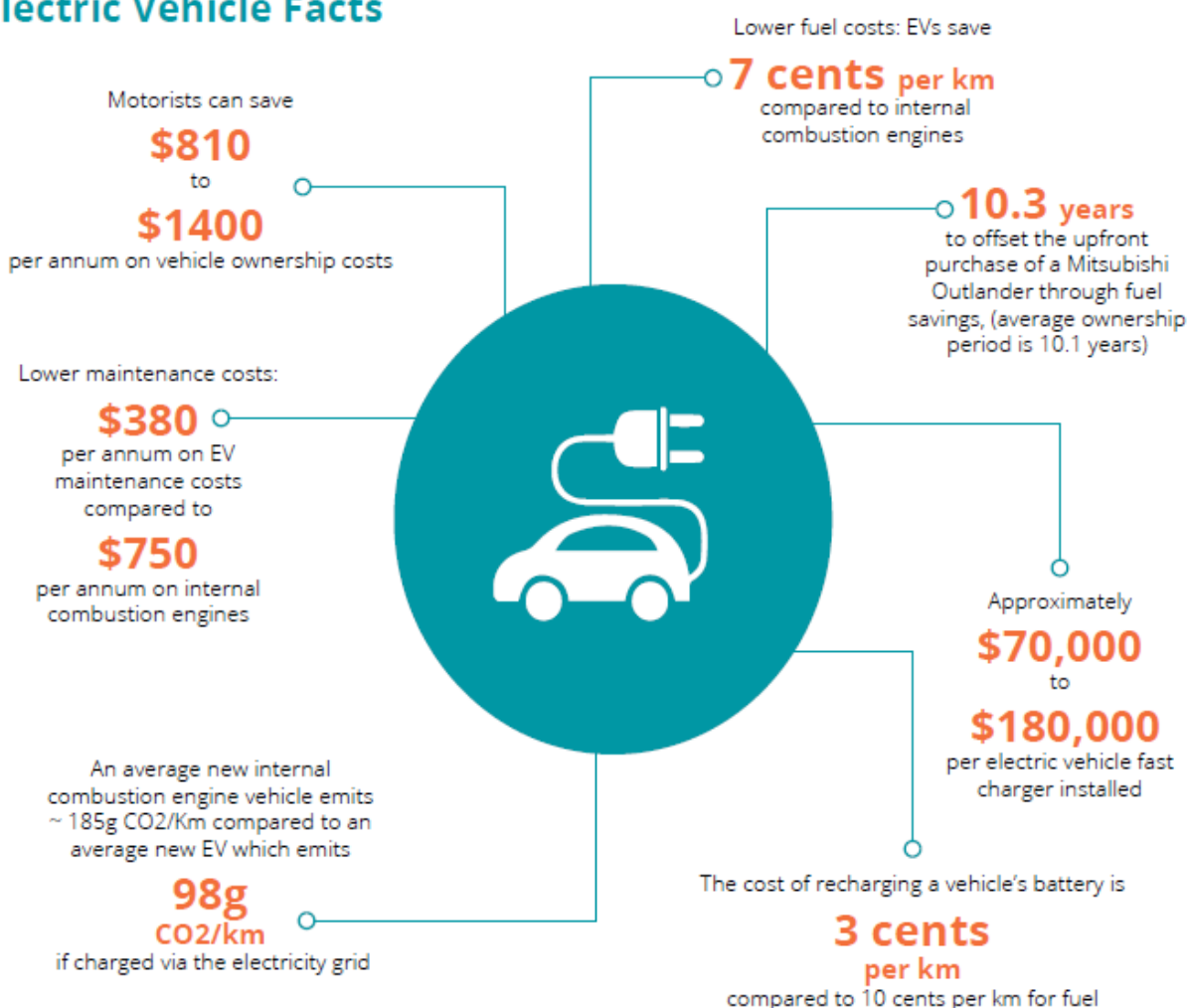
21 Mr Karl Gehling, Head of Corporate Communications and Government Relations, Mitsubishi Motors Australia, *Committee Hansard*, 10 August 2018, p. 3.

22 Mr Rodger Whitby, Chief Executive Officer, St Baker Energy Innovation Fund, *Committee Hansard*, 27 September 2018, p. 28.

23 Fast Cities - answers to questions taken on notice from public hearing in Brisbane on 27 September 2018 (received 19 October 2018).

Figure 3.2: Projected electric vehicle operation costs and savings for Australian motorists²⁴

Electric Vehicle Facts



Mining and manufacturing

3.17 The Committee has heard that Australia has a number of natural advantages that could support mining and manufacturing opportunities in relation to EV lithium-ion batteries. In its submission, the Association of Mining and Exploration Companies highlighted that Australia has large reserves of the minerals required to make lithium-ion batteries and outlined the advantages that Australia has in this area:

- Australia currently mines over 60 per cent of the world's lithium by value;
- Australia has all of the other minerals necessary to progress further down the lithium ion battery value chain;

24 PwC, 'Recharging the economy', March 2018, p. 5.

- Lithium spodumene, which is mined in Australia, is over 10% cheaper to process to lithium hydroxide than brine, which is more common internationally;
- The economics of developing further lithium hydroxide processing facilities in Western Australia is sufficient for four companies, including two of the world's largest lithium companies (Tianqi and Albermarle), to have invested;
- Currently, independent research suggests 89% of the battery precursor material processing occurs in China, thus Australia may stand to benefit from any international interest in geopolitical diversification; and
- The processing and manufacturing of battery precursors, components and final products is dependent on quality, precision and robotics rather than cheap labour and assembly line processing.²⁵

3.18 Professor Peter Newman affirmed this view, and expanded on the value-adding opportunities beyond commodity mineral extraction and export activities, referring to a 2018 report titled *Lithium Valley: Establishing the Case for Energy Metals and Battery Manufacturing in Western Australia*:

The need for quality battery metals means that processing of minerals is now happening in WA close to the mining so that shipping is minimised and high quality product can be made through highly automated production systems. Three new plants are being built.

The next phase of this remarkable opportunity for Australia is to continue to develop the full value chain of battery metals from mining and processing to battery manufacture, battery use and battery recycling as set out in the report.²⁶

3.19 The Committee also heard about the development of lithium-ion battery manufacturing facilities in the Northern Territory and Queensland (Townsville).²⁷ Mr Brian Craighead, Director of Renaissance Energy, spoke optimistically about the advantages that Australia has and the future of manufacturing in this country:

I have personally been in several different electronic vehicle start-up manufacturing facilities around the world. They're small, they're lean, they're clean and they are more about smarts [than] design beauty. Scale isn't the advantage it once was. It's intelligence and design and customisation for market. For me, that works perfectly with the advantage

25 AMEC, *Submission 20*, p. [1].

26 Professor Peter Newman AO, *Submission 23*, p. 1. See also: Regional Development Australia Perth, *Lithium Valley: Establishing the Case for Energy Metals and Battery Manufacturing in Western Australia*, 2018, <https://www.rdaperth.org/rda-projects/lithium-valley/> (accessed 15 October 2018).

27 Mr Brian Craighead, Director, Energy Renaissance, *Committee Hansard*, 27 September 2018, pp. 11 & 13.

here in Australia, We have very smart folks. We have the raw materials we need all within our walled garden. Pretty much every single raw material required to construct an electronic vehicle is within our walled garden of Australia, and that's quite unique. We've got the smarts, certainly. So, for me, it was really about: if the opportunity is there, the demand is there.²⁸

3.20 Several witnesses and submitters expressed a view that Australia should look at its advantages and strategically manufacture in areas of competitive advantage in the supply chain.²⁹ Professor Mainak Majumder, Department of Mechanical and Aerospace Engineering at Monash University argued:

The next question is: should we manufacture EVs in Australia? My opinion would be no, because there are already companies rolling out products, but we can be selective about this opportunity. We can identify and support areas of strength instead of joining the mass manufacturing bandwagon. In summary, I believe opportunities may lie in leveraging the strengths we have in our innovation and intellectual capability by finding and developing niches which can play well in this upcoming world.³⁰

3.21 Throughout this inquiry, the Committee has visited and heard from a number of successful Australian manufacturers associated with the EV industry. The Victorian Branch of the AEVA highlighted that electric trucks and buses were currently being assembled in Australia by companies such as Victorian-based AVAAS and SEA.³¹ The issues in relation to developing mining and manufacturing industries associated with EVs are explored further in chapter 4.

Environment—reducing greenhouse gas emissions

3.22 The Department of the Environment and Energy stated that 'transport, predominantly light vehicles, is the second largest source of greenhouse gas emissions (GHG) in Australia behind electricity', contributing about 19 per cent of Australia's total emissions.³² The department further noted that:

Under current policies, transport sector emissions are projected to steadily increase to 112 million tonnes CO₂-e by 2030 (a 15 per cent increase from present levels)...due to population and economic growth, with cars and light commercial vehicles projected to remain the sector's largest source of emissions.³³

28 Mr Brian Craighead, Director, Energy Renaissance, *Committee Hansard*, 27 September 2018, pp. 11.

29 See, for example: Mr Tony Wood, Director, Energy Program, Grattan Institute, *Committee Hansard*, 31 August 2018, p. 13; Australian Productivity Council, *Submission 7*.

30 Professor Mainak Majumder, Department of Mechanical and Aerospace Engineering, Monash University, *Committee Hansard*, 31 August 2018, p. 39.

31 Australian Electric Vehicle Association—Victoria, *Submission 9*, p. 2.

32 Department of the Environment and Energy, *Submission 72*, p. 5. See also: Australian Government Department of the Environment and Energy, *Quarterly update of Australia's National Greenhouse Gas Inventory: September 2017* p. 14.

33 Department of the Environment and Energy, *Submission 72*, p. 5.

3.23 Primarily these emissions reflect the combustion of petroleum-based fuels with 58.4 per cent of fuels being used by light passenger vehicles; and the balance, 41.6 per cent, being used by commercial and heavy vehicles.³⁴

3.24 The PwC Analysis observed that Australia's transport sector would have to reduce its emissions profile in order for Australia to meet its commitments under the United Nations Framework Convention on Climate Change as agreed in Paris on 12 December 2015:

Assuming the electricity sector meets its target emissions reductions, further contributions from transport and other sectors would be required to meet the overall national Paris commitment, as emissions from the electricity sector make up one third of total emissions.³⁵

3.25 The PwC Analysis found if 57 per cent of new cars were EVs by 2030, there would be a cumulative reduction in CO₂ emissions of 18 million tonnes—the equivalent of removing 8 million petrol vehicles off the road.³⁶ Analysis from the International Energy Agency noted that in Europe, electric cars 'emitted about 50 per cent less than gasoline cars and 40 per cent less than diesel cars' when their fuel use (electricity or gasoline) was taken into account. Importantly, when the entire life-cycle of the car (including manufacturing, use and disposal) was considered, there was a reduction in GHG emissions of 30 per cent for EVs.³⁷

3.26 The Queensland Government submitted that 'EVs charged on Queensland's current electricity grid, emit around 25 per cent less than a fossil fuel vehicle' noting that this will improve as Queensland 'works towards its target of 50 per cent renewable energy by 2030'.³⁸

3.27 Although increased uptake of EVs leads to a reduction in GHG emissions from direct fossil fuel combustion as alluded to above, an important consideration becomes the source of electricity used to recharge the EVs. A NSW Parliamentary Research Paper highlighted that currently 'electricity generation in Australia is highly reliant on coal and other fossil fuels'.³⁹ Furthermore, 'charging EVs from high fossil fuel electricity networks generates more GHG emissions than charging EVs from low

34 ABS 9208.0, *Survey of Motor Vehicle Use, Australia, 12 months ended 30 June 2016*, <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/9208.0Main+Features112%20months%20ended%2030%20June%202016?OpenDocument> (accessed 16 July 2018).

35 PwC, 'Recharging the economy', March 2018, p. 7. See also: United Nations Framework Convention on Climate Change, *The Paris Agreement*, <https://unfccc.int/process#:a0659cbd-3b30-4c05-a4f9-268f16e5dd6b> (accessed 6 November 2018).

36 PwC, 'Recharging the economy', March 2018, p. 6, <http://electricvehiclecouncil.com.au/wp-content/uploads/2015/05/Recharging-the-economy.pdf> (accessed 26 November 2018). See also: St Baker Energy Innovation Fund, *Submission 59*, p. 2.

37 International Energy Agency, 'Global EV Outlook 2018', May 2018, p. 58.

38 Queensland Department of Transport and Main Roads, *Submission 43*, p. [2].

39 NSW Parliamentary Research Service, *Electric Vehicles in NSW*, May 2018, pp. 7–8.

fossil fuel electricity networks'.⁴⁰ In the Australian context, Tasmania emits the lowest GHG emissions due to its high reliance on hydroelectricity and other renewable sources for its electricity generation.⁴¹ Whilst Victoria is the only jurisdiction where an EV's GHG emissions slightly exceed that of an average ICE due to the state's high reliance on brown coal generation.⁴²

3.28 The Australia Institute (TAI) acknowledged the impact of electricity generated from brown coal on EV emissions:

Critics of electric vehicles claim that they would perversely increase emissions when compared with business as usual, when the vehicle fleet is overwhelmingly dominated by internal combustion engines. For example, a very powerful electric vehicle [Teslas] charged in Victoria today will be responsible for relatively high emissions compared with the national fleet average for internal combustion engine vehicles, because brown coal burned in that state produces a lot of carbon dioxide per unit of energy generated.⁴³

3.29 TAI has put forward the counter-argument noting that an increased demand for electricity stemming from increased EV uptake would lead to a requirement for additional or marginal electricity production. TAI observed:

What we do know is that almost universally around the world new generation capacity is mainly renewable and old coal-fired power plants are being junked. So to the extent that new generation capacity is required to meet increases in demand (and to replace coal-fired generation) then the marginal response to an increase in demand has a very low emissions intensity and may well be zero.⁴⁴

Air pollutants and public health

3.30 The Committee has heard that increased use of EVs can also lead to a reduction in local air pollutants. Hobsons Bay Council noted that 'electric vehicles due to their electric motors emit less air pollutants than' ICE vehicles.⁴⁵ The Centre for Air pollution, energy and health Research expanded:

Conventional vehicles with internal combustion engines are a major source of ground level air pollutants such as carbon dioxide (CO₂), nitrogen oxides (NO_x), and particulate matter (PM). Air pollution has severe adverse effects on health that can lead to premature mortality. The replacement of conventional vehicles with electric vehicles may result in a range of

40 NSW Parliamentary Research Service, *Electric Vehicles in NSW*, May 2018, pp. 7–8.

41 NSW Parliamentary Research Service, *Electric Vehicles in NSW*, May 2018, pp. 7–8. See also: Australian Productivity Council, *Submission 7*, p. 3.

42 ClimateWorks, *Submission 46.1*, p. 26.

43 TAI, *Supplementary Submission 1*, pp. 15–16.

44 TAI, *Submission 1*, p. 2.

45 Hobsons Bay Council, *Submission 52*, p. 3.

environmental, health, and climate benefits due to possible reductions in ground level pollutants as well as greenhouse gas emissions.⁴⁶

3.31 Dr Liz Hanna set out the impact of air pollution on health at a global scale:

The World Health Organisation (WHO) reports that over 4.2 million deaths a year are linked to exposure to outdoor air pollution, and children are particularly susceptible. The WHO 2018 Fact Sheet on Air Pollution finds 9 out of 10 people worldwide breathe polluted air, almost all urban residents on the planet. Air pollution causes 24% of all stroke deaths (1.4 million deaths annually), 25% of global heart disease deaths (2.4 million deaths), and 43% of all lung disease and lung cancer deaths (1.8 million deaths every year).⁴⁷

3.32 Dr Ingrid Johnson stated that 'air pollution from vehicle emissions results in thousands of deaths and yet the technology exists to massively reduce this pollution through the use of no-emissions [EVs]'.⁴⁸ ClimateWorks referred to research demonstrating the impact reduced vehicle emissions could have:

Through reducing air pollution, the transition to electric vehicles will also have benefits for health. In their submission to the Australian Government's discussion paper on fuel quality standards, the Clean Air and Urban Landscape Hub and the Melbourne Energy Institute estimate that air pollution due to vehicle emissions caused 1 715 deaths in Australia in 2015, a number larger than the national road toll for the same year. Given that electric vehicle adoption is likely to be concentrated in metropolitan areas of Australia, where population densities are at their highest, there is strong potential for reductions in urban air pollution and meaningful benefits to community health.⁴⁹

3.33 Dr Hanna estimated that the economic cost of air pollution from the transport sector to be as high as \$17.4 billion in 2018. This cost takes into account:

the economic burden on families for days, weeks and years and from premature deaths. It means (a) they lose their earning capacity (b) the society misses all the effort and cost that was put into their training and expertise, and (c) the society misses the additional contribution that people make to society not only as productive workers but in mentoring, parenting and caring et cetera.⁵⁰

46 Centre for Air pollution, energy and health Research, *Submission 63*, pp. 2–3. See also: Tesla, *Submission 92*, p. [6].

47 Dr Liz Hanna, *Submission 3*, p. 3.

48 Dr Ingrid Johnston, Senior Policy Officer, Public Health Association of Australia, *Committee Hansard*, 17 August 2018, p. 39.

49 ClimateWorks, *Submission 46*, p. 2. See also: Queensland Government Department of Transport and Main Roads, *Submission 43*, p. 2; Doctors for the Environment, *Submission 50*, p. 4; Department of the Environment and Energy, *Submission 72*, pp. 4–5.

50 Dr Liz Hanna, Senior Fellow, Fenner School of Environment and Society, and Climate Change Institute, Australian National University, *Committee Hansard*, 17 August 2018, p. 39.

3.34 Dr Hanna noted that some of the long term negative effects of air pollution on humans still remain unknown:

You can draw the corollary to lead and lead petrol. Initially, we thought blood lead levels were okay and kiddies wouldn't have cognitive impairment. Of course, as more and more research came out, the safe levels in the regulations came down and down. We realised that exposure was harmful even at lower levels. Again, it gets back to...actually needing the work to be able to do it. It would be impossible to think that, as new research was done, we'd find out that it's actually less harmful. Without question, with everything we do, when we go and find out we find it's not as safe as we thought.⁵¹

3.35 Concerns were expressed that the benefits of using no-emissions EVs may be reduced if the electricity were sourced from fossil fuels. The panel argued that if the power generated to recharge the EVs is from fossil fuels, then 'that's only going to remove the health effects from one site [roads] to another site [fossil fuel power generator]'.⁵²

Noise

3.36 Many submitters and witnesses pointed out that EVs have the benefit of emitting less noise than their ICE equivalents.⁵³ A NSW Parliamentary Research Paper also highlighted the potential for reduced traffic noise due to increasing EV uptake:

EVs at slower speeds are virtually silent, as they have no internal combustion engine and the only noise emitted from their electric motors is a barely perceptible high-pitched frequency. EVs do produce noise from wind resistance and tyre-road contact, but this noise only becomes perceptible at higher speeds.⁵⁴

3.37 However, low levels of noise may 'pose an additional risk to pedestrian safety'. A recent paper identified that EVs are 'very difficult for [pedestrians who are vision impaired] to detect and respond to as they are unable to rely on their other sensory modalities such as hearing, to navigate when it is safe to cross roads.

51 Dr Liz Hanna, Senior Fellow, Fenner School of Environment and Society, and Climate Change Institute, Australian National University, *Committee Hansard*, 17 August 2018, p. 41.

52 Professor Guy Marks, Chief Investigator, Centre for Air Pollution, Energy and Health Research, *Committee Hansard*, 17 August 2018, p. 40. See also: Dr Liz Hanna & Dr Ingrid Johnston, *Committee Hansard*, 17 August 2018, p. 40.

53 See, for example: Ms Michelle English, Associate Director, Sustainability, City of Adelaide, *Committee Hansard*, 10 August 2018, p. 48; Dr Matthew Stocks, Research Fellow, College of Engineering and Computer Science, Australian National University, *Committee Hansard*, 17 August 2018, p. 10; Hyundai Motor Company, *Submission 103*, p. [6].

54 NSW Parliamentary Research Service, *Electric Vehicles in NSW*, May 2018, pp. 4–5.

Similarly, detection concerns have also been raised about cyclists'.⁵⁵ The paper also put forward a broad range of recommendations to address this issue including regulatory reform to fit acoustic alert systems and advanced driver assistance systems to EVs in order to avoid collisions with pedestrians.⁵⁶

Fuel security—national security and resilience

3.38 A number of submitters highlighted the economic and national security implications of Australia's current reliance on imported oil.⁵⁷ The Victorian Government Department of Environment, Land, Water and Planning (DELWP) noted that 'Australia is increasingly reliant on imports for its liquid fuels' with 91 per cent of transport oil and 67 per cent of total oil imported. This makes 'Australia vulnerable to potential supply disruptions and to unexpected changes in demand from other customers in Asia'.⁵⁸ DELWP described the impact of EV uptake on Australia's reliance on oil imports:

Electric vehicle adoption can help address the issue of fuel security. As Australia is vulnerable to a disruption to transport fuel supplies due to the current and increasingly high oil and fuel import dependency, local production of electricity as [a] fuel source for electric vehicles will decrease our international reliance on oil and enhance our fuel security. Analysis developed by ClimateWorks in its 2016 report, *The path forward for electric vehicles in Australia*[,] indicates that the increase of electric vehicles into the Australian fleet, consistent with the pathway to zero net emissions by 2050, would increase fuel stocks from 18 to 21 days in 2030, and 16 to 20 days in 2050 compared to a business as usual baseline. Oil/fuel imports would decrease 16% in 2030 and 28% in 2050.⁵⁹

3.39 Air Vice-Marshall John Blackburn AO (Retired), a noted fuel security expert, told the Committee that:

Electric vehicles could play a significant role by improving our energy security by reducing the demand for foreign sourced oil and fuels and by

55 Dr Sara Liu, Associate Professor Michael Fitzharris, Associate Professor Jennie Oxley, Mr Chris Edwards, *The impact of electric/hybrid vehicles and bicycles on pedestrians who are blind or have low vision*, Monash University Accident Research Centre and Vision Australia, October 2018, p. 10, <http://apo.org.au/system/files/197121/apo-nid197121-1026741.pdf> (accessed 17 October 2018).

56 Dr Sara Liu, Associate Professor Michael Fitzharris, Associate Professor Jennie Oxley, Mr Chris Edwards, *The impact of electric/hybrid vehicles and bicycles on pedestrians who are blind or have low vision*, Monash University Accident Research Centre and Vision Australia, October 2018, p. 13.

57 See, for example: 350 Canberra, *Submission 21*, p. 5; AEVA, *Submission 6*; AGL Energy, *Submission 55*.

58 Victorian Government Department of Environment, Land, Water and Planning, *Submission 129*, p. 6.

59 Victorian Government Department of Environment, Land, Water and Planning, *Submission 129*, p. 6.

providing a significant increase in the transport system resilience in the event of a fuel supply disruption.⁶⁰

Challenges

3.40 Notwithstanding the considerable benefits of increased EV uptake, there are a number of associated challenges including range anxiety, a declining fuel excise revenue base, changes to demand and supply on the electricity grid, and industry transition including a reshaping of the job market.

Range anxiety

3.41 Concerns have been raised about range anxiety linked to limited charging infrastructure, particularly in non-metropolitan areas.⁶¹ Although it is expected that most EV recharges are undertaken at home or at a workplace, concerns stem from the relatively shorter driving ranges of current model EVs—ranging from 150km to 489km on one charge—and the current dearth of charging infrastructure, both geographically and in total—there are 783 public charging stations compared to 6 400 petrol stations with multiple bowzers.⁶² The majority of these stations are 'slow charging AC stations', with a little under one-tenth being 'fast charging DC stations'.⁶³ As noted in Chapter 2, newer fast charge stations enable close to full charging in as little as 15 minutes allowing travellers to recharge and undertake the next leg of their journey.

3.42 Mr Ali Asghar, Senior Associate at Bloomberg New Energy Finance told the Committee that many automakers are 'introducing more cars with longer driving ranges', further noting that 'greater model availability and reduced range anxiety should attract a larger consumer base for electric vehicles'.⁶⁴ The Committee notes the imminent release to market of a number of more affordable, longer range EVs such as the Hyundai Ioniq Electric, Nissan Leaf, and the Volkswagon I.D.⁶⁵

3.43 Plug-in Hybrid Electric Vehicles (PHEV) can be seen as a viable transition technology to alleviate range anxiety as public charging infrastructure is built:

60 Air Vice-Marshal John Blackburn AO (Retired), *Committee Hansard*, 18 October 2018, p. 20.

61 See, for example: Mr Adrian Dwyer, Chief Executive, Infrastructure Partnerships Australia, *Committee Hansard*, 31 August 2018, p. 27; Mr Ali Asghar, Senior Associate, Bloomberg NEF, *Committee Hansard*, 31 August 2018, p. 11.

62 Knight Frank Research and Consulting, *NSW Service Stations Insight*, February 2017, p. 1, https://www.knightfrank.com.au/resources/commercial/service-stations/kf_nsw-service-stations-insight-feb17.pdf (accessed 26 November 2018).

63 NSW Parliamentary Research Service, *Electric Vehicles in NSW*, May 2018, p. 9.

64 Mr Ali Asghar, Senior Associate, Bloomberg New Energy Finance, *Committee Hansard*, 31 August 2018, p. 7.

65 James Wong, 'EV Onslaught: 10 Electric Cars Coming By 2021—Update', *CarAdvice*, 17 April 2018, <https://www.caradvice.com.au/618789/ev-onslaught-10-electric-cars-coming-by-2021/> (accessed 28 November 2018).

PHEVs with electric range aligned with the typical day-to-day usage of the vehicle should be given especially close consideration in this respect. They will deliver the vast majority of benefits (economic, environmental, and social), without any issues around range anxiety caused by a lack of public charging infrastructure in the early days of the transition. Beyond its electric range, a PHEV functions very much like a typical petrol vehicle. The PHEV can be considered a stepping-stone on the journey to a future which is more fully electric.⁶⁶

3.44 The issue of public charging infrastructure and consumer education will be discussed later in the report.

Fuel excise revenue

3.45 The Committee heard that one of the consequences of an increasing EV fleet and the corresponding reduction in liquid fuel consumption would be a decrease in the federal fuel excise tax. Mr Adrian Dwyer, Chief Executive Officer of Infrastructure Partnerships Australia noted that more EVs would 'drive a rapid and terminal decline in the major funding base for Australia's road network'.⁶⁷ Mr Dwyer noted recent trends associated with fuel excise:

According to the [Parliamentary Budget Office], fuel excise has fallen from 1.6 per cent of GDP in 2001–02 to one per cent in the year 2016–17. At the same time, the number of vehicle kilometres travelled on Australian roads has increased to 250 billion. In short, revenue is going down while consumption is going up. This is the exact opposite of a good funding model. While fuel excise is not directly hypothecated, it's clear that a declining revenue base will not support the investment required to meet increasing demand for our road networks.⁶⁸

3.46 Mr Steve Bletsos, Senior Research Analyst at VACC highlighted that fuel excise is 'roughly \$16 billion per annum and that money has to come from somewhere' if it is not coming from excise.⁶⁹ The Committee has received evidence on a replacement scheme known as a road user charge—a distance based tax that would apply to all vehicles regardless of propulsion type.

3.47 The federal government has acknowledged the challenges around revenue in this space, and, in 2016 instigated a study into how road user charging might be

66 NHP, *Submission 95*, p. 4.

67 Mr Adrian Dwyer, Chief Executive Officer, Infrastructure Partnerships Australia, *Committee Hansard*, 31 August 2018, p. 25.

68 Mr Adrian Dwyer, Chief Executive Officer, Infrastructure Partnerships Australia, *Committee Hansard*, 31 August 2018, p. 25.

69 Mr Steve Bletsos, Senior Research Analyst, VACC, *Committee Hansard*, 31 August 2018, p. 78.

implemented as a replacement to fuel excise.⁷⁰ The Committee has not received evidence indicating significant progress since 2016.⁷¹

3.48 Dr Jake Whitehead of the University of Queensland identified 'public resistance' as the main challenge to implementation of a road user charge.⁷² Dr Whitehead explained the current system and how it would translate into a road-user charge, and the challenges that a road user charge would need to overcome:

At the moment we have fuel excise in terms of standard fossil fuel vehicles, and that effectively is a proxy for both how far people travel and how fuel-intensive their vehicles are. With electric vehicles, obviously they don't pay fuel excise, so there's been a lot of discussion about bringing in a per-kilometre charge. But what you see is that, in cases where that has been undertaken, you can have some pretty significant equity impacts. Obviously, in a country like Australia, where we have a significant population outside of urban areas, if we are charging them purely based on how far they travel, that's going to have a much more significant financial impact on them as opposed to those individuals who are driving in urban areas. The reality is, though, that it's those drivers in urban areas who are causing the greatest cost to society through congestion but also much higher emissions through that kind of stop-start-idle traffic.⁷³

3.49 Road user charging will be discussed further in Chapter 5.

The electricity grid—energy demand and grid stability

3.50 An increased uptake of EVs would displace the transport sector's fuel source from petroleum to the electricity network, placing a range of unprecedented demands on the grid. The International Energy Agency made the point that 'power demand and road mobility demand are both characterised by peaks during morning and evening hours and a period of low demand during night time'.⁷⁴ The former Minister for the Environment and Energy, Hon Josh Frydenberg MP quantified this extra demand:

An extra one million electric cars is the equivalent of 5.2 terawatt hours of power demand. This is about a 2 per cent increase in overall grid demand.⁷⁵

70 Mr Alex Foulds, Executive Director, Surface Transport Policy Division, Department of Infrastructure, Regional Development and Cities, *Committee Hansard*, 17 August 2018, p. 73.

71 Mr Alex Foulds, Executive Director, Surface Transport Policy Division, Department of Infrastructure, Regional Development and Cities, *Committee Hansard*, 17 August 2018, p. 73.

72 Dr Jake Whitehead, Research Fellow, School of Civil Engineering, University of Queensland, *Committee Hansard*, 27 September 2018, p. 50.

73 Dr Jake Whitehead, Research Fellow, School of Civil Engineering, University of Queensland, *Committee Hansard*, 27 September 2018, p. 50.

74 International Energy Agency, *Global EV Outlook 2018*, May 2018, p. 56.

75 Hon Josh Frydenberg MP, 'Standby, Australia, for the electric car revolution', *The Sydney Morning Herald*, 12 January 2018, <https://www.smh.com.au/opinion/stand-by-australia-for-the-electric-car-revolution-20180112-h0hazy.html> (accessed 15 July 2018).

3.51 In its supplementary submission, Infrastructure Australia (IA) stated that EVs will have 'negligible effects on grid consumption' over the next five years, but that this demand is then expected to grow over the next 5–10 years:

[Australian Energy Market Operator] AEMO [forecasts] that electric vehicles will begin to have sizeable impacts on consumption. In this period, consumption is forecast to increase at an annual average rate of approximately 1.3%. [The *Independent Review into the Future Security of the National Electricity Market* conducted by the Chief Scientist Dr Alan Finkel] found a 20% EV uptake could account for 4% of grid demand. Extrapolating on that figure, 100% uptake could account for [an additional] 20% of grid demand.⁷⁶

3.52 It is likely that most of the power for EVs will be drawn from the grid—unless it is powered by on-site solar panels and batteries. During week days, most of the charging events are likely to occur when people return home from work for the day, potentially resulting in peak EV charging coinciding with the peak energy use period of the day.⁷⁷ This raises questions about additional generating capacity and how EV owners can be incentivised to charge during off-peak periods.

3.53 In addition to the abovementioned issues there will also be an impact on the transmission system as more electricity is demanded by households and public chargers. This may push the grid to its operating limits, hence requiring upgrades to substations and transmission infrastructure. Equally, this may lead to, and require a more coordinated approach to vehicle charging.

3.54 Energy Networks Australia (ENA), the peak national body representing gas distribution, electricity transmission and distribution businesses, noted that 'Australia's distribution networks were not designed for any significant uptake of electric vehicles and the consequential demand for charging'.⁷⁸ ENA flagged mass EV charging events at existing peak times such as when people arrive home from work at 5–6pm on an extremely hot day as a potential issue with the following effects:

- Exacerbation of electricity consumption peaks.
- Exceedance of low voltage (suburban) network capacity, causing poor reliability or restrictions on EV charging.⁷⁹

3.55 IA stated that 'making sure EVs do not contribute to peak demand is crucial to keeping network costs down for consumers and taxpayers'.⁸⁰

76 Infrastructure Australia, *Submission 79.1*, p. 2. See also: Alan Finkel, Karen Moses, Chloe Munro, Terry Effeneey, Mary O'Kane, *Independent Review into the Future Security of the Energy Markey: Blueprint for the Future*, June 2017, <https://www.energy.gov.au/sites/g/files/net3411/f/independent-review-future-nem-blueprint-for-the-future-2017.pdf> (accessed 7 November 2018).

77 Energy Networks Australia, *Submission 60*, pp. [2–3].

78 ENA, *Submission 60*, p. [2].

79 ENA, *Submission 60*, pp. [2–3].

80 Infrastructure Australia, *Submission 79.1*, p. 2.

3.56 AEMO stated that the lack of visibility on the location of distributed energy resources (DER) such as EVs, solar panels and home batteries make it difficult for AEMO to 'manage power system security in the short term and longer term'.⁸¹ AEMO elaborated:

Impacts of lack of visibility include barriers to operational planning and inefficiencies in asset utilisation, market operation, or investment decision-making, which ultimately lead to additional costs borne by consumers.⁸²

3.57 AEMO is currently 'undertaking a broad [DER] work program to assess and address the challenges and opportunities of changing consumer behaviour'.⁸³

3.58 There is an expectation that increased small-scale and large-scale solar photovoltaic (PV) will lead to an accentuated generation peak during the day.⁸⁴ There is also a potential role for EVs to charge during periods of low demand and discharge battery power into the grid at times of high demand.⁸⁵ In an answer to a question on notice, AEMO provided the Committee with a graph that outlined how the use of batteries (both stationary and mobile EVs) could assist in flattening out the demand and supply curve.

81 AEMO, *Submission 38*, p. 1.

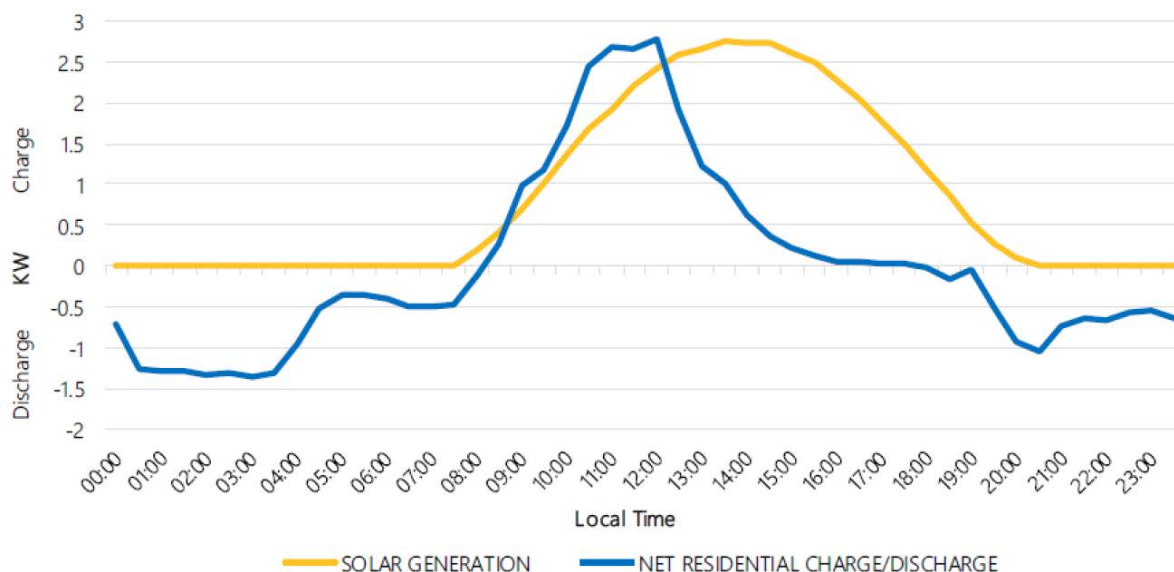
82 AEMO, *Submission 38*, p. 2.

83 AEMO, *Submission 38*, p. 1. See also: Australian Energy Market Operator - answers to questions taken on notice from public hearing in Melbourne on 31 August 2018 (received 27 September 2018), p. 4.

84 ENA, *Submission 60.1*, pp. 100–103.

85 Tesla Owners Club of Australia, *Submission 28*, p. 4. See also: Victorian Legislative Council Economy and Infrastructure Committee, *Inquiry into electric vehicles*, May 2018, pp. 19–21, <https://www.parliament.vic.gov.au/eic/inquiries/article/3507> (accessed 15 July 2018).

Graph 3.1: National Energy Market battery charge and discharge profile overlaid with PV generation⁸⁶



3.59 IA flagged that by 2030, there would be significant residential (small-scale) generation and storage:

By 2030–31 AEMO estimates that consumers could have as much as 33,136 MW of solar PV and 4,969 MW of battery storage, as well as the battery capacity of their electric vehicles.⁸⁷

3.60 ENA advised that changing consumer behaviour around charging would need to involve the use of incentives through changes to tariffs. For instance, modifications to flat tariff structures are required to incentivise consumers to move away from convenience charging at peak times to making vehicle batteries available for both charging during peak generation times and discharge during lower generation and higher demand periods.⁸⁸

3.61 In addition to a projected increase in peaking requirements and overall electricity demand AEMO also raised the challenges in locating and establishing public charging equipment.⁸⁹

3.62 Using fast chargers 'requires on-demand power similar to an industrial facility'.⁹⁰ For example, 'a large, fast charging station in a rural area will have a much greater impact on the surrounding network than charging stations in metropolitan areas' noting the following considerations:

⁸⁶ Australian Energy Market Operator - answers to questions taken on notice from public hearing in Melbourne on 31 August 2018 (received 27 September 2018), p. 4.

⁸⁷ Infrastructure Australia, *Submission 79.1*, p. 3.

⁸⁸ ENA, *Submission 60*, pp. 1–2. See also: Infrastructure Australia, *Submission 79.1*, p. 3.

⁸⁹ AEMO, *Submission 38*, p. 3.

⁹⁰ Infrastructure Australia, *Submission 79.1*, p. 2.

The planning of public charging infrastructure needs to be closely coordinated with AEMO and network operators in order to:

- Understand any limitations on the local network.
- Determine technical requirements to effectively interface with the network at each location.
- Understand requirements for any supporting technical infrastructure such as batteries.
- Identify network areas where public charging infrastructure may provide benefits.
- Determine efficient network connection processes.
- Standardise regulation and technical standards for infrastructure.⁹¹

3.63 In its submission, TAI affirmed this view focusing on the need for coordinated EV charging to optimise the supply and demand of electricity. Coordinated charging would prevent [EV] charging from increasing the size of afternoon and evening peaks' and would 'shift the charging periods overnight to "fill" the demand "valley", when electricity is cheaper'.⁹²

3.64 The *Electricity Network Transformation Roadmap: Final Report* found 'that there is a need to redefine the structure and architecture of the electricity system to meet the requirement for flexibility and agility in the future grid'.⁹³ IA highlighted that 'there could be a need for an [electricity sector] investment between \$2.2 billion and \$9.7 billion by 2046'.⁹⁴

3.65 IA argued:

With the right frameworks in place, electric vehicles will be useful grid assets whose benefits will increase the more electric vehicles are adopted. EVs used in a smart network could be used as a short-term storage of excess, off-peak electricity generated from renewable sources that could flexibly be dispatched [to] counteract peak demand. They could also be used for local, residential consumption.⁹⁵

3.66 Transgrid suggested that by 2040 EVs could provide up to 350GWh of storage, and observed:

If aggregated effectively, this level of storage could play a significant role in providing grid stability and ancillary services, with 350 GWh[,]

91 AEMO, *Submission 38*, p. 3.

92 The Australia Institute, *Submission 1.1*, p. 14.

93 ENA, *Submission 60.1*, p. 69.

94 Infrastructure Australia, *Submission 79.1*, p. 2.

95 Infrastructure Australia, *Submission 79.1*, p. 4.

equivalent to the proposed capacity of the Commonwealth Government's Snowy 2.0 project.⁹⁶

3.67 The impact of EV charging on the grid will be explored further in Chapter 5.

Industry transition

3.68 Earlier in the report, the Committee highlighted the projected net increase of 13 400 jobs as a result of an increased uptake in EVs.⁹⁷ Notwithstanding the increased job opportunities in EV sales, servicing, components and charging infrastructure, the paradigm shift away from an oil-based logistics, parts and servicing transportation system will result in job losses and negatively affect some businesses in these sectors.

3.69 Motor Trades Association of Queensland (MTAQ) explained the fundamental changes to the automotive sector resulting from the uptake of EVs:

Business models in most cases will require profound changes to adapt to the progressive change in vehicle propulsion technology. There is likely to be extensive structural change needed within the automotive value chain that will have repercussions for the transport sector and the national economy.⁹⁸

3.70 One submitter described a 'seismic shift in the fuel distribution network in Australia' arguing that major fuel retailers will be significantly affected:

Fuel retailers will have difficulty competing with the convenience and cost of cheap home charging even if they install DC charging stations in local service stations. Most local service stations will disappear because electric cars will charge in homes.⁹⁹

3.71 An August 2018 report from Infrastructure Victoria into automated and zero emissions vehicles infrastructure found that there would be a 25 per cent reduction in ongoing maintenance requirements for battery electric vehicles and nearly 11 000 job losses nationally in the fuelling sector.¹⁰⁰

3.72 The VACC submission put forward a Victorian perspective on projected job losses of up to 6 000 as EV uptake increases and lower demand is experienced in sectors associated with ICE vehicles and then not replaced in the sectors associated with EVs. VACC highlighted that nearly 6 000 job losses and 2 000 automotive business closures are projected by 2030 if there is a high uptake of EV (20 per cent). These losses are projected across fuel retailing (910 jobs), automotive repair and maintenance (1 900 jobs), motor vehicle parts retailing (1 370 jobs) and car wholesaling and car retailing (1 200 jobs). The projected losses and closures are about halved under a scenario where 10 per cent of new cars are EVs by 2030.¹⁰¹ The

96 Transgrid, *Submission 90*, p. 4.

97 Electric Vehicle Council, *Submission 100*, p. 16.

98 Motor Trades Association of Queensland, *Submission 41*, p. [3].

99 Name withheld, *Submission 86*, p. 6.

100 Infrastructure Victoria, *Submission 88.1*, p. 46.

101 VACC, *Submission 26*, pp. 9–10.

primary reasons for the net loss of jobs relate to lower liquid fuel demand and lower servicing requirements for EVs discussed earlier in the chapter.

3.73 Noting the risk of job losses, the City of Adelaide highlighted the importance of supporting and encouraging the 'motor trades sector to transition to electric vehicle sales, servicing and potentially business models, such as car share and mobility as a service, which may result in lower levels of private car ownership'. Notwithstanding this commercial and industrial transformation, MTAQ was mindful that there would be significant new opportunities through the new propulsion technologies combined with emerging trends such as automation and car sharing.¹⁰²

Concluding comment

3.74 Australia is on the cusp of the most significant disruption and transformation of our transport system since the advent of the internal combustion engine. Taking into account the evidence received during this inquiry, the Committee is optimistic about the environmental, economic, public health and national security benefits that increased uptake of EVs will bring to Australia. Reductions in greenhouse gas emissions, cost savings for vehicle owner-operators, increased job opportunities and economic growth, improved health outcomes and increased fuel security are just some of the benefits that Australia can realise as EV use begins to climb.

3.75 Notwithstanding the overwhelming benefits of increased EV use, the Committee is cognisant of some of the challenges that are emerging as Australia moves away from an oil-based transportation system towards EVs. A continued erosion of the fuel tax excise, questions about how we plan and manage our electricity generation and transmission, and transitional arrangements for employees and businesses reliant on the ICE vehicle are just some of the challenges that need to be met.

3.76 The Committee considers that the benefits of EV uptake are not to be taken for granted; likewise, the challenges that we now face will also not be resolved in the absence of a coordinated strategy. The pathway forward that seizes the opportunity and manages the risks of an EV future is discussed in Chapter 5.

102 MTAQ, *Submission 41*, p. [3].

Chapter 4

Manufacturing and value-chain activities—opportunities and challenges

Introduction

4.1 This chapter focuses on the opportunities and challenges associated with electric vehicle (EV) manufacturing and value-chain activities including:

- EV and EV component manufacturing;
- Battery manufacturing and commodity value-adding; and
- Charging infrastructure.

EV and EV component manufacturing

4.2 The Committee has heard about the future opportunities for manufacturing in the industries related to EVs. A number of companies the Committee has spoken to and visited are already on the front foot seeking to take advantage of the commercial opportunities presented by the rising consumer demand for EVs.

4.3 In its submission, Deakin University shared its positive outlook for manufacturing in this area:

No component, nor assembly of a complete electric vehicle, is beyond the capability of Australian industry.

The opportunities for local manufacture will, therefore, be determined on price, production volumes and access to requisite designs, which may otherwise be constrained by intellectual property protections.

Volume can be enhanced by exports and intellectual property issues addressed through partnerships. A comprehensive analysis of supply chain requirements and opportunities should be undertaken by an industry capability network or similar agency.¹

4.4 One of the inherent benefits to EVs is that they are less complex than internal combustion engine vehicles and hence have 'thousands of fewer components per vehicle'.² Not only does this lead to potentially lower costs per vehicle (excluding the batteries) for the consumer (and cheaper servicing), but it also reduces the capital cost and complexity of manufacturing including logistics.³

4.5 There will also be changes to how motor vehicles are made and how much they cost to build. Uniti Australia has stated that 'new advanced manufacturing processes, light-weight materials and new vehicle designs have led to a dramatic

1 Deakin University, *Submission 35*, p. 3.

2 Association of Mining and Exploration Companies (AMEC), *Submission 20.2*, p. 4.

3 See, for example: University of Adelaide, *Submission 91*, p. [3]; Uniti Australia, *Submission 2*, p. [3].

reduction in the costs of assembling vehicles'.⁴ Dr Brett Dale, Chief Executive Officer of the Motor Trades Association of Queensland (MTAQ) made his views clear on the future of manufacturing, including custom order motor vehicles:

I [spoke about] the concept of 3D printing. With the way in which that's developing and the rate at which it's developing, there's a real possibility that, in the next five to 10 years, you'll custom print the car that you want. When you look at the components associated with electric vehicles, there are way fewer than the existing fleets on the road. Printing a fully electric vehicle, which will be autonomous by then, could be done custom; you would get a product comparative to an architecturally designed home or a spec home. So, manufacturing is the key, and governments need to support the investment into that, because it will be the technology that determines whether we are a competitive nation.⁵

4.6 The advent of automated vehicles will also likely present changes to structural and material requirements, and vehicle design, 'which might create further opportunities to utilise Australian resources'.⁶

4.7 Although the majority of submitters and witnesses expressed support for local manufacturing associated with EVs, others, such as Mr Tony Weber, Chief Executive Officer of the Federal Chamber of Automotive Industries were more circumspect:

On the question of manufacturing in the future, obviously we ceased [vehicle] manufacturing late last year [2017]. In the future, if we were to look at manufacturing being realistic, we'd have to examine the fact that, despite Australia having a market of 1.2 million vehicles a year, no vehicle sells at 50,000 units per year in Australia. Fifty thousand units is not considered to be the scale required for a factory anywhere in the world, and therefore you would need extensive export markets, in conjunction with a very successful product in the domestic market, before it was viable. One of the substantial issues with manufacturing in Australia is lack of real access to markets outside of Australia, especially in the Asian region, because of tariffs and non-tariff barriers.⁷

Residual car-making skills and experience

4.8 In October 2017, the General Motors (GM) Holden automotive manufacturing facility in Elizabeth, South Australia was closed. As the last car making plant in Australia at the time, it also signified the end of passenger vehicle manufacturing in

4 Uniti Australia, *Submission 2*, p. [3].

5 Dr Brett Dale, Chief Executive Officer, Motor Trades Association of Queensland, *Committee Hansard*, 27 September 2018, p. 39.

6 University of Adelaide, *Submission 91*, p. [3].

7 Mr Tony Weber, Chief Executive Officer, Federal Chamber of Automotive Industries, *Committee Hansard*, 18 October 2018, p. 15.

Australia at that time.⁸ This left not only hundreds of highly skilled automotive workers unemployed, but many thousands more who worked in businesses supplying components to GM Holden. This effect has been mirrored across the country in the wake of other high profile car plant closures in recent years with estimates suggesting that up to 50 000 workers could have been impacted as a result.⁹ The Committee notes that Iveco manufactures trucks at its Dandenong plant.¹⁰

4.9 Notwithstanding the closure of Toyota's Altona plant in western Melbourne, the Hobsons Bay Council observed that 'there remains capacity and expertise in the areas of vehicle design, heavy vehicle manufacturing, conversions, component manufacturing and servicing'. This capacity stands ready to take advantage of the growth in EVs.¹¹ The South Australian Government put forward a similar view:

The state also retains an automotive sector following the closure of Holden with many component suppliers, a strong research base and a remnant pool of skilled workers.¹²

4.10 The Victorian Automobile Chamber of Commerce (VACC) expressed its view that opportunities exist for Australian industry stemming from a ready skilled workforce and the introduction of automated manufacturing techniques:

Whilst passenger car manufacturing has now ceased, it is not beyond possibility that the assembly of EVs may become a viable business option. EVs have fewer components than traditional ICE vehicles, thus eliminating the need for many costly manufacturing processes such as engine casting, tooling and the creation of component parts. Given the inherent residual engineering capacity that is available in Victoria and other states, business models involving the importation of electric motors and the assembly of EVs from Completely Knocked Down packs (CKDs) using robotics and other automated processes may be viable.¹³

4.11 The Australian Council of Trade Unions (ACTU) has argued that it would make sense to take advantage of such a large skilled workforce and existing supplier capacity, and situate any new industry in areas where skilled automotive workers and associated businesses are located:

EV manufacturing could be centred in precisely the communities and area, such as Elizabeth in SA and Geelong in Victoria, that have been most

8 Mike Ladd, 'Holden closure: Australia's history of car manufacturing comes to an end', *ABC News Online*, 8 October 2017, <https://www.abc.net.au/news/2017-10-08/holden-closure-australia-history-car-manufacturing/9015562> (accessed 25 October 2018).

9 Australian Council of Trade Unions, *Submission 107*, p. 4.

10 Iveco, *Manufacturing*, <https://www.iveco.com.au/manufacturing> (accessed 26 November 2018).

11 Hobsons Bay Council, *Submission 52*, p. 4.

12 South Australian Government, *Submission 130*, p. 4. See also: AEVA—SA, *Submission 69*, p. 4.

13 Victorian Automobile Chamber of Commerce, *Submission 26*, p. 12.

affected by the destruction of the Australian car industry. The return of vehicle production to these areas would revitalise these communities, bringing jobs, allowing families to escape poverty and would encourage the engagement of young people with education and training.¹⁴

4.12 The Australian Manufacturers Workers Union (AMWU) echoed these sentiments:

Australia is uniquely placed as a country with a ready supply of skilled workers capable of building a world-class EV manufacturing facility. As a result of the closure of Australia's conventional automotive manufacturing industry, there are many workers capable of supporting the development of an electric vehicle industry in Australia.

In addition, there is also a significant infrastructure to support the development of such an industry in Australia, particularly in the former regions that hosted automotive manufacturing facilities until recently. These areas have vocational education providers that specialise in the skills required, they have connections for import and export and are close to established supply chains.¹⁵

Automotive Transformation Scheme

4.13 As car manufacturers signalled their intention to close Australian manufacturing facilities, the Australian Government established a \$2 billion industry adjustment scheme called the Automotive Transformation Scheme (ATS). The ATS, started in 2011 will run until the end of 2020, and provides:

businesses involved in the Australian automotive industry with cash payments to cover up to 15% of the cost of investing in plant and equipment, and 50% of the cost of investing in research and development, to encourage investment and innovation in the Australian automotive industry.¹⁶

4.14 The ATS has been taken up by firms such as Precision Components to reshape their businesses for the opportunities of the future. Mr Christian Reynolds, Director of Precision Buses, a South Australian bus manufacturer, explained his company's journey from 'metal stamping component manufacturer' to an 'advanced manufacturing group'.¹⁷

Precision Buses is a genesis from Precision Components. Precision Components was a component manufacturer at tier 1 level to Holden and Ford, which, through the Automotive Transformation Scheme, took the opportunity to transition into vehicle manufacturing. We've set up an

14 ACTU, *Submission 107*, p. 2.

15 Australian Manufacturers Workers Union, *Submission 116*, p. [4].

16 Australian Government Business Website, Automotive Transformation Scheme (ATS), <https://www.business.gov.au/assistance/automotive-transformation-scheme> (accessed 25 October 2018).

17 Mr Christian Reynolds, Director, Precision Buses, *Committee Hansard*, 10 August 2018, p. 21.

advanced manufacturing facility in Edinburgh Parks [South Australia], where we have a level of collaboration between four business entities. We're looking at co-locating to advance the knowledge share and the engineering detail around how we progress autonomous and electric vehicles.¹⁸

4.15 The Committee heard that there were a number of limitations with the ATS and its eligibility requirements. For example, many companies do not meet the minimum throughput of 30 000 vehicles per annum. However, there is an exemption in the form of a national interest test. The Department of Industry, Innovation and Science's (DIIS) submission explained how the ATS was being expanded:

Businesses that have made a financial commitment to carry on business in Australia as a motor vehicle producer or supplier to the automotive industry, for the first time can also participate in the scheme. Businesses that do not satisfy certain registration requirements may seek the Minister's permission to apply for registration on national interest grounds.¹⁹

4.16 Prospective EV manufacturer, Australian Clean Energy Electric Vehicle Group (ACE-EV) suggested that this test was difficult to meet for start-up manufacturers.²⁰ Ms Claire Johnson, Chief Executive Officer from Hydrogen Mobility Australia suggested that the ATS should be reframed 'around zero- and ultra-low emission vehicles'.²¹ Ms Johnson continued:

When [the ATS] is set to cease with, at this point, no future assistance available in the form of an automotive scheme, we think that can send a strong signal to international companies who are looking to invest in Australia.²²

4.17 Hyundai's submission said that funding is available for research and development (R&D) under the ATS and that this should be further prioritised.²³ Tritium suggested that the ATS be extended to component manufacturing, noting that 'grant programs are vital in supporting entrepreneurs who may be building or seeking to build a business in the EV industry'.²⁴

18 Mr Christian Reynolds, Director, Precision Buses, *Committee Hansard*, 10 August 2018, p. 20.

19 Department of Industry, Innovation and Science, *Submission 112*, p. 13.

20 Mr Gregory McGarvie, Managing Director, Australian Clean Energy Electric Vehicle Group, *Committee Hansard*, 27 September 2018, p. 55.

21 Ms Claire Johnson, Chief Executive Officer from Hydrogen Mobility Australia, *Committee Hansard*, 10 August 2018, pp. 28–29. See also: Toyota, *Submission 77*, p. 11.

22 Ms Claire Johnson, Chief Executive Officer from Hydrogen Mobility Australia, *Committee Hansard*, 10 August 2018, pp. 28–29.

23 Hyundai, *Submission 103*, pp. [12–13].

24 Tritium, *Submission 58*, p. [5].

Assembly of imported parts

4.18 Some submitters and witnesses have expressed their support for EV manufacturing based on the local assembly of imported pre-built parts. Volvo confirmed that it is currently contemplating such an approach in relation to buses:

Volvo Bus also sees a future where we will be able to provide local manufacturers in Australia with a chassis product that can be bodied locally here in Australia. This will allow the same high standards of body building to deliver safe, reliable and [Australian Design Rules] compliant vehicles manufactured here in Australia, sustaining a vibrant and specialised body manufacturing industry.²⁵

4.19 In its submission, Uniti Australia said that it 'is designing a vehicle to be assembled in Australia by Australians and for Australians' from imported parts.²⁶ Dr Michael Molitor, Chairman of Uniti Sweden AB (parent company of Uniti Australia) explained that his company expected to be manufacturing 'up to 100 000 units within three to five years' in Australia.²⁷ Mr Greg McGarvie, Managing Director of the ACE-EV provided details about his company's two-stage approach for its Australian EV manufacturing plant:

We're taking a low-risk approach. Initially we were looking at \$5 million to get the assembly plant. We've got an assembly facility available to get that set up and get their components in CKD and then, as soon as it looked like there was interest and appetite for more vehicles, to the second stage, which is full manufacturing here. In other words, we'd be doing carbon fibre structures here, their panels here, supply chain—we've been contacted by various lithium suppliers. We've got quite a few different supply chains wanting to link in with us. We've got research facilities wanting to link in with us. As you know, the carbon fibre research in Australia is quite advanced.²⁸

Retrofitting electric drive trains

4.20 As part of this inquiry, the Committee visited the SEA Electric manufacturing facility in Dandenong, Victoria (see Appendix 3). SEA Electric is an Australian-based company that initially retrofitted electric powertrains and batteries to a wide range of commercial buses and trucks. SEA Electric now supports the importation of gliders—a manufactured vehicle without a powertrain—to which SEA Electric fits a powertrain and batteries providing a fully electric vehicle to their clients. The Group Managing Director of SEA Electric, Mr Tony Fairweather, described a future scenario where local manufacturing may form part of the light truck manufacturing process:

25 Volvo, *Submission 70*, p. 3.

26 Uniti, *Submission 2*, p. [3].

27 Dr Michael Molitor, Chairman, Uniti Sweden AB, *Committee Hansard*, 10 August 2018, p. 56.

28 Mr Greg McGarvie, Managing Director, Australian Clean Energy Electric Vehicle Group, *Committee Hansard*, 27 September 2018, p. 56.

The chief engineer from Isuzu Australia visited yesterday. He explained how the pilot process at the moment in their particular case involves substantial testing and evaluation of half a dozen vehicles, which are going into service with some of Australia's largest operators of trucks later this year. Their hope and intention is to potentially be producing their glider vehicles, assembled in Australia with our driveline technology in them, early next year or sometime next year. At the moment, everything they do right now, which is up to 10,000 units a year, is 100 per cent imported internal combustion engine product. Isuzu is an example of a company that is very progressive and working towards an electrification option with, hopefully, some local content. That opportunity for others is there. Our intention is in licensing our technology but also very much in having a local assembly element for our products and for end users. It's kind of a hybrid approach.²⁹

4.21 Mr Fairweather noted that it was not only the new segment of the truck market that is looking to convert to fully-electric, there are also those who may seek to retrofit existing trucks with end of life conventional powertrains.³⁰ Mr Fairweather asserted that SEA's all-electric commercial trucks now 'had payback periods of three or four years based on the total-cost-of-ownership model'.³¹

4.22 In October 2018, the Victorian Government announced it had signed an agreement that would result in SEA Electric establishing an additional factory in the regional town of Morwell in Victoria's Latrobe Valley. Mr Fairweather estimated that the Morwell plant could build 2 400 four-tonne vans and commuter buses, and employ up to 500 workers over the next five years. The plant is expected to be up and running in less than a year and generate about \$200 million in economic activity.³²

4.23 The Australian Productivity Council put forward its views on a more cost-competitive manufacturing approach that would be better suited to a lower volume producer such as Australia:

The business concept had three main features.

Firstly, it proposed a way of building cars on a common flexible platform (CFP) to substantially reduce initial development and tooling cost per model at the expense of a higher base unit cost. Trading up-front costs against unit costs in this way would provide better production economies,

29 Mr Tony Fairweather, Group Managing Director, SEA Electric, *Committee Hansard*, 31 August 2018, p. 5.

30 Mr Tony Fairweather, Group Managing Director, SEA Electric, *Committee Hansard*, 31 August 2018, p. 4.

31 Mr Tony Fairweather, Group Managing Director, SEA Electric, *Committee Hansard*, 31 August 2018, p. 2.

32 Ben Potter, 'SEA Electric eyes \$200 million-plus annual van sales with Vic Labor backing', *Australian Financial Review*, 30 October 2018, <https://www.afr.com/news/sea-electric-eyes-200mplus-annual-van-sales-with-vic-labor-backing-20181030-h17ajk> (accessed 31 October 2018).

more variety and shorter model cycle times at all volumes below 40,000 annual units than the conventional manufacturing methods.

Secondly, the business proposed a different plant format, similar to production concepts developed by Volvo at Uddevalla in Sweden, as an alternative to the Toyota Production System (TPS). The proposed plant design had fixed assembly stations as distinct from a moving assembly line with part sets delivered sequentially to the workspace for assembly by a skilled two-person team completing one vehicle per shift. Such a plant is much less expensive to build, is more flexible, offers higher worker morale and a flatter, less expensive, management structure than a conventional plant.

Thirdly, the business proposed a direct-selling model from a digital platform supported by company-owned sites in shopping centres, a model subsequently demonstrated by Tesla in Australia. This would collapse the dealer margin into the producing business and enable solid profit margins, budgeted at 30%, providing rapid growth through retained earnings while offering customers an ultra high quality product at a reasonable price.³³

4.24 Mr Reynolds described how Precision Buses has used existing local Australian engineering and design capability, previously harnessed for car manufacturing to reimagine how buses are built. Instead of importing chassis and fitting a coach body and other fittings as has been done in the past, Precision Buses is looking at how it can bring together bus components from a range of local and imported suppliers to build a product that meets their client's requirements:

We've manufactured two electric buses to date that are being prepared to go into trial. The aim of those buses is to look at how electric drive line is affected by mass transport patronage, topography, traffic structure in terms of time and delay, and also weather conditions. We also manufacture an architecture which [has] moved away from the traditional chassis and coach into an integrated model which allows us to become an [Original Equipment Manufacturer (OEM)] in the bus manufacturing space. This allows us to integrate various technologies from partners, whether that be drive line from other OEMs or autonomous technologies from other companies, which allows us to try and connect mass transport artery with last mile solution so that we have an integrated solution. By setting that up in a local condition, we're able to bring economic benefit to suppliers and manufacturers locally. We use the existing capability that was available with OEM manufacturers in the passenger car space to engineer for us today.³⁴

4.25 One of the benefits to manufacturing locally are the synergies that could be generated by having collaborators co-located, particularly in regard to emerging technologies such as automation. Two companies, EasyMile and Transit Australia Group, have announced plans to manufacture autonomous vehicles in South

33 Australian Productivity Council, *Submission 7*, pp. [5–6].

34 Mr Christian Reynolds, Director, Precision Buses, *Committee Hansard*, 10 August 2018, p. 20.

Australia.³⁵ Mr Simon Pearce, Head of EasyMile Asia-Pacific described EasyMile's relationship with Precision Buses as 'seamless' when integrating their technology. Mr Pearce suggested that automated vehicles are a parallel technology that would develop side by side with electric and that it made sense to co-locate where synergies might be gained for both parties.³⁶

EV component manufacturing

4.26 The Committee heard that 'Australia has the skills needed to manufacture EVs and components like battery cells, motors and power electronics'.³⁷ The MTAQ noted that 'Australia has always been an effective supplier of components'.³⁸

4.27 Monash University submitted that Australia would need to be 'selective' in deciding where to focus in regards to manufacturing EVs or components. The submission suggested that:

Areas of strength lie in development of [Intellectual Property], protection and nurturing of emerging energy storage technologies and integrated systems for electric vehicles developed in our innovation system so that we are better prepared for the next-generation of technologies required for the EV market.³⁹

4.28 Associate Professor Nesimi Ertugrul from the School of Electrical and Electronic Engineering at the University of Adelaide put forward a similar view:

My view is: why don't we focus on some value-added part of these electronics—from the battery level, motor control level, similar topology, similar developers. If this continues happening, we can become an electronic nation. We can compete, with electronics all produced in automated manner without touching a single hand. That's how I see it.⁴⁰

4.29 During the inquiry, the Committee visited the Nissan Casting Plant Australia (NCAP) in Dandenong, Victoria (see Appendix 3). The plant casts, machines and assembles components for motor vehicles in the Nissan range with parts exported to Japan, Thailand, Mexico and the United States. The plant employs nearly 150 people and operates six days per week.⁴¹ NCAP's submission stated:

35 Hon David Ridgway MLC, South Australian Minister for Trade, Tourism and Investment, *South Australia, EasyMile and Transit Australia Group sign a MOU to advance AV manufacturing and technology in South Australia*, Media Release, 24 July 2018, <https://premier.sa.gov.au/news/south-australia-easymile-and-transit-australia-group-sign-a-mou-to-advance-av-manufacturing-and> (accessed 26 November 2018).

36 Mr Simon Pearce, Head of EasyMile Asia-Pacific, *Committee Hansard*, 10 August 2018, p. 18.

37 See, for example: AEVA—ACT, *Submission 6*, p. 13; VACC, *Submission 26*, p. 12.

38 MTA of Queensland, *Submission 41*, p. [4].

39 Monash University, *Submission 128*, p. 2. See also: HMA, *Submission 73*, p. [17].

40 Associate Professor Nesimi Ertugrul, School of Electrical and Electronic Engineering, University of Adelaide, *Committee Hansard*, 10 August 2018, p. 47.

41 Nissan, *Submission 40*, p. 1.

NCAP produces six key components for Nissan EV and hybrid vehicles that are sold globally. The growth of EVs globally is allowing us to not only expand our workforce, but also develop talents in areas such as engineering, manufacturing, logistics and more.⁴²

4.30 Pilbara Metals Group (PMG) commented that Australia's large reserves of raw materials required for battery manufacturing 'has allowed companies to [proceed] with planning and engineering studies to produce various components of batteries in Australia'. PMG suggested that production of battery cathodes could be a logical starting point.⁴³

4.31 MTAQ submitted that the manufacture of a key component such as a battery pack in Australia could lead to other parts of the EV manufacturing chain also being based in Australia:

The economics of vehicle manufacture tends to indicate the most important component is the battery pack. The geographic sourcing of these items can be expected in large part to determine the architecture of the future electric vehicle manufacturing. Tesla has demonstrated the economic power that battery manufacturing confers on an OEM electric vehicle producer.⁴⁴

4.32 The Committee has also heard that Australia has significant, high-quality deposits of rare earth elements (REE) that are used to manufacture permanent magnets for EVs and 'for electric generators that power wind turbines'.⁴⁵ China currently dominates the mining of REE and the manufacture of permanent magnets. Deakin University argued that there is an opportunity for Australia to take advantage of its reserves, to build local manufacture of value-added products and to do so in an environmentally responsible way.⁴⁶ The University of Adelaide submitted a similar proposition:

Australia can also develop high quality brushless permanent magnet motor manufacturing facilities used in EVs which rely on two critical value added materials: copper and rare earth magnets.⁴⁷

Research and development

4.33 Many witnesses and submitters highlighted the key role that R&D has, and could, continue to play in underpinning Australia's future automotive manufacturing capacity. This R&D runs the spectrum from academia through to in-house OEM R&D centres.

4.34 The Committee has heard that Australia is an R&D hub for major OEMs such as Ford, GM Holden and Toyota in the Asia-Pacific:

42 Nissan, *Submission 40*, p. 1.

43 Pilbara Metals Group, *Submission 17*, p. 2.

44 MTAQ, *Submission 41*, p. [4].

45 Deakin University, *Submission 35*, p. 4.

46 Deakin University, *Submission 35*, p. 4.

47 University of Adelaide, *Submission 91*, p. [2].

Currently, Ford has a design/styling, engineering and homologation/testing team in Australia, and General Motors and Toyota have their design/styling and small engineering teams in Australia.⁴⁸

4.35 Mr David Magill, Director, Government Relations and Public Policy, GM Holden explained that GM Holden 'are now doing over \$120 million worth of R&D annually in Australia each year and our engineering program in advanced vehicle development is going to be working on electrification projects for GM'.⁴⁹ The Committee also heard that GM Holden is expanding this capacity in advanced vehicle development—the 'area between pure research and development and establishing programs that are technically feasible and business case feasible and can be produced'.⁵⁰

4.36 In its submission, Hyundai noted that it invests in Australian R&D and the value of this work:

This is valuable, highly skilled work that both secures and develops automotive engineering expertise in Australia and should continue to be supported through a dedicated program if the country is to recognise the sector as having strategic importance to the economy.⁵¹

4.37 Noting the importance of batteries not just in motor vehicles, but also for stationary energy storage, the CSIRO is contemplating establishing a new future science platform focusing on the lithium value-chain. This would place it as one of the CSIRO's six priority areas for future scientific research.⁵² The CSIRO has also reiterated to the Committee the importance of its partnerships with industry as a means to commercialise research outcomes with benefits for both industry and CSIRO.⁵³

4.38 Associate Professor Patrick Howlett from Deakin University told the Committee that research in the automotive sector is constantly evolving as a result of changing priorities and scientific breakthroughs. Associate Professor Howlett raised the example of advances in lithium metal electrodes in high-energy batteries:

The [United States Department of Defence] made a directive to essentially investigate the lithium-metal electrode for high-energy batteries for electric vehicles, and they have the target of 500 watt-hours per kilo. There were a lot of slogans that went around that. What that has driven is research in the

48 Deakin University, *Submission 35*, p. 5.

49 Mr David Magill, Director, Government Relations and Public Policy, GM Holden, *Committee Hansard*, 31 August 2018, p. 62.

50 Mr Brett Vivian, Executive Director Engineering, GM Holden, *Committee Hansard*, 31 August 2018, p. 63.

51 Hyundai, *Submission 103*, pp. 12–13.

52 Dr Keith McLean, Director, Manufacturing, CSIRO, *Committee Hansard*, 17 August 2018, p. 47.

53 Dr David Harris, Research Director, Low Emissions Technologies, CSIRO, *Committee Hansard*, 18 October 2018, p. 11.

US on the lithium metal electrode, and then that has further driven worldwide research to the point where now there have been rapid advances in that technology. Where not so long ago that was essentially ignored as a potential technology, now it's probably the most likely next technology. That's the metal electrode; that's only the bottom half of the battery, if you like. The cathode remains a problem, and there are a range of technologies that can be addressed there.⁵⁴

4.39 In its submission, Deakin University flagged a number of constraints to research in the automotive sector. The most significant of these is the lack of students available to undertake post-graduate study and the difficulty in recruiting automotive engineering researchers. This difficulty stems from the perceived lack of employment opportunities in the automotive sector and complications accessing student visas.⁵⁵ During the Adelaide hearing, Professor Rocco Zito, Head of Civil Engineering, College of Science and Engineering at Flinders University noted the current professional development and employment pathways that exist, but flagged that more could be done to ensure that employment opportunities exist for these students at the conclusion of their studies:

I think there is a need to bring some coherence to this debate in the form of an industry roadmap for EV and AV in Australia to provide short- and medium-term guidance to how we can maximise our participation in the value chain in both inputs like batteries and taking on that larger challenge and opportunity of being part of a global EV-AV industry into the future. We should never rule that out in the great sweep of history. Even in the wake of the closure of the auto industry, which hurt us in South Australia so badly, there are plenty of skills and capabilities available to be redeployed cleverly in a very high value industry at its best, EV and AV.⁵⁶

Industry 4.0

4.40 A key opportunity for the manufacturing of EVs and associated componentry in Australia is the worldwide phenomenon of 'Industry 4.0'. This refers to what is being termed as the fourth industrial revolution—that is, technological developments such as the improvement of artificial intelligence and machine-to-machine integration across 'almost every industry worldwide'.⁵⁷ In a recent article, Dr Jens Goennemann, Managing Director, Advanced Manufacturing Growth Centre described the benefits of Industry 4.0:

Industry 4.0 can start with as little as sticking a sensor on a piece of equipment so that one can monitor where it is or what it does. In the longer

54 Associate Professor Patrick Howlett, Deakin University, *Committee Hansard*, 31 August 2018, p. 42.

55 Deakin University, *Submission 35*, p. 6.

56 Professor Rocco Zito, Head of Civil Engineering, College of Science and Engineering at Flinders University, *Committee Hansard*, 10 August 2018, p. 46.

57 Department of Industry, Innovation and Science, *Industry 4.0*, <https://www.industry.gov.au/funding-and-incentives/manufacturing/industry-40> (accessed 2 October 2018)

perspective though, it is about establishing a relationship with embedded intelligence across the entire manufacturing process from research and design through to the final customer engagement. If we get this right, then customer feedback loops back into the R&D process and starts the next iterative step in delivering high-quality outcomes and rich customer experiences.⁵⁸

4.41 Of most relevance to this Committee is the increase in manufacturing automation. The Boston Consulting Group explained how increased automation will also lead to significant decrease in battery price:

By transitioning to the factory of the future [Industry 4.0], producers can reduce total battery cell costs per kilowatt-hour (kWh) of capacity by up to 20%. The savings result from lower capex and utility costs and higher yield rates. The production-related costs (excluding materials) can be reduced by 20% to 35% in each of the major steps of battery cell production: electrode production, cell assembly, and cell finishing. Electrode production benefits from faster drying times that increase yield rates and reduce capex for equipment. In cell assembly, data-driven automated adjustment of parameter settings increases accuracy and reduces production times. Cell finishing is enhanced by shorter times for formation and aging, which significantly reduces capex requirements.⁵⁹

4.42 Professor Peter Newman highlighted the opportunities that Western Australia has in taking advantage of Industry 4.0 developments:

Fourth stage technologies offer WA the opportunity to develop a much larger industrial base that is complementary to its world-leading resource extraction sector. These technologies shift the competitive advantage of early stage value adding away from low cost labour countries to the earliest point in the value chain where all the input materials can be brought together for highly automated manufacturing processes. Components are then shipped to the major global manufacturing centres for later stage manufacturing where proximity to markets or low-cost labour still afford an advantage. WA is in the unique position of having abundant quantities of almost all the New Energy metals, giving it a large advantage in electro-chemical processing.⁶⁰

4.43 Automated manufacturing will have a lower labour requirement and allow Australian firms to compete globally. Deakin University's submission indicated the need for Australia to adopt and develop Industry 4.0 frameworks and technologies to be competitive in EV manufacturing:

58 Australian Institute of Company Directors, *Industry 4.0: a whole of economy opportunity*, August 2017, <https://aicd.companydirectors.com.au/membership/company-director-magazine/2017-back-editions/august/industry-4-0-a-whole-of-economy-opportunity> (accessed 28 November 2018).

59 Boston Consulting Group, *The Future of Battery Production for Electric Vehicles*, September 2018, <https://www.bcg.com/en-au/publications/2018/future-battery-production-electric-vehicles.aspx> (accessed 28 November 2018).

60 Professor Peter Newman AO, *Submission 23.1*, p. 13.

The competitive manufacture of electric vehicles in Australia will need to leverage Australia's research and development capabilities to deliver future integrated factories. These Industry 4.0 facilities will operate as a 'system of systems' through intelligent machines, human factor integration, and integrated supply chains.⁶¹

4.44 Deakin University also anticipated the benefits that would eventuate from adopting Industry 4.0 framework in electric vehicle manufacturing through the ability to 'participate in the global supply chain' without having to commit to a full-scale 'end-to-end vehicle manufacturing industry'.⁶²

4.45 The concept of Industry 4.0 was discussed in a November 2015 report of the intergovernmental Australia-Germany Advisory Group, *Collaboration, Innovation and Opportunity*.⁶³ Recommendation 10 of this report called for 'initiating a collaborative approach to the development of global Industry 4.0 standards'.⁶⁴

4.46 The report of the Australia-Germany Advisory Group resulted in the creation of the Prime Minister's Industry 4.0 Taskforce (now the Industry 4.0 Advanced Manufacturing Forum).⁶⁵ The Taskforce and its successor have fostered an industry relationship with the German Plattform Industrie 4.0, and supported Industry 4.0 test laboratories in Australian universities.⁶⁶

Battery manufacturing and commodity value-adding

4.47 Earlier in the report, the Committee discussed the benefits for the mining sector from an increased use of EVs both here and in Australia.⁶⁷ The future of EV manufacturing will lead to an increase in demand for a number of key resources including copper, nickel, cobalt and lithium. Given the anticipated increase in demand for EV manufacturing in the coming decades, there could be a significant upsurge in the value of these minerals.⁶⁸ The Electrical Trades Union highlighted Australia's natural advantages:

61 Deakin University, *Submission 35*, p. 1.

62 Deakin University, *Submission 35*, p. 1.

63 Australia-Germany Advisory Group, *Collaboration, Innovation and Opportunity*, November 2015, <https://dfat.gov.au/about-us/publications/international-relations/Documents/australia-germany-advisory-group.pdf> (accessed 22 October 2018).

64 Australia-Germany Advisory Group, *Collaboration, Innovation and Opportunity*, November 2015, p. 4.

65 Australia-Germany Advisory Group, *Collaboration, Innovation and Opportunity*, November 2015, p. 4.

66 Australian Advanced Manufacturing Council, *Industry 4.0 Advanced Manufacturing Forum*, <http://aamc.org.au/industry-4-0/> (accessed 3 October 2018)

67 See, for example: AMEC, *Submission 20*; Bloomberg New Energy Finance, *Submission 127*; Pilbara Metals Group, *Submission 17*; Deakin University, *Submission 35*, p. 4.

68 Australian Electric Vehicle Association, *Submission 6*, p. 6.

Australia has some of the highest grade, and largest, deposits of Lithium and Vanadium in the world, particularly in Western Australia. Western Australia is also currently the largest producer of lithium, which is necessary to supply batteries for the emerging EV market.⁶⁹

4.48 Bloomberg NEF projected that 'global demand for metals and materials used to produce lithium ion batteries will increase 25-fold by 2030'.⁷⁰ Dr Howard Lovatt, Team Leader, Electrical Machines at the CSIRO made the point that Australia's diversity of mineral resources makes it well placed to take advantage of any changes to battery chemistry and composition:

Generally in terms of batteries it most definitely is an area that's changing rapidly, and new developments are occurring, and that will mean that some minerals that were important suddenly become not important and vice versa. Particularly when you get a big growth in an industry like lithium batteries, it does put stress on the supply of some minerals, so then everyone's motivated to change the composition of the batteries to avoid those minerals. So this is very much a moving target. But I guess the good news for Australia is that we're well supplied with lots of different minerals, so it's likely to benefit Australia regardless of the final commercial outcome.⁷¹

Commodity value-add

4.49 Mr Warren Pearce, Chief Executive Officer of the Association of Mining and Exploration Companies explained the lithium value chain from mining to battery manufacture:

we've broken the value chain into the five steps toward the creation of manufacturing of batteries: the first step being mining concentrate; the second step being refining and processing; the third step being electrochemical processing; the fourth step being the production of battery cells; and the final step being the assembly of batteries.⁷²

4.50 Mr Pearce noted that Australia currently only participated in the first step—mining the raw materials—but that involvement in the subsequent stages could bring huge economic returns to Australia saying that many Australian companies 'are now quite legitimately looking to process or value-add their materials to see if they can get into a greater part of the value chain.'⁷³

69 ETU, *Submission 110*, p. 4.

70 Mr Ali Asghar, Senior Associate, Bloomberg NEF, *Committee Hansard*, 31 August 2018, p. 7.

71 Dr Howard Lovatt, Team Leader, Electrical Machines, CSIRO, *Committee Hansard*, 18 October 2018, p. 8.

72 Mr Warren Pearce, Chief Executive Officer, Association of Mining and Exploration Companies, *Committee Hansard*, 17 August 2018, p. 27.

73 Mr Warren Pearce, Chief Executive Officer, Association of Mining and Exploration Companies, *Committee Hansard*, 17 August 2018, p. 27.

4.51 Currently, it is estimated that Australian mining companies capture less than 0.5 per cent of the lithium chain.⁷⁴ Deakin University agreed with this estimation stating that 'there is a great opportunity for Australia to capture a larger part of the value chain of lithium ion batteries, by not only exporting the lithium minerals, but also by designing and manufacturing batteries'.⁷⁵

4.52 Mr Pearce provided the Committee with examples of a number of Western Australian mining and exploration companies where Australian mining and exploration companies have partnered with larger international companies with capital and expertise in processing in order to build processing facilities for lithium and other commodities.⁷⁶

4.53 Mr Pearce discussed the need for linkages to be facilitated between Australian mining and exploration companies with international processing companies in order to import much needed expertise and capital. This expertise would enable Australian businesses to value-add our mineral resources on-shore for export or domestic use:

In order to achieve that, there are some barriers that our report has tried to identify, primarily being that our member companies are mid-tier or small-cap mining companies. They don't have large balance sheets and they require support to find investment to build these types of facilities. Also, in order to move into that space, we're capable explorers and miners but we are not processors or refiners. We need to access the proprietary knowledge and technical expertise to undertake that successfully. To make that possibility a reality, our organisation has been promoting the opportunity for partnerships between international companies that hold this knowledge and Australian mining companies.⁷⁷

4.54 The 2018 report titled *Lithium Valley: Establishing the Case for Energy Metals and Battery Manufacturing in Western Australia* observed how trends such as automation are changing the economic paradigm of value-adding raw minerals:

Historically, it was more cost effective to value add closer to large markets or in countries with large, low cost workforces. This is no longer the case. Information technologies, artificial intelligence, automation and new energy systems now favour manufacturing at the earliest point in the value chain

74 Professor Peter Newman AO, *Submission 23.1*, p. 14. See also: Regional Development Australia Perth, *Lithium Valley: Establishing the Case for Energy Metals and Battery Manufacturing in Western Australia*, 2018.

75 Deakin University, *Submission 35*, p. 4.

76 Mr Warren Pearce, Chief Executive Officer of the Association of Mining and Exploration Companies, *Committee Hansard*, 17 August 2018, p. 27.

77 Mr Warren Pearce, Chief Executive Officer of the Association of Mining and Exploration Companies, *Committee Hansard*, 17 August 2018, p. 27.

where all the input materials can be brought together in a low, cost effective way.⁷⁸

4.55 This same report quantified the projected economic importance of value-adding. An integrated approach that focused on mining, refining with 10 per cent electro-processing (the first three steps that Mr Pearce outlined) is projected to result in over 100 000 jobs, economic investment of over \$34 billion and an economic contribution of \$56 billion per annum by 2025. This compares to a mining only scenario whereby less than 30 000 jobs are created and total investment of nearly \$14 billion.⁷⁹

Battery manufacturing

4.56 In addition to processing and advanced refining of minerals, there is an opportunity for Australian companies to value-add refined minerals into battery cells and then assemble into batteries. The University of Adelaide stated that Australia could play a part in the 'automated production of batteries and battery management systems in [the] EV supply chain'.⁸⁰

4.57 Mr Brian Craighead, Director of Renaissance Energy told the Committee about his company's intention to construct a lithium-ion battery factory in the Northern Territory.⁸¹ Mr Craighead explained the benefits to his company of building tailored products in Australia:

We are manufacturing a particular type of battery cell that works better in hot climates. That's South-East Asia and Australia. Part of the reason we're up in Darwin is that the export capability is very good for us when it comes to South-East Asian markets. Ours is, we think, about 70 per cent an export business, but Australia is an important market for us in both the grid market and the electronic vehicle market. We've met a few folks who seem to be quite ambitious with plans for electronic vehicle manufacturing. An EV, fundamentally, is a battery on wheels. So for us it's a very attractive market. We can customise batteries and stick them in EVs. For hot-climate [EVs], we think that there will be a very clear market.⁸²

4.58 Mr Craighead also noted that the capital expense of building an automated factory is 'not what it once used to be', and explained the counterintuitive proposition that Australia could find itself as a leader in extracting the raw materials required in

78 Professor Peter Newman AO, *Submission 23.1*, p. 8. See also: Regional Development Australia Perth, *Lithium Valley: Establishing the Case for Energy Metals and Battery Manufacturing in Western Australia*, 2018.

79 Professor Peter Newman AO, *Submission 23.1*, p. 14. See also: Regional Development Australia Perth, *Lithium Valley: Establishing the Case for Energy Metals and Battery Manufacturing in Western Australia*, 2018.

80 University of Adelaide, *Submission 91*, p. [1].

81 Mr Brian Craighead, Director, Energy Renaissance, *Committee Hansard*, 27 September 2018, p. 11.

82 Mr Brian Craighead, Director, Energy Renaissance, *Committee Hansard*, 27 September 2018, p. 12.

batteries and manufacturing the batteries themselves but not having the capacity in Australia to process and refine the raw material to battery manufacturing grade:

The great sadness of Australia—the kind of twist here—is that, although we have all the raw materials we need to manufacture competitively lithium-ion batteries in Australia, the reality is that all those raw materials without exception are mined and shipped overseas to be processed to battery grade and then reimported; we have to re-import. Most of the margin is given overseas because there aren't processing facilities locally for battery-grade raw material.⁸³

4.59 Mr Craighead was confident that the establishment of a battery manufacturing sector in Australia could provide the critical mass to encourage local miners to develop processing and refining capabilities:

What they need is security in offtake. If there is enough confidence in forward orders, people can justify and bank the capital investment to do the processing locally. In some cases—lithium, less so—it's quite expensive to bring a processing facility on shore. And it's the process as well, because some of them are power hungry and with some of them you have to be very careful that you're not hurting the environment. So because of the cost involved all of them need security in forward orders. Basically, they need to know if they have enough orders for the next three years to justify the capital investment.

And here's how you get that: we will bring some level of security in forward orders to these folks locally, because, obviously, the reason you exist is to buy Australian. But if another factory comes up—if the Townsville comes up—it will be much bigger than ours; it's a very differently sized facility. If that goes up it would bring even more security in forward orders. So, really, it's just like any bankable project: the more forward orders you've got then the more comfortable the lenders are and the more comfortable the investors are. That's what will suit our local processing. For every dollar of benefit and economic benefit that our little factory brings there's about six that go to the raw material producers so that they can get processing. There's much more in it for Australia if we can have them processing to battery grade, rather than our little factory.⁸⁴

83 Mr Brian Craighead, Director, Energy Renaissance, *Committee Hansard*, 27 September 2018, p. 13.

84 Mr Brian Craighead, Director, Energy Renaissance, *Committee Hansard*, 27 September 2018, p. 13.

4.60 Two battery manufacturers, Sonnen and Alpha ESS, have recently announced that they will manufacture lithium-ion home batteries in Adelaide.⁸⁵

4.61 Professor Mainak Majumder of Monash University was more cautious in his advice to the Committee:

My view is that because battery manufacturing is so well established in South-East Asia and in Japan and that they're so good at that we might not be able to compete with them in battery manufacturing. But we could possibly think about the resources that go into battery manufacturing, and that could be a much better approach for us to invest in.⁸⁶

4.62 Mr Pearce observed that the establishment of a local battery manufacturing sector would be beneficial for mining and processing companies 'as a local market to sell their product into'.⁸⁷ An Australian-based battery manufacturing sector would also have flow-on benefits to other industries 'such as the manufacture of new submarines in South Australia which is expected to involve battery technology'.⁸⁸

Battery technology and developments

4.63 At its Melbourne hearing, the Committee heard from a panel of academics specialising in battery chemistry research who spoke about their research areas and the implications this work would have on battery use into the future. Associate Professor Patrick Howlett from Deakin University stated that his focus was on 'next generation prototype batteries with new materials that have superior properties, for example, lighter weight'.⁸⁹ Associate Professor Howlett also described the industry's move to lithium-ion batteries with higher levels of cobalt:

The main attractiveness there is their higher theoretical energy density or specific capacity, which is the amount of charge they can store per gram, as well as their higher voltage.⁹⁰

85 See, for example: Giles Parkinson, 'Sonnen to manufacture home batteries at old Holden factory in Adelaide' *RenewEconomy*, 9 September 2018, <https://reneweconomy.com.au/sonnen-to-manufacture-home-batteries-at-old-holden-factory-in-adelaide-92563/> (accessed 26 November 2018); Sophie Vorrath, 'Alpha-ESS to become second battery manufacturer to set up shop in Adelaide', *One Step Off the Grid*, 14 November 2018, <https://onestepoffthegrid.com.au/alpha-ess-become-second-battery-manufacture-set-shop-adelaide/> (accessed 26 November 2018).

86 Professor Mainak Majumder, Department of Mechanical and Aerospace Engineering, Monash University, *Committee Hansard*, 27 September 2018, p. 45.

87 Mr Warren Pearce, Chief Executive Officer of the Association of Mining and Exploration Companies, *Committee Hansard*, 17 August 2018, p. 28.

88 ACTU, *Submission 107*, pp. 3–4.

89 Associate Professor Patrick Howlett, Deakin University, *Committee Hansard*, 17 August 2018, p. 38.

90 Associate Professor Patrick Howlett, Deakin University, *Committee Hansard*, 17 August 2018, p. 40.

4.64 Mr Ali Asghar, Senior Associate for Power, Energy Storage and EVs at Bloomberg New Energy Finance explained that as demand for particular minerals increases with battery demand, this will drive innovation and amongst the battery industry to modify the chemical composition of batteries to reduce battery input costs:

We do look at battery chemistry changes in the chemical composition of batteries—the amount of cobalt, lithium, nickel, manganese composition within batteries. We do expect a change towards chemistries with a lower composition of cobalt, mainly because that is a metal that we expect to be a bottleneck in lithium-ion battery manufacturing. It is basically a road block in putting pressure down on lithium-ion battery pricing.⁹¹

4.65 Associate Professor Howlett noted that higher energy density can pose difficulties from an operating perspective as they are restricted in how quickly the batteries can be charged.⁹²

4.66 Professor Baohua Jia, Research Leader at the Swinburne University of Technology highlighted her team's work on supercapacitors, which are 'a very good alternative for the current batteries in terms of safety issues, lifetime, cost and also environmental concerns'.⁹³

4.67 The University of Adelaide has projected that by 2030 'silicon carbide and gallium nitride based switching devices will drastically change the power electronics systems used in EVs (including battery chargers and motor drives)'. The use of such devices will 'improve efficiency, operating temperature, reliability while significantly reducing system size and weight'.⁹⁴

4.68 Nonetheless, many witnesses argued that despite these advances lithium-based batteries would remain the dominant underlying chemistry in batteries well into the future.⁹⁵ Mr Asghar affirmed this view:

Absolutely, lithium-ion batteries have an incumbency advantage. They have governments that are supporting the technology, governments that are supporting the manufacturing—for the electric vehicle industry and lithium-ion battery manufacturing. That gives me a little bit of confidence that, at

91 Mr Ali Asghar, Senior Associate for Power, Energy Storage and EVs at Bloomberg New Energy Finance, *Committee Hansard*, 27 September 2018, p. 9.

92 Associate Professor Patrick Howlett, Deakin University, *Committee Hansard*, 17 August 2018, p. 42.

93 Professor Baohua Jia, Research Leader, Swinburne University of Technology, *Committee Hansard*, 17 August 2018, p. 38.

94 University of Adelaide, *Submission 91*, p. [3].

95 Professor Mainak Majumder, Department of Mechanical and Aerospace Engineering, Monash University & Associate Professor Patrick Howlett, Deakin University, *Committee Hansard*, 17 August 2018, p. 42.

least in the next five to seven years, lithium-ion batteries will likely be the major source for electric vehicles.⁹⁶

4.69 Associate Professor Howlett added to this noting that 'there are a number of fundamental barriers to making [lithium-ion batteries] work well, particularly when we try to achieve long cycle lives or the high rates that we need for acceleration'.⁹⁷

4.70 Importantly, this dominance of lithium-ion is likely to underpin the continued fall in battery pricing and, in turn, the improved affordability of EVs. The Committee heard that the average pricing of lithium-ion battery pack is expected to fall from its current pricing of \$209/kilowatt (kW) to \$70/kW by 2030.⁹⁸ Mr Asghar explained the reasons for this projected trend:

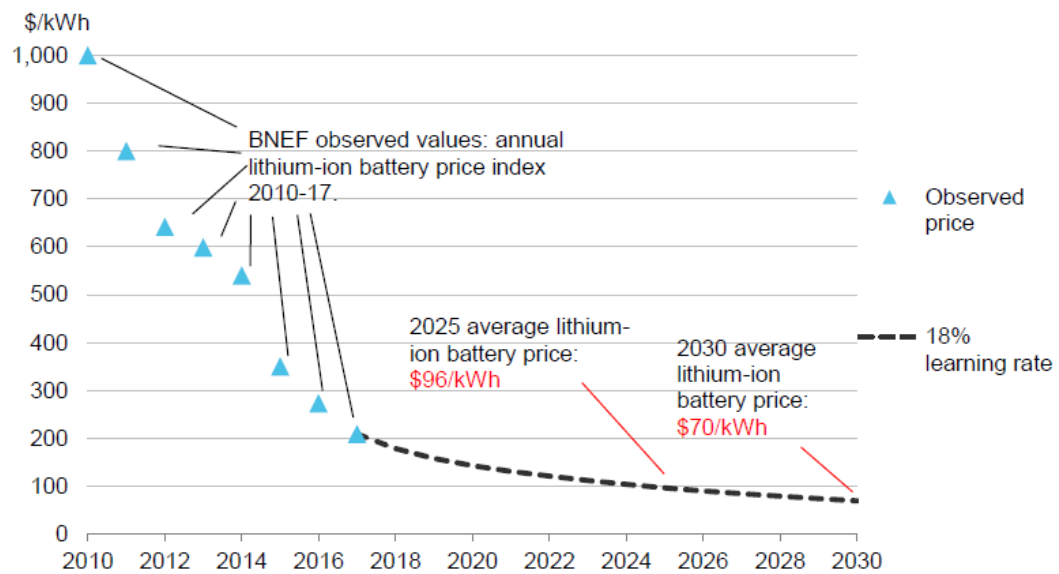
It's a story of mass manufacturing—so economies of scale—technology development and a major push towards electric vehicles. Electric vehicles are currently the biggest consumer of lithium-ion batteries. They've surpassed consumer electronics or stationary storage. Because of that demand for lithium-ion batteries there's been a lot of R&D into the technology and there's been a lot of investment into manufacturing capacity, specifically in Asia—in China, South Korea and Japan. Economies of scale have a big role in this. We've seen this in solar panels, where the Chinese started entering the solar PV manufacturing sector and brought the cost down considerably over the last decade. It's a similar trend that we see in lithium-ion batteries. I would say: technology improvement and economies of scale.⁹⁹

96 Mr Ali Asghar, Senior Associate for Power, Energy Storage and EVs, Bloomberg New Energy Finance, *Committee Hansard*, 27 September 2018, p. 11.

97 Associate Professor Patrick Howlett, Deakin University, *Committee Hansard*, 17 August 2018, p. 40.

98 Bloomberg New Energy Finance, *Submission 127*, pp.3–4.

99 Mr Ali Asghar, Senior Associate, Power, Energy Storage and EVs, Bloomberg New Energy Finance, *Committee Hansard*, 27 September 2018, p. 10.

Figure 4.1: Lithium-ion battery prices, historical and forecast¹⁰⁰

Source: Bloomberg New Energy Finance Note: Prices are for EVs and stationary storage, and include both cell and pack costs. Historical prices are nominal, future prices are in real 2017 U.S. dollars.

4.71 Mr Fairweather also noted:

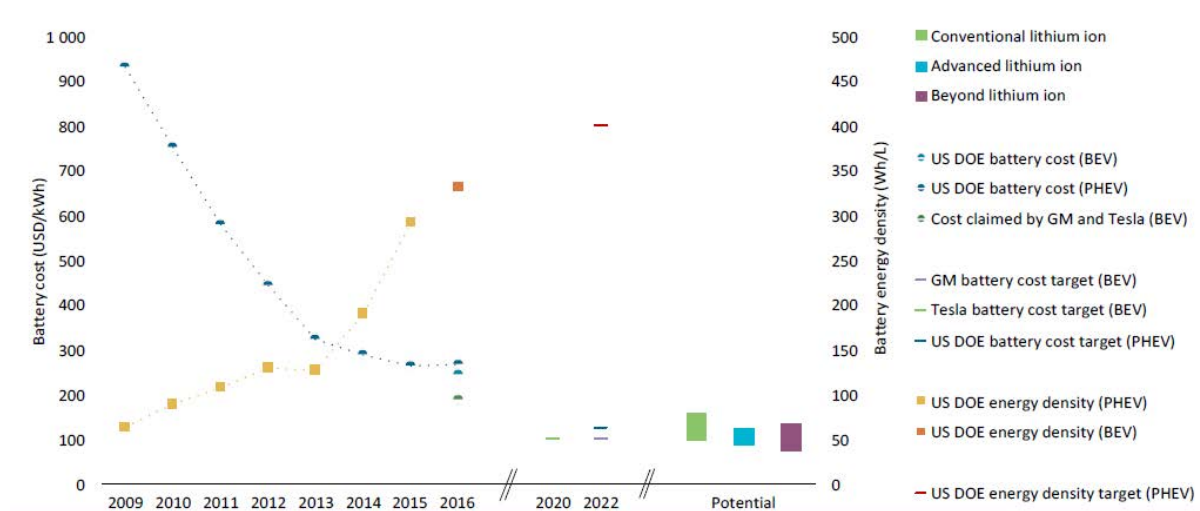
With the technology developing and density increasing in batteries at the scale and rate that they currently are, in the very short term—maybe 12 months to two years—the battery sizes will start to be reduced with range still being retained.¹⁰¹

4.72 The International Energy Agency's (IEA) *Global EV Outlook 2017*, noted that '[r]esearch, development and deployment...and mass production prospects are leading to rapid battery cost declines and increases in energy density'.¹⁰² Figure 4.2 is taken from the IEA's report and shows the evolution of battery energy density and cost.

¹⁰⁰ Bloomberg New Energy Finance, *Submission 127*, p. 4.

¹⁰¹ Mr Tony Fairweather, Managing Director, SEA Electric, *Committee Hansard*, 31 August 2018, p. 2.

¹⁰² International Energy Agency, *Global EV Outlook 2017: Two million and counting*, 2017, p. 6.

Figure 4.2: Evolution of battery energy density and cost¹⁰³

Battery recycling and repurposing

4.73 As the number of EVs rises and the batteries reach end-of-life, a number of witnesses have identified the recycling and repurposing of EV lithium-ion batteries as both a significant challenge and opportunity. The Queensland Department of Transport and Main Roads (DTMR) claimed that significant prospects exist for Australian businesses in relation to battery recycling:

As a greater number of EVs are brought into the vehicle fleet, there will be opportunities to create industries around recycling and reusing EV batteries. EV batteries can be used for stationary storage, and following this, the raw materials can be recycled to create new batteries.¹⁰⁴

4.74 According to the CSIRO only about three per cent of lithium batteries currently sold in Australia 'are being captured and sent for recycling off-shore'.¹⁰⁵ In its submission, MTAQ referred to a CSIRO report projecting between 100 000 and 188 000 tonnes of lithium battery waste by 2036, noting that 95 per cent of this waste could be recycled into 'new batteries or used in other industries' and yield an economic benefit of between \$813 million and \$3 billion by 2036.¹⁰⁶

4.75 However, Dr David Harris, Research Director for Low Emissions Technologies and Energy at the CSIRO acknowledged that there are serious challenges in the recycling space, but that these are not insurmountable:

We have projects underway now looking at how we can help companies who currently recycle some components of batteries adapt their processes to

¹⁰³ International Energy Agency, *Global EV Outlook 2017: Two million and counting*, 2017, p. 14.

¹⁰⁴ DTMR, *Submission 43*, p. 3.

¹⁰⁵ CSIRO, *Submission 134*, p. 10.

¹⁰⁶ MTAQ, *Submission 41*, p. [4]. See also: Sarah King, Naomi J. Boxall & Anand I. Bhatt, *Lithium battery recycling in Australia: Current status and opportunities for developing a new industry*, CSIRO, April 2018, <https://www.csiro.au/en/Research/EF/Areas/Energy-storage/Battery-recycling> (accessed 29 October 2018).

accommodate the changing composition of batteries, the higher metal contents, the different metals that are coming on—so, how we fit into existing processes and add new capability as the batteries change. We're helping to do that. In some cases the materials get recycled either back to the manufacturer or for different purposes altogether in Australia. We're now working with groups looking at different applications and separating those safely, because just recycling them itself is not a trivial process; that's a process that requires safety procedures. Batteries still have some charge and can still catch fire in those processes. We are doing work with people to try to develop efficient processes for battery recycling.¹⁰⁷

4.76 Some manufacturers such as Tesla and Toyota are already taking responsibility for 'whole of the battery life'.¹⁰⁸ Toyota has established a hybrid EV Battery Recycling Program with cash rebates and discounts for the return of EV batteries.¹⁰⁹ Whilst a recent media article claimed that 60 per cent of Tesla batteries are recycled with a further 10 per cent being reused in some form. Tesla is working towards a closed manufacturing loop that 'reuses the same recycled materials'.¹¹⁰

4.77 Dr Dale of the MTAQ told the Committee that there were many businesses excited by the commercial opportunities presented by battery recycling and ready to take up the challenge. Notwithstanding this confidence, many of these businesses need support to understand some of the technological issues associated with this industry. Dr Dale stated:

If we can develop the technology to support businesses with that interest then that's where Australia will win in the longer term.¹¹¹

4.78 In this context, the Committee notes the recent grants from ARENA and the CEFC to Melbourne-based company Reelectrify who are seeking to commercialise battery recycling technology.¹¹²

107 Dr David Harris, Research Director, Low Emissions Technologies and Energy, CSIRO, *Committee Hansard*, 18 October 2018, p. 10.

108 Dr Howard Lovatt, Team Leader, Electrical Machines, CSIRO, *Committee Hansard*, 17 August 2018, p. 50. See also: ACT Government, *Submission 48*, p. 3; Mr Gregory McGarvie, Managing Director, Australian Clean Energy Electric Vehicle Group, *Committee Hansard*, 27 September 2018, p. 55.

109 Toyota Australia, *Hybrid HV Battery Recycling Program*, <https://www.toyota.com.au/hybrid/battery-recycling> (accessed 28 November 2018).

110 John Forfar, 'Tesla's approach to recycling is the way of the future for sustainable production', *Medium*, August 2018, <https://medium.com/tradr/teslas-approach-to-recycling-is-the-way-of-the-future-for-sustainable-production-5af99b62aa0e> (accessed 28 November 2018). See also: Tesla, *Tesla's closed loop battery recycling program*, January 2011, https://www.tesla.com/en_AU/blog/teslas-closed-loop-battery-recycling-program (accessed 28 November 2018). See also: Mr Gregory McGarvie, Managing Director, Australian Clean Energy Electric Vehicle Group, *Committee Hansard*, 27 September 2018, p. 55.

111 Dr Brett Dale, Chief Executive Officer, Motor Trades Association of Queensland, *Committee Hansard*, 27 September 2018, p. 39.

4.79 Dr Matthew Stocks, Research Fellow at the College of Engineering and Computer Science at the Australian National University provided a practical example of how a used EV battery might be repurposed:

Electric vehicle range is important. Electric vehicles have a more limited battery life than stationary energy. As battery capacity decreases, you are likely to say: 'I don't want this battery anymore; I want a new one.' That battery still has a significant life potentially for other applications like replacing a Tesla Powerwall in stationary energy, where I don't actually care if I put in another three batteries—instead of putting in 10, I put in 13—because there is no real space cost. So I suspect that a lot will go into re-use rather than recycling, to begin with.¹¹³

4.80 Dr Howard Lovatt, Team Leader, Electrical Machines, CSIRO noted that recycling car batteries may in fact be a more straightforward process than recycling batteries associated with smaller, personal devices:

To make one observation on that, with a vehicle it is a lot easier to capture the battery at the end of life because there is already significant infrastructure for recycling the vehicle as a whole and the batteries could be an add-on to that, whereas, like your phone or your laptop batteries, it is much harder to actually capture the battery at the end of life.¹¹⁴

Manufacturing and installation of charging infrastructure

4.81 The lack of charging infrastructure is a barrier to increased uptake of EVs. The Royal Automobile Club of Victoria (RACV) cited a recent survey that found 80 per cent of 'respondents consider the availability of public fast charging (ie. 15 minutes to full charge) to be an important factor in influencing their decision to buy/own an electric vehicle'.¹¹⁵ Furthermore, over half of respondents to the survey 'believe government should implement subsidies to reduce the cost of installing home charging, and provide public charging infrastructure'.¹¹⁶

4.82 Although Australia currently has a relatively high ratio of public chargers to EVs—about one charger to every six EVs—the low number of EVs and the large geographical area of Australia mean that this number will need to continue to grow to maintain this ratio and public confidence in using EVs across the country.

112 Giles Parkinson, 'ARENA, CEFC back plan to recycle EV-batteries for household storage', *RenewEconomy*, 4 October 2018, <https://reneweconomy.com.au/arena-cefc-back-plan-to-recycle-ev-batteries-for-household-storage-65580/> (accessed 26 November 2018).

113 Dr Matthew Stocks, Research Fellow, College of Engineering and Computer Science, Australian National University, *Committee Hansard*, 17 August 2018, p. 13.

114 Dr Howard Lovatt, Team Leader, Electrical Machines, CSIRO, *Committee Hansard*, 17 August 2018, p. 50.

115 Royal Automobile Club of Victoria, *Submission 114*, p. 3.

116 Royal Automobile Club of Victoria, *Submission 114*, p. 3.

4.83 In its submission, the Australian Logistics Council (ALC) described the three types of charging infrastructure—'home charging, public charging and rapid/fast charging' and noted that :

Home charging and public charging can further be grouped as *destination charging* – a slow charge designed to help motorists travel in metropolitan centres.

Rapid/fast charging is analogous to highway petrol stations and is known as *journey charging*. As its name implies, it is designed to rapidly charge an electric vehicle for longer journeys.¹¹⁷

4.84 There are currently considerable opportunities for local companies to take advantage of the forecast increased demand for manufacture and installation of charging infrastructure for residential, commercial and government applications.

Home charging

4.85 The vast majority of EV charging is expected to occur at home, with about 70 per cent of EVs having a dedicated charging unit either at home or work.¹¹⁸ Home charging at its simplest is connecting the EV to a regular household power outlet which provides the equivalent of 100 kilometres of charge in 17 hours. This can be upgraded to a basic AC charger known as a "slow" or "trickle" charger which can fully charge a vehicle overnight.¹¹⁹

4.86 About 85 per cent of kilometres travelled in Australian passenger cars are classified as short range driving, that is generally less than 100 kilometres from home.¹²⁰ Another survey showed that 'more than 99% of daily trips were under 50 kilometres, implying a round trip of 100 kilometres.'¹²¹ Most of this driving is commuting to work, study and recreation; visiting friends; and shopping. With newer EV models having a range of over 350 kilometres,¹²² a home charger will meet the average day-to-day needs of most Australians. The Tesla Owners Club of Australia (TOC) confirmed this and made the point that most owners will not require public charging the majority of the time.

The day to day requirement does not require high speed charging, with vehicles typically sitting idle for ten or more hours overnight or for a similar period during the day whilst the owner is at work.¹²³

117 ALC, *Submission 104*, p. 13.

118 Energy Networks Australia, *Submission 60.5*, p. 6. See also: ARENA, *Submission 99.2*, p. 54. A US-based simulation undertaken in 2017 assumed that 88 per cent of all PEVs would be charged at home.

119 Royal Automobile Club of WA, *Submission 117*, p. 8.

120 Fast Cities Australia, *Submission 64*, p. 3.

121 Energy Networks Australia, *Submission 60.5*, p. 5.

122 Fast Cities Australia, *Submission 64*, p. 3. Converted miles to kilometres.

123 Tesla Owners Club of Australia, *Submission 28*, p. 7.

4.87 Even so, people for whom most charging is undertaken at home will still have a public charging requirement for long-haul trips.¹²⁴

4.88 TOC noted that the limitation to home charging, particularly those who live in apartments is the availability of charging points:

The key is availability, particularly for those who live in apartments. This can be addressed through building codes for new residential and commercial properties. As long as the electricity supply to the premises is appropriate the charging facilities do not need to be anything more complex than a standard 15A or 3 phase outlet which can be used with a suitable lead or adaptor.

This will not immediately address the demand in existing buildings and it may be appropriate to make grants available to local councils or other authorities to provide publicly accessible charging points on street, in car parks and places of work.¹²⁵

4.89 In its submission, the vehicle manufacturer Tesla confirmed the difficulties for apartment owners and observed that another barrier to home charging is for those who rent homes:

Customers who are keen to purchase electric vehicles in Australia are often unable to do so if they live in apartments or are renting their home. Some are able to install charging quickly. However, others can be delayed because strata meetings for their building are very infrequent or have no clear process to follow for charging installations. Customers can also be faced with unreasonable demands or objections from landlords or strata Committees.¹²⁶

4.90 An Energeia report also noted that EV 'drivers without access to home charging must rely entirely on public charging'.¹²⁷ The next section explores public charging stations.

Public charging stations

4.91 As noted earlier, 'two thirds of motorists indicate that a lack of adequate charging infrastructure is the greatest barrier to purchasing an [EV]'.¹²⁸ A small proportion of total Australian passenger vehicle kilometres are classified as long-range driving—about 15 per cent. Public chargers are primarily used for convenience but will also be used by drivers undertaking long-range trips and for those who do not have access to a charger at home or work. The Committee heard that public chargers form an 'important part of the electric vehicle ecosystem'.¹²⁹

124 Energy Networks Australia, *Submission 60.5*, p. 6.

125 Tesla Owners Club of Australia, *Submission 28*, p. 7.

126 Tesla, *Submission 92*, p. [10].

127 Energy Networks Australia, *Submission 60.5*, p. 6.

128 ALC, *Submission 104*, p. 13.

129 ARENA, *Submission 99.1*, p. 13.

4.92 During the inquiry, the Committee heard about some of the businesses that are benefiting from the growing demand for public charging infrastructure. Mr Nathan Dunlop, the New Markets and Sales Analyst at Tritium, a Brisbane-based company, provided a background on his company:

we're almost 250 staff now at Tritium. Those staff are in engineering, automotive and high-tech roles, working on exporting our product overseas. I guess the thing to note here is that those jobs also create downstream jobs throughout the supply chain. We create installation, maintenance and field service opportunities for installers that are putting our product in the ground. That's worldwide and in Australia. We also create jobs in regard to the supply chain. As you saw, our product has very many components in it, and 40 per cent of that procurement spending goes to Australian businesses at the moment. So those jobs are coming to Tritium but are also creating downstream job impacts.¹³⁰

4.93 Chapter 2 of the report described the different types of public charging infrastructure. Level 2 chargers (slow chargers) can charge an average car in 4–6 hours; whereas level 3 chargers (fast/ultra-fast chargers) can charge a car in as little as 20 minutes (even less for ultra-fast chargers currently under development).¹³¹ A recent Energeia report estimated that up to 30 per cent of EV drivers will rely on public chargers for 100 per cent of their EV charging needs.¹³² Level 2 public chargers are primarily used 'for public destination-based charging locations to attract drivers' such as supermarkets or shopping centres.¹³³ Level 3 chargers are mainly used for long-distance charging where an EV needs to quickly recharge in order to continue its journey.

Highway charging

4.94 In its submission, Fast Cities Australia estimated that the optimal spacing for an ultra-fast charging network would be 150 kilometres, and that a network of this type would cost a minimum of \$100 million.¹³⁴ Fast Cities Australia also stated that 'ultrafast highway charging networks are capital-intensive but cannot attract conventional equity and debt in medium term due to revenue uncertainty'.¹³⁵

4.95 A number of state governments and other organisations are establishing, or planning to establish, new public charging infrastructure. Mr Paul Fox, Head, Corporate Development at Fast Cities Australia told the Committee of their intention to complete a network of fast chargers along the major federally funded highways:

130 Mr Nathan Dunlop, New Markets and Sales Analyst, Tritium, *Committee Hansard*, 27 September 2018, p. 1.

131 Energy Networks Australia, *Submission 60.3*, p. 30.

132 Energy Networks Australia, *Submission 60.5*, p. 5.

133 Energy Networks Australia, *Submission 60.5*, p. 5.

134 Fast Cities Australia, *Submission 64*, p. 4.

135 Fast Cities Australia, *Submission 64*, p. 1.

My colleague tells me that he could knock out 42 sites very quickly. It's really a matter of the timing of funding. But our intention is to have the Melbourne to Brisbane completed by the end of next year, and then we would roll out the remaining 42 sites in the following year and six months. So it's about a two and a half year process in total. We could go faster; we have to be careful about going faster, because we need to match it to the growth in demand. We're already going ahead of ourselves; we don't want to go too far ahead of ourselves.¹³⁶

4.96 The DTMR described the Queensland Government's Electric Super Highway (QESH), which stretches from Coolangatta to Cairns and Brisbane to Toowoomba. DTMR explained:

Fast charging stations have been built in Cairns, Tully, Townsville, Bowen, Mackay, Carmila, Marlborough, Rockhampton, Miriam Vale, Childers, Maryborough, Cooroy, Brisbane, Coolangatta, Springfield, Gatton and Toowoomba. An additional charging site will be built at the Helensvale Queensland Rail carpark now that the Commonwealth Games have finished, once the carpark upgrade is complete.

Each site is no more than 200km apart and was chosen considering the driving range of EVs, local amenities, and the local energy network capacity. Sites are located close to amenities, such as cafes, shopping centres and restrooms, allowing drivers to take a break to stop, revive and survive while they recharge their vehicle.¹³⁷

4.97 DTMR stated that the large rollout of charging stations has resulted in a reduction in the ratio of EVs to public chargers from 10.5 to 4.9. This is despite a 70 per cent increase in the EV fleet over the last two years.¹³⁸ Ms Sally Noonan, Chief Economist at DTMR stated that the Queensland Government's reasons for building the QESH was not just about refuelling vehicles but also encouraging people to spend time in various locations around Queensland:

It's quite a different experience. The Queensland government's Electric Super Highway is not about just filling up in 10 minutes and then you're gone. It's actually trying to, in particular, look at that range anxiety around tourists, for example. That is where we see there's a real opportunity, where people are going to spend some time in the location where their vehicle is charging. It's quite a different proposition to the petrol station kind of scenario that I understand.¹³⁹

136 Mr Paul Fox, Head, Corporate Development, Fast Cities Australia, *Committee Hansard*, 27 September 2018, p. 27. See also: Fast Cities Australia, *Submission* 64, p. 8. In its submission, Fast Cities Australia has stated that it intends to install up to 100 chargers.

137 DTMR, *Submission* 43, p. 3.

138 DTMR, *Submission* 43, p. 5.

139 Ms Sally Noonan, Chief Economist, Queensland Department of Transport and Main Roads, *Committee Hansard*, 27 September 2018, p. 36.

4.98 The Royal Automobile Club of Western Australia (RACWA) also described the RAC Super Highway, 'a network of 11 publicly accessible EV fast charging DC stations located between Perth and Augusta' (520 kilometres) in south-west Western Australia.¹⁴⁰ The NRMA stated that it intends to build 'Australia's largest charging [EV] fast charging network' in NSW at a cost of \$10 million.¹⁴¹

4.99 Mr Tim Washington, Chief Executive Officer at Jetcharge, a Melbourne-based business explained how his business is benefitting:

JET Charge is what I would call a small business, one of the beneficiaries of the downstream jobs that Tritium are talking about. We started about five years ago, and we're now the leading installer of electric vehicle charging stations in Australia, being the recommended installer for nine vehicle brands nationwide. If you think of us as, basically, the people on the ground actually making sure the infrastructure gets installed, we're those people. We're the largest hardware distributor of charging stations in the Australian market. We've seen a large growth period over the last two years in the market. We currently employ 14 people in the head office and have a large contractor network of electricians who perform installations for us. That comes from a base of only two to three people, two years ago, and so we've seen some good growth in the market. From my perspective, it's really important that small businesses like ours have the room to grow into this new industry.¹⁴²

4.100 Mr Washington also described an associated business called Chargefox:

Chargefox is basically a software business that controls the charging stations. You need software to control the charging stations, and Chargefox was born out of a joint venture between us and a software business. It is another example of the new age of automotive, in terms of the technologies that are required, and is another Australian-born business, which currently employs four people.¹⁴³

Metropolitan charging

4.101 A number of local governments have also declared their interest in establishing public charging infrastructure within their local areas.¹⁴⁴

4.102 The Committee heard that the ACT Government is funding '50 new EV public charging stations in Canberra' at a cost of about \$450 000.¹⁴⁵ That works out to be \$9 500 per charger.

140 Royal Automobile Club of Western Australia, *Submission 117*, p. [1].

141 NRMA, *Submission 78*, p. [6].

142 Mr Tim Washington, Chief Executive Officer, Jetcharge; and Founder, Chargefox, *Committee Hansard*, 27 September 2018, p. 2.

143 Mr Tim Washington, Chief Executive Officer, Jetcharge; and Founder, Chargefox, *Committee Hansard*, 27 September 2018, p. 2.

144 See, for example: City of Darebin, *Submission 51*, p. [2]; City of Adelaide, *Submission 93*, p. 10.

4.103 Ms Michelle English, Associate Director at the City of Adelaide spoke about the how the City of Adelaide was seeking to leverage private sector capital to build charging infrastructure:

At a local level, we have several initiatives that demonstrate our commitment and our leadership. In the last 12 months we have co-funded with the state government, Esso power networks and Mitsubishi Motors the installation of 30 off-street electric vehicle charging stations in our council owned UPark stations and an additional 10 on-street electric vehicle charging stations. We've also partnered with Tesla and our eight-bay electric vehicle charging hub in Franklin Street to enable them to install four 120-kilowatt superchargers. We offer two hours free parking in selected high-profile locations, such as the Franklin Street EV charging hub.¹⁴⁶

4.104 Ms English continued describing incentives for local businesses and community members:

In addition to infrastructure, our Sustainability Incentives Scheme provides financial rebates to our businesses, property owners and community for rebates of up to \$1,000 for each fast charger less than 20 kilowatts, \$5,000 for each superfast charger over 20 kilowatts, and \$250 for each electric bike charging station installed in the city.¹⁴⁷

4.105 In its submission to the Committee, Jolt explained that it is building a network of public chargers, 'providing free charging for users and free installation for cities, funded by the billion dollar digital out-of-home advertising market'.¹⁴⁸

4.106 The UK Government, in its Road to Zero Strategy, noted that in addition to charging at home overnight, charging at workplaces during the day will be one of the 'most attractive options' as 'EVs go mainstream'.¹⁴⁹ The UK Government has made funding available to private businesses and public bodies through a Workplace Charging Scheme and recently announced an increase in the levels of the scheme to

145 350 Canberra, *Submission 21*, p. 4. See also: Mr Geoffrey Rutledge, Deputy Director-General, Sustainability and the Built Environment, Environment, Planning and Sustainable Development Directorate, Australian Capital Territory, *Committee Hansard*, 17 August 2018, p. 5.

146 Ms Michelle English, Associate Director, Sustainability, City of Adelaide, *Committee Hansard*, 10 August 2018, p. 48.

147 Ms Michelle English, Associate Director, Sustainability, City of Adelaide, *Committee Hansard*, 10 August 2018, p. 48.

148 Jolt, *Submission 96*, p. 1.

149 Department of Transport (UK), Road to Zero: Next steps towards cleaner roads transport and delivering our industrial strategy, July 2018, p. 82, available at: <https://www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strategy> (accessed 2 January 2019).

provide up to £500 off installation costs of charging sockets deployed at workplaces.¹⁵⁰

Rural charging

4.107 The Victorian Government Department of Environment, Land, Water and Planning identified that some gaps may emerge in the deployment of public charging infrastructure particularly in rural and regional parts of the country:

Research has found that the private sector will develop charging infrastructure at destinations such as shopping centres as there is an economic benefit. However, the areas less enticing for private investment are regional areas. A charging network along key regional routes could unlock tourism and economic development opportunities.

Tourists and residents are more likely to rely on public charging stations in regional and rural areas. Those living in rural areas travel further to access services than metropolitan residents, including education and employment precincts, and do not have as many public transport options. Vehicle ownership is perceived as more of a necessity for those living in regional Victoria. Similarly, tourists driving through regional Victoria need easy access to public charging infrastructure along popular tourist routes. Fast charging is particularly beneficial for long trips.¹⁵¹

Concluding comments

4.108 With increasing global demand for EVs, the Committee has heard that there are tremendous opportunities for Australian manufacturers. The Committee notes evidence suggesting that increasing automation will lead to fundamental changes to the processes and costs of manufacturing opening niches for Australian industry. The Committee has also heard that the Australian automotive sector might look differently to the mass manufacturing model of the past. The sector may choose to identify and play to its strengths, building specialist componentry, or assembling imported and locally made parts.

4.109 The Committee is encouraged by the companies that it has had heard from and visited who are at the forefront of the transition to EVs. For example, Nissan Casting Australia is already making components for EVs that are then assembled overseas; SEA Electric is fitting EV technology to truck gliders and has recently announced an expansion into EV bus manufacturing. In addition to these companies, there is a significant skilled workforce available to migrate from conventional automotive manufacturing to EVs; and a substantial and growing automotive research and development capacity.

4.110 Australia has significant reserves of a range of minerals essential to the production of lithium-ion batteries, the preferred battery type for EVs currently and

150 Department of Transport (UK), *Road to Zero: Next steps towards cleaner roads transport and delivering our industrial strategy*, July 2018, p. 86.

151 Victorian Government Department of Environment, Land, Water and Planning, *Submission 129*, pp. 8–9.

into the foreseeable future. A number of large lithium deposits have been developed with more on the way. The Committee is concerned that Australia is primarily engaged in the raw material extraction and export which only captures 0.5 per cent of the lithium value chain. Clearly more of this value chain can and should be captured by Australian companies.

4.111 Some mining and exploration companies are partnering with international companies with processing experience as a means to build processing capability. The Committee has heard that there are currently four lithium battery factories under development in Darwin, Townsville and Adelaide. These and other similar developments may provide the catalyst for an increased refining and processing presence for lithium and other minerals used in battery manufacture. The Committee is concerned about the likelihood of a surge in end-of-life EV batteries requiring recycling or repurposing. There is a need to ensure that companies interested in battery recycling are guided by comprehensive regulatory frameworks and the latest R&D to minimise any environmental and safety risks.

4.112 It is clear that the demand for charging infrastructure will continue to grow in line with EV numbers. Production of charging units and componentry for both home and public use, and the installation of such equipment is already providing economic benefits in states such as Queensland and Western Australia. This is being led by both the private sector and government. Although it is likely that the private sector will primarily fund public charging infrastructure in cities, public funding and planning will be required for highways and regional areas. Government has a role to play in enabling the private sector to rollout public charging infrastructure to all parts of the country.

4.113 A targeted approach will ensure that Australian industry optimises its economic participation in the transition to EVs. The next chapter will examine a range of possible federal and state government policies that could support the Australian industry to seize the opportunities associated with manufacturing EVs.

Chapter 5

Seizing the opportunity and managing the risks

Introduction

5.1 Much of this report has focused on the opportunities that are available for Australian consumers and industry as a result of the increasing use of electric vehicles (EVs). This chapter explores some of the proposals put forward by submitters and witnesses in order to support EV uptake; assist manufacturing and value chain activities; and to manage the risks associated with the transition towards increased EV use.

Supporting EV uptake

5.2 At the Committee's final hearing in Canberra, Infrastructure Australia's Executive Director for Policy and Research, Mr Peter Colacino clearly laid out the role that incentives play in supporting EV uptake:

We see the patchwork of incentives that are available across Australian jurisdictions as naturally assisting electric vehicle adoption levels where they are provided. In jurisdictions where incentives are lower, it's obvious that the effect would be a dampening of electric vehicle demand. So our view of the range of incentives is that electric vehicle adoption rates are occurring at a rate that's commensurate to the scale of the incentives.¹

5.3 The Electric Vehicle Council also highlighted the value of incentives in creating market certainty and spurring investment decisions.²

5.4 Globally, sales of EVs are 'still largely driven by policy support' with 95 per cent of EV sales occurring in 'just ten countries with robust EV policies'.³ These countries are China, the United States, Japan, Canada, Norway, the United Kingdom, France, Germany, The Netherlands and Sweden.⁴ In Chapter 2, the Committee reproduced a table by ClimateWorks summarising the current policy approaches of Australian federal, state and territory governments that support EV uptake (see Table 2.3). The Committee notes that not all measures focus exclusively on EVs, for example, the higher luxury car threshold applies to fuel-efficient internal combustion engine (ICE) vehicles as well.

1 Mr Peter Colacino, Executive Director, Policy and Research, Infrastructure Australia, *Committee Hansard*, 18 October 2018, p. 1.

2 Electric Vehicle Council, *Submission 100*, p. 8.

3 NSW Parliamentary Research Service, *Electric vehicles in NSW*, May 2018, p. 11, <https://www.parliament.nsw.gov.au/researchpapers/Documents/electric%20vehicles%20in%20NSW.pdf> (accessed 11 July 2018).

4 NSW Parliamentary Research Service, *Electric vehicles in NSW*, May 2018, p. 11.

5.5 In broad terms, incentives or penalties work by reducing the relative cost of EVs compared to ICE vehicles, and by improving the number and geographic spread of charging stations. As discussed in Chapter 2, this trend has been seen in the reverse in Denmark, where removal of incentives resulted in a fall in the number of new EVs purchased.

5.6 This section will focus on a number of mechanisms that could provide support for increased EV uptake, including:

- Incentives (including registration and stamp-duty concessions, tax rebates, and grants);
- Targets;
- Vehicle emissions standards;
- Charging infrastructure;
- Education and familiarisation;
- Upskilling and training service technicians; and
- Importation of second-hand EVs.

Incentives

5.7 There are a range of direct consumer subsidies to encourage EV uptake that are explored below. Although each incentive is explored individually, a cumulative consideration of implementation of multiple incentives could yield a significant reduction in EV purchase and operating cost.

Registration and stamp duty concessions

5.8 A number of submitters have indicated that state and territory based annual vehicle registration fees and stamp duty payable on new EVs should be reduced or removed as they form a barrier to EV ownership.⁵ The ACT Government currently offers 'zero stamp-duty on new zero emissions vehicles' and a '20 per cent discount on registration fees'.⁶ 350 Canberra made the point that these discounts are often counteracted as EVs are heavier than conventional vehicles consequently attracting higher fees and recommended that any proposals around registration should not penalise EV owners for higher EV weights.⁷ In the absence of concessional registration fees, some EV owners are subject to higher registration charges.

Tax concessions and rebates

5.9 There are four federal taxes that apply to sales of all motor vehicles including EVs—the goods and services tax (GST); luxury car tax (LCT), fringe benefits tax (FBT) and import duties. Infrastructure Partnerships Australia submitted that

5 Electric Vehicle Council, *Submission 100*, p. 9. See, for example: ACE-EV Group, *Submission 4*; SEA Electric, *Submission 24*.

6 ACT Government, *Submission 48.1*, p. 2.

7 350 Canberra, *Submission 21*, p. 4.

'substantial upfront taxes' like these 'stifle the uptake of EVs as a mass market option'.⁸ The Committee were told that amendments to these taxes on EVs—either concessions or abolition—would increase EV uptake. The Electric Vehicle Council observed that New Zealand is applying tax concessions until EVs reach two per cent of the fleet.⁹

Luxury car tax

5.10 LCT is applied to any vehicle with a GST-inclusive value above the threshold (for the 2018–19 financial year, the threshold was \$66 331) at a rate of 33 per cent applied to any value above the threshold. There is a partial exemption for fuel-efficient vehicles that lifts the threshold to \$75 526.¹⁰ A fuel efficient car is defined by the Australian Taxation Office (ATO) as having 'a fuel consumption that does not exceed seven litres per 100 kilometres'.¹¹ Table 5.1 sets out the LCT threshold for both fuel-efficient vehicles and other vehicles over the last 10 years.

Table 5.1: Luxury Car Tax thresholds 2009–10 to 2018–19¹²

Financial Year	Fuel-efficient vehicles	Other vehicles
2018–19	\$75,526	\$66,331
2017–18	\$75,526	\$65,094
2016–17	\$75,526	\$64,132
2015–16	\$75,375	\$63,184
2014–15	\$75,375	\$61,884
2013–14	\$75,375	\$60,316
2012–13	\$75,375	\$59,133
2011–12	\$75,375	\$57,466
2010–11	\$75,375	\$57,466
2009–10	\$75,000	\$57,180

8 Infrastructure Partnerships Australia, *Submission 121*, p. 3.

9 Electric Vehicle Council, *Submission 100*, p. 1.

10 ATO, *Luxury car tax rate and thresholds*, 25 May 2018, <https://www.ato.gov.au/rates/luxury-car-tax-rate-and-thresholds/> (accessed 31 October 2018).

11 ATO, *Definitions*, November 2016, <https://www.ato.gov.au/business/luxury-car-tax/in-detail/definitions/> (accessed 31 October 2018).

12 ATO, *Luxury car tax rate and thresholds*, 25 May 2018. The 'fuel-efficient vehicles' category was introduced in the 2008–09 financial year and the threshold was set at \$75,000.

5.11 Many submissions simply called for the abolition of the luxury car tax on EVs. The Victorian Department of Environment, Land, Water and Planning (DELWP) proposed 'exempting zero emission EVs from the LCT until EVs become price competitive with ICEs'.¹³

5.12 The Australia Institute noted that an LCT exemption for EVs would 'better target the scheme's two-tiered threshold structure towards environmental outcomes'.¹⁴ The ACT Branch of the Australian Electric Vehicle Association argued that the original intent of the fuel efficient exemption had been eroded since its implementation in 2009:

We note that the Federal Government's Luxury Car Tax imposes a lower tax burden on the purchasers of fuel efficient vehicles. This difference in tax levels has been eroded over the past decade: it was 31% higher for less efficient vehicles in 2009, and is now only 16% higher, thus diminishing whatever encouragement there has been to prefer a luxury EV over a luxury petrol or diesel vehicle. Some commentators have called for the Luxury Car Tax to be abolished for EVs. We support this call, but if it is not heeded, we would alternatively support a restoration of the difference in tax levels which prevailed in 2009.¹⁵

5.13 On the issue of the reduced difference in the LCT threshold between fuel-efficient cars and other vehicles, the ATO's *Luxury Car Tax Determination* explains the methods of indexing for each threshold:

The LCT threshold [for 'other vehicles'] is indexed annually according to a factor to be determined by Parliament or, if such a factor is not determined by Parliament, indexed annually in accordance with movements in the All Groups Consumer Price Index (All Groups CPI).

...

The fuel-efficient car limit is indexed annually in line with movements in the motor vehicle purchase sub-group of the CPI, unless the indexation factor is 1 or less [in which case, no indexation is applied].¹⁶

5.14 CPI data from the Australian Bureau of Statistics demonstrates that the motor vehicle CPI expenditure class has been on an overall downward trajectory since 1995.¹⁷ The Committee understands this data to indicate that motor vehicles are

13 Victorian Government Department of Environment, Land, Water and Planning, *Submission 129*, p. 12.

14 The Australia Institute (TAI), *Submission 1*, p. 1.

15 ACT AEVA, *Submission 6*, pp. 8–9. See also: 350 Canberra, *Submission 21*, p. 7.

16 ATO, *Luxury Car Tax Determination – LCTD 2018/1*, 23 May 2018, available at: <https://www.ato.gov.au/law/view/document?docid=LCD/LCTD20181/NAT/ATO/00001#fp6> (accessed 12 December 2018).

17 See, for Australian Bureau of Statistics, Consumer Price Index, Australia, September 2018, Time Series Spreadsheet, Table 7, Index Numbers for Motor Vehicles, available at: <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6401.0Sep%202018?OpenDocument#Time> (accessed 14 January 2019).

actually becoming cheaper on average over time, down 12.2 per cent since September 2008.

5.15 As can be seen in Table 5.1, since the introduction a higher LCT threshold for fuel efficient vehicles in 2008–09, the threshold for these vehicles has been lifted twice, \$375 in 2010–11 and \$151 in 2016–17. In the same period, the LCT threshold for standard vehicles, which has been based on the All Groups CPI rate since 2013–14, has increased by \$9 151.

5.16 The Committee also notes information provided by the Parliamentary Library as to the increasing number of vehicle models which use 7 litres of fuel per 100km, or less.¹⁸ In particular, the Committee notes that EVs make up a large percentage of vehicles consuming less than four litres of fuel per 100 km, and a large majority of vehicles using between four and seven litres per 100 km are petrol or diesel vehicles.

5.17 Table 5.2 summarises modelling by the Parliamentary Budget Office of the impact on revenue of amending several aspects of the LCT parameters over the 2018–19 forward estimates, namely narrowing the definition of 'fuel efficient vehicles' reducing the LCT threshold for standard vehicles and indexing the LCT threshold for standard vehicles using the motor vehicle expenditure class of CPI.¹⁹

Table 5.2: Impact of narrowing definition of 'fuel-efficient vehicles' and lowering LCT threshold for standard vehicles²⁰

Option number	LCT threshold for standard vehicles	Definition of 'fuel-efficient vehicles' (L/100km)	Fiscal balance to 2021–22 (\$m)
1.	\$57 180	7.0	850
2.	\$57 180	4.0	1,540
3.	\$57 180	2.0	1,560
4.	\$57 180	0	1,560

5.18 In the longer term, the Parliamentary Budget Office stated that Option 2 above would result in an increase to the Australian Government fiscal balance of \$5.77 billion to 2028–29.²¹

18 *Vehicles in Australia using 7L per 100 kms or less*, Parliamentary Library, Additional Information.

19 *Revenue implications of changes to vehicle taxation measures*, Parliamentary Budget Office, 4 December 2018, p. 4.

20 *Revenue implications of changes to vehicle taxation measures*, Parliamentary Budget Office, 4 December 2018, p. 3.

Import duties

5.19 The Federal Chamber of Automotive Industries (FCAI) noted that currently there is an import duty of 5 per cent on all imported motor vehicles (excluding those imported from countries with which Australia has a free trade agreement). FCAI argued that this 'acts as a brake on new environmental and safety technologies entering the Australian market'.²² Infrastructure Partnerships Australia contended that import duties should be reduced to zero to 'reduce upfront disincentives'.²³

5.20 Modelling from the Parliamentary Budget Office estimates that exempting newly purchased EVs from import tariffs from 1 July 2019 would decrease the Australian Government fiscal and underlying cash balances by \$300 million over the 2018–19 Budget forward estimates period (out to 2021–22).²⁴

Goods and services tax

5.21 The GST is applied at a rate of 10 per cent to the purchase price of a new motor vehicle. Currently, the only exemption to paying the GST on a motor vehicle is if it is used fully or partly to carry out business-related activities. There are currently no GST exemptions for motor vehicles purchased for personal use.²⁵ Some submitters called for a waiver or discount of GST on all new EV purchases, either for a specified period, such as three years, or until EVs had reached an unspecified proportion of the motor vehicle fleet.²⁶ The FCAI highlighted that Norway which has the highest proportion of new EVs currently exempts EVs from paying a tax similar to the GST called a value added tax (VAT). Norway's VAT is considerably higher at 25 per cent.²⁷

5.22 Modelling from the Parliamentary Budget Office estimates that exempting newly purchased EVs from GST from 1 July 2019 would decrease the Australian Government fiscal balance by \$190 million over the 2018–19 Budget forward estimates period (out to 2021–22).²⁸

21 *Revenue implications of changes to vehicle taxation measures*, Parliamentary Budget Office, 4 December 2018, p. 8.

22 FCAI, *Submission 119*, p. 10.

23 Infrastructure Partnerships Australia, *Submission 121*, p. 3.

24 *Revenue implications of changes to vehicle taxation measures*, Parliamentary Budget Office, 4 December 2018, p. 4.

25 ATO, *Purchasing a motor vehicle*, 11 January 2018, <https://www.ato.gov.au/business/gst/in-detail/your-industry/motor-vehicle-and-transport/gst-and-motor-vehicles/?page=2> (accessed 31 October 2018).

26 See, for example: Australian Electric Vehicle Association, *Submission 8*, p. 4; Hyundai Motor Company Australia, *Submission 103*, p. [11].

27 FCAI, *Submission 119*, p. 11.

28 *Revenue implications of changes to vehicle taxation measures*, Parliamentary Budget Office, 4 December 2018, p. 5.

Fringe benefits tax

5.23 FBT is 'a tax employers pay on certain benefits they provide to their employees—including their employees' family or other associates. The benefit may be in addition to, or part of, their salary or wages package'.²⁹ The Committee's interest in FBT is where it is provided in relation to motor vehicles. DELWP noted modelling in a recent ClimateWorks and Electric Vehicle Council report that showed 'changes to FBT treatment for EVs is also an enabler for greater uptake'. EVs are currently at a disadvantage in regards to FBT due to the current price premium of EVs—that is, typically a higher rate of FBT is payable by a business or individual on an EV simply because of the higher purchase price. The removal of FBT on EVs would result in no disadvantage from a 'vehicle cost to business' perspective.³⁰ Hydrogen Mobility Australia (HMA) stated that the removal of FBT on EVs and other zero emission vehicles would help 'mitigate the typically higher costs of these vehicles'. Removal of FBT could be predicated on its reinstatement once price parity was reached with ICEs.³¹

5.24 Aside from the higher purchase price of EVs, Tesla noted a further disadvantage in the application of FBT:

For ICEVs, drivers are able to claim deductions against Fringe Benefits Tax for fuel. Electricity is not currently defined as a fuel for the purposes of FBT, and nor are EV-owners able to claim equipment used to charge for their EVs, such as solar panels, home batteries, and charging equipment.³²

5.25 Mr Greg Partridge, President of the Australian Electric Vehicle Association (AEVA) also commented that greater clarity on existing FBT and salary sacrifice rules would be required.³³ In its submission AEVA detailed its concerns in relation to salary sacrificing:

Employees who wish to claim electric vehicle expenses are confused by the existing tax provisions, and in some cases the legislation encourages profligate use of salary sacrificed ICE vehicles.³⁴

5.26 In an answer to a question taken on notice, AEVA recommended improved guidance on how to factor electricity costs into FBT operating calculations for EVs:

We believe the ATO needs to provide guidance on an accepted method of assessing this electricity cost, such a use of agreed Wh/km for EVs (or classes of EVs) x km travelled (end minus start odometer readings) x electricity tariff where the relevant 'rates' are statutory or supported by

29 ATO, *Fringe Benefits Tax (FBT)*, 2 August 2018, [https://www.ato.gov.au/General/Fringe-benefits-tax-\(FBT\)/](https://www.ato.gov.au/General/Fringe-benefits-tax-(FBT)/) (accessed 31 October 2018).

30 DELWP, *Submission 129*, p. 13.

31 Hydrogen Mobility Australia, *Submission 73*, p. 14.

32 Tesla, *Submission 92*, p. [12].

33 Mr Greg Partridge, President, AEVA, *Committee Hansard*, 27 September 2018, p. 19.

34 Australian Electric Vehicle Association, *Submission 8*, p. 3.

taxpayer's documentation, as is permitted for petrol/diesel fuel in the absence of a complete record of all refuelling events (as might be provided by a fleet fuel card).³⁵

5.27 Modelling from the Parliamentary Budget Office estimates that exempting newly purchased EVs from FBT from 1 July 2019 would decrease the Australian Government fiscal and underlying cash balances by \$140 million over the 2018–19 Budget forward estimates period (out to 2021–22).³⁶

Subsidies to buyers

5.28 A number of countries have adopted one-off cash payments to encourage people to purchase EVs. Ms Gail Broadbent, a transport researcher from the University of New South Wales outlined some of the incentives available, which are summarised in Table 5.3.

Table 5.3: Comparison of one-off subsidies to encourage EV purchases³⁷

Country	Subsidy	Comments
Belgium	€4000	
France	€2500–€4000	
United Kingdom	£2500–£8000	Limited to total car price of £60 000
Portugal	€125–€2250	Trading in used ICE
Germany	€3000–€4000	Vehicles under €60 000
Denmark	\$AUD1470–\$AUD3675	Subsidy for businesses and local councils

5.29 In its submission, 350 Canberra outlined how a one-off grant might assist EV uptake:

We strongly support this approach to encouraging EV uptake in Australia. A purchase rebate of (say) \$5000 would significantly reduce the price premium paid by any Australians who purchase a moderately affordable EV (such as a Nissan Leaf, Renault Zoe or Hyundai Ioniq) in 2019 or 2020. We recognise that such incentives should last only long enough to "kickstart" the local market: to encourage auto makers to bring more EV models to Australia, to encourage dealers to offer and support them, and to encourage

35 Australian Electric Vehicle Association - answer to question on notice from public hearing in Brisbane on 27 September 2018 (received 22 November 2018).

36 *Revenue implications of changes to vehicle taxation measures (Fringe Benefits Tax)*, Parliamentary Budget Office, 14 December 2018, p. 2.

37 Ms Gail Broadbent, *Submission 15.4*, pp. 3–8.

a wider roll-out of charging infrastructure. For example, such incentives might begin to phase out once EVs constitute 2% of the national car fleet.³⁸

5.30 However, one submitter pointed out that as EVs are 'roughly twice the price of the petrol equivalent', that 'even a generous state grant of \$5 000 per electric vehicle still leaves a \$20,000 gap between electric and petrol vehicles in the same class'.³⁹ With price parity expected in six to eight years' time, the government 'can either wait and let the price of electric cars drop of its own accord or jumpstart the market by offering rebates or some other sort of financial incentive'.⁴⁰

Targets

National

5.31 The Committee has heard that establishing a national target for EV uptake would stimulate growth in this sector and signal to the global EV industry that government is supportive of EV uptake.⁴¹ Associate Professor Tim Nelson, Chief Economist at AGL Energy said that 'a national EV target would provide a powerful platform to drive coordinated, whole-of-government policy initiatives'.⁴² Associate Professor Nelson stated that a target in concert with other supporting measures would provide a clear signal to business to invest in EVs and supportive infrastructure such as charging stations.⁴³ Hobsons Bay Council advocated for a national EV target noting these 'targets provide leadership to business and the community' and 'provide assurance to manufacturers that a local market exists'.⁴⁴

5.32 Mr Tim Washington, Chief Executive Officer at JET Charge, a local company that installs EV chargers, told the Committee about the value of the national government having a vision as a means to underwrite support for the EV sector:

... unless you start at the start, where the government basically says, 'Yes, there is a vision for it,' and if you want to start a business in this space the government has already said you will be in an industry that the government supports, that's incredibly important. And the thing for me is that everybody says that EVs are coming. What I can say, being in the industry itself and working with these manufacturers, is that yes, vehicles are coming, but they're not going to come as soon as you necessarily think they will in the Australian market if those manufacturer head offices don't think the Australian market is suitable. We are in a supply-constrained market right

38 350 Canberra, *Submission 21*, p. 6.

39 Name withheld, *Submission 86*, p. 12.

40 Name withheld, *Submission 86*, p. 12.

41 See, for example: NRMA, *Submission 78.2*, p. 8; AITI, *Submission 5.1*, p. 3.

42 Associate Professor Tim Nelson, Chief Economist, AGL Energy, *Committee Hansard*, 31 August 2018, p. 79.

43 Associate Professor Tim Nelson, Chief Economist, AGL Energy, *Committee Hansard*, 31 August 2018, p. 79.

44 Hobson's Bay Council, *Submission 52*, p. 6.

now in terms of electric vehicles. So, [original equipment manufacturers] have the power to choose what markets they send the vehicle to.⁴⁵

5.33 Dr James Prest, Senior Lecturer from the College of Law at the Australian National University explained how a national target might work:

That may be in either policy or legislation. I recommend short-, medium- and long-term targets. Those targets don't necessarily have to be tied to a particular policy mechanism; they could just give a clear direction to the market and an expectation to international investors about where Australia is hoping to go to.⁴⁶

5.34 The Australian Industrial Transformation Institute (AITI) at Flinders University emphasised that there are a number of different forms that targets might take including:

Targets for EV manufacture and sales, replacement/reduction in conventional vehicles or fossil fuels, and EV parking spaces or charging stations are common forms of target-based policy.⁴⁷

5.35 Globally, there are many examples where targets are being employed; countries that adopt targets predominantly have higher EV uptake. The Chinese Government has a target of 5 million EVs on the road by 2020.⁴⁸ The New Zealand EV Programme is targeting 64 000 EVs by 2021, whereas the United Kingdom's Road to Zero Strategy is targeting new EV purchasing to constitute 50–70 per cent of the market by 2030 and 100 per cent by 2040.⁴⁹ In 2016, the South Korean Government announced 'targets of 250 000 electric vehicles and 1 240 000 hybrid vehicles on the road by 2020'.⁵⁰ The Netherlands also has a national target for electric buses of 680 by the end of 2019.⁵¹

5.36 Hobsons Bay Council also stated that some countries—such as The Netherlands, Norway, India, China, France, Germany and the UK—have taken step further and nominated dates for the phase-out of conventional vehicles.⁵²

Government fleet

5.37 As at 1 July 2018, the Australian Government Fleet comprised a total of 12 691 vehicles. Table 5.4 sets out the breakdown of the fleet across vehicle types.

45 Mr Tim Washington, Chief Executive Officer, JET Charge, *Committee Hansard*, 27 September 2018, p. 6.

46 Dr James Prest, Senior Lecturer, College of Law, Australian National University, *Committee Hansard*, 17 August 2018, p. 11.

47 AITI, *Submission 5.1*, p. 3.

48 AITI, *Submission 5.1*, p. 4.

49 Electric Vehicle Council, *Submission 100*, p. 1.

50 Hyundai Motor Company Australia, *Submission 103*, p. [9].

51 Infrastructure Victoria, *Submission 88.1*, p. 48.

52 Hobson's Bay Council, *Submission 52*, p. 6.

Table 5.4: Australian Government Fleet profile by vehicle type⁵³

Fleet Profile	
Vehicle Classification	Volume
Passenger (including SUV)	5 735
Light Commercial	4 816
Heavy Commercial	1 467
Others (trailers & equipment)	626
Motorcycles	47

5.38 There are 10 EVs in the passenger fleet of 5 735 vehicles.⁵⁴

5.39 Mr Jonathon Lathleiff, Senior Manager for Corporate and External Affairs at Toyota Australia, told the Committee that 'there's great value in government having proactive purchasing leadership' in relation to EVs and that this leads to a 'cascade effect' to the broader automotive fleet.⁵⁵ Associate Professor Nelson was also supportive of government fleet targets:

A government fleet EV target, not too dissimilar to AGL's business-specific target, would provide scale and could potentially create a second-hand market for depreciated EVs that would provide an additional avenue for private ownership.⁵⁶

5.40 The Electric Vehicle Council submitted that governments should adopt a 'buy electric first' approach:

Under this arrangement, when a suitable electric model is available, it or they will be the preferred purchasing option—to the exclusion of petrol and diesel alternatives.⁵⁷

53 Department of Finance, Australian Government Fleet Statistics as at 1 July 2018, Additional Information, received 22 January 2019.

54 Department of Finance, Australian Government Fleet Statistics as at 1 July 2018, Additional Information, received 22 January 2019.

55 Mr Jonathon Lathleiff, Senior Manager, Corporate and External Affairs, Toyota Australia, *Committee Hansard*, 31 August 2018, p. 64.

56 Associate Professor Tim Nelson, Chief Economist, AGL Energy, *Committee Hansard*, 31 August 2018, p. 79. See also: City of Adelaide, *Submission 93*, p. 2.

57 Electric Vehicle Council, *Submission 100*, p. 8.

5.41 NHP Electrical Engineering Products (NHP) asserted that a robust local second hand market for 3–4 year old EVs could be established in a 4–8 year timeframe as a result of government EV procurement.⁵⁸

5.42 In addition to the benefits to the second hand market for private buyers, Mr Sam McLean, Senior Manager at Tesla, remarked on some of the other benefits associated with increased EV purchasing in government fleets:

government fleet purchases, which are very important because they fuel the second-hand market, and it also means that fleet providers and companies that manage private fleets change their processes: they look at the total cost calculations, they update their way of rolling out vehicles to include charging stations et cetera. So government fleet targets are a very effective way of driving change not only in government fleets but beyond.⁵⁹

5.43 The UK Government has already committed to 25 per cent of the government car fleet being ultra-low emission vehicles by 2022 and recently announced a goal of 100 per cent of the government car fleet being ultra-low emission by 2030.⁶⁰

5.44 The ACT Government is integrating an increasing number of EVs into the territory government's fleet in the immediate future, and was flagged as an exemplar model for other Australian jurisdictions.⁶¹ The ACT Government outlined its strategy to the Committee:

The Action Plan includes a commitment to ensuring 50 per cent of newly leased Government passenger fleet vehicles are zero emissions vehicles in 2019–20, increasing to 100 per cent of newly leased vehicles from 2020–21. This will mean that the ACT has a zero emissions vehicle fleet of approximately 600 vehicles. There is also an expectation of a growing second hand market as leases expire. In this way Governments can help facilitate a community transition through their own fleet purchasing.⁶²

5.45 In January 2019, the NSW Government announced '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'.⁶³

58 NHP Electrical Engineering Products, *Submission 95*, p. [4].

59 Mr Sam McLean, Senior Manager, Tesla, *Committee Hansard*, 10 August 2018, p. 7.

60 Department of Transport (UK), *Road to Zero: Next steps towards cleaner roads transport and delivering our industrial strategy*, July 2018, p. 60, available at: <https://www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strategy> (accessed 2 January 2019).

61 See, for example: Hyundai Motor Company Australia, *Submission 103*, p. [9].

62 ACT Government, *Submission 48*, p. 2.

63 NSW Government, *Future Transport 2056: Electric and Hybrid Vehicle Plan*, January 2019, available at: https://www.future.transport.nsw.gov.au/sites/default/files/media/documents/2019/Future_Transport_NSW_Electric_and_Hybrid_vehicle_plan.pdf (accessed 21 January 2019).

5.46 The Parliamentary Budget Office provided modelling setting out the budget implications for meeting government fleet targets of 30, 40 and 50 per cent by 2025 and 2030 respectively over the 2018–19 forward estimates, and these are presented in Table 5.5.

Table 5.5: Budget impact of government fleet targets⁶⁴

Government fleet target (per cent)	Target date – 2025 (fiscal balance \$m to 2021–22)	Target date – 2030 (fiscal balance \$m to 2021–22)
30	-3.0	-1.6
40	-4.0	-2.2
50	-5.0	-2.7

Vehicle emissions standards

5.47 Vehicle emissions standards were explained by the Royal Automobile Club of Western Australia (RACWA):

Vehicle emissions standards set a 'limit' for vehicle emissions. The limit for each vehicle is determined by the weight of the vehicle, known as the 'limit curve'. Vehicles that produce emissions greater than the designated limit have penalties imposed on the manufacturer. Credits and debits are accrued and offset against each other for vehicles that are 'under' or 'over' their designated emissions limit.⁶⁵

5.48 Mr Ali Asghar, Senior Associate, Power, Energy Storage and EVs, Bloomberg New Energy Finance, told the Committee that vehicle emissions standards are 'a major factor' in vehicle manufacturers introducing new EV models to any market.⁶⁶

5.49 Australia's current vehicle emissions standards for new light vehicles is based on the Euro 5 standards. The Ministerial Forum for Vehicle Emissions (Ministerial Forum) is currently reviewing whether Australia should adopt the Euro 6 standards for

64 *Revenue implications of setting mandatory Government fleet electric vehicle purchasing targets*, Parliamentary Budget Office, 11 January 2019, Additional Information, p. 2.

65 Royal Automobile Club of Western Australia, *Submission 117*, p. [5].

66 Mr Ali Asghar, Senior Associate, Power, Energy Storage and EVs, Bloomberg New Energy Finance, *Committee Hansard*, 31 August 2018, p. 11.

light vehicles.⁶⁷ However, as noted in Table 2.1, Australia does not have a light vehicle carbon dioxide (CO₂) emission standard in place.⁶⁸

5.50 The RACWA highlighted how Australia's CO₂ emissions intensity for passenger vehicles compared globally:

According to the National Transport Commission, the CO₂ emissions intensity for passenger cars in Australia during 2017 was 171.5g/km, 45 per cent higher than the European average of 118.5 g/km. The European Union currently has a CO₂ emissions standard of 130g/km which was introduced in 2015. This will be reduced to 95g/km for all new cars by 2021 (phased in from 2020) and plans to reduce that by a further 30 per cent by 2030, with the first 15 per cent reduction required by 2025. The United States' CO₂ standard will be approximately 99g/km by 2025.⁶⁹

5.51 Ms Sarah Fumei, Project Manager at ClimateWorks Australia explained the effect of applying a CO₂ vehicle emission standard:

Vehicle emissions standards would set an average emissions requirement across a manufacturer's fleet and would thereby encourage manufacturers to sell more electric vehicles with zero tailpipe emissions.⁷⁰

5.52 The Committee were told that the Ministerial Forum on Vehicle Emissions (Ministerial Forum) had modelled three standards, 105/119/135 grams of CO₂ per kilometre. Each standard was found to not only provide net economic benefits, but also environmental benefits through greenhouse gas abatement. Counterintuitively, the stronger the standard, the higher the economic benefit to the economy. Ms Fumei elaborated on the net benefits of establishing the most stringent standard of 105 grams of CO₂ per kilometre:

The standard would provide 65 megatons of abatement by 2030, \$27.5 billion in fuel savings and \$13.9 billion of net economic benefit. So it's an important policy and would provide benefits for the Australian economy and for emissions.⁷¹

5.53 At the Melbourne hearing, Mr Anthony Larkins, a member of Professionals Australia and engineer from GM Holden outlined his view on an approach to emissions controls and its benefits:

We should legislate a future-emissions-standard road map, commencing with the implementation of the complete Euro 6d standard, followed by a

67 Department of Infrastructure, Regional Development and Cities, *Vehicle Emissions Standards*, available at: <https://infrastructure.gov.au/vehicles/environment/emission/index.aspx> (accessed 7 January 2019)

68 ClimateWorks Australia, *Submission 46*, Attachment 1, p. 26.

69 RACWA, *Submission 117*, p. [5].

70 Ms Sarah Fumei, Project Manager, ClimateWorks Australia, *Committee Hansard*, 17 August 2018, p. 60.

71 Ms Sarah Fumei, Project Manager, ClimateWorks Australia, *Committee Hansard*, 17 August 2018, p. 60.

continued trajectory of reducing CO₂-grams-per-kilometre targets, helping to improve our fuel security and reduce greenhouse gas emissions. We should consider the implementation of clean-air zones around cities as per most European countries, which will help reduce air and noise pollution from our growing cities.⁷²

5.54 The DELWP submitted that improved fuel consumption labelling on all motor vehicles—new and used—would lead to more informed decision making by consumers and subsequently the types of cars they choose to drive:

The current Australian fuel consumption label on new vehicles discloses direct fuel consumption and CO₂ emission values. According to the International Energy Agency, a label combining direct disclosure and an eye catching comparative rating is the most useful to vehicle purchasers. This combined fuel economy labelling system has been applied in New Zealand. The fuel economy label for new vehicles in New Zealand displays their fuel economy values in litres per 100 kilometres alongside a star rating. The label also displays future financial savings. In addition, the United Kingdom provides an easy to read comparative bar graph that gives an immediate indication of where the vehicle's fuel economy fits within the market.⁷³

5.55 The submission continued:

In addition, several countries, including New Zealand and the United Kingdom, mandate the labelling of fuel economy on new and / or used vehicles. The current Australian labelling system only mandates it for new vehicles.⁷⁴

Evidence relating to the Ministerial Forum on Vehicle Emissions

5.56 At the Committee's first Canberra hearing held on 17 August 2018, the committee received evidence from the Department of Infrastructure, Regional Development and Cities (Department of Infrastructure) and other departments relating to the Ministerial Forum. Senator Patrick asked whether the Ministerial Forum produces minutes, to which Mr Alex Foulds, Executive Director, Surface Transport Division, Department of Infrastructure replied:

No, they don't produce minutes as such.⁷⁵

5.57 At the time, Mr Foulds acknowledged that departmental officials attended these Ministerial Forum meetings. The three departments agreed to provide on notice:

...notebooks of officials that have attended insofar as there are notes relating to electric vehicles.⁷⁶

72 Mr Anthony Larkins, Member, Professionals Australia, *Committee Hansard*, 31 August 2018, p. 48.

73 DELWP, *Submission 129*, p. 12.

74 DELWP, *Submission 129*, p. 12.

75 Mr Alex Foulds, Executive Director, Surface Transport Division, Department of Infrastructure, Regional Development and Cities, *Committee Hansard*, 17 August 2018, p. 75.

5.58 On 13 September 2018, Mr Alex Foulds, then Acting Deputy Secretary, Department of Infrastructure, wrote to the Committee correcting the evidence he provided at the hearing on 17 August 2018.⁷⁷ Mr Foulds noted in his evidence that he had stated that 'the forum had met three times'. Mr Foulds clarified this statement:

In my response I was referring to the number of official stakeholder consultation forums the [Ministerial Forum] has held (7 December 2015, 4 April 2016, 15 February 2017).

The [forum] has also met on nine other occasions (24 November 2015, 4 February 2016, 17 August 2016, 5 June 2017, 4 July 2017, 24 October 2017, 12 February 2018, 29 May 2018, 18 June 2018).⁷⁸

5.59 The Committee received responses to questions taken on notice in late September 2018 from the three departments. The Department of Infrastructure stated that it was unable to provide any further information to the Committee:

...the Department has asked all current officials who attended meetings of the Ministerial Forum on Vehicle Emissions to review their notebooks for meeting notes relating to electric vehicles. The Department can confirm that the relevant notebooks have been destroyed or contained no notes relating to electric vehicles.⁷⁹

5.60 The Department of Industry was also unable to provide additional information⁸⁰ whilst the Department of the Environment provided a more detailed response relating to the Ministerial Forum's meeting of 4 April 2016.⁸¹ The Committee were not provided with any copies of minutes as part of these responses.

5.61 Separate to the Committee's inquiry processes, Senator Patrick made a Freedom of Information (FOI) request on 18 August 2018 to the Department of Infrastructure requesting minutes of the Ministerial Forum. Senator Patrick was provided with draft minutes or notes relating to seven meetings of the Ministerial Forum. Senator Patrick made a second request asking the Department of Infrastructure to undertake an internal review of the FOI, which unearthed additional documents related to meetings of the Ministerial Forum.

76 *Committee Hansard*, 17 August 2018, pp. 75–76.

77 Correspondence from Mr Alex Foulds, Acting Deputy Secretary, Department of Infrastructure, Regional Development and Cities following the committee's public hearing in Canberra on 17 August 2018, dated 13 September 2018.

78 Correspondence from Mr Alex Foulds, Acting Deputy Secretary, Department of Infrastructure, Regional Development and Cities following the committee's public hearing in Canberra on 17 August 2018, dated 13 September 2018.

79 Department of Infrastructure, Regional Development and Cities - answers to questions on notice from public hearing in Canberra on 17 August 2018 (received 25 September 2018).

80 Department of Industry Innovation and Science - answers to questions on notice from public hearing in Canberra on 17 August 2018 (received 24 September 2018).

81 Department of the Environment and Energy - answers to questions on notice from public hearing in Canberra on 17 August 2018 (received 25 September 2018).

5.62 Senator Patrick circulated the FOI response to Committee members. The same material was also attached to correspondence provided to the Committee by Mr Alex Foulds on 22 November 2018.⁸² The minutes indicated that officials from the Department of Industry and the Department of the Environment were also at the Ministerial Forum meetings, as well as officials from the Department of Infrastructure. Meeting minutes for five meetings were not included.⁸³

Correspondence with departments seeking clarification of evidence

5.63 On 23 October 2018, the Committee wrote to Mr Alex Foulds, Department of Infrastructure, and the Secretaries of the Department of the Environment and the Department of Industry requesting a reconsideration of evidence provided to the Committee in relation to the Ministerial Forum in light of the minutes provided pursuant to Senator Patrick's FOI request.

Responses from the Department of Infrastructure

5.64 On 22 October 2018, prior to the Committee sending out its request for clarification, the committee received correspondence from Ms Pip Spence, Deputy Secretary, Department of Infrastructure. This letter noted Mr Foulds' evidence that the Ministerial Forum 'don't produce minutes as such' and acknowledged Senator Patrick's FOI request.⁸⁴

5.65 Ms Spence brought the existence of two Ministerial Forum meeting minutes from 'late 2015 and early 2016' to the Committee's attention (documents that were provided to Senator Patrick as part of an FOI request). Ms Spence acknowledged that the Department of Infrastructure should have clarified the record to draw attention to the draft minutes and apologised for this error. Ms Spence did not provide copies of the minutes.⁸⁵

5.66 On 22 November 2018, Mr Alex Foulds wrote to the Committee. In this letter, Mr Foulds:

- sincerely apologised for not personally clarifying his evidence of 17 August;
- provided draft minutes of some Ministerial Forum meetings as provided to Senator Patrick in an FOI. A subsequent request by Senator Patrick for an internal review of the FOI request identified an additional document that has also been provided to the committee.

82 Correspondence from Mr Alex Foulds, Executive Director, Surface Transport Division, Department of Infrastructure, Regional Development, and Cities, dated 22 November 2018.

83 The following meeting minutes were not included in this or subsequent correspondence to the committee: 17 August 2016, 4 July 2017, 24 October 2017, 29 May 2018, and 18 June 2018.

84 Correspondence from Ms Pip Spence, Deputy Secretary, Department of Infrastructure, Regional Development, and Cities, dated 22 October 2018.

85 Correspondence from Ms Pip Spence, Deputy Secretary, Department of Infrastructure, Regional Development, and Cities, dated 22 October 2018.

- Noted that 'minutes (draft or final) or notes for the other meetings of the Ministerial Forum were not provided as there were either no officials from the department present or no notes were taken'.
- Noted the past topics discussed at the forum.⁸⁶

Responses from the Department of the Environment and the Department of Industry

5.67 The Department of the Environment responded to the Committee's correspondence stating that it would not seek to correct the record and noting that it would defer to the Department of Infrastructure on this matter as Department of Infrastructure provide the secretariat to the Ministerial Forum. In addition, the Department of the Environment provided a brief summary of topics discussed at the Ministerial Forum relating to EVs.⁸⁷

5.68 The Department of Industry stated that it would not seek to correct the record as officers speaking with the Committee on 17 August 2018 were not familiar with the work of the forum. The Department of Industry also stated it would defer to the Department of Infrastructure as the secretariat to the Ministerial Forum. The Department of Industry raised one amendment to its earlier evidence noting that the official who attended Ministerial Forum meetings had actually only attended one meeting of the Ministerial Forum. The department provided a copy of minutes from the second stakeholder engagement session held on 4 April 2016.⁸⁸

5.69 On 4 December 2018, the Committee placed a number of questions on notice in an effort to understand if any records existed for the meetings for which minutes had not been provided. Furthermore, the Committee sought to understand the Department of Infrastructure's processes and obligations with respect to secretariat support for the forum.

5.70 On 17 December 2018, the Department of Infrastructure provided the Committee with answers to questions on notice confirming that notes and minutes for five meetings of the Ministerial Forum did not exist. For the meetings of the Ministerial Forum where no minutes exist, no departmental officials had attended the meetings and the Department of Infrastructure stated that it did not make arrangements for notes or minutes to be taken for meetings which are not attended by departmental officers.⁸⁹

5.71 All witnesses should remain mindful of their duty to correct or clarify evidence at the earliest opportunity. The *Government guidelines for official witnesses*

86 Correspondence from Mr Alex Foulds, Executive Director, Surface transport Division, Department of Infrastructure, Regional Development, and Cities, dated 22 November 2018.

87 Correspondence from Ms Jo Evans, Deputy Secretary, Climate Change and Energy Innovation, Department of the Environment and Energy, dated 5 November 2018.

88 Correspondence from Dr Heather Smith, Secretary, Department of Industry, Innovation and Science, dated 2 November 2018.

89 Department of Infrastructure, Regional Development and Cities, answers to written questions on notice, received 17 December 2018.

before Parliamentary Committees and related matters quite clearly specifies this obligation:

5.6. Correction or clarification of evidence

5.6.1. Witnesses will receive transcripts of their evidence in the days following their appearance. The transcript should be examined promptly to establish whether any evidence needs to be corrected or clarified. On occasions, a witness may become aware of the need for correction or clarification before the receipt of the transcript or, in the case of a written submission, before the commencement of hearings.

5.6.2. Once the need to provide a committee with revised information has been established, it is most important that the committee receive that revised information at the earliest opportunity. In the case of officials who made submissions or appeared as witnesses in relation to the administration and implementation of government policy (but not necessarily those covered by Part 3), the departmental secretary or agency head (or senior official who represented the secretary at the hearing) should be informed that revised information is to be provided. Depending on the nature of the correction, it may also be appropriate to inform the minister. Officials need to keep in mind that, while their evidence remains uncorrected or unclarified they are vulnerable to allegations that they have misled a committee.

5.6.3. Supplementary information for a committee should be forwarded to the committee secretary. If uncertain of the most appropriate way to provide a committee with additional or corrected information, officials should seek the guidance of the committee secretary.⁹⁰

Charging infrastructure

Tenancy laws and building codes for new units and detached dwellings

5.72 The Committee has been told that there are a range of constraints in relation to the installation of home charging infrastructure for current and prospective EV owners. In its submission, Tesla described these barriers, particularly for those who live in apartments or for those who rent their home who are not able to install charging equipment due to inflexible strata rules and landlords.⁹¹

5.73 The International Energy Agency (IEA) observed that a number of countries such as France, Spain, Portugal and the United States have taken steps to 'adapt property laws to simplify and accelerate the process of approval procedures for electric car owners to deploy (private) [charging] infrastructure, notably in rented and/or owned multi-unit dwellings, including in parking garages'.⁹²

90 *Government guidelines for official witnesses before Parliamentary Committees and related matters*, February 2015, pp. 18–19, https://www.pmc.gov.au/sites/default/files/publications/Gov_Guidelines_for_Official_Witnesses_Feb_2015.pdf (accessed 4 December 2018).

91 Tesla, *Submission 92*, p. 10.

92 Energy Networks Australia, *Submission 60.3*, p. 35. See also: Tesla, *Submission 92*, p. 10.

5.74 Consideration also needs to be given to new developments and future EV charging requirements. In its submission, NHP specifically called for mandated charging infrastructure in all new apartment complexes:

NHP recommends that consideration be given to incorporating a clause in the National Construction Code, to require that a given percentage of car parking spaces in new multi-residential builds include AC electric vehicle chargers in the 7kW range. This percentage could start relatively low (for example 5%, one car parking space provided with EV charging per 20 on the plan) and scale up as the transition to electric vehicles in the national fleet increases. The cost of this would be negligible in the scheme of the overall construction cost but would very effectively remove a barrier to early adoption of electric vehicles by residents of apartments. Arrangements for how the energy delivered is metered and paid for can be left to the private sector – many solutions around this already exist and will be deployed wherever deployment of EV charging equipment is required by the code.⁹³

5.75 The submission continued, flagging the indirect benefits of this approach:

An added benefit of this approach is that it will cause every electrician working in apartment construction to become familiar with electric vehicle charging equipment, supporting the future large-scale rollouts that will be needed.⁹⁴

5.76 The IEA noted that France and the EU are taking steps to ensure that all new and renovated apartment complexes are ready for EV charging when it is required:

In France, recent legislation mandated that 50–75% of parking bays in any new or renovated residential building must be pre-installed with conduits that allow the easy installation of [electric vehicle supply equipment (EVSE)] ranging between 7 kW and 22 kW. In commercial buildings, 5–10% of parking bays must have conduits suitable for installing [EVSE] with a power rating of at least 22 kW. The European Commission included similar provisions in a proposal aiming to revise the EU Directive on the Energy Performance of Buildings.⁹⁵

5.77 NHP reported that one of the current Australian Standards for electrical installation in new buildings is acting as a barrier to new developments being ready for EV chargers. NHP noted that if building plans included capacity for EV chargers, the electrical system needs to be wired to 'assume all the [EV] chargers will be running at full capacity all the time'.⁹⁶ The submitter continued:

93 NHP, *Submission 95*, p. [5]. See also: Name withheld, *Submission 86*, p. 15. See also: *Committee Hansard*, 31 August 2018, pp. 51–52.

94 NHP, *Submission 95*, p. [5].

95 Energy Networks Australia, *Submission 60.3*, p. 35.

96 NHP, *Submission 95*, p. [6]. The relevant AS is AS/NZ3000:2018 (Electrical installations: Wiring Rules).

This conservative assumption leads electrical system designers to require a significantly larger upstream supply and network connection than would otherwise be required. This, in turn, leads to the provision for electric vehicle charging being removed from the scope of construction as a cost saving measure. The cost of the electric vehicle charging equipment is often quite small, by comparison to the costs associated with the larger network connection.⁹⁷

5.78 A more measured approach would be to include a smart load management system that schedules EV charging to occur when other electricity use within the complex is at its lowest such as late at night or early in the morning. That would allow EVs to be recharged overnight, but not require a considerable network upgrade that prohibits any EVs being charged in the development. Accordingly, NHP recommended that the Australian Standard be amended in the following way:

Where a smart load management system **is not implemented**, assume all the electric vehicle chargers will be running at full capacity all the time. Where a smart load management system **is implemented**, assume electric vehicle charging load will be effectively limited by the parameters of this system.⁹⁸

Public charging infrastructure

5.79 The Electric Vehicle Council has observed that increasing the number of charging stations is a key factor in increasing EV uptake. The availability of sufficient charging facilities and provisions within the electricity market will be essential to avoid consumer disruption and potential impacts on the power grid. A lack of charging locations to service specific journeys, emergence of queues at charging stations or grid impacts causing localised brownouts (as has occurred in some locations in the UK) would quickly discourage EV uptake.⁹⁹

5.80 Energeia put forward a similar view noting that 'investment in public charging infrastructure, particularly Direct Current Fast Chargers (DCFC), is correlated with high levels of EV uptake globally, as evidenced by the impact of DCFC deployment in Norway'.¹⁰⁰ Energeia also found that under its moderate EV uptake scenario (described in Chapter 2) that 28 370 fast charge "hoses" would be required up to 2040 at a cost of nearly \$1.7 billion (excluding land).¹⁰¹

5.81 The Electric Vehicle Council also flagged that 'access to suitable roadside sites and costly connections to state-owned electricity grids are major inhibitors to

97 NHP Electrical Engineering Products, *Submission 95*, p. [6].

98 NHP Electrical Engineering Products, *Submission 95*, p. [6]. Emphasis in original.

99 Energy Networks Australia, *Submission 60*, p. 5. See also: PwC, 'Recharging the economy: The economic impact of accelerating electric vehicle adoption', July 2018, p. 11, <http://electricvehiclecouncil.com.au/wp-content/uploads/2015/05/Recharging-the-economy.pdf> (accessed 1 November 2018).

100 Australian Renewable Energy Agency, *Submission 99.2*, p. 3.

101 Australian Renewable Energy Agency, *Submission 99.2*, p. 8.

establishing charging stations.¹⁰² Furthermore, 'processes to plan, assess or construct electric vehicle charging sites are non-existent within most governments', and the lack of information and regulatory capacity are impeding the roll-out by private companies.

5.82 With the bulk of charging occurring at home, the rollout of public charging infrastructure will need to be driven by a coordinated strategy to ensure that high value infrastructure is located where needed and not duplicated. The ACT Government has called for 'a coordinated approach to supporting installation of a strategic network of charging stations in capital cities, at national institutions, regional centres and rural areas'.¹⁰³

5.83 In Chapter 4 of the report, the Committee has discussed the public charging infrastructure plans of the Queensland and ACT Government, the RAC in Western Australia, and the NRMA in NSW. The IEA has stated that some countries are aiming to establish EV charging stations along major highways at an interval of between 45 and 115 kilometres (kms). As an example, the Chinese Government aims to install a total of 800 highway chargers with a minimum distance between chargers of about 50km by 2020.¹⁰⁴ By comparison, the United States aims to install 900 chargers at a minimum interval of approximately 115km in the same time period.¹⁰⁵ Fast Cities Australia cited recent research that found that 'a national network of 200 regular DC fast chargers (100 x dual-charger sites)...would be equivalent to a \$1 000 direct consumer incentive'.¹⁰⁶

5.84 Mr Rodger Whitby, Chief Executive Officer, St Baker Energy Innovation Fund, explained that the public confidence and increased uptake of EVs hinged on the rollout of public chargers, but that private investors took on huge risk in the early years until demand for the chargers caught up:

...the Fast Cities project is a bold move to build critical infrastructure here in Australia well ahead of the minimal viable uptake level of EVs. It's a chicken-and-egg scenario. If the infrastructure is not built, the EVs will not come, but, until the EVs come, the infrastructure is not viable. So this investment is a huge risk for private investors such as ourselves, and we are actively seeking ways to share that risk with others, including, for instance, [Australian Renewable Energy Agency (ARENA)].

5.85 In addition, the DELWP identified regional and rural areas as 'less enticing for private investment':

Tourists and residents are more likely to rely on public charging stations in regional and rural areas. Those living in rural areas travel further to access

102 Electric Vehicle Council, NRMA, St Baker Energy Innovation Fund, PwC, 'Recharging the economy: The economic impact of accelerating electric vehicle adoption', July 2018, p. 11.

103 ACT Government, *Submission 48*, p. 4.

104 International Energy Agency, *Global EV Outlook 2018*, May 2018, pp. 47–48, <https://www.iea.org/gevo2018/> (accessed 1 November 2018).

105 International Energy Agency, *Global EV Outlook 2018*, May 2018, pp. 47–48.

106 FCA, *Submission 64*, p. 6.

services than metropolitan residents, including education and employment precincts, and do not have as many public transport options. Vehicle ownership is perceived as more of a necessity for those living in regional Victoria. Similarly, tourists driving through regional Victoria need easy access to public charging infrastructure along popular tourist routes.¹⁰⁷

5.86 Environment Victoria submitted that the federal, state and territory governments need to establish targets for public charging stations and adopt policies that encourage the rollout of public charging station infrastructure:

This can be achieved by offering rebates for developing public charging stations in the locations where they are most needed to encourage a broad coverage of charging stations across the state and avoiding clusters in affluent areas. Governments can draw from the experience of New Hampshire in the USA, where the government has successfully incentivised the rollout of charging stations through reverse auctions for publicly available charging stations in priority areas. Under this scheme the government has subsidised bids that offer best value-for-money stations in priority locations.¹⁰⁸

5.87 The Australian Logistics Council advocated that the Clean Energy Finance Corporation (CEFC) should 'provide low interest finance to companies in order to install' EV charging infrastructure.¹⁰⁹

5.88 In its submission the CEFC noted it 'is in discussion with EV charging network developers with a view to investing in commercial EV charging networks'.¹¹⁰

Education and familiarisation

5.89 One of the challenges the Committee covered earlier in the report was concerns that consumers have about the reliability or range capability of EVs. The AITI explained that increased familiarisation of drivers with EVs can improve their acceptance of the new technology:

...research has noted through the experience of drivers that a 'learning phase' is essential to successful behavioural change processes. Drivers must be immersed in the experience of driving an EV to feel confident in the knowledge that a range of factors—such as the 'quietness' of EVs and the need to plan lifestyles around the much shorter range of EVs compared to ICEs—defines the parameters of their attitude and behavioural changes.¹¹¹

5.90 In its submission, the Tesla Owners Club of Australia (TOC) spelt out the benefits of an education program to dispel some of the myths around EVs:

107 DELWP, *Submission 129*, p. [9].

108 Environment Victoria, *Submission 102*, p. [2].

109 ALC, *Submission 104*, p. 13.

110 Clean Energy Finance Corporation, *Submission 31*, p. 1.

111 AITI, *Submission 5*, pp. 3–4. See also: Labeye, E., Hugot, M., Brusque, C., & Regan, M. A. (2016). The electric vehicle: A new driving experience involving specific skills and rules. *Transportation Research Part F: Traffic Psychology and Behaviour*, 37, pp. 27–40

Whilst much focus is placed upon the green credentials of electric vehicles, we see a surprisingly diverse set of drivers from [TOC] members in choosing a Tesla electric vehicle. These include outright performance of the vehicle, the technology, freedom from the oil supply chain, reduced running costs, disruptive change to the automotive industry and the overall superior driving experience. Much of the public resistance to electric vehicles relates to outdated concepts regarding the range, charging times, cost of electricity and a reduction in the fun of driving.¹¹²

5.91 The Australian Electric Vehicle Association of South Australia remarked on the use of sport as a means to 'capture the public's imagination' and to show that EVs are high performance machines. The submitter called for Adelaide to host a round of the Formula E:

There is growing interest in the electrification of motor sports. Recently an electric vehicle won Pikes Peak and the Goodwood Festival of Speed. Motor racing captures the public's imagination. In the case of EVs it removes the myth that EVs do not perform.

By hosting a round of the Formula E in Adelaide, there would be more than just the race, but a host of aligned activities with a focus on e-mobility.

Racing also spawns innovation. For example Renault and Jaguar have used Formula E as a testing ground for their road going vehicles, in particular battery management.

This event would dovetail nicely into EV manufacturing in the state, as the innovation demonstrated on the track has the potential to be transferred quickly to the road going vehicles.

By hosting a round of the Formula E in Adelaide, it would build on Adelaide's rich history of staging major motor sports events and see Adelaide become the focal point for electric vehicles within the region.¹¹³

5.92 TheDELWP observed that 'some manufacturers use their own fleet and demonstrator vehicles for promotion and education',¹¹⁴ but TOC reported that car dealerships were not providing prospective EV buyers with all of the facts:

It is noted that traditional car dealerships have generally not been good at promoting electric vehicles either due to lack of staff education or a conscious decision to not promote the new technology which needs less after sales service support (which drives their profitability).¹¹⁵

5.93 FCAI said that original equipment manufacturers, through their dealerships, were willing to bring EVs to the market, and provide ongoing maintenance and service to the vehicle over its life. Dealerships are investing in the equipment required to service EVs as Mr Tony Weber, Chief Executive Officer, FCAI explained:

112 Tesla Owners Club of Australia, *Submission 28*, p. 6.

113 AEVA—SA, *Submission 69*, p. 4.

114 DELWP, *Submission 129*, p. 7.

115 Tesla Owners Club of Australia, *Submission 28*, p. 6.

we don't sell just a product; we also sell a service to consumers. Part of that service is that we train the technicians or the mechanics so that they are in the right place to actually be able to service and maintain your vehicle. They provide the dealerships with the right diagnostic tools so that they can actually work on the vehicles. So, the important part is not only to bring the vehicle to market but to actually maintain and service that vehicle across its life.¹¹⁶

5.94 A number of submitters recommended that a consumer education campaign be developed to raise awareness of the benefits of EVs.¹¹⁷ HMA suggested that an education program could include EV demonstrations and trials.¹¹⁸ AITI noted the establishment of an EV Experience Centre in the UK and the "Plug'n'Drive" EV Discovery Centre in Toronto, Canada which 'aims to help residents understand the benefits of EVs'.¹¹⁹ The AITI has suggested that a similar centre known as a Future Mobility Centre could be established in Australia to enable members of the public to become familiar with EVs in a non-sales environment.¹²⁰

Upskilling and training service technicians

5.95 The forecast increase in EVs will require service centres and the technicians they employ to focus on developing new skills and the use of new diagnostic equipment. The Australian Automotive Dealer Association expressed their views on expected changes in the vehicle servicing sector:

It is also important to note that when these vehicles do need repairs, they will require appropriately trained technicians as EVs pose an increased risk of electrocution and fire. In fact, the emergence of EVs will necessitate significant changes in skills and training requirements which will be needed to service and maintain an increasingly electrified fleet.¹²¹

5.96 The Australian Automotive Aftermarket Association articulated a similar concern noting the possible future shortage of suitably qualified service technicians:

The most immediate concern is likely to be the availability of suitably trained technicians to service and maintain vehicles to ensure roadworthiness and road safety. Whilst these vehicles will have fewer serviceable components, EVs generate heat and friction and these components will require maintenance and servicing.¹²²

116 Mr Tony Weber, CEO, FCAI, *Committee Hansard*, 18 October 2018, p. 19.

117 See, for example: Electric Vehicle Council, *Submission 100*, p. 6; Mr David Lloyd, *Submission 22*, p. 3; AEVA—SA, *Submission 69*, p. 1; ITM Power, *Submission 74*, p. [3].

118 HMA, *Submission 73*, p. [4].

119 AITI, *Submission 5*, p. 3.

120 AITI, *Submission 5*, p. 4.

121 Australian Automotive Dealer Association, *Submission 54*, pp. 5–6.

122 Australian Automotive Aftermarket Association, *Submission 37*, p. 2.

5.97 The Victorian Automobile Chamber of Commerce (VACC) was mindful that the servicing sector would face the competing pressures of less work for businesses (as EVs require less servicing than conventional vehicles) whilst also fundamentally changing the types of skills required by technicians in the sector:

[There] will also [be a reduction in] the volume of work for automotive mechanical repair businesses given the greater reliability of EVs and their need for less servicing and maintenance. The technical sophistication of electric vehicles will also require investment in upskilling within the sector. Diagnostics, programming and coding skills for vehicle technicians will be essential to remedy vehicle faults – including the customisation of EVs. Given the high voltages inherent with EVs, there will also be greater occupational health and safety compliance required to protect both staff and the general public. These cost pressures and the imminent decline in volume of repair work, is anticipated to reduce the number of operators and employment within the sector, as EVs establish a greater presence in the vehicle fleet.

5.98 On this point, Sage Automation advised that 'as our vehicles become smarter, traditional mechanical jobs will become high-end technician roles, responsible for vehicle control systems that integrate with intelligent road technology'.¹²³

5.99 VACC recommended that a comprehensive Certificate 3 level training qualification for emerging [EV] technician roles' be developed with a focus on 'appropriate theory and training in electrical and battery systems, diagnostics, programming and other core requirements pertaining to the service and repair of EVs'.¹²⁴

Importation of second hand EVs

5.100 Vehicle pricing forms a significant barrier to uptake as the costs of new model EVs are considerably higher than conventional counterparts. As raised earlier in this chapter, the formation of a large second hand EV market would help to underpin a more affordable entry point for prospective private EV buyers. The Australian Imported Motor Vehicle Industry Association (AIMVIA) observed that:

A large proportion of Australian car buyers are simply not in a position to afford a new environmental vehicle, irrespective of their desire to reduce their vehicle running costs or carbon footprint.¹²⁵

5.101 AIMVIA continued:

Sluggish sales of new environmental vehicles in Australia over a number of years has meant that used environmental vehicles are in exceptionally short supply, representing just 0.07% of the total used vehicle market. This chronic lack of availability has in turn pushed up the price of used EVs, making them even less attractive to potential buyers.

123 Sage Automation, *Submission 84*, p. [6].

124 VACC, *Submission 26*, p. 15

125 AIMVIA, *Submission 57*, p. 4.

5.102 Nichibo Australia submitted that allowing the import of second hand vehicles will 'mean that car manufacturers will need to be more price competitive on Environmental Vehicles otherwise they will risk losing market share to vehicles imported via the concessional pathway'.¹²⁶

5.103 The AEVA referred to the experience in New Zealand where barriers to second hand imports have been removed and there has been a surge in EV uptake as a consequence.¹²⁷

5.104 Currently, second hand vehicles can be imported into Australia under the specialist and enthusiasts register if they meet two of four criteria relating to appearance, unusual design features, performance and appearance in specialist motoring magazines. AIMVIA noted that the Road Vehicle Standards (RVS) Bill 2018 is currently being considered by the Australian Parliament.¹²⁸ The then Minister for Urban Infrastructure and Cities, Hon Paul Fletcher MP, explained one of the purposes of the bill:

The bill simplifies and clarifies arrangements for the importation of vehicles granted concessions against the national standards by consolidating the current pathways into one concessional entry pathway. It also expands the range of vehicles that can be considered under the specialist and enthusiast vehicle provisions.¹²⁹

5.105 As part of this bill, a new Environmental Vehicle criterion is to be included under the Specialist and Enthusiast Vehicle Scheme. AIMVIA explained the effect of this proposed change:

In essence, the proposed Bill and Rules will soon permit the independent importation of vehicles (both new and used) that use an alternative method of propulsion to internal combustion engines, or use an alternative method or propulsion in conjunction with an internal combustion engine.¹³⁰

5.106 AIMVIA suggested that the current RVS rules be amended to 'allow all environmental vehicles to be considered eligible for independent importation, irrespective of whether have been previously sold by the OEM in Australia, but only after they cease being sold new in dealerships'.¹³¹ AIMVIA argued that this change would result in 'approximately 2000 more environmental vehicles [entering] the Australian market per annum, at far more affordable prices than the new EVs currently available'.¹³²

126 Nichibo Australia, *Submission 118*, p. 4.

127 AEVA, *Submission 8*, p. 3.

128 AIMVIA, *Submission 57*, p. 6.

129 Hon Paul Fletcher MP, Minister for Urban Infrastructure and Cities, Road Vehicle Standards Bill 2018, *Second Reading Speech*, 7 February 2018, pp. 494–495.

130 AIMVIA, *Submission 57*, p. 6.

131 AIMVIA, *Submission 57*, p. 6.

132 AIMVIA, *Submission 57*, p. 6.

5.107 Mr Tony Weber, Chief Executive Officer of the FCAI argued against allowing second hand imports pointing out that there are a range of safety and regulatory issues associated with importing second hand vehicles into the Australian market:

The problem is that the individual who buys that car has no rights under the domestic law and is subject to the laws of the original country of that vehicle. So, if I purchase a second-hand Japanese car and I have an issue with it, I need to go to the Japanese legal system for my protections.¹³³

5.108 Nichibo Australia advocated for a 'cautious, staged approach, combined with appropriate consumer protections, would go a long way to increase the Environmental Vehicle fleet in Australia without subsidies'.¹³⁴

Supporting manufacturing and value chain activities

5.109 Chapter 4 examines the opportunities and challenges for manufacturing and value chain activities associated with EVs. This section builds on that discussion and explores a range of mechanisms that would support Australian industry including:

- Industry assistance;
- An industry plan; and
- Training.

Industry assistance

Boosting domestic EV demand

5.110 Earlier parts of this chapter have focused on how governments might directly support consumers to purchase new EVs through a range of incentives. Increasing domestic demand could help to stimulate local supply chains.

5.111 There are a number of other countries that are providing funding and support to increase EV uptake. The New Zealand Energy Efficiency and Conservation Authority (EECA) has 'established a contestable fund to encourage innovation and investment in promoting, enabling and/or accelerating the uptake of electric and other low emission vehicles in New Zealand'.¹³⁵ Mr Tony Fairweather, Group Managing Director at SEA Electric described how his Australian-based company is a beneficiary of this fund:

Yes, it's been a fantastic initiative that we've benefited from as a supplier of commercial electric vehicles in New Zealand, as have the operators over there. It's a funding program through EECA...the EECA contestable fund. The concept behind the fund is that every three months the New Zealand

133 Mr Tony Weber, Chief Executive Officer, Federal Chamber of Automotive Industries, *Committee Hansard*, 18 October 2018, p. 17.

134 Nichibo Australia Pty Ltd, *Submission 118*, p. 5.

135 New Zealand Energy Efficiency and Conservation Fund, *Low Emission Vehicles Contestable Fund*, August 2017, <https://www.eeca.govt.nz/funding-and-support/low-emission-vehicles-contestable-fund/> (accessed 5 November 2018).

government releases a certain amount of funding, somewhere in the vicinity of \$4 million or \$5 million. Companies, end users, have the ability to submit an EV, an electric-vehicle-related initiative, that they would like some funding for from that fund on a quarterly basis.¹³⁶

5.112 Mr Fairweather continued:

The funding is 50 per cent of what's required to approve submissions, up to a million dollars. Most of them are around the \$200,000 or \$300,000 mark. Typically, for one vehicle or a couple of charging stations on a property, they try to approve different submissions. There's been some rubbish trucks that we've been lucky enough to supply over there. But, once rubbish trucks in Auckland have been fulfilled, they'll look at other initiatives like concrete mixers. We were also lucky enough to be able to supply five delivery vehicles for a company over there called Countdown, which is essentially Woolworths. We supplied them with their first electric home-delivery vehicles with refrigerated bodies, which were 50 per cent funded by the New Zealand government. The initiative has very much accelerated EV uptake for those wanting to test and try and feel and get an understanding for EV. I think the initiative is great and it's proven extremely successful in New Zealand. They're up to around [round] five, I think, at the moment.¹³⁷

Existing government programs and grants

5.113 The Department of Industry, Innovation and Science (Department of Industry) indicated that the Australian Government is supporting Australian industry in a number of ways:

The Australian Government has a range of programs that build business capabilities in many aspects of Australian manufacturing and services. These programs can help businesses to participate in the global supply chains of multinational car makers manufacturing EVs. The programs include the: \$100 million Advanced Manufacturing Fund; Automotive Transformation Scheme; Entrepreneurs' Programme; Industry Growth Centres Initiative; Cooperative Research Centres (CRC) program; R&D Tax Incentive; and CSIRO.¹³⁸

5.114 These schemes are briefly described below:

- The Research and Development (R&D) tax incentive 'is the government's key mechanism to stimulate Australian industry investment in R&D' offering 'tax offsets for eligible R&D expenditure'.¹³⁹
- The Automotive Transformation Scheme (ATS) is discussed in Chapter 4. The ATS was established in 2011 to encourage businesses in the automotive

136 Mr Tony Fairweather, Group Managing Director, SEA Electric, *Committee Hansard*, 31 August 2018, p. 2.

137 Mr Tony Fairweather, Group Managing Director, SEA Electric, *Committee Hansard*, 31 August 2018, p. 2.

138 Department of Industry, Innovation and Science, *Submission 112*, p. 11.

139 Department of Industry, Innovation and Science, *Submission 112*, p. 15.

sector to upgrade equipment and engage in innovation and R&D. The ATS 'encourages competitive investment and economic sustainability in the Australian automotive industry'.¹⁴⁰

- The \$155 million Growth Fund was established as a joint exercise between the federal, Victorian and South Australian Governments, and Toyota and Holden in response to the announced closure of the Toyota and Holden car-making plants in Australia. The majority of this funding has been allocated as grants to a number of companies seeking to diversify their businesses away from Toyota and Holden. The balance of the fund is dedicated to training and job placement for retrenched staff.¹⁴¹
- The Advanced Manufacturing Growth Fund is valued at \$100 million and was established to 'help industry in South Australia and Victoria be more competitive through innovative processes and equipment'.¹⁴² The Department of Industry has also flagged the importance of the industry growth initiative—in particular, the Advanced Manufacturing Growth Centre and the Mining Equipment, Technology and Services Growth Centre—and the Cooperative Research Centres Program, specifically iMove CRC.¹⁴³

5.115 The Australian Renewable Energy Agency (ARENA) described its remit and what projects are eligible for funding:

Under the *Australian Renewable Energy Agency Act 2011*, ARENA is permitted to provide financial assistance (grants) for research, development, demonstration, commercialisation and deployment of renewable energy technologies and the storage and sharing of information and knowledge about these technologies. Renewable energy technologies include "hybrid", "enabling" or "related" technologies. These can include technologies and approaches such as energy storage, load shifting, electrification, fuel switching and energy efficiency, where these use, enable or support greater deployment of renewable energy.

5.116 Notwithstanding ARENA's broad remit, its direct investment in EV projects is currently limited to research projects with no clear engagement with industry.¹⁴⁴

5.117 State governments are also providing industry support. The Centre for Energy and Environmental Markets at the University of NSW (CEEM UNSW) submitted that 'the South Australian Government has awarded Precision Buses a \$2 [million] grant for electric buses and the Victorian Government [awarded] SEA Automotive \$517 000 for commercial vehicles'.¹⁴⁵

140 Department of Industry, Innovation and Science, *Submission 112*, p. 13.

141 Department of Industry, Innovation and Science, *Submission 112*, p. 12.

142 Department of Industry, Innovation and Science, *Submission 112*, p. 12.

143 Department of Industry, Innovation and Science, *Submission 112*, pp. 14–15.

144 ARENA, *Submission 99*, pp. 2–3.

145 CEEM UNSW, *Submission 65*, p. 13.

Importance of industry grants and government support

5.118 The Committee heard that Australian-based public charger manufacturers Chargefox and Tritium had applied for ARENA grants in the past and were in the process of seeking funding from ARENA.¹⁴⁶

5.119 Dr Paul Sernia, Chief Product Officer, Tritium explained the importance of grants as the stimulus for Tritium's growth during its formative years:

I'd also add that really we have benefited from government grants. There are two things which are always important: the amount of money you get and the timing of the money. So often, early in the day, we weren't getting a lot of money out of those grants, but they were very important in pushing us along to the next stage. I'd highlight that one of the key ones was, at the time—this was in 2011—that there was a federal Commercialisation Australia innovation grant scheme, and that was fundamental to us receiving our first private investment into the company. That matched those funds 50-50, so we received a \$1.15 million grant and were able to raise \$1.15 million in private investment. A part of the conditions of that investment was a successful grant outcome, so that's a good example.¹⁴⁷

5.120 Whilst acknowledging that Tritium had received about \$6 million in grants since 2005, Tritium also noted that some grant programs were not able to be accessed by those in the EV supply and value chain:

...access to grants and funding specifically focused on the Automotive sector are not readily applicable for businesses in the EV industry. For example, the Automotive Transformation Scheme (ATS) criteria are not applicable for businesses in the EV supply and value chain.¹⁴⁸

5.121 Dr Sernia also reasoned that requirements relating to eligibility for CEFC and ARENA grants could be broadened to recognise the embedded energy storage inherent in EVs:

Perhaps another example is the potential for electric vehicles to be used as energy storage devices. Similar to solar schemes, if energy storage schemes are being looked at in the future, perhaps electric vehicles should fall within the scope of those as well.¹⁴⁹

5.122 Tritium indicated that it had benefited from existing federal R&D tax incentives.¹⁵⁰ Mr Warren Pearce, Chief Executive Officer of the Association of Mining and Exploration Companies expressed concerns about the government's proposed changes to the R&D tax incentives:

146 Dr Paul Sernia, Chief Product Officer, Tritium, *Committee Hansard*, 27 September 2018, p. 4.

147 Dr Paul Sernia, Chief Product Officer, Tritium, *Committee Hansard*, 27 September 2018, p. 3.

148 Tritium, *Submission 58*, p. [5].

149 Dr Paul Sernia, Chief Product Officer, Tritium, *Committee Hansard*, 27 September 2018, p. 3.

150 Dr Paul Sernia, Chief Product Officer, Tritium, *Committee Hansard*, 27 September 2018, p. 3.

Our concern is that, in this space where we're trying to encourage companies to get into processing and refining and potentially into electrochemical processing into the third stage, there is going to be a significant R&D component to that and we wouldn't like to see that opportunity lost as an unforeseen consequence of the change.¹⁵¹

5.123 In a report produced for ARENA and the CEFC, Energeia found that government grants assisted public charging network operators offset the high cost of establishing the network:

Our research has identified a number of clear winners in the public charging infrastructure market including ChargePoint, SemaConnect and New Motion, all originally independent players focused on [Level 2 slow] charging technology development that have leveraged revenue from government grants and third party charging infrastructure owners and operators to address the high capital requirements of infrastructure deployment.¹⁵²

5.124 Mr Paul Fox, Head of Corporate Development at Fast Cities Australia explained that Fast Cities Australia is seeking to develop a fast charging network around Australia. Mr Fox contended that his company would benefit if it could successfully acquire a government loan equating to about 50 per cent of the network's cost with the remaining 50 per cent being funded by private investors.¹⁵³

5.125 The Australian Logistics Council suggested that the Smart Cities and Suburbs Programs (known as City Deals) should be leveraged to 'further develop charging infrastructure and encourage planning regimes favourable to' EV use.¹⁵⁴

5.126 Deakin University explained that its battery materials research program, BatTRI-Hub is funded through both Australian Research Council and Centre of Excellence grants. Deakin explained the value of this work:

This research is geared towards the development of the next generation of battery technologies such as lithium-sulphur and lithium metal batteries that offer substantially longer battery life, improved safety and high temperature operation. The research group has engaged with international companies including Honda, Toyota and Cytec/Solvay to develop new materials and now has a state-of-the art, flexible prototyping facility for electrochemical devices including advanced Li-ion, Li metal, sodium-ion and battery-supercapacitor hybrid prototypes.¹⁵⁵

151 Mr Warren Pearce, Chief Executive Officer, Association of Mining and Exploration Companies, *Committee Hansard*, 17 August 2018, p. 28. See also: AMEC, *Submission 20.3*, p. 3.

152 Energy Networks Australia, *Submission 60.5*, p. 64. See also: Energeia, *Australian Electric Vehicle Market Study*, May 2018, prepared for ARENA and CEFC.

153 Mr Paul Fox, Head, Corporate Development, Fast Cities Australia, *Committee Hansard*, 27 September 2018, p. 27.

154 ALC, *Submission 104*, p. 14.

155 Deakin University, *Submission 35*, p. 4.

5.127 The submission continued, explaining the commercial linkages that this research has fostered:

The research program has led to the filing of several materials patents and the group has engaged with local chemical companies such as Boron Molecular on the synthesis and upscaling of materials for wider use in battery research. The battery materials characterisation expertise within the group offers a major opportunity to support the chemical synthesis and characterisation for an electric vehicle manufacturing sector.¹⁵⁶

Procurement

5.128 Some submitters raised government procurement policy as an area which could be used to support local EV manufacturing. State and territory governments in Australia are also acting to boost demand. The Queensland Government's fleet manager QFleet 'has committed to doubling the number of EVs in its leased fleet each year over the next four years'.¹⁵⁷ The City of Adelaide told the Committee that it will seek to transition its entire fleet to EV by 2030.¹⁵⁸

5.129 Public transport procurement is another area which could drive EV demand and associated local job creation. Mr Christian Reynolds, Director of Precision Buses observed that the City of London aims to convert its entire fleet of 4 000 buses to EVs by 2020. Australia has nearly 100 000 buses with about 500 replaced annually.¹⁵⁹ One submitter argued that the bus manufacturing sector could be the catalyst to rebuild Australia's industrial base:

Australia has a nascent electric bus manufacturing industry in South Australia and Victoria and there exists an opportunity there to revive Australia's manufacturing expertise.¹⁶⁰

5.130 In a response to a question taken on notice, the Queensland Department of Transport and Main Roads (DTMR) explained the role of the Local Benefits Test within the Queensland Government's procurement policy:

The Queensland Procurement Policy does not prevent suppliers tendering for its contracts. The Policy requires the application of a Local Benefits Test for all significant procurement. The Local Benefits Test focuses on the benefits that any supplier can bring to the local area.¹⁶¹

156 Deakin University, *Submission 35*, p. 4.

157 Queensland Government Department of Transport and Main Roads, *Submission 43*, p. 4. See also: ACT Government, *Submission 48*, p. 2.

158 Ms Michelle English, Associate Director, Sustainability, City of Adelaide, *Committee Hansard*, 10 August 2018, p. 52.

159 Mr Christian Reynolds, Director, Precision Buses, *Committee Hansard*, 10 August 2018, p. 23.

160 Doctors for the Environment, *Submission 50*, p. 9.

161 Department of Transport and Main Roads Queensland - answers to questions taken on notice from public hearing in Brisbane on 27 September 2018 (received 19 October 2018)

5.131 The ACT Government acknowledged that it has a similar procurement requirement for 'local industry participation' which includes 'employment of local people, the training of local people or commitment to a trades course'.¹⁶² Ms Michelle English, Associate Director, Sustainability, City of Adelaide said that 'council's procurement policy certainly has a weighting for South Australian companies'.¹⁶³

5.132 Mr David Smith, Secretary of the Vehicle Division at the Australian Manufacturing Workers Union suggested how local content rules within a procurement framework might take practical shape:

Ensuring that those cars that we bring into Australia have local content in them with the battery would be a good place to start.¹⁶⁴

5.133 In a response to a question taken on notice, the ACTU called for a re-write of the Commonwealth Procurement Rules:

The rules must be required to be applied in a manner that consistently and correctly ensures overall economic benefits from tenders are considered when assessing value for money, rather than just an assessment of the cheapest cost.¹⁶⁵

5.134 Sage Automation claimed that there is a need for a step-change in how procurement is undertaken moving away from open tenders to more collaborative processes that allow for specifications to be developed and optimised throughout the procurement process:

Procurement models need to move from the current open tender process to a collaborative procurement model based upon an agile framework. Whilst transport tender writers have a view of what they are looking to achieve, they lack the technical expertise to clearly specify it within tender documents. This results in missed opportunities to deliver the step change advancement of our transport and infrastructure we require. Agile tender documentation includes the vision and outcome but uses a collaborative approach and specialist expertise to specify advancement and an outcome that is more cost effective in the end. Some upskilling of governments and councils in this area will also help to acquire the understanding of incorporating fast advancing technology into long-term programs of work.¹⁶⁶

162 Mr Geoffrey Rutledge, Deputy Director-General, Sustainability and the Built Environment, Environment, Planning and Sustainable Development Directorate, Australian Capital Territory, *Committee Hansard*, 17 August 2018, pp. 5–6.

163 Ms Michelle English, Associate Director, Sustainability, City of Adelaide, *Committee Hansard*, 10 August 2018, p. 52.

164 Mr David Smith, Secretary, Vehicle Division and Assistant National Secretary, Australian Manufacturing Workers Union, *Committee Hansard*, 31 August 2018, p. 49.

165 Australian Council of Trade - answers to questions on notice from public hearing in Melbourne on 31 August 2018 (received 27 September 2018).

166 Sage Automation, *Submission 84*, p. 7.

An industry plan

5.135 The Committee has received no evidence of a clear, coherent and comprehensive federal government policy position supporting the development of an EV industry. Further, it is also not clear whether there is any crossover or overarching strategy in relation to the transitional automotive sector funds—ATS, the \$155 million Growth Fund—the Advanced Manufacturing Growth Fund and research grants.

5.136 This lack of leadership by the federal government was highlighted in evidence to the Committee. Mr Lance McCallum, National Campaign Coordinator at the Australian Council of Trade Unions spoke about whether Australia should have started making plans some time ago for the domestic manufacture of EVs and associated componentry:

if you've got a time machine, or if you had one, I would say we should definitely have a serious conversation about maybe getting in that time machine and going back five years or seven years, or possibly even 10 years and maybe doing things a bit differently, in terms of creating a space for EVs domestically here in Australia.¹⁶⁷

5.137 Mr McCallum noted that 'it would be nice to have some industry plans in a number of different industries' including EVs.¹⁶⁸ Ideally, these plans would recognise the development of advanced manufacturing techniques, the rise of Industry 4.0 and the specific needs of the local Australian EV sector.¹⁶⁹

5.138 CEEM UNSW explained some of the risks of a coordinated approach:

The risk is of course that the price of such coherence in Australia would often seem to be "lowest common denominator" outcomes that stifle technology innovation and progress.¹⁷⁰

5.139 Whilst acknowledging these risks, CEEM UNSW described the role of different jurisdictions in developing and adopting an industry strategy:

particularly in still emerging electric mobility areas, we need frameworks that allow different jurisdictions to support different pilots and trials, while seeking federal and State government policy measures to drive wider deployment and value adding progress.¹⁷¹

5.140 Sage Automation stated that any policy approach should be driven by a focus on local Australian businesses through targeted grants whilst noting that 'attracting off-shore manufacturers to set up shop in Australia' could become possible with new

167 Mr Lance McCallum, National Campaign Coordinator, Australian Council of Trade Unions, *Committee Hansard*, 31 August 2018, p. 54.

168 Mr Lance McCallum, National Campaign Coordinator, Australian Council of Trade Unions, *Committee Hansard*, 31 August 2018, p. 54.

169 Mr Lance McCallum, National Campaign Coordinator, Australian Council of Trade Unions, *Committee Hansard*, 31 August 2018, p. 54.

170 CEEM UNSW, *Submission 65*, p. 13.

171 CEEM UNSW, *Submission 65*, p. 13.

models of automotive manufacturing focused on upgrading vehicles. Sage Automation cautioned that this could only happen in the presence of an efficient and capable workforce.¹⁷²

Training the EV workforce

5.141 Building on the discussion in Chapter 4 about the large, highly skilled and experienced automotive workforce in Australia, the Committee has been told that with specific and targeted training, this workforce is ready to employ their expertise in the emerging EV sector.¹⁷³ The DTMR highlighted the prospective job opportunities in this sector:

Clean energy and eco-friendly jobs are considered to be one area of future job growth. These industries will require new skills and training programs to ensure these future industries have a capable and available workforce. This includes ensuring that future workforces are appropriately qualified in science, technology, engineering and mathematics (STEM) fields. Industry development programs should also be considered alongside appropriate education and skills training programs.¹⁷⁴

5.142 The DTMR continued:

These industries will require new skills and training programs to ensure that these future industries have a capable and available workforce. Industry development programs should also be considered alongside appropriate education and skills training programs.¹⁷⁵

5.143 The ACTU also supported training workers in this area and acknowledged that the EV sector's workforce requirements would be quite diverse:

The training of qualified workers in this field must be a priority. While small, there is already a growing electric conversions industry in Australia and it is integral that this work is done by trained and qualified workers to ensure that it is done safely. Building a qualified and effective EV production workforce would also serve to provide safe and qualified workers to industries like EV conversions and battery production.¹⁷⁶

5.144 The TOC indicated that any future manufacturing would most likely take place in the context of automation requiring a highly skilled workforce.¹⁷⁷

5.145 Deakin University noted that there is currently a shortage of skilled graduates in the automotive sector. Acknowledging the increased role of automation, Deakin University highlighted the diverse range of skills that graduates in this sector would require in the future:

172 Sage Automation, *Submission 84*, p. 8.

173 See: CEEM UNSW, *Submission 65*, p. 11.

174 DTMR, *Submission 43*, p. 5.

175 DTMR, *Submission 43*, p. 5.

176 ACTU, *Submission 107*, p. 5.

177 Tesla Owners Club of Australia, *Submission 28*, p. 5.

Higher degree content in this sector will need to evolve to provide skills such that these students will become leaders in the Australian advanced manufacturing sector. Training in leadership, intellectual property, marketing, business management and finance would make these graduates more industry ready and desirable for the sector. Provision of substantial stipends to attract the best students to this sector will be required.¹⁷⁸

5.146 Ensuring that the industry is growing and ready to employ these graduates is also an important factor in attracting graduates and undergraduates to study in these fields.¹⁷⁹

5.147 The Electrical Trades Union suggested a number of initiatives that would support the development of an EV workforce:

- Transition incentives for workers to return to the industry. For [example], a transition centre was set up at Elizabeth [South Australia] for workers leaving the industry. There is capacity to turn this initiative around and use it to return workers to the industry.
- Apprenticeships and in particular, mandatory apprentice rations linked to all forms of Government support to the industry;
- Development of an appropriate training package consistent with the historical concept of ensuring skills learnt are transportable.¹⁸⁰

5.148 In his submission, Mr Larkins suggested that the EV 'industry could be fostered by providing investment into PhD scholarships and university research grants administered through the CSIRO'.¹⁸¹

Managing the risks

5.149 The transition from conventional vehicles to EVs is not without risk and needs to be undertaken in a coordinated manner to mitigate against any unintended consequences. This section explores the following:

- Coordination and planning;
- Standards; and
- Road user charging.

Coordination and planning

5.150 Earlier in the chapter, the Committee discussed a range of ways in which governments can act to increase EV uptake, ranging from establishing a vision, through to concrete proposals that can incentivise people to purchase EVs. The Committee has heard that after establishing this policy framework, there is a need to plan and coordinate its implementation.

178 Deakin University, *Submission 35*, p. 6.

179 Deakin University, *Submission 35*, p. 6.

180 ETU, *Submission 110*, p. 13.

181 Mr Anthony Larkins, *Submission 32*, p. 2.

5.151 The Committee has heard about a number of different models used globally to coordinate the transition to EVs. In the United Kingdom, the Office for Low Emission Vehicles (OLEV) works across government to 'support the early market for ultra-low emission vehicles' including 'development, manufacture and use'.¹⁸² Mr Daniel Hilson, Founder and Managing Director of Everergi provided more detail noting that OLEV's function is to 'develop and coordinate strategy and to create and manage grant programs, research, awareness programs, infrastructure, strategy and standards'.¹⁸³

5.152 Mr Tim Washington, Chief Executive Office at JET Charge described the overarching coordination role that the OLEV plays in implementing the United Kingdom Government's approach to EVs:

Then you have a practical means of delivering that vision, which is something like the UK's Office of Low Emission Vehicles, whereby basically all the government policy is channelled through that office. Then you have very specific policies that the office enforces, which are the kinds of things that Tritium were just talking about, like toll roads and all that kind of stuff, and vehicle incentives.¹⁸⁴

5.153 Mr Hilson talked about how OLEV also functions as an independent consumer advocacy body in addition to its other functions:

Essentially, under the Office for Low Emission Vehicles they've established Go Ultra Low. They invited the manufacturers and government to participate, and they implemented a number of measures to coordinate things like the grants, consumer awareness and creating a path to purchase. So through that mechanism you could work out how to install a charging station, how to claim grants, and essentially where you could do a test drive and the various steps along the journey to buying an electric vehicle. That just doesn't exist in Australia at the moment. If you go online tonight and try to buy a petrol powered vehicle, you go to carsales.com and you know exactly what to do. If you go to buy an electric vehicle—I challenge any of you to figure out how you can actually execute on that.¹⁸⁵

5.154 The South Australian Government was mindful that the United Kingdom's model allowed for a whole of government response to a profound change in the transportation system with implications on a number of interrelated areas including energy:

182 United Kingdom Office for Low Emission Vehicles, *Homepage*, <https://www.gov.uk/government/organisations/office-for-low-emission-vehicles> (accessed 6 November 2018).

183 Mr Daniel Hilson, Founder and Managing Director, Everergi, *Committee Hansard*, 31 August 2018, p. 57.

184 Mr Tim Washington, Chief Executive Office, JET Charge, *Committee Hansard*, 27 September 2018, pp. 5–6.

185 Mr Daniel Hilson, Founder and Managing Director, Everergi, *Committee Hansard*, 31 August 2018, p. 58.

A well-led national response may require a new national policy structure, for example the UK Office for Low Emission Vehicles that sits across the Transport and Energy/Industry portfolios, and the better use and coordination of existing [Council of Australian Governments (COAG)]-related transport, energy and environment groups, for example the Transport and Infrastructure Council (TIC) and Transport and Infrastructure Senior Officials Committee (TISOC). If so, then any group should consider the inter-relationships with wider future mobility disruptors including autonomous vehicles.¹⁸⁶

5.155 On this point of coordination, the Committee has noted the recent COAG Transport and Infrastructure Council communiqué, which discussed a coordinated national approach to encourage the uptake of low and zero emission vehicles, particularly electric vehicles:

It was agreed the Transport and Infrastructure Senior Officials' Committee will develop a program of work to address the barriers and challenges impeding the uptake of these vehicles for Council consideration in the first half of 2019. This work could include initiatives to support infrastructure development, measures to reduce upfront costs and increase model availability, and programs to educate and improve the awareness of consumers of the benefits of shifting to low emission vehicles, while acknowledging the need for a market-based response.¹⁸⁷

5.156 A number of submitters also expressed support for the New Zealand Government's EECA EV program which coordinates the government's effort to increase EV uptake.¹⁸⁸ During the course of the inquiry, the Committee met with EECA officials.

Standards

5.157 The Committee has been told that the early stages of the transition to EVs is the ideal time to establish a number of national standards across the industry to ensure a uniform approach in key areas such as charging adaptors. In a supplementary submission, Flinders University described the establishment of EV standards at the national level as an 'enabling initiative'.¹⁸⁹ Hyundai Australia called for the introduction of 'internationally harmonised regulations, codes and standards'.¹⁹⁰ The South Australian Government went further saying that the absence of national coordination could result in a similar situation to the ad-hoc development of rail

186 South Australian Government, *Submission 130*, p. 3.

187 Transport and Infrastructure Council, Communiqué, Sydney, 9 November 2018, available at: <https://transportinfrastructurecouncil.gov.au/communique/> (accessed 2 January 2019).

188 See, for example: Isuzu Australia, *Submission 67*, p. 3; SEA Electric, *Submission 24*, p. [3]. See also: New Zealand Energy Efficiency and Conservation Authority, *Electric Vehicles*, October 2017, <https://www.energywise.govt.nz/on-the-road/electric-vehicles/> (accessed 6 November 2018).

189 Flinders University, *Submission 5.1*, p. [9].

190 Hyundai Australia, *Submission 103*, p. 5.

networks in Australia during the mid- to late- nineteenth century which resulted in Australia having a number of different rail gauges across the national network.¹⁹¹

5.158 The Australian Electric Vehicle Association put forward its preferred charging standard:

Embrace the Type-2 charging standard as Australia's national charging standard. This is important for preventing further delays in infrastructure roll-outs. DC fast charging should also shift to the CCS-2 standard. Financial support should be offered to convert vehicles over to this standard, where applicable.¹⁹²

5.159 Type-2 is the predominant charging standard in Europe.¹⁹³ FCAI and its membership are supportive of the Type-2 standard¹⁹⁴ with the City of Adelaide indicating that it had also adopted this standard.¹⁹⁵ In its submission, FCAI outlined its support for a harmonised approach:

Recognising the need for rapid deployment of battery electric vehicle charging infrastructure, the FCAI membership has made a public commitment to supplying vehicles from 2020 that meet a set of international charging standards. Certainty in these standards within Australia will enable vehicle manufacturers and EV charging infrastructure providers to make investment in future electric vehicle-related product plans with reduced risk, and encourage government to develop programs to incentivise uptake of electric vehicles.¹⁹⁶

5.160 Furthermore, FCAI highlighted that lack of certainty on the charging standard is also providing another level of uncertainty for organisations considering installing public charging equipment.¹⁹⁷ iMove Australia commented that 'adoption of charging standards would help to avoid incompatibility issues with proprietary technologies'.¹⁹⁸

5.161 The need for standards around battery technology and battery management systems were also raised as a priority area, particularly in seizing the opportunity to develop standards that are suited for Australian conditions.¹⁹⁹ Ms Gail Broadbent called for the public recharge stations to be 'signposted with standardised signage' to

191 South Australian Government, *Submission 130*, p. 3. See also: Productivity Commission, *Progress in Rail Reform: Inquiry Report*, Report No. 6, 5 August 1999, Attachment C, pp. C1–2, https://www.pc.gov.au/data/assets/pdf_file/0020/34526/rail.pdf (accessed 6 November 2018).

192 AEVA, *Submission 6*, p. 3.

193 International Energy Agency, *Global EV Outlook 2017*, June 2017, p. 30.

194 FCAI, *Submission 119*, p. 16.

195 City of Adelaide, *Submission 93*, p. 5.

196 FCAI, *Submission 119*, p. 14.

197 FCAI, *Submission 119*, p. 14.

198 iMove Australia, *Submission 124*, p. [1].

199 Deakin University, *Submission 128*, p. 1.

'improve accessibility for customers' and to maximise network value.²⁰⁰ TOC raised concerns that not having a national signage standard for accessing charging infrastructure would inconvenience interstate travellers.²⁰¹

5.162 The Committee also received evidence in relation to the weight of EV trucks. The Committee were told that EV trucks weigh five to ten per cent more than ICE equivalents due to the batteries. Mr Fairweather spoke about the difficulties this causes for operators of 4.5 tonne gross vehicle mass (GVM) trucks:

The particular issue that we've spoken about as part of this only relates to one segment of the commercial vehicle space and it's at the smallest end of the truck area—what's referred to as the 4.5 tonne GBM truck area, which is the threshold upon which a passenger car licence needs to become a truck licence, a commercial vehicle licence. That's why you see many small 4.5 tonne trucks around Australia. Hire companies and rental companies et cetera use them by the thousands, because a passenger car licence driver can use them. An example is New Zealand of Countdown, who've got those five vehicles for delivery vehicles. New Zealand has a six tonne limit for exactly the same trucks. So it just seems unusual that 4.5 is required here. It seems unnecessary. I think it's a terrific opportunity to be able to open that space—just for electric vehicles for the time being and for our professional fleets maybe initially, maybe without the allowable towing capacity that normally comes with a passenger car licence, so you're compensating.²⁰²

5.163 In its submission, SEA Electric anticipated that battery weights would decline over the short term due to technological advances, and noted that any measures to increase vehicle masses would only be required in the short term.²⁰³

Road user charging

5.164 Earlier in the report, the Committee discussed the erosion of the fuel tax excise. Bloomberg New Energy Finance estimated that loss excise could range from about \$1 billion per year by 2030 up to about \$5.5 billion by 2040.²⁰⁴ With the risk of this continued erosion as vehicle fuel efficiency improves and EV uptake increases, many submitters and witnesses advocated for the introduction of a road user charge as a replacement funding measure. This measure could be introduced for EV owners who do not pay fuel excise tax as they do not use fuel. In addition, EV owners are currently a relatively small grouping which would allow for a pilot program to trial the new revenue mechanism.

5.165 Infrastructure Partnerships Australia called for 'a new distance-based road user charging mechanism' in conjunction with other upfront disincentives for EV

200 Ms Gail Broadbent, *Submission 115*, p. [4].

201 Tesla Owners Club of Australia, *Submission 28*, p. 9.

202 Mr Tony Fairweather, Managing Director, SEA Electric, *Committee Hansard*, 31 August 2018, p. 2.

203 SEA Electric, *Submission 24*, p. [4].

204 Bloomberg New Energy Finance, *Submission 127*, p. 26.

owners (such as LCT and vehicle import duties) to be reduced to zero, which would reduce the purchase price of an EV.²⁰⁵ Mr Adrian O'Dwyer, Chief Executive Officer of Infrastructure Partnerships Australia put forward his organisation's view that levying the charge on EVs would be a way to slowly introduce it on vehicles that are not subject to fuel tax excise:

I see electric vehicles as an opportunity to introduce that type of system, but, at the thin end of the wedge, that will grow over time so that there's less upfront cost for that transition [from fuel excise tax to a road user charge].²⁰⁶

5.166 A separate approach has been used in New Zealand where a distance-based Road User Charge (RUC) applying to all vehicles has been in place since 1977.²⁰⁷ Dr James Prest, from the College of Law at the Australian National University stated that the New Zealand Government currently provides an exemption from RUC for light EVs 'until they make up two percent of the light vehicles fleet'.²⁰⁸ This exemption takes effect until the end of 2021, with a similar exemption in place for heavy commercial EVs.²⁰⁹

5.167 The Parliamentary Budget Office provided the Committee with modelling on the budgetary implications of introducing a road user charge on electric vehicles.²¹⁰ The Parliamentary Budget Office assumed the charge would be phased in over five years, levied on a per kilometer driven basis at an equivalent rate to fuel excise, and collected from EV owners monthly. The Parliamentary Budget Office modelled four options for the starting date of the scheme. Table 5.6 sets out the fiscal balance (revenue generated minus departmental expenses) for the road user charge at 2028–29 for each of the starting dates.

205 Infrastructure Partnerships Australia, *Submission 121*, p. 3.

206 Mr Adrian O'Dwyer, Chief Executive Officer, Infrastructure Partnerships Australia, *Committee Hansard*, 31 August 2018, p. 26.

207 Road User Charges Review Group, *An Independent Review of the New Zealand Road User Charging System*, 31 March 2009, p. 20, <https://www.nzta.govt.nz/assets/resources/road-user-charges/docs/ruc-final-report.pdf> (accessed 28 November 2018).

208 Dr James Prest, College of Law, Australian National University, *Submission 101*, pp. 10–11.

209 New Zealand Ministry of Transport, *Electric Vehicles*, <https://www.transport.govt.nz/multi-modal/climatechange/electric-vehicles/> (accessed 28 November 2018).

210 *Applying a road user charge to electric vehicles*, Parliamentary Budget Office, 7 December 2018.

Table 5.6: Fiscal balance 2028–29 for road user charge²¹¹

Start date for road user charge	Revenue generated to 2028–29 (\$m)
1 July 2022	1 229
1 July 2023	1 089
1 July 2024	899
1 July 2025	639

Concluding comments

5.168 This chapter has canvassed a comprehensive suite of measures that would encourage and facilitate the increased use of EVs, and support the local manufacture of EVs and their components. The Committee has heard those jurisdictions that provide incentives, such as vehicle registration and other tax concessions (including luxury car tax and import duties), help to reduce EV purchase price and in turn increase EV uptake. One-off grants to new EV purchasers provide a similar type of support.

5.169 The Committee was told about the role that national EV targets play in outlining a vision and the expectations that individual countries have for EVs as part of the transport system. National targets can provide a level of certainty to vehicle manufacturers, charging infrastructure operators and local industry, indicating the extent to which they should engage in particular markets.

5.170 The Committee heard that government can add to this certainty through committing to government fleet EV procurement targets. Government fleet targets increase demand, encouraging vehicle manufacturers to introduce additional and cheaper models to market, whilst also underpinning a second-hand market providing more affordable access to EVs. Relaxing restrictions on second hand imported EVs would also support the used EV market and provide a lower price entry to EV ownership.

5.171 Evidence received during the inquiry supports the introduction of more stringent vehicle emissions standards, including on carbon dioxide, noting that this would not only make EVs more competitive, but also lead to improved economic, public health, and environmental outcomes.

5.172 A coordinated approach to the rollout of public EV charging infrastructure and amendments to tenancy laws and building codes that will provide EV owners with a supportive eco-system, offering certainty that EVs can be charged as required at home or in public. Some states and territories, motoring associations and the private

211 *Applying a road user charge to electric vehicles*, Parliamentary Budget Office, 7 December 2018, pp. 6–7.

sector are taking the first steps in rolling out public infrastructure, but federal government support could accelerate this process and ensure that rural and regional parts of the country are not left behind.

5.173 Consumer education and vehicle demonstrations will assist in allaying any concerns or misconceptions around EV use. Whilst amendments to national training requirements for vehicle service technicians to include EVs will ensure that trade qualifications evolve with the changing transport fleet and that sufficient qualified technicians are able to meet the growing demand.

5.174 The Committee has heard about the positive flow-on effects that increased EV uptake—both in Australia and globally—will have on the local manufacturing sector. There are some businesses who are already taking advantage of these opportunities. Currently, there are a number of federal schemes such as the ATS, the Growth Fund and the Advanced Manufacturing Growth Fund that are providing grants to eligible companies involved in the conventional and EV automotive space. Notwithstanding this investment, there is a lack of an overarching national strategy to ensure that this funding is more effectively targeted to emerging automotive sectors including electric and automated vehicles.

5.175 Targeted government procurement can also help to drive a growing manufacturing sector based on EV components, assembly and supply-chain products. Part of a coordinated national approach should also factor in the growing need for a highly skilled workforce that utilises and augments existing skillsets, whilst nurturing the next generation of workers.

5.176 Finally, this chapter has examined the need for a comprehensive coordinated approach from the federal government, anticipated the need for harmonised national standards and considered applying a road user charge mechanism as a strategy to replace failing fuel excise revenue.

5.177 The next chapter outlines the Committee's conclusions and recommendations.

Chapter 6

Committee view and recommendations

Introduction

6.1 EVs are at the forefront of a major transformation of the world's transport sector. Global EV sales are growing rapidly, driven by government policy in large consumer markets in Europe, Asia and North America. Vehicle manufacturers are leading the transition, investing heavily to expand their EV offerings and improve EV driving range and performance. The technological disruption is also providing opportunities for new business models and companies to emerge.

6.2 The widespread use of EVs in the Australian transportation fleet would provide significant economic, environmental and health benefits. While the Committee is cognisant that transitioning to EVs presents challenges on a number of fronts, the Committee is of the view that the benefits of EVs substantially outweigh these challenges.

6.3 However, the uptake of EVs in Australia is slower than in other countries. The expense of EVs, compared with internal combustion engine (ICE) equivalent vehicles, and concerns about the driving range and lack of recharging infrastructure for EVs are key factors hindering motorists purchasing these vehicles.

6.4 The Committee has included battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs) and fuel cell electric vehicles (FCEVs) in its definition of EVs. In terms of technology development, the Committee notes evidence provided that FCEV development has progressed more slowly than BEVs and PHEVs and there may now be an acceptance that BEVs and PHEVs will become the dominant technology longer-term. The Committee also notes the preference of most vehicle manufacturers for battery technology, and that the uptake of FCEVs may be further disadvantaged by the lack of refuelling infrastructure.

6.5 The evidence to the Committee is that, in the absence of any change to regulatory settings, EV uptake in Australia will be constrained and will continue to lag behind other comparable nations. Slow uptake will result in EV manufacturers not prioritising the Australian market and fewer EV models being available to Australian motorists. It will also delay the realisation of substantial economic, environmental and health benefits.

6.6 The Committee has also heard that the transition to EVs presents opportunities for EV manufacturing and associated businesses in Australia. These opportunities include harnessing existing manufacturing capability and developing new manufacturing fields for Australian industry.

6.7 In this Chapter, the Committee outlines its recommendations for measures to support and accelerate the uptake of EVs, as well as measures to support and develop EV manufacturing and associated business opportunities.

Development of a national EV strategy and targets

6.8 The Committee has carefully considered whether there is a role for updated regulatory settings to increase the uptake of EVs in Australia. On balance, the Committee is of the view that a status-quo approach is detrimental to Australia's interest. It is clear to the Committee that policy leadership from government would provide an important signal to the market of Australia's support for EVs and thus promote confidence for both business and consumers.

6.9 The Committee welcomes the announcement by the Council of Australian Governments' (COAG) Transport and Infrastructure Council for a Senior Officials' Committee to develop a program of work to address the barriers and challenges in EV uptake. However, the Committee believes the Australian Government should also develop a comprehensive national EV strategy to ensure Australia takes advantage of opportunities EVs present, while also responsibly managing the risks.

6.10 The Committee further recommends that the Australian Government establish an inter-governmental taskforce to take responsibility for the implementation of the national EV strategy. The role of the inter-governmental taskforce will be to ensure that there is a nationally consistent approach to EV policy and to identify areas of regulatory reform. The Committee's view is that the National Transport Commission should provide an annual report detailing areas for regulatory reform to COAG's Transport and Infrastructure Council for implementation by the inter-governmental taskforce

6.11 The evidence to the Committee highlighted economic, environmental, and health benefits from a transition to EVs, and opportunities to enhance Australian industrial capabilities in research and development – in the resources, automotive and transport sectors. It highlighted that there are a host of challenges and risks which need to be considered so the approach must be comprehensive and integrated.

6.12 Addressing these risks and challenges will require effective national standards and regulation in regards to charging infrastructure and electricity grid integration, building and construction, public safety, consumer protection, processes for disposal and/or re-use of batteries, and skills training.

6.13 The Committee notes that the pace of change and technology is largely driven by overseas developments. Lithium ion battery technology is under continuous attention for re- development and that alternatives to lithium iron – such as solid state batteries – are being actively pursued.

Recommendation 1

6.14 The Committee recommends that the Australian Government develop a national EV strategy to facilitate and accelerate EV uptake and ensure Australia takes advantage of the opportunities, and manages the risks and challenges, of the transition to EVs.

Addressing these risks and challenges will require effective national standards and regulation in regards to charging infrastructure and electricity grid integration, building and construction, public safety, consumer protection, processes for disposal and/or re-use of batteries, and skills training.

Recommendation 2

6.15 The Committee recommends that the Australian Government should take a national leadership position in establishing an inter-governmental taskforce to lead the development and implementation of a national EV strategy.

6.16 The Committee has heard that establishing national EV targets provides leadership to consumers and businesses and assures vehicle manufacturers that a local market exists. Countries with the highest EV uptake all have national targets as the overarching part of their strategy. National targets could provide international vehicle manufacturers with confidence that the Australian EV market will grow and encourage them to make a broader range of models available, specifically more affordable models. For consumers, national targets offer confidence that a critical mass of EVs will be reached and that supporting infrastructure will be available as the number of EVs grows.

6.17 Accordingly, as part of the national strategy, the Committee recommends setting national targets focused on passenger vehicles, light commercial vehicles and metropolitan buses. There are various views on the pace of the adoption or targets and Committee considers that percentage of vehicles sales by 2025, rather than a longer term target for the complete phase out of ICE vehicle sales is more appropriate. In the Committee's view, consideration of short-to-medium term targets could demonstrate the government's commitment to accelerating EV uptake. The Committee is hopeful that the initial targets will provide the momentum required to increase EV sales to a point such that targets will no longer be required. Targets will also bolster the business case for expanding domestic EV manufacturing and supply chain activities.

Recommendation 3

6.18 The Committee recommends that the Australian Government consider establishing national EV targets for light passenger vehicles, light commercial vehicles and metropolitan buses.

Government fleet targets

6.19 Motor vehicle sales and leases of motor vehicles to the government sector at a national, state and local government level make up a significant proportion of the total Australian motor vehicle fleet. The Committee recognises that a higher portion of EVs in government fleets would help stimulate growth in the sector and encourage

manufacturers to bring a greater range of EV models to Australia. It would also help to underpin a larger second-hand EV market, and in turn, create a larger pool of more affordable EVs for consumer and small business.

6.20 The Committee is encouraged by the ACT Government's action in mandating 50 per cent zero emissions vehicles by 2019-20 and 100 per cent by 2020-21, and the United Kingdom Government's commitment to 25 per cent ultra-low emissions vehicles in the government fleet by 2022.

Recommendation 4

6.21 The Committee recommends that the Australian Government consider establishing a national EV target for the Government fleet.

Measures to support EV uptake

6.22 The evidence suggests that the price of EVs will continue to fall as production expands and battery prices decline. Evidence to the Committee suggested that EVs would reach price parity around the mid-2020s, and becoming cheaper than combustion engine (ICE) equivalents thereafter. Some commercial vehicle classes are expected to reach price parity sooner than passenger vehicles, with the lower operating cost making the whole-of-life cost cheaper than an ICE equivalent. At the same time the effort required to get achieve that should not be underestimated.

6.23 The Committee notes that in some international jurisdictions, direct financial incentives have been provided to motorists in order to promote the uptake of EVs. The Committee does not propose the implementation of such subsidies in Australia.

6.24 The Committee has heard evidence on a range of program initiatives and the intersection and overlap with tax and financial measures that could support demand for EV's but has not committed to any specific proposal or package of measures.

Public charging infrastructure

6.25 Readily available and easily accessible public charging infrastructure is a key to accelerating the uptake of EV passenger vehicles in Australia. While the Committee understands that the majority of charging of EVs is likely to occur at residential properties overnight, a comprehensive network of public charging infrastructure is required to address range anxiety, support longer distance travel and will provide confidence for consumers that they will be able to charge their vehicle when required.

6.26 The Committee supports the initiatives underway in Queensland, the ACT, Western Australia and NSW which are increasing public charging infrastructure, as well as plans for a fast charging network on federal highways. However, the Committee is concerned that, at present, there is no integrated plan for the rollout of public charging infrastructure. For this reason, the Committee recommends that as part of the national strategy, the Australian Government, along with charging infrastructure operators, develop a comprehensive plan for the rollout of a national public charging network.

6.27 The Committee recognises that highway fast charging will be important in addressing motorist's range anxiety. Government funding can play a major role in

supporting more expansive coverage, particularly in areas that may not be a commercially viable for the private sector at present.

6.28 The Committee notes the benefits of workplace charging, not only in providing access to charging facilities for those who are unable to install home charging facilities, but also in shifting electricity demand away from the early evening peak to the middle of the day, when solar PV is expected to provide surplus generation. The Committee agrees with the evidence provided that making sure EVs do not overload the electricity network at times of peak demand will also be important for maintaining grid stability and preventing price spikes.

Recommendation 5

6.29 The Committee recommends that the Australian Government coordinate with operators in the charging infrastructure industry to develop a comprehensive plan for the rollout of a national public charging network.

Vehicles emissions standards

6.30 While Australia has long had vehicle emissions standards in place, the standard for light vehicles in Australia are based on a European standard (Euro 5) which has now been superseded. Further, the Committee understands the current Australian vehicle emissions standards do not include a specific standard for carbon dioxide (CO₂) emissions.

6.31 The Committee understands that modelling undertaken for the Ministerial Forum on Vehicle Emissions estimated that phasing in an efficiency target for new light vehicles from 2020 of 105 grams of CO₂ per kilometre would deliver \$13.9 billion in net economic benefit out to 2040. Further, evidence to the Committee indicates that Australia's less stringent vehicle emissions standards may result in vehicle manufacturers not prioritising the Australian market for EVs. The Committee is therefore recommending that the Australian Government introduce more stringent vehicle emissions standards.

Recommendation 6

6.32 The Committee recommends that the Australian Government introduce more stringent vehicle emissions standards, and establish a new CO₂ standard, informed by those implemented in other developed countries and the findings of the Ministerial Forum on Vehicle Emissions.

Consumer education

6.33 Throughout the inquiry, the Committee heard that consumer concern about the driving range of EVs is hindering the uptake in Australia. The Committee understands that these concerns will be allayed with the introduction of newer EV models with greater range and the continuing roll out of charging infrastructure.

6.34 The Committee is of the view that, as part of the national strategy, the Australian Government should also undertake an education campaign to familiarise motorists with the capabilities and benefits of EVs.

Recommendation 7

6.35 The Committee recommends that any national strategy by the Australian Government should develop a consumer education campaign to raise awareness of the capabilities and benefits of EVs.

6.36 The Committee notes the establishment of the United Kingdom's EV Experience Centre and the EV Discovery Centre in Toronto, Canada. Such centres provide an excellent opportunity for consumers to experience, and become familiar with the benefits of, EVs. The Committee notes in particular the proposal by the Australian Industrial Transformation Institute, Flinders University, for a pilot EV experience centre, or 'Future Mobility Centre', at Tonsley in South Australia.

6.37 The Committee also support other means of increasing awareness and education of the public of EVs. In particular, the Committee supports a Formula E event being hosted in Australia. The Committee also notes the possible flow-on benefits that such an event would have in relation to the hosting of associated EV activities.

Recommendation 8

6.38 The Committee recommends that the Australian Government work with the state and territory governments to bring a Formula-E Championship race to Australia.

Developing an EV industry in Australia

6.39 One of the highlights of the Committee's inquiry was the opportunity to undertake site visits to companies involved in the manufacture of EVs and EV components. With the closure of manufacturing plants for ICE vehicles, the Committee believes that there are significant opportunities in the research and development, systems and manufacturing of EVs and EV components for Australian companies. In the Committee's view, this is an area where the Australian Government should be providing policy leadership through the development of an EV manufacturing roadmap.

Recommendation 9

6.40 The Committee recommends that the Australian Government develop and implement a comprehensive 10-year EV manufacturing roadmap, also covering research and development, vehicle and system design and manufacture batteries, telematics, supply chain and component manufacturing.

Procurement policy

6.41 Beyond the provision of grants, the Committee believes that the Australian Government can provide support to businesses in the EV industry through its procurement decisions and spending.

6.42 The Committee heard, for example, that public transport procurement has significant potential to support local EV manufacturing. 'Local benefits' or 'local content' provisions in government procurement policies would provide further support to local industry. On this point, the Committee notes the Commonwealth Procurement

Rules provide that, in considering value for money for procurements above \$4 million, Commonwealth officials are required to consider the economic benefit of the procurement to the Australian economy.

6.43 The Committee acknowledges the significant government fleet procurement, and particularly public transport fleet procurement, activity which occurs at local, state and territory government level, and recommends the Australian Government, coordinate federal, state and local government EV fleet and electric bus *and truck* procurement through the inter-governmental EV taskforce (Recommendation 2), informed by the national EV strategy (Recommendation 1) and EV manufacturing road map (Recommendation 9).

Recommendation 10

6.44 The Committee recommends the Australian Government coordinate federal, state and local government EV fleet, truck and electric bus procurement through the inter-governmental EV taskforce (Recommendation 2).

Research and training

6.45 EV manufacture, supply and value-chain activities present potentially significant areas of industry and economic benefit for Australia. Evidence to the Committee highlighted the breadth of research activity which is already being undertaken within Australia in relation to EV design and engineering. Further, the Committee heard that battery composition research; mining, refinement and processing of component minerals for batteries; and battery manufacture, are all promising areas for further research and development.

6.46 The Committee strongly supports increased research into these areas and recommends that the Australian Government provides grant funding accordingly.

6.47 The introduction of EVs into the Australian vehicle fleet will result in a fundamental change in the skills required for vehicle servicing and maintenance. To this end, the Committee supports the development of specific training qualifications for EV service technicians, as well as funding for apprenticeships and traineeships, to provide a workforce of technicians for EVs.

Recommendation 11

6.48 The Committee recommends that the Australian Government works with state and territory governments through the COAG Industry and Skills Council to establish national training arrangements for automotive service technicians in relation to electric vehicles.

Recommendation 12

6.49 The Committee recommends that the Australian Government, in conjunction with industry stakeholders, fund apprenticeships and traineeships in the local EV and associated manufacturing sector.

Regulatory reform***Charging and electricity infrastructure***

6.50 The Australian Government will have an important role in ensuring the electricity network is capable of managing the variable demands EVs will place on it. To this end, the Committee recommends that a 10-year plan be developed in consultation with Australian Energy Market Operator, Infrastructure Australia, business, industry, and other relevant stakeholders outlining electricity network infrastructure upgrades needed to manage the demand from an increasing EV fleet.

Recommendation 13

6.51 The Committee recommends that the Australian Government work closely with electricity market agencies, states and other relevant stakeholders to prepare a 10-year plan detailing priority electricity network infrastructure upgrades needed to manage demand from EVs.

6.52 In addition to a plan to ensure grid stability, the Committee is of the view that the impact of distributed energy resources, (DER) such as home solar photo-voltaic arrays and EV batteries, will need to be considered.

6.53 The Committee notes that the Australian Energy Market Operator (AEMO) is currently working on a DER register. In the Committee's view the work on the DER register needs to be completed as a matter of urgency.

6.54 In parallel with the DER register, the Committee is of the view that work needs to start immediately on mechanisms and strategies for AEMO to be able to access and direct DER to charge or discharge to meet operational requirements.

6.55 The Committee notes that AEMO is currently working on updating its Integrated System Plan (ISP). In the Committee's view, the ISP needs to take specific account of the need for the grid to support increased uptake of EVs.

Recommendation 14

6.56 The Committee recommends that the Australian Government work closely with the Australian Energy Market Operator (AEMO) to:

- **Expedite the establishment of a register of distributed energy resources (DER);**
- **Develop a strategy for AEMO to access and direct the DER to charge or provide electricity to the grid to meet operational requirements.**

Building codes

6.57 The Committee has heard that current tenancy laws and building codes impede the installation of home charging infrastructure, in particular for those who rent and those who live in apartments. The Committee is encouraged by international examples which have made it easier for apartment dwellers and renters to install EV charging equipment.

6.58 Many existing buildings in Australia do not have the electrical infrastructure to support the required demand for electricity expected from rising EV numbers. There exists an opportunity to future-proof new and renovated buildings for the expected increase in demand for home charging equipment by ensuring the electricity infrastructure is in place to support charger installation.

6.59 The Committee has heard specific evidence that in order to avoid over-engineering the electricity transmission system, changes to the electrical wiring requirements for new and renovated buildings should encourage installation of smart load management systems as a means of calibrating EV energy demands with supply.

Recommendation 15

6.60 The Committee recommends that the Australian Government work with state and territory governments, through COAG and the Building Ministers Forum, to explore necessary amendments to the National Construction Code to render all new dwellings 'electric vehicle charger ready'.

Recommendation 16

6.61 The Committee recommends that the Australian Government work with Standards Australia to amend AS/NZS3000:2018 *Electrical installations: Wiring Rules* to the following effect:

Where a smart load management system is not implemented, assume all the electric vehicle chargers will be running at full capacity all the time. Where a smart load management system is implemented, assume electric vehicle charging load will be effectively limited by the parameters of this system.

Standards

6.62 It is clear to the Committee that it is an opportune time to establish national standards in relation to various aspects of EVs in order to provide uniformity and certainty for motorists, vehicle manufactures and charging infrastructure providers. Some key standards identified to the Committee included: a national charging standard; a signage standard; safety standards, including minimum noise at low speeds and advanced driver assistance systems standards; and battery system standards.

Recommendation 17

6.63 The Committee recommends that the Australian Government work closely with Standards Australia to establish a series of national standards in relation to EVs.

6.64 The Committee notes evidence called for the gross vehicle weight (GVM) for passenger car licences to be increased from 4.5 to 5.5 tonnes. The Committee understands that this change would accommodate a reduction in payload due to the weight of batteries. While the Committee, in principle supports such an increase, the Committee is mindful that issues such as the towing weight allowable for EVs and licensing requirements would also need to be considered as part of any such amendment.

Senator Tim Storer
Chair

Chair's Additional Comments

Introduction

1.1 While I am pleased to have achieved a consensus report, I am disappointed that Senators from the Labor and Liberal parties were not prepared to go further, particularly with regards to measures that were fiscally balanced.

1.2 Throughout the course of this inquiry, the Committee was presented with strong evidence on the benefits to Australia of accelerating EV uptake. With the right leadership, Australia has an opportunity to capitalise on the global EV transformation. That would result in benefits to the economy, our environment, and public health.

1.3 Seizing this opportunity does not have to come at great cost. Measures like setting national EV purchasing targets will come at no cost to the Australian Government. While others, like investing in public charging infrastructure, can be offset by sensible policy reforms in related areas.

National targets

1.4 As the Committee found, targets can provide confidence to consumers and businesses and encourage vehicle manufacturers to make a broader range of EV models available. Setting specific targets for the light passenger, light commercial and metropolitan bus sectors would also bolster the business case for expanding domestic EV manufacturing and supply chain activities.

Recommendation 1

1.5 The Australian Government establish national targets for EVs to make up:

- **25 per cent of new light passenger motor vehicle sales by 2025;**
- **30 per cent of new light commercial vehicles sales by 2025; and**
- **20 per cent of new metropolitan bus sales by 2025.**

Fiscally balanced measures

1.6 Backed by modelling from the Parliamentary Budget Office, I presented the Committee with a fiscally balanced package of measures to support the transition to EVs in the short to medium term, while addressing longer term challenges posed by the emergence of EV technology, such as reductions in fuel excise revenue (summarised in Table 1). Further background on the measures detailed below can be found in Chapter 5 of the Committee Report.

Table 1

#	Measure	Fiscal impact (2018-19 to 2021-22)
I	Changes to the Luxury Car Tax from 2018-19 (narrowing definition of fuel efficient vehicles to 4L/100km, returning the standard vehicle rate to \$57,180, and indexing both to vehicle CPI).	\$1.54 billion
II	Introduction of Road User Charge on EVs from 2025-26, phased in over five years and levied at same rate as fuel excise.	\$0
<i>Subtotal</i>		<i>\$1.54 billion</i>
III	Exempting EVs from import tariffs from 2018-19 to 2025-26	-\$300 million
IV	Exempting EVs from fringe benefit tax from 2018-19 to 2025-26	-\$140 million
V	State/Territory EV registration/stamp duty reduction co-funding	-\$390 million
VI	Mandating 50% of all new Australian Government fleet leases be EVs by 2025-26	-\$5 million
VII	Highway and workplace charging infrastructure grant funding	-\$300 million
VIII	EV manufacturing grants scheme	-\$300 million
IX	EV research and development grants scheme	-\$100 million
<i>Subtotal</i>		<i>-\$1.535 billion</i>

I Luxury car tax

1.7 I recommend the Australian Government implement changes to the luxury car tax (LCT) as a means of improving the price competitiveness of EVs and funding measures to support EV uptake.

1.8 The structure of the LCT does provide fuel efficient vehicles with a lower tax burden (a higher tax threshold) than other vehicles. However, I note evidence that the differing indexing mechanisms for the two thresholds has meant that, over time, the price advantage for fuel efficient vehicles has been eroded.

1.9 While the Committee heard there is some support for exempting EVs from the LCT, I do not see this as an appropriate measure. Instead, I support modifying the LCT in three ways: narrowing the definition of 'fuel-efficient vehicles'; returning the taxation threshold for standard vehicles to its 2009-10 level; and indexing both rates to motor vehicle CPI.

1.10 Due to improving fuel efficiency, the number of vehicles which qualify as 'fuel efficient' vehicles for the purposes of the LCT has significantly increased since 2008. The definition of 'fuel-efficient vehicle' should be updated to take account of

fleet fuel efficiency improvements. Narrowing the definition to vehicles with fuel consumption not exceeding four litres per 100km, down from seven litres per 100km, would provide a greater price advantage to BEVs and PHEVs, which currently make up the vast majority of vehicles that use less than four litres per 100km.

1.11 The different mechanisms for indexing the LCT threshold for fuel-efficient vehicles and standard vehicles has resulted in the LCT threshold for standard vehicles increasing by \$9,151 over the previous 10 years, compared with an increase of \$526 for fuel-efficient vehicles (see Table 5.1 in Committee Report). This is despite the average price of vehicles having significantly reduced over the same period, as indicated by the decrease in the motor vehicle CPI expenditure class (down 12.2 per cent since 2008). As such, I see no policy rationale for having lifted the standard vehicle rate, and I support returning that rate to its 2009-10 level. I also support indexing these vehicle rates to motor vehicle CPI, so that any increase to the thresholds reflects increases in the average price of vehicles, rather than CPI in general.

1.12 Analysis provided by the Parliamentary Budget Office estimates that narrowing the definition of fuel efficient vehicles to four litres per 100km, lowering the standard vehicle rate to \$57 180 (as it was in 2009-10), and indexing both rates to motor vehicle expenditure class of CPI would generate \$1.54 billion in Government revenue out to 2021-22 and \$5.77 billion out to 2028-29.

Recommendation 2

1.13 The Australian Government narrow the definition of 'fuel efficient vehicles' to vehicles that do not use more than four litres of fuel per 100 kilometres, reduce the standard luxury car tax threshold to \$57 180, and freeze the index both rates to motor vehicle CPI.

II Road user charge

1.14 I note the historical decrease in fuel excise, and projected further erosion over time, and agree with the proposition that this revenue will need to be replaced. Reducing fuel excise could be partially offset by the introduction of a road user charging scheme specifically on EVs in Australia.

1.15 However, I am mindful that the imposition of road user charge on EVs may, given the current price disparity between EVs and ICE vehicles, serve as a disincentive to the purchase of EVs. To this end, I recommend phasing in a road user charge on EVs from 1 July 2025. According to modelling by the Parliamentary Budget Office, this would generate \$639 million in Government revenue out to 2028-29.

Recommendation 3

1.16 The Australian Government phase in a road user charge on EVs over a five year period (20 per cent per year) from 1 July 2025, levied at an equivalent rate to fuel excise, and calculated on a per kilometre travelled basis.

III Import tariffs

1.17 The evidence to the Committee is that the up-front price premium on EVs serves as a deterrent to motorists purchasing these vehicles. In order to reduce the upfront cost of EVs and address this price disparity, it would be appropriate to exempt EVs from import tariffs from 1 July 2019 to 30 June 2026 (after EV-ICE price parity is expected). Modelling from the Parliamentary Budget Office estimates this would decrease the Australian Government fiscal and underlying cash balances by \$300 million over the 2018-19 Budget forward estimates period.

Recommendation 4

1.18 The Australian Government exempt EVs from import tariffs from 1 July 2019 to 30 June 2026.

IV Fringe benefits tax

1.19 In order to further reduce the upfront cost of EVs, it would also be appropriate to exempt EVs from fringe benefits tax (FBT) from 1 July 2019 to 30 June 2026. Modelling from the Parliamentary Budget Office estimates this would decrease the Australian Government fiscal and underlying cash balances by \$140 million over the 2018-19 Budget forward estimates period.

1.20 A lack of clarity around the calculation of EV operating costs in FBT and salary sacrificing arrangements can put EVs at a disadvantage when compared to ICEs. I therefore recommend a review of the operation of the FBT to ensure that EVs are not unfairly disadvantaged when the exemption period ends.

Recommendation 5

1.21 The Australian Government exempt EVs from fringe benefit tax from 1 July 2019 to 30 June 2026, and review fringe benefits tax and salary sacrifice arrangements to ensure EVs are not unfairly disadvantaged compared to internal combustion engine vehicles.

V Registration and stamp duty

1.22 The ACT Government has already put in place a stamp-duty exemption for zero emissions vehicles and a significant reduction in registration fees. I recommend that the Australian Government allocate \$390 million in co-funding to help state and territory governments to temporarily reduce stamp duty and registration charges on all new and existing EVs.

Recommendation 6

1.23 The Australian Government allocate \$390 million in co-funding to help state and territory governments temporarily reduce motor vehicle registration and stamp duty for all new and existing EVs.

VI Government fleet target

1.24 A mandated target that EVs comprise 50 per cent of new purchases or leases for the Australian Government fleet by 2025 would underpin an increase to EV uptake in Australia. Analysis provided by the Parliamentary Budget Office estimates a target of 50 percent by 2025 would decrease the Australian Government fiscal and

underlying cash balances by \$5 million over the 2018-19 Budget forward estimates period, and \$39.5 million out to 2025-26.

Recommendation 7

1.25 The Australian Government establish mandated targets that 50 per cent of new Australian Government motor vehicle purchases/leases be EVs by 2025.

VII Public charging infrastructure

1.26 I recommend the Australian Government establish a \$300 million grant fund to support the rollout of highway and workplace EV charging infrastructure where it is not commercially viable without government support.

1.27 I note the range of business models emerging around the development of commercial EV networks, particularly in metropolitan areas, and recommend that the Clean Energy Finance Corporation (CEFC) establish a dedicated 'EV Charging Infrastructure Program' of \$300 million from its existing funding allocation to support the rollout of commercial EV charging infrastructure.

1.28 Given the roll out of public charging infrastructure in rural and regional areas may not be a commercially attractive option for private operators, the Australian Government should consider allocating additional funding to support rural and regional charging infrastructure.

Recommendation 8

1.29 The Australian Government establish a \$300 million grant fund to support the rollout of highway and workplace EV charging infrastructure where it is not commercially viable without government support, and a \$300 million EV Charging Infrastructure Program within the Clean Energy Finance Corporation to support the roll out of commercially viable EV charging infrastructure.

VIII Manufacturing

1.30 During the inquiry, it became clear that the current Automotive Transformation Scheme (ATS) is not designed to provide assistance to companies involved in the manufacture of EVs and EV components. However, rather than trying to adjust the requirements of the ATS to encompass the EV industry, a better approach would be to establish a specific grant scheme for domestic EV and EV component manufacturing. To this end, I recommend the Australian Government establish a \$300 million EV and EV component manufacturing grant scheme.

Recommendation 9

1.31 The Australian Government establish a \$300 million manufacturing grants scheme for domestic EV and EV component manufacturing.

IX Research and development

Recommendation 10

1.32 The Australian Government allocate \$100 million to an EV technology research and development grants scheme.

Regulatory reform

Importation of second hand EVs

1.33 As a further means to address the barrier that price forms to motorists purchasing an EV, and increasing the availability of EVs through the second-hand market, I support amending the Road Vehicle Standards Rules to facilitate the importation of second hand EVs.

Recommendation 11

1.34 The Road Vehicle Standards Rules be amended to allow all EVs to be considered eligible for independent importation, irrespective of whether a model has been previously sold by Original Equipment Manufacturers (OEM) in Australia, but only after the models cease being sold new in dealerships.

Vehicle dimension limits

Recommendation 12

1.35 The Australian Government work with the state and territory governments through the COAG Transport and Infrastructure Council to amend state and territory based light vehicle dimension limits to reflect the heavier weight (battery pack related) of light commercial EVs.

Consumer education

1.36 I note the establishment of the United Kingdom's EV Experience Centre and the EV Discovery Centre in Toronto, Canada. Such centres provide an excellent opportunity for consumers to experience, and become familiar with the benefits of, EVs. I support the proposal by the Australian Industrial Transformation Institute, Flinders University, for a pilot EV experience centre, or 'Future Mobility Centre', at Tonsley in South Australia.

Recommendation 13

1.37 The Australian Government work with Flinders University and automotive and energy industry partners to establish a pilot Future Mobility Centre (FMC) at Tonsley, South Australia.

Labor Senators' Additional Comments

1.1 The Committee Report has included discussion of the specific tax and expenditure proposals put in submissions but makes no recommendations on them. Some may accuse the Committee of a lack of ambition for not doing so, but, although the Committee advises on these issues in the report, it was not in a position to develop the comprehensive national strategy that is required. That is a task for the national government, engaging with industry and the wider community. This engagement will be fundamental to achieving a just and effective transition to new forms of automotive and other transport propulsion.

1.2 The Committee's report provides a comprehensive account of the evidence presented to it. That evidence demonstrates that the shift in the automotive industry and the broader transport system to new forms of propulsion is part of a global transition in which Australia has a role to play. The shift has the potential not only to reduce greenhouse gas emissions but also to create substantial economic benefits for the nation. There are opportunities for the Australian automotive industry in design, technology, components and systems, and new manufacturing opportunities in the processing of lithium and other mineral resources, batteries and hydrogen. It is a transition that will incorporate electric vehicles, hybrids, and hydrogen fuelled vehicles. It is not just about cars but includes buses, light commercial vehicles, trucks, long distance vehicles and rail. There may, for instance, be early gains in emission reduction and improving city amenity by converting our aging truck fleet to batteries or hydrogen.

1.3 The report recommends that the Commonwealth Government take the lead in developing a strategy for the introduction of electric vehicles. It urges the Government to do what is currently not being done. That is, to take a coordinated, integrated and national approach that will not only begin the transition to electric vehicles but also initiate a manufacturing strategy to realise the industry growth and job opportunities the transition can offer.

1.4 While the report rightly outlines a wide range of actions necessary for the transition there are some basics we have to get right; the safety and technical standards, for the vehicles themselves, buildings and in integrating these new vehicles and supporting charging infrastructure with planning for the grid. We have to ensure public and worker safety and build a skilled workforce.

1.5 It must be a just transition. An approach that merely subsidises the purchases of people who are already well off is unfair. Investment by Government should work to a national interest. Making significant commitments on funding subsidies for EVs without getting the foundations right may make a difference in the take up of EVs but will miss the bigger opportunities to drive smarter, sustainable change and support a just transition in such a change.

1.6 There are manufacturing and value adding opportunities for Australia in this transition. The Government could use own procurement to support it. Research and development will be fundamental. Government must be ready to work with the Australian automotive industry, whose skills and globally recognised expertise could

play a key role in building new growth opportunities. Sensible investment in industry capabilities in this area will build support for the transition.

1.7 System-wide, energy-related transitions are hard work. The strategy for the adoption and greater use of electric vehicles need to account for the driving and purchasing decisions of every day Australian families. There are competing technologies and systems in play, and even Tesla's Elon Musk has acknowledged – in announcing layoffs recently –how difficult it is to get an EV supplied at a mainstream price. There is no law of nature that can achieve price parity between EVs and internal-combustion-engine vehicles. If it is to be done, it will be done as a result of sustained scientific, engineering and technical effort by skilled white-and-blue-collar workers.

1.8 That is the challenge we must meet and overcome – and that is genuine ambition.

Senator Kim Carr
Deputy Chair

Senator David Smith

Australian Greens' Additional Comments

1.1 The Greens welcome the committee report. Chapters 1 to 5 provide a comprehensive outline of the committee's inquiry and Chapter 6 makes important recommendations for government.

1.2 The Greens particularly welcome Recommendation 1 calling for a national electric vehicle strategy. The lack of coordination and leadership by the Commonwealth Government has been one of the major roadblocks to increasing electric vehicle uptake, and we strongly support a clearer and more comprehensive role for the Commonwealth.

1.3 However it is unfortunate that the committee recommendations do not reflect much of the testimony heard by the inquiry about the speed and urgency required for action if Australia wants to play a meaningful role in the future of the electric vehicle industry.

1.4 The weight of evidence received by the committee made it clear that the electric vehicle revolution is already underway and it is only a matter of time before they are the dominant vehicle technology.¹ Australia has a choice as to whether to be an early mover, with all the economic and environmental benefits that go with it, or a laggard.

1.5 We believe the committee recommendations, while a step in the right direction, lack the necessary ambition to put Australia on the path to becoming an electric vehicle industrial powerhouse and reaping the many benefits of fast and significant uptake of EVs.

1.6 The Greens believe that Australia is at a crossroads. If government policy and programs only reflect the limited ambition and lack of certainty of the recommendations of the majority report, Australia is at great risk of missing out on the many benefits electric vehicles would otherwise bring. Australia needs to act now - the window of opportunity is closing.

1.7 The evidence presented to the committee was clear that without a strong and growing domestic electric vehicle market, electric vehicle assembly and component manufacturing will struggle to develop as a viable industry in Australia. Mr. Behyad Jafari from the Electric Vehicle Council said:

The first thing that we need to look at, if we want to be participants inside of this new industry, is we need to at least be in the middle of the pack.

But the first thing they need to look at is if you don't have a market there yourselves, or if you have a market that is so far behind the rest of the world, it makes it very hard for me to justify bringing my investment to

1 Bloomberg New Energy Finance, *Submission 127*; Australian Renewable Energy Agency, *Submission 99*.

Australia, even though some of that investment does also include exporting within our region and globally.²

1.8 That is why any plan for the development of an Australian electric vehicle industry must put in place strong incentives for both manufacturers and consumers to increase the number of electric vehicles sold per year.

1.9 Growing climate disruption and the ongoing public health crisis from fossil fuel combustion make this transition even more urgent. Transport greenhouse gas emissions make up nearly a fifth of all of Australia's annual carbon pollution, with road transport alone making up more than 15%. Furthermore, air pollution from vehicle emissions caused 1715 deaths in Australia in 2015 according to a study by the Clean Air and Urban Landscape Hub and the Melbourne Energy Institute.³

1.10 Evidence provided in the committee report demonstrated that ambitious targets in both the short and long-term are required, as a strong investment signal for business and as a guide for policymakers and planners at all levels of government about the timing and speed of the transformation. The electric vehicle transition will be disruptive for many existing business models, but with strong government leadership, including with the setting of targets, negative impacts can be minimised and positive impacts enhanced and shared equitably.

1.11 Many countries around the world are sending these signals by setting phase out dates for the sale of new internal combustion engine light vehicles, with some of the more ambitious countries including Norway (2025), the Netherlands, Sweden, Denmark and Ireland (2030).⁴

1.12 If Australia wishes to become a leader in the electric vehicle industry, the Commonwealth Government will at minimum need to commit to a similarly ambitious phase out timeline.

Recommendation 1

1.13 That the Commonwealth Government commit to a 100 per cent phase-in of passenger and light commercial electric vehicles by 2030.

1.14 Countries such as China and states like California in the USA have had large successes in driving electric vehicle uptake by setting mandatory electric vehicle fleet standards for new sales by the major automotive companies.⁵

1.15 By requiring a set percentage of annual sales for each manufacturer to be electric vehicles, many existing barriers to purchase such as price, dealership resistance and consumer awareness will be mitigated by the automotive companies themselves to ensure that they are able to meet their targets.

2 Mr. Behyad Jafari, Electric Vehicle Council, *Committee Hansard*, Friday, 17 August 2018 p. 20.

3 ClimateWorks, *Submission 46*.

4 Electric Vehicle Council, *Submission 100*.

5 100 Renewable Energy Research Group ANU, *Submission 108*.

1.16 While non-mandatory Government targets serve as a useful signal to industry and society, they are unlikely to be met without sufficient incentives and penalties in place.

Recommendation 2

1.17 That the Commonwealth Government set mandatory electric vehicle sales targets for each year between 2020 and 2030.

1.18 The revenue and expenditure options mapped out in the Chair's additional recommendations provide a useful suite of near-term actions that Governments can take to boost electric vehicle uptake. Although the Greens would go further in providing near-term price incentives for consumers, we strongly support the adoption of these measures by any current or future Governments.

1.19 The Greens however cannot support the Chair's additional Recommendation 3 in relation to imposing road pricing on electric vehicles beginning in 2025.

1.20 While the Greens acknowledge the impact of electric vehicle uptake on revenue from fuel excise, any road pricing regime needs to be very carefully examined to ensure that it is equitable, transparent and will work effectively. This cannot be done by treating electric vehicles in isolation.

1.21 The combined urgency and complexity of the shift to road pricing is exactly why the Government announced a study of road pricing to be led by an eminent Australian in November 2016, but that eminent Australian is yet to be chosen and the study has been reported as shelved.⁶

Recommendation 3

1.22 That the Government immediately begin work on its proposed road pricing study and that that study report before the end of 2019.

Senator Janet Rice
Australian Greens

6 Andrew Tillett, 'Deputy PM Michael McCormack shelves inquiry into road pricing', *Australian Financial Review*, 5 October 2018, available at: <https://www.afr.com/news/politics/deputy-pm-michael-mccormack-shelves-inquiry-into-road-pricing-20181004-h1688d>.

Additional Comments by Senator Rex Patrick

Australia's Electric Vehicle Policy: Battery Dead, Jump Start Required

The Work of the Committee

1.1 I thank the committee for the work it has done in relation to this inquiry. I also thank the secretariat for their background work in organising the committee activities and assisting in preparing the report.

1.2 The compiled facts and descriptions laid out in Chapters 1 through 5 of the Committee's report are comprehensive, solid and most useful.

1.3 However the recommendations, as they stand in Chapter 6, represent a lost opportunity to accelerate the uptake of electric vehicles (EVs) in Australia and to exploit opportunities for Australian industry in this growing worldwide market.

1.4 It is not as though the Government is being asked to back a technology that ultimately may fail by way of uptake. The car manufacturers themselves have backed the technology and are all moving to supply electric vehicles into a growing market. Other countries are setting solid targets in relation to EV take up. EVs are at the forefront of a major transformation of the world's transport sector. It's not a question of if, simply one of when.

1.5 That the Government and alternative Government were not prepared to endorse a report containing affirmative and, in many cases, costed policy approaches epitomises what is wrong about the two major political parties in this country; they lack vision and conviction when it matters most and are at best perfunctory in their approach to important national issues.

1.6 The Committee recommendations are shallow and weak. While I support them, they must be broadened and strengthened.

The Chair's Recommendations

1.7 The recommendations made by the Chair in his additional comments go a long way to broadening and strengthening the Committee's recommendations. To the extent that the Chair's recommendations are not inconsistent with my recommendations below, they should also be accepted.

Benefits of electric vehicles and opportunities for Australia

1.8 As noted in Chapter 3 of the report, there are considerable benefits associated with an increased uptake in EVs. These benefits include:

- GDP Improvements: If EVs made up 57 per cent of new car sales in 2030, there would be an increase in real GDP of \$2.9 billion, an increase in net employment of 13,400 jobs and additional investment in charging infrastructure of \$3.2 billion.

- **Productivity Improvement:** On account of EV's fuel economy and maintenance simplicity, there would be direct fuel savings of \$500 million and \$100 million in maintenance costs for each one million EVs in the national fleet.
- **Balance of Payment Advantages:** There is the potential for up to \$15 billion dollars per annum in fuel import replacement and benefit to the balance of payments, with \$8 billion dollars transferred to the local economy.
- **Fuel Security Advantages:** Against a backdrop of failed fuel security policy by successive governments, switching the national fleet to EVs would substantially reduce Australia's reliance on imported oil, reducing vulnerabilities to potential supply disruption and unexpected changes in demand from other customers in Asia.
- **Reduced Greenhouse Gas Emission:** Transport, in particular light vehicles, are the second largest source (19 per cent) of greenhouse gas emissions in Australia. A national uptake of EVs would greatly assist Australia in reaching, indeed exceeding, its Paris targets. Noting all the benefits of EVs, and the current Government total paralysis on actively dealing with electricity sector emissions, supporting the uptake of EVs should have been a policy 'no-brainer' for the Coalition fighting climate change deniers within the party.
- **Reduction in Air Pollutants:** The elimination of internal combustion engine (ICE) vehicle air pollutants such as carbon dioxide, nitrogen oxides and particulate matter from the air has significant public health advantages.

1.9 While there are some challenges that come with the switch from ICE vehicles to EVs, these are all surmountable if the recommendations of the Committee, coupled with the Chair's recommendations (in his additional comments), were accepted. However, even more can and should be done.

Manufacturing and Value Chain Activities

1.10 As identified in Chapter 4 of the Report, there is substantial opportunity for Australia, leveraging off the considerable ongoing and residual automotive industry skill and experience, to become involved in the manufacturing of EVs and EV components in-country.

1.11 Ambition in this area should extend to the manufacturing and assembly of complete EVs in addition to the continuing and transitioning the OEM and after-market design and manufacturing that resides in Australia.

1.12 One component area that deserves special attention (and was discussed in the report) is the potential for Australia to design, manufacture and export EV batteries.

1.13 Australia currently mines over 60 per cent of the world's lithium by value. We also have all of the other minerals necessary to progress further down the lithium ion battery value chain.

1.14 Australia has historically mined all kinds of minerals and shipped them offshore to subsequently be turned into product for importing back here as much more expensive product. In doing so it has sold itself out and distorted our balance of trade.

1.15 With large lithium reserves that have captured 60 per cent of a world market hungry for lithium batteries, Australia has a chance to change its mining modus

operandi to great national benefit. With a plan and national will, Australia could become an international lithium battery power house – not just for EVs, but for batteries needed in consumer electronics, power tools, robots, drones and home power banks.

1.16 There are five stages of processing in the production of lithium batteries; mining and concentrating (world market total in 2025 is projected to be US\$12 billion), refining and processing (US\$41 billion), electro chemical processing (US\$297 billion), cell production (US\$424 billion) and battery assembly (US\$1.3 trillion). We don't want to just dig and export; that's not where the money, or jobs, lie.

1.17 A well-considered whole of government approach to the industry could see Australia engaging in all five stages with significant benefits to the Australian economy. Mining and concentrating is in hand. We are currently transitioning into second stage 'refine and process' through Tianqi's recent investment at Kwinana in WA.

1.18 In relation to the latter stages of processing, Australia has many of the reagents and input materials for the second and third processing stages and, finally, there are already early stage proposals to develop cell production facilities in Townsville and Darwin and the SA Government has recently supported a battery manufacturing plant in Adelaide as part of its Home Solar Panel Battery Scheme. A national lithium battery endeavour could be supercharged through the production of EV batteries in Australia.

1.19 Clearly support for manufacturing of EVs and components, including and especially batteries, must come from Government. Fortunately there is already money allocated by statute for assisting Australia's automotive industry in the form of an Automotive Transformation Scheme (ATS). In the wake of the Abbott Government's foolish decision to shut down the ICE automotive industry in Australia, that money has not been fully spent.

1.20 Analysis undertaken by the Parliamentary Budget Office for former Senator Nick Xenophon in 2016 outlined the capped component of ATS funding allocated to the program, funding that has been spent, estimated future spending and amounts of underspend.

1.21 This analysis shows that the ATS underspend will be approximately \$740 million.

1.22 This significant amount of money could and should be utilised for EV manufacturing and value chain support. Such a decision would very obviously be in Australia's national interest.

Recommendation 1

The Government should utilise the approximate \$740 million of underspent and forecast underspend funding in the ATS to jump start EV manufacturing and value chain support activities.

Proper EV Targets

1.23 As noted in the Committee report, worldwide, in 2017, there has been a 57 per cent increase of new EV sales from the previous year to 3.1 million electric passenger cars sold. More than half of global sales of EVs were in China, where electric cars hold a market share of 2.2 per cent.

1.24 The data from Australia is sobering and demonstrates that substantially more needs to be done to accelerate the uptake of EVs. Recent annual sales figures show that, of over a million cars purchased in 2017, only a measly 2300 were battery-electric vehicles or plug-in electric vehicles – about 0.2 per cent market share.

1.25 Australia's position is in stark contrast to other countries. While Australia has geographical challenges not faced by many European countries, the uptake of EVs through targets and the eventual prohibition of the sale of new ICEs is a challenge that should be met with tenacity and decisiveness; not put in the too hard basket.

1.26 China, Germany and the USA are just three of the many countries that have targets for the uptake of EVs.

1.27 There are also more than a dozen countries (including China, Germany and the US) that have announced they will ban the sale of new ICE vehicles. Further, the Volkswagen Group has announced that its next generation of ICEs, due in 2026, would be its last.

1.28 It's clear the world and manufacturers are transitioning. This transition must be embraced by current and future Australian governments.

1.29 The most significant policy decision the Government could pursue is prohibiting the import and sale of new vehicles with ICEs. While a prohibition appears to be a dramatic position to take, it has some key advantages.

1.30 Prohibiting the import and sale of new vehicles with ICEs sends a clear message that Australia recognises that the world is in transition and is embracing a future where EVs are commonplace. A prohibition of ICEs, rather than setting targets for the uptake of EVs, is the most effective way of addressing the risks and challenges associated with the transition to EVs.

Recommendation 2

The Government should legislate to prohibit the sale and import of new internal combustion engines in motor vehicles by 2035.

Luddite Policies Must be Overcome

1.31 The Government must abandon its Luddite approach to Australia's inevitable transition from ICE Vehicles to EVs. The Government must accept and implement the Committee's, the Chair's and my recommendations as a matter of urgency.

Appendix 1

Submissions and additional information received by the committee

Submissions

- 1 The Australia Institute
- 1.1 Supplementary submission
- 2 Uniti Australia Pty Ltd
- 3 Dr Liz Hanna
- 4 ACE-EV Group
- 5 Australian Industrial Transformation Institute, Flinders University
- 6 Australian Electric Vehicle Association - ACT Branch
- 7 Australian Productivity Council
- 8 Australian Electric Vehicle Association
- 9 Australian Electric Vehicle Association - Victorian Branch
- 10 Mr Brian Woods
- 11 Ms Susan Czermak
- 12 Ms Camille Velnaar
- 13 Mr Phil Browne
- 14 Mr Jayson Stanley
- 15 Ms Gail Broadbent
- 16 Name Withheld
- 17 Pilbara Metals Group
- 18 La Trobe University
- 19 ANCAP Safety
- 20 Association of Mining And Exploration Companies Inc
- 21 350 Canberra
- 22 Mr David Lloyd
- 23 Professor Peter Newman
- 24 SEA Electric
- 25 Mr Les Johnston

- 26 VACC
- 27 Mr Nigel Morris
- 28 Tesla Owners Club of Australia Inc
- 29 Australian Electric Vehicle Association - Tasmanian branch
- 30 Ms Sally Perini
- 31 Clean Energy Finance Corporation
- 32 Mr Anthony Larkins
- 33 Public Health Association of Australia
- 34 Mr Peter Horan
- 35 Deakin University
- 36 Dr Michael Wadsley
- 37 Australian Automotive Aftermarket Association (AAAA)
- 38 Australian Energy Market Operator
- 39 Origin
- 40 Nissan Motor Co.
- 41 Motoring Trades Association Queensland
- 42 Woodside Energy
- 43 Queensland Department of Transport and Main Roads
- 44 Name Withheld
- 45 Public Transport Users Association
- 46 ClimateWorks
- 47 The Sustainable Engineering Society
- 48 ACT Government
- 49 The University of Queensland
- 50 Doctors for the Environment
- 51 Darebin City Council
- 52 Hobsons Bay Council
- 53 SMR Automotive Australia Pty Limited
- 54 Australian Automotive Dealer Association
- 55 AGL Energy
- 56 Bicycle Institute of S.A
- 57 Australian Imported Motor Vehicle Industry Association
- 58 Tritium

59	St Baker Energy Innovation Fund
60	Energy Networks Australia
61	Resonant Solutions
62	Mitsubishi Motors Australia
63	Centre for Air pollution, energy and health Research (CAR)
64	Fast Cities Australia
65	CEEM UNSW
66	Mr Scott Gow
67	ISUZU Australia
68	Bus Industry Confederation
69	Australian Electric Vehicle Association - South Australian Branch
70	Volvo Bus Corporation
71	Mr Matt Mushalik
72	Department of the Environment and Energy
73	Hydrogen Mobility Australia
74	ITM Power
75	Australian Gas Infrastructure Group
76	Mr William Goode
	76.1 Supplementary submission
	76.2 Supplementary submission
77	Toyota Australia
78	NRMA
79	Infrastructure Australia
80	Name Withheld
81	Mr Erwin Boermans
82	Air Liquide
83	Queensland Conservation Council
84	Sage Automation
85	GELCOservices
86	Name Withheld
87	Climate Council
88	Infrastructure Victoria
89	Viva Energy Australia

- 90 TransGrid
- 91 University of Adelaide
- 92 Tesla
- 93 City of Adelaide
- 94 Associate Professor Donna Green
- 95 NHP Electrical Engineering Products
- 96 JOLT
- 97 Evenergi
- 98 AusNet Services
- 99 Australian Renewable Energy Agency (ARENA)
- 100 Electric Vehicle Council
- 101 Dr James Prest, College of Law, Australian National University
- 102 Environment Victoria
- 103 Hyundai Motor Company Australia
- 104 Australian Logistics Council
- 105 Jemena
- 106 Sassafras Group
- 107 Australian Council of Trade Unions (ACTU)
- 108 100% Renewable Energy Research Group ANU
- 109 East Gippsland Shire Council
- 110 Electrical Trades Union (ETU)
- 111 Department of Infrastructure, Regional Development and Cities
- 112 Department of Industry, Innovation and Science
- 113 Transport for NSW
- 114 Royal Automobile Club of Victoria
- 115 Municipal Association of Victoria (MAV)
- 116 Australian Manufacturing Workers Union (AMWU)
- 117 Royal Automobile Club of WA
- 118 Nichibo Australia Pty Ltd
- 119 Federal Chamber of Automotive Industries
- 120 e-Motion Concepts
- 121 Infrastructure Partnerships Australia
- 122 Dr Tom Denigan

123	Mr Harald Murphy
124	iMove
125	Swinburne University of Technology
126	Grattan Institute
127	Bloomberg NEF
128	Dr Jacek Jasieniak and Prof. Mainak Majumder, Monash Energy Materials and Systems Institute (MEMSI), Monash University
129	Victorian Department of Environment, Land, Water and Planning
130	South Australian Government
131	Energy Renaissance

Tabled Documents

1. Additional information tabled by Mr Andrew Dillon, CEO, Energy Networks Australia, received at public hearing, Melbourne, Friday 31 August 2018

Additional Information

1. Clarification of evidence provided by Ms Jo Evans, Department of the Environment and Energy at the committee's public hearing in Canberra on 17 August 2018 (received 7 September 2018)
2. Clarification of evidence provided by Mr Alex Foulds, A/g Deputy Secretary Department of Infrastructure, Regional Development and Cities at the committee's public hearing in Canberra on 17 August 2018 (received 14 September 2018)
3. Nichibo Australia response to comments made by Tony Webber, Chief Executive, Federal Chamber of Automotive Industries
4. Correspondence from Mr Ron Hooten, Chief Executive Officer, Vision Australia (received 4 December 2018)
5. Clarification of evidence provided by Ms Pip Spence, Deputy Secretary, Department of Infrastructure at the committee's public hearing in Canberra on 17 August 2018 (received 22 October 2018)
6. Correspondence from Dr Heather Smith, Department of Industry, Innovation and Science (received 9 November 2018)
7. Correspondence from Ms Jo Evans, Department of the Environment and Energy (received 5 November 2018)

8. Correspondence from Mr Alex Foulds, A/g Deputy Secretary Department of Department of Infrastructure, Regional Development and Cities (received 22 November 2018)
9. Request by Chair to the Australian Taxation Office for further information on fuel efficient vehicles for purposes of luxury car tax (received 30 January 2019)
10. Information provided by the Parliamentary Library on vehicles in Australia using 7L per 100kms or less of fuel
11. Australian Government Fleet Statistics to 1 July 2018, provided by the Department of Finance
12. Correspondence from Chair of the Committee to the Secretary of the Department of Infrastructure, Regional Development and Cities, dated 30 January 2019
13. Revenue implications of setting mandatory Government fleet electric vehicle purchasing targets, Parliamentary Budget Office, 11 January 2019

Answers to Questions taken on Notice

1. Public Health Association Australia - answers to questions on notice from public hearing in Canberra on 17 August 2018 (received 5 September 2018)
2. Mitsubishi Motors Australia - answers to questions on notice from public hearing in Adelaide on 10 August 2018, (received 11 September 2018)
3. Hydrogen Mobility Australia - answers to questions on notice from public hearing in Adelaide on 10 August 2018 (received 11 September 2018)
4. Bloomberg NEF - answers to questions on notice from public hearing in Melbourne on 31 August 2018 (received 11 September 2018)
5. Tesla - answers to questions on notice from public hearing in Adelaide on 10 August 2018 (received 14 September 2018)
6. ARENA - answers to questions on notice from public hearing in Canberra on 17 August 2018 (received 21 September 2018)
7. NRMA - answers to questions on notice from public hearing in Canberra on 17 August 2018 (received 21 September 2018)
8. Climateworks - answers to questions on notice from public hearing in Canberra on 17 August 2018 (received 21 September 2018)
9. Department of Industry Innovation and Science - answers to questions on notice from public hearing in Canberra on 17 August 2018 (received 21 September 2018)
10. Clean Energy Finance Corporation - answers to questions on notice from public hearing in Canberra on 17 August 2018 (received 24 September 2018)
11. Department of Infrastructure, Regional Development and Cities - answers to questions on notice from public hearing in Canberra on 17 August 2018 (received 25 September 2018)

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12. Department of the Environment and Energy - answers to questions on notice from public hearing in Canberra on 17 August 2018 (received 25 September 2018)
 13. Australian Council of Trade - answers to questions on notice from public hearing in Melbourne on 31 August 2018 (received 27 September 2018)
 14. Australian Energy Market Operator - answers to questions taken on notice from public hearing in Melbourne on 31 August 2018 (received 27 September 2018)
 15. Australian Logistics Council - answers to questions taken on notice from public hearing in Melbourne on 31 August 2018 (received 28 September 2018)
 16. Dr Liz Hanna - answer to question on notice from public hearing in Canberra on 17 August 2018 (received 27 August 2018)
 17. Toyota - answer to written question on notice from Senator Storer (received 4 October 2018)
 18. MTAQ - answers to questions taken on notice from public hearing in Brisbane on 27 September 2018 (received 19 October 2018)
 19. Department of Transport and Main Roads Queensland - answers to questions taken on notice from public hearing in Brisbane on 27 September 2018 (received 19 October 2018)
 20. Fast Cities - answers to questions taken on notice from public hearing in Brisbane on 27 September 2018 (received 19 October 2018)
 21. Infrastructure Australia - answers to questions taken on notice from public hearing in Canberra on 18 October 2018 (received 14 November 2018)
 22. Mitsubishi Motors Australia - answer to written question on notice from Senator Storer (received on 21 November 2018)
 23. Australian Electric Vehicle Association - answer to question on notice from public hearing in Brisbane on 27 September 2018 (received 22 November 2018)
 24. Energy Efficiency and Conservation Authority (EECA) - answer to question on notice (received 30 November 2018)
 25. Department of Infrastructure, Regional Development and Cities - answer to written question on notice (received 17 December 2018)

Appendix 2

Public Hearings

Friday, 10 August 2018
Mitsubishi Administration Building
Tonsley, SA

Witnesses

Mitsubishi Motors Australia

Mr Karl Gehling, Head of Corporate Communications & Government Relations

Mr Craig Norris, National PHEV Sales Manager, Fleet

Tesla

Mr Samuel Mclean, Senior Manager

EasyMile

Mr Simon Pearce, Head of Asia-Pacific

SAGE Automation

Mr Adrian Fahey, Chief Executive Officer

Mr Damian Hewitt, National Manager, Transport

Aurrigo Ltd

Mr Roger Van der Lee, Director, Autonomous Programs

Fusion Capital

Mr Christian Reynolds, Director, and Director, Precision Buses

Hydrogen Mobility Australia

Ms Claire Johnson, Chief Executive Officer

Australian Imported Motor Vehicle Industry Association

Mr Kristian Appelt, Vice-President

University of Adelaide

Associate Professor Jeremy Woolley, Director, Centre for Automotive Safety Research

Associate Professor Nesimi Ertugrul, School of Electrical and Electronic Engineering

Flinders University

Professor John Spoehr, Director, Australian Industrial Transformation Institute

Professor Rocco Zito, Head of Civil Engineering, College of Science and Engineering,

City of Adelaide

Ms Michelle English, Associate Director, Sustainability

Uniti Sweden AB

Dr Michael Molitor, Chairman

GELCOservices

Mr Philip Gell, Technical Director

Friday, 17 August 2018

Committee Room 2S1, Parliament House

Canberra, ACT

Witnesses

ACT Government

Mr Shane Rattenbury MLA, Minister for Climate Change and Sustainability

Mr Geoffrey Rutledge, Deputy Director-General, ACT Government – Environment,
Planning and Sustainable Development Directorate

Australian National University

Dr Matthew Stocks, 100% Renewable Energy Research Group

Dr James Prest, College of Law

Electric Vehicle Council

Mr Behyad Jafari, Chief Executive Officer

Association of Mining and Exploration Companies

Mr Warren Pearce, Chief Executive Officer

Mr Neil van Drunen, Policy Manager

NRMA

Mr Tim Trumper, Chairman

Mr Robert Giltinan, Senior Policy and Public Affairs Advisor

Dr Liz Hanna**Public Health Association of Australia**

Dr Ingrid Johnston, Senior Policy Officer

Centre for Air Pollution, Energy and Health Research

Professor Guy Marks, Principal Investigator

CSIRO

Dr Keith McLean, Director, Manufacturing

Dr Howard Lovatt, Team Leader – Electrical Machines

Dr David Harris, Research Director: Low Emissions Technologies, CSIRO Energy

Australian Renewable Energy Agency

Mr Ivor Frischknecht

Mr Peter Haenke, Manager, Energy Productivity

Clean Energy Finance Corporation

Mr Tim Jordan, Director – Investment Research

Mr Paul Dowling, Associate Director – Investment Research

ClimateWorks

Ms Sarah Fumei, Project Manager

The Australia Institute

Mr David Richardson, Senior Research Fellow

Mr Dan Cass, Strategist

Department of the Environment and Energy

Ms Jo Evans, Deputy Secretary, Climate Change and Energy Innovation

Department of Industry, Innovation and Science

Mr Trevor Power, Head of Division, Industry Growth

Dr Gary Richards, General Manager, Advanced Technologies

Ms Annie Ryan, General Manager, DIIS Grants Administration

Department of Infrastructure, Regional Development and Cities

Mr Alex Foulds, A/g Deputy Secretary Department of Infrastructure,
Regional Development and Cities

Ms Stephanie Werner, General Manager, Land Transport Policy and Safety Branch

Friday, 31 August 2018

*Edinburgh Room, Stamford Plaza
Melbourne, Vic*

Witnesses

SEA Electric

Mr Tony Fairweather

Bloomberg New Energy Finance

Mr Ali Asghar, Senior Associate – Power Energy storage and Electric vehicles

Grattan Institute

Mr Tony Wood, Director - Energy Program

Mr Guy Dundas, Energy Fellow

Australian Logistics Council

Mr Simon Morgan, Director, Communications & Government

Linfox Logistics

Mr Andrew Porter, Government Relations

DHL Australia

Olivera Goodwin - Head of Sustainability

Infrastructure Partnerships Australia

Mr Adrian Dwyer, Chief Executive Office

iMove

Mr Ian Christensen, Managing Director

Deakin University

Associate Professor Patrick Howlett, ARC Centre of Excellence for Electromaterials Science (ACES)

Monash University

Dr Jacek Jasinek, Associate Professor and Director

Professor Mainak Majumder, Professor, Department of Mechanical and Aerospace Engineering

Swinburne University of Technology

Professor Baohua Jia, Research Leader

Australian Council of Trade Unions

Mr Christopher Watts, Social Policy Adviser

Mr Lance McCallum, National Campaign Coordinator

Professionals Australia

Mr Anthony Larkin, Member

Australian Manufacturing Workers Union

Mr David Smith, National Vehicle Division Secretary

Electrical Trades Union

Mr Matthew Murphy, National Industry Coordinator

Everengi

Mr Daniel Hilson, Chief Executive

Toyota

Mr Bernard Nadal, Senior Manager – Product Planning & Pricing

Mr Jonathan Lathleiff, Senior Manager – Corporate & External Affairs

GMH

Mr Brett Vivian, Executive Director Engineering

Mr Scott Heywood, Lead Engineering Manager Future Product

Mr David Magill, Director - Government Relations and Public Policy

Nissan

Mr Wayne Harris, Head of Electrification and Future Mobility

Australian Energy Market Operator

Ms Violette Mouchaileh, Group Manager, Market Enhancement

Victorian Automobile Chamber of Commerce (VACC)

Mr Steve Bletsos, Senior Research Analyst

Mr John Khoury, Industry Policy Adviser

AGL Energy

Associate Professor Timothy Nelson, Chief Economist

Energy Networks Australia

Mr Andrew Dillon, Chief Executive Officer

Thursday, 27 September 2018

*Waldorf McLeod Room, Novotel Brisbane Airport
Brisbane, Vic*

Witnesses**Tritium**

Mr Paul Sernia, Co-Founder

Mr Nathan Dunlop, Sales & New Market Analyst

JET Charge and Chargefox

Mr Tim Washington, Director

Energy Renaissance

Mr Brian Craighead, Director

Australian Electric Vehicle Association

Mr Greg Partridge, President

St Baker Energy Innovation Fund

Mr Rodger Whitby, Chief Executive Officer

Fast Cities Australia

Mr Paul Fox, Head of Corporate Development

Queensland Department of Transport and Main Roads

Ms Sally Noonan, Chief Economist

MTA Qld

Dr Brett Dale, Group Chief Executive

Australian Automotive Dealer Association

Mr James Voortman, Executive Director, Policy and Communication

ACE-EV

Mr Gregory McGarvie, Managing Director

Mr Will Qiang, Director International Business

Appendix 3

Summary of committee site visits

This appendix contains summaries of the committee's site visits to Precision Buses (Edinburgh, South Australia); Nissan Casting Plant and SEA Electric (Dandenong, Victoria); and Tritium (Murrarie, Queensland).

Site visit to Precision Buses workshop, Edinburgh (South Australia)

Thursday 9 August 2018

Introduction

A sub-committee conducted a site visit to the Precision Buses workshop at Edinburgh (South Australia) on Thursday 9 August 2018. The workshop is located in an industrial region of Adelaide that used to host the Elizabeth motor vehicle manufacturing plant for General Motors Holden.

Senator Tim Storer (Chair) and Senator David Smith participated in the site visit.

Precision Buses

The subcommittee were welcomed to Precision Buses by its directors, Mr Christian Reynolds and Mr Dan Marks; and the director of an associated business, Precision Components, Mr Mat Finch.

The committee were taken on a tour of the workshop which was described as a mobility and advanced engineering hub. Mr Reynolds explained that the hub would encourage collaboration between different companies (with different skillsets and products) that would foster a culture of innovation.

Photo 1: Electric buses being manufactured at Precision Buses, Edinburgh (SA)



Precision Buses employs 75 employees completing two electric or low-emissions buses per week. Buses take about eight weeks to assemble from start to finish. Currently, Precision Buses import and assemble the buses, but are looking at opportunities to bring more of the manufacturing process in-house and to business partners here in Australia.

The sub-committee was provided with a demonstration drive in a fully-electric bus.

Photo 2: Senator Storer and Senator David Smith inspecting a fully-electric bus prior to the demonstration



The visit concluded with a presentation on future opportunities for the company and the sector more broadly. The subcommittee was told that Precision Buses saw manufacturing electric buses as the first part of journey to a re-imagined public transport system. Precision Buses view automation, changed seating arrangements, using buses as work stations as just some of the changes that could drive increased productivity and enjoyment from commuting time.

On behalf of the committee, the Chair thanked Precision Buses for hosting and speaking with the subcommittee.

Site visit to Nissan Casting Plant, Dandenong (Victoria)

Thursday 30 August 2018

The committee visited the Nissan Casting Australia Plant (NCAP) in Dandenong on Thursday 30 August 2018. Senator Storer (Chair), Senator Carr (Deputy Chair), Senator Rice, Senator David Smith and Senator Patrick participated in the site visit.

The committee were welcomed by Mr Marcus Spindler (General Manager, NCAP), Mr Stephen Hope (Chief Financial Officer, Nissan Motor Co. Australia (Nissan)), Mr Balaji Narayana (Operations and Engineering Manager, Nissan), Mr Wayne Harris (Head of Electrification and Future Mobility, Nissan), Mr Angus Robinson (Manager, OHE and Quality, Nissan), Mr Brian Cooper (New Projects Manager, NCAP), and Ms Karla Leach (General Manager, Corporate Communications, Nissan).

The visit commenced with brief introductions and a short presentation about NCAP.

The committee was told that NCAP is a high pressure die casting facility manufacturing over 40 cast aluminium parts for a range of Nissan vehicles—both internal combustion vehicles and electric vehicles. The plant has the capacity to cast 10 000 tonnes/annum of aluminium parts and employs 196 full time equivalents. The 13 die-cast machines have a rated capacity ranging from 800 tonnes to 2 500 tonnes. The facility also uses integrated robot fettling and laser marking to finish the casts. The casting process is then followed by a quality assurance program that ranks the NCAP facility as one of the highest performing of Nissan's worldwide plants with respect to minimising part failures.

Photo 3: Completed die cast vehicle components ready for dispatch at NCAP



The committee was told that the low rates of failure are recognised by Nissan's head office as this a critical attribute for electric vehicle componentry. Currently, NCAP is operating at its capacity and is looking at ways to increase its production.

Photo 4: Examples of completed die-cast components

NCAP spoke about the high level of integration that NCAP has with a large number of local suppliers in the Dandenong area.

The committee was told that the most significant factors for the future of NCAP were cost-competitiveness and quality. Energy costs were also cited as one of the most challenging attributes in maintaining the cost-competitiveness and profitability of the facility.

The committee was taken on a tour of the plant. At the conclusion of the tour, committee members thanked NCAP and Nissan for hosting and speaking with the committee.

Photo 5: Committee members and NCAP employees at the conclusion of the site visit



Site visit to SEA Electric, Dandenong (Victoria)

Thursday 30 August 2018

The committee travelled to SEA Electric at the conclusion of its visit to NCAP. Senator Storer (Chair), Senator Carr (Deputy Chair), Senator Rice, Senator David Smith and Senator Patrick participated in the site visit.

The committee was welcomed to SEA Electric by Mr Tony Fairweather (Chief Executive Officer) and Mr Simon Humphries (Chief Engineer, Isuzu Australia). The visit commenced with brief introductions and a short presentation.

The committee was told that SEA Electric currently fits a range of commercial delivery vehicles with electric powertrains and batteries (moving to simply fitting electric powertrain and batteries to gliders).¹ These vehicles would be used for delivering groceries, freight, concrete and collecting rubbish. These vehicles typically have a daily driving range of up to 300 kilometres and a regular dwell-time to facilitate battery charging. SEA claimed that purchase and conversion of these new vehicles are economical in these vehicle classes with a payback of less than four years.

1 A glider is a vehicle without a powertrain.

Photo 6: A number of gliders being fitted with EV powertrains and batteries in the SEA Electric workshop



Once the conversions are complete, the committee was told that each vehicle must undergo a vehicle certification consistent with the Australian Design Rules including noise and instrumentation assessments, but not crash testing.

The committee was told that some of the components being used such as the cooling packs were designed in Australia.

SEA Electric noted that some of the conversion work was originating from New Zealand. These conversions were funded through the New Zealand Government Energy and Efficiency and Conservation Authority's Low Emission Vehicles Contestable Fund.²

Mr Fairweather stated that there was an opportunity for companies such as SEA to retrofit as larger original equipment manufacturers were not able to dynamically compete with companies like SEA Electric due to a combination of long lead times for vehicle development and rapid changes in battery, powertrain and integrator software technology.

One of the challenges in converting internal combustion vehicles is that EVs are generally heavier due to the weight of batteries. Typically, the smaller of the vehicles

2 <https://www.eeca.govt.nz/funding-and-support/low-emission-vehicles-contestable-fund/>

converted are a nominally 4.5 tonne Gross Vehicle Mass (GVM), which can be driven by a person with a regular car licence. However, once these vehicles are converted to an EV, the vehicles can exceed the 4.5 tonne GVM and require a driver to hold a specialist licence class.

The committee was taken on a tour of the workshop and was taken on a test-drive in one of the converted vehicles. At the conclusion of the tour, committee members thanked SEA Electric for hosting and speaking with the committee.

Site visit to Tritium, Murrarie (Queensland)

Thursday 27 September 2018

Prior to the committee's Brisbane public hearing on Thursday 27 September 2018, the committee conducted a site visit to the Tritium manufacturing workshop at Murrarie in Brisbane's eastern suburbs. Senator Storer (Chair), Senator Carr (Deputy Chair), Senator Bushby, Senator Rice, Senator David Smith and Senator Patrick participated in the site visit.

The committee was welcomed to Tritium by Mr Paul Sernia (Co-Founder and Chief Product Officer), Mr David Toomey (Head of Corporate Development) and Mr Nathan Dunlop (Sales and New Market Analyst). Mr Toomey and Mr Sernia provided the committee with a brief overview of the company which manufactures public chargers and the broader sector.

Photo 7: Committee members and tritium employees in front of some of the EV chargers manufactured by Tritium



Mr Sernia informed the committee that Tritium was founded about 20 years ago and started out building components for EVs. In more recent years, it has moved to manufacturing public charging infrastructure that is largely being rolled out in mature European EV markets such as Norway. The company has increased its workforce from 58 employees (2016) to 254 (2018) with the vast majority of these employees in Australia (229). Tritium also has offices in the United States (15 employees) and the

European Union (10). A little over half of the employees are involved in manufacturing (98) with a slightly smaller number conducting research and development.

The committee were told that Tritium's ethos is clean, healthy and convenient cities with a focus on providing energy freedom. Tritium has a specific emphasis on transportation and energy storage solutions associated with using EVs. The company manufactures three different models which range from slow charging to fast (and why the prices varied accordingly). Mr Sernia said that work is being undertaken on ultra-fast chargers to bring charging time down from 20 minutes to a 5–10 minute charge time.

Mr Sernia described some of the unique characteristics of Tritium's charging equipment including that it is compact enough to fit into smaller spaces such as narrow pathways. Mr Toomey stated that the charger's compact design is aided by a liquid cooled design which is different to the air-cooled models developed by a number of competitors. Intellectual property generation is an important aspect of the business (about half of Tritium's engineers are software engineers). Tritium meets regularly with EV manufacturers to ensure that Tritium's technology is able to 'talk' or communicate to many different types of EVs.

Photo 8: The workshop floor at Tritium



The committee discussed a range of opportunities and challenges related to EVs and public charging infrastructure before taking a tour of the workshop. Committee members thanked Tritium for hosting and speaking with the committee.

