Australia's National
Science Agency

Electric vehicle projections 2025

Commissioned for AEMO's Draft 2026 Forecasting Assumptions Update

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Acknowledgments

This report was developed with input from AEMO staff and participants in the 22nd October 2025 Forecasting Reference Group stakeholder forum.

Executive summary

This report updates projections for electric vehicle uptake and charging profiles and was commissioned by AEMO as part of their regular updates to modelling and planning inputs and assumptions.

After a year of relatively slow (16%) growth in 2024-25, Australia's electric vehicle sales are expected to resume relatively strong growth in 2025-26 (40%) and will be made up of more plug-in hybrids than in the past as the introduction by the Australian government of the New Vehicle Efficiency Standard (NVES) for cars drives growth in all types of fuel efficient vehicles including hybrids that do not plug-in. The policy is modelled by including targets for sales in 2030 consistent with the standard. The outlook to 2030 is also influenced by state electric vehicles targets in Victoria, Queensland and South Australia, which boost electric vehicles sales in those states relative to the remaining states.

The NVES policy does not have a target beyond 2030, however, regardless of whether efficiency standards are extended beyond that date, the scenario modelling recognises the existing net zero emissions by 2050 policy and global manufacturer targets. Consequently, electric vehicles uptake is assumed to eventually dominate road transport in Australia, albeit over a multi-decade timeframe and different rates of change between the scenarios explored.

An important consideration for how fast and how much electric vehicles may dominate is the state of road vehicle manufacturing and after sales support in the period where electric vehicles are the majority of vehicles sold. Vehicle manufacturers may not be able to guarantee supply of spare parts for discontinued models of internal combustion vehicles. Falling demand for liquid fuel may reduce the number of service stations supplying liquid fuel and/or increase the price of fuel. In these circumstances, and over a multi-decade timeframe, the projections assume that internal combustion vehicles will eventually experience accelerated scrapping rates relative to the present, as some consumers find it too inconvenient to maintain internal combustion vehicles for their main road transport vehicle. This development results in a faster fleet transition than current fleet scrapping rates would allow for.

The report further refines the charging profiles applied in previous projections reports by CSIRO. The adjustments to charging profiles considered the increasing role of time of use tariffs in Australia- particularly those that incentivise solar aligned charging, the more modest charging needs of plug-in hybrid vehicles and weaker outlook for fuel cell vehicles.

At the same time, the share of unscheduled charging and public charging has been reduced to 2030 relative to previous projections to acknowledge the greater uptake of TOU tariffs and as well as a reduction in public charging share assumptions to align them with more verifiable trial data.

1 Introduction

Each year, AEMO requires updated projections of electric vehicle adoption and operation of electric vehicle chargers for input into its various planning and forecasting publications. CSIRO has been commissioned to provide electric vehicles projections for three scenarios: *Slower Growth*, *Step Change* and *Accelerated Transition*. These are described further in the body of this report.

The report focusses on battery electric vehicles, plug-in hybrid electric vehicles and fuel cell electric vehicles (BEVs, PHEVs and FCEVs). Only electric vehicles in the on-road sector are considered. Electrification of vehicles in off-road sectors such as mining are not included. On-road vehicles include light vehicles (cars and motorcycles) owned by households or businesses as well as trucks and buses.

In calculating on-road vehicle electrification we consider the size of the road sector versus other transport modes. We calculate the electricity needed to produce the hydrogen for FCEVs but do not highlight this in the results which focus on the electricity needs of BEVs and PHEVs.

This report is set out in five sections. The methodology is described in Section 2. Section 3 describes the scenarios. Section 4 outlines the scenario and data assumptions. The resulting updated 2025 projections are presented in Section 5 and compared to the previous CSIRO projections.

2 Methodology

AEMO requires two different types of projections: the number of electric vehicles and their electricity consumption. The technology types we include are:

- Battery electric vehicle (BEV) with short- and long- range variations
- Plug-in hybrid electric vehicle (PHEV)
- Fuel cell electric vehicle (FCEV)

Internal combustion vehicles are also part of the method since they represent most of the existing stock of vehicles but are not a focus of the projection results. Vehicle types included are:

- Motorcycles
- Passenger vehicles with small, medium and large sizes
- Light commercial vehicles with small, medium and large sizes
- Trucks of which there are two types: rigid and articulated
- Buses

The number of each vehicle and technology type is an essential input to calculating electricity consumption from road transport. The number of vehicles is calculated via methodologies described further below. The calculation of electricity consumption is carried out in two ways (Figure 2 1). Two methods are required because data is needed on both the total annual consumption but also shape of electricity consumption on a daily half-hourly basis. The half hourly data can be summed up to a year as a crosscheck on the annual data.

Annual consumption is calculated by multiplying the number of vehicles by the kilometres each vehicle travels per year and its electricity consumption per vehicle per kilometre. Half hourly electricity load is calculated by multiplying the number of vehicles by the half hourly charging profiles weighted by the percentage of each profile that applies to that vehicle. Each half hourly profile is in kilowatts and the charge at any point in time is based upon various charging behaviour types and the daily distance travelled (which relates back to the annual vehicle kilometres but with some consideration of weekday/weekend and monthly variability). To aggregate the half hourly consumption to an annual consumption amount, each half hour in the year is summed up (and divided by two to convert kilowatts to kilowatt hours).

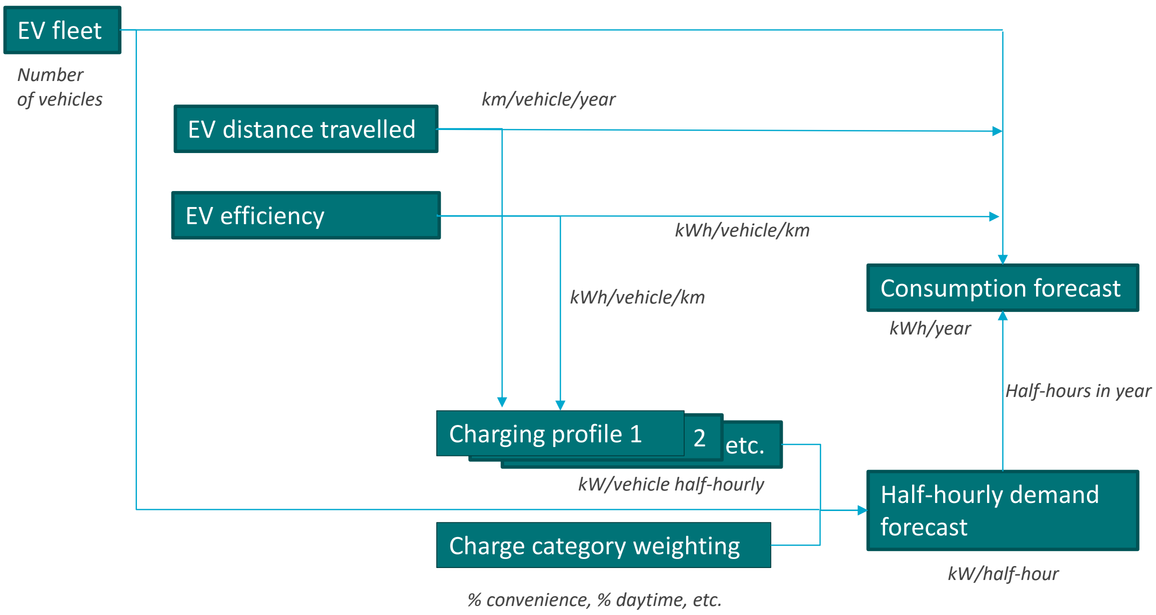

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Figure 2-1 Illustration of the two ways in which electric vehicle consumption is calculated (jointly developed with AEMO).

2.1 Adoption projections method overview

The projections for the number of vehicles are provided for periods of months, years and decades. Consequently, the projection approach needs to be robust over both shorter- and longer-term projection periods. The longer-term adoption projections are based on fundamental models of relevant drivers that includes human behaviour, market behaviour as well as physical drivers and constraints. While these models are sound, long term adoption models can overlook short term variations due to imperfect information, unexpected shifts in key drivers and delays in observing the current state of the market[1]. To improve the short-term performance of the adoption models, the approach should ideally include a specific shorter-term projection approach to account for short term variations in the EV market.

Short term projection approaches tend to be based on extrapolation of recent activity without considering the fundamental drivers. These include regression analysis and other types of trend analysis. While trend analysis generally performs best in the short term, extrapolating a simple trend indefinitely leads to poor projection results as fundamental drivers or constraints on the activity will assert themselves over time, shifting the activity away from past trends.

Based on these observations about the performance of short- and long-term projection approaches, and our requirement to deliver both long- and short-term projections, this report applies the combination of a short-term trend model and two long-term models. The first long term model is a Consumer Technology Adoption Model. The Transport Demand Model determines the total number of vehicles of any type that will be needed over the projection period. Figure 2-2

[1] For example, in this report we have only been able to observe electric vehicle sales up to June 2022

provides an overview of the models and the projection timeline over which they are applied. The retirement model is deployed from around 60% sales but with some leeway to account for plausible global supply chain shifts. The following sections describe each of the models in more detail.

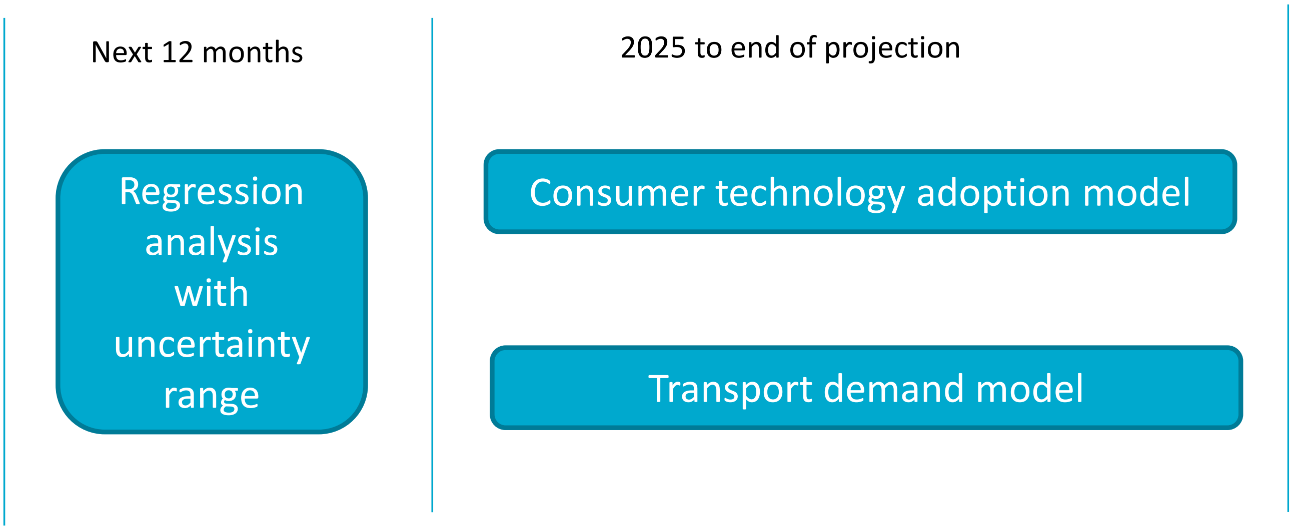

Figure 2-2 Models and the projection timeline over which they are applied

2.1.1 Trend model (regression analysis)

For the period to June 2024-25, trend analysis is applied to produce projections based on historical data. Only the most recent six to twelve months are included in the trend calculation to provide more emphasis on recent outcomes. At the state level, the historical sales data to the September quarter 2025 is sourced from the AAA EV Index. This source also provides fleet data to the postcode level.

The EV trend is developed as a linear regression or ratio of previous growth depending on whether recent quarters are typical of historical trends. A separate trend is developed for plug-in hybrid and battery electric vehicles (PHEVs and BEVs). Figure 5-1 shows the projections for the year ahead. The projected trend implies an expected recovery relative to the previous financial year which is evident in recent quarterly data.

The trend model also applies some variation between scenarios[2] in the short-term to capture uncertainty during this period. The *Slower Growth* scenario assumes the underlying trend remains unchanged. The trend for scenarios *Step Change* and *Accelerated Transition* is adjusted upwards to by 5% and 10% respectively. This captures the potential for stronger than linear growth which is aligned with those scenarios having stronger EV uptake. The ranges are based on the author's judgement of the degree of upside uncertainty in the trend.

[2] Not shown here. The variation is added as part of the results shown in Section 5. Figure 5-1 is the underlying trend only which is assigned to the *Slower Growth* scenario.

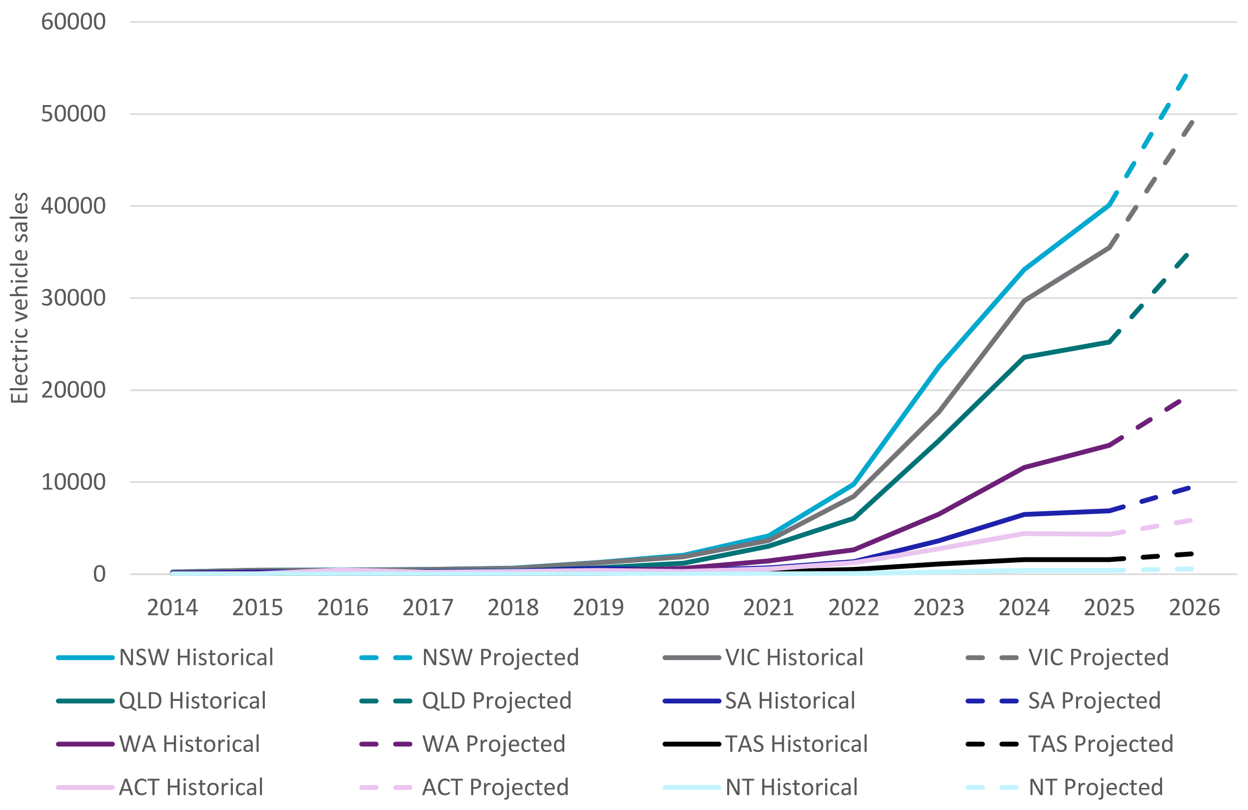

Figure 2-3 Historical and projected electric vehicle annual sales by state to 2026, *Slower Growth* scenario

2.1.2 Consumer technology adoption model

The consumer technology adoption curve is a whole of market scale property that is exploited for the purposes of projecting adoption, particularly in markets for new products. The theory posits that technology adoption will be led by an early adopter group who, despite high payback periods, are driven to invest by other motivations such as values, autonomy and enthusiasm for new technologies. As time passes, fast followers or the early majority take over and this is the most rapid period of adoption. In the latter stages the late majority or late followers may still be holding back due to constraints they may not be able to overcome, nor wish to overcome even if the product is attractively priced. These early concepts were developed by authors such as Rogers (1962) and Bass (1969).

Adoption as a function of payback or time

Over the last 50 years, a wide range of applications seeking to use this as a projection tool have experimented with different ways of implementing the adoption curve. In the past, CSIRO had calibrated adoption to changes in the payback period (see the methodology discussion in Graham, 2022). This adoption curve could be used to project adoption over time when the payback period changed over time. However, the methodology presented here changes that approach and relates adoption directly to time without calculating the payback period.

The were several reasons for this change in methodology. The payback period calculated was most heavily influenced by the vehicle cost. However, with the introduction of the New Vehicle Efficiency Standard (NVES), vehicle manufacturers will be incentivised to cross subsidise electric vehicles either through an internal mechanism or through the receipt of credits from other vehicle manufacturers who do not sell enough electric vehicles or other low emission vehicles to meet the standard which applies to all manufacturers. This mechanism means that, in terms of the direction of cause and effect, vehicle costs will change to meet the target level of average efficiency of each manufacturers vehicles sold rather than vehicles costs determining what is sold. It is therefore no longer appropriate to have a method where vehicle costs drive the projections.

Even when the payback period approach was applied, the results were modified in the latter half of the projection period to account for the withdrawal of commercial services for internal combustion vehicles. Once electric vehicles sales reach a majority, it becomes less convenient to own and maintain an internal combustion vehicle reducing sales and accelerating their retirement before their normal end of life. This increased electric vehicle sales even further beyond what the payback period approach would project on its own. The payback period also becomes somewhat meaningless when electric vehicles reach cost parity which they have been widely predicted to do so in the next decade[3]. At cost parity the payback period can no longer improve and is therefore no longer a driver of adoption.

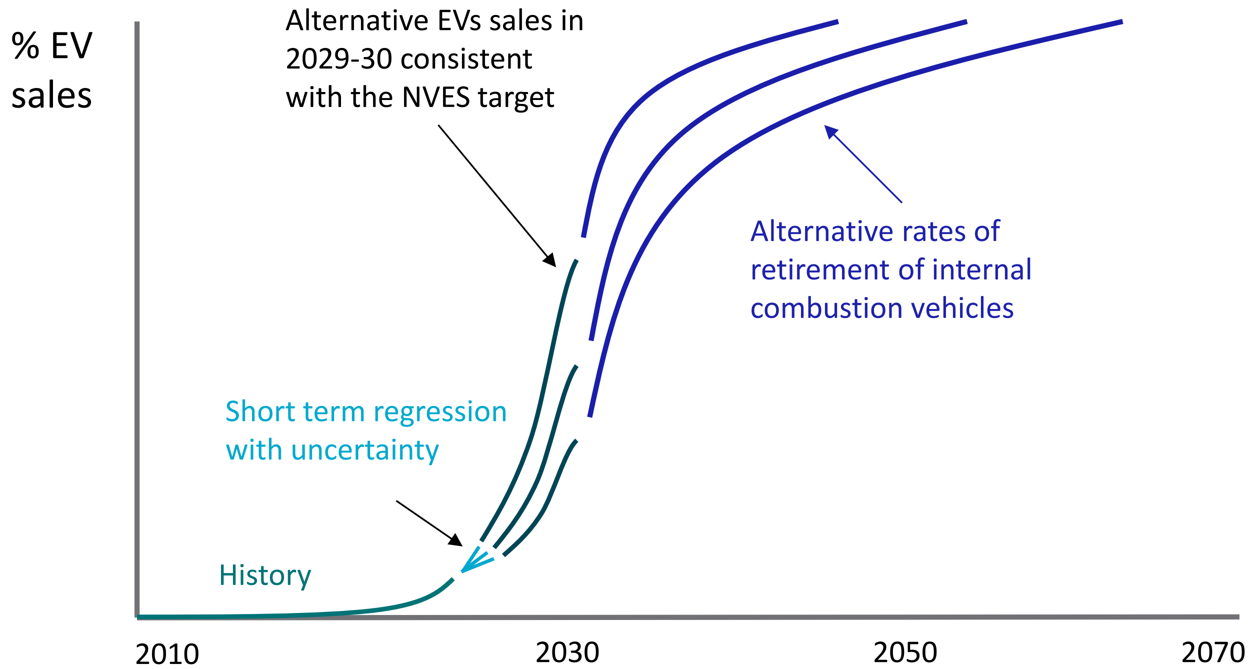

Figure 2-4 Adoption model methodology overview

Both the previous approach and the new approach are centred around three important points in time: the year ahead trend projection to 2025, meeting the NVES target in 2029 (or 2029-30 in our financial year projections) and the end point as defined by the year in which electric vehicles have almost fully replaced the internal combustion vehicle fleet except for a few special-purpose and

[3] Electric vehicle costs have been falling but not as fast has previously hoped. There is now a more complex environment then previously envisaged. Global inflationary pressures following the pandemic temporarily halted cost reductions in most technologies worldwide. Furthermore, some western countries have started to view lower cost Chinese electric vehicles as a threat to the long erm market share of their domestic automotive industries. Several leading global manufacturers such as Toyota have yet to fully put their weight behind electric vehicle models. These factors add significant uncertainty to the timing of cost parity but not to the long term direction of cost changes.

historic vehicles. As discussed above the 2025 point is determined by regression analysis combined with an overlay of uncertainty depending on the scenario.

Meeting the NVES target

The EV sales share in 2029-30 is determined by an algorithm which is applied to determine what combinations of internal combustion, hybrid, PHEV and BEV vehicles are consistent with meeting the passenger and light commercial vehicle efficiency standards. Multiple combinations are feasible but we select a range that results in a spread of low medium and high EV uptake across the scenarios. Where EV uptake is lower, more hybrid vehicles are sold to meet the standard. Conversely, in the high EV uptake scenario, hybrid sales grow more slowly.

Policies have been adopted per AEMO's approach as described in Stage 1 of the Draft 2025 Inputs Assumptions and Scenarios Report. Where a state electric vehicle sales target has been determined to be part of the scenario assumptions, the state sales target is assumed to prevail (and might exceed that average the sales rate as determined by the NVES target). This leads to higher electric vehicles sales in those states with a target relative to those without applicable state targets. Jurisdictional targets that are not required by AEMO's approach may still be met or exceeded due to the NVES target, depending on the scenario. See section 3.1.3 for further details on policy and target treatment.

The end point

The end point, where EVs have replaced most of the internal combustion fleet is the most uncertain aspect of the projection given it is the furthest point in time. While the timing is uncertain, it is widely accepted that electric vehicle costs are likely to progress downwards to the point where they become economically attractive to a wide range of consumers, achieving a majority sales share (we define this typically around 60% but with some leeway to account for plausible global supply chain shifts).

If EVs reach this point, the transport supply industry may continue to supply both internal combustion engine (ICE) and EV vehicles services in parallel for a time. However, there will become a tipping point where vehicle manufacturers no longer develop new ICE vehicle models. The lack of new models makes further declines in the sales of ICEs inevitable. Following that, the support and servicing of internal combustion vehicles will begin to contract. Refuelling stations will eventually need to close due to low petroleum fuel sales volumes or reorient their business towards the needs of electric and fuel cell vehicles. Given the operating life of internal combustion vehicles we expect this process of a withdrawal of commercial services for ICE vehicles will take around a decade from when majority EV sales are achieved. At this point EV sales achieve close to 100% share and remain there until a new technology challenger emerges.

The end point timing is defined by scenario assumptions with earlier end-points assigned to scenarios with higher EV uptake. Plausible endpoint dates are from 2035 at the earliest[4] to around 2050. Earlier dates are more consistent with the transport sector making a reasonable contribution to meeting Australian net zero by 2050 target. However, any residual emissions from

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[4] Some European countries have considered banning internal combustion vehicles sales as or near this date. This is not to suggest Australia is considering such bans but bans in other regions of the world may influence attitudes more broadly to internal combustion vehicles.

internal combustion and hybrids vehicles that still remain in the fleet could be either offset through emission savings elsewhere in the economy or directly addressed through low emission liquid fuels such as biofuels and synthetic fuels.

Three-point calibration and spatial, technological and type disaggregation

The adoption curve as a function of time is a logistic function in mathematical terms. The method calibrates an adoption curve for each scenario to our three points: the 2025 year ahead projection of EV sales share, the 2029-30 EV sales rate consistent with the NVES target and end point at which EV sales reach near 100% sometime between 2035 and 2050.

This is the high level view. However, for greater accuracy, it is necessary to disaggregate these broad drivers down to greater levels of spatial, technological and vehicle type detail.

Spatial disaggregation

From a spatial perspective we calibrate each adoption curve at the postcode level. We take our national level view of the 2029-30 calibration point and adjust those values to take account of local factors. The 2025 calibration point is adjusted based on the historical distribution of vehicles by postcode. The end point is common to all postcodes since the preferences of a single postcode will never outweigh global trends in the provision of internal combustion vehicles.

Local factors for adjusting the 2029-30 calibration point are drawn from accessible demographic data and historical sales shares by state. States which lead or lag in electric vehicles sales are assumed to continue to do so. In applying demographic factors, CSIRO assigns different weights to each factor to reflect their relative importance.

Previous analysis by Higgins et al (2012) validated several demographic factors and weights for Victoria. A similar combination of factors and weights is applied across all states and outlined in Table 2-1. These weighting factors provide a guide for the adoption locations, particularly during the early adoption phase which Australia currently remains in. However, adoption is allowed to grow in all locations over time. It is likely that some of the factors included act as a proxy for other drivers not explicitly included (such as income).

Table 2-1 Weights and factors for electric vehicles

Factors	Weight ranges
Share of ages (in 10-year bands)	0-1 with the 35 to 54 age bands receiving highest scores
Share of number of household residents (1-6+)	0.3-1 increasing with smaller households
Share of educational attainment	0.25-1 for advanced diploma and above, 0 otherwise
Share of mode of transport to place of work	1 for car, 0 otherwise

The weights, defined in the range of 0 to 1 for each factor are used to calculate a score for each postcode to indicate relative propensity for electric vehicle uptake. After a general level of national electric vehicle adoption in 2029-30 is set, for example 50%, the postcode score is used to adjust the local level of adoption up or down. An algorithm is applied to ensure the national NVES target is still met despite varying postcode level targets.

Technological and vehicle type disaggregation

A separate adoption curve is calculated for each technology and vehicle type. As discussed, we use an algorithm to determine combinations of hybrids, PHEVs, BEVs and HVs consistent with meeting the NVES. However, there is some subjective judgement involved. BEVs and hybrids are in a leading market position over PHEVs and HVs and so their contribution is assumed to be much higher. BEVs are also assumed to have a dominant share in the light vehicle category at the end point given PHEVs will still have some emissions and are expected to be higher cost at that point in time given the decline of internal combustion vehicle manufacturing and lower battery costs. HV market share is not expected to grow significantly by the end point except in scenarios that are more aligned with a hydrogen economy.

The NVES only applies to cars and light commercial vehicles. Consequently, trucks and buses are assumed to have a more delayed uptake of electric vehicles. While most state governments have credible plans to convert their bus fleets to electric vehicles. Commercial trucks and buses will wait until they present an economic advantage. However, it is possible some future legislation may eventually force the industry to move faster, and it is reasonable to anticipate this as part of the scenario design.

Light commercial vehicles are assumed to adopt BEVs slower than the passenger vehicle types due to the lack of electric light commercial vehicle models currently offered. It is also assumed that whether passenger or light commercial vehicle types, larger vehicles within those vehicle types are slower to adopt electric vehicle technology.

2.1.3 Transport demand model

An overview of the process of projecting transport demand is shown in Figure 2-5. Growth in passenger (passenger kilometre) and freight (tonne kilometre) transport demand is driven by growth in population and GDP. This is a widely recognised relationship and the data models employed by CSIRO draw heavily on the annual BITRE (2023) *Infrastructure Yearbook* which provides historical transport activity data back to 1975. This provides a sound foundation from which to project transport activity forward.

GDP historically has been the stronger driver of both types of transport, but in more recent decades population has been better at explaining growth in passenger transport. This is because most forms of transport are now affordable under current average household income. That is, the demand for passenger transport per person has reached a saturation point as cost of transport is not a significant barrier. New passenger transport demand is therefore driven by growth in population (immigration assumptions therefore become important).

Future mode share assumptions are developed based on an observation of historical trends and consideration of the future of cities in Australia that includes specific government programs to extend airports, rail and road infrastructure. For the non-road sectors, fuel consumption projections are based on multiplying projected demand by long term trends in fuel efficiency. In the past CSIRO would include some changes in transport mode[5] shares over time. For example, historically, aviation had been steadily capturing more of the passenger share market. However, the COVID-19 pandemic has interrupted and reversed some of these trends. Road and the active share of transport increased while aviation and rail decreased. The assumptions for the future of passenger mode shares are outlined later in the report. Freight transport mode shares were less impacted by COVID-19 and so their historical trends in mode share are allowed to continue with some differences in the rate of change by scenario (Section 4.8 shows the impact of these assumptions).

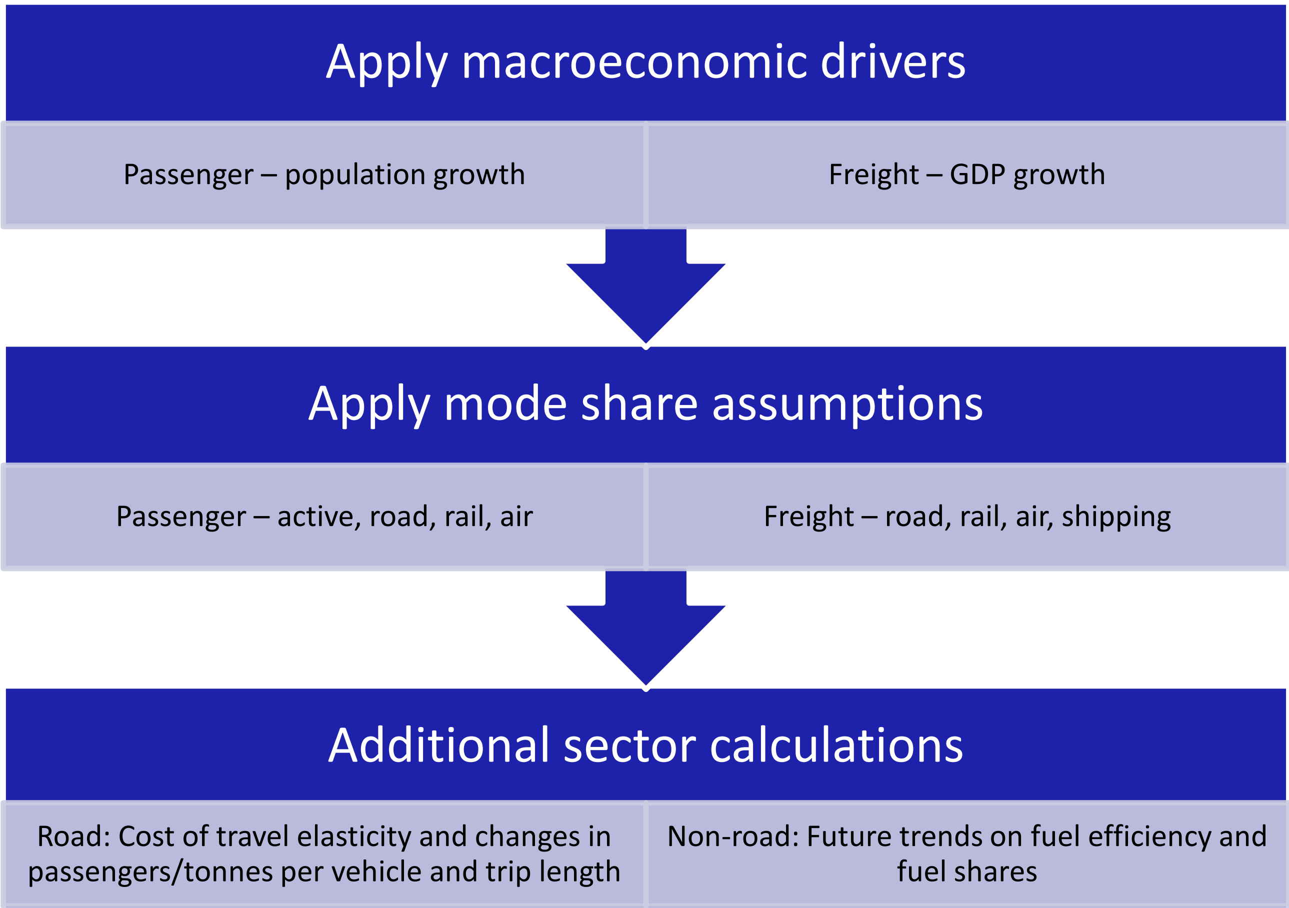

Figure 2-5 Overview of transport demand model

There are several more steps in projecting road sector transport demand. The first additional step is that the demand model takes cost of travel information from the adoption model and applies a price elasticity to demand of -0.2[6]. That is, if the cost of road transport (passenger or freight) is expected to fall by 10% this will lead to 2% increase in road transport demand. Conversely a 10% increase in cost of travel would lead to a 2% decrease in transport demand. Cost of travel is

[5] In transport sector generally, the key transport modes are road, rail, aviation, shipping and active. The active transport mode includes walking and cycling. In the road sector we also talk about cars and trucks as sub-types of road transport modes.

[6] Transport demand elasticities have been studied for many decades. This site summarises available evidence: https://www.bitre.gov.au/databases/tedb

measured in dollars per kilometre and includes the whole cost of vehicle ownership and operation. The main driver of rising transport costs in the future is expected to be fuel prices. However, improved fuel efficiency and higher vehicle utilisation from vehicle electrification and autonomous vehicles[7] respectively could see costs fall.

The second additional step is to take account of changes in the vehicle load. For example, a decrease in passengers per vehicle implies more vehicle kilometres will be required to meet total demand for passenger kilometres. Similarly, an increase in tonnes per vehicle capacity would mean fewer vehicles were required to meet freight tonne kilometre demand. Tonnes per vehicle are held constant over time for freight vehicles. Passengers per vehicle increases if the adoption model projects greater adoption of rideshare services.

The final step takes account of changes in trip length which is measured in aggregate by kilometres per vehicle. Kilometres per vehicle is varied to take account of changes due to the impact of COVID-19 and of autonomous vehicles and ride sharing. COVID-19 has reduced average kilometres per vehicle for passenger vehicles. The data now indicates vehicle utilisation has recovered, although still a little lower in some states which might reflect greater or lesser degrees of long term uptake of working from home arrangements, reducing commuter trips. This utilisation factor was a significant source of volatility in electric vehicle numbers between CSIRO projection but is likely to be a lesser factor in the future now that the long term impacts of COVID-19 are more easily observable in the historical transport data.

The model projects the uptake of autonomous vehicles and ridesharing and their impact on transport demand. Ride sharing increases the number of passengers per vehicle which on face value reduces the amount of vehicle kilometres needed to meet passenger kilometre demand and this is taken account of in the previous step. However, the most convenient service[8] would pick up and drop off each passenger at their destination meaning that each passenger takes a longer trip than if they had used a non-ride sharing mode. These extra kilometres associated with ride sharing trips are considered in this step.

Depreciation rates

Transport demand and vehicle utilisation are mostly responsible for setting the future level vehicle sales and fleet numbers but depreciation or scrapping rates are also important. If depreciation is higher then more sales are needed to maintain or grow the fleet and meet demand. Towards the end of the projection period our adoption model proposes that depreciation will increase because of the commercial withdrawal of services for internal combustion vehicles. Under these circumstances, with ICE services being more difficult to access, consumers will naturally want to limit their exposure to ICE vehicles. At this point consumers only have three choices: sell the

[7] Autonomous vehicles are assumed to all be electric because they are only widely available after electric vehicles become the dominant vehicle sold. Autonomous vehicle technology can apply to all vehicle types such as cars, buses and trucks.

[8] Note that the Australian version of UberPool currently does not directly pick up and drop off at your desired points. Rather it includes some walking to connect you with the route an existing vehicle is travelling and may include some walking after drop-off. However, some overseas version include point to point drop-off and pick-up. https://www.uber.com/en-AU/ride/uberpool/

vehicle before the end of its natural life, scrap[9] it if they are unable to find a buyer or garage the vehicle (using it infrequently for special occasions).

The early removal of ICE vehicles from the fleet, while road transport demand is still growing, means that there will need to be a period of accelerated electric vehicle sales to make up the gap. We generally replace around 5% of vehicles in the fleet each year but that number if lower or higher depending on the region of Australia. The rate of replacement in the period of faster than normal fleet replacement is calculated by the model depending on the starting and end points of the electric vehicle fleet under the scenario. The period continues until the fleet reaches a new equilibrium where almost the entire fleet is electric, or hydrogen fuelled (allowing for a small number of special purposes ICE vehicles). This process is outlined in (Figure 2-6)

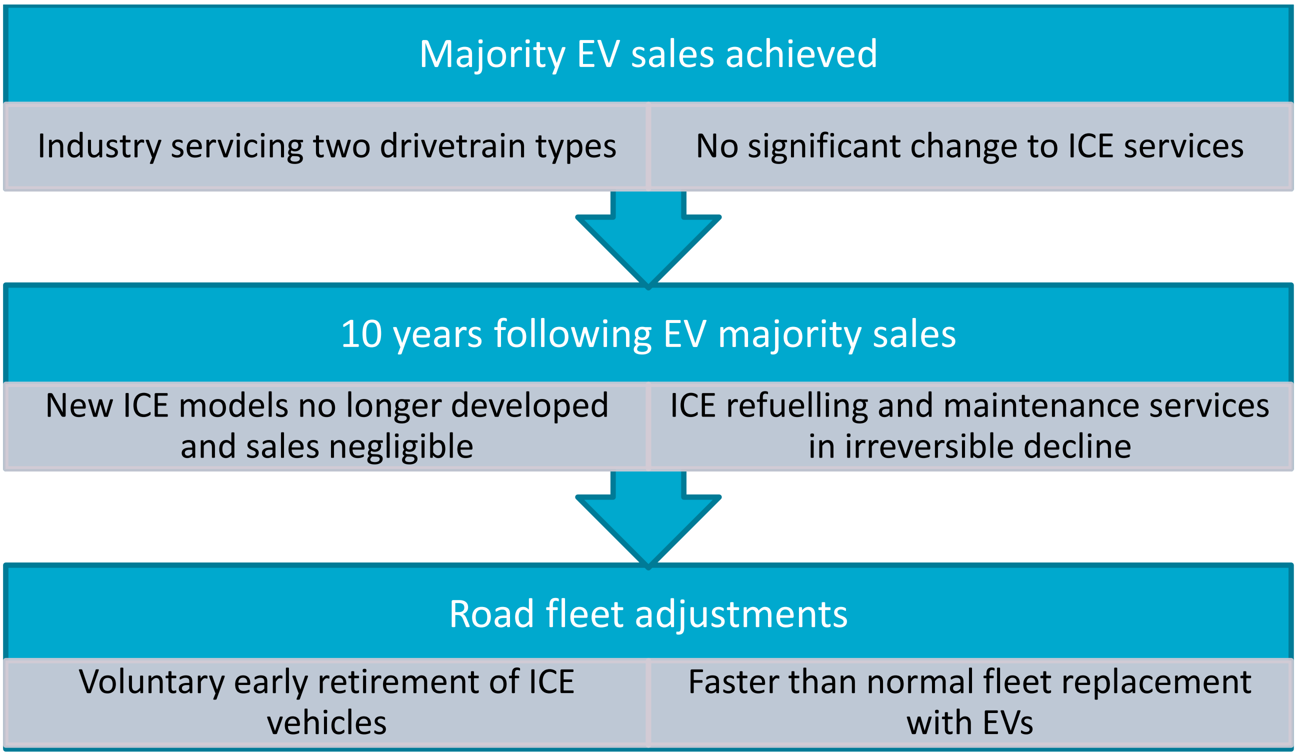

Figure 2-6 Implications of EV sales reaching a majority for depreciation

2.2 Role of economic growth in projection method

Population and economic growth projections are sourced from AEMO's consultants. Economic growth closely tracks changes in residential and business income and is a metric for the general health of the economy. This section provides an overview of how changes in economic growth impact the projections through the modelling approach we apply.

Income influences the electric vehicle adoption model only through the size of transport demand. Economic growth is not considered in the demographic score for calibration of the electric vehicle

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[9] Around a quarter of Australia's steel is produced from scrap recycling. This is where most vehicles are sent when they are no longer road worthy. Some usable parts are extracted beforehand. The value of the vehicle depends on the current price of steel. In densely populated areas, owners can expect to receive a small fee (no more than a few hundred dollars) down to a free takeaway service. Remotely located vehicles will have to pay for removal (and as a result may be left on vacant land). Given we are focussed on a mass scrapping event in these projections, our assumption is that there is no payment to owners but the vehicle is taken away for free.

adoption curve. Passenger transport demand is a larger component of transport, and this is driven by population growth. However, demand for light commercial vehicle and truck transport is driven by economic growth. This means, while stronger demand for EV means more vehicle sales, it influences only a small proportion of total vehicle sales. A large proportion of sales is car replacement, making up about 80% of sales.

With this context, it can be concluded that changes in economic growth only impacts around 20% of the sales of a minority of vehicle types (freight vehicles only). As such, alternative economic growth assumptions only have a marginal direct impact on EV projections. Indirectly, if higher economic growth occurred due to higher population growth, that mechanism would broaden the impact of higher economic growth because the whole of transport demand is experiencing higher demand. In that case, the impact would still affect approximately 20% of sales increasing in line with increases in GDP and population.

3 Scenario definitions

The three scenarios defined in this section are *Slower Growth*, *Step Change* and *Accelerated Transition*. The AEMO scenario definitions are described in narrative form and then by their key drivers in Table 3-1.Further detail is available in AEMO (2025). To implement the electric vehicles projections, CSIRO has developed an additional set of extended scenario definitions based on more detailed road transport sector drivers that are covered in the broader scenario design process.

3.1.1 AEMO's scenario narratives and definitions

Slower Growth

This scenario achieves the objectives of Australia's government policies in transitioning the energy system, and reflects domestic action to contribute to lesser global ambition to extend specific commitments to limit temperature rise. It is a future that is challenged by lesser economic growth and greater challenges than other scenarios, and AEMO has reflected on stakeholder concerns that the previous *Progressive Change* name did not reasonably convey this key distinguishment relative to other scenarios. The new *Slower Growth* name provides increased clarity that while Australia's economy continues to grow in the long term, it has slower growth and lesser continued action beyond current commitments. Amidst weaker domestic and international economic conditions, Australia's energy-intensive industry and businesses are at greater operating risk, and a material proportion of the business sector closes in this scenario in the short to medium term. Energy efficiency, CER and electrification investments are naturally lower due to the weaker economic circumstances, and consumers lower their enthusiasm for offering their assets to third-party coordination.

Step Change

This scenario achieves the objectives of Australia's government policies in transitioning the energy system, and reflects a scale of global and domestic action that limits global temperature rise to below 2°C compared to pre-industrial levels. Similar to the 2023 *Step Change* scenario, consumers continue to embrace opportunities to support the transition through continued investment in consumer energy resources (CER), energy efficiency and electrification, or other investments that can contribute to reducing emissions. While consumers' own energy assets (that is, investments in rooftop solar, batteries and electric vehicles) are a key part of the transition, consumers are more tentative to share control and coordinate the operation of their energy devices through a third party than previously assumed in this scenario, relative to the 2023 IASR's *Step Change*. In this scenario, Australia's economy grows similar to historical trends, while emerging trends in artificial intelligence and other data-heavy applications encourage growth in data centres in Australia.

Accelerated Transition

This scenario achieves the objectives of Australia's government policies in transitioning the energy system, and provides an 'upside alternative' that explores the possible drivers for rapid emissions reduction domestically and globally. The scenario refines the 2023 *Green Energy Exports* scenario – it continues to feature a rapid transformation of Australia's energy sectors greater than that required by current domestic and global decarbonisation commitments, to limit temperature rise to 1.5°C above pre-industrial levels. This acceleration in the energy transition is fundamental to the scenario, and the scenario's new name captures this key driver more clearly than previous names that described a specific solution. The acceleration in investments across the economy is supported by positive economic conditions domestically and internationally, increasing the local population through migration and assuming a faster growing economy than other scenarios. With these conditions, consumers' own investments in CER, energy efficiency and electrification, and emerging opportunities in green commodity development, all provide key contributions to consumers' energy demand. Compared to the 2023 *Green Energy Exports* scenario, the role for hydrogen production is significantly lower, reflecting current uncertainties affecting commercial investment and supportive policy.

Table 3-1 AEMO scenario definitions (current at time of modelling)

	Slower Growth	Step Change	Accelerated Transition
National decarbonisation targets	At least 43% emissions reduction by 2030. Net zero by 2050	At least 43% emissions reduction by 2030. Net zero by 2050	At least 43% emissions reduction by 2030. Net zero by 2050
Global economic growth and policy coordination	Slower economic growth, lesser coordination	Moderate economic growth, stronger coordination	High economic growth, stronger coordination
Australian economic and demographic drivers	Lower, with near-term economic growth calibrated with current economic conditions	Moderate economic growth, with near-term economic growth calibrated with current economic conditions	Higher, with near-term economic growth calibrated with current economic conditions
Electrification	Electrification is tailored to meet existing emissions reduction commitments, with slower adoption given weaker economic circumstances	High electrification to meet emissions reduction commitments, with pace of adoption reflecting economic conditions	Higher electrification efforts to meet aggressive emissions reduction objectives, with faster pace of adoption
Emerging commercial and industrial loads	Emerging sectors such as data centres experience lower growth as weaker economic circumstances limit technology uptake	Emerging sectors such as data centres match opportunities associated with moderate domestic economic drivers	Emerging sectors such as data centres match opportunities associated with higher domestic economic drivers
Coordination of CER (VPP and V2G)	Low long-term coordination, with gradual acceptance of coordination	Moderate long-term coordination, with gradual acceptance of coordination	High long-term coordination, with faster acceptance of coordination
Energy efficiency	Moderate	High	Higher

Hydrogen use and availability	Low production for domestic use, with no export hydrogen	Moderate-low production for domestic use, with no export hydrogen	Moderate production for domestic industries and green commodities, with no export hydrogen
Industrial load closures	Weak economic conditions provide challenging commercial conditions, resulting in closures of industrial loads	No specific load closures	No specific load closures
Demand-side participation uptake	Lower	Moderate	Higher
CER investments (batteries, PV and EVs)	Lower	High	Higher
Renewable gas blending in the gas distribution network (vol%)	Up to 5% hydrogen blending by 2050, with unlimited blending opportunity for biomethane and other renewable gases	Up to 2% hydrogen blending by 2050, with unlimited blending opportunity for biomethane and other renewable gases	Negligible hydrogen blending by 2050, with unlimited blending opportunity for biomethane and other renewable gases
Potential for supply chain limitations affecting demand forecasts	High	Moderate	Low
Global/domestic temperature settings and outcomes	Applies Representative Concentration Pathway (RCP) 4.5 where relevant, consistent with a global temperature rise of ~ 2.6°C by 2100	Applies RCP 2.6 where relevant, consistent with a global temperature rise of ~ 1.8°C by 2100	Applies Representative Concentration Pathway (RCP) 1.9 where relevant, consistent with a global temperature rise of ~ 1.5°C by 2100
International Energy Agency (IEA) 2024 World Energy Outlook scenario alignment	Stated Policies Scenario (STEPS)	Announced Pledges Scenario (APS)	Net Zero Emissions by 2050 NZE

3.1.2 Extended scenario definitions

The AEMO scenario definitions have been extended in Table 3-2 by adding additional detailed assumptions on the economic, infrastructure and business model drivers for road transport. The purpose is to fill out more detail about how the scenarios are implemented whilst remaining consistent with the higher level AEMO scenario definitions. The scenario definitions are in some cases described here in general terms such as “High” or “Low”. More specific scenario data assumptions are outlined further in Section 3.

Table 3-2 Extended scenario definitions

Driver	Slower Growth	Step Change	Accelerated Transition
Cost of fuel cell vehicles	High	Medium-high	Medium
Growth in apartment share of dwellings	Medium-low	Medium	Medium-high
Decline in home ownership	High	Medium	Low
Extent of access to variety of charging options	Low	Medium	High
Feasibility of ride sharing services	Low	Medium	High
Affordable public charging availability	Low	High	High
Vehicle to home or grid (passenger vehicles)	Yes from 2028	Yes from 2028	Yes from 2028
New ICE vehicle availability concludes[1]	2050	2045	2040
ICE commercial services collapse / no longer viable to operate[1]	2060	2055	2050

1. Special purpose vehicles and articulated trucks exempted. Commercial services include fuel supply, parts supply and mechanical repairs.

3.1.3 Government policy

The major new policy impacting the outlook for electric vehicles is the New Vehicle Efficiency Standard (NVES) which is discussed below. At an Australian government level the Fringe Benefits Tax exemption remains in place which increases the amount of salary remaining after an employee has sacrificed part of their salary towards a novated vehicle lease. This therefore presents as a subsidy.

The projections produced in this report meet the policies and targets as detailed in AEMO's Stage 1 Draft 2025 Input, Assumptions and Scenarios Report, whereby policies and targets listed in the AEMC (2025) *Emissions targets statement* under the national energy laws are included in the forecast. These are presented in Table 3-3. AEMO's Input, Assumptions and Scenarios Report recognises the 2030 targets for Victoria, Queensland and South Australia.

Table 3-3 Summary of relevant state EV targets under the AEMC's emission targets statement under the national electricity laws

State	Target
ACT	ACT Zero Emissions vehicle (ZEV) strategy 2022-2030 • ZEV sales target for ACT of 80-90% by 2030 • No new ICEV into taxi or ride share fleets by 2030 • Cease registration of new non-ZEVs by 2035 • At least 180 chargers by 2025.
New South Wales	Nil
Northern Territory	Northern Territory EV strategy and implementation plan 2021-2026 • Increase the number of EVs in NT Government fleet by 20 per year over ten years, totalling 200 vehicles by 2030. • Reduce stamp duty for first time registration of new and second hand EVs in the Northern Territory by $1500 for five years
Queensland	Zero Emission Vehicle Strategy 2022-2032 • 50% of new passenger vehicle sales to be zero emissions by 2030 and 100% by 2036 • 100% of eligible Qfleet passenger vehicles (incl. SUVs) to be zero emissions vehicles by 2026 • Every new TransLink funded bus added to the fleet to be a zero emission bus from 2025 in South East Queensland and from 2025–2030 across regional Queensland
South Australia	170,000 EVs to be on SA roads by 2030 and 1m EVs integrated into the electricity system over the next 20 years.
Tasmania	Target to convert government fleet to 100% electric by 2030
Victoria	Zero Emissions Vehicle (ZEV) Roadmap • 50% of light vehicle sales to be ZEVs by 2030 • Electric vehicle charging stations across Victoria by 2024
Western Australia	Nil

New Vehicle Efficiency Standard

An Australian wide new vehicle efficiency standard[10] (NVES) for light vehicles has been legislated commencing in 2025 with the first target period carrying through to 2029. Each manufacturer must meet per kilometre efficiency standards. There are slightly higher targets for utility vehicles and large four wheel drives (4WDs). Manufacturers are penalised or credited for under- or over-achievement respectively. Credits and penalties can be carried over some years. While the penalty/credit system is designed to ensure that the sector meets the efficiency target (on average) over the target period, each manufacturer will independently determine whether any positive net credit/penalty positions are passed through to their respective vehicle model price ranges.

A range of vehicle technology type configurations will meet the target. Stronger improvements in internal combustion vehicles (ICEs) and non-plug-in-hybrids (hybrids) reduce the share of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) required to meet the target (Figure 3-1).

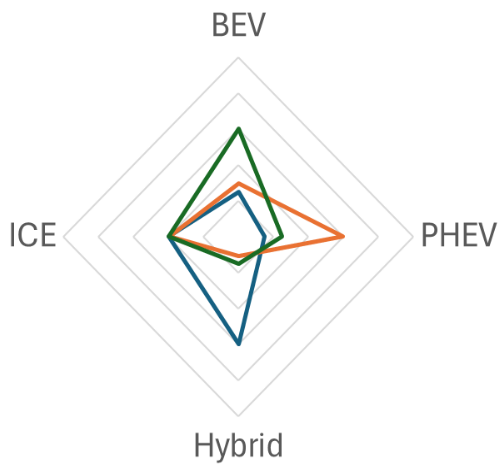

Figure 3-1 Schematic of vehicle technology combinations consistent with meeting the NVES target

From a business perspective, manufacturers who have a competitive advantage in vehicle technologies based on internal combustion engines will emphasise advanced ICEs, hybrids and PHEVs in the models they make available. Manufacturers who have no experience in ICE technology will emphasise BEVs in the models they seek to sell.

Consumers are expected to be influenced by what is available but also make their own preferences known. Hybrids and PHEVs are likely to have stronger appeal to some consumers than BEVs because hybrids and PHEVs are likely to meet a wider range of customer needs such as relatively lower cost, high travel range, wider range of models, reliability history and established after sales support. BEVs are decreasing in cost and a wider model range is expected to become

[10] These are implemented as fuel efficiency standards but are targeting an emission outcome. When fuel is consumed in a vehicle it is nearly 100% combusted and as such the amount of emissions released into the atmosphere is in a direct proportion to fuel use. Zero greenhouse gas emission fuels such as electricity and hydrogen are considered to have no emissions or fuel consumption for the purposes of the standards. European Union legislation also allows for synthetic fuels made from hydrogen and captured CO_2 to be deemed as a zero emission fuel. Standards already exist in Australia for emission of non-greenhouse gases such as nitrogen oxides and particulates.

available but from a much lower base. Initially less established after sale support and high insurance costs will be a concern for some consumers but less so for new technology enthusiasts.

2030 sales targets resulting from NVES policy

The competitive tension between new BEV focussed manufacturers and ICE manufacturers in how they meet the NVES target combined with the divergent needs of customers underpins significant uncertainty in the technology mix in 2030. Some key factors that will help to shape the outcome are:

- Hybrids are currently cheaper than BEVs with long travel range. There has been a substantial increase in hybrid sales in 2024.
- Global vehicle manufacturers have their own 2030 targets for EVs (often a combination of BEV and PHEV). Most are aiming for 50% or 100% by 2030. However, those manufacturers with a target of around 30% are typically Asian vehicle brands. These are brands which are commonly sold in Australia (e.g. Toyota, Mazda, Hyundai).
- Prior to NVES, most state targets were aiming for 50% EV car sales. Victorian, Queensland and South Australian targets are imposed as minimum levels in 2030.

Based on these factors *Step Change* is assigned a 57% target for BEV and PHEV vehicles which is considered the most likely outcome in a world with reasonably strong global climate policy coordination. *Slower Growth* and *Accelerated Transition* explore relatively weaker and stronger BEV and PHEV shares respectively reflecting their weaker and stronger global climate policy ambitions.

Table 3-4 Assumed light vehicle new sales share by scenario consistent with meeting the NVES and state targets by end of 2029

	Slower Growth	Step Change	Accelerated Transition
Hybrid	20%	18%	15%
BEV plus PHEV	55%	57%	60%
ICE	25%	25%	25%

Reflecting the policy design and fewer range of models available for large vehicles, small to medium size cars will deliver a greater share of this target. Furthermore, the new sales share achieved will differ because of regional differences in preferences and driving conditions. Regions with longer driving ranges will have greater concerns about the range capability and adequacy of charging infrastructure for electric vehicles and lag other states with shorter driving distances. Charging infrastructure will be more economic to deploy in more densely populated areas. Any minimum state sales targets are always achieved but their degree of over achievement in some scenarios will be subject to these additional regional factors.

4 Data assumptions

The scenario assumptions are implemented by data inputs that vary across the scenarios. This section provides further detail on those data inputs.

4.1 Income and population growth

4.1.1 Gross state product

Gross state product (GSP) assumptions by scenario are presented in Table 4-1 and these are provided by AEMO and their economic consultant. These assumptions have been applied to project total commercial and freight vehicle numbers. Strong growth in total vehicle numbers leads to higher sales of all vehicle technology types and ultimately higher numbers of electric vehicles. Lower growth in total vehicles leads to few electric vehicles in the projections.

Table 4-1 Average annual percentage growth in GSP to 2050 by state and scenario, source: AEMO and economic consultant

	New South Wales	Victoria	Queensland	South Australia	Western Australia	Tasmania	Australian Capital Territory
Slower Growth	1.4	1.5	1.5	1.0	1.2	1.1	1.3
Step Change	1.9	2.0	1.9	1.5	1.7	1.5	1.8
Accelerated Transition	2.6	2.8	2.6	2.2	2.4	2.1	2.5

4.1.2 Population

Population growth assumptions by scenario are shown in Table 4-2 and these are provided by AEMO and their economic consultant. These assumptions have been applied for determining growth in passenger transport demand.

Table 4-2 Average annual percentage rate of growth in population to 2050 by state and scenario, source: AEMO and economic consultant

	New South Wales	Victoria	Queensland	South Australia	Western Australia	Tasmania	Australian Capital Territory
Slower Growth	0.8	1.0	1.0	0.5	0.8	0.3	0.9
Step Change	1.0	1.3	1.2	0.7	1.0	0.5	1.1
Accelerated Transition	1.3	1.5	1.4	1.0	1.2	0.7	1.3

4.2 Separate dwellings and home ownership

Owing to rising land costs in large cities where most residential customers reside, there is a trend towards building of apartments or town houses, compared to detached and semi-detached houses (also referred to as separate dwellings in housing statistics). As a result, it is expected that the share of separate dwellings will fall over time in all scenarios (Figure 4-1). The trend is strongest in the larger states of NSW, Queensland and Victoria with the trend being flatter to very slightly rising in others. This assumption does not preclude periods of volatility in the housing market where there may be over and undersupply of apartments relative to demand. The assumptions have been provided by AEMO and their economic consultant.

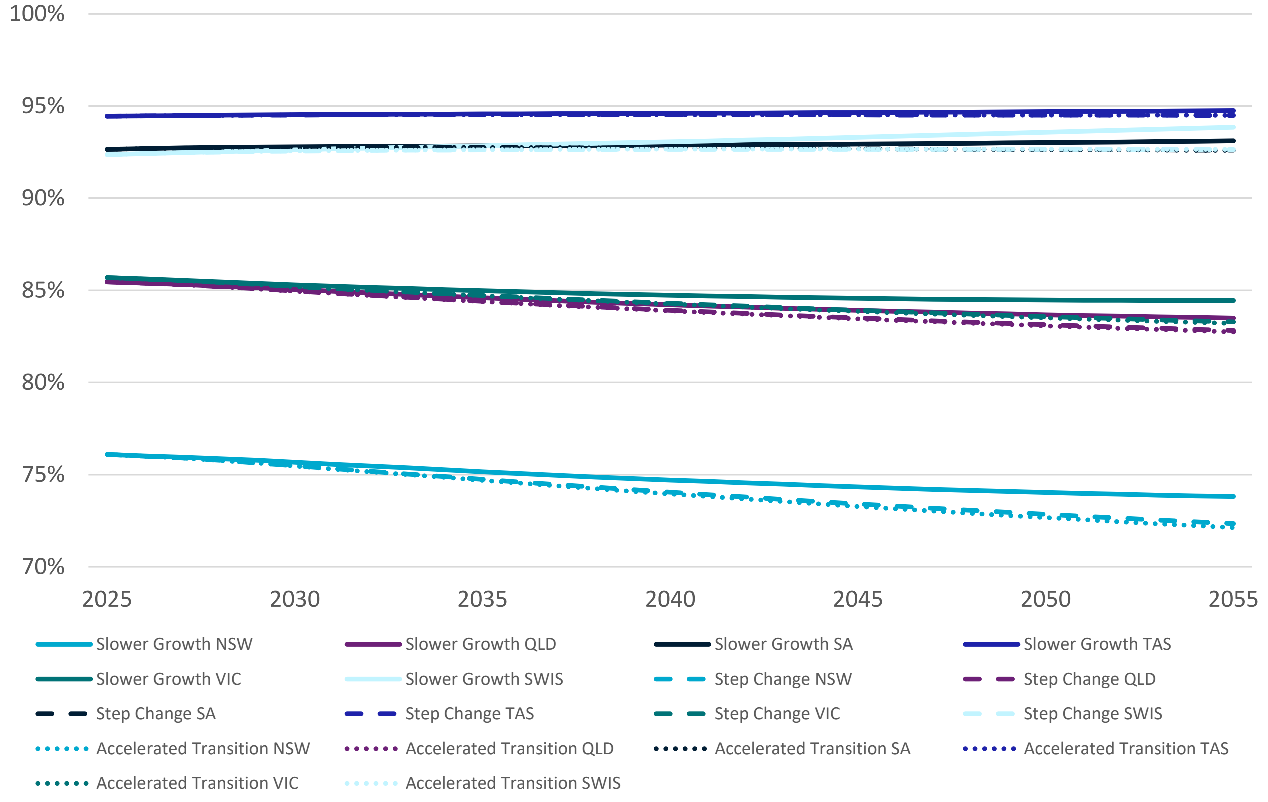

Figure 4-1 Assumed share of separate dwellings in total dwelling stock by scenario

AEMO's consultant does not provide home ownership projections. Home ownership projections are shown in Figure 4-2 with home ownership being higher the stronger the economic growth and climate policy ambition. If housing is less affordable then it will be more difficult to attract labour to the required locations and there will be less political support for higher order concerns such as health of the environment.

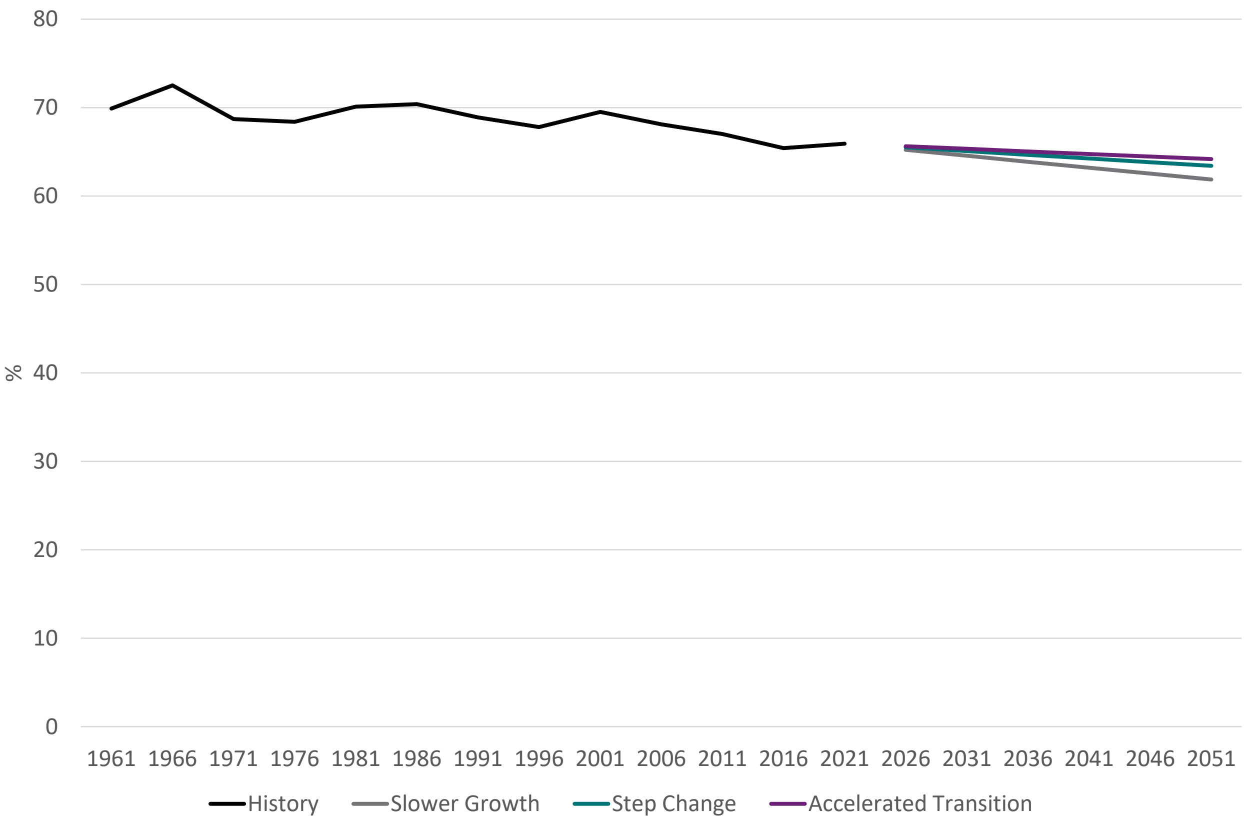

Figure 4-2 Projected home ownership rates by scenario

4.3 Shares of electric vehicle charger types and charging behaviour

Charging behaviours are directly related to the charger type given that the size of the charger can influence power demand over time and the degree of control over charging. Charger types include Level 1 and Level 2 chargers which may be public or private and fast direct current chargers which are generally public. Truck and bus fleets may also use a version of fast charging given their much larger power needs. Level 1 chargers use a standard power point and existing wiring. A level 1 charger can recover average daily driving in 2 to 3 hours. However, a 500km range electric vehicle requiring a full charge after a longer trip would take 30 to 40 hours to recharge. Level 2 chargers require new wiring and deliver higher charge. They can recharge average daily travel in an hour and a full recharge in around 14 hours. Fast chargers require specialised distribution connections as well as new wiring but can recharge average daily travel in minutes and a full recharge in a few hours depending on the size.

4.3.1 Charger type

There is no public source of data which directly links charging profiles to charger type. The profile shape of the small number of publicly available charging profile studies can be inferred to relate to a particular tariff type since the presence of a time of use tariff tends to create an obvious reduction in charging at peak times. Publicly available charging profiles also contain an obvious daytime increase in charging regardless of the tariff type indicating that some owners are taking advantage of their lower cost home solar electricity production to charge their vehicles. These conclusions are based on observing the charging shape and reports of reasonable high solar ownership in Australian charging trials.

Most charging trials provide some information about the type of chargers used and the degree of home versus away charging in their sample of EV owners. From this information, an estimate of the current share of charger types by vehicles is presented in Table 4-4. Shares of charger type by scenario were then projected forward based on the following principles:

- Workplace and public charging will decline in the short term as it becomes more congested and moves to a more commercial footing. However, in the long run it will need to grow to accommodate housing which has limited off-street parking. More fast public charging will also be preferable for all households regardless of home charging access as more electric passenger vehicles are used for longer trips. A complete recharge is much easier to achieve at a public fast charger.
- Greater coordination of electric vehicle charging will be required as the share of the EV fleet increases, and this activity will be more associated with Level 2 chargers (the required communication and other capability is more likely to come as an extra feature in Level 2 than in lower cost Level 1 devices). The stronger the climate policy, the faster the electric vehicle uptake and greater the resulting coordination (which is to the benefit of the system by increasing access to storage resources and also to individual consumers who would receive direct payments).

This approach leads to a lower share of Level 1 chargers and a drift towards more high powered charging for all vehicle types over time, the faster the electric vehicle uptake in each scenario. The main reason why charging does not shift even more strongly to workplace and public charging is the limitations to funding the infrastructure. The appetite from EV owners for more convenient charging will be strong but ultimately the charging infrastructure needs to be funded. The product being supplied at work or public spaces can be accessed at home for a few dollars a day. This puts a limit on how many customers would be willing to pay a premium to owners of public or workplace chargers for their electric supply. A premium is likely to be necessary to cover the cost of installing workplace and public chargers, notwithstanding any subsidy programs that may be available in the short term[11].

4.3.2 Charging profile type

The next step is to relate these charger type shares to charging profiles. The current and projected charging profile shares are shown in Table 4-5. To create this data, the principles for relating charger type to charging profiles were:

- Level 1 charger ownership was assumed to be more associated with unscheduled charging profiles given a simple power point offers the least capability in terms of power available and control. However, it is recognised that charging can be scheduled by in-car settings and so not all level 1 charging is associated with unscheduled charging.

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[11] For example, Western Australia has a relevant subsidy scheme: https://www.wa.gov.au/organisation/energy-policy-wa/charge-workplace-ev-charging-grants

- Level 2 charging was assumed to be associated with TOU tariff charging and business vehicles are generally assumed to be facing TOU tariffs than passenger vehicle owners.
- The degree of TOU charging that included price structures designed to encourage day or solar aligned charging was limited by the vehicle type. Passenger vehicles were considered to be most amenable to taking up this incentive. Light commercial vehicles, buses and trucks were significantly less amenable due to their greater day time use of the vehicle.
- Public chargers are assigned the profile that have been collected from public chargers.

Vehicle to grid (V2G) and vehicle to home charging (V2H[12]) are assumed to require at least a Level 2 charger but are otherwise considered as an independent assumption (included in row 3 of Table 4-5 data).

There are a few changes to assumed charging shares. Continued growth in time of use (TOU) tariff assignment supported a small upward revision in the TOU charging profiles to 2030, but the 2050 share remains the same. Secondly the publicly charging share was increased in 2024 due to stakeholder input but this assumption has been difficult to verify and so has been reduced for the current year consistent with more verifiable trial data. Public charging to 2030 has also been reduced to recognise greater plug-in hybrid share of electric vehicles. Plug-in hybrids have a smaller onboard battery and a so will have less need of public charging. The 2050 assumption for the share of public charging is unchanged.

Table 4-3 provides a guide to the charging profile names and abbreviations that are used.

Table 4-3 Guide to charging profile naming conventions

Descriptive name	New abbreviation
Unscheduled home charging, flat tariff	UNSCHED
TOU tariff with no day incentives other than use of home solar	TOU_HOME_SOLAR
Vehicle to home/grid (dynamic system-controlled charging)	V2G/V2H
Public L2 and fast charge	PUBLIC
TOU tariff including day charging incentives	TOU_GRID_SOLAR

[12] Vehicle to load (V2L) where a car might provide power directly to a variety of electric appliances is treated as a sub-category of V2H for the purpose of this report.

Table 4-4 Assumed shares of different electric vehicle chargers by vehicle type by 2050

Vehicle type	Charger type	Current (estimated)	Slower Growth	Step Change	Accelerated Transition
Passenger	Home - L1	49%	44%	39%	28%
	Home - L2	16%	30%	26%	28%
	Work - L2	5%	10%	15%	20%
	Public - L2	6%	4%	5%	6%
	Public - Fast	24%	12%	15%	18%
LCV	Home - L1	38%	18%	14%	10%
	Home - L2	13%	28%	21%	14%
	Work - L2	45%	50%	60%	70%
	Public - Fast	5%	4%	5%	6%
Truck/bus	Work - L2	29%	24%	19%	14%
	Work - Fast	69%	72%	76%	80%
	Public - Fast	2%	4%	5%	6%

Table 4-5 Assumed shares of different charging profiles by 2050

	Current (estimated)	Slower Growth	Step Change	Accelerated Transition
Passenger - Unscheduled home charging, flat tariff	50%	37%	32%	21%
Passenger - TOU tariff with no day incentives other than use of home solar	18%	9%	8%	7%
Passenger - Vehicle to home/grid (dynamic system-controlled charging)	0%	17%	23%	32%
Passenger - Public L2 and fast charge	30%	16%	20%	24%
Passenger - TOU tariff including day charging incentives	2%	20%	18%	16%
LCV - Overnight due to day use of vehicle	78%	77%	71%	65%
LCV - Daytime oriented allowing for vehicles parked at workplace	17%	19%	24%	30%
LCV - public fast charge	5%	4%	5%	6%
Trucks & buses - Overnight due to day use of vehicle	86%	83%	77%	70%
Trucks & buses - Daytime oriented allowing for vehicles parked at workplace	12%	13%	18%	24%
Trucks & buses - public fast charge	2%	4%	5%	6%

4.3.3 Vehicle to grid and vehicle to home

From 2028 V2G and V2H are assumed to be able to stand up as standard market offerings, recognising the available capacity of battery storage is large enough to be of interest to the electricity market[13] and for home use. For example, if long-range electric vehicles are popular, each vehicle will represent around 100kWh of battery storage – some nine times larger than the historical average 11kWh stationary batteries that are marketed for shifting rooftop solar for households[14]. It is therefore natural to consider whether this battery storage resource could be used either after its life on board a vehicle or during that life. In this report we consider on board use.

The average vehicle in Australia travels around 11,000km per year. For an EV of 400km range and 0.2kWh/km the battery size is around 80kWh, the average daily charge cycle will be 6kWh which is a depth of charge/discharge of around 8%. If a driver were to travel 3 times that distance each year the charging demand and subsequent battery cycle life still does not present a great limitation on use.

Given the expected under-working of electric vehicle batteries, on average, it therefore makes sense to consider how to get more use out of the battery while it is on the vehicle. Household yearly average electricity demand is 6000kWh or 16.4kWh/day. As such, any fully charged electric vehicle, short or long range, can cover the required power needs with room to spare for the daily commute. However, the most likely candidate for vehicle to home would be a longer-range vehicle with around 100-120kWh battery storage. Such a vehicle could deliver energy to a home and would on average only lose 110km or 16% or less of its 660+km range for the next day's drive.

Vehicle to home would best suit a household that has access to charging at their normal place of daytime parking (i.e., at work, home (solar) or in a carpark). Apart from getting better utilisation out of an existing resource (the battery storage capacity in the vehicle), the other financial incentive to this arrangement is the potential that the vehicle can charge up at lower cost. This follows the general expectation that in the long term, as solar generation capacity increases, the lowest priced period for electricity from the grid will be around midday. The economics would also work well for the charging infrastructure provider. Instead of simply providing electricity for each car's daily driving needs (around $2/day) they can instead provide their car plus home needs ($7/day).

The process is achievable from a technical point of view with a more specialised connection to the home. Several manufacturers have made this capability available while recent research has shown that any EV with a CCS2 plug type can be V2G or V2H compatible[15].

[13] The scenario design assumes this to occurs at measurable levels from 2028 to 2030. However it is recognised that V2G already exists individuals conducting personal trials and in business level trials such as https://www.amber.com.au/blog/amber-partners-with-australian-renewable-energy-agency-for-ev-and-vehicle-to-grid-optimisation and https://www.csiro.au/en/news/All/Articles/2024/October/V2G-vehicle-to-grid-technology.

[14] However, at the time or writing, these sizes have been increasing significantly following introduction of subsidies from the Cheaper Home Batteries Program.

[15] https://zecar.com/reviews/new-study-on-vehicle-to-grid.

The major difference with vehicle to grid is that it may push the boundaries further in terms of utilisation of the vehicle battery to meet system needs which may be greater than home needs. The business model in this case includes reaching an agreement with the vehicle owner on how much of the battery capacity can be accessed so that the owner's transport needs are not compromised[16]. Potential faster and deeper discharges could shorten the vehicle battery life. Nevertheless, the scale of electric vehicle battery capacity in the higher EV uptake scenarios (even accounting for low availability and only accessing half the battery) could be sufficient to avoid the need for major large-scale battery deployment. As such, some level of compensation will be available to vehicle owners.

Vehicle to grid trials are also proceeding, but will take a few years to deliver their lessons. As such, and consistent with the scenario assumptions (Table 3-2), the share of vehicles participating in vehicle to grid is assumed to be negligible over the next few years before growing more significantly from 2028 in all scenarios.

Our assumption is that commercial vehicles will not participate in either vehicle to grid or vehicle to business (home). The rationale is that higher duty vehicles will have less excess capacity that owners would be willing to make available to the grid. Commercial vehicles may still support the system through non-dynamic pricing (tariffs).

4.3.4 PHEV charging

More information has become available in regard to how often PHEVs are charged to allow for greater share of kilometres running on electricity rather than liquid fuel[17]. The information suggests that private vehicle owners have strong incentive to reduce fuel costs by keeping PHEVs charged. However, fleet vehicles (light commercial vehicles) are not charged as often. This may be because employees lack sufficient incentive to charge them. For larger trucks the share of electric kilometres is reduced further based on their duty cycle only allowing for very limited recharge opportunities. The assumptions used in the modelling are shown in Table 4-6

Table 4-6 Assumed share of electric kilometres travelled by vehicle type

Passenger	Light commercial vehicle	Rigid truck	Articulated truck	Bus
65%	35%	35%	20%	35%

4.4 Transport demand

The future number of electric vehicles is partly determined by demand for transport and the number of road vehicles required to meet that demand. To develop our road vehicle demand projections, the process commences by projecting demand for passenger transport (passenger

[16] For example, the Origin EV Power Up plan has this feature. https://www.originenergy.com.au/ev-power-up/.

[17] https://www.abc.net.au/news/science/2025-10-29/how-often-do-plug-in-hybrid-phev-users-recharge/105921670.

kilometres or pkm) and freight transport (tonne kilometres or tkm) across all transport modes. Passenger transport demand is a function of population, while freight demand is a function of economic growth. Next, assumptions are made about the share of transport delivered by each mode.

Before the COVID-19 pandemic a simple extrapolation of past mode share trends would have been appropriate because that event the aviation transport mode has been steadily gaining market share in passenger transport demand for decades at the expense of road transport. However, the COVID-19 pandemic has disrupted this trend. Besides the share of transport modes shifting, passenger travel was forced down by the pandemic and has not fully recovered to its previous levels. Due to the greater prevalence of working from home and use of telepresence rather than meeting in person in business, some passenger travel is likely permanently lost to transport demand. In contrast, freight transport was not significantly impacted by the pandemic.

It is assumed that the increased share of the road mode share persists in *Accelerated Transition* as this would be consistent with a strong vehicle market and strong climate action since road transport is the most amenable to adoption of low emission technologies such as electric vehicles. The *Step Change* and *Slower Growth* scenarios are assumed to progressively revert back to the historical trend of declining road mode share.

Given the lack of impact of the pandemic on freight transport mode shares the historical trend in mode share, namely rail share increasing at the expense of other modes, is allowed to continue but at different rates, with the strong usage of road modes again associated with stronger climate policy ambition.

Freight transport is highly sensitive to growth in Gross Domestic Product (GDP) and grows faster when economic growth is stronger which, in the AEMO scenarios, tends to be aligned with stronger climate action.

In some scenarios and modes the economic growth and mode share assumptions reinforce each other. In others they are countervailing forces. For example in passenger road transport the mode share is higher and the population growth strongest in *Accelerated Transition* and population growth and mode share are lowest in *Slower Growth* leading to a wide projection of road passenger kilometres. However, the mode share is weaker the stronger the population growth for passenger air and passenger rail leading to a narrower range of projected passenger kilometres for these modes.

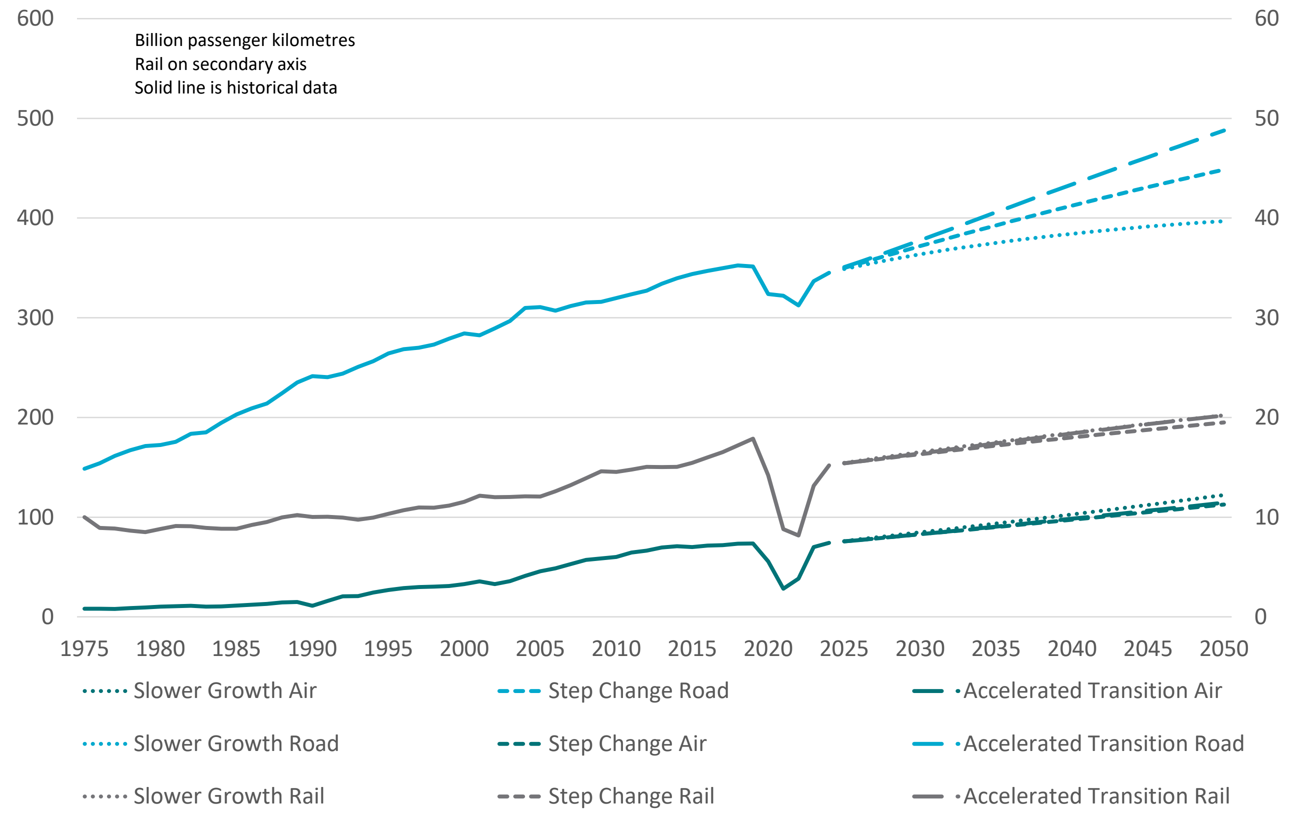

Figure 4-3 Historical and projected passenger transport demand

Assumed mode share changes also countervail the economic growth assumptions in the rail sector in freight transport in the same way that they do in aviation and rail passenger transport. Freight rail projections for *Accelerated Transition* has the strongest economic growth but with no growth in mode share to make it the second strongest projected rail freight tonne kilometres. Stronger growth in mode share means that rail freight tonne kilometres also grow strongly in *Step Change* and *Slower Growth* despite having relatively slower economic growth. For the other freight sectors, road, air and shipping economic growth and mode share move in the same direction creating proportionately wider uncertainty ranges across the scenarios.

The results of these passenger and freight transport demand projections are shown in Figure 4-3 and Figure 4-4. The reduction in passenger transport demand during the COVID-19 pandemic is strongly evident in the 2020 data. The data outlined in Figure 4-3 and Figure 4-4 are national, but the projections are developed for each state and account for different levels of disruption and recovery from COVID-19 by state.

To calculate road transport demand in vehicle kilometres the modelling approach also imposes a price elasticity response by tracking future road transport costs. In effect this creates a small rebound effect such that, if driving electric vehicles significantly reduces costs, there will be more demand for road travel.

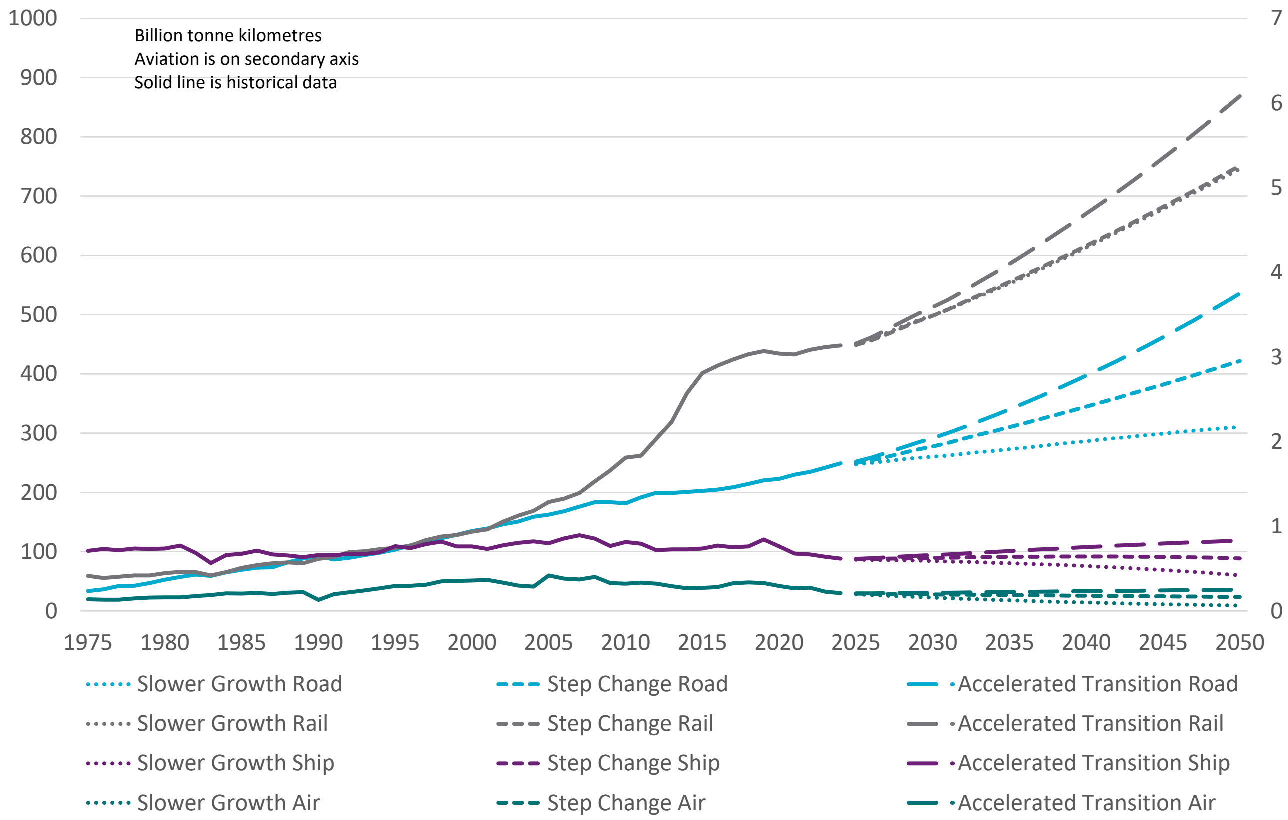

Figure 4-4 Historical and projected freight transport demand

4.4.1 Vehicle utilisation and numbers

To convert road passenger transport demand to vehicle numbers requires assumptions to be made about average kilometres travelled per vehicle. All passenger vehicle types (motorcycles, passenger cars and buses) in all states experienced a significant reduction due to COVID-19. All road vehicle types were traveling around 10% less per year on average than in 2022 compared to 2019. Western Australia, Northern Territory and the Australian Capital Territory had the least changes in vehicle utilisation.

This data indicates that working from home and greater use of telepresence in place of face to face meetings are likely to persist and as a result the modelling does not assume a full recovery in average kilometres travelled per vehicle.

Taking the passenger and freight kilometres projection in Figure 4-3 and Figure 4-4 and assumed average freight load and passengers per vehicle (the average is 1.59 for cars before adjusting for some uptake of rideshare vehicles in decades ahead), the road vehicle kilometres travelled to meet passenger and freight tasks is calculated and presented in Figure 4-5. The demand for road vehicles is calculated by dividing through by vehicle utilisation and the result is shown in Figure 4-6.

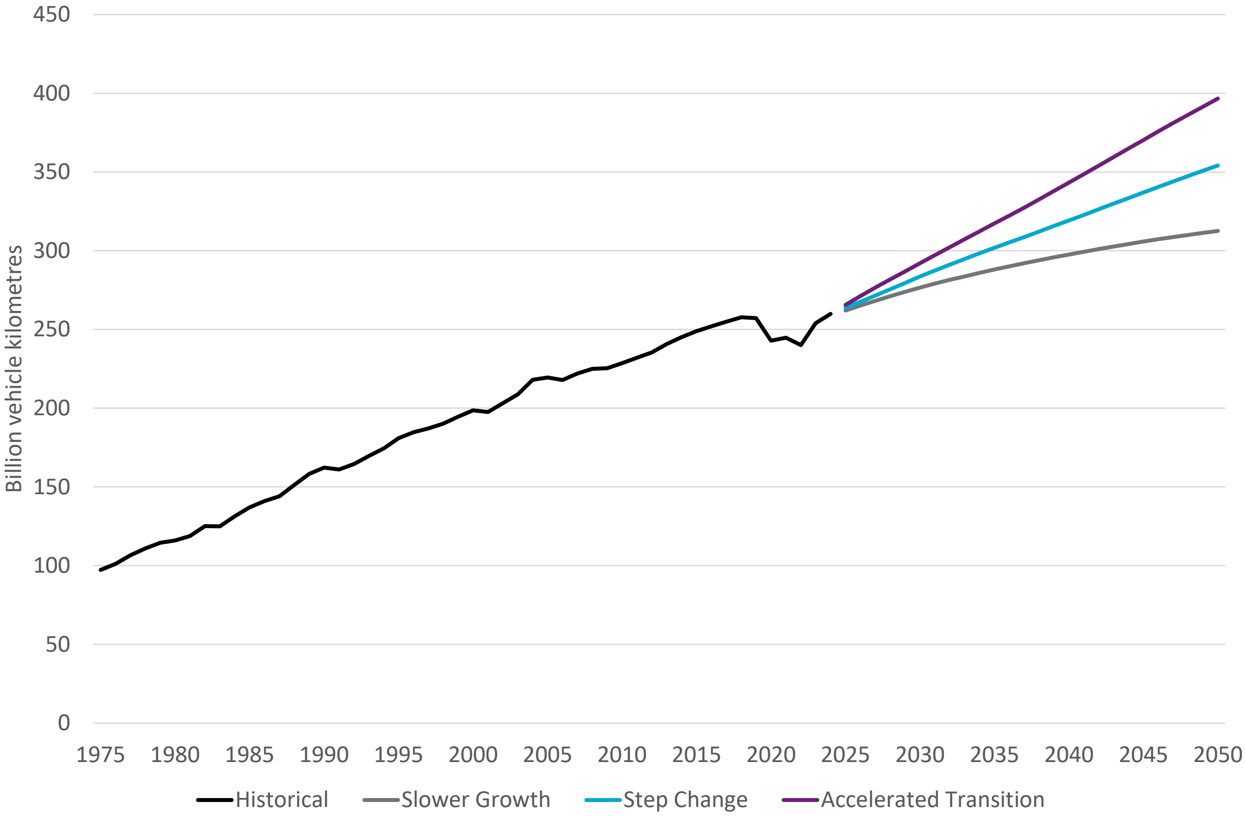

Figure 4-5 Historical and projected national road vehicle kilometres travelled, all road modes

The highest demand for road transport is in *Accelerated Transition* reflecting stronger economic and population growth and slightly stronger road share of passenger transport. *Slower Growth* has the lowest economic growth and population and most significant decline in road mode share of passenger transport. *Step Change* has medium economic and population growth and subsequent road transport demand. All scenarios are assumed to have slightly stronger growth in the short term during the ongoing recovery in passenger travel demand from the COVID-19 pandemic. As discussed, this recovery is assumed to be incomplete with some passenger travel demand permanently lost. Together with a declining rate of growth in population owing to historical trends in birth rates, this tends to result in a slowing trend in growth over time, particularly in *Slower Growth*.

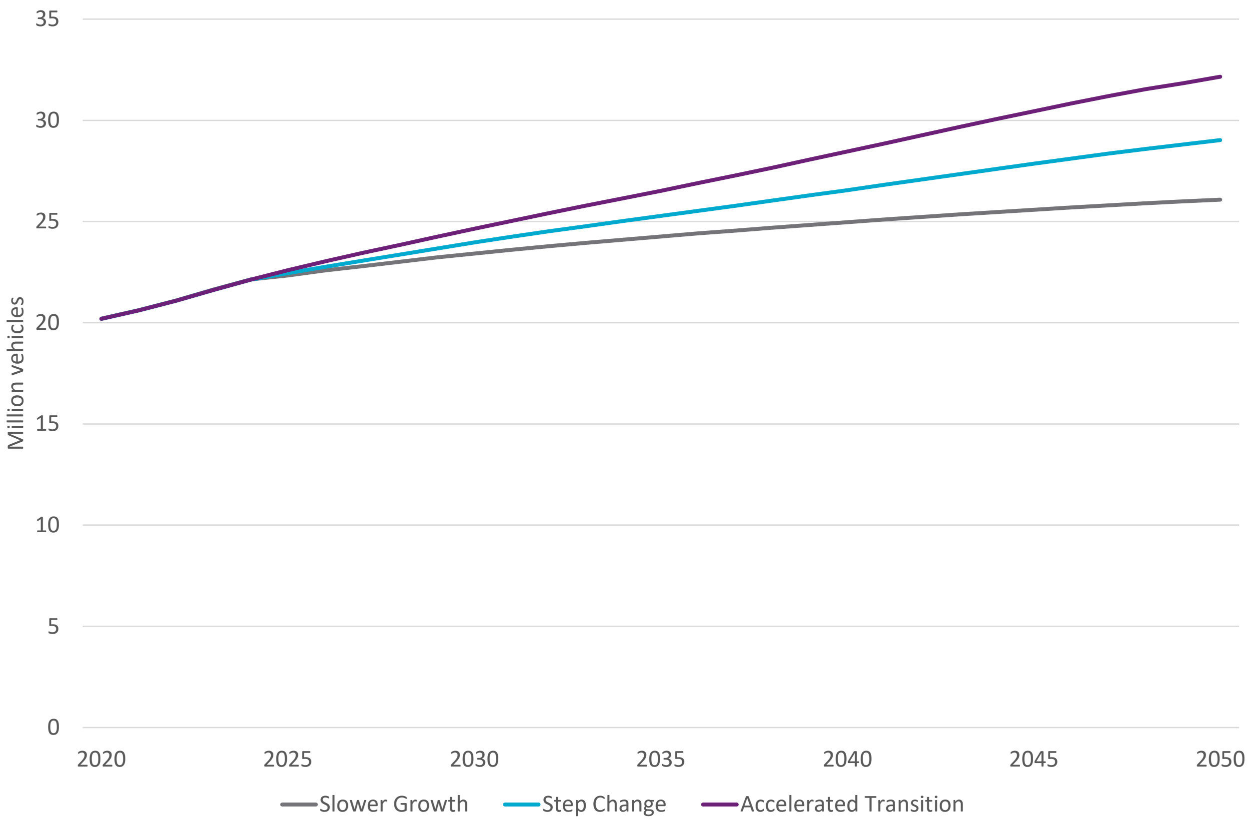

Figure 4-6 Projected national road vehicle fleet by scenario

4.5 Vehicle charging profiles

AEMO requires state level charging profiles which represent the aggregated charging profiles from all vehicles in the state divided by the number of vehicles. These are also called after-diversity profiles. After-diversity profiles are very different from individual charging profiles. The diverse behaviour of many individuals smooths and flattens out the kilowatts per vehicle charging profile compared to the behaviour of a single individual vehicle. Individual charging profiles are useful in circumstances where the behaviour being studied is at a less aggregated level such as charging demand at the street level. The profiles discussed here are not relevant for those lower scales.

A number of Australian trials have become available in the past three to four years which provide average daily load profiles. These include Energex and Ergon Energy Network (2022a, 2022b), AGL (2023), Jemena (2023), Origin Energy (2021, 2022) and Philip et al. (2022). The trials have been used to construct unscheduled (with flat tariff) and time of use (TOU) tariff charging profiles for light vehicles. Distinguishing between these two types of behaviours is not simple. It is evident that in the baseline data of Australian trials, some customer either have TOU tariffs or have voluntarily set their vehicles to charge after 9pm, in the case of Origin trial, after 8pm in the Philip et al. (2022) trial or after midnight in the Queensland trial. Based on the information provided in the trials, manual adjustments have been made to remove as much scheduling behaviour as possible in the unscheduled profile.

Several trials provide a separate TOU tariff daily profile, and they show that there is a very low, but not zero, rate of charging during peak times. When the off-peak period begins at night, charging is not constant. Instead, there is an immediate peak and then tapering off. While there is no off-peak period in the middle of the day TOU profiles show high charging during that time indicating that TOU customers are charging off their own solar. We call this profile TOU_HOME_SOLAR. We have also created a second profile called TOU_GRID_SOLAR which is designed such that it has an off-peak tariff period during the daytime as well as the night. This charging profile was created on the basis that the retailers will want to provide tariffs that encourage charging during the day as a voluntary measure that is aligned to balancing electricity supply and demand. More recently the government is consulting on introducing this as a requirement for retailers to provide such a tariff called the Solar Sharer Offer[18] which would guarantee a short period of 0c/kWh. While not yet a formal policy, to align with this potential policy, the TOU_GRID_SOLAR profile has been adjusted to have a narrower profile to recognise the proposed incentive is stronger (at 0c/kWh) and as such is likely to result in a more concentrated charging behaviour then the original design of that charging profile.

AEMO has provided CSIRO with data on public charger profiles. The data is based on actual public charging metering data. The public charging profile has been given a slight adjustment, increasing night time charging. This is to recognise that eventually some public charging will also provide more night charging (the current profile is heavily weighted toward daytime fast charging). This change recognises that nighttime, slower public charging will be a necessary service for some houses without off-street parking.

The current and 2050 aggregated national profiles for are shown in Figure 4-7 for cars and in Figure 4-8 for trucks and buses relative to previously assumed profiles. The changes relative to the 2024 projection are modest. The narrower profile on the TOU_GRID_SOLAR profile is evident in the shortening of the solar aligned charging period. This is offset by slightly more height at midday and slightly more night charging.

Between scenarios, there is a tendency towards less charging in the evening and more in the daytime (see the difference between “Current” and the remaining lines in Figure 4-7). These developments are strongest in *Accelerated Transition*, more moderate in *Step Change* and weakest in *Slower Growth*.

Trucks and buses perform heavy duty cycles in the sense that they carry heavy loads for long distances. While most cars will only use a small portion of their battery for daily travel, for cost and cargo space reasons, trucks and buses will likely be configured so that they consume close to their full battery capacity each day. This means that they need to do most of their charging at night and will need much more of the available night hours to get back up to full charge, particularly large articulated freight trucks. The updated projections reduced fuel cell articulated trucks and re-assigned the majority of those vehicles to BEVs. As a result, there are more articulated trucks in the truck and bus profile shown in Figure 4-8. This results in more night time charging relative to the 2024 projections.

Between the scenarios, the modelling allows for a slight increase in day time charging compared to “Current” for a minority of lower utilised or night duty trucks and buses that might have that option to take advantage of lower midday charging costs.

[18] https://consult.dcceew.gov.au/solar-sharer-offer

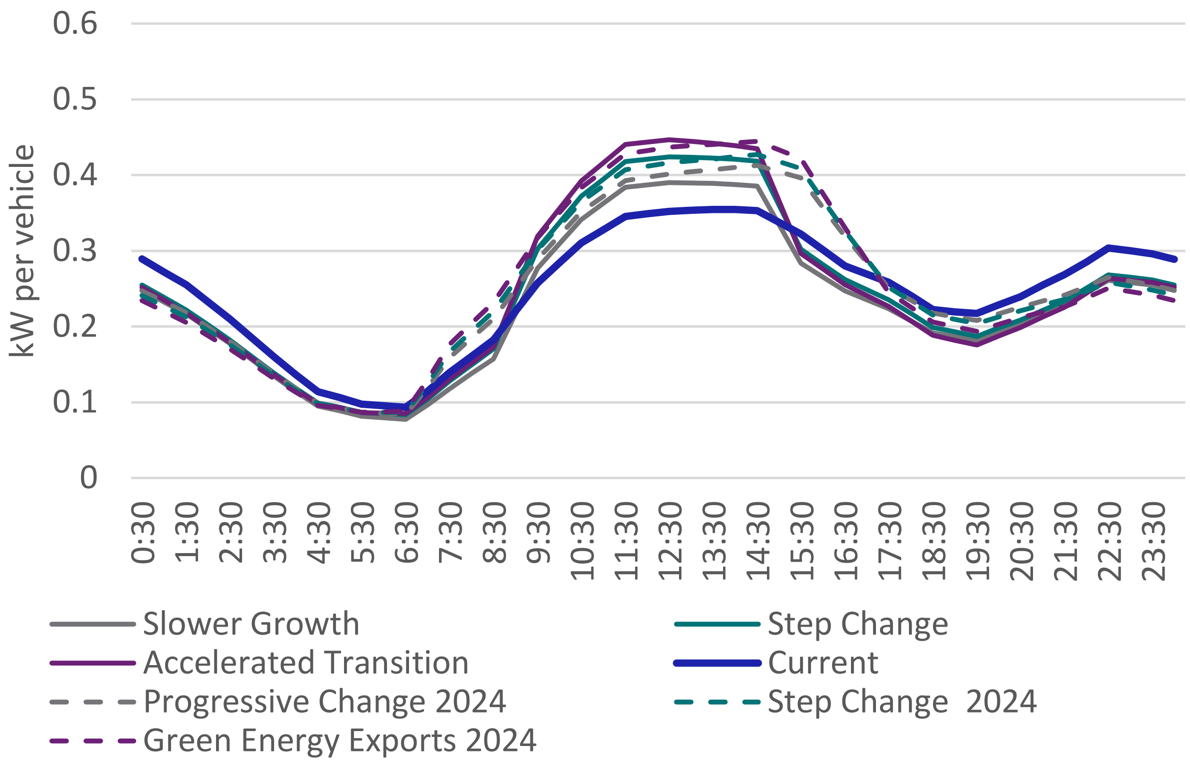

Figure 4-7 Aggregated electric vehicle charging profile for cars, Current and 2050, by scenario relative to March 2024 projections

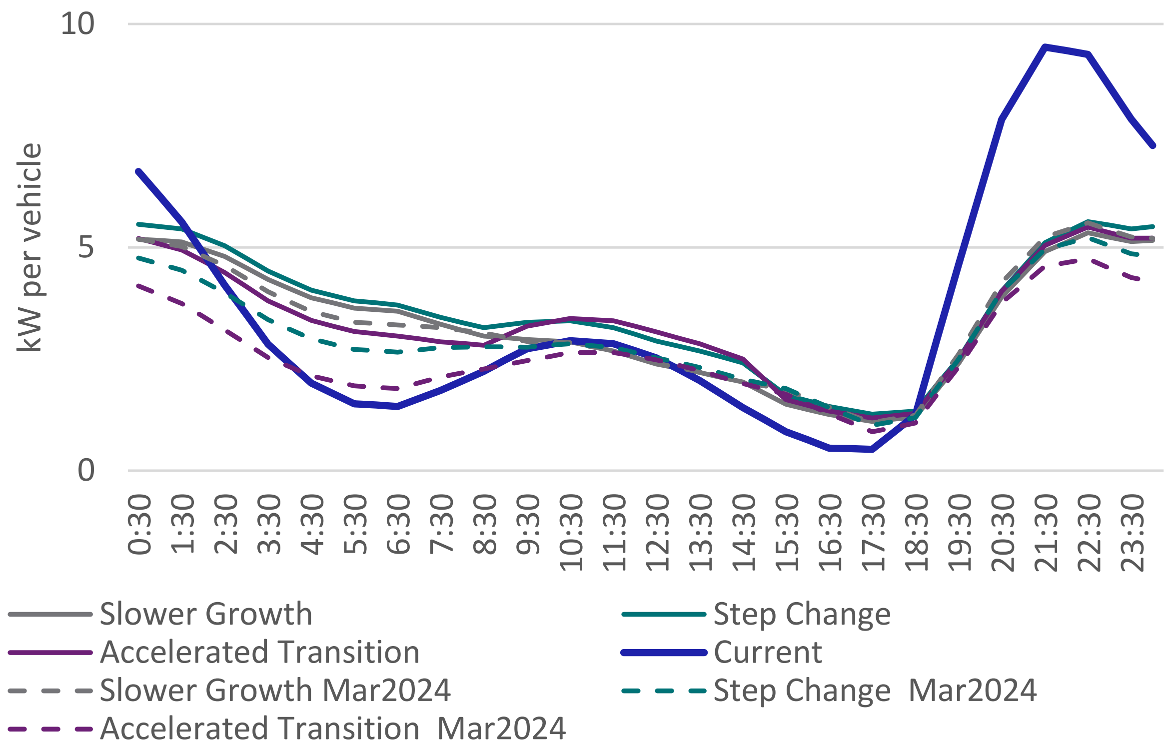

Figure 4-8 Aggregated electric vehicle charging profile for trucks and buses, Current and 2050, by scenario relative to March 2024 projections

CSIRO's projected statewide charging profiles are the first approximation. TOU style tariffs are used as the main incentive for orchestrating EV charging behaviour. In a secondary stage, AEMO makes further adjustment to charging behaviour that anticipates future changes in tariffs or other types of group coordination to address the changes in demand not anticipated by today's tariffs. For example, on a state-wide cloudy day, it may not be preferable for customers to concentrate their charging in the middle of the day (despite their TOU rates encouraging such activity). Changing the charging pattern on that day or asking customers to postpone charging until the next day would require additional coordination.

It is also important to note that the charging of vehicles participating in vehicle to grid is only approximated in the figures above but is modelled dynamically to suit the grid's needs (within set vehicle boundaries) when applied in AEMO modelling.

5 Projections results

The projections results are compared to CSIRO's February 2025 projections released as part of the AEMO's draft 2025 Inputs, Assumptions and Scenario Report consultation.

CSIRO's previous projections are the most valid point of comparison because they represent those changes that arise from changes in model inputs. Electric vehicle projections published by AEMO as part of its forecasting and planning assumptions will not perfectly align with CSIRO projections due to adjustments that take place post-modelling to take account of new developments such as policy changes or new historical data.

The CSIRO February projections are referred to as Feb2025.

Most projections are presented to either 2055 or 2060. While 2055 is often a focus, it is useful to present another 5 years in some cases to highlight changes in the vehicle market beyond that point.

Unless otherwise stated, electric vehicle projections include battery (BEV), plug-in hybrid (PHEV) and fuel cell electric vehicles (FCEV) which is generally only relevant for trucks and buses. All of these vehicles use a common electric drivetrain but with alternative ways of delivering electricity to that drivetrain.

5.1.1 One year trend projection

Sales grew linearly up until 2023-24 and slowed significantly in 2024-25. The historical value for 2024-25 ultimately landed in the middle of the Feb2025 projection uncertainty range for that year. The uncertainty at that point was low because six months of sales data was already known. In preparing the year ahead projection for 2025-26 there is only one quarter of data available. If that quarter's rate of sales was repeated for the remainder of 2025-26 then sales would reach 167,000. As such that quarter of data already indicates that there may be a recovery in 2025-26 relative to the slowing of sales in 2024-25.

The uncertainty range in the updated 2025-26 year ahead annual sales projection has assumed that electric vehicle sales will be level or higher than the September quarter annualised rate of 167,000. This result is likely because there have been ongoing declines in the costs of EVs and the New Vehicle Efficiency standard (NVES) which commenced in 2025, is encouraging more EV models to be marketed to Australians by manufacturers as they seek to meet their obligations under the targets (although the targets are fairly modest in the first few years).

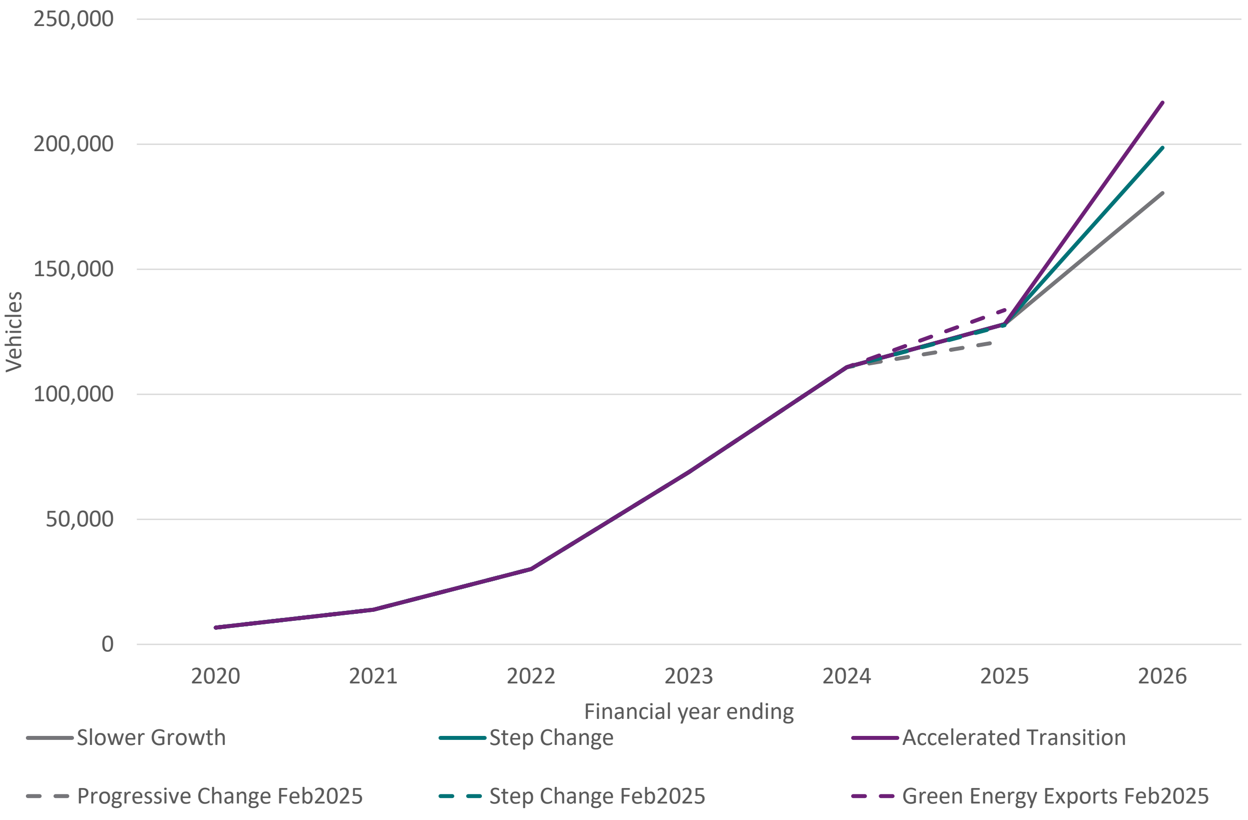

Figure 5-1 Historical and projected electric vehicle annual sales to 2025-26

Figure 5-2 provides some more insight into how the competitive environment for electric vehicles has shifted in the past year for competitors of pure battery electric vehicles (BEVs), namely hybrids and PHEVs which still include some form of onboard internal combustion engine. Hybrid vehicles had been growing slowly up to the end of 2022-23. However, there was a sharp increase in sales in 2023-24, almost doubling the annual sales rate in a single year that had previously taken many years to achieve. Hybrids have slowed somewhat in 2024-25.

PHEVs experienced a sharp increase in 2023-24 annual sales a year later than hybrids and continued that steep linear rate of growth into 2024-25 (although their sales levels are four and a half times less than that for hybrids). Given that Australia's NVES policy is not yet in place this surge in hybrid vehicles can potentially be explained as being driven by global markets. Many global markets have had NVES style policies in place for many years which have forced them to gradually increase the fuel efficiency of vehicles. As fuel efficiency targets progress, there is increasing pressure for hybrid technology to be taken up.

While some Australian consumers may prefer hybrids as an environmentally sensitive choice, it is also the case that a hybrid vehicle is more likely to be from a manufacturing brand that customers are familiar with and some vehicle models are being offered with hybrid technology as a standard feature rather than a consumer choice. It is worth noting that one of the leading BEV manufacturers, Tesla, do not offer hybrid vehicles of any type and have no experience manufacturing vehicles with an internal combustion engine. As such, the marketing of hybrids represents a form of competition between legacy manufacturers with strong experience and supply chains in internal combustion engine vehicles and new vehicle manufacturers who have a stronger competitive advantage in a purely electric drive chain.

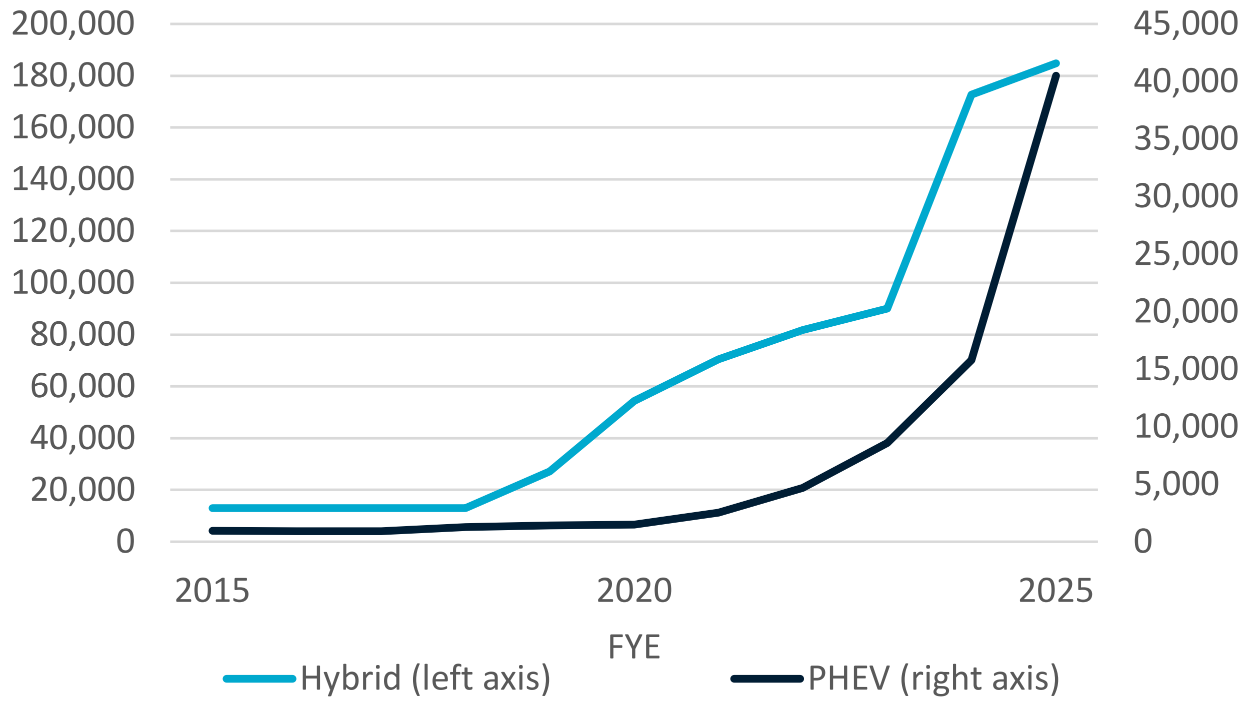

Figure 5-2 Historical sales of PHEV (right axis) and hybrid (left axis) vehicles

5.2 Sales and fleet share

Figure 5-3 and Figure 5-4 show the projected sales share and fleet share respectively. These are for all vehicle types including trucks and buses. However, data in Appendix A provides the same data for cars only. Car sales and fleet shares are expected to progress faster than trucks and buses so the total share for all vehicles is slightly lower than in the cars only data. However, it should be noted that most state governments are progressively working towards transitioning their bus fleets over to electric vehicles. For this reason, buses are expected to progress faster than trucks. There are already electric trucks in the road fleet but they have a longer path towards commercial viability given the competitive pressures on freight businesses and heavy duty cycles, particularly in the larger sizes (articulated trucks).

Beyond the year ahead projection discussed above, our projection methodology focuses next on assigning plausible shares of electric and non-electric vehicle types to meet the five year NVES target period and meet state electric vehicles targets in Queensland, South Australia and Victoria. The combination of these targets is expected to lift the sales of electric and fuel efficient non-electric vehicles such as hybrids. These policies are included in every scenario with only minor differences. Under *Slower Growth*, the NVES policy is met but relies on more hybrids and fewer electric vehicles to meet the target in states without electric vehicle targets. *Step Change* and *Accelerated Transition* rely progressively more on electric vehicles in all states.

Compared to the Feb2025 projections the 2030 targets are met with slightly less EVs. This has been achieved after reconsidering how to treat states without their own state target. In states without a state target, it is assumed states EV sales make a lower contribution to meeting the national NVES target than was previously assumed in the Feb2025 projections, supporting a lower level of EV uptake in total.

After 2030, if the NVES policy remains in place policy makers can extend the policy to create sequential five year target periods that place ever greater requirements for efficiency improvements until eventually only electric vehicles are able to meet them. Alternatively, there might be other policy mechanisms (e.g. subsidies, bans, tax rebates). Ultimately, no specific policy mechanism is applied in the post-2030 modelling. Instead, we assume that both global and national electric vehicle policies are strong enough to result in electric vehicles sales shares tipping over into being the majority of sales in the 2030s. Once a majority is reached this event is expected to cause the eventual withdrawal of services which are needed to support ownership of hybrids and ordinary internal combustion vehicles. Specifically, there would be fewer liquid fuel refuelling stations, replacement parts are harder to source and appropriately qualified mechanics less available. This gradual decline in services for internal combustion vehicles is driven by a shrinking market for these services which makes it harder to maintain them as viable supply chains. This will be a slow process. The withdrawal of services for hybrid and internal combustion vehicles occurs at the earliest by 2050 under *Accelerated Transition* and as late as 2060 under *Slower Growth*. However, sales shares will increase sooner with all scenarios reaching close to 100%[19] electric vehicles sales during the 2030s or early 2040s.

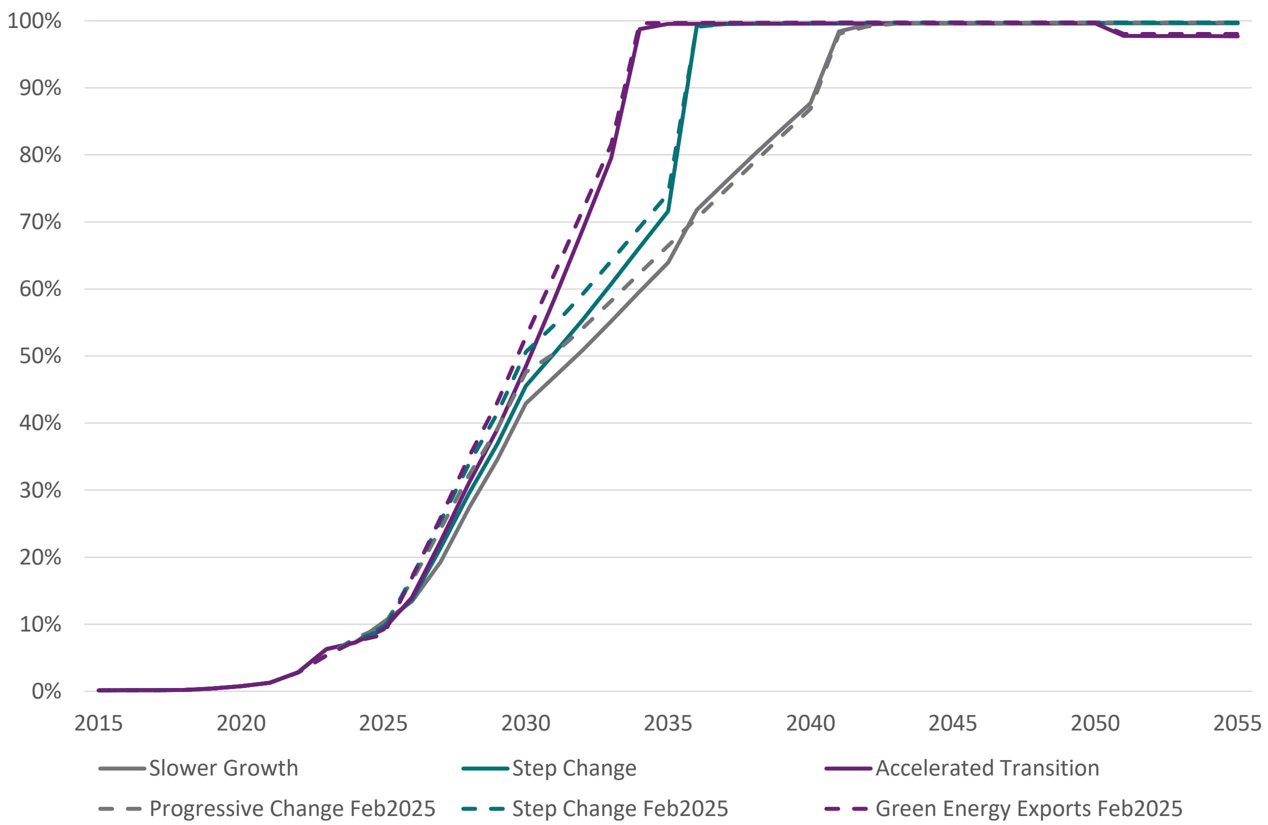

Figure 5-3 Projected electric vehicle sales share by scenario

[19] Sales vary between 100% and 99% because we allow for an ongoing 2-5% share of internal combustion vehicles, depending on the vehicle type for special purposes and for trucks using e-fuels or biofuels such as renewable diesel. This means even in the long run there are some sales of internal combustion vehicles

Under normal scrapping rates the stock of vehicles takes between 20 to 35 years to be completely replaced, differing by location around Australia. Consequently, near 100% sales in the mid- 2030s and 2040s would not be sufficient time to achieve the 95% to 98% electric vehicle fleet projected across all scenario post-2050.. However, as discussed these are not normal circumstances. Although it is expected many owners would be willing to continue to run their internal combustion vehicles until the natural end of life, our expectation is that they will be prevented from doing so by commercial forces that result in a lack of services to keep those vehicles easily fuelled and repaired except under special circumstances. The projected fleet share is therefore the combined product of growth in the electric vehicle sales share and accelerated scrapping of internal combustion vehicles in the latter half of the projection period.

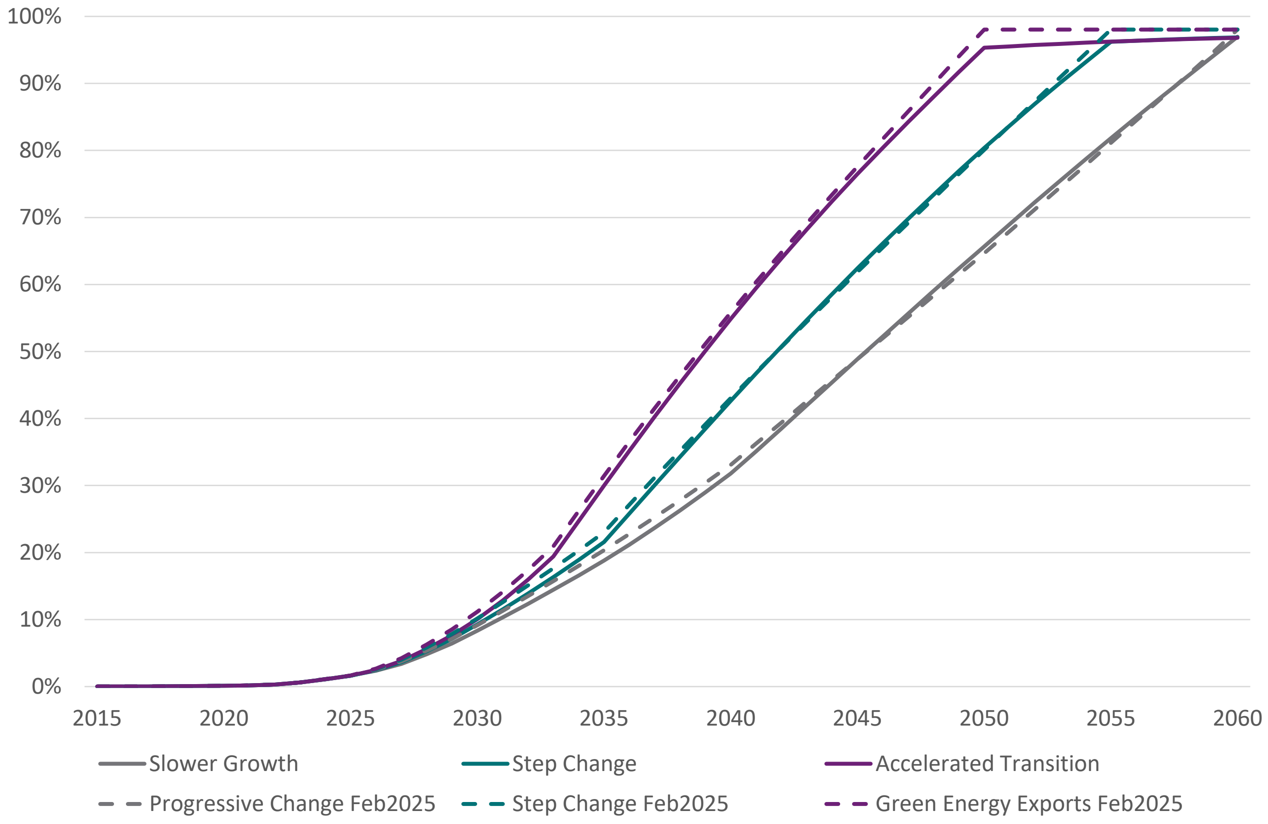

Figure 5-4 Projected electric vehicle fleet share

5.3 Mix of vehicle technology types

Figure 5-5 shows the projected mix of vehicles in car sales by technology types now, in 2030 and 2050. BEVs and PHEVs were around 9% and 4% of sales in 2024-25. Hybrids were 19%. Internal combustion vehicles make up the remaining 68% with FCEV sales being at a negligible level. There are several ways in which the projections have considered changes in these shares over time.

5.3.1 Hybrids

Hybrid vehicles have the advantage of being the lowest cost of the vehicle choices beyond internal combustion vehicles which is appealing to consumers. They are also appealing to manufacturers who have an existing competitive advantage in internal combustion vehicle manufacturing because they retain that engine technology, extending its usefulness but with lower fuel consumption. Because of this lower fuel consumption rate, hybrids will make a considerable contribution to the NVES.

The major long term risk for hybrids is that they cannot operate without fossil fuels and cannot use electricity directly. This means that while they can make a useful contribution to emission reduction in this next five year period, they will eventually become a disadvantage in meeting targets beyond that. In the long run, they are incompatible with the 2050 net zero target and may become more difficult to service as internal combustion vehicles, as a whole, gradually fall into the minority.

5.3.2 PHEVs

PHEVs are more expensive than a hybrid but, owing to fewer batteries, not as expensive as a BEV which will be appealing to some consumers. Like hybrids, they are also appealing to existing internal combustion vehicle manufacturers who can use their expertise in that technology as a competitive advantage. PHEVs also strike a better balance for customers who want to electrify but have heavy duty requirements currently less suitable for a BEVs such as towing, going off-road, remote travel or sequential multi-day driving trips for work or leisure. More wide spread fast charging and lower cost batteries will overcome some but not all of these issues over time. For these reasons and the continued strong sales performance of PHEVS in 2024-25, the updated projections have a higher share of PHEVS in 2030 than the Feb2025 projections.

At some point after 2030 batteries are expected to become cheap enough such that PHEVs cost more than a BEV with the same vehicle range. It is certainly less complex to have only two types of engines on board. Therefore, while PHEVs are currently experiencing growth, their share would be expected to decline in the long run based on cost.

On the other hand, a BEV may never be appropriate for remote work or undertaking heavy loads for multiple days. Remote work is somewhat niche but there is also multidecadal trend of Australians undertaking caravan or trailer holidays. Many households own and maintain a multi-tonne towing capable vehicle specifically for this purpose.

To recognise this potential long term need for PHEVs we have allowed for a minimum share of between 4-5% PHEVs across the scenarios. This broadly corresponds to the share of caravans relative to the car vehicle stock. To make this vehicle type consistent with long term climate policies, it is possible that PHEVs may use a biofuel or e-fuel[20] as the secondary liquid fuel. These alternative low emission fuels will be expensive but not drawn on frequently.

[20] E-fuels are synthetic forms of petrol and diesel that can be created from green hydrogen and carbon dioxide. When combusted they return the carbon dioxide to the atmosphere resulting in no net increase in emissions so long as energy used in the conversion processes is emission free.

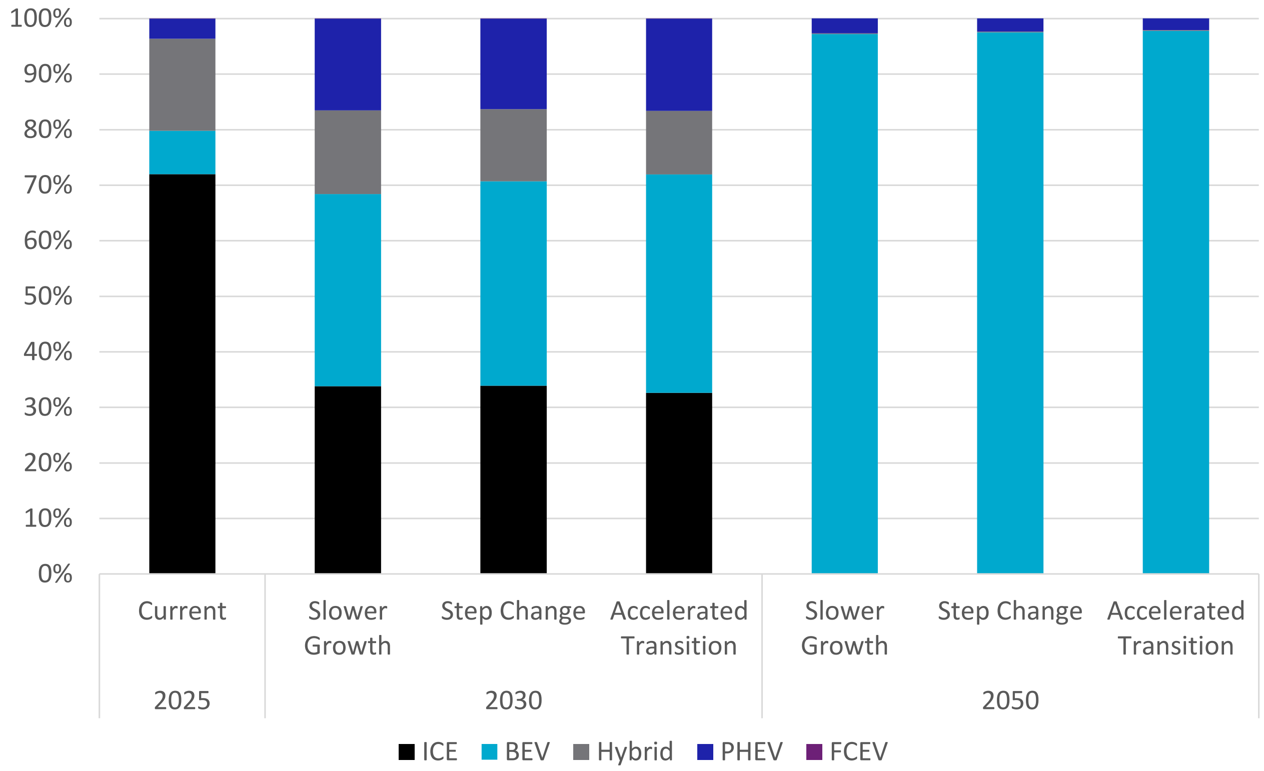

Figure 5-5 Projected mix of vehicle types in car sales by scenario in 2025, 2030 and 2050

5.3.3 FCEVs

Historically the number of models available, refuelling services, sales and pricing of FCEVs has made little progress. For this reason, we no longer include FCEVs in projected car sales.

Where FCEVs can potentially make inroads is in heavy duty vehicles such as trucks and buses. Articulated trucks in particular require such large amounts of energy that the onboard space for batteries begins to significantly impact their freight carrying capacity. There are proposals to address these issues such as a trolley systems for charging while driving and battery pack designs that can be lifted in and out of trucks along the trip route. More frequently stopping for fast charging would also be possible but impact on the cost of freight due to lower truck and driver productivity. A fuel cell truck would instead be able to carry enough fuel without the same impact on freight capacity and productivity.

However, it is becoming clearer that truck manufacturers are not prioritising FCEVs and the current lack of hydrogen refuelling remains a constraint. While small in number, electric trucks remain the main type of electric drive train trucks supplied deployed in Australia. The availability of hydrogen is assumed to be higher in *Accelerated Transition* due to the assumed increase in hydrogen based industries. This increases the likelihood of some synergies in hydrogen distribution and production. Consequently, FCEV uptake is assumed to be highest in this scenario.

The round trip efficiency of hydrogen production and end-use is a final issue worth mentioning. Converting electricity to hydrogen currently results in losses of around 30% although this can be expected to improve. There are also fuel compression losses and losses in converting hydrogen to motive power (around 40%). If hydrogen is produced from renewables, the losses do not impact decarbonisation, but they have a large impact on the cost of FCEVs and the broader electricity infrastructure required to produce the hydrogen. Hydrogen will always be a more expensive fuel than directly using electricity due to these supply chain losses. In contrast, the losses from storing electricity and converting it to motive power are relatively low (less than 10% in both steps)

Consistent with our characterisation of the competitiveness of fuel cell electric vehicles and the ongoing lack of progress, the projected share of fuel cell electric vehicles in the articulated truck fleet has been decreased across all scenarios. In the case of *Accelerated Transition* a maximum 20% share of FCEVS is assigned down from 70% in Feb2025. For *Step Change* the reduction is down to 5% from 50% in Feb2025. For *Slower Growth* the reduction is down to 2% from 30% in Feb2025. Given articulate trucks a small share of the total road fleet, these scenario settings mean that FCEVs are less than 1% of the road fleet in all scenarios (Figure 5-6).

75% of the trucks that were previously assigned to FCEVs in the Feb2025 projections are now assigned as BEVs. The remainder are assigned to internal combustion engines and to be consistent with the climate ambitions of the scenarios would expected to be running on a e-fuels or biofuels such as renewable diesel. Such fuels are expensive, however and in the case of biofuels draw on limited resources that will be in demand from other industries (such as the aviation sector). Hence the majority will be electric.

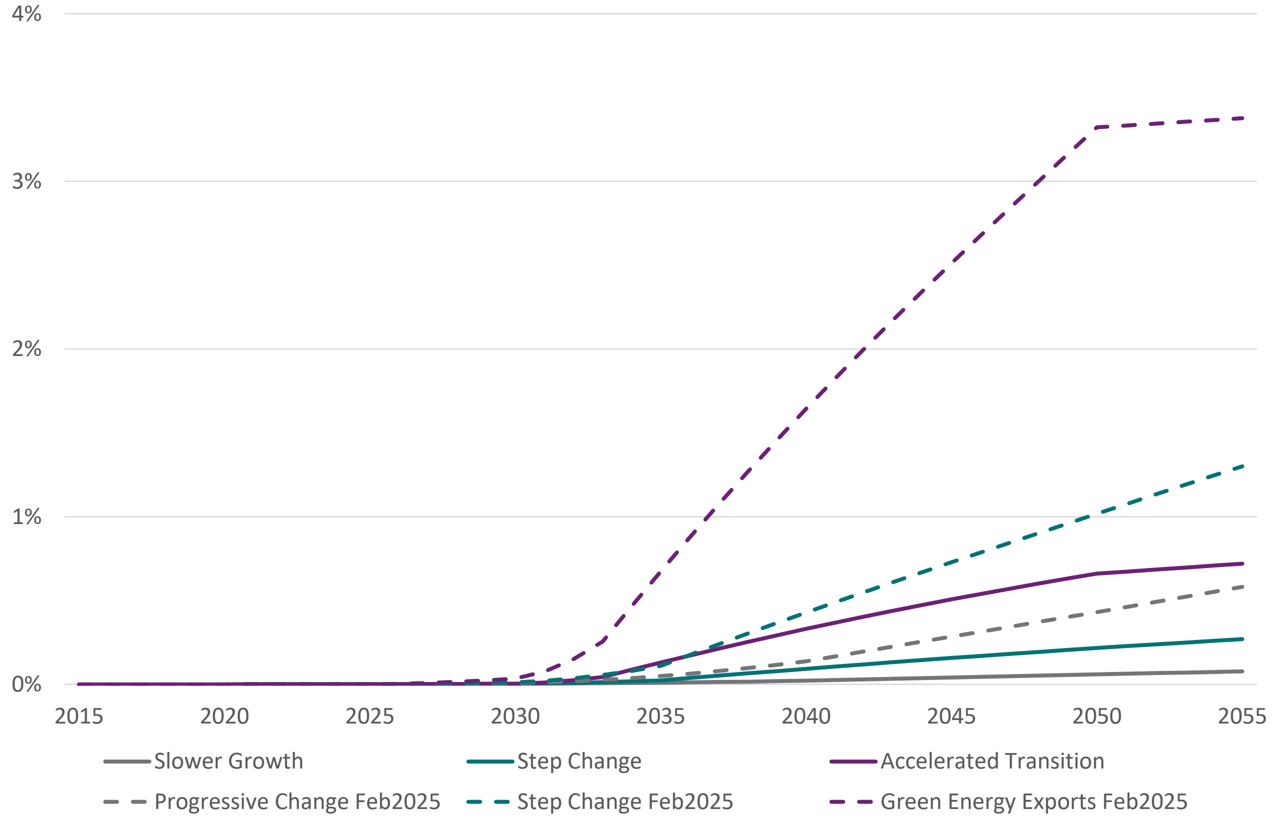

Figure 5-6 Projected fuel cell electric vehicle fleet share

5.3.4 BEVs

BEV vehicles offer the greatest emission reduction due to have zero 'tail pipe' emissions as well as strong overall energy conversion and transport efficiency along their whole fuel supply chain. They are lower cost than FCEVs but higher cost than PHEVs or hybrids (at present). Their costs are falling, so much so that some dealers are worried about the perceived resale value of BEVs[21]. In time it is expected that long range BEVs may be lower than the cost of PHEVs on the assumption that as battery costs fall, adding extra batteries will cost less than the complexity of having two engines onboard. Long range BEVs may never be cheaper than hybrids, but hybrids may eventually be too emission intensive to remain in the vehicle market for countries such as Australia with a net zero emission goal.

From a manufacturers point of view, those electric vehicle manufactures that had never produced internal combustion vehicles will prefer to only produce BEVs. Those that have come from an internal combustion vehicle background will likely prefer to offer BEVs and other technology types based on internal combustion engines. This dynamic means that manufacturers will have different goals and targets regarding the share of BEVs and number of models they intend to offer over time.

As a whole, vehicle manufacturers are responding to governments implementing climate policies in the transport sector which require lower emission vehicles over time. Australia's NVES policy is an example of this and reflects policy mechanisms that have been in place in other countries for much longer. As a consequence of these policies, nearly all manufacturers plan to increase their share of BEVs with targets ranging from 30% to 100% by 2030 (sometimes including PHEVs in that total). This limited global consensus on increasing the manufacturing of BEVs is expected to create a tipping point whereby BEVs will fall further in costs as competition increases and eventually cement BEVs as the majority vehicle type as the full range of electric vehicle types are offered. However, this process will take at least a decade in the best case or longer if global climate policies are weaker. This is reflected in the scenarios whereby the pace of BEV uptake is strongest in *Accelerated Transition* and weakest in *Slower Growth*.

5.4 Number of vehicles and consumption

Population is the most significant driver of passenger vehicle transport which dominates vehicle numbers. Compared to the Feb2025 projections population is projected to be slightly lower in the updated projections. Offsetting the population driver in the latter half of the projection period, the number of electric vehicles (excluding fuel cell electric vehicles) is projected to be higher in all scenarios due to a reduction in fuel cell vehicles which are replaced with BEVs. In the Western Australia Wholesale Electricity Market (WEM), articulated trucks are a larger share of the road fleet and so the uplift in BEVs from the lower share of FCEVs is more pronounced than in the NEM (Figure 5-8).

The hook shape at 2050 in *Accelerated Transition* represents the point at which accelerated scrapping of internal combustion vehicles (discussed above) has ceased and the scrapping rate of vehicles has returned to normal. This results in a lower rate of vehicle growth post-2050. *Step Change* and *Slower Growth* undergo the same slowdown in electric vehicle growth post-2055 and post-2060 respectively (not shown).

[21] https://www.drive.com.au/caradvice/used-electric-car-prices-fall-after-two-years-data-finds/

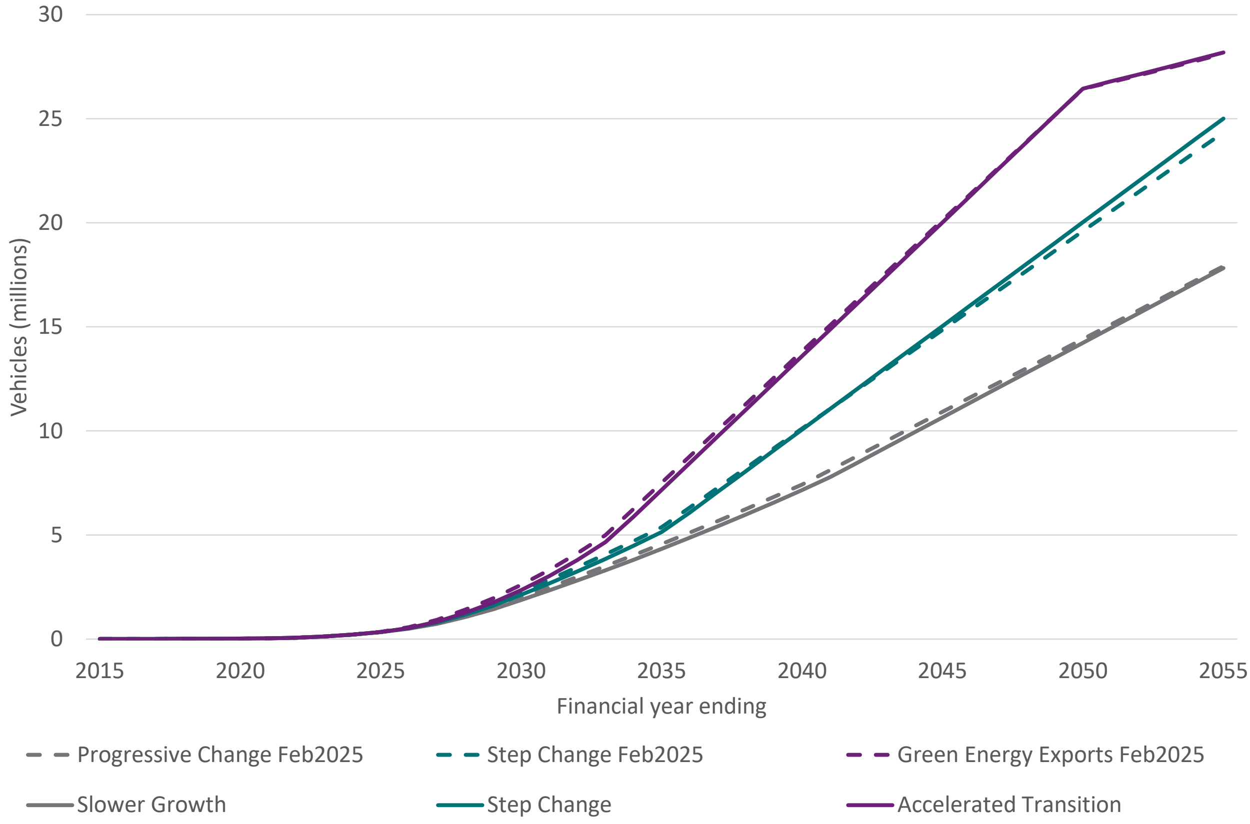

Figure 5-7 Projected number of electric vehicles in the NEM, excluding fuel cell electric vehicles

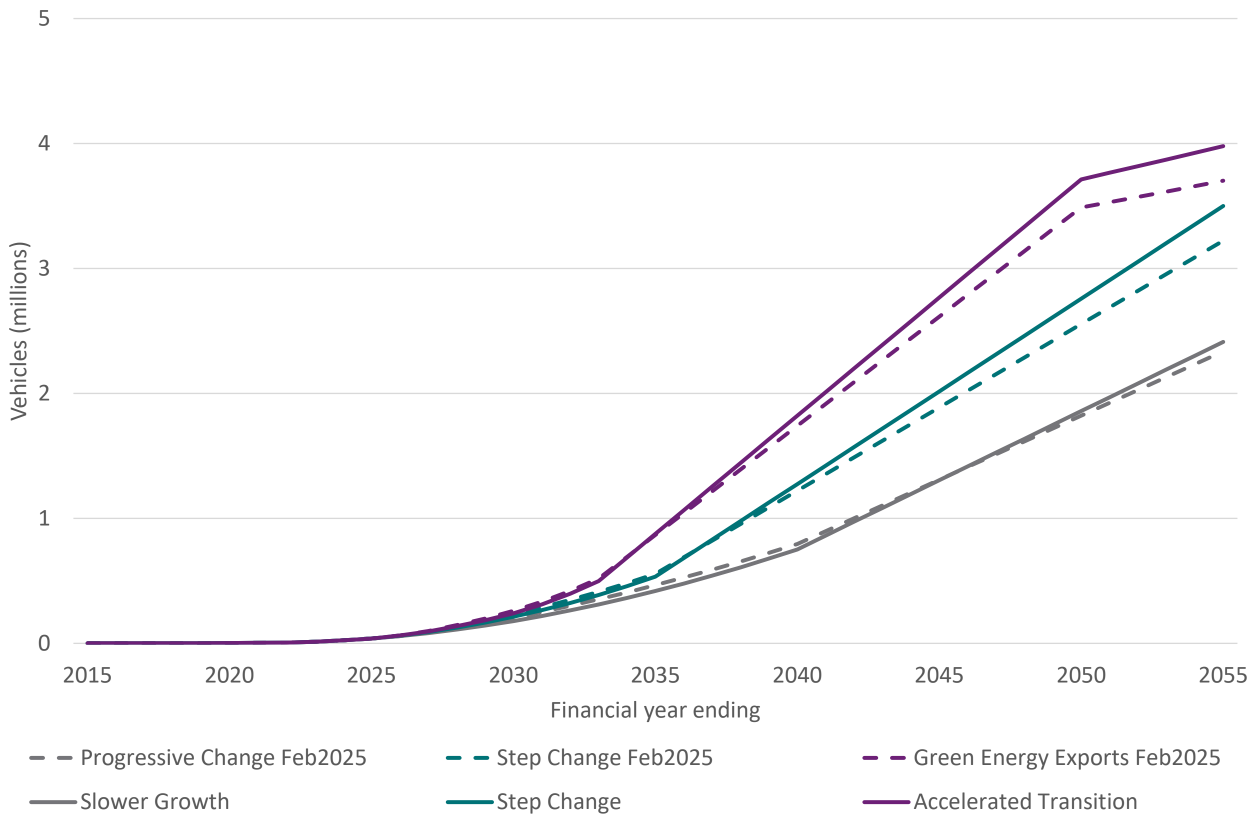

Figure 5-8 Projected number of electric vehicles in the WEM, excluding fuel cell electric vehicles

Electric vehicle electricity consumption would follow the same trend as the vehicle numbers except for the higher electricity consumption per kilometre of articulated trucks. This higher electricity consumption rate means that the small number of additional articulated trucks has an outsized impact on the total consumption from electricity vehicles. Again the impact is stronger in the WEM than the NEM due to the higher proportion of articulated trucks in the road fleet in that region.

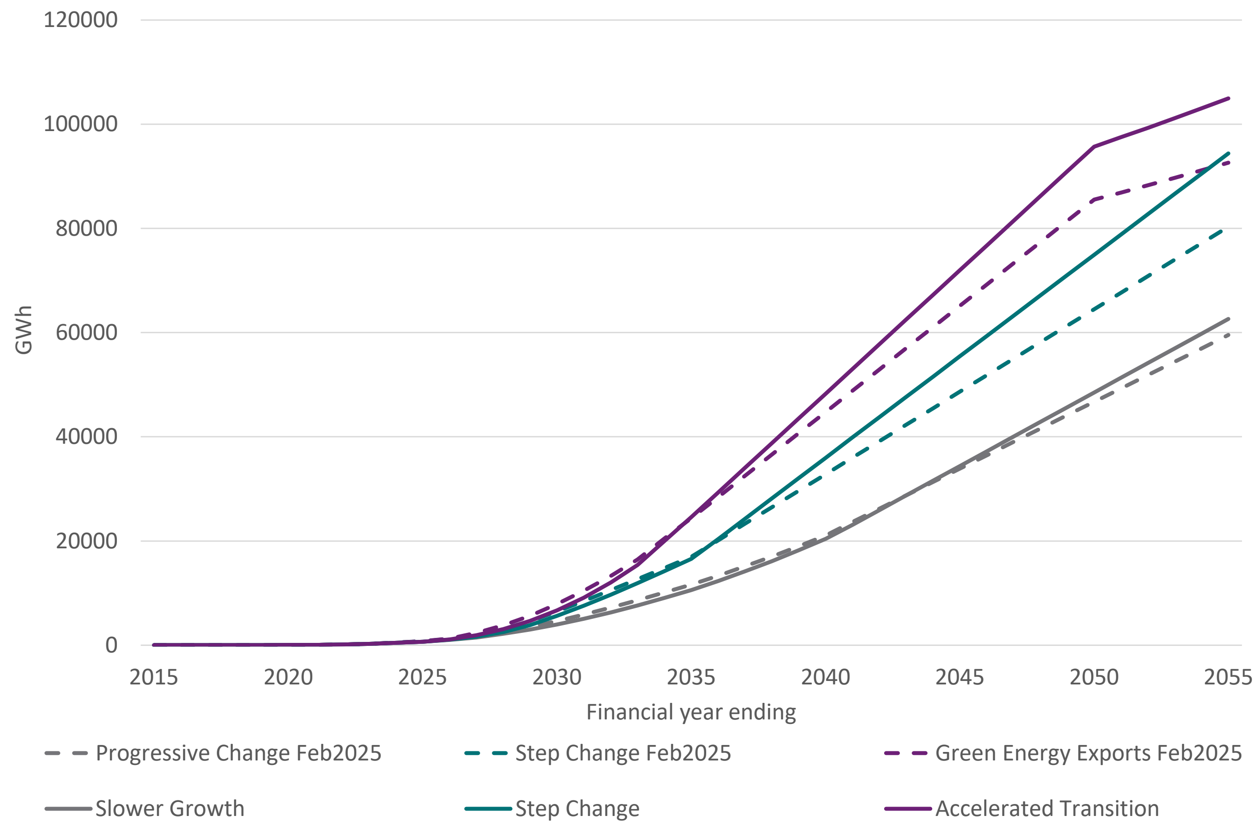

Figure 5-9 Projected electricity consumption from electric vehicles in the NEM

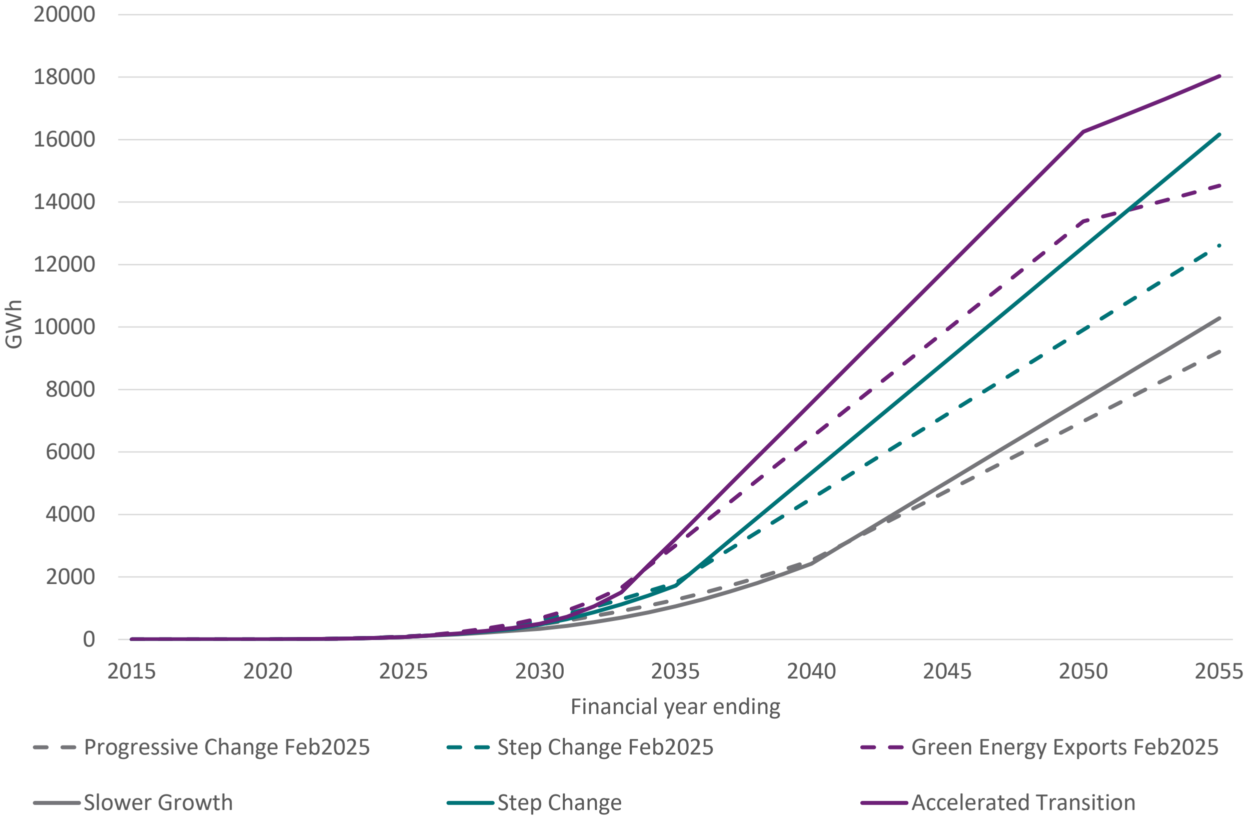

Figure 5-10 Projected electricity consumption from electric vehicles in the WEM

Appendix A Projection data tables

A.1 Sales and fleet share projection data

As part of its normal assumptions reporting, AEMO publishes data on the number and electricity consumption of electric vehicles. However, vehicle sales and fleet share projections are not published elsewhere. We therefore provide these data tables. The shares relate to all electric passenger and light commercial vehicles including fuel cell electric vehicles at the national level. The residual of the sum subtracted from 1 therefore represents the share of internal combustion vehicles. This represents a change from previous publications which showed all vehicle types including trucks and buses. However, given the introduction of the NVES our assumptions is that the stronger interest is in projected car sales outcomes.

Apx Table A.1 Projected electric vehicle sales share (cars only)

	Slower Growth	Step Change	Accelerated Transition
2015	0.001	0.001	0.001
2016	0.002	0.002	0.002
2017	0.002	0.002	0.002
2018	0.002	0.002	0.002
2019	0.005	0.005	0.005
2020	0.008	0.008	0.008
2021	0.015	0.015	0.015
2022	0.032	0.032	0.032
2023	0.074	0.074	0.074
2024	0.089	0.089	0.089
2025	0.115	0.115	0.115
2026	0.171	0.175	0.181
2027	0.237	0.263	0.273
2028	0.335	0.359	0.376
2029	0.417	0.439	0.462
2030	0.511	0.531	0.559
2031	0.546	0.573	0.641
2032	0.580	0.615	0.724
2033	0.616	0.661	0.810
2034	0.653	0.707	0.991
2035	0.690	0.752	1.000
2036	0.761	0.999	1.000
2037	0.795	1.000	1.000
2038	0.828	1.000	1.000
2039	0.860	1.000	1.000
2040	0.893	1.000	1.000

2041	0.990	1.000	1.000
2042	1.000	1.000	1.000
2043	1.000	1.000	1.000
2044	1.000	1.000	1.000
2045	1.000	1.000	1.000
2046	1.000	1.000	1.000
2047	1.000	1.000	1.000
2048	1.000	1.000	1.000
2049	1.000	1.000	1.000
2050	1.000	1.000	1.000
2051	1.000	1.000	0.992
2052	1.000	1.000	0.992
2053	1.000	1.000	0.992
2054	1.000	1.000	0.992
2055	1.000	1.000	0.992

Apx Table A.2 Projected electric vehicle fleet share (cars only)

	Slower Growth	Step Change	Accelerated Transition
2015	0.000	0.000	0.000
2016	0.000	0.000	0.000
2017	0.000	0.000	0.000
2018	0.000	0.000	0.000
2019	0.001	0.001	0.001
2020	0.001	0.001	0.001
2021	0.002	0.002	0.002
2022	0.003	0.003	0.003
2023	0.007	0.007	0.007
2024	0.012	0.012	0.012
2025	0.018	0.018	0.018
2026	0.027	0.027	0.028
2027	0.038	0.041	0.043
2028	0.054	0.060	0.063
2029	0.073	0.080	0.086
2030	0.094	0.104	0.113
2031	0.116	0.129	0.143
2032	0.139	0.155	0.176
2033	0.162	0.181	0.211
2034	0.185	0.208	0.264
2035	0.209	0.237	0.317
2036	0.235	0.278	0.370
2037	0.261	0.321	0.421
2038	0.287	0.364	0.471
2039	0.315	0.407	0.520
2040	0.343	0.448	0.567
2041	0.374	0.489	0.613

2042	0.409	0.530	0.657
2043	0.444	0.569	0.700
2044	0.478	0.608	0.741
2045	0.513	0.645	0.781
2046	0.547	0.682	0.819
2047	0.581	0.718	0.857
2048	0.614	0.753	0.893
2049	0.647	0.788	0.930
2050	0.680	0.821	0.964
2051	0.712	0.853	0.967
2052	0.744	0.885	0.969
2053	0.775	0.915	0.971
2054	0.806	0.944	0.973
2055	0.837	0.973	0.974

Shortened forms

Abbreviation	Meaning
ABS	Australian Bureau of Statistics
ACCU	Australian Carbon Credit Unit
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AV	Autonomous Vehicle
COVID-19	Coronavirus Disease of 2019
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DER	Distributed energy resources
EE	Energy Efficiency
ERF	Emissions Reduction Fund
EV	Electric Vehicle
FCAI	Federal Chamber of Automotive Industries
FCAS	Frequency Control Ancillary Services
FCEV	Fuel Cell Electric Vehicle
GDP	Gross Domestic Product
GSP	Gross State Product
hrs	Hours
ICE	Internal Combustion Engine
IPART	Independent Pricing and Regulatory Tribunal
km	Kilometre
kW	Kilowatt

kWh	Kilowatt hour
LCV	Light Commercial Vehicle
LREV	Long-range electric vehicle
MW	Megawatt
MWh	Megawatt hour
NEM	National Electricity Market
NSG	Non-Scheduled Generation
PHEV	Plug-in hybrid electric vehicle
pkm	Passenger kilometres
SA2	Statistical Area Level 2
SGSC	Smart Grid Smart Cities
SREV	Short-range electric vehicle
SWIS	South-West Interconnected System
tkm	Tonne kilometres
TOU	Time-of-use
TOU_GRID_SOLAR	TOU tariff including day charging incentives
TOU_HOME_SOLAR	TOU tariff with no day incentives other than use of home solar
TWh	Terawatt hour
UNSCHED	Unscheduled home charging, flat tariff
V2G	Vehicle to grid
V2H	Vehicle to home
VPP	Virtual Power Plant
VRE	Variable Renewable Energy
WEM	Wholesale Electricity Market

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