ENERGY SECURITY BOARD

Electric Vehicle Supply Equipment Standing Data

CONSULTATION PAPER

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Contents

Abbreviations and Technical Terms

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
BEV	Battery Electric Vehicle
CEC	Clean Energy Council
CER	Consumer energy resources
CBA	Cost Benefit Analysis
CSMS	Charging Station Management System
DER	Distributed energy resources[1]
DCA	Dedicated Connection Assets
DEIP	Distributed Energy Integration Program
DNA	Designated Network Assets
DNSP	Distribution Network Service Providers
ECA	Energy Consumers Australia
ERAC	Electrical Regulators Authorities Council
ESB	Energy Security Board
EV	Electric Vehicle
EVSE	Electric vehicle supply equipment
FCAS	Frequency Control Ancillary Services
IEC	International Electrotechnical Commission
ISP	Integrated System Plan
FEL	Flexible export limits
GW	Gigawatt
NMI	National Metering Identifier
NEL	National Energy Law
NEM	National Electricity Market
NEO	National Electricity Objective
NER	National Electricity Rules
NMI	National Meter Identifier
MW	Megawatt
MWh	Megawatt hour
OEM	Original Equipment Manufacturer
PHEV	Plug-in Hybrid Electric Vehicle
SAPN	South Australia Power Networks
SRES	Small Scale Renewable Energy Scheme
V2G	Vehicle to Grid
WEM	Wholesale Electricity Market – Western Australia

[1] The term Consumer Energy Resources (CER) has now been adopted by the ESB and market bodies.

Executive Summary

Electric vehicle (EV) charging is set to transform our electricity systems. While there is some uncertainty regarding the exact pace of adoption of EVs and the technology and charging choices of EV owners (including the use of public charging infrastructure), there is broad consensus that EV integration presents both major opportunities and challenges for the electricity grid. Currently, networks and AEMO do not have access to reliable data on the size, location, and characteristics of electric vehicle supply equipment (EVSE) to enable them to determine and manage these opportunities and challenges effectively.

While EV uptake is currently low compared to other markets, uptake is expected to accelerate rapidly. There is a current opportunity for Australia to put in place appropriate systems to ensure system planners and operators, or other parties, have the information they need to manage this transition effectively.

This paper presents a rationale and options for capturing 'standing data' for new EVSE installations, for stakeholder feedback. EV standing data has been defined as data concerning the *location and characteristics of EVSE to inform network modelling and forecasting*[2] necessary to guide planning processes of the energy sector and the planning of EV infrastructure. This excludes data associated with ongoing EV operation.

Chapter 1 - Introduction

Chapter 1 provides context regarding the uptake of EVs and the roll-out of EVSE across the electricity system. It notes that EVs are one category of consumer energy resources (CER) that can generate or store electricity or actively manage energy demand, along with devices such as solar PV systems and batteries. It explains the purpose of the EV standing data workstream relative to other market reform workstreams underway or planned for the near future.

Chapter 2 - EVSE standing data needs and use cases

Chapter 2 described 15 potential future use cases for EVSE standing data. In summary, EVSE standing data is intended to be used as a basis for load modelling at the local network and bulk system level. Knowing the EVSE location will allow network businesses and AEMO to cross-reference EVSE standing data with meter data to develop load profiles associated with different EV installation types. Understanding the size and type of charger, and its performance characteristics, provides a basis for assessing the real-time and forecast impacts of EV charging on local networks, and how large-scale disturbances that may impact power system voltage and frequency. Network and AEMO models can be validated against operational data from EV trials or other sources.

The more detailed the standing data is for the EV or EVSE charger type, the more accurate these models can become, allowing the network to predict load more precisely over different timescales. Ultimately, better data means more confident and accurate planning and operational decisions, reducing the costs and maximising the benefits associated with the electrification of Australia's vehicle fleet.

Distribution networks use EVSE data to inform planning and operational decisions, including expenditure and tariff proposals. **AEMO** requires EVSE standing data as an input into load growth modelling and operational decisions over various timeframes. CER (generating units or aggregations under 5 MW, as well as most flexible loads) are not directly visible to AEMO. Instead, it must rely on models to estimate the current and likely operation of these resources. AEMO has reported that if current information gaps on CER persist, as CER penetration increases, this will progressively decrease its ability to:

- deliver information to support efficient market outcomes

[2] DEIP EV Data Availability Taskforce, *Electric Vehicles Grid Integration Recommendations*, February 2021, p.16.

- maintain power system security.

Power system security relates to the technical parameters of the power system, such as voltage and frequency, and its ability to withstand faults or other disturbances. A 'contingency event' is an event that affects the power system in a way which would likely involve the failure or sudden and unexpected removal from operational service of a generating unit or transmission element. EV loads can vary substantially in real time. In the future, this may include a coincident response to wholesale market price changes, changes in retail price bands (e.g. shoulder to off-peak prices) or unpredictable events such as a cyber-attack or a loss of communication between a remote charge point operator and its fleet of EVSE. AEMO and network businesses typically have no direct visibility of this behaviour.

AEMO and transmission operators are required to support power system security through the procurement of various services including system strength, inertia and contingency and regulation frequency control ancillary services (FCAS). More confident and accurate forecasting can reduce the requirement to procure system security services at a saving to consumers.

Fire services can benefit from understanding the location of EVSE installations to improve the effectiveness and manage risk in emergency response. While EVSE standing data would not contain critical information on an EV's battery chemistry, it could provide an indication of the likelihood of one or more EVs being at a premises and inform response strategies and support electrical safety during a response.

Initial consultations with EVSE OEMs, and EV industry representatives, indicates there is limited benefit in providing **industry** with access to collected EVSE standing data, outside of satisfying personal or narrow commercial interests.

Stakeholder feedback is sought on the characterisation of each of the use cases presented.

Chapter 3 – Draft EVSE standing data specification

Data collection involves trade-offs between the usefulness of large data sets, and the cost and risks in data collection and management. Increasing data collection requirements increases complexity and effort at the time of installation and, anecdotally, this can contribute to higher costs as well as lower response rates and data quality issues. This can undermine data quality for system-critical use-cases and erode stakeholder confidence in overall data collection processes and data uses.

Chapter 3 sets out a number of considerations for the imposition of new data collection requirements as well as a draft data specification for stakeholder feedback. This specification has been iterated via stakeholder interviews undertaken as an input into the paper but is not considered final. It is important to note that the collection of EVSE standing data register is not intended to satisfy all the data needs of key data users. For example, it is expected that DNSPs, AEMO and researchers will periodically require interval data from a sample of EVSEs to develop and validate load models. This can be obtained separately.

National EVSE database

Data collection efforts can be streamlined by the creation of a database that lists all EVSE available for installation in Australia. Database listing is not intended to represent any certification or warranty of product quality, capability or performance. However, if installers were mandated to enter EVSE standing data at the time of installation, then listing products in the National EVSE Database would become a critical business process for EVSE importers and OEMs. Stakeholder consultations thus far indicate this should be a relatively straightforward task and that OEMs and importers should have strong incentives to keep their listings up to date.

An organisation would need to be made responsible for the listing or delisting of products, and for the rectification of any technical issues. This function could, for example, be added to the hosting services provided by the CEC for inverter product listing. In some cases, these lists will be cross-referenced such as where an EVSE includes a native inverter that supports V2G and therefore requires AS/NZ 4777.2:2020 certification. Common data structures across both lists (e.g. common data field definitions) could enhance consistency and streamline data provision and use.

Chapter 4 – Determining which EVSE installations should be captured

The DER Register was created by an AEMC rule change in September 2018, to establish a register of distributed energy resources in the national electricity market, including small scale battery storage systems and rooftop solar. AEMO worked with stakeholders across the electricity sector to design the datasets and data collections processes to establish the Register. It was launched by AEMO on 1 March 2020 and it is currently collecting data across all NEM jurisdictions and the WEM.[3]

The DER Register stores information about any new small generating unit, installed on-site at any residential or business location in Australia. The information required to be entered into the DER Register includes around 90 standing data fields. Reporting requirements are set out in the DER Register Information Guidelines, which were published by AEMO in May 2019.

Potential 'triggers' for reporting EVSE standing data

Currently, DER Register reporting for EVSE by installers is limited to where the EVSE has V2G capabilities and thereby classed as a small generation unit. There are only three instances of this in the DER Register, illustrating that changes to reporting requirements are required to meet emerging EVSE standing data needs. The 2022 ISP, using CSIRO modelling, provides an indication of how electrical loads associated with different installation types could vary over time. From this, it is possible to infer approximate potential loads associated with various EVSE categories over time. This analysis indicates that EVSE with V2G capability is estimated to account for less than 10% of total EV charging loads by 2037. Extending coverage to other EVSE types therefore requires a consideration of alternative reporting 'triggers' including EVSE type or installation type.

The vast majority of future EVSE load could be associated with EVSE hardwired to an electricity mains supply, as opposed to plugging the car into a general-purpose outlet. Coverage could be extended to include Level 1 chargers that involve an electrician (e.g. putting the EVSE on a 15 Amp circuit).[4] Such triggers could be similar to the current requirement in South Australia where electricians are required to report EVSE standing data when installing EVSE on a circuit with a rating of 20 Amps or above. The analysis undertaken for this paper suggests such an approach could be relatively communicable to installers and achieve >95% coverage of future EV charging loads.

Chapter 5 - Achieving a nationally consistent approach to EVSE data collection

Stakeholder consultation has identified a consensus view that a nationally consistent and coordinated method for collection of EVSE standing data is required. Industry participants are seeking a consistent national approach to lower costs and to ensure that the benefits of a centralised source of EVSE standing data are fully realised.

[3] Western Australia has included in its Electric Vehicle Action Plan, the expectation that the DER Register will incorporate "relevant EV and EVSE data," p 27.

[4] See *Appendix A - Summary of EVSE categories and interoperability standards* (p. 44).

Collection via the National DER Register as the preferred approach

The DER Register is considered the only suitable existing national database that can be expanded to include the data specification for EVSE standing data detailed above. This approach would involve extension of the existing mechanisms under National Electricity Rule 3.7E that established the DER Register, require AEMO to produce the DER Register Information Guideline, and currently require DNSPs to collect and report CER standing data to AEMO. The NER may need to be amended to provide for EVSE standing data collection.

Under this approach, the obligation to comply with the Guidelines would continue to rest with the customer, and the obligation to supply correct information will be completed, as usual, by the licensed electrician, who is required to undertake electrical work by electrical safety laws in each state and territory. Alternative regulatory frameworks are explored and stakeholder feedback is sought on the evaluation framework that ESB should apply for the consideration of options. Achieving quality consistent EVSE standing data collection is likely to take time as installers need to become accustomed to the reporting requirement and DNSP and AEMO reporting systems will need to be updated. A broad-based installer awareness program may also be required.

Appendices

Appendix A provides a summary of EVSE 'modes, types and standards' to support discussion around how different EVSE can be classed and captured.

Appendix B reviews of current data collection frameworks for consumer energy resources provides a more detailed summary of the processes and limitation of current DER Register reporting arrangements. It identifies a range of issues with the DER Register that may need to be addressed to ensure EVSE standing data can be collected as intended.

Appendix C provides a summary of national and international policies associated with EVSE data collection. Ultimately, due to the unique characteristics of Australia's energy transition and existing regulatory frameworks, international precedents for EVSE standing data collection, of the kind proposed for Australia, are currently limited.

1. Introduction

1.1 Background

The Energy Security Board (ESB) has developed a Data Strategy as a necessary foundation for the ongoing rapid transition of the energy system, to ensure that market planners, operators, policy makers, participants, service providers, consumers and researchers can access the data they need for effective decision making in a timely manner. The Data Strategy identified a range of priority data gaps to resolve to manage risks as the energy market transition – including visibility of electric vehicle charging.[5]

Electric vehicle (EV) charging is set to become the most rapid form of demand growth and expected levels of uptake will transform the energy system. While there is some uncertainty regarding the exact pace of adoption of EVs and behavioural characteristics of EV owners (including the use of charging infrastructure), there is broad consensus that EV integration presents both major opportunities and challenges, and these need to be actively managed to reduce risks and inefficient costs in power system planning and operation.

Currently, networks, AEMO, market participants and researchers are not able to capture reliable data on the size, location, and characteristics of electric vehicle supply equipment (EVSE) to enable them to determine and manage these risks. While EV uptake is currently low compared to other markets, uptake is expected to accelerate rapidly. There is a current opportunity for Australia to put in place appropriate systems to ensure system planners and operators, or other parties, have the information they need to manage this transition effectively. As summarised in Chapter 2 (page 14), EVSE standing data can support a range of use cases to support power system planning and operation. In summary, better planning and operational data can reduce costs and risks to electricity consumers.

This discussion paper presents a rationale and options for capturing standing data for new EVSE installations, for stakeholder feedback. EV standing data has been defined as data concerning the *location and characteristics of EVSE to inform network modelling and forecasting*[6] necessary to guide planning processes of the energy sector and the planning of EV infrastructure. EVSE standing data is one category within the broader set of EV data that is required to for government, industry and consumers to manage costs, risk and benefits associated with the accelerating uptake of EVs, and the rollout of EV charger infrastructure, in Australia. Other forms of data include operational data (e.g. charging profiles) and vehicle sales and registration data, that are also important for broader power system and transport infrastructure planning.

Sales of EVs are quickly gaining momentum with the Electric Vehicle Council reporting that sales have more than tripled (post-covid) in two years from 6,900 in 2020 to 26,356. As of September 2022, 45 EV models were locally available including 69 model variants made up of 35 plug-in hybrid EV (PHEV), and 60 battery EV (BEV) variants.[7]

In NSW alone, AEMO's Integrated System Plan Step Change scenario assumes there may be over 2.4 million EVs by 2035. Figure 1 (below) breaks these down by vehicle type. The national deployment of public EV charging stations has also been increasing quickly, with State and Federal government programs estimated to contribute to the installation of 700 public fast charging locations over the next 5 years.[8] There has been a 15% increase in public charging locations since early 2021.[9]

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[5] ESB Data Strategy

[6] DEIP EV Data Availability Taskforce, *Electric Vehicles Grid Integration Recommendations*, February 2021, p.16.

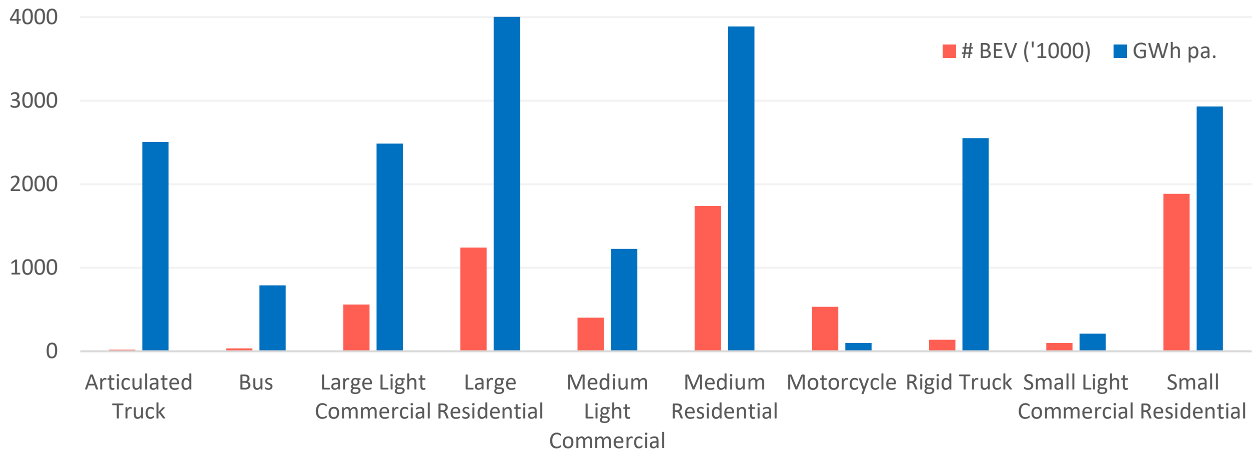
[7] Electric Vehicle Council, *State of Electric Vehicles*, October 2022.

[8] Electric Vehicle Council, *State of Electric Vehicles,* March 2022, p. 10.

[9] Electric Vehicle Council, *State of Electric Vehicles,* October 2022, p. 14.

While residential chargers are used by the largest number of vehicles, energy demand for residential chargers is typically lower on a per-vehicle basis, than for heavier vehicles. Heavier vehicles are expected to have a significant charging load that will often be more concentrated in electricity distribution areas. In 2035, residential vehicles are estimated to account for around 73% of all battery electric vehicles (BEV), but only 52% of total BEV electricity demand. Commercial vehicles account for 16% of EV and 19% of EV charging load. The remaining load is predicted to be made up of articulated trucks, buses, rigid trucks and motorcycles.

Figure 1: Battery electric vehicles (BEV) in the NEM, and total charging load by 2035 (AEMO step change scenario)[10]



1.2 Purpose of this paper in relation to other reform initiatives

This consultation paper:

1. Presents analysis of the need for the collection of EVSE standing data for a range of data use-cases, confirmed by stakeholder (chapter 2, p.14)
2. Provides a draft data specification for new EVSE installations to meet the limited requirements of the identified use-cases and considerations for data collection (chapter 3, p.24)
3. Assesses the potential EVSE installation types that should be captured nationally (chapter 4, p.28)
4. Proposes an extension to the national DER Register as a repository for EVSE standing data, utilising supporting data collection frameworks (chapter 5, p.33)

Consultation questions are provided to seek stakeholder views on whether ESB's understanding of current arrangements is correct and on options to achieve EVSE standing data collection going forward.

Electric vehicles are one category of consumer energy resources (CER) that can generate or store electricity or actively manage energy demand, along with devices such as solar PV systems and batteries.

The integration of CER into the electricity system is being considered by a range of workstreams as summarised in Table 1.

[10] AEMO ISP 2022, Inputs, assumptions and scenarios workbook It is noted that grid impacts are typically associated with peak demand (GW) rather that aggregate demand (GWh).

Table 1: Summary of key related workstreams underway by the market bodies

Consultation paper	Summary
Electric Vehicle Smart Charging consultation (ESB)	The ESB has been tasked with developing policy advice regarding what technical foundations are necessary to support the effective integration of smart charging for EVs into the National Electricity Market (NEM), as part of the DER Implementation Plan. An *Electric Vehicle Smart Charging Issues Paper* sought stakeholder views on a range of issues relating to the development of effective arrangements for EV smart charging in both domestic and public settings, including EVSE minimum standards, Interoperability standards, international experiences, and potential local policy settings to encouraging the uptake of smart charging.
Review of CER technical standards (AEMC)	The Australian Energy Market Commission's (AEMC) review into consumer energy resources (CER) technical standards in the National Electricity Rules (NER) is focused on the implementation of CER technical standards. The review is considering: • compliance with, and enforcement of, CER technical standards in the NER • the interpretation of standards by NEM participants and other relevant stakeholders • interactions between the NER and other regulatory regimes that require compliance with CER technical standards. While the review's initial focus will be on experiences of implementing existing obligations in the NER (namely, Australian Standard 4777.2:2020), this will inform a broader analysis of approaches to implementing future CER technical standards.
Interoperability for Consumer Energy Resources directions paper (ESB)	The ESB is consulting on priorities and actions to promote greater interoperability of CER. This includes an implementation framework for CSIP-Aus to support a nationally consistent approach to flexible exports limits, and the future development of standards for behind-the-meter interoperability and interoperability for market participants. This process highlights roles and responsibility issues raised in the specific context of interoperability that will be investigated more fully through the AEMC CER Technical Standards Review process.
Network Visibility for market planning (ESB)	The ESB's Network Visibility workstream sits under its data strategy and is exploring ways to improve third party access to distribution network data, including to support the efficient deployment of EVSE. The focus of this project is on ensuring market systems, and supporting policies create a pathway to deliver network visibility to the market, including clear use cases and benefits, definitions of the data needed and appropriate arrangements for it to be delivered.

Several related reform initiatives are also underway, or planned, that have close relationships with this work. These include:

- The **ESB Data Strategy** is seeking to reduce barriers to accessing existing data sets, enabling more effective policy and decision making and delivering value to consumers. Initial consumer energy resources related projects in the Data Strategy are focussed on developing market use-cases for low-voltage network data and undertaking real-world trials of alternative data definitions to meet these needs, considering the varied state of network data in different regions in the near and longer term.
- The **Customer Insights Collaboration** (CIC) is an ESB-led initiative bringing a diverse range of consumer and stakeholder interests together, to build an evidence base to inform reforms (and related policy initiatives) across the Post-2025 CER Implementation Plan.
- **Review of Consumer Protections for Future Energy Services** is an AER led initiative that will review the retailer authorisation and exemption framework as defined in the Retail Law. This will include an assessment of the adequacy of the current consumer protection framework and their application.
- The **Flexible Trading Arrangements** rule change request, put forward by AEMO, seeks to better support consumers with unlocking the value of the consumer energy resource assets. The rule change, if successful, will enable customers to engage with a single retailer for their electricity supply and a second provider for consumer energy resource specific services (i.e. battery services).
- The **Scheduled Lite** workstream seeks to develop a voluntary mechanism to incentivise the participation of non-scheduled load and generation in the NEM. AEMO has been tasked by the ESB to prepare a high-level design for the scheduled lite mechanism which will be used to inform the development of a rule change request.
- The National Measurement Institute Is conducting a **Review of the trade measurement policy for EV charging stations** as part of a comprehensive review of the legislative framework underpinning Australia's measurement legislation. The feedback received for this consultation is expected to inform the development of new measurement laws.

- **The Consumer Data Right** is being progressively implemented by AEMO to offer Australians greater control over their data and empower consumers to choose from a range of products and services.

1.3 Approach and stakeholder consultations to date

enX Consulting was engaged by the ESB to advise on the need for, and benefits of, improved EVSE standing data collection, and to develop options for future data collection, including a preferred regulatory model. An inter-agency Project Steering Group is leading this project, comprising representatives of the ESB, AEMC, AER and AEMO.

The development of this discussion paper has involved:

- A review of existing policies and regulatory frameworks in Australia and overseas, including submissions made to prior ESB consultation processes.
- Targeted stakeholder consultation with regard to:
    - a needs and benefits analysis to identify the materiality of the future impact of EV charging
    - the identification of current and potential use-cases for EVSE standing data
    - the development of a proposed data specification to respond to identified EVSE standing data use-cases
    - issues associated with current DER Register data collection approaches.
- The identification of options for the collection of EVSE standing data, including regulatory models and an assessment framework for the range of options.

1.4 How to make a submission

The ESB invites comments from interested parties in response to this consultation paper by **Friday 10 February 2023.** Submissions will be published on the Energy Security Board website, following a review for claims of confidentiality. All submissions should be sent to info@esb.org.au.

Submission information	
Submission close date	10 February 2023
Lodgement details	Email to: info@esb.org.au
Naming of submission document	[Company name] Response to EVSE Standing Data Register - Consultation Paper
Form of submission	Clearly indicate any confidentiality claims by noting “Confidential” in document name and in the body of the email.
Publication	Submissions will be published on the Energy Ministers website, following a review for claims of confidentiality.

The ESB intends to hold a workshop with stakeholders and interested parties on the material covered in this paper on Thursday 15 December at 4pm AEDT.

Interested parties are invited to register their interest by email to info@esb.org.au.

2. EVSE standing data needs and use-cases

2.1 What is EVSE standing data and why is it important

EVSE standing data is defined as data concerning *the location and characteristics of EVSE to inform network modelling and forecasting*. It is widely regarded as a critical input into planning and operational decision-making by a range of entities responsible for ensuring the reliable, safe and efficient operation of the power system.

Figure 2 (page 18) shows EV peak load (under the ISP Step Change Scenario) growing to nearly 4 GW by 2035, around 9% or total NEM summer peak demand. In the shoulder seasons, EV load grows to 11% and 18% relative to peak demand, for 2035 and 2045 respectively.[11] This easily eclipses electricity consumption associated with any other technology categories within the NEM other than perhaps air-conditioning during peak times.

While the future uptake of smart charging and V2G remains uncertain, as a source of demand flexibility, EV charging has a relatively low short run marginal cost.[12] This suggests it is likely to be among CER targeted for aggregation by traders[13] as well as 'out-of-market' aggregators. The inherent flexibility of EV charging, relative to other consumer equipment loads, makes them especially material to power system security planning. This will be particularly true for the discretionary charging that is most likely to occur in places where the vehicles spend most of their time. Individually and collectively, EV charging load has the potential to change rapidly creating risks at all system levels that need to be managed effectively. Relative to other equipment loads, aggregated EV charging could represent benefits and risks more akin to large-scale generators than traditional 'inflexible' load.

EVSE standing data will be used as a basis for load modelling at the local network and bulk system level. Knowing the EVSE location (via the NMI) allows network businesses and AEMO to cross-reference with meter data and for load profiles to be build up from the feeder-level, right through to a NEM region. Load profiles can be validated against EV operational data from trials or other sources. Understanding the size and type of charger, and its performance characteristics, provides a basis for assessing the impacts of EV charging on local networks, and how large-scale disturbances that may impact power system voltage and frequency.

AEMO generally utilises load profiles at the regional level, or aggregate profiles for major load centres on the transmission network. These profiles are built up from a consideration of different CER technologies, each having different characteristics. DNSPs undertake similar processes at a more granular level, building up load profile models for potentially thousands of individual network assets. While random sampling methods could be considered for use at higher system levels (which would avoid a need to report all EVSE installations), this is not considered to be appropriate for DNSP use cases which require granular, location-specific information, to assess for example, local voltage impacts.

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[11] Note that the extent to which EV load peaks and NEM peaks are not coincident, increases EV peak load as a percentage of total instantaneous demand.

[12] ARENA Load Flex Study Technical Summary. See slides 9 and 11.

[13] A 'trader' is an entity registered with AEMO and participates in an energy or ancillary services market.

2.2 Impacts of EV charging on distribution networks

While various studies and modelling exercises suggest EV charging may have significant impacts on local electricity networks, this does not mean they are a net detriment. If managed well, EVs can support electricity network operations, increase network utilisation, potentially reducing network pricing for all network users.[14]

EVSE standing data can allow networks to better manage a range of risks associated with EV uptake:

- **Thermal ratings** – demand increases may cause transformer ratings or line ratings to be exceeded.
- **Phase unbalance** – may lead to excessive neutral line currents and/or supply voltages may deviate from prescribed limits.
- **Stability** – more complex scenarios include cascade tripping from step or oscillating loads, degraded stability, impairment of system restoration efforts.
- **Step changes in load** – associated with the change-over of retail price bands or other financial incentives impacting local voltage.
- **Cyber security** – some impacts may occur unintentionally, others may result from the actions of malicious actors.
- **Costs** – the need to accommodate additional loads, and manage associated risks, creates higher operating costs for electricity distributors which are typically recovered from consumers.

The effects of uncoordinated, (particularly) coincident EV charging, depend significantly on the nature of loads presented and the characteristics of that part of the distribution network. A limited number of international regions having high EV uptake can offer early insights from practical experience, however the estimation of local impacts needs to account for local network topology, design characteristics and broader operating context of the network area being considered.

While it is not appropriate to directly translate international findings into a local context, high level patterns can be observed. In Norway, studies have positively correlated local prevalence of EVs to increased network operator costs though noted that increased costs does not imply investment inefficiency (2021).[15] In California, researchers have assessed charging profiles at one-second intervals to known distribution feeder capacities and limits, identifying that the impact of EV charging (without intervention) may require approximately one-fifth of PG&E's feeders to be upgraded within the next few years, significantly exceeding actual network investment schedules.[16]

2.3 EVSE data use cases for DNSPs

Load profile models for EV charging require the estimation of EV charging at different times and under different conditions. Where networks know that an EV charger is present at a customer premises, that customer’s meter data can be used to determine how load is impacted by different factors (using various statistical tools). The more detailed the standing data is for the EV or EVSE charger type, the more accurate these models can become, allowing the network to predict load more precisely over different timescales. Better standing data therefore assists network business planning and operational practices as detailed in the following use cases.

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[14] Baringa Partners, *Potential network benefits from more efficient DER integration*, June 2021.

[15] Wangsness, P.B. and Halse, A.H., 2020. *The impact of electric vehicle density on local grid costs*: Empirical evidence (No. 1-2020)., Wangsness, P.B., Proost, S. and Rødseth, K.L., 2021. *Optimal policies for electromobility: Joint assessment of transport and electricity distribution.*

[16] Jenn, A. and Highleyman, J., 2022. Distribution grid impacts of electric vehicles: A California case study. Science, 25(1).

N1. Network planning

EVSE standing data is an increasingly important input into network planning processes. The uptake of EVs is expected to bring forward the requirement for network augmentation in some areas and anecdotally, EV load forecasts are among the most significant factors influencing network expenditure decision in the current round of regulatory determinations. Standing data can be combined with load profile models to estimate the likely future load on specific network assets, and the requirement to build out network capacity to ensure sufficient hosting capacity. Consumers will benefit from improved EVSE standing data provision where networks can target investments accurately such that the location, timing and size of that investment is well-matched to the requirement. Access to better, more granular data will assist networks manage demand growth including through demand management solutions. This will reduce total capex leading to lower network charges to customers (for both EV and non-EV owning customers).

N2. Regulatory Compliance

Forecasts of EV uptake in a network area are a key input into network expenditure proposals and Distribution Annual Planning Reporting (DAPR) processes. DAPRs must include information on network constraints, and proposed solutions, in a useable, consistent, accessible format, to assist third parties to propose alternative options to address system limitations. More accurate forecasts of EV load growth will reduce uncertainty in investment proposals thereby supporting more accurate network pricing determinations, and transparency for stakeholders, promoting efficient expenditure of revenues recovered from consumers.

N3. Real time network operations

More accurate forecasting will enable more targeted and confident procurement and dispatch of network support services from third parties (e.g. active power dispatch, or load curtailment during system peaks). These procurements are expected to become more common in the future and will benefit from more accurate EV charge profile models. If DNSPs can accurately predict the location, shape and timing of an EV charging peak or change, they can procure services to preserve local grid security. To the extent that procurement is cheaper than augmenting the network, then that is a saving to consumers. Some networks have also expressed an interest in understanding the likely ‘state of charge’ of EV batteries for this purpose. Such data would need to be collected directly from contracted service providers and is considered outside of the scope of this project. To some extent this can be substituted by enhancements to EV charging profiles, which can infer a state of charge, and is enhanced by the accuracy of load profiles using more detailed standing data.

N4. Dynamic operating envelopes

Dynamic operating envelopes (including flexible export limits) rely on networks being able to accurately estimate the state of voltage and load across its network (including potentially to a feeder level where direct network state visibility may be limited). Accurate network load models can improve network state estimation and increase the ability of networks to more fully allocate available capacity (and reduce buffers required to manage uncertainties). This benefits consumers by providing them with increased imports or exports, increasing customer utility and enhancing access to revenues from energy and ancillary services markets.

N5. Tariff and incentive design

Clause 6.18.1C of the National Electricity Rules, from 2014, allows a DNSP to introduce tariffs not covered by its approved Tariff Structure Statement as long as they do not recover more than 1% of the annual revenue requirement. Distributors are allowed to run multiple trials as long as no more than 5% of revenue is recovered from all the tariff trials it is running each year. These thresholds are temporary and apply to the current and next regulatory periods for each DNSP.[17] The AER expect distributors to progress tariff reform by undertaking tariff trials to test more complex and innovative tariffs which could also enable new services. The AER has provided guidance for distributors on how tariff trials can be approached.

Understanding what EVSE assets customers have, allows for more targeted experimentation with tariffs and incentives aimed at improving the efficiency of EV charging while ensuring customers are not adversely impacted. For example, a network could directly target customers with a specified EVSE type, having some confidence that those customers have the technical capacity to respond. Without this information, incentives may be less targeted increasing costs (and diluting benefits) for networks and consumers.

N6. Mandatory tariff assignment

The Victorian Government requires all EV owners to be assigned to cost reflective network tariffs, such as time of use or demand charging. To implement this policy, Victorian distributors have amended their tariff structure statement proposals to confirm that existing residential electric vehicle users, once identified, will be not have access to flat rate tariffs. EVSE standing data can support this tariff assignment. This policy is intended to encourage efficient EV charging and thereby reduce costs for all electricity consumers.

2.4 Impacts of EV charging on overall resource adequacy in the NEM

Figure 2 shows electricity maximum demand EVs in summer under the ISP 2022 Step Change scenario. This indicates EV charging could increase from 45MW in 2022 to over 8GW in 2050. EV charging loads are forecast to be 9% of total NEM peak demand in 2035 and 15% by 2045. As a fraction of total peak demand, EV loads are fairly consistent across each NEM region, although somewhat lower in Tasmania and South Australia.[18]

The CSIRO load profile model on which this is based, indicates that for the medium term at least, charging loads are expected to peak in the early evening contributing substantially to overall resource adequacy concerns. This modelling has since been updated based on more recent charging profile data from trials. AEMO has indicated that more up to date modelling shows a smoother profile, incorporating more flexible charging. The actual future charging behaviour of a mass market of EV owners is uncertain and a range of eventualities need to be planned for.

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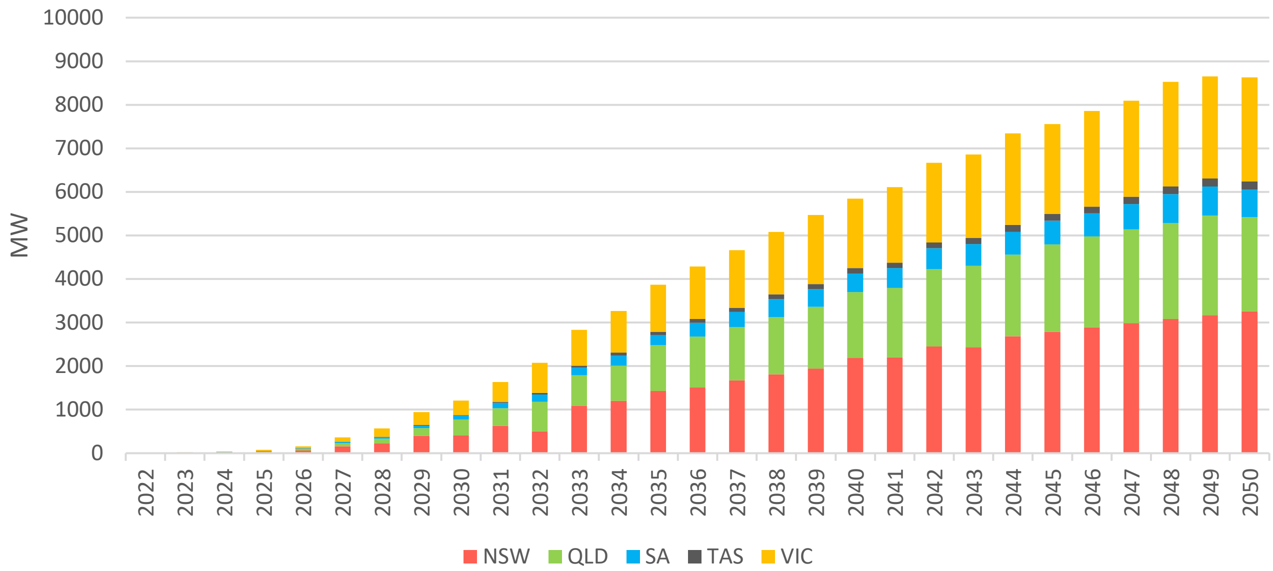
17 https://www.aer.gov.au/networks-pipelines/network-tariff-reform/tariff-trials

18 NATIONAL ELECTRICITY FORECASTING (aemo.com.au)

Figure 2: EV charging summer peak demand in each NEM region - ISP 2022 Step Change Scenario (POE 10)[19]



In any plausible scenario, EV charging will have a growing impact on generation and transmission planning and investment. Better EVSE standing data can support enhancements to aggregate and instantaneous demand estimates, supporting more efficient forecasting and more targeted planning, investment and operational decisions.

2.5 Impacts EV charging on system security

Power system security relates to the technical parameters of the power system, such as voltage and frequency, and its ability to withstand faults or other disturbances. A 'contingency event' is an event that affects the power system in a way which *would likely involve the failure or sudden and unexpected removal from operational service of a generating unit or transmission element*.[20] AEMO and transmission operators are required to support power system security through the procurement of various services including system strength, inertia and contingency and regulation frequency control ancillary services (FCAS).

EV loads can vary substantially in real time. In the future, this may include a coincident response to wholesale market price changes, changes in retail price bands (e.g. shoulder to off-peak prices) or unpredictable events such as a cyber-attack or a loss of communication between a remote charge point operator and its fleet of EVSE.

If a significant proportion EV load were to drop (or increase) unexpectedly, this could constitute a major contingency event. AEMO would have to manage this by procuring appropriate levels of system services, especially FCAS, and this could be a material cost to consumers.[21] The likelihood and impact on such changes in load depends on a range of factors including the overall uptake of smart charging, institutional controls around cyber security, and market concentration of EVSE and vehicle OEMS, as well as charge point operations.

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[19] NATIONAL ELECTRICITY FORECASTING (aemo.com.au) - *Electricity Maximum Demand Electric Vehicles.*

[20] Security | AEMC

[21] Based on a levelised cost of contingency *and* regulation FCAS (LCoFCAS) of $42/MW/hr, each additional GW of FCAS procured would cost $367,920,000 per annum. LCoFCAS source: Gilmore, J.,& Nolan, T., & Simshauser, P. (2022). *The Levelised Cost of Frequency Control Ancillary Services in Australia's National Electricity Market.*

A concentrated market raises risks associated with inadvertent or malicious contingency event associated with an entire model fleet having its charging behaviour simultaneously modified, turned on or off. Historically, vehicle sales in Australia have been dominated by a few major brands. The largest selling brand in Australia has been Toyota (~25% market share).[22] Tesla currently accounts for over 50% of EV sales in Australia.[23] If similar dynamics were to continue, we can expect that a high proportion of vehicles *could* be subject to coincident changes in demand resulting from a range of factors related to the intended operation or an unintended disruption of charge management systems.

It must be stressed that costs associated with managing the integration of EVs are not necessarily inefficient costs. While better data on EVSE location and performance characteristics cannot eliminate all power system EV integration costs, it can help ensure these costs are kept to an efficient level by, in part, improving AEMO's ability to quantify and manage system security risks. Naturally, an EV relies on EVSE devices, to charge. Access to EVSE standing data will assist in accurately modelling for contingency events associated with EVs.

2.6 EVSE data use cases for AEMO

Traditionally, load forecasting has relied on a diversity of load types and operational characteristics. While individually unpredictable, *en masse*, customer load profiles can form relatively predicable patterns that vary gradually in response to factors such as weather, time, day of the week or, over the longer term, macroeconomic conditions and changes in technology and industry structure.

Conversely, CER operation can be highly coincident at different system levels, and change rapidly due to, for example, changes in cloud cover or DNSP operating envelopes. Flexible generation and load can also respond to market-wide events such as wholesale electricity or changeovers of retail time-of-use price bands. As load becomes more dynamic, so do load forecast models. To accurately forecast load changes, AEMO needs to understand the extent, performance characteristics and geographic disbursal of CER.

Various reforms are underway that may, in the future, provide AEMO with greater visibility and predictability of CER operation. These include Scheduled Lite and Flexible Trading Arrangement proposals (see section 1.2 from page 10). However, it is unclear the extent of coverage these reforms will achieve and the extent to which they can substitute for standing data in relation to the physical characteristics of CER technologies (such that might make them vulnerable under different contingency events).

As is the case for DNSPs, standing data is used as the basis for establishing the extent, performance characteristics and geographic disbursal of CER, although generally at higher system levels. This is then combined with 'behavioural profiles' for different CER types, to estimate current and likely aggregate loads in difference classes at various system levels. EVSE standing data can be used to inform these behavioural profiles, as AEMO can combine it with metering data to select relevant sites for analysis when building these profiles. More complete and accurate standing data can improve the accuracy of these models, reducing forecast uncertainty, and thereby reducing the need to procure market ancillary services required to manage associated power system security risks. AEMO intends to use EVSE standing data for a variety of use-cases, including those described in this section (below).

AEMO requires CER standing data as an input into load growth modelling and operational planning over various timeframes. CER (generating units or aggregations under 5 MW, as well as most flexible loads) are not directly visible to AEMO. Instead, it must rely on models to estimate the current and likely operation of these resources.

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[22] [Australian Car Market: Car Sales Statistics & Figures Australia]

[23] [State-of-EVs-October-2022.pdf (electricvehiclecouncil.com.au)]

AEMO has reported that if current information gaps on CER persist, as CER penetration increases, this will progressively decrease its ability to:

- maintain power system security
- deliver information to support efficient market outcomes.

The implications of limited visibility for CER are summarised in Figure 3. While access to EVSE standing data does not directly address these issues, it is intended to provide an enhanced basis for the development of system security risk mitigation strategies.

Figure 3: Lack of visibility of CER - impacts on load forecasting (Source: AEMO 2022)

	Description	Implications without visibility
Variability and uncertainty	Underlying variability and uncertainty in many DER	Greater demand forecast error increasing regulation FCAS requirements.
Ramping	Large localised concentrations of DER can ramp up or down quickly because of their variability	Need for additional ramping resources and FCAS due to ramping events.
Performance characteristics	Each type of DER will vary in its performance characteristics.	Forecast impact on load profiles need to be calibrated against real performance to more accurately reflect the properties of the system.
Price decoupled	DER may respond to prices decoupled from the wholesale price (e.g. retail tariff) or self-optimise based on prices.	AEMO needs to forecast the behavioural investment decisions of consumers. Without visibility, it will be difficult to predict aggregate behaviour.
Measurement and telemetry	DER do not generally have associated metering or remote control.	AEMO has to estimate how much underlying demand is required to be met from grid-supplied generation.

This challenge is being considered via the *Scheduled Lite* and *Flexible Trading Arrangements* reform proposals however, these reforms are unlikely to bring about material improvements in CER forecasting in the near term, or even a complete solution in the longer term.

A1. Stability analysis and emergency planning

Operating the power system in a secure state requires continuous analysis of the potential impact of factors internal or external to the system. This requires an understanding of how CER *would* respond to changes in system voltage and frequency that may could occur due to a sudden loss in generation or load. This is particularly relevant for inverter-based CER, including EVSE enabled for vehicle to grid, and aggregated (or otherwise coincident) loads.

Understanding the performance characteristics of EVSE is also a critical input into emergency response planning, such as in the event of a 'system black'. During the recovery phase following a system black event, AEMO requires an accurate, locational, understanding of how CER will respond to re-energisation (to stabilise the recovery) and what services CER can provide to assist in recovery. The operation of EV charging is expected to become increasingly critical to the emergency recovery planning activities of AEMO and network businesses into the future and EVSE standing data is expected to be an important input into this.

A2. Congestion management

AEMO uses load models, along with generation forecasts, as an input into transmission congestion models. Congestion at a point in the transmission network indicates that demand for electricity is near or at the limit of what a transmission element can carry (taking into account thermal limits and power system security requirements).

Congestion requires that generation is curtailed locally and supplemented by other generation located elsewhere in the network, allowing electricity to be supplied to customers through a safe and stable route. Congestion can have material commercial implications for generators and retailers, and long run prices for customers. Accurate CER generation and load forecasting can improve the efficiency of curtailment decisions, reducing these costs. As EV penetration grows, it is expected that EV load modelling will become increasingly material to AEMO's congestion models and curtailment/mitigation decisions. This includes the identification of optimal solutions to alleviate congestion.

A3. Generator performance standards

AEMO uses load models and network power flow models to determine the performance standards for generation looking to connect to the network. A better understanding of the potential changes in load on the transmission network, and how load may respond to different conditions or events, can assist AEMO develop and apply technical performance requirements for large-scale generators in a manner that reduces generator costs and the complexity of grid connection processes that arises from uncertainty in load characteristics.

A4. Longer term planning

The extent, location and timing of EV charging load is a major input into AEMO's longer-term planning functions, including the *Integrated System Plan* and the *Electricity Statement of Opportunities*. These models underpin the investment case for new large-scale generators and transmission infrastructure. Improving the accuracy of these models can have material implications for resource adequacy planning and market intervention decisions, which ultimately effect long-run electricity prices for consumers.

2.7 Other EVSE standing data use cases

This section describes secondary use cases for EVSE standing data.

O1. Government and researcher use-cases

Other parties, such as governments and researchers and emergency services agencies, also have an interest in EVSE standing data. Policymakers and researchers, for example, have an interest in understanding EV uptake over time and in different locations. In some cases, EVSE standing data may be used to explore technology or market development potential for smarter EV charging, to inform policy and program design or implementation. These use-cases are considered secondary in that, in most instances, data needs can be met by aggregated EVSE standing data, or alternately, by EV sales registration data held by jurisdictional transport authorities. For example, AEMO provides a dashboard by which third parties can view and download summary data from the current DER Register. These are provided to the postcode level and updated quarterly.[24]

O2. Emergency services use-cases

Emergency services organisations, particularly fire services, can benefit from understanding the location of EVs to help manage battery fire and electrical safety risks. EVSE standing data would not normally contain critical information on battery chemistry and this information can obtained from vehicle OEMs, jurisdictional vehicle registration databases or information collectable under jurisdictional planning/safety codes and regulations (i.e. outside of the National Electricity Rules framework) which would allow specifically relevant information to be captured for safety-related purposes.

[24] AEMO | DER Register data

Emergency services agencies have however demonstrated an interest in DER Register data and report that EVSE standing data can enhance their capacity to provide an efficient and effective emergency response. DER Register data can be integrated into information systems used by emergency responders. While this use case is considered a *relatively* low priority for EVSE standing data, fire services organisations are an existing user of the DER Register and should continue to be supported if they have an interest in EVSE standing data.

O3. Installer update/delete CER use-case

To ensure CER/EVSE data remains accurate over time, provision should be provided, such as through the DER portal interface, for installers to update or amend EVSE data in the register when undertaking a new or replacement installation. This is provided for under some jurisdictional implementations of current DER Register reporting frameworks. Access by installers should be limited to CER at the customer's site at which they are working, as is currently the case. While not a reason to collect EVSE standing data, this use case that should be provided for through EVSE standing data system design.

O4. Industry use cases

Initial consultations with EVSE OEMs, and EV industry representatives, indicates there is limited benefit in providing industry access to EVSE standing data, outside of satisfying personal or narrow commercial interests. The primary, and separate, reported interest of industry is in obtaining information on local network congestion to assist with the siting of charging infrastructure. This data use case is being separately explored through the ESB's *Priority Project: Network visibility for market planning*.[25]

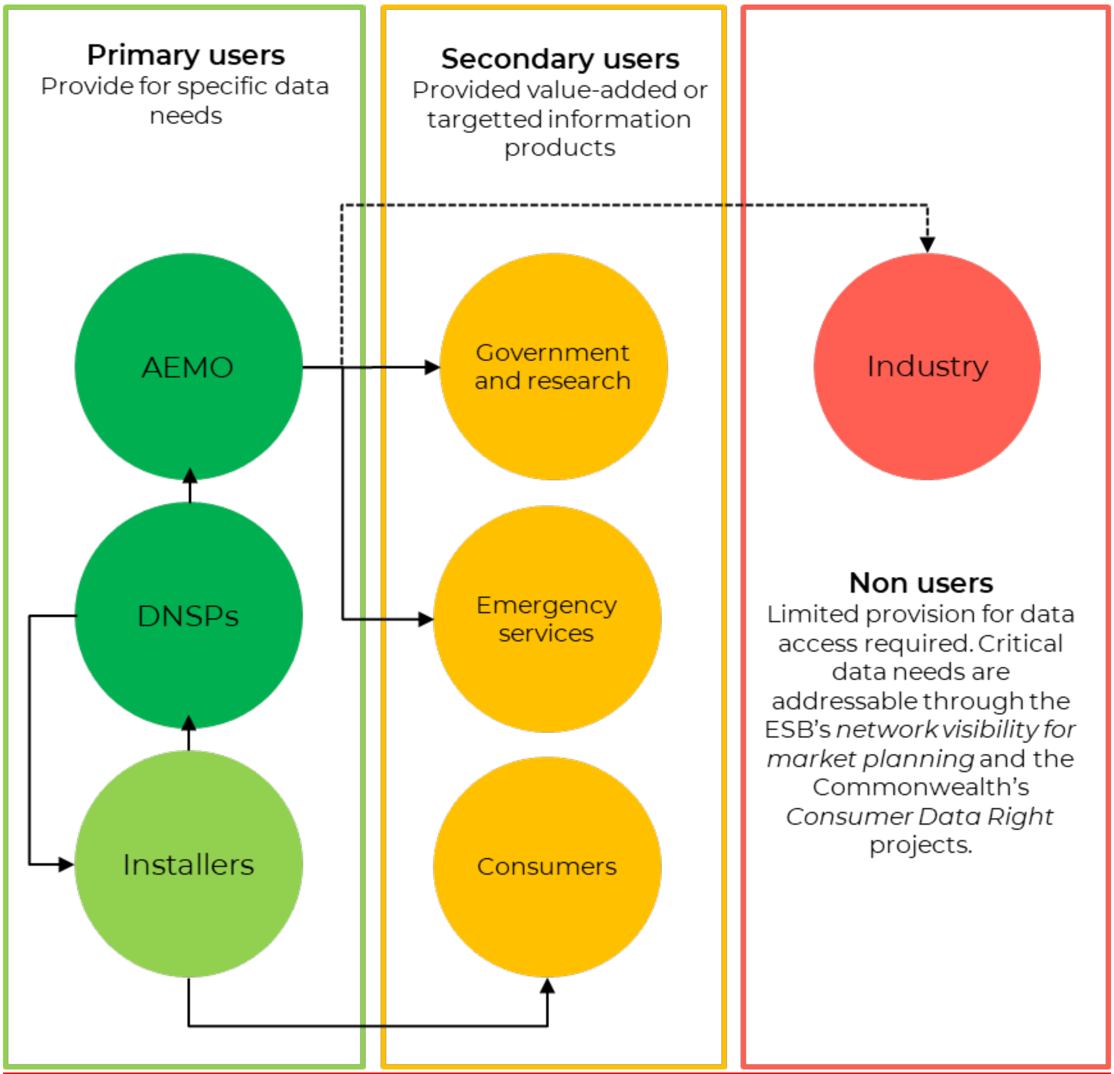
O5. Consumer use cases

Details of the history of CER in a particular premise may be used by the original or subsequent owners of the premises. This may assist consumers and their agents in scheduling maintenance, in making warranty claims, or in establishing the history of installations, and changes in technology uses. This information can be accessed by an installer and shared with the relevant customer.

Figure 4 summarises primary, secondary and non-users of EVSE standing data as described above. It illustrates the potential direct and indirect data access arrangements for different parties based on the characterisation of data uses described above.

[25] Data Strategy (aemc.gov.au)

Figure 4: Summary of standing data users (primary, secondary, and non-users)



QUESTIONS FOR CONSULTATION

Consultation Question 1: Are the key use cases for EVSE standing data adequately captured and described?

3. Draft EVSE standing data specification

3.1 Considerations for data collection

Data collection involves trade-offs between the usefulness of achieving large data sets, and the cost of data collection and management. Increasing data collection requirements increases complexity and effort and the time of installation and, anecdotally, this can contribute to lower response rates and data quality issues. This can undermine data quality for essential data elements and erode stakeholder confidence in overall data collection processes and data uses.

The decision to impose new data collection requirements should be subject to the considerations set out in Table 2. This is to ensure that data is not collected 'for its own sake' and rather, remains limited to clear and valuable use cases with due consideration of the costs and risks of data collection for different stakeholders.

Table 2: General tests and considerations for data collection

Test	Description
1. Clear purpose	Data should only be collected where there is a link to a clear purpose or use-case that is of substantial value to electricity consumers (i.e. consistent with the National Electricity Objective) and where that cannot be satisfied by an existing data collection method.
2. Validity	Not to be confused with 'validation', validity can be considered as the degree to which the data being collected is a reasonable indicator of what it is intended to represent. For example, the sum of max load capacity of EVSE at a site may not be a valid measure of the total load that can be expected at a site. This may be more validly measured via the power circuit rating of all EVSE at site.
3. Data minimisation	EVSE standing data collection adds cost and complexity to installation processes and contributes to data management and processing costs and risks. Data collection should therefore be kept to the minimum level necessary to achieve the stated purpose. Cyber risk means that private or commercially sensitive data collection should be avoided where suitable alternatives are present. Automated data collection from centralised sources can reduce time and effort and reduce data entry errors.
4. Internal and external consistency	The utility of data sets can be enhanced when standardised fields are used. This supports more efficient data processing efforts and supports analysis across alternative data sets (and data holders).
5. Maintainability	Data should be structured to minimise the need for changes over time. This can be achieved by providing flexible data entry (balanced against *Test 4*) and by not collecting data that is likely to be highly dynamic in its scope and structure over time. Maintainability is especially important when multiple data applications are connected (e.g. DNSP installer apps, AEMO DER Register Portal, CEC Product Database). Changing one system can have material implications for another, increasing costs and undermining data quality and completeness.
6. Role alignment	Data collection should be limited to the specific, and generally accepted, roles and functions of data users (e.g. for AEMO, power system planning and market operation). This can justify and improve the 'social licence' for data collection, management, and reporting processes and reduce legal risk.

3.2 Draft data specification

A number of potential EVSE standing data fields have been identified that may form part of a future EVSE data collection framework. This builds on the DEIP EV Taskforce work which identified a range of EVSE, EV, customer, aggregator standing and operational data types (i.e. beyond the scope of an EVSE standing data register) that are of interest to stakeholders including AEMO, DNSP and researchers. DEIP identified 54 data fields of interest while the draft EVSE data specification identifies 24 fields.[26]

Table 3 sets out a draft data specification for stakeholder feedback.[27] This list has been iterated via stakeholder interviews undertaken as an input into the paper but is considered far from final.

Table 3: Draft EVSE Standing Data Specification. Blue fields entered by the installer, green auto populated from a central EVSE database. Right column indicates a DEIP Taskforce Specification item (Yes+ = beyond DEIP Specification)

#	Data source	Field	Value options	Purpose	DEIP Req.
1	Installer	Installer ID	[ID Code]	Compliance monitoring	No
2	Installer	NMI	[Number]	Location / site lookup	Yes
3	Installer	Circuit rating (Amps) of all EVSE at NMI	[Number]	Physical capability	No
4	Installer	EVSE connection type	Standalone/BTM	Identify mixed loads	No
5	Installer	EVSE type/make/model	[Select from list]	EVSE Database (DB) lookup	Yes
6	Installer	Phases	Single/Two/Three	Physical capability	Yes
7	Installer	Local energy management	Yes/No	Communications capability	Yes+
8	Installer	Remote energy management	Yes/No	Communications capability	Yes+
9	Installer	Internet connected	Yes/No	Communications capability	Yes+
10	Installer	Ownership status	Private/Public/Fleet	Collect for transport planning	Yes
11	Installer	Commissioning date	[Date]	Time series analysis	No
12	EVSE DB	AC V2x capable	Yes/No	Physical capability	Yes
13	EVSE DB	DC V2x capable	Yes/No	Physical capability	Yes
14	EVSE DB	Max power import rating (A/C, kW)	[Number]	Physical capability	Yes
15	EVSE DB	Max power export rating (A/C, kW)	[N/A or Number]	Physical capability	Yes
16	EVSE DB	ISO/DIS 15118 version	[N/A or select from list]	Interoperability capability	No
17	EVSE DB	OCPP version	[N/A or select from list]	Interoperability capability	No
18	EVSE DB	IEEE 2030.5 client version	[N/A or select from list]	Interoperability capability	No
19	EVSE DB	CSIP-Aus client version	[N/A or select from list]	Interoperability capability	No
20	EVSE DB	Other comms protocol	[Text]	Interoperability capability	No
21	EVSE DB	Remote firmware upgradeable	Yes/No	Interoperability capability	No
22	EVSE DB	AS4777.2 version	[N/A or select from list]	Performance characteristics	Yes
23	EVSE DB	Energy metering specification	[N/A or select from list]	Market capability	No
24	EVSE DB	FCAS metering specification	[N/A or select from list]	Market capability	No

[26] DEIP EV Data Availability Taskforce, *Electric Vehicles Grid Integration Recommendations*, February 2021, pp 31-35.

[27] See Chapter 5.2 and Table 7below for more details of a national EVSE database to capture and enter the data at items 12-24 in Table 3.

Draft EVSE data specification fields can be grouped into two categories:

- **Installation data** – information that is only created at the time of installation and so needs to be collected by the installer (or another party) that has access to installation-specific details. This includes site-specific information such as site characteristics, the manner of connection (power and communications), what EVSE is being installed.
- **EVSE data –** information that is linked to a specific make and model of EVSE, such as its electrical and communications capabilities, and its metering functions (to assess market participation potential). This information can be stored in a central database and auto-populated based on the installers selection of the EVSE type/make/model.

Each data field can be used by different parties for multiple purposes, some of which are listed in Table 3. Of particular note is the **physical capability** of the EVSE in relation to its capacity to draw or generate electricity. This information is considered critical in determining the potential profile associated with EVSE loads on the low voltage network for planning and operational purposes. **Interoperability and communications capability** is important to assessing the potential impacts of disruption to communication infrastructure and a site, network or regional level.

Market capability is considered of value but not strictly essential. Having this information can help inform strategies to promote participation of EVs in ancillary services markets. This data has the potential to support use cases associated with assessing system security risks of EV charging loads and determining the potential for EVs to participate in markets or in out-of-market load management schemes. This information could also provide a range of indicators that reflect the maturation and characteristics of the smart charging in the Australian market for government policy and research purposes.

It is important to note that fields stored in a national EVSE database would only need to be collected once, nationally. This means there is zero marginal cost associated with having this information for each EVSE installation. This contrasts with installation-specific data where there may be material costs associated with each additional item that must be gathered and reported by an installer.

Table 4 sets out additional data fields that were considered in the development of the draft specification but have been currently excluded due their potentially failing one or more of the data collection tests set out in section 3.1 (page 24).

Table 4: Data fields <u>not</u> included in the draft EVSE Standing Data Specification. The right-hand column indicates a DEIP Taskforce Specification item.

Data source	Field	Value options	Reason for not including / test	DEIP Req.
Installer	EVSE product serial numbers	[Number]	Purpose, minimisation, maintainability	No
Installer	Firmware version	[Text]	Maintainability	No
Installer	Controlled load circuit	Yes/No	Minimisation, can infer from NMI	No
Installer	Circuit rating (Amps) per EVSE	[Number]	Purpose, minimisation, validity	No
EVSE DB	EVSE connector type	[E.g. CCS / CHAdeMO]	Purpose, minimisation	No
EVSE DB	AS/NZS 4755 version	[N/A or select from list]	Purpose, minimisation	No
Installer	GPS location	[Number]	Minimisation, role, can derive from NMI	Yes
Installer	No. chargers per station	{Number]	Purpose, minimisation	Yes

Stakeholders are encouraged to review the DEIP Taskforce Specification and assess whether there are additional data fields that warrant inclusion in a national EVSE standing data register, and whether they satisfy the tests set out in section 3.1 of this paper.

It is important to note that the EVSE standing data register is not intended to provide all EV-related data of interest to all parties. For example, it is expected that DNSPs, AEMO and researcher will periodically require interval data from a sample of EVSEs to develop and validate load models. This is expected to be obtained separately to the EVSE standing data register such as via commercial or other non-regulatory processes.

3.3 A national EVSE database

The above data collection approach relies on the creation of a database that lists all EVSE available for installation in Australia. Database listing is not intended to represent any certification or warranty of product quality, capability or performance. However, if installers were mandated to enter EVSE standing data at the time of installation, then listing products in the National EVSE Database would become a critical business process for EVSE importers and OEMs. It would, in effect, mean that an installation requires a EVSE to be listed for the installation to comply with reporting requirements. Stakeholder consultations thus far indicate the development of a national EVSE database should be a relatively straightforward task and that OEMs and importers should have strong incentives to keep their listings up to date.

An organisation would need to be made responsible for the listing or delisting of products, and for the rectification of any technical issues. This function could be added to the information hosting services provided by the CEC for inverter product listing. In some cases, these lists will be cross referenced such as where an EVSE includes a native inverter that supports V2G and therefore requires AS/NZ 4777.2:2020 certification. Common data structures across both lists (e.g. common data field definitions) could enhance consistency and streamline industry data provision.

Depending on the final scope of information contained in the National EVSE Database, it is likely that it could be available for search or download by interested parties (including the general public). It is noted that the CEC's approved inverter list is free to browse, but payment is required to download or access the live data via an API.[28]

3.4 Data collection and validation processes

Efficient process for data collection can support more complete and quality data sets. This includes allowing installers to add to, amend or delete legacy installations at a customer premises. It could be a requirement, when submitting data to the DER Register, that the installer validates the existing records at that site. Applications can also streamline processes by allowing installers to clone data entries where there are various identical EVSE at a premises (such as in an apartment of commercial building).

The current framework for DER Register data collection allows networks to develop their own methods for installer reporting. This has resulted in a diversity of approaches and significant variability in the quality and completeness of data capture (summarised in *Appendix B –* at page 49).

QUESTIONS FOR CONSULTATION

Consultation Question 2: Are the listed considerations for data collection appropriate?

Consultation Question 3: What data fields should or should not be collected, and why? What is the minimum set of data required to facilitate the above use cases?

Consultation Question 4: How can timely and accurate reporting of EVSE installation data best be supported?

Consultation Question 5: What else could a National EVSE Database be used for, in addition to supporting EVSE standing data collection processes?

Consultation Question 6: What governance arrangements are needed to ensure the appropriate operation of a National EVSE Database?

[28] Approved Inverters | Clean Energy Council

4. Determining EVSE charger installations that should be captured

4.1 Materiality of different charger types

Table 5 provides a breakdown of EVSE installation types to illustrate what can be captured under current DER Register data collection processes. Currently, DER Register reporting for EVSE by installers is limited to where the EVSE has vehicle-to-grid (V2G) capabilities and thereby classed as a small generation unit. There are only three instances of this in the DER Register, illustrating that changes to reporting requirements are required to meet emerging EVSE standing data needs. The table also indicates which classes of installation require an electrician or achieve some level of DNSP visibility of the installation process. This is relevant to later discussions regarding potential triggers for EVSE standing data reporting as they may apply to networks or installers. This analysis indicates, for example, that it may be insufficient to rely on DNSPs reporting on installations where they have existing visibility.

Table 5: Breakdown of EVSE installation types identifying potential electrician and DNSP visibility

EVSE installation type	Requires an electrician	New connection visibility by DNSP	Captured in DER Register	Estimated % of total EV charge load (2022)[29]
Residential Level 2 charger with V2G	Yes	Yes – Embedded generator triggers connection agreement revision	Yes, no instances	0%
Non-residential Level 2-3 charger with V2G	Yes	Yes – Embedded generator triggers connection agreement revision	Yes, only 3 instances	0%
Public EVSE with V2G	Yes	Yes – Embedded generator triggers connection agreement revision	Yes, no instances	0%
Non-residential Level 2-3 charger without V2G	Yes	Often visible at site-level. Limited visibility of onsite configuration.	No	22%
Public EVSE without V2G	Yes	Often visible at site-level. Limited visibility of onsite configuration.	No	4%
Private Level 1 charger	No, unless circuit is upgraded (e.g. 10 to 15 Amps)	No	No	11%
Residential Level 2 charger without V2G	Yes	No visibility other that when connection is upgraded (e.g. 1 to 3-phase)	No	63%
Total load capturable under current DER Register processes				0%

The 2022 ISP provides an indication of how electrical loads associated with different installation types could vary over time based on CSIRO modelling. From this, and applying some simple assumptions, it is possible to infer approximate potential loads associated with various EVSE categories over time. This is shown in Figure 5 to Figure 7 on page 29. Note that this includes all vehicle types including heavy vehicles.

This analysis indicates that the vast majority (>95%) of future EVSE load could be associated with EVSE Level 2-3 installations (IEC Modes 3-4). This grouping is indicated by the grey dotted line overlaying the charts. Future coverage could be achieved by including Level 1 charging that involves an electrician (e.g. putting the EVSE on a 15 Amp circuit). Given uncertainties, this analysis should be treated as indicative only.

[29] Based on AEMO ISP 2022 Step Change scenario.

*Figure 5: Estimated breakdown of load by EVSE charger type, **2021-2022** (ISP 2022 Step Change scenario)*

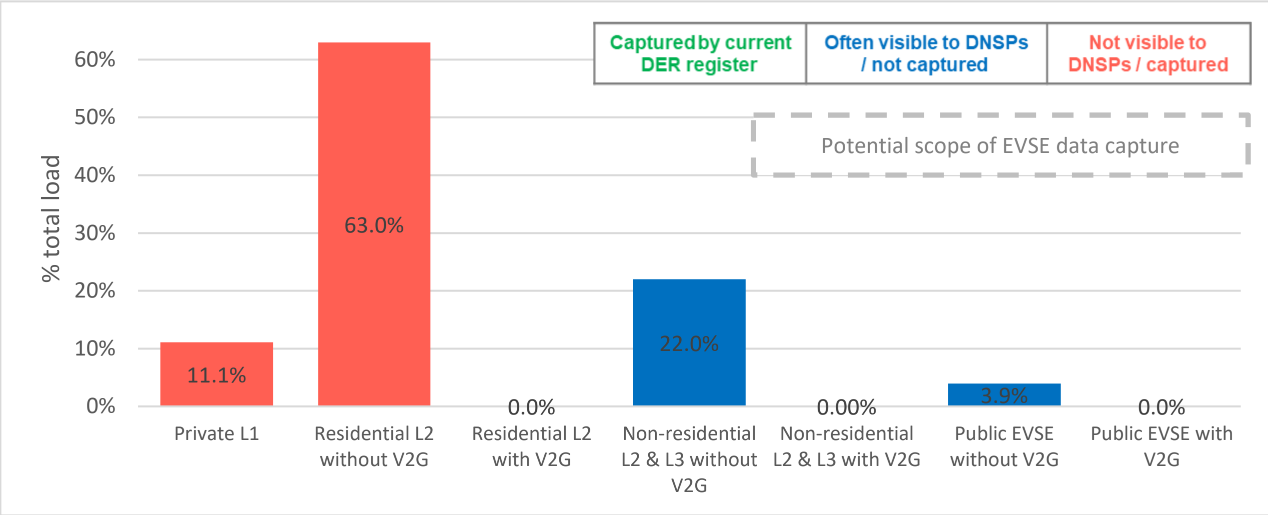


*Figure 6: Estimated breakdown of load by EVSE charger type, **2036-2037** (ISP 2022 Step Change scenario)*

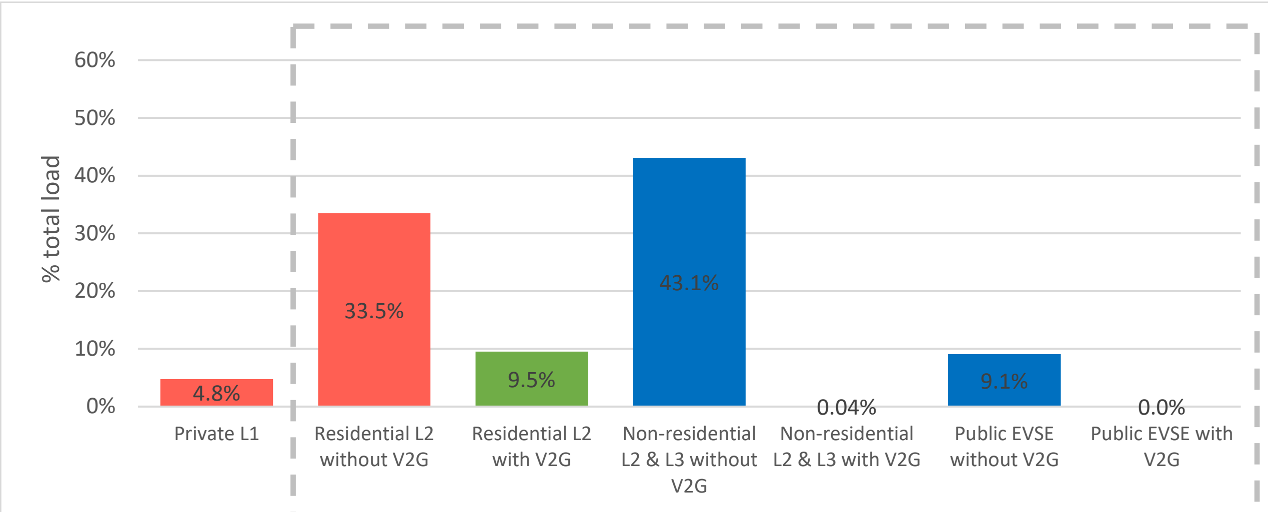
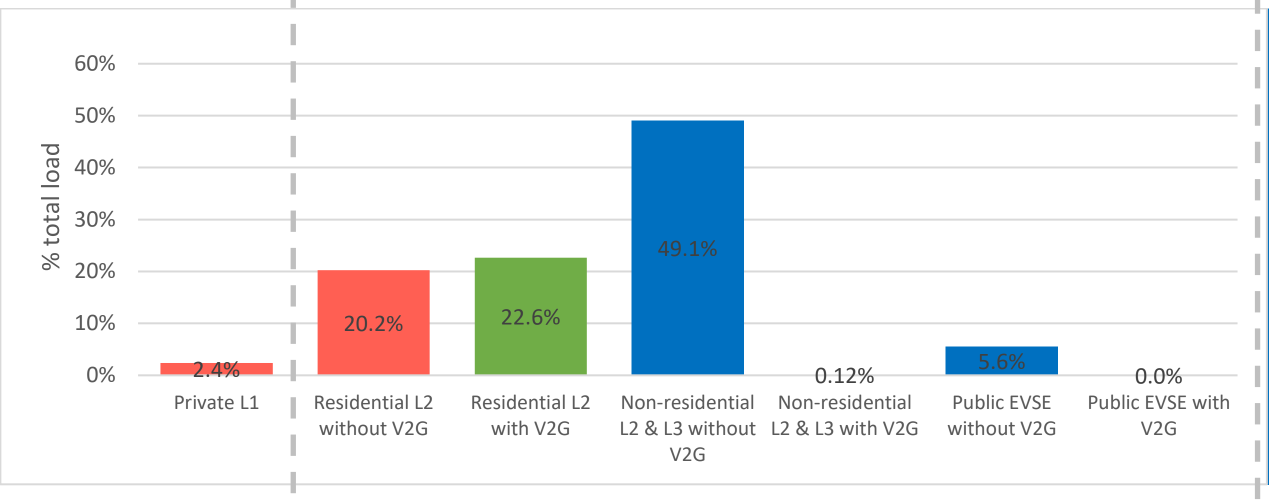


*Figure 7: Estimated breakdown of load by EVSE charger type, **2051-2052** (ISP 2022 Step Change scenario)*



4.2 Potential reporting triggers (EVSE coverage)

An obligation to report EVSE standing data to the DER Register during the installation of EVSE can be attached to a range of reporting triggers. These are:

- when certification of electrical safety is required by a jurisdictional safety regulator
- upon installation of a smart meter
- upon installation of any EVSE
- upon installation of specified EVSE Mode(s)
- upon installation of EVSE with a particular electricity circuit maximum rating (e.g. 15 or 20 Amps).

Each reporting trigger has advantages and disadvantages, that are assessed Table 6 (next page) against the following criteria:

- the extent of EVSE installations likely to be captured on a national basis
- the extent of alignment with existing regulatory arrangements
- the likelihood of compliance.

Depending on the future uptake of Level 1 charging, using Triggers 4 to 6 could provide coverage of EVSE devices that will be responsible for the vast majority (>95%) of overall EV charging load. Triggers 5 and 6 provide additional coverage in that they would cover installations not hardwired to an electricity mains, but that have higher capacity ratings (and therefore potential grid impacts). This could provide some 'insurance' in the event that consumer usage of Level 1 charging remains high. This would ensure a higher proportion of EV charging loads are captured, regardless of future consumer charging preferences. Each of these requirements is also relatively communicable to industry.

Depending on the regulatory model, implementation of an EVSE standing data-reporting trigger would rely on a combination of changes to jurisdictional safety regulations, changes to the DNSP connection agreement and/or changes to the service and installation rules. The different options for the desired regulatory model, and an assessment framework are discussed in Chapter 5 (see Figure 8: *Summary of regulatory implementation models to implement EVSE standing data in the DER Register*, and *Figure 9: Summary of the proposed regulatory model evaluation framework*).

Table 6: Advantages & disadvantages of potential reporting triggers, generally ordered from lowest to highest coverage. Triggers 4 to 6 (shaded green) are expected to provide coverage of >95% of future EV charger load.

Reporting trigger	How the requirement would apply	Advantages	Disadvantages
1. On revision of a customer connection agreement due to an EVSE installation.	Requiring an electrician to enter EVSE standing data in the DER Register, when a revised connection agreement is required due to any EVSE installation.	Would ensure consistent national coverage, an extension of the existing DER Register.	The current threshold for requiring a new connection agreement is variable between DNSPs (due to DNSP management preferences, and variable jurisdictional legal requirements). Mandating a requirement for a new connection agreement whenever there is an EVSE installation would be required under triggers 4-6 below and could have significant implications for DNSPs.
2. To achieve a certificate of electrical safety required by state safety regulators.	Requiring an electrician to enter EVSE standing data in the DER Register, as a state safety regulatory requirement, when a new generating system is installed.	This is a common requirement of jurisdictional safety regulators that licenced electricians are familiar with. Safety regulator inspection processes could improve data accuracy. As a precondition for connection of new systems, this trigger constitutes a significant incentive for compliance.	May result in inconsistent national coverage. Will not pick up all EVSE installations installed by electricians, only those requiring safety certification. The national objectives of this data collection requirement do not align with the statutory objectives of state safety regulators.
3. Upon installation of a smart meter.	Requiring an electrician to enter EVSE standing data in the DER Register, as a DNSP requirement when installing a smart meter on a system that includes an EVSE.	If this trigger was created in addition to other triggers, it may increase coverage of previously unreported installations.	If relied on exclusively, without combining with other triggers, the EVSE covered by this trigger would be arbitrary and unlikely to substantially cover the installation of higher capacity EVSE.
4. Upon installation of specified EVSE type/mode(s).	Requiring an electrician to enter EVSE standing data in the DER Register when installing specified classes of EVSE (e.g. Level 2 charging hardwired to an electricity mains), as specified in DNSP service and installation rules.	Would ensure consistent national coverage, an extension of the existing DER Register. This will achieve complete coverage in relation to the majority of EVSE load.	Requires the development of an industry-accepted taxonomy of EVSE types. Would require an extension of the DNSP service and installation rules., involving varying operational issues across DNSP regions. [30]
5. Upon installation of EVSE installed with a specified circuit rating (e.g. => 20Amps).	Requiring an electrician to enter EVSE standing data in the DER Register: when installing EVSE of a specified circuit rating.	Will ensure consistent national coverage, an extension of the existing DER Register. This will achieve coverage in relation to the majority of future EVSE load.	Would require an extension of the DNSP service and installation rules, involving varying operational issues across DNSP regions.
6. Upon installation of any EVSE by an electrician.	Requiring an electrician to enter EVSE standing data in the DER Register, as a requirement under DNSP service and installation rules, whenever an electrician installs an EVSE.	Would ensure consistent national coverage, an extension of the existing DER Register. Would maximise capture of EVSE data.	Would require an extension of the DNSP service and installation rules, involving varying operational issues across DNSP regions.

[30] It is understood that there are no regulatory, or major practical barriers, inhibiting DNSPs from creating a requirement for EVSE standing data reporting as set out in options 4, 5 and 6.

QUESTIONS FOR CONSULTATION

Consultation Question 7: Are there any other reporting triggers that have not been considered?

Consultation Question 8: What other advantages and disadvantages should be considered when comparing available reporting triggers?

Consultation Question 9: Is it agreed that networks could impose a requirement for EVSE standing data reporting, through an amendment to the service and installation rules?

5. Achieving a nationally consistent approach to EVSE data collection.

5.1 Is a nationally consistent approach needed?

Stakeholder consultation has identified a consensus view that a nationally consistent and coordinated method for collection of EVSE standing data is required. Industry participants are seeking a consistent national approach to lower costs and to ensure that the benefits of a centralised source of EVSE standing data are fully realised.

There are some inconsistent views between DNSPs regarding the priority of issues that must be addressed prior to extending the DER Register to include EVSE standing data. There is, however, consistent recognition that EVSE standing data must be collected consistently, at a national level, to ensure that local, regional, and national load modelling can be performed, supporting efficient outcomes for electricity consumers.

5.2 Use of the current DER Register framework

There are several existing national and state-based systems established for the collection of CER data, that could provide a basis for, or contribute to, an EVSE standing data collection framework.

- The **Clean Energy Regulator** collects data relating to the operation of the small-scale renewable energy scheme.[31] This includes a range of data relating to the products used, including installation details, NMI identifier, rated power output of energy generating systems, and serial numbers of key products including PV solar panels,[32] and inverters.[33]
- The **Clean Energy Council** collects data about a range of products, including solar panels, inverters, and batteries,[34] that are approved by the CEC for use in Australian renewable energy systems.
- The **Electrical Equipment Safety System** is a scheme that requires manufacturers to provide registration and certification information to a national database managed on behalf of participating jurisdictions[35] by ERAC.[36]
- **South Australia Power Networks**, are currently collecting data in relation to all Level 2 chargers above 20A, using the existing (DNSP) service and installation rules.[37]
- **AEMO** has created the DER Register to collect information about the installation of embedded generators (e.g. solar, batteries and V2G capable EVSE). This includes data relating to the products used, product settings and generating capacity of the system.

Each of the existing frameworks have limitations that inhibit their suitability to be extended for the purpose of collecting EVSE standing data. Aspects of existing approaches to data collection may be leveraged in a national EVSE standing data collection framework. The scope and limitations of each data collection framework are summarised in Table 7.

Overall, AEMO's DER Register is currently the only suitable existing national framework that could be readily extended for the purpose of EVSE standing data collection. *Appendix B – Summary of DER Register processes* explores the features and limitations of the current regulatory framework for the DER Register in more detail, including issues that should be explored to ensure complete and accurate EVSE data collection.

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31 CER Data and Information; Small-scale Renewable Energy Scheme (cleanenergyregulator.gov.au)

32 Requirements for solar PV component manufacturers and importers (cleanenergyregulator.gov.au)

33 Inverter serial number ledger guidance (cleanenergyregulator.gov.au)

34 Products | Clean Energy Council

35 Currently mandated under an Inter-governmental agreement by Queensland, Victoria, Western Australia and Tasmania.

36 About the EESS – EESS

37 South Australia Power Networks, *Service and Installation Rules*, May 2022.

Table 7: Summary of current CER databases and suitability to expand for EVSE standing data collection

System	Scope	Limitation	EVSE standing data candidate assessment
Clean Energy Regulator, Small-scale Renewable Energy Scheme (SRES) data	Comprehensive CER product and installation details, confirmed by the accredited system installer.	Does not cover systems installed outside the operation of the SRES Scheme (i.e. limited to solar and solar/heat pump water heaters).	Would require the establishment of a reconstituted version of the Clean Energy Regulator, with national regulatory powers that extend beyond SRES operation.
Clean Energy Council, Product listing data	Lists product and product details, including inverter model numbers, and compliance-related features.	Only provides details provided voluntarily by manufacturers and does not include installation details. This is a voluntary industry program, operated on a cost-recovery basis, without statutory duties.	Would require the development statutory powers and duties for the CEC. Program operates outside of established data protection frameworks that apply to government. CEC product listing processes could be leveraged as a source of EVSE model data.
SAPN EVSE data capture	Comprehensive installation and product data is captured via an online portal.	Only covers South Australia.	Only applies to South Australian installations of L2 chargers >20A. EVSE standing data specifications and collection system could be leveraged.
Electrical Equipment Safety System Database	A national register of electrical equipment, mandated by ERAC members.	Relates to electrical safety standards, and is not mandated in NSW, the ACT, or SA. Does not include installation details.	Registration is based on three levels of safety to increase consumer safety. The registration obligation is with OEMs and does not include installer obligations. The EESS could be leveraged as a source of EVSE model data.
AEMO DER Register	Comprehensive CER product and installation details, confirmed by the responsible installer.	Does not cover new systems that are not embedded generators. Would need to be extended to EVSE.	The existing national regulatory framework makes this option the most viable, however there are underlying operational and regulatory issues that need to be addressed to ensure data quality and completeness.

5.3 Why is a simple solution important?

The challenge in collecting a complete and quality dataset relates to the challenge of improving regulatory compliance in CER technical standards more broadly. Detailed analysis of these issues is beyond the scope of this paper, however it is acknowledged that:

- Industry training and continuing professional development cannot easily keep pace with advances in technologies and the complexity of compliance obligations.
- Commercial pressures drive installers to minimise time spent at a customer premises.
- Increasing complexity of compliance requirements, coupled with a lack of perceived consequences/lack of incentive to comply, is likely to lead some installers to provide incomplete or incorrect information.

- Specific incentives (e.g. SRES payments) coupled with effective inspection processes, can contribute to higher levels of compliance.

An important consideration in developing future reporting obligations is to consolidate and further develop the existing regulatory framework, to avoid further fragmentation of requirements. This means, simplifying the regulatory approach as far as possible, potentially at the expense of establishing a 'perfect' technical solution.

We have so far identified three potential regulatory approaches, and two non-regulatory approaches to support the national collection of EVSE standing data in the DER Register. These are summarised in Table 8 and regulatory options are described further below.

It is currently considered that the two non-regulatory options can be ruled-out on the basis that these options are unlikely to achieve sufficient coverage of installations required to justify the substantial costs associated with EVSE standing data collection and management. Outcomes from each framework need to be measured against the need for sufficient data for DNSPs and AEMO to understand and manage the impact of EV charging across various system levels, including at specific locations within low voltage networks. Any material gaps in data could undermine the confidence in, and use of, collected data thereby undermining its ability to be utilised for critical power system security purposes. The non-regulatory frameworks D and E are therefore not considered viable options and are not explored further in the remaining sections of this paper. Figure 8 provides a summary of regulatory models to implement EVSE standing data in the DER Register.

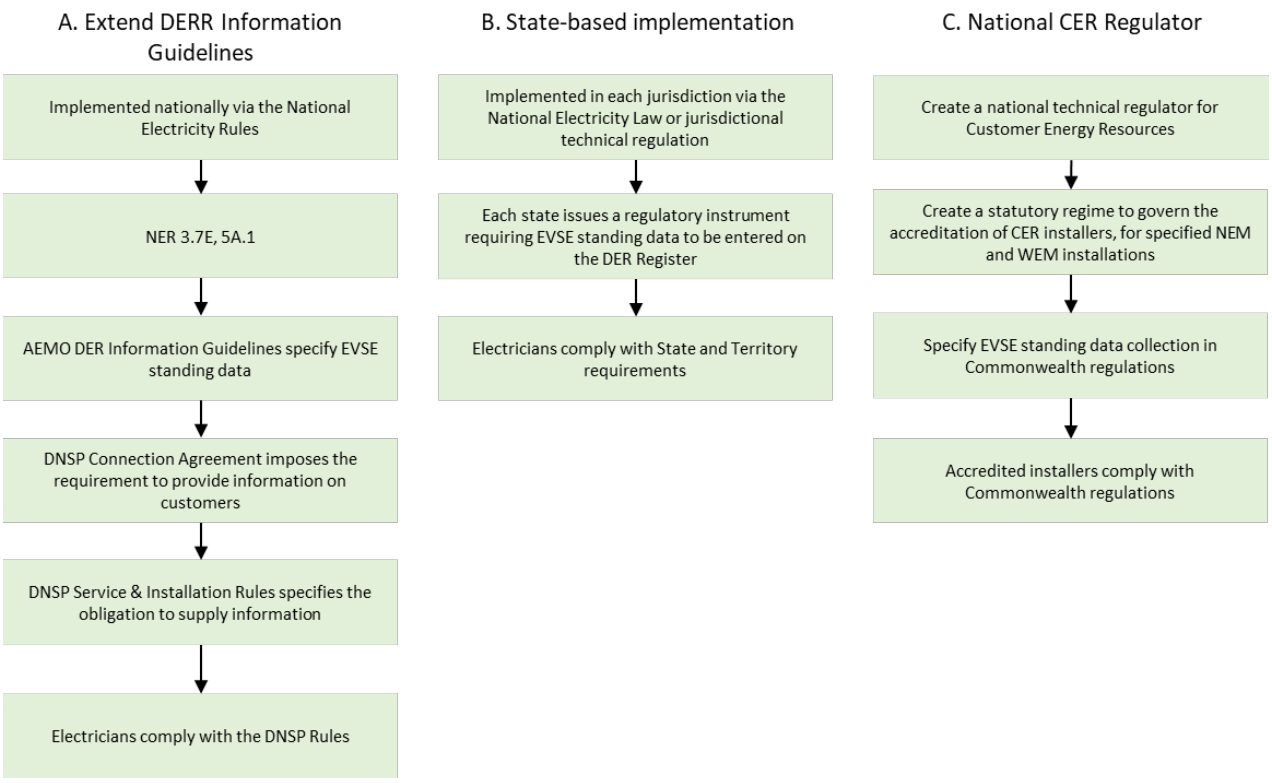
Table 8: Summary of alternative regulatory frameworks to enable EVSE standing data reporting to the DER Register.

Name	Legislative Instrument	Obligated party	Enforcement mechanism	Key limitations
A. Extend DER Register Information Guidelines	DER Register Information Guidelines (potential amendment to NER) [38]	DNSP	Requirement passed onto customers and installers under DNSP service and installation rules and/or the connection agreement.	Limited incentives for, and oversight of, installer compliance.
B. State-based implementation	State Safety Legislation	Electrician	Extension to existing electrical licencing and inspection regimes	Fragments regulatory landscape. Substantial policy decision/change
C. National CER Regulator	Commonwealth legislation or NEL amendment	Electrician	New technical inspectorate	Substantial policy decision/change
D. Incentives to report	N/A	Electricians provided incentives to report	Program management and compliance framework.	Unlikely to achieve compliance without substantial new funding.
E. Industry self-regulation	N/A	Electrician under installer accreditation	Program management and compliance framework.	Unlikely to achieve broad coverage

[38] For the WEM, this may require amendment to Rule 3.24.8 of the WEM Rules. Amendment of the WEM rules requires approval by the West Australian Minister for Energy. The three regulated electricity networks in the Northern Territory are governed by the National Electricity Rules of the Northern Territory, which would require amendment if the DER Register were to be extended to the Northern Territory, including any EVSE data collection requirements..

It is currently considered that the two non-regulatory options[39] can be ruled-out on the basis that these options are unlikely to achieve sufficient coverage of installations required to justify the substantial costs associated with EVSE standing data collection and management. Outcomes from each framework need to be measured against the need for sufficient data for DNSPs and AEMO to understand and manage the impact of EV charging across various system levels, including at specific locations within low voltage networks. Any material gaps in data could undermine the confidence in, and use of, collected data thereby undermining its ability to be utilised for critical power system security purposes. The non-regulatory frameworks D and E are therefore not considered viable options and are not explored further in the remaining sections of this paper.

Figure 8: Summary of regulatory implementation models to implement EVSE standing data in the DER Register



5.4 Regulatory options – key benefits and limitations

This section analyses the key benefits and limitations of different regulatory options to implement a requirement for EVSE installers to report specified information to the DER Register, for stakeholder consideration and feedback.

A. Extend DER Register Information Guidelines under the NER

This approach would involve extending the DER Register to require DNSPs to collect EVSE standing data as required by the AEMO DER Register Information Guidelines (the Guidelines). This would require a review and amendment of the Guidelines, together with review and possible amendment to the NER (for instance rule 3.7E).

[39] Options D. and E. in Table 8.

The obligation to comply with the Guidelines would continue to rest with the customer, and the obligation to supply correct information will be completed, as usual, by the licensed electrician, who is required to undertake electrical work by electrical safety laws in each state and territory.

As with the current operation of the DER Register, the Guidelines would specify EVSE standing data to be collected. Under this approach, the DNSPs would allocate responsibility for the collection of EVSE standing data to the customer, via amendment to the customer connection agreement itself, or via its service and installation rules, or both.

This approach would require a number of underlying issues to be addressed, that impede the current operation of the DER Register. A description and analysis of these issues in provided at *Appendix B – Summary of DER Register processes*.

Table 9: Potential benefits and limitations of extending the DER Register Information Guidelines under the NER

Benefits	**Limitations**
• Simplicity and relative ease of implementation. • Would support rapid iterative development when required. • This approach leverages the existing framework, and will avoid fragmentation of effort in relation to the continuous improvement DER Register processes. • The DER Register was created to include additional technologies over time.	• Underlying issues relating to installer compliance, data integration and data access need to be addressed.

The critical path to extend the DER Register Information Guidelines under the NER is summarised below.

1. *A potential change to the NER*
   Amendments to the NER may be required in relation to the creation and maintenance of the DER Register and the Information Guidelines that support its operation. Further public consultation would be undertaken on potential changes to the rules if, following feedback on this paper, this option is pursued.

2. *Amendment of AEMO DER Information Guidelines (the Guidelines)*
   The Guidelines would need to be revised to include the collection of EVSE Standing Data, including the data specification and all relevant procedures. The details of those amendments would be subject to further consultation processes, in accordance with Rule 8.9 of the NER.

3. *IT systems will require development by AEMO and DNSPs*
   Implementation will require system infrastructure, to update and upgrade the existing IT systems to receive EVSE standing data. This will require project management resources for centralised national tasks as well as for each DNSP. Careful assessment of required resources for AEMO and for the DNSPs to implement the necessary system upgrades will be required to ensure efficient implementation.

4. *Electrician installer training and communication*
   A national training and communication strategy will be required, to communicate the new requirements to all electricians. The expansion of the installer cohort from those familiar with the DER Register (principally CEC accredited installers) to all electricians, will require careful planning and engagement through state electrical licensing bodies, industry peak bodies and unions.

5. *Development of a product database*
   To optimise data accuracy and minimise human error and effort in data entry, an EVSE product database will require development. This will minimise installer data entry to installation-specific data fields. There are similar databases currently in operation, or proposed for other CER devices (e.g. the CEC maintains a list of 'approved inverters' and the ESB is exploring a database for CSIP-Aus compliant products[40]). The EVSE database will require the development of a standard for EVSE model data, by reference to the EVSE standing data specification, and a data collection and verification model. An entity would need to be assigned to oversee the product listing/delisting process.

6. *DER technical standards governance development*
   As described in Appendix B, there are a number of issues that need to be resolved in order for this regulatory option to operate as an effective legal mandate, binding installers to enter EVSE standing data into the DER Register. These issues are currently being considered by the AEMC in its review of Review of CER technical standards. The principal issue is the ineffective chain of legal responsibility that is present in the current legal arrangements that are intended to require electricians to comply with technical requirements, imposed via the DNSP connection agreement with an energy customer.

B. State-based implementation

This would require agreement to be reached among state and territory governments, regarding the creation of a regulatory instrument under the jurisdictional electrical licensing scheme, to require EVSE standing data to be entered onto the DER Register, during EVSE installation.

Table 10: Potential benefits and limitations of State-based implementation

Benefits	**Limitations**
• The installer's obligation will exist as a regulatory requirement linked to the electrician's licence conditions, which would support compliance and enforcement processes. • Existing safety inspection processes could be leveraged as a reporting verification strategy.	• Support for national technical reporting arrangements does not align well with jurisdictional electrical licensing schemes which primarily exist to support safety objectives, and has limited precedents. • Consistency of compliance assurance and enforcement processes will be challenging to achieve. • It would fragment the reform effort relating to the DER Register and CER technical standards more broadly. • Difficult to rapidly iterate in response to technological and other developments.

The critical path for state-based implementation is summarised below.

1. *Secure a policy commitment from jurisdictions*
   To achieve national implementation, agreement from all states and territories to expand the remit of their state electrical licensing schemes will be required. This will involve state-by-by consideration of the case to move from an exclusive responsibility for safety regulation, to technical regulation. The scope of this policy change may include the acceptance by the jurisdictions of DER technical standards governance as a state and territory responsibility.

40 ESB Interoperability Directions Paper, October 2022

2. *Development of revised AEMO DER Register Information Guidelines*
   A common national instrument, in the form of a new EVSE standing data guideline (or revised DER Register information guidelines) will be required. This will include the data specification for EVSE standing data and all relevant procedures.

3. *IT systems will require development by AEMO*
   Implementation will require system infrastructure, to update and upgrade the existing IT systems to receive EVSE standing data. This will require project management resources for centralised national tasks. Careful assessment of required resources for AEMO will be required.

4. *Electrician installer training and communication*
   A national training and communication strategy will be required, to communicate the new requirements to all electricians. The expansion of the installer cohort from those familiar with the DER Register (principally CEC accredited installers) to all electricians, will require careful planning and engagement through state electrical licensing bodies, industry peak bodies and unions.

5. *Development of a product database*
   To optimise data accuracy and minimise human error and effort in data entry, an EVSE product database will require development. This will minimise installer data entry to installation-specific data fields. There are similar databases currently in operation or proposed for other CER devices. The EVSE database will require the development of a standard for EVSE model data, by reference to the EVSE standing data specification, and a data collection and verification model. An entity would need to be assigned to oversee the product listing/delisting process.

C. New national CER regulator (potentially within or external to the AER)

This would involve the creation of a new statutory regime in Commonwealth legislation, or under the NEL, to govern the accreditation of CER installers. The role of a new regulator could include oversight of the implementation of a range of technical standards and operational responsibilities for the assurance and enforcement activity needed to support compliance with technical standards. A new regulator with broad responsibility for oversight of CER has been suggested by a key industry body as an option to address underlying regulatory governance issues, in the context of regulatory reforms to support interoperability and the implementation and oversight of compliance with inverter standards.[41] The option of a national technical regulator has been contemplated in earlier reviews of governance of CER technical standards[42] and support for this major reform has been reflected in a range of recent stakeholder submissions.[43]

A CER regulator would establish the EVSE standing data reporting obligation, within the broad suite of installation responsibilities to be allocated to accredited installers of generating systems, and EVSE. Such an agency could potentially, in time, take over the board industry quality assurance role currently performed by the Commonwealth Clean Energy Regulator (although currently limited to solar PV and solar/heat water heater installations).

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[41] See, submission-consultation-paper-review-consumer-energy-resources-technical-standards.pdf (cleanenergycouncil.org.au), p 4.

[42] See ESB Governance of DER Technical Standards (srgexpert.com), pp 94-95.

[43] At the time of writing, the AEMC Review into CER Technical Standards had received a number of submissions calling for consideration of the creation of a new national technical regulatory of CER.

Table 11: Potential benefits and limitations of a new national CER regulator

Benefits	**Limitations**
• The installer's obligation would exist as a regulatory requirement linked to the electrician's accreditation to undertake prescribed installations, which would support disciplinary and enforcement processes. • Could consolidate national compliance assurance and enforcement activity to achieve a range of regulatory objectives in the current and future state of CER. • Could support rapid iterative development when required. • Could support broader information sharing and reporting functions for CER data beyond the current remit of national energy market bodies. • Increasing support from industry and government stakeholder groups.	• Potentially costly and complex to implement, including the development of a new regulatory regime and institutional capability (and funding). • State by state arrangements would need to be reviewed to clarify responsibilities and interactions in relation to electrician licensing.

The critical path to support the creation of a national CER Regulator is summarised below.

1. *Legislative reform*
   This will require a detailed policy development process, to assess the suitability of expanding the statutory remit of an existing regulatory bodies (such as the AER), the creation of a new body to perform a range of regulatory functions and oversee the development and maintenance of a new regulatory framework.

2. *Development of regulatory instruments*
   New regulatory instruments (regulations or other subordinate legislative instruments) will be required to establish the obligations upon electricians to supply EVSE standing data to the DER Register. This will include the data specification to govern the collection of EVSE standing data.

3. *IT systems will require development by AEMO*
   Implementation will require system infrastructure, to update and upgrade the existing IT systems to receive EVSE standing data. This will require project management resources for centralised national tasks. Careful assessment of required resources for AEMO will be required.

4. *Electrician installer training and communication*
   A national training and communication strategy will be required, to communicate the new requirements to all electricians. The expansion of the installer cohort from those familiar with the DER Register (principally CEC accredited installers) to all electricians, will require careful planning and engagement through state electrical licensing bodies, industry peak bodies and unions.

5. *Development of a product database*
   To optimise data accuracy and minimise human error and effort in data entry, an EVSE product database will require development. This will minimise installer data entry to installation-specific data fields. There are similar databases currently in operation, or proposed for other CER devices. The EVSE database will require the development of a standard for EVSE model data, by reference to the EVSE standing data specification, and a data collection and verification model. An entity would need to be assigned to oversee the product listing/delisting process.

5.5 Regulatory model evaluation framework

The ESB is seeking stakeholder views on a proposed framework for the assessment of options to achieve EVSE standing data collection within the DER Register. This framework is summarised in Figure 9 on page 42 and described below.

Two questions underpin this evaluation framework:[44]

- Part A – Is a statutory mandate for the collection of EVSE standing data justified based on best practice regulatory principles?
- Part B – What is the optimal regulatory model to implement the mandate (based on a series of regulatory model assessment criteria)?

Part A: Is a statutory mandate for the collection of EVSE standing data justified?

To determine whether a statutory mandate is justified, the following criteria have been identified:

A1. Has a case for action been established?
A2. Have a range of alternatives to regulation been considered?
A3. Is the form of regulatory action proportional to the intended outcomes from a cost-benefit and risk-management perspective?
A4. Will the form of regulation restrict competition?
A5. Has the policy intent of the form of regulatory action be made clear.[45]

Part B: What is the optimal regulatory model to implement the mandate?

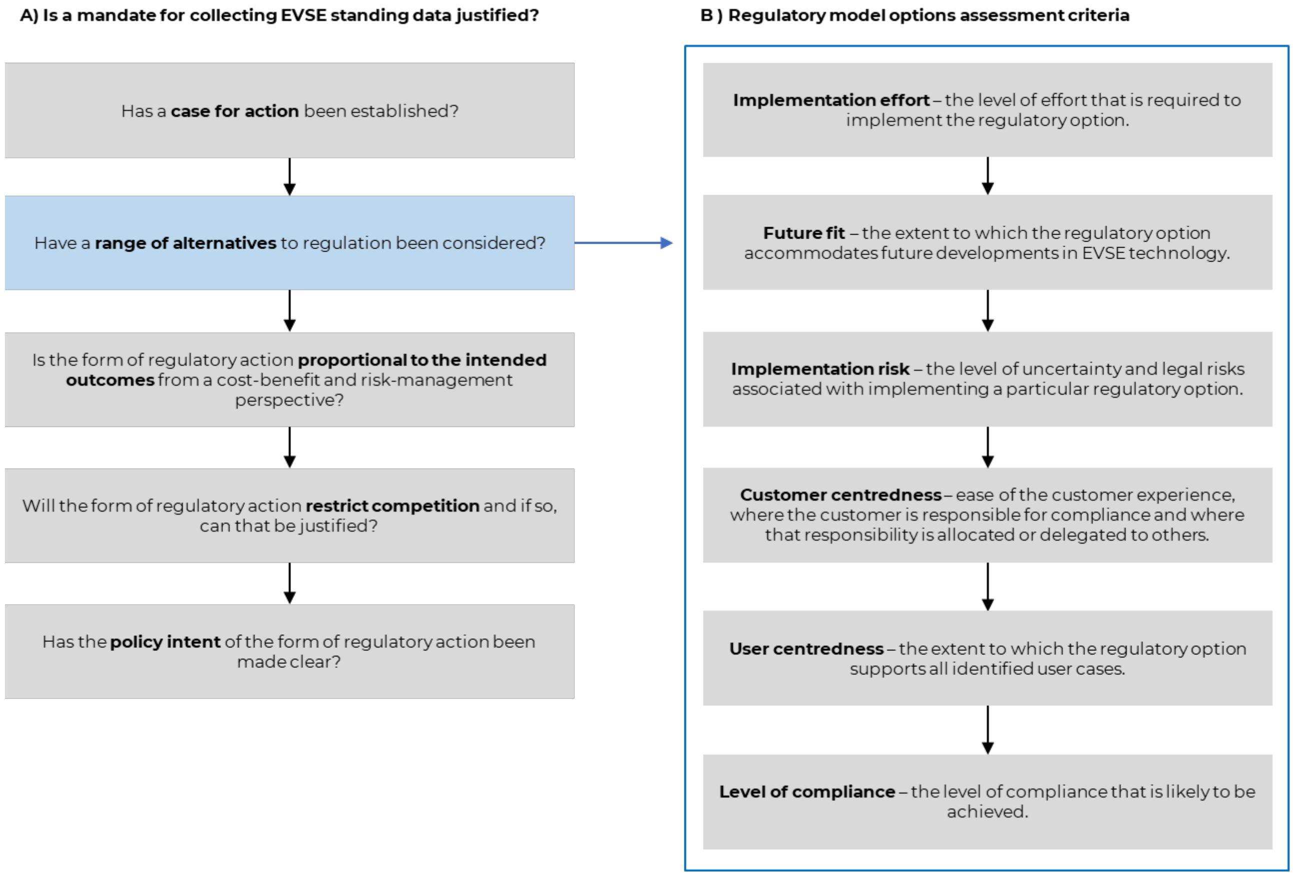
To assess which regulatory model is best suited to support the implementation and operation of the mandatory collection of EVSE standing data, the following criteria have been identified:

B1. What is the implementation effort associated with the regulatory model and what is the cost of implementation?
B2. To what extent will the regulatory model accommodate and respond to future developments in technology?
B3. What level of uncertainty and legal risks are associated with implementing the regulatory model?
B4. How customer-centred is the regulatory option, in terms of supporting a positive customer experience?
B5. How user-centred is the regulatory option, in terms of supporting identified use-cases?
B6. What is the level of compliance that is likely to be achieved?

[44] Note that in the event that a change to the NER was required, the AEMC would be required to consider the extent to which the rule change aligned with the NEO, provided in s 7 of the NEL. This requirement is expected to be satisfied under the evaluation framework proposed here.

[45] These are derived from Australian Government [principles for best practice regulation.]

Figure 9: Summary of the proposed regulatory model evaluation framework



Questions for Consultation

Consultation Question 10: Is it accepted that an expanded DER Register should be the database system for collection and sharing of EVSE standing data?

Consultation Question 11: What preferences or issues do stakeholders have regarding the described regulatory options? If a rule change is needed to achieve EVSE standing data collection, do you consider the rule change would be likely to have a significant effect on the national electricity market?[46]

Consultation Question 12: Is the proposed regulatory assessment framework fit for purpose?

[46] Feedback on this question may be considered by the AEMC in deciding whether an expedited rule determination process may be applied under section 96 of the National Electricity Law.

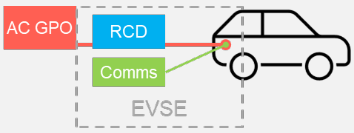
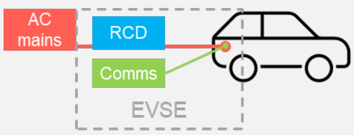
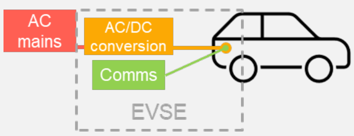
Appendix A - Summary of EVSE categories and interoperability standards

This section sets out the diversity of EVSE technologies and categories that are relevant to the consideration of the which EVSE technologies need to be captured to support the users of EVSE standing data. The parallel development of EV supply chains across different parts of the world has led to diversity in charging technologies and the way they are categorised.

A1. Summary of EVSE Modes

Internationally, the commonly typology for different categories of EVSE is found in the standard that defines the fundamental aspects of EV charging, including safety requirements: IEC 61851-1:2017 (IEC 61851).[47] IEC 61851 defines four modes of charging which are summarised in Table 12. These relate to power conversion and associated protection functions. The International Electrotechnical Commission (IEC) Mode definitions are useful when determining the scope of potential EVSE captured under future data collection frameworks.

Table 12: IEC EVSE Modes

Mode	Description
Mode 1 	In Mode 1, the EV connects directly to an AC mains (in Australia, this typically infers a standard 10 Amp general purpose outlet) without residual current detection (RCD) or over current protection. The lack of residual current detection has resulted Mode 1 charging is disallowed in the US, UK and a number of EU countries. There is no communication between the EV and the AC mains. While this sort of connection is not prohibited in Australia, it is considered very rare.
Mode 2 	In Mode 2, the EV connects to the AC mains. These are the typical residential EVSE that connect to a single phase, 10 Amp general purpose outlet drawing 7kW up to around 22kW with a 3 phase connection. Mode 2 EVSE requires a cable incorporating some form of signalling and residual current detection. The majority of EVs sold in Australia to date are equipped with a Mode 2 EVSE with some owners using them regularly. They typically incorporate an in-cable control box (ICCB), which effects standards-compliant signalling and fault detection (and may, optionally, incorporate external communications for a variety of purposes).
Mode 3 	In Mode 3, the EV connects through an EVSE that is hardwired to the AC mains, typically with dedicated circuit protection. Mode 3 EVSE are most frequently used in public EVSE applications. These are expected to account for the majority of vehicle loads in the future, with the potential to incorporate a software platform for Charging Station Management System (CSMS)[48] integration and V2G. Typical Limitations include EVSE maximum power ratings (typically 32A single or three phase, limited by an EV's on-board charger).
Mode 4 	In Mode 4, the EVSE converts the AC mains current to DC for use by the vehicle. Otherwise, Mode 4 EVSE typically provide for the same levels of control and interoperability as per Mode 3. Mode 3 & 4 EVSE are usually used in public EVSE and private commercial applications. They need to be built near special network infrastructure like a pad mounted transformer or a substation. Mode 4 are often able to operate at higher power levels as they are not dependent on the on-board power conversion, however (within limits of the EVSE) voltage and overall power levels are ultimately commanded by the EV on a dynamic basis.

[47] IEC 61851-1:2017 - Standards Australia

[48] CSMS operators in Australia include ChargeFox, Evie, JET Charge and Jolt

A2. Summary of EVSE Levels

In Australia, EVSE are *informally* classed as Level 1, 2 or 3 which are colloquially derived from the SAE J1772 standard that covers EVSE connector types.[49] These categories are not standardised, and definitions vary internationally. For the purposes of this paper, definitions can be summarised as follows:

- **Level 1** – Utilises a standard 10- or 15-Amp wall plug. This is broadly equivalent to IEC 68151-1 Mode 2, save that Level 1 connections are limited to single-phase AC mains,
- **Level 2** - Is a fixed-wired connection to an AC mains supply. This is broadly equivalent to J1772 AC Level 2 or IEC 68151-1 Mode 3.
- **Level 3** - Is a fixed-wired connection to an AC mains supply and supplies DC directly to the vehicle battery. This broadly aligns with J1772 DC Levels 1 and 2 or IEC 68151-1 Mode 4.

In July 2022, Australia had just over 3669 individual public chargers in service, including 356 that are DC Level 3/Mode 4.[50]

Different charger types have different functionalities such as AC (Modes 1-3, Level 1-3) or DC (Mode 4, Level 3) as well as power transfer limits and communications capabilities:

- **J1772 (also known as 'Type 1')** chargers are common in the United States, Japan and Korea. The standard includes a Combined Charging System (CCS) for AC/DC charging. The current standard supports single-phase AC charging up to 19.2kW. A number of earlier EVs and PHEVs sold in Australia also utilise the J1772 connector.
- **Mennekes (also known as VDE-AR-E 2623-2-2 or 'Type 2')** connectors are originally a European standard, intended to support single and three-phase AC charging, and DC charging up to 70kW through the same connector.
- **Combined Charging System (CCS)** adds two separate high-current DC contacts to a range of existing connectors including Type 1 and 2. The Australian market is converging around Type 2 CCS. CCS was formally mandated within the EU as the region's high-power DC charging system in 2013. Whilst higher power levels may be possible in future, CCS is presently practically limited to 350kW noting that this would only be achieve in a commercial or public charging context. CCS is implemented with common communication protocols.
- **GB/T** is the charging standard for electric vehicle in China. While physically and functionally similar to the Type 2 connector, the connectors are not compatible as GB/T has male pins on the plug, not the socket, and unique communication protocols are employed.
- **CHAdeMO** defines a system including the connector, unique latching and communication separate from those used by the CCS system, with which it competes. CHAdeMO was the first standard to offer high-power DC connections. CHAdeMO 2.0 became the first standard to offer bidirectional DC capabilities. It is mandated in Japan. The State Grid Corporation of China and the CHAdeMO Association have collaborated to develop the third version of the CHAdeMO standard implementing a new "ChaoJi" connector, which will supersede the GB/T connector and support maximum power levels of 900kW (1.8MW with additional DC contacts).
- **Tesla –** Commencing with the Model S, Tesla developed a proprietary connector and communications specification for its own vehicles sold in North America (with limited use in other markets). The connector supports single-phase AC and DC charging. Tesla vehicles sold outside of US markets typically use connector types legislated for those markets, or otherwise representative of local market directions (e.g., GB/T in China and Type 2 CCS sockets in Europe and Australia).

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[49] J1772_201710: SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler - SAE International

[50] Electric Vehicle Council, *State of Electric Vehicles,* October 2022, p. 7.

- **The Megawatt Charging System (MCS)** is a development of CCS intended for commercial vehicles. Using the same underlying standards for general requirements and communications, MCS utilises a new connector supporting six times the maximum current of CCS at higher voltage (1250V DC nominal) for a total maximum power of 3.75MW per connection. It is scheduled for deployment in market in 2025.

Table 13: EVSE charger connection types used in Australia

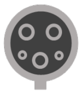
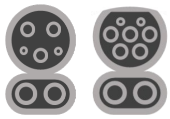
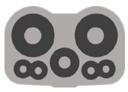
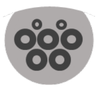
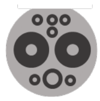
Connector	J1772 (Type 1)	"Mennekes" (Type 2)	CCS2 (Types 1 and 2)	CHAdeMO 2.0	MCS
Connector shape					
AC modes supported (Max kW)	19.2kW 1-phase	40kW 1-phase 54.5kW 3-phase	As per derivative connector	Not supported	Not supported
DC modes supported (Max kW)	Not supported	40kW DC-low 70kW DC-mid	350kW	400kW	3.75MW
Origins	North America	Europe	Europe	Japan	Europe
Use in Australia	Early EVs and PHEVs	Common	Type 2 CCS2 common	Declining, limited currently to two Japanese models	Likely future use in commercial vehicles

Table 14: EVSE charger connection types not used in Australia

Connector	CHAdeMO 3.0 "ChaoJi"	GB/T 20234.2 "GB/T AC"	20234.3 "GB/T DC"	Tesla proprietary
Connector shape				
AC modes supported (Max kW)	Not supported	27.7kW 1-phase (3-phase supported but not implemented)	Not supported	22kW 1-phase
DC modes supported (Max kW)	Standard 900kW Extended 1.8MW	Not supported	250kW	250kW
Origins	Japan, China	China	China	North America
Use in Australia	Not anticipated	Not used	Not used	Not used

A3. Summary of the EVSE communications standards

Managing charging of EVs requires communications to an EV, which may be achieved through the EVSE, directly to the EV (e.g., via telematics) or both. Where modern, interoperable approaches are implemented, any data used to manage EV charging may be made available through the EVSE. This is relevant to EVSE standing data collection in that an EVSE's communications capabilities are a standing data point. In addition, EVSE communications frameworks provide a means to transfer some standing data points to a remote data repository (such as EVSE settings). Where EVSE communication frameworks are open and interoperable, as is mostly the case, this allows for automated data capture reducing the risks of incomplete or inaccurate data collection. The introduction of 15118 into the market is likely to support a rapid development of new features in vehicle charging applications.

Figure 10 summarises the major communications standards and protocols. In this illustration, the CSMS could be sending control signals to the EVSE for market participation purposes, including incorporating physical constraints sent by a distribution system operator (via IEEE 2030.5, in Australia using CSIP/Aus). Other markets (e.g. South Korea) use OpenADR in place of IEEE 2030.5. Alternately, a gateway device could mediate DSO communications. This diagram does not describe financial relationships.

Figure 10: Stylised example of interoperability standards/protocols in EV managed charging. In reality, different deployments can have alternative configurations for example, including or excluding IEEE 2030.5, CSMS, or gateway communication/control.

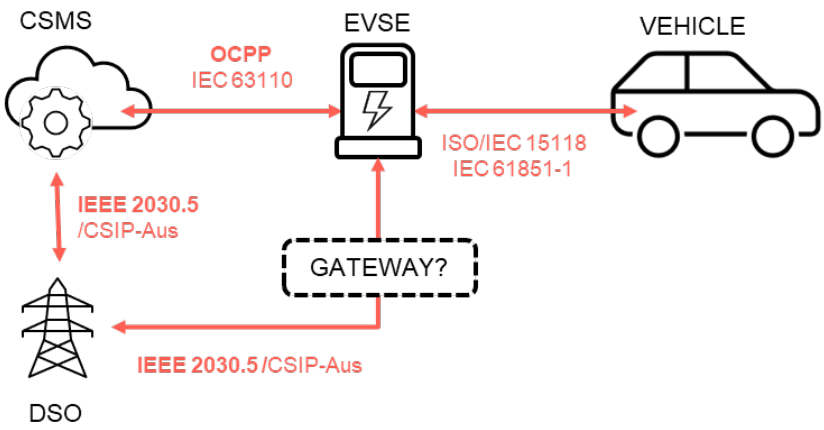


Table 15: Summary of key EVSE communications protocols

EV – EVSE communication	EVSE – CSMS	Utility communication
• **IEC 61851-1** provides for simple signalling between EV and EVSE, and is a long-established standard by which the safety, power level and other parameters of a charging session are established. • **ISO/IEC 15118** is an international standard for bi-directional digital communications between electric vehicles and the charging station. The ISO 15118 client sits in the vehicle itself and it is a key enabler of the plug & charge and	• **OCPP** is the predominant communications protocol between EVSEs and CPMS. While it is not itself a standard, it is being adopted as a mandatory requirement in the UK and potentially California. More recent versions of OCPP include contemporary security and energy management and cost recovery features. The latest production version of OCPP (version 2.0.1) can, where an EV is also capable, communicate EV	• **IEEE 2030.5** - CSIP-Aus is an Australian adaptation to the Common Smart Inverter Profile (CSIP) IEEE 2030.5 Implementation Guide for Smart Inverters, which provides capability to deliver Flexible Export Limits (as well as Dynamic Operating Envelopes). In the future, Australia implementations of IEEE 2030.5 may be extended to include customer-trader communications, where a 'trader' is a party registered with AEMO

V2G capability.[51] This process is enabled by a digital certificate in the vehicle, allowing it to communicate with the charging point management system (CPMS). The latest version of ISO 15118's network and application protocol requirements are only recently published.	state of charge, departure requirements and a range of other data required to accurately compute and communicate the impact of grid-connected electric vehicles. • **IEC 63110** is an 'in-development' standards-based approach that broadly replicates the functionality of OCPP.	to participate in energy or ancillary services markets.

A4. Overall standards development outlook for EVSE in Australia

Interoperability standards

In future, there will be the potential to collect EVSE data via interoperable smart chargers, and interoperable EVs. The implementation of standards to govern the communication protocols of interoperable devices is being considered by related work that is underway.[52] This section provides an update of that work in progress, up to the time of writing.

The ESB's smart charging consultation paper[53] explored options to promote charging of EVs that minimises their cost and power system impacts. This included consideration of equipment and interoperability standards. Stakeholders expressed support for mandating an EVSE management framework capability such as OCPP 1.6, while noting that OCPP 2.0.1 has more advanced features for smart energy system integration and is not backward compatible. Stakeholders also expressed a general view that basic provisions to ensure visibility and traceability of charge event energy consumption and network impact visibility should be met.

Smart charging infrastructure, depending on the application protocols supported, is often able to communicate significant data around the performance capabilities of charging infrastructure and the status of the charging station (including fault status). These capabilities can be remotely upgradeable.

In future, where both charging infrastructure and EV capabilities allow, it will be possible to communicate, through the EVSE, a range of vehicle data including vehicle state-of-charge, vehicle identification and charging preferences (e.g. times to charge, preferred departure times, etc). Some of this data may be user contributed either through vehicle interfaces, vehicle manufacturer apps or both. This data can be useful to network operators and market participants in forecasting and optimising network states and charging behaviour.

EV to EVSE communications is underpinned by IEC 61851-1. Building on the historical methods in 61851-1, ISO 15118-20 (recently finalised) allows richer communications between EV and EVSE supporting modern cybersecurity frameworks, bidirectional power, certificate-based cost recovery and a range of other functions. Standardisation is currently evolving rapidly with standards undergoing rapid parallel development, both maturing and converging, supported by jurisdictional regulatory requirements. For example, California has determined to adopt regulatory changes requiring all EVSEs to be "15118 ready" by Q3 2023[54], and the Megawatt Charging System, the commercial-vehicle-intended higher-power implementation of CCS, will utilise ISO 15118-20.

[51] Plug and Charge (initially introduced in ISO/IEC 15118), is an international standard for charging EVs. When owners connect their vehicle to the charge point (via cable for AC and DC charging vehicles or Wi-Fi for wireless charging) it automatically registers and transacts information for billing purposes (i.e. no credit cards are required).

[52] See Section 1.2 above.

[53] ESB, *Electric Vehicle Smart Charging Issues Paper*, July 2022.

[54] https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M496/K405/496405751.PDF

The OCPP framework – managing communications between EVSE and CSMS – has been developed independently of IEC and ISO standards. The present latest OCPP release (2.0.1) does not natively realise the full capability of ISO 15118-20; this will be addressed in version 2.1 (due in 2023).

Stakeholders have also voiced support for the adoption of IEEE 2030.5 to facilitate communication between DNSPs and EVSE, utilising CSIP-Aus for the issuance of Dynamic Operating Envelopes. The ESB is currently consulting on a national mandate of CSIP-Aus for all new embedded generator installations (including EV V2G installations). Local vendors have offered various solutions on ways to integrate 2030.5 signalling into EVSE operation, from local energy management gates to cloud-to-cloud integrations between DSO and CSMS – to date, these developments are broadly replicating directions explored in stationary battery DER management.

Whilst the prevailing view is that V2H and V2G technology is still some years away from commercial viability in Australia, there is nonetheless strong support for clarification of the appropriate standards for their installation and connection to DSNP networks. While some stakeholders highlighted AS4777.2 as the appropriate standard for small-scale inverter-based grid connections in Australia, there remains some salient, open questions around potential international alignment of such standards in future, and of how such standards can be adapted in ways that better enable V2H/V2G adoption.

Physical connections

Charging connectors in Australia are aligning behind Type 2 CCS due to market forces (in lieu of a standard or policy direction). Early EVs and PHEVs sold in Australia used the J1772 connector for AC charging, which is being superseded by the Type 2 connector. This is due to its ability to support three-phase AC charging aligned with Australia's three-phase mains supply. This has led, in turn, to market uptake of Type 2 CCS as a preferred DC charging solution, integrating best-suited AC and suitable DC into the same connector - whether charging via a Type 2 connection (as is typical with low-power EVSEs) or a CCS2 connection for high-power DC charging. Vehicle-side connections in locally-sold EVs are increasingly streamlined to a single CCS2 socket for all AC and DC charging. This direction is consistent with global forces in most major EV markets (excluding China and Japan). Some CHAdeMO vehicles are still sold in Australia though these constitute a minority of new EVs.

All levels of government in Australia are committed to building Level 3 highway and destination infrastructure.

Appendix B – Summary of DER Register processes

B1. AEMO DER Register framework and operation

The DER Register (DER Register) was created by an AEMC rule change in September 2018, "*to establish a register of distributed energy resources in the national electricity market, including small scale battery storage systems and rooftop solar*".[55]

AEMO worked with stakeholders across the electricity sector to design the DER Register, the data sets and data collections processes to establish the Register. It was launched by AEMO on 1 March 2020. The DER Register stores information about any new *small generating unit*, installed on-site at any residential or business location in Australia.

Information is entered into the DER Register under slightly different arrangements in each state. This has allowed DER Register data collection processes to be adapted to local DNSP systems and requirements. Essentially, the responsibility for data entry, while formally assigned to the network, is shared between the DNSP and the electrical contractor responsible for the installation. In NSW, for instance, the DNSP does not enter any 'as installed' data into the DER register and requires the installer to enter this data directly. This contrasts with other jurisdictions where DNSPs collate and report all data to the DER Register

The requirement for installers to report DER Register data is established under each DNSP's service and installation rules. The information required to be entered into the DER Register includes standing data for specified CER devices, connected to the electricity network. These reporting requirements are set out in the DER Register Information Guidelines, which were published by AEMO in May 2019.[56]

The rule change that implemented the DER Register in the NER requires:

- AEMO to establish, maintain and update a DER Register (r 3.7E(b)).
- DNSPs to provide to AEMO, DER generation information in relation to connection points on their network, in accordance with the DER Register Information Guidelines (r 3.7E(d)).
- AEMO to develop, maintain and publish guidelines that specify: details of the information that NSPs must provide; how information in the DER Register is stored by AEMO; and how AEMO will provide access to NSPs to that data (r 3.7E(g)).

The DER Register draws on available datasets to streamline data provision from existing product data lists (solar panels, inverters, and batteries) made available by the Clean Energy Council.

Figure 11 shows the various sources of data that constitute the inputs into the DER Register, and a summary of the users and desired outcomes of the DER Register.

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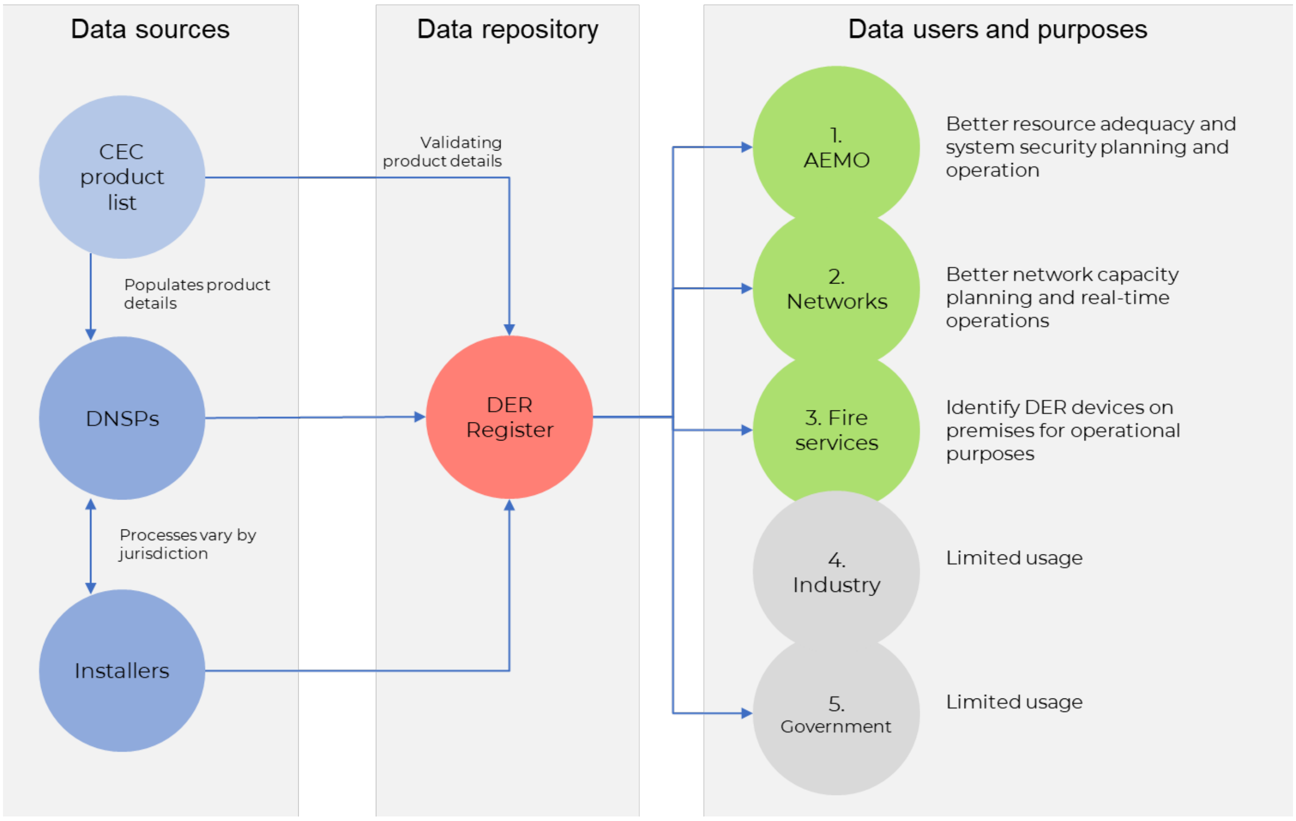
[55] Register of distributed energy resources | AEMC

[56] AEMO, *DER Register Information Guidelines*, 31 May 2019.

Figure 11: High level summary of DER Register data sources and users



B2. Enforcement of the DER Register

This section provides an overview of the compliance and enforcement processes and limitations in the current regulatory framework that supports the DER Register, which are relevant in ensuring effective collection of EVSE standing data.[57] The matters covered below are closely related to broader challenges relating to the governance of CER technical standards, which are within the scope of the AEMC *Review into CER Technical Standards*.[58]

The AER has a range of powers to enforce a DNSP's obligations under the NER[59] to enter information in the DER Register. These include: accepting voluntary or court enforceable undertakings, and issuing legal proceedings to compel performance.

DNSPs rely on installers to provide accurate DER Register data, under each DNSPs service and installation rules. The service and installation rules provide a DNSP with the basis to refuse a connection to the customer, due to non-conformance with its rules, however, this is considered a relatively and disproportionately severe sanction relative to any individual instance of incomplete or incorrect data being reported. DNSPs have reported instances where connections have been 'delayed'.

57 See Section B5 for an overview of data completeness and accuracy issues in the current operation of the DER Register.

58 [Review into consumer energy resources technical standards | AEMC]

59 under Rule 3.7E of the NER.

Stakeholders have confirmed that the AER powers have not been used against a DNSP in relation to DER Register non-compliance. Instead, AEMO has taken a "support to comply" approach, working closely with DNSPs to improve data quality and completeness. However, AEMO (with AER support) has noted the potential for enforcement action to be undertaken, which is considered to have contributed to improved outcomes. In this way, it can be seen that the existence of an express legal obligation can create an effective basis for generating compliance by significant commercial entities.

The AEMC, in making the rule change to implement the DER Register in 2018 acknowledged that the AER's enforcement powers are more suitable for significant breaches, rather than for addressing individual instances of non-compliance with the NER that have limited impact.[60] AEMO's potential enforcement role with respect to DER installers was also considered.[61]

The AEMC concluded that "*a high level of compliance is likely to be difficult to achieve*",[62] but that establishing the DER Register in the NER would provide, "*a basis for other entities (such as jurisdictional regulators, as well as industry bodies) to require or encourage submission of the appropriate data to NSPs by installers on behalf of customers*". Anecdotally, there has been little or no activity by jurisdictional regulators or industry bodies to support compliance with the DER Register, due primarily to the focus of jurisdictional regulators on their primary functions of safety regulation.

In summary, the difficulties in enforcing DER Register requirements relate to the following limiting aspects of the regulatory framework:

1) **Enforcement powers of the AER are more suited to address systematic non-compliance.** The DNSP has the legal obligation to comply under the NER, and the AER enforcement powers and techniques are not well adapted to a high-volume compliance and enforcement practice. The AER's powers are more suited to address large scale, systematic malfeasance, rather than individual examples of non-compliance which have little impact.

2) **The DNSP's obligation is formally allocated to the energy customer.** This is achieved via the connection agreement (with an energy customer) and the service and installation rules. This means that the primary remedy for non-compliance lies against the customer in the form of the extreme sanction of refusing or, delaying the commencement of or suspending a network connection. It most cases, the customer is not aware of DNSP technical requirements, or is not in a position to ensure they are met.

3) **The installer is engaged by the customer and has no legal relationship with the DNSP.** This means that the DNSP has no legal mechanism to compel compliance by the installer. The installer has a contractual obligation to the customer to meet all installation requirements and ensure the system is functioning, but no independent legal duty to supply correct CER information to AEMO.

4) **In any individual case, non-compliance with a data provision requirement is insufficient in scope, to justify the transaction costs** and potential reputational harm to a DNSP, arising from the extreme available remedy of a delayed connection.

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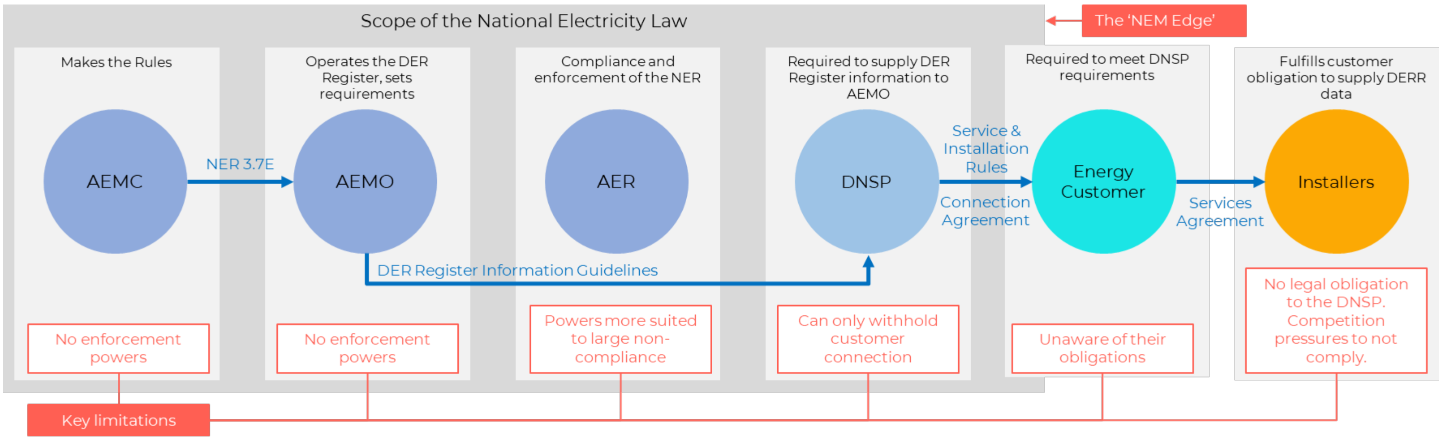
[60] AEMO's role in the accreditation of metering parties (Metering Coordinators, Metering Data Providers and Metering Providers) was not considered to be suited for modification to include compliance of DER installers – see AEMC, *Rule Determination – Register of Distributed Energy Resources*, 13 September 2018, p. 53.

[61] Ibid.

[62] Ibid, p. 54.

5) **Existing system inspection arrangements are insufficient** to be able to rely on a pre-commissioning inspection, or a sufficient sample of inspections, to identify incorrect DER Register information, even if the DNSP was motivated to do so.

Figure 12: Overview of the functions, powers and responsibilities of all parties (and non-parties) in the regulatory framework that supports the DER Register.



B3. The role of electricians/installers

The requirement to engage electrician installers of CER devices is embedded in jurisdictional electrical safety requirements which require licenced electricians to undertake electrical work. Licenced electricians are generally entitled to install CER devices across all jurisdictions. However additional industry-based accreditation is required by a number of funding programs in Australia, including under the SRES, which captures a large proportion of small generating units in Australia.

Recognition of the more specialised skills required for installation of renewable energy technologies began in the late 1980's and led to the development of industry-led renewable energy system training that commenced in the early 90's. An industry-led, voluntary scheme for accreditation of installers of renewable energy systems has been maintained since that time.

The present-day iteration is the CEC's Installer Accreditation Program. This program accredits electrician installers to different levels of accreditation for different categories of renewable energy installation and design work. Accreditation requires the completion of initial training modules (provided by TAFE and other tertiary education institutions) and a practical assessment exercise. To maintain accreditation, installers must comply with CEC requirements. CEC requirements include the legal obligations in all jurisdictions, insurance obligations, compliance with the CEC Code of Conduct and annual continuing professional development requirements. The accreditation program includes compliance procedures where evidence of non-compliance with requirements is supplied to the CEC. The program is funded from the accreditation fees that total $715 and an annual renewal fee of $240. Of the 186,200[63] electricians currently employed in Australia, less than 5% (around 8500[64]) are accredited under the CEC installer accreditation program.

The CEC installer accreditation program is mandated by the SRES and a range of state-based renewable energy funding schemes and private renewable energy funding services.

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[63] See the current Labour Market Insights data provided by the National Skills Commission

[64] Installers | Clean Energy Council

Table 16: Overview of compliance requirements imposed on electricians.[65]

Regulatory Framework	**Mandatory qualifications**	**Continuing professional development**	**Site attendance requirements**[66]	**Installation certification**	**Pre-commissioning inspection**	**Supply DER Register data**	**Supply SRES data**	**Post-commissioning inspection**	**Disciplinary procedures for non-compliance**	**Rectification obligation**	**Insurance obligation**
Electrical safety (varies by jurisdiction)	✓	✗	✓	✓	✓	✗	✗	✗	✓	✗	✗
SRES (CEC accreditation program)	✓	✓	✓	✗	✓	✗	✓	✗	✓	✓	✓
NEM technical standards (via the DNSP connection agreement and service and installation rules)	✗	✗	✗	✗	Varies	✓	✗	✗	✗	✗	✗

B4. DER Register and the WEM

The DER Register has been implemented in the WEM, with procedures that are similar to the NEM that commenced operation on 1 July 2020. This falls under AEMO's function of developing WEM procedures under Rule 2.1A.2(h) of the WEM Rules. Requirements are set out in the DER Register Information Procedure (WEM).[67] More relevantly, under its EV Action Plan,[68] the Government of Western Australia has indicated an expectation that the DER Register system and processes will be extended to incorporate relevant EVSE data from December 2022. As at the time of writing, the DER Register has not been implemented in the Northern Territory's regulated electricity networks.

B5. Current issues in the operation of the DER Register

Figure 13 sets out indicative DER Register data entry arrangements (although these vary substantially by jurisdiction) with each DNSP implementing systems and processes that align with local business processes.

Stakeholder consultation has identified various issues that impede the efficient functioning of DER Register processes. These issues would need to be addressed, for the DER Register to fully support the requirements of users of EVSE standing data. These issues relate primarily to data, completeness and accuracy, and data integration and data sharing.

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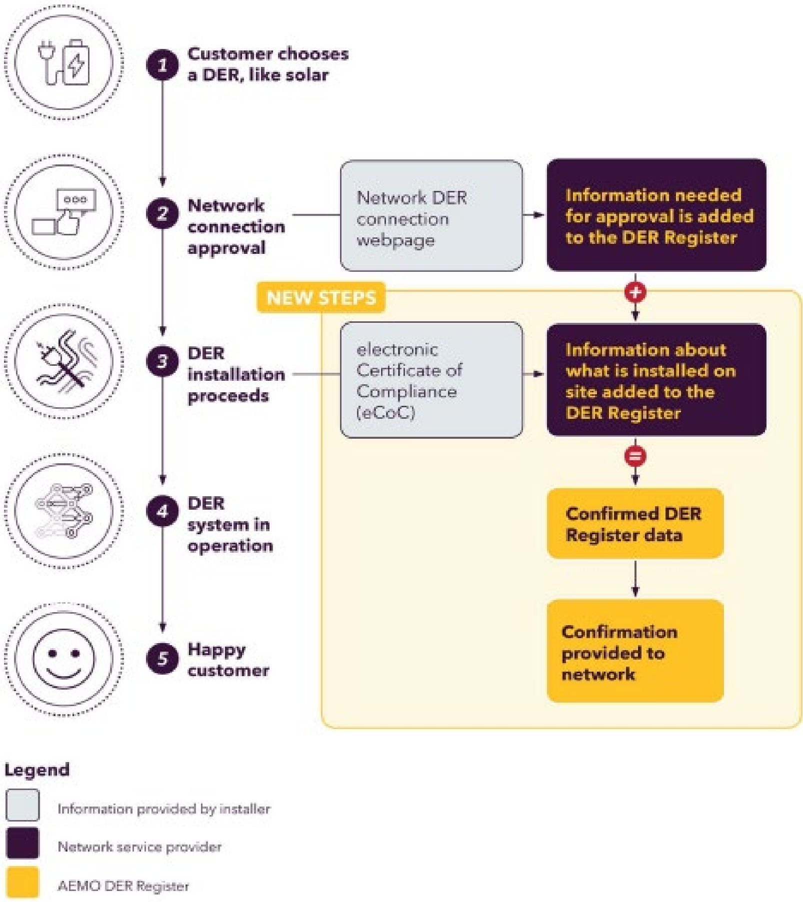
[65] This table does not include the considerable list of technical standards that apply to CER installations.

[66] Including requirements to supervise apprentices, and SRES/CEC requirements for supervising installers to provide evidence of attendance at the installation site.

[67] AEMO, DER Register Information Procedure (WEM), 1 July 2020.

[68] Government of Western Australia, Electric Vehicle Action Plan, August 2021, p. 27

Figure 13: Indicative DER Register data entry arrangements (processes vary by jurisdiction)[69]



Data accuracy and completeness

Data completeness and accuracy problems are common issues with many data management systems.

The DER Register involves a data entry responsibility that is shared between DNSPs, system installers, AEMO and the CEC. Each party is responsible for different aspects to maximise data accuracy. See Figure 13 and *DER Register Information Collection Framework* for an overview of the data collection points and responsibilities.

Issues concerning data accuracy relate to a range influencing factors, including:

- the complexity and number of data fields that are required to be completed by electrician installers of CER
- problems with survey design in the DER Register user interface that may generate contradictory user responses (specific to NSW)
- insufficient training and support for electrician installers

[69] AEMO, DER Register: Information for Installers in Victoria and Tasmania, 2019, p. 2, https://aemo.com.au/-/media/files/electricity/nem/der/2019/der-register-implementation/aemo-der-register-factsheet-for-installers_use-case-2-vic-tas.pdf?la=en

- insufficient incentives for accurate completion
- no apparent compliance assurance/enforcement activity
- ignorance, or non-acceptance of a public duty to enter accurate information by some electrician installers.

AEMO continues to work in close cooperation with DNSPs to address data gaps and errors in a 'support to comply' mode. This work includes:

- implementing strategies to identify missing records, from generating connection points including using NMI records and analysis of data from the Clean Energy Regulator.[70]
- improving data validation processes
- raising awareness within DNSPs of the benefits and uses of accurate DNSP data to increase support.
- resolving options for improved data.

A number of these issues are associated with limitations in the underlying regulatory framework[71] that supports the implementation and enforcement of DER technical standards. These issues are currently the subject the AEMC's Review into consumer energy resources technical standards.[72]

Data integration

The operation of the DER Register relies on effective data integration across a variety of data sources operated by the Clean Energy Council, and many DNSPs. There are issues concerning the integration of data from systems operated externally to the DER Register, that verify or provide data into DNSP systems that interact with the DER Register. A review of data integration issues will be required in advance of collaborative effort between the AEMO, DNSPs and other data providers.

The root causes of the identified data integration problems appear to relate to:

- some inflexibility of external systems, that impacts on the practicality of data mapping across systems
- high costs being borne by some DNSPs when DER Register data fields are modified
- inflexibility of some DNSP systems that verify large volumes of data from external sources.

DER Register information sharing and public reporting

The NER requires AEMO to report on aggregated DER Register information.[73] AEMO provides a dashboard by which third parties can view and download summary data from the current DER Register. These data sets are provided to the postcode level and are updated quarterly.[74]

AEMO must also provide relevant networks with disaggregated data regarding locational and technical characteristics of devices on their network, subject to privacy laws and protected information provisions in the NEL.

NER rule 3.7E(q) requires that AEMO may provide information requested by an emergency services agency, for the purpose of the agency's response to an emergency or for planning in relation to emergency response. South Australia, New South Wales and Tasmania have entered into legal agreements that enable deal primarily with privacy compliance arrangements needed to support data being used by fire management authorities in operational emergencies.

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70 See Section 5.2 above.

71 See Section B2 above.

72 https://www.aemc.gov.au/market-reviews-advice/review-consumer-energy-resources-technical-standards

73 In accordance with the DER Register Information Guidelines, clause 7.

74 AEMO | DER Register data

Generally, state authorities require data to be supplied by AEMO via a regular CSV file, rather than an API. These arrangements are progressing to completion quickly and should be in place for all jurisdictions soon.

B6. EVSE standing data privacy and protections

The collection, storage and use of EVSE standing data will be subject to jurisdictional privacy and data protection laws, which protect individuals and businesses from data breaches and breaches of privacy and confidentiality. In particular, these laws apply to personal information that may be capable of identifying an individual. The consent of individuals is required, prior to it being disclosed. Concerns about data sharing in ways that could bring the potential for exploitation for commercial benefit, have also been raised.

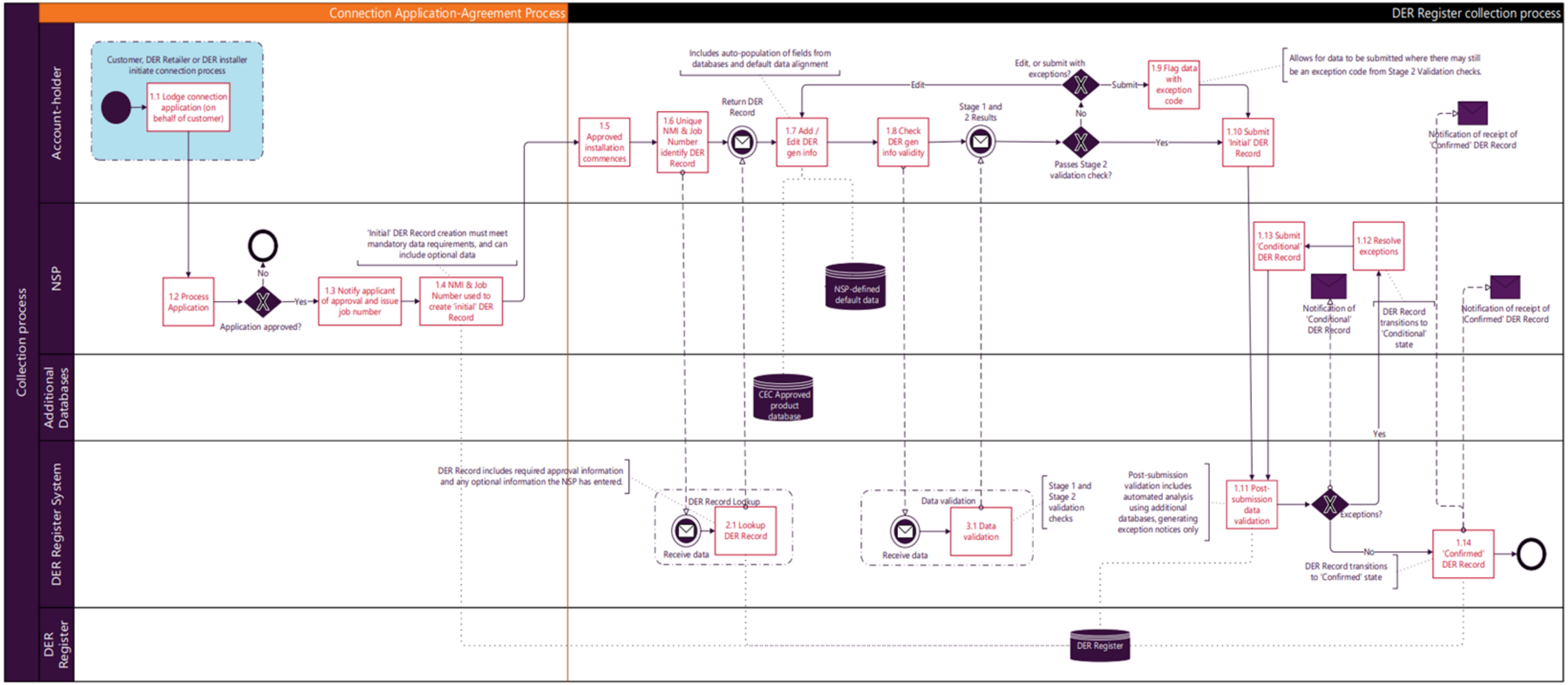
These issues are addressed in the current operation of the DER Register, which includes a data sharing framework. This framework requires AEMO to share disaggregated data regarding the locational and technical characteristics of devices in the DER Register with network business and in relation to their network areas (including data that was not reported through their connection processes or contracts), subject to privacy laws and protected information provisions in the *National Electricity Law*.

However, the legal environment related to privacy and data protection is dynamic. The ESB Data Strategy has identified that economy-wide digitisation is a source of innovation and new opportunities, supporting not only new technologies and data science, but also more active and savvy consumers, capable of assessing choices that may impact on data protection and privacy. Expectations that government will use data more effectively have led to recent reforms such as the *Data Availability and Transparency Act 2022*, which commenced operation on 1 April 2022. This Act establishes the DATA Scheme under which Commonwealth bodies are authorised to share their public sector data with Accredited Users. The presence of this scheme may support further development of the DER Register, to support enhanced access arrangements in future.

Further consideration of how the evolving privacy and data protection laws will impact on EVSE standing data collection and disclosure will occur during the design of any new reporting requirements.

B7. DER Register Information Collection Framework[75]

The following process diagram reflects the final information collection framework, as reflected in this document. AEMO will also provide the capability for NSPs to comply with the information collection framework via API.



[75] AEMO, *DER Register Information Guidelines – Final Report and Determination*, May 2019, p.77.

Appendix C - Jurisdictional and International policies on EVSEs and EVSE data collection

C1. Jurisdictional policies on EVSE and EVSE data collection

EV uptake in Australia is being driven by market forces combined with government subsidies, primarily for public EV charging infrastructure. While such programs provide a mechanism to require the provision of EVSE standing data, South Australia is the only jurisdiction that is collecting data on EVSE being installed. This is in relation to all EVSE that are over 20A single phase, or 25A three phase.

Table 17: Summary of Australian jurisdictional EV and EVSE policies and programs

Jurisdiction	Current (or recently closed) EV Charger Incentive Programs	Network Tariff/ Load control requirement	Systematic EVSE standing data collection
National (ARENA)	$24.55 million awarded in 2021 under the Future Fuels Fund (Round 1) to support the roll-out of 403 public electric vehicle fast charging stations nationwide. In 2021, the Fund was increased to nearly $250 million.	None	Some internal data collection and ARENA and ARENA has Knowledge Sharing requirements for grant recipients.
NSW	$171M to incentivise private EV charger infrastructure	None identified	None identified.
QLD	$10M to incentivise EV charging infrastructure	EVSE over 20A must be on a controlled circuit and must be on a load control tariff.	A voluntary EV registration scheme. No identified EVSE standing data collection.
VIC	$1.5M to incentivise EV charging for Council fleets $1.5M to incentivise charging for business fleets $5M to incentivise public fast EV charging infrastructure	All new EV owners to be assigned to cost-reflective tariffs to encourage business and individuals to shift energy use to off peak times and reduce network constraints.	None identified.
SA	$3.2M Smart charger grants program $12.35M grant to RAA to create EV charging network	None identified	SAPN is capturing EVSE data from 1 July 2022, for Level 2 chargers >20A through DNSP service and installation rules. Level 1 reporting is optional.
TAS	$250,000 to incentivise public DC EV chargers	None identified	None identified.
WA	$21M to incentivise EV charging infrastructure	None identified	None identified.
NT	$1000 or $2500 grants for EV charger installation at residential and business premises	None identified	None identified.
ACT	$1.4M to incentivise public EV charging network		None identified.

C2. International frameworks for data collection

Research undertaken for this paper has been unable to identify any other regions undertaking comprehensive national collection of EVSE standing data.

The challenges and opportunities of the evaluated regions differ significantly from Australia, in relation to the significance of CER uptake (solar and batteries) and associated integration issues here. Most other regions use alternate, indirect methods of generating standing data able to inform EVSE uptake, fleet size and relevant characteristics.

Some regions have adopted smart charging and interoperability standards (particularly OCPP and ISO 15118)) as means of reducing grid impacts and supporting consumer product innovation and protections.

United Kingdom

The UK requires EVSE installers to report the brand, model and firmware (but not location of sale) to a register which indirectly reports the capability of devices in the fleet. The UK has recently committed to a smart EVSE fleet complete with cybersecurity requirements for which solutions (and firmware) are evolving. A whole-of-site demand impact is taken with respect to the effect of EVSE installation: the Distribution Network Operator (DNO) needs to be informed via email within one month of installation if the maximum demand of a customer installation (EVSE inclusive) exceeds 13.8kVA.[76]

California

California (CA) has a requirement that EV Service Providers report EVSE data to the California Air Research Board (CARB), including volume of EVSEs installed yearly. Their impact is reported to the National Research Energy Laboratory (NREL) and Alternative Fuels Data Center (AFDC) monthly. This applies to public infrastructure only at Level 2 or greater. California has recently committed to enabling submetering capabilities inherent in smart EVSEs to be used for energy billing, allowing the creating of tariff products suited specifically to EV charging, in all market segments[77]

Norway

Norway is commonly regarded as a leading country for EV uptake however the challenges in building and supplying an EVSE fleet are considered less onerous than elsewhere due to the relatively low overall rates of vehicle ownership per capita. Norwegian vehicles travel less distance than Australian vehicles, and electricity transmission and distribution networks are smaller with fewer VRE integration challenges. With respect to mechanisms for EVSE standing data collection, a large portion of Norwegians live in accommodation organised into housing associations ("Borettslags") which reduces the proportion of stand-alone private installations which, in turn, provides more avenues to collect relevant data in residential settings.[78]

South Korea

South Korea has the highest rate of EVSEs per vehicle (and power density of EVSEs per vehicle). South Korea has a number of key differences to Australia. There is a single, monopoly electricity market with one seller (KEPCO), a single distributor (KEPCO), and a single market operator (KPX). The South Korean power system is physically small and highly synchronous. The Ministry of Trade, Industry and Energy (MOTIE) has determined a special, subsidised tariff for EV charging. KEPCO is required to offer it to public or private charging, with dedicated sub-metering, down to L1 charging infrastructure.

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[76] UK Electric Vehicle Charging Installations FAQ

[77] EVSE Att A - Final Reg. Order (ca.gov), Guide to California Regulations for Electric Vehicle Charging Stations (calevip.org), Decision Adopting Plug-In Electric Vehicle Submetering Protocol And Electric Vehicle Supply Equipment Communication Protocols

[78] EV and EV Charging Incentives in Norway: A Complete Guide (wallbox.com)

The scheme has contributed to the availability of robust EVSE fleet data. The Korean government has also initiated demand response schemes targeted at increasingly smaller CER for which EVSEs may qualify.

EVSE requirements have long existed in building codes for EVSE. The Ministry of Energy (MOE) has run subsidies for AC charging, and MOTIE for DC charging. With respect to public charging, KEPCO also acts as South Korea's largest clearing house, aggregating a range of charging networks and providing a direct line of visibility to their assets and power system impacts. Although Korea does not have a specific standing data initiative for EVSEs, South Korea serves as an excellent example of what can be achieved by a tightly-integrated, top-down approach to EVSE incentives, visibility and connectivity. South Korea's EV and EVSE involvement also goes considerably deeper and wider than this, with significant, state-directed involvement in the development of global standards, local industry manufacturing relevant products.[79]

China

The world's largest EV market has some similarities to South Korea from a policy perspective. China has significant policies at a federal level and tariff incentives from a near-federal level. China has two utilities each historically offering discounted EV tariffs, though some key differences in how subsidies are directed, at the federal-level (e.g., tax credits), and local municipal level (tariff incentives). Accordingly, China has many potential avenues for collecting EVSE standing data. China maintains a significant focus in convincing its public of EVSE operation being a viable business in public and private sectors as an incentive underpinning fleet transition. Similar to South Korea, China is deeply and broadly involved in electromobility having significant dedicated industry and unique vehicle standards creating strong commitments between local industry capability and strategy and the types of charging infrastructure being installed. For example, China, together with Japan, drives CHAdeMO 3.0 (known as ChaoJi). This may ultimately displace the need for on-board chargers within electric vehicles. China leads the world globally in power conversion infrastructure manufacturing. Accordingly, industry development and transport policies are designed to be complementary.[80]

Germany

Acquisition of standing data for public infrastructure is robust. Charge Point Operators (CPOs) are required to notify the electricity distributor of the construction of any charging station not less than four weeks prior to the start of construction – a regulatory requirement supported in law.

All EVSE installations that are public and/or needing external cost recovery in private settings (e.g., a paid by work' EVSE in a residential setting) exceeding 3.7kW maximum power are required to have calibrated, certified energy metering infrastructure (the 'Eichrecht' law). A range of other details of digital solutions for cost recovery are similarly required as part of a national commitment (and regional strategy) for Plug & Charge, a certificate-based approach to digital cost recovery considered core to ISO 15118. Accordingly, all EVSEs within this scope (or their meters, where discrete) are centrally registered.[81]

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[79] S. Korea has best EV infrastructure per unit in world: report (koreaherald.com), - KEPCO -, Electric vehicle charging rates will increase to KRW mid-300 - ETNews

[80] EV_ChargingChina-CGEP_Report_Final.pdf (columbia.edu)

[81] White-paper-calibration-law-EV-charging-infrastructure-2020-08-13-1.pdf (dropbox.com), Tritium-PlugCharge-WhitePaper.pdf (tritiumcharging.com), Microsoft PowerPoint - 190327 German charging infrastructure regulations (rvo.nl), EV and EV Charging Incentives in Germany: A Complete Guide (wallbox.com), Microsoft PowerPoint - 190327 German charging infrastructure regulations (rvo.nl)

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