Regional Report Business Case and Transition Plan for Electric Vehicle Fleets

Prepared for Eastern Alliance for Greenhouse Action

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Institute for Sensible Transport

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1. Introduction

The Eastern Alliance for Greenhouse Action (EAGA) have commissioned the development of a business case and transition plan for electric vehicle (EV) fleets, across six participating LGAs. Most of these councils now receive a 100% renewable energy supply, and thus a fleet conversion to EV will provide the reductions necessary to become carbon neutral by 2030.

1.1 Project objectives

The two key objectives of this project are to:

1. Fast-track the uptake of EVs in council fleets to support the target of zero net emissions by 2030
2. Build the capacity of council fleet managers to incorporate financial, social and environmental costs into decision making.

1.2 What this report provides – in brief

This report presents a regional overview to EAGA council fleets. In addition, a transition plan and business case for conversion to an all-electric fleet has been undertaken for each of the six participating councils. These separate reports provide detailed information about their existing fleet and the plan towards a net zero emission fleet by 2030.

This report provides:

- An introduction to EVs, including the reasons why transitioning to EVs is important for Councils, and the barriers and challenges they may face.
- An analysis of the EAGA Councils' vehicle fleets, as a whole region. This includes the profile of each council's fleet, average use, fuel consumption, and estimated greenhouse gas emissions. This acts to create an understanding of Council fleets to assist in transition.
- An analysis of the EAGA Councils' plant equipment. This includes a profile of each council's plant assets. Further, a detailed assessment of electric options for plant is undertaken. This highlights whether electric options are currently available, and what limits or use considerations apply.

The six Council reports, offered separately to this report, provide:

- A business case and transition plan for each of the six participating councils.
- A comprehensive, whole of life cost assessment tool that can be used by councils to understand the budget and greenhouse implications of fleet transition practices. An Excel based Tool (one of each council) has been prepared and accompanies this report. This includes tabular outputs to enable fleet managers and others to understand the costs and benefits associated with a transition to a cleaner fleet, to assist in making informed decisions towards a zero emission fleet by 2030.
- An EV charging plan for participating councils. This identify the quantity of chargers required each year and recommends a charging speed suitable for the vehicles they will support. As many vehicles are parked at the home of staff overnight, charging considerations for residential locations have also been included as part of this project.

1.3 Study area

Figure 1 provides a snapshot of the EAGA members, separated into the *participating* and *non-participating* local government areas.

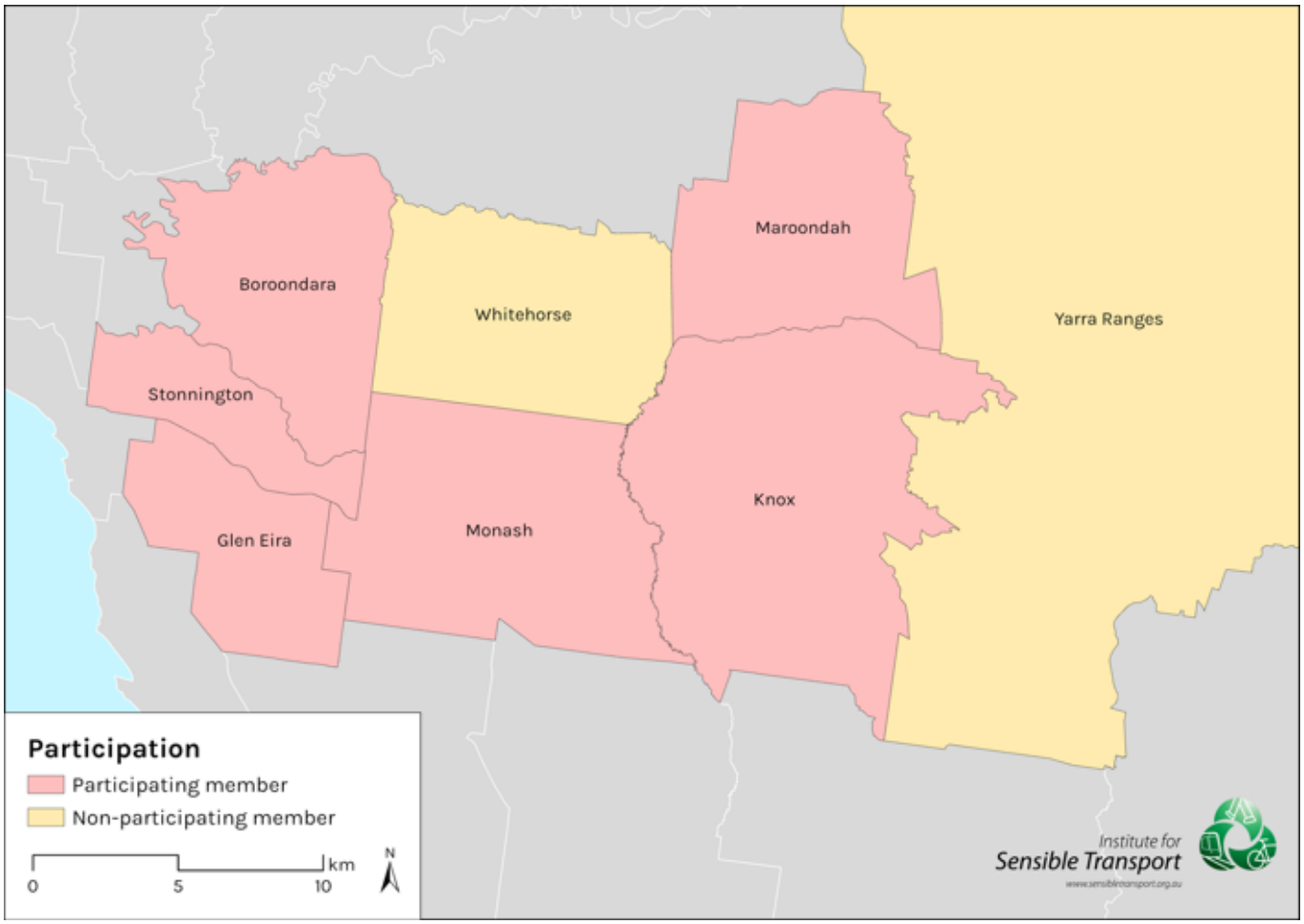
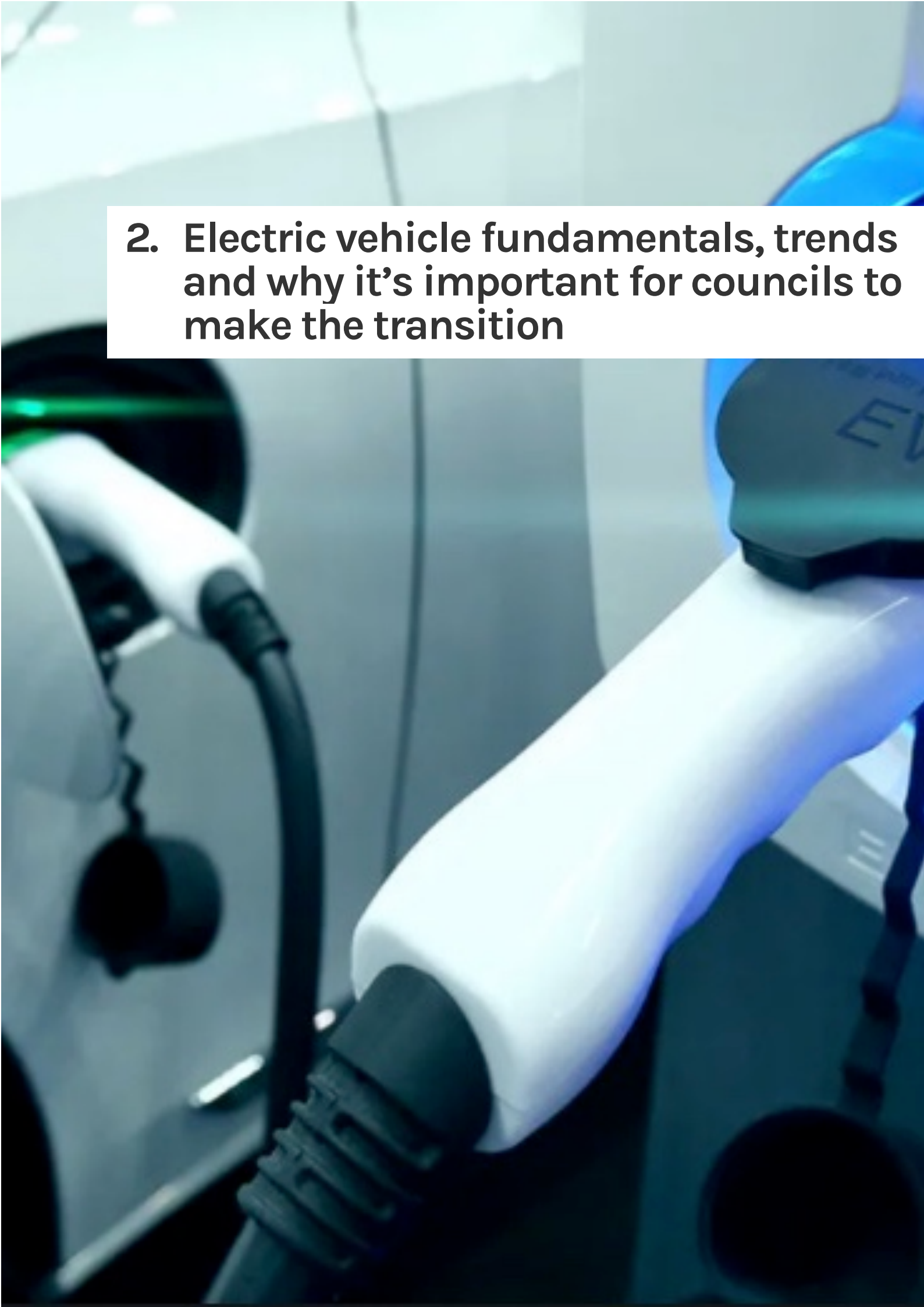


Figure 1 EAGA Members

2. Electric vehicle fundamentals, trends and why it's important for councils to make the transition



The electric vehicle (EV) market is evolving rapidly, with a greater range of more affordable vehicles and an expanding network of charging options. The growth of the EV market is expected to continue, and it has been estimated that price parity may occur ~2025/26.

2.1 What is an electric vehicle?

There are several different categories of EVs, and it is important to identify the main types, as shown in Figure 2. The vehicle at the top of this image is not an EV, but rather a conventional or *internal combustion engine* (ICE) vehicle. In 2022, almost all vehicles in the six council fleets are ICE vehicles.

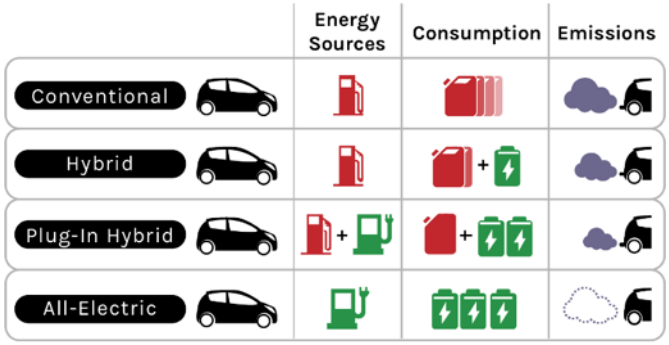


Figure 2 Different types of consumption and electric vehicles (EVs)

Source: Adapted from Adnan et al (2017)

The following provides a brief description of each of the vehicle categories listed in Figure 2.

- *Conventional vehicle* – or ICE vehicle, is the standard vehicle type widely known and used since the invention of the motor vehicle. It is *not* an EV.
- *Hybrid vehicle* – a vehicle that uses petrol/diesel as its only fuel source, but also has an electric motor and battery that can store energy from regenerative breaking. A *Toyota Prius* is a common example of a hybrid vehicle.
- *Plug-in Hybrid Electric Vehicles* (PHEV) - combines a mixture of fuel combustion and electricity. It is similar to the hybrid vehicle described above; however, it has the ability to take electricity from a socket and can store this in a battery. A *Mitsubishi Outlander* is an example of a model available as a PHEV.
- *Battery Electric Vehicles (BEV),* or *All-Electric*, take electricity from a socket and rely entirely on the electricity stored in an on-board battery for propulsion. A *Tesla Model 3* and *Nissan Leaf* are two popular models of BEV.

2.2 Electric vehicle sales in Australia

While Australia has among the lowest levels of EV adoption in the OECD, at around 1.95% of new vehicle sales (based on 2021 sales data), growth has been strong in recent years. In 2021 there were 20,665 EVs sold in Australia, up from 6,900 in 2020. Figure 3 captures EV sales in Australia, both in total and as a percentage of light vehicle sales.

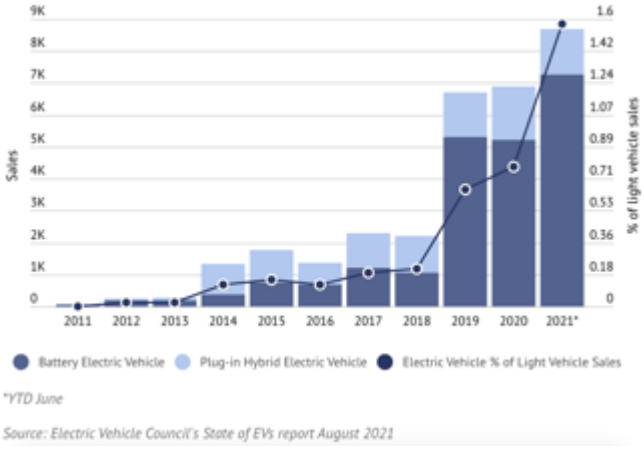


Figure 3 EV sales in Australia

Several surveys have found around 50% of consumers are considering an EV for their next vehicle purchase.

Figure 4 provides our analysis of EV registrations in Melbourne. This is also displayed on an interactive map (see https://tinyurl.com/59h845cp) which allows the user to see the growth rate over the last few years. Many of the postcodes within the EAGA study area have experienced a very strong EV growth rate in recent years.

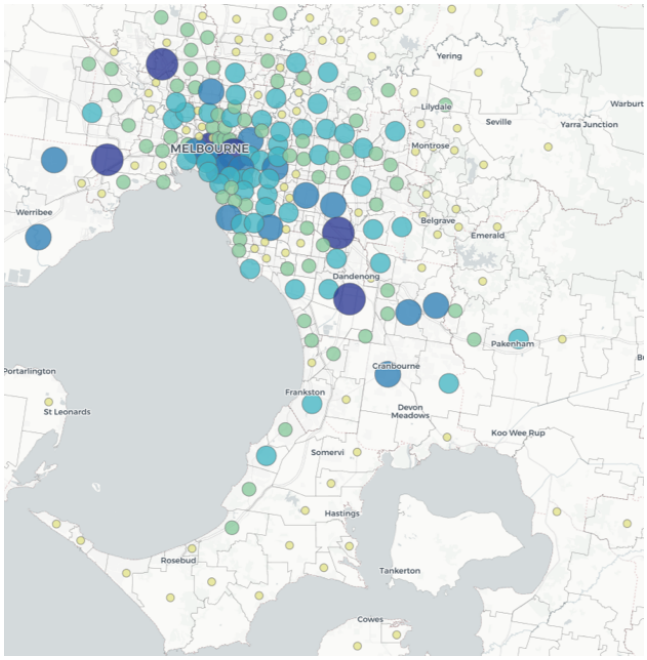


Figure 4 EV registrations in Melbourne
Source: Institute for Sensible Transport, using ABS data

2.3 Electric vehicle benefits

Electric vehicle technology has advanced rapidly in recent years. Electric vehicles avoid the tailpipe emissions of ICE vehicles, have lower running and servicing costs, and last longer. Compared to just five years ago, EVs:

- Have become cheaper
- Offer longer battery range, and
- Are available in a wider variety of vehicle types.

EVs also now have access to more chargers, including publicly available fast chargers, in more parts of Melbourne and this is set to grow further in coming years.

The presence of EVs in Australia is growing rapidly, albeit from a very low base, and the next 12 months are set to see the introduction of several lower cost models that, while still more expensive to purchase than their ICE equivalents, may compete strongly in terms of *whole of life* costs for vehicles that travel over a relatively high distance per year.

Electric vehicles are important because they:

- Improve local air quality
- Reduce tailpipe GHG emissions
- Reduce noise pollution
- Reduce vehicle running costs.

2.4 EV Chargers

The three main EV charging equipment characteristics that differentiate chargers from one another include (International Energy Agency, 2018) are identified below:

1. Level: the power output range of the EVSE outlet. The maximum is lower for Alternative Current (AC) for most cars.
2. Type: the socket and connector used for charging.
3. Mode: the communication protocol between the vehicle and the charger.

The number of chargers and the speed with which a battery can be changed has improved significantly over recent years, and countries (including Australia) are building networks of fast chargers to facilitate long distance travel. Table 1 provides a snapshot of different charging types.

Table 1 EV Charging types[1]

	Power	Range added per hour	Charging Time	Typical Application
Level 1 - single phase (domestic)	2.4 - 3.7kW	10 - 20km range / hour	5 - 6 hours	Home
Level 2 - slow single phase (domestic or public)	7kW	30 - 45km range / hour	2 - 5 hours	Home, work, shopping centres, car parks
Level 2 - fast three phase (public)	11 - 22kW	50 - 150km range / hour	30mins - 2 hours	Urban roadside
Level 3 - fast charge (public)	50kW	250 - 300km range / hour	20 - 60 mins	Regional near highways, motorways and key routes
Level 4 - super-fast charge (public)	120kW	400 - 500km range / hour	20 - 40 mins	Regional near highways, motorways and key routes
Ultra fast charge (public)	350kW	1,000+ km range / hour	10 - 15 mins	Highways and motorways

Vehicle manufacturers are continuing to upgrade the ability of their cars to accept high-capacity chargers. In essence, what this means from a

[1] Relatively few cars are currently able to use the full capacity of ultra-fast chargers.

usability perspective is that an EV can be fully charged in as little as 15 minutes. It is important to recognise that this will be rare (few vehicles will be able to) and expensive (it is based on a battery optimised for high-speed charging with other downsides). The reality is that most fast-charging sessions, even now, are only ~30 minutes – enough to get you to where you are going.

Over 90% of EV charging occurs at home or fleet base.

2.4.1 EV charger costs

Table 2 provides approximate costs for different EV charging capabilities. These costs are for Council sites and include wiring and central management/control units (smart chargers). These costs are at P80 (meaning the cost should not be exceeded 80% of the time). Firm costs can only be calculated via an electrical contractor inspecting each site. More information of costs for EV chargers has been provided within the Excel Tool, calibrated to the individual fleet characteristics over time for each council.

Table 2 EV chargers - CapEx costs (approx.)

Charger type	AU$ Cost
Single port AC 32A 3-Phase 22kW charger	$5,500
Dual port AC 32A 3-Phase 22kW charger	$7,000
Dual port DC 25kW charger (one car at a time)	$30,000
Dual port DC 50kW charger	$50,000

2.5 Assessment of EV adoption factors

Figure 5 captures the three broad areas in which government can influence the uptake of EVs. Purchase incentives and traffic priority are largely the domain of national and state government – though Council may wish to undertake an advocacy role to encourage adoption of policies in these areas.

Figure 5 Policies for boosting EV adoption - 3 categories

Source: Institute for Sensible Transport

Purchase incentives and enhanced capabilities are focused on measures designed to make the *vehicle* more attractive to the market. This includes such policies as sales tax exemptions and accelerated depreciation arrangements. This category also includes enhanced vehicle capabilities, such as extended battery range or a diversity of vehicle types. Disincentives for ICE vehicles can also be used to increase the relative value proposition of EVs.

Traffic priority relates to measures such as free use of toll roads and congestion zones, as well as the ability for a single occupant EV to use High Occupancy Vehicle lanes.

This project is directly focused on council fleet transition rather than community uptake of EVs.

The factors required to be in place before EVs are preferred (or at least equal to ICE) for typical

consumer preferences is summarised below (adapted from AEVA[2]):

1. Awareness and social norms: People need to be familiar with EVs and their capabilities.
2. Range: EVs should have an adequate range (distance) for the vehicle's intended purpose.
3. Charging infrastructure: A perception must exist that there is adequate charging infrastructure.
4. Variety of vehicles: It is important that the EV market contains a sufficient diversity of models to meet the needs of council and staff (cost and features).
5. Cost comparability: Financial incentives and/or lower sticker price will assist consumers. There are two thresholds here; whole of life and sticker price.

2.6 Victorian policy context

The Victorian government has articulated its support for the EV market, with the publication of its *Zero Emissions Vehicle Roadmap.* They have a target of 50% of vehicles sold in 2030 to be EV. While the Victorian government has been criticised by some for introducing an EV specific tax of 2.5 cents per kilometre, it has also provided some incentives for EVs, including:

- $19m for charging infrastructure
- Trialling electric buses
- Including more EVs into the government fleet
- $46m for a $3,000 purchase subsidy for EVs under $68,740.
- $100 off registration costs for EVs.

The provision of incentives from the State is partly attributed to the advocacy activities of EAGA and the Victorian Greenhouse Alliances.

2.7 Bulk procurement

Given that demand far outstrips supply for EVs currently, there are limited opportunities for obtaining significant price savings through bulk purchases. There may however still be benefits in doing so, in terms of increasing access to certain vehicles that may not be accessed as easily on an individual basis. Special purpose zero emission vehicles may be more accessible when purchasing in bulk.

2.8 Key trends

Several trends are identified that are likely to have a significant impact on EAGA members' ability to meet its emissions reduction goals associated with their fleet in the future, including:

- Greater range of vehicle types, including SUVs, utes, vans, as well as a wider range of sedans. As will be described within Section 3 and 4, some vehicle classes, such as utes, are not commercially available and it maybe a several years before these can be purchased at a cost competitive price.
- Lower cost models, including those at around $35,000 in the next 12 months, available in Australia.
- Long range vehicles, with batteries capable of a 500km+ range.
- Greater access to faster chargers, with the number of fast chargers increasing rapidly over the last two years.
- Availability of battery electric plant equipment, such as backhoes, excavators etc. A detailed list of plant options is included in Section 5.
- More vehicles capable of accessing ultra-fast charging (250kW to 350kW), allowing vehicles to be charged to 80% in less than 10 minutes.
- Vehicle to Grid (V2G) and Vehicle to Load (V2L) capable vehicles, whereby the energy in the vehicle's battery can be used to supply the grid, the home or offer a 240v power outlet for tools or appliances.

More detail on each of the above areas can be found in the *Future Scan* report.

Table 3 provides an overview of the expected timeframes in the development of zero emission vehicles.

[2] Australian Electric Vehicle Association Inc.

Table 3 Status of zero emission vehicle transition timeframes

Appliance	Short term 1-3yrs	Medium term 3-7years	Long term 7-10 years
	As available. Already transitioning and suitable for outdoor crew	Natural transition based on suitability and availability.	
Maintenance Vehicles	Trial as vehicle becomes available.	Increase number of vehicles if performance is good, depending on price and availability.	Likely that vehicles will be common price competitive.
	Install charging equipment to support number of trial vehicles.		Charging equipment will be more advanced and cheaper.
Passenger vehicles	Purchase an EV to allow staff to experience.	EV's likely to be far more common and public opinion will push demand. Early adopters will have changed public opinion by this time.	Unlikely that incentives are needed by this time.
	Allow people that want EV's to set a trend.		
	Install charging in appropriate location to support EV transition.		
Trucks	Short range vehicles demonstrate the pro's and con's of electrification	Purchase vehicles according to the specifics of each appliance, and availability.	Purchase vehicles according to the specifics of each appliance, and availability
Charging equipment	Strategic placement to signal change, and support early adoption of Council vehicles.	Refine plan for chargers based on experience and strategy.	Vehicle to Home and Vehicle to Grid likely, as well as wireless 'pad' charging.
	Install home charging equipment for EVs that overnight at home.		

2.9 Why it's important for Council to transition to a zero emission fleet

There are several reasons why it's important for Councils to lead the transition to zero emission fleets. These are identified below:

- Councils are leaders in the community and can help normalise a new technology
- Boosting the availability of EVs on the used car market. Second hand EV options are very limited in Australia, and fleet purchases are expected to enter the second hand car market in 3 – 5 years from initial purchase. This broadens the availability and lowers the price for households to consider an EV. This is currently the approach taken by the ACT government in their decision to convert their fleet to EVs.
- Councils have declared a climate emergency and transport is a major and growing source of greenhouse gas emissions. With many councils part of the Victorian Energy Collaboration (VECO), 100% of the electricity supplied to Council will be renewable by July 2022. As the overwhelming majority of vehicles in Council fleets are ICE vehicles, this results in transport emissions

possibly becoming the largest source of organisational emissions.

- Cost effective. While the upfront costs of EVs are generally more expensive than a comparable model ICE vehicle, the running costs are considerably less. This means for vehicles that have high annual mileage, the whole of life costs of EVs may be more favourable. As the cost of EVs continues to fall, the relative cost competitiveness of EVs will improve.
- Enhanced grid stability. In coming years, starting around 2025, certain EVs and chargers will have the availability to provide *bi-directional* charging. This may help support the resilience of the grid
- by allowing electricity to be drawn from the vehicle's battery back to premises or grid.

2.9.1 Pathways to zero emission transport

There are four key methods through which transport emissions can be lowered, as identified in Figure 6. Conversion to EVs is one key method for reducing emissions, but other pathways are also available. Figure 6 serves to contextualise the role EVs play in reducing transport emissions, within the broader scope of actions.

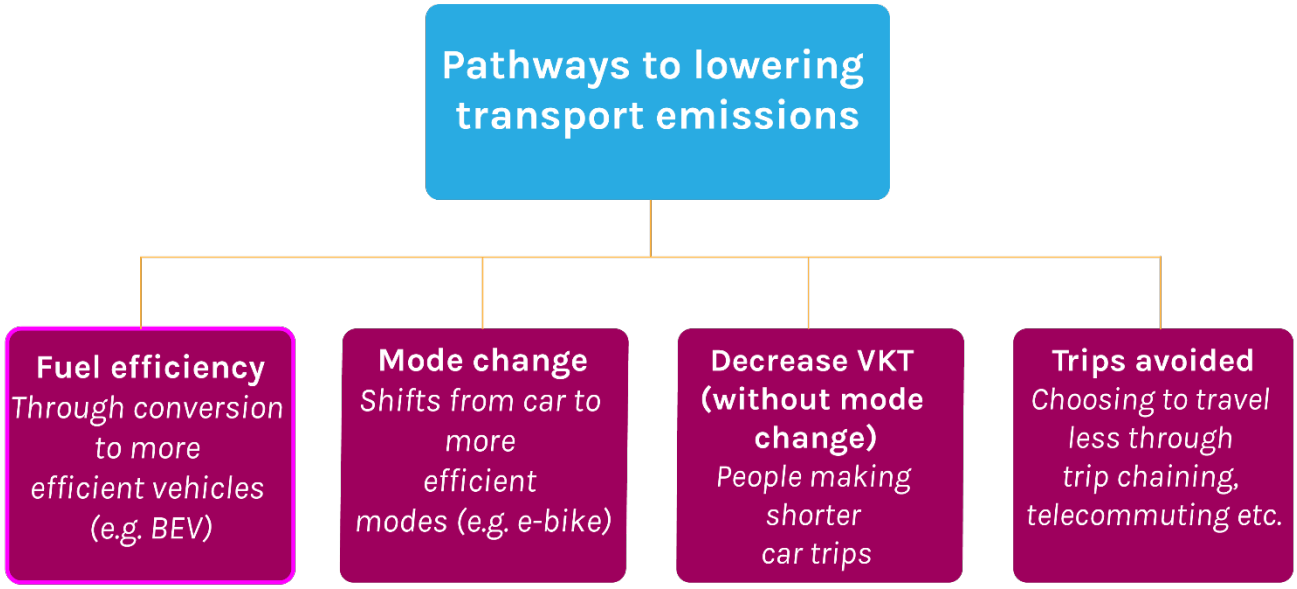


Figure 6 Pathways for lowering emissions

NB: VKT stands for Vehicle Kilometres Travelled

Source: Institute for Sensible Transport

Figure 7 provides a representation of the *emissions intensity* and *space consumption* of different modes of transport. One implication from this work is the importance of a clean, renewable electricity supply to maximise the benefits of EVs.

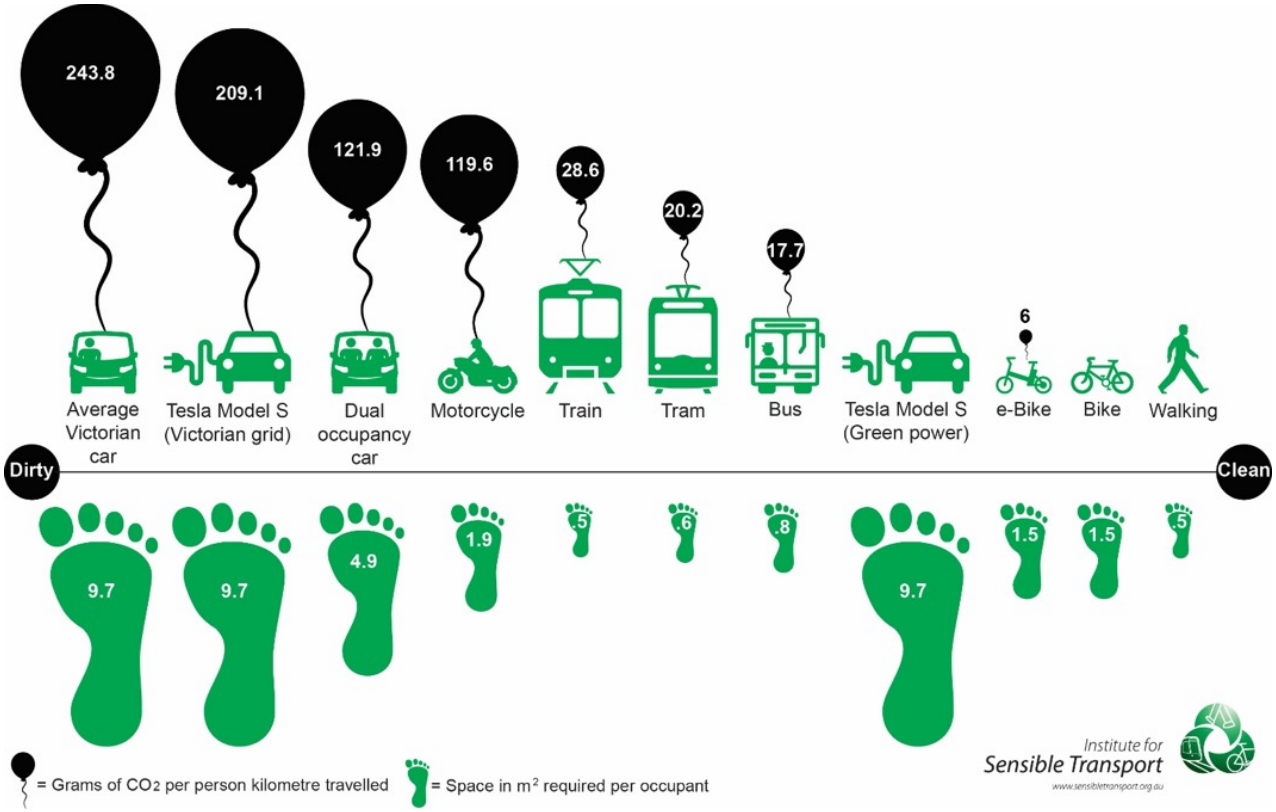


Figure 7 Emissions intensity and space consumption of different transport modes

Source: Institute for Sensible Transport

2.9.1.1 Cost comparison

Two vehicles within the ACT government fleet, two ICE vehicles and two BEVs have been compared, over a 20 month period, as shown in Table 4. This shows the two BEVs had running costs ¼ that of the ICE vehicles.

Table 4 EV and ICE Cost Comparison

EV vs ICE – 20 Month Running Cost Comparison

- CMTEDD Shared Services took delivery of 2 IONIQ EV's
- The data to date highlights the "running costs" savings available from EV's
- Telematics and "smart" EV Chargers are essential

Data for IONIQ EV's at Winyu House - 1st June 2019 to 31st January 2021							
Rego	Total kms travelled	Total Drivers	Av Trip Distance	Total Usage (kWh)	Electricity Cost	Maintenance Cost	Cost/ km
215995	15,336	54	14.6	2,080	$332.80	$250.90	$0.038
215996	14,390	68	15.8	2,276	$364.16	$145.45	$0.035

Data for Mitsubishi ASX's at Winyu House – 1st June 2019 to 31st January 2021							
Rego	Total kms travelled	Total Drivers	Av Trip Distance	Total Fuel (L)	Petrol Cost	Maintenance Cost	Cost/ km
216908	17,186	33	13.0	1450	$1,753.39	$589.85	$0.136
216909	16,409	27	9.8	1509	$1,792.06	$669.17	$0.150

Electricity cost @$0.16/kWh

sgfleet

Source: SGFleets

3. Barriers and challenges

There are a number of barriers and challenges to a zero emission fleet. Some of these can be largely perceived issues (often with an element of *actual)*, and others are more clearly within the *actual* category.

3.1 Up front cost

As highlighted earlier, EVs are currently more expensive to purchase and this is expect to continue until ~2025 – 2026. In particular, lithium batteries put the cost of EVs above the equivalent model ICE vehicle. Prices at the time of writing were around US$132 per kwh[3] in 2021 and even though this is a reduction on the 2020 price, the surge in demand for the raw materials that make up a vehicle's battery has meant that some are predicting a stable or even rising price for battery storage in the short term. It has been suggested by Bloomberg New Energy Finance that once the price gets as low as $US100 per kwh, EVs will reach price parity with ICE vehicles.[4]

While the upfront costs are higher for an EV than the equivalent ICE vehicle, the *whole of life* cost comparison helps to bridge the cost gap. As highlighted previously, because EV running costs are significantly less than ICE vehicles, the more a vehicle travels, the stronger it is likely to perform on a whole of life cost assessment. For councils that only have a modest proportion of the vehicles as EVs, developing practices that maximise their use will reduce overall fleet costs and emissions. This can include a fleet booking system to favours the EVs first, to ensure they are the prioritised option.

3.2 Limited model availability

The global supply of vehicles (both ICE and EVs) are currently constrained. This is due to COVID-19 related supply chain disruptions, as well as the global chip shortage, in addition to a global surge in demand for EVs. The current range of vehicle types that are available as a zero emission vehicle, whether BEV or Hydrogen fuel cell is very limited in Australia. Manufacturers have noted that the lack of supportive policies, incentives and emissions standards has resulted in some companies choosing not to import EVs into the Australian market, or to do so in very limited quantities.

While there are an increasing number of sedans and compact SUVs, there are no utes. The two top selling vehicles in Australia are both utes (Ford Ranger 4x4 and the Toyota Hilux 4x4).

The Electric Vehicle Council expect the number of EV models to increase from 31 at the middle of 2021 to 58 by the end of 2022.

It is expected that by 2024, a number of EV models will be available to help bridge the current gap, including:

- Several models of utility vehicles, including the Rivian R1T (see Figure 8).
- Several models of vans
- Low cost sedans.

Figure 8 EV utes are not expected in Australia until 2023 or 2024

As will be highlighted in the methodology section of each council report, high cost utes were included in the transition plans as these were the only models available on the international market at the time of writing. There is no suggestion that such vehicles would need to be purchased, as lower cost vehicles are anticipated to become available during the life of this transition plan. A series of fact sheets on available EVs can be downloaded at: http://evchoice.com.au/ev-information-sheets.html

[3] www.greencarreports.com

[4] www.abc.net.au/news/2022-01-16/qld-cheaper-electric -vehicles-industry/100757642

3.3 Towing

Only a fraction of the EV models currently available in Australia are capable of towing, including the following makes/models with the braked towing capacity in (), with an * denoting models not yet available in Australia:

- Polestar 2 (1,500kg)
- Hyundai IONIC 5 (1,600kg)
- Kia EV6 (1,600kg)
- Tesla Model X (2,250kg)
- Audi e-tron 50 (1,800kg)
- Audi e-tron 55 (1,800kg)
- BMW i4 eDrive40 (TBC)
- BMW xDrive40 (2,500kg)
- BMW xDrive50 (2,500kg)
- Jaguar I-Pace (750kg)
- Kia e-Niro (300kg)
- Volvo XC40 Recharge (1,500kg)
- Tesla Model 3 Long Range (910kg)
- Tesla Model Y (1,600kg)
- Renault Kangoo ZE Van (322kg)
- Rivian R1T (5,000kg)*
- Ford 150 Lightning (4,500kg)*

3.4 Range and charger availability

It has commonly been reported that one of the main factors acting as a barrier to the uptake of EVs is concern over the range they can travel between charges. A decade ago, it was understandable that people may have concerns regarding range. There were few, if any EVs capable of travelling 200km on a full battery, and the publicly available DC fast charging network was non-existent. Two important changes have occurred that makes driving longer distances easier:

- Large EV batteries, typically around 60 – 75kwh, providing between 400 – 550km for urban driving, dropping to around 300 – 400km for country driving.
- A substantially larger network of DC fast chargers. There are currently more than 3,000 public chargers in Australia, including 470 DC fast chargers. The network of DC fast chargers is increasing rapidly due to a combination of Commonwealth and Victorian government funding, and an increasing appetite from the private sector to invest, at minimal or no cost to local government. The Commonwealth funding has concentrated their investment in cities, including the LGAs that make up EAGA.

As EV batteries continue to increase in size, and the fast charger network continues to expand, it is expected range anxiety will become a non-issue for the majority of people, especially those in an urban setting.

3.5 User behaviour

Some fleet managers have noticed that some users do not plug in EVs when a staff member has completed their journey. This can result in a battery having less charge than the next vehicle user requires. Fleet managers have had to add messages to vehicle users and notices on the inside of the vehicle to encourage staff to plug the vehicle in after use.

3.6 Limited understanding

As EVs are still quite novel in Australia, and only a small percentage of the population have any experience driving one, the community's awareness and understanding of EVs is quite low. This results in many misconceptions which can reduce people's interest in EVs. Some of the common misconceptions include:

- EVs cannot tow and will not be offered as a ute or large vehicle format
- EVs cannot do 4x4 driving
- EVs cannot be charged outside
- The environmental impacts of EV production makes them worse than ICE vehicles. This is a myth, and EVs have been shown to make up for

higher emission costs in production within 1 – 3 years of use.[5]

- EV batteries do not last and will need to be replaced well before the vehicle's life has come to an end and will be costly to replace
- EVs take too long to charge. While it is true that an EV will take a long time to charge from a standard 10AMP household outlet, the reality is that it is rare to get to close to 0%. Moreover, if one plugs in when they arrive home regularly, the vehicle will generally be at 80% by morning. With some 90% of charging occurring at home, and cars being parked for 96% of their life, the slow rate of charge from a regular power point will rarely be an issue.

The introduction of EVs may need an additional induction session for staff using the fleet.

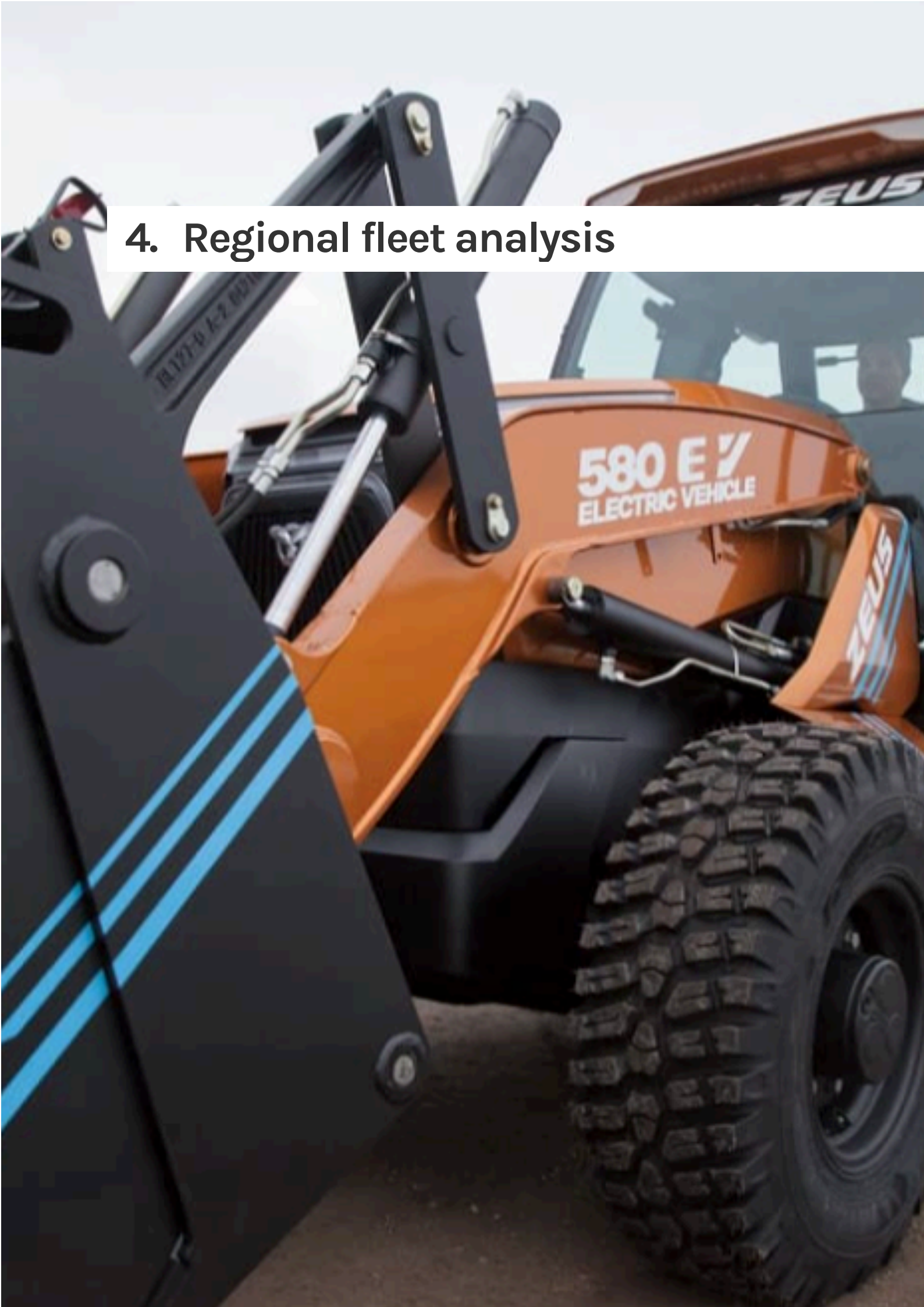
3.7 Additional barriers

The following identifies some additional barriers:

- The need to provide charging facilities where vehicles are parked – easy if planned for in advance but may be expensive or awkward to retrofit at some sites.
- If users get a say in selecting their vehicle, they may need to be exposed to suitable EVs before they will choose one.
- Lease arrangements – some lease companies assume very low resale values for EVs because there is limited market evidence – this can potentially be overcome by buying, not leasing
- Safety ratings – not all EVs are tested to Australian safety standards. They may be safe, just not proven to be so.
- Cultural expectations around vehicles and historical financial arrangements such as Fringe Benefit Tax and salary sacrificing.

[5] This extensively covered in a range of publications, including *Renew* Issue 159, April – June, 2022.

4. Regional fleet analysis



This section provides a regional assessment of the fleet, across EAGA participating councils. The main focus of this assessment covers:

- Number of vehicles
- Vehicle types
- Ownership category
- Fuel cost and emissions

In addition to this section, a more detailed assessment of each council fleet and the recommended transition to a zero emission fleet has been undertaken. Each individual council report provides an overview of the methodology used to develop the business case and transition plan for each council, followed by each councils' business case and transition plan.

This section provides analysis of the six participating councils' fleets.

4.1 Vehicle class

The vehicle fleet of the six councils consists of 944 vehicles, as shown in Figure 9. Of these vehicles, 219 are micro to large passenger vehicles, 214 are Sports Utility Vehicles (SUVs), 362 are light commercial pick-up trucks, 134 are light commercial vans and 15 are light buses/people mover passenger vehicles. The largest two vehicle classes are light commercial pick-up trucks and micro to large passenger vehicles.

For the purposes of this analysis, plant (e.g, larger trucks, garbage trucks, and smaller purpose build pieces of equipment like lawn mowers), have been excluded. This is because they have different use and replacement profiles and as BEVs are generally at a less mature stage of development. Plant are addressed in a separate analysis comparing available electric equipment to conventional fossil fuel equipment, highlighting the maturity of technology and limitations to consider. This can found in Section 5 and is intended to assist councils make decisions on transitioning plant equipment to electric.

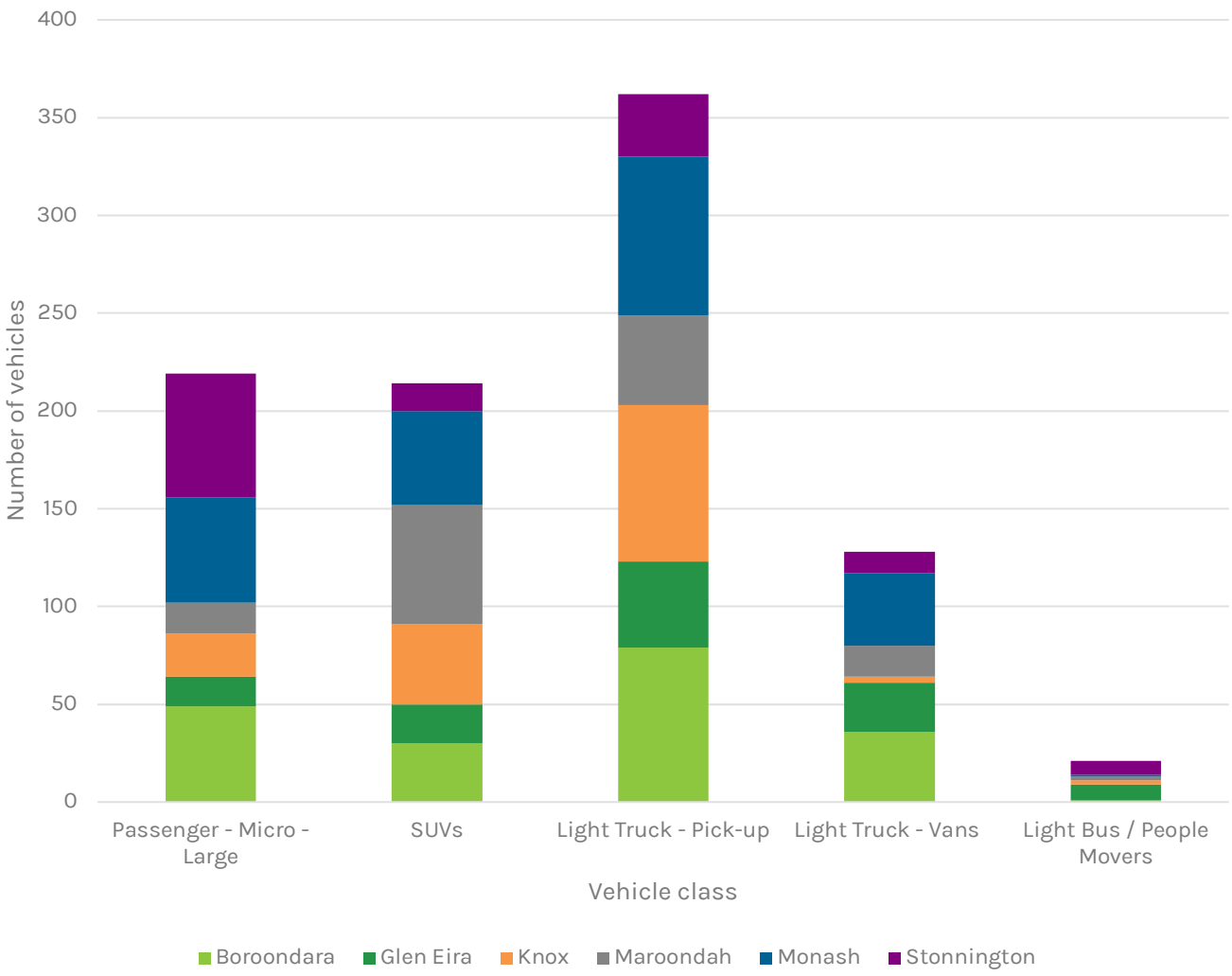


Figure 9 Vehicles by class, all Councils

4.2 Vehicle drivetrain type

The number of vehicles in the six councils' fleet, by drivetrain type, is shown in Figure 10. While the majority (over 80%), of all six Council fleets are ICE vehicles, there are 49 hybrid electric vehicles (HEV) and 13 battery electric vehicles (BEV) in the combined Council fleets. Stonnington's fleet has the greatest degree of electrification, accounting for nearly 40% of HEV and BEV vehicles across all six Councils. All of Maroondah's vehicle fleet are ICE vehicles.

Over 80% of the vehicles that make up the fleets for the EAGA participating councils only have internal combustion engines. This highlights the scale of the challenge of converting to 100% zero emission by 2030.

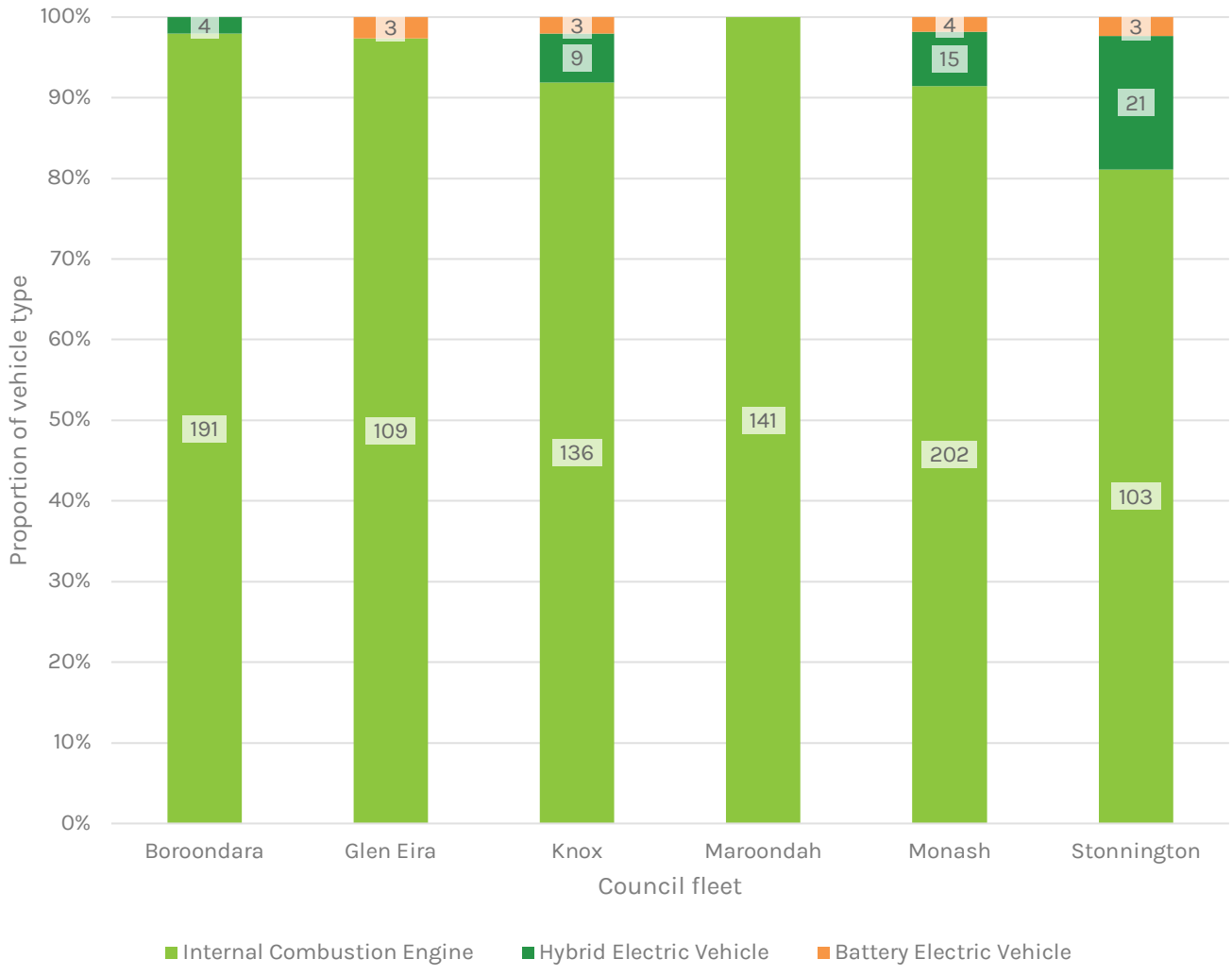


Figure 10 Vehicle type by Council, all Councils

4.3 Distance travelled

The distance travelled by the vehicles that make up the fleet for all six councils has been examined. This is a critical data point to consider as part of the fleet transition, as it has direct implications for the cost and emissions of each vehicle. Moreover, as highlighted earlier, the higher the amount of vehicle travel, the more impactful an EV replacement will be, as it will lower emissions and operating costs to a greater degree than a vehicle that travels less. Electric vehicles are more cost competitive the farther it travels.

The annual average distance travelled per vehicle class is shown in Figure 11. Across the six council fleets, SUVs and light pick-up trucks travelled the most on average, with SUVs travelling from 11,500km to over 23,000km on average per year and light pick-up trucks travelling from 10,000km to 18,000km on average per year. Passenger vehicles and light commercial vans were generally used less, except for light commercial vans in Glen Eira and Knox, which travelling close to 20,000km and 17,5000km, respectively and were among the most used vehicles across the six council fleets. SUVs in Stonnington's fleet were the most used vehicles, travelling over 23,000km on average per annum. Except for Boroondara and Stonnington, light buses and people movers travelled significantly less than other vehicle classes.

Across the six Council fleets, SUVs and light pick-up trucks travelled the most per year, on average.

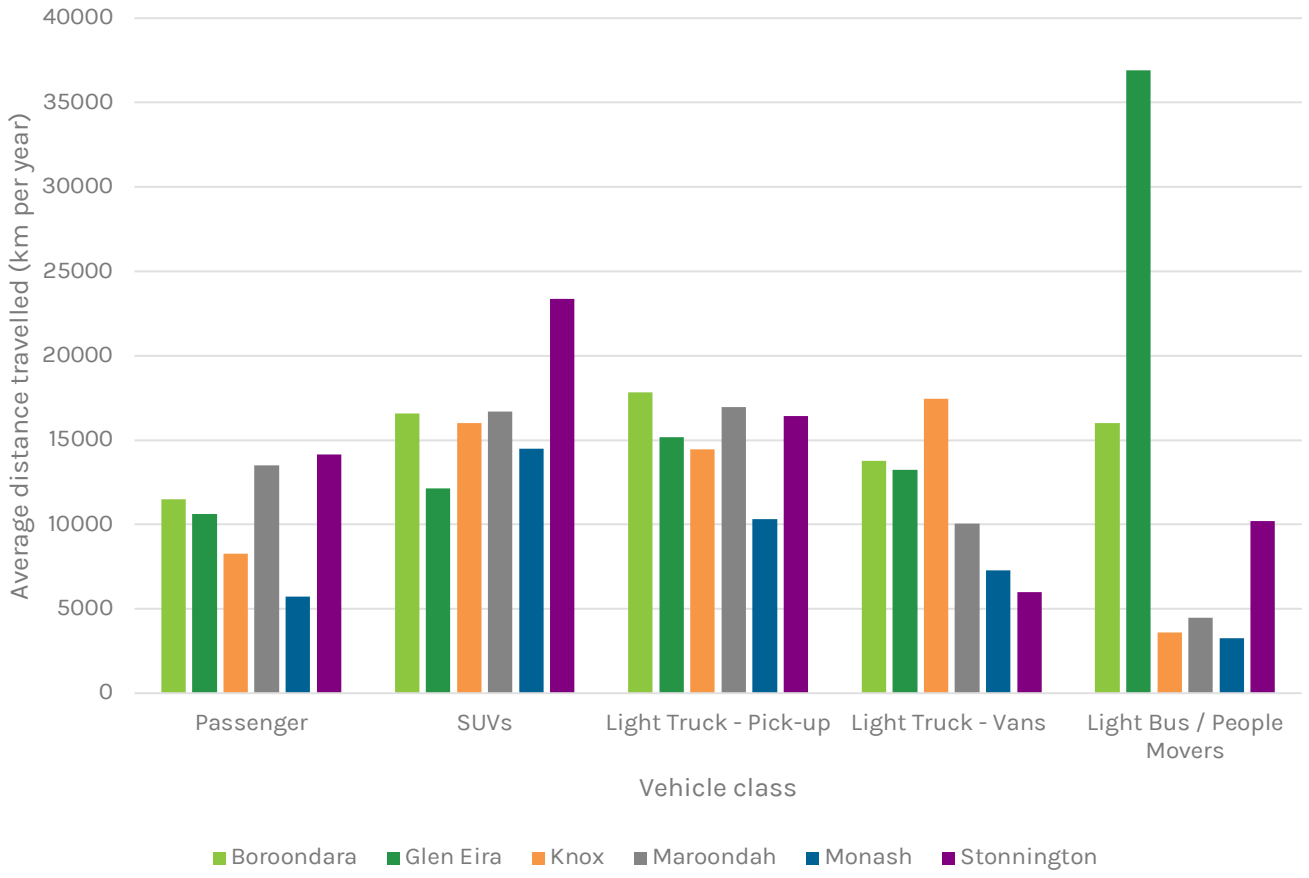


Figure 11 Annual vehicle km travelled, by vehicle class, all Councils

4.4 Fuel consumption

The average fuel consumption of vehicles in the six council fleets per vehicle class are shown in Figure 12. Except for Glen Eira, light buses and people mover passenger vehicles have the highest fuel consumption per 100km, from 11.5 to over 17 litres, on average. However, this vehicle class comprises of less than 2% of the combined EAGA fleet and uses significantly less fuel when the number of vehicles and distance travelled is considered. The next vehicle class that uses the most fuel per 100km are light pick-up trucks, which use 8 to 14.5 litres per 100km, followed by commercial vans, which use 7.5 to 13 litres per 100km. Except for Glen Eira, SUVs use between 7 to 9.5 litres per 100km, on average. Passenger vehicles have lower rates of fuel consumption at 6.5 to 9.5 litres per 100km, on average.

Figure 13 presents the data on how much fuel is consumed by each council, including the fuel type (unleaded, diesel and LPG). There is considerable variation in terms of both the total quantity of fuel consumed as well as the relative mix of unleaded and diesel. In all case, LPG comprises a minor proportion of total fuel consumed.

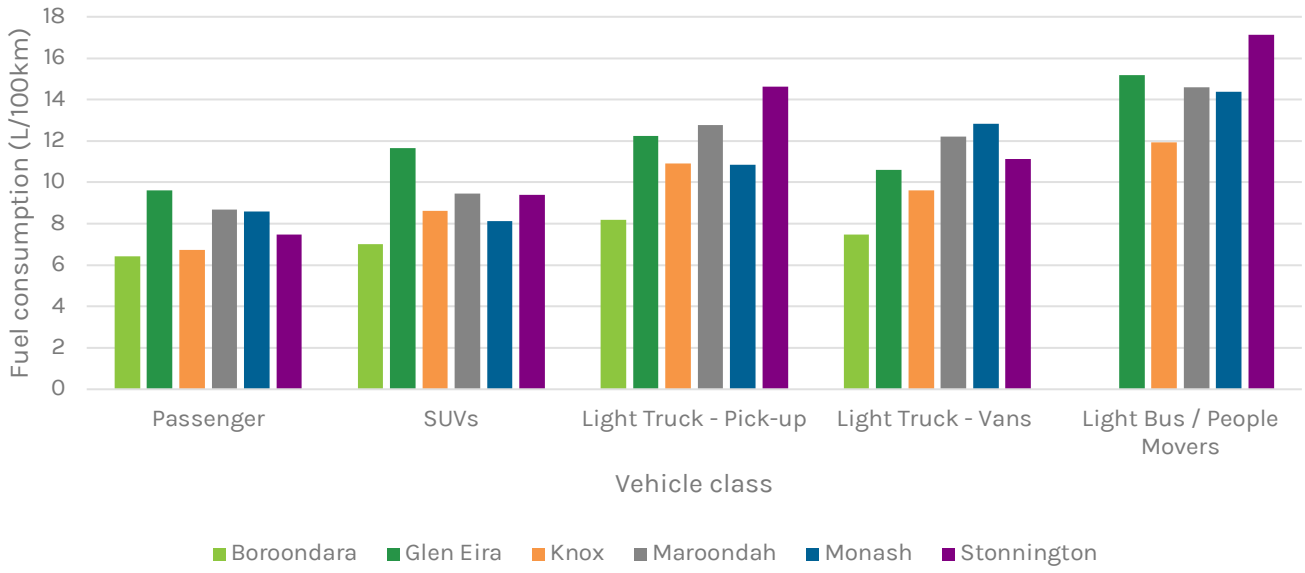


Figure 12 Vehicle fuel consumption by vehicle class, all Councils

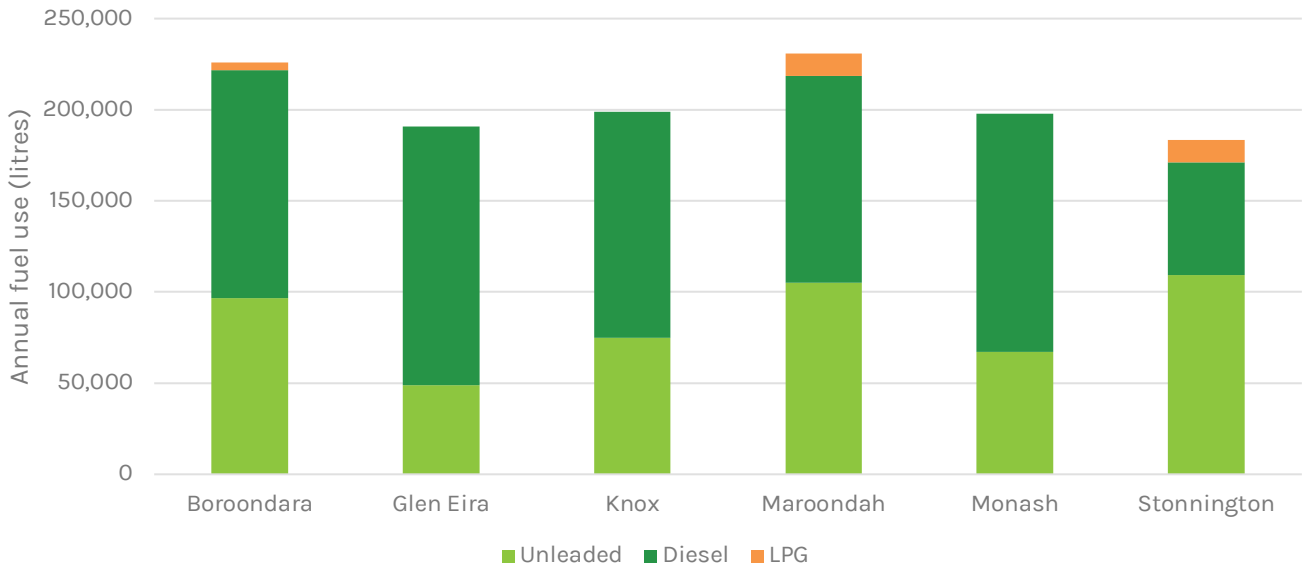


Figure 13 Annual fuel use, by Council

4.5 Emissions

Using the information presented earlier, as well as the emissions factors for each fuel type, it is possible to estimate the annual emissions from the vehicle fleets of each of the six councils. This is presented in Figure 14 and shows that emissions range from just under 450,000 $kgCO^2$-e for Stonnington, through to over 650,000 $kgCO^2$-e for Maroondah.

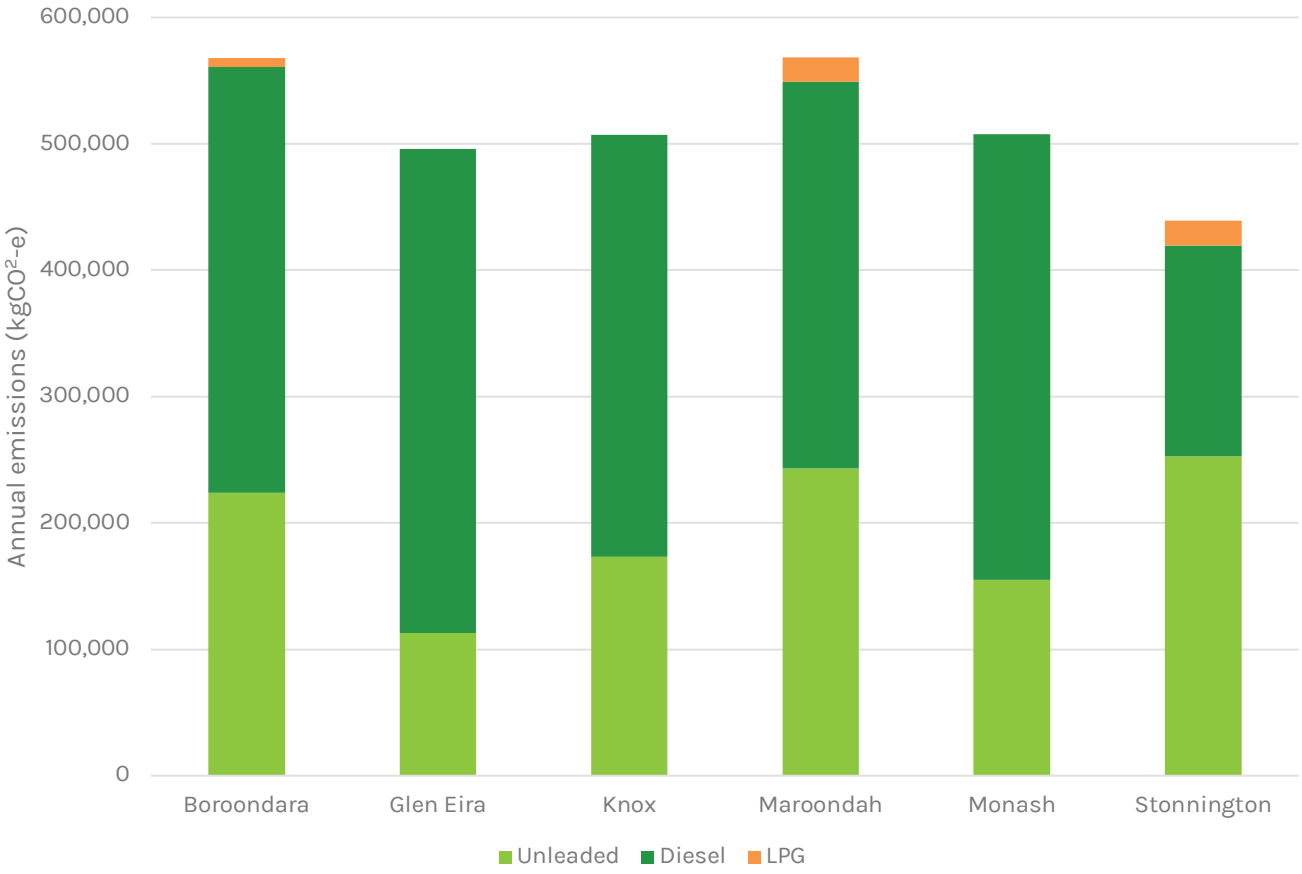


Figure 14 Annual Emissions, by Council

5. Regional plant assessment

Councils rely on a wide range of plant equipment. Tractors, mowers, leaf blowers and other equipment are critical to the work councils perform every day and in most cases, these equipment are dependent on liquid petroleum fuel.

5.1 Fit for purpose

The on-site consultations conducted with the fleet managers at each council revealed that it has been the experience of councils that many of the electric alternatives for small devices like leaf blowers are not fit for purpose. While there are many commercially available electric alternatives for small plant, these are generally more suited to a domestic setting, in which the power output and battery life can be lower. With the exception of chain saws, most electric alternatives have not had the same level of performance as their petroleum competitor.

Zero emission alternatives for plant for commercial purposes are evolving rapidly and these developments mean that suitable alternatives are likely to become available in coming years. In some cases, suitable alternatives are already available but there is limited awareness of these options. An example of this can be seen in Figure 15 (ride on lawn mower), which Geelong City Council use and have found to run for a full day and then charge 100% overnight, from a standard power point. The fleet manager at Geelong City Council report that while it is twice the cost of the equivalent ICE vehicle, they have been happy with its performance.

Figure 15 EcoTeq rider on lawnmower

5.1.1 Understanding the capabilities and roles of heavy BEVs in 2022

Councils use heavy vehicles for a variety of different purposes. While the use of some heavy vehicles make them good candidates for transition to BEVs, in many cases, the technology, or the way in which a council uses a heavy vehicles, can make the current stock of heavy BEVs unsuitable for transition at the time of writing. This section is intended to outline the conditions in which heavy BEVs are, and are *not* currently practical. As with EVs in general, the technology is changing rapidly for heavy BEVs, and therefore it is recommended councils review developments on an annual basis.

5.1.1.1 Regulatory issues

Due to the weight of the battery, heavy BEVs with a battery capable of providing the range needed for many council purposes may exceed regulations.

- Front Axle (FA) limited by the chassis rating or a maximum of 6,500kg if the chassis is rated to this.
- Rear Axle limited by the chassis rating or is a maximum of 9,000kg for a single drive axle or 16,500kg for a tandem axle.
- Maximum Gross Vehicle Mass (GVM) is 23,000kg.
- Rear overhang must be 60% of the wheelbase or less.

5.1.1.2 Other considerations

- Turning circle: A longer wheelbase increases the vehicle's turning circle.
- A side loader refuse collection body loads from the front, so the FA mass needs to be below 6,000kg before starting to collect bins.
- For waste collection vehicles, the bin lifter needs to be in close proximity of the operator and they need to be able to have full view of the bin through the truck mirrors as they tip the bin.

5.1.1.3 Battery range, sizes and charging times

A variety of battery sizes are available, depending on the use case and vehicle. The SEA Electric BEVs often have a battery size of 220kWh, which is more than double any of the passenger vehicle BEVs currently on the market.

The range is highly depended on the size and weight of the vehicle, but will typically be within the 80 – 120km range. Overnight charging is typical for municipal heavy BEVs, often using on 22kW AC charger. It is now possible to charge heavy BEVs, including those from SEA Electric, using DC fast chargers.

5.1.1.4 Pricing

A general rule of thumb is that a heavy BEV generally has upfront costs around 130% higher than the equivalent ICE vehicle. For example, if a diesel vehicle costs $200,000, the BEV comparator would be ~$460,000. This is expected to reduce as battery costs become more affordable. While the upfront costs are a major barrier currently, the operational savings are considerable, given that some heavy ICE vehicles have high annual VKT and consume large quantities of diesel.

5.1.1.5 Commercial availability

No Original Equipment Manufacturers (OEMs) offer a high-volume model of BEVs to Australia currently. It is likely that when models do become available, no modifications will be possible and therefore will not be suitable for some applications.

SEA Electric are a Melbourne based conversion company that import *gliders* and then build the BEV drivetrain for clients. They are not a high-volume company and the current lead time is 9 – 12 months, though this is not unusual for some high volume BEV manufacturers, like Tesla and Hyundai.

Another challenge is that some chassis OEMs will not allow third party companies to complete conversions.

5.2 Policy recommendation

It is recommended councils use the information contained in Section 5.4 to guide decisions when petrol powered plant equipment is replaced. While each councils will need to make decisions that best meet the needs of their organisation, it is recommended:

1. Council share information about their experiences of battery electric plant equipment to establish which models/options are fit for council work.
2. Council select the battery electric option whenever a fit for purpose model exist.
3. Council update the information provided in Section 5.4 annually, as it is expected significant advances will be made to the performance of small plant battery electric options over the next five years.

5.3 Audit of plant equipment

An audit of all plant equipment which consume liquid fossil fuels was undertaken concurrently with the vehicle fleet audit. Plant was categorised as either handheld equipment, light plant (smaller items such as compact ride on lawn mowers) and heavy plant (larger items which are generally self-propelled, such as garbage trucks).

In total, 49 different types of plant were identified, with a total of 408 items of plant across all six councils. Items of handheld plant are shown in Table 5. Light plant items are shown in Table 6. Heavy plant items are shown in Table 7.

Handheld and light plant items largely relate to lawn and garden care, with some items related to road maintenance. This is a reflection of councils' role in maintaining a broad variety of different types of open space along side the road network. Some items are very specific, related to golf course or cricket pitch maintenance. These specialist items are likely to be most difficult to replace with electric options in the short term.

Heavy plant items more often relate to garbage and or/cleaning, and other heavy maintenance items. Councils own a large number of trucks (spanning a variety of different sizes). While electric alternatives are available for trucks, Councils have very specific purposes for using trucks; for example, a medium duty truck is the base for street sweeping equipment and garbage truck compactor units. As these additional pieces of equipment can have substantial power requirements, the decision to transition to EV must be made on a case-by-case basis.

Table 5 EAGA councils' handheld plant

Plant type	Boroondara	Glen Eira	Knox	Maroondah	Monash	Stonnington	Total
Aerator - push	1	0	0	0	0	0	**1**
Blower - backpack	0	0	0	0	0	2	**2**
Blower - hand held	0	0	0	1	0	19	**20**
Brushcutter - hand held	0	0	0	0	0	3	**3**
Chainsaw - hand held	0	0	0	0	0	2	**2**
Concrete Saw	0	0	0	0	0	5	**5**
Cricket Pitch Mower	0	0	0	0	0	2	**2**
Digger - push	1	0	0	0	0	0	**1**
Hedge Trimmer - hand held	0	0	0	0	0	2	**2**
Lawn mower - Push	0	0	0	4	0	7	**11**
Line marker - push	0	0	0	0	0	1	**1**
Scarifier - push	0	0	0	0	0	2	**2**
Tiller - push	0	0	0	0	0	1	**1**
Total	**2**	**0**	**0**	**5**	**0**	**46**	**53**

Note: Zeros may reflect lack of data, rather than Councils not possessing this equipment.

Table 6 EAGA councils' light plant

Plant type	Boroondara	Glen Eira	Knox	Maroondah	Monash	Stonnington	Total
Blower Trailer	1	1	0	0	0	1	**3**
Cricket Pitch Roller	0	0	0	3	0	1	**4**
Forklift	3	2	0	3	0	1	**9**
Golf equipment - Bunker Rake	0	0	0	2	0	0	**2**
Golf equipment - Sod Cutter	0	0	0	1	0	0	**1**
Golf equipment - Verticutter	0	0	0	1	0	0	**1**
Golf equipment - Vertimower	0	0	0	1	0	0	**1**
Lawn mower - Compact ride on	2	1	0	1	0	0	**4**
Lawn mower - Medium ride on	5	12	0	14	0	7	**38**
Light Utility Vehicle	3	3	2	8	0	1	**17**
Milling Machine	0	0	0	0	0	1	**1**
Pump	0	0	0	0	0	3	**3**
Sprayer - medium ride on	1	1	0	0	0	0	**2**
Sprayer cart	0	0	0	1	0	0	**1**
Sprayer Trailer	0	0	0	1	0	2	**3**
Topdresser	1	0	0	0	0	1	**2**
Wood chipper	1	1	0	2	0	0	**4**
Total	**17**	**21**	**2**	**38**	**0**	**18**	**96**

Note: Zeros may reflect lack of data, rather than Councils not possessing this equipment.

Table 7 EAGA councils' heavy plant

Plant type	Boroondara	Glen Eira	Knox	Maroondah	Monash	Stonnington	Total
Backhoe loader	1	1	1	2	0	1	**6**
Bus	0	0	4	0	0	0	**4**
Drain Cleaning Truck	1	0	0	0	0	0	**1**
Excavator	0	0	1	1	0	0	**2**
Excavator - small	1	0	1	0	0	0	**2**
Front End Loader	1	0	2	1	0	2	**6**
Garbage Truck	24	0	0	1	1	21	**47**
Loader - small	1	0	1	0	0	0	**2**
Road roller	0	0	0	1	0	0	**1**
Steer Loader - Compact	0	1	0	0	0	1	**2**
Street sweeper - Large	0	0	3	2	2	5	**12**
Street sweeper - Small	0	0	0	1	2	4	**7**
Track Loader - Compact	0	1	0	2	0	0	**3**
Tractor - Large	2	4	3	4	8	0	**21**
Tractor - Small	3	0	0	5	2	0	**10**
Truck - Heavy duty	0	0	0	0	0	1	**1**
Truck - Light duty	9	17	10	7	22	18	**83**
Truck - Medium duty	6	7	7	11	7	3	**41**
Truck - Prime Mover	5	0	0	0	0	3	**8**
Total	**54**	**31**	**33**	**38**	**44**	**59**	**259**

Note: Zeros may reflect lack of data, rather than Councils not possessing this equipment.

5.4 Battery electric alternatives for plant equipment

This section provides a list of electric alternatives for common plant equipment. It is designed to act as a resource for councils to use when looking for a zero emission options for plant equipment. It is recommended councils review this list regularly, as this is a rapidly developing area and new models with improved capabilities are likely to become available. The structure of this section generally begins with an ICE model, and then lists available electric alternatives.

5.4.1 Truck – Light Duty

Light duty trucks are trucks that generally have a GVM of less than 5 tonnes.

5.4.1.1 Hino 300

A typical fossil fuel example of a light duty truck is a Hino 300. This type of vehicle has a 4 and 5 litre common-rail turbo engine, outputting 110kW to 151kW of power. The Hino 300 Series has a gross vehicle mass (GVM) of 4.5 tonnes.

Link: https://www.hino.com.au/300/300-series/

5.4.1.2 SEA 300 EV

A SEA 300 EV represents an electric equivalent to the Hino 300. It is built on the same base chassis, having similar dimensions to a Hino 300. It is powered with a variety of torque and kW variant motors that outputs up to 125kW of power. SEA estimate it has a range of up to 300km. The GVM of the SEA 300 EV Series range from 4.5 to 8.5 tonnes.

Link: https://www.sea-electric.com/en_au/sea300ev/

Availability: Available now, but technology is still developing.

5.4.2 Truck – Medium Duty

Medium duty trucks are trucks that generally have a GVM of 5 to 12 tonnes.

5.4.2.1 Hino 500

A typical fossil fuel example of a medium duty truck is a Hino 500. This type of vehicle is built on a 4x2 cab chassis and has a four-cylinder diesel engine, outputting a maximum of 177kW of power and delivering a maximum torque of 794 Nm at 1,400 rpm. This truck has a gross vehicle mass (GVM) ranging from 8 to 11 tonnes.

Link: https://www.hino.com.au/500/

5.4.2.2 SEA 500 EV

A SEA 500 EV represents an electric equivalent to the Hino 500. It is built on the same base chassis, having similar dimensions to a Hino 500. It is powered with a variety of torque and kW variant motors that outputs up to 350kW of power. SEA estimate it has a range of up to 225km. The GVM of the SEA 500 EV Series range from 14 to 22.5 tonnes.

Link: https://www.sea-electric.com/en_au/sea500ev/

Availability: Available now, but technology is still developing.

5.4.3 Truck – Heavy Duty

Heavy duty trucks are trucks that generally have a GVM of more than 12 tonnes.

5.4.3.1 Scania P 450

A typical fossil fuel example of a medium duty truck is a Scania P 450. This type of vehicle is built on a 8x4 rigid chassis and has a six-cylinder diesel engine, outputting a maximum of 339kW of power and delivering a maximum torque of 2,350 Nm at 1,300 rpm.

Link: https://www.scania.com/content/dam/scanianoe/market/au/products-and-services/trucks/specification-documents/SCA0707_P450-8x4-RIGID.pdf

5.4.3.2 Volvo FE Electric

An electric alternative to the Scania P 450 is the Volvo FE Electric. It has a similar gross vehicle mass (GVM) of up to 27 tonnes. This truck operates on an electric motor with dual engine installation, outputting 400kW of power at peak and 330kW of power at a continuous rate. The Volvo FE Electric delivers up to 850Nm of torque.

It is fitted with 4 batteries, with an energy capacity of 50kWh for each battery, and has an estimated lifetime of 8 to 10 years. The charging time is less than one hour on fast charges and 6.5 hours on regular charges.

The torque on this electric option is considerably weaker than the Scania P 450 and can make transporting heavy loads less efficient and more difficult, particularly when moving up steep inclines.

Link: https://www.volvotrucks.com/en-en/trucks/trucks/volvo-fe/volvo-fe-electric.html

Availability: Available now.

5.4.4 Truck – Prime Mover

Prime mover trucks are a type of heavy-duty truck that have a robust engine capable of hauling heavy cargo loads. The primary use of prime movers is to transport large quantities of goods including livestock, dry and refrigerated goods, vehicles, multi-loaded containers and over-height invisible loads.

5.4.4.1 Mack Trident

An example of a fossil fuel prime mover is the Mack Trident. This type of truck runs on a Mack MP8 372kW or 399kW engine and delivers up to 2,600Nm of torque. The Mack Trident has a gross vehicle mass (GVM) of up to 29.3 tonnes and has a maximum towing capacity of up to 100 tonnes. The gross combination mass (GCM) of this vehicle is 130 tonnes.

Link: https://www.macktrucks.com.au/trucks/trident/

5.4.4.2 Janus Electric Engine System

An electric alternative is to convert existing fossil-fuel prime movers into electric vehicles using the Janus change and charge system. This involves removing existing diesel engines and replacing it with the Janus Electric battery cell technology that outputs 600kWh. This battery lasts between 500 to 600kms and has a battery life of up to 8 years. In addition, a Janus Electric Battery takes 3 minutes to swap out.

This conversion system is currently under development and Janus Electric expects it will be commercially available during 2022.

Link: https://www.januselectric.com.au/

Availability: Available during 2022.

5.4.5 Drain Cleaning Trailer

Drain cleaning trailers, or jetting trailer, are fitted with hoses and jet nozzles used to clean and clear blockages in stormwater and sewer pipelines. They use high pressure water to flush out dirt, litter, sludge and other debris that can cause back-ups in pipelines.

5.4.5.1 Spoutvac Trailer Rouge KF36-1000

A fossil fuel example of a drain cleaning trailer is the Spoutvac Rouge KF36-1000 trailer. This plant has a 56kW diesel engine and an aggregate trailer mass (ATM) of 3.2 tonnes. It Is fitted with a jetting system that pumps water at 137 litre per minute and has a volume of 1,000 litres. The main hose reel can extend up to 120 metres.

Link: https://www.spoutvac.com.au/wp-content/uploads/2020/01/Drain-Cleaning-Trailer-Rouge-Trailer-KF36-1000.pdf

There is currently no suitable electric option for a drain cleaning trailer.

5.4.6 Garbage Truck

Garbage trucks play an important role in collecting and transporting municipal waste for disposal. Of council fleets, garbage trucks consume substantial volumes of fuel due to their frequent and extensive use that requires making several stop-starts and idling.

5.4.6.1 Iveco ACCO E6

An example of a fossil fuel garbage truck is the Iveco ACCO E6. This truck is built on a 6x4 chassis and has an engine outputting a maximum of 265kW of power. It has a GVM of 25 tonnes.

Link: https://www.iveco.com.au/product/acco-e6

5.4.6.2 SEA Hino FE EV

The SEA Hino FE EV is an electric alternative to the Iveco ACCO E6. This truck has an engine outputting a maximum of 250kW of power. It has a GVM of 14 tonnes.

Link: https://www.sea-electric.com/en_au/sea-hino-fe-ev/

Availability: Available now.

5.4.7 Light Utility Vehicle

Light utility vehicles are multi-purpose vehicles generally used to transport people and small loads across varying terrain.

5.4.7.1 John Deere 2030A ProGator

A fossil fuel example of a light utility vehicle is the John Deere 2030 ProGator. This type of vehicle has a 3-cylinder diesel engine, outputting 17.6kW at maximum power and 30.7km/h at maximum speed. It has a payload capacity of 1,594kg and a towing capacity of 680kg. The built-in cargo box has a steel frame with a volume of 550L and a capacity of 907kg.

Link: https://www.deere.com.au/en/gator-utility-vehicles/turf-gators/2030a-progator-utility-vehicle/

5.4.7.2 Polaris Ranger EV

A Polaris Ranger EV is an electric option for a light utility vehicle. This vehicle has a battery-operated AC-induction motor, outputting 22.4kW at maximum power. It has a payload capacity of 453.6kg, a towing capacity of 680kg and is fitted with a steel bed box capable of carrying 226.8kg.

Link: https://ranger.polaris.com/en-us/ranger-ev-avalanche-gray/specs/

Availability: Available now.

5.4.8 Tractor – Compact

A tractor provides machine power for hauling trailers and other plant machinery including rotary tillers and mowers. Size classification of tractors depend on their power output and torque capacity.

5.4.8.1 John Deere 2025R

A fossil fuel example of a compact tractor is a John Deere 2025R. It has a three-cylinder, diesel engine that outputs 17.8kW and delivers a maximum torque of 53.1 Nm. This compact tractor has a lift capacity of 400kg and a towing capacity of 1,712kg.

Link: https://www.deere.com.au/en/tractors/utility-tractors/4-family-compact-utility-tractors/

5.4.8.2 Monarch MK-V

An electric option for a compact tractor is the Monarch MK-V. This tractor has a battery-operated engine, outputting 29.4kW of continuous power and a power take off at 540 rpm. It has a lift capacity 1,000kg. The tractor's towing capacity could not be sourced.

Link: https://www.monarchtractor.com/mkv.html

Availability: Available now.

5.4.9 Tractor – Large

A tractor provides machine power for hauling trailers and other plant machinery including rotary tillers and mowers. Size classification of tractors depend on their power output and torque capacity.

5.4.9.1 John Deere 5100E

A fossil fuel example of a large tractor is a John Deere 5100E. It has a four-cylinder diesel engine, outputting 76.4kW of power and a rated PTO power of 63.4kW. This tractor has a maximum lift capacity of 1,457kg. The approximate towing capacity of this model was not found.

Link: https://www.deere.com/en/tractors/utility-tractors/5-family-utility-tractors/5100e-utility-tractor/

There is currently no electric option for large tractors.

Availability: Not available.

5.4.10 Backhoe Loader

Loaders are primarily used for collecting and moving finer materials and have large front bucket.

Backhoe loaders are fitted with a bucket at the front for loading, as well as a rear-mounted bucker for excavation. This type of loader has versatile uses including digging new gardens and foundations and moving materials back and forth.

5.4.10.1 Caterpillar 432F2

A fossil fuel example of a backhoe loader is the Caterpillar 432F2. Fitted with a diesel engine, this heavy machinery outputs 70.9kW of power. It has a maximum operating weight of 11 tonnes and a backhoe digging depth up to 5.27m.

Link: https://www.cat.com/en_AU/products/new/equipment/backhoe-loaders/side-shift/1000004510.html

5.4.10.2Case 580 EV

An electric option for a backhoe loader is the Case 580 EV. This heavy machinery is fitted with lithium-ion batteries that provide enough power for the typical 8-hour workday. Additional technical specifications and features could not be sourced.

Link: https://www.casece.com/northamerica/en-us/products/backhoe-loaders/580ev-project-zeus?utm_source=Content&utm_medium=CCE&utm_term=Vanity-Redirect&utm_content=Announcement&utm_campaign=ZEUS

Availability: Not available in Australia.

5.4.11 Skid Steer Loader

Loaders are primarily used for collecting and moving finer materials and have large front bucket.

Skid steer loaders are ideal for jobs where terrain is rough, hard and uneven.

5.4.11.1 Caterpillar 262D3

A Caterpillar 262D3 is a fossil fuel example of a skid steer loader. Fitted with a diesel engine, this plant outputs 54.4kW of power. It has a total operating weight of 3.8 tonnes and a rated operating capacity of 1.2 tonnes. The Caterpillar 262D3 has a maximum lift hinge pin height of 3.17 metres.

Link: https://www.cat.com/en_AU/products/new/equipment/skid-steer-and-compact-track-loaders/skid-steer-loaders/30056688548127.html

5.4.11.2 Kovaco Elise 900

An electric equivalent of the Caterpillar 262D3 is a Kovaco Elise 900. This plant has a lead-acid battery-operated electric motor, outputting 38.5kW of power. It has a total operating weight of 3.3 tonnes and a rated operating capacity of 1 tonne. The Kovaco Elise 900 has a maximum lift hinge pin height of 3.64 metres.

Link: https://www.kovacoelectric.com/en/elise-900

Availability: Available now.

5.4.12 Track Loader

Loaders are primarily used for collecting and moving finer materials and have large front bucket.

Track loaders are used for jobs that require more contact with the ground, particularly on softer or steep terrain such as swampy areas, and construction sites with soft surfaces.

5.4.12.1 Caterpillar 249D3

A fossil fuel example of a track loader is a Caterpillar 249D3. Fitted with a diesel engine, this plant outputs 50.1kW of power. It has a total operating weight of 3.5 tonnes and a rated operating capacity of 0.79 tonnes. The Caterpillar 249D3 has a maximum lift hinge pin height of 3.0 metres.

Link: https://www.cat.com/en_AU/products/new/equipment/skid-steer-and-compact-track-loaders/compact-track-loaders/15970464.html

5.4.12.2 Bobcat T7X

The Bobcat T7X is an electric alternative to the Caterpillar 249D3. Fitted with a lithium-ion battery operated electric motor, it outputs 62kW of power. It has a total operating weight of 5.5 tonnes and a rated operating capacity of 1.3 tonnes.

Link: https://www.bobcat.com/company-info/innovation/all-electric-compact-loader

Availability: Not available in Australia yet.

5.4.13 Forklift

A forklift is primarily used to lift and carry heavy loads over short distances.

5.4.13.1 Komatsu FG 25 HT-16

The Komatsu FG 25 HT-16 is a fossil fuel example of a forklift. It has a four-cylinder diesel engine, outputting 44kW of power. This plant has a load capacity of 2,500kg and a maximum fork height at 4.5 metres.

Link: https://www.lectura-specs.com/en/model/forklifts/lpg-forklifts-komatsu/fg-25-ht-16-r-1031060

5.4.13.2 Hyster J2.2-3.5XN

An electric equivalent to the Komatsu FG 25 HT-16 is a Hyster J2.2-3.5XN. This plant is fitted with a battery-operated, electric motor, outputting up to 56kW of power. It has a load capacity of 3,500kg and a maximum fork height of 5.81 metres.

Link: https://www.adaptalift.com.au/new-equipment/j2-2-3-5xn-series-electric-forklifts-2-3-tonne

Availability: Available now.

5.4.14 Mini Excavator – Wheeled

Excavators are primarily used for digging purposes, as well as for various lifting and carrying tasks and has an undercarriage with tracks or wheels. Wheeled excavators have greater manoeuvrability and is suitable for jobs with uneven terrain.

Mini excavators are suitable for smaller projects and generally weigh between 1 to 10 tons.

5.4.14.1 Bobcat E57W

A fossil fuel example of a mini wheeled excavator is a Bobcat E57W. Fitted with a four-cylinder diesel engine, this plant outputs 42.5kW of power. It has a maximum dig depth and dumping height at 3.495m, and has a maximum operating weight of 6,312kg.

Link: https://www.bobcat.com/eu/excavators/models/e57w/features

There is currently no suitable electric option for a mini wheeled excavator; however, Volvo CE is currently developing technology for a mid-sized, wheeled, electric excavator.

Link: https://www.volvoce.com/global/en/news-and-events/press-releases/2020/volvo-ce-unveils-first-mid-size-electric-excavator-concept/

Availability: Technology in development.

5.4.15 Mini Excavator – Track

Excavators are primarily used for digging purposes, as well as for various lifting and carrying tasks and has an undercarriage with tracks or wheels. Track excavators have a lower centre of gravity and more even weight distribution, making it suitable for work on hills or steep terrain.

Mini excavators are suitable for smaller projects and generally weigh between 1 to 10 tons.

5.4.15.1 KUBOTA KX018-4

The Kubota KX018-4 is a fossil fuel example of a mini tracked excavator. Fitted with a 3-cylinder, 4-cycle diesel engine, this type of machinery outputs up to 12.7kW of power. It has a maximum dig depth and dumping height at 2.38m, and has a maximum operating weight of 1,700kg.

Link: https://kubota.com.au/product/kx018-4/

5.4.15.2 JCB E-TECH 19C-IE

An electric equivalent for the Kubota KX018-4 is a JCB 19C-IE. This excavator is fitted with a lithium-ion batteries that can power a full typical day of work on a single charge. It has a maximum dig depth and dumping height at 2.82m, and has a maximum operating weight of 1,902kg.

Link: https://www.jcb.com/en-au/products/mini-excavators/19c-1e

Availability: Available now.

5.4.16 Plate Compactor – Push

Plate compactors, or vibration plates, use vibration to compress granular soil or gravel to reduce space between soil particles, resulting in a higher density that slows infiltration and drainage rates of the subsurface. They can be used to compact asphalt and sub-bases on driveways and parking lots and in areas large rollers cannot access.

5.4.16.1 Wacker Neuson WP1550AW

A fossil fuel example of a plate compactor is the Wacker Neuson WP1550AW. This plant operates on a four-stroke gasoline engine, outputting 3.6kW of power. It has an operating width of 498mm and has an area capacity of 870m^3/h. It has an operating weight of 96kg that delivers 15,000kN of centrifugal force.

Link: Vibration Plate WP1550AW (wackerneuson.com)

5.4.16.2 Wacker Neuson AP1850e

A Wacker Neuson AP1850e is an electric substitute for the Wacker Neuson WP1550AW. With a battery-operated electric motor, this plant outputs 1.2kW of power. The AP1859e has an operating width of 500mm and has an area capacity of 810m^3/h. It has an operating weight of 97kg that delivers 18,000kN of centrifugal force.

Link: https://shop.wackerneuson.com/estore/uk/en/Compaction/Vibratory-Plates/Single-direction-Vibratory-Plates/Vibration-Plate/p/5100038319

Availability: Available now.

5.4.17 Demolition Hammer – Handheld

Demolition hammers are designed to chip, chisel and break out slabs of concrete, brickwork or masonry.

5.4.17.1 Wacker Neuson BH55rw

A fossil fuel example of a demolition hammer is a Wacker Neuson BH55rw. It has a 1.6kW engine, outputting 55 joules in a single stroke impact and delivering 1,350 blows per minute. This operating plant has a handling weight of 24.2kg.

Link: https://www.wackerneuson.com/en/in/products/demolition/breakers/electric-breakers/model/eh75/type/TechnicalData/

5.4.17.2 Wacker Neuson EH75

The Wacker Neuson EH75 is an electric equivalent to the Wacker Neuson BH55rw. It operates on a three-phase asynchronous 2.5kW motor, outputting 75 joules in a single stroke impact and delivering 1,300 blows per minute. The handling weight is 26kg.

Link: https://www.wackerneuson.com/en/in/products/demolition/breakers/electric-breakers/model/eh75/type/TechnicalData/

Availability: Available now.

5.4.18 Trencher – Push

A trencher is a piece of construction equipment used for various purposes including digging trenches in soil, clay, sand, rock and shale, for laying pipes, electrical cables and installing drainage.

5.4.18.1 Paddock Walk Behind Trencher

The BBT Trencher has a four-stroke petrol engine, outputting 9.9kW of power. It has three adjustable depths at 200, 400 or 600mm and a trenching width of 100mm. This trencher has a rotational speed of 300 to 460 rpm and a working speed of up to 60 metres per hour.

Link: https://www.scintex.com.au/products/paddock-walk-behind-trencher

There is currently no suitable electric option for a trencher.

5.4.19 Road Roller

Road rollers smooths, levels and compacts soil for road work. It is also used to compact asphalt for sealing purposes.

5.4.19.1 John Deere HD 10C VV

A fossil fuel example of a road roller is the John Deere HD 10C VV. It is a tandem roller with front and rear vibrating roller drums and operates on a diesel engine that outputs 16.1kW at 2,600 rpm. This plant weighs approximately 1,680kg and has a 1.07 metre working width. The John Deere HD 10c VV delivers up to 1,735kg of centrifugal force at vibration frequency of 2,880 to 3,660 vibrations per minute.

Link: https://www.wirtgen-group.com/ocs/en-us/hamm/hd-10c-vv-15820-p/

There is currently no suitable electric option for a road roller available in Australia. The technology is currently in development by BAM Infra Nederland, a Dutch company who has built and commissioned the first fully electric 10 to 12 tonne road roller.

Availability: Technology under development.

5.4.20 Street Sweeper – Compact

Street sweepers clean large public outdoor areas through removing dirt, broken glass, leaves and other small debris. Small street sweepers have greater flexibility and can manoeuvre more easily in smaller spaces.

5.4.20.1Bucher Municipal C202

The Bucher Municipal C202 is a fossil fuel example of a compact street sweeper. It has a 1650kg payload, a 1.8 cubic metre hopper volume and a travelling speed of 0-50km/h.

Link: https://www.buchermunicipal.com/au/en/products/sweepers/compact-sweepers/c202

5.4.20.2 Bucher Municipal CityCat V 20e

The Bucher Municipal CityCat V 20e is an electric equivalent to the Bucher Municipal C202. It runs on a 63kWh automotive lithium-ion battery and can last a full 8-hour shift. It has similar specifications to the C202 with a top speed of 40km/h and has a greater payload at 1800kg and a larger hopper volume at 2 cubic metres.

While the top speed is lower than the fossil fuel example, the CityCat v 20e has a greater storage capacity and can see longer intervals between emptying and cleaning the sweeper. The battery requires 2 to 3 hours for a full charge.

Link: https://www.buchermunicipal.com/au/en/products/sweepers/compact-sweepers/citycat-v20e

Availability: Available now.

5.4.21 Street Sweeper – Large

Street sweepers clean large public outdoor areas through removing dirt, broken glass, leaves and other small debris. Large street sweepers are suitable for larger areas and can clean spaces more efficiently.

5.4.21.1 Bucher Municipal V65t

A fossil fuel example of a large street sweeper is the Bucher Municipal V65t. This operative system was designed with a JCB 55 kW industrial engine and provides 410 joules of torque at 1200 rpm. In addition, it has a sweeper width of 3.6 metres, a 6.5 cubic metre hopper capacity and a 1554 litre water tank.

Link: https://www.buchermunicipal.com/au/en/products/sweepers/truck-mounted-sweepers/maxpowa-v65

5.4.21.2Fulongma BEV Sweeper Truck

An electric alternative to the Bucher Municipal V65t is the Fulongma Bev Sweeper Truck. The battery outputs 48.8kW of power. This sweeper truck has a maximum cleaning width of 2.15 metres, a hopper capacity of 1.4 cubic metres and water tank volume of 750 litres.

While this electric option delivers similar power outputs to the fossil fuel example, the dimensions of this truck's mowing width and the smaller hopper and water tank capacity will require more frequent emptying and refills.

Link: https://www.fulongmagroup.com/bev-sweeper-truck-flm5040tslnjbev/

Availability: Available now.

5.4.22 Lawn Mower – Push

Lawn mowers tidy lawns by mowing grass to uniform heights. Push lawn mowers are generally used for small to medium sized areas around 1000 sqm; however, can also be used for larger jobs up to 4000 sqm.

5.4.22.1Stihl 756 GS

A fossil fuel example of a lawn mower is a Stihl 756 GS. This push lawn mower has a petrol engine that outputs 2.9kW of power at 2,800 rpm. The Stihl 756 GS effectively operates on lawns up to 3000 sqm and has a grass catcher box capacity of 80 litres. It has cutting heights from 25 to 90mm, cutting width of 54cm and weighs 60kg without the box.

Link: https://www.stihl.com/STIHL-power-tools-A-great-range/Robotic-mowers-lawn-mowers-ride-on-mowers-and-lawn-scarifiers/Petrol-lawn-mower-for-professional-use/292516-95576/RM-756-GS.aspx

5.4.22.2 Pellenc Raison 2

The Pellenc Raison 2 is an electric option for push lawn mowers. It operates on a lithium-ion battery, outputting 1.6kW of power at 3,000 to 5,000 rpm. The Pellenc Raison 2 has a maximum ground speed of 5km/h and a grass catcher box capacity of 70 litres. This lawn mower has a cutting width of 60cm, cutting heights from 25mm to 75mm and weighs 30kg without the battery or grass catcher box.

This electric option delivers just over half of the power output of the fossil fuel example and may unsuitable for larger, commercial jobs.

Link: https://www.pellenc.com/en-au/our-products/green-spaces-and-urban-cleanliness/rasion-2-lawnmowers

Availability: Available now.

5.4.23 Lawn Mower – Compact Ride On

Compact ride-on mowers are ideal for large yards and commercial use for lawns up to 4000 metres square or 1 acre in size.

5.4.23.1Walker MD21D-H

The Walker M21D-H is a standard example of a compact ride on mower. This mower runs on a 722cc diesel engine, outputting 20.9hp/15.4kW. The mower deck width ranges from 91cm to 188cm.

Link: https://www.macmm.com.au/walker-md21d-h-out-front-zero-turn-hi-dump-ride-on-mower-mower-only-with-20-9hp-kubota-d722-three-cylinder-diesel-engine.html

5.4.23.2 Cub Cadet Ultima ZT1 42 E

A Cab Cadet Ultima ZT1 42 E is an electric alternative to the Walker MD21D-H. It is powered by a 56V Lithium-Ion 3000Wh 60Ah motor that can cover up to 2 acres on a single charge. The mower deck width is approximately 106cm.

The Ultima ZT1 42 E has a battery run time of up to 2 hours and has a charge time of 4 hours. This poses potential limitations for more detailed or back-to-back mowing jobs.

Link: https://www.cubcadet.com.au/ride-on-mowers/electric-ride-on-mowers-2/zt1-42e.html

Availability: Available now.

5.4.24 Lawn Mower – Medium Ride On

Medium ride on lawn mowers are suitable for lawn sizes 4000 metres square to 1 hectare.

5.4.24.1John Deere Z920M

A fossil fuel example of a medium ride on lawn mower is a John Deere Z920M. This ride on mower has an engine power of 23.5hp/17.5kW and a maximum speed of 16.1km/h, and a blade tip speed of 5,486 m/min. The mower deck width ranges from 122cm to 152cm.

Link: https://www.deere.com/en/mowers/commercial-mowers/commercial-zero-turn-ztrak-mowers/z920m-mower/

5.4.25 Lawn Mower – Large Ride On

5.4.25.1Ecoteq Evo

A full battery electric mower that can sustain 8 hours of use and can charge fully overnight from a standard power point.

Link: https://www.ecoteq.com.au/

5.4.26 Cricket Pitch Roller

Pitch rolling is an important process for maintaining quality pitch performance through compacting top layer soil, reducing live grass coverage, and removing ground level variation. Regular maintenance ensures the pitch is hard, smooth and uniform.

5.4.26.1Mentay 2000

A typical fossil fuel example of a cricket pitch roller is the Mentay 2000. The Mentay 2000 has a 16hp/11.8kW petrol or diesel engine and an operating weight of 1660kg. It has a single barrel construction 900mm wide.

Link: https://www.mentay.com.au/products/rollers/mentay-2000

5.4.26.2 Gama Electric 0018

The Gama Electric 0018 is an electric substitute for the Mentay 2000. It has a single barrel structure and similar roller dimensions at 914mm wide. This roller has motor power of up to 3hp/2.24kW and an operating weight of 2000kg.

Lower power out poses limitations for big jobs and commercial use.

Link: http://www.gamasport.com.au/Cricket-Pitch-Rollers/Cricket-Pitch-Electric-Roller-(2-Ton-Capacity)

Availability: Available now.

5.4.27 Cricket Pitch Mower

Cricket pitch mowers are specialised lawn mowers that are more precise and have a higher clip rate, suitable for maintaining pitch quality and performance.

5.4.27.1 Mow Master R22W

A fossil fuel example of a cricket pitch mower is the Mow Master $22W. This type of lawn mower has a four-stroke petrol engine, outputting 2.4kW of power. It has a cut height ranging from 20 to 28mm, a cutting width of 56cm and higher clip rate of 20 percent compared to standard lawn mowers.

Link: http://www.mowmaster.com.au/services/r22w-cricket-pitch-mower/

While there are several standard lawn mowers capable of cutting heights down to 20 to 25mm, they do not deliver high clip rates required for pitch maintenance. As such, there is currently no electric option of a cricket pitch mower available in Australia.

5.4.28 Golf Equipment – Bunker Rake

Bunker rakes are used to rake bunkers to produce as smooth of a surface as possible.

5.4.28.1 John Deere 1200H Hydro

The John Deere 1200H Hydro is a fossil fuel example of a bunker and field rake. This type of golf equipment has a 16hp/11.9kW petrol engine and operates on a hydrostatic 3WD system. It has a standard 185.4cm rear rake.

Link: https://www.deere.com.au/en/bunker-rakes/1200-hydro-bunker-rake/

5.4.28.2 Sand Star E 48V

An electric alternative to the John Deere 1200H Hydro is the Sand Star E 48V. It operates on a similar hydrostatic system and has a 173cm rear rake. This operating system is powered on Mahle motor with engine displacement of 48V/5kW and a Roy Pow 48V 160Ah lithium battery pack. It has run time of 9 to 10 hours and can rake approximately 185 bunkers before requiring charging.

Link: https://smithco.com/sand-star-e-48v-ac/

Availability: Available now.

5.4.29 Verti-cutter

A verti-mower, sometimes referred to as a sod-cutteror verti-mower, is used for dethatching and removing dead organic matter or excessive roots and stems from the top of lawns/soil that prevent quality plant and lawn growth. It uses metal blades or tines to comb across lawns to pull thatch up to the surface.

5.4.29.1Mow Master VMM36/2

The Mow Master VMM36/2 is a fossil fuel example of a verti-cutter. It is powered by a petrol engine outputting 9.7kW and has a cutting depth of up to 40mm.

Link: http://www.mowmaster.com.au/services/verti-mower/

There is currently no electric equivalent of a verti-cutter that is suitable for commercial use.

5.4.30 Topdresser

Topdressers spread thin layers of soil or finely granulated organic materials over turf surfaces to maintain and improve lawn growth and health. This process also levels the playing ground level variations, smoothing out bumps and ridges and consequently, reducing thatch.

5.4.30.1Toro ProPass 200

A fossil fuel example of a topdresser is the Toro Propass 200. It has a diesel engine, outputting 8.2kW of power. The Propass 200 has a hopper capacity of 0.54 cubic metres level and 0.7 cubic metres heaped. His topdresser can evenly apply materials to the turf from 2.74m to 10.67m.

Link: https://www.toro.com.au/product/propass-200-standard-hydraulic-44701

5.4.30.2 Sustainable Machinery TT-2400

An electric equivalent to the Toro Propass 200 is a TT-2400 from Sustainable Machinery. This topdresser is a tow model and can be operated with an electric drive tractor or through it's own vehicle plug-in hydraulics, outputting 7.5kW of power. The TT-2400 has a hopper capacity of 0.5 cubic metres level and 1 cubic metre heaped.

This plant can be used with a tractor with minimum towing capacity of 685kg.

Link: https://www.sustainablemachinery.com.au/product/tt-2400-series-pull-type/

Availability: Available now.

5.4.31 Sprayer – Ride On

Sprayers precisely apply liquid pesticides and fertilizers more quickly to turf areas. Small to medium ride on sprayers have the advantage of manoeuvrability and can also operate on smaller land plots.

5.4.31.1 Toro Multi Pro 5800

A fossil fuel example of a medium ride-on sprayer is a Toro Multi Pro 5800. It has a four-cylinder, EFI petrol engine, outputting 37.3kW of power. It has a tank capacity of 1,136 litres and a spray pump with flow rate of 170.3L/min at 220psi.

Link: https://www.toro.com.au/product/multi-pro-5800-41393?c3=sprayers

There is currently no suitable electric option for a ride-sprayer; however, sprayer units and sprayer trailers (see Section 5.4.32 below), can be used in conjunction with electric utility vehicles.

5.4.32 Sprayer Trailer

A trailer mounted sprayer is used for land plots of varying sizes depending on trailer and tank capacity. This plant requires an ATV for use.

5.4.32.1TTi 200L SpotPro

A TTi 200L SpotPro is a fossil fuel example of a sprayer trailer. This plant has a four-stroke, on cylinder engine, outputting 1.0kW and has a 12L/min 360PSI spray pump. It has a standard 50mm tow hitch, built on a single-axle trailer and has an approximate mass of 225kg.

Link: https://www.oxquip.com.au/product/weed-spraying-equipment/tow-behind-sprayers/200-litre-utv-tow-behind-weed-sprayer/?gclid=Cj0KCQjwmPSSBhCNARIsAH3cYgaLGoXpE-Of5mr-b5U5o3_hcHvtlHWbz6pIl8miZ-t7eFiwwDTWqtYaAiFlEALw_wcB

5.4.32.2 Rapid Spray 200L FarmMax ATV

An electric equivalent to the TTi 200L SpotPro is the Rapid Spray 200L FarmMax ATV. This sprayer trailer has a similar frame, with a single-axle trailer and 50mm tow hitch. It has a 15.2L/min 360PSI spray pump and an approximate mass of 215kg.

This trailer is not fitted with an engine or motor and relies entirely on the towing capacity of the ATV it is attached to.

Link: https://www.rapidspray.net/product/200l-farmmax-electric-atv-trailer-sprayer

Availability: Available now.

5.4.33 Aerator – push

Lawn aeration creates holes so that air, water and nutrients can better penetrate the root zone and promote deep root growth. This alleviates soil compaction and enhances grass growth for producing a stronger and more healthy lawn.

5.4.33.1Toro Procore 648

The Toro Procore 648 is a standard fossil fuel example of a lawn aerator. This handheld-push plant runs on a 17.1kW Kohler gas engine and an operating speed of 1.2-2.4 km/h. It has a working width of 121cm, aerating depth of up to 10.2cm and a variable hole spacing ranging from 3.8cm to 7.6cm apart.

Link: https://www.toro.com/en/golf/aerators/procore-648

5.4.33.2 Stihl RLE 240

An example of an electric alternative to the Toro Procore 648 currently available is the Stihl RLE 240. It has the functionality of a scarifier in addition to aerating lawns; however, it operates on a smaller scale with an output of 1.5kW of power. The working width and aeration depth are 34cm and 1.5cm respectively.

The significant difference in power and dimension poses limitations for aerating larger areas of lawn as efficiently and effectively.

Link: https://www.stihl.com/STIHL-power-tools-A-great-range/Robotic-mowers-lawn-mowers-ride-on-mowers-and-lawn-scarifiers/Lawn-scarifiers/291079-95583/RLE-240.aspx

Availability: Available now.

5.4.33.3 Paddock Machinery Tow Behind Drum Spike Aerator

An alternative to a handheld-push lawn aerator is the Paddock Machinery Tow Behind Drum Spike Aerator, which can be attached to an (electric) ATV, quad bike or ride-on mower. The tow behind aerator does not have an engine and relies solely on the power of the small vehicle or ride-on mower it is attached to.

This tow behind aerator has similar dimensions to the Toro Procore 648. It has a working width of 91cm to 150cm and a maximum aeration depth of 7cm.

Availability: Available now.

Link: https://www.paddockmachinery.com/products/spike-aerator

5.4.34 Surface Scarifier – Push

A surface scarifier, distinct from a scarifier (a gardening tool), is a surface preparation tool designed for use on concrete and asphalt surfaces. It cuts or scars the surface, which enables fast removal of thick film, such as epoxy. This process allows for successful bonding between the surface and new binding materials.

5.4.34.1Flextool FSP200

A fossil fuel example of a scarifier is a Flextool FSP200. This gardening machinery has a petrol engine, outputting 4.1kW of power. It has a working width of 200mm and operating weight of 87.5kg.

Link: https://www.flextool.com.au/products/surface-floor-preparation/scarifiers/surface-scarifier-petrol-fsp200/

There is currently no suitable electric option for a surface scarifier.

5.4.35 Tiller – Push

A tiller breaks up hard, compact soil into broken-up, loose dirt that can allow for planting.

5.4.35.1Honda F501

The Honda F501 is fossil fuel example of a tiller. Fitted with a single cylinder, four-stroke, petrol engine, this plant outputs 4.1kW of power. It has a tilling width of 914 mm and depth of 280mm.

Link: https://powerequipment.honda.com.au/models/lawnandgarden/tillers/f501

There is currently no suitable electric option for a tiller due to existing electric options available in Australia having very low power output (up to 1.5kW), rendering unsuitable for commercial use.

5.4.36 Line Marker – Push

Line markers mark semi-permanent lines on grass and hard surfaces such as sporting grounds and car parking areas.

5.4.36.1Graco LineLazer 3400

The Graco LineLazer 3400 is a fossil fuel example of a line marker. This fossil fuel plant has a four-stroke, petrol engine, outputting 2.4kW at 3,600rpm. It has a hopper volume capacity of 56.8 litres and a maximum flow rate of 2.8 L/min.

Link: https://www.graco.com/au/en/contractor/product/25m224-linelazer-3400.html#table-specifications

5.4.36.2 Fountain Proline V4

An electric equivalent to the Graco 3400 is the Fountain Proline V4. This plant is battery operated and outputs 2.88kW of power. It has a hopper volume capacity of 30 litres and a maximum flow rate of 2.9 L/min.

Link: https://fountainline.com.au/line-markers/proline-v4-line-marker/

Availability: Available now.

5.4.37 Hedge Trimmer – Handheld

Hedge trimmers are smaller, lighter machines, used for trimming light foliage including hedges, shrubs and bushes.

5.4.37.1 Stihl HS 56 C

A Stihl HS 56 C is a fossil fuel example of a hedge trimmer. This handheld plant has a single cylinder, two-stroke engine, outputting 0.65kW of power. It has a bidirectional cutting blade a cutting length of 60 cm and stroke rate of 3,600 per minute. The Stihl HS 56 C weighs 4.5kg.

Link: https://www.stihl.com.au/STIHL-Products/Hedge-Trimmers/Petrol-Hedge-Trimmers/21897-1589/HS-56.aspx

5.4.37.2 Pellenc Helion 3

An electric equivalent to the Stihl HS 56 C is a Pellenc Helion 3. Powered on a lithium-ion battery, this garden machinery can operate for up to 3 days without charge and outputs 1.2kW of power.

Like the Stihl HS 56 C, it has a bidirectional cutting blade. The cutting blade length ranges from 51 to 75cm and has stroke rate of 3,200 to 3,800 per minute. This handheld plant weighs 3.4 to 3.7kg.

Link: https://www.pellenc.com/en-gb/our-products/green-spaces-and-urban-cleanliness/pruning/helion-hedge-trimmer

Availability: Available now.

5.4.38 Brush Cutter – Handheld

A brush cutter is used to trim more dense, organic green material such as weeds, small trees, and other foliage where a lawn mower cannot reach.

5.4.38.1Stihl FS 131

A Stihl FS 131 is a fossil fuel example of a brush cutter. It has a 4-stroke engine that runs on a fuel-oil mix and has power output of 1.4kW at 8,500 rpm. The FS 131 weighs 5.8kg and is 1.8 metres in length.

Link: https://www.stihl.com.au/STIHL-Products/Grass-Trimmers-Brushcutters/Professional-Brushcutters/275065-1621/FS-131.aspx

5.4.38.2 Pellenc Excelion 2

A electric option for a brush cutter is the Pellenc Excelion 2. With the ULiB 1500 lithium-ion battery, it has a working time of up to 3 hours and outputs from 3000 to 6600 rpm, with upgrades. The Excelion 2 weighs 4.9 to 5.9kg depending on handle type and is 1.87 metres in length.

Limitations to this electric option include the short operating hours and lower rotation speeds (rpm), which can prove inefficient and limited in capacity to complete big jobs.

Link: https://www.pellenc.com/en-au/our-products/green-spaces-and-urban-cleanliness/brush-cutting/excelion-2-brush-cutter

Availability: Available now.

5.4.39 Blower – Handheld

Handheld debris blowers clear paths and other maintained paved areas of leaves, grass clippings and other organic debris.

5.4.39.1Stihl BG 86 C-E

A fossil fuel example of a handheld debris blower is the Stihl BG 86 C-E. It has a single-cylinder two-stroke petrol engine, that outputs 0.8kW of power. The Stihl BG 86 C-E has a blowing force of 15 N and delivers an air speed of 63 m/s and air flow rate of 810 m^3/h. This handheld plant weighs 4.5kg.

Link: https://www.stihl.com.au/STIHL-Products/Blowers-Shredder-Vacs-Mistblowers/Petrol-Blowers/21522-1577/BG-86-C-E.aspx

5.4.39.2 Pellenc Airion 3

An electric equivalent to the Stihl BG 86 C-E is the Pellenc Airion 3. It is fitted with a battery that can power use for up to 6 hours. The Pellenc Airion 3 outputs 0.94kW of power and has a blowing force of up to 17.5 N. This handheld plant delivers 63 m/s air speed, 920 m^3/h airflow and weighs 2.7kg, including the cable.

Link: https://www.pellenc.com/en-au/our-products/green-spaces-and-urban-cleanliness/airion-3-blower

Availability: Available now.

5.4.40 Blower – Backpack

Backpack debris blowers have the added advantage of clearing debris without the load on the user's arm and wrist.

5.4.40.1Stihl Petrol Blower BR 700

A fossil fuel example of a backpack debris blower is the Stihl BR 700. It has a petrol engine, outputting a blowing force of 35 N. This plant delivers an air speed of 74 m/s and an air flow rate of 1550 m^3/h. The Stihl BR 700 weighs 10.7kg without fuel.

Link: https://www.stihl.com.au/STIHL-Products/Blowers-Shredder-Vacs-Mistblowers/Backpack-Blowers/263529-1578/BR-700.aspx

5.4.40.2 Pellenc Airion Backpack Blower

An electric alternative to the Stihl BR 700 is the Pellenc Airion. It is battery powered, outputting 27 N at an air speed of 73 m/s. The Pellenc Airion delivers an air flow rate of 1455 m^3/h and weighs 6.8kg. This type of debris blower can operate up to 3 hours for standard maintenance or up to 1 h 50 min for intense road cleaning work.

Link: https://www.pellenc.com/en-gb/our-products/green-spaces-and-urban-cleanliness/cleaning/airion-backpack-blower

Availability: Available now.

5.4.41 Blower – Trailer

Debris blower trailers deliver great volumes of air, clearing debris, particularly in larger areas, with greater efficiency.

5.4.41.1 Toro Pro Force Debris Blower

The Toro Pro Force Debris Blower is a fossil fuel example of a debris blower trailer. It has 2-cylinder engine outputting 18.3kW of power. This plant can be attached to any vehicle that has a towing capacity of at least 216kg.

Link: https://www.toro.com.au/product/pro-force-debris-blower-44552

There is currently no suitable electric option for a debris blower trailer.

5.4.42 Chainsaw – Handheld

Handheld chainsaws are portable power tools with a set of teeth attached to a rotating chain driven along a guide bar. It is used to cut through trees, wood, plastic and some metals, depending on the type and thickness.

5.4.42.1STIHL MS 260

A fossil fuel example of a handheld chainsaw is a Stihl MS 260. It has a petrol engine outputting 2.6kW and has a vibration level of 3.6 to 4.1 m/s^2. The Stihl MS 260 is available in guide bar lengths of 32cm and 45cm with both built with a .325 inch saw chain pitch.

Link: https://www.stihl.com/STIHL-power-tools-A-great-range/Chainsaws/Petrol-chainsaws-for-forestry/2219-131/MS-260.aspx

5.4.42.2 STIHL MSE 250

The Stihl MSE 250 is an electric equivalent to the Stihl MS 260. This electric chainsaw outputs 2.5kW and has a vibration level of 3.6 to 4.1 m/s^2. The Stihl MSE 250 has a larger bar length than the MS 260, available in 40cm and 45cm, and has a thicker and more robust saw chain at pitch at .375 inches.

Link: https://www.stihl.com/STIHL-power-tools-A-great-range/Chainsaws/Electric-chainsaws/240853-150/MSE-250.aspx

Availability: Available now.

5.4.43 Concrete Saw

Concrete saws can cut through hard materials including concrete, asphalt, masonry, tiles and bricks to create openings or channels through the material.

5.4.43.1STIHL TS 420

The Stihl TS 420 is a fossil fuel example of a concrete saw. This machine has a power output of 3.2kW and has a blade diameter of 350mm. This handheld concrete saw weighs around 9.6kg.

Link: https://www.stihl.com.au/STIHL-Products/Cut-Off-Machines-Concrete-Cutter/Cut-Off-Machines/21340-1597/TS-420.aspx

5.4.43.2 Husqvqrna K4000

An electric equivalent to the Stihl TS 420 is the Husqvqrna K4000. This concrete saw has the same size cutting wheel with blade diameter of 350mm and has a power output of 2.2kW. This handheld plant weighs 7.6kg.

While the Husqvqrna K4000 is of similar make to the Stihl TS 420, its lower power output impacts operating capacity and efficiency.

Link: https://www.husqvarnacp.com/au/machines/power-cutters/k-4000/967084401/

Availability: Available now.

5.4.44 Woodchipper

This plant is used to reduce wood including branches, tree limbs and unprocessed wood into chips and sawdust, as part of a wood recycling process.

5.4.44.1Vermeer BC900XL

A fossil fuel example of a woodchipper is the Vermeer BC900XL. This plant operates on a gasoline engine outputting a maximum of 21.1kW and 71.9Nm of torque. It can chip wood material up to 9 inches (22.9cm) in diameter and 14 inches (35.5cm) wide.

Link: https://vermeeraustralia.com.au/equipment/wood-chippers/bc900xl-wood-chipper/

5.4.44.2 Linddana TP 175 Electric

A suitable electric replacement is the Linddana TP 175 Electric. This woodchipper has an electric motor outputting 22.1kW and can chip wood material up to 10 cubic metres per hour. It can chip material down to 4mm to 12mm in size.

Link: https://www.chipstar.com.au/product-Linddana-TP-175-Electric.html

Availability: Available now.

5.4.45 Submersible Pump

Submersible pumps are used to pump water and other liquids from work and construction sites, flooded sites and small waterbodies, such as ponds, springs and low-order streams. They are often used for flood drainage and sewerage pumping.

5.4.45.1 Wacker Neuson SP55/6

The Wacker Neuson SP55/6 is a fossil fuel example of a submersible pump. This pump can handle solids up to 15mm and has a discharge diameter of 50mm and flexible shaft length of 6 meters. This plant can pump up to 55,000 litres per hour.

Link: https://sydneytools.com.au/product/wacker-neuson-sp556-50mm-2-flexible-submersible-pump

There is currently no suitable electric option for a submersible pump.

5.4.46 Drive Unit

A drive unit is used to convert electrical or hydraulic power into mechanical motion.

5.4.46.1 Wacker Neuson HD 3.7 Honda Drive Unit 6906

A fossil fuel example of a power drive unit is the Wacker Neuson HD 3.7 Honda Drive 6906. This drive unit operates on a diesel or petrol engine and is connected to a three-dog coupling, which fits most manufactured machinery. It has a power output capacity of 3.7kW.

Link: https://www.totaltools.com.au/120828-wacker-hd-3-7-honda-drive-unit-6906

5.4.46.2 Scintex Paddock Electric Drive Unit

The Scintex Paddock Electric Drive Unit is an electric alternative to a fossil fuel power drive unit. This plant operates on a single phase industrial electric motor outputting 2kW of power. Like the Wacker Neuson HD 3.7 Honda Drive Unit 9606, it is fitted with a three-dog coupling that is compatible with most tools and can easily substitute existing drive units.

Compared to the fossil fuel example, this electric option has limited power output and operating capacity, outputting a maximum of just over half of the power of the Wacker Neuson drive unit.

Link: https://www.scintex.com.au/products/electric-drive-unit?_pos=1&_sid=c1287cadc&_ss=r

Availability: Available now.

5.4.47 Milling Machine

A milling machine is a type of machinery that removes material from a workpiece using rotary cutters that drills and bores precise lines and shapes into the workpiece.

5.4.47.1 Red Fox Metex Pro E3

A fossil fuel example of a milling machine is the Red Fox Metex Pro E3. This milling machine has motor power of 1.5kW and has a variable direct drive from 100 to 2500 rpm. It has a maximum drilling capacity of 32mm.

Link: https://redfoxmachinery.com.au/product/milling-machine-e-3/

There is currently no suitable electric option for a milling machine.

5.4.48 Generator

Portable generators are devices that provide electrical power up to certain level of wattage. They are often used to power small electrical appliances such as laptops, dryers, toasters and mobile phones.

5.4.48.1Honda EU30IS

A fossil fuel example of a portable generator is the Honda EU30IS. It has a single cylinder petrol engine with a maximum output of 2.6kW.

Link: https://www.bluedm.com.au/honda-3kva-inverter-generator-eu30i/?gclid=Cj0KCQjwz7uRBhDRARIsAFqjulkxHiBZch6fjjiLOkH2gx2YgcIJ3urA20VBqXi8qKCNN_PImLepwpAaArWCEALw_wcB

5.4.48.2 EcoFlow Delta Pro

An electric alternative to the Honda EU30IS is a EcoFlow Delta Pro Portable Power Station. This electric generator has a prismatic LFP battery cell type and has an extra rechargeable smart battery. A single EcoFlow Delta Pro generator has a maximum power output capacity of 4.5kW.

This generator can be fully charged within 1.8 hours through wall charging. It can be charged via car outlets for on-the-go top ups and is compatible with most portable solar panels.

Link: https://www.ecoflow.com/delta-pro-portable-power-station

Availability: Available now.

5.4.49 Compactor

Compactors compress large volumes of recyclable paper and cardboard to reduce space uptake by up to 80 per cent.

5.4.49.1Mil-tek 2306 Cardboard & Plastic Baler

An example of a compactor is the Mil-tek 2306 Cardboard and Plastic Baler. This type of machinery is powered by compressed air delivered by an existing air-line or from a petrol or diesel air compressor. It delivers 8500kg of pressure at 8 bar and can compress up to 250kg of plastic and 200kg of cardboard by up to 85 to 95%.

Link: https://www.miltek.com.au/product/2306-cardboard-plastic-baler

5.4.49.2 Blue Diamond Genesys Electric Air Compressor

The Mil-tek 2306 compactor can see continual use by substituting any petrol or diesel air compressors used to power the machinery with an electric air compressor, such as the Blue Diamond Genesys. This air compressor has a tank size of 160 litres and outputs 7.5kW of power and 145 PSI.

Link: https://www.bluedm.com.au/piston-air-compressor-electric-10hp-42-cfm-160l-145-psi/

Availability: Available now.

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