Recommendations paper: Electric Vehicle Data

April 2025

This document provides recommendations for the non-regulatory collection, sharing and analysis of electric vehicle (EV) data

Explanatory statement and consultation notice

On 8th October 2024, the Australian Energy Market Operator (AEMO) submitted a rule change retraction to the Australian Energy Market Commission (AEMC) to amend the National Electricity Rules (NER) to include Electric Vehicle Supply Equipment (EVSE) standing data in the Distributed Energy Resources (DER) register. As part of the retraction, AEMO committed to pursue a non-regulatory work program in the short-term to capture other data relevant to EV charging, whilst continuing to work with the interjurisdictional CER Working Group on the establishment of a national regulatory framework that could provide a future framework to consider regulatory solutions to improve electric vehicle (EV) and EVSE visibility.

This recommendations paper provides an update and consultation opportunity for industry and stakeholders on the process, findings and draft recommendations that have resulted from AEMO's non-regulatory work program to improve EV data visibility (the EV Data project).

Consultation notice

AEMO would like to hear from industry and stakeholders on the matters discussed in this paper and the draft recommendations AEMO has proposed. AEMO would also be pleased to hear from stakeholders on matters that they believe could help meet the objectives and scope outlined by AEMO that is not covered in this paper.

Written submissions from interested persons on the issues identified in this paper are invited to NEMReform@aemo.com.au by 5:00pm (Melbourne time) on 23 May 2025.

Before making a submission, please read and take note of AEMO's consultation submission guidelines, which can be found at https://aemo.com.au/consultations. Subject to those guidelines, submissions will be published on AEMO's website.

Please identify any parts of your submission that you wish to remain confidential, and explain why. AEMO may still publish that information if it does not consider it to be confidential, but will consult with you before doing so. Material identified as confidential may be given less weight in the decision-making process than material that is published.

Submissions received after the closing date and time will not be valid, and AEMO is not obliged to consider them. Any late submissions should explain the reason for lateness and the detriment to you if AEMO does not consider your submission.

Interested persons can request a meeting with AEMO to discuss any particularly complex, sensitive or confidential matters relating to the proposal. Please refer to NER 8.9.1(k). Meeting requests must be received by the end of the submission period and include reasons for the request. We will try to accommodate reasonable meeting requests but, where appropriate, we may hold joint meetings with other stakeholders or convene a meeting with a broader industry group. Subject to confidentiality restrictions, AEMO will publish a summary of matters discussed at stakeholder meetings.

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1 Context

1.1 Role of EV data

The transition to electric vehicles (EVs) presents both opportunities and challenges for Australia. EV uptake is rapidly increasing in Australia, driven by global automotive industry technology trends, operating cost efficiencies, consumer environmental awareness, and government and business emissions and transport policies. With the rising adoption of EVs, the demand for electricity is expected to increase substantially, adding new and relatively complex loads to distribution and transmission networks.

While EV charging load forecasts face an inherent degree of uncertainty, AEMO's 2025 Draft Inputs, assumptions and scenarios report (IASR) forecasts that EVs will contribute up to 6.5 TWh in annual electricity consumption in the National Electricity Market (NEM) by 2030, growing to over 60 TWh by 2050. This is comparable to current annual electricity generation volumes in NSW, the largest region in the NEM.

EV charging loads, where controllable, can have a high intrinsic degree of flexibility which is valuable in power system planning and operation. EV charging loads can be used to consume excess renewable electricity generation and thus optimise network infrastructure utilisation, contributing to greater investment efficiencies for both generators and network operators, which reduces prices for all electricity consumers. They present similarities to hot water loads, which network operators have learnt how to utilise to optimise the network. As was the case with hot water systems when it became apparent that network operators required data and information regarding these loads, work is now needed to explore how EV loads can be understood and utilised to the benefit of consumers. In the future, bidirectional EV charging is expected to allow EVs to share stored energy, potentially mitigating local network congestion or bulk electricity supply shortfalls.

EV charging loads are associated with important grid impacts that need to be carefully managed:

- **Increased load variability**: EV charging may introduce increased variability in demand. Unlike many traditional loads, EV charging patterns (where appropriately controlled) are more flexible and can shift in response to user behaviour, time-varying electricity pricing, or demand management incentives.
- **Network infrastructure requirements**: Clusters of EVs in certain areas can place localised strain on transformers, feeders, and other distribution system assets, necessitating infrastructure upgrades or demand management programs to manage load concentrations.
- **Voltage and frequency management challenges**: Large-scale, uncontrolled EV charging can contribute to voltage drops or (if sufficiently large) frequency instability.

Better data on EV location and charging behaviour will support industry stakeholders adapt the grid to accommodate the unique and flexible demand profiles that EV charging introduces. This includes informing assumptions about the timing and location of future EV uptake, likely EV charging load profiles and the extent to which EV loads may increase demand against infrastructure limits. These will all be greatly impacted by the charging behaviour of EV owners, pricing incentives and the charge management technologies they employ.

Limitations in long term load forecasts may contribute to higher investments costs which can flow through to higher prices for electricity consumers. In operational timeframes, forecasting errors can also increase the need for frequency regulation services, which also contributes to electricity prices.

As EVs become a greater component of electricity demand the need for timely, granular EV charging data (both near-real-time and long-term forecasts) may also become a more critical input into network and energy market planning and real-time operational decision-making.

1.2 History of reform

There has been a significant history of work across the energy sector and governments to improve EV charging visibility by seeking to unlock access to EV and Electric Vehicle Supply Equipment (EVSE) data. Table 1 summarises related reforms and reports that have been produced on this matter. In producing this recommendations paper, AEMO is seeking to acknowledge and progress these numerous pieces of past work.

Table 1: Summary of previous and related reform undertaken on EV and/or EVSE data collection

Previous work	Description and outcomes
SA Government – Technical Standard for Installation of Electric Vehicle Supply Equipment (EVSE) (2021)	Requires EVSE installations to be certified and registered with South Australia's Technical Regulator.
WA Government - DER Roadmap (2020) & WA Government - Electric Vehicle Action Plan (2021)	In accordance with the Western Australia's (WA) Government Electric Vehicle Action Plan, AEMO delivered changes to the WA DER Register in October 2023 to capture EVSE standing data. These changes were made in preparation to support the exploration of future and related actions under the WA Governments DER Roadmap.
Energy Security Board's Electricity Supply Equipment Standing Data Consultation Paper (2022)	In 2021 the Energy Security Board's Consumer Energy Resources and the Transformation of the NEM identified data gaps to manage the energy market transition including visibility of EVSE. In their outcomes report, the ESB made recommendations to collect EVSE standing data. Includes a proposed implementation path to support collection through the DER Register and complementary initiatives to improve the accuracy and completeness of data.

Previous work	Description and outcomes
Distributed Energy Integration Program (DEIP) EV Data Availability Taskforce	Document summarising industry findings on a prioritised set of data requirements required to improve visibility of EV charging. Included four recommended areas of focus, outlined to be an EVSE standing data register, a vehicle standing data register, market/operational data services and research data to support EV-focused research.
Ernst & Young EV market reforms gap analysis (2022)	DCCEEW engaged Ernst & Young to undertake a gap analysis on EV grid and market integration. A final report was delivered in May 2023 making six recommendations, including one to establish a common mechanism for EVSE data sharing.
AEMO-commissioned report EV Technical Standards for Grid Operation (2023)	Explores the power system risks associated with increasing EV penetrations. The report identifies risks related to EV behaviour, in response to price, weather or other factors, and highlights that effective monitoring data collection and management is required to mitigate these load step risks.
AEMC Review into consumer energy resources technical standards, Final report, Sep 2023	Provides clear direction for the need of regulation for CER devices to define and support their compliance to technical standards. The report provides 10 recommendations, including the recommendation for OEMs to provide data to DNSPs and AEMO to better support the monitoring of compliance of DER/CER devices.
AEMO Rule change request – EVSE standing data (2023) and retraction (2024).	AEMO submitted a rule change proposal to the Australian Energy Market Commission (AEMC) to collect EVSE standing data. This rule change was later retracted by AEMO, given reasons below.
National CER Roadmap – Powering Decarbonised Homes and Communities (2024)	In November 2023, Energy Ministers agreed to give consideration to consider implementing a national approach to technical regulatory settings for CER in 2024 and to develop a National CER Roadmap – Powering Decarbonised Homes and Communities. In line with this commitment, a National CER Roadmap was delivered and endorsed by Ministers in July 2024. Includes capture of EVSE standing data.

The previous EVSE standing data rule change proposal

The EVSE standing data rule change proposal outlined amendments to the NER to integrate EVSE standing data into the existing DER Register to improve visibility on EV charging locations and characteristics to enhance planning and forecasting capabilities for both AEMO and Distribution Network Service Providers (DNSPs). AEMO proposed amendments to the NER that placed an obligation on DNSPs to collect and provide EVSE data to AEMO. This required updates to connection agreements and service installation rules to facilitate data collection. The proposal also obligated

AEMO to update its guidelines to specify the requirements for EVSE data collection with a commencement date in 2026.

Whilst AEMO's rule change request identified key challenges regarding existing limitations in the compliance and enforcement framework for CER, following its submission AEMO and the AEMC identified additional challenges related to the reporting trigger necessary to ensure DNSPs can be made aware of EVSE installations across their network. It was also acknowledged that EVSE standing data by itself would not provide adequate visibility of all forms of EV charging nor satisfy all use cases.

As such, it was decided by the CER Working Group that the roadmap's commitment to an operational national regulatory framework for CER in 2026 would be more suitable for considering a mechanism to support the effective collection of standing data for EVSE from 2027. It was also agreed, that while this regulatory framework was being developed, and given challenges identified, AEMO would develop and lead a non-regulatory work program focused on leveraging existing data sources and collaborating with industry and governments to improve EV visibility across the NEM.

1.3 Related areas of AEMO reform

In this section, AEMO has briefly summarised two other of its current reforms that relate most to the EV data project and this paper's proposed recommendations. AEMO notes that there are also significant pieces of related work underway outside of AEMO, including:

- ARENA and RACE for 2030's National Roadmap for Bidirectional EV Charging in Australia, which seeks to identify the critical path to achieving commercial adoption of bidirectional EV charging in Australia[1]. The roadmap will be important for understanding and monitoring the uptake of V2G and how this may relate to unidirectional EV charging (load only).
- RACE for 2030's RACE for EVs, which will provide insights under two main research themes, optimising transport and power use and integrating electric vehicles with the grid, that can help inform trends related to EV charging behaviours and characteristics and their impact on the grid.
- C4NET's EV Data Warehouse, which was developed to help researchers, industry and government access EV datasets, including EV charging profiles, smart meter data and trial outcomes. The EV Data Warehouse has established significant data sharing frameworks across stakeholders, however its scope of data access, including smart meter data, does not cover all stakeholder EV data use cases, specifically for DNSPs and AEMO.

[1] Bidirectional EV charging installations that are electrically connected to the grid, referred to as vehicle to grid (V2G), fit the definition of an embedded generator under AS4777.2 for both AC and DC. As such, these installations will require DNSP connection approval and will be picked up in the DER register.

Integrating price-responsive resources

The AEMC's Integrating price-responsive resources (IPRR) into the NEM Rule Change introduces a new framework to monitor and report on unscheduled price-responsive resources. The reporting framework includes reporting by AEMO and the Australian Energy Regulator (AER) on the impacts, efficiency implications, and costs associated with unscheduled price-responsive resources in the market.

The key features of the framework are:

- Monitoring and reporting by AEMO to identify the presence and issues created by increased unscheduled price-responsive resources. This requires AEMO to report annually on the impact of this response on its operational forecasting and the measures it takes to improve it to account for unscheduled price-responsive resources.
- Monitoring and reporting by the AER to assess the estimated efficiency implications and costs associated with actual demand deviating from forecasts due to unscheduled price-responsive resources.

EV data will therefore help enable AEMO to examine, under these new requirements, energy consumption behaviour, of which EV charging is expected to be a significant growth component.

CER Data Exchange

The CER Data Exchange is a collaborative project led by AEMO and Aus Net Services with support from the Australian Renewable Energy Agency (ARENA). AEMO is currently finalising an industry co-design process.

The CER Data Exchange framework serves as the foundational capability to support the scaling of CER coordination by providing an exchange that facilitates streamlined and secure data exchange of CER data between organisations.

By creating a consistent, efficient and secure way for organisations to access and exchange CER data, the CER Data Exchange will enable greater CER coordination between participants, support greater customer choice and reduce cost for industry and consumers.

Through the Co-Design process, stakeholders have identified three priority use cases to take into Detailed Design:

- Broader Access to Consistent CER standing data
- Efficient Sharing of Network Limits
- Network Support and Flexibility Services

This is a long-term project that may require regulatory reforms. This recommendations paper complements these initiatives by focussing on immediate data needs and incremental changes to current EV data collection activities to address them.

2 Objective & Scope

2.1 Objective

The primary objective of this recommendations paper is to establish and consult on an efficient and effective non-regulatory framework for collecting, managing, and utilising EV-related data across the industry to enhance grid stability, operational planning, and forecasting accuracy at the distribution and market level. In doing so, AEMO seeks to leverage and utilise the past work that has been done in this area, and consider the needs of both primary data users and broader stakeholders, including how any recommendations could either provide costs or benefits to industry stakeholders and energy consumers.

2.2 Scope

The scope of the project encompasses:

- Defining immediate EV-related data requirements related to power system management.
- Evaluating existing data collection methodologies and assessing their benefits and limitations.
- Proposing non-regulatory activities to address immediate data needs and improve EV (and/or their related load) visibility within networks.
- Laying a foundation for consideration of a long-term, investment-efficient, integrated EV data framework that aligns with the CER Roadmap and its intent to reform regulations surrounding CER data collection arrangements.

Within the above scope, this paper covers all forms of EV charging including residential, workplace, destination and public charging. It also seeks to cover both the NEM and the Wholesale Electricity Market (WEM) for the South West Interconnected System in Western Australia (SWIS), noting that there are some differences between the NEM and the WEM regarding the regulatory collection of EVSE standing data, with the potential to collect this data as part of the required changes made by AEMO in October 2023 to the WA DER Register in accordance with the WA Governments Electric Vehicle Action Plan and future and related actions under the WA Governments DER Roadmap still being explored.

Data considerations in this project's scope refer to standing EV and EVSE data, with the need and options for collection and use of operational, near real-time EV and EVSE data not in scope. In considering options for the collection of EV and EVSE standing data using available data sources, historical operational data has been included given its potential to allow EV and EVSE detection to meet the use cases discussed in section 3.

The main stages that were undertaken by AEMO as part of this non-regulatory work program included:

- Literature Review and analysis: A review of existing studies, reports, and regulatory documents was conducted to assess the current state of EV data collection, data needs and to identify best practices.
- Stakeholder engagement: Interviews were held with DNSPs, research organisations, government bodies, and other stakeholders to gather insights on data requirements, existing challenges, and potential solutions.
- Evaluation of data collection approaches: Existing EV data collection methodologies (direct measurement, inferential analysis, and simulation) were evaluated to identify potential inefficiencies and emerging best practices.
- Recommendations formulation: From the above processes, a set of near-term activities were defined reflecting stakeholder reported needs and preferences and a high-level assessment of costs and benefits of alternative EV data initiatives.

Building on previous work in this area, this paper focusses primarily on the data needs of AEMO and DNSPs, noting that a wide range of other stakeholders also have an interest in these areas, including emergency services and regulatory bodies, electricity retailers, and EV charging ecosystem industry participants. DNSP and AEMO data needs have been focused on as improved data management outcomes was identified in stakeholder discussions as having a direct bearing on improved outcomes for power system operation and planning, resulting in improved reliability, security and affordability of electricity supplies for energy consumers.

In performing the engagements on this work, AEMO noted the significant amount of engagement that has already occurred in this area. However, initial work by AEMO to progress the non-regulatory approaches highlighted the need for broader and more targeted engagement to understand, across Australia, recent trends and initiatives related to the collection, use and sharing of EV charging data. This included using further consultation to identify and test the priority data sets that will most efficiently meet use cases for stakeholders and ensure that any non-regulatory approaches pursued by AEMO through this project can provide benefit.

Ongoing work on the establishment of a national regulatory framework under the CER Working Group's National CER Roadmap is not in the scope of this paper. The recommendations that come from the EV Data project however, and their subsequent impact on the availability of EV data, will be used to inform future consideration at the establishment of the national regulatory framework of whether or not there is a further need to consider the regulatory collection of EVSE standing data.

3 Current use cases, existing initiatives and remaining gaps

Engagements with DNSPs and other external stakeholders highlighted that, in the absence of a regulatory lever for the collection of EVSE standing data, DNSPs have progressed several initiatives to meet their EV-related data requirements. Internally, AEMO has also progressed several initiatives, which are included here for stakeholders' awareness.

3.1 AEMO

Table 2 below overviews the EV-related data use cases and current and expected initiatives for AEMO. In doing so, focus is on initiatives in the NEM, noting as outlined in Table 1, that in the WEM capture of EVSE standing data in the WEM's WA DER Register, such as through classifying EVSE as a "controlled load," were introduced in October 2023 in preparation to support the exploration of regulations to collect this data as part of future and related actions under the WA Governments DER Roadmap. As can be seen, AEMO's main areas of use for EV-related data are in forecasting and system planning, as well as operational preparedness and management and reporting under AEMO's new IPRR obligation. This includes development of accurate estimates of the likely contribution of aggregated EV loads to peak demand and under minimum system load (MSL) conditions, and the magnitude to which such loads may be controlled as flexible loads. Such estimates can help shape AEMO's operational forecasting decisions and their associated costs.

A key component of AEMO's EV data workbook is a collaboration with consultants to develop EV load profiles. The most recent consultant, CSIRO, sourced EV profiles from several various trials that have occurred under funding from RACE for 2030 or under state and territory government initiatives that provide this EV trial data.

To date AEMO have used vehicle sales data to estimate actual EVs on the road. For the draft 2025 IASR, annual numbers have been aligned with additional sources, including the Australian Automobile Association (AAA) and Bureau of Infrastructure and Transport Research Economics (BITRE). AEMO is also working with the National Exchange of Vehicle and Driver Information System (NEVDIS) through BITRE to explore the potential of obtaining monthly updates of vehicle registration data.

Table 2: AEMO's EV data use cases and initiatives

Use case	Description	AEMO initiatives	
		Current	Expected
Forecasting and system planning	• Forecasts done for IASR report, including the preparation of a detailed EV workbook, that is used in AEMO's forecasting and planning publications, including the Electricity Statement of Opportunities (ESOO) and Integrated System Plan (ISP). • Currently the EV workbook is assumption-based, so improved access to EV and charging data can allow it to include data-driven charging behaviours to understand demand and consumption related to EVs, as well as charging characteristics like charging location (such as commercial or residential) and charger types.	<u>Standing data</u> • Vehicle sales data from EVC and Federal Chamber of Automotive Industries (FCAI). • CSIRO EV uptake profiles • Identification of potential EV charging sites using Consumer Administration and Transfer Solution (CATS) NMI standing data for the NEM. • Reliability Forecasting Guidelines provide AEMO with power to make information requests of Market Participants that is needed to support the ESOO forecast. In recent years, AEMO has added voluntary questions to their information request, asking DNSPs for EVSE standing data.	• Vehicle registration data expected to be obtained in future from NEVDIS through BITRE. • Demand-side participation information (DSPI) collects time of use (TOU) tariffs and in future may collect information on EV specific tariffs from some retailers.
		<u>Operational data (for historical, after-the-fact identification and trends analysis)</u> • CSIRO load profiles. • Public charging load profiles validated with OEMs.	• Matching standing data with metering data in Market Settlement and Transfer Solution (MSATS) to identify and analyse public EV charging trends for the NEM. • Have sourced sub-metered BTM residential data, including for individually metered EV chargers.

<table>
<tr><th rowspan="2">Use case</th><th rowspan="2">Description</th><th colspan="2">AEMO initiatives</th></tr>
<tr><th>Current</th><th>Expected</th></tr>
<tr><td rowspan="2">DER/CER operational preparedness and management</td><td rowspan="2">Various areas of DER/CER operational management will require EV data in:
- Developing dynamic power system models to represent aggregate EV response in power system incidents and disturbances.
- Analysing impact of EVs on operational limits and developing procedures and processes if necessary to manage.
- Impacts of EVs in MSL periods.
For operational preparedness, understand the current and emerging impacts of 5 and 30-minute EV charging (and discharging) on operational forecasting to inform if there is a need to incorporate real-time EV data.</td><td colspan="2"><u>Operational data (for historical, after-the-fact identification and trends analysis)</u></td></tr>
<tr><td>Laboratory ‘bench testing’ of EV chargers in collaboration with the University of Wollongong to provide high resolution data under a range of power system disturbance conditions.</td><td>Historical operational data provided voluntarily by an OEM to AEMO to inform research on behaviour and impact of EVs during system events.
Same as above, using the small sample of static BTM EV AC charging profiles that have been sourced to perform high level analysis and quality assurance checks in relation to operational preparedness.</td></tr>
<tr><td>Reporting under IPRR</td><td>Monitor and report impact of unscheduled price-responsive resources on operational forecasting.</td><td></td><td>As part of clause 3.10C.2 of the NER, developed under IPRR, AEMO is required to identify the presence and issues created by increased unscheduled price-responsive resources on operational forecasting.</td></tr>
</table>

3.2 DNSPs

The Energy Security Board's consultation of EVSE standing data collection identified a range of relevant EV data use cases for DNSPs that are presented and expanded on below in Table 3**Error! Reference source not found.** considering recent industry consultations. AEMO notes that this section does not capture the view of all DNSPs, and that overall, the maturity and initiatives being undertaken by DNSPs range considerably.

Most current efforts to collect operational EV data for the use of analysing EV load profiles and detecting the presence of EVSE revolve around non-intrusive load monitoring (NILM), with DNSPs typically using either external vendors or internally developed methods.

What is NILM?

Non-Intrusive Load Monitoring (NILM) is a data analysis method used to disaggregate energy usage within a household or business, identifying specific appliances or devices from aggregate electricity consumption data. By leveraging algorithms that analyse patterns in energy and/or power quality readings collected from smart meters, NILM can infer the presence and usage of individual loads without requiring direct measurement from each device. This approach is particularly valuable for networks seeking to detect EV charging loads amidst broader household energy consumption, especially where direct registration or notification of EV chargers is absent.

In the context of network operations, NILM partially addresses the challenge of limited visibility into CER/DER loads by offering a relatively cost-effective and scalable alternative to installing dedicated monitoring equipment. However, its effectiveness can vary based on the quality of training data, the complexity of overlapping load patterns and the resolution and type of available training data. While NILM provides a valuable tool for enhancing EV load forecasting and network planning it requires ongoing refinement and validation to improve accuracy, particularly for smaller or low-power charging events that are harder to detect.

Detection will generally be most effective for larger block charging loads (e.g. 7 to 22 kW Mode 3 charging loads that do not change power state) and leaves a gap in terms of detecting other types of charging (e.g. low power or load balance charging or charging at complex sites). Current NILM models, based on 5 or 30 minute interval data, are generally considered not effective in identifying Mode 2 charging, which is used by nearly half of Australian EV drivers.[2]

In summary, NILM approaches provide a relatively low cost way to identify the location and shape of certain EV charging loads. Continued development of NILM algorithms will require representative historical data on EV charging sessions containing EV load shape and location mapped against aggregate sub-meter loads.

[2] Evenergi (2023) *EV owner demographics and behaviours* (p.4)

DNSPs observed that some customers – broadly related to customers with solar PV – were engaged in advanced EV load management for behind-meter optimisation, and some DNSPs are tailoring NILM models specifically for this cohort. These efforts were agreed to have usable accuracy with Mode 3 (AC) fast charging. No DNSPs had made a successful business case to extend NILM methods to Mode 2 charging at this stage. DNSPs noted their ability to conduct broad-scale EV load detection would be enhanced by proposed changes to the NER that will allow DNSPs full access to customer smart meter data from 1 July 2026.[3]

Question
Do DNSPs agree with AEMO's summary of their main EV data use cases and the different initiatives that they are pursuing?

[3] AEMC (2024) *National Electricity Amendment (Accelerating Smart Meter Deployment) Rule* (p.24)

Table 3: DNSP EV data use cases and initiatives

Use case	Description	DNSP initiatives
Network planning	EV locational data Can be combined with 'representative load profiles' to estimate current and likely future loads on specific network assets, and to justify requirements to build out network capacity to ensure consumers demand for electricity can be reliably met. Includes consideration of EV clustering. DNSPs require data on cluster locations and charging patterns to proactively upgrade or reinforce their networks where necessary. Local concentrations of EV ownership also help them understand relevant demand projections e.g., wherein social factors may contribute to 'neighboured effects' whereby EV purchase decisions are influenced by other EV ownership in the area.	Standing data • Connection agreements: DNSPs generally record the presence of public charging infrastructure where a connection agreement has been triggered, e.g., at a public charging location (such connection agreements typically exceed a nominal capacity e.g., 100A). At residential level, relevant data may be collected during connection upgrade processes (e.g., from single to three-phase). • Vehicle registration data: Most DNSPs are accessing vehicle registration data at postcode or local government area (LGA) level via their state or territory transport departments or in some states (NSW, VIC), access to public datasets. • Cross-referencing public databases: e.g. PlugShare, used to correlate NMIs with locations of known EV charging infrastructure. EV sales data from EVC and FCAI also used to offer further context. • Consumer surveys: DNSPs may collect information, such as EVSE make and model, through surveys or registration processes for EV charging equipment • Tariff-based detection: DNSPs (and electricity retailers) exploring EV-specific tariffs that can provide indirect insights into EV locations and potentially aid in the detection of EV usage.
	EV load forecasts Includes improving the granularity of load forecasts to align with network assets (which may be at e.g., street level). Accuracy in forecasting EV uptake and charging behaviour is paramount for both short-term operational decisions and long-term infrastructure investments.	Operational data (for historical, after-the-fact identification and trends analysis) • CSIRO load profiles • Reprocessing of IASR data: DNSPs may engage third parties to map scenario data (typically state-based) around EV uptake to postcodes using a variety of methods. • Smart meter data disaggregation • Proprietary models: including digital twins and clustering analysis tools

Use case	Description	DNSP initiatives
EV data in real time network operations	The core functions of network operation revolve around ensuring reliable, safe, and efficient electricity delivery to consumers while adapting to evolving demands, technologies and regulatory requirements. These functions include managing real-time system reliability and stability, including using load management tools and contracts. Additional responsibilities include ensuring compliance with regulatory and safety standards and integrating advanced data systems for monitoring and decision-making. The evolving use of flexible import limits (FILs),and dynamic operating envelopes (DOEs) further requires ongoing network state estimation for purposes of determining real-time network hosting capacity.	• Very few cases were observed of direct measurements of EV charging integrated into operational environments, whether via industry-standard means (e.g., from a charging station management system (CSMS)) or using bespoke measurements. • Where DNSPs had invested in direct measurement it typically comprised data acquisition under trial conditions (e.g., which were later used to train NILM algorithms).
Tariff and incentives design	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 confidence that those customers have the technical capacity to respond.	• EV trial tariffs

3.3 Other stakeholders

The prior work summarised in Table 1 identified the priority EV-related data needs of stakeholders. During consultation on this non-regulatory work program and that done formerly by the ESB, the data needs of AEMO and DNSPs were generally considered the highest priority by all stakeholders. A significant factor in this prioritisation included the prevalent role AEMO's IASR forecasts play across the industry in informing other's EV uptakes and forecasts. AEMO has summarised potential use cases of other stakeholders below:

- **Emergency services:** Location-specific data on EV charging stations is valuable information for emergency services to develop and implement safety protocols. EVs can present unique risks in fire and emergency scenarios, and having accurate location data supports the development of effective response strategies.
- **Regulatory bodies and government agencies:** Government and regulatory bodies need access to aggregated EV data to shape policies, assess the effectiveness of transport and electricity market policies, and monitor progress towards national emissions targets. Accurate data also helps these entities develop and evaluate initiatives related to EV infrastructure funding, market reforms and environmental regulations.
- **Electricity retailers:** Retailers benefit from EV and EVSE standing data to better understand consumer behaviour and preferences in different market segments (e.g., residential & commercial fleets). Retailers work to create synthetic, data-driven consumer models that can substantiate investment cases for new tariff, finance, service, or hardware offerings (or combinations thereof) that best meet evolving consumer needs. Aggregate EV load forecasts also inform retailer trading behaviour and long run wholesale electricity contracting.
- **EV charging infrastructure developers:** Investment cases for new charging infrastructure projects benefit significantly from credible understandings of potential revenues (e.g., vehicle throughput based on co-location of EVs where domiciled and other adjacent factors). High resolution spatial data on vehicle uptake can increases investment efficiencies and accelerate EV charging investment.

Question
Are there any other key EV data use cases across stakeholders that AEMO has not included?

3.4 Summary of remaining gaps and challenges for AEMO, DNSPs, and other stakeholders

Following the above identification of the EV data use cases and initiatives, AEMO have identified several areas of remaining gaps and challenges across all stakeholders.

Limited visibility of charging events

DNSPs, AEMO and CSIRO have limited access to empirical data on real-world EV charging loads that can inform realistic estimates of the timing and magnitude of charging events across:

- **Residential installations:** Data from EV smart charging trials is patchy and skewed to early adopter cohorts and customers with hardwired EVSE and active energy management. Detection algorithms applied to smart meter data where there is net metering is generally only effective for Mode 3 chargers with 'block loads' and do not yet accurately detect Mode 2 'trickle' charging, loads that are 'generation following' (i.e., for solar self-consumption) or embedded in complex sites like apartment buildings.
- **Commercial and apartment installations:** Trial data for EVs charging in a commercial and apartment building context is less common and loads are harder to detect when other large loads (e.g., pumps or fans) are present. The application of behind-the-meter (BTM) load balancing to ensure charging does not exceed local electrical circuit limits further complicates load detection.
- **Public and destination charging:** Standalone public charging stations may be registered with DNSPs and can be monitored using smart meter data. EV charging loads are significantly harder to identify and monitor where charging is embedded within a larger commercial building or complex (for example, a shopping centre).

Current planning and operational decision-making, as well as AEMO's IASR EV load forecasts, are based on a range of assumptions that are derived from a mix of diverse data sets that may not be fully representative of current and future EV charging load patterns. Consultations indicated significant advantages in improving on available data sources and collaborating in the development of representative load profiles and, specifically for DNSPs, after diversity maximum demand (ADMD) estimates across different EV market segments. Empirical data limitations contributed to varying levels of confidence across industry in current ADMD estimates and projections and vehicle telematics were considered a highly prospective complement to other data sources.

- **Vehicle telematics data:** Vehicle OEMs collect and store data on charging sessions by vehicle owners, whether that occurs at home or in a destination or public charging context, and this can be GPS located, depending on the capability of the vehicle. This is commercially valuable data, and it is not widely shared. While there are precedents for OEMs sharing selected data as input into policy and planning decisions, levels of trust in this data varies across industry. Anonymised bulk data can be purchased directly or through an intermediary. Privacy concerns limit data granularity, and there may be inconsistencies in data available between OEMs and vehicle models. Vehicle telematics data is considered the most accurate and complete dataset on EV charging behaviour available, and this will improve over time.

More comprehensive and higher quality EV load profile datasets can improve the accuracy of estimates, which are a key input into DNSP planning decisions. For AEMO, load profile estimation is a key input into long term forecasting activities like the IASR, and it will become more material to medium-term and operational forecasting, as well as DER/CER operational preparedness and management over the coming years. For example, higher quality EV load profile datasets like vehicle telematics data will be needed to inform understanding of charging behaviour and its impacts on the power system that underpins any future consideration to incorporate ongoing or real-time EV data into AEMO's operational forecasting and DER/CER operations. This includes information relating to the split between charging behaviour that is uncontrolled, time-of-use, solar optimised or price-optimised, of which there is currently very little data available on.

Limited training data and collaboration on detection algorithms

Data to train NILM models is limited due to the above lack of EV charging visibility, and also due to varying access to smart meter data.

- **Access to smart meter data**: DNSPs outside of Victoria do not have automatic access to smart meter data measuring load and power quality data (PQD). This means that EV load detection algorithms can only be sample based.

This substantially reduces confidence in current detection models. Several DNSPs are exploring ways to improve training data scope and quality, and there is no process for this data to be shared to develop data pools that could enhance whole of industry outcomes.

Whilst AEMO has access to smart meter data, utilisation of this data, including as a means for larger scale detection and load profile estimation of EVs is in its early stages, with one of the reasons for this including the need for AEMO to develop its capability to effectively leverage the smart meter data it has access to (and increasingly will do so under the advanced roll-out of smart metering in the NEM). CSIRO and AEMO have also procured a significant data set of residential BTM CER loads including metered EV charging data which could be applied to improve modelling accuracy across industry.

While it is possible to use NILM methods to detect smaller or more variant loads, specific training data and disaggregation algorithm development is required. As these loads are lesser in magnitude, value cases for these developments can be less obvious at localised levels. The extent to which these loads are a driver of future maximum demand, and demand elasticity, is uncertain but they are considered potentially material to transmission-scale generation dispatch requirements in the longer term.[4]

Granularity of vehicle registration data

Most DNSPs obtain CSIRO uptake and aggregate load forecast data at the postcode level and re-map these estimates to local network assets applying a range of assumptions, often with the support of

[4] Mode 2 charging loads can increasingly be controlled via offboard charging equipment or vehicle telematics.

external consultants. These costs could be mitigated, and greater consistency and accuracy achieved, if DNSPs had access to more disaggregated data.

Consumer data privacy concerns currently limit transport agencies from providing data at more granular levels. From discussions with DNSPs it is apparent that various transport agencies may also impose different terms and conditions on data use. The address at which a vehicle is located also does not always correspond to the place at which a vehicle charged, especially for business fleet vehicles.

DNSPs universally considered there to be material benefits in accessing data provided at a lower level of aggregation such as by suburb, street or address level either by their respective transport authorities directly, or preferably through a national arrangement.

It is important to also note that stakeholders also highlighted how vehicle registration address is not always a good indication of where charging may occur, given limitations in the accuracy of registration data and also the inherent mobility of EVs. Higher spatial resolution registration data presents an opportunity to better quantify the relationship between registration location and vehicle charging location data obtained from other sources (e.g. vehicle telematics) to improve the accuracy of load forecasts as derived from EV uptake reporting.

Limitations in EV uptake forecasts

DNSPs universally derive their EV uptake forecasts from AEMO's IASR forecasts which are currently developed by CSIRO. CSIRO also publish their forecasts at postcode level. The process by which this is disaggregated to lower system levels (e.g. for specific network assets) is variable and assumptions made in this process could have a material impact on forecast requirements for local network expenditure. Through its IASR forecasts (which are used in the ISP), AEMO seeks to understand the long-term needs of the energy system to manage power system security, reliability and affordability.

DNSPs noted that 'neighbourhood effects' can lead to unexpected, localised demand peaks well beyond the spatial or temporal resolution of higher level forecasts, potentially requiring targeted infrastructure upgrades to accommodate increased loads. They also acknowledged the need for granular data at the street or transformer level to identify and model these effects accurately, with some highlighting the necessity of more detailed insights to predict and respond to these localised adoption patterns.

Finally, some stakeholders noted that whilst AEMO's IASR forecasts are presented in a sequence of scenarios, additional value may be derived by presenting uptake certainty by confidence-intervals.

Burden of EV data requests placed on broader stakeholder groups

Further to the above, the lack of collaboration in accessing and sharing EV-related data increases the burden placed on a range of organisations that hold data relevant to modelling DNSP uptake and load shape modelling efforts, including charging infrastructure and EV OEMs, aggregators, charge point operators and various government agencies. Some data sets are sourced identically by multiple

DNSPs. While requests can be revenue-earning for some data providers, for others they represent non-core business activities and can prove burdensome to comply with.

Retailers and third parties are not authorised to access the DER Register

Under the NER clause 3.7E, retailers and third parties, including OEMs and aggregators, are not able to access standing data contained in AEMO's DER Register. This means that any EV or EVSE standing data that can be collected through this work, and flows into the DER Register, will not be able to be accessed by these stakeholders. AEMO is aware and acknowledges this remaining gap, noting that it is being considered in other work currently underway, including within the CER Data Exchange.

Limited access to ongoing post-event or (near) real-time operational EV data

Whilst real-time, operational EV data is out-of-scope for this work, access to ongoing or (near) real-time operational data on EVs may be required in the future and is a remaining gap worth highlighting.

For DER/CER operations, including development of power system models, AEMO perceives that it will require in the future ongoing, post-event operational data (at 60 seconds or smaller time increments) on EV behaviour during different system events (and possibly system normal) from all OEMs with significant market share. This data will be required to inform AEMO's power system models, and to allow AEMO to understand factors like how EVs perform during power system events, how EVs behave during a loss of communications event, and the level of cybersecurity or operational risk EVs may present.

If the need is identified to incorporate real-time EV data into operational forecasting, either by AEMO or DNSPs, near real-time quality, reliable and robust EV charging and discharging data, either directly from the vehicle or from charging infrastructure, will be required and processes will need to be established. Challenges also remain for AEMO regarding how the uptake and behaviours of EV charging and discharging may impact other forecasting outcomes. For example, charging into the middle of the day could utilise PV generation that otherwise would be constrained in the distribution network from static and flexible export limits, and price-responsive behaviour during extreme high or negative prices could affect load forecasts at peak and at times of minimum demand.

Question
Are there any gaps or challenges that AEMO has not captured, or you consider AEMO has not accurately portrayed?

4 Recommendations

Several common themes emerged from the engagements that were conducted, which have informed AEMO's recommendations, including:

- DNSPs have implemented and progressed relevant EV data initiatives independently. Whilst these initiatives have remaining challenges and gaps, overall, they are largely meeting the data needs of DNSPs. This is especially true in the context of the current risk and priority level that EVs pose for DNSPs in their network planning and operations.
- Stakeholders reported that while EV data issues were not currently critical business priorities, the need for accurate and efficient EV data gathering and analysis processes was likely to increase substantially over the next three to five years.
- The need to ensure any recommended reform provides clear benefits, with stakeholders articulating a strong wariness of any costs or obligations that potential reforms could introduce that may not improve or replace existing initiatives.
- Potential of interest for greater collaboration and data sharing.
- Interest and appeal of an independent source of truth on EV data.

Question
Do you agree with AEMO's summary of the common themes from engagements?

Using these common themes, AEMO has considered recommendations under two categories. The first category includes initiatives that AEMO has identified would help meet some of the remaining gaps and challenges in EV data as summarised in section 4.4, whilst also supporting AEMO's existing core functions and new obligations under the IPRR final rule change. This first category also allows initiatives to be commenced from Q2 2025 by AEMO.

The second category considers the potential for a longer-term national collaboration framework for pooling EV data and contributing to capacity uplift across industry. As will be outlined, this category has been separately categorised to AEMO initiatives as AEMO recognises that for such a framework to be considered and implemented, it will require consultation with industry and consideration of what benefits it could derive and what capacity stakeholders have to participate. Options for the best organisation to house and lead on this initiative will also be critical in supporting its potential.

4.1 AEMO initiatives

Vehicle telematics data

AEMO proposes to acquire a nationally representative sample of vehicle charging load profiles through either third-party aggregators of vehicle telematics data or through voluntary data sharing agreements with vehicle OEMs.

Vehicle telematics data was widely recognised during engagements as a timely and relatively comprehensive data resource on EV driver charging behaviour, location and load profiles across all charging modes (IEC modes 2-4) including loads that are difficult to identify with remote detection models. AEMO therefore view this as a potentially valuable, and largely untapped data resource that can be used to cross-validate EV load models and to help train EV detection algorithms.

Third party aggregators of telematics data

Various IoT service providers buy telematics data and rights from vehicle OEMs in bulk for historical and real-time data. Such providers aggregate data across vehicle OEMs and their various models and provide bespoke APIs and applications for third parties to use having negotiated access from over 40 unique vehicle OEMs.

A vehicle's data is typically onboarded for use in the platform when an organisation seeks it's use in an individualised context (e.g., insurance, road toll, charge management products, etc). The leading provider of such data in Australia already maintains several data services contracts with a range of private and government organisations (both state and federal). Onboarding, identifiable use or control of vehicles over telematics requires customer consent. In some markets (e.g., NZ for road user tolling) mass onboarding is policy-driven, creating rapid uptake.

Available data includes charging location, charging power and vehicle state-of-charge. Time series power or SoC levels throughout a charge event are also available at sample rates (vehicle-dependent) of typically 1 to 15 seconds. The quality and quantity of this data may therefore allow various inferential conclusions (e.g., estimated load shapes) to be replaced with empirical data, and could be a key data source for meeting the use cases identified in section 3.1. Data also covers all charging modes including Mode 2 ('trickle') charging.

Customer permissions can also allow charging to be controlled en masse, such as in an emergency demand response scenario. Presently these solutions may be too expensive for DNSPs to acquire individually and national joint procurement approaches may offer cost-efficiencies.

AEMO proposes it may also explore adjacent OEM vendors for corroborating data. Both EVSE OEMs and CPOs have access to data on charging events and in some cases, data formats follow open, available standards (e.g., OCPI for public vehicle charging as used by a variety of CSMS vendors). Commercial and privacy concerns are more likely to remain prevalent for private installations, however public infrastructure is intrinsically designed to share relevant data.

NILM project for smart meter load disaggregation

AEMO considers that there is benefit in developing a smart meter load disaggregation model, both for the detection of EVs but also to support AEMO's new obligation under the IPRR final rule change monitoring and reporting framework that tasks AEMO with producing quarterly reports on unscheduled price-responsive resources for the NEM. Given AEMO's access to smart meter data collected through Enterprise Meter Data Management system[5] (eMDM) and sub-meter data that AEMO has already procured, as well as AEMO's interest in acquiring a representative sample of vehicle telematics data, AEMO considers that it is well placed to trial a NILM approach and share insights from it with industry.

An option for development of this NILM model is for AEMO to partner with CSIRO. In doing so, the project would look at developing and training the model over the next 12-14 months, leveraging prior investments in sub-meter datasets and eMDM.

EV uptake data

AEMO proposes it could share more frequent EV uptake insights under a potential future data sharing arrangement with NEVDIS. As mentioned in section 3.1, AEMO expects to commence receiving monthly vehicle registration data from NEVDIS in the second half of 2025. Upon receiving this data, AEMO proposes that it could be included in AEMO's quarterly reporting obligations for unscheduled price-responsive resources under the IPRR monitoring and reporting framework (NER 3.10C.2(d)). This would support AEMO's current provision of EV uptake actuals and forecasts in its IASR EV workbook that is published biannually (in the year preceding AEMO's publication of the ISP) and in AEMO's Forecasting Assumption Update (FAU) and associated workbooks, which are typically published in years where AEMO doesn't publish an ISP.

Question
What are your views on the initiatives that AEMO proposes to implement? • **Do you consider these initiatives as capable of providing benefit through improved accuracy of AEMO's forecasting and planning at a reasonable cost?**

[5] AEMO's Meter Data Management (MDM) system is part of the Market Settlement and Transfer Solutions (MSATS) system. The MDM system stores and manages data from smart metering systems.

4.2 Option for a collaboration framework

During engagements, there was broad stakeholder support for greater industry collaboration, especially amongst DNSPs who have closely aligned requirements and interests.

Among DNSPs, engagements highlighted that there are widely differing levels of maturity in the application tools and methods for EV data collection and handling. It was therefore generally considered that there were benefits in fostering greater collaboration on current initiatives regardless of a DNSPs' own level of solution maturity or whether they were developing solutions inhouse or procuring 'off the shelf' software from third parties. This included greater collaboration being seen as an option for supporting a broad capability uplift across DNSPs and the opportunity for smaller DNSPs, with more limited resources, to leverage the experience of those with greater resourcing.

Among other stakeholders, industry collaboration was seen both as an opportunity to gain greater visibility of assumptions and methods going into EV load detection and forecasting and as an opportunity to learn from leading approaches. Stakeholders saw merit in exploring greater centralisation of targeted functions such as the pooling and analysis of new and existing EV data resources. While third party software providers have not been consulted directly, they are also likely to benefit from any future EV data sharing arrangements and AEMO notes that consideration should be given to including third party software providers as a potential participant in any pursued collaboration framework.

Overall, stakeholders generally had preference for simple, less costly and informal processes for collaboration that could allow them to participate without having to commit substantial resources.

AEMO has taken these preferences from stakeholders and presents in this paper for consultation the option for establishing a collaboration framework on EV data, referred to as an 'EV Data Forum'. AEMO notes that the establishment of such a framework would be dependent on the resourcing available, willingness and benefits that stakeholders perceive in such an effort, and therefore has recommended the option for a collaboration framework accordingly.

Further, AEMO acknowledges that for such a collaboration framework to be successful, it will require anchorage within a particular organisation or body that can lead the work and establish the necessary governance amongst interested stakeholders. AEMO considers that potential organisations that could fill this role include ARENA, RACE for 2030, or CSIRO. These organisations have been identified as they are all independent third parties with potential resourcing streams that could fund the collaboration framework to support collaboration amongst DNSPs and other stakeholders on EV data sharing.

Table 4 below outlines four potential workstreams that could be included in the establishment of a collaboration framework for EV data sharing, and summarises the main objectives and activities for each workstream.

Table 4: Summary of objectives and main activities of potential collaboration framework workstreams

	Objectives	Main activities
Workstream 1 - EV data industry collaboration framework	• Greater coordination of current activities and knowledge sharing under a national collaboration framework. • Aim to accelerate industry learning while improving confidence, accuracy and transparency in available industry datasets and EV load detection methods. • Build stakeholder visibility and alignment.	• Establish terms of reference for framework. • Periodic meetings (e.g. monthly, or as needed). • Scope and explore funding options for a centralised data manager role to streamline industry access to data resources and value-added data products. • Oversee and coordinate the implementation of the other workstream initiatives.
Workstream 2 - Pooling of EV charging load profile data	• Ensuring stakeholders (especially AEMO and DNSPs) have access to a robust evidence base for load forecasts developed for operational and planning purposes. • Reducing duplication of effort and cost across industry in gathering and processing EV load profile data. • Support consistency and best practice assumptions and approaches in ADMD estimation for DNSP regulatory submissions, especially for smaller DNSPs with fewer dedicated resources.	• Pooling of data resources from DNSP load monitoring, industry trials and vehicle telematics.
Workstream 3 - Increasing the granularity of EV uptake and load forecasts	• Exploring higher spatial resolution EV uptake and load projections to reduce costs across networks and support a range of secondary use cases. • Greater national consistency and transparency in the way EV uptake and load forecasts are interpolated to estimate loading on network assets	• Monthly EV uptake data sharing, including where attainable sub-postcode vehicle registration data. • Provide a range of spatial aggregation products suitable to different stakeholders

	Objectives	Main activities
	• Increased ability to accurately account for localised clustering effects on EV load forecasts. • Support more accurate targeting of infrastructure investments by public charging infrastructure developers.	
Workstream 4 – Collaboration on smart meter detection models	• Collaborate on NILM through complementary measures to reduce inefficient duplication of efforts	• Identify limitations in the accuracy of remote load detection models, resulting gaps in EV load's detected

Workstream 1 – EV data industry collaboration framework

Implementation options and approaches

AEMO has explored making use of an existing forum to this end, however no forum currently exists, from those identified, with an appropriate scope, membership and objective. As such, AEMO recommends establishing a new EV Data Forum with the purpose of collaboration and knowledge sharing under a national collaboration framework.

Given broad interest among stakeholders consulted, AEMO proposes that the invitations to participate in the EV Data Forum would be extended to relevant groups that represent both potential data sources and data users. These could include:

- AEMO
- All Australian electricity network businesses
- EV industry representatives
- Electricity retailer representatives
- Transport authorities
- Relevant research institutions (e.g. CSIRO)
- ARENA
- State and territory and federal government representatives
- Third party software providers

It is recommended forum arrangements be supported by a Terms of Reference setting out the scope of activities and expectations of participants, and allowing for them to be designed to complement, rather than duplicate existing EV data activities.

AEMO perceives that the primary resourcing requirement under this workstream would be expectations on participants to actively participate in forum meetings and related planning and knowledge sharing activities.

Workstream 2 – Pooling of vehicle load profile data

DNSPs are making significant efforts to gather charging load data (particularly load profiles) from a range of sources to support the development and validation of load models. Currently, data is being sourced from a mix of commercial and public sources and internal data acquisition efforts.

Several DNSPs and electricity retailers expressed an interest in accessing data via a common pool, noting that it would likely reduce the costs of their own data collection efforts. Several DNSPs expressed an openness to pooling collected data for common use subject to relevant commercial and privacy considerations. It was noted that any data pooling arrangements should be efficient and able to produce valued outputs.

Implementation options and approaches

A key focus for the EV Data Forum would be to establish arrangements for data pooling including consideration of centralised versus peer-to-peer data sharing arrangements. AEMO considers there is merit in a centralised data pool to build consistency and improve access to EV data across industry. This could include the appointment of a Data Manager who could work on behalf of industry to collect and share data and where agreed, transform EV-related data into high-value data products. AEMO considers the Data Manager could be from an independent research organisation such as CSIRO, or be an independent consultant.

Data sets that may be included in data pooling through the forum could include:

- EV load profile data from trials
- Vehicle telematics data
- Locational and load profile data detected from NILM models
- Metadata to inform market segmentation analysis.

Implementation considerations include the need for formal data sharing agreements to protect sensitive data and working through present barriers to data sharing by DNSPs, OEMs and ARENA trial participants. The Data Manager would be responsible for complying with the terms of any data sharing agreements and could develop value-added data products targeted at the needs of priority data users.

Under a centralised model, the Data Manager would work with EV Data Forum members to collect and standardise relevant data sets and would lead the engagement with third party data providers. The Data Manager would also host the data pool and provide online to Data Forum participants, or where appropriate, the broader public.

Future work could also look to define standardised data specifications that could be used in ARENA and other publicly-funded trials, including standardised metadata to identify data relevance to different market segments. A centralised model would also require contributors to agree to a common data license model. A range of relevant license templates exist and trade-offs between specific models will need to be further considered.

Critically, the approach relies on EV Data Forum participants maintaining a commitment to open data sharing and some degree of equity between participant contributions. AEMO notes that this will be complicated by significant resource disparities and divergent interests across relevant parties. For example, within the DNSP cohort, some DNSPs have resources to obtain relevant data through bespoke trials, while others do not.

Workstream 3 – Increase the granularity of EV uptake and load forecasts

Electricity industry stakeholders would likely benefit from EV registration data as a key input into local distribution network load forecasts, long-term forecasts, and EV charging infrastructure investment planning.

While AEMO has limited use for higher spatial resolution data, several DNSPs expressed an interest in exploring alternative options for obtaining higher resolution data such as at the mesh block[6], suburb or street level – or (most usefully) in aggregations aligned with network assets.

Several stakeholders expressed interest in this work performed by a third party at a national level. National data management arrangements could achieve cost efficiencies and enable a data product to be developed for a range of stakeholders including DNSPs and charging infrastructure developers. The EVC highlighted the benefits of publishing more granular data in informing industry decisions regarding the location of EV charging infrastructure.

Implementation options and approaches

This workstream could facilitate consultation with BITRE under NEVDIS towards the provision of a more granular and standardised vehicle registration dataset. Options explored could include developing anonymised aggregations suited to different use cases, supporting data exchange formats, licencing frameworks and activity resourcing.

A centralised Data Manager model presents the opportunity to:

- Provide a range of spatial aggregation products suitable to different stakeholders (e.g. DNSPs versus public charging infrastructure developers), and
- Improve the accuracy of localised load forecasting by cross comparing vehicle registration and high spatial resolution load data from other sources.

Decentralised or peer-to-peer data sharing models do not readily support these outcomes.

[6] An ABS statistical area typically representing 30 to 60 houses

Workstream 4: Collaboration on smart meter detection models

DNSPs generally considered they would look for EV load detection solutions that integrated well into their pre-existing data management systems and processes but were broadly open to considering an AEMO or a trusted third party providing EV load detection services based on AEMO's eMDM dataset where that delivered overall efficiencies to their business. Such an arrangement may benefit from networks making available PQD which is not typically collected by AEMO.

Whilst AEMO has recommended interest in pursuing development of a national NILM model, there is also likelihood that some or all DNSPs will continue, at least in the short to medium term, in developing their own NILM models. Under this workstream, collaboration on these initiatives could also be supported through potential knowledge sharing and also the pooling and sharing of EV load data that could be used for training purposes (workstream 2), which was highlighted as an interest during engagements.

Questions
What are your views on the proposed national collaboration framework and workstreams? • **Do you have any views on how this forum should be set up? For example, from the proposed organisations (ARENA, RACE for 2030, CSIRO) who would be the best organisation to chair it and drive it forward, and how could we best support industry participation?** • **What are your views on how these initiatives will align with longer-term objectives either of your organisation or more broadly to improve access to EV data?**

5 Proposed implementation

5.1 Costs and considerations

Table 5 summarises the potential costs that AEMO identifies being associated with both AEMO's proposed initiatives and the collaboration framework. As has informed development of the recommendations in this paper, AEMO has sought to select what it perceives could be low-cost, 'no regrets' actions to address short to medium term EV data needs for stakeholders. For the AEMO initiatives, AEMO proposes that these be AEMO-funded initiatives, given their linkages with AEMO's core work and new IPRR obligations. For the four workstreams under the national collaboration framework, AEMO proposes that this could be the potential for ARENA or RACE for 2030 funding, and would be explored if chosen to pursue by industry.

In relation to the four workstreams under the collaboration framework, AEMO identifies that there would also be costs and resourcing associated with participation time and effort for stakeholders that may choose to engage in the EV Data forum if it is established. This again reflects the need for stakeholders to see and be capable of deriving benefit from the forum for this participation time and effort to be offset by benefits in other areas, such as improved access to representative EV charging load profiles through data pooling.

Table 5: High level costs associated with the different recommendations

Proposed activity	Potential costs
AEMO initiatives	• Estimated costs would be $0.7m +/-40%, noting that part of this would be funded through AEMO's implementation of the IPRR regulatory reform. • Commercial costs for vehicle telematics data sets are currently untested. AEMO proposes a value-driven approach to obtaining vehicle telematics data and utilising it, wherein we would look to demonstrate value from a limited data set initially, before procuring larger sets.
WS1 – EV data collaboration framework	• Meeting administration: 0.2 FTE • Stakeholder participation time and effort (not specified)
WS2 – Pooling of EV load data	• Baseline administration effort: 0.5 FTE • Stakeholder participation time and effort (not specified) • Data hosting provision costs are highly dependent on the extent of data pooling that may occur under this workstream, however, the intent would be to initially demonstrate value with a limited data set before continuing at a larger scale.

Proposed activity	Potential costs
WS3 – More granular EV data	• Baseline administration effort: 0.3 FTE • Stakeholder participation time and effort (not specified)
WS4 – Collaboration on smart meter detection models	• Stakeholder participation time and effort (not specified)

5.2 Potential implementation timeline

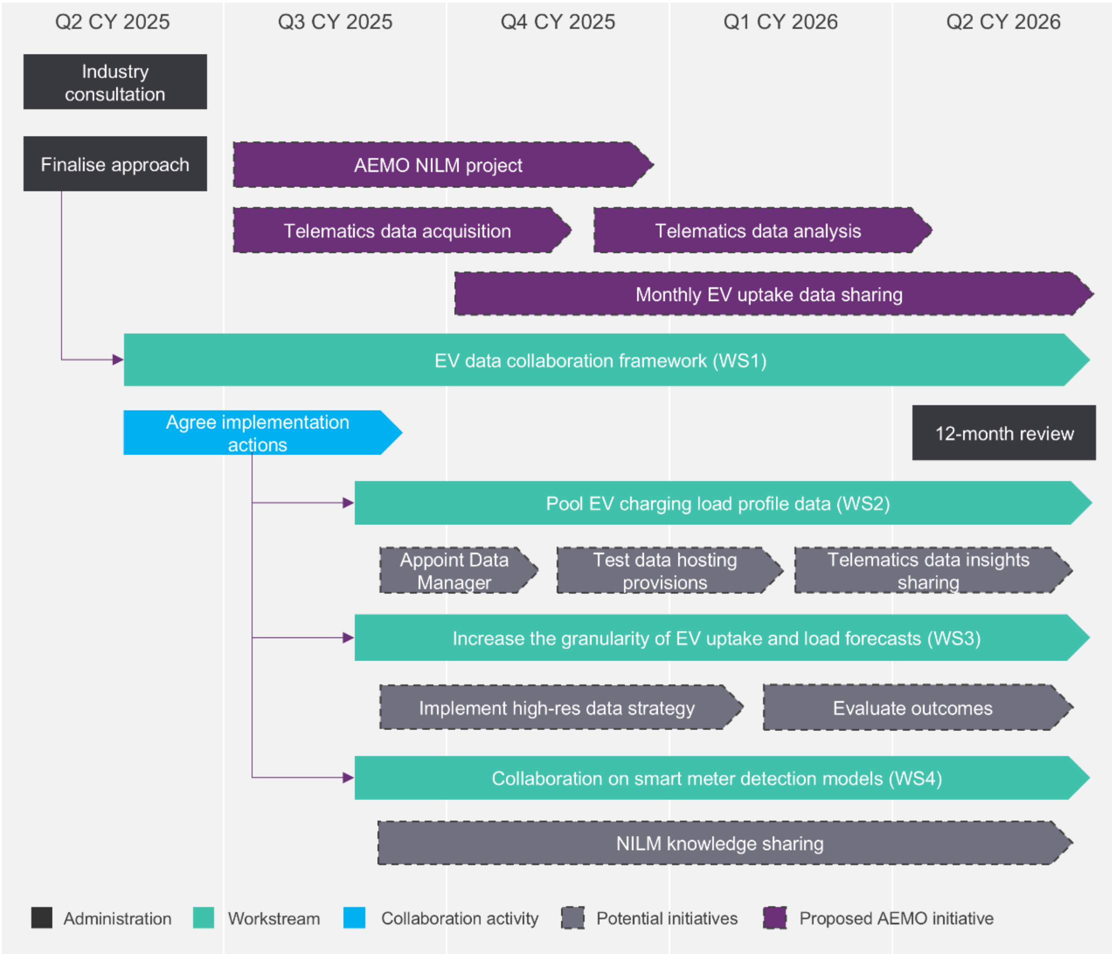

Figure 1: Potential timeline for implementation of EV Data recommendations

Figure 1 above provides a draft implementation schedule outlining the intended sequencing of activities, including AEMO's proposed initiatives and option for a national collaboration framework. This schedule emphasises that, while the workstreams presented provides a framework for developing collaborative industry initiatives, the scope, design and timing of specific initiatives will be determined by stakeholders through EV Data Forum collaborative processes.

Workstream activities, if implemented, would be ongoing until such time as agreed stakeholder objectives have been achieved, or alternative approaches are identified and agreed. It is proposed an operational review be conducted however after 12 months of establishing the framework to assess and determine its value and ability to meet objectives.

Questions
• **Do you consider these costs appropriate in relation to the potential benefits that could be derived?** • **Do you agree with the proposed implementation timeline?** • **Do you perceive any risks in AEMO's proposed recommendations and implementation?** • **Are there any other comments or suggestions you would like to make on AEMO's proposals in this recommendation paper related to EV data?**

A1. Glossary

Term or acronym	Meaning
AAA	Australian Automobile Association
AC	Alternating current
DC	Direct current
ADMA	After diversity maximum demand
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulatory
ARENA	Australian Renewable Energy Agency
BITRE	Bureau of Infrastructure and Transport Research Economics
CER/DER	Consumer energy resources/Distributed energy resources
CPO	Charge point operator
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSMS	Charging station management system
DNSP	Distribution Network Service Provider
ENA	Energy Networks Australia
EV	Electric vehicle
EVC	Electric Vehicle Council
EVSE	Electric vehicle supply equipment
FCAI	Federal Chamber of Automotive Industries
Mode 2 charging	AC charging using existing power point (10-15 Amp, single phase) in combination with a specialised cable, typically supplied with the vehicle
Mode 3 charging	AC charging, using a dedicated EV charger (32 Amp, single phase)
Mode 4 charging	DC fast charging (40-500 Amp, three phase), can range from around 25 kW to over 300 kW
NER	National Electricity Rules
NEVDIS	National Exchange of Vehicle and Driver Information System
NILM	Non-intrusive load monitoring
OEM	Original equipment manufacturer
OCPI	Open charge point interface
PQD	Power quality data
IASR	Inputs, assumptions and scenarios report
IEC	International Electrotechnical Commission
IPRR	Integrating price-responsive resources
ISP	Integrated system plan