Government of **Western Australia**
**Energy Policy WA**

# Electric Vehicle Action Plan

## Preparing Western Australia's electricity system for EVs

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**Distributed Energy Resources Roadmap**
Action 16: Electric Vehicle Action Plan

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# Executive Summary

On 4 April 2020, the Western Australian Government released the Energy Transformation Taskforce's Distributed Energy Resources (DER) Roadmap, outlining a series of actions, action owners, and timeframes required to realise a vision where DER supports a safe, reliable, and efficient power system.

The DER Roadmap includes Action 16: "By June 2020, commence work on planning to integrate electric vehicles (EVs) in the grid". Further, the *State Electric Vehicle Strategy for Western Australia* (State EV Strategy), released in November 2020 and overseen by the Department of Water and Environmental Regulation, requires that Energy Policy WA implement DER Roadmap actions that "will assist the integration of electric vehicles".

To progress the requirements of the DER Roadmap and State EV Strategy as they relate to the integration of EVs into the grid, the Energy Transformation Taskforce has prepared this *EV Action Plan*.

The EV Action Plan mirrors the approach taken by the DER Roadmap. The DER Roadmap summarised the clear and present challenge posed by the rapid uptake of DER, outlined a vision for the future where DER is effectively and efficiently integrated into the power system, and then outlined the actions to achieve this vision. This EV Action Plan:

- outlines the Western Australian context for EV uptake and its relationship to the State EV Strategy and DER Roadmap;
- outlines the opportunities created by EVs including: improved utilisation of the power system and their role in supporting the integration of renewable energy within the power system;
- describes the risks to Western Australian power systems that may result from the rapid uptake of EVs in the absence of planning;
- identifies "no- or least-regrets" steps that can be taken now and over the medium-term to minimise these risks; and
- allocates 26 actions to Energy Policy WA, Western Power, Horizon Power, Synergy and the Australian Energy Market Operator (AEMO).

The analysis finds that EVs present a significant opportunity to the power system if their integration is well managed. They can help smooth load on the power system and improve overall utilisation, reducing costs for all consumers. Conversely, uncoordinated charging could add considerably to peak load and therefore power system costs. As such, there are major gains to be made from early and coordinated action to support the integration of EVs while consumer norms are still being set prior to mass uptake.

To maintain consistency with the approach and to provide ease of cross referencing with other DER Roadmap activities, actions within the EV Action Plan have been grouped according to the themes outlined in the DER Roadmap: Technical integration; Tariffs and investment signals; DER participation; and Customer protection and engagement.

Major initiatives contained within the draft EV Action Plan include:

- development of credible scenarios for EV uptake and reflection of these scenarios in Whole of System Planning and the Electricity Statement of Opportunities;

- steps to improve visibility of, and connection requirements for, EVs in the power system;
- achieving longer-term integration of EVs within the power system through the development and implementation of capability for aggregation and control (consistent with the approach to other DER); and
- development of a specific electricity tariff for EV customers.

While uptake rates for EVs are currently low in Western Australia compared with some international jurisdictions, this situation could change rapidly in response to changes in State or Commonwealth Government policy or initiatives within the broader motor vehicle industry. Analysis of global trends by Energy Policy WA also indicates an accelerating move toward widespread adoption of EV as a mainstream transport technology over the next 10-20 years.

The EV Action Plan seeks to leverage the experience of the challenges that have been experienced in the integration of other appliances and DER technologies, thereby helping to reduce the risks associated with the anticipated, future uptake of EVs. With proactive implementation of the actions identified in the EV Action Plan alongside those within the DER Roadmap, EVs will support the evolution of an efficient, secure power system at the same time as providing households and businesses with increased options for lower-emissions transport.

A summary version of the EV Action Plan is available at www.brighterenergyfuture.wa.gov.au

# 1. Introduction

Electric vehicles (EVs), supported by improvements in battery storage technology, are increasingly viewed as a means of reducing emissions, pollution, and fuel costs in the transport sector. This is reflected in initiatives by many governments and major vehicle manufacturers to phase out vehicles with internal combustion (ICE) engines and transition to EVs and vehicles using alternative fuels such as hydrogen.

Owing to the unique characteristics of EVs, a transition to electrified transport fleets will have significant implications for power grids in Western Australia.

To date, uptake rates for EVs in Australia have lagged significantly behind other advanced economies. However, changes to Commonwealth Government policies (such as emission standards or vehicle import requirements) or acceleration of the already apparent shift toward EVs by manufacturers, could rapidly increase the speed at which EVs are adopted in Western Australia relative to current forecasts. Such a rapid uptake in EVs would have consequences for the power system. Managing this impact is a major element of the energy transformation and the Distributed Energy Resources (DER) Roadmap.

The DER Roadmap, released on 4 April 2020, outlines a suite of actions to ensure the safe and efficient integration of DER, such as solar photovoltaic (PV), batteries and EV, on the South West Interconnected System (SWIS), and to unlock the full potential of these technologies.

Specifically, Action 16 of the DER Roadmap[1] requires:

**By June 2020, commence[ment of] work on planning to integrate electric vehicles in the grid, including for the deployment of charging points (household and fast-charge) and trials to better understand the capabilities of vehicle-to-grid technology.**

This Action requires that preparation for integrating EVs with the grid begins now to ensure that when large-scale uptake eventuates, Western Australia has implemented measures to address the potential risks to network costs so that the full benefits of EVs flow to consumers and the power system.

A summary version of the EV Action Plan is available at www.brighterenergyfuture.wa.gov.au

## Purpose

This EV Action Plan outlines a range of “no- or least-regrets” actions that have been developed in consultation with industry stakeholders to help manage the future integration of EVs in Western Australia, and in doing so, meet the requirements of Action 16 of the DER Roadmap and the State EV Strategy.

## Relationship to the State EV Strategy

The State EV Strategy was released on 30 November 2020 and is intended to support Western Australia’s transition to the widespread adoption of EVs. It does this through consideration of the impacts on economic development, decarbonisation, and potential risks and opportunities for the State’s power systems that may emerge as EVs grow as a proportion of the total vehicle fleet.

[1] Energy Transformation Taskforce, December 2019, DER Roadmap, p 60.

Under the State EV Strategy, the State Government will:

1. **invest up to $20 million to support the creation of an EV charging infrastructure network facilitating travel north from Perth to Kununurra, along the south-west coast to Esperance and east to Kalgoorlie;**

2. **implement actions outlined in the State Government's DER Roadmap that will assist the integration of EVs, including consideration of incentives to promote daytime charging to help make best use of the midday solar generation peak and assessment of vehicle-to-grid technology forecasts. Buyback payments will be extended to energy exported to the grid from EVs in the same way as rooftop solar;**

3. **undertake scenario modelling of EV uptake and charging behaviour over the next 30 years and investigate charging models to support grid benefits; and**

4. **plan for the integration of EVs in the electricity grid, including the deployment of charging points (household and fast-charge) and trials to better understand the capabilities of vehicle-to-grid technology.**

In meeting the requirements of Action 16 of the DER Roadmap, this EV Action Plan will also meet the relevant requirements of the State EV Strategy.

## The need for specific actions on electric vehicles

EVs are a form of DER that warrant special consideration because of the unique characteristics and impacts on the power system. These include:

- *Scale* – Full electrification of transport vehicles (light, commercial and freight vehicles) will lead to a significant increase in demand for electricity over the coming decades. The relatively large capacity of in-vehicle storage, and the size and timing of the load during charging, mean that the charging of EVs has the potential to have a material impact on the operation of the electricity system. Some forecasts indicate a fully EV fleet could add over 10% to the State's total electricity demands.[2]

  EVs present a growing source of electricity demand on the distribution network, and there are significant opportunities to better align day-time load with growing output from solar PV systems. However, this same demand may create risks if charging occurs at scale during evening peak demand windows.

- *Flexibility and intelligence* – Consumers are anticipated to have much greater day-to-day interaction with EVs than they do with other forms of DER that sit unobtrusively in the background, and do not require active consideration or management by the customer. Consumers are likely to prioritise maintaining their vehicle at sufficient charge to meet transport needs.

  Already, in-vehicle or mobile device software applications and interfaces are in place or being developed that bring the customers' experience of managing the battery charging timing and rate to the interactive and easy to use level of features such as navigation maps, climate controls, and music.

[2] Braunl, T., Harries, D., McHenry, M. P., & Wager, G. 2018. *Electric Vehicle Infrastructure Strategic Planning*. The University of Western Australia.

Improved device intelligence and functionality can be leveraged to ensure that EV charging behaviour at homes, businesses or carparks is optimised to reduce pressures on the power system and utilise low-cost generation from solar PV systems during the day.

With the potential to act as dispatchable, controllable loads and in future to export electricity to the grid, EVs represent a significant source of flexible DER if actively managed. At scale, the ability to centrally manage the rate of charge is a key attribute of EVs.

- *Mobility* – The mobility of EVs makes them unique as a DER. EV charging – whether at home or elsewhere – must be carefully managed, especially as consumers adapt from habits acquired using ICE vehicles. Individual driving and usage patterns, which may vary from day to day, make charging behaviours for EVs less predictable than is the case for other DER. Lack of predictability (as distinct from other DER) is one of the key attributes – not only in terms of energy, but also location of energy.

This document considers the current and forecast EV trends, assesses gaps in the current body of work preparing for widespread EV adoption, and presents a series of no- or least-regrets actions that should be undertaken to ensure that power systems in Western Australian are positively impacted by EVs.

# 2. Problem definition

There is a high degree of uncertainty surrounding the speed at which EVs will be adopted in Western Australia.

Factors that will influence uptake include:

- the speed and nature of manufacturer actions (such as the decision to offer only specific vehicles in the Western Australian market);
- the rate at which up-front prices of EVs come down;
- changes to technology such as battery chemistry improvements and other technical characteristics that reduce costs and improve customer experience of EVs;
- Commonwealth and State Government policies;
- corporate and local government commitments and actions; and
- customer attitudes and behaviour to EVs.

These factors will influence the effect that mass EV uptake has on the power system. More importantly, these factors will have implications for the timing of significant impact thresholds where the effects transition (potentially quickly) from being relatively inconsequential to being substantial.

Given this uncertainty, there is a need to ensure that Western Australian power grids (and associated systems, regulations, tariffs, data requirements) are prepared.

Accordingly, this EV Action Plan does not define a forecast for EV uptake. Rather, it contemplates a scenario of a material increase in EV uptake in Western Australia to:

1) understand the risks to the stability of the power system from a rapid uptake of EVs and identify "no- or least-regrets" actions that can be taken now and over the medium-term to mitigate identified risks; and

2) understand what steps can be taken now and in the medium-term to enable the optimised use of EVs in the SWIS and Horizon Power areas for the benefit of consumers.

**Step 1** above serves to reduce risks associated with uncertainty about technology, policy, and customer sentiment, and focuses on ensuring the stability and efficiency of the power system in a high-uptake scenario. It considers efficient, no- or least-regrets options for policy settings that should be in place *prior* to a material increase in EV demand. This step recognises the difficulties presented by changing policy settings after EV investment decisions have been made by many customers.

**Step 2** will describe an optimised future state for EV uptake and integration with the power system (assuming adequate maturity of EV technology) and will consider pathways to reach this future state. It will also consider the longer-term customer journey at the centre of EV uptake and usage patterns.

# 3. Context

We have analysed the Western Australian EV experience in the following respects:

- Uptake
- Status of EV supply equipment (EVSE) infrastructure and car capability
- Standards for EVs and EVSE
- Visibility
- Customer journey
- Customer behaviour and tariffs

## Uptake

The current uptake rate of EVs in Western Australia is extremely low, comprising under 1% of new car sales. EVs represent around 0.1% of all light vehicles registered in Western Australia.[3]

The choice of vehicles in the Australian EV market is currently very limited when compared to overseas markets, with only around 50 models available (of which only 13 are battery electric and 16 plug-in hybrid). Owing to this small uptake and legislative barriers to the import of second-hand EVs by third parties into Australia, the local secondary market for EVs is almost non-existent. As a result of these factors, prices remain significantly higher for EVs than for comparable internal combustion engine vehicles.

For example, a Nissan Leaf (a small car) costs $49,990, compared to $32,000 for the comparable ICE Toyota Corolla (2020 pricing). Other customer concerns regarding EV charging availability and battery range also appear to have contributed to suppressed uptake.[4]

Western Australia has a slightly higher level of private vehicle use than other Australian jurisdictions, with Western Australian motorists travelling 12,100km per year, just above the national average of 11,100km per year.[5]

Maintenance and operating costs for EVs are significantly less than for ICE vehicles. This is an important consideration for fleet operators but is less so for households which tend to focus more on the up-front costs, driving experience, and brand relationship.

As the availability of low- and medium-priced EV options increases (including through a second-hand market for EVs), uptake rates are expected to increase.

Highlighting the uncertainty associated with forecasting future growth in EV uptake, the Australian Energy Market Operator (AEMO) 2020 Wholesale Electricity Statement of Opportunities (ESOO)

[3] Data courtesy of Department of Transport (March 2021).

[4] https://consult.industry.gov.au/climate-change/future-fuels-strategy/supporting_documents/Future%20Fuels%20Strategy%20%20Discussion%20Paper.pdf

[5] https://www.abs.gov.au/statistics/industry/tourism-and-transport/survey-motor-vehicle-use-australia/12-months-ended-30-june-2020

has both a low and high growth scenario for Western Australia out to 2030 – from about 11,200 vehicles to over 500,000 respectively.[6]

## Status of EV supply equipment (EVSE) infrastructure and car capabilities

Unlike ICE vehicles where there is effectively only one method of refuelling, by visiting a fuel pump, there are alternatives to consider for charging EVs.

The first consideration is the charging location. This can be at home, at a public or private fast-charge facility, or via EVSE located at shared long stay locations such as workplaces, apartments, and public carparks. Battery swap is also an emerging alternative but has not yet been widely adopted by manufacturers so is not included in this discussion.

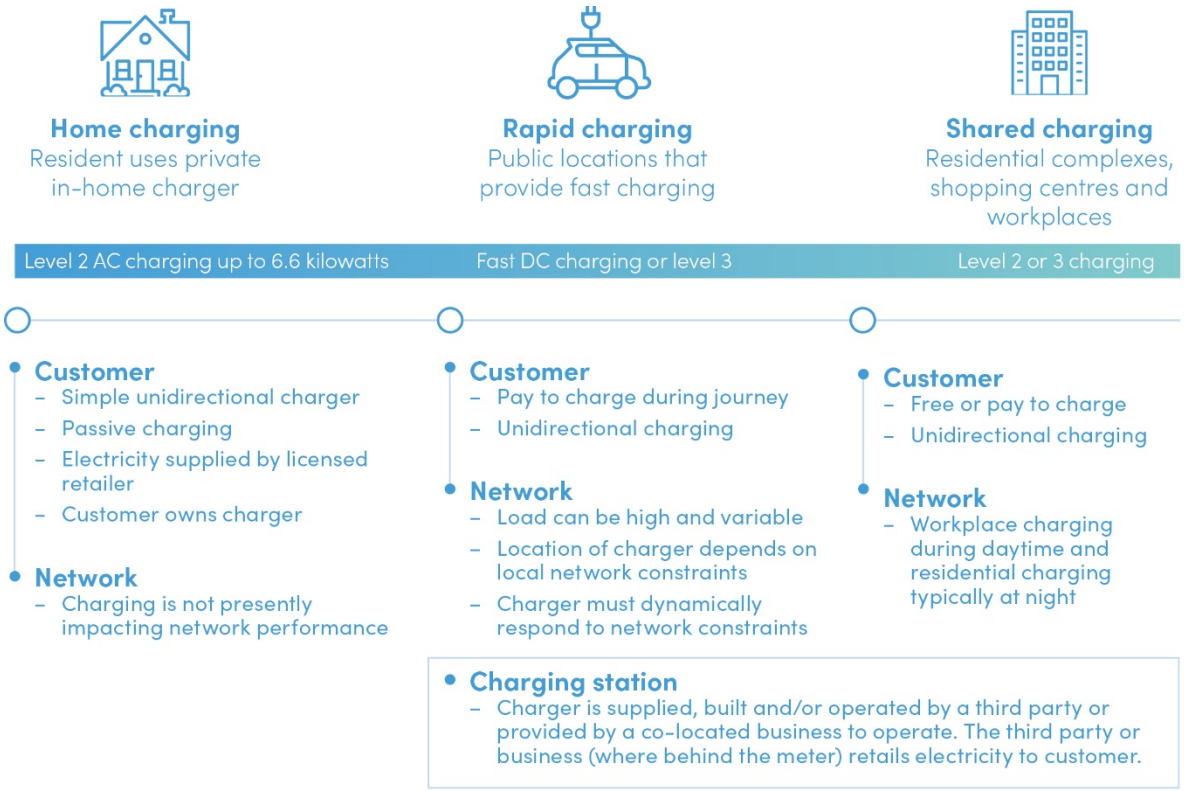



*Figure 1. EV charging locations.*

[6] AEMO 2020 wholesale electricity market statement of opportunities p52
https://aemo.com.au/-/media/files/electricity/wem/planning_and_forecasting/esoo/2020/2020-wholesale-electricity-market-electricity-statement-of-opportunities.pdf?la=en

The second consideration is the type of charging. Passive charging is currently the most common method in use today and occurs when the customer plugs in their vehicle, whether by slow-charge at home or via a fast-charge EVSE.

Adding management capability of the timing of, and rate of, charge is the first step to managing the load risks and facilitating oportunities for increased customer value. Beyond this capability, significant potential can be unlocked by moving to full vehicle-to-building or vehicle-to-grid mangement systems for bi-directional energy flows.

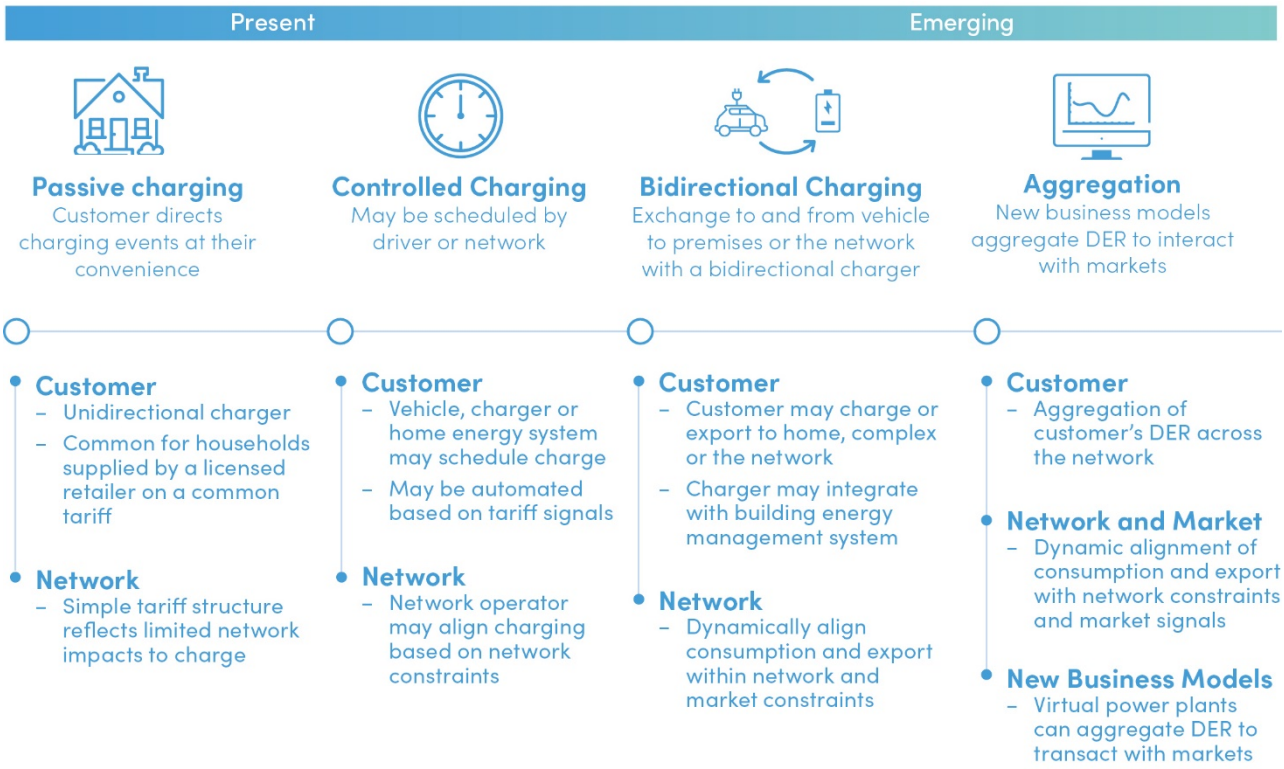



*Figure 2. EV charging types.*

The cost of EV charging infrastructure varies from negligible where the EV is connected to a normal 240-volt household power outlet, to hundreds or thousands of dollars for a dedicated fast-charge EVSE operating at higher voltages (currently up to 350 kilowatts (kW)).

A significant component of the cost for fast-charge EVSE is related to the need for network augmentation. These facilities can also attract higher ongoing network capacity charges.

An increase in the number of household EV chargers can pose risks for low and medium voltage networks because of coincident charging at peak times presenting thermal and voltage issues. In the absence of some level of control or incentive to charge outside peak times, managing these risks for what will likely be a short duration of time, is likely to result in increased costs to the power system as a whole because of network augmentation and additional generation may be required to supply demand during peak load periods.

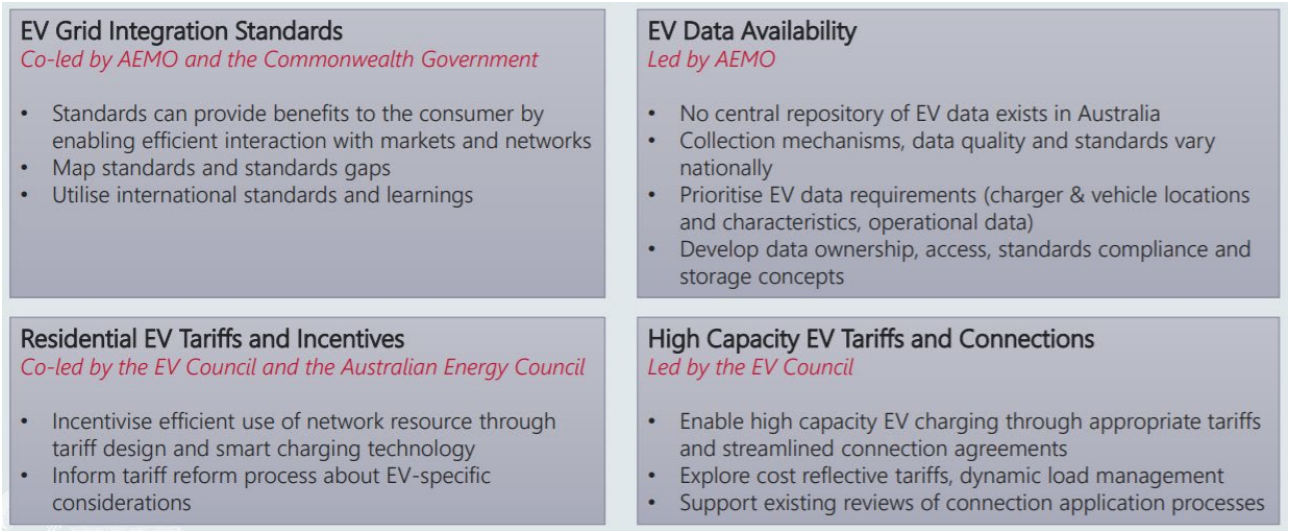
## Standards for EVs and EVSE

Consultation and research by Energy Policy WA identified limited regulatory and technical standards for EVs (and importantly, EV charging infrastructure). Standards that refer to DER or energy devices broadly do not reflect the capabilities that will be required to facilitate the large-scale integration of EVs.

Technical standards for EVs and EV chargers broadly fall under three categories:

1. Disturbance performance and grid support – relate to the functions and capabilities for DER (Australian and international standards AS 4777.2 and IEEE 1547a respectively) and will govern how EVs and chargers can play a role in supporting the day-to-day operation of the power system and its response to contingencies and disturbances.
2. Charger interoperability – relate to the ability of charging infrastructure to exchange information with other systems such as the network or power system operator. This includes energy and services market integration – relating to communications protocols (such as international standard IEEE 2030.5) and demand response standards (such as Australian standard AS 4755) to facilitate the participation of EVs in energy markets.
3. Underlying wiring and device level standards such as plug configuration and interface.

The national Distributed Energy Integration Program's (DEIP) Electric Vehicle Grid Integration Working Group, led by the Australian Renewable Energy Agency (ARENA), AEMO and the Electric Vehicle Council, are considering a suite of changes to enable the integration of EVs within the power system. It is doing this through four workstreams (referred to by DEIP as taskforces), including an EV Grid Integration Standards taskforce.




Note: The EV Grid Integration Standards and EV Data Availability programs are being merged into a single program of work in 2021.

*Figure 3: DEIP EV Grid Integration Working Group Taskforces.*

The DEIP EV Data Availability report was published in February 2021.[7]

[7] https://aemo.com.au/-/media/files/stakeholder_consultation/working_groups/der-program/deip-ev/2021/deip-ev-data-availability-taskforce-report.pdf?la=en

The DEIP EV Grid Integration Standards taskforce released its publication in May 2021 on the development of vehicle grid integration (VGI) standards and summarises[8]:

1. gaps in VGI standards from an Australian perspective;
2. the approach taken by selected international VGI standards; and
3. input from a range of stakeholders on the potential development of comprehensive VGI standards.

At the national level, in 2019, the (then) Council of Australian Governments (COAG) Energy Council introduced demand response capability requirements for a range of devices including EV charging controllers. It will now be a requirement for EV chargers supplied in Australia to be compliant with the Australian standard AS 4755 – *Requirements of demand response systems*, from 1 July 2026.[9] (Noting that the E3 Technical Working Group under DEIP will decide (by mid-2022) whether an international equivalent standard exists that could be implemented instead of AS 4755.)

South Australia is proposing to bring forward these demand response requirements to 1 July 2024. This plan has been contentious, with at least one major EV manufacturer presenting a submission against the proposal.

Advancements to the Australian standard AS 4777.2, *Grid connection of energy systems via inverters*, are being progressed by the national body Standards Australia. In December 2020, updates to the standard included new undervoltage disturbance ride-through capability (to withstand network faults and limit the risks of inverters shutting down and exacerbating events). Further development of the standard proposed by AEMO will focus on interoperability and cyber security, both of which could have implications for inverters located within charge points or EVs.

Some EV manufacturers are developing alternating current-coupled charging controls that sit "under the hood" (for example, your inverter sitting within your vehicle, as opposed to on your house wall). As these variations in technology configurations become more widespread, further work will be required at a national level to resolve standard requirements.

Possible regulatory approaches have been considered that mandate dedicated charging infrastructure (for example, in apartment buildings or at small business premises) meeting specified standards. Further contemplation of such approaches must have regard for these requirements in respect to national construction codes.

Lastly, all electrical wiring work for all Australian premises must fit under the electrical installation safety requirements of AS/NZS 3000, *Wiring Rules*.

Western Power and Horizon Power can implement requirements of devices connecting to their networks via their respective network technical rules and connection guidelines (with varying regulatory processes for amending these).

There is currently an electricity distribution and retail licence exemption for EV charging stations in place in Western Australia until 30 June 2024 (Electricity Industry Exemption Order 2005). This is an area of policy and regulation that could become complex as more charging is provided on private

[8] https://aemo.com.au/-/media/files/stakeholder_consultation/working_groups/der-program/deip-ev/2021/deip-vgi-standards-report.pdf?la=en

[9] Regulation Impact Statement for Decision: 'Smart' Demand Response Capabilities for Selected Appliances October 2019, https://www.energyrating.gov.au/document/regulation-impact-statement-decision-smart-demand-response-capabilities-selected-appliances )

property and long-stay facilities as opposed to fuel-pump style fast-chargers. Consideration should be given to whether the current form of licence exemption remains an appropriate mechanism for regulating the licencing of charging stations.

### Visibility

Limited visibility of the location of EVs and charging devices on the network means the timing and location of EV charging is also uncertain.

Standing data for vehicles in Western Australia is limited to the Department of Transport's vehicle registration process which does not capture information relevant to the operation and regulation of the power system in terms of vehicle capability and charging location. Additionally, the location or capabilities of charging infrastructure, including the location of fast-charge EVSE which have the potential to draw substantial electrical current in a single network location, is not currently captured in the DER Register administered by AEMO. AEMO is considering enhancing the DER Register to include capture of some EV data in the future.

The DEIP EV Data Availability Taskforce in February 2021 released recommendations around EV data requirements.[10] This included working on a national approach to a register of EV charge points and standing vehicle data as well as to enable systems that allow EVs to better participate in energy markets and provide services alongside other DER.

The Western Australian context is also unique compared to other Australian jurisdictions – the road network, distances travelled in single journeys, unique housing arrangement, prevalence of second vehicle ownership, and variance in driving behaviours – and will need to be considered in the development of the specific arrangements to apply in Western Australia.

### Customer journey

Customers have limited interaction with Western Australian Government departments or energy service providers as part of the process for deciding on and purchasing an EV. The key touch point for customers with Western Australia Government agencies relates primarily to vehicle registration, where Department of Transport records vehicle type and registration addresses. Synergy may also receive information on customers who opt-in to its trial EV Home Plan.

For the installation of EV chargers, electrical contractors must submit a Notice of Completion to the Building and Energy section of the Department of Mines, Industry Regulation and Safety. Relevant data is then transferred to Western Power. This transferred information is very basic (partly due to the reason for its collection being primarily related to electrical safety) and does not provide any insights into the capability of the chargers installed.

(Slow-charging is also possible through a conventional plug, but is less likely to impact the power system and so is not a focus of this report.)

### Customer behaviour and tariffs

Understanding how, where, and when consumers will choose to charge their EVs is difficult to predict. It is also difficult to predict how they will react to different price signals. However, these patterns, and responses to price signals, are important factors to be understood in the efficient integration of EVs within the power system. Collecting data and trialling new products to gauge

[10] https://aemo.com.au/-/media/files/stakeholder_consultation/working_groups/der-program/deip-ev/2021/deip-ev-data-availability-taskforce-report.pdf?la=en

customer response will be important in developing an optimal approach. There also remains significant technological and timing uncertainty around the potential for two-way power flows associated with EVs.

High rooftop solar penetration is resulting in surplus daytime output, and there is an increasing need to shift load to the middle of the day to manage this. Tariffs can play an important role in encouraging daytime charging. Although charging at home is not possible if the car is away from home during weekdays, charging during the middle of the day on weekends may be relatively easy to achieve for many households and warrants further testing.

Early surveys and analysis from the EV Council, AusNet and KPMG noted that customers who had purchased EVs were most likely to also have solar PV installed, and charged at home daily at off-peak times. However, there was significant diversity in start times for charging, and on average, charging only occurred every 1 in 3 days. This analysis also found that with incentives, customers were responsive to moving charging to overnight off-peak times.

Currently, there is only one retail tariff targeted at EV customers in the SWIS – Synergy's EV Home Plan – which is very similar to the standard A1 Residential Tariff, but provides a discount (8.7c/kWh, or 30%) for charging between 11pm and 4am. 83% of the 200 customers on the EV tariff have solar PV and so are likely to already be incentivised to charge during the day where this is possible. As EV uptake grows, improved outcomes for the grid could be achieved with a daytime price signal to encourage charging when there is significant renewable energy on the power system and low load is of concern. In the future, dynamic pricing may be an option for consumers.

Participants in the Synergy trial have showed responsiveness to price signals that encourage shifting charge times. The current tariff design has successfully shifted charging behaviour outside of the peak 5–7pm time which is traditionally the time consumers return home from work and would otherwise be charging their vehicle. Testing the ability of customers to charge from solar output, particularly on weekends, could benefit both consumers and the power system.

A standard time-of-use tariff product could also act as an alternative tariff for EV customers, and Synergy has had some customers with EVs expressing interest in participating in the Midday Saver time-of-use tariff pilot primarily for the purposes of charging their EV.

Network tariffs that provide price signals to incentivise charging in the middle of the day can also support the design and delivery of a more efficient and effective EV retail tariff.

A common theme in various EV tariff and other trials in Australia is that current participants are not representative of the wider community and that early learnings may not reflect the preferences and behaviours seen once uptake becomes more common. This is because many current EV owners are relatively early adopters of technology or enthusiasts and as such are more engaged and willing to actively manage their charging behaviour than the average customer.

# 4. Power system risks

The magnitude and unpredictable nature of a new EV load presents significant risks to the network and power system, as well as opportunities if coordinated – both in the SWIS and the isolated microgrids in Horizon Power's service area.

This section explores the nature of those risks in more detail in the following areas:

- Network
- Power System
- Market
- Customer

## Network

The key risks posed by EV uptake relate to their contribution to peak load, and the consequent risk of a breach of thermal capacity constraints and voltage limits (especially in rural locations) for network infrastructure.

Thermal constraint breaches would likely first present on overhead low-voltage distribution networks which have less capacity to host EVs compared with underground networks. Western Power estimates that 10% of households charging an EV at peak times in geographically small areas would be required before these issues could reach a severity requiring network augmentation or alternative solutions.

At sufficient uptake levels, network constraints would also present challenges on medium voltage (11 or 22 kV overhead network) feeders which service many older metropolitan suburbs. Newer suburbs with underground power have a higher capacity and are less likely to be impacted initially. According to Department of Transport data, older suburbs currently have the highest numbers of EVs and are likely to continue to lead uptake due to higher than average incomes and observed preferences. Newer suburbs tend to have undergrounded 22kV services that have greater capacity to absorb the increased loads from EVs in the short term, but for older suburbs, the medium voltage network is likely to be to be affected if 20% of households on a feeder are charging EVs at peak times.

To resolve these risks, Western Power would be required to make significant investments in network augmentation, or otherwise procure network support services. Initial estimates suggest that the capital cost could be around $650 million in the period to 2030 if the risk of large volumes of EVs charging together at peak times is unmanaged.

In some of Horizon Power's service areas, it is likely that the additional load represented by a single fast-charger would overwhelm a small microgrid. Unique to Horizon Power is that while the risk from EVs presents at peak load, the timing of peaks can be distinctly different across its 34 microgrids.

Horizon Power is at higher risk, relatively, of commercial fleet conversion. For example, large mining companies have demonstrated an ability to make wide ranging and rapid changes to their vehicle fleet. If this pattern replicated in a transition to EVs, this would present significant challenges for Horizon Power. This presents a non-trivial risk, as the International Council for Mining has indicated a net zero emissions target by 2040.

While there remains a high degree of uncertainty regarding EV fast-charging infrastructure, the primary risks are expected to manifest from unmanaged residential charging. These risks are exacerbated by very limited visibility of chargers, and the inability to communicate operating envelopes (to ensure EV load stays within network constraints).

### Power system

There is currently excess generation capacity in the SWIS. EV charging will increase load and may lead to new capacity being added through the capacity mechanism. It is not expected that the additional unmanaged demand presented by an uptake in EVs will result in demand exceeding generation capacity in the SWIS beyond the capability of the capacity mechanism. However, this new capacity will add to system costs, and could be avoided through the optimisation of charging behaviour.

It is also possible that uncontrolled EV charging could increase peak demand and exacerbate the rapid increase in demand in the evening which leads to ramping issues, resulting in inefficient operation of generation plant and risks to power system security.

Therefore, the optimisation of charging behaviour to spread the charging load will reduce costs to the power system and avoid risks to system security.

### Market

EV charging during the day has the potential to dampen the effect of DER output on the system. That is, arresting the so-called “duck curve”. In doing so, EV charging supports power system security and reduces the need to procure more expensive Essential System Services (ESS). Conversely, EV charging behaviour, if concentrated at evening peak times, has the potential to increase the need for AEMO to procure ESS to ensure that the grid remains secure and stable. Any need for additional services would come at a cost to the market and customers. Coincident charging of EVs during periods of peak demand may also require higher-cost generation to be turned on to meet demand, with flow-on impacts on the cost of supply for other customers.

### Customer

If network charges and market prices increase because of the take up of EVs, customer costs would also increase. Conversely, customer costs may be reduced if EV charging adds additional load in the middle of the day when the price of wholesale energy is low or negative, smoothing-out demand.

There is a risk that the installation of EV chargers without smart capabilities will preclude customers from participating in virtual power plants (VPP) and accessing other potential future offerings such as dynamic tariffs (ie. tariffs that change as demand changes).

There is also a risk that if Government is slow to act and put in place standards and settings needed to integrate EVs, then customers may face higher electricity prices and other negative impacts once the collective impacts of EV charging are felt on the system. This may include restrictions around when vehicles are able to charge.

# 5. Future state

The risks outlined in the previous section, while high level, are significant enough to demonstrate that doing nothing would have significant costs and risks for the power system. This would result in a repetition of the same type of catch-up in terms of policy actions and technology related fixes that have been associated with air-conditioning and distributed rooftop solar uptake. This risk is even greater should significant action be taken at a Commonwealth level that results in raising uptake rates nationally.

In addition to mitigating these risks, EVs present an opportunity to improve the utilisation of the electricity network and to support the power system. For instance, by charging at times when low load is impacting on the stability of the system, EVs can improve the security of the power system and reduce the need to curtail low-cost generation from renewable energy or procure additional ESS. If EVs can reliably increase demand in the middle of the day on weekends, then a higher level of renewable energy will be able to be accommodated on the grid as a result.

In the future, EVs may also be able to store excess output from rooftop solar and provide it back to the household, or even onto the grid, to meet the evening peak. However, for EVs to achieve this potential future state, many elements are required in terms of infrastructure, policy settings, price signals and customer engagement.

Smart metering and smart charging infrastructure that can respond to signals from the network operator or system operator, likely via an aggregator, can benefit both the power system and the consumer. Retail tariffs that incentivise efficient behaviour have proven very effective in other jurisdictions at influencing charging behaviour.

Finally, customers must also be comfortable with controllability and understand that dynamic charging can benefit households by better using distributed rooftop solar and also put downward pressure on costs by reducing impacts on the power system.

Underpinning this must be a clear framework of customer protections, ensuring that customers retain control over key decisions such as the maximum and minimum level of charge for their battery, and ultimately have the confidence that they will always have sufficient charge to meet their transport needs.

The following actions are designed to lay the groundwork that provides the capability for Western Australia to respond in a prepared manner to a range of EV uptake scenarios.

# 6. Action Plan

There is clearly a significant transition required to move from the current state to the ideal future state for EVs. Given the current low rates of EV take up, there is time to establish the right settings. However, change in policy at the Commonwealth level could alter the uptake of EVs over the short-term. Additionally, consumer norms will start to become entrenched in the early stages of adoption of new EV technology and may be difficult to change later. Therefore, getting the policy settings correct prior to a significant uptake in EVs will help shape customer expectation and provide a seamless customer experience.

This plan has been developed with the input of industry, government, and consumer stakeholders. It identifies actions that will assist in bridging the gap to an optimal future state. The plan comprises 26 actions that are designed to address the risks outlined above and build capability for the future.

### Stakeholder engagement

In developing this Action Plan, Energy Policy WA has undertaken several policy workshops and one-on-one meetings with key stakeholders who were given the opportunity to present their perspective on the risks and opportunities. These views have helped shape the final set of actions.

These stakeholders included:

- AEMO;
- Department of Water and Environmental Regulation (DWER);
- Horizon Power;
- Synergy;
- Western Power;
- EV Council;
- Western Australian Local Government Association;
- Clean Energy Council; and
- customer representative bodies, such as the Royal Automobile Club of Western Australia.

### Key themes

The feedback from consultation and the gap analysis findings reflected four key themes. These were used as guiding principles in the development of the actions:

1) ‘Community first’ - Other major transitions in energy have been shaped by customer choices, and early actions relating to EVs need to start developing customer norms, attitudes, and behaviours.

   These actions should include education towards making cost-effective decisions and be accompanied by the appropriate price and regulatory signals to guide these decisions.

2) Visibility of chargers and vehicle data - Visibility of EVs and charging infrastructure will be a critical prerequisite for effective management of the network, system, and customer risks.

3) Need for connection standards - A range of requirements are necessary for EVs and chargers to facilitate their controllability and enable participation in energy and other markets, resolving risks to the power system and realising opportunities.

4) Focus on the opportunities - While presenting challenges, EVs should also be recognised for the opportunities they provide for the power system and all consumers if given the right tariff signals. Acting as controllable storage, EVs can present benefits to EV owners directly, and enhance the efficient operation of the power system.

To maintain consistency with the DER Roadmap terminology, actions have been grouped under the following themes:

- Technology integration
- Tariffs and investment signals
- DER participation
- Customer engagement

A summary table of these actions is provided at appendix 1.

## 6.1 Technology integration

The key risks presented by EVs first manifest on the distribution network, where the additional load to charge EVs at peak times can overload network equipment or breach voltage limits.

This section includes actions associated with:

- Network management and planning
- EV visibility
- Scenario planning
- Charging infrastructure standards
- Interaction of EVs in microgrid control platforms

### Network management and planning

Management of these risks will require detailed understanding by Western Power, as network operator, of the location and scale of network risks, and the potential solutions and their costs. Western Power is presently developing its network modelling capabilities, and further development of these capabilities with a focus on EV impacts is recommended. The development of cost estimates of solutions will provide information for Western Power business planning and inform policy development.

Horizon Power operates very small microgrids that are susceptible to fluctuations in load – the use of one fast-charger may be sufficient to overwhelm a microgrid at peak times. It's pioneering work through the DER Management System (DERMS) in Onslow puts Horizon Power in a position to test controllability and management of EV and chargers to provide network support.

Consideration is also being given to the use of stand-alone power systems in conjunction with regional and remote charging locations to minimise local network impacts.

### Actions: Distribution network impacts

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **Tech Integration** | Distribution Network impacts | 1. Western Power to develop Grid Transformation Engine (GTEng) model outlining network impacts, constraints, and cost estimates for network upgrades under different scenarios for EV uptake and charging behaviour (see also Action 14).<br>2. Western Power to deliver a report outlining how EV uptake is incorporated into our forecasting for its short-term and longer-term planning horizons.<br>3. Horizon Power to assess fast-charging policy/application requirements.<br>4. Western Power to explore and report on the application and use of Dynamic Operating Envelopes in the context of EV charging to maximise network utilisation. | Jun 2022<br>Dec 2022<br>From Dec 2021; then annually<br>Sep 2023 |
| **Tech Integration** | Distribution Network impacts – collaboration | 5. Western Power and Horizon Power to collaborate, holding knowledge-sharing workshops on learnings on remote and edge-of-grid network management in relation to EVs. | Quarterly, ongoing |

## EV visibility

A range of stakeholders, in Western Australia and other jurisdictions, are keen for greater availability of EV data. In the first instance, visibility is crucial for network and power system management.

It is critical that EVs are visible to the network operator to ensure network impacts can be adequately modelled for network operation and investment planning. At present, visibility is limited to Department of Transport registration processes, and some information on chargers available through Notice of Completion data collection for electrical works. The importance of this area is reflected in the DEIP EV Grid Integration Working Group Taskforces.

Data availability through public-facing information sources will provide benefits.

The issues raised in stakeholder feedback relate to:

- Data collection processes
- Data availability
- Uniqueness of Western Australia – requiring specific Western Australian arrangements

Actions: EV Visibility

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **Tech Integration** | Visibility of EVs (both SWIS and Horizon Power service areas) | **6.** Energy Policy WA to complete assessment of customer journey from EV purchase point to actual charging – to inform the development of a customer-focussed connection process. | Oct 2021 |
| | | **7.** Western Power and Horizon Power to complete an assessment of level of visibility and appropriate data required for EVs and EVSEs at connection and in ongoing operation. | Dec 2021; then annually |
| | | **8.** Western Power, Synergy, and Horizon Power to complete review of customer-facing connection processes, guidelines, technical requirements, and agreements relating to EVs & EVSEs. | Mar 2022 |
| | | **9.** Western Power, Horizon Power, and Synergy to update technical requirements, guidelines, connection processes, and agreements as required. | Sep 2022 |
| | | **10.** All agencies to have regard to the findings of the DEIP Data Availability Taskforce, including findings on data requirements. | Ongoing |
| **Tech Integration** | Visibility of EVs by AEMO | **11.** AEMO and Western Power to complete the assessment of the incorporation of EVs and EVSEs in the DER Register. | Jul 2022 |
| | | **12.** AEMO to update the DER Register system and process to incorporate relevant EV and EVSE data. | Dec 2022 |
| | | **13.** AEMO to undertake and complete assessment of EV-specific requirements for DER aggregation and market participation. | Dec 2023 |

## Scenario planning

Over time, system operation will necessarily be impacted by the increase in demand for and changing consumption patterns of electricity presented by EV uptake. Existing system planning processes undertaken by Energy Policy WA through the Whole of System Plan (WOSP) and AEMO through its ESOO planning already include consideration of EVs.

However, noting the high degree of uncertainty and potential magnitude of demand, it is important to the ongoing security, reliability, and efficiency of the power system that EVs are adequately incorporated into these processes.

### Actions: Scenario Planning

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **Tech Integration** | Scenario planning | **14.** Energy Policy WA, DWER, Synergy and Western Power to determine suitable uptake and charging behaviour assumptions and scenarios, with output to inform policy settings and planning studies. | Jul 2022 |
| | | **15.** Energy Policy WA, AEMO and Western Power to ensure EV assumptions and scenarios for the SWIS are adequately incorporated in Whole of System Planning, the ESOO and GTEng, respectively. | Dec 2022 - WOSP, GTEng, annually - ESOO |

## Charging infrastructure (EVSE) standards

As discussed earlier, requirements and standards applying to EV chargers are limited in respect of their interoperability, controllability, and performance, including their ability to provide network support.

In the main, these standards are likely to be developed at the national level; however, there remains the ongoing opportunity for collaboration and input into these processes, notably through the work being done by DEIP.

Given the long lead time normally associated with updating and implementing national standards, it is essential that Western Australia is engaged with and supports timely implementation of those associated with EVSE to unlock opportunities.

However, there may be a need to take local action. Western Power and Horizon Power are able to specify through network guidelines and the Technical Rules the requirements for devices connecting to their networks. Best practice aligns these with reference to any national standards. However, where needed, these instruments can point to Western Australian specific requirements or settings to flexibly address local needs.

As an example of a jurisdiction taking local action in response to power system risks associated with EV charging, South Australia is proposing to bring forward demand management control capability for EVSE under AS/NZS 4577 by several years from the proposed national date of 2026.[11]

### Actions: Charging infrastructure standards

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **Tech Integration** | Charging infrastructure standards – national processes | **16.** Western Power and Horizon Power support relevant national standards processes, including through continued involvement in DEIP taskforces. | Ongoing |
| | | **17.** Horizon Power to advocate for Standards Australia to have regard for isolated microgrids. | Ongoing |

[11] https://energymining.sa.gov.au/energy_and_technical_regulation/energy_efficiency/proposed_local_demand_response_requirements_for_selected_appliances_and_proposed_amendments_to_local_energy_requirements_for_water_heaters

### Integration of EVs in microgrid control platforms

The ability for the network operator to actively manage power flows on the network to resolve network risks is reliant on the development of DER management capabilities.

Horizon Power is already planning a trial of commercially available EVs in Onslow, to test the ability to manage EVs without limiting customer choice.

#### Actions: Charging infrastructure standards

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **Tech Integration** | Integration of EVs in DER control platforms | **18.** Horizon Power to complete trial of the integration of commercially available EVs in its Onslow DERMS project. | Jan 2022 |

## 6.2 Tariffs and investment signals

#### Retail tariffs

Residential tariffs present a key lever for managing additional costs presented by EVs by signalling for efficient investment decisions and behaviour. Results from Synergy's current (limited) EV tariff indicate that a time-of-use tariff can be effective at setting customer behaviour for charging at home. With low load in the middle of the day, it is important that middle of the day charging is supported through tariffs where car charging is offered by Government agencies. There is also an opportunity for Synergy's tariffs to encourage charging at home during the day on weekends.

Regarding fast-charge facilities, there is not currently a standard network tariff or class of tariffs that is in use. This can add uncertainty for investors and could act to limit the speed at which these facilities are deployed.

#### Actions: Retail tariffs

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **Tariffs and investment signals** | Retail tariffs | **19.** Synergy to develop an updated EV-specific tariff (for residential connections) reflecting the needs of the power system, in coordination with other tariff updates. | Jan 2022 |
| | | **20.** Government agencies installing fast-chargers to liaise with Energy Policy WA regarding charging tariffs to ensure optimal integration with the power system. | Ongoing |
| | | **21.** Western Power to complete assessment of charging station network tariffs. | Feb 2022 |

### Access process for fast-charge EVSE

Investment signals for fast-charging infrastructure can provide guidance for the optimal locations and size of charging infrastructure. For example, even small changes in facility location can result in significant variation network connection costs. Providing greater transparency for applicants on cost inputs and the application process will help in decision making and planning for investment by third parties.

In future, potential installers should have good guidance on the costs of connection through accessible information and installation locations will be balanced between lowering network connection costs and proximity to customer needs. Complexity is also added as the process may also involve third parties, for example where local government approval is needed. As the number of facilities required increase in line with uptake rates to service a larger number of vehicles, the application and approval process should be able to scale smoothly. This could happen in a relatively short time.

### Actions: Access process for fast-charge EVSE

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **Tariffs and investment signals** | Access process for fast-charging EVSE | **22.** Western Power and Horizon Power develop streamlined network connection process for fast-charging infrastructure, including clear application cost, cost evaluation methodology, and suitable information availability. | Mar 2023 |

## 6.3 DER participation

Key to the long-term integration and participation of EVs is the development capabilities within equipment and the rules, guidelines and processes of network and market operators. Full technical trials involving EVs and EVSE will be required to understand and test integration.

There are conflicting views among EV manufacturers as to long term effects on vehicle batteries from two-way energy flows related to vehicle-to-home (V2H) or vehicle-to-grid (V2G) services, with some fully embracing the opportunity and others viewing it as a warranty risk. Much of the uncertainty is a result of a lack of large-scale and long-term research or implemented V2G services.

There are differing views on whether participation is best served through fleets, such as corporate or government fleets, on-demand transport and rideshare services, public transport fleets or residential VPPs. In testing the ability to aggregate through residential VPPs, it will make sense to make use of the distribution system operator and aggregator platforms developed through the Onslow DERMS project and Project Symphony. Therefore, the timing will be dependent on both technical capability within the vehicle-to-power system interface, but also the DER orchestration platforms.

Actions: Orchestration trials

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **DER Participation** | Orchestration trials | **23.** Energy Policy WA, Western Power and Synergy to evaluate the need and optimal timing for a trial of controlled charging and V2G and develop plans for a trial as appropriate; including customer interface and building customer norms and acceptance as well as ability to provide services under aggregation. | Dec 2023 |

## 6.4 Customer engagement

Customer engagement and education has been recognised in consultation as a critical element for the long-term integration of EVs. Currently there is limited understanding by consumers of the potential impact of EVs on the power system in Western Australia, and therefore limited awareness of the need for actions to integrate EVs. Engagement with consumers on this journey will be important in shaping customer norms about charging, and in the future, participation of EVs in orchestration.

Overwhelming stakeholder feedback notes that while there are potential risks to the power system, EVs offer substantial opportunities and that these should be the focus for consumers. It is also noted that addressing climate issues is a strong motivation for the purchase of EVs and therefore a strong desire to use more renewable energy in charging. Further research is needed to understand how consumers can be incentivised to charge in a way that supports the power system in the Western Australian context and the transition to renewable energy.

Uptake rates, and the adoption of EVs and EVSE, will change rapidly based on shifts in corporate and government fleets. For example, mining companies have already demonstrated rapid pace in changing suppliers and ICE fleets. State Government fleet targets, such as those outlined in the State EV Strategy, and local government fleets could also accelerate uptake rapidly. These may also have highly localised impacts.

Research may incorporate fleet turnover modelling, and engagement with government bodies to understand timings.

Customers should also remain protected as new products (for vehicles, charging options and pricing) become available. Energy Policy WA is undertaking a licencing review and anticipates including an assessment of licencing arrangements and associated customer protection requirements for fast-charging stations.

## Actions: Customer protections, research, and engagement

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **Customer Engagement** | Customer protections and fast-charge/away from home licencing framework | **24.** Energy Policy WA to assess the requirements for electricity licencing arrangements relating to EVs and EVSEs as part of its licencing review. | Jun 2024 |
| **Customer Engagement** | Customer norms – research | **25.** Energy Policy WA to coordinate research into customer/ behavioural economics responses in Western Australia including:<br>- the value proposition for customers, including benefits for transport, home and the power system;<br>- reaction to signals to support the power system; and<br>- understanding likely consumer behaviour (e.g. price points/intended use of EVs/charging behaviour) and its implications.<br>(This research should have regard for international norms, and learnings from other jurisdictions.) | Scope of Work by Jul 2022<br><br>Research to be determined |
| **Customer Engagement** | Customer norms – outreach | **26.** Energy Policy WA and GTEs to support DWER outreach program, including EV demonstration days. | Ongoing |

# Appendix 1 Summary table of actions

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **Tech Integration** | Distribution Network impacts | 1. Western Power to develop Grid Transformation Engine (GTEng) model outlining network impacts, constraints, and cost estimates for network upgrades under different scenarios for EV uptake and charging behaviour (see also Action 14), | Jun 2022 |
| | | 2. Western Power to deliver a report outlining how EV uptake is incorporated into our forecasting for our short-term and longer-term planning horizons. | Dec 2022 |
| **Tech Integration** | Distribution Network impacts | 3. Horizon Power to assess fast-charging policy/application requirements. | From Dec 2021; then annually |
| | | 4. Western Power to explore and report on the application and use of Dynamic Operating Envelopes in the context of EV charging to maximise network utilisation. | Sep 2023 |
| **Tech Integration** | Distribution Network impacts – collaboration | 5. Western Power and Horizon Power to collaborate, holding knowledge-sharing workshops on learnings on remote and edge-of-grid network management in relation to EVs. | Quarterly, ongoing |
| **Tech Integration** | Visibility of EVs (both SWIS and Horizon Power service areas) | 6. Energy Policy WA to complete assessment of customer journey from EV purchase point to actual charging – to inform the development of a customer-focussed connection process. | Oct 2021 |
| | | 7. Western Power and Horizon Power to complete an assessment of level of visibility and appropriate data required for EVs and EVSEs at connection and in ongoing operation. | Dec 2021; then annually |
| | | 8. Western Power, Synergy, and Horizon Power to complete review of customer-facing connection processes, guidelines, technical requirements, and agreements relating to EVs & EVSEs. | Mar 2022 |
| | | 9. Western Power, Horizon Power, and Synergy to update technical requirements, guidelines, connection processes, and agreements as required. | Sep 2022 |
| | | 10. All agencies to have regard to the findings of the DEIP Data Availability Taskforce, including findings on data requirements. | Ongoing |

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **Tech Integration** | Visibility of EVs by AEMO | 11. AEMO and Western Power to complete the assessment of the incorporation of EVs and EVSEs in the DER Register. | Jul 2022 |
| | | 12. AEMO to update the DER Register system and process to incorporate relevant EV and EVSE data. | Dec 2022 |
| | | 13. AEMO to undertake and complete assessment of EV-specific requirements for DER aggregation and market participation. | Dec 2023 |
| **Tech Integration** | Scenario planning | 14. Energy Policy WA, DWER, Synergy and Western Power to determine suitable uptake and charging behaviour assumptions and scenarios, with output to inform policy settings and planning studies. | Jul 2022 |
| | | 15. Energy Policy WA, AEMO and Western Power to ensure EV assumptions and scenarios for the SWIS are adequately incorporated in Whole of System Planning, the ESOO and GTEng, respectively. | Dec 2022: WOSP, GTEng, annually: ESOO |
| **Tech Integration** | Charging infrastructure standards – national processes | 16. Western Power and Horizon Power support relevant national standards processes, including through continued involvement in DEIP taskforces. | Ongoing |
| | | 17. Horizon Power to advocate for Standards Australia to have regard for isolated microgrids. | Ongoing |
| **Tech Integration** | Integration of EVs in DER control platforms | 18. Horizon Power to complete trial of the integration of commercially available EVs in its Onslow DERMS project. | Jan 2022 |
| **Tariffs and investment signals** | Retail tariffs | 19. Synergy to develop an updated EV-specific tariff (for residential connections) reflecting the needs of the power system, in coordination with other tariff updates. | Jan 2022 |
| | | 20. Government agencies installing fast-chargers to liaise with Energy Policy WA regarding charging tariffs to ensure optimal integration with the power system. | Aug 2022 |
| | | 21. Western Power to complete assessment of charging station network tariffs (for inclusion in AA5 price list). | |
| **Tariffs and investment signals** | Access process for fast-charging EVSE | 22. Western Power and Horizon Power develop streamlined network connection process for fast-charging infrastructure, including clear application cost, cost evaluation methodology, and suitable information availability. | Mar 2023 |

| Roadmap Theme | Element | Action | Timing |
|---|---|---|---|
| **DER Participation** | Orchestration trials | **23.** Energy Policy WA, Western Power and Synergy to evaluate the need and optimal timing for a trial of controlled charging and V2G and develop plans for a trial as appropriate; including customer interface and building customer norms and acceptance as well as ability to provide services under aggregation. | Dec 2023 |
| **Customer Engagement** | Customer protections and fast-charge/away from home licencing framework | **24.** Energy Policy WA to assess the requirements for electricity licencing arrangements relating to EVs and EVSEs as part of its licencing review. | Jun 2024 |
| **Customer Engagement** | Customer norms – research | **25.** Energy Policy WA to coordinate research into customer/ behavioural economics responses in WA including:<br>- the value proposition for customers, including benefits for transport, home, and the power system;<br>- reaction to signals to support the power system; and<br>- understanding likely consumer behaviour (e.g. price points/intended use of EVs/charging behaviour) and its implications.<br>(This research should have regard for international norms, and learnings from other jurisdictions.) | Scope of Work by Jul 2022<br><br>Research to be determined |
| **Customer Engagement** | Customer norms – outreach | **26.** Energy Policy WA and GTEs to support DWER outreach program, including EV demonstration days. | Ongoing |

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