# AEMO
# on behalf of the DEIP EV Data Availability Taskforce

## Distributed Energy Integration Program – Electric Vehicles Grid Integration

**February 2021**

Recommendations

# Important notice

## PURPOSE

The Data Availability Taskforce was established by the Distributed Energy Integration Program (DEIP) - Electric Vehicle Grid Integration Working Group to identify the types of electric vehicle-related data sought by the energy sector. On behalf of the Taskforce, AEMO has prepared this summary of what categories of data stakeholders in the energy sector seek and how the data might be delivered in order to support the study, modelling and regulation of electric vehicle grid integration and provide a basis for informed decision making. This report is exploratory in nature and further work needs to be done, including to explore costs and benefits of options for collection, protection and delivery of the data.


## ACKNOWLEDGEMENT

AEMO acknowledges the support, co-operation and contribution of Taskforce members in the development of categories of electric vehicle-related data requirements and potential delivery mechanisms summarised in this publication. The Taskforce followed a collaborative and exploratory process to capture input from a broad range of energy and transport sector stakeholders, then collated and assessed this input to establish a prioritised set of data requirements. AEMO prepared this report on behalf of the Taskforce to summarise the group's findings, and wishes to thank all the organisations and individuals who contributed their valuable time and expertise to this effort, including:

- ACE Electric Vehicle Group
- AGL
- Australian Energy Regulator (AER)
- Australian Renewable Energy Agency (ARENA)
- C4NET
- CitiPower, Powercor and United Energy
- Deloitte
- Electric Vehicle Council
- Energy Security Board
- Energy Queensland
- Horizon Power
- JET Charge
- RMIT University
- TasNetworks
- Tritium


## DISCLAIMER

AEMO and Taskforce members have made reasonable efforts to ensure the quality of the information in this publication but cannot guarantee that information, forecasts and assumptions are accurate, complete or appropriate for your circumstances. This publication does not include all of the information that an investor, potential investor, participant or potential participant in electricity, transport or infrastructure markets might require, and does not amount to a recommendation of any investment.

# Executive summary

The transition to electrified transportation represents a nexus of the transport, energy and infrastructure sectors, and will require close collaboration between industry, government and regulatory bodies to ensure an efficient transition across these closely coupled sectors[1]. Preparing now in a coordinated fashion, before wide-scale electric vehicle (EV) uptake begins, will enable the energy sector to effectively integrate EVs and create value for Australian consumers and industry stakeholders.

To coordinate the transition to electrified transportation, the energy sector needs access to detailed and relevant information to support decision-making processes. These data form direct inputs into the forecasting and planning processes of AEMO and distribution network service providers (DNSPs), and also feed into modelling and analytics work undertaken by research organisations and academia that, in turn, inform decision-making and regulatory processes within the energy sector and government. These processes all require access to accurate and comprehensive data to ensure decisions are made on an informed basis, as the decisions made during these early stages of EV uptake could have significant cost implications for EV owners and energy consumers more broadly.

In 2019, the Distributed Energy Integration Program (DEIP) EV Grid Integration Working Group ('Working Group') identified that the availability of EV data was a key challenge for the energy sector[2]. The Working Group then established a Data Availability Taskforce ('Taskforce') to identify EV data needs from an energy sector perspective, alongside potential collection mechanisms and delivery options for EV data.

The Taskforce followed a collaborative and exploratory process to capture input from a broad range of energy and transport sector stakeholders, then collated and assessed this input to establish a prioritised set of data requirements. AEMO prepared this report on behalf of the Taskforce to summarise the group's findings, and wishes to thank all the organisations and individuals who contributed their valuable time and expertise to this effort.

This report represents early-stage requirements capture and does not include any cost-benefit analysis of proposed delivery mechanisms. Rather, it provides a qualitative starting point for further investigation of the proposed mechanisms by relevant organisations or forums. Collection, provision and protection of data comes at a cost, so appropriate benefits would need to be realised to justify any new EV-related data mechanism. Potential benefits of improved EV data availability are detailed in section 4.2, and broadly include:

- Improved accuracy of uptake and impact modelling.
- More detailed system stability modelling.
- Evidence-based research to inform public policy and infrastructure planning.
- Enabling EVs to participate in energy and services markets.
- Targeted, efficient investment in charging infrastructure.

The Taskforce identified seven categories of data requirements, including static (infrequently updated) and dynamic (time varying) data. Standing data for vehicles and electric vehicle supply equipment (EVSE – commonly referred to as 'chargers') and EVSE operations data were deemed the highest priority categories, as shown below.

[1] See https://aemo.com.au/-/media/files/major-publications/isp/2020/appendix--10.pdf.

[2] See https://arena.gov.au/knowledge-innovation/distributed-energy-integration-program/ev-grid-integration-workstream/.

**Figure 1 EV data requirements**

● Immediate ● Important ● Future

| | Static | | Dynamic | |
|---|---|---|---|---|
| | **EVSE Standing Data**<br>Location and characteristics of EVSE to inform network modelling and forecasting | Immediate | **EVSE Operations**<br>Data on EV charging operations for research purposes | Immediate |
| | **Vehicle Standing Data**<br>Vehicle registration and sales information to inform uptake projections | Immediate | **Vehicle Operations**<br>Detailed vehicle usage data for research purposes | Important |
| | **Consumer Characteristics**<br>Characteristics of EV owners/drivers for research purposes | Important | **Consumer Experience**<br>Ongoing customer experience data for research purposes | Important |
| | | | **Market/Operational Data**<br>Data used in the operation of energy and services markets | Future |

The Taskforce discussed these seven data categories from an implementation perspective to identify four potential delivery mechanisms, and makes the following recommendations for further development.

**Figure 2 Taskforce recommendations**

### EVSE Standing Data Register

Capture individual details of all EVSE in an access-controlled register

**Recommendation**

*In 2021, AEMO – in consultation with stakeholders – will undertake an opportunity assessment to establish a minimum viable product for an EVSE standing data register under the existing electricity rules and regulatory frameworks*

### Vehicle Standing Data Register

Centralise EV registration data in a standard format, providing both aggregate data and access-controlled individual data

**Recommendation**

*The Working Group will engage with Government transport departments and committees to communicate the energy sector's need for consistent and streamlined reporting of vehicle standing data and to support reform and development in this space. 'Quick win' solutions will be pursued where available to support current initiatives*

### Market/Operational Data Services

Systems enabling EVs to participate in energy and services markets alongside other DER

**Recommendation**

*To ensure EVs have a level playing field alongside other forms of DER, these data requirements are best progressed in the broader context of the DEIP Standards, Data and Interoperability Working Group*

### Research Data

Provide research institutions and industry organisations with the EV data they need to progress their work

**Recommendation**

*The Working Group will work with the relevant Energy Security Board (ESB) Data Strategy workstreams to pursue the delivery options proposed in this report within a broader energy data context*

# Contents



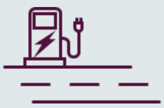
# Tables

# Figures

# 1. Introduction

In recent years, the energy system has seen a significant increase in distributed energy resources (DER). DER are consumer-owned devices that, as individual units, can generate or store electricity or have the capacity to actively manage energy demand. These include devices such as solar photovoltaic (PV) systems, batteries, and electric vehicle supply equipment (EVSE)[3].

The number of electric vehicles (EVs) on Australian roads is predicted[4] to increase dramatically over coming years, presenting both opportunities and challenges for Australia's electricity sector. A chaotic integration of EVs would pose significant challenges to the energy system. An EV rollout that is supported by appropriate market frameworks, regulation and infrastructure that meets consumer demand will enable an effective energy system designed to meet future needs.



An EVSE is a stationary device which delivers energy between an electricity network and an EV. While these devices are commonly known as 'chargers' or 'charging stations', the term EVSE is used in this report to avoid confusion with on-vehicle charging equipment.

Before wide-scale EV adoption begins, industry and government stakeholders have an opportunity to coordinate their activities to deliver value to consumers and reduce future costs. As part of the Distributed Energy Integration Program (DEIP)[5], AEMO has been working with key industry and government stakeholders to establish the DEIP EV Grid Integration Working Group ('Working Group'), providing a forum for collaboration and coordination of EV activities.

The Working Group has identified[6] the lack of access to relevant, local EV-related data as a key factor impacting forecasting, planning and regulatory change in Australian EV grid integration. Data on EVSE, vehicles, and consumers' driving and charging behaviour is often either not collected or is not collected comprehensively. Where data collection does occur, it can be spread across many organisations or government bodies with access limited due to privacy or commercial considerations. Better access to data on charger capability, vehicle uptake and consumer behaviour will enable the energy sector to forecast and plan for the transition to electrified transportation in a more efficient manner.

To progress this issue, the Working Group established a Data Availability Taskforce ('Taskforce'). This report captures the views of this Taskforce on EV data requirements and assesses data sources, potential collection pathways and delivery mechanisms. Like other forms of energy data, EV data access involves many challenges with a diversity of owners, sources, rights holders, commercial interests and regulatory frameworks leading to a complex set of considerations for parties wishing to obtain data. These issues are drawn out in this report with a view to overcoming any barriers that may exist between these parties and the data they require.

The Taskforce's work has been exploratory and collaborative in nature and makes recommendations for ongoing improvements to data access rather than providing a consensus on specific decisions. To fully understand the detail and impact of these recommendations, further work will be required. The *Data Availability Taskforce – Recommendations* report provides direction for future EV data availability efforts and a basis for DEIP, the Working Group and wider industry to engage with governments, industry and market bodies to address their EV-related data needs.

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[3] More information about AEMO's DER program can be found at https://aemo.com.au/en/initiatives/major-programs/nem-distributed-energy-resources-der-program.

[4] See https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo.

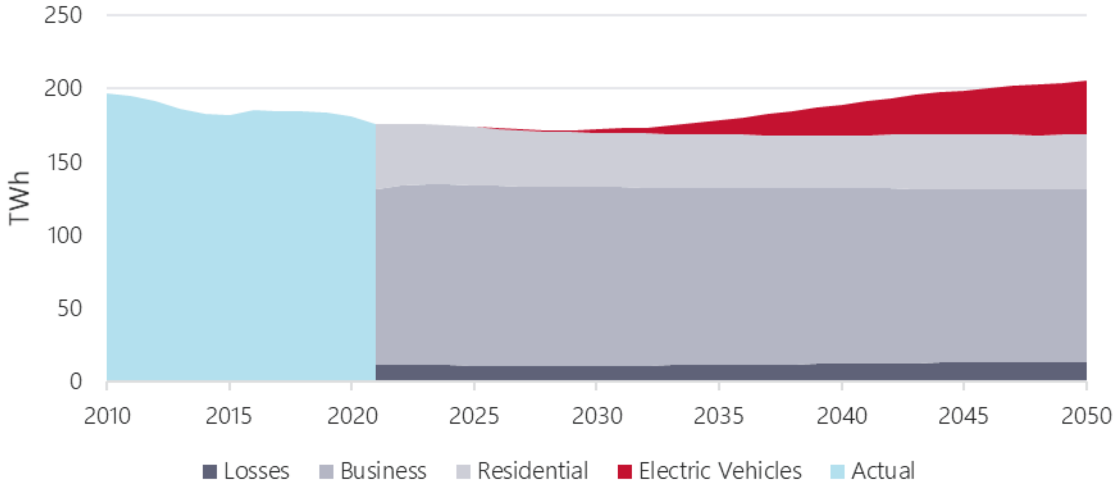
[5] See https://arena.gov.au/knowledge-innovation/distributed-energy-integration-program/.

[6] See https://arena.gov.au/assets/2020/05/electric-vehicle-grid-integration-working-group-post-workshop-summary-pack.pdf.

# 2. Background

AEMO's 2020 *Electricity Statement of Opportunities* (ESOO)[7] Central scenario shows EVs are predicted to be the fastest growing energy demand category in the National Electricity Market (NEM) from the mid-2020s. EV demand is forecast to add over 1 terawatt hour (TWh) of new consumption to the NEM each year from the late 2020s, approaching the level of total residential consumption by 2050, with similar EV uptake growth predicted in Western Australia's Wholesale Energy Market (WEM) from the mid 2020s. Figure 3 shows the projected growth of EV energy consumption in the NEM alongside other sectors of demand.

**Figure 3 NEM operational consumption, ESOO 2020 Central scenario**




The time of day that EVs consume (or export) energy will have a significant impact on the costs associated with accommodating them in the electricity network. From a bulk system perspective, if large numbers of EVs are charging during peak energy demand conditions in the late afternoon, costly additional network and supply capacity may be required to ensure this extra energy demand can be met. Conversely, if many EVs are charging around the middle of the day during mild weather conditions, they may provide benefits to the energy system by mitigating minimum energy demand challenges and increasing network utilisation. Whenever large numbers of EVs are charging, their impact on system stability will need to be well understood to ensure system security can be maintained under the full range of load conditions.

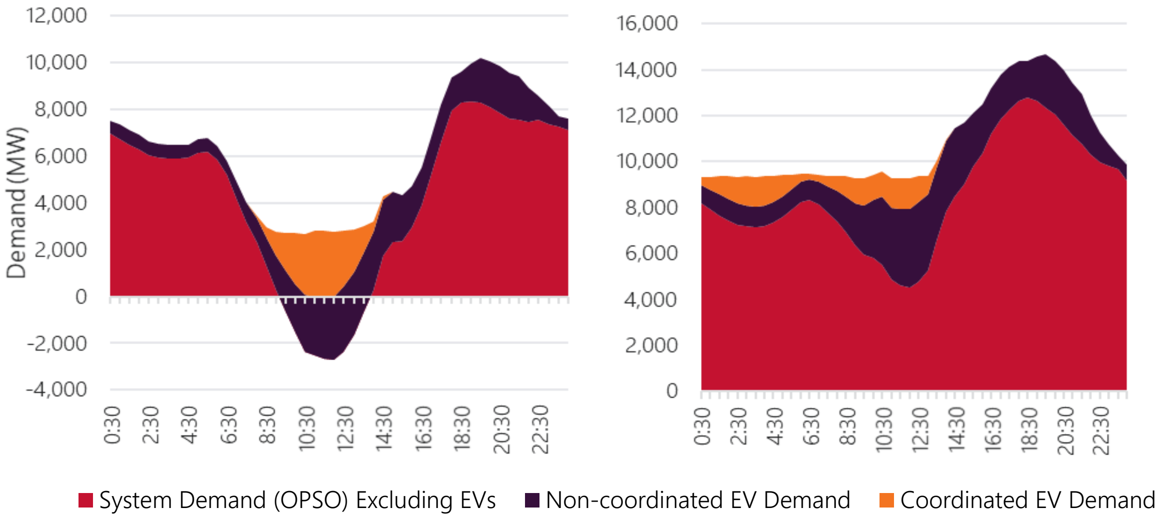
Wide-scale EV adoption will also pose challenges to distribution network service providers (DNSPs), who own and operate the electricity network at a local level where the impacts of EV charging will be felt first. In many scenarios, the power EVSE draws is comparable to or may even exceed the typical demand of a residential household. The potential for concentrated EV charging activity, such as a street where multiple EV owners charge their vehicles when returning from work, might give rise to localised distribution network capacity issues.

A broad range of datasets is required to predict how future consumers will charge their EVs. Data on the location and capability of charging facilities, consumer behaviour and market incentives can be combined to model a range of potential future scenarios to assess the impact of EV charging during minimum and peak energy demand. Of particular interest is the proportion of consumers who might respond to incentives or signals to modify their charging behaviour in a coordinated way, to manage their impact on the energy system and to minimise their own charging costs. Figure 4 shows an example of how coordinated EV

[7] At https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo.

charging might impact the future demand profile under various conditions. These assumptions are used in the 2020 NEM ESOO modelling of EVs[8].

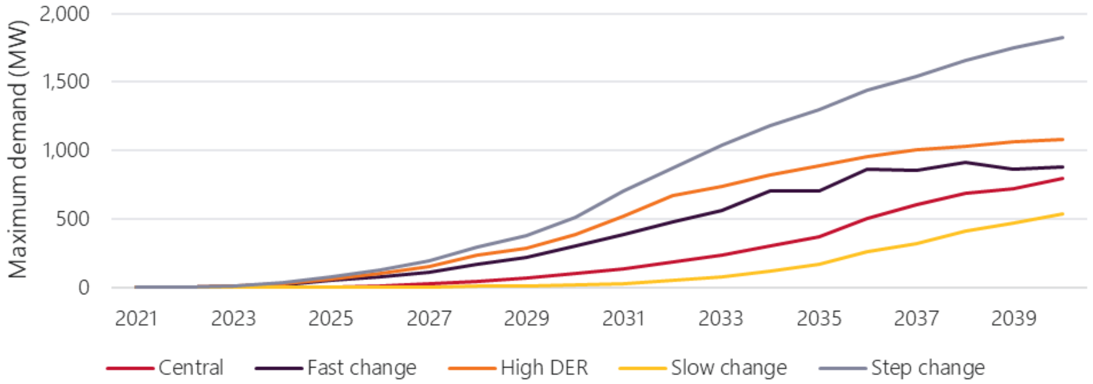
**Figure 4 Example of coordinated EV charging profiles during mild conditions (October) (left) and high demand conditions (January) (right) in the Step Change scenario in 2040 for New South Wales.**




Note: OPSO means operational demand sent-out.

Figure 5 shows the breadth of scenarios used in the 2020 NEM ESOO to predict the impact of EVs on maximum electricity demand in New South Wales[9]. Much of this spread comes from uncertainty in how future consumers will chose to charge their EVs, specifically whether they will be charging at times of peak energy demand. Access to detailed data and insights on EV charging behaviour could help narrow the breadth of these scenarios, providing a firmer target for planning processes.

**Figure 5 Predicted contribution of EVs to maximum summer electricity demand in New South Wales – 2020 ESOO (10% probability of exceedance)**




Increased access to EV-related data will help network businesses, energy market bodies and other electricity sector businesses in planning and investing in public and private infrastructure. Some organisations may be beneficiaries of EV data being available to researchers, but do not necessarily require the raw data; some could act as data intermediaries, without a need to directly use the data themselves. This report aims to collate the data requirements of this broad stakeholder base and present some potential delivery mechanisms and products to meet their needs.

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[8] AEMO's 2020 *Inputs, Assumptions* and *Scenarios Report* (IASR), at https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputs-assumptions-methodologies/2020/2020-forecasting-and-planning-inputs-assumptions-and-scenarios-report-iasr.pdf.

[9] Scenarios are characterised by the varying rates of EV uptake. See https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo for more information.

# 3. Process and acknowledgements

In early 2019, AEMO worked with industry stakeholders to develop an EV Modelling Roadmap to highlight where action is needed to improve EV data access within the energy sector. Since December 2019, AEMO has continued that collaboration through the DEIP EV Working Group Data Availability Taskforce. AEMO would like to thank all organisations and individuals who contributed considerable time and expertise toward the efforts detailed in this section, including:

- ACE Electric Vehicle Group
- AGL
- Australian Energy Regulator (AER)
- Australian Renewable Energy Agency (ARENA)
- C4NET
- CitiPower, Powercor and United Energy
- Deloitte
- Electric Vehicle Council
- Energy Security Board
- Energy Queensland
- Horizon Power
- JET Charge
- RMIT University
- TasNetworks
- Tritium

## 3.1 EV Grid Integration Working Group

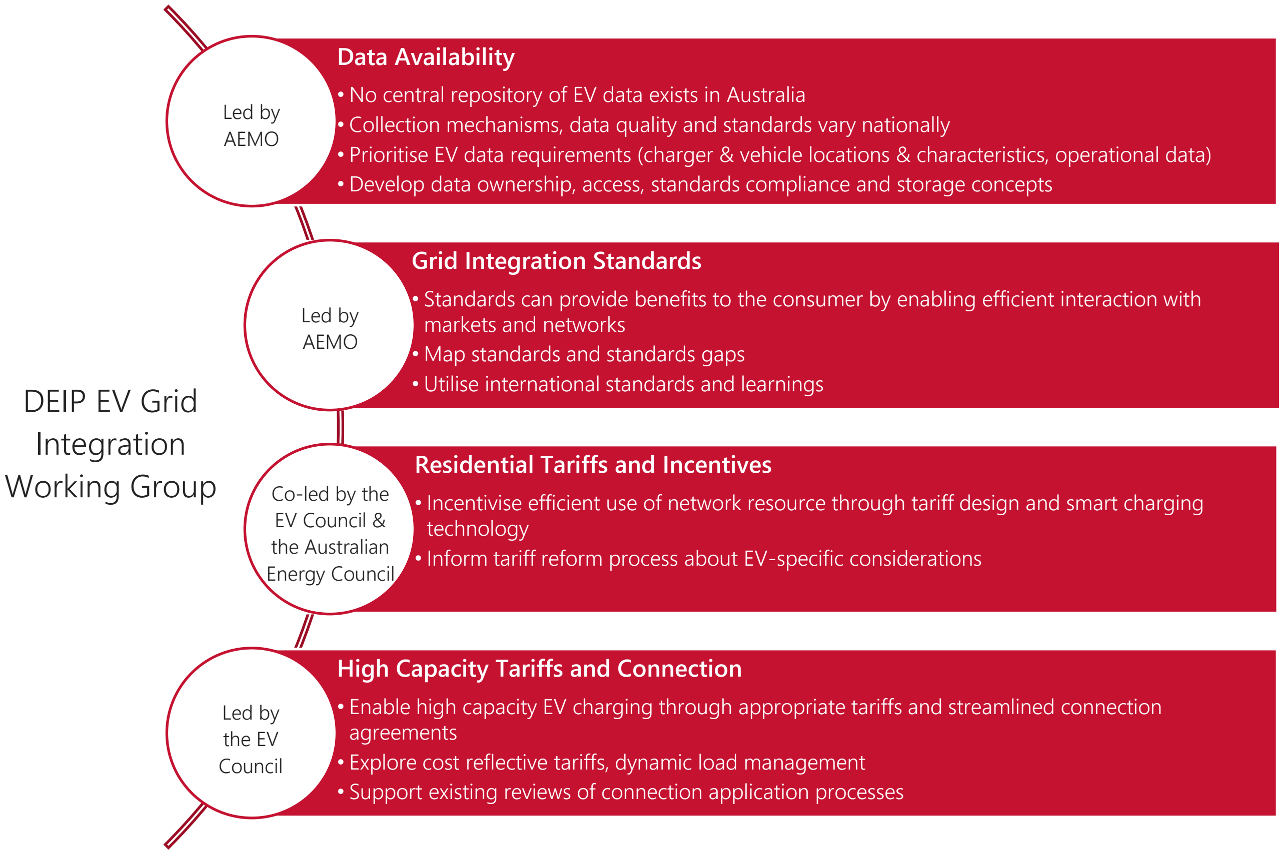
The DEIP EV Grid Integration Working Group was established in 2019 to help facilitate the efficient integration of EVs into existing networks and markets. The Working Group aims to:

- Provide a central forum for key industry and government stakeholders to collaborate and coordinate EV activities.
- Approach EVs from an energy sector perspective together with transport and infrastructure partners.
- Promote policy and regulatory development before wide-scale EV adoption begins.

To progress these objectives, four taskforces were established under the Working Group for 2020, as shown in Figure 6.

The term 'grid integration' in the Working Group context represents the ways EVs and EVSE (individually or collectively via an aggregator) influence and interact with the electricity system.

**Figure 6 DEIP EV Grid Integration Working Group taskforces 2020**




## 3.2 EV Data Availability Taskforce

### 3.2.1 Terms of Reference

The Working Group developed Terms of Reference for the Taskforce to help guide its activity. The premise of the Taskforce is that a central repository or another means of access to EV-related data is needed to facilitate the study, modelling and regulation of EV grid integration. This will provide a basis for informed decision making during the transition to electrified transportation and over time will build an ongoing historical record to enable deeper analysis in the future.

**Table 1 Summary of Taskforce scope and objectives**

| | |
|---|---|
| **Scope** | • Complete a gap analysis to identify EV data needs from an energy sector perspective. Prioritise needs and assess potential collection mechanisms and storage/delivery options for an EV data repository. |
| **Objectives** | • Provide recommendation to DEIP regarding industry needs and priorities for EV data, alongside proposed data sources, collection mechanisms and delivery options.<br>• Progress data access requirements identified in AEMO's EV Modelling Roadmap, as well as priorities determined by wider industry.<br>• Demonstrate the value of an EV data repository to decision makers/regulators/legislators. |

### 3.2.2 Taskforce membership and workflow

AEMO reached out to the Working Group members and their contacts in May 2020 to invite participation in the Taskforce, with participants electing their chosen levels of commitment:

- *Members* – able to commit to attend regular meetings and contribute time/expertise to progress Taskforce deliverables.
- *Attendees* – able to contribute through attendance at workshops or via surveys and consultation.
- *Observers* – included on the mailing list for Taskforce proceedings.

Taskforce Members met every four weeks between June 2020 and February 2021 to progress the development of this report. Due to the disruption caused by COVID-19, the Taskforce did not run any additional events or workshops. Attendees and Observers were kept informed and consulted via email and virtual meetings.

# 4. Key themes and challenges

EV data access involves many similar themes and challenges as other forms of energy data, with a diversity of owners, sources, rights holders, commercial interests and regulatory frameworks leading to a complex set of considerations for parties wishing to obtain data. The Energy Security Board (ESB) published a consultation paper on a new data strategy for the NEM[10] in October 2020 which provides additional context to many of the themes detailed in this section.

## 4.1 Privacy and confidentiality

It is critical for organisations that utilise sensitive data to respect the rights of the individuals and businesses who the data relates to and adhere to privacy and confidentiality policy and regulation. Privacy and confidentiality are two separate concepts governing how information can be used:

- Privacy law relates to the collection, use and disclosure of personal information such as names and addresses.
- Confidentiality relates to a broad range of information that an individual or business only wishes to disclose under specific conditions, perhaps for commercial or legal reasons, and is governed by a range of regulatory instruments and contracts.

The EV data requirements detailed in this report include many examples of private and/or confidential information. Importantly, the diversity of data sources needed to perform detailed analysis on EV charging behaviour and the linked nature of these datasets (see Section 5.3) mean close care needs to meet the requirements of privacy law, including to ensure individuals can only be identified by those who are authorised to do so. While data can often be used in a de-identified form for modelling purposes, robust methods and privacy protecting agreements need to be employed to prevent re-identification, particularly through linkages to other identifiable datasets.

[10] At http://www.coagenergycouncil.gov.au/publications/energy-security-board-data-strategy-consultation-paper.

## 4.2 Cost/benefit

Collection, provision and protection of data comes at a cost, so appropriate benefits would need to be realised to justify any new EV-related data mechanism. Benefits of improved EV data availability could include:

- More accurate EV uptake and impact models to mitigate risk of over- or under-investment in network and generation assets, enabling more efficient investment and lowering costs and prices to energy consumers.
- Detailed understanding of EV and EVSE performance and their demand profile enables more accurate system stability modelling, reducing the need for dispatch/procurement of costly services to maintain system security.
- Evidence-based, localised research to inform public policy and infrastructure planning, guiding the evolution of the EV grid integration regulatory environment in a cost-efficient manner.
- Enabling EVs to participate in energy and services markets provides their owners with additional revenue streams. Greater market participation and diversity lowers costs to all energy consumers by improving network utilisation through market signals and incentives.
- Greater understanding and visibility of consumer behaviour and charging preferences enables targeted, efficient investment in charging infrastructure.

Expansion of existing systems to accommodate EV-related data should be considered wherever possible to keep costs to a minimum. Examples might include:

- Utilising AEMO's existing Distributed Energy Resources (DER) Register to capture EVSE standing data. Examples of standing EVSE data are explored in Section 5.2.1.
- Leveraging existing state/territory government motor vehicle registration databases to capture EV-specific fields.

The *Data Availability Taskforce – Recommendations* report is exploratory in nature and aims to raise candidates for future cost-benefit analysis. Delivery mechanism candidates are outlined in Section 6.

## 4.3 Mobile data

The mobile nature of EVs presents a unique challenge to the electricity sector, where assets are predominantly stationary. Linking the location of a vehicle to its relevant connection point will require specific parameters to be tracked, potentially including data exchanged between the vehicle and EVSE during charging. While some emerging standards might facilitate this linkage automatically, validating the grid location of vehicle charging remains a complex issue for the electricity sector to navigate.

The diversity of EV charging configurations and communications pathways adds to this challenge, as there may be multiple ways to obtain a given measurement. For example, both the vehicle and a 'smart EVSE' might monitor the rate of charging and one or both of those devices may be enabled for remote communications and data storage. Locating, reconciling and appropriately storing this data will require suitable logic to ensure the correct data is stored against its relevant record.

# 5. Data requirements

A key activity of the Taskforce involved capturing industry views on the EV-related data requirements of their organisations. These requirements were grouped and categorised according to their common characteristics and applications.

## 5.1 Definitions

The Taskforce introduced terminology to identify datasets with related frequency of update:

**Static**
*Infrequently updated information relating to state and characteristics, such as a vehicle registration database*

**Dynamic**
*Time varying information relating to a measurement or instruction, such as electricity consumption data measured by an EVSE every five minutes*

Dynamic data can be more costly to collect than static data due to the communications links and technology interfaces required, however it can provide a rich source of information for detailed analysis.

Terms were also introduced to describe the level of data coverage required:

**Population**
*Complete coverage is required, such as a vehicle registration database – population data is often used to facilitate planning and compliance activities*

**Sample**
*Only a subset of information needs to be captured to inform a research or modelling exercise, with the model then providing population-level insights. For example, a survey of consumer behaviour does not need to contact every EV owner since conclusions can be drawn from a smaller sample*

Collecting sample data can provide a cost-effective means of gaining insights through modelling, however some applications will require a full population dataset.

## 5.2 Data categories

Using the terminology from Section 5.1, the Taskforce defined seven categories of EV-related data:

| | Static | Dynamic |
|---|---|---|
| **Population** | Enable planning and compliance at suitable spatial resolutions<br>EVSE Standing Data<br>Vehicle Standing Data | Enable participation of EVs in electricity markets and system operations<br>Market/Operational Data |
| **Sample** | Enable research and insights with low overheads<br>Consumer Characteristics | Enable detailed research with comprehensive data at an individual level<br>Vehicle Operations<br>Consumer Experience<br>EVSE Operations |

The following sections contain a brief summary of each of these seven data categories. A more comprehensive view of required fields for each data category is available in Appendix A2.

### 5.2.1 EVSE standing data

Location and characteristics of EVSE to inform network modelling and forecasting

**Static** **Population**

The location and characteristics of EVSE is of great interest to AEMO and DNSPs, who require this data to inform their network modelling, simulation, forecasting and planning functions. In future, DNSPs and AEMO may also need this data for registration and compliance purposes where EVSE participate in DER markets or charging management programs. To perform these functions at both the local network level and from a bulk system perspective, a population dataset is preferred. This would also enable linkage to AEMO's DER Register[11] to facilitate modelling of EV demand alongside other distributed generation and battery resources.

Given that many EVs can be charged from a standard household power socket, it is unlikely that all charging locations could ever be captured within a register. Setting a minimum threshold for inclusion in the register would help manage compliance costs and provide a clear demarcation point where alternative estimation methods would be required to model low-power charging.

**EVSE standing data relevant to the energy sector includes:**

- Type/make/model
- Capacity and capability – kW rating, import/export limits, communications interfaces
- Standards compliance/protection settings
- National Metering Identifier (NMI) to enable linkage to other datasets

**Potential collection mechanisms:**

- DNSPs collect EVSE standing data from installers as per other DER – noting that currently few EVSE installations require DNSP notification.
- Installers obliged to contribute directly to a central EVSE register operated by government or industry body – noting the regulatory/legislative pathway to this is not yet clear.
- Installers obliged to contribute EVSE data to their relevant electrical licencing body – a similar mechanism currently operates for air conditioners in some jurisdictions.
- Detect EV charging activity from existing interval meters, store in a central register – noting that interval meter penetration rates vary significantly between jurisdictions, and currently EVSE installation does not necessarily trigger the need for an interval meter. Machine learning could be utilised to identify low-power charging activity.
- EVSE remotely register themselves via interoperation with electricity network/market – noting that this capability is still under discussion/development.
- Capture EVSE standing data alongside any future widespread incentive scheme – the Clean Energy Regulator has held a similar role for many years under the Small-scale Renewable Energy Scheme (SRES) and Large-scale Renewable Energy Target (LRET) programs
- Sample data obtained from trials could provide an interim collection mechanism.

### 5.2.2 EVSE operations

Data on EV charging operations for research purposes

**Dynamic** **Sample**

[11] See https://aemo.com.au/en/energy-systems/electricity/der-register.

Research organisations, government, DNSPs and AEMO all require an understanding of the typical usage patterns of EVSE to enable modelling and analysis. At a local network level, this data would inform capacity modelling, operating envelope management and development of charging management programs. At a bulk system level, charging profiles are used[12] to predict the impact of EVs at critical periods of very high or low energy demand.

By studying a representative sample of EVSE, typical charging profiles can be developed and used in conjunction with EVSE asset standing data to infer the behaviour of the complete charging fleet. Time-series data would be preferable, however cycle logs captured at the beginning and end of each charging session may also be of use.

**Operational data relevant to understanding the impact of EV charging includes:**

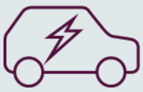
- Power flow into/out of the EVSE
- Voltage measurements
- Vehicle connection status and battery state-of-charge (where available)

**Potential collection mechanisms:**

- Financial procurement or voluntary submission of data, for example from public charge point operators, charging services businesses, fleet operators, vehicle manufacturers
- Funding agreements for trials to include specific data sharing conditions
- Disaggregate EV charging behaviour from existing interval net metering data (noting that dedicated metering already exists for some larger EVSE)
- Participation in future energy and services markets requiring device-level telemetry

### 5.2.3 Vehicle standing data

Vehicle registration and sales information to inform uptake projections



Static

Population

The size and composition of Australia's vehicle fleet is a key input to forecasting EV uptake and predicting EV impact. AEMO, DNSPs, researchers and government all require this information for forecasting and planning activities such as network impact projections. This data is also valuable outside of the energy space, with transport, infrastructure and resources sectors performing their own analysis on vehicle data.

Population data sets already exist because all vehicles are required to be registered by jurisdictional motor vehicle registration bodies; however, data quality and consistency issues create challenges for users of this data (discussed further in Section 6.2). The energy sector does not necessarily require vehicle registration data to this level of granularity and could use geospatially aggregated data to inform planning, noting that a vehicle's registered address may not be an accurate indicator of charging activity as EVs do not always charge at their registered address.

**Vehicle standing data relevant to the energy sector includes:**

- Make/model/year manufactured
- Battery capacity
- Specification data such as rated consumption (kWh/100km), maximum charge rates, export capability (standard specifications could be identified from make/model/year)

[12] See AEMO's 2020 IASR, page 74, at https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputs-assumptions-methodologies/2020/csiro-der-forecast-report.pdf.

- Where individual data is available, linkage to other datasets could occur via the registered address or vehicle registration number

**Potential collection mechanisms:**

- Capture EV-specific data alongside existing jurisdictional vehicle registration processes with supporting data sharing arrangements
- Vehicle sales data provided by vehicle manufacturers or automotive industry bodies (noting that not all EV manufacturers currently report sales figures)
- Vehicle importation data
- Telemetry and specification data provided by vehicle manufacturers

### 5.2.4 Vehicle operations

Detailed vehicle usage data for research purposes | Dynamic | Sample

Driving patterns, traffic flows and trip distances all influence the ways consumers charge their EVs. Daytime commuters without access to charging infrastructure at their workplace may prefer to charge their EVs at home, where long distance travellers will create demand for roadside fast-charging infrastructure. AEMO and DNSPs can use research on vehicle operations to better understand the locational and temporal aspects of charging demand and charging management programs, while charging services businesses and governments can use this data to identify optimal locations for public EVSE placement.

This is a particularly sensitive area from a privacy perspective, as locational data could readily identify an individual and their behaviours. Careful attention to consent, data ownership and data stewardship would be required to ensure consumers are protected and remain comfortable with how this data will be used. Aggregate trends or models developed from this data would likely be sufficient for most energy sector uses, with raw data only required by the organisation performing the analysis (under appropriate privacy controls). Time-series data provides a rich dataset for research, but less detailed trip log records can also provide valuable insight into driving and charging patterns and might be considered less sensitive to trial participants.

Research on EV operations is already underway, with the SmartCharge Queensland Research Program[13] led by Energex and Ergon Energy Network a key example of the importance of this data to DNSPs.

**Vehicle operations data relevant to the energy sector includes:**

- Trip route or statistics
- Charging locations and rates (kW and kWh delivered)
- Battery state of charge

**Potential collection mechanisms:**

- Financial procurement or voluntary submission of data, for example from fleet/car-share operators, vehicle manufacturers, insurance companies, vehicle monitoring/maintenance service providers – likely obtained via telemetry or in-vehicle monitoring devices
- Funding agreements for trials to include specific data sharing conditions
- Mobile applications (both phone and on-vehicle apps)
- Collection of data from roadside infrastructure, using 'vehicle-to-infrastructure' (V2I) communication

[13] See https://www.ergon.com.au/network/smarter-energy/electric-vehicles/ev-smartcharge-qld-research-program.

### 5.2.5 Consumer characteristics

Characteristics of EV owners/drivers for research purposes

Static

Sample

Coupling data from vehicles and EVSE with information on the consumers who own or operate those vehicles can lead to a greater understanding of the underlying behaviour inherent in that data. In any large EV trial, there is likely to be a diverse range of ownership characteristics. By grouping the vehicles based on these characteristics, deeper insights can be obtained. For example, vehicles without access to off-street parking will likely exhibit different charging habits to those with a permanent garage, and owners with a solar PV system may choose to charge their EV during the day to take advantage of this low-cost energy. Researchers can take advantage of this insight to build more accurate models on consumer behaviour.

**Relevant consumer characteristics include:**

- Vehicle ownership status (own/lease/fleet/share)
- Parking status (for example, garage/basement/employee carpark)
- DER ownership at primary point of charging (PV, battery)
- Any third-party incentives (aggregators/VPP/Demand response)

Consumer characteristics are likely to be obtained at the initiation of a trial, but there may also be opportunities to capture this information from a wider audience. Consumer information is most relevant when linked to other datasets, so capturing key data such as a National Metering Identifier (NMI) or vehicle registration can be valuable.

**Potential collection mechanisms:**

- Funding agreements for trials to include specific data sharing conditions
- Data provided during signup to charging services, mobile applications, loyalty programs etc.
- Voluntary submission of data by consumers via survey, direct outreach by retailers/DNSPs

### 5.2.6 Consumer experience

Ongoing customer experience data for research purposes

Dynamic

Sample

Dynamic data on consumers can provide valuable insight into their experience within a trial or product and gives researchers an understanding of whether the consumers' needs are being met. This data can be commercially sensitive and needs to be treated with appropriate privacy controls.

Mechanisms used to obtain dynamic consumer data could also be used to update static consumer data, such as their NMI if they have moved to a new home or business.

| **Potential collection mechanisms:** |
|---|
| • Funding agreements for trials to include specific data sharing conditions<br>• Voluntary submission of data by consumers via survey, such as Energy Consumers Australia's biannual Consumer Sentiment Survey |

### 5.2.7 Market/operational data

Data used in the operation of energy and services markets

**Dynamic** **Population**

Some degree of dynamic data will be required to enable EVs and/or EVSE to participate in energy and services markets alongside other forms of DER such as PV and battery systems. Population data will be needed, however in this case the population only includes those devices enrolled in energy and services markets with dynamic data requirements, as opposed to all EVs or EVSE.

Several other groups are actively investigating the necessary degree of visibility, communication protocols and standards required to manage the interoperation between DER devices and the energy system. EVs are considered a form of DER, so the Taskforce has chosen to collaborate with these groups to ensure the needs and capabilities of EVs are well understood, rather than risking duplication of effort by developing EV-specific data requirements.

| **Relevant forums where DER market integration is being discussed include:** |
|---|
| • DEIP Standards, Data and Interoperability Working Group[14]<br>• DEIP Operating Envelopes workstream<br>• ESB DER Integration Roadmap and Workplan, as well as related work within the wider Post 2025 Electricity Market Design project[15]. |

## 5.3 Data linkage

Many EV modelling activities will require more than one of the data categories detailed in Section 5.2. To ensure accurate linkage between datasets, it is critical that standardised fields are included to allow records in one data category to be matched against their counterparts in another category. For example, a study on vehicle usage patterns might need to link data on the driving route of a vehicle to the make/model of that vehicle, and perhaps the parking options available to the vehicle's owner.

| **Standardised fields that could be used as keys to enable dataset linkage include:** |
|---|
| • NMI<br>• Vehicle registration number |
| **Where these key fields are not available, other fields might provide a less reliable method of linking datasets:** |
| • Registered vehicle address – noting the vehicle might not charge (or even be stored) at its registered address<br>• Personal consumer details such as name, contact details |

[14] See https://aemo.com.au/en/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/deip-sdiwg.

[15] See https://esb-post2025-market-design.aemc.gov.au/.

Data linkage can also assist with minimising the burden of collecting some forms of data, by matching key fields against another dataset to locate fields which are already known. For example, if an EVSE standing data register captured the NMI of an EVSE, it might not need to capture the street address of that device, since that information can be obtained from the pre-existing NMI standing data register held by AEMO. AEMO's DER Register uses similar data linkage techniques to automatically populate the specifications of DER devices based on their make and model, saving users from manually entering this data. Users are then able to manually edit these specifications where they diverge from their typical values.

Additionally, the marriage of data linkage and Artificial Intelligence (AI) might diminish the need for future consumer behaviour surveys, by inferring behavioural patterns from other data sources such as electricity metering data. Although data linkage can offer additional value, it can also raise privacy issues, as linkage often depends on identifiable information such as an address. Careful consideration must be given to ensure privacy policies are adhered to when linking and sharing data sets. The ESB Data Strategy Consultation paper highlights these issues as central to improving data access in the energy sector.

# 6. Delivery mechanisms

The Taskforce considered potential delivery options for the data categories identified in Section 5 and determined four key 'products' that, if available, could meet the identified data requirements. This diverges from the original premise that a single, central data repository would be the optimal solution, and reflects the breadth of data owners, roles and responsibilities across the energy and transport sectors. In order to efficiently progress the data needs of industry a multi-pronged approach is required.

The four product areas/delivery mechanisms are made up of three of the seven identified data categories as standalone cases, with the remainder grouped into a single concept:

EVSE Standing Data Register

Vehicle Standing Data Register

Market/Operational Data Services

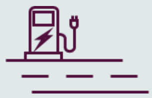
Research Data

- *Charger Operations*
- *Vehicle Operations*
- *Consumer Characteristics*
- *Consumer Experience*

The rest of this section will discuss each of these delivery mechanisms in turn, identifying their scope, potential delivery options, relevant stakeholders and the sector/forum best placed to progress development.

## 6.1 EVSE standing data register

Capture individual details of all EVSE in an access-controlled register



An EVSE standing data register would capture locational and characteristic information about individual EVSE installations, similarly to how the DER Register captures this information for small generation systems. This information would need to be stored in an access-controlled register, allowing organisations with appropriate access rights to view and/or edit specific records.

The DER Register currently enables record-level access for AEMO, DNSPs, installers and emergency services groups, with aggregate data provided on AEMO's website. An EVSE register would need to consider the access requirements of stakeholder groups such as research organisations, government and charging services businesses.

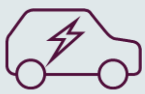
**Potential delivery options:**

- Mandatory inclusion of EVSE in DER Register or Demand Side Participation Information (DSPI) portal, via new NER rule or other regulatory means, with the obligation falling on DNSPs to manage the collection and submission process as per other generation and storage technologies
- Voluntary/partial inclusion of EVSE in DER Register or DSPI portal, via industry agreement or consumer incentive
- New, central register operated specifically for EVSE – operator and collection mechanism to be determined (could be automated registration as part of future market systems)
- Jurisdictional registers operated by DNSPs, government or electrical licencing bodies

The Working Group includes many stakeholders with a strong interest in progressing the development of an EVSE asset standing data register and will continue the discussion on this high priority activity. In consultation with the Working Group and other stakeholders, AEMO will undertake an opportunity assessment in early 2021 to better understand potential delivery options for an EVSE standing data register under the existing electricity rules and regulatory frameworks.

## 6.2 Vehicle standing data register

Centralise EV registration data in a standard format, providing both aggregate data and access-controlled individual data



A vehicle standing data register would capture locational and characteristic information about individual vehicles, with the existing jurisdictional vehicle registration systems being an obvious data source. However, due to differences in data collection and audit mechanisms between jurisdictions, some challenges exist regarding data standards, consistency and quality. While datasets aggregated by vehicle type and geospatial area would likely suffice for most energy sector applications, it is likely that any standardisation and cleaning process would require visibility of individual record-level data.

Many energy sector organisations, including AEMO and DNSPs, regularly approach jurisdictional vehicle registration bodies separately to obtain EV registration information, which then requires collation and cleaning and data matching. This process is inefficient and risks inconsistent interpretation of the same datasets, particularly where knowledge of specific vehicle models is required to correctly determine the fuel type and battery characteristics for each registered vehicle. A centralised, standardised source of vehicle registration information would provide industry with a single source of truth on which to base analysis, increasing efficiency and data transparency across multiple sectors.

In July 2020, Austroads completed a project documenting the registration data requirements for EVs and potential data flows between existing and future data sources and jurisdictional registration systems[16]. Due to the complexity of these systems, implementing change in line with these requirements will likely take several years.

The Taskforce considers that a 'quick win' would be valuable to bridge this timing gap. This 'quick win' could involve an organisation taking the lead on the collation and cleaning process on behalf of industry. If no single industry or government organisation wishes to take on this role, then a third-party organisation may wish to provide this service on commercial terms.

**Potential delivery options:**

- Single point of access to standardised, quality assured data collated from jurisdictional registration systems
- Individual access points to each jurisdictional registration system, providing standardised and quality assured data
- Industry body or third-party organisation provides a service to collate and clean existing registration data from each jurisdictional registration system – noting that data quality and availability currently varies significantly
- Industry body collates complete statistics on EV sales, including locational detail where available. Similar products are already available, however not all EV manufacturers report their sales data, leaving these datasets incomplete.

Given the existing ownership of vehicle registration data lies within the transport sector, it is appropriate to pursue a vehicle standing data register through relevant transport sector bodies. The Low and Zero Emissions Vehicles Working Group reporting to the Infrastructure Transport Ministers Meeting, Austroads, and state and federal government transport departments are all viable channels for the energy sector to communicate data requirements and to influence change. The Working Group remains a suitable forum for energy sector stakeholders to contribute to this effort.

The group will engage with relevant Government bodies during 2021 to communicate the energy sector's need for consistent and streamlined reporting of vehicle standing data and to support reform and development in this space.

## 6.3 Market/operational data services

Systems enabling EVs to participate in energy and services markets alongside other DER

As detailed in Section 5.2.7, several other groups are currently investigating delivery mechanisms for DER market and operational services. To avoid duplication of effort, Taskforce members will continue this

[16] See https://austroads.com.au/latest-news/data-requirements-for-automated-and-electric-vehicle-registration.

discussion within the DEIP Standards, Data and Interoperability workstream, which will closely link into the broader DEIP work program as well as the ESB DER and Post 2025 work plans.

## 6.4 Research data repository/concierge

> Provide research institutions, industry organisations and the public sector with the EV-related data they need to progress their work

Research and industry organisations often experience difficulties in obtaining suitable datasets to enable their analysis in the EV space. Commercial, regulatory and privacy constraints can make open sharing of data challenging, while achieving agreeable terms and conditions to access privately held datasets can be time consuming and may not lead to a successful outcome. This often necessitates that these organisations run or collaborate directly in a trial to obtain the data themselves, or the analysis simply does not progress.

A data repository or concierge service to facilitate the provision of sample data (both static and dynamic) to organisations wishing to undertake EV research could lead to more efficient use of existing datasets in the broader public interest, and reduce duplication of effort and public funding for trials with closely related terms of reference. Updates to the repository or service could occur at major project milestones, helping to publicise the research underway and open opportunity for future projects. Up-to-date data will often be necessary to keep research outcomes current, however research does not usually require data delivered at operational levels of timeliness. A repository with periodic updates (several times a year) could provide a lower cost solution than a more complex data delivery solution connecting researchers with market or operational systems.

Even within a trial context, data access challenges can exist when complex agreements are required to enable customer data to be shared with the trial operators. Bespoke agreements are often developed to achieve this, requiring significant time and legal resources. The ESB Data Strategy Consultation Paper addresses risks related to bespoke data arrangements and proposes that improved guidance to data gathering and sharing will simplify and reduce risks in these processes.

**Potential delivery options:**

- Research organisation to provide a data concierge service to match research data requirements with relevant data sources. This could be delivered on commercial terms or through a suitable funding vehicle.
- Industry or government organisation to create a data repository to securely store relevant EV-related datasets and provide access to them on appropriate terms. This could be developed through grant funding and/or as a commercial service.
- Establish a catalogue of EV-related data sources that research organisations could use to facilitate their work. Public data could be made available through existing platforms such as data.gov.au, or a separate catalogue could be established to identify private data sources alongside their relevant point of contact.
- Develop standard terms and conditions for data sharing to streamline trial initiation and assist with incorporating the data within a repository or concierge service

The ESB Data Strategy Consultation Paper highlights several existing government and industry organisations and programs that seek to share data, however many experience unique limitations regulatory frameworks, resources and direction. The Strategy proposes a range of reforms regarding the sharing of sensitive datasets for public-good research, through trusted bodies and protected environments. There are also a range of open data forums emerging in the research sector (such as the Australian Research Data Commons), developing methodologies for sharing research data and supporting development of related common-data platforms and partnerships.

The challenges in this space are by no means unique to EVs, or to the energy sector more generally. The Working Group will continue to investigate pathways toward achieving these delivery options alongside the ESB Data Strategy efforts, and is open to considering existing or proposed solutions from other areas such as the medical sector where the protection of data is also of foremost concern.

# 7. Summary and recommendations

Through a collaborative process, the Taskforce identified seven categories of EV-related data requirements, shown in the below table alongside the priority of obtaining access to each category in the near term prior to wide-scale EV uptake beginning. Categories flagged as 'Immediate' require attention now to inform existing forecasting and planning processes. 'Important' categories will inform regulatory and market development as EV uptake begins to climb over the next 1-5 years, while 'Future' requirements will become relevant as DER market development begins. Further detail on each data category can be found in Section 5.

**Figure 7 EV data requirements**

● Immediate ● Important ● Future

| | Static | | Dynamic | |
|---|---|---|---|---|
| | **EVSE Standing Data**<br>Location and characteristics of EVSE to inform network modelling and forecasting | Immediate | **EVSE Operations**<br>Data on EV charging operations for research purposes | Immediate |
| | **Vehicle Standing Data**<br>Vehicle registration and sales information to inform uptake projections | Immediate | **Vehicle Operations**<br>Detailed vehicle usage data for research purposes | Important |
| | **Consumer Characteristics**<br>Characteristics of EV owners/drivers for research purposes | Important | **Consumer Experience**<br>Ongoing customer experience data for research purposes | Important |
| | | | **Market/Operational Data**<br>Data used in the operation of energy and services markets | Future |

The Taskforce discussed these seven data categories from an implementation perspective to identify four potential delivery mechanisms, and makes the following recommendations for further development:

**EVSE Standing Data Register**

Capture individual details of all EVSE in an access-controlled register

***Recommendation***

*In 2021, AEMO – in consultation with stakeholders – will undertake an opportunity assessment to establish a minimum viable product for an EVSE standing data register under the existing electricity rules and regulatory frameworks*

**Vehicle Standing Data Register**

Centralise EV registration data in a standard format, providing both aggregate data and access-controlled individual data

***Recommendation***

*The Working Group will engage with Government transport departments and committees to communicate the energy sector's need for consistent and streamlined reporting of vehicle standing data and to support reform and development in this space. 'Quick win' solutions will be pursued where available to support current initiatives*

**Market/Operational Data Services**

Systems enabling EVs to participate in energy and services markets alongside other DER

***Recommendation***

*To ensure EVs have a level playing field alongside other forms of DER, these data requirements are best progressed in the broader context of the DEIP Standards, Data and Interoperability Working Group*

**Research Data**

Provide research institutions and industry organisations with the EV data they need to progress their work

***Recommendation***

*The Working Group will work with the relevant Energy Security Board (ESB) Data Strategy workstreams to pursue the delivery options proposed in this report within a broader energy data context*

Further detail on each of these delivery mechanisms can be found in Section 6.

The Working Group will continue to monitor progress of each of the above recommendations, noting that in many cases the implementation of this work will lie outside of the Working Group and its steering organisations. Where possible, the group will support regulatory change to establish robust data collection mechanisms and implementation of delivery solutions through engagement via appropriate channels.

Organisations or individuals who have an interest in the work presented in this report are welcome to reach out to AEMO at electricvehicles@aemo.com.au.

# A1. Relevant case studies

The following case studies highlight the effective collection and distribution of DER data.

## A1.1 SmartCharge Queensland Research Program

Queensland electricity distributors Energex and Ergon Energy Network, part of the Energy Queensland Group, have implemented the first EV charging study in Australia to use 3G in-car monitoring devices that record and report the how, when and where of each charging event for almost 200 EVs for up to three years[17].

Participants are spread across Queensland but are mainly located in the south-east corner. A wide range of both battery EVs (BEVs) and Plug-in Hybrid EVs (PHEVs) are included, and 75% of participants have a solar PV system and 17% have a battery energy storage system. Nine participating households have two EVs. Most devices are in private vehicles, with around 20 installed in fleet vehicles, including some owned by Energy Queensland.

Every 15 minutes of a charging event, the devices record the kW charge rate, kWh delivered, kW consumed (including energy losses) and other attributes. The devices also record where the charging event occurred (home or away from home), the total length of charge time, as well as the timing and distance of trips. This quantitative data collection will be complemented by qualitative research with a subset of participants to understand the influences behind the data.

The first devices were deployed in July 2020, with the first fulsome monthly data set compiled for September 2020. The monthly data sets collected so far are too small to define accurate insights. It is planned to release initial findings by mid-2021.

For the first 12 months, the charging events will be purely recorded and analysed. Beyond that, various incentives, information and other influencers will be deployed to determine their effectiveness at altering charging times and choices to reduce EV charging during peak network demand periods.

Energex and Ergon Energy Network will be sharing insights to help inform responses to both the challenges and opportunities posed by the growth in EV volumes. A schedule for releasing suitable insights is being planned.

**Key takeaways**

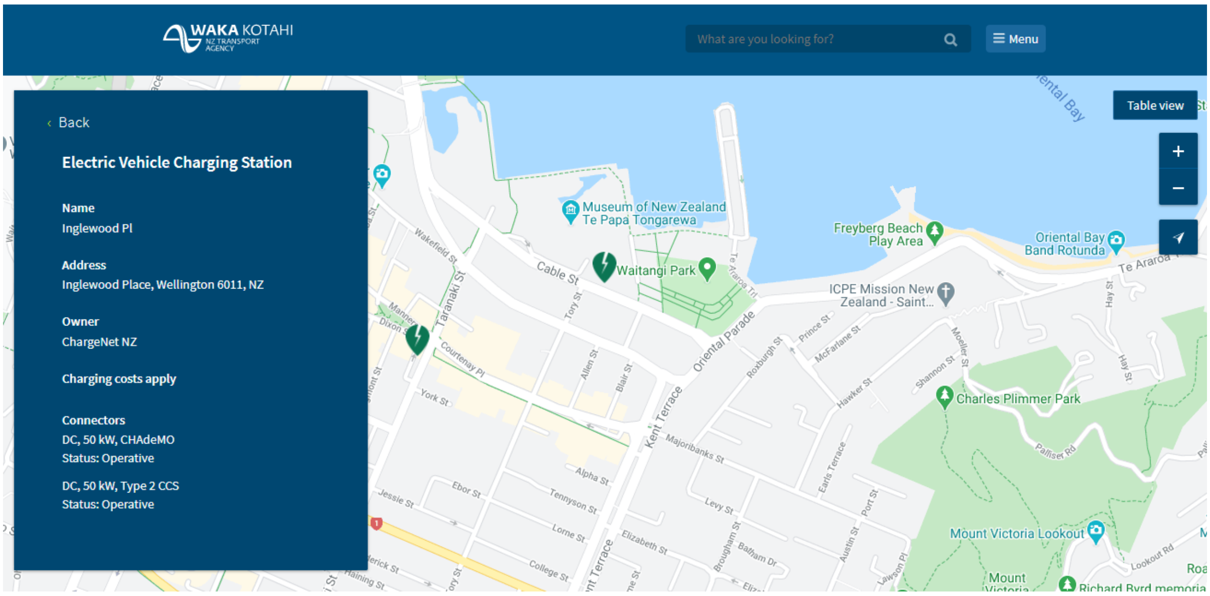
- Many EV owners committed to helping create data and insights to accelerate EV growth – privacy is a challenge but is not insurmountable
- DNSPs and other electricity sector organisations have to make significant financial commitments in research alone to prepare for inevitable EV growth
- These devices not only collect data, but can control charging in future. Research mechanisms with an ability to influence change are optimal

[17] See https://www.energex.com.au/home/control-your-energy/smarter-energy/electric-vehicles/ev-smartcharge-queensland-research-program.

## A1.2 EVroam

EVroam is a live database of New Zealand's EV public charging infrastructure[18]. EVroam freely distributes locational and real-time status data of public EVSE on the NZ transport agency website and on TomTom products.

**Figure 8 EVroam NZ transport agency map view, showing the address, owner and operational status of public charging station**




Source: https://www.journeys.nzta.govt.nz/ev-chargers

EVroam provides a clear picture of New Zealand's EVSE network allowing EV drivers to plan their journey. EVroam directly integrates with charging stations, which provide real-time operational status data. Only charging stations which meet government guidelines are added to the EVroam database giving EV drivers confidence their vehicle will charge at all points.

EVroam is a public-private partnership to provide an EV charging station database and forms part of New Zealand's EV program from the national Land Transport Fund.

### Key takeaways

- Real-time EVSE operational status updates
- Example of a centrally hosted repository of EVSE data
- Government-led initiative with private sector data contribution
- Provides benefits to consumers by enabling trip planning, but also benefits industry by collating data on EVSE location and characteristics

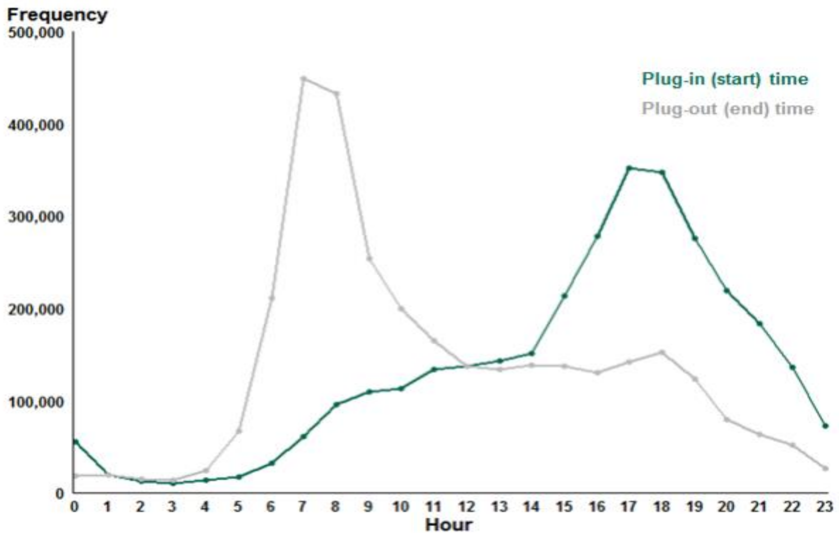
[18] See https://www.nzta.govt.nz/planning-and-investment/planning/transport-planning/planning-for-electric-vehicles/evroam.

## A1.3 UK Electric Chargepoint Analysis

In December 2018, the UK Department for Transport released statistical data detailing the energy supplied, time and duration of plug-in events for domestic and public charging stations. Local authorities, public sector bodies, train operator companies and EVSE providers supplied data to the UK Office for Low Emission Vehicles as a condition of receiving grants to partially-funded the installation of EVSE[19].

Grant recipients were required to provide timing, the amount of energy delivered, price (where applicable) and the charging station ID for each charging event for a period of three years following the installation of EVSE.

**Figure 9 Example of data found in Electric Chargepoint Analysis 2017: Domestics Report**




Source: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/764270/electric-chargepoint-analysis-2017-domestics.pdf.

The UK Department of Transport has released subsequent EV charging device statistics. EV charging device statistics (released in 2019 and 2020[20]) are based on publicly available data from charging point platform Zap-Map and include data related to the number and location of public charging devices.

**Key takeaways**

- Use of government grant to incentivise data submission, notably domestic EVSE
- Captures EVSE standing data at time of installation and also operational data for three years, providing a valuable resource for network planning and modelling applications

[19] See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/764268/electric-chargepoint-analysis-notes-and-definitions.pdf.

[20] See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/891900/electric-vehicle-charging-device-statistics-april-2020.pdf.

## A1.4 Australian Photovoltaic Institute

The Australian PV Institute (APVI) has created a suite of live generated solar PV graphical tools. The ARENA supported Australian Solar Mapping Tools project addressed the lack of understanding of solar PV potential, performance and impact on a regional basis by collating data from multiple sources to produce maps, animations, and tools to explore PV across Australia.

The APVI maps include[21]:

- Installed capacity from the Clean Energy Regulator's Renewable Energy Target database:
  - Installed capacity on a regional basis (postcode, state).
  - Installed capacity on a monthly basis.
- Performance data from Solar Analytics, PVOutput.org, SMA and Solcast

**Figure 10 PV density by postcode found on APVI map website**


The APVI solar maps provides access to data that can be used to conduct research related to photovoltaics markets, performance, reliability and integration with energy markets and networks: https://arena.gov.au/projects/development-of-an-australian-solar-map/.

### Key takeaways

- Use of government grants to incentivise data submission
- Locational data to post-code level granularity
- Utilised by AEMO and DNSPs as a convenient collation of multiple data sources

[21] https://pv-map.apvi.org.au/

# A2. Detailed data requirements

A key activity of the Taskforce involved capturing industry views on the EV-related data requirements of their organisations. Requirements are catalogued in the table below. Note this table should not be considered comprehensive and is simply a record of Taskforce discussions. Further detailed exploration and design would be required during development of any delivery mechanisms relating to these data requirements.

In the table, the column headed "Priority" sets out the data requirement priority, categorised by 1 – immediate need, 2 – important need or 3 – future need.

**Table 2 Detailed Data Requirements**

| Source Category | Field Description | Desired Coverage | | Temporal Class | | Desired Temporal Resolution (minimum) | Spatial Resolution | Required by | | | Purpose / Application | Priority | Potential Sources | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Population | Sample | Static | Dynamic | | | AEMO | DNSPs | Researchers | | | | |
| EVSE | NMI | ✓ | | ✓ | | Daily (Monthly ) | Individual device | ✓ | ✓ | | Network modelling / simulation, forecasting, registration and compliance for future DER markets | 1 | Installer, charging services businesses, sales /installation data | |
| | kW rating | ✓ | | ✓ | | | | ✓ | ✓ | | | 1 | | Optional lookup from make/model |
| | Phases (single or 3-phase) | ✓ | | ✓ | | | | ✓ | ✓ | | | 1 | | Optional lookup from make/model |
| | GPS Location | ✓ | | ✓ | | | | ✓ | ✓ | | | 1 | | Lookup from NMI |
| | Import/export capacity and/or limits | ✓ | | ✓ | | | | ✓ | ✓ | | | 1 | | |
| | Type/make/model | ✓ | | ✓ | | | | ✓ | ✓ | | | 1 | | |
| | No. of chargers per station | ✓ | | ✓ | | | | ✓ | ✓ | | | 1 | | Optional lookup from make/model |
| | Communications capability | ✓ | | ✓ | | | | ✓ | ✓ | | | 1 | | |
| | Aggregation/enrolment status | ✓ | | ✓ | | | | ✓ | ✓ | | | 1 | | |
| | Ownership status | ✓ | | ✓ | | | | ✓ | ✓ | | | 1 | | Public/private/fleet |

| Source Category | Field Description | Desired Coverage | | Temporal Class | | Desired Temporal Resolution (minimum) | Spatial Resolution | Required by | | | Purpose / Application | Priority | Potential Sources | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Population | Sample | Static | Dynamic | | | AEMO | DNSPs | Researchers | | | | |
| | Standards compliance/protection settings | ✓ | | ✓ | | | | ✓ | ✓ | | | 1 | | Optional lookup from make/model |
| | V2G capability | ✓ | | ✓ | | | | ✓ | ✓ | | | 1 | | Optional lookup from make/model |
| | Power flow | | ✓ | | ✓ | 5min (30min) | Individual device | | ✓ | ✓ | Operating envelope management, participation in future DER markets | 1 | Charging services businesses, charger manufacturers | Where time-series data is available |
| | Input/output voltage | | ✓ | | ✓ | | | | ✓ | ✓ | | 1 | | Where time-series data is available |
| | Operating envelope limits | | ✓ | | ✓ | | | | ✓ | ✓ | | 1 | | |
| | Charge - Start time / stop time | | ✓ | | ✓ | | | | ✓ | ✓ | | 1 | | Where session log data available (not needed for time-series data) |
| | Connection time length | | ✓ | | ✓ | | | | ✓ | ✓ | | 1 | | Total time EV plugged in, including time charging and time idle (where session log data used) |
| | State of Charge | | ✓ | | ✓ | | | | ✓ | ✓ | | 1 | | Replace with 'vehicle connected flag' where time-series data used |
| | | | | | | | | | | | | 1 | | |
| Vehicle | NMI, i.e. for premises of EV owners that don't have a dedicated charger | ✓ | | ✓ | | Daily (Monthly ) | Min postcode / SA1 or 2/Zone substation | ✓ | ✓ | ✓ | Uptake rate and sector coupling modelling, registration and compliance for future DER markets | 1 | State department of transport, sales data | |
| | Registration / vehicle identification number | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | Registration number only required where individual vehicle data can be accessed |
| | Make/model/year | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | |
| | Battery Electric Vehicle (BEV) or Plug-in Hybrid Electric Vehicle (PHEV) | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | Optional lookup from make/model/year |

| Source Category | Field Description | Desired Coverage | | Temporal Class | | Desired Temporal Resolution (minimum) | Spatial Resolution | Required by | | | Purpose / Application | Priority | Potential Sources | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Population | Sample | Static | Dynamic | | | AEMO | DNSPs | Researchers | | | | |
| | Battery capacity (nominal and usable kWh) | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | |
| | Rated consumption (kWh/100km) | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | Optional lookup from make/model/year |
| | Maximum charge rates and options | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | Including AC/DC rating etc. |
| | Estimated range and assessment standard | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | Optional lookup from make/model/year |
| | V2G capability | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | Optional lookup from make/model/year |
| | Registered/garage location & business category | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | Optional lookup from make/model/year |
| | Communications/export/features capability | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | Where individual data can be accessed |
| | Aggregation/enrolment status | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | Individual data may be required for market enrolment purposes |
| | Standards compliance/protection settings | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | Individual data may be required for market enrolment purposes |
| | Date of first registration | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | 1 | | |
| | GPS Location | | ✓ | | ✓ | 5min (30min) | Individual device | | ✓ | ✓ | Sector coupling and consumer behaviour modelling, network demand and energy management | 2 | Dedicated trials, e.g. SmartCharge Queensland (Energex / Ergon Energy Network), vehicle | Consider privacy (trip monitoring) - trip dynamics by journey (distance, length, temperature) or point of charge events could be sufficient |

| Source Category | Field Description | Desired Coverage | | Temporal Class | | Desired Temporal Resolution (minimum) | Spatial Resolution | Required by | | | Purpose / Application | Priority | Potential Sources | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Population | Sample | Static | Dynamic | | | AEMO | DNSPs | Researchers | | | | |
| | km driven | | ✓ | | ✓ | | | | ✓ | ✓ | | 2 | manufacturers, insurance companies | If time-series information is not available, per-trip or per-charge event statistics could also be useful |
| | Power consumption/accumulated energy | | ✓ | | ✓ | | | | ✓ | ✓ | | 2 | | |
| | Trip energy consumption | | ✓ | | ✓ | | | | ✓ | ✓ | | 2 | | |
| | Charge/discharge rate | | ✓ | | ✓ | | | | ✓ | ✓ | | 2 | | |
| | Battery state-of-charge | | ✓ | | ✓ | | | | ✓ | ✓ | | 2 | | |
| | Odometer (at start of each charge event) | | ✓ | | ✓ | | | | ✓ | ✓ | | 2 | | |
| | Time (at start and end of each trip) | | ✓ | | ✓ | | | | ✓ | ✓ | | 2 | | |
| | Charger connection state (& ID) | | ✓ | | ✓ | | | | ✓ | ✓ | | 2 | | |
| Consumer | NMI/vehicle registration | | ✓ | ✓ | | Trial Initiation | Individual consumer | | | ✓ | Consumer behaviour modelling and insights | 2 | Trials | Unique identifier to link datasets |
| | Ownership status (own/lease/fleet/share) | | ✓ | ✓ | | | | | | ✓ | | 2 | | |
| | Typical vehicle-use characteristics | | ✓ | ✓ | | | | | | ✓ | | 2 | | |
| | Parking status (private, street, employer, public, home/work) | | ✓ | ✓ | | | | | | ✓ | | 2 | | |
| | PV ownership | | ✓ | ✓ | | | | | | ✓ | | 2 | | And ideally attributes such as feed-in tariff and export status. Could link to DER Register if NMI available |
| | Battery Energy Storage System ownership | | ✓ | ✓ | | | | | | ✓ | | 2 | | As per PV |

| Source Category | Field Description | Desired Coverage | | Temporal Class | | Desired Temporal Resolution (minimum) | Spatial Resolution | Required by | | | Purpose / Application | Priority | Potential Sources | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Population | Sample | Static | Dynamic | | | AEMO | DNSPs | Researchers | | | | |
| | Meter type (smart/MRIM/accumulation) | | ✓ | ✓ | | | | | | ✓ | | 2 | | Could obtain from MSATS via NMI lookup |
| | Any third-party incentives (aggregators/VPP/Demand response) | | ✓ | ✓ | | | | | | ✓ | | 2 | | |
| | Consumer experience data, surveys etc. | | ✓ | | ✓ | Ad hoc | | | ✓ | ✓ | | 2 | Trials, DNSP research | |
| Aggregator | Requested power setpoint | ✓ | | | ✓ | 5min (30min) | Aggregate fleet | ✓ | ✓ | | Operating envelope management, participation in future DER markets | 3 | Future DSO/DMO | |
| | Power limits | ✓ | | | ✓ | | | ✓ | ✓ | | | 3 | | |
| | Enabled services | ✓ | | | ✓ | | | ✓ | ✓ | | | 3 | | Individual data may be needed for registration purposes |
| | Delivered services | ✓ | | | ✓ | | | ✓ | ✓ | | | 3 | | |

# Glossary

This document uses many terms that have meanings defined in the National Electricity Rules (NER). The NER meanings are adopted unless otherwise specified.

| Term | Definition |
|---|---|
| **Artificial Intelligence (AI)** | AI refers to advanced computing which simulates human intelligence. AI can be used to recognise patterns in the data. |
| **Data cleaning** | Data cleaning is the process of detecting and rectifying corrupt or inaccurate records from a data set. |
| **Distributed energy resources (DER)** | Distribution level resources which produce electricity or actively manage consumer demand (examples include solar rooftop PV systems and batteries, and demand response via hot water systems, pool pumps, smart appliances and air conditioning control). |
| **Dispatch** | Dispatch refers to the process of issuing instructions to scheduled and semi-scheduled generating units and to scheduled loads, to produce or consume the instructed amount of energy every 5 minutes. |
| **Distribution network service provider (DNSP)** | A business that owns, operates or controls an electricity distribution network. |
| **Electric vehicle (EV)** | Electric vehicle refers to cars or other vehicles with motors that are powered by electricity rather than liquid fuels. |
| **Electric vehicle supply equipment (EVSE)** | EVSE denotes the stationary device which delivers energy between an electricity network and a vehicle. While these devices are commonly known as 'chargers' or 'charging stations', the term EVSE is used in this report to avoid confusion with on-vehicle charging equipment. |
| **Energy Security Board (ESB)** | Responsible for the implementation of the recommendations from the Independent Review into the Future Security of the National Energy Market (the Finkel Review). It also provides whole-of-system oversight for energy security and reliability. |
| **Grid integration** | Grid Integration (VGI) encompasses the ways EVs and/or EVSE influence and interact with the power grid. This includes unidirectional charging and bidirectional vehicle-to-grid connection. |
| **Minimum demand** | Minimum demand refers the lowest level of electricity demand from the grid in any given day, week or year. When consumers' energy needs, particularly during daylight hours, are being met by their own distributed energy resources (DER) such as solar PV, that results in low demand for energy from the grid. |
| **National Meter Identifier (NMI)** | A unique 10- or 11-digit number used to identify every electricity network connection point in Australia. |
| **Operating envelope** | An operating envelope refers to the set of limits and conditions within which equipment must be operated to ensure conformance with the safety. |
| **Peak demand** | Highest amount of electrical power delivered, or forecast to be delivered, over a defined period (day, week, month, season, or year) either at a connection point, or simultaneously at a defined set of connection points. |
| **Smart** | A 'smart' device is context-aware and can respond to signals. |
| **System security** | Power system security arises when the power system is operating within defined technical limits, and is likely to return within those technical limits after a disruptive event occurs, such as the disconnection of a major power system element (such as a power station or major powerline). |