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Legislative Council
Economy and Infrastructure Committee

Inquiry into electric vehicles

Parliament of Victoria
Economy and Infrastructure Committee

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Committee functions

The Economy and Infrastructure Standing Committee is established under the Legislative Council Standing Orders Chapter 23 — Council Committees and Sessional Orders.

The committee's functions are to inquire into and report on any proposal, matter or thing concerned with agriculture, commerce, infrastructure, industry, major projects, public sector finances, transport and education.

The Economy and Infrastructure Committee (References) may inquire into, hold public hearings, consider and report on other matters that are relevant to its functions.

The Economy and Infrastructure Committee (Legislation) may inquire into, hold public hearings, consider and report on any Bills or draft Bills referred by the Legislative Council, annual reports, estimates of expenditure or other documents laid before the Legislative Council in accordance with an Act, provided these are relevant to its functions.

Government Departments allocated for oversight:

- Department of Economic Development, Jobs, Transport and Resources
- Department of Education and Training
- Department of Treasury and Finance.

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This report is available on the Committee's website.

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Terms of reference

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On 8 February 2017, the Legislative Council agreed to the following motion:

That pursuant to Sessional Order 6 this House requires the Economy and Infrastructure Committee to inquire into, consider and report, no later than 14 December 2017, on —

(1) the potential benefits of widespread uptake of electric vehicles in Victoria to the environment, including greenhouse gas emissions, air quality, noise and amenity, whereby electric vehicles are defined as vehicles that both:

   (a) use one or more electric motors as their sole means of propulsion; and

   (b) require recharge from an off-board electricity source;

(2) the regulatory, infrastructure, economic, employment and incentive options for supporting the uptake of privately owned electric vehicles;

(3) the applicability of electric vehicles in public transport bus fleets and public sector fleets;

(4) options for supporting the manufacture and assembly of electric vehicles in Victoria, including transition of workers and suppliers affected by the closure of vehicle manufacturing in Victoria; and

(5) the applicability of electric vehicles to the car share providers market.

Chair's foreword

The Parliament directed the Economy and Infrastructure Committee to conduct an inquiry into electric vehicles in February 2017. This report is a result of that inquiry.

Some evidence to the Committee at public hearings and in submissions supported the importance of electric vehicles to Victoria's transport future. The report however does not make any recommendations to government in terms of supporting this sector. Personally I believe that a lot more work needs to be done to ensure that we understand and can support electric vehicles in Victoria. I support any sector that would bring more employment to our State but I remain sceptical about whether electric vehicles will lead to significantly more jobs for Victoria. If a transition to electric vehicles is inevitable, as some of our evidence suggested, then I am concerned with the support that traditional industries receive.

I thank all of our stakeholders for the work that they put into their submissions and presentations to the Committee. I would also like to thank my colleagues on the Committee for their input into the report.

Finally I would like to thank the staff who provide research, writing and administrative suport to the Committee: Lilian Topic, Committee Secretary; Pamie Fung, Inquiry Officer; Kieran Crowe and Michelle Kurrle, Research Assistants for this Inquiry.

Bernie Finn MLC
Chair

Acronyms

AAA	Australian Automobile Association
AEMO	Australian Energy Market Operator
AEVA	Australian Electric Vehicle Association
ARENA	Australian Renewable Energy Agency
AWD	All-wheel drive
BZE	Beyond Zero Emissions
CAUL	Clean Air and Urban Landscapes Hub
CCS	Combined Charging System
CEFC	Clean Energy Finance Corporation (Federal)
CNG	Compressed natural gas
CO2	Carbon dioxide
DEDJTR	Department of Economic Development, Jobs, Transport and Resources (Victoria)
DTF	Department of Treasury and Finance (Victoria)
EAGA	Eastern Alliance for Greenhouse Action
EPA	Environmental Protection Authority
EVs	Electric vehicles
EVSE	Electric Vehicle Supply Equipment
FCAI	Federal Chamber of Automotive Industries
FCEVs	Fuel cell electric vehicles
GBGA	Goulburn Broken Greenhouse Alliance
HMCA	Hyundai Motoring Corporation Australia
ICCT	International Council on Clean Transportation
ICE/ICEVs	Internal combustion engine (vehicles)
Li-ion	Lithium-on battery
NEM	National Electricity Market
NRMA	National Roads and Motorists Association
OECD	Organisation for Economic Cooperation and Development
OEMs	Original equipment manufacturers
PEMs	Power electronics modules
PHEV	Plug-in hybrid electric vehicle

PTUA	Public Transport Users Association
RAC	Royal Automobile Club
RACV	Royal Automomobile Club Victoria
SMVP	Standard Motor Vehicle Policy (VicFleet)
SUV	Sport utility vehicle
TTF	Tourism and Transport Forum (National)
VACC	Victorian Automobile Chamber of Commerce
VRET	Victorian Renewable Energy Target
ZEVs	Zero Emissions Vehicles

Findings

2 Electric vehicles: potential benefits and losses

3 Measures for electric vehicle private ownership

5 Options to support the manufacture and assembly of electric vehicles in Victoria

6 Car sharing and electric vehicles

1 Introduction

1.1 Scope of the inquiry

The Parliament of Victoria's Legislative Council directed the Economy and Infrastructure Committee to inquire into electric vehicles on 8 February 2017. The Terms of Reference for the Committee's Inquiry into Electric Vehicles called for the Committee to:

> inquire into, consider and report, no later than 14 December 2017, on —
>
> (1) the potential benefits of widespread uptake of electric vehicles in Victoria to the environment, including greenhouse gas emissions, air quality, noise and amenity, whereby electric vehicles are defined as vehicles that both:
>
> (a) use one or more electric motors as their sole means of propulsion; and
>
> (b) require recharge from an off-board electricity source;
>
> (2) the regulatory, infrastructure, economic, employment and incentive options for supporting the uptake of privately owned electric vehicles;
>
> (3) the applicability of electric vehicles in public transport bus fleets and public sector fleets;
>
> (4) options for supporting the manufacture and assembly of electric vehicles in Victoria, including transition of workers and suppliers affected by the closure of vehicle manufacturing in Victoria; and
>
> (5) the applicability of electric vehicles to the car share providers market

The Committee's Inquiry was focussed on electric vehicles and investigating their use by consumers and for public infrastructure.

The report does not consider automated vehicles in depth. However, in assessing what the future of transport might look like for Victoria, the Committee also heard from an expert in Victoria's first-ever automated vehicle trial during the Inquiry.

The Committee acknowledges the significance of the impact that automation of transport will have to Victoria. It is important that this impact be considered in planning for the State's future, particularly in relation to transport infrastructure. The Committee is aware that Infrastructure Victoria is currently preparing advice to the Special Minister of State regarding automation and transport. The first stage of advice is due to be delivered to the Government in April 2018.

1.2 Inquiry process

Evidence put before the Committee at public hearings and in submissions overwhelmingly supported the importance of electric vehicles to Victoria's transport future. Evidence provided to the Committee was not conclusive with

regard to when a full transition to electric vehicles would take place in Victoria. However, a number of jurisdictions in Australia and internationally have initiated support for the adoption of electric vehicles and electric vehicle numbers are growing in these jurisdictions.

1.2.1 Submissions and public hearings

For this Inquiry, the Committee received over 200 submissions from Victorians. Over one hundred submissions were similar pro forma submissions supporting electric vehicles.

The Committee conducted three days of public hearings to gather relevant information from stakeholders, including the following:

- Transport for Victoria
- Victorian branch of the Australian Electric Vehicle Association
- Goulburn Broken Greenhouse Alliance
- Federal Chamber of Automotive Industries
- Victorian Automobile Chamber of Commerce
- Tim Olding, Electric Vehicle Transport and Energy Consultant, Sassafras Group
- Professor Aniruddha (Ani) Desai, Director of Centre for Technology Infusion, La Trobe University
- Dr Julian de Hoog, Honorary Research Fellow, Melbourne School of Engineering, the University of Melbourne
- ABB Australia Ltd
- Institute for Sensible Transport
- Hydrogen Mobility Australia
- Quickar
- JET Charge
- SGFleet
- GoGet Car Share
- ClimateWorks Australia
- SEA Electric
- Electric Vehicle Council
- Eastern Alliance for Greenhouse Action
- Yarra Ranges Council
- Moreland City Council.

Transcripts from the hearings are available on the Committee's website (www.parliament.vic.gov.au/eic).

Furthermore, the Inquiry was featured on the Parliament's social media sites garnering attention from many Victorians who engaged with our posts and provided their comments.

The Committee thanks all those who took the time and made the effort to provide information, advice and their views for the report. Advice from stakeholders in this area has been very important in shaping the report's Findings.

1.3 Definitions

For the purposes of this Inquiry, an **electric vehicle** is generally defined as a vehicle that:

(a) Uses one or more electric motors as their sole means of propulsion; and

(b) Requires recharge from an off-board electricity source.

A list of acronyms used in the report can be found at page xiii.

Other terms used frequently throughout the report are defined below:

- **Internal Combustion Engine Vehicles** are powered by an internal combustion engine using petrol, diesel or gas. These are the vehicles that we are familiar with.
- **Hybrid Vehicles** combine both an internal combustion engine with an electric engine. When more power is required, a hybrid vehicle will switch to its internal combustion engine.
- **Plug-in Hybrid Electric Vehicles** combine both an internal combustion engine and an electric engine. These vehicles are propelled by a mix of the internal combustion engine and conventional fuels, and the electric engine. The main difference between hybrid and plug-in hybrid vehicles is that plug-in hybrid electric vehicles are predominately powered by the electric engine. The internal combustion engine is used to extend driving range beyond battery capacity for longer distances and to recharge the battery itself.[1]
- **Hydrogen Fuel Cell Vehicles** or **Fuel Cell Vehicles** are powered by a hydrogen fuel cell. In these vehicles, hydrogen mixes with oxygen to create a chemical reaction, which powers the vehicle's electric motor. These vehicles are virtually emissions free (emitting only heat and water); there are only a few demonstration models available at present in Australia.[2]

Throughout this Inquiry, in keeping with the way stakeholders have used the terms 'electric vehicle' and plug-in hybrid electric vehicle interchangeably – plug-in hybrid electric vehicles have also been counted as electric vehicles in

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1 Definitions drawn from, Australian Electricity Market Operator (AEMO) and Energeia, *AEMO Insights: Electric Vehicles*, August 2016, AEMO, p. 6.

2 Rebecca Turner, 'Hydrogen Vehicles: what are they? And when will we drive them?' ABC News, 14 September 2017, <http://www.abc.net.au/news/2017-09-14/hydrogen-car-explainer-what-are-they-and-when-will-we-drive-them/8946184>, accessed 10 January 2018.

most instances. An exception occurs in Chapter Four on the applicability of electric vehicles in public sector fleets. In Chapter Four, 'all electric vehicles' are referred to separately to make a distinction between fully battery operated electric vehicles and plug-in hybrid electric vehicles.

1.4 The report

This report discusses electric vehicle use and potential manufacture in Victoria.

Chapter Two looks at the potential benefits for Victoria that could result from the higher uptake of electric vehicles, and corresponding move away from traditional internal combustion engine vehicles. Benefits could include jobs in a new industry, cleaner air, emissions-free driving and reduced transport and traffic noise.

Chapter Three considers the support that government could give to the electric vehicle industry and to consumers considering purchasing an electric vehicle. This could be through the introduction of regulatory, infrastructure or finance related incentives. The chapter also discusses the building of public charging infrastructure for electric vehicles and the uptake of electric vehicles in the private market.

The first half of Chapter Four discusses the applicability of electric vehicles in the public sector fleet, focusing on the Victorian State Government and Local Government. The second half of this chapter considers the potential of introducing electric buses into Victoria's public transport fleet.

Chapter Five is primarily concerned with what the State Government can do to support the manufacture and assembly of electric vehicles in Victoria. The chapter concludes that rather than investing in a large-scale electric vehicle manufacturing industry the Government should encourage a focus on niche or high value areas of electric vehicle manufacturing that capitalise on Victoria's strengths in advanced manufacturing and workforce skills.

Chapter Six looks at the concept of car-sharing, a service allowing users on-demand access to a fleet of vehicles for individual, short-term usage. Car-sharing is becoming increasingly popular in both metropolitan and regional Victoria. This chapter explores the applicability of electric vehicles to car-sharing as requested in the terms of reference (5.).

Over the course of the Inquiry, the Committee received evidence indicating the measures that could support and encourage the electric vehicle industry and consumers in Victoria.

The Committee heard that electric vehicles and their associated technology are changing the leading markets overseas.

It is important to note that support for electric vehicles will also have an impact on the traditional sectors of the automotive industry and a potential impact on future energy supplies to this State.

Further investigation of electric vehicles and careful policy development are required to support the introduction of electric vehicles in Victoria. In assessing the evidence, the report provides a number of findings for government. The findings for each chapter can be found at page xv.

2 Electric vehicles: potential benefits and losses

This chapter discusses the potential benefits and losses that a higher uptake of electric vehicles could mean for Victoria. The chapter primarily responds to the first of the Inquiry's terms of reference, which asked the Committee to inquire into the potential benefits of widespread uptake of electric vehicles in Victoria, with a focus on the environmental impacts as well as the impacts on air quality, noise and amenities.

This chapter also discusses the effect that greater numbers of electric vehicles might have on electricity supply in Victoria.

How the uptake of electric vehicles in Australia compares to other jurisdictions in Europe, North America and Asia is briefly discussed, in addition to the pace of transition to electric vehicles in Australia.

The potential environmental, health and economic benefits for Victorians that could result from a higher uptake of electric vehicles and a corresponding shift away from traditional vehicles that rely on internal combustion engines include:

- Potential for new jobs in Victoria in electric vehicle technology and in charging infrastructure
- Enhanced fuel security and independence from imported oil supplies
- Reduced vehicle operating and maintenance costs for drivers
- Reduced transport and traffic noises, as well as improved amenities
- Environmental benefits such as a reduction in greenhouse gas emissions
- Cleaner air in Metropolitan Melbourne
- Potential positive impacts of electric vehicles on electricity supply and distribution to Victoria when electric vehicle charging is managed and supported by new electric vehicle-to-grid technology that is in development.

The Committee also heard that electric vehicles will have an impact on automotive industry jobs and government revenue from tax on fuel:

- Job losses in parts of the existing automotive industry (for example, in fuel retailing and servicing of internal combustion engine vehicles)
- Loss of government income from reduced Fuel Excise Tax.

2.1 Potential economic benefits and losses with the advent of electric vehicles

During the Victorian Government's 2010-2014 Electric Vehicle Trial, the Department of Transport commissioned infrastructure, project design and management firm AECOM to undertake modelling of the economic benefits of electric vehicles. According to the results:

> Under all scenarios, electric vehicles will provide a net economic benefit for Victoria. The benefit varies from 1.8 billion to 23.4 billion over the period to 2040, without considering the economic contribution of the electricity and automotive industry sectors.[3]

According to the trial's mid-term report, electric vehicles cost more to purchase upfront but they are cheaper to run overall than internal combustion engine vehicles. This may lead to savings to households and businesses in transport costs.[4] The Committee heard about the significantly lower cost of recharging and maintaining an electric vehicle compared to an internal combustion engine vehicle and the potential benefits for Victorian households and businesses.

In 2016, Australia's peak motoring organisation, the Australian Automobile Association (AAA) reported the results of its first ever Transport Affordability Index. Their results showed that on average Australian households were spending up to $22,000 a year to keep their cars on the road. The AAA found that a two-car household faced transport costs of $419 per week in Sydney, $376 in Brisbane and $348 in Melbourne.[5]

2.1.1 Recharging and maintenance costs

The upfront costs of electric vehicles are high at present – however, once purchased, they may cost less to drive and maintain due to fewer system parts. In a submission to the Inquiry, the Victorian branch of the Australian Electric Vehicle Association (AEVA) explained:

> Electric cars do not require regular oil and coolant changes (if at all) to the extent of internal combustion models, avoiding most of the cost and environmental impact of waste disposal.[6]

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3 Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 103.

4 Ibid.

5 Joshua Dowling, 'The staggering costs to own and operate a car in Australia - every capital city compared in landmark study', *News Corp Australia Network*, 22 August 2016, <http://www.news.com.au/technology/innovation/motoring/the-staggering-costs-to-own-and-operate-a-car-in-australia--every-capital-city-compared-in-landmark-study/news-story/2490f96d0ea55e00879dac2c61b7d70c>, accessed 30 November 2017.

6 Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 2.

Mr Chris Jones, the National Secretary of the AEVA has previously stated:

> Perhaps the best thing about EVs is their maintenance schedule – check the brakes once a year and rotate the tyres every 20,000 km. That's about it! With just one moving part – the rotor – electric vehicles are particularly simple and very robust.[7]

In addition to lower maintenance costs, the Committee heard that recharging an electric vehicle is significantly cheaper compared to refuelling a conventional internal combustion engine vehicle. At a public hearing, Mr Behyad Jafari, Chief Executive Officer of the Electric Vehicle Council, the national body representing the electric vehicle industry, told the Committee that recharging an electric vehicle is 25 per cent cheaper than refuelling a petrol or diesel fuelled car. He stated:

> What we say is without any electricity discounts being in place, and there are quite a lot of electricity discounts available for electric vehicles at the moment, if you were paying a cents-per-kilowatt-hour charge, which is like cents per litre, the equivalent for what we call a E-litre, an electric litre of about 30 cents compared to about $1.20 worth of petrol. It is an order of magnitude of about a quarter cheaper...[8]

Mr Jafari noted that charging vehicles at off-peak times and or using solar panels when the sun is shining during off-peak times, would lead to significant savings – recharging could cost as little as 2 cents or become entirely free.[9] In their submission, energy provider AGL discussed their Electric Vehicle Plan for Victorian drivers, which allows drivers to recharge for $1 a day.[10]

In a submission, Ms Coralie Coulson, owner of a Holden Volt, purchased in 2014, described the operating and maintenance costs for her Volt, which runs on electricity, with a backup petrol-fuelled electricity generator that kicks in when the battery is depleted. She stated:

> By the way, my car is serviced once a year at a cost of $180... and I currently put petrol into my car about 4-5 times per annum at a cost of max $30 each time.[11]

Mr Peter Horan, an owner of a plug-in hybrid electric vehicle purchased in 2014, also highlighted the lower cost of operating the hybrid vehicle compared to a petrol-fuelled sedan:

- reduced petrol usage by 922L, saving $1,300 at the time and perhaps $1,150 at current prices; there is already a significant economic incentive to use electric vehicles.[12]

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7 Gumtree support, 'Electric cars buying guide', <https://help.gumtree.com.au/AU/articles/en_US/KB_Article/Electric-Cars-Buying-Guide-AU?vgroup1=PKB&c=PKB%3ABasics&vcategory2=Selling_and_Buying_Guides&s=>, accessed 30 November 2017.

8 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 8.

9 Ibid.

10 AGL Energy, *Submission,* no. 42, p. 2; AGL Energy, 'Charge your electric vehicle for only $1 a day', <https://content.agl.com.au/energy/electric-vehicle-cost-to-run>, accessed 10 February 2018.

11 Coralie Coulson, *Submission,* no. 11, p. 2.

12 Peter Horan, *Submission,* no. 1, p. 1.

Swinburne University of Technology's Electric Vehicle Laboratory has been developing electric vehicle technology in Melbourne. According to Swinburne University's submission, most internal combustion engine vehicles have a useful life of 10 – 15 years and 200,000 to 300,000 km. On the other hand 'new automotive design and development practices' are exploring opportunities to 'extend the useful life' of an electric vehicle.[13]

Regenerative braking

Regenerative braking increases the cost-efficiency of an electric vehicle when a car brakes, and recovers energy for the car battery.

Braking in a petrol or diesel fuelled car requires the brake discs to clamp onto the wheels and the engine to slow down. During this process, the energy generated from braking dissipates as heat into the atmosphere. In electric vehicles, regenerative braking means that the kinetic energy used to turn the car wheels and brake is stored back into the electric battery and this energy can be used to power up the car or power up other features in the car. In urban spaces where cars frequently stop and start, regenerative braking means greater cost-efficiency for electric vehicle drivers.

At a public hearing in Melbourne, Mr Tony Fairweather of SEA Electric (a Victorian automotive technology company specialising in the electrification of commercial vehicles) explained the added potential benefits of regenerative braking for businesses in their freight work, including noise reduction:

> On an electric vehicle you have got what is called regen braking, which means you are actually collecting that energy... So it tops up the batteries as you go. It actually brakes the vehicle without using the discs, and it saves on noise but also on the costs of having to replace brakings. Efficiency wise, without a doubt electric vehicles are a lot more operationally efficient...[14]

Currently the high upfront costs of purchasing electric vehicles (with the available electric vehicle and plug-in hybrid models in 2016, in Australia, priced above $60,000, see Chapter Three) can be prohibitive for consumers.[15] The full cost benefit of driving electric vehicles may not be realised until the cost of electric vehicles decreases. Chapter Three discusses ways that the Government could support the uptake of electric vehicles in the private market in Victoria.

FINDING 1: Currently the high upfront cost of electric vehicles compared to other vehicles in the same class, makes them prohibitively expensive for many Victorians.

13 Swinburne University, *Submission,* no. 46, p. 3.

14 Tony Fairweather, Managing Director, SEA Electric, *Transcript of evidence*, 8 November 2017, p. 35.

15 Electric Vehicle Council ClimateWorks Australia, *The state of electric vehicles in Australia*, 2017, p. 8.

2.1.2 Potential jobs growth in electric vehicle technology

During the Victorian Government EV Trial, authors of the mid-term report described electric vehicles as a potential 'sweet-spot' for Victorian jobs. The trial's mid-term report cited the Auto Cooperative Research Centre (now known as Excellerate). Their Automotive Australia 2020 Roadmap published in 2010 provides some insights into the electric vehicle technology applications around which jobs could be created. These applications included:

- Supercapacitors for electric vehicles
- Design and assembly of Power Electronics Modules (PEMs)
- High energy-density batteries
- Low cost, robust, efficient electric machines
- Modular, standardised battery packs
- Expertise in solutions for electric vehicle architectures and technologies
- Seamless integrated charging infrastructure
- Software and hardware for electric vehicle specific driver-interface
- Hybrid and electric vehicle production for fleets and taxis.[16]

In 2017, the National Roads and Motorists' Association (NRMA) released a report titled *The Future is Electric,* which highlighted Australia's potential to transition to electric vehicles and benefit from the transition. In the report, the NRMA cited the Boston Consulting Group, which reported that electric vehicle batteries will become a $240 billion industry within two decades and that by as early as 2020 the electric vehicle battery industry could reach $25 billion.[17]

At a public hearing in Melbourne, Mr Tim Washington, Founder of JET Charge, a Victorian business that supplies, installs and manages locally-coded electric vehicle charging infrastructure spoke about the opportunities for future jobs growth in electric vehicle charging infrastructure. He stated:

> Globally the charger industry is expected to grow at a compound rate of close to 50 per cent from now until 2025 and will reach annual global revenue of A$60 billion. In the US alone, EV charging infrastructure has increased by 576 per cent in revenue for the last five years and was expected to go from $27 million in 2011 to $182 million last year, so it is a significant business.[18]

During the Inquiry, the Committee heard from InvertedPower, a Melbourne based start-up company developing and commercialising intellectual property for improving the functionality, economics, and ultimately, viability, of electric vehicles. In a submission, Mr Stefan Smolenaers, Founder of InvertedPower stated:

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16 Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 104.

17 NRMA, *The Future is Electric*, NRMA, Strathfield, NSW, 2017, p. 7. Cites bcg perspectives

18 Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 19.

> Victoria has the potential to become a market leader in technology and development of electric vehicles and energy. Indeed, Australian companies are already developing and commercialising market leading technologies in the electric vehicle space. Victoria has a rich history for automotive engineering and development, and this can continue into the near future with support for developing technologies for the next generation of mobility. Indeed, many of the submissions for this inquiry are by Victorian businesses innovating in this field. Victoria still has local manufacturing for heavy vehicles, and this can be utilised to adopt electrification locally, and create a business case to deploy a statewide future-proof charging infrastructure network.[19]

The Committee believes that an updated analysis of the potential jobs growth from electric vehicles and their technology should be undertaken. Chapter Five of this report discusses the possible options for manufacturing and assemblage of electric vehicles in Victoria.

FINDING 2: An updated analysis of the potential jobs growth from electric vehicles and their technology would be a useful undertaking by government.

2.1.3 Job losses in the automotive industry

Victoria has a large automotive industry that supports the widespread use of internal combustion engine vehicles. The automotive industry has many sectors including vehicle retailing, parts retailing, vehicle repair, maintenance and fuel retailing. It can be expected that the introduction of electric vehicles, which may require less maintenance, would lead to a decline in the automotive sectors that support combustion engine cars.

The Victorian Automobile Chamber of Commerce (VACC), which represents the interests of automotive businesses, told the Committee that in 2015/16 the automotive industry employed 102,810 people in 17,961 businesses and contributed $9.6 billion to the Victorian economy.[20]

The VACC provided the Committee with a breakdown of the Victorian Automotive Industry in 2015-16 as outlined in Table 2.1.

19 InvertedPower, *Submission,* no. 223, p. 5.

20 Victorian Automobile Chamber of Commerce, *Submission,* no. 38, p. 7.

Table 2.1 Victorian automotive industry profile 2015-16

Automotive Sector	Employment year ending June 2016	Number of businesses as at 30 June 2016	Industry Value added ($m)
Motor Vehicle and Parts Manufacturing	24,618	1,210	648
Motor Vehicle and Parts Wholesaling	7,054	1,537	823
Motor Vehicle Retailing	18,331	1,471	788
Motor Vehicle Parts and Tyre Retailing	6,167	974	522
Fuel Retailing	6,925	1,036	555
Automotive Repair and Maintenance	31,971	9,576	5,128
Passenger Car Rental and Hiring	2,152	437	234
Bicycle Retailing	1,280	281	150
Marine Equipment Retailing	560	138	74
Outdoor Power Equipment Retailing	1,169	323	173
Towing Services	751	606	325
Agricultural Machinery Retail and Repair	1,832	372	199
Total Automotive Industry	**102,810**	**17,961**	**9,619**

Source: Victorian Automobile Chamber of Commerce, *Submission 38*, p.8

Impact of electric vehicles on the automotive industry

The Committee heard that the introduction of electric vehicles could lead to a decline in sectors of the automotive industry that are dependent on internal combustion engine vehicles. In particular the repair and maintenance, new and used parts retailing, and fuel retailing sectors.

As noted in Chapter Five, electric vehicles require considerably fewer moving parts than internal combustion engine vehicles. According to the VACC, electric vehicles typically have 17 moving parts while an internal combustion car has around 2,000.[21] The lack of moving parts means that electric vehicles are less susceptible to wear and require less servicing and maintenance.[22] Because of this, the VACC predict that businesses such as mechanics and vehicle parts retailers may experience a decline in trade:

> The greater reliability of electrical vehicles, in conjunction with fewer moving parts, will impact on vehicle parts retailing businesses, reducing current profitable income streams from the sale of catalytic converters, engine components and many other ICE vehicle parts and consumables. This will likely result in a significant contraction in investment within the sector, along with large numbers of business closures or consolidation.
>
> These same factors will also reduce the volume of work for automotive mechanical repair businesses given the greater reliability of EVs and their need for less servicing and maintenance.[23]

21 Ibid., p. 9.

22 Ibid.

23 Ibid., p. 10.

This view was partly shared by Mr Bryce Gaton from the Victorian Branch of the Australian Electric Vehicle Association. Mr Gaton said that while it was likely that electric vehicles would impact mechanics, the automotive repair business is already highly specialised and electric vehicles would still need to be serviced:

> There is a two-pronged look at it. One is a lot of automotive mechanics are basically being pushed out of the trade because cars are becoming more and more electronic anyway, so that technology has already been taken in-house by the manufacturers far more so than it used to be. To some degree a lot of the private mechanical workshops are being pushed out of the business anyway with electrification of current vehicles. It makes no difference.
>
> The second side of the coin is that you are saving people a lot of money with less servicing, but there is still servicing required on EV. They still need brakes, tyres; they still need an annual check. You would be mad not to have your EV checked annually anyway. So it is reduced, but a lot of petrol cars these days are only annual checks. So yes, there is less work in them. You do not have the waste of oil, oil filters and spark plugs, but you will also still need to have some checks. The training still needs to be provided in automotive EVs. That is part of where I work — trying to train engineers to work with EVs. There is still a lot of work in that area.[24]

The fuel retailing industry will also face disruption. Service stations will likely see a drop in fuel sales due to the introduction of electric vehicles. Sales of automotive fuel in Australia have declined in the past five years from 18,716.8 megalitres in 2011-12, to 18,240.1 megalitres in 2016-17.[25] However, the decline in fuel sales cannot be attributed to the uptake of electric vehicles alone. The decline may also be attributed to factors such as decreasing car ownership and vehicles with greater fuel efficiency. The VACC believe that the uptake of electric vehicles will progressively reduce the viability of service stations in Victoria:

> In both the United Kingdom and the United States (US), declining trends in the number of fuel station outlets have been observed relative to growing EV sales. This is despite record lows in the price of petrol. Growing numbers of EVs on-road displace conventional petrol-powered vehicles; progressively reducing the viability of many fuel retail businesses. This trend is also anticipated to occur in Victoria and Australia as the number of EVs increases.[26]

Job losses and business closures

The VACC provided the Committee with a scenario in which the sales of electric vehicles in Victoria was 20 per cent of new car sales by 2030. The VACC classed this as a 'high-uptake scenario.' If this were to occur, the VACC predict that 2,000 automotive businesses would close and 6,000 people would lose their jobs.[27] In comparison, 5,000 jobs were lost as a direct result of the closure of the Ford, Toyota and Holden Factories in 2016 and 2017 (see Chapter 4).

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24 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 16.

25 Department of Infrastructure and Regional Development (Australia), *Yearbook 2017: Australian Infrastructure Statistics*, Australian Government, Canberra, 2017, p. 155.

26 Victorian Automobile Chamber of Commerce, *Submission,* no. 38, p. 9.

27 Ibid., p. 12.

The VACC provided the Committee with a table outlining the impact the introduction of electric vehicles may have on the automotive industry under a high uptake scenario in Table 2.2.

Table 2.2 **Businesses closures and job losses between 2017 and 2030 in a high electric vehicle uptake scenario**

BUSINESS POPULATION				
Automotive sector	**2020**	**2025**	**2030**	**Cumulative total**
Car Wholesaling	-9	-30	-60	-99
Motor Vehicle used parts wholesaling and dismantling	-13	-52	-104	-169
Car Retailing	-70	-80	-150	-300
Motor Vehicle Parts Retailing	-35	-100	-170	-305
Fuel Retailing	-80	-120	-250	-450
Automotive Repair and Maintenance	-100	-200	-380	-680
Total – All sectors	**-307**	**-582**	**-1084**	**-2003**
Employment				
Car Wholesaling	-50	-120	-210	-380
Motor Vehicle used parts wholesaling and dismantling	-58	-162	-302	-522
Car Retailing	-200	-220	-400	-820
Motor Vehicle Parts Retailing	-190	-480	-700	-1370
Fuel Retailing	-160	-250	-500	-910
Automotive Repair and Maintenance	-300	-600	-1000	-1900
Total – All sectors	**-958**	**-1832**	**-2987**	**-5902**

Source: Victorian Automobile Chamber of Commerce, *Submission 38*, p.12

The Committee heard from a peak representative of the Victorian automotive industry who stated that the industry needed some guidance in relation to electric vehicles. At a public hearing Mr Bletsos, the VACC's Senior Research Analyst argued that the automotive industry and their sector, needed first and foremost:

> to see a framework which provides a clear road map for businesses regarding their regulatory responsibilities and to assist businesses to make the transition towards that sort of future. We need some sort of clarity, some signals, in a policy framework. That would aid business currently in making that transition. There is a lot of uncertainty in the automotive business community regarding the electric vehicles and their uptake, and some signals would be of benefit here.[28]

Stakeholders suggested that the transition to electric vehicles is inevitable in the future. In taking action to accelerate the advent of electric vehicles in Victoria, there will be benefits for Victorians as well as some losses. The Committee heard that job losses in the servicing and repairs side of the traditional automotive industry would occur with a greater uptake of electric vehicles in Victoria.

28 Steve Bletsos, Senior Research Analyst, Victorian Automobile Chamber of Commerce, *Transcript of evidence*, 9 November 2017, p. 3.

However, this will not occur immediately and the Committee is aware that it may take some time before electric vehicles begin to 'displace' internal combustion engine vehicles. Nonetheless, existing businesses will need to be supported in the inevitable transition to electric vehicles.

FINDING 3: Existing businesses will need to be supported during any transition to electric vehicles, particularly the vehicle retailing, parts retailing, vehicle repair, maintenance and fuel retailing sectors.

2.2 The loss of Fuel Excise Tax from electric vehicles

An average driver in Australia pays more than $1,300 in fuel excise, registration and other fees each year to State and Commonwealth Governments.[29] The largest component of these taxes and charges is the Commonwealth Government's fuel excise, which is a tax of 40 cents paid on every litre of petrol. The Commonwealth Government also collects road-related revenue from other taxes and charges such as GST and fringe benefits tax. State Governments collect road-related revenue from fees and taxes such as vehicle registration fees, drivers licence fees and tolls.

The revenue from road-related fees and taxes collected by State and Commonwealth Governments is not spent directly on roads. The revenue from these sources is pooled into governments' general (consolidated) funds, from which expenditure on roads (and other public services) is allocated.[30]

The Commonwealth Government provides funding to State and Local Governments for roads. In 2015-16, the Commonwealth Government provided $547 million in road-related funding to Victoria. This figure fluctuates from year-to-year, for example, in 2013-14 Victoria received $1.9 billion in road funding. The State Government also spends money on roads, in 2015-16, the Victorian Government spent $1.9 billion on road related projects, including grants for councils. Local Governments also fund roads, in 2015-16 Victorian Councils spent 1.2 billion on road projects.[31]

Road-related taxes and charges and road-related spending in Victoria and Australia is outlined in Tables 2.3 and 2.4.

29 Commonwealth Government Productivity Commission, *Shifting the Dial: 5 year productivity review*, Australian Government, Canberra, 2017, p. 134.

30 Ibid.

31 Department of Infrastructure and Regional Development (Australia), *Yearbook 2017: Australian Infrastructure Statistics*, Australian Government, Canberra, 2017. See, Tables T 1.2a, T 1.2b, T1.2c, T1.4a and T1.4d pp. 39-40 and 42-43

Table 2.3 Road-related taxes and charges in Victoria and Australia

Road-related taxes and charges	2015-16	2014-15	2013-14
Net Commonwealth road related fuel excise	$10.976 billion	$11.184 billion	$11.178 billion
Other Commonwealth taxes and charges[(a)]	$6.410 billion	$6.582 billion	$6.974 billion
Victorian Government road related taxes and charges[(b)]	$3.349 billion	$3.147 billion	$2.899 billion

(a) The other Commonwealth taxes and charges are: Road-related GST, Road–related Fringe Benefits Tax, Federal Interstate Registration Scheme, Luxury car tax and Passenger motor vehicles customs duty.

(b) The Victorian Government road related taxes and charges are: Vehicle Registration Fees, Drivers Licence Fees and Stamp Duty and Tolls

Source: Commonwealth Department of Infrastructure and Regional Development, *Yearbook 2017: Australian Infrastructure Statistics* T1.4a, T1.4d, pp.42-43.

Table 2.4 Road-related spending in Victoria and Australia

Road-related spending	2015-16	2014-15	2013-14
Victoria			
Commonwealth Government	$547.9 million	$543.7 million	$1.9414 billion
Victorian State Government	$1.998 billion	$1.918 billion	$996.3 million
Victorian Local Governments	$1.252 billion	$1.362 billion	$1.356 billion
Total road-related spending in Victoria	**$3.798 billion**	**$3.824 billion**	**$4.294 billion**
Australia			
Total road-related Commonwealth Government spending in Australia (including Victoria)	**$5.167 billion**	**$4.530 billion**	**$5.304 billion**

Source: Commonwealth Department of Infrastructure and Regional Development, *Yearbook 2017: Australian Infrastructure Statistics*, Tables T 1.2a, T 1.2b, T1.2c, pp. 39-41.

According to the Productivity Commission, between 2003-04 and 2014-15, both Commonwealth and State Governments received more in road-related revenue than was eventually spent on roads. However, the gap between what was received in revenue, and what was spent on roads has narrowed.[32]

2.2.1 Decline in fuel excise tax revenue

Because electric vehicles do not use petrol, the Committee heard that the amount of fuel excise tax, (which makes up the largest source of road-related revenue) will decrease.

In a submission, the Victorian Automobile Chamber of Commerce (VACC) stated that the uptake of electric vehicles would likely, 'even under a low electric vehicle uptake scenario... substantially effect fuel excise revenues'.[33] This issue was also raised by Pro-Vice Chancellor, Professor Ajay Kapoor in a submission on behalf of the Swinburne University of Technology. Swinburne University operates an electric vehicle technology laboratory. Professor Kapoor stated:

32 Commonwealth Government Productivity Commission, *Shifting the Dial: 5 year productivity review*, Australian Government, Canberra, 2017, p. 135.

33 Victorian Automobile Chamber of Commerce, *Submission,* no. 38, p. 4.

> In Australia, according to the Bureau of Infrastructure, Transport and Regional Development, public sector road-related revenue totalled $28.7 billion in 2014-1514. Fuel excise contributed about $11.03 billion or 38%, down from about 44% in the early 2000s. This revenue will come under direct threat with increasing electric vehicle market adoption. Our research at Swinburne, also shows that under some future scenarios of shared autonomous mobility, the car fleet size could shrink by around 80% meaning less income from vehicle registration fees and sale taxes, maintenance, insurance and parking.[34]

With a greater number of electric vehicles on Australia's roads, as well as the potential decline in the number of private vehicles through automation, ride sharing and car sharing developments, the CSIRO has predicted revenue from the fuel excise tax could reduce by 45 per cent by 2050.[35]

The Committee notes that a reduction in revenue from the fuel excise tax may not necessarily mean a decline in funding for roads, as the funding is sourced from governments' consolidated funds.[36] However, a drop in revenue from the fuel excise tax due to the uptake of electric vehicles and ride sharing development may prompt the Commonwealth Government to move away from taxing fuel as the primary way of charging motorists for the amount they drive.

At a public hearing, Mr Paul Salter, Acting Executive Director of Network Strategy at Transport for Victoria (the State Government's central transport agency) told the Committee that the Federal Government is considering the introduction of a road users' tax instead. Drivers would be taxed according to the distance they have travelled. This would mean that electric vehicles would attract the same level of taxation as other vehicle types, and would ensure the amount of road-related revenue to the Commonwealth would remain steady. Mr Salter stated that discussions have been held between the Federal Government and the state and territory governments through the Council of Australian Governments (COAG):

> One of the things that is very much being looked at, at the national level through COAG and through the Transport and Infrastructure Council — no one state is looking at it in isolation because it ultimately involves a change in the mix of different state and commonwealth taxes and so forth — is road pricing, obviously more in the medium to longer term, as a means of addressing some of the fiscal consequences of reduction in excise revenue, for example.[37]

The Committee heard that revenue towards road infrastructure will decline as Australia transitions to new vehicle and transportation technologies. This may involve a different role for the Victorian Government in relation to a road user taxation scheme and will require discussion between the Victorian Government, the Federal Government and other states and territories through the COAG to

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34 Swinburne University, *Submission,* no. 46, pp. 5-6.

35 Paul Graham and Luke Reedman (CSIRO), *Projecting future road transport revenues 2015 - 2050*, Commonwealth Scientific and Industrial Research Organisation (CSIRO), 2015, p. ix.

36 Commonwealth Government Productivity Commission, *Shifting the Dial: 5 year productivity review*, Australian Government, Canberra, 2017, p. 134.

37 Paul Salter, Acting Executive Director - Network Strategy, Transport for Victoria, *Transcript of evidence*, 13 February 2018, pp. 8-9.

identify a taxation measure that will replace the fuel excise tax without penalising the increasing numbers of drivers who are adopting electric vehicle and other new transportation technologies.

Recent news reports have identified the greater dependence on cars by families living in the fringes of metropolitan Melbourne.[38] The new taxation measure will also need to take into account how electric vehicle technology can be made more accessible for families who cannot at present afford electric vehicles and other lower emission vehicles such as plug-in hybrid electric vehicles. This could involve a suite of measures that include incentives to make electric vehicles more accessible to the wider community and investment into electric buses for public transport fleets (see, Chapters Two and Three).

2.3 The potential impact of electric vehicles on the electricity grid

While the potential impact of larger numbers of electric vehicles charging from Australia's electricity grid is outside the Inquiry's Terms of Reference, the Committee questioned whether a higher uptake of electric vehicles could compromise Victoria's future energy supply and the stability of the network. The Committee invited Dr Julian de Hoog, Honorary Research Fellow at the University of Melbourne to a public hearing in Melbourne. Dr de Hoog led a research project from 2012-15, which examined the impact of electric vehicles on the grid at distribution level. The project also aimed to design an optimal charging policy that could maximise the uptake of electric vehicles, with minimal upgrade requirements for the electricity grid.

Dr de Hoog believes that in the event of a higher uptake of electric vehicles in Victoria, the demand on the grid could be managed. The Committee also heard that electric vehicles could potentially store electricity and feed it back into the grid, which may lead to greater stability of the grid and lower electricity prices.

The Committee notes that Victoria draws electricity from the National Electricity Market and that ensuring energy security for Victorians would require coordination between state and federal departments and agencies. A further issue may be the need to look at the legislation and regulations, which govern energy supply to ensure that energy distribution companies are able to ensure energy security in emerging market circumstances.

2.3.1 The impact of more electric vehicles on energy security

The Committee heard that an electric vehicle's battery requires a substantial amount of electricity to recharge. According to a submission by energy retailer AGL, a car with a 20 kilowatt-hour battery, stores as much electricity as the

38 Jackson Gothe-Snape, 'Electric cars are breaking our roads, here's how', *ABC News*, 16 January 2018, <http://www.abc.net.au/news/2018-01-15/electric-cars-breaking-australia-roads-reform-road-user-charging/9235564>, accessed 20 February 2018.

average Australian home consumes in a day.[39] Unless an electric vehicle is being charged from solar panels – an electric vehicle will draw electricity from the national electricity grid. This raises concerns about the potential impact of electric vehicle mass-charging events on Victoria's energy security at a time when Victoria is susceptible to power outages during peak periods of energy demand.

The Australian Energy Market Operator (AEMO) is responsible for operating Australia's largest gas and electricity markets and power systems including the National Electricity Market. According to an AEMO report in late 2017, Victoria faced a higher risk of blackouts in the summer of 2017, due to a shortage of reserve power in the national energy market.[40] Victoria experiences power outages during peak periods of demand, such as during hot weather.

Recent summer outages in Victoria have however highlighted the vulnerability of the distribution networks, which carry electricity to consumers, rather than a shortage of electricity supply in the grid.[41]

Some witnesses described electric vehicles as a potential risk to energy security. This will be especially problematic at periods where the grid is congested with individuals and businesses accessing power supply simultaneously. This may occur on a daily basis. Others suggested that they may represent a potential means to enhance the stability of the grid by acting as a distributed battery and a backup source of energy. As Mr Tim Olding, Director of the Sassafras Group, a Melbourne-based consultancy group specialising in different transportation technologies and electric vehicles stated:

> In the last few weeks we have seen how the Tesla big battery in South Australia has already started to have substantial impacts not only on the stability of the grid but also on the cost of providing grid services. One of the things that you need to provide is what is called FCAS, frequency control, or basically gridstability services. They are actually supplied traditionally by power stations being on standby. The Tesla battery has come along and it is basically providing those services at the flick of a switch at a lower cost, and so it is actually driving down the cost of providing those FCAS services. If you have an electric bus network which then has recharge stations built into that network which are run off stationary batteries which are trickle charged from the grid, you do two things: number one, you do not put any high loads on the grid, and therefore not having the surge charge coming out of the grid into the bus, you buffer it through a battery; and number two, you can use that battery as a grid services device at the same time.[42]

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39 AGL Energy, *Submission,* no. 42, p. 10., Liam Davis, Transport Analyst, Institute for Sensible Transport, *Transcript of evidence*, 13 February 2018, p. 63.

40 Adam Carey, 'Rise of blackouts in Victoria on the rise this summer, report warns', *The Age*, 6 September 2017, <https://www.theage.com.au/national/victoria/risk-of-blackouts-in-victoria-on-the-rise-this-summer-report-warns-20170906-gybool.html>, accessed 10 February 2018.

41 See for example, Adam Carey, 'Sunday blackouts a failure of electricity networks', *The Age*, 6 September 2017, <https://www.theage.com.au/national/victoria/risk-of-blackouts-in-victoria-on-the-rise-this-summer-report-warns-20170906-gybool.html>, accessed 10 February 2018.

42 Tim Olding, Electric Vehicle Transport and Energy Consultant, Sassafras Group, *Transcript of evidence*, 13 February 2018, p. 42.

During the Inquiry, witnesses drew attention to the fact that electric vehicles will represent one element of change to the grid, in a context of wider changes as Australia increasingly relies on renewable energy over traditional energy sources. As AGL described, in a submission:

> These developments mean that utilisation of the grid is changing dramatically. Customers increasingly see the grid as much as a means to export, as well as import, electricity. Customers are also becoming interested in understanding how they can share energy locally (for example, through a peer-to-peer trading program) or participate in wholesale or network services markets. Thus, the grid is increasingly becoming the gateway to a range of other markets and additional value streams for customers. At the same time, these developments are presenting new challenges for the safe and reliable management of distribution networks. Distribution networks were originally designed for one-way flows and expenditure may be required to accommodate the increasingly bi-directional nature of energy flows. If not managed, reverse flows can cause voltage, protection and thermal network problems.[43]

The Committee heard concerns that electric vehicles will compromise energy security for Victorians, particularly without a 'well-planned whole of system approach' to introducing them.[44] Mr Olding stated:

> If we can take a whole of system approach to developing electric vehicle networks, taking into consideration not only the vehicles and the charge stations but also the generating resources, you can probably kill a couple of birds with one stone, create something that is creating value on both sides of the coin — lower transportation cost, more stable grid, with lower grid services costs that go with that.[45]

2.3.2 The electricity grid

According to Dr Julian de Hoog, Honorary Fellow at the University of Melbourne, there are several problems that could arise in a scenario of greater numbers of electric vehicles charging from the grid. In summary:

1. Extra demand in the network, which in turn means there is extra demand on the transformer and on the cables.
2. As more electricity is drawn through these networks, the voltage is affected at individual houses and affects appliances and other possessions that are also reliant on electricity at a certain voltage.
3. Most networks have three phases - each house connects to one, and if a lot of people on one phase start to buy electric vehicles, you start to unbalance networks and that in turn leads to problems of voltage.[46]

Dr de Hoog explained that in a typical network there are already imbalances due to houses being connected away from transformers. With the added demand of electric vehicles drawing on a network, the project team had found in their

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43 AGL Energy, *Submission,* no. 42, p. 10.

44 Tim Olding, Electric Vehicle Transport and Energy Consultant, Sassafras Group, *Transcript of evidence*, 13 February 2018, p. 42.

45 Ibid.

46 Dr Julian de Hoog, Honorary Research Fellow, Melbourne School of Engineering - The University of Melbourne, *Transcript of evidence*, 9 November 2017, p. 32.

modelling that 'typically the first problems start to occur at around 10 per cent uptake' or 'every 10th house' when it starts to plug in an electric vehicle, 'that is when you may start to see the first problems... typically around low voltage'.[47]

Dr de Hoog said: 'Adding electric vehicles to lightly loaded phases could rebalance the network and create opportunity for more vehicles to charge.'.[48]

Another low-cost way to rebalance the network in a scenario of increasing numbers of electric vehicles would involve shifting charging times from peak to off-peak periods via incentives for their owners. As Dr de Hoog explained:

> You can see that all the charging is likely to overlap right around peak time – 7:00p.m. or 8:00p.m. – if everybody plugs in as soon as they get home. But then there is all this flexibility where the cars are at home and where they are not charging.[49]

Dr De Hoog further explained:

> Basically there are fairly simple ways to shift that charging. If you do it in the optimal way that we developed, we can get uptake levels of 80 per cent, so almost every house in the street could have a vehicle, and as far as the network goes, we could handle this uptake.[50]

In 2016, the Australian Energy Market Operator (AEMO) modelled the impact of electric vehicles on electricity consumption and demand in Australia. AEMO concluded that the impact of electric vehicles on electricity consumption over the next 20 years would be small relative to the impact of other changes expected to take place including the transition to renewable energy sources. AEMO believes the impact of electric vehicles to the electricity industry over the next 20 years will be modest, adding 4 per cent to 2035-36 projections of electricity usage in Australia.[51]

At a public hearing, Mr Jafari of the Electric Vehicle Council discussed the potential benefits of electric vehicles for the electricity grid:

> The positives of electric vehicles are they can do what is called flattening out demand, so essentially meaning that with smarter technology — technology that is already available to us — we can ensure that vehicles are charging at the right times, when we actually have an excess of supply. That can also reduce things like the unit price of electricity, stabilise our grid, improve the reliability of our grid and, if we so choose, go into newer technologies like vehicle to grid, so vehicles are able to discharge back in at times when we have very little supply of electricity as well.[52]

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47 Ibid.

48 Ibid.

49 Ibid., p. 33.

50 Ibid.

51 Australian Energy Market Operator (AEMO) and Energeia, *Electric Vehicles*, AEMO, 2016, p. 4.

52 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 4. See also, Beyond Zero Emissions, *Submission,* no. 7, p. 2., AGL Energy, *Submission,* no. 42, p. 9.

In vehicle-to-grid technology, electric vehicles can be considered 'batteries you can drive' and as a distributed storage system, which can 'ease the pressure on spikes in electricity prices' by feeding electricity back to the grid when prices are high.[53]

Given the scope of the Inquiry, the Committee did not inquire further into the potential of vehicle-to-grid technology. However, the Committee is aware that it is being trialled overseas. In 2016, Nissan Great Britain partnered with a multinational power company to launch a major vehicle-to-grid trial in the U.K. As part of the trial, 100 vehicle-to-grid units will be installed in the U.K. to enable electric vehicle drivers to sell stored energy in their vehicles back to the grid for profit.[54] AGL also believes that vehicle-to-grid technology will 'help protect and enhance the reliability and affordability of Australia's electricity'. In a submission, AGL noted that smart grid technology could overcome issues such as battery degradation from the additional cycling of electricity for vehicle-to-grid technology.[55]

FINDING 4: The electricity grid will need to adapt for the increased uptake of electric vehicles.

2.4 Regional and rural Victoria

The Committee heard there are barriers and opportunities for regional and rural communities in relation to electric vehicles. It is important to note particular issues in relation to the applicability of electric vehicles to this context.

Ms Bronwyn Chapman, Executive Officer of the Goulburn Broken Greenhouse Alliance (which supports sustainability projects for 11 local government authorities in Victoria's north-eastern region) described the potential benefits of electric vehicles being adopted in greater numbers in regional and rural communities:

> Transport is a key contributor to emissions from our rural regions, as we have large distances to travel and generally very little effective public transport infrastructure. There is limited bicycle infrastructure in and between towns in many cases. This limits the ability of many regional councils and communities to reduce emissions, fuel consumption and associated costs, and is an area where EVs could prove very effective.[56]

Stakeholders living in the regions highlighted their greater capacity to harness solar energy. According to Ms Marisa O'Halloran, Project Officer for the GBGA:

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53 Mark Andrich and Jemma Green, 'How electric cars can help save the grid', *The Conversation*, 22 March 2018, <http://theconversation.com/how-electric-cars-can-help-save-the-grid-73914>, accessed 28 November 2017.

54 Nissan (Great Britain), *Nissan and Enel Launch Groundbreaking Vehicle-to-Grid Technology in the UK*, media release, Nissan, London, 10 May 2016.

55 AGL Energy, *Submission,* no. 42, p. 9.

56 Goulburn Broken Greenhouse Alliance, *Submission,* no. 40, p. 2.

> We have got very strong solar potential. We have got a lot of space so we can actually put solar installations in, and the solar radiation is actually higher than in areas such as Melbourne, so we actually get a more economical return on investment having solar up north.[57]

The Committee heard that regional and rural communities rely heavily on fuel – more so than in cities and that electric vehicles could provide the fuel security, which these communities need. In their submission, the GBGA stated:

> Our regions rely on heavy vehicles such as trucks for goods transport, and farming machinery in our agricultural industries both of which are dependent on a secure supply of diesel. Investigations into alternatives such as electric or hydrogen fuels would be welcome to provide cleaner technologies, alternative fuel sources and potentially cheaper fuel options. Diversification of transport energy sources with electric and/or hydrogen fuel sources would reduce the risk of petrol/diesel fuel supply interruption disrupting economic and social activities.[58]

However, the upfront cost of electric vehicles and the lack of charging infrastructure in the regions are barriers. The lack of infrastructure was cited as a significant barrier not just for locals but for visitors to the area, as regional communities often rely on tourism for their local economy. The Committee heard that regional communities require electric vehicle charging infrastructure to draw metropolitan drivers to the regions (see also, Chapter Three).[59]

The lack of fit-for-purpose heavy duty electric vehicles is of significant concern. In regional and rural communities, the Committee heard that these limitations to broader uptake are particularly pronounced. Ms O'Halloran explained that regional councils will often require four-wheel drive towing capacity vehicles 'and that is a real big gap in the market' for electric vehicles.[60]

Given the significance of agriculture to rural and regional economies, the Committee asked relevant witnesses about the availability of electric-powered agricultural machinery and vehicles used on farms (such as, headers and tractors). The Committee heard that at present, this segment of the electric vehicle market requires further development. According to Mr Bryce Gaton, Executive Committee member of the Victorian branch of the AEVA, it could be difficult to manage their charging requirements:

> You are at the far end of the supply line so you would have issues if you wanted highdemand charge. The Tesla trucks will have that sort of range and capacity. They are talking about significant ranges on their batteries in large trucks for haulage, but the issue would be very big charging stations required for that, and I still do not understand how they are going to charge them.[61]

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57 Marisa O'Halloran, Project Manager, Goulburn Broken Greenhouse Alliance, *Transcript of evidence*, 13 February 2018, p. 27.

58 Goulburn Broken Greenhouse Alliance, *Submission,* no. 40, p. 2.

59 Marisa O'Halloran, Project Manager, Goulburn Broken Greenhouse Alliance, *Transcript of evidence*, 13 February 2018, p. 29.

60 Ibid., p. 26.

61 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 19.

The Committee heard that hydrogen fuel cell vehicles, which run on an electric motor powered by hydrogen, could represent the best option for heavy machinery and freight vehicles. Mr Daryl Budgeon, Secretary of AEVA Victoria told the Committee:

> The issue with larger pieces of equipment is there is a costbenefit relationship between the weight and the size of the batteries in the vehicle and how much power you need to supply to the vehicle. I would think in the case of very highpowered, very energyintensive farm equipment, if you had to run it electrically, you would be looking at a fuel cell solution, and you would bring in hydrogen and run it through a fuel cell to run the electric on the equipment.[62]

At a public hearing Ms Claire Johnson, CEO of Hydrogen Mobility Australia, described the potential of hydrogen-fuelled farming machinery filling that gap in the market. Hydrogen Mobility Australia is a group of vehicle manufacturers, energy companies, infrastructure providers and researchers supporting hydrogen-powered transport. She stated:

> In a farming context we are seeing the utilisation of hydrogen trucks and also forklifts as well. The application, as I mentioned, is really around commercial transport in the beginning. That is where we see that the clear advantages will be, particularly for those organisations that maintain a fleet with that backtobase model.[63]

Hydrogen-fuelled vehicles also present a possible advantage over electric vehicles in the farming context. As Ms Johnson explained to the Committee, the charging requirements for fuel cell vehicles present an advantage over electric vehicles in the heavy vehicle segment because of longer range, shorter downtimes due to quick refuelling and reduced weight versus battery electric vehicles.[64]

During the Inquiry, the Committee heard that the Victorian Government is supporting Moreland City Council to trial a hydrogen fuel cell waste vehicle under the New Energy Jobs Fund. The Committee considers that there is the potential to trial hydrogen fuel cell vehicles in the agricultural context in Victoria in the future. This may mean that regional and rural communities can also gain the benefits of electric vehicles.

2.5 The transition to electric vehicles

According to the International Energy Agency, which compiles information on the numbers of electric vehicles worldwide, 'new registrations of electric cars, hit a record in 2016, with over 750,000 sales worldwide'. The global electric car stock surpassed 2 million vehicles in 2016.[65] Electric vehicles are being driven in increasing numbers in Europe including the leading nation for electric vehicles, Norway, as well as in the US, Japan, China, and other nations in Asia.

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62 Daryl Budgeon, Secretary, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 18.

63 Claire Johnson, CEO, Hydrogen Mobility Australia, *Transcript of evidence*, 13 February 2018, p. 74.

64 Ibid., p. 70.

65 International Energy Agency, *Global EV Outlook 2017: Two million and counting*, International Energy Agency, France, 2017, p. 5.

During this Inquiry, the Committee heard that electric vehicles are the future of driving. However, electric vehicle sales are low in Australia. According to the Electric Vehicle Council, Australians purchased 701 plug-in hybrid electric vehicles and 668 fully electric vehicles in 2016, which made up 0.1 per cent of the Australian market. Australian electric vehicle sales had also fallen by 23 per cent from 2015 to 2016.[66]

The Electric Vehicle Council found Victorians have purchased the highest number of electric vehicles over the last six years compared to other states, with 1,017 vehicles (excluding Teslas) purchased from 2011 to 2016.[67] However, when taking into account market size, the Australian Capital Territory is significant with 18 electric vehicles purchased for every 10,000 vehicle sold.[68]

Recognising the benefits of electric vehicles, in 2010 the Victorian State Government funded a $5 million trial to provide a foundation for an electric vehicle market in Victoria (referred to in this report as the Victorian Government EV Trial). While a mid-term report was published in 2013, the final report of the trial has not been published.

A key question of this Inquiry has been whether to support electric vehicles now by helping the electric vehicle market grow in Victoria. Or to wait and let electric vehicles gain price parity with internal combustion engine vehicles, and for commercial interests to unfold and shape how Victoria adopts electric vehicles.

2.5.1 Timing of the arrival of electric vehicles in Australia and Victoria

The Committee received mixed evidence about the time that it will take for electric vehicles to gain price parity and to begin to become a larger share of the new vehicle market in Australia.

The 'tipping point' is a common way of describing the moment in time when electric vehicles gain price parity with internal combustion engine vehicles, as vehicle and battery technology improves thereby reducing the price of electric vehicles. In 2017, Mr Behyad Jafari, Chief Executive Officer of the Electric Vehicle Council stated:

> The cost of electric vehicles in Europe will match that of combustion cars as early as next year, with drivers of electric vehicles able to save up to $2,000 per year on fuel costs, so owning an electric vehicle is a cost-effective option long-term.[69]

66 Electric Vehicle Council ClimateWorks Australia, *The state of electric vehicles in Australia*, 2017, p. 5.

67 The report notes that Tesla does not release its sales figures to the public. See, Ibid.

68 Ibid.

69 Mr Jafari cited in: NRMA, 'The future of cars is electric, according to new NRMA research', <https://www.mynrma.com.au/community/news-and-media-centre/the-future-of-cars-is-electric>, accessed 25 February 2018.

International institutions such as Bloomberg New Energy Finance have forecasted that electric vehicles will become cheaper than conventional internal combustion engine vehicles by 2022 even without subsidies or a global carbon price.[70]

The Committee heard that these forecasted dates will be affected by oil prices, vehicle purchase prices and public charging infrastructure availability in Australia. During the term of the earlier Victorian Government EV Trial (2010–14), the former Victorian Department of Transport commissioned AECOM, a leading infrastructure and project firm, to forecast the uptake and evaluation of electric vehicles in Victoria. In a 'mid-range scenario', AECOM forecast the sale of plug-in hybrids and other electric vehicles to comprise a small share of new vehicle sales until 2020. After that time the share of electric vehicles will grow to become a larger share of new vehicle sales compared to internal combustion engine vehicles.[71]

Even when price parity is gained in the leading markets overseas, the Committee heard that the uptake of electric vehicles could be slowed down by a number of factors such as, a lack of infrastructure and higher priced electric vehicles compared to internal combustion engine vehicles.[72] The Federal Chamber of Automotive Industries (FCAI) represents most major manufacturers and importers of vehicles to Australia. At a public hearing, Mr Ashley Wells, Policy Director of the FCAI stated:

> In 2016 an international consulting company by the name of IHS Markit undertook some modelling work for the federal government on the uptake of electric vehicles. Their assessment was that by 2030 we would be looking at around 2 per cent uptake in the new vehicle fleet.[73]

Mr Jafari of the Electric Vehicle Council had also noted that a rapid increase in the number of electric vehicles in Victoria would not be an immediate occurrence – given the average life of a traditional internal combustion engine vehicle is 12 years.[74]

2.5.2 Manufacture of electric vehicles

The major car manufacturers overseas have announced the manufacturing of more electric vehicles. For example, General Motors announced it is transitioning to a zero emissions future and 20 new electric models are on the way. Volkswagen

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70 Cited in: Dan Cass and Matt Grudnoff, *If you build it, they will charge: Sparking Australia's electric vehicle boom*, The Australia Institute, Canberra, 2017, p. i.

71 AECOM report cited in: Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 100.

72 Ashley Wells, Policy Director, Federal Chamber of Automotive Industries, *Transcript of evidence*, 13 February 2018, p. 32.

73 Ibid.

74 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 5.

announced that it will electrify its entire fleet by 2030.[75] In the absence of policy to support low and zero emission vehicles, it is possible that Australia could become a market for traditional vehicles in the future.[76]

The global growth in electric vehicle numbers also signals the potential for Victoria to participate in developing new electric vehicle technology that could benefit the State and other nations. Stakeholders such as JET Charge, a Victorian business that has innovated in the electric vehicle space by supplying locally-coded charging infrastructure told the Committee that without support for electric vehicles in Victoria, businesses and innovators will be limited in their ability to participate in the global development of related technology. At a public hearing in Melbourne, Mr Tim Washington, Founder of JET Charge, described the global uptake of electric vehicles as a 'race'. He told the Committee:

> There will be clear winners in this race. I will not say there are losers, but there are going to be clear winners. I think as a Victorian business we have to make a decision: do we want to be part of that circle or do we want to sit back and kind of let the rest of the world dictate what we should and should not take? Doing nothing is definitely an option... But from my perspective, if we choose to do nothing, then we will forever be a technology taker in this space and not a technology provider. Given that this is one of the greatest modal shifts in automotive history I think it is important for us to provide the technology that sits behind that, and there are Victorian businesses that are doing that right now.[77]

South Australia and the Australian Capital Territory (ACT) have implemented measures to promote the uptake of electric vehicles in their jurisdictions (see, Chapters Three and Four).

The following chapter will consider the types of incentives that could be introduced to support the uptake of electric vehicles in Victoria.

2.6 The potential environmental benefits of electric vehicles

The most commonly cited benefit of electric vehicles is their potential for reducing greenhouse gas emissions. Greenhouse gas emissions comprise Carbon Dioxide (CO_2) as well as other noxious gases such as Methane (CH_2) and Nitrous Oxide (N_2O). While CO_2 is normally reabsorbed by plant-life, higher emission rates have meant an increasing level of greenhouse gases trapped in the earth's atmosphere. This has contributed to negative environmental, health and economic consequences for populations worldwide.[78]

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75 NRMA, *The Future is Electric*, NRMA, Strathfield, NSW, 2017, p. 3.

76 Anna Mortimore, 'Australia's weaker emissions standards allow car makers to "dump" polluting cars', *The Conversation*, 30 September 2015, <https://theconversation.com/australias-weaker-emissions-standards-allow-car-makers-to-dump-polluting-cars-48172>, accessed 20 February 2018.

77 Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 18.

78 Department of Environment and Energy (Australia), 'Climate Change Impacts in Australia', <http://www.environment.gov.au/climate-change/climate-science-data/climate-science/impacts>, accessed 15 December 2017.

During the Inquiry environmental stakeholders including ClimateWorks Australia (hereon ClimateWorks), which aims to assist Australia achieve net zero emissions, informed the Committee that the transport sector is the fastest growing source of emissions in Australia 'increasing by 47.5 per cent since 1990'.[79] In Victoria, the transport sector currently accounts for 22 per cent of Victoria's total emissions.[80]

An earlier Victorian Auditor-General's Office report on the environmental impacts of transport similarly noted that the transport sector is the 'second largest producer of Greenhouse Gases in Victoria' with passenger vehicles responsible for 60 per cent of the State's transport-related greenhouse gas emissions.[81]

During the Inquiry, the Committee frequently heard that electric vehicles have an important role to play in reducing greenhouse gas emissions. Victoria is currently an emissions-intensive electricity generator, with 85 per cent of its electricity drawn from coal-fired power plants.[82] The Committee heard that the advent of greater numbers of electric vehicles on the road, offers opportunities for Victoria to lower its emissions.

2.6.1 Victorian renewable energy targets

With the Victorian Government's recent introduction of renewable energy targets, the Committee heard that driving electric vehicles charged from Victoria's energy sources will lead to lower emissions.

In 2016, the Victorian Government introduced renewable energy generation targets of 25 per cent by 2020 and 40 per cent by 2025. The *Renewable Energy (Jobs and Investment) Act 2017* (Vic) legislated the Victorian Renewable Energy Targets (VRET).[83] Other policy changes at the time included:

- The *Climate Change Act 2017*, which sets out a longer-term target of zero car emissions by 2050
- The TAKE2 pledge program
- The New Energy Jobs Fund
- The Renewable Energy Action Plan
- Government renewable energy purchasing.[84]

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79 ClimateWorks Australia, *Submission,* no. 37, p. 1.

80 Ibid., p. 2.

81 Victorian Auditor-General's Office, *Managing the Environmental Impacts of Transport*, Victorian Auditor-General's Office, Melbourne, 2014, p. ix.

82 Department of Economic Development Jobs Transport and Resources (Vic), 'Victoria's Earth Resources', <http://earthresources.vic.gov.au/earth-resources/victorias-earth-resources>, accessed 30 November 2017.

83 ClimateWorks Australia, *Submission,* no. 37, p. 2; Department of Environment Water Land and Planning (Vic), 'Renewable Energy Action Plan', <https://www.energy.vic.gov.au/renewable-energy/victorias-renewable-energy-action-plan>, accessed 28 February 2018.

84 Department of Environment Water Land and Planning (Vic), 'Renewable Energy Action Plan', <https://www.energy.vic.gov.au/renewable-energy/victorias-renewable-energy-action-plan>, accessed 28 February 2018.

The VRET is supported by the Victorian Renewable Energy Action Scheme (VREAS), which offers long-term contracts to successful renewable energy projects.

The Renewable Energy Action Plan outlines the actions that the Victorian Government will take to encourage investment in Victoria's energy sector and aims to ensure Victorians benefit from renewable, affordable and reliable energy into the future. Currently, the Victorian energy landscape is characterised by, the centralised production of energy from power plants and centrally-located transmission and distribution of electricity. The Government's Action Plan outlines the pathway to transition to large-scale sustainable production of energy from a mix of traditional and renewable sources to a future of:

- Clean and reliable energy generation
- Flexible and decentralised energy grids
- Consumer and community-driven energy services.[85]

A feature of the Government's Action Plan is to improve Victoria's energy storage. As part of this action, electric vehicles are envisioned to support localised energy storage as a new consumer product that offers a new electricity storage capacity.[86]

The Committee heard that electric vehicles could be beneficial for Victorians, including employment and environmental benefits.

2.6.2 Electric vehicles and emission reductions in Victoria

The Committee received mixed evidence about the CO_2 emission rate of electric vehicles charged on Victoria's electricity at present. Some stakeholders have noted that electric vehicles charged on electricity from Victoria's high emission, coal-fired power plants, only serve to 'displace' greenhouse gas emissions from the city to the power plants.[87]

In a submission, Victorian driver and owner of a sports utility plug-in hybrid vehicle, Mr Peter Horan, estimated the CO_2 emissions for the year before and after he switched from driving a conventional petrol-fuelled sedan to a plug-in hybrid. Mr Horan concluded that in switching to that vehicle, there was no significant reduction in CO_2 emissions. The volume of emissions produced was similar between the two vehicles: 2,559 kg of CO_2 emissions emitted by the plug-in hybrid electric vehicle in 2014 and 2,451 kg of CO_2 emitted by the conventional sedan in the previous year.[88]

He pointed out that there are presently no significant gains in CO_2 reductions by driving an electric vehicle in Victoria. Mr Horan noted however that there are significant gains by way of improved air quality and in operational savings. He

85 Ibid.
86 Ibid.
87 Peter Horan, *Submission,* no. 1, p. 1.
88 Ibid.

calculated that he saved $1,300 from using significantly less petrol for the plug-in hybrid electric vehicle. He also drove the plug-in hybrid electric vehicle further (10,519 km) than the sedan (9,696 km) when comparing the two types of vehicles.[89]

Other stakeholders stated that there are gains in CO_2 emissions reduction by driving electric vehicles now, which could be enhanced if governments enacted proactive decarbonisation policies. At a public hearing, Mr Scott Ferraro, Head of Implementation at ClimateWorks Australia told the Committee:

> There are a lot of questions that get raised around the emissions performance of an electric vehicle based on Victoria's grid today, which has an emissions intensity of about 1.06 tonnes of CO_2 per kilowatt hour, which is pretty high in terms of the Australian context as well. But based on some analysis we have done looking at a like-for-like vehicle – so comparing a Nissan Leaf with a Toyota Corolla, or a Tesla with a similar large-type vehicle – we anticipate at the moment EVs actually providing emissions savings based on conventional vehicles if powered solely from the grid. That is based on today's numbers.[90]

According to ClimateWorks' analysis, the Nissan Leaf would emit less CO_2 than the Mazda 3, Australia's top-selling car in the years leading up to 2030. In their analysis, an electric vehicle charging on energy from the National Electricity Market, will emit less CO_2 compared to a Mazda 3, which has an average emission rate of 154 gCO_2/km. If powered by renewably-sourced energy, an electric vehicle will achieve significant emission reductions (below 30 gCO_2/km by 2030).[91]

Mr Tim Olding, Director of the Sassafras Group, a Melbourne-based company specialising in transportation and energy policy has had 19 years of experience in automotive engineering at General Motors Holden.

Mr Olding has also had experience in the fields of electric vehicle design. He became chief engineer of a start-up company called electric vehicle Engineering, which built a fleet of fully electric Holden Commodores as a demonstration fleet. The company wanted to uncover how electric vehicles performed in comparison to petrol-fuelled vehicles. One of the questions they sought to answer was, 'how good is an electric vehicle compared to a petrol vehicle in terms of emissions and operating costs?'

The Committee heard that the company ran a series of 'real-world trials', where they took a standard Holden petrol-powered vehicle and the electric Holden on five different routes around Melbourne to replicate real-world driving conditions. The trials measured energy, fuel and electricity, to calculate CO_2 emissions from both types of vehicles.

Their results showed that the electric Holden Commodore emitted less CO_2 compared to the petrol-fuelled Commodore (see, Figure 2.1). Mr Olding explained:

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89 Ibid.

90 Scott Ferraro, Head of Implementation, ClimateWorks, *Transcript of evidence*, 8 November 2017, p. 25.

91 ClimateWorks Australia, *The Path Forward for Electric Vehicles in Australia*, ClimateWorks Australia, 2016, p. 19.

> ...the top blue line is the petrol, CO_2 per kilometre. The red is if you were using Victoriansourced coal as of 2017; this was done in 2012, but we have updated the results to 2017. The green is basically just assuming they are using electricity off the national energy market. And the purple is probably by 2020 where the national energy market would be. One of the great things about it is they [electric vehicles] get cleaner over time if your grid is going in the right direction in terms of emissions.[92]

Figure 2.1 **CO_2 emissions per kilometre for the petrol-fuelled Commodore and electric-powered Commodore**

Source: Mr Tim Olding, Sassafras Group.

Under the trials, the electric Commodores consistently emitted less CO_2 than the petrol-fuelled Commodores – an exception occurred on freeways. As Mr Olding explained, 'basically combustion engines get a bit more efficient the higher you load them... that is why the freeway condition is worse for the electric vehicle in terms of CO_2 emissions'.[93]

While the Committee received mixed views about the value of driving electric vehicles for CO_2 emission reductions now in Victoria, they will equate to greater CO_2 reductions as Victoria moves towards its renewable energy targets.[94] Mr Ferraro from ClimateWorks stated at a public hearing:

92 Tim Olding, Electric Vehicle Transport and Energy Consultant, Sassafras Group, *Transcript of evidence*, 13 February 2018, p. 40.

93 Ibid., p. 44.

94 Brian Tehan, *Submission,* no. 28, p. 1., Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 2.

> At the moment in Victoria we have 12 per cent renewable energy within the grid. Under the recently legislated [Victorian Renewable Energy Target] VRET we are looking to get 40 per cent by about 2025. We would estimate that an EV in this scenario would be somewhere in the range of 30 to 60 per cent less emission than today's average vehicle.[95]

Stakeholders consistently told the Committee that electric vehicles are zero emissions when they are charged on renewable energy.[96]

It is possible for electric vehicles to be powered by renewable energy in Victoria before the transition to more renewable energy in Victoria's electricity supply. In a submission, Beyond Zero Emissions, wrote:

> Consumers can readily purchase 'greenpower', where a rigourous certification system ensures sufficient electricity is generated from renewable sources to meet consumer demand.[97]

Carbon offsets and certification against the National Carbon Offset Standard are market-based mechanisms that can reconcile electric vehicles with renewably generated electricity.[98] In a submission, energy provider AGL explained that its Electric Car Plan will offset emissions through its Future Forests Program to facilitate low emissions driving for electric vehicle customers.[99]

2.6.3 Electric vehicles have recyclable batteries

During the Inquiry, the Committee heard that electric vehicles also have recyclable batteries. At a public hearing, Mr Behyad Jafari, Chief Executive Officer of the Electric Vehicle Council told the Committee that an electric vehicle's depleted battery can be reused:

> So the battery that goes into an electric vehicle today, we are working out how long in the life of that battery it exists as what we call a dynamic battery, one that moves around and powers a vehicle. From there it can be repurposed into stationary energy, so providing battery storage for a building — a commercial building or a home — and then from there as well the minerals can be extracted back out from the battery and repurposed.[100]

According to Pro-Vice Chancellor, Professor Ajay Kapoor at the Swinburne University of Technology, most conventional passenger vehicles have a useful life of 10 to 15 years. While electric vehicles cost more upfront, they tend to have a flatter maintenance cost over time with the first battery replacement in electric vehicles occurring at 7 to 10 years and then again at 15 to 20 years.[101] The Committee heard that a Melbourne-based start-up company called Relectrify

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95 Scott Ferraro, Head of Implementation, ClimateWorks, *Transcript of evidence*, 8 November 2017, p. 15.

96 Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 2; Hyundai Motoring Company Australia, *Submission,* no. 5, p. 10; ClimateWorks Australia, *Submission,* no. 37, p. 2.

97 Beyond Zero Emissions, *Submission,* no. 7, p. 2.

98 ClimateWorks Australia, *The Path Forward for Electric Vehicles in Australia*, ClimateWorks Australia, 2016, p. 20.

99 AGL Energy, *Submission,* no. 42, p. 6.

100 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 4.

101 Swinburne University, *Submission,* no. 46, p. 3.

has been repurposing used electric vehicle batteries for household storage purposes.[102] Chapter Five discusses the establishment of an electric vehicle end-of-life policy in Victoria.

2.6.4 Solar power and electric vehicles

The Committee also heard that electric vehicles can be powered on renewable solar power, harnessed by households and businesses. Currently there is a possibility for Victorian households and businesses with solar panelling to drive electric vehicles emissions free:

> At present, there are over 300,000 households and small commercial businesses in Victoria which have installed solar PV, so a large portion of potential electric vehicle purchasers will have access to renewables.[103]

Other stakeholders described the benefits of using solar power to charge electric vehicles. According to Dr Elliot Fishman, Director of the Institute for Sensible Transport in Melbourne:

> Electric vehicles offer an opportunity, especially in conjunction with household solar, and a lot of these lowincome areas actually have surprisingly high levels of household solar, so they can get access to relatively affordable fuel with which they can power their electric vehicle up in terms of charging their battery. So it does protect against oil vulnerability, and when we do get to the next oil shock, it will be the families that have EVs that will be protected. It will be sad, I think, if the only households that have those EVs are highincome, innercity households rather than those on the outer suburban fringe as well.[104]

The Committee heard that solar power represents an opportunity to reduce the drawdown of electricity from the grid when powering electric vehicles. The Goulburn Broken Greenhouse Alliance (GBGA) supports 11 Local Government Authorities in Victoria's north-eastern region on sustainability projects. According to Ms Marisa O'Halloran, Project Officer of the GBGA, increasingly, rural and regional councils in Victoria's north-east are installing solar panelling.[105] This provides an opportunity for councils in the region to reduce operating costs and provide environmental benefits. Ms O'Halloran stated:

> ...one thing that the councils do have is that generally we do not use our facilities during the weekend. So we know that a least two days a week whatever solar installation you have is going to be using minimal drawdown for actual council facilities. So you know you have got two days a week generally where that is all going into the grid, so it is an opportunity to charge vehicles over the weekend as opposed to during the week if that needs to be.[106]

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102 Relectrify, <https://www.relectrify.com>, accessed 28 February 2018.

103 ClimateWorks Australia, *Submission,* no. 37, p. 2.

104 Dr Eliot Fishman, Director, Institute for Sensible Transport, *Transcript of evidence*, 13 February 2018, p. 67.

105 Marisa O'Halloran, Project Manager, Goulburn Broken Greenhouse Alliance, *Transcript of evidence*, 13 February 2018, p. 27.

106 Ibid.

Transport for Victoria is the State Government's transport agency. At a public hearing, Mr Paul Salter, Acting Executive Director of Network Strategy at Transport for Victoria stated that there are currently complex factors that affect whether electric vehicles powered on Victoria's electricity lead to reduced CO_2 emissions:

> With renewable energy, we would certainly expect that to be the outcome, but it does depend somewhat on behaviour and the availability of that power. If most people are charging at night, then there is limited scope to make use of renewable power. Most of the new renewable power sources coming online, particularly solar, obviously are not available at night. Having said that, there is obviously new investment in hydroelectric and there is new investment in wind. The changes in the mix of the power is happening all the time. These things are all very much dynamic...[107]

However, Mr Salter noted that Victoria's energy mix is in a dynamic process of change as more renewables from diverse sources including hydro-electric power and wind power are introduced into the system.[108]

The Committee heard that some electric vehicle drivers in Victoria are looking to install solar panelling to power their vehicles for environmental benefits to be gained.[109] At a public hearing, the Committee was pleased to hear from Mr Bryce Gaton, Executive Committee member of the Victorian branch of the AEVA who said that some people are starting to package solar panelling and the installation of electric vehicle supply equipment in homes and workplaces.[110]

2.6.5 Electric vehicles represent a low-cost option to support reduce transport emissions

The Committee received evidence that the most cost-effective pathway for Victoria to reduce its greenhouse gas emissions and to meet its target of zero emissions by 2050, is to support a widespread switch to electric vehicles alongside a shift to renewable energy sources.[111] In their submission, ClimateWorks explained:

> ClimateWorks modelling shows that the electrification of passenger vehicles, combined with decarbonising the electricity grid, could reduce Victoria's emissions by up to approximately 4 $MtCO_2$ in 2030. This is more than a 30 per cent reduction on current emissions in the passenger vehicle sector, assuming that electric vehicles account for 39 per cent of passenger vehicle kilometres travelled.[112]

Similarly, Beyond Zero Emissions concluded in a recent report on electric vehicles that:

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107 Paul Salter, Acting Executive Director - Network Strategy, Transport for Victoria, *Transcript of evidence*, 13 February 2018, p. 3.

108 Ibid.

109 Coralie Coulson, *Submission,* no. 11., Amanda Best, *Submission,* no. 39.

110 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 20.

111 Beyond Zero Emissions, *Submission,* no. 7, p. 1., ClimateWorks Australia, *Submission,* no. 37, p. 1.

112 ClimateWorks Australia, *Submission,* no. 37, p. 2.

> A rapid shift to electric vehicles operating on 100 per cent renewable electricity is both realistic and affordable.[113]

Beyond Zero Emissions found that at the high end of their modelling, a proactive transition to 100 per cent electric cars by 2025 would cost Australians approximately 25 per cent more – equating to an extra $20 per capita, per week. Their modelling also found that a 100 per cent transition to electric cars could cost nothing extra in a scenario where electric vehicles gain price parity with internal combustion engine vehicles faster, and petrol prices fluctuate in the future, to the higher end of their projections.[114] Beyond Zero Emissions projected that moving urban passenger vehicles to an electric fleet powered by renewable electricity, would eliminate 55 million tonnes of CO_2 each year, providing environmental, health and economic benefits to Australia.[115]

2.7 Public health benefits with the advent of more electric vehicles

By world standards, Australia's air is very clean. However, as the Australian Department of Environment and Energy states, 'levels of some pollutants, including ground-level ozone and particulate matter, can still exceed current air quality standards'. Further, as population and urbanisation continues to increase, the demands for transportation and energy consumption will have an impact on Australia's air quality.[116]

In addition to CO_2, the tailpipe emissions from conventional internal combustion engine vehicles are damaging to human health and the environment. These noxious emissions include: Carbon Monoxide, non-methane volatile organic compounds, nitrous oxides and particulate matters, which are known to contribute to Cancer, heart disease and respiratory problems, among other illnesses.[117] The World Health Organisation (WHO) states that air pollution is the most significant environmental cause of ill health.[118] According to the Organisation for the Economic Cooperation and Development (OECD), globally, more than 3.5 million people die each year from air pollution, with noxious vehicle emissions being a primary contributor to poor air quality in cities.[119]

FINDING 5: While increasing the number of electric vehicles in Victoria is unlikely to lead to significant reductions in Carbon Dioxide (CO2) without a shift to renewable energy sources, more electric vehicles on the road will lead to an improvement in air quality in Metropolitan Melbourne.

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113 Beyond Zero Emissions, *Electric Vehicles Report*, Beyond Zero Emissions, Melbourne, 2016, p. 2.

114 Ibid., pp. 2-3.

115 Ibid., p. 1.

116 Department of Environment and Energy (Australia), 'Air quality', <http://www.environment.gov.au/protection/air-quality>, accessed 28 November 2017.

117 World Health Organisation, 'Air pollution', <http://www.who.int/topics/air_pollution/en>, accessed 18 December 2017.

118 World Health Organisation, 'Global platform on air quality and health', <http://www.who.int/phe/health_topics/outdoorair/global_platform/en>, accessed 18 December 2017.

119 The Organisation for Economic Co-operation and Development (OECD), *The Cost of Air Pollution: health impacts of road transport (policy highlights)*, OECD Publishing, 2014.

2.7.1 Internal combustion engine vehicles and public health in Australia and in Victoria

The Committee received evidence on the negative impact of internal combustion engine vehicles on public health in Victoria. Stakeholders often cited evidence submitted to the Federal Government's Ministerial Forum on Vehicle Emissions, which aims to address emissions from motor vehicles. The Ministerial Forum released a discussion paper in 2016 seeking public feedback on potential measures to reduce vehicle emissions in Australia. It also released a further three consultation papers on improving the efficiency of new light vehicles; strengthening noxious emissions standards for light and heavy vehicles; and improving fuel quality standards.[120]

In a joint submission to the Ministerial Forum's 'Better fuel for cleaner air' discussion paper, the Clean Air and Urban Landscapes Hub (CAUL) (a consortium of four universities, the University of Melbourne, RMIT University, the University of Western Australia and the University of Wollongong) and the Melbourne Energy Institute, gathered evidence on how poor air quality from vehicle emissions damages public health – particularly affecting vulnerable members of society including children and the elderly.

One stakeholder for this Inquiry described the health benefits that may be gained if electric vehicles replace internal combustion engine vehicles on Victoria's roads:

> Emissions from the use of internal combustion engine cars is likely to cause around 500 – 1,000 deaths in Australia every year. This is broadly equivalent to the annual road toll of around 1,200 fatalities every year.[121]

Similarly, at a public hearing in Melbourne, the Committee heard from Moreland City Council – one of the first Local Government councils to adopt electric vehicles into their fleet. Citing the CAUL and Melbourne Energy Institute's submission to the Ministerial Forum, Mr Stuart Nesbitt, Climate Change and Technical Officer at Moreland council stated:

> Air pollution due to vehicle emissions is estimated to have caused 1715 deaths in Australia in 2015 – greater than the national road toll in that year.[122]

Mr Nesbitt and Ms Sue Vujevic, Manager of City Strategy and Design at Moreland Council told the Committee that Moreland's decision to introduce a policy to transition to a zero emission fleet is based on the health and environmental benefits of electric vehicles.

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120 Department of Infrastructure Regional Development and Cities (Australia), 'Ministerial Forum on Vehicle Emissions', <https://infrastructure.gov.au/roads/environment/forum>, accessed 19 January 2018.

121 Beyond Zero Emissions, *Submission,* no. 7, p. 2.

122 Stuart Nesbitt, Climate Change Technical Officer, Moreland City Council, *Transcript of evidence*, 8 November 2017, p. 18. Cites, Robyn Schofield Claire Walters, Jeremy Silver, Michael Brear, Peter Rayner and Martin Bush (Melbourne: Clean Air and Urban Landscaps Hub and Melbourne Energy Institute) *Submission*, March 2017, Better Fuel for Cleaner Air discussion paper, Ministerial Forum on Vehicle Emissions, Australian Government, p. 15.

CAUL and the Melbourne Energy Institute's submission to the Ministerial Forum on Vehicle Emissions, described the impact of noxious tailpipe emissions from internal combustion engine vehicles on public health in Victoria. For example, their submission noted particular 'hotspots' of poor health due to vehicle emissions. According to their submission to the Ministerial Forum, metropolitan schoolchildren's highest daily exposure to noxious air pollutants are experienced during the commute to school and outdoor school activities. They stated that the City of Maribyrnong in Melbourne's west is an area particularly affected by noxious emissions from internal combustion engine vehicles:

> Maribyrnong in Melbourne's Inner West is situated between the port and container yards. It records 21,000 trucks per day, the majority of which travel on residential streets, stopping and starting at multiple traffic lights in close proximity to a number of school outdoor play areas and childcare centres. The reported asthma incidence of children in this area is double the national rate.[123]

In a 2016 report on the health and wellbeing of residents, the Maribyrnong City Council identified key trends for the city's population. They noted that poor air quality and traffic noise in their city are expected to increase. Maribyrnong City Council also stated that many of its kindergartens, schools and childcare centres are located near noisy and air polluted roads.[124]

The impact of poor air quality on public health amounts to a significant economic cost in Australia. According to the Ministerial Forum's 'Better Fuel for Cleaner Air discussion paper' the estimated cost to Australia of premature death, illness and lost productivity from poor air quality is approximately $7.7 billion (AUD). In their joint submission, CAUL and the Melbourne Energy Institute, estimated is the cost to be closer to $17.8 billion (AUD).[125]

2.8 Electric vehicles reduce transport noise and improve amenities

The Committee heard that electric vehicles could potentially benefit Victorians by reducing transport and traffic noise and by improving amenities.[126]

AEVA is a not-for-profit, volunteer-run association dedicated to promoting electric vehicles. In a submission, the Victorian branch of the Association described the benefits of electric vehicles and the positive experience of driving a quieter vehicle:

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123 Robyn Schofield Claire Walters, Jeremy Silver, Michael Brear, Peter Rayner and Martin Bush (Melbourne: Clean Air and Urban Landscaps Hub and Melbourne Energy Institute) *Submission*, March 2017, Better Fuel for Cleaner Air discussion paper, Ministerial Forum on Vehicle Emissions, Australian Government, p. 15. See also, Maribyrnong City Council, *Municipal Scan: health and wellbeing profile of the residents living in the City of Maribyrnong*, Maribyrnong City Council, 2016, p. 43.

124 Maribyrnong City Council, *Municipal Scan: health and wellbeing profile of the residents living in the City of Maribyrnong*, Maribyrnong City Council, 2016, p. 43.

125 Robyn Schofield Claire Walters, Jeremy Silver, Michael Brear, Peter Rayner and Martin Bush (Melbourne: Clean Air and Urban Landscaps Hub and Melbourne Energy Institute) *Submission*, March 2017, Better Fuel for Cleaner Air discussion paper, Ministerial Forum on Vehicle Emissions, Australian Government, p. 10.

126 See for example, Australian Electric Vehicle Association (Vic), *Submission,* no. 14., Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 110.

> Electric vehicles are very quiet in operation, so widespread adoption would reduce the noise in areas of heavy traffic in congested inner suburban and metropolitan areas considerably. In addition less noise inside the car reduces the stress on the driver. Personal observation suggests that electric vehicles promote more efficient and safer driving techniques, which also reduce stress. Together, this is likely to reduce the change of traffic accidents.[127]

SEA Electric is a Victorian automotive technology company specialising in the electrification of commercial vehicles. Mr Tony Fairweather, Managing Director of SEA Electric similarly told the Committee that the noises made by the exhaust brakes of conventional trucks, which are frequently heard in Melbourne's suburban areas, would diminish with the use of electric-powered trucks.[128]

Mr Fairweather said that their clients have been particularly attracted to the quietness of electric-powered vehicles, which enable them to operate at times of the evening when there are traffic noise restrictions. Mr Fairweather stated that one of their clients, Kings, is interested in SEA Electric's 14-tonne truck for this reason:

> We are dealing with Kings, one of our customers, at the moment. One of their clients is interested in the 14-tonne product to be able to get into a particular site after hours... There are particular restrictions that are put on our clients from a noise perspective...[129]

According to the Environment Protection Authority in Victoria (EPA) 'road traffic is the most common source of noise in Victoria'.[130] The EPA states that it is also the 'loudest noise source' experienced by Victorians above other common sources of noise pollution such as, 'neighbour noise' and construction noise.[131] According to the EPA's Noise Surveys conducted during 2006 and 2007, road traffic noise is heard by 70 per cent of Victorian residents and it significantly 'bothered, annoyed or disturbed' 20 per cent of people annually, which was over a million Victorians at the time of their surveys.[132] Noise pollution is a cause of stress and ill health. With a growing population in Victoria and increasing urban density, there are some benefits in uptake of electric vehicles in the improvement of amenities.

2.8.1 Sound standard in electric vehicles to ensure audibility for pedestrians

The Committee is aware that the quietness of electric vehicles poses a potential threat to pedestrians.[133] In a submission, Blind Citizens Australia, 'the peak consumer body of and for Australians who are vision impaired or blind', wrote:

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127 Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 3.

128 Tony Fairweather, Managing Director, SEA Electric, *Transcript of evidence*, 8 November 2017, p. 31.

129 Ibid., p. 34.

130 Environment Protection Authority Victoria, '2007 Noise Surveys', <http://www.epa.vic.gov.au/your-environment/noise/2007-noise-surveys>, accessed 28 November 2017.

131 Environment Protection Authority Victoria, 'Motor vehicle, train and tram noise', <http://www.epa.vic.gov.au/your-environment/noise/motor-vehicle-train-and-tram-noise>.

132 Environment Protection Authority Victoria, '2007 Noise Surveys, <http://www.epa.vic.gov.au/your-environment/noise/2007-noise-surveys>', accessed 28 November 2017.

133 Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 110.

> Hybrid and electric vehicles have a virtually silent motor when idling or travelling at a slow speed. These vehicles therefore pose a serious threat of injury or death to those who rely on their hearing to assess whether it is safe to cross roads, or move through high-risk areas such as carparks. These risks are also applicable to cyclists, children, the elderly and people who are distracted by phones or other devices or otherwise inattentive while crossing a road.[134]

As their submission further noted, the European Union and the U.S. have introduced regulations to include standards of sound in electric vehicles to alert pedestrians to the presence of the speed and direction of vehicles. In the EU, the installation of artificial sound generators in all electric and hybrid vehicles will be required by 2021 to improve safety for pedestrians.[135] In the U.S., the federal Department of Transportation's National Highway Traffic Safety Administration announced that it is adding a sound requirement for all newly manufactured hybrid and electric light-duty vehicles to help protect pedestrians in 2016.[136]

This issue was recognised earlier during the Victorian Government EV Trial. Authors of the mid-term trial report stated that the Australian Government had committed to harmonisation with international vehicle safety standards. Electric vehicle safety standards should align with new standards in the audibility of electric vehicles and that the Federal Government could ensure such a standard within the Australian Design Rules and the *Motor Vehicle Standards Act 1989*. The Act requires all road vehicles manufactured in Australia or imported, to comply with the Australian Design Rules.[137]

2.9 Electric vehicles may reduce Victoria and Australia's fuel insecurity

One of the benefits of a higher uptake of electric vehicles would be Australia and Victoria's withdrawal from their current high dependence on foreign oil imports. As one Victorian driver, Mr Brian Tehan, described in a submission 'the greater the electric fleet, the less dependence on imported fuel supplies'.[138] Volatile and high fuel prices add pressure to Australian and Victorian drivers. In their submission to this inquiry, Beyond Zero Emissions stated:

> Electric vehicles have the potential to reduce reliance on imported oil... Research indicates that oil price volatility of liquid fuels is likely to continue or increase in the future.[139]

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134 Blind Citizens Australia, *Submission,* no. 34, p. 1.

135 European Environment Agency, 'Environmental Noise', <https://www.eea.europa.eu/airs/2017/environment-and-health/environmental-noise>, accessed 29 November 2017.

136 United States Department of Transportation, 'NHTSA sets 'quiet car' safety standard to protect pedestrians', <https://www.transportation.gov/briefing-room/nhtsa2716>, accessed 18 December 2017.

137 Department of Infrastructure Regional Development and Cities (Australian), 'Australian Design Rules', <https://infrastructure.gov.au/roads/motor/design>, accessed 7 December 2017.

138 Brian Tehan, *Submission,* no. 28, p. 1.

139 Beyond Zero Emissions, *Submission,* no. 7, p. 3.

While the majority of all cars in Australia are fuelled by petrol (which is also the case in Victoria) Australia is highly dependent on fuel from other countries, which is primarily imported from the Middle East and transported through Asia.[140]

In 2013 and 2014, the National Roads and Motorists' Association (NRMA) commissioned security expert Air Vice Marshall John Blackburn AO to report on Australia's Liquid Fuel Security. Blackburn reported on the low fuel stock held in Australia and Australia's decreasing capacity to refine fuel imported from overseas. As of April 2012, there was the equivalent of 23 days of fuel stock held in Australia, with increasingly dire predictions through to 2030. A shortage of fuel equates to serious consequences for Australia, as Blackburn explained:

> Australians will suffer food shortages, will not have adequate access to medical services or pharmaceutical supplies, will not be able to get to work and, if the problem lasts for more than a few weeks, many will no longer have work to go to. It is that serious.[141]

Blackburn's report advised of a number of measures to bolster Australia's fuel security including by reducing the demand for imported fuel.[142] According to Mr Jafari of the Electric Vehicle Council, Australia has more reason than other nations to benefit from a switch to electric vehicles because of its dependency on imported fuel. He believes that Australia should take action to support the availability of electric vehicles in the market.[143]

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140 Behyad Jafari, 'Australia needs electric vehicles more than any other nation', *ABC News*, 6 October 2017, <http://www.abc.net.au/news/2017-10-06/australia-needs-electric-vehicles-more-than-any-other-nation/9022252>, accessed 13 December 2017.

141 John Blackburn AO, *Australia's Liquid Fuel Security - Part 2: a report for NRMA Motoring and Services*, February 2014, p. 12.

142 Ibid., p. 15.

143 Behyad Jafari, 'Australia needs electric vehicles more than any other nation', *ABC News*, 6 October 2017, <http://www.abc.net.au/news/2017-10-06/australia-needs-electric-vehicles-more-than-any-other-nation/9022252>, accessed 13 December 2017.

3 Measures for electric vehicle private ownership

This Chapter considers the measures that the Victorian State government could implement relating to private ownership of electric vehicles in Victoria.

Leading markets such as the U.S., Europe and Asia have increased new electric vehicle sales by offering various incentives. Public charging infrastructure for electric vehicles has also been provided by governments in these jurisdictions. As a result, consumers in these markets are being provided with the confidence to purchase electric cars.[144] As researchers at the International Council on Clean Transportation (ICCT) stated:

> It is widely expected the electric vehicle costs will reduce over time, and that until then a combination of supporting incentives and policy will be key in accelerating the early market development.[145]

The Committee heard there is a degree of inevitability to the take up of electric vehicles as the primary mode of transport globally over the next five to ten years. The question is not whether we will be driving electric vehicles but when will they become our main form of transport?

There are a number of ways the Victorian Government could assist with the uptake of electric vehicles in the private market, namely by:

- Establishing a State electric vehicle target
- Reducing the upfront costs for consumers of electric vehicles in Victoria
- Offering non-financial incentives such as special vehicle lane access and parking privileges
- Future-proofing Victoria by supporting the development of a comprehensive and reliable network of electric vehicle charging infrastructure.

These measures would remove range anxiety; signal to the major electric car manufacturers overseas that Victoria is a viable growing market for electric vehicles; and future-proof Victoria in the inevitable transition to electric vehicles.

Victoria's electric vehicle charging infrastructure needs are considered in the second half of the Chapter.

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144 Zifei Yang, et al., *Principles for effective electric vehicle incentive design*, The International Council on Clean Transportation, Washington, 2016, p. 1.

145 Ibid.

3.1 Unlocking electric vehicle uptake

The barriers to electric vehicle uptake in the private market are widely known. Consumers are reluctant to purchase an electric vehicle because of the:

- High upfront cost and the limited low-cost models available in the Australian market
- Range anxiety (or the fear of being stranded without battery life)
- Limited choice of models in the Australian market.[146]

The Committee heard that the high upfront cost of electric vehicles and the limited choice of vehicles available in Australia, poses a significant barrier to the uptake of electric vehicles in the private market. In 2016, Climateworks Australia and the Electric Vehicle Council compiled information on the electric vehicles (and plug-in hybrid electric vehicles) for sale in the Australian market. They found a total of 16 models available, 13 of which were priced over $60,000. There were only 3 models sold in Australia, the Nissan Leaf, Mitsubishi Outlander and the Renault Kangoo, which were priced under $60,000.

Moreover, during 2016, the Nissan Leaf was only available early in the year; the Mitsubishi Outlander was sold out by mid-2016 and the Renault Kangoo ZE is a commercial van only available to consumers by arrangement with Renault, further limiting the availability of affordable electric vehicles to the Australian market.[147] The Renault Zoe ('the best-selling electric vehicle in Europe')[148] is currently only available for business-to-business and government purchase.[149]

3.1.1 Victorian consumers are interested in purchasing electric vehicles

Recent surveys conducted by the Royal Automobile Club Victoria (RACV) and the road toll authority, Eastlink, have indicated that Victorian motorists would consider purchasing an electric vehicle if more government support was available.

The RACV represents over 2.1 million members in Victoria. On average, three out of four Victorian households include an RACV member.[150] The RACV is a member of the Electric Vehicle Council and a member of the council's Charging Infrastructure Working Group. The working group is 'focusing on a coordinated and standardized approach in the rollout of electric vehicle charging infrastructure in Australia'.[151]

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146 See for example, Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 47. See also, ClimateWorks Australia, *The Path Forward for Electric Vehicles in Australia*, ClimateWorks Australia, 2016, p. 10.

147 Electric Vehicle Council ClimateWorks Australia, *The state of electric vehicles in Australia*, 2017., p. 8.

148 InvertedPower, *Submission,* no. 223, p. 3.

149 Ibid; Renault, 'Renault Electric Vehicles', <http://www.renault.com.au/all-new-electric>, accessed 15 February 2018

150 RACV, *Submission,* no. 49, p. 1.

151 Ibid.

According to a submission, in 2017, the RACV undertook an 'electric vehicle consumer attitudes survey', which found that over half of their respondents would consider buying an electric vehicle if in the market for a car. The RACV reported the key findings from their consumer survey:

- More than a quarter of respondents would be willing to pay more for an electric vehicle than a petrol or diesel vehicle only if there were more support, incentives and infrastructure in place.[152]
- More than 55% respondents think subsidies to reduce the cost to purchase electric vehicles should be implemented by government and a similar percentage (53%) believe government should implement subsidies to reduce the cost of installing home charging, and provide public charging infrastructure.
- 80% of respondents consider the availability of public fast charging (i.e. 15 minutes to full charge) to be an important factor in influencing their decision to buy/ own an electric vehicle.[153]

The RACV has also found that a significant number of Victorians believe that the development of alternative energy vehicles can provide a 'major solution to reducing the environmental impacts of motoring'.[154] The RACV concluded:

> Based on what our members have told us, and what we have found through the varied electric vehicle activities we have undertaken, RACV supports measures and incentives by government to encourage the uptake of electric and ultra-low emissions vehicles (such as plug-in hybrid), on the proviso that consumer choice and affordability is not detrimentally affected. In doing so, it is critically important that adequate recharging infrastructure and appropriate standards are in place to support the uptake of electric vehicles (e.g. plug consistency and charger interoperability).[155]

During 2017, Eastlink surveyed 15,000 Victorian drivers and similarly found more than half of respondents were no longer considering a traditional internal combustion engine vehicle for their next vehicle purchase and a quarter were considering an electric vehicle as their next vehicle-of-choice.[156]

3.1.2 Car manufacturers seek a signal that the electric vehicle market will grow in Australia

Given Australia's relatively low uptake of electric vehicles, the Committee heard that the major car manufacturers do not currently see a business case for bringing out a greater range and number of new technology and more affordable electric vehicle models to Australia.[157]

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152 Ibid., p. 2.

153 Ibid.

154 Ibid.

155 Ibid.

156 ClimateWorks Australia, *Submission,* no. 37, p. 3. See also, EastLink, *Eastlink announces results of first annual Victorian self-driving vehicle survey*, media release, EastLink, Melbourne, 9 October 2017.

157 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 5.

ClimateWorks Australia and other industry stakeholders noted this reluctance to supply vehicles in *The Path Forward for Electric Vehicles* (2016). Nissan Australia's CEO, Mr Richard Emery, stated that car manufacturers need government assistance. Mr Emery said that they need 'the same kind of assistance that governments in Europe, the USA and Japan provide' to overcome the barriers to electric vehicle uptake in Australia and increase model availability.[158]

During the Inquiry, the Committee received similar evidence from the Australian representatives of three major global car manufacturers (Hyundai, Toyota and Nissan). In their submission, the Hyundai Motoring Corporation Australia (HMCA) reiterated the need for government assistance for electric vehicles in Australia. HMCA stated:

> The Australian market is almost unique amongst developed global markets in not offering any meaningful incentives to drive consumer purchase of qualifying green vehicles, nor any incentive for the creation of supporting infrastructure for such vehicles.

HMCA recommended:

> that State Governments should introduce a range of financial and practical market incentives to encourage greater consumer adoption of EV motoring...[159]

Hyundai stated that it is looking to release its IONIQ range of electric vehicles and plug-in hybrid electric vehicles in Australia in 2018-2019.

Toyota Australia similarly argued that both the Victorian and Federal Governments could introduce initiatives for electric vehicles and hydrogen fuel cell vehicles. In their submission, Toyota Australia identified the need for corresponding infrastructure and the potential for the Government to introduce a range of monetary and non-monetary consumer incentives to drive the uptake of electric vehicles and other complementary low and zero emission vehicles. These incentives, could include:

- Rebates for low emission vehicles that reduce the price gap between traditional internal combustion engine vehicles and technologically advanced cars
- Reduced stamp duty and vehicle registration costs
- Preferential traffic and parking conditions for low emission vehicle owners
- Rebates for trading in older higher polluting vehicles for newer low emission vehicles.[160]

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158 Cited in: ClimateWorks Australia, *The Path Forward for Electric Vehicles in Australia*, ClimateWorks Australia, 2016, p. 10.

159 Hyundai Motoring Company Australia, *Submission,* no. 5, p. 5.

160 Toyota Australia, *Submission,* no. 29, pp. 6-7.

The Committee heard that the major car manufacturers are investing in alternative vehicle technology including hydrogen fuel cell technology. They are urging the Federal and State Governments to create a regulatory environment for electric vehicles and fuel cell vehicles, and provide assistance for consumers to make the change to electric vehicles and fuel cell vehicles.

Similarly, in a submission, the Nissan Motoring Company Australia wrote:

> The success of the Nissan LEAF electric car in regions such as North America, Europe, Japan and China is underpinned by the same two factors driving the wider consumer uptake of EVs overseas:
>
> - Government-led purchase incentives for new-car consumers to select an electric car, and;
> - Wide-spread publicly available electric vehicle recharging infrastructure, with full or partial funding from US and EU governments.[161]

Other major car manufacturers have announced their transition to zero emissions vehicles in recent announcements. General Motors has 20 new electric models on the way; Volkswagen Daimler and BMW Groups have committed $75 billion to electric cars; Volkswagen has stated that it will electrify its entire fleet by 2030 and Ford has announced it is shifting away from internal combustion engine vehicles to electric vehicles.[162]

3.1.3 Options for Victoria

In assessing the regulatory and infrastructure options and financial and other incentives that could suit Victoria, the Committee looked at evidence received from stakeholders across the board. Of those suggested, the following incentives may be suitable for implementation in Victoria:

- Establishment of a State electric vehicle target and corresponding strategy that complements the Victorian Renewable Energy Targets and sets a target figure for the number of electric vehicles on the roads by certain dates
- Support for Commonwealth government initiated vehicle emission regulations that outline a preference for low emitting vehicles including electric vehicles
- Upfront purchase incentives that include reducing or removing the current Luxury Car Tax 'penalty' for electric vehicles
- Reducing the Stamp Duty for electric vehicles
- Driver benefits such as the introduction of time limited traffic and parking privileges for electric vehicle drivers
- Partnering with key stakeholders including Local Government and industry in the planning, design and roll out of charging infrastructure.

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161 Nissan Australia, *Submission,* no. 222, p. 1.

162 NRMA, *The Future is Electric*, NRMA, Strathfield, NSW, 2017.

These options would require the development of Victoria-specific policies and collaboration with other states and territories. The Victorian Government would also need to work with the Federal Government to align incentives and standardise the deployment of infrastructure across the nation. These options are discussed in detail further below.

Other chapters in this report outline related findings on the uptake of electric vehicles:

- The potential to introduce all-electric vehicles into the public sector fleet (see, Chapter Four)
- An electric bus trial in Victoria (see, Chapter Four)
- Support for electric vehicle manufacturing and assemblage, and support for existing automotive industry workers including retail, service and repair workers in the industry (Chapter Five)
- Support for car-share providers to introduce electric vehicles into their fleets (Chapter Six).

3.1.4 Government actions overseas

Governments in the leading markets overseas have introduced a range of policy incentives and support for infrastructure for electric vehicles. Research produced by the International Council on Clean Transportation (ICCT) illustrates the actions taken by governments in the leading electric vehicle markets (that is in the U.S., Europe and Asia). A snapshot of these actions include:

- Government funding in the vehicle manufacturing sector towards: research and development, long-term vehicle efficiency standards, charging infrastructure, and vehicle production and purchase subsidies
- Government introduction of consumer purchasing incentives, such as, vehicle purchase subsidies that are given to the consumer as a tax credit or as a government rebate on the cost of the electric vehicle
- Consumer use incentives, such as: annual vehicle fee exemptions, discounted or free electric vehicle charging, preferential lane access and reduced roadway or tolls and preferential parking access
- Infrastructure-focused actions, such as, public charging network funding and home charging equipment tax incentives.[163]

In an earlier ICCT white paper (July 2015) assessing electric vehicle promotion activities in the most populous U.S. cities, researchers found 'the top EV adoption cities' tended to have 'some combination of more EV promotion action, greater charging infrastructure per capita, greater consumer incentives and greater model availability'.[164] Policy also supports electric vehicle sales. In the same

163 Nic Lutsey, *Transition to a Global Zero-Emission Vehicle Fleet: A Collaborative Agenda for Governments (White Paper)*, The International Council on Clean Transportation, Washington, 2015, p. 16.

164 Nic Lutsey, et al., *Assessment of leading electric vehicle promotion activities in United States cities (2015)*, The International Council on Clean Transportation, Washington, 2015, p. v.

report focusing on the U.S. market, the ICCT found that car manufacturers targeted state jurisdictions where there were zero emission vehicle policies, which has spurred electric vehicle sales in these states and cities.[165]

Stakeholders told the Committee that governments can help with the development of an electric vehicle market, which would help move electric vehicles from the early high-cost stage to larger volume, greater economies of scale and lower costs of electric vehicles for consumers.[166]

3.1.5 Electric vehicle assistance in Australian states and territories

In *The State of Electric Vehicles* (June 2017) report by ClimateWorks Australia and the Electric Vehicle Council, an overview of Australian states and territories and the types of electric vehicle initiatives deployed by state governments is shown in Figure 3.1. According to this information, the Victorian Government is falling behind in terms of development of regulations, incentives and initiatives for electric vehicles. Of the options listed, the Victorian Government offers a discounted registration fee for hybrid and electric cars.

Figure 3.1 Overview of federal, state and territory government policy

		ACT	NSW	NT	QLD	SA	TAS	VIC	WA	FED
Uptake	EV purchases 2011 - 2016	125	843	12	541	805	56	1017	298	3697
	EV sales per 10,00 vehicles (2016)	18	7	4	5	9	5	8	3	7
Regulation	Vehicle CO_2 emissions standards									O
Financial incentives	Stamp duty, registration and tax discounts	✓	✓	✓	✓		O	✓		✓
	Direct vehicle subsidy						O			
	Fleet incentive						O			✓
	Charging infrastructure support	✓		O	✓	✓	✓*			
Non-financial incentives	Vehicle lane and parking privileges	✓					O			
	Electric vehicle public transport trials			✓		✓				
	Government fleet initiatives	✓	✓			✓	✓			
	Information and education programs	✓			✓*	✓	✓			✓

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

Source: ClimateWorks Australia and the Electric Vehicle Council, *The State of Electric Vehicles*, (June 2017), p. 12.

165 Ibid.

166 Zifei Yang, et al., *Principles for effective electric vehicle incentive design*, The International Council on Clean Transportation, Washington, 2016, p. iv., Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 2.

3.1.6 A State electric vehicle target

A number of governments worldwide have established national electric car deployment targets as part of their 'clean energy and mobility ambitions'.[167] In 2016, there were 14 countries with electric car targets. They include: Austria, China, Denmark, France, Germany, India, Ireland, Japan, the Netherlands, Portugal, Korea, Spain, the United States and the United Kingdom.[168] The Committee heard that setting a target figure for the number of electric vehicles on the roads by certain dates, could be a viable Victorian Government action to support electric vehicle uptake.

South Australia's Carbon Neutral Adelaide Action Plan 2016-21 outlined five pathways to achieve carbon neutrality, which included the aim of decarbonising transport in the city. Goals under the 'zero emissions transport' pathway included: increasing the proportion of electric vehicles and hybrid new vehicles registered in South Australia to at least 30 per cent by 2025, and increasing the number of publicly accessible electric vehicle recharge points in the city to 250 by 2020.[169]

In a submission, Environment Victoria stated that setting a State electric vehicle target, such as having 10,000 electric vehicles on Victorian roads by 2020, would demonstrate a commitment that would encourage the major car manufacturers to import models to Australia.[170] Stakeholders such as the Central Victorian Greenhouse Alliance, have noted that 'one of the greatest barriers to EV uptake is familiarity'.[171] Increasing the numbers of electric vehicles in public sector fleets as well as in the private market will help to encourage consumer familiarity with electric vehicles across Victoria. =

In their submission, energy provider and retailer, AGL supported the introduction of a State EV target as a key feature of Victorian Government action to increase EV uptake:

> Establishing a target for EV uptake is the centrepiece of most international government policy support frameworks for EVs, with other policies and their relative settings crafted to achieve that target. Given that transport infrastructure is substantially a matter for State jurisdictions, we consider that planning and deployment of EV charging infrastructure should be designed around a State EV target. Just as the Victorian Government has recently legislated its Renewable Energy Target, we consider that a State EV target would act as the complementary driver for the transport sector's necessary transition towards a lower-carbon economy. Indeed, a State EV target would provide a powerful platform to drive coordinated whole-of government policy initiatives across the Victorian Government. It would also establish a clear benchmark against which to measure ambition and progress.[172]

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167 International Energy Agency, *Global EV Outlook 2017: Two million and counting*, International Energy Agency, France, 2017, p. 23.

168 Ibid.

169 Government of South Australia, *Carbon neutral Adelaide : action plan summary 2016-21*, Government of South Australia, Adelaide, 2016, p. 27.

170 Environment Victoria, *Submission,* no. 53, p. 1.

171 Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 4; Central Victorian Greenhouse Alliance, *Submission,* no. 12, p. 3; ClimateWorks Australia, *Submission,* no. 37, p. 4.

172 AGL Energy, *Submission,* no. 42, p. 7.

By introducing the Victorian Renewable Energy Targets (VRETs), the Victorian State Government is committed to adopting net zero emissions by 2050. A State EV target would be a key platform for a whole-of-government approach.

FINDING 6: Some governments in other jurisdictions have established targets for electric vehicle uptake to increase the number of electric vehicles in their jurisdictions. A State electric vehicles target that aligns with the current Victorian Government's Renewable Energy Targets may support Victoria to achieve net zero emissions by 2050.

3.1.7 Options for financial incentives

The introduction of financial incentives that reduce the present upfront cost of electric vehicles for the consumer could be put into place to increase uptake in the private market. International research on financial incentives has found that such incentives are a significant driver for electric vehicle sales.[173]

For example, the U.S. federal government offers up to $7,500 (USD) income tax credit on the purchase of an electric vehicle by consumers. The amount of tax credit available to a consumer is based on their income level. A number of states across the U.S. also offer a range of financial incentives. In California, an additional state rebate of up to $2,500 (USD) is given to a purchaser of a zero emissions vehicle within months of purchasing the vehicle.[174] California's rebate is also scaled to a consumer's level of income, which enables lower income earners access to a higher rebate. California is one of the leading electric vehicle adopter states in the U.S.[175]

The Committee heard that Victoria's current discount of $100 on registration is inadequate. ClimateWorks Australia and the Electric Vehicle Council surveyed the financial incentives offered in other Australian jurisdictions and found that the ACT currently offers the highest financial incentive among five states and territories (see Figure 3.2).

Figure 3.2 Comparison of estimated discounts on stamp duty and registration for a $60,000 electric vehicle

	ACT	NSW	NT	QLD	VIC
Discount	$2110	<$250	$40 to $80	$660	$100

Source: ClimateWorks Australia and Electric Vehicle Council, *The State of Electric Vehicles*, June 2017, p. 13.

173 Zifei Yang, et al., *Principles for effective electric vehicle incentive design*, The International Council on Clean Transportation, Washington, 2016, p. 2.

174 Ibid., p. 12. The rebate funds can also be applied directly to the price of an eligible vehicle at the time of purchase from a participating dealership. Current values of the rebate include up to $7,000 for Fuel Cell electric vehicles, up to $4,500 for all-battery electric vehicles, up to $3,500 for plug-in hybrid electric light duty vehicles and up to $900 for zero-emission motorcycles. See: California Climate Investments and California Air Resources Board, *Implementation Manual for the Clean Vehicle Rebate Project*, 2018, p. 3.

175 Zifei Yang, et al., *Principles for effective electric vehicle incentive design*, The International Council on Clean Transportation, Washington, 2016, p. 21.

The Committee heard of the need to remove the Luxury Car Tax and reduce the stamp duty on electric vehicles for consumers. At a public hearing, Mr Behyad Jafari, Chief Executive Officer of the Electric Vehicle Council told the Committee:

> So it is not an incentive that is required to be the entire $10 000, $12 000 or $15 000 premium, but enough of that when you are more appropriately modelling out how much that vehicle will cost you over three years, you can provide slight exceptions to things like stamp duty and registration costs to help lower that gap and help people choose electric vehicles starting today.[176]

In designing an incentive scheme for electric vehicles, energy provider AGL suggested that 'the concessions could be intelligently designed to ensure that their revenue impact is contained'. For example, 'a sunset provision' could be built into any concession framework to end the incentive scheme at a time when the early adopter electric vehicle market transitions to the mainstream and such incentives are no longer required.[177]

Luxury Car Tax

In Australia, consumers are required to pay a Luxury Car Tax at a rate of 33 per cent for vehicles over the luxury car tax threshold. A luxury car is a vehicle that carries fewer than 9 passengers and is priced from $65,094. A concession exists for fuel-efficient cars and the Luxury Car Tax threshold for fuel-efficient cars is priced at $75,526.[178]

In their respective submissions, Hyundai and Toyota (Australia) recommended that the State Government could work with the Federal Government to remove the Luxury Car Tax for electric vehicles.[179] As Hyundai stated in a submission:

> HMCA acknowledges that there is a role for Federal Government invective to support the up-take of EVs. To that end HMCA has recommended to the Federal Government Review of Emission Standards that the Luxury Car Tax threshold should be removed from zero-emission vehicles. HMCA believes that such a move would provide further incentive for the market to embrace green motoring.[180]

Acknowledging the potential loss of revenue, Toyota Australia recommended replacing the Luxury Car Tax with a tax on vehicles with higher emissions.[181] According to Toyota Australia:

> If there is an ongoing revenue requirement, Toyota Australia recommends that the LCT [Luxury Car Tax] be replaced by a high emissions tax (HET) that is directed towards supporting the Australian Government's light vehicle environmental policy objectives such as incentives for low emission vehicles and associated infrastructure.[182]

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176 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 3.

177 AGL Energy, *Submission,* no. 42, p. 8.

178 Tax and Super Australia, *Tax Summary 2017: The Guide to Australian Tax (9th ed)*, Taxpayers Australia Ltd, 2016, pp. 1627, 1630.

179 Hyundai Motoring Company Australia, *Submission,* no. 5, p. 6; Toyota Australia, *Submission,* no. 29, p. 9.

180 Hyundai Motoring Company Australia, *Submission,* no. 5, p. 6.

181 Toyota Australia, *Submission,* no. 29, p. 9; ClimateWorks Australia, *The Path Forward for Electric Vehicles in Australia*, ClimateWorks Australia, 2016, p. 28.

182 Toyota Australia, *Submission,* no. 29, p. 9.

Toyota further stated:

> The HET could levy a charge on vehicles that are on the higher end of the CO_2 spectrum for the particular vehicle category. This would have the effect of encouraging the early introduction of new technology to the Australian market.[183]

However, Toyota cautioned that an allowance would need to be made for vehicles in such sectors as mining, construction and agriculture.[184]

The Luxury Car Tax is a federal-level tax and the Committee recognises that the Victorian State Government's role in supporting the removal of the Luxury Car Tax for electric vehicles would require discussion through the Council of Australian Governments (COAG).[185]

Employer-based options: Fringe Benefit Tax (FBT)

Fringe Benefits Tax (FBT) is a tax payable by employers for benefits provided to an employee in lieu of salary or wages.[186] A common example of a benefit is a company car permitted for private use. This can include reimbursements for fuel or road tolls, or other servicing costs of the vehicle in addition to or instead of the cost of the vehicle.[187]

Reducing or removing the amount of tax employers have to pay to offer non-salary incentives to employees around electric vehicles could provide a workplace-based option for encouraging uptake.

Evidence to the Committee has advocated for a reduction or removal of FBT on electric vehicles in the short or long-term.[188] This could also extend to cover installation of home-charging stations for electric vehicles instead of fuel or servicing fees ("running costs") traditionally covered by employer-supplied internal combustion engine vehicles.[189]

The Committee notes that the federal government has typically used the FBT as a subsidy for the automotive industry in Australia. Common criticisms of car FBT concessions centre on their encouragement of car overuse and related increases in emissions and congestion.[190] For reasons discussed throughout this Final

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183 Ibid.

184 Ibid.

185 Hyundai Motoring Company Australia, *Submission,* no. 5, p. 6.

186 Australian Government, 'Business.gov.au', <https://www.business.gov.au/info/run/tax/fringe-benefits-tax>, accessed 27 February 2018.

187 Australian Tax Office (Australian Government), 'Car Fringe Benefits', <https://www.ato.gov.au/General/Fringe-benefits-tax-(FBT)/Types-of-fringe-benefits/Car-fringe-benefits>, accessed 27 February 2018.

188 Northern Alliance for Greenhouse Action, *Submission,* no. 13, pp. 2-3; Tourism and Transport Forum Australia, *Submission,* no. 33, p. 2; ClimateWorks Australia, *Submission,* no. 37, p. 3; Municipal Association of Victoria, *Submission,* no. 41, pp. 6, 10; Scott Ferraro, Head of Implementation, ClimateWorks, *Transcript of evidence*, 8 November 2017, p. 26.

189 Australian Taxation Office (Australian Government), 'Fring benefts tax - a guide for employers', <http://law.ato.gov.au/atolaw/view.htm?DocID=SAV%2FFBTGEMP%2F00008http://law.ato.gov.au/atolaw/view.htm?DocID=SAV%2FFBTGEMP%2F00008>, accessed 27 February 2018.

190 Senate Standing Committee on Rural and Regional Affairs and Transport, *Investment of Commonwealth and State funds in public passenger transport infrastructure and services*, Australian Government, Canberra, 2009, p. 66.

Report, electric vehicles occupy a unique space where FBT concessions would support the existing and emerging electric vehicles industry without producing increased emissions.

Novated leasing

Novated leasing is a form of salary packaging, which allows the employee to take out a loan for the vehicle and then *novate* the loan repayment responsibility to their employer. The loan repayments are taken out of the employees wage for the duration they are employed by that employer.[191]

Novated leasing counts as a fringe benefit. Exemptions or reductions to FBT for electric vehicles may, therefore, also have flow-on effects for the desirability of electric vehicles for employers and employees under novated leasing arrangements.

Stamp duty and electric vehicles

Stamp duty is a state-based tax that consumers pay when purchasing a new or used car, or other items such as a house or land. Stakeholders frequently noted that this is one area in which the Victorian State Government could directly implement a financial incentive to make electric vehicles more accessible.[192]

In the ACT, under a Green Vehicle Stamp Duty Scheme, rating 'A' vehicles are fully exempt from stamp duty. The Scheme works by allocating all new light vehicles a performance rating based on their CO_2 emissions. New vehicles that achieve 'A' rating are those that emit up to 130g of CO_2 per kilometre. In 2016, electric vehicles emitted a CO_2 average of 30 g/km and would classify as rating 'A'. Under the ACT Scheme, new vehicles with a 'B' rating (131g to 175g per kilometre) pay 50 per cent on a sliding scale depending on the cost of the vehicle. In explaining their scheme, the ACT Government stated that since 'adopting a single CO_2 emission per kilometre' rating scheme to encourage the uptake of low emission vehicles, they have been able to provide 'better equity' between vehicles using different types of fuel. Previously, a similar scheme in the ACT had difficulty with diesel fuelled vehicles.[193] This approach has also been advocated by major car manufacturer Toyota Australia as a 'user pays approach' designed to penalise and reward vehicle users based on their CO_2 emissions.[194]

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191 Australian Taxation Office (Australian Government), 'GST and vehicles purchases under novated leases', <https://www.ato.gov.au/Business/GST/In-detail/Your-industry/Motor-vehicle-and-transport/GST-and-vehicles-purchased-under-novated-leases>, accessed 27 February 2018. See also, australian Taxation Office (Australian Government), 'Salary sacrifice arrangements for employees', <https://www.ato.gov.au/General/Fringe-benefits-tax-(FBT)/In-detail/Employees/Salary-sacrifice-arrangements-for-employees>, accessed 27 February 2018.

192 See for example, Central Victorian Greenhouse Alliance, *Submission,* no. 12, p. 2., Origin, *Submission,* no. 26, p. 2; AGL Energy, *Submission,* no. 42, p. 8; Northern Alliance for Greenhouse Action, *Submission,* no. 13, p. 2; Hyundai Motoring Company Australia, *Submission,* no. 5, p. 5.

193 Access Canberra, 'Duty payable upon registration or transfer of a motor vehicle: Calculation of duty under the Vehicle Emission Reduction Scheme', <https://www.accesscanberra.act.gov.au/app/answers/detail/a_id/2928#!tabs-2>, accessed 18 January 2018.

194 Toyota Australia, *Submission,* no. 29, pp. 6-7.

The sliding scale adopted by the ACT Government in calculating the duty paid on new light vehicles provides an example of ensuring that cars priced at the higher end pay a higher stamp duty. Any design of a similar reduction in stamp duty in Victoria would need to ensure that low-income earners are not penalised.

The adoption of a similar stamp duty reduction scheme in Victoria could encourage the uptake of electric vehicles across the board.

FINDING 7: The ACT government have introduced a Green Vehicle Stamp Duty Scheme to support consumers to purchase low and zero emission vehicles.

3.1.8 Non-financial incentive options

Non-financial incentives for electric vehicle drivers include: access to high occupancy lanes (which are also known as 'carpool lanes' in the U.S.), parking privileges and reduced road tolls.[195]

Special vehicle lanes

Overseas jurisdictions allow electric vehicles access to special vehicle lanes, which have increased uptake in the private market in these jurisdictions.[196] The Committee heard that in Norway, Germany, certain U.S. states and cities (such as, California and Atlanta), and in certain cities in China and in New Zealand governments have introduced special vehicle lane access for electric vehicle drivers. In California, electric vehicles have been allowed use of special carpool lanes (which encourage ride-sharing and aim to reduce congestion) for some years.[197] California has recently extended its special lane access for electric vehicle drivers beyond 2019.[198]

In Australia, these types of lanes are known as 'High Occupancy Vehicle lanes' or more commonly 'T2' or 'T3' lanes or transit lanes. In an explanation published by the RACV, vehicles using these lanes:

> Must have at least the same number of occupants (including the driver) as displayed on the sign... Public transport vehicles, taxis and motorbikes can use transit lanes regardless of the number of passengers.[199]

Transit lanes are in operation across metropolitan Melbourne, including on Hoddle Street, Eastern Freeway, CityLink, Tullamarine Freeway and on some freeway entry ramps such as the Warrigal Road ramp onto the Monash Freeway.[200]

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195 Australian Electric Vehicle Association Inc., *Submission,* no. 14, p. 6; Hyundai Motoring Company Australia, *Submission,* no. 5, p. 5; Toyota Australia, *Submission,* no. 29, p. 7; AGL Energy, *Submission,* no. 42, p. 8; Origin, *Submission,* no. 26, p. 2.

196 New Zealand Government, 'Energy Innovation Bill introduced', <https://www.beehive.govt.nz/release/energy-innovation-bill-introduced>, accessed 17 January 2018.

197 Nic Lutsey, et al., *Assessment of leading electric vehicle promotion activities in United States cities (2015)*, The International Council on Clean Transportation, Washington, 2015, p. 11.

198 Ibid.

199 Emily McLean, 'Who can use a transit lane? Can I use one with a baby on board?', *RACV RoyalAuto Magazine*, no. February 2017, RACV, 2017, <https://www.racv.com.au/membership/member-benefits/royalauto/motoring/information-and-advice/road-rules/who-can-use-a-transit-lane.html>.

200 Ibid.

The Committee heard support from stakeholders for this non-financial incentive to be introduced to make electric vehicles more viable for early adopters.

However such incentives will need to be regularly reviewed to ensure that they do not negatively impact upon the needs of public transport and other types of vehicles that use these lanes. In a submission, the Public Transport User Association expressed concerns that bus services should not be hindered and public transport usage made less attractive as a result of such incentives.[201]

Electric vehicles would also likely require their own number plates or other form of identification to ensure recognition on the roads by other drivers.[202] The Committee heard that providing electric vehicles with access to special vehicle lanes may be additionally beneficial by paving the way for automated vehicle technology. In the future, these lanes could be reallocated to automated vehicles for vehicle platooning.[203] (Vehicle platooning is a grouping of vehicles together to increase the capacity of roads and provide congestion relief.)

Parking

Preferential parking for electric vehicles is another incentive that has been offered by some jurisdictions overseas. For example, Hawaii and Nevada have offered the incentive of free parking to electric vehicle drivers in addition to other incentives to drive consumer uptake. According to the International Council on Clean Transportation (ICCT) free parking equates to some value for electric vehicle drivers. In one study, it was estimated that the value of free parking benefits in Hawaii and Nevada equated to savings of $1,000 and $600 per vehicle respectively, across the vehicle's lifetime.[204] In China, the major cities which experience high levels of air pollution have already seen government introduction of disincentives for the driving of internal combustion engine vehicles. In Beijing, conventional internal combustion engine vehicles are restricted from the road one day a week to tackle air pollution, however this restriction does not apply to electric vehicles. Cities such as Shenzhen and Hefei have also promoted electric vehicles by providing valuable parking benefits.[205]

The Committee heard of some of the possible types of preferential parking benefits, such as, an exemption from parking fees in on-street parking and reduced fees for electric vehicles in parking structures.[206]

According to the Victorian Government EV Trial's mid-term report, parking spaces reserved for electric vehicles either for the installation of public charging stations or for reduced parking was a barrier. This is because parking is a lucrative business. The trial report found parking revenue was 'a valuable budget input for

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201 Public Transport Users Association, *Submission,* no. 43, p. 6.

202 Environment Victoria, *Submission,* no. 53, p. 3.

203 AGL Energy, *Submission,* no. 42, p. 8.

204 Nic Lutsey, et al., *Assessment of leading electric vehicle promotion activities in United States cities (2015)*, The International Council on Clean Transportation, Washington, 2015, p. 11.

205 Zifei Yang, et al., *Principles for effective electric vehicle incentive design*, The International Council on Clean Transportation, Washington, 2016, pp. 25-26.

206 Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 6; Toyota Australia, *Submission,* no. 29, p. 7; Hyundai Motoring Company Australia, *Submission,* no. 5, p. 8.

many councils', which when 'combined with efforts to disincentivise car traffic, limited council appetite to offer free or even reduced parking costs for electric vehicle parking or on-street charging'.[207] The design of these incentives could be time-limited to support consumers in an early adopter market and be reviewed when electric vehicle numbers increase. This incentive could also be agreed upon only with 'target Local Government Authorities'.[208]

Local councils will need to be consulted. While reduced parking did not feature in their submission, the Municipal Council of Victoria, the statutory peak body for local government stated that electric vehicle-only parking spaces adjacent to charging infrastructure has been raised by local councils in Victoria who would like to see this implemented, given the known benefits of electric vehicles.[209]

Parking benefits and charging

Stakeholders suggested provision of parking privileges for drivers of electric vehicles, potentially in designated locations which included charging points.

In some jurisdictions overseas, governments have introduced electric vehicle driver incentives such as access to special vehicle lanes and preferential parking benefits, which have supported the uptake of privately owned electric vehicles.

Introduced in 2005, the Congestion Levy is charged each year to off-street private and public car parking spaces in two specified areas in Victoria. Some exemptions and concessions to the Congestion Levy already apply for local residential drivers, and disabled drivers.[210] Exempting electric vehicles from the Congestion Levy would assist consumer uptake of electric vehicles and allow drivers to charge their vehicles within residential and commercial buildings.[211]

While much of this Inquiry has focused on electric cars, the City of Port Phillip, also drew attention to the need for designated parking areas for electric bicycles, which could be recharged in charging docks.[212]

Other incentives suggested, such as reduced or exempt fees on tollways, could also be considered by the Victorian State Government.[213]

Government (State and Local) planning in cooperation and consultation with major parking operators will be critical to ensure that any introduction of parking incentives for electric vehicles are designed to operate effectively without adverse impacts, for example, on drivers with disabilities who require places close to entrances of shopping centres.

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207 Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 91.

208 Hyundai Motoring Company Australia, *Submission,* no. 5, p. 8.

209 Municipal Association of Victoria, *Submission,* no. 41, p. 7.

210 State Revenue Office, 'Car Parks: What is the Congestion Levy?', <https://www.sro.vic.gov.au/car-parks>, accessed 18 January 2018.

211 ClimateWorks Australia, *Submission,* no. 37, p. 4.

212 City of Port Phillip, *Submission,* no. 47, p. 4.

213 Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 6.

3.1.9 Coordination between Federal and State Governments

Stakeholders agreed on the need for 'a coordinated approach' to ensure that incentives and actions to promote electric vehicles are aligned with other states and territories. In a submission, the Victorian branch of the Australian Electric Vehicle Association stated:

> there are many incentive options and actions that cover areas under Federal, State and Local Government responsibility. The Victorian State Government and opposition should therefore work with their Federal counterparts to co-ordinate consistent progress in these areas and avoid duplication of resources.[214]

Mr Behyad Jafari, Chief Executive Officer of the Electric Vehicle Council similarly described the need for the Federal Government to lead the states and territories in policies and strategies to increase the adoption of electric vehicles. This would provide a definite signal across all levels of government in Australia that electric vehicles will be supported in the long-term:

> Again having that top-down leadership does provide, does facilitate, more opportunities for people to take even earlier action... With the life of a vehicle being around 12 years, that means that people can start planning accordingly today, but very importantly it is that signal back from government that this is an area that they would like to move towards, certainty really being the biggest issue here.[215]

A coordinated approach at the state level would ensure that Local Government is provided with guidance regarding electric vehicles now and into the future.[216] The Municipal Association of Victoria, the statutory peak body for Local Government stated:

> In order to assist with a smooth and efficient transition to EVs it is critical that the Commonwealth and state governments work together to ensure a coordinated approach is taken and that the appropriate policies and incentives are in place.[217]

National vehicle emission standards

Government electric vehicle promotion actions overseas have included the introduction of more stringent vehicle emission standards.

According to the Electric Vehicle Council and ClimateWorks Australia, Australia is one of the few remaining developed countries without light vehicle CO_2 emission standards in place, despite such standards covering over 80 per cent of the global automotive market, including many developing nations such as China, Brazil, India and Mexico.[218] In addition to vehicle emission standards, a number of countries have recognised the negative environment and health impact of

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214 Ibid., p. 3.

215 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 5.

216 Scott McKenry, Executive Officer, Eastern Alliance for Greenhouse Action, *Transcript of evidence*, 8 November 2017, p. 10.

217 Municipal Association of Victoria, *Submission,* no. 41, p. 10.

218 Scott Ferraro, 'No, cutting your car's carbon emissions won't cost you more', *The Conversation - Australia*, 22 September 2016, <https://theconversation.com/no-cutting-your-cars-carbon-emissions-wont-cost-you-more-65718>, accessed 10 January 2018..

internal combustion engine vehicles and have announced a ban on the sale of new petrol and diesel vehicles (for example, Norway by 2025; the Netherlands 2025; Germany 2030; India 2030; France and the U.K. 2040).

During the Inquiry, the Committee heard that the adoption of lower vehicle emission standards is an approach 'that can help drive uptake of electric vehicles'.[219] The Federal Chamber of Automotive Industries (FCAI) represents most major manufacturers and importers of vehicles to Australia. At a public hearing, Mr Ashley Wells, Policy Director at the FCAI stated:

> The FCAI supports the introduction of a mandated CO_2 target, acknowledging that there is a gap that remains between Australia and other markets around the world...[220]

According to Mr Wells, the price of fuel is low in Australia because 'unfortunately Australia has quite dirty fuel',

> ... at the moment it sits outside of comparable countries in Europe, the United States and Canada and so on. We have a sulphur content in our fuel. Our 91 RON is around about a maximum of 150 parts per million sulphur. It might sound like very much, but, to put it into comparison, in Europe it is 10 parts per million...[221]

In 2015, the Federal Government established a Ministerial Forum on Vehicle Emissions to coordinate a whole-of-government approach to address emissions from motor vehicles.[222] Since the 1970s, Australia has adopted international vehicle emission standards to reduce noxious emissions. The most recent standard being the European 'Euro 5' emission standards adopted in 2013. Most developed countries around the world have now adopted the more stringent Euro 6 standard for light vehicles (Euro VI for heavy vehicles).[223] The Ministerial Forum on Vehicle Emissions is considering several issues, including whether to adopt Euro 6 standards.[224]

The Committee notes that the Ministerial Forum on Vehicle Emissions has not yet agreed to standards for vehicle emissions in Australia.

Vehicle emission standards at the federal-level would be aimed at improving vehicle efficiency, air quality and reducing CO_2 emissions. Furthermore, the adoption of national regulation on vehicle emissions, which outline a preference for low and zero emission vehicles, may provide the major car manufacturers overseas with an indication that Australia is a viable market for electric vehicles.[225]

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219 Stuart Nesbitt, Climate Change Technical Officer, Moreland City Council, *Transcript of evidence*, 8 November 2017, p. 26; Beyond Zero Emissions, *Submission,* no. 7, p. 3; ClimateWorks Australia, *Submission,* no. 37, p. 3; Municipal Association of Victoria, *Submission,* no. 41, p. 6.

220 Ashley Wells, Policy Director, Federal Chamber of Automotive Industries, *Transcript of evidence*, 13 February 2018, p. 32.

221 Ibid., p. 35.

222 Ibid.; Department of Infrastructure Regional Development and Cities (Australia), 'Ministerial Forum on Vehicle Emissions', <https://infrastructure.gov.au/roads/environment/forum>, accessed 19 January 2018.

223 Ibid.

224 Ibid.

225 Beyond Zero Emissions, *Submission,* no. 7., ClimateWorks Australia, *Submission,* no. 37.

FINDING 8: National vehicle emissions policy initiated by the Commonwealth is currently under discussion.

A Memorandum of Understanding

Several other state and territory governments have already commenced discussions with each other to align their plans and actions to promote electric vehicles. In December 2017, *Government News* online, reported a Memorandum of Understanding between South Australia, Adelaide, Tasmania, Hobart, Western Australia and the Australian Capital Territory – with the Electric Vehicle Council. The Memorandum of Understanding will involve actions such as, states and cities combining their purchasing of electric vehicles to increase the model availability in the Australian market. The Memorandum of Understanding will also seek to 'coordinate the strategic planning and construction of infrastructure for electric vehicles and to seek to align states' standards and incentives'.[226]

Introducing a state electric vehicle target and incentives in Victoria would give states and territories a clear indication that Victoria intends to participate in the Memorandum. The Victorian Government's participation will also ensure that charging infrastructure that could be deployed in Victoria is consistent and aligned with the networks created in other states and territories, allowing all drivers to access compatible charging stations when traveling interstate (see section 3.2).

3.2 Infrastructure to support electric vehicles

ABB Australia Ltd is a branch of the global ABB Group, which specialises in industrial technology. The ABB Group has deployed electric vehicle charging stations worldwide. According to Mr Dino Hazdic, Engineer at ABB Australia Ltd, the major car manufacturers view 'undeveloped infrastructure' as a sign of low EV uptake and 'they don't see the appeal in introducing' their new electric cars into these markets.[227] Stakeholders told the Committee that although electric vehicle drivers will predominately charge at home or at workplaces – public charging stations 'are needed to mitigate range anxiety on the part of prospective purchasers.'[228]

The Committee heard that electric vehicle drivers commonly purchase adaptors that allow their vehicles to recharge at stations that have a different charging standard. In addition, while Victoria has the largest number of public charging stations compared to other Australian states and territories, not all stations are operating reliably and there are few charging stations outside of the city.

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226 Graeme Philipson, 'States and cities sign up for electric vehicle fleets', <https://www.governmentnews.com.au/2017/12/states-cities-sign-electric-vehicle-fleets>, accessed 8 January 2018.

227 ABB Australia Ltd, *Submission,* no. 52, p. 1.

228 See for example, Marisa O'Halloran, Project Manager, Goulburn Broken Greenhouse Alliance, *Transcript of evidence*, 13 February 2018, p. 23.

Electric vehicles are an evolving technology and stakeholders have pointed out that today's solutions may soon become outdated.[229] For example, new generation electric vehicles have extended range capacities (of up to 600 km on a single charge in the new model Tesla Roadster).[230] These developments do not remove the need for public charging infrastructure but it will require careful planning to develop a cost-efficient public charging infrastructure to promote electric vehicles in the present, and future proof Victoria.

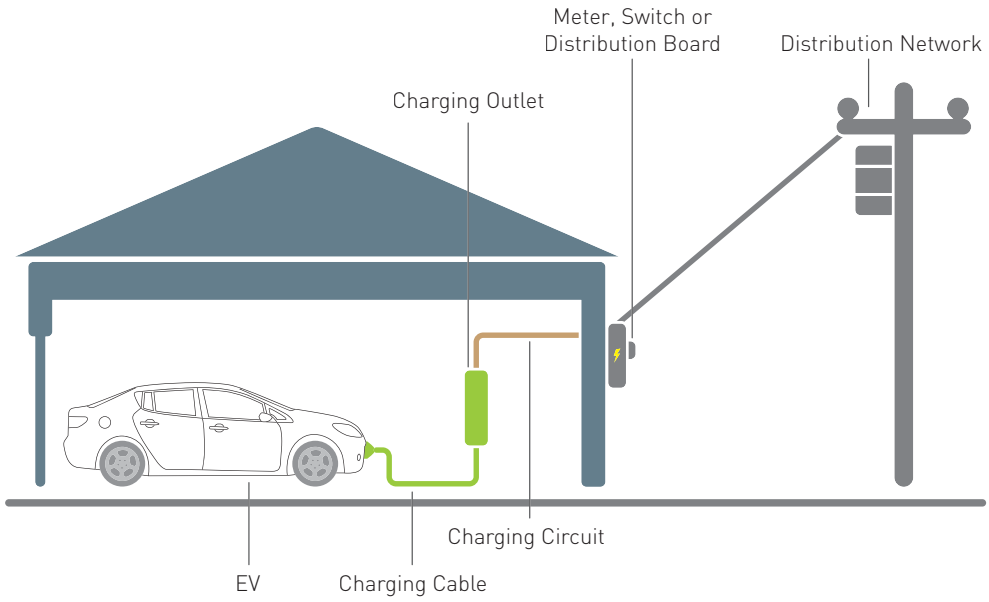
3.2.1 What is electric vehicle charging infrastructure?

According to the Victorian Government EV Trial's mid-term report (2013) electric vehicle charging infrastructure consists of the following two basic elements:

- The charging outlet, 'which provides the charge management capability and is the hardware from which the connection is made to the vehicle'
- The charging circuit, 'which connects the charging outlet to the point of electrical supply'.[231]

Figure 3.3 is a basic description of electric vehicle charging infrastructure that was used during the government EV Trial. It illustrates the core elements of charging infrastructure.

Figure 3.3 A basic description of EV infrastructure



Source: Department of Transport, Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 13.

229 InvertedPower, *Submission,* no. 223; ABB Australia Ltd, *Submission,* no. 52; Dino Hazdic, Engineer, ABB Australia, *Transcript of evidence*, 13 February 2018..

230 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 13.

231 Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 11.

As the mid-term report further explained, charging outlets can include a range of features that differ across models and suppliers. Some charging outlets are a 'fully networked device' that can provide additional capabilities that include features such as, internet connection, data collection and energy management.[232] The Electric Vehicle Council lists the following charging infrastructure suppliers in Australia: JET Charge, ChargePoint, E-station, Tritium, Keba and Egodock.[233] The Committee heard from JET Charge during the Inquiry.[234]

Charging generally occurs at three different levels. From the most basic form of charging from a wall socket through to charging from fast charging stations. electric vehicles can be slowly recharged via an existing 10 amp power point at home. Alternatively charging at home can be upgraded to Level 2 to allow charging from a 15 amp power point, which will allow electric vehicles to be fully recharged overnight. Level 3 charging outlets are typically deployed in public spaces. They offer charging at 55 amp and can provide close to a full-charge in 30 minutes..[235]

3.2.2 Charging infrastructure in Australia

In the *State of Electric Vehicles report* (2017), ClimateWorks Australia and the Electric Vehicle Council reported the number and types of public charging stations across Australia:

> There are currently 476 dedicated EV public charging stations in Australia. While Victoria has the highest number of charging stations, the Australian Capital Territory is leading on a per capita basis with 3.5 chargers per 100,000 residents.[236]

The report explained that charging infrastructure comes in a variety of forms. Alternate Current (AC) charging stations are located where electric vehicles will be parked for more than an hour.

Direct Current (DC) charging stations provide faster charging and are more useful for travelling long distance between cities.[237] There are 40 DC charging stations available in Australia.[238]

Victoria has 2.2 charging stations per 100,000 residents. At a public hearing, Mr Behyad Jafari, Chief Executive Officer of the Electric Vehicle Council, told the Committee 'what we should have is about one per every five to seven drivers'.[239]

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232 Ibid., p. 11.

233 Electric Vehicle Council, 'Charger Map', <http://electricvehiclecouncil.com.au/charger-guide>, accessed 3 January 2017.

234 Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 18.

235 Electric Vehicle Council, 'Charger Map', <http://electricvehiclecouncil.com.au/charger-guide>, accessed 3 January 2017.

236 Electric Vehicle Council ClimateWorks Australia, *The state of electric vehicles in Australia*, 2017, p. 9.

237 Ibid.

238 Ibid.

239 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 6.

3.2.3 Faster charging

ABB Australia Ltd is a branch of the global ABB Group, which specialises in industrial technology and has deployed electric vehicle charging stations worldwide. According to Mr Dino Hazdic, Engineer at ABB Australia Ltd, there are different levels of DC charging available that are suitable for 'different applications'. These are outlined in Figure 3.4 below.

Figure 3.4 Charging service, application and demand

Service	Power	Application
AC Charging	3-22kW	4-16 hour charge sessions: This is ideal for home and also workplace charging, where cars tend to sit for a long time.
DC Destination	20-25kW	1-3 hour charge sessions: This is suitable for visitor parking where a person is only around for a couple hours. The AC charging is not suitable for these scenarios as the return on charging in that time provides no real benefit.
DC Fast	50kW	20-90min: This application fits your retail, grocery, shopping centres, high turnover parking.
DC High Power	150-350kW+	10-20min: This charging is for your highway corridor travel or Metro charge and go. The benefits of this is that when people travel long distances it creates the opportunity for drivers to rest. For the next five years 150kW will be sufficient.

Source: ABB Australia Ltd, *Submission*, no. 52, p. 2.

In Victoria there are seven public DC charging stations and 127 AC charging stations.[240]

3.2.4 The costs of public and private charging outlets in Victoria

The Committee heard that the costs of installing public charging stations are high and a barrier for many businesses. During the Victorian Government EV Trial, 140 charging outlets were deployed for households, fleets and public sites. Overall, costs of charging infrastructure ranged from $1,750 for a household charging circuit and up to $2,500 for a dedicated household charging outlet. The establishment of a fast charging public station could cost up to $100,000.[241]

The cost of charging circuitry, rather than the outlet, was the most expensive aspect of charging infrastructure across all categories and particularly for public charging stations. As Ms Fiona Calvert, Director, Transport Analysis and Assessment at the State Government's Transport for Victoria agency stated:

> Probably the most important factor that was found through the trial was that actually the installation costs of charging infrastructure — not the charge points themselves but the cost of cabling and so on — were a much bigger factor than anything else. The logistics of that were complex, and the costs of it could be quite

240 Electric Vehicle Council ClimateWorks Australia, *The state of electric vehicles in Australia*, 2017, p. 9.

241 Costs drawn from: Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, pp. 61-82.

> significant, particularly where you are retrofitting into circumstances that noone ever expected — having to lay cables to reach an underground car park or a place that is distant or inaccessible from electrical supply.[242]

Given the small number of electric vehicles and high upfront costs, businesses are reluctant to install public charging stations. As ABB Australia Ltd explained in a submission:

> The challenges faced is that the installation of electric vehicle infrastructure provides a small return creating a loss on investment to businesses to justify the purchase and installation. A 50 kW unit on its own can cost between $30,000 – $35,000 and installation costs can vary depending on the sites supply capabilities. For high power chargers that would be used for inter-city travel or "charge and go" can cost over $100k. It also doesn't help that there is a low population density when looking at large networks which makes the return difficult.[243]

The Committee recognises these barriers for businesses. Stakeholders frequently identified infrastructure as another area where governments could provide assistance. At a public hearing, Mr Jafari, Chief Executive Officer of the Electric Vehicle Council, told the Committee:

> Again, this is an area where possibly outside of the direct vehicle sector where we have the most amount of interest. This is everyone from shopping centres, restaurants and charging providers being very interested in making investments. Again though there is some leadership in this of building up the charging first to encourage people to buy the vehicles in the first place. But it is slightly chicken and egg in not wanting to build so early that your technology becomes defunct and the cars never arrive, so looking for that certainty of how far away we are from supporting our electric vehicle market in Australia to start to grow.
>
> Again it is an industry that is looking for those signals of support. A lot of this, as we have seen internationally, is government support that is required to start the transition...[244]

3.2.5 What happens when a driver wants to recharge their car in Victoria?

As discussed above, electric vehicle drivers typically recharge their car at home by connecting to a wall socket or by installing a charging outlet at home for a faster charge. The Committee heard there are public charging stations in Victoria but the network is not extensive or dense;[245] and the stations are not always reliable.[246] There are also issues with vehicle and charging station compatibility (see section 3.2.6).

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242 Paul Salter, Acting Executive Director - Network Strategy, Transport for Victoria, *Transcript of evidence*, 13 February 2018, p. 4.

243 ABB Australia Ltd, *Submission,* no. 52, p. 3.

244 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 7.

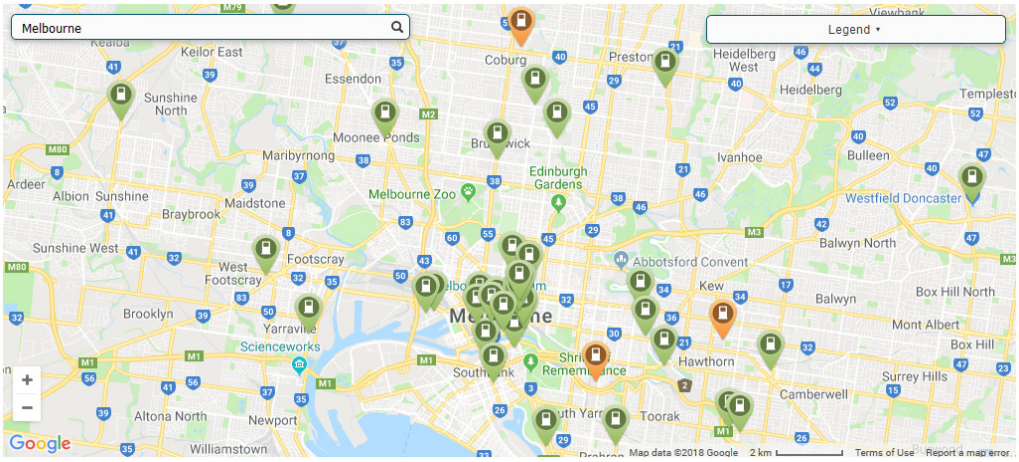
245 Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 22; Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 17.

246 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 17.

Victorian electric vehicle drivers who want to access public charging stations need to check their vehicle's compatibility with the station. Various online maps and apps are available for drivers to locate public charging stations. A popular free-to-access map is PlugShare, a global online map and app that provides search functions for public charging stations and enables drivers to view plug requirements and the station's availability status. Drivers are asked to sign up for an account with PlugShare and are encouraged to share information about the stations' availability with other PlugShare members.[247]

Victoria has a total of 134 charging stations across the State.[248] The following map shows the three locations of the fast chargers in Metropolitan Melbourne (Figure 3.5). The fast chargers are shown in orange and the other public charging stations are shown in green.

Figure 3.5 **Charger Map including fast chargers – location Melbourne**



Source: Electric Vehicle Council, 'Charger Map', <http://electricvehiclecouncil.com.au/charger-guide>. accessed 16 April 2018.

The fast chargers in Melbourne include:

- 4 Tesla Superchargers installed at the Tesla Store in Cremorne. Notably, Tesla Superchargers can only charge Tesla vehicles (for further explanation, see 3.2.8)
- 1 fast charger at Swinburne University in Hawthorne
- 1 DC fast charger at the premises of the Moreland City Council. This fast charger is located close to two Level 2 charging stations.

Mr Bryce Gaton, Executive Committee member of the Victorian branch of the AEVA, owns two electric vehicles including a first generation Nissan Leaf, which he drives daily. At a public hearing, Mr Gaton told the Committee that of the few DC fast chargers available in Melbourne (listed above – except for the Tesla chargers), one of the fast chargers 'never works' and 'they are locked up after hours'.[249]

247 PlugShare, 'PlugShare Homepage', <https://www.plugshare.com>, accessed 10 January 2018.

248 Electric Vehicle Council ClimateWorks Australia, *The state of electric vehicles in Australia*, 2017, p. 9.

249 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 17.

Mr Gaton also provided further insight into the electric vehicle driving and charging experience:

> I drive to work and back every day, have done for five years, in an electric car from Noble Park, Dandenong North, into the city and back again. If I want to, I go over and visit relatives who live near the airport — the airport and back with my car, which is a generation 1 car with a range of just over 120 kilometres. There is no problem. The problem is taking country trips.[250]

The Committee also asked stakeholders about the cost of charging and payment methods. Stakeholders responded that some public charging stations (such as the one at Moreland City Council) offer free charging, due to the small number of electric vehicles presently on the roads. Stakeholders confirmed that the cost of charging is low.[251] At present, Victorian electric vehicle drivers are required to pay for charging by registering with different charging station operators.[252]

3.2.6 Charging standards and international trends

There is no universal charging station for all electric vehicle makes and models driven in Victoria.

The Committee heard that competition between the major car manufacturers and technology leaders overseas has led to the development of different charging standards for electric vehicles. The two competing global standards being the Japanese-led CHAdeMo and the European CCS standards.

Electric vehicle drivers in Australia and Victoria will often need to purchase adaptors and cables, known as Electric Vehicle Supply Equipment (EVSE) to ensure that their car can recharge from stations that use a different charging standard.[253] Australian companies like JET Charge provide an online tool for electric vehicle drivers to ascertain the EVSE required to access different charging stations in Victoria.[254]

According to the Victorian branch of AEVA, the issue of vehicle-to-charging station compatibility is not viewed as a significant barrier, as Mr Bryce Gaton explained, the Federal Chamber of Automotive Industries (FCAI) in Canberra recently released an industry-wide standard:

> Charging plugs and standards are actually settled. FCAI put that out on 18 September last year, to use what is called the Mennekes, or type 2, plugs, which are threephase AC. All Australian EVs will have the Mennekes, apart from Japanese, which are the J1772. I think there will be some discussions — I am guessing there — because everybody else in the world will be providing Mennekes type 2. DC charging, the fast charging, is either CHAdeMO, which is the Japanese standard, or CCS, which is

250 Ibid.

251 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 8.

252 See for example, PlugShare, 'PlugShare Homepage', <https://www.plugshare.com>, accessed 10 January 2018.

253 EVSE.com.au, 'What is the Electric Vehicle Charging Standard in Australia?', <https://www.evse.com.au/blog/evchargingaustralia>, accessed 10 January 2018.

254 JET Charge, 'What kind of EV cables do you need?', <https://www.jetcharge.com.au/what-kind-of-ev-cables-do-you-need>, accessed 26 February 2018.

> basically for everywhere else. All the European stuff that we will be bringing in will be CCS type 2, which is a combination. If you see that picture there, that is a CCS. It has the round plug for the first one — that is a type 1, which is what we have had so far. The type 2 is a threephase...
>
> For my cars I have adapters for type 2 or the type 1. So I have either the leads that come with it — there is a tethered lead generally for the type 1s — or if I come across a BYO socket I have a type 2 to type 1 lead, so it is pretty much sorted now. The standards are there now. That was the FCAI late last year.[255]

According to the FCAI's website:

> Certainty in charging standards within Australia would enable vehicle manufacturers and EV charging infrastructure providers to make investment in future EV-related product plans with reduced risk, and encourage government to develop programs to incentivise uptake of EVs.[256]

The Committee heard that car manufacturers are developing electric vehicles with integrated fast charging technologies, longer ranges, higher voltages and battery chemistries with higher achievable charging rates.[257] This means further development in electric vehicle charging standards.

InvertedPower, a Melbourne-based start-up, has developed and commercialised intellectual property to improve the functionality, economics and viability of electric vehicles. In the submission, Mr Stefan Smolenaers, Founder of InvertedPower explained:

> Electric vehicles are in relatively early developmental phase and are therefore still rapidly evolving. Any investment in electric vehicles, supporting infrastructure, and/or policy development needs to account for technology trajectories to gain long-term relevance, value and effectiveness.[258]

In assessing the trends overseas, Mr Smolenaers described a number of features of global trends in charging infrastructure. For example, he stated that as new generation electric vehicles (Gen3) are being released, the current generation (Gen 2) of 50kW 'fast' charging infrastructure in Europe and the U.S., is rapidly becoming outdated.[259]

Mr Smolenaers of InvertedPower also identified a move towards higher powered on-board AC charging.[260] Mr Smolanaers stated:

> If Australia does not act, it risks being left behind with outdated and incompatible infrastructure for a newer generation of EVs, thereby limiting our access to these vehicles.[261]

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255 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 14.

256 Federal Chamber of Automotive Industries, 'FCAI Technical Statement On Ev Charging Standards For Public Recharging Infrastructure', <https://www.fcai.com.au/news/publication/index/year/all/month/all/publication/99>, accessed 4 January 2018.

257 InvertedPower, *Submission,* no. 223, p. 2. See also, ABB Australia Ltd, *Submission,* no. 52, pp. 1-2.

258 InvertedPower, *Submission,* no. 223, p. 2.

259 Ibid.

260 Ibid.

261 Ibid.

InvertedPower's submission suggested ways to maximise the longevity of charging infrastructure in Australia based on these global trends, which will ensure that Australia has access to new generation vehicles.

FINDING 9: Any electric vehicle charging infrastructure deployed in Victoria must be accessible, comprehensive, up-to-date and relevant for the future.

3.2.7 Public charging infrastructure in the regions

The Victorian Government could help to ensure that charging infrastructure is accessible to a wide range of consumers across geographical locations. While the average distances travelled by metropolitan drivers are within the range of electric vehicles (at 35 km per day), regional and rural stakeholders have highlighted the importance of building a network of charging stations in the regions where travelling distances are much longer.[262]

The Goulburn Broken Greenhouse Alliance (GBGA) represents a network of local councils in central and north-eastern Victoria. In a submission, the GBGA stated that it is investigating the feasibility of sharing the cost and effort to create electric vehicle infrastructure between several councils. According to the GBGA's submission,

> Infrastructure and range anxiety has been a key component highlighted through our discussions with councils, particularly in rural areas... Most councils have fleets returning to a central base making it ideal for charging infrastructure, but due to the kilometres travelled by our regional vehicles, appropriate infrastructure also needs to be developed outside our municipalities to ensure electric vehicles can be successfully integrated into our regions.[263]

The GBGA would like to see:

> linked infrastructure in public facilities allowing travel between municipalities, with charging infrastructure at each municipality. Charging infrastructure should also incorporate renewable energy...[264]

At a public hearing, Ms Marisa O'Halloran, Project Officer of the GBGA, explained that regional economies benefit from charging infrastructure as it supports tourism in the regions:

> Yes, absolutely. Because of the distance we are from Melbourne it really could be a dealbreaker to not actually have that infrastructure in. And a lot of our towns are tourism based, so you would imagine you would go from one to another and explore the region, and without that effective infrastructure there that is not going to happen. So it is still a very key part of what the councils are doing in terms of getting the public infrastructure in to be able to get the tourism in.[265]

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262 Goulburn Broken Greenhouse Alliance, *Submission,* no. 40, p. 2; Municipal Association of Victoria, *Submission,* no. 41, pp. 7-8.

263 Goulburn Broken Greenhouse Alliance, *Submission,* no. 40, pp. 2-3.

264 Ibid., p. 3.

265 Marisa O'Halloran, Project Manager, Goulburn Broken Greenhouse Alliance, *Transcript of evidence*, 13 February 2018, p. 29.

Similarly, Colac Otway Shire Council in Victoria's western region, was a member of the Victorian Government's EV Trial from 2012-14. In a submission, the Colac Otway Shire Council explained that they had been given a Nissan Leaf to trial and found 'one of the biggest barriers' to its use was the limited distances that the vehicle was able to travel, which:

> For a large, rural Council this was a significant issue, as day to day tasks require vehicles to be able to travel 400-500km as a minimum.[266]

Research has confirmed that most metropolitan drivers will drive distances that are well within the range of electric vehicles.[267] The Committee heard however that regional and rural areas would require additional infrastructure.

3.2.8 Diversifying the charging stations deployed in Victoria

Where there are charging stations in Melbourne and in the regions, the Committee heard that Tesla charging stations dominate the current landscape. Tesla chargers are only compatible with Tesla vehicles, further limiting the driving range of other electric vehicle brands in Victoria. Tesla has developed its own charging standard as part of its aim to increase global sales.[268]

During a public hearing in Melbourne, Mr Tim Washington, Founder of JET Charge, a Victorian business that specialises in locally-coded charging infrastructure, described the limited availability of charging stations in Melbourne's CBD for other brands of electric vehicles:

> In Melbourne's CBD, I think we have around 20 to 30. The vast majority of them are Tesla owned and can only charge Tesla cars, and that is something that needs to change. In Victoria as a whole we only have a couple of hundred [public and private charging stations]; most of them locked away as well. We want to be able to change that, but it is very hard to change that when businesses do not see it as a priority and see no signal from government.[269]

In a submission, the Municipal Association of Victoria, the statutory peak body for Local Government, described a need for charging infrastructure across Victoria and particularly in the regions. They also described the need for there to be charging stations that enable all electric vehicles to recharge. The Association cited the example of the East Gippsland Shire Council – Victoria's second largest municipality in land size. According to the Municipal Association of Victoria:

> East Gippsland Shire Council... noted that there is currently no public charging infrastructure within the shire and only one commercial premises that offers a charge point for Tesla vehicles only.[270]

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266 Colac Otway Shire Council, *Submission,* no. 44, p. 1.

267 Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 39.

268 Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 23.

269 Ibid., p. 22.

270 Municipal Association of Victoria, *Submission,* no. 41, p. 7., Colac Otway Shire Council, *Submission,* no. 44, p. 1.

As Ms Marisa O'Halloran of the Goulburn Broken Greenhouse Alliance in Victoria's north-east similarly stated:

> We in our region have a handful of Tesla charge points. They are located at Euroa and Wodonga, and there are a few going in at wineries and cafes around the Wangaratta and Shepparton region, but we have no other public charging infrastructure at all. We cannot get other carmakers up to the region at all...[271]

They explained:

> It would be a poor outcome indeed to find ourselves with one monopoly provider of EVs or EV charging infrastructure and for there not to be a smart spread of charging stations to enable EV travel across all regions of Victoria.[272]

Tesla charging stations are a welcome development in regional Victoria. However, charging infrastructure would need to be deployed across Victoria to increase accessibility for other electric vehicle brands.

FINDING 10: In regional and rural towns where electric vehicle charging infrastructure exists it has allowed for long distance electric vehicle driving and in some scenarios may promote tourism in the area.

FINDING 11: In the deployment of electric vehicle charging infrastructure, the Victorian Government and or industry representatives would work with relevant counterparts in other states and territories to ensure that electric vehicles can be driven across Australia.

3.2.9 Homes and houses without private driveways and garages

Without clear guidelines from State Government, the Committee heard that local governments are struggling in the instances when they need to provide advice and or make amendments in their own planning schemes in relation to charging infrastructure for electric vehicles.[273] For example, in some inner city neighbourhoods, houses do not necessarily have a private driveway or garage where a car could be recharged. This was pointed out by Victorian driver, Ms Amanda Best who lives in the City of Port Phillip in Melbourne. She is planning to purchase an electric vehicle and to install solar panels on her house to charge it but she has found a barrier for people who have no off-street parking,

> Like many residents of older, inner-city suburbs, I have no off-street parking. I made enquiries with the City of Port Phillip as to whether they have any policies on charging of electric vehicles in the street but no such policy has been developed as yet. City of Port Phillip staff recommended I make a submission to this enquiry as a result.[274]

Ms Best made a submission to the Inquiry in which she explained that she would:

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271 Marisa O'Halloran, Project Manager, Goulburn Broken Greenhouse Alliance, *Transcript of evidence*, 13 February 2018, pp. 23-24.

272 Municipal Association of Victoria, *Submission,* no. 41, p. 7.

273 Eastern Alliance for Greenhouse Action, *Submission,* no. 54, p. 2., City of Port Phillip, *Submission,* no. 47, p. 4.

274 Amanda Best, *Submission,* no. 39, p. 1.

> ...eventually like to seek permission, at my expense, to run a cable from my property under the footpath to the roadside to enable me to charge my vehicle near my property from my own power source.[275]

Following Ms Best's submission, the Committee received a submission from the City of Port Phillip, which highlighted the need for a state-wide policy framework that encourages electric vehicle uptake for all households and building types. They stated:

> The State Government could consider targeted policy positions via the planning scheme to encourage the adoption of EV charging to be included on-site across different building typologies, such as is adopted for car parking, car share and bicycle parking provision. Importantly, the policy should consider and overcome the spilt incentive between building owners and renters.[276]

The Committee recognises the potential hazards resulting from unregulated charging infrastructure in city neighbourhoods, which Ms Best provided further information about to illustrate what can occur and has occurred in other jurisdictions. Cables run across pavements to connect private charging outlets to electric vehicles parked on-street and private charging outlets built on public pavements are far from ideal.[277] Ensuring consistent regulations across Victoria for infrastructure and clear roles for State and Local Governments would help establish state-wide best practice in this space.[278]

At a public hearing, Mr Bryce Gaton, Executive Member of the Victorian branch of AEVA stated that some builders of new housing stock are already installing basic electric vehicle charging needs:

> At the very least they will put a 15 amp outlet in there for you to put your EVs in later. Running a six square millimetre cable is what I advise people to put in now. It is just put in the spot where you think the charger is going to be, and even if you do not use it or just put a 15 amp outlet on it, it is there. It is just literally a fiveminute job to swap it over.[279]

However, the Committee heard that old housing stock presents particular challenges when it comes to electric vehicle infrastructure because they need substantial rewiring.[280]

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275 Ibid.

276 City of Port Phillip, *Submission,* no. 47, p. 4.

277 Robin Levinson King, 'Toronto electric car owner stuck trying to charge car on the street', *The Star (Toronto)*, 1 September 2016; Lloyd Alter, 'Should Private Charging Stations be Installed in Public Space', BLOG, dated 19 February 2013 cited in Amanda Best, *Submission,* no. 39, Attachment A.

278 Eastern Alliance for Greenhouse Action, *Submission,* no. 54, p. 2.

279 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 20.

280 Ibid.

3.2.10 Multi-dwelling developments and commercial buildings

There are also a growing number of Victorian households in multi-dwelling developments who require access to charging outlets. The Committee heard that similar to private housing, commercial buildings need to be prepared for electric vehicle charging infrastructure.

At a public hearing, Mr Scott McKenry, Executive Officer of the Eastern Alliance for Greenhouse Action, representing a network of local councils in Melbourne's Metropolitan east explained:

> If you look at a document like *Plan Melbourne*, apparently the city is going to accommodate an extra 1.2 million people in high-density urban development, particularly around the satellite centres... so those people are going to be housed in big apartment blocks et cetera. There has got to be some sort of incentive or framework to ensure that those developers are providing charging infrastructure in the car parking spaces...[281]

The Committee heard that the alternative of retrofitting multi-dwelling developments with charging infrastructure will be much more costly than making the necessary preparations when they are built. As Mr Jafari of the Electric Vehicle Council stated, 'ensuring that things like all new buildings are at least future-ready for charging infrastructure' would result in significant savings for Victoria:

> So the difference between futureproofing a development for charging infrastructure is the difference of around $200 to put a wire in the right place, for instance, compared potentially to up to $10,000 to knock down concrete, re-dig trenches or rewire entire portions of apartment buildings. So the disparity in cost is quite large, and this is an area that we can start looking at providing appropriate standards for today.[282]

Victoria's planning scheme could include provisions to future-proof multi-dwelling developments for electric vehicles. New developments that include car parks in office buildings and shopping centres would also require provisions to ensure they are ready for electric vehicle charging and minimise the cost of future charging infrastructure.[283]

Stakeholders identified the Victorian Planning Provisions as a planning and regulatory tool that could be revised to accommodate the charging infrastructure for electric vehicles. In a submission, Beyond Zero Emissions found:

> The Better Apartment Design Standards, implemented in the Victoria Planning Provisions and all planning schemes via Amendment VC136 on 13 April 2017 do not appear to explicitly support the uptake of charging capacity for electric vehicles in multi-unit developments.[284]

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281 Scott McKenry, Executive Officer, Eastern Alliance for Greenhouse Action, *Transcript of evidence*, 8 November 2017, p. 14.

282 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, pp. 6-7.

283 Ibid., p. 8.

284 Beyond Zero Emissions, *Submission,* no. 7, pp. 3-4.

In a submission, Hobsons Bay City Council in Melbourne's west, noted that in Victoria:

> several inner city councils have adopted the use of the green building tool Built Environment Sustainability Scorecard (BESS) as a requirement of applicable statutory planning applications. Applicants are required to achieve a minimum score in several different sustainability-related categories. Within the BESS tool, the transport section contains a credit which requires that as a minimum, one parking space should be nominated for electric vehicle charging, with appropriate signage and charging infrastructure installed (2.1. Electric Vehicle infrastructure).

This tool, Hobsons Bay City Council wrote, 'could be utilised and expanded upon to include electric vehicles such as buses and bicycles along with those that are owned by car share organisations'.[285]

FINDING 12: Should electric vehicles become more prevalent in Victoria it will be necessary for the State and Local Governments to update the relevant Victorian building and planning provisions and guidelines to ensure that all new residential and commercial developments are prepared for electric vehicle charging needs.

3.2.11 What are governments doing overseas?

Governments overseas have offered incentives for charging outlets in homes, workplaces and public spaces. For example, the U.S. Federal Government has budgeted USD$15 million worth of grants to fund public charging stations through the American Recovery and Reinvestment Act, following the Volkswagon scandal. Matching grants for local governments are also a feature of this program. The U.K. has allocated a budget of £2.5 million for curb-side charging stations and £12 million for fast chargers along highways. The funding being deployed through municipality grants and installer reimbursement for curb-side stations and through grants and tenders for highway chargers.[286]

Recent research indicates that government incentive programs for infrastructure are increasingly being refined in mature electric vehicle markets. According to the International Council on Clean Transportation, a set of best-practice principles is emerging worldwide.[287] Governments in the leading markets are targeting specific and known charging needs and facilitating competition among charging providers to identify the leading business models over time.[288]

Governments overseas are also funding incentives for electric vehicle infrastructure to regulate the development of charging infrastructure networks. In 2017, the Australia Institute, a public policy think tank, made a case for governments in Australia to similarly incentivise public charging infrastructure for electric vehicles.

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285 Hobsons Bay City Council, *Submission,* no. 48, p. 5.

286 Nic Lutsey Dale Hall, *Emerging Best Practices for Electric Vehicle Charging Infrastructure*, International Council on Clean Transportation, Washington, 2017, p. 13.

287 See for example: ibid., p. iv.

288 Ibid., pp. 13-14.

The Institute highlighted the case of the state government of New Hampshire (U.S), which offers rebates to businesses to build public charging stations. One of the features of the New Hampshire incentive scheme is that it provides higher rebates to businesses that will deliver charging infrastructure for difficult segments of the market (such as, curb-side charging stations). In this way, the Institute stated that New Hampshire's 'state regulators need not contend with a sprawling, anarchic network of electric vehicles placed in suboptimal locations'.[289]

The Committee is aware of current developments in other states and territories in Australia (described below). In assessing these developments, the Committee considers that a partnership between government and industry offers options for electric vehicle infrastructure in Victoria. Incentivising the development of infrastructure may be required following consultation with industry representatives.

3.2.12 What are other Australian states and territories doing?

State and territory governments in Australia have invested in public charging infrastructure, often in partnership with major car manufacturers, Australian electric vehicle infrastructure suppliers and utility companies.

In addition to government support, electricity and gas companies, peak organisations including the AEVA and the motoring companies (for example, the National Roads and Motorists' Association, NRMA) are installing charging infrastructure. Recent developments in electric vehicle infrastructure in other states and territories are described below and they indicate the potential for the Victorian Government to partner with relevant stakeholders to deliver similar outcomes.

South Australia and Adelaide City

The South Australian Government has committed to becoming a carbon neutral state and the Government has also introduced a Low Vehicle Emission strategy (2010 – 2016), which supports the uptake of electric vehicles in the state.

At a public hearing, Mr Bryce Gaton of the Victorian branch of AEVA, described the charging hub that has been developed in the city centre of Adelaide, with support from the South Australian Government:

> Really obvious, really public. It is a really good EV hub and really good advertising for EVs. Tesla owns half of it and provided half of the costing, and the other half, as you can see there, was between the City of Adelaide, SA Power, Mitsubishi Motors, Tesla and the government of South Australia. So it is a really good, prominent way of advertising EVs, let alone providing parking for EVs — just encouraging people to know about them.[290]

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289 Dan Cass and Matt Grudnoff, *If you build it, they will charge: Sparking Australia's electric vehicle boom*, The Australia Institute, Canberra, 2017, p. 5.

290 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 13.

Similarly, Mr Tim Washington, Founder of JET Charge, a Melbourne-based infrastructure supplier and developer stated at a public hearing:

> We are working with people like Adelaide City Council to deliver the most sophisticated electric vehicle infrastructure in a car park around the world, and we are doing that because Adelaide City Council and the South Australian government have offered us support to do that. Those are the kinds of things where, if the Victorian government were involved, we could offer the same things.[291]

According to the Adelaide City Council website, charging of electric vehicles at the hub is currently free, with ongoing fees to commence in mid-2018. Adelaide council released a draft fee schedule for consultation in 2017, showing a fee of $0.20 per kilowatt-hour (kWh) after the first hour of charging in peak time.[292] It is estimated to take about 18 kWh to travel 100km in an average electric vehicle and under Adelaide's proposed fees it would cost $3.40 to recharge that vehicle. The draft also indicated that off peak charging for $0.10 per kWh will be available.[293]

Queensland's Electric Super Highway

The Queensland Government commenced work on its Electric Super Highway in 2017. According to the Queensland Government this will be the world's longest electric vehicle -friendly highway.[294] The infrastructure project will make it possible to drive an electric vehicle from Queensland's southern border to the Far North. The Electric Super Highway represents a collaboration between the Queensland Government, local councils and industry partners including Energy Queensland. The *Courier-Mail* reported that it will cost the Queensland Government $3 million.[295]

The Electric Super Highway is the first phase of a range of projects designed under Queensland's promotion strategy, 'The Future is Electric', which features the electric super highway project. Other features of Queensland electric vehicle strategy include:

- The establishment of a Queensland Electric Vehicle Council
- Installation of regional electric vehicle destination charging rollout
- Support for workplace charging
- Exploring the potential to transition the Queensland Government's fleet to electric vehicles and developing projects towards adopting them in the public transport fleet.[296]

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291 Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 19.

292 Draft fees available at: City of Adelaide, 'EV Charging Stations: Service Fees', <https://yoursay.cityofadelaide.com.au/evfees>, accessed 15 January 2018.

293 Average kWh travel described by: Ergon Energy, 'Charging your electric vehicle', <https://www.ergon.com.au/network/smarter-energy/electric-vehicles/charging-your-electric-vehicle>, accessed 15 January 2018.

294 Road Safety and Ports Hon. Stephen Miles - Acting Minister for Main Roads, *The future is electric for Queensland motorists*, media release, Queensland Government, Brisbane, July 27 2017.

295 Sarah Vogler, 'Queensland's new "electric super highway"', *The Courier Mail*, July 27 2017.

296 Road Safety and Ports Hon. Stephen Miles - Acting Minister for Main Roads, *The future is electric for Queensland motorists*, media release, Queensland Government, Brisbane, July 27 2017; Queensland Government, *The Future is Electric: Queensland's Electric Vehicle Strategy*, Queensland Government, Brisbane, 2017..

Tasmania

In November 2017, the Tasmanian Government announced its support for electric vehicle charging stations. As part of their Climate Change Action Plan the Tasmanian Government is investing $250,000 to establish an electric vehicle working group and begin the strategic rollout of charging stations.[297]

An earlier briefing paper released by the Australia Institute, outlined how Tasmania could remove range anxiety for electric vehicle drivers altogether by installing just a few strategically placed fast chargers across Tasmania. The Australia Institute canvassed two options – the first option involved installing 3 fast chargers to support Tasmania's most dense vehicle routes and a second option presented the case for 6 fast chargers to be installed in Tasmania's key cities and towns, which would provide 'blanket coverage'. The options would cost Tasmania $1 million and $2 million respectively.[298]

The ACT

As mentioned previously, the ACT is a leading Australian jurisdiction in electric vehicle uptake with the most substantial financial incentive to reduce their upfront cost, compared to other states and territories. Building on a conducive environment for electric vehicles, the energy distributor, ActewAGL Distribution Network has built a small network of charging stations in the ACT. ActewAGL installed the first 50 kW Rapid Charger in 2015, the first of its kind in the ACT. ActewAGL's electric vehicle charging network consists of 11 charging stations across the ACT. This network includes 3 Rapid Chargers and 5 Fast Chargers and the charging stations are publicly available and accessible for all makes and models of electric vehicles.[299]

ActewAGL's charging stations were accessible free-of-charge until 1 March 2017. A pricing structure has since become effective. The company has pledged to further expand their network and 'are currently investigating additional locations'.[300]

Western Australia

In October 2017, state-owned electricity retailer Synergy and distributor Western Power announced the utility was 'committed to playing a lead role in creating a market here for EVs'.[301] In 2017, the AEVA's Western Australia branch announced it would work with electricity retailer, Synergy, to install 70 charging stations in rural and remote towns across WA.[302]

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297 Trade Roger Jaensch - Parliamentary Secretary for Small Business, and Red Tape Reduction, *Tasmanian Government support for electric vehicle charging stations*, media release, Tasmanian Government, Hobart, 9 November 2017.

298 Leanne Minshull, *Tasmania in pole position for electric car industry: The potential of electric vehicles in Tasmania*, The Australia Institute, Canberra, 2017, p. 1.

299 ActweAGL, 'Electric Vehicle Charging Network', <https://actewaglevlution.com.au>, accessed 9 January 2018.

300 Ibid.

301 Daniel Mercer, 'Introduce Incentives to Boost Electric Car Sales or Risk Being Left Behind', *The West Australian*, October 29 2017.

302 Hannah Barry, 'More than 70 new electric car power points for rural WA', *WA Today*, July 5 2017.

New South Wales

The NSW Government launched a fleet of electric vehicles in 2017, which are being trialled by regional government departments before the government introduces electric vehicles into the rest of the NSW state fleet. NSW has introduced renewable energy targets, which aim for zero emissions by 2050.[303]

In addition, the national motoring organisation, the National Roads and Motorists' Association (NRMA), which represents 2.4 million Australians principally from New South Wales, announced a plan to establish Australia's largest electric vehicle fast-charging network in 2017. It will deliver at least 40 charging stations across New South Wales and the Australian Capital Territory.[304] The NRMA released a report in 2017 titled 'The Future is Electric', which made six recommendations for Australian governments to support electric vehicle uptake; the first of the recommendations was for governments to support uptake of electric vehiclesthrough a 'rollout of charging infrastructure', especially in rural and regional areas.[305]

The Northern Rivers Electric Vehicle Strategy, New South Wales

In 2017, Sustain Northern Rivers, and the Byron and Tweed shire councils in northern New South Wales released an electric vehicle strategy that has several aims. These include: attracting electric vehicle drivers to the region from afar, removing barriers for local residents, and enhancing the region's eco-tourism reputation. Charging infrastructure was identified as a vital feature of their electric vehicle strategy.

The strategy proposed 'a primary network' of public charging stations across six towns and cities, followed by a secondary network of charging stations at 'key commuter and tourism centres'.[306]

Australian Government – Macquarie leasing and CEFC

The Clean Energy Finance Corporation (CEFC) is a statutory authority established by the Australian Government under the *Clean Energy Finance Corporation Act 2012*.[307]

In September 2017, the Australian Government announced a deal with Macquarie Leasing, a company that provides asset management and finance services, to offer cheaper financing of electric vehicles and PHEVs through a $100 million

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303 Department of Planning and Environment (New South Wales), 'NSW Government unveils electric vehicle fleet', <https://www.resourcesandenergy.nsw.gov.au/about-us/news/2017/nsw-government-unveils-electric-vehicle-fleet>, accessed 8 March 2018; Giles Parkinson, 'NSW makes major push into renewables, electric vehicles', *Renew Economy*, 3 November 2016, <http://reneweconomy.com.au/nsw-makes-major-push-into-renewables-electric-vehicles-72622>, accessed 8 March 2018.

304 National Roads and Motorists' Association, *NRMA to build Australia's largest fast charging network*, media release, National Roads and Motorists' Association, 20 October 2017.

305 NRMA, *The Future is Electric*, NRMA, Strathfield, NSW, 2017, p. 2.

306 Byron Shire Council and Tweed Shire Council, *Power Up: Northern Rivers Electric Vehicle Strategy*, Tweed Shire Council, 2017.

307 Clean Energy Finance Corporation, 'About us - how we operate', <https://www.cefc.com.au/about-us/how-we-operate.aspx>, accessed 8 March 2018.

asset finance program supported by the CEFC. The deal is retailed through Macquarie Leasing to provide a 0.7 per cent discount for customers to lease electric vehicles and plug-in hybrid electric vehicles.[308]

Approximately 1,200 vehicles will be financed under the arrangement.[309]

Victoria

In comparison to South Australia and other leading states and territories, Mr Gaton of the Victorian branch of the AEVA told the Committee at a public hearing that 'in Victoria we are not actually doing a lot at the moment'.[310]

In a submission, the RACV, which was a premier partner during the earlier Victorian Government EV Trial and a member of the Electric Vehicle Council, described its key activities in promoting electric vehicles, such as:

- [The] Introduction of electric vehicles into our Resorts for guests and members to use as part of their leisure experience and to become more accustomed and informed about this emerging vehicle technology;
- Progressive expansion of a public and free to use EV charging network across all RACV sites in Victoria, Queensland and Tasmania as well as additional tourist sites in collaboration with regional partners at Phillip Island Nature Park, Lorne Visitors Centre, Sovereign Hill and Australia Zoo (in total 26 Level 2 intermediate chargers + additional 12 dedicated Tesla chargers).[311]

FINDING 13: The South Australian Government have partnered with manufacturers and business to establish an electric vehicle charging hub in the City of Adelaide and electric vehicle charging infrastructure across their state.

3.3 Automotive industry concerns about the impact on the mechanics and service industry

Throughout the Inquiry, the Committee was concerned about the potential job losses in the automotive industry. The Committee heard from automotive industry representatives – the Victorian Automobile Chamber of Commerce (VACC) and the Federal Chamber of Automotive Industries (FCAI).

The VACC represents the interests of more than 5,100 members in Victoria who own and work in automotive businesses across all sectors of the automotive industry, but in particular the retail, service and repair sectors of the industry. The FCAI represents the interests of a number of manufacturers and importers of passenger vehicles, light commercial vehicles and motorcycles in Australia.

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308 Clean Energy Finance Corporation, *Macquarie leasing drives electric vehicle and energy efficiency push with $100m in CEFC finance*, media release, Clean Energy Finance Corporation, 6 September 2017.

309 Electric Vehicle Council, 'Australian Government Supports Electric Vehicle Leasing', <http://electricvehiclecouncil.com.au/australian-government-supports-electric-vehicle-leasing>, accessed 8 March 2018.

310 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 13.

311 RACV, *Submission,* no. 49, p. 1.

The VACC recommended that the Victorian State Government should not support the introduction of government funded incentives. At a public hearing, Mr Geoff Gwilym, Executive Director of the VACC explained that the introduction of financial incentives might lead to a 'distortion of the market', which could lead to plummeting electric vehicle sales when government incentives are withdrawn.[312] The VACC stated that in Denmark, electric vehicle sales are reported to have plummeted in 2016 when existing incentives were withdrawn.[313]

The VACC has also stated that encouraging a faster growth in electric vehicle sales would lead to a more rapid loss of jobs for the 87,000 mechanics in Australia who service the Australian fleet of 18 million internal combustion engine vehicles.[314] The Committee heard that significant change has occurred with the end of Australian car manufacturing in 2017 and the inevitability of electric vehicles means that the retail, repair and servicing side of the industry will need support to transition, alongside changes in the market. The Committee discusses support for this side of the industry to work with electric vehicles, later in the report (see, Chapter Five).

3.3.1 New vehicle technology is changing the industry

Regarding the future of automotive industry jobs and electric vehicles, Mr Ashley Wells, Policy Director of the FCAI, explained to the Committee that new technology in internal combustion engine vehicles is already having an impact on the traditional mechanics and service industry. He stated:

> I think the broader point to make though is that the automotive industry is full of change and it is ongoing change. Smash repairs are one area where there has been profound change over the last 20 years. Advanced technologies, crash avoidance technologies, autonomous emergency braking, lane keep assist, lane departure warnings, eyes in the windscreen —
>
> Reverse park assist, reverse warning, parallel park assist — all of those points are meaning that there are less bingles. There are fewer bingles on more modern cars. That is not to say they do not happen. They do, of course, but they are fewer and further between. So that is forcing change within that industry.[315]

The Committee also heard that electric vehicles will still require a retail, service and repair industry.

Given the global trend towards zero emission driving, the FCAI supports the introduction of government incentives at the state-level. As Mr Wells stated:

> At a state level we believe that there are a number of financial and nonfinancial incentives that can be offered. They range from registration discounts across all states and stamp duty discounts, such as has been introduced in the ACT.

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312 Geoff Gwilym, Executive Director, Victorian Automobile Chamber of Commerce, *Transcript of evidence*, 9 November 2017, p. 8.

313 Ibid., p. 8.

314 Ibid., p. 8.

315 Ashley Wells, Policy Director, Federal Chamber of Automotive Industries, *Transcript of evidence*, 13 February 2018, p. 34.

> Nonfinancial incentives could include measures such as home EV charging infrastructure on a 'buy as you save' basis potentially. Again I would raise the issue of building standards, transit lane access and toll road exemptions.[316]

The existing automotive industry businesses require a clear road map from the Victorian Government regarding the transition to electric vehicles. The VACC have pointed out in their submission, the rate of electric vehicle sales growth would have an impact on automotive jobs reliant on internal combustion engine vehicles.[317] The Committee heard from a number of stakeholders that the progressive loss of jobs in servicing these traditional vehicles is inevitable with the onset of new vehicle technology.

FINDING 14: In any transition to electric vehicles, the Victorian State Government must consider the existing automotive industry workers that retail, service and repair internal combustion engine vehicles by developing a clear road map, which outlines timing and options to support existing businesses in this sector of the automotive industry and to assist them to transition to a future industry focused on electric vehicles.

316 Ibid., p. 33.

317 Victorian Automobile Chamber of Commerce, *Submission,* no. 38, p. 12.

4 Electric vehicles: government fleets and public transport

Australia's public sector is the largest buyer of vehicles in Australia. Of the 1.25 million new vehicles sold in Australia in 2015, over 50,000 were bought by government agencies and authorities. There are well over 200,000 vehicles total in government fleets across Australia.[318] During the Inquiry, the Committee heard the Victorian State Government could include all-electric vehicles into the government fleet of over 8,000 vehicles. The Victorian Government fleet currently includes several hybrid and plug-in hybrid electric vehicle models and no all-electric vehicles. The Committee also heard that government fleet purchasing of all-electric vehicles could provide used electric vehicles for a second-hand market.[319] The Committee is aware that all-electric vehicles have higher capital costs and the limited charging infrastructure available are barriers for fleet operators.

The first half of this chapter discusses the applicability of electric vehicles in the public sector fleet, focusing on the Victorian State Government and local government. The second half of this chapter considers the applicability of electric buses in Victoria's public transport fleet. The Committee heard that electric buses are being trialled in South Australia (SA) and the Australian Capital Territory (ACT). Electric buses have already been integrated into the transport fleets of other countries such as China, where they make up a significant percentage of the public bus fleet.

4.1 Electric vehicles and public sector fleets

Throughout the Inquiry, the Committee heard the Victorian State Government could support the uptake of electric vehicles by introducing all-electric vehicles into the government fleet. What are the benefits and drawbacks of introducing electric vehicles into the government fleet?

4.1.1 Electric vehicles and public sector fleets

SG Fleet is a business that provides fleet management and leasing services to corporate and public sector clients in Australia, New Zealand and the U.K. At a public hearing, the Committee heard from Mr Yves Noldus, Head of Corporate

318 Graeme Philipson, 'Driving Change: Fleet management', *Government News*, 2016, <https://www.governmentnews.com.au/2016/01/22647>, accessed 30 January 2018.

319 In this Chapter, 'all-electric vehicles' are referred to separately to make a distinction between fully battery-operated vehicles and plug-in hybrid electric vehicles.

Affairs, Marketing and Investor Relations at SG Fleet. According to Mr Noldus, corporate and government bulk buying could reduce the high upfront cost of electric vehicles in an early adopter market. Mr Noldus stated:

> ... in our view the adoption of EVs is likely to accelerate most with selected applications in controlled environments – for example, public sector or corporate fleets – as this may to some extent negate current impediments to uptake by individual members of the public... From a cost perspective, there would be lower vehicle acquisition costs per vehicle due to the larger number of vehicles being acquired. Efficient fleet management will also optimise individual vehicle usage and lower the total cost of ownership per vehicle and for the entire fleet...[320]

Mr Noldus noted that corporate and government fleet managers are required to factor in environmental credentials, in addition to vehicle functionality and cost, when making vehicle selections:

> ... corporations are increasingly being required to report on their environmental impact. If companies or public bodies operate large fleets for pooled or individual transport, CO_2 emissions constitute a significant part of their environmental impact, and consequently the reduction of emissions via the electrification of parts of their fleets will be a significant contributor to their impact minimisation efforts.[321]

The Victorian State Government has introduced hybrids and plug-in hybrid electric vehicles into the government fleet; the Government had earlier mandated the purchasing 2,000 of these vehicles by 2010.[322] Stakeholders told the Committee that the State Government could promote all-electric vehicles into government fleets, which could then support the development of a second-hand market for electric vehicles.[323] However, there are barriers to introducing all-electric vehicles into current fleets (as discussed below).

The Committee heard that some local councils have proactively introduced electric vehicles into their fleets. At a public hearing, Mr Stuart Nesbitt, Climate Change and Technical Officer at Moreland City Council stated:

> We believe it is a corporate responsibility for all tiers of government to feed the used vehicle market with more fuel efficient, sustainable vehicles, and of course to demonstrate leadership.[324]

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320 Yves Noldus, Head of Corporate Affairs – Marketing and Investor Relations, SG Fleet, *Transcript of evidence*, 9 November 2017, p. 27.

321 Ibid.

322 ClimateWorks Australia, *Improving the fuel efficiency of the Victorian Government's passenger vehicle fleet*, ClimateWorks Australia, Melbourne, 2016, p. 4.

323 Hyundai Motoring Company Australia, *Submission,* no. 5, p. 6; Central Victorian Greenhouse Alliance, *Submission,* no. 12, p. 3; Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 5; Municipal Association of Victoria, *Submission,* no. 41, p. 6; AGL Energy, *Submission,* no. 42, p. 2.

324 Stuart Nesbitt, Climate Change Technical Officer, Moreland City Council, *Transcript of evidence*, 8 November 2017, p. 18.

The Committee received evidence from other stakeholders, who supported the Victorian Government introducing all-electric vehicles into the government fleet.[325]

The disadvantages of electric vehicles in fleets

There are disadvantages at present for fleet managers seeking to include electric vehicles into their fleets. For example, electric vehicles have a higher overall vehicle operating cost due to rapid depreciation, which affects their feasibility in government fleets. There are also few all-electric models available in the vehicle market. The Committee heard that fleet operators need to locate fit-for-purpose vehicles that provide value-for-money and that the current electric vehicles in the Australian market offer limited choices.

Local councils have demonstrated in recent years that the present barriers to electric vehicle uptake in fleets can be surmounted. The Committee received evidence from some local councils who have demonstrated that the benefits of all-electric vehicles outweigh their current drawbacks.

4.1.2 Electric vehicles and local council fleets

There are 79 local government councils in Victoria. According to the Municipal Association of Victoria the statutory peak body for Local Government:

> A number of Victorian councils have invested in and/or trialled electric vehicles for their fleet and have also supported the installation of public charging stations. The City of Melbourne and the City of Moreland are notable early adopters and leaders in the EV space, as are Whitehorse City Council and City of Casey.

During the Inquiry, the Committee heard that Moreland City Council located in Melbourne's inner north has adopted electric vehicles in their fleet. The Council has also built several charging stations, and in the current early adopter phase, Moreland City Council offers free charging to owners of electric vehicles. Other councils are undertaking feasibility studies to investigate their environmental and economic benefits compared to conventional combustion engine vehicles. The Committee also heard of other local councils that are considering or have purchased all-electric vehicles for their fleets.[326]

Moreland City Council

The Committee heard that Moreland City Council was one of the participating councils in the Victorian Government's earlier EV Trial (2010-14). Participation in the trial enabled the council to trial a Nissan Leaf for six months. As Mr Stuart Nesbitt, Climate Change Technical Officer explained at a public hearing in Melbourne:

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325 Central Victorian Greenhouse Alliance, *Submission,* no. 12, p. 3; Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 5; Municipal Association of Victoria, *Submission,* no. 41, p. 6; AGL Energy, *Submission,* no. 42, p. 2.

326 Goulburn Broken Greenhouse Alliance, *Submission,* no. 40; Scott McKenry, Executive Officer, Eastern Alliance for Greenhouse Action, *Transcript of evidence*, 8 November 2017.

> So the starting point for Moreland's transition to zero emissions was to participate in the Victorian government's EV trial back in 2012 and get an understanding of how EVs might operate in our fleet. Moreland's participation in the Victorian government trial was one of the more successful. The Nissan Leaf operated in council's pool fleet for about six months and staff training was introduced to encourage participation. The EV was the most popular pool vehicle by a margin of 2 to 1 and covered more than 15 000 kilometres over the six months — one of the highest of any vehicle in the government trial. To understand the impact of introducing EVs to staff we conducted a preand postdrive survey to gauge reaction to the trial, which received high praise from the Victorian government as potentially a useful piece of research that might be used in their final report.[327]

Mr Nesbitt followed on by discussing the feasibility study conducted by engineering and environment consultants pitt&sherry for Moreland City Council, which compared a Nissan Leaf and a Toyota Camry Hybrid in relation to cost and environmental benefits:

> ...so pitt&sherry were commissioned to produce a comprehensive feasibility study in 2014, and this study is available on the council's website. The study looked at a wide range of issues but key criteria was a direct life cycle costofownership comparison between a hybrid Camry, which at the time was considered a baseline vehicle in council's fleet, and a Nissan Leaf. The purpose of that of course, following a successful trial, was to understand the pros and cons of operating EVs in council's fleet and to receive some professional evaluation. It was also to promote the environmental benefits to the community and business and local government sector.

The feasibility study concluded that the adoption of additional Nissan Leafs within the Moreland fleet would:

- Save Moreland City Council $2,300 per vehicle, per three year cycle – 'attributable to the discounted purchase price, low cost electricity rate, recharge infrastructure already in place and the low ongoing costs'
- Lower greenhouse gas output.[328]

The Committee heard that with the support of the State Government, Moreland City Council, is currently trialling a hydrogen fuel cell waste disposal truck. This will entail the installation of a hydrogen refuelling depot for the truck on council premises. As the Municipal Association of Victoria stated in their submission, the trial could lead to the replacement of petrol and diesel fuelled waste disposal trucks, which would result in benefits such as, quieter rubbish collection, better air quality as well as carbon emission reductions and savings for councils. [329]

Other Melbourne Councils

The Committee received evidence that other local councils are investigating the feasibility of introducing low and zero emission vehicles including all-electric vehicles into their fleets. Mr Scott McKenry, Executive Officer of the Eastern

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327 Stuart Nesbitt, Climate Change Technical Officer, Moreland City Council, *Transcript of evidence*, 8 November 2017, p. 17.

328 pitt&sherry, *Electric Vehicle Fleet Feasibility Study*, Moreland City Council, 2014, p. i.

329 Stuart Nesbitt, Climate Change Technical Officer, Moreland City Council, *Transcript of evidence*, 8 November 2017, p. 21., Municipal Association of Victoria, *Submission,* no. 41, p. 8.

Alliance for Greenhouse Action (EAGA) provided evidence about a Low Emissions Fleet Assessment project undertaken by the Manningham City Council, Moreland City Council, Yarra City Council and Nillumbik Shire Council. The aim of this collaborative project is to develop tailored fleet assessments to transition the four participating councils to 'greener' fleets.[330]

During the public hearing, Mr McKenry observed that the Stonnington City Council in Melbourne's inner south-east:

> I think has got four cars in its fleet currently. It is working with its fleet's team to try to understand the challenges et cetera. They have got a range of charging points I believe at different council sites – at its transfer stations, civic centres, others – and I think it has developed some partnerships with some others across the city to be able to share the infrastructure.[331]

Goulburn Broken Greenhouse Alliance – electric vehicles and the regions

The Committee also received evidence about a State Government funded project coordinated by one of Victoria's greenhouse alliances, which aims to introduce electric vehicles into regional and rural council fleets in Victoria's north-eastern region. The Goulburn Broken Greenhouse Alliance (GBGA) connects 11 participating local regional and rural councils in Victoria's north-east on sustainability projects. In a submission, the GBGA stated that they are undertaking a project titled *Collaborating Council – Building the Case for Electric Vehicles in Regional Councils Fleet*, which is co-funded by Local Government Victoria (LGV).

The project has produced an EV Feasibility Study and a business case for the region. According to GBGA's submission,

> The feasibility study has reviewed current council fleet vehicle policies, and collated data on current pool vehicle types, costs, kilometres and usage patterns to determine which current vehicles may be suitable for replacement with electric vehicles. A business case is currently being developed to assist those councils keen to pursue electric vehicles further, with group procurement as a key outcome.[332]

At a public hearing in Melbourne, the Committee heard from Ms Marisa O'Halloran, Project Officer at the GBGA. According to Ms O'Halloran,

> ...all our councils are working to reduce their greenhouse gas emissions in order to reduce the impacts of climate change on our communities. All our councils have agricultural sectors, and they are already being impacted on by climate change. Our regions are particularly vulnerable to further impacts, and so all our councils are keen to decrease their emissions. All our councils have environment officers, and often their role is to actually assess current emissions, impacts council operations have and how any improvements can be made.[333]

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330 Eastern Alliance for Greenhouse Action, *Response to Question on Notice*, attachment to *Submission*.

331 Scott McKenry, Executive Officer, Eastern Alliance for Greenhouse Action, *Transcript of evidence*, 8 November 2017, p. 14

332 Goulburn Broken Greenhouse Alliance, *Submission,* no. 40, p. 1.

333 Marisa O'Halloran, Project Manager, Goulburn Broken Greenhouse Alliance, *Transcript of evidence*, 13 February 2018, p. 24.

The GBGA told the Committee that electric vehicles represent an opportunity for councils to reduce their fuel costs and for environmental benefits:

> Council vehicle fleets, although they are not generally the highest pedigree of emissions compared to other energy sources — usually that is the gas and electricity — are a constant measurable contributor to our council emissions, and therefore they are a target for our energy reductions. They are also a constant contributor to our council costs, and particularly as our regions often have high fuel costs just because of the distances we have to travel, that is reflected in our fuel costs for our councils. Some of our councils are looking at and have trialled hybrid vehicles to try and address this, but some of them have not as well. Fuel costs are an issue, an ongoing issue, for our councils.[334]

The City of Port Phillip and Hobsons Bay City Council requested the State Government trial electric vehicles in their municipalities.[335]

The Committee also received evidence from the Muncipal Association of Victoria, the statutory peak body for Local Government. That oganisation recommended that the State Government 'support increased uptake of EVs' across government fleets for their cost and environmental benefits.[336]

4.1.3 Local government purchasing policy and protocols

Under the *Local Government Act 1989*, Local Government purchases are guided by a best practice guideline, *The Victorian Local Government, Best Practice Procurement Guidelines* (*Guidelines*), which guides local councils and regional library corporations in their procurement activities.[337]

According to the *Guidelines*, the procurement activities of local councils are governed by a set of general principles, which are founded on legislative requirements to ensure councils deliver optimum outcomes for their communities through any procurement process. Councils are bound by their statutory objectives to:

> ensure that resources are used efficiently and effectively and services are provided in accordance with Best Value principles to best meet the needs of the local community and to improve the overall quality of life of people in the local community.[338]

The Committee heard that some councils have established internal protocol to guide vehicle purchases. For example, Moreland City Council has a fleet purchasing protocol that supports staff to purchase vehicles with lower emissions. Figure 4.1 illustrates the Moreland City Council, Fleet Purchasing Protocol.

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334 Ibid., p. 25.

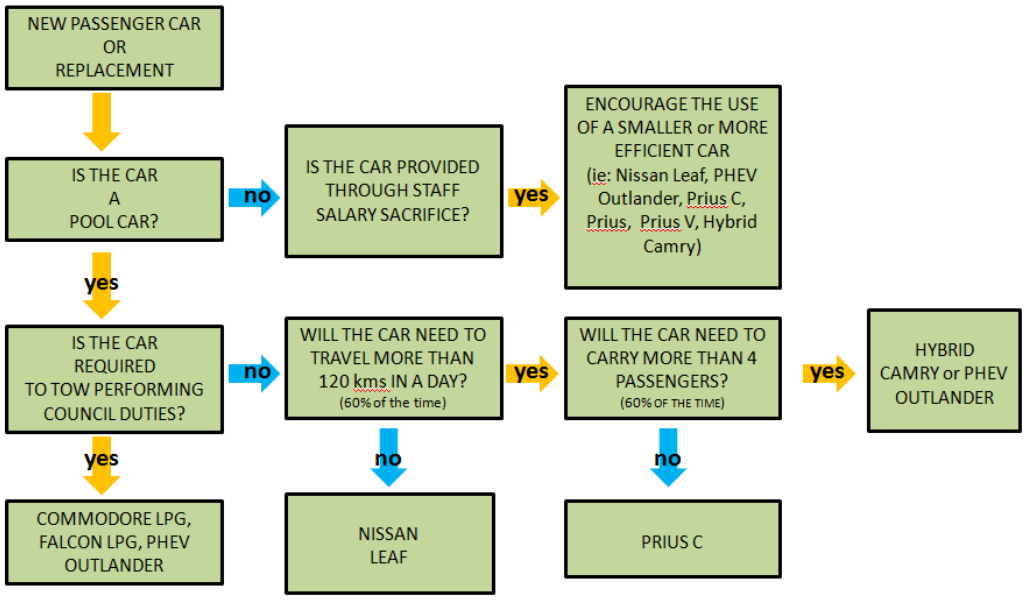
335 City of Port Phillip, *Submission,* no. 47, p. 1; Hobsons Bay City Council, *Submission,* no. 48, p. 6.

336 Municipal Association of Victoria, *Submission,* no. 41, p. 10.

337 Department of Planning and Community Development - Local Government Victoria, *Victorian Local Government Best Practice Procurement Guidelines 2013*, Victorian Government, Melbourne, 2013, p. 9.

338 Ibid.

Figure 4.1 Moreland City Council, Passenger Fleet Purchasing Protocol



Source: pitt&sherry, Electric Vehicle Fleet Feasibility Study: prepared for Moreland City Council, (2014), p. 20.

FINDING 15: Some local councils such as Moreland City Council have introduced electric vehicles into their fleets. Others such as those in the Goulburn Broken Greenhouse Alliance are investigating ways to support electric vehicles in their communities with support from the Victorian Government, such as through the New Energy Jobs Fund.

4.2 The Victorian State Government fleet

How are vehicles procured for the State Government fleet? The Victorian Minister for Finance is responsible for policy overseeing the State Government's passenger and light commercial motor vehicle fleet. The Department of Treasury and Finance (DTF) supports the Minister for Finance by managing fleet services for the State Government. DTF has established whole-of-government vehicle contracts, which provide significant discounts and benefits in the purchase and operation of public sector vehicles. As part of this arrangement, a business unit, VicFleet, was created to manage the government fleet for DTF. VicFleet is responsible for managing the whole of government Standard Motor Vehicle Procurement Policy (the SMVP, see below), which aims to optimise and manage the use of government vehicle assets. VicFleet also provides advice on the executive vehicle policy.[339]

339 Department of Treasury and Finance, 'Victorian Government vehicle contract and policies', <http://www.dtf.vic.gov.au/Fleet-Management/Victorian-Government-vehicle-contract-and-policies>, accessed 1 February 2018.

VicFleet has a total of approximately 8,500 vehicles under lease that include a number of passenger and light commercial vehicles.[340] VicFleet provides a full fleet management service to 20 government departments and agencies.[341] VicFleet also provides a vehicle Finance Lease Facility to about 40 government departments and agencies in which VicFleet is the lessor and eligible government departments and agencies are lessees of government fleet vehicles.[342]

In addition, the Victorian Public Sector Commission (VPSC) and the Victorian Government Purchasing Board (VGPB) also have policy roles in governing the public sector fleet. Other roles and responsibilities include:

- DTF managing a Car Pool Service, which hires cars to government departments and agencies for short and medium term use
- The Victorian Public Sector Commission determining policy and advice on salary packaging for the Executive Motor Vehicle Scheme and Novated Leasing arrangement. Novated Lease Vehicles are for private use and therefore not subject to the SMVP
- The Victorian Government Purchasing Board determining the policies and procedures for the procurement and disposal of goods and services including vehicles by departments and agencies.[343]

The Standard Motor Vehicle Procurement Policy (SMVP)

VicFleet is responsible for managing the Standard Motor Vehicle Policy (the SMVP), which all Victorian Government departments and inner budget agencies, statutory authorities and government business enterprises are required to adhere to. The SMVP's aims are to ensure: fleet efficiency, vehicle and passenger safety and environmental sustainability in the government fleet.[344]

The SMVP outlines a range of directives for its users, covering the entire procurement, leasing, and managing and disposal process for government vehicles. As part of the principles of fleet management, the SMVP directs all departments and agencies to develop a fleet efficiency plan before making any new purchases. This involves:

- Conducting a transport needs analysis where fleet size and composition are optimised against actual transport needs
- Fit-for-purpose vehicle selection
- Reduction of vehicle emissions 'by selecting fuel and emission-efficient vehicles that meet operational needs' and other policy requirements

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340 Department of Treasury and Finance, 'Vehicle lease and management', <http://www.dtf.vic.gov.au/Fleet-Management/Vehicle-lease-and-management>, accessed 1 February 2018.

341 Department of Treasury and Finance, 'Fleet management', <http://www.dtf.vic.gov.au/Fleet-Management/Vehicle-lease-and-management/Fleet-management>, accessed 1 February 2018.

342 Department of Treasury and Finance, 'Vehicle leases', <http://www.dtf.vic.gov.au/Fleet-Management/Vehicle-lease-and-management/Vehicle-leases>, accessed 1 February 2018.

343 Department of Treasury and Finance, *Victorian Government Standard Motor Vehicle policy*, Department of Treasury and Finance, Melbourne, 2017, p. 1.

344 Ibid.

- Vehicle disposal requirement at 60,000 kms or three years from the date of delivery whichever comes first – unless an extension is granted by VicFleet; together with:
  - The development and implementation of strategies that achieve optimum vehicle utilisation from the minimum number of vehicles
  - A vehicle replacement policy
  - To monitor and assess fleet performances against the key fleet objectives.[345]

4.2.1 Barriers to inclusion of electric vehicles in the Victorian Government fleet

There are barriers to the inclusion of all-electric vehicles in the Victorian Government fleet, which were identified by stakeholders during the Inquiry. For example, there are few all-electric models available in the Australian market at present (see further below).

The Government fleet has, up until recently, required fleet managers to procure Australian manufactured vehicles, which limited the availability of electric vehicles for government fleet operators.

Australian manufactured vehicles for fleets

The Committee supports the State Government's earlier decision to purchase Australian-manufactured vehicles for the government fleet. According to VicFleet's website,

> Only passenger vehicles that are substantially manufactured in Australia are permitted for lease or purchase.[346]

With the closure of car manufacturing in Australia, VicFleet's website currently states that this policy will change:

> We have obtained an exemption that allows you to continue to purchase vehicles as you currently do on a fit for purpose basis. We are developing a new policy for 2018 & beyond, which will require approval by the Minister for Finance.[347]

Other evidence submitted to the Inquiry shows that the policy has already been altered in other states and territories. For example, the South Australian (SA) Government Financing Authority, which provides vehicle fleet purchasing and

345 Ibid., p. 10.

346 Department of Treasury and Finance, 'Whole of government standard motor vehicle policy', <http://www.dtf.vic.gov.au/VicFleet/Victorian-Government-vehicle-contract-and-policies/Whole-of-government-standard-motor-vehicle-policy>, accessed 5 February 2018.

347 Department of Treasury and Finance, 'More efficient car fleet arrangements - FAQs', <http://www.dtf.vic.gov.au/VicFleet/More-efficient-car-fleet-arrangements-FAQs>, accessed 15 February 2018.

management services to the SA public sector now states – 'where practicable', they will support Australian based manufacturers by purchasing Australian made passenger vehicles 'where possible'.[348]

During the Inquiry, the Committee sought evidence from DTF and VicFleet regarding electric vehicles in the Government fleet. The Committee received evidence from Mr Robin Scott, Minister for Finance. In correspondence to the Committee, Minister Scott stated that the current VicFleet policy on Australian manufactured vehicles has undergone some changes, in the wake of the end of car manufacturing in Australia.[349]

The Victorian Government Approved Vehicle List

According to the letter from Minister Scott, following the end of local vehicle manufacturing in October 2017, DTF amended the SMVP to replace the requirement to purchase Australian-made vehicles with the requirement to purchase vehicles from an Approved Vehicle List. Vehicles on the approved list have been selected because they offer 'safety, value for money and environmental performance'.[350]

The list is made available to government departments and agencies on VicFleet's website.[351] Only passenger and light commercial vehicles on the Approved Vehicle List are permitted for lease or purchase by government departments and agencies. Departments and agencies need to apply in writing to VicFleet for exemptions.

The list is divided into passenger, sports utility and light commercial vehicles and it also specifies which vehicles are approved for operational staff and for executive-level staff procurement. The list is updated as vehicle models, pricing and safety features change. Currently, the list does not include any all-electric vehicles; it includes hybrid and plug-in hybrid vehicles.[352] The present list (updated November 2017) includes a total of 89 vehicles of which eight are hybrid and plug-in hybrid models. The approved models are shown in Table 4.1, according to vehicle type.[353]

According to Minister Scott, the fleet managed by VicFleet at 31 December 2017 included 1,693 Hybrid Vehicles, representing 19 per cent of the total fleet, or 29 per cent of the passenger vehicle fleet in the State Government fleet.[354]

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348 South Australian Government Financing Authority, *Annual Report: 2013-14*, South Australian Government, Adelaide, 2014. Cited in ClimateWorks Australia, *Improving the fuel efficiency of the Victorian Government's passenger vehicle fleet*, ClimateWorks Australia, Melbourne, 2016, p. 16.

349 Department of Treasury and Finance (Vic), Correspondence to Ms Lilian Topic, Secretary, Economy and Infrastructure Committee, *Letter - Electric Vehicles in Public Sector Fleets*, 15 March 2018.

350 Ibid.

351 Department of Treasury and Finance (Vic), 'List of approved vehicles for executive salary packaging', <http://www.dtf.vic.gov.au/Publications/VicFleet-publications/List-of-approved-vehicles-for-executive-salary-packaging>, accessed 10 January 2018.

352 Department of Treasury and Finance, *Victorian Government Standard Motor Vehicle policy*, Department of Treasury and Finance, Melbourne, 2017, p. 12.

353 Ibid.

354 Department of Treasury and Finance (Vic), Correspondence to Ms Lilian Topic, Secretary, Economy and Infrastructure Committee, *Letter - Electric Vehicles in Public Sector Fleets*, 15 March 2018.

Minister Scott stated that the Victorian Government has the largest hybrid vehicle fleet in Australia.[355]

Minister Scott further stated that the Government will support the purchase of electric vehicles by working with the State Government's transport planning, coordination and operation agency, Transport for Victoria. However, the high upfront costs of electric vehicles at present is expected to limit the number initially in the fleet.[356]

Table 4.1 **Approved Vehicle List November 2017, Hybrid and PHEV models only, VicFleet website**

EO Band	Level	Operational/ Executive	Model, Type, Engine, Body	Fuel l/100km	CO_2G/km
Small Passenger					
1,2,3	Base	Both	TOYOTA Corolla Hybrid Hatch	4.1	96
Small SUV 2WD					
No hybrid/PHEV models available					
Small SUV AWD					
No hybrid/PHEV models available					
Medium Passenger					
1,2,3	Base	Both	TOYOTA Camry Ascent Hybrid	4.7	98
1,2,3	Upmarket	Executive	TOYOTA Camry Ascent Sport Hybrid	4.7	98
1,2,3	Prestige	Executive	TOYOTA Camry SL Hybrid	4.7	98
Medium SUV 2WD					
No hybrid/PHEV models available					
Medium SUV AWD					
1,2,3	Upmarket	Both	MITSUBISHI Outlander PHEV LS Hybrid	1.7	41
1,2	Prestige	Executive	MITSUBISHI Outlander PHEV Exceed Hybrid	1.7	41
Large Passenger					
No hybrid/PHEV models available					
Large SUV 2WD					
1,2,3	Base	Both	NISSAN Pathfinder ST Hybrid	8.6	200
Large SUV AWD					
1,2,3	Prestige	Executive	NISSAN Pathfinder ST-L Hybrid	8.7	202
Large 4WD					
No hybrid/PHEV models available					

Source: Department of Treasury and Finance (Vic), 'List of approved vehicles for executive salary packaging', <http://www.dtf.vic.gov.au/Publications/VicFleet-publications/List-of-approved-vehicles-for-executive-salary-packaging>, accessed 10 January 2017.

355 Ibid.

356 Ibid.

Limited fit-for-purpose all-electric vehicle models available

The limited fit-for-purpose full-battery electric vehicles in the Australian market poses another barrier to their inclusion in government fleets. As described in earlier chapters, there are few all-electric vehicle models available in Australia. The only all-electric models presently available are Teslas and BMW i3, which are priced in the luxury car range. At a public hearing, the Committee heard that the Nissan Leaf and the Mitsubishi i-Miev (both small passenger cars) are unavailable in the Australian market at present.[357]

The government fleets require different types of motor vehicles. Government departments and agencies need to purchase fit-for-purpose vehicles and to manage their fleet requirements based on value-for-money, as well as environmental objectives.[358]

There are limited models of electric vehicles currently available to government fleets. The Renault Zoe (a passenger vehicle) and Renault Kangoo (a light commercial vehicle) are the only all-electric vehicles 'currently available for business-to-business and business-to-government purchases only'.[359]

Workplace charging infrastructure

The Victorian Government EV Trial identified the need for charging infrastructure as well as a level of understanding and interest in electric vehicles among fleet managers and staff.[360] The Committee heard that workplace charging infrastructure is required to support the uptake of electric vehicles in the government fleet. Packages for government staff which include home charging infrastructure could support the uptake of all-electric vehicles among government staff.[361] This would require however, an upfront investment into electric vehicles by the State Government.

According to Minister Scott, DTF and VicFleet have identified several charging-related issues, which will need to be resolved. These include:

- charging vehicles at home
- charging vehicles at Government premises
- charging vehicles in commercial buildings; and
- capturing charging costs.[362]

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357 Dino Hazdic, Engineer, ABB Australia, *Transcript of evidence*, 13 February 2018, p. 54.

358 Department of Treasury and Finance, 'Whole of government standard motor vehicle policy', <http://www.dtf.vic.gov.au/VicFleet/Victorian-Government-vehicle-contract-and-policies/Whole-of-government-standard-motor-vehicle-policy>, accessed 5 February 2018.

359 Renault, 'Renault Electric Vehicles', <http://www.renault.com.au/all-new-electric>, accessed 15 February 2018.

360 Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 50.

361 ClimateWorks Australia, *Improving the fuel efficiency of the Victorian Government's passenger vehicle fleet*, ClimateWorks Australia, Melbourne, 2016, p. 36.

362 Department of Treasury and Finance (Vic), Correspondence to Ms Lilian Topic, Secretary, Economy and Infrastructure Committee, *Letter - Electric Vehicles in Public Sector Fleets*, 15 March 2018.

Minister Scott further explained that the departments and agencies with PHEVS or considering purchase of a PHEV are considering these issues. The introduction of plug-in hybrid vehicles into the state fleet will provide time to resolve these issues before the transition to fully battery operated electric vehicles. VicFleet is working with departments, agencies and vehicle manufacturers to determine electric vehicle charging requirements.[363]

Electric vehicle depreciation

The public sector purchases the largest number of new vehicles in the Australian market.[364] The Committee heard that state and local governments have the purchasing power to encourage car manufacturers to bring out more electric vehicles at a lower price. Government fleet vehicles also eventually flow on to the second hand market. According to a submission from the Victorian branch of the Australian Electric Vehicle Association (AEVA):

> Many Australians are not financially able to purchase new motor vehicles and rely on the second hand market. Private buyers tend to not change cars purchased new for a number of years. A lack of second hand electric cars will disadvantage many citizens and delay achieving a high proportion of EVs in the national fleet. If car purchases at all levels of Government heavily favoured electric vehicles, this could help redress this situation.
>
> This option would result in the least distortion of vehicle prices in both the new and used car markets while providing a supply of affordable second hand electric cars.[365]

However, electric vehicles currently have high vehicle operating costs due to depreciation. The Royal Automobile Club of Victoria (RACV) and its counterparts in other states and territories, conduct annual vehicle running cost surveys. These surveys take into account both the running costs and the 'standing costs', which include the purchase price and what a driver pays to keep their car registered and insured. In recent state surveys, the RACV reported rising vehicle operating costs due to interest rates having risen slightly, joined by rises in on-road taxes and fuel prices. In 2017, the overall cost of owning and running a car has risen on average by 1.6 per cent to $207.84 a week.[366]

The RACV surveys found that low emission vehicles including electric vehicles have particularly high vehicle operating costs due to depreciation. For example, a Tesla Model X is estimated to have an overall vehicle operating cost of over $500 a week.[367] According to RACV, on average 50.9 per cent of the cost of ownership was attributed to depreciation, over a forecasted 5 year period. This is because:

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363 Ibid.

364 Graeme Philipson, 'Driving Change: Fleet management', *Government News*, 2016, <https://www.governmentnews.com.au/2016/01/22647>, accessed 30 January 2018.

365 Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 5.

366 Liam McPhan, 'Vehicle Running Costs on the Rise', *RACV RoyalAuto Magazine,*, RACV 2017, <https://www.racv.com.au/membership/member-benefits/royalauto/motoring/information-and-advice/car-running-costs.html>, accessed 30 November 2017.

367 Royal Automotive Company Tasmania (RACT), 'Rise in vehicle ownership costs', <http://www.ract.com.au/vehicle-operating-costs>, accessed 7 February 2018.

> Electric cars often have poor resale value, which doesn't help when depreciation is, on average, 41 per cent of weekly running costs. Mitsubishi Outlander PHEV, for instance holds only 29 per cent of its value at trade-in after five years, compared with the Mitsubishi average of 37.5.[368]

In fleet contexts, high vehicle operating costs will have a flow on effect for vehicle lessees.

However, according to Mr Noldus of SG Fleet, a private company that provides fleet management and leasing services to the corporate and public sector:

> It should be noted that corporations and consumers generally have concerns about the resale value of new-generation or new-technology vehicles. This was also the case at the time that hybrids were introduced.[369]

In their earlier report on how the Victorian Government can improve fuel efficiency in its passenger vehicle fleet, ClimateWorks Australia (hereon ClimateWorks) described some of the approaches the Victorian Government could take to reduce the high upfront cost and rapid depreciation of low and zero emission vehicles in Australia:

> Other approaches could also include collaboration with private sector and investigation into the establishment of a second-hand market for lower emission vehicles which would contribute to a reduction in depreciation...
>
> The ability to create second-hand markets has been demonstrated previously with the purchase of Toyota Camry Hybrid's, which have made Hybrid vehicles an affordable and obtainable choice for those purchasing a second-hand vehicle, and in particular the taxi industry. The Victorian Government could use its purchasing power and networks with industry to establish a reliable second hand market for low emission vehicles, to help increase resale values and reducing depreciation. Savings achieved through overall cost reductions and fleet optimisation could offset any additional costs associated with more efficient vehicles.[370]

The Committee heard that there is interest in electric vehicles from departments and agencies, as existing and available plug-in hybrid vehicles have been ordered by the Department of Justice and Regulation, Environment Protection Authority (EPA), and by a Member of Parliament as an electorate vehicle. In addition, quotations for plug-in hybrid vehicles have been requested by the Department of Premier and Cabinet, Department of Environment, Land, Water and Planning, Kardinia Park Trust, and the Emergency Services and Telecommunications Authority.[371]

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368 Liam McPhan, 'Vehicle Running Costs on the Rise', *RACV RoyalAuto Magazine,*, RACV 2017, <https://www.racv.com.au/membership/member-benefits/royalauto/motoring/information-and-advice/car-running-costs.html>, accessed 30 November 2017.

369 Yves Noldus, Head of Corporate Affairs - Marketing and Investor Relations, SG Fleet, *Transcript of evidence*, 9 November 2017, p. 26.

370 ClimateWorks Australia, *Improving the fuel efficiency of the Victorian Government's passenger vehicle fleet*, ClimateWorks Australia, Melbourne, 2016, p. 39.

371 Department of Treasury and Finance (Vic), Correspondence to Ms Lilian Topic, Secretary, Economy and Infrastructure Committee, *Letter - Electric Vehicles in Public Sector Fleets*, 15 March 2018.

According to Minister Scott, targets are not required for hybrid vehicles and plug-in hybrid vehicles in the government fleet. The considerable interest in low emission vehicles among state government departments and agencies has led to the Victorian Government having the largest hybrid fleet in Australia.[372]

This potentially indicates that State Government fleet purchasing of fully battery operated electric vehicles could support the creation of a second-hand market of hybrid and fully electric vehicles in the future.

Executive vehicles

VicFleet also advises on policy aspects of the executive vehicle scheme. Executive-level officers in the Victorian Public Service can only select vehicles from the government's Approved Vehicle List, unless an exemption is granted – as discussed above, there are no all-electric vehicles available on the approved list.[373]

Stakeholders told the Committee that one low-cost option is for senior members of the Government and the Victorian Public Service to support the sector by driving all-electric vehicles.

The Committee heard there is a promotional value for electric vehicles, when Members of Parliament, as well as the most senior officers in the Public Service have the option to drive them. The Committee received evidence that there would be no need for incentives to support executive-level officers in relation to electric vehicles. The extra cost of premium electric vehicle brands could be borne by departments and staff.[374] The incoming Tesla Model S may be competitively priced with similar internal combustion engine vehicles in this vehicle segment for executive-level use.

Fuel efficiency and the Victorian Government fleet

The Committee heard that driving electric vehicles will lead to environmental and health benefits (see Chapter One). During the Inquiry, ClimateWorks, described the emissions intensity of the Victorian Government passenger vehicle fleet as in line with Australia's national average in 2015 of 182 gCO_2/km for new passenger vehicles. However, it fell below what would be considered a leadership position in relation to jurisdictions overseas.[375] ClimateWorks made five recommendations to improve the fuel efficiency of the Victorian Government passenger vehicle fleet, which included, among other recommendations:

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372 Ibid.

373 Department of Treasury and Finance, 'Executive vehicle policy - Frequently asked questions', <http://www.dtf.vic.gov.au/Fleet-Management/Victorian-Government-vehicle-contract-and-policies/Executive-vehicle-policy/Executive-vehicle-policy-Frequently-asked-questions>, accessed 1 February 2018.

374 ClimateWorks Australia, *Improving the fuel efficiency of the Victorian Government's passenger vehicle fleet*, ClimateWorks Australia, Melbourne, 2016, p. 36.

375 Ibid., p. 4.

> Introducing electric vehicles into the fleet and extending the lease terms to accommodate these vehicles, which have lower maintenance requirements and can be driven for a longer period of time.[376]

The Committee heard that electric vehicles could be beneficial in government fleets and by adopting them in this sector, governments could support their uptake in the private market through the creation of a second-hand market.[377]

Policy and targets

The Committee received evidence that electric vehicles could be included in state and local government fleets.

In a submission, energy provider and retailer AGL advocated that the Victorian Government play an important leadership role by establishing a target number and timeline for electric vehicles in the government fleet, to stimulate their uptake. They stated:

> Around 4% of new cars sold each year are purchased for Government fleets, equating to around 40,000 vehicles per year. By mandating that new fleet purchases include EVs, the Victorian Government could substantially stimulate EV uptake in Australia. As well as socialising consumer appetite towards EVs, it would also create a second-hand market for depreciated EVs that would provide an additional avenue for private ownership.[378]

The Committee notes that AGL has already commenced transitioning 10 per cent of its business vehicle fleet to electric vehicles by mid-2018.[379] In a submission, Origin Energy also supported the introduction of fleet purchasing policy for minimum targets of electric vehicles in Federal, State and Local Government fleets.[380]

The Municipal Association of Victoria and other local councils, advocated for the Victorian State Government to reinvigorate electric vehicle policy, following the earlier Victorian Government EV Trial.[381] The Committee heard the state government could gradually introduce all-electric vehicles into the government fleet and encourage its staff to select these vehicles.

In his letter to the Committee, Minister Scott stated that DTF and VicFleet do not consider a need for a specific policy for the procurement of fully battery powered electric vehicles. It is expected that the existing purchasing policies supporting the procurement of hybrid vehicles will support the purchase of all-electric vehicles once they become available.[382]

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376 Ibid., pp. 34-38.

377 AGL Energy, *Submission,* no. 42, p. 8.

378 Ibid.

379 Ibid., p. 2.

380 Origin, *Submission,* no. 26, p. 2.

381 Municipal Association of Victoria, *Submission,* no. 41, p. 10; Eastern Alliance for Greenhouse Action, *Submission,* no. 54, p. 1; Scott McKenry, Executive Officer, Eastern Alliance for Greenhouse Action, *Transcript of evidence*, 8 November 2017, p. 13.

382 Department of Treasury and Finance (Vic), Correspondence to Ms Lilian Topic, Secretary, Economy and Infrastructure Committee, *Letter - Electric Vehicles in Public Sector Fleets*, 15 March 2018.

FINDING 16: The Victorian Department of Treasury and Finance does not have targets for inclusion of fully battery operated electric vehicles in the Victorian Government fleet, nor do they have comprehensive charging infrastructure to support them. However, the Department has indicated that it will include fully battery operated electric vehicles in the Victorian Government fleet in future and is investigating the charging infrastructure required to support electric vehicles.

FINDING 17: The Department of Parliamentary Services at the Parliament of Victoria does not supply charging infrastructure to Parliamentarians or executive-level Parliamentary staff driving electric vehicles.

4.3 Public transport bus fleets

The Committee heard that electric buses could provide a cost-effective way to introduce a greater number of Victorians to electric vehicle technology.[383] Electric buses could provide a more cost-effective option to reduce emissions and improve air quality by virtue of size and the numbers of passengers they can hold, compared to private passenger vehicles. The Committee heard that a transition to electric buses can also provide a greater number of Victorians with exposure to electric vehicle technology and offer a more efficient and cost-effective means to lower emissions and improve air quality, noise and amenity.[384]

The Committee heard that the upfront costs of electric buses are significantly higher than internal combustion engine buses, presenting a barrier to their uptake. Electric buses will also require corresponding infrastructure.

4.3.1 The applicability of electric buses in public transport fleets

During the Inquiry, the Committee heard electric buses could be a positive inclusion into the Victorian public transport network. Stakeholders cited the environmental benefits of electric buses and their lower costs in the long-term. The Victorian branch of the AEVA told the Committee that electric buses are in operation in many parts of the world, including in Australia where they are being trialled in SA and the ACT. In a submission, the Victorian branch of AEVA stated the applicability of electric vehicles in fleets including bus fleets:

> Electric vehicles are well matched to fleet operations which are supported by a maintenance department. They reduce maintenance in several ways: motor simplicity, speed control and regenerative braking. Electric motors consist of very few parts compared with internal combustion engines and as a result, reduce the extent of maintenance. Their torque characteristics are very well matched to accelerating vehicles from rest and they are controlled electronically to avoid the need for complex transmission systems. Furthermore, vehicles can be slowed (but

383 Tim Olding, Electric Vehicle Transport and Energy Consultant, Sassafras Group, *Transcript of evidence*, 13 February 2018, p. 42; InvertedPower, *Submission,* no. 223, p. 7; Dino Hazdic, Engineer, ABB Australia, *Transcript of evidence*, 13 February 2018, p. 55.

384 Tim Olding, Electric Vehicle Transport and Energy Consultant, Sassafras Group, *Transcript of evidence*, 13 February 2018, p. 42; Dino Hazdic, Engineer, ABB Australia, *Transcript of evidence*, 13 February 2018, p. 7; Hobsons Bay City Council, *Submission,* no. 48, p. 6.

> not halted) using regenerative braking, recovering much of the energy used to accelerate the vehicle, rather than dissipating it as heat generated by friction; this avoids much wear on brakes.[385]

The Public Transport Users Association supported the inclusion of electric buses in the Victorian public transport fleet but they pointed out some of the present barriers to the operation of electric buses in the public transport fleet:

> In common with the concerns of potential private EV purchasers, equipment standards and recharging requirements are among the key issues needing to be resolves to enhance confidence among fleet operators. Issues that are specific to fleet operators include the availability of suitable skills for fleet maintenance and the substantial upfront cost of vehicles and fleet-scale charging infrastructure.[386]

Some stakeholders also described the potential benefits of hydrogen fuel cell buses, which have been trialled in other jurisdictions. The Committee heard that hydrogen fuel cell vehicles, which are vehicles that run on electric motors and are powered by hydrogen, represents a progression towards zero emissions driving, particularly in the heavy vehicle sector. In their submission, the Central Victorian Greenhouse Alliance wrote:

> Similarly, Fuel Cell Vehicles offer a zero emission solution for heavy vehicles such as buses and waste vehicles that run on diesel... The Western Australian Government ran a very successful trial from 2004-2007 testing three hydrogen fuel cell buses in the City of Perth. The three EcoBuses performed well beyond expectations and at the conclusion of the trial saved 300 tonnes of tailpipe carbon emissions by not operating conventional diesel buses. However, the main barrier at the time was the cost of technology...[387]

During the earlier Victorian Government EV Trial, the Department of Transport conducted an assessment of electric bus technology as part of an investigation into alternative fuel and vehicle technologies for the bus industry. The trial report noted that the long charging times and high purchase prices for electric buses made them 'best suited to light duties with high promotional values'.[388] Since then, the Committee heard that electric bus technology has developed further and electric buses are being trialled on public bus routes most notably in the ACT and in SA.[389] Electric buses are also in operation overseas.[390] At present, there is no corresponding trial of electric buses in Victoria, with the exception of a hybrid bus trial conducted by local bus operator Latrobe Valley Bus Lines in Victoria's eastern region.[391]

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385 Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 7.

386 Public Transport Users Association, *Submission,* no. 43, p. 10.

387 Central Victorian Greenhouse Alliance, *Submission,* no. 12, pp. 1-2.

388 Department of Transport Planning and Local Infrastructure (Vic), *Creating a Market: Victorian Electric Vehicle Trial Mid-Term Report*, Victorian Government, Melbourne, 2013, p. 33.

389 Katie Burgess, 'Canberra's first electric and hybrid buses go into service on Monday', *The Canberra Times*, 25 August 2017; *First Australian-made electric bus rolls off production line in Northern Adelaide*, media release, Government of South Australia, Adelaide,, 23 June 2017.

390 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, pp. 14-15; Dino Hazdic, Engineer, ABB Australia, *Transcript of evidence*, 13 February 2018, p. 56.

391 Australasian Bus and Coach, 'Vic Operator Goes for Volvo Hybrids', accessed 29 January 2018, <https://www.busnews.com.au/industry-news/1711/vic-operator-goes-for-volvo-hybrids>.

The cost of transitioning to an electric bus fleet

The Committee heard the high upfront cost of electric buses and their infrastructure requirements are current barriers to their application in the public transport sector. The AVASS Group in Melbourne, produces entire electric vehicles (chassis and body) in the heavy vehicle segment, including electric buses. In a submission, Dr Allen Saylav, Chief Executive Officer of the AVASS Group wrote:

> Initial investments of charging public transportation fleet to electric buses and the costs of battery replacement still outweighs the monetary advantages gained from lower operational costs and additional environmental benefits with rapid returns on investment (ROI).[392]

There are however long term gains with electric buses following the initial high upfront costs of purchasing electric buses, as Dr Saylav explained:

> When analysing differences in of [sic] Electric Public Transport Vehicles and fossil fuel powered Vehicles, both operational costs and initial investment comparison undoubtedly has higher initial capital outlay involved when electric energy is being added/ used. However, operational costs, including energy costs, show opposite picture, especially with large annual distances covered – electrical energy is substantially cheaper.[393]

Beyond Zero Emissions provided an indication of the cost differences between an electric and an internal combustion engine bus, illustrating the capital cost differences (Figure 4.2). Beyond Zero Emissions also illustrated the different fuel efficiencies for all three types of buses (Figure 4.3).

Figure 4.2 **Capital and Maintenance Cost of Electric and internal combustion engine buses in 2012, (adapted by BYD Auto, 2012)**

Fuel Type of Bus	Capital Cost in 2012 (2014 AUD per Bus)	Maintenance Cost in 2012 (2014 AUD per Bus per Year)
Diesel/Petrol	$353,120	$25,223
CNG	$454,012	$21,019
Electric	$655,795	$12,611

Source: Beyond Zero Emissions, 'Appendix B' in Electric Vehicles, (2016), p. xvii.

Figure 4.3 **Fuel Efficiency of Electric and combustion engine buses**

Type	Fuel Efficiency
Diesel/Petrol	45L/100km
CNG	111.87L/100km
Electric	120kWh/100km

Source: Beyond Zero Emissions, 'Appendix B' in Electric Vehicles, (2016), p. xvii.

392 AVASS Group, *AVASS Group - Attachment 1*, attachment to AVASS Group, *Submission*, p. 4.

393 Ibid.

At a public hearing, Councillor Mike Clarke of the Yarra Ranges Council advocated for improvements in the delivery of bus services in the Dandenong Ranges where he described services are 'completely inadequate'. Cr Clarke described the need for a 'dial-a-bus' service, ideally delivered by a small electric bus. The type of electric bus Cr Clarke identified as fit-for-service, operates in Europe. These small electric buses, the Committee heard, have a battery-swap capacity and according to Cr Clarke would cost,

> around the €250 000 mark, so say $300 000, which is an un-negotiated position. This is an initial one-off price, but for this sort of scale of bus we need about 60 buses to run the network and we need another 60 to run the roaming bus. We are talking about 120-odd buses, so negotiations for discounting on that basis would hopefully get it down to $200 000 for a bus.[394]

It is likely, as in the case of electric cars, that the upfront costs associated with electric buses will reduce as batteries improve in capability and price. In a submission, energy retailer AGL stated that in early 2017, their Electric Vehicle Lead staff member supervised a Master of Energy Systems student whose project compared the costs of electric and diesel buses in Australia:

> The findings of that study revealed that the extra cost of an electric bus would be paid back within 3 years (based on current price points and forecasts). Moreover as battery prices continue to fall, the electric bus advantage will continue to grow.[395]

At a public hearing, Mr Behyad Jafari of the Electric Vehicle Council reiterated the cost benefits of electric buses over conventional buses:

> In our conversations with particularly people who provide the Victorian fleet of buses as well as what we know from international evidence, the economics for electric buses already stack up — you can use the bus fleet in a correct way so that it is already more efficient to drive an electric bus...[396]

Mr Jafari added that the electric vehicle industry is waiting for direction and support from state and local governments in Australia, in relation to electric buses. He stated,

> So yes, we are seeing quite a lot of pilot projects and trials of electric buses in Australia. This is an area where, because international evidence has moved this along a bit further, industry is further along, and they would like to invest further if they started to see that reflected inside of tenders being provided by governments and councils.[397]

The Committee heard that current concerns about the applicability of electric buses centre on their high upfront costs including those associated with infrastructure requirements. However they also heard that the cost of electric buses will reduce with improvements in battery technology and prices. Beyond Zero Emissions recently modelled the potential environmental and cost benefits

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394 Mike Clarke, Councillor, Yarra Ranges Council, *Transcript of evidence*, 8 November 2017, p. 13.

395 AGL Energy, *Submission,* no. 42, p. 9.

396 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 4.

397 Ibid.

if Australia were to transition to a fully electric public bus fleet. Their modelling included the costs of installing rapid charging stations for electric buses in each state and territory.

Costs were calculated based on two scenarios.

- A high cost scenario characterised by low petrol prices and high capital costs for the buses
- A low cost scenario characterised by high petrol prices and capital cost parity between electric and combustion engine buses.

Beyond Zero Emissions found that a transition to 100 percent electric buses in Australia will cost 12 per cent less than continuing operation with internal combustion engine (ICE) buses. In a high cost scenario, a wholesale transition to electric buses may cost only slightly more than ongoing operations. They found that even in a high cost scenario, a 100 per cent shift to electric buses would cost Australia 10 per cent more than a business as usual scenario.[398]

4.3.2 Charging infrastructure requirements for electric buses

The Committee heard that electric buses will need dedicated charging infrastructure. The electric buses currently on trial in the ACT can be driven for about 430 kilometres per charge on route operations.[399] In a submission, ABB Australia Ltd, an Australian office of the global ABB Group, which deploys DC fast charging technology, explained the two types of electric buses available and their charging infrastructure requirements:

> There is the bus that can travel 200km+ without needing a recharge and buses with about 20km range that charge regularly. Both have their own advantages and disadvantages and it is important just like the car chargers, to match the bus service with the correct application.
>
> High Capacity Buses – These buses are ideal for long distance travel where the opportunity to charge is limited. They carry a large number of batteries to achieve this, however this adds significantly to the weight and reduces room on the bus
>
> Smaller Capacity Buses – These buses tend to use the layover time to re-charge and therefore ideal for smaller routs. This allows the bus to be a lot lighter and carry more passengers. The way it works is the bus chargers [sic] fully overnight to be able to make a few trips, then on its journey when it reaches the end of the line it stops under a post with a pantograph and re-charges the bus. This takes about 3-6 minutes.[400]

Electric buses require recharging and the frequency will depend on the battery capacity of the bus. The Committee heard they can be charged at bus depots during layovers and overnight. There are electric buses that can be charged through on-road top-ups and or swappable batteries. There are also innovations

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398 Beyond Zero Emissions, *Electric Vehicles Report*, Beyond Zero Emissions, Melbourne, 2016, pp. 42-43.

399 Katie Burgess, 'Canberra's first electric and hybrid buses go into service on Monday', *The Canberra Times*, 25 August 2017.

400 ABB Australia Ltd, *Submission,* no. 52, p. 3.

such as induction charging, which uses an electro-magnetic field to transfer energy to buses and is wireless.[401] Opportunity charging is another model, according to energy retailer AGL:

> Opportunity charging nominally uses battery-buffered high-powered fast-charging stations to regularly charge the vehicles along their services route during passenger on/ off-boarding.[402]

Following consultation with technology vendors and bus operators, AGL stated that they are of the view that the opportunity charging model will provide the greatest advantages if Victoria were to transition to electric buses. Opportunity charging:

- allows downsizing of the bus batteries and conservation of the bus payload for passengers;
- enables more efficient asset utilisation by avoiding over-capitalising on the bus battery, shifting investment to better utilized charging infrastructure; and
- provides a distributed network of batteries that could potentially be used to support the grid.[403]

InvertedPower is a Melbourne-based technology start-up business that has developed and commercialised intellectual property, which improves the functionality and economics of electric vehicles. In a submission to the Inquiry, Mr Stefan Smolenaers, Founder of InvertedPower stated:

> In many examples worldwide, opportunity charged electric bus fleets have been proven to provide a lower total cost of ownership compared with traditional diesel fleets. Commercial vehicle operators are more attuned to making decisions based on total cost of ownership, and in many cases, opportunity charged electric buses are now being deployed by transport operators purely on economic reasoning. Therefore, the adoption of opportunity charged electric buses within the PTV fleet would yield a favourable return-on-investment and provide net economic benefits to Victorians, whilst providing desired EV market stimulation.[404]

An example of opportunity charging is illustrated below (Figure 4.4). A 'pantograph' also known as a jointed framework that conveys electricity to an electric vehicle is shown. An electric bus connects to the pantograph and recharges during stopovers and overnight.

The introduction of electric buses in Victoria would require corresponding development of charging infrastructure. Charging stations have been installed in the ACT for the trial, where, as *The Canberra Times* reported, the infrastructure is of 'minor cost'.[405]

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401 Ibid., p. 42.

402 AGL Energy, *Submission,* no. 42, p. 9.

403 Ibid.

404 InvertedPower, *Submission,* no. 223, p. 7.

405 Katie Burgess, 'Canberra's first electric and hybrid buses go into service on Monday', *The Canberra Times*, 25 August 2017.

Beyond Zero Emission's modelling took into account a conservative estimate of the bus charging infrastructure. Rapid charging units, which are able to charge an electric bus in 10 to 20 minutes were conservatively estimated to cost ten times that of an electric car rapid charge unit ($550,250 per unit). It was further estimated that 16 rapid bus charging units would be required for Victoria.[406]

Electric bus technology is rapidly evolving and depending on the options considered, range capacities, infrastructure requirements and infrastructure will incur different costs.

Figure 4.4 **An electric bus recharging from an inverted pantograph, in front of Volvo in Gothenburg, Sweden, from the global ABB website**

Source: The ABB Group, 'Opportunity Charging for Electric Buses',<http://www.abb.com/cawp/seitp202/be24f0a9ca998b59c12581e00031630b.aspx>, accessed 31 January 2018.

406 Beyond Zero Emissions, *Electric Vehicles Report*, Beyond Zero Emissions, Melbourne, 2016, Appendix B, p. xvii

Electric bus charging and their impact on electricity supply

According to energy provider and retailer AGL, consumers are increasingly seeing the grid as a 'means to export, as well as import, electricity'. Electric buses could provide added benefits to the grid by providing a distributed network of batteries.[407] Mr Tim Olding, an Electric Vehicle Transport and Energy Consultant explained the potential for electric buses to support the electricity grid, at a public hearing:

> We are going to go to a grid which is probably substantially more dynamic than it has been in the past in terms of you have got a lot more renewables in that grid. That can obviously be an issue, and we have actually seen some issues related to that, although whether they were truly related to renewables or whether the network in general was not operating robustly is a big question mark. Once you start to put a large network of electric vehicles into the system, and particularly buses, you have the opportunity to start to use the bus network and the recharging infrastructure for the bus network to also be a stabilising influence on the grid as well.[408]

Mr Olding further stated:

> If we can take a whole-of-system approach to developing electric vehicle networks, taking into consideration not only the vehicles and the charge stations but also the generating resources, you can probably kill a couple of birds with one stone, create something that is creating value on both sides of the coin — lower transportation cost, more stable grid, with lower grid services costs that go with that.[409]

Victorian technology start-up business, InvertedPower, is working with a Dutch charge station supplier, Heliox BV to integrate InvertedPower's battery buffered technologies in heavy vehicle charging stations.[410] According to Mr Smolenaers of InvertedPower, the opportunity charging model's economic return is further improved when each charging stations is coupled with a battery buffer:

> ...the batteries in these charging stations could be used to support the national electricity market (NEM) and abate the up to 90% of power failures caused by distribution failures. A full-scale network deployment of opportunity charging infrastructure would form the largest virtual power plant in the world, and would advance and promote Australian innovation in the energy sector.[411]

The Committee heard that more electric vehicles on the road could further stabilise Victoria's electricity supply – if charging is managed, new technology, which couples electric vehicle charging with battery buffering is introduced to support the grid and distribution networks and electricity generating assets are prepared for electric vehicles.

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407 AGL Energy, *Submission,* no. 42, p. 9.

408 Tim Olding, Electric Vehicle Transport and Energy Consultant, Sassafras Group, *Transcript of evidence*, 13 February 2018, p. 42.

409 Ibid.

410 Ibid., p. 46., InvertedPower, *Submission,* no. 223, p. 8.

411 InvertedPower, *Submission,* no. 223, p. 8.

4.3.3 Victoria's public bus operators

The Victorian Government currently has contracts with about 13 bus operators to provide services to Victoria's public bus routes.[412] Leading businesses such as Transdev Melbourne operate one-third of the public bus services in Melbourne with a fleet of 505 vehicles in its Melbourne operations.[413] Victoria's bus operators, a number of which are family-owned businesses also operate private services and school buses. The Committee did not hear of any electric bus trials in Victoria, with the exception of a trial of a hybrid bus by Latrobe Valley Bus Lines in the State's eastern region.[414]

In 2017, the Latrobe Valley Bus Lines was reported to have placed an order for eight Euro 6 Volvo B5LH single deck hybrid chassis in early November, following a successful 12-month trial.[415] The technology has 'saved[d] more than 30 per cent fuel and CO_2 emissions, and reduced harmful Nitrous Oxide (NO_X) emissions by up to 50 per cent compared to a regular diesel bus. The first of the hybrid buses are set to go into operation in 2018.[416] This trial was reported to be a first move by government in 'the longer journey towards electric buses'.[417]

The recent Better Bus Network plan launched by the Victorian State Government aims to deliver more buses where they are needed to improve the existing bus network. The Committee notes that the $100 million plan does not currently include explicit actions to help bus operators introduce electric buses or other low emission buses, although the Minister for Transport, Ms Jacinta Allan was quoted in an ABC news report, stating that the Government would look at introducing 'smaller, more frequent and possibly electric busses'.[418] At a public hearing, Mr Paul Salter, Acting Executive Director, Network Strategy at Transport for Victoria, the Victorian Government's transport agency stated that at the time of the earlier Victorian Government EV Trial:

> Hybrids were used as part of the trial. Since then, however, electric buses have been brought into service in large numbers in major cities around the world. Particularly in China in the last couple of years where there have been over 200 000 new electric buses brought into service, so it is certainly possible to make them work. The assertion in some of these other jurisdictions is that it is already cheaper to operate them than conventional buses, but their applicability to the Melbourne circumstance obviously depends on rostering, cycles and how it works. It is very much a logistical

412 Hobsons Bay City Council, *Submission,* no. 48, p. 6. See also, 'Melbourne's bus system set for overhaul as Government opens up contracts', *ABC News*, 16 February 2017, <http://www.abc.net.au/news/2017-02-16/melbourne-bus-contracts-system-set-for-overhaul/8275196>, accessed 29 January 2018.

413 Transdev Melbourne, 'About TDM', <http://www.transdevmelbourne.com.au/about/about-tdm>, accessed 29 January 2018.

414 Latrobe Valley Bus Lines, 'Hybrid Bus Launch', <http://www.lvbl.com.au/hybrid-trial>, accessed 10 January 2018.

415 Australasian Bus and Coach, 'Vic Operator Goes for Volvo Hybrids', <https://www.busnews.com.au/industry-news/1711/vic-operator-goes-for-volvo-hybrids>, accessed 29 January 2018.

416 Ibid.

417 Ibid.

418 'Melbourne's bus system set for overhaul as Government opens up contracts', *ABC News*, 16 February 2017, <http://www.abc.net.au/news/2017-02-16/melbourne-bus-contracts-system-set-for-overhaul/8275196>, accessed 29 January 2018.

> issue in terms of how it is done. It might be possible to make them work, but you might need double the vehicles. It has a cost implication. It is obviously something that is being looked at.[419]

The Committee heard that Victoria's bus contracts are up for renegotiation in early 2018 providing an opportunity for the Victorian Government to develop a strategy in partnership with private industry to trial electric buses.[420] At a public hearing, representatives of Transport for Victoria confirmed that the existing bus contracts will expire this year and that Transport for Victoria are in the midst of the recontracting process. At this stage, Transport for Victoria could not provide further details about the future of electric buses in Victoria.[421]

The Committee heard there is interest among regional stakeholders in the introduction of electric school buses. Goulburn Broken Greenhouse Alliance advocated for an electric school bus trial given that 'school buses run for specified time periods and charging could take advantage of these scheduled times'.[422]

Electric bus fleets overseas

According to a Reuter's article, more than 15 per cent of the 608,600 buses in China are fully electric.[423] During a public hearing in Melbourne, Mr Bryce Gaton, Executive Committee member of the Victorian branch of the AEVA told the Committee '12 cities will buy only electric buses from 2025, with more expected to join':[424]

> London, Paris, Los Angeles, Copenhagen, Barcelona, Quito, Vancouver, Mexico City, Milan, Seattle, Auckland, and Cape Town all signed the C40 Fossil-Fuel-Free Streets Declaration, which pledges that they will add only fully electric buses to their cities' public transportation from 2025.[425]

Mr Dino Hazdic, Engineer at ABB Australia Ltd, the Australian offices of the global ABB Group told the Committee that Belgium has deployed a fleet of 101 electric buses, which are being supported by 15 charging stations.[426]

The Tourism and Transport Forum (TTF) is the Australian peak industry group that represents the tourism, transport and aviation sectors. According to the TTF, Transdev recently commenced operations of electric bus fleets in Sweden, Finland, France, Canada and the Netherlands, with substantial operations in the Netherlands:

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419 Paul Salter, Acting Executive Director - Network Strategy, Transport for Victoria, *Transcript of evidence*, 13 February 2018, p. 5.

420 Hobsons Bay City Council, *Submission,* no. 48, p. 6.

421 Paul Salter, Acting Executive Director - Network Strategy, Transport for Victoria, *Transcript of evidence*, 13 February 2018, p. 5.

422 Goulburn Broken Greenhouse Alliance, *Submission,* no. 40, p. 4.

423 Nichola Groom, 'U.S. transit agencies cautious on electric buses despite bold forecasts', *Reuters - Business Daily*, 12 December 2017, <https://www.reuters.com/article/us-transportation-buses-electric-analysi/u-s-transit-agencies-cautious-on-electric-buses-despite-bold-forecasts-idUSKBN1E60GS>, accessed 29 January 2018.

424 Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, pp. 14-15.

425 Cited from visual slides provided by Mr Gaton at public hearing. Ibid.

426 Dino Hazdic, Engineer, ABB Australia, *Transcript of evidence*, 13 February 2018, p. 56.

> ...in 2016, Transdev, through its subsidiary Hermes, commenced operation of 43 electric buses in Eindhoven in the Netherlands – the largest zero-emission public transport bus fleet in Europe.[427]

TTF wrote:

> One of the challenges faced by Transdev in operating the electric fleet in Eindhoven was the limited operational radius of the electric fleet. To overcome this, Transdev developed an innovative charging strategy that enabled buses to run more than 300 kilometres a day on highly patronised routes through the implementation of ultra-fast charging technology and a sophisticated fleet rotation system.[428]

TTF noted that 'as battery technology improves, the challenges faced by operators of public transport bus fleets will gradually dissipate'.[429] Given that Transdev operates a third of Melbourne's public bus routes, the Committee heard there are opportunities for the State Government to draw on overseas experiences in deploying electric buses.[430]

The Committee heard that the electrification of the public transport sector could provide the most cost-effective means for Victorians to experience new electric vehicle technology. During the Inquiry, the Committee heard widespread support for the launch of an electric bus trial in Victoria. While electric buses represent significant capital cost and require supporting infrastructure, the Committee heard that Victoria could transition to electric buses as the existing petrol or diesel fuelled buses come to the end of life. Victoria could stand to reap environmental and long-term economic gains by replacing current buses as they age with electric buses. The upfront costs to transition the electric bus fleet and the infrastructure requirements are however present as barriers for now.

FINDING 18: Electric buses are currently being trialled in South Australia and the Australian Capital Territory.

FINDING 19: Electric buses could replace diesel fuel buses. In some other jurisdictions, electric buses and corresponding charging stations have been introduced.

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427 Tourism and Transport Forum Australia, *Submission,* no. 33, p. 4.

428 Ibid.

429 Ibid.

430 Ibid., Dino Hazdic, Engineer, ABB Australia, *Transcript of evidence*, 13 February 2018; Tim Olding, Electric Vehicle Transport and Energy Consultant, Sassafras Group, *Transcript of evidence*, 13 February 2018; AGL Energy, *Submission,* no. 42; Hobsons Bay City Council, *Submission,* no. 48; Bryce Gaton, Executive Committee, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018.

5 Options to support the manufacture and assembly of electric vehicles in Victoria

The terms of reference for this Inquiry into electric vehicles required the Committee to consider options for supporting the manufacture and assembly of electric vehicles in Victoria. Importantly, this includes managing the transition of workers and suppliers affected by the closure of vehicle manufacturing in Victoria.

When considering the options for the manufacture and assembly of electric vehicles, the Committee looked at the factors that led to the closure of Victoria's conventional car manufacturing industry in 2017. This chapter discusses the factors that led to the closure of Victoria's automotive industry and suggests that these may inhibit the establishment of an electric passenger vehicle manufacturing industry. A large-scale electric vehicle manufacturing industry would require significant investment and ongoing support from government and large capital investment from car manufacturers.

Instead, the Committee believes that the Government should encourage a focus on niche or high value areas of electric vehicle manufacturing that capitalise on Victoria's strengths in advanced manufacturing and workforce skills. In doing so, the Government should provide specific grants for electric vehicle manufacturing (including the manufacture of electric vehicle parts), support the establishment of training for workers in electric vehicle manufacturing and inquire into the establishment of an electric vehicle battery manufacturing sector.

5.1 Victoria's automotive manufacturing industry

Conventional internal combustion engine cars have been made in Victoria for over 90 years.[431] During these years Ford, Holden and Toyota, amongst others, manufactured cars for the domestic market and for export overseas.

Ford Australia began producing cars in Geelong in 1928.[432] Ford opened another plant in Campbellfield (known as the Broadmeadows plant) on the northern outskirts of Melbourne in 1961 that produced Ford Falcons.[433]

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431 Hon. Wade Noonan MP - Minister for Industry and Employment, *Statement on the Closure of Ford*, media release, Victorian Government, Melbourne, 7 October 2016.

432 Heritage Council Victoria, *Victorian Heritage Database Report: Ford Motor Company Complex*, Heritage Council Victoria, Melbourne, 2012, p. 2.

433 Ibid.

Holden began manufacturing vehicles at its Fisherman's Bend plant in 1948.[434] Holden moved its car manufacturing facilities to South Australia, however its Fisherman's Bend plant continued to make engines until its closure in 2016.[435]

Toyota began vehicle production in Australia in 1963. Australia was the first western country to produce Toyota vehicles.[436] Its plant in Altona had been producing cars since 1995.[437]

Other large car manufacturers have come and gone in Victoria including Nissan, who closed its car assembly factory in Clayton in 1992, but still operates an automotive parts manufacturing facility in Dandenong.[438]

5.1.1 Car manufacturing in Victoria before the industry's closure

In 2013 Ford, Holden and Toyota were the three remaining large car manufacturing companies in Victoria. Ford Australia assembled cars at its Broadmeadows plant and built engines in Geelong.[439] At the Broadmeadows site, Ford manufactured the Ford Falcon, the Ford Territory and Ford Performance Vehicles.

Holden had an engine plant in Fisherman's Bend which made engines for domestic use and export sale. A separate assembly plant in South Australia produced the Holden Commodore and the Holden Cruze for export and domestic sale.

Toyota Australia had a plant in Altona, which made parts and assembled the Toyota Camry and Toyota Aurion Models. The production of Toyota Camry models included a Camry Hybrid Model, which had an electric engine and battery as well as a conventional combustion engine to extend its range.

These manufacturers were supported by a large automotive supply chain industry that engineered, designed and manufactured automotive parts and components.[440]

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434 Holden Australia, *Holden Honours Its Manufacturing Legacy; Completes Transformation To Sales, Engineering And Design Business*, media release, Holden Australia, 20 October 2017.

435 Hon. Wade Noonan MP - Minister for Industry and Employment, *Statement on Holden*, media release, Victorian Government, Melbourne, 29 November 2016.

436 Tom Barnes, *Transition to where? Thinking through transitional policies for Victoria's automotive manufacturing industry*, Parliamentary Library and Information Service (Vic), Melbourne, 2016, p. 7.

437 Toyota Australia, *Toyota Australia Closes Manufacturing Operations*, media release, Toyota Australia, 3 October 2017.

438 Nissan Casting Australia, *Committed To The Future, Nissan Celebrates 35 Years Of Ongoing Local Manufacturing*, media release, Nissan Australia, 16 November 2017.

439 Tom Barnes, *Transition to where? Thinking through transitional policies for Victoria's automotive manufacturing industry*, Parliamentary Library and Information Service (Vic), Melbourne, 2016, p. 6.

440 Commonwealth Government Productivity Commission, *Australia's Automotive Manufacturing Industry*, Australian Government, Melbourne, 2014, p. 5.

5.2 The closure of Victoria's automotive manufacturing industry

In May 2013, Ford Australia announced it would end automotive manufacturing at its Geelong and Broadmeadows plants by October 2016. This was followed in December 2013 by an announcement from Holden that it would cease manufacturing in Australia by the end of 2017, including the closure of Holden's engine making plant at Fisherman's Bend. Finally, in February 2014, Toyota Australia announced that it would cease car manufacturing with the closure of its Altona plant in 2017.[441]

In October 2016, the last Ford Falcon, Falcon Ute and Ford Territory were produced at the company's Broadmeadows plant.[442]

The Holden plant that produced engines in Fisherman's bend closed in November 2016. Its assembly plant in South Australia closed later in 2017.[443]

Toyota's Altona assembly plant closed in October 2017. A museum in Japan received a commemorative model of the last Camry produced in Australia.[444]

5.3 Why did Victoria's automotive manufacturing industry close?

A number of long-term political and economic trends contributed to the closure of Victoria's automotive manufacturing industry. Each of the major car manufacturers, when announcing the closure of their manufacturing plants noted the high cost of manufacturing in Australia and the small, but highly competitive domestic new car market.

The Productivity Commission conducted an inquiry into Australia's automotive manufacturing industry in 2014. The inquiry noted that Australia's small domestic market, low tariffs and high production costs meant that cars made in Australia had difficulty competing with imported cars produced more efficiently in larger factories with lower wage costs and imported with low tariffs.[445]

5.3.1 Reasons given by the car manufactures for their closure

Ford Australia announced the closure of their manufacturing activities in May 2013. In a media release, they stated that the competitive nature of the Australian market was one of the reasons for the closure:

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441 Ibid., p. 3.

442 Ford Australia, *Falcon Legacy Lives On; Final Vehicles to Fund STEAM Student Robotics Programs in Broadmeadows and Geelong Schools*, media release, Ford Australia, 5 October 2016.

443 Hon. Wade Noonan MP - Minister for Industry and Employment, *Statement on Holden*, media release, Victorian Government, Melbourne, 29 November 2016.

444 Toyota Australia, 'Toyota Releases Commemorative Camry', <https://www.toyota.com.au/latest-news/toyota-releases-commemorative-camry>, accessed 22 February 2018.

445 Commonwealth Government Productivity Commission, *Australia's Automotive Manufacturing Industry*, Australian Government, Melbourne, 2014, p. 288.

> The decision on local manufacturing was driven by increasingly challenging market conditions – including market fragmentation and the high cost of manufacturing. Ford losses in Australia in the last five years have totalled approximately $600 million (AUD)...[446]
>
> ...Australia has annual sales of approximately 1.1 million new vehicles, and customers have access to more than 65 brands and 365 models available for sale. This makes Australia one of the most competitive and crowded automotive markets in the world. Given the fragmented marketplace and the low model volumes that result, we decided that manufacturing locally is no longer viable. [447]

Similarly, Holden's announcement of the closure of their manufacturing business in December 2013 cited the competitive domestic market, as well as the high cost of manufacturing and the strong Australian dollar:

> The decision to end manufacturing in Australia reflects the perfect storm of negative influences the automotive industry faces in the country, including the sustained strength of the Australian dollar, high cost of production, small domestic market and arguably the most competitive and fragmented auto market in the world.[448]

Toyota Australia also reasoned that the high Australian dollar, high manufacturing costs, low economies of scale and a fragmented domestic market meant they felt they could not continue manufacturing operations:

> The decision was not based on any single factor. The market and economic factors contributing to the decision include the unfavourable Australian dollar that makes exports unviable, high costs of manufacturing and low economies of scale for our vehicle production and local supplier base. Together with one of the most open and fragmented automotive markets in the world and increased competitiveness due to current and future Free Trade Agreements, it is not viable to continue building cars in Australia.[449]

5.3.2 The Productivity Commission's inquiry into Australia's Automotive Industry

The reasons given by the car manufacturers for their closure were echoed in the Productivity Commission's inquiry into Australia's Automotive Industry. Like the car manufacturers, the Commission identified that Australia's small and fractured domestic market hindered economies of scale savings. The Commission also illustrated that the lowering of tariffs on imported cars meant that imported cars made in low-wage countries were cheaper than domestically produced models.

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446 'The full Ford Australia statement', *The Ballarat Courier*, 23 May 2013, <http://www.thecourier.com.au/story/1521736/the-full-ford-australia-statement>, accessed 29 November 2017.

447 Ibid.

448 Holden Australia, *GM To Transition To A National Sales Company In Australia And New Zealand: Company to cease manufacturing in Australia by 2017*, media release, Holden Australia, 11 December 2013.

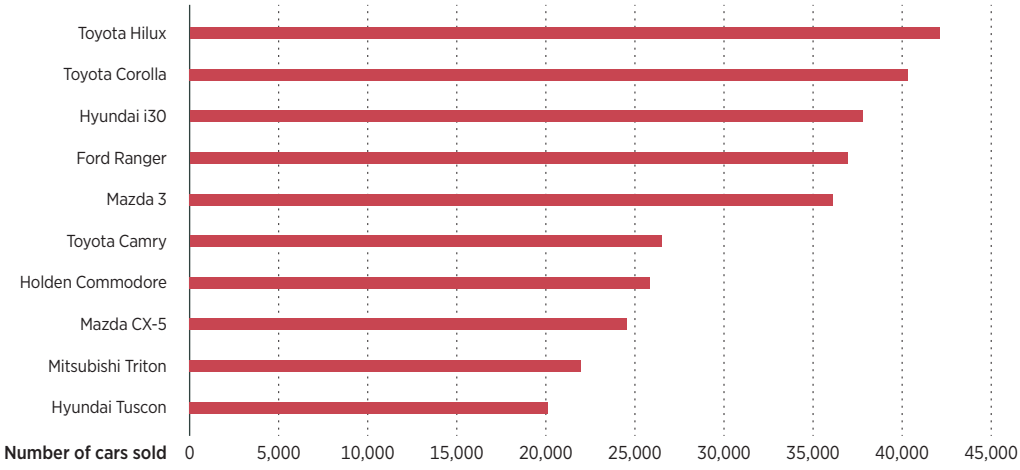
449 Toyota Australia, *Toyota Australia Announces Future Plan for Local Manufacturing*, media release, Toyota Australia, 10 February 2014.

Australia manufactured a very small number of vehicles in comparison to other countries. In 2013, Australia manufactured 200,000 vehicles per year, which accounted for 0.25 per cent of Global production.[450] A number of submissions to the Productivity Commission's report stated that this relatively small output meant that Australian manufacturers were unable to make economies of scale savings. Toyota Australia produced the largest number of vehicles of the Australian car manufacturers with just over 100,000 produced in 2012.[451] The Productivity Commission heard that between 200,000 and 300,000 cars were required to be produced for a plant to be efficient enough to compete with other overseas high volume manufactures.[452]

In Australia the market for new cars is competitive. A number of brands and models compete in a relatively small market. In 2013, 66 vehicle brands were competing for one million new car sales in Australia. A decade earlier, there were 56 brands.[453] This high level of competition, coupled with the small domestic demand for cars meant that although domestically produced cars such as the Toyota Camry were amongst the highest selling new cars in Australia,[454] the sales were not enough for the manufactures to make economies of scale savings.

In addition to this, consumer tastes for new cars have been shifting towards small cars, utility vehicles (utes) and sports utility vehicles (SUV's). Australian manufacturers have traditionally specialised in large sedans such as the Holden Commodore and the Ford Falcon. However, as shown in Figure 5.1, in 2016 the most popular vehicle was the Toyota Hilux, a commercial ute, followed by a number of small cars and SUV's. The Toyota Camry and the Holden Commodore were the only sedans in the top 10 and were the 6th and 7th top selling cars respectively. The shift towards small cars and SUV's has been happening for at least the past 15 years, as shown in Figure 5.2.

Figure 5.1 Highest selling new car models in Australia in 2016



Source: Federal Chamber of Automotive Industries

450 Commonwealth Government Productivity Commission, *Australia's Automotive Manufacturing Industry*, Australian Government, Melbourne, 2014, p. 7.

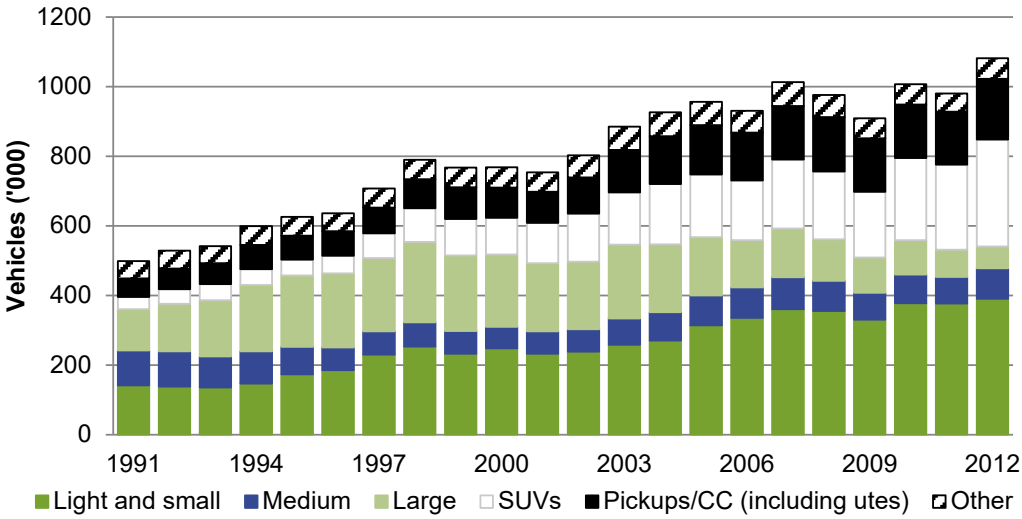
451 Ibid.

452 Ibid., p. 50.

453 Ibid., p. 63.

454 Ibid., p. 65.

Figure 5.2 Australian new car sales by type between 1991 and 2012



Source: Australian Productivity Commission, *Australia's Automotive Manufacturing Industry* (2014), p.65

Labour costs for Australian car manufacturers were also mentioned by the Productivity Commission and the car manufacturers as one of the factors that led to the decline of the industry. The Commission noted that Australia had relatively high labour costs in comparison to other car manufacturing countries. The Commission cited a study by the US Bureau of Labour Statistics which showed that Australia had the second highest automotive wage rates of the countries considered, after Germany.[455] These higher wage rates meant that domestically produced cars could be more expensive than imported cars of a similar make and quality. A submission by Holden to the Productivity Commission said that labour costs in Australia added $2000 to the cost of producing a vehicle in comparison to General Motors plants in other countries.[456]

The Commission also noted that tariff reduction for imported cars played a role in making imported cars cheaper than domestically produced cars. Between 1988 to 2000, the tariff rate on passenger vehicles and parts was reduced by 2.5 per cent annually. There were further one-off reductions of 5 per cent in 2005 and 2010.[457] The tariff rate for imported passenger vehicles is currently 5 per cent.[458] This is lower than in other markets such as the European Union, which has a tariff of 10 per cent and China, which has a rate of 25 per cent.[459]

455 Ibid., pp. 60-61.

456 Ibid.

457 Ibid., p. 108.

458 Federal Chamber of Automotive Industries, *Submission*, February 2016, Australia-European Union Free Trade Agreement, Department of Foreign Affairs and Trade, p. 2.

459 Commonwealth Government Productivity Commission, *Australia's Automotive Manufacturing Industry*, Australian Government, Melbourne, 2014, p. 288.

5.4 Financial assistance to car manufacturers

Between 1997 and 2012, the Commonwealth Government provided nearly $30 billion worth of support to Australian vehicle manufacturers and the automotive supply chain through grants, incentives and economic protection through tariffs on imported vehicles.[460]

The main form of assistance for domestic car manufacturers was through tariffs. In 1988, imported cars attracted a tariff of 40 per cent, making domestically produced cars significantly less costly. However, the tariff rate declined with the de-regulation of the national economy from a rate of above 40 per cent in 1988 to 5 per cent in 2010.[461]

Industry assistance packages were another form of financial assistance. This included the Automotive Competitiveness and Investment Scheme, which ran from 2001 until 2011. The scheme gave vehicle manufacturers and automotive supply chain companies credits for investing in equipment and research and development. Vehicle manufacturers could also earn credits for producing vehicles.[462] The credits could be used to 'offset the duty payable on certain imports (motor vehicles and related parts) or traded with other Scheme participants and third parties'.[463]

The Automotive Transformation Scheme replaced the Automotive Competitiveness and investment scheme in 2011. It also allowed car manufacturers and automotive supply chain companies to claim reimbursement for research and development and equipment costs.[464] The scheme was earmarked to provide $1.5 billion in assistance for the period 2011 to 2015. $1 billion in funding has been set aside for the scheme for the period from 2016 to 2020.[465]

5.5 The impact of the closure of the automotive manufacturing industry in Victoria

5.5.1 Direct job losses from the large car manufacturers

Approximately 5000 manufacturing jobs were lost as a result of the closure of the three big car manufactures in 2016 and 2017. In their respective media releases, Ford announced that 1200 jobs would be lost at its plants in Broadmeadows

460 Ibid., p. 108.

461 Ibid., pp. 108-109.

462 Australian National Audit Office, *Administration of the Automotive Competitiveness and Investment Scheme*, Australian National Audit Office, Canberra, 2008.

463 Ibid.

464 Commonwealth Department of Industry Innovation and Science, *Factsheet: Automotive Transformation Scheme* p. 1.

465 Ibid.

and Geelong.[466] Holden announced that 1300 staff members would be made redundant in Victoria.[467] Toyota said approximately 2500 employees would be 'impacted' by the closure of its Altona manufacturing plant.[468]

According to the Productivity Commission, the loss of the 5000 jobs represented a relatively small portion of Australia's total automotive manufacturing industry workforce:

> In 2013, about 44 000 people in Australia were employed in the manufacture of cars, engines, electrical and other components, as well as trucks, buses and products for the automotive aftermarket.[469]

5.5.2 The automotive supply chain industry

Victoria has a large automotive supply chain industry that has made and supplied parts for car manufacturers. This industry employed more workers and represented a bigger proportion of Victoria's manufacturing industry than those directly employed by the large car manufacturers. Dr Tom Barnes, in a paper for the Victorian Parliamentary Library outlined the structure of the Australian automotive supply chain industry:

> Most workers in the car manufacturing industry are employed in the supply chain rather than directly employed by the carmakers. The automotive industry is complex and multi-layered, with the main branded manufacturers like Ford, GMH and Toyota—known as Original Equipment Manufacturers (OEMs) in industry parlance—purchasing and subcontracting components from a wide range of manufacturers. These companies operate in different 'tiers', with OEMs purchasing primarily from tier-1 manufacturers, who purchase from tier-2 manufacturers, who purchase from tier-3 manufacturers, and so on. Hundreds of companies are locked into commercial relations with OEMs who operate as global production networks (also known as global value chains). The presence of an OEM in a region has a major influence over manufacturing and employment trends, due to its demands for design and engineering specifications, technology standards and product quality. In recent years, the three Australian-based OEMs have sourced 30-50 per cent of their components from Australian-based suppliers.[470]

With the closure of the car manufacturing industry, automotive supply chain businesses have lost a large market for their products. It is expected job losses and company closures will have occurred since the closure of the car manufactures in October 2017. Dr Barnes' paper notes that, while it is likely some automotive supply chain businesses will close, it is hoped that others will be able to diversify their businesses and continue to operate:

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466 'The full Ford Australia statement', *The Ballarat Courier*, 23 May 2013, <http://www.thecourier.com.au/story/1521736/the-full-ford-australia-statement>, accessed 29 November 2017.

467 Holden Australia, *GM To Transition To A National Sales Company In Australia And New Zealand: Company to cease manufacturing in Australia by 2017*, media release, Holden Australia, 11 December 2013.

468 Toyota Australia, *Toyota Australia Announces Future Plan for Local Manufacturing*, media release, Toyota Australia, 10 February 2014.

469 Commonwealth Government Productivity Commission, *Australia's Automotive Manufacturing Industry*, Australian Government, Melbourne, 2014, p. 59.

470 Tom Barnes, *Transition to where? Thinking through transitional policies for Victoria's automotive manufacturing industry*, Parliamentary Library and Information Service (Vic), Melbourne, 2016, p. 7.

Some 25,100 people are employed in the Victorian supply chain, amongst a total of 45,000 across Australia. These businesses and their employees face closure and unemployment unless they can maintain their commercial viability by diversifying their businesses and entering global supply chains.[471]

5.6 Measures to assist Victoria's automotive industry workers and businesses

The car manufacturers, the Victorian Government and the Commonwealth Government have set up programs to assist Victoria's automotive industry workers.

5.6.1 Commonwealth Government assistance programs

The Growth Fund is a project coordinated by the Commonwealth Government in conjunction with the Victorian Government and car manufacturers. It aims to re-train automotive workers, promote diversification in the automotive supply chain industry and invest in regional infrastructure. The Growth Fund includes:

- $30 million funding for a Skills and Training Program to assist automotive employees to have their skills recognised and provide training for new jobs
- $15 million for an Automotive Industry Structural Adjustment Program to provide careers advice and assist automotive employees to secure new jobs
- $20 million for an Automotive Diversification Program to assist automotive supply chain firms capable of diversifying to enter new markets
- $60 million for a Next Generation Manufacturing Investment Program to accelerate private sector investment in high value non-automotive manufacturing sectors in Victoria and South Australia
- $30 million for a Regional Infrastructure Program to support investment in non-manufacturing opportunities in affected regions.[472]

The Fund is made up from $101 million funding from the Commonwealth Government, $15 million each from Toyota Australia and Holden, and $12 million each from the Victorian and South Australian State Governments.[473]

The Fund includes the Automotive Diversification Program. $20 million has been put aside to provide grants to automotive manufacturing and supply chain businesses to diversify their businesses. For example, Blackwell IXL is a Geelong

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471 Thomas Grant, *Opportunity and Challenge the Future of a Sector in Decline: Transforming and Diversifying the Automotive Supply Chain*, Parliamentary Library and Information Service (Vic), Melbourne, 2014, p. 3.

472 Hon. Ian Macfarlane MP - Minister for Industry and Science, *'$155 Million to Grow the Jobs of Tomorrow*, media release, Commonwealth Government, Canberra, 30 April 2014.

473 Thomas Grant, *Opportunity and Challenge the Future of a Sector in Decline: Transforming and Diversifying the Automotive Supply Chain*, Parliamentary Library and Information Service (Vic), Melbourne, 2014, p. 13.

based company which previously produced parts for Ford, Toyota and Holden.[474] The company has been given $1 million in grants from the Commonwealth Government for three separate projects to diversify into heating, venting and lighting units, mounts for solar panels and components for heaters.[475]

5.6.2 Victorian Government assistance programs

The Victorian Government also has its own program to assist automotive workers. The scheme is detailed in a paper titled *Towards Future Industries: Victoria's Automotive Transition Plan* (The Plan). The Plan sets out a $46.5 million assistance package for automotive industry workers. The majority of this funding ($33.1 million) is earmarked for the New Local Industry Fund for Transition Program, which will provide grants for businesses wishing to invest or re-locate to regions affected by the closure of automotive businesses.[476]

There will also be subsidies for employers to hire and train former automotive workers. Employers will be eligible for a one-off payment of $7000 for full time workers and employers can receive payments of $4000 for providing accredited training to those employees.[477]

The Plan also outlines the establishment of Skills and Jobs Centres at Victorian TAFE colleges, which will provide information, training and career advice for former automotive workers. Workers in the automotive supply chain industry will also be eligible for subsidies to train for accredited qualifications.[478]

Dr Barnes' paper on automotive transition notes that these employment schemes are in addition to the assistance provided by the Commonwealth Government under the Jobactive Scheme to provide subsidies to employers who hire workers aged 50 and over:

> This approach runs parallel with existing wage subsidies provided by the Federal Government via the Jobactive system, including higher subsidies aimed at encouraging employers to hire workers aged 50 or over. This policy is relevant to auto workers as many are in this age category.

The Victorian Government also runs the Automotive Supply Chain Transition program, which set aside $5 million in grants for automotive supply chain industries to diversify their businesses into new markets.[479]

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474 Leon Gettler, 'Surviving the end of Auto Manufacturing', *The Australian*, 15 October 2014, <http://www.theaustralian.com.au/business/business-spectator/surviving-the-end-of-auto-manufacturing/news-story/6c7aa3c2d70283cd660159c50e1f7d32>, accessed 11 December 2017.

475 Tom Barnes, *Transition to where? Thinking through transitional policies for Victoria's automotive manufacturing industry*, Parliamentary Library and Information Service (Vic), Melbourne, 2016, p. 17.

476 Business Victoria, 'Local Industry Fund for Transition', <http://www.business.vic.gov.au/support-for-your-business/grants-and-assistance/local-industry-fund-for-transition>, accessed 12 January 2018.

477 Business Victoria, *Towards Future Industries: Victoria's automotive Transition plan*, Business Victoria, Melbourne, 2016, p. 13.

478 Ibid., p. 14.

479 Ibid., p. 6.

The Victorian Government has promoted the transition to defence industries for automotive supply chain businesses.[480] The Government purchased the old Holden manufacturing facility at Fisherman's Bend. It aims to attract defence, automotive, engineering and research and development businesses to create an advanced manufacturing and technology hub to assist the defence industry:

> Fisherman's Bend is central to the Victorian Government's vision for an innovative, globally competitive, highly skilled and adaptive defence industry that maintains its position at the leading edge of providers serving the Australian Defence Force and global supply chains.[481]

The Victorian Government has featured automotive supply companies who are competing for defence contracts in advertisements to promote the Victorian defence industry.[482]

5.6.3 Assistance provided by car manufacturers

Each of the large car manufacturers also provided assistance to employees who were made redundant as a result of the closure of their manufacturing facilities. This assistance included training and support to find new employment.

Toyota provided assistance to its employees through a program known as the DRIVE program.[483] The program included:

- Information sessions, including financial education, small business and retirement planning services
- Career and training advice, including individualised careers advice and planning
- Re-skilling and training, including assistance with VET, tertiary and general training, and assistance to gain tickets and licences
- Job search support including help with résumé and job application writing, interview and job search skills.[484]

Ford assisted its workers through the Ford Transition project. The project gave workers assistance with:

- Information sessions, including advice on finance, health and wellbeing and employment services
- Skills Recognition and Training

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480 'Auto Supply Sector Adapts for Growth (advertiser content for the Victorian Government)', *The Age*, <http://paidcontent.theage.com.au/victoria-government/defence-victoria-government/article/auto-supply-sector-adapts-growth/>, accessed 22 February 2018.

481 Defence Victoria, 'Fishermen's Bend, re-imagined', accessed 22 February 2018, <https://defence.vic.gov.au/projects/fishermans-bend>.

482 'Auto Supply Sector Adapts for Growth (advertiser content for the Victorian Government)', *The Age*, <http://paidcontent.theage.com.au/victoria-government/defence-victoria-government/article/auto-supply-sector-adapts-growth/>, accessed 22 February 2018.

483 Commonwealth Government, 'What's Next? Toyota', <https://whatsnext.jobs.gov.au/toyota>, accessed 11 January 2018.

484 Ibid.

- Finding a new job, including assistance with resume writing, job application and interview skills.[485]

Holden also provided assistance to workers through two transition centres. The centres provided employees assistance in a number of areas, including:

- Labour market information
- Health and wellbeing support
- Financial education
- Community support services
- Superannuation and taxation advice.

Holden also gave its employees career and training advice including access to career coaches and appraisal of training needs. Employees were able to receive funding for training towards licences and tickets, tertiary studies, professional development and accredited and non-accredited skill sets. Help finding employment was also provided through resume writing, job application and interview skills training.[486]

5.6.4 Impact of assistance programs

The assistance programs for automotive supply chain companies and automotive workers are ongoing. As noted in section 5.2, the last automotive manufacturing company, Toyota, closed in October 2017 during the period the Committee began to gather evidence for this Inquiry. As such, the Committee believes it is too early to gather reliable evidence on the effectiveness or otherwise of the assistance programs for the automotive industry.

Data gathered previously in South Australia following the closure of a Mitsubishi manufacturing plant in 2006, shows that assistance programs can have mixed outcomes. A report showed that many of the 700 employees made redundant in South Australia found it difficult to find full time work a year after the closure of the plant:

> 12 months post-redundancy only 34% of displaced Mitsubishi workers were in full-time work. Over 20% of respondents were in casual or part-time employment, and some 69% of those in casual employment reported that they would rather be working full-time.[487]

The Committee also notes that regardless of the success of the assistance programs, it was unable to find evidence of assistance programs that specifically offered affected workers training in the field of electric vehicles. The Committee believes the government should explore options to support training in electric vehicle manufacturing. This is discussed further in section 5.11.1.

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485 Ibid.

486 Ibid.

487 Dr Kay Bowman and Professor Victor Callan, *Brief for a Longitudinal Study of Automotive Manufacturing and Supply Chain Workers* South Australian Government Department for State Development, Adelaide, 2017, p. 30.

5.7 Electric vehicle manufacturing

5.7.1 How electric vehicles are different to internal combustion engine vehicles

Electric vehicles are different to conventional internal combustion engine cars. The main difference is the system used to power the car, known as the powertrain. In conventional cars, the powertrain involves a series of components with many moving parts. Conventional cars require a fuel tank to provide fuel to an engine, which turns a drive shaft via a transmission and differential to rotate the wheels. There are a number of supporting systems for the powertrain of a conventional car, including cooling, lubrication and exhaust systems.[488]

The powertrain system in an electric vehicle is far simpler. A battery supplies power, via a power distribution system, to an electric motor. The motor powers the wheels via a transmission, which is usually single speed. The electric motor needs fewer supporting systems such as lubrication, cooling and exhaust systems. The battery is powered through a plug-in charge port. [489] Electric cars can also be fitted with a capability to re-charge the battery through energy generated by braking.[490]

UBS, a financial services company, conducted a comparative study between an electric car (a Chevrolet Bolt) and a conventional internal combustion engine car (a Volkswagen Golf). They found that in the engine alone of the conventional car there were 113 moving parts in comparison to the electric engine's three moving parts.[491] Because there are less moving parts, there are less parts that are susceptible to wear. This means far less maintenance and replacement parts are required. Parts that require regular replacement such as spark plugs, fan belts and engine oil are not required.[492]

Apart from the drive train, electric cars have a similar makeup to conventional cars, including the chassis, body, suspension, tyres, lights and interior.

An overview of the differences between the powertrain of an electric car (a Chevrolet Bolt) and a conventional combustion engine car (a VW Golf) is provided in Figure 5.3.

488 Automotive Training Board of New South Wales, *AURT202170A Inspect & Service Cooling Systems*, Automotive Training Board of New South Wales, 2008, pp. 7-9 and 14-22.

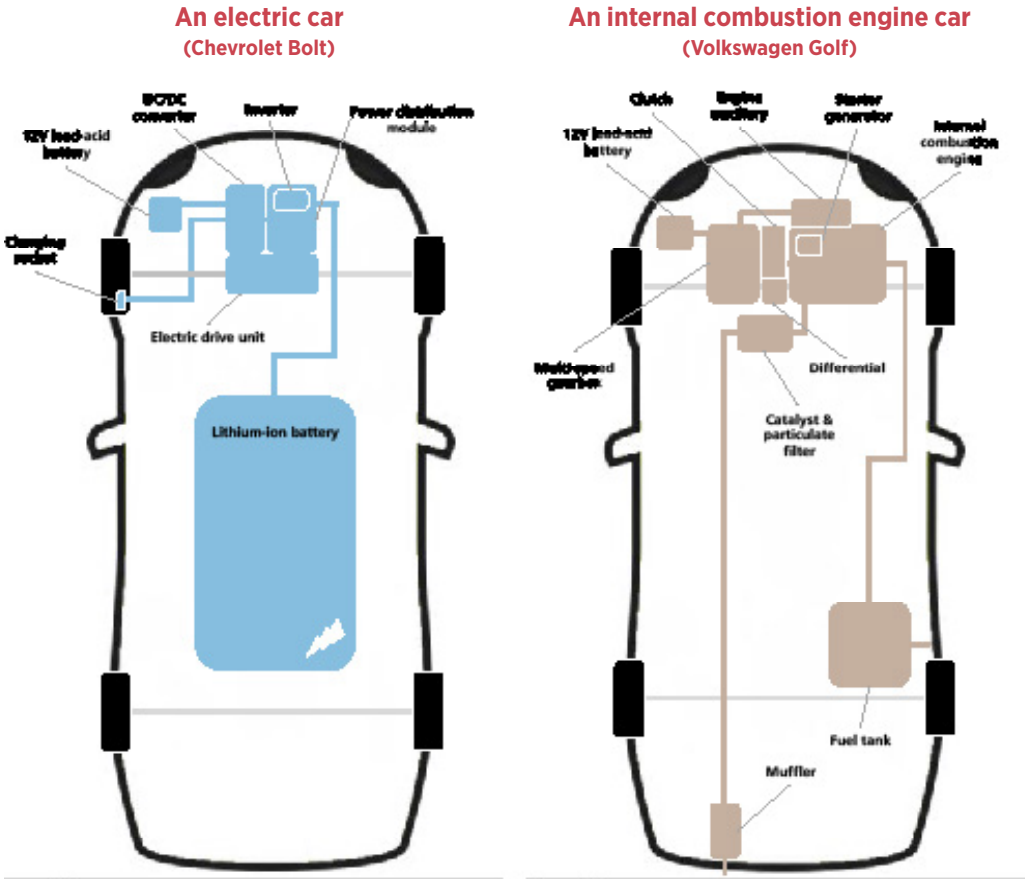
489 UBS, *Q-Series: UBS Evidence Lab Electric Car Teardown – Disruption Ahead?*, UBS, 2017, pp. 25-26.

490 Greg Solberg, 'The Magic of Tesla Roadster Regenerative Braking', <https://www.tesla.com/en_AU/blog/magic-tesla-roadster-regenerative-braking>, accessed 14 December 2017.

491 UBS, *Q-Series: UBS Evidence Lab Electric Car Teardown – Disruption Ahead?*, UBS, 2017, p. 27.

492 Ibid.

Figure 5.3 The difference between the powertrain of an Electric Car and an Internal Combustion Engine Car



Source: UBS, Q-Series, UBS Evidence Lab Electric Car Teardown – Disruption Ahead? (2017), p.21

5.7.2 How are electric cars manufactured in comparison to combustion engine cars?

Electric cars may be simpler to manufacture and may require less workers to produce than internal combustion engine cars. Fewer parts are required to be manufactured for electric cars because the powertrain has fewer components.[493] Apart from the powertrain, other elements of car production may be similar between both car types such as stamping, welding, painting, assembly and quality assurance.

Many car manufacturers make parts of a car such as the body and engine. Other parts are delivered to the factory from suppliers, known as tier 1 suppliers. The parts made by the car manufacturer and parts made by suppliers are assembled at the factory to make the finished product. The Toyota factory at Altona manufactured the Toyota Camry (including a Hybrid electric model) and the Toyota Aurion. The factory contained seven separate plants and shops which manufactured separate parts for the cars and assembled them. The Altona factory included:

493 Ibid., p. 39.

- A press shop to make and press body parts
- A unit shop to make some parts for the car and to weld others
- A resin shop to make some body parts from resin
- A weld shop, including robots to weld and assemble car undercarriage and body parts
- A paint shop with robots to paint car bodies
- A powertrain plant to cast, make and test engines
- An assembly plant with production lines to weld, seal and install parts onto chassis.[494]

While this process will be much the same for the construction of electric vehicles, the parts supplied to car manufacturers will be different. Car manufacturers will require more electronic components and less mechanical parts. The overall number of components required will also be reduced because of the simplified powertrain (see 5.7.1).

The analysis by UBS of the Volkswagen Golf and the Chevrolet Bolt outlines the production differences between the two types of car. The battery in the Chevrolet Bolt is manufactured and supplied by LG Electronics.[495] Some electric car manufacturers, such as Tesla, make their own batteries. The electric motor in the Bolt is also supplied by LG electronics. The motor, transmission and regenerative breaking function are housed in the same unit. The report notes that 'e-motors are significantly easier and less costly to manufacture compared to engines and transmissions, with lower cost and less labour input required'.[496] The UBS report says that they believe significantly less machining will be required for the motor:

> Our channel checks indicate up to 80% of the cutting tool work needed to manufacture a car happens in the combustion engine. Significantly less machining is required for the e-motor.[497]

The Chevrolet Bolt also has a power distribution module, a DC/DC converter and an inverter, which are also supplied by LG electronics.[498] There are also heating and cooling and systems for the cabin and to cool the motor. The motor is cooled through built in passages in the motor module housing. This 'avoids the need for a dedicated e-motor oil cooling loop, reducing cost, mass and design complexity'.[499]

The remaining manufacture and assembly requirements for electric cars are similar to the process followed by conventional cars. For example, the stamping, assembly, welding and painting processes are similar.

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494 Hilco Industrial & Grays Online, 'Toyota Altona Car Manufacturing Plant Closure Sale (digital brochure)', <https://www.hilcoind.com/sale/toyotaplant/featured>, accessed 13 December 2017.

495 UBS, *Q-Series: UBS Evidence Lab Electric Car Teardown – Disruption Ahead?*, UBS, 2017, p. 32.

496 Ibid., p. 39.

497 Ibid., p. 35.

498 Ibid.

499 Ibid., p. 36.

5.8 Further potential job losses in the automotive manufacturing industry

It can be expected there will be job losses as a result of electric vehicles becoming more prevalent. This is primarily the case for manufacturers who supply parts for cars because many of the components will no longer be needed in electric vehicles.

A report produced for the German Association of the Automotive Industry analysed the effect of a hypothetical ban on cars with internal combustion engines from 2030.[500] Based on 2015 production statistics, the report estimated that at least 620,000 employees who produce vehicles and parts associated with internal combustion engines would be affected by the ban. This represents over 10 per cent of total German manufacturing employment.[501]

This is backed up by the report by UBS, which analysed the make-up of the Chevrolet Bolt. It found that the Bolt contained very few parts that were made by traditional tier 1 suppliers and that most of the components were made by LG, an electronics company:

> ...the content from "traditional" tier-1 suppliers in the Bolt is nearly zero. The other parts and components outside the scope of this teardown (interior, lighting, etc) are similar to an ICE car and therefore represent content from established suppliers.[502]

The report found that:

> The Bolt example underscores the threat of new entrants. LG has >50% content share in the Bolt, higher than the "traditional" tier-1 suppliers altogether.[503]

The report for the German Association of the Automotive Industry, and the analysis by UBS show the likelihood that the introduction of electric vehicles would have caused similar disruption in the Victorian Automotive manufacturing supply chain industry. However, the slower rate of electric vehicle take-up in Australia has given companies more time to adjust.[504]

In their submission to the Inquiry, the Victorian Automobile Chamber of Commerce outlined a hypothetical 'high-uptake' scenario whereby electric vehicles would constitute 20 per cent of new car-sales in Victoria by 2030. In this scenario, the VACC predict that the vehicle parts retailing sector could lose up to 300 businesses and 1,300 jobs.[505]

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500 Oliver Falck, et al., *Consequenses of a potential ban on new cars and light trucks with combustion engines prepared for the German Association of the Automotive Industry*, Centre for Economic Studies ifo Institute, Munich, Germany, 2017.

501 Ibid.

502 UBS, *Q-Series: UBS Evidence Lab Electric Car Teardown – Disruption Ahead?*, UBS, 2017, p. 51.

503 Ibid., p. 53.

504 Victorian Automobile Chamber of Commerce, *Submission,* no. 38, p. 9.

505 Ibid., p. 12.

However, it should be noted that new jobs may be created due to the introduction of electric vehicles. Mr Tim Washington from JET Charge told the Committee that the manufacture of charging infrastructure will create jobs, and noted that Tesla currently employs 2,600 people in charging related jobs.[506] Tritium, an electric charger manufacturing company based in Queensland has recently added 50 jobs and has manufactured electric vehicle chargers for 22 countries since 2015.[507]

FINDING 20: Electric vehicles are physically different to conventional internal combustion engine cars in that they require fewer parts. Because of this, it can be expected that the automotive manufacturing industry, particularly the automotive supply chain industry may be affected.

5.9 Options to support the manufacture and assembly of electric vehicles in Victoria

Large investment by car manufacturers along with significant government incentives would be required to support large-scale electric vehicle manufacturing in Victoria. This is because the economic factors that led to the closure of Victoria's conventional vehicle manufacturing industry remain significant. As noted in section 5.3, the challenges include Australia's small domestic car market, high market segmentation, high wage costs and low tariffs. In addition, the skills and type of manufacturing required to produce conventional cars are not directly transferrable to electric vehicles (see section 5.7). It is preferable instead that Victoria attracts niche, high value electric vehicle jobs. These high value industries are in-line with Victoria's strengths as a high-tech, knowledge based economy.

5.9.1 Electric vehicle manufacturers currently operating in Victoria

The Committee received evidence from two electric vehicle manufacturers operating in Victoria: SEA Electric and AVASS. SEA Electric is a company that has developed an electric powertrain for trucks, minibuses and vans. The powertrain is made with components from suppliers, including Australian suppliers and is integrated with software from SEA Electric. The powertrains are installed into an empty truck, van or minibus chassis, which are imported by SEA Electric already manufactured.[508] SEA Electric is a growing business and has supplied electric trucks to a Victorian transport company to help them reduce their business costs. It has plans to expand its business and has been the recipient of state and Commonwealth grants to do so.[509]

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506 Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 19.

507 Hon. Curtis Pitt MP - Treasurer and Minister for Trade and Investment, *Brisbane-based manufacturer Tritium charges ahead while Qld launches new EV strategy*, media release, Queensland Government, Brisbane, 4 October 2017.

508 Tony Fairweather, Managing Director, SEA Electric, *Transcript of evidence*, 8 November 2017, pp. 31-32.

509 Hon. Lily D'Ambrosio MP - Minister for Energy Environment and Climate Change, *Victoria To Become The Electric Vehicle Powerhouse*, media release, Victorian Government, Melbourne, 5 October 2016.

AVASS is a company that manufacturers electric buses out of a facility at Avalon Airport. The company converts buses from combustion engine to electric, manufactures electric bus chassis' and manufactures full electric buses.[510]

The Committee notes that these companies are growing small to medium enterprises that produce a limited number of specialised vehicles for the commercial and transport sectors. There are currently no electric vehicle manufacturers in Victoria intending to mass-produce electric passenger vehicles.

Case study – how Tesla manufactures electric cars

The electric car manufacturer Tesla is the world's largest electric vehicles manufacturer and a leader in the field of electric vehicles. The company is relatively new. Its first car, the Tesla Roadster, was first manufactured in 2008 and only approximately 2450 were produced between 2008 and 2012.[511] The company has since grown significantly and now offers four models which are built at its factory in Fremont, California in the United States.[512] The factory is highly 'vertically integrated'. This means many of the parts required to manufacture Tesla's cars are made at the factory. The factory is intended to be able to produce up to 500,000 cars per year.[513] Tesla is also in the process of building a larger factory in Nevada, known as the Gigafactory, that will produce batteries for Tesla cars. Both the Gigafactory and the Fremont factory are intended to reduce Tesla's reliance on suppliers and be big enough to create significant economies of scale savings.

The Tesla Fremont Factory

The Fremont factory was formerly owned by General Motors and first manufactured cars between 1962 and 1982. In 1984, the factory was taken over by New United Motor Manufacturing Inc., a joint venture between General Motors and Toyota, and vehicles for both companies were produced. [514] The New United Motor Manufacturing Inc. partnership ended in 2009 as a result of General Motors' bankruptcy following the 2008 financial crisis. Tesla bought the facility for $42 million (US dollars) in 2010 as part of a deal with Toyota in which Toyota bought a 3 per cent stake in Tesla for $50 million (US dollars).[515]

Tesla was given a $465 million loan from the US Federal Government's alternative vehicle fund in 2009 'to manufacture its new electric sedan'.[516] The new sedan was the Tesla Model S, which is built at the Fremont factory. According to Tesla, the factory was 'extensively re-modelled' before the first Model S was completed in June 2012.[517]

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510 AVASS, 'Manufacturing', <http://avass.com.au/manufacturing-1>, accessed 9 January 2018.

511 Tesla Motors Inc., *Annual Report 2012*, 2012.

512 Ibid.

513 Tesla Australia, 'Tesla Factory', <https://www.tesla.com/en_AU/factory>, accessed 18 December 2017.

514 Ibid.

515 Joshua Davies, '2010', *How Elon Musk Turned Tesla into the Car Company of the Future*, 27 September 2010, <https://www.wired.com/2010/09/ff_tesla>, accessed 18 December 2017.

516 United States Department of Energy, 'DOE Awards $8 Billion in Loans for Advanced Vehicle Technologies', <https://web.archive.org/web/20100528000955/http://apps1.eere.energy.gov/news/news_detail.cfm/news_id%3D12594>, accessed 18 December 2017.

517 Tesla Australia, 'Tesla Factory', <https://www.tesla.com/en_AU/factory>, accessed 18 December 2017.

The Tesla Gigafactory

The Tesla Gigafactory is a battery production facility that is under construction in the U.S. state of Nevada. While it is still under construction, the factory has already begun making batteries.[518] The factory is part of a partnership between Panasonic and Tesla to mass-produce batteries for cars and for energy storage. Once complete, Tesla expects the Gigafactory to be the largest building in the world.[519]

The factory will produce batteries with the assistance of Panasonic, who will manufacture the battery cells on-site.[520] The factory has been built with the assistance of a reported $1.25 billion (US dollars) tax incentive package from the Nevada State Government.[521] According to Tesla's website, the Gigafactory will help lower its car manufacturing costs through economies of scale:

> With the Gigafactory ramping up production, Tesla's cost of battery cells will significantly decline through economies of scale, innovative manufacturing, reduction of waste, and the simple optimization of locating most manufacturing processes under one roof. By reducing the cost of batteries, Tesla can make products available to more and more people, allowing us to make the biggest possible impact on transitioning the world to sustainable energy.[522]

Vertical integration

Tesla makes more of the components that go into its cars than other car manufacturers.[523] Many of the components manufactured by Tesla are made at the Fremont Factory or at the Gigafactory in Nevada. This includes the battery, the drive unit, the seats, the body and the infotainment system.[524] Tesla also owns the dealerships that sell its cars and provides the network of chargers to keep its cars running.[525] Tesla owns and operates different stages of the production process. This manufacturing approach is known as vertical integration. It is different to other automotive manufacturers that may source many of their parts from suppliers and assemble them in factories.

518 Tesla Australia, 'Tesla Gigafactory', <https://www.tesla.com/en_AU/gigafactory>, accessed 20 December 2017.

519 Ibid.

520 Tesla and Panasonic, *Panasonic and Tesla Sign Agreement for the Gigafactory*, media release, Tesla & Panasonic, 30 July 2014.

521 Anjeanette Damon, 'Inside Nevada's $1.25 billion Tesla tax deal', *Reno Gazette Journal*, 4 September 2014, <http://www.rgj.com/story/news/2014/09/04/nevada-strikes-billion-tax-break-deal-tesla/15096777>, accessed 20 December 2017.

522 Tesla Australia, 'Tesla Gigafactory', <https://www.tesla.com/en_AU/gigafactory>, accessed 20 December 2017.

523 Tesla, 'About Tesla', <https://www.tesla.com/about>, accessed 21 December 2017.

524 Supplier Business, 'Suppliers to the 2013 Tesla Model S', <http://www.autonews.com/assets/PDF/CA843311210.PDF>, accessed 21 December 2017; My Purchasing Centre, 'Tesla Builds Supply Chain in its Own Image', <http://www.mypurchasingcenter.com/electronics/articles/tesla-builds-supply-chain-own-image>, accessed 21 December 2017; Alexandria Sage, 'Tesla's seat strategy goes against the grain…for now', *Reuters*, 26 October 2017, <https://www.reuters.com/article/us-tesla-seats/teslas-seat-strategy-goes-against-the-grain-for-now-idUSKBN1CV0DS>, accessed 21 December 2017.

525 'Tesla's mass-market ambitions: On a charge', *The Economist*, 19 March 2016, <https://www.economist.com/news/business/21695012-tesla-becomes-more-regular-carmaker-it-faces-bumpier-ride-charge>, accessed 21 December 2017.

5.10 Could Victoria have a large-scale electric passenger vehicle manufacturing industry?

The Committee heard a number of views from stakeholders about the possibility of re-starting Victoria's automotive manufacturing industry by producing electric vehicles. The Public Transport Users Association told the Committee that it believed the factors that made conventional car manufacturing un-economical, would apply to electric vehicle manufacturing:

> We are not aware of any evidence indicating a high likelihood of a mass production electric car industry establishing and succeeding in Australia. Similar factors that led to the demise of conventional mass production car manufacture seem likely to apply to electric cars.[526]

This view is reiterated by the Victorian branch of the Australian Electric Vehicle Association (AEVA), who state that vehicle manufacturers in Victoria may be un-competitive because Australia's small domestic market would continue to hamper economies of scale savings:

> The issue for local manufacture is achieving the volume required for economy of scale, with at least 50,000 and preferably 200,000+ sales per annum required. Developments in low volume manufacturing could ameliorate this, but without significant local sales, only supply to niche markets is available, and these are also well served by overseas builders. [527]

However, the VACC told the Committee that the idea of manufacturing electric vehicles should not be dismissed because the production of electric vehicles is different to conventional combustion engine vehicles. This view was supported by Mr Geoff Gwilym, Executive Director of the VACC at a public hearing. He argued that notwithstanding the demise of the vehicle manufacturing industry in Australia, there remains potential in relation to electric vehicles:

> I still argue that when you manufacture electric vehicles you manufacture them in a different way than you do vehicles that have got diesel and petrol engines in them. You could argue that I have a sentimentality around this issue, but I think there is logic that says that if you were actually serious about introducing electric vehicles into Australia and a government wanted to lead that, then they should look seriously at the manufacture of electric vehicles in Australia, whether it be knockdown kits or full manufacture. I do not think this should be overlooked by government.[528]

5.10.1 What considerations do vehicle manufacturers make when choosing locations for manufacturing facilities?

If a large automotive manufacturer were seeking to locate an electric vehicle manufacturing facility in Victoria to mass-produce passenger vehicles, there are a number of considerations the company may make when selecting a site. The

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526 Public Transport Users Association, *Submission,* no. 43, p. 8.

527 Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 8.

528 Geoff Gwilym, Executive Director, Victorian Automobile Chamber of Commerce, *Transcript of evidence*, 9 November 2017, p. 8.

UK Department of Trade and Industries, in a submission to a House of Commons inquiry into the automotive industry, outlined some of the factors considered by manufacturers when choosing a location:

> Investment decisions can be complex, involving the consideration of many geographical factors (such as the availability of economical land, raw materials, labour force, suppliers and customer markets). Other important influences may be more dependent on government policy: tax regimes, transport infrastructure, employment law, R&D infrastructure and government support. Less tangible factors such as quality of life, attitudes of locals towards business, and quality of public services may also influence a firm's decision. [529]

Factors such as the nearby location of automotive parts suppliers is also important. Automotive manufacturers who practice just-in-time manufacturing may require suppliers to be located nearby.[530] Workforce considerations are also significant and companies may choose to locate in areas with an availability of skilled workers.[531]

The Victorian Government recognises the need to promote attributes that may attract manufacturers to establish facilities in Victoria. The government has produced a factsheet outlining Victoria's strengths in advanced manufacturing, which may correlate to the types of features conducive to electric vehicle manufacturing. The strengths are:

- A highly-skilled workforce
- Strong digital technology capabilities and the largest number of highly-qualified information and communication technology graduates in Australia
- Expertise in design and engineering with the largest number of qualified engineering graduates in Australia
- A highly developed professional services sector
- Global hub for science infrastructure and world leading R&D in high growth sectors
- Well-developed freight and logistics systems, including Australia's largest port and a 24 hour international airport
- Renewable energy targets provide manufacturers certainty and opportunity
- Accessible to Asia-Pacific with similar time zones
- Melbourne awarded World's Most Liveable City seven years in a row
- Competitive business costs
- An enabling regulatory regime.[532]

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529 House of Commons Trade and Industry Committee, *Success and failure in the UK car manufacturing industry: Fourth Report of Session 2006-07*, House of Commons, London, 2007, p. 83.

530 Dr CR Canup, 'How to Site Your Next Facility: Site Selection Factors for Automotive Suppliers', *Area Development*, <http://www.areadevelopment.com/specialPub/auto07/autoHowToSite.shtml>, accessed 10 January 2018.

531 Ibid.

532 Department of Economic Development Jobs Transport and Resources, 'Advancing Victorian Manufacturing: Factsheet', <https://economicdevelopment.vic.gov.au/__data/assets/pdf_file/0004/1544350/10764-DEJTR-EIT-Advancing-Victorian-Manufacturing-factsheet.pdf>, accessed 20 December 2017.

Despite Victoria's strengths in advanced manufacturing, government incentives are also an important consideration for automotive manufacturers when selecting sites for large-scale plants. For example, it was reported that Tesla was offered an incentive package of USD$1.25 billion from the Nevada State Government to locate its Gigafactory in the state. [533]

5.10.2 Government incentives to attract electric vehicle manufacturers

There are a number of incentives and regulatory tools that can be used by Governments to assist and attract electric vehicle manufacturers. Government support in the form of grants and tax incentives may be necessary to overcome the economic difficulties inherent with manufacturing cars in Australia. Regulation is another tool that has been used to promote electric vehicles and encourage consumers to switch from combustion engine cars, making electric vehicle manufacture in the region more attractive as a result.

Regulations

A number of regulatory tools can be used to assist electric vehicle manufactures and increase the uptake of electric vehicles.

The AEVA (Victoria branch) told the Committee that regulation could be used to specify design standards for cars sold in Australia and to raise tariffs on imported vehicles and combustion engine vehicles. This would encourage the development of a domestic electric vehicle manufacturing industry:

> The original legislative remedies for encouraging local manufacture could be re-enacted specifically for electric vehicles, such as: unique Australian design rules. Australian content regulations and high tariffs on imports (in tandem with higher tariffs on conventional cars).[534]

The association noted, however, that these types of regulations are a Commonwealth responsibility and that the Commonwealth Government may be opposed to raising tariffs and increased regulation:

> The AEVA notes these are all Federal areas of responsibility and unlikely to be re-enacted in the current economic climate.
>
> The window of opportunity for Victoria (and Australia) to retain any competitive advantage in this area of manufacturing is rapidly closing. Therefore the AEVA believes only a large Government led intervention will enable vehicle manufacture on a large scale in Victoria.[535]

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533 Anjeanette Damon, 'Inside Nevada's $1.25 billion Tesla tax deal', *Reno Gazette Journal*, 4 September 2014, <http://www.rgj.com/story/news/2014/09/04/nevada-strikes-billion-tax-break-deal-tesla/15096777>, accessed 20 December 2017.

534 Australian Electric Vehicle Association (Vic), *Submission,* no. 14.

535 Ibid., p. 8.

The VACC, in their submission to a Victorian Government's Transport Technologies Sector Strategy paper[536] advocated that the Victorian Industry Participation Policy (VIPP) could be utilised to better support businesses that have hired displaced automotive workers.[537] The VIPP is a program that requires Victorian businesses to be considered when awarding government contracts.[538] As discussed in Chapter Four, the Committee considers that it may be beneficial for electric vehicles to be considered by the Victorian Government when purchasing their fleet. The VIPP could help Victorian electric vehicle manufacturers to secure Government fleet contracts and provide a large customer base for manufacturing operations.

The European Union (EU) has introduced regulations to encourage the manufacture of electric vehicles through carbon emissions targets. Car manufacturers will be fined in 2021 if their new cars, on average, do not meet carbon targets. This encourages manufacturers to produce electric vehicles that produce zero emissions as it will lower the average carbon output of their new vehicle fleets.[539]

As well as fines, the EU has proposed to introduce incentives to car manufacturers to produce electric vehicles. The EU will set CO_2 emissions targets for car manufacturers in-line with undertakings made at the 2015 Paris Climate Change agreement. Those manufacturers who produce more low emission vehicles will be eligible for credits to offset CO_2 targets.[540] It is hoped this will encourage large European car manufacturers to produce more electric vehicles to get carbon credits.

Incentives to purchase electric vehicles

As discussed in Chapter Three demand for electric vehicles in Victoria may be improved by adopting incentives such as reduced stamp duty on new cars and the use of priority lanes. Improved domestic demand for electric vehicles may demonstrate to manufacturers an improvement in the economic viability of manufacturing electric vehicles in Victoria.

Grants, Finance and Tax incentives

There are currently a number of state government grants available for companies who manufacture electric vehicles or electric vehicle parts. These include:

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536 The *Transport Technology Sector Strategy* was released by the Department for Economic Development, Jobs, Transport and Resources in 2016.

537 Victorian Automobile Chamber of Commerce, *Submission*, Victoria's Future Industries Transport Technologies: Discussion Paper, Department of Economic Development, Jobs, Transport and Resources, p. 4.

538 Department of Economic Development Jobs Transport and Resources, 'Victorian Industry Participation Policy Local Jobs First', <https://economicdevelopment.vic.gov.au/victorian-industry-participation-policy>, accessed 18 January 2018.

539 The European Commission, 'Reducing CO2 emissions from passenger cars', <https://ec.europa.eu/clima/policies/transport/vehicles/cars_en>, accessed 8 January 2018.

540 The European Commission, *Proposal for a Regulation of The European Parliament and of the Council - Setting Emission Performance Standards for New Passenger Cars and for New Light Commercial Vehicles as Part of the Union's Integrated Approach to Reduce CO2 Emissions From Light-Duty Vehicles: Explanatory Memorandum*, The European Commission, Brussels, 2017.

- The Local Industry Fund for Transition, which provides grants between $50,000 and $2 million to businesses in areas affected by the closure of the automotive manufacturing industry. This includes Melbourne's West and the Geelong region[541]
- Future Industries Program, this includes:
  - the Sector Growth Program
  - Future Industries Manufacturing Program: Future Industries Fund, which provides funding of up to $500,000 to assist Victorian businesses to invest in new manufacturing technologies and processes[542]
  - New Energy Jobs Fund: Future Industries Fund, which provides grants between $50,000 and $1 million to new-energy technology projects and businesses in Victoria[543]
- The Automotive Supply Chain Transition Program, which provides grants of up to $16,000 to help companies with a business transition plan, $55,000 for business transition services, and $10,000 for Merger advisory services.[544]

These funding streams have already assisted Victorian companies to manufacture electric cars. SEA Electric received a $516 000 grant under the New Energy Jobs Fund to assist it to buy assembly equipment.[545]

The Commonwealth Government also provides a mechanism to finance electric vehicle manufacturing. The Clean Energy Finance Corporation (CEFC) invests in clean energy companies, such as electric vehicle companies, to assist them with finance. For example, SEA Electric has also benefited from a $5 million investment from the CEFC to scale up its manufacturing capabilities.[546]

Hyundai Australia, in their submission to the inquiry noted that the CEFC appeared to 'fit well with the role of assisting new green motoring technology roll-out'.[547] The submission also suggested that the Victorian State Government partner with electric vehicle manufacturers funded by the CEFC to convert the State Government car fleet to electric vehicles and boost electric vehicle infrastructure (See Chapter Four for further discussion of the Victorian Government's vehicle fleet). It argued that this will assist the development of Victoria's electric vehicle industry and provide jobs for automotive workers:

> HMCA believes that The Victorian State Government could partner industry to develop programs, assisted by ARENA and CEFC, to speed the roll-out (perhaps at first of State Government owned) fleet and depot-based EV and FCEV refuelling /

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541 Invest Victoria, 'Incentives, grants and programs', <http://www.invest.vic.gov.au/how-we-can-help/planning/incentives-grants-and-programs>, accessed 3 January 2018.

542 Ibid.

543 Ibid.

544 Business Victoria, *Towards Future Industries: Victoria's automotive Transition plan*, Business Victoria, Melbourne, 2016.

545 Tony Fairweather, Managing Director, SEA Electric, *Transcript of evidence*, 8 November 2017, p. 38.

546 Steven Impey, '$5m clean energy funding boosts electric vehicle manufacturer', *Manufacturers' Monthly*, 15 August 2017, <http://www.manmonthly.com.au/news/5m-clean-energy-funding-boosts-electric-vehicle-manufacturer>, accessed 11 January 2018.

547 Hyundai Motoring Company Australia, *Submission,* no. 5, p. 7.

recharge facilities. As has occurred in overseas markets, such recharge/refuelling infrastructure could be made available for private and commercial use and thus act as a catalyst for greater consumer and commercial take-up of such vehicles.

The rollout of such infrastructure could offer the opportunity for some of the automotive manufacture skills present in Victoria to be redirected into the manufacture, installation and maintenance of comprehensive ZEV recharge/refuelling networks. [548]

As noted in section 5.4, significant assistance was provided by the Commonwealth Government to automotive manufacturers in Australia before the closure of the industry in 2017. Between 2011 and 2015, $1.5 billion was allocated as part of the Automotive Transformation Scheme.[549] The scheme, which is still in operation and due to run until 2020, aims to encourage innovation, but also to ensure the automotive industry is 'placed on an economically sustainable footing'.[550]

5.10.3 Conclusion

Given the decision by automotive manufacturers to close manufacturing plants in Australia and Victoria in 2017, it is expected that any electric vehicle manufacturer would need to access a high level of government support to be economically viable. In other countries electric vehicle manufacturers have received a high degree of financial assistance to set up manufacturing sites. For example, as outlined in section 5.9, in the US, Tesla received USD$1.2 billion in subsidies when it constructed its Gigafactory in Nevada. Toyota and Mazda have also received a USD$700 million incentive package to site their new joint factory in Alabama. It was reported that the incentive package from local and state US governments included tax concessions, and government purchase of the land for the new factory.[551]

The Committee considers that this kind of expenditure to attract large-scale electric passenger vehicle manufacturers may be problematic because the production of electric passenger vehicles may face the same economic constraints as the conventional automotive manufacturing industry in Australia. As noted in section 5.3, these include the small domestic market, a highly fractured market, high labour costs and low tariffs.

FINDING 21: The establishment of a large-scale electric passenger vehicle manufacturing industry would require significant government investment and may not be economically competitive for the same reasons that led to closure of Victoria's conventional automotive manufacturing industry.

548 Ibid., p. 8.

549 Commonwealth Department of Industry Innovation and Science, *Factsheet: Automotive Transformation Scheme*

550 Department of Industry Innovation and Science, *Factsheet: Automotive Transformation Scheme (ATS)*, Department of Industry, Innovation and Science, Canberra, 2016, p. 5.

551 'Alabama incentives for Toyota-Mazda factory top $700 million', *The Economic Times - ET Auto*, 12 January 2018, <https://auto.economictimes.indiatimes.com/news/industry/alabama-incentives-for-toyota-mazda-factory-top-700-million/62473143>, accessed 18 January 2018.

5.11 Victoria should incentivise niche or high-value manufacturing of electric vehicles and their parts instead

The Committee believes that large-scale electric passenger vehicle manufacturing in Victoria would be economically challenging and would require significant government investment. However, the Committee heard evidence that niche and high-value manufacturing of electric vehicles and their parts may be more economically viable. This view was expressed by Mr Beyhad Jafari of the Electric Vehicle Council who told the Committee at a public hearing:

> We could certainly be at the very least playing a role in the manufacture of the components and the batteries and the technology inside the vehicles. But ultimately as well, particularly looking at right-hand-drive vehicles, we could certainly play a role in that as well.[552]

SEA Electric, in their evidence to the inquiry said that their business supplying specialised transport vehicles had a promising outlook. The company has received interest from an Indian truck manufacturer to use its electric powertrains:

> India, just to put some perspective around this, one of the largest vehicle manufacturing countries in the world, only three or four months ago announced that it was going to ban the sale of internal combustion engines in all vehicles by 2030. A company we are dealing with at the moment last year produced 10 000 trucks, all diesel. In 12 years time they will not have a business, and they do not have the technology at the moment. So the day after the Kings announcement I had a call from Mr Rama in India. I have been over there twice so far, and we are at the last stage of negotiating a licence agreement with them. Ultimately we will supply the technology to them if we have anything significant being manufactured here, and there are a range of local components. We have localised as much as we can in Australia. All of our brackets and mounts, wiring and harnesses are coming out of Australia et cetera. Whatever else we can get here, we are effectively opening the world to commercial vehicle drive-line supply with our licensed partners around the world. So to answer your question, Bernie, the demand is out of control.[553]

SEA Electric received a $516 000 grant under the Victorian Government's New Energy Jobs Fund to assist it to buy assembly equipment.[554] It also received $5m in assistance from the Clean Energy Finance Corporation, a Commonwealth Government initiative.[555]

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552 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 3.

553 Tony Fairweather, Managing Director, SEA Electric, *Transcript of evidence*, 8 November 2017, p. 34.

554 Ibid., p. 38.

555 Steven Impey, '$5m clean energy funding boosts electric vehicle manufacturer', *Manufacturers' Monthly*, 15 August 2017, <http://www.manmonthly.com.au/news/5m-clean-energy-funding-boosts-electric-vehicle-manufacturer>, accessed 11 January 2018.

In a submission to the inquiry, Pro-Vice Chancellor of Swinburne University, Professor Ajay Kapoor and members of the university's Electric Vehicle Laboratory told the Committee that Victoria's strengths in advanced manufacturing meant that it is well positioned to take advantage of new manufacturing techniques and grow its electric vehicle manufacturing industry:

> With the closing of automotive vehicle manufacturing, the Australian manufacturing industry is now further dominated by SMEs. This may be seen by some as a weakness regarding economies of scale, however Australia, and indeed Victoria has an opportunity to become a global leader in the application of Industry 4.0 technologies via distributed manufacturing networks and value stream hubs. New applications of lightweight high strength alloys and composite materials coupled with advanced rapid manufacturing techniques and design methods augmented with artificial intelligent systems will enable production of components, sub-systems and final assemblies in small-scale operations in localised regions. It is time to stimulate a new dynamic manufacturing strategy that is agile and adaptable to changing needs and rapidly emerging technologies. Further to this, existing automotive knowledge and skills may be redeployed to enable a new generation of automotive industry producing electric vehicles.[556]

Nissan Australia told the Committee in their submission that their component manufacturing facility in Australia, Nissan Casting Australia, which is based in Dandenong, manufactures parts for electric vehicles. The plant employs 150 people and exports parts to Japan, the US, Thailand and Mexico.[557] The managing director of Nissan Casting Australia, Mr Peter Jones, stated in a press release that the company is producing parts for the new Nissan LEAF model. The parts produced are:

> An EV water jacket Inverter, Inverter cover, Inverter case and Motor Stator Housing that all come directly out of Dandenong. This is significant for Australian manufacturing.[558]

Mr Jones also said that the products produced at the plant are high-quality, precision engineered parts:

> Our quality department uses the same kind of measuring machines and granite tables used by Formula One teams...
>
> ...These parts are so precise that they match up exactly with parts made in Japan to a tolerance of 15 microns, less than the diameter of a human hair.[559]

In an interview about the manufacture of electric vehicle parts for Drive magazine, Mr Jones said that manufacturers recognised the high quality of the parts produced by the plant and that this quality had won them further business:

> I think quality is the thing we have over everybody else at the moment...

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556 Swinburne University, *Submission,* no. 46, p. 4.

557 Nissan Australia, *Submission,* no. 222, p. 2.

558 Nissan Casting Australia, *Committed To The Future, Nissan Celebrates 35 Years Of Ongoing Local Manufacturing*, media release, Nissan Australia, 16 November 2017.

559 Ibid.

> ...Quality can't be undersold. Our parts have been of very, very good quality and we have the confidence of plants around the world.[560]

Mr Jones also said that the company intended to consolidate its position as a large manufacturer for electric vehicle parts:

> Bear in mind there are a number of components that go into making these (electric) motors and we're three of those, so in terms of setting ourselves up as a mother plant (for EV production) or a plant that specialises in these things, that's what we're aiming to do.[561]

Nissan Casting Australia is shifting its focus to newer technology and in the last two years, it has invested $11 million in plant facilities including 'investing in specific tooling, and equipment with the most up-to-date technology for new generation Hybrid and EV components'. [562] This investment has been supported by grants from the State and Commonwealth Governments, including a grant from the State Government's Future Industries Manufacturing Program to buy equipment to manufacture parts for electric vehicles.[563]

The Committee hopes other businesses will follow in the footsteps of Nissan Casting Australia and utilise Victoria's strengths in advanced manufacturing to produce high-quality products that are sought-after by electric vehicle manufacturers.

FINDING 22: Victorian electric vehicle manufacturers and automotive supply-chain companies are manufacturing niche or specialised electric vehicles and high-quality components for electric vehicles with the support of Victorian Government grants.

5.11.1 What training and skills are needed to manufacture electric vehicles?

The Committee heard that some of the skills required for the manufacture of electric vehicles and their parts are transferrable from the conventional automotive manufacturing industry. For example, Nissan Casting Australia's foundry products are used for conventional cars and electric vehicles. However, other more specialised engineering roles may be required for the powertrain and electronic components of electric vehicles. SEA Electric, in their evidence to the Committee said that a range of automotive assembly skills were directly transferrable, however, some of the engineering required for electric vehicles may require additional training:

560 Drive, 'Australian manufacturing could flourish in EV future: Nissan Australia winning EV parts production contracts', <https://www.drive.com.au/motor-news/australian-manufacturing-could-flourish-in-ev-future-116354>, accessed 17 January 2017.

561 Ibid.

562 Nissan Casting Australia, *Committed To The Future, Nissan Celebrates 35 Years Of Ongoing Local Manufacturing*, media release, Nissan Australia, 16 November 2017.

563 Ibid., Hon. Wade Noonan MP - Minister for Industry and Employment, *A Further Boost for Workers and Industries in Transition*, media release, 3 May 2017.

> A range of our required skills are general assembly skills, so perfect for straight out of local automotive manufacturing. With the engineers it is a fairly specialised-type area, but we have been working with Deakin and Monash on that. We have got some good overseas experience that we are able to bring in for those new engineers.[564]

The Committee notes that Victoria has a number of institutions such as the electric vehicle Laboratory at Swinburne University and Excellerate Australia (formerly AutoCRC), which provide specialised engineering and electric vehicle research.[565] It remains to be seen whether these institutions would provide a suitable pool of trained electric vehicle engineers to support electric vehicle manufacturers.

The VACC, in their submission recommended the creation of a new Certificate 3 level apprenticeship training qualification specifically for electric vehicle technician roles. The certificate should include:

> Theory and training in electrical and battery systems, diagnostics, programming and other core requirements pertaining to the service and repair of electric vehicles.[566]

This recommendation is for the creation of a qualification for the service and repair of electric vehicles. While the Committee supports this, the Committee believes similar vocational qualifications could be offered for electric vehicle manufacturing.

FINDING 23: The establishment of relevant vocational and tertiary education and training courses would support the electric vehicle manufacturing industry.

5.12 Electric vehicle batteries

The Committee received evidence from a number of stakeholders that the Government should consider supporting manufacturing electric vehicle batteries and setting up battery recycle programs. The Committee also heard that Australia has significant deposits of Lithium, a key component in the Lithium-ion batteries that power electric vehicles. Mr Behyad Jafari of the Electric Vehicle Council told the Committee that Australia's Lithium reserves, combined with Victoria's advanced manufacturing capabilities could make it an attractive place to manufacture electric vehicle batteries and also to recycle and re-purpose old batteries:

> In Australia that is very attractive for us because we already have — and it is something that we will continue to have — the world's largest reserves of the mineral resources that are required for batteries that go inside the vehicles, as well as people with the skills and expertise to process, manufacture, repurpose and recycle those

564 Tony Fairweather, Managing Director, SEA Electric, *Transcript of evidence*, 8 November 2017, p. 37.

565 Swinburne University, 'Electric Vehicle Laboratory', <http://www.swinburne.edu.au/research/strengths-achievements/specialist-facilities/electric-vehicle-laboratory>, accessed 18 January 2018; Excellerate Australia, 'Vehicle electrification research projects', <http://www.excellerateaustralia.com/20-projects>, accessed 18 January 2018.

566 Victorian Automobile Chamber of Commerce, *Submission,* no. 38, p. 15.

> batteries, as well as the componentry and technology that goes within vehicles — and ultimately, again, potentially even restarting our automotive manufacturing industry.[567]

5.12.1 Could Victoria set up an electric vehicle battery manufacturing industry?

The Committee heard in a number of submissions that Victoria should investigate the possibility of establishing a manufacturing industry for electric vehicle batteries. The AEVA (Victorian Branch) recommended the Victorian Government establish an electric vehicle battery manufacturing and recycling facility in partnership with a private or state enterprise:

> That the Victorian Government in a public private partnership and possibly in partnership with one more other States, entice a suitable party or else independently establish a large scale modern battery manufacturing and re-cycling facility. [568]

Lithium-ion batteries are currently the most common type of electric vehicle battery. Lithium–ion batteries are also used in laptops and other electronic devices such as smartphones.[569] An electric vehicle battery typically involves many lithium-ion battery cells connected to each other in modules to make a larger battery pack.[570]

While the minerals for manufacturing electric vehicle batteries exist in Australia,[571] the lithium-ion battery manufacturing industry in Australia is in its infancy. The Queensland University of Technology constructed Australia's first facility for manufacturing lithium-ion batteries in 2017.[572] This facility was set up partly through funding from Auto Cooperative Research Centre (now known as Excellerate) and conducted in conjunction with the Malaysia Automotive Institute.[573]

In Victoria, academics are researching improvements to electric vehicle batteries that may provide technical advantages to battery manufacturers. Professor Ajay Kapoor from Swinburne University told the Committee that he and his colleagues from the University's Electric Vehicle Laboratory are developing higher density batteries, with a longer life-cycle that charge faster and are more reliable:

> Other promising technologies include the development of high energy density super capacitors based on nano fabricated graphene laminates. Professor Baohua Jia and Dr Han Lin are leading research at Swinburne into technologies that promise a new type of battery that will be competitive with existing Li-ion batteries with regards to

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567 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 2.

568 Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 8.

569 'FAQs: Electric vehicles', *Motoring*, 10 November 2017, <https://www.motoring.com.au/faqs-electric-vehicles-109744>, accessed 25 January 2018.

570 DMC, *White Paper: DMC Battery Testing Platform*, DMC, 2014, p. 2.

571 Jarrod Lucas, 'Galaxy Resources waves off first lithium shipment from Mt Cattlin mine', *ABC News*, 3 January 2017, <http://www.abc.net.au/news/rural/rural-news/2017-01-03/galaxy-resources-waves-off-first-lithium-shipment/8159118>, accessed 23 January 2018.

572 Queensland University of Technology, 'News - QUT creates Australia's first lithium-ion battery', <https://www.qut.edu.au/news?news-id=122958>, accessed 23 January 2018.

573 Ibid.

> energy density. If this technology is developed for EVs, it will be able to charge a full EV energy storage system in a few minutes, most probably quicker than you could fill a tank with petrol. Although this technology is most likely still a decade away from full-scale commercialisation, it will not have a limited lifecycle like existing batteries. 10,000-20,000 charge cycles will be possible without any noticeable degradation in storage capacity or performance.[574]

The University has also been working with partners to improve battery design and monitoring:

> A modular vehicle systems architecture for an electric city bus has been developed by Swinburne in collaboration with the Malaysian Automotive Institute and Excellerate Australia, the CRC for Advanced Automotive Technology. This system was delivered with a uniquely scalable battery system with battery management and monitoring of individual packs. The battery packs may be added or removed depending on the intended duty cycle and the distance of the service route. In a further iteration of the design, batteries would be able to be swapped out for charging and / or replaced as new technology becomes available.[575]

Given Australia's deposits of minerals required for electric vehicle battery manufacture and Victoria's strengths in advanced manufacturing, the Committee believes the Government should investigate options for the establishment of a lithium-ion battery manufacturing facility, with a view to establishing an electric vehicle battery manufacturing industry. In doing so, the Government should consider the support required to establish such an industry including grants, incentives and training.

FINDING 24: Establishment of an electric vehicle battery manufacturing industry with the support of government may be beneficial to Victoria and may provide much needed employment.

5.12.2 Battery recycling

The Committee heard that Victoria could play a role in electric vehicle battery recycling. Mr Beyhad Jafari from the Electric Vehicle Council told the Committee that Australia's skilled workforce and mineral deposits could make it a suitable location for providing services at each stage of the battery lifecycle, including recycling:

> Nobody else can beat us to do something about the battery value chain. Because we also have people with the skills and expertise in the automotive industry, a lot of whom are, unfortunately, out of work at the moment but do have very critical skills, we should be leaders in areas particularly around the value chain of batteries — and that is everything from extracting to eventually recycling the battery, a very long-term life cycle — to developing components and developing new technologies to help support the global industry.[576]

574 Swinburne University, *Submission,* no. 46, p. 4.

575 Ibid.

576 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 3.

Electric vehicle battery recycling services are in their early stages. The first generations of widely available commercial electric vehicles are yet to require replacement batteries in large numbers. According to a report, *Lithium-ion battery consultation report*, prepared for the Commonwealth Department for the Environment, few electric vehicle batteries have been recycled in Australia because the take-up of electric vehicles has been relatively small and the batteries have a life span of around 10 years.[577]

The majority of car manufacturers, including all members of the Federal Automotive Chamber of Industries, have systems in place to recover used batteries at the end of their life.[578] In these cases, old batteries are disposed of through dealerships and removed by trained technicians to be supplied to an approved recycler.[579]

According to Sustainability Victoria, there are a number of legislative regulations in place in Victoria for the storage, transfer, transport and recycling of batteries, including lithium-ion batteries:

- Occupational health and safety (OH&S):
  - *Occupational Health and Safety Act 2004*
  - Occupational Health and Safety Regulations 2007
  - Guide to Best Practice at Resource Recovery Centres (Sustainability Victoria)
  - Safety Alert: Preventing battery explosions (Work Safe Victoria)
  - Handheld Battery Recycling: Guidelines for aggregation points (Sustainability Victoria)
  - Guideline: Bunding (EPA Victoria)
  - Code of Practice for Manual Handling 2000 (WorkSafe Victoria)
- Environmental:
  - *Environment Protection Act 1970* (EPA Victoria)
  - Environment Protection (Industrial Waste Resource) Regulations 2009 (EPA Victoria)
- Dangerous goods storage:
  - *Dangerous Goods Act 1985* (Victorian Government)
  - Code of Practice for the Storage and Handling of Dangerous Goods (Work Safe Victoria).[580]

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577 Helen Lewis, *Lithium-ion battery consultation report: Prepared for the Department of Environment (Cth)*, Helen Lewis Research, 2016, p. 6.

578 Ibid., pp. 6-7.

579 Ibid., p. 17.

580 Sustainability Victoria, *Batteries Fact Sheet: Improving Resource Recovery Centres*, Sustainability Victoria, Melbourne, 2016, p. 1.

Despite this, there seems to be little guidance for electric vehicle manufacturers or electric vehicle owners regarding recycling or disposal of electric vehicle batteries specifically. This was also noted by the *Lithium-ion battery consultation report,* which quoted an electric car manufacturer's view on the lack of clarity for regulations for recycling electric vehicle batteries:

> [Our company is] very mindful of battery recycling and we would not market a vehicle without a recycling policy in place. However when doing our research over a year ago, it was not so easy or clear on what local responsibilities or regulations were necessary or required without engaging a company like MRI.[581]

This view was shared by the AEVA (Victorian branch) who recommend that the Victorian Government regulate for the disposal and recycle of electric vehicle batteries:

> Recommendation 21: That the Victorian Government legislate specific rules for the disposal and re-cycling of modern chemistry batteries used for medium to large scale power storage. [582]

The Government could provide more clarity on the regulations in place, or develop policies for the recycle or disposal of electric vehicle batteries.

5.12.3 Battery re-purposing

The Committee heard that some companies are recycling electric vehicle batteries by re-purposing them to act as energy storage batteries for use in the home. The Electric Vehicle Council supported this initiative, saying that the life of electric vehicle batteries could be usefully extended for many years through re-purposing:

> The minerals that go into creating a battery are so valuable that the expectation is they will never go back into the ground. So the battery that goes into an electric vehicle today, we are working out how long in the life of that battery it exists as what we call a dynamic battery, one that moves around and powers a vehicle. From there it can be repurposed into stationary energy, so providing battery storage for a building — a commercial building or a home — and then from there as well the minerals can be extracted back out from the battery and repurposed. By this time we are talking 70 years away, 75 years after the battery has been created, possibly even longer as the proficiency and the technology continue to get better.[583]

This was also noted by Mr Daryl Budgeon of the Victorian Branch of the AEVA:

> One possibility with electric vehicles is that the batteries need to be in good condition when they are used in the vehicle. Once they are no good for traction batteries, they are still usable for storage batteries for perhaps another 10 to 15 years. So there is

581 Helen Lewis, *Lithium-ion battery consultation report: Prepared for the Department of Environment (Cth)*, Helen Lewis Research, 2016, p. 17.

582 Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 8.

583 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 4.

> a possibility, if you get enough electric vehicles on the roads, that after a certain amount of time these batteries start being back on the market and you get cheap storage options.[584]

FINDING 25: The re-purposing of electric vehicle batteries for home storage batteries may be a cost-effective method of recycling and extending the life of a product that may otherwise be difficult to dispose of. Regulatory change may be required to allow this to occur.

FINDING 26: Regulations for the safe recycling and disposal of electric vehicle batteries will need to be developed if the take-up of electric vehicles increases.

584 Daryl Budgeon, Secretary, Australian Electric Vehicle Association (Victoria branch), *Transcript of evidence*, 13 February 2018, p. 21.

6 Car sharing and electric vehicles

Car-sharing – a service allowing users on-demand access to a fleet of vehicles for individual, short-term usage – is becoming increasingly popular in Victoria, particularly in urban centres and the Central Business District (CBD). User uptake of these services is predicted to continue increasing into the future.[585] In response, providers are experimenting with different ways of providing 'mobility as service'. Car-sharing services have the potential to change how we see and interact with transport, including a move away from private ownership and towards shared and public mobility options.[586]

Internationally car-share providers have been successfully introducing electric vehicles into their fleets, a trend which has begun to be replicated locally in Victoria. Facilitating and supporting electric vehicle use in car-share fleets expands the benefits of both by offering more efficient and user-friendly mobility options for the state, and improving access to the benefits of electric vehicles for a wider cross-section of the population.

6.1 Types of car sharing

In assessing the applicability and potential benefits of electric vehicles for the car-share market it is important to understand the different car-share service models that currently exist.

There are several different car-sharing service models currently operating in Victoria and internationally. They vary in how the cars are purchased, how users access the cars and how users are charged among other factors.

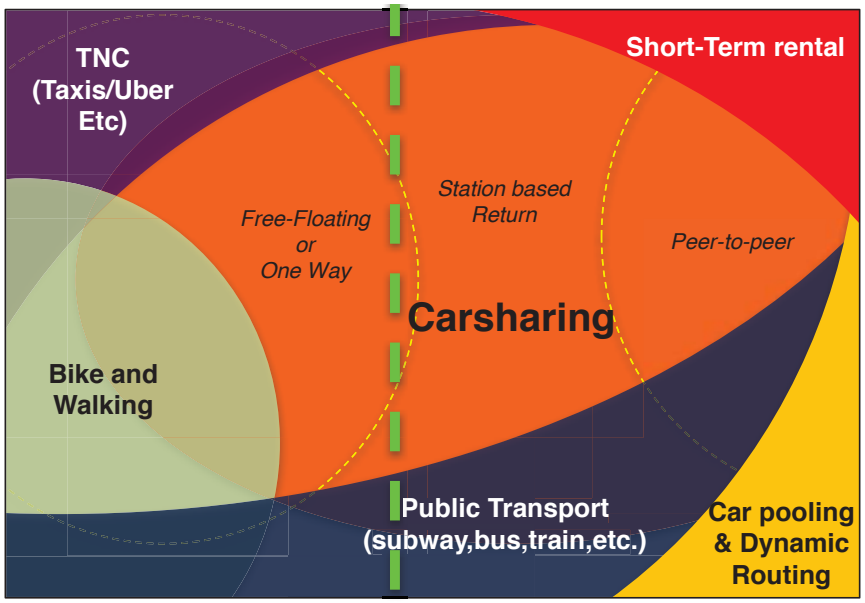
These car-sharing service models can all operate within an overall car-sharing 'eco-system' offering services across a spectrum of flexibility for users and travelling distance.[587] Figure 6.1 (below) shows how the different car-sharing service model options interact with each other and existing public transport or rental market options.

585 Quickar, *Submission,* no. 8, pp. 7-8 and 11; Beyond Zero Emissions, *Zero Carbon Australia: Electric Vehicles*, Beyond Zero Emissions, 2016, p. 51.

586 Quickar, *Submission,* no. 8, pp. 7-8 and 11; Beyond Zero Emissions, *Zero Carbon Australia: Electric Vehicles*, Beyond Zero Emissions, 2016, p. 51; NRMA, et al., *Transforming mobility: A regulatory roadmap for connected and automated vehicles*, 2017, pp. 2, 10; Swinburne University, *Submission,* no. 46, p. 4.

587 Quickar, *Submission,* no. 8, p. 13.

Figure 6.1 Multimodal design in large urban centres, excluding the private car



Source: Vincent Pilloy, 'Car Sharing, Yes! But Which One?', viewed 15 December 2017; Quickar, *Submission*, no. 8, p. 13.

The features and functions of the three main car-sharing models currently operating in Victoria – station-based, free-floating and peer-to-peer - will be briefly considered here.

6.1.1 Station-based

Users can pick up and drop off cars at a set of designated locations (stations) around the region they serve. These cars can be reserved through smartphone and offline methods. Costs for this type of car-share service are usually charged on an hourly basis. The advantage and disadvantage of this model is the need to collect and return the car to designated spaces, which constrains users' flexibility. This model also requires station infrastructure to be set up.[588]

Examples of station-based car-share services currently operating in Victoria include:[589]

- GoGet
- Flexicar
- Greensharecar.

The Committee heard evidence from GoGet at a public hearing in Melbourne in November 2017.

588 Quickar, *Submission,* no. 8, p. 11; Susan Shaheen, et al., *Zero- and Low-Emission Vehicles in US Carsharing Fleets: Impacts of exposure on member perceptions*, UC Berkley, 2015, p. 4; Elliot Martin and Susan Shaheen, *Impacts of Car2Go on Vehicle Ownership, Modal Shift, Vehicle Miles Travelled, and Greenhouse Gas Emissions: An Analysis of Five North American Cities*, UC Berkley, 2016, p. 3; Scott Browning, CEO, Quickar, *Transcript of evidence*, 9 November 2017, p. 13.

589 Quickar, *Submission,* no. 8, p. 11; Elliot Fishman, *Emerging Transport Technologies: Assessing impacts and implications for the City of Melbourne*, Institute for Sensible Transport, Melbourne, 2016, p. 14.

6.1.2 Free-floating

In a free floating car-share system users can find and collect cars from changing locations within the region they serve and park them anywhere within the region at the end of their journey. Reserving and finding these cars is often done via smartphone. The advantage to this model is the flexibility for users in where they can collect and drop off the cars. It allows users to find the nearest free-floating car and park the car in a residential parking space at their destination when their journey is finished. This supports spontaneous and flexible use, suitable to densely-populated urban environments. Costs for this model of car sharing is typically calculated on a per minute basis.[590]

Mr Scott Browning, CEO of mobility consultancy Quickar, explained the model to the Committee at a public hearing in Melbourne:

> At the moment you have got to go, pick up a car, drive it and you have got to bring it back to where you found it, to a dedicated base. Free floating says, 'I go to a car, I find it, I go to point B, I leave it'. Think about sort of Uber meets car sharing: instead of the car coming to you, you go and find it within a certain radius.[591]

As free floating car-sharing systems do not use stations the vehicles are routinely taken offline and returned to charging hubs by the company's fleet management before being returned to public use.[592] Mr Scott Browning, CEO of Quickar, told the Committee that routinely taking cars offline for maintenance 'has no impact on the network' in terms of being able to continue to provide services.[593]

This model is emerging as one of the more popular and efficient car-sharing options and it has been identified as a likely future growth area.[594] There are concerns that free floating car-sharing will result in 'clumps' of cars being parked in certain areas. Dr Christopher Vanneste, Head of Locations and Partnerships at GoGet, also told the Committee that electric vehicle car-share fleets internationally tend to compete with local public transport. However, Dr Vanneste further stated that GoGet's intention is to integrate with existing public transport, rather than replacing it.[595]

An example of a free floating car-share service currently operating in Australia is Car2Go (Australia).[596]

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590 Quickar, *Submission,* no. 8, p. 11; Susan Shaheen, et al., *Zero- and Low-Emission Vehicles in US Carsharing Fleets: Impacts of exposure on member perceptions*, UC Berkley, 2015, p. 4; Elliot Martin and Susan Shaheen, *Impacts of Car2Go on Vehicle Ownership, Modal Shift, Vehicle Miles Travelled, and Greenhouse Gas Emissions: An Analysis of Five North American Cities*, UC Berkley, 2016, p. 3; Elliot Fishman, *Emerging Transport Technologies: Assessing impacts and implications for the City of Melbourne*, Institute for Sensible Transport, Melbourne, 2016, p. 15; Scott Browning, CEO, Quickar, *Transcript of evidence*, 9 November 2017, p. 13.

591 Scott Browning, CEO, Quickar, *Transcript of evidence*, 9 November 2017, p. 13.

592 Ibid., pp. 14-15.

593 Ibid., p. 14.

594 Elliot Fishman, *Emerging Transport Technologies: Assessing impacts and implications for the City of Melbourne*, Institute for Sensible Transport, Melbourne, 2016, p. 30.

595 Christopher Vanneste, Head of Locations and Partnerships, Go Get, *Transcript of evidence*, 9 November 2017, p. 39.

596 Quickar, *Submission,* no. 8, p. 11.

6.1.3 Peer-to-peer

Peer-to-peer services allow individual car owners to rent out their vehicles through an online, third-party platform. This service model has built-in insurance, does not require investing in a full fleet and can provide cheaper fares for users. However, it requires a 'critical mass' of owners renting out their cars for the service to become viable for consumers to use.[597]

Examples of peer-to-peer car-sharing services currently operating in Australia are Car Next Door and DriveMyCar.[598]

During the Inquiry, the Committee also received evidence from Eveeh, a new electric car-sharing platform launched in 2016 in Sydney, New South Wales. Eveeh allows owners of electric vehicles to list their vehicles online for rent. Eveeh's website indicates there are currently six cars available for rent. The vehicles are currently only located in Sydney and surrounds although Eveeh has plans to expand to other states with Sydney and Melbourne being its two initial cities.[599] According to Eveeh, electric vehicle owners are likely to see economic and environmental benefits in listing their cars on such peer-to-peer services, and this car-sharing model has potential to expand.[600]

6.2 Electric vehicles for car share fleets

Electric vehicles are increasingly relevant in fleet contexts, including car-sharing fleets, due to lower total vehicle running costs and, potentially, lower vehicle acquisition costs.[601] Electric vehicles are likely to be more suitable for car-share services as their predominant urban use results in shorter trips and reduced range challenges.[602] Car-share fleets are also likely to be able to convert to electric vehicles more quickly than private buyers due to the high turnover rate of vehicles used in these contexts.[603]

Mr Yves Noldus, Head of Corporate Affairs – Marketing and Investor Relations at SG Fleet, a fleet management service, explained to the Committee how electric vehicles can become cost-effective much more quickly in a fleet or car-sharing context than in private markets. He stated:

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597 Susan Shaheen, et al., *Zero- and Low-Emission Vehicles in US Carsharing Fleets: Impacts of exposure on member perceptions*, UC Berkley, 2015, p. 4; Quickar, *Submission,* no. 8, p. 11; Elliot Martin and Susan Shaheen, *Impacts of Car2Go on Vehicle Ownership, Modal Shift, Vehicle Miles Travelled, and Greenhouse Gas Emissions: An Analysis of Five North American Cities*, UC Berkley, 2016, p. 3; Elliot Fishman, *Emerging Transport Technologies: Assessing impacts and implications for the City of Melbourne*, Institute for Sensible Transport, Melbourne, 2016, pp. 15-16.

598 Quickar, *Submission,* no. 8, p. 12.

599 Eveeh, 'Find cars', <https://www.eveeh.com.au/search?from=2018-03-23T10:00&to=2018-03-25T10:00>, accessed 22 March 2018.

600 Eveeh, *Submission,* no. 6, p. 4.

601 Yves Noldus, Head of Corporate Affairs - Marketing and Investor Relations, SG Fleet, *Transcript of evidence*, 9 November 2017, p. 27; Quickar, *Submission,* no. 8, pp. 7-8; Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 24; Beyond Zero Emissions, *Zero Carbon Australia: Electric Vehicles*, Beyond Zero Emissions, 2016, p. 51.

602 Yves Noldus, Head of Corporate Affairs - Marketing and Investor Relations, SG Fleet, *Transcript of evidence*, 9 November 2017. p. 28; Quickar, *Submission,* no. 8. p. 8.

603 Christopher Vanneste, Head of Locations and Partnerships, Go Get, *Transcript of evidence*, 9 November 2017, p. 40; Quickar, *Submission,* no. 8. p. 8.

> ...clearly from a fuel cost perspective there is no doubt that eventually it will become a cheaper option, pending the establishment of a charging infrastructure and pending the lowering of the cost of vehicles over time. As I mentioned, the cost of batteries is coming down; it will make the vehicle cheaper. In a fleet context the great benefit of electric vehicles is that effectively you have less of an issue about the recharging. If you have a vehicle pool — say, if the Victorian government has a fleet of electric vehicles behind this building — with a charging station clearly there are sufficient economies of scale to utilise that charging station for a large number of vehicles. By virtue of having a fleet of such vehicles you do get significant benefits...[604]

However, there are identified challenges to adopting electric vehicles in existing or emerging car-share businesses. These include:[605]

- User range anxiety
- Slow recharging and related unreliability of vehicle charge
- Lack of existing electric vehicle charging infrastructure and the cost of installing this infrastructure privately
- Lack of availability of electric vehicles in Australia.

Despite these challenges existing car-share providers are optimistic about using electric vehicles in their fleet and are actively planning for wider inclusion in the future.

As Dr Christopher Vanneste, Head of Locations and Partnerships at GoGet informed the Committee at a public hearing:

> ...when that cost comes down and the charging time comes down and the distance that you can go in those goes longer, we would definitely be looking to adopt those vehicles. Also, I think, when the price comes down there will be significant cost savings in terms of the fuel for a business like ours. So we would be very open to it, but we will do it when it becomes viable.[606]

Not all car-share providers have had good experiences integrating electric vehicles into their fleets. Dr Vanneste at GoGet, described the difficulties GoGet has experienced acquiring electric vehicles in Australia and getting users to engage with them, particularly citing range anxiety and difficulty in ensuring vehicles were charged for users as key hurdles. He stated:

> At the moment we do not have any full electrics, just because they are quite hard to get and they stopped bringing them in. We are just bringing in six plug-ins, so they are PEVs, and then we would have hybrids and so forth. We had full electrics, but we have now taken them out of our fleet as they got older, and due to certain utilisation issues they were utilised 50 per cent less than a standard vehicle.
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> ...

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604 Yves Noldus, Head of Corporate Affairs - Marketing and Investor Relations, SG Fleet, *Transcript of evidence*, 9 November 2017, p. 29.

605 Christopher Vanneste, Head of Locations and Partnerships, Go Get, *Transcript of evidence*, 9 November 2017, pp. 39-40.

606 Ibid., p. 40.

> it is pretty hard to get people to car share in the first place. You are actually trying to get them to give up the car, so making other additional steps for them to do so is difficult. One was definitely range anxiety, because we did ask customers about that. They were afraid that they would not make it as far as they would like to go. Whether that was true or not, it was a perception in their mind. The other side of it with electric vehicles was also that when they come back they take quite a long time to recharge back up, so you often had to leave them for several hours unless you had a superfast charger like Tesla's, which costs $1 million...[607]

6.3 Potential community benefits from increasing the use of electric vehicles in car-sharing

Wider adoption of car-sharing is economically viable, with research showing a net public and private cost-benefit from their use.[608]

Of particular note is the potential for large-scale adoption of electric vehicle car-sharing to improve car parking availability and use of public urban space.[609] Car-sharing proponents argue that due to increased movement of these vehicles and use by multiple people in a day the time spent occupying parking spaces will be reduced, improving overall vacancy rates in public car parking spaces and enabling the available spaces to be used more efficiently.[610] Evidence from other jurisdictions has shown car-sharing can reduce demand for existing parking by up to 95 per cent.[611]

Electric vehicle car-sharing is likely to accelerate the uptake of electric vehicles in the community generally,[612] providing exposure to the vehicles and familiarity with support infrastructure such as charging and battery swap stations.[613] Car-sharing allows users to overcome common barriers to electric vehicle adoption, namely, range anxiety and ownership costs.[614] Electric vehicle car-sharing services can therefore affect purchasing decisions and have a real impact on improving market penetration of electric vehicles.[615]

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607 Ibid., p. 39.

608 Quickar, *Submission,* no. 8, p. 24; Elliot Fishman, *Emerging Transport Technologies: Assessing impacts and implications for the City of Melbourne*, Institute for Sensible Transport, Melbourne, 2016, p. 15.

609 OECD International Transport Forum - Corporate Partnership Board, *Transition to Shared Mobility: How large cities can deliver inclusive transport services*, International Transport Forum, 2017, p. 51; NRMA, et al., *Transforming mobility: A regulatory roadmap for connected and automated vehicles*, 2017, pp. 18, 51.

610 Quickar, *Submission,* no. 8, pp. 26, 45-46.

611 OECD International Transport Forum - Corporate Partnership Board, *Transition to Shared Mobility: How large cities can deliver inclusive transport services*, International Transport Forum, 2017, pp. 7, 11; Quickar, *Submission,* no. 8, p. 26.

612 Quickar, *Submission,* no. 8, p. 63; Susan Shaheen, et al., *Zero- and Low-Emission Vehicles in US Carsharing Fleets: Impacts of exposure on member perceptions*, UC Berkley, 2015, p. 3.

613 Susan Shaheen, et al., *Zero- and Low-Emission Vehicles in US Carsharing Fleets: Impacts of exposure on member perceptions*, UC Berkley, 2015, pp. 3, 7, 11-12, 14, 17; Scott Browning, CEO, Quickar, *Transcript of evidence*, 9 November 2017, p. 16; ClimateWorks Australia, *Submission,* no. 37, p. 4., Quickar, *Submission,* no. 8, p. 18.

614 ClimateWorks Australia, *The Path Forward for Electric Vehicles in Australia*, ClimateWorks Australia, 2016, p. 15; Uber, *Submission,* no. 25, pp. 3-4.

615 Susan Shaheen, et al., *Zero- and Low-Emission Vehicles in US Carsharing Fleets: Impacts of exposure on member perceptions*, UC Berkley, 2015, p. 17.

A high turnover of vehicles through car-sharing fleets could also promote private ownership through providing cheaper second-hand vehicles for sale in the community, bringing down the initial purchase cost hurdles for private buyers as described in Chapter Three.[616]

6.4 Future potential: autonomous vehicles and shared mobility

The evidence the Committee received regarding electric vehicle car-sharing in Victoria often linked to what broader uptake of these technologies could mean for transport habits and practices in the future. This included the potential transition to autonomous vehicles, and increased share mobility and public transport options.

6.4.1 Autonomous vehicles

Widespread uptake of electric vehicles is anticipated to have a corresponding influence on the future uptake of autonomous ('self driving') vehicles, which are predicted to increase in Victoria. The majority of autonomous vehicles currently in development are electric vehicles designed to suit an international market that is increasingly moving away from vehicles with internal combustion engines (ICEVs).[617]

Current electric vehicle car-share providers and ride sharing services such as Uber are aware of autonomous vehicles as an emerging technology. These companies are already considering how to incorporate autonomous vehicles into their fleets as an extension of their thinking and planning around electric vehicles.[618] Car-sharing services, therefore, are likely to promote greater access to autonomous vehicles through car-sharing services, similarly to broader use of electric vehicles in these fleets.

6.4.2 Shared mobility public transport options

In an evaluation of the benefits of car-sharing in the City of Munich (Germany), Team Red – a mobility and transport innovation consultancy firm – concluded that:

> ... a closer collaboration between public transport and car-sharing services is a win-win situation. Not only do providers and public transport benefit mutually from a greater binding of users to these systems, but also the community in general benefits.... Collaborations between public transport and car-sharing providers should be supported by [government]...[619]

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616 Quickar, *Submission,* no. 8, p. 8; ClimateWorks Australia, *Submission,* no. 37, p. 4.

617 Beyond Zero Emissions, *Zero Carbon Australia: Electric Vehicles*, Beyond Zero Emissions, 2016, p. 51; NRMA, et al., *Transforming mobility: A regulatory roadmap for connected and automated vehicles*, 2017.

618 Quickar, *Submission,* no. 8, pp. 19, 63; Beyond Zero Emissions, *Zero Carbon Australia: Electric Vehicles*, Beyond Zero Emissions, 2016, p. 37.

619 Team Red, *Evaluation Car-Sharing: City of Munich*, TeamRed, Berlin, 2015, p. 26.

Car-sharing services have the potential to provide an additional public transport option or to integrate with existing public transport systems by enabling residents in places with dense public transport networks the option of using a car without needing to own one. Both of these approaches would improve public transport amenity and mobility options for specific groups within the community such as those with disabilities, young people, and the elderly.[620]

Car-share fleets are able to provide a range of vehicles accessible to the wider community, including baby-friendly, pet-friendly, and disability-friendly options.[621] Increased provision of car-sharing services can therefore improve accessibility for a range of citizens at a very small cost increase and remaining cheaper than traditional taxis or public transport services.[622]

According to the OECD International Transport Forum, electric car-sharing vehicles should be encouraged as they can provide share-taxi bus services either door-to-door or along dynamically defined routes updated according to real-time service.[623] Share-taxi or taxi-bus services can integrate with existing public transport systems such as trains, improving the access to these services.[624]

Increasing uptake of these services can improve congestion through more efficient use of resources and connectivity between public transport infrastructure.[625]

The use of electric vehicles in car-sharing has been identified as having the potential to be particularly positive even in areas where existing public transport infrastructure is less comprehensive, such as areas not serviced by rail lines.[626] These services have the potential to improve overall mobility in suburban communities and reduce congestion into the CBD.[627]

Car-share options can improve access to public transport services, including to those who may find it difficult to reach key infrastructure such as stations.[628]

Quickar, described one potential example of how car share options can be integrated into a wider and diverse transportation network in their submission:

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620 OECD International Transport Forum - Corporate Partnership Board, *Transition to Shared Mobility: How large cities can deliver inclusive transport services*, International Transport Forum, 2017, p. 7; Tourism and Transport Forum Australia, *Submission,* no. 33, p. 4; NRMA, et al., *Transforming mobility: A regulatory roadmap for connected and automated vehicles*, 2017, pp. 9, 11, 13; Elliot Martin and Susan Shaheen, *Impacts of Car2Go on Vehicle Ownership, Modal Shift, Vehicle Miles Travelled, and Greenhouse Gas Emissions: An Analysis of Five North American Cities*, UC Berkley, 2016, p. 4.

621 Tristan Sender, CEO, GoGet, *Transcript of evidence*, 9 November 2017, p. 38.

622 OECD International Transport Forum - Corporate Partnership Board, *Transition to Shared Mobility: How large cities can deliver inclusive transport services*, International Transport Forum, 2017, p. 8; Mike Clarke, Councillor, Yarra Ranges Council, *Transcript of evidence*, 8 November 2017, p. 11; NRMA, et al., *Transforming mobility: A regulatory roadmap for connected and automated vehicles*, 2017, p. 9.

623 OECD International Transport Forum - Corporate Partnership Board, *Transition to Shared Mobility: How large cities can deliver inclusive transport services*, International Transport Forum, 2017, pp. 7, 10.

624 Ibid., pp. 7, 51.

625 Ibid., p. 7.

626 Elliot Fishman, *Emerging Transport Technologies: Assessing impacts and implications for the City of Melbourne*, Institute for Sensible Transport, Melbourne, 2016, p. 18.

627 Ibid.

628 OECD International Transport Forum - Corporate Partnership Board, *Transition to Shared Mobility: How large cities can deliver inclusive transport services*, International Transport Forum, 2017, pp. 7-8.

> Travel first by train, then drive to a bar in a Free-Floating car share vehicle, but then take an Uber back home.[629]

Offering services to joint destinations such as stations or shopping centres also improves the efficiency of car-share services.[630]

However, offering car-sharing services that integrate with existing public transport services involves coordination between key stakeholders and, in some cases, improvement of the design of public transport spaces such as stations.[631]

Christopher Vanneste and Tristan Sender of GoGet spoke to the Committee about how GoGet is focused on linking their car-share services with transport hubs such as rail lines as a priority. At a public hearing Dr Vanneste, Head of Locations and Partnership, stated:

> Any transport hub is a key part for us. Anywhere that you can use public transport for the majority of your journey is where we can put a car-share vehicle currently. So the public transport network is a major focus for us having car shares — that kind of last mile service at a transport hub.[632]

Mr Sender, CEO of GoGet further explained:

> We think that all stations should have car-share cars at them, and actually you do get a wider network when they are at stations because people travel on a train, for example, out of the traffic congestion and then they will take a car-share car for the last bit of their journey. Thus they have saved time and they can also get directly to where they want to be. The train station might be a mile or two or a kilometre or two from where they are actually going, so they would drive the whole way, because they did not have a real solution at the other end, and we are solving that.[633]

Supporting the uptake of car-share electric vehicles across Victoria, therefore, has the potential to also improve public transport access and mobility options more broadly across the community.

6.5 Necessary government support

As discussed throughout this report, the widespread adoption of electric vehicles in Victoria in the future is likely. With this in mind the State Government has an opportunity to ease this transition and take advantage of opportunities to improve mobility outcomes for Victorians, including supporting electric vehicle car-sharing initiatives.

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629 Quickar, *Submission,* no. 8, pp. 45-46.

630 OECD International Transport Forum - Corporate Partnership Board, *Transition to Shared Mobility: How large cities can deliver inclusive transport services*, International Transport Forum, 2017, p. 8; NRMA, et al., *Transforming mobility: A regulatory roadmap for connected and automated vehicles*, 2017, p. 16.

631 OECD International Transport Forum - Corporate Partnership Board, *Transition to Shared Mobility: How large cities can deliver inclusive transport services*, International Transport Forum, 2017, p. 8.

632 Christopher Vanneste, Head of Locations and Partnerships, Go Get, *Transcript of evidence*, 9 November 2017.

633 Tristan Sender, CEO, GoGet, *Transcript of evidence*, 9 November 2017, p. 41.

At a public hearing, Mr Yves Noldus of SGFleet stated:

> The uptake of EVs by car-share providers will depend on ... the same government initiatives and incentives as for members of the public.[634]

The Committee received evidence that a number of factors are constraining innovation and broader expansion of electric vehicle car-sharing in Victoria. Many of these factors overlap with those identified in other chapters in this report to do with private vehicle ownership and Government fleet vehicles. However, this section aims to briefly discuss the key identified factors restricting development of electric vehicle car-sharing services in Victoria. These include:

- Government leadership and policy stance
- Regulatory, planning scheme and legislative barriers
- Adequate support infrastructure provision
- Access to parking for car-share vehicles
- Various incentives for car-share businesses and users.[635]

6.5.1 Leadership and policy stance

The Committee received evidence that a current barrier to broader uptake of electric vehicles by car-share operators in Victoria is a lack of a clear statement of intention and overall policy stance on future vehicle use and emissions.

This includes a lack of a clear statement on:[636]

- Future mobility and transport strategies and systems specific to electric vehicles
- How different mobility strategies will be integrated with one another
- How different elements will be coordinated and monitored
- A holistic approach to urban planning, mobility and public transport for the state.[637]

Victoria currently has none of the commonly cited policy initiatives identified as being beneficial to improving electric vehicle uptake, including for car-sharing.[638] A clear statement of intention from government is important for indicating general support and the likelihood of a stable market environment around

634 Yves Noldus, Head of Corporate Affairs - Marketing and Investor Relations, SG Fleet, *Transcript of evidence*, 9 November 2017, p. 28.

635 Northern Alliance for Greenhouse Action, *Submission,* no. 13, p. 3; Uber, *Submission,* no. 25, p. 4.

636 Quickar, *Submission,* no. 8, p. 63; Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 2; City of Darebin, *Submission,* no. 45, p. 3.

637 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 2; City of Port Phillip, *Submission,* no. 47, p. 3; Swinburne University, *Submission,* no. 46, p. 5; Colac Otway Shire Council, *Submission,* no. 44, p. 2.

638 See: Electric Vehicle Council ClimateWorks Australia, *The state of electric vehicles in Australia*, 2017. Table 3, p. 12.

electric vehicles for international and local car-share businesses to invest into.[639] Other jurisdictions where electric vehicle and electric vehicle car-sharing uptake has been strong have occurred within the context of a clear and supportive legislative and policy environment.

The Committee notes that certain recommendations in Infrastructure Victoria's *30-year plan* indicate general support for the identified areas. However these general indications of support lack the specificity and commitment required to provide the private sector with the clear signals that they need to comfortably invest in this area. A clear statement of government support for electric vehicles would provide this.[640]

Strong government leadership and involvement in electric vehicle car-sharing can help ensure that key elements of a successful electric vehicle car-share ecosystem such as safety standards, equity of access, and a comprehensive service network are not overlooked and are instead developed to suit community needs.[641]

Mr Behyad Jafari, CEO of the Electric Vehicle Council, told the Committee about the effect government support and leadership statements can have on electric vehicle and car-sharing uptake:

> ...having that top-down leadership does provide, does facilitate, more opportunities for people to take even earlier action. Yes, 10 years is quite a lot of time...that means that people can start planning accordingly today, but very importantly it is that signal back from government that this is an area that they would like to move towards, certainty really being the biggest issue here.[642]

> ...it is an industry that is looking for those signals of support....It is governments that need to intervene to help transition us in this direction, and by being able to see the beginnings of that support, industry is comfortable enough that there will be change starting to occur in our marketplace and that investment will be made in more charging infrastructure.[643]

As discussed in earlier chapters, examples of how Victoria could demonstrate a strong policy position on electric vehicles for car-sharing include:

- State electric vehicle and emissions targets
- Policies supporting car-share services using electric vehicles
- Facilitating dialogue between car-share providers, local councils, and other private sector stakeholders, to discuss barriers to electric car-share provision in Victoria and possible mechanisms for improving this.[644]

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639 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 5; Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 19.

640 Northern Alliance for Greenhouse Action, *Submission,* no. 13, pp. 2, 5, 7; Electric Vehicle Council ClimateWorks Australia, *The state of electric vehicles in Australia*, 2017, p. 3.

641 Elliot Fishman, *Emerging Transport Technologies: Assessing impacts and implications for the City of Melbourne*, Institute for Sensible Transport, Melbourne, 2016, p. 40.

642 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 5.

643 Ibid., p. 7.

644 Northern Alliance for Greenhouse Action, *Submission,* no. 13, p. 3; Uber, *Submission,* no. 25, pp. 4, 43.

6.5.2 Regulatory, planning scheme and legislation changes

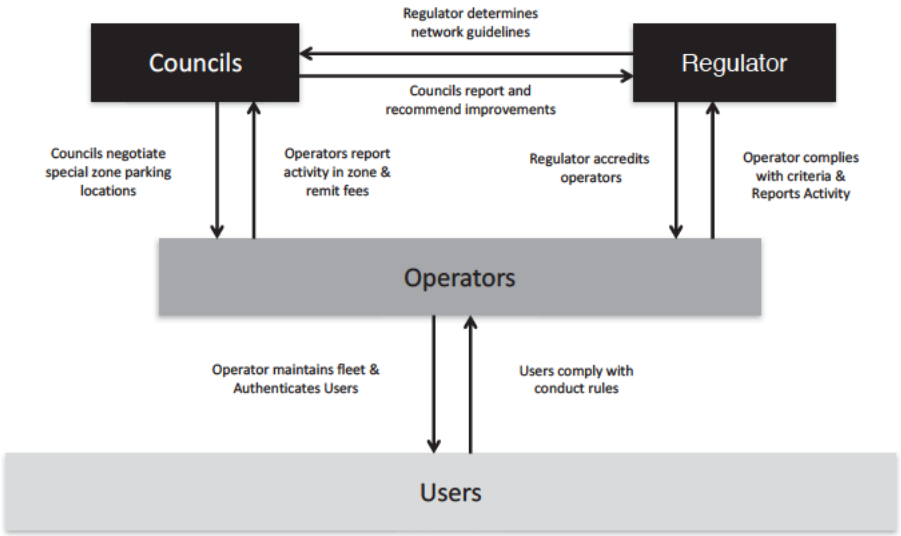
Evidence provided to the Committee identified a number of regulatory, legislative and planning barriers to wider uptake and use of electric vehicle car-sharing services in Victoria. For example, Quickar's submission to the Inquiry stated:

> The Victorian Government has a duty to regulate in the area of mobility as a service: to encourage choice, competition, safety, sustainability and innovation.[645]

Appropriate regulations around car-share use and parking, particularly in inner city areas, is necessary to facilitate the widespread use and uptake of electric vehicle car-share services – particularly free floating services. Some evidence to the Inquiry suggested that appropriate regulatory frameworks and allowances may be all that is required to facilitate establishment of a robust car-share service provision ecosystem in Victoria.[646] In contrast, car-sharing providers noted that restrictive regulatory and administrative operating requirements would constrain the service provision of existing operators and deter new service providers from entering the market.[647]

Figure 6.2 presented an example of how local councils and a regulator responsible for electric vehicles could interact to support free-floating car-sharing operators and users.

Figure 6.2 Suggested free-floating car-sharing regulatory framework



Source: Quickar, *Submission* no. 8, p. 37

An identified element of the regulatory environment around electric vehicle car-sharing is the $1 point-to-point transport levy beginning in 2018.[648] Current car-share providers who use electric vehicles in their fleets argue that this levy

645 Quickar, *Submission,* no. 8, p. 42.

646 Ibid., pp. 2, 34, 36, 63.

647 Ibid., pp. 2, 10.

648 Introduced in the *Commercial Passenger Vehicle Industry Act 2017* in response to abolishing taxi and hire car license fees the point-to-point levy is intended to fund a compensation package for existing taxi license holders.

disincentivises using car-share services. However, removing this levy for electric vehicles may incentivise car-share providers in investing in using electric vehicles.[649]

Legislative changes

Current provisions in the *Transport Integration Act 2010* and the *Road Safety Act 1986* have been identified as restrictive to electric car-share service provision. Specifically, current legislation does not permit long-term parking in some spaces, which limits where car-share users can park their vehicles at the end of their trip.[650] According to ClimateWorks Australia, legislation is also currently restrictive for kerbside charging of electric vehicles.[651]

FINDING 27: Division 7 of the *Road Safety Rules 2009* and Sections 95 and 95D of the *Road Safety Act 1986* currently do not permit longer-term parking for free floating electric car-share vehicles.

Planning provisions

The Committee received evidence that there is insufficient guidance in Victorian planning provisions relating to electric vehicles and environmental sustainability. Clarification of this area could facilitate better provision of support infrastructure for electric vehicles, including car-share vehicles.[652]

Improving state-level guidance to local councils regarding application of planning provisions for installation of charging infrastructure, and what government expectations are for local councils' role in providing electric vehicle charging infrastructure, would also support the uptake of electric vehicles for car-share providers.[653]

6.5.3 Infrastructure incentives and support

According to Mr Tim Washington, founder of local electric vehicle infrastructure company JET Charge:

> There is a reason why some of the biggest names in charging infrastructure come from places with the most government support behind electric vehicles and electric vehicle infrastructure.[654]

A commonly identified barrier to broader uptake of electric vehicles in Victoria generally and specifically for car-share electric vehicles is a lack of support for infrastructure such as charging stations, as discussed in Chapter Three.

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649 Uber, *Submission,* no. 25, pp. 7-8., Tourism and Transport Forum Australia, *Submission,* no. 33, p. 5.

650 Quickar, *Submission,* no. 8, p. 60.

651 ClimateWorks Australia, *The Path Forward for Electric Vehicles in Australia*, ClimateWorks Australia, 2016, pp. 24-25.

652 Scott McKenry, Executive Officer, Eastern Alliance for Greenhouse Action, *Transcript of evidence*, 8 November 2017, pp. 10-11; Northern Alliance for Greenhouse Action, *Submission,* no. 13, p. 3.

653 Scott McKenry, Executive Officer, Eastern Alliance for Greenhouse Action, *Transcript of evidence*, 8 November 2017, pp. 10-11.

654 Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 19.

Mr Washington told the Committee that government support for infrastructure is vital to wider consumer uptake of electric vehicles, including by car-sharing businesses. Government support or investment in this infrastructure can give the wider industry confidence to invest in vehicles and further charging infrastructure.[655] Examples from jurisdictions overseas have shown that incentives such as rebates introduced to promote electric vehicle uptake have been ineffective without appropriate charging infrastructure in place to support it.[656]

Mr Washington argued that electric vehicle infrastructure that was built on funding from government or businesses would support electric vehicle use throughout the community, including car-share service providers and future autonomous vehicles.[657] He stated:

> … you [can] create a natural economic incentive for people to install charging infrastructure, and you can create one of the largest metropolitan charging networks in the world, which helps things like car share. When we heard before about hub and spoke charging hubs, essentially those charging hubs have to be built and there needs to be an economic case for those charging hubs to be built. It is easy to say these high-capacity chargers will just be installed. Well, no. There is no economic incentive for them to be installed, because the charging stations cost $100 000 before installation. How do we go about encouraging people to install charging infrastructure to service these autonomous vehicles and share vehicles?[658]

While electric vehicle charging infrastructure and how it can be supported has been discussed in Chapter Three, electric vehicle infrastructure initiatives that could be considered specifically to support car-sharing services include:

- Capital funding for 10 private charging hubs (estimated $3.0-$6.0 million)
- Subsidised occupancy expenses at private charging hubs (estimated $600-$900,000 per annum)
- Tax offset credits for electric vehicle car-sharing service providers purchasing and installing associated charging equipment
- Discounted sales tax on electric vehicle charging equipment
- Subsidised or free-to-use public charging for car-share vehicles
- Identifying strategic locations for charging stations across the state, including regional centres and transport corridors, as priority areas for subsidised or government provided charging services
- Coordinate infrastructure efforts across levels of government, including considering potential incentive approaches
- Consider options for supporting local businesses to provide charging infrastructure

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655 Ibid., p. 22.

656 Uber, *Submission,* no. 25, p. 6; Tourism and Transport Forum Australia, *Submission,* no. 33, p. 3.

657 Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 20.

658 Ibid.

- Expedited permitting and installation of charging units.[659]

Charging infrastructure to support car-sharing services specifically needs to be fast to prevent users experiencing delays getting to their destinations and abandoning the service as inconvenient. Further, charging infrastructure to support car-sharing services needs to be near or on-street in practical locations that are high-traffic, easy to get to, and facilitate drivers pulling aside to use them. Provision of this public, central infrastructure is not associated with any particular business and would therefore likely need to be initiated by government.[660] Incentives could be developed to encourage private infrastructure installations to be placed in publicly accessible locations such as car parks to encourage wider distribution and coverage of services.[661]

Estimates for how much public infrastructure would need to be provided to support electric vehicle car-sharing differs. Mr Jafari of the Electric Vehicle Council suggested that there should be one publicly available charging station per five to seven drivers to provide sufficient coverage.[662] Whereas Quickar estimated that 4 DCFC 350Kw+ charging stations, with potential to expand to another 4 to 8 chargers, along with backup battery provision would provide medium- to long-term support for up to 500 free-floating electric vehicles in Melbourne. These charging stations may be able to be made available to the public and would be managed by the car-share provider's fleet technician team.[663]

6.5.4 Parking

Providing concessions and exemptions to car-share vehicles acknowledges that these vehicles have different impacts on parking demand than privately owned vehicles and indirectly offers support.[664]

Public parking permits, zones and regulations are difficult for car-share providers and users to navigate. Currently private vehicle owners are able to park on public streets in three ways:

- Permit parking
- Time-restricted parking
- Paid parking.[665]

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659 Northern Alliance for Greenhouse Action, *Submission,* no. 13, pp. 1-3; Sam West, 'They're supposed to be taking over: So where are all the electric cars?', *Wire*, 11 July 2017; Electric Vehicle Council ClimateWorks Australia, *The state of electric vehicles in Australia*, 2017, pp. 10, 24-25; ClimateWorks Australia, *The Path Forward for Electric Vehicles in Australia*, ClimateWorks Australia, 2016, p. 11; Environment Victoria, *Submission,* no. 53, p. 2; City of Port Phillip, *Submission,* no. 47, p. 3; City of Darebin, *Submission,* no. 45, p. 2; Yves Noldus, Head of Corporate Affairs - Marketing and Investor Relations, SG Fleet, *Transcript of evidence*, 9 November 2017, pp. 28-29.

660 Uber, *Submission,* no. 25, pp. 6-7; John Fisher, *Submission,* no. 27, p. 1; Tourism and Transport Forum Australia, *Submission,* no. 33, p. 3; Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, pp. 6-7; City of Port Phillip, *Submission,* no. 47, p. 3.

661 Scott McKenry, Executive Officer, Eastern Alliance for Greenhouse Action, *Transcript of evidence*, 8 November 2017, p. 14; City of Port Phillip, *Submission,* no. 47, p. 3.

662 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 6.

663 Quickar, *Submission,* no. 8, p. 33.

664 Ibid., p. 26.

665 Ibid., p. 24.

Free floating car-sharing is currently unsuited to most of these options, as the time a car-share vehicle spends in a parking space varies and responsibility for paying for paid parking and moving the vehicle in time to avoid fines in time-restricted parking are almost impossible for users and service providers to navigate successfully.

According to Quickar, possible solutions include:[666]

- Creating an exemption permit classification under the *Road Safety Regulations* that removes time restrictions (e.g. 1 hour parking spaces) on use for electric vehicles in car-sharing systems
- Amending the Permissive Parking Regulation under the *Road Safety Act 1986* to exempt electric vehicles in car-sharing systems, which currently prohibits free-floating car-sharing in commercial and residential zones
- Creating dedicated electric vehicle or electric vehicle car-sharing parking places in residential and commercial zones, including key areas of public amenity such as stations and shopping centres
- Exemptions or reductions in parking fees in paid parking areas for electric car-share vehicles
- Collective time credits for an entire car-sharing fleet (where one car which is only in a space a portion of the possible time can 'give' the excess to another car in the fleet in another space)
- Negotiating market rates 'per vehicle hour parked' for electric car-share vehicles in public parking allowing service providers to remunerate councils for access to the service and establish a consistent operating fee which companies can account for in their business model.

Mr Jafari of the Electric Vehicle Council, explained to the Committee how public provision of dedicated parking for electric vehicles and car-share vehicles can signal to the private market that Victoria is receptive to their products and worth investing in.[667]

> Just some of the things we look at that can be helpful that provide, again, that certainty and which can help to kickstart the market are where people are providing parking with electric vehicle charging attached to it as well, being able to provide things like exemptions to parking levies. Again, this will not be a total exemption to all parking levies and revenue forgone, but if you have 20 spaces, two or three of those spaces can have an exemption if you spend that money to provide charging. It is just reallocating that funding. What we have seen internationally is governments actually pouring money into providing charging, but the market is now mature enough globally for private investment to take over. They are just looking for a little bit of that burden to be relieved.[668]

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666 Ibid., pp. 2, 17, 24-27, 35; Tim Washington, Founder, JET Charge, *Transcript of evidence*, 9 November 2017, p. 20; Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 6; Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 5; John Fisher, *Submission,* no. 27, p. 1; ClimateWorks Australia, *The Path Forward for Electric Vehicles in Australia*, ClimateWorks Australia, 2016, pp. 11, 24 -25; Public Transport Users Association, *Submission,* no. 43, p. 7.

667 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 5.

668 Ibid.

Other jurisdictions such as the City of Munich have successfully introduced special permits for electric car-sharing vehicles.[669] Studies from other jurisdictions and projections based in Victoria show that providing specific parking spaces for electric car-share vehicles is unlikely to have any change in current parking availability. For example, a projection based on the City of Port Phillip presented by Quickar would have a 0.6 per cent impact on available spaces and 'a zero impact on the council's own targeted impacts and no relative community detriment whatsoever.' In addition, permissions and exemptions for electric car-share vehicles could be introduced gradually to further ease this transition.[670]

6.5.5 Purchaser incentives and support

Current car-share providers can be encouraged towards faster or more comprehensive adoption of electric vehicles into their existing fleets. Exposure to electric vehicles through car-sharing has been shown to have a positive effect in private consumer uptake, therefore providing incentives to car-share providers can assist with promoting overall electric vehicle uptake and use in Victoria.[671]

Purchasing incentives can take a number of forms including:

- Lowering the purchase cost of electric vehicles for car-share providers
- Removing stamp duty for electric vehicles for car-share providers
- Free or reduced registration for electric vehicles for car-share providers
- Tax rebates or offsets (such as a carbon credit) for the cost of acquiring and running electric vehicles for car-share providers
- Introduction of a fuel tax to encourage car-share providers towards electric vehicles as a more cost-effective fleet option
- Discounted tolls or parking credits for electric vehicles in car-share fleets
- Offering additional parking or tax offset credits to car sharing providers to help promote general public access to and familiarity with the vehicles
- Rebates for trading in internal combustion engine vehicles for electric vehicles in existing car-share fleets.[672]

Mr Jafari of the Electric Vehicle Council told the Committee that upfront cost savings incentives can be particularly effective for fleet or car-share vehicles. The high turnover of these cars means that commercial or fleet owners do not often keep the car long enough for the bottom-line benefits from running the car

669 Team Red, *Evaluation Car-Sharing: City of Munich*, TeamRed, Berlin, 2015, p. 3.

670 Quickar, *Submission,* no. 8, p. 26.

671 Ibid., p. 63; Susan Shaheen, et al., *Zero- and Low-Emission Vehicles in US Carsharing Fleets: Impacts of exposure on member perceptions*, UC Berkley, 2015, p. 3.

672 Quickar, *Submission,* no. 8, p. 35; Northern Alliance for Greenhouse Action, *Submission,* no. 13, pp. 2-3; Uber, *Submission,* no. 25, p. 5; Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 6; Toyota Australia, *Submission,* no. 29, pp. 6-7, 9; ClimateWorks Australia, *The Path Forward for Electric Vehicles in Australia*, ClimateWorks Australia, 2016, pp. 3, 11, 34; Yves Noldus, Head of Corporate Affairs - Marketing and Investor Relations, SG Fleet, *Transcript of evidence*, 9 November 2017, p. 27; Environment Victoria, *Submission,* no. 53, pp. 2-3; City of Port Phillip, *Submission,* no. 47, p. 4; City of Darebin, *Submission,* no. 45, p. 2; Public Transport Users Association, *Submission,* no. 43, pp. 6-8.

long-term to be relevant. However, applying an upfront purchasing cost incentive can influence the likelihood of an electric vehicle being cost-effective for these services.[673]

Incentives can also be targeted at electric vehicle share-care users to encourage interest in services, and drive demand-side interest.

Examples of incentives on this front could include:

- Rate subsidies for active users of car-sharing services
- Access to preferential parking or driving lanes for electric vehicle car-share users
- Introduction of a fuel tax to encourage users away from private vehicle use.[674]

While not essential to the overall future of electric vehicles in Victoria, supporting electric vehicle car-sharing alongside private ownership and industry-focused initiatives is an important component for ensuring that the economic and environmental benefits of electric vehicles are able to be experienced by all Victorians.

673 Behyad Jafari, CEO, Electric Vehicle Council, *Transcript of evidence*, 8 November 2017, p. 3.

674 Quickar, *Submission,* no. 8, p. 35; Australian Electric Vehicle Association (Vic), *Submission,* no. 14, p. 6; Toyota Australia, *Submission,* no. 29, pp. 6-7, 9; ClimateWorks Australia, *The Path Forward for Electric Vehicles in Australia*, ClimateWorks Australia, 2016, pp. 11, 23.

Appendix 1
Submissions

Submission no.	Name
1	Peter Horan
2	AVASS Group
3	Mannie De Saxe
4	Bob Hale
5	Hyundai
6	Eveeh
7	Beyond Zero Emissions
8	Quickar
9	Noel Lowe
10	Glenn Ruddle
11	Coralie Coulson
12	Central Victorian Greenhouse Alliance
13	Northern Alliance for Greenhouse Action
14	Australian Electric Vehicle Association Inc.
15	Leigh Raymond
16	John Handley
17	Ian Bird
18	Leni May
19	Michael Shaw
20	Kevin Cato
21	Tom Morely
22	Michelle Croughan
23	Daniel Cocker
24	Automotive Alternative Fuels Association Inc.
25	Uber
26	Origin
27	John Fisher
28	Brian Tehan
29	Toyota
30	Dr Albert Barrie Pittock
31	Nick Pastalatzis
32	Yarra Climate Action Now
33	Tourism & Transport Forum Australia
34	Blind Citizens Australia
35	RVS Industries
36	John Bird
37	ClimateWorks
38	Victorian Automobile Chamber of Commerce

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Submission no.	Name
39	Amanda Best
40	Goulburn Broken Greenhouse Alliance
41	Municipal Association of Victoria
42	AGL Engery
43	Public Transport Users Association
44	Colac Otway Shire Council
45	City of Darebin
46	Swinburne University
47	City of Port Phillip
48	Hobsons Bay City Council
49	RACV
50	Not Available
51	Peter Campbell
52	ABB
53	Environment Victoria
54	Eastern Alliance for Greenhouse Action
55	Robert Stephen
56	Logan Sheild
57	Patrick Hearps
58	Stewart Reed
59	Ian Tanner
60	Mira Thurner
61	Kirstin Wood
62	Andrew Heale
63	Virginia Lowe
64	Mick Sirianni
65	Helen Gardner
66	Robin Gardner
67	Elizabeth Pilbven
68	Anna Wilson
69	Elida De Felice
70	Thomas Wheeler
71	Remy Shergill
72	Clare Parry
73	Ben Mullen
74	A Barrie Pittock
75	Penelope Langmead
76	Ashley Voigt
77	Ron Hooper
78	Margot Foster
79	Bruce Echberg
80	Victoria Gray
81	Ray Cowling
82	Ben Curnow

Submission no.	Name
83	Sylvia Patcas
84	Stephen Wootten
85	Bob Doak
86	Robert Follis
87	Tassia Kolesnikow
88	Paul Judd
89	Joshua Torrance
90	Cheryl Kaulfuss
91	Jonathan Crockett
92	Robert Lyon
93	Tom Maher
94	Carolyn Masel
95	Daniel Twomey
96	Sean Hutchinson
97	Charles Clarke
98	Lee Massi
99	Pro forma submission A
216	Pro forma submission B
222	Nissan Australia
223	InvertedPower

Appendix 2
Public hearings

Wednesday 8 November 2017 – Legislative Council Committee Room, Parliament, Spring Street, East Melbourne

Name	Title	Organisation
Behyad Jafari	Chief Executive Officer	Electric Vehicle Council
Scott McKenry	Executive Officer	Eastern Alliance for Greenhouse Action
Cr Mike Clarke	Councillor, Yarra Ranges Council	
Stuart Nesbitt	Climate Change Technical Officer	Moreland City Council
Sue Vujcevic	Manager, City Strategy and Design	
Scott Ferraro	Head of Implementation	ClimateWorks Australia
Tony Fairweather	Managing Director	SEA Electric

Thursday 9 November 2017 – Legislative Council Committee Room, Parliament, Spring Street, East Melbourne

Name	Title	Organisation
Geoff Gwilym	Executive Director	Victorian Automobile Chamber of Commerce
Steve Bletsos	Senior Research Analysist	
Scott Browning	Chief Executive Officer	Quickar
Tim Washington	Founder	JET Charge
Yves Noldus	Head of Corporate Affairs, Marketing and Investor Relations	SG Fleet
Dr Julian de Hoog	Honorary Research Fellow, Melbourne School of Engineering	University of Melbourne
Tristan Sender	Chief Executive Officer	GoGet
Dr Christopher Vanneste	Head of Locations and Partnerships	

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Tuesday 13 February 2018 – Meeting Room G.6, 55 St Andrews Place, East Melbourne

Name	Title	Organisation
Fiona Calvert	Director, Transport Analysis and Assessment	Transport for Victoria
Paul Salter	Acting Executive Director, Network Strategy	
Daryl Budgeon	Victorian Branch Secretary	Australian Electric Vehicle Association
Bryce Gaton	Executive Committee, Victorian Branch	
Marissa O'Halloran	Project Manager	Goulburn Broken Greenhouse Alliance
Ashley Wells	Director	Federal Chamber of Automotive Industries
Rhys Griffiths	Motorcycle Manager	
Tim Olding	Director	Sassafras Group
Professor Aniruddha Desai	Director, Centre for Technology Infusion	La Trobe University
Dino Hadzic	Engineer	ABB Australia
Dr Elliot Fishman	Director, Transport Innovation	Institute for Sensible Transport
Liam Davies	Transport Analyst	
Claire Johnson	CEO	Hydrogen Mobility Australia