STANDARDS Australia

REPORT

EV Charging Infrastructure Essentials

July 2025

Acknowledgements

Standards Australia extends its gratitude to the members of the Electric Vehicle Charging Infrastructure Advisory Group for their invaluable insights and guidance throughout this project. Their expertise has been instrumental in shaping our approach and ensuring the relevance and applicability of the recommendations developed in this report.

We also wish to express our sincere appreciation to the Department of Finance for their generous funding support, which has been crucial in advancing this work. Furthermore, we acknowledge the ongoing assistance and collaboration provided by the Department of Climate Change, Energy, the Environment and Water, and the Department of Industry, Science, and Resources. Their partnership has been vital in driving the project forward and achieving its goals. This collective effort exemplifies the power of collaboration.

ABOUT STANDARDS AUSTRALIA

Standards Australia is Australia's peak non-government, not-for-profit standards organisation. We work with Australian industry, government, academia, consumer groups, and the community to help address the challenges and opportunities facing the nation. Standards Australia represents Australia at the ISO and the International Electrotechnical Commission (IEC) and specialises in the development and adoption of internationally aligned standards.

Standards Australia's vision is to be a global leader in trusted solutions that improve life – today and tomorrow. This vision has taken on renewed importance as we grapple with emerging technologies that are transformative and developing at a rate that outpaces regulation and legislation. We work with a diverse group of stakeholders nationally and internationally to act on the opportunities and challenges posed by these technologies including quantum computing, smart cities, digital twin, the metaverse, and artificial intelligence (AI).

Key Terms, Abbreviations and Acronyms

AC	Alternating Current
ACEA	European Automobile Manufacturers' Association - Standards development organisation
ANSI	American National Standards Institute - Standards development organisation
BMS	Building Management System
CEN	European Committee for Standardization - Standards development organisation
DC	Direct Current
DNSP	Distribution Network Service Provider
EV	Electric Vehicle including cars, buses, trucks
EVSE	Electric Vehicle Supply Equipment
HEMS	Home Energy Management System
IEC	International Electrotechnical Commission - Standards development organisation
IEEE	Institute of Electrical and Electronics Engineers - Standards development organisation
ISO	International Organization for Standardization - Standards development organisation
JSA	Japanese Standards Association - Standards development organisation
KATS	Korean Agency for Technology and Standards - Standards development organisation
kW	Kilowatt (unit of measurement for power – the rate of electricity usage)
kWh	Kilowatt-hour (unit of measurement for energy – the total amount of electricity used)
NCC	The National Construction Code
OCPP	Open Charge Point Protocol
OEM	Original Equipment Manufacturer
SA	Standards Australia - Standards development organisation
SDO	Standards Development Organisation
SIRs	Service and Installation Rules
UL	Underwriters Laboratories - Standards development organisation
V	Voltage
V2G	Vehicle-to-Grid
V2H	Vehicle-to-Home

Executive Summary

Global efforts to decarbonise road transport are gaining momentum, fuelled by the rising demand for electric vehicles (EVs) and the pressing need to reduce emissions. In 2023, over 14 million electric vehicles were sold globally. Although the Australian EV market is still in its early stages, it is steadily gaining momentum.

The National Electric Vehicle Strategy (2023) outlines the Australian Government's ambition to make Australia a globally competitive market for electric vehicles by increasing access to affordable EV models, expanding charging infrastructure, and supporting the growth of a domestic EV industry. Meeting the expected surge in demand for chargers will depend heavily on the successful deployment of charging infrastructure. Ensuring a smooth, nationwide transition to EVs will require adopting and implementing key standards to guarantee the safety, reliability, and interoperability of this infrastructure.

Standards set best practices that foster global harmonisation and industry alignment, guaranteeing the quality, safety, and effectiveness of charging infrastructure in key areas such as electrical wiring, installation, and grid connection. Embracing and advancing these standards will support the national energy transition and enhance Australia's position as a global leader in the EV market.

The Australian EV standards landscape is well-positioned to adapt to the evolving energy transition. This report presents nine recommendations to further enhance Australian Standards for EV charging infrastructure. Key recommendations include updating well-established and fit-for-purpose Australian Standards to meet emerging needs, adopting relevant international benchmarks, and developing new labelling standards for vehicle-to-grid technologies where Australia can lead globally. Additionally, the recommendations advocate for increasing Australia's influence on international standards committees and promoting industry-led initiatives and government actions to harmonise regulations across states and territories.

Recommendations Summary

Recommendation 1: Support revision of electrical safety standards

Standards Australia should support revisions currently being undertaken to strengthen existing electrical safety standards. These revisions are being done to ensure the safety and reliability of EV charging infrastructure. Electrical standards such as AS/NZS 3000:2018, *Electrical installations*, will be updated to include earthing, protection, maximum demand and distribution board requirements for electric vehicle supply equipment.

Recommendation 2: Modified text adoption of IEC 61851-1:2017, *Electric vehicle conductive charging system - Part 1: General requirements*, for EV supply equipment

Standards Australia and the Australian Government should collaborate to propose a modified text adoption of IEC 61851-1:2017, *Electric vehicle conductive charging system – Part 1: General requirements*, to include resistance to heat and fire requirements from AS/NZS 60335.1:2020, *Household and similar electrical appliances — Safety, Part 1: General requirements,* Clause 30.2.

Recommendation 3: Guidelines for EV charging standards to support industry

Standards Australia and industry stakeholders should work together to develop informative documents and guidelines for the EV industry to raise awareness about existing standards for EV charging and vehicle-to-grid technologies.

Recommendation 4: Develop international labelling regulation for vehicle-to-grid and vehicle-to-home classification

The Australian Government should propose the development of an international labelling regulation that classifies EVs with vehicle-to-grid (V2G) or vehicle-to-home (V2H) capabilities. Developed through Commonwealth participation in the UNECE World Forum for Harmonization of Vehicle Regulations (WP.29), this standard would lead the way internationally by promoting transparency about vehicle capabilities and reducing confusion among EV purchasers.

Recommendation 5: Harmonise DNSP requirements in Australia

The Australian Government and electricity suppliers should work together to harmonise the various Service and Installation Rules outlined by Distribution Network Service Providers (DNSPs) across Australian states and territories.

Recommendation 6: Support Australian representation on international standards committees

Standards Australia should proactively support Australia's application to become a participating member of the IEC subcommittee responsible for the standardisation of Electrical Energy Efficiency products (IEC TC/23 SC 23K).

Recommendation 7: Align EV charging infrastructure standards with National CER Roadmap

Standards Australia, the Australian Government, and industry should work together to deliver on EV infrastructure standards priorities outlined in the Australian Government's National Consumer Energy Resources (CER) Roadmap. This includes standards for device interoperability, and vehicle-to-grid charging.

Recommendation 8: Increase Australian participation in IEC technical committees

Standards Australia and technical experts should work together to increase committee involvement in international standardisation projects conducted by IEC TC 69 working groups, the international committee responsible for standards development relating to electrical power and energy transfer systems for electrically propelled road vehicles and industrial trucks.

Recommendation 9: Adopt international standards for communication between EVs and charging management systems

Standards Australia and the Australian Government should collaborate to consider adopting IEC 63584, *Open Charge Point Protocol (OCPP) (Fast track)*, when published. The standard is a direct fast-tracked adoption of the Open Charge Point Protocol (OCPP), an application protocol for the communication between EVs and charging management systems.

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Introduction

The increasing demand for electric vehicles highlights the urgent need for a reliable and extensive charging infrastructure. In Australia, a lack of sufficient charging facilities could hinder the adoption of EVs. To support the expansion of this infrastructure, the Australian Government has allocated $500 million to expand national EV charging and hydrogen refuelling infrastructure and support investment in fleets through its Driving the Nation Fund.[1] With predictions that EVs could account for 90% of all cars and light vehicles in Australia by 2050[2], establishing a robust charging network capable of meeting this growing demand is essential.

Electric vehicles offer a significant opportunity to decarbonise Australia's transport sector, providing environmental, economic, and public health benefits. By 2035, over a quarter of vehicles on global roads could be electric.[3] Australia's rich renewable energy resources, critical minerals, and skilled workforce position the country to become a strong player in the global EV market. The rising domestic demand for EVs and the development of a fast-charging network along major highways underscore the need for comprehensive EV infrastructure. Leveraging Australia's natural resources, strong policy frameworks, and a wide range of internationally aligned standards will be crucial for successfully implementing EV charging infrastructure across the nation. As EV adoption increases, so will the demands on chargers and the electricity grid, further emphasising the need for a resilient EV infrastructure network.

Standards are integral to the EV infrastructure ecosystem, providing nationally harmonised best practices that ensure safety, global interoperability, and consistency across the industry.

Purpose

The purpose of this report is to set out findings from the EV Charging Infrastructure Advisory Group meetings and associated standards mapping research. This report aims to:

- Highlight gaps in standards relating to EV charging infrastructure
- Provide recommendations which may include the adoption and development of appropriate standards in Australia

Addressing gaps in technical standards for EV charging infrastructure will ensure uniform installation requirements and support scalable solutions, both of which simplify the deployment of new charging setups and facilitate the seamless expansion of networks. Prioritising the adoption and development of international standards will facilitate market access, promote harmonisation and boost interoperability.

Internationally aligned standards can ensure compatibility between various electric vehicles and chargers, enhancing user convenience. They can also facilitate network expansion, allowing new chargers to integrate more smoothly into the existing systems, and ensuring greater accessibility for all EV owners, including those with disabilities. Standards can define clear metrics for charging performance, ensuring reliable and effective charging while promoting safety and reliability by mitigating accidents, managing electrical loads, and handling emergency situations effectively.

The project's focus is to highlight insights and findings from the Advisory Group. In addition to these insights, the project will also present results from the research mapping of Australian and international standards covering EV charging infrastructure.

1 The National Electric Vehicle Strategy, Department of Climate Change, Energy, the Environment and Water (2023)
2 Australian Electric Vehicle Market Study, Clean Energy Finance Corporation, Australian Renewable Energy Agency, and Energeia (2018)
3 Global EV Outlook 2024, IEA (2024)

Scope

This project aims to identify and rectify gaps in existing Australian Standards related to the following areas:

- Electrical Wiring and Switchboard Requirements
- Charger Standards and Installation
- Electricity Grid and Grid Connection Protocols
- Charger Scheduling, Control, and Smart Charging

The project seeks to address gaps in the above areas to ensure EV charging infrastructure in Australia is safe, reliable and in adequate supply.

The scope of this project excludes vehicle specific charging systems standards, non-electrical safety standards, renewable energy integration standards, and environmental impact standards for chargers.

Standards Australia

Standards Australia is Australia's peak, independent, non-governmental, not-for-profit standards organisation. Standards Australia is Australia's representative of the ISO and IEC.

Standards Australia facilitates the development and adoption of internationally aligned standards in Australia. This is achieved through:

- Partnering in ISO and IEC standards development.
- Adoption of international standards, or regional standards where international standards do not exist.
- Creation and development of new standards where there are gaps in the international landscape or Australia has specific requirements.
- Empowering other organisations/bodies to develop standards content.

Standards Australia is not responsible for enforcing regulations, mandating standards, or certifying conformance with standards. However, state and federal governments often refer to Australian Standards or joint Australian/New Zealand Standards in legislation. For further information, see "Standards and the Law" on our website.

Advisory Group

There are various stakeholders working to understand the EV charging infrastructure landscape. To ensure that the recommendations put forward in this report are well-considered and comprehensive, it was important to bring together a group of stakeholders that understand the many aspects of EV charging and can advise Standards Australia on the future standardisation needs as a result.

The Advisory Group, representing the stakeholder engagement component of the project, was established to review and provide advice on standards relating to EV charging infrastructure. The group used its expertise to shape the development of the standards mapping research, analyse the gaps and opportunities, and identify a strategy to address them.

Advisory Group members involved in this project have relevant expertise in the project scope, standards development, industry, academia, and/or government policy and regulation. Their collective knowledge and insights were crucial in ensuring that the standards pathway is robust, relevant, and effective in addressing the needs of the EV charging infrastructure sector.

Role of Standards Australia on national and international standards development

Standards Australia develops standards that deliver a net benefit to the Australian community. Our processes are designed to ensure that standardisation in Australia remains robust, promotes economic efficiency, and supports consumer safety.

Standards Australia is committed to aligning with Australia's international obligations under the WTO Technical Barriers to Trade Agreement. This means using relevant international standards, guides, or recommendations as a basis for regulations, unless a relevant international standard does not exist, or the international standard is not appropriate to fulfill the policy objectives. For example, due to climatic or geographical differences. As Australia's representative at the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC), Standards Australia specialises in the development and adoption of internationally aligned standards in Australia. We facilitate technical committees of Australian experts who provide expertise to help shape international standards, ensuring Australia's interests are represented globally. Our contributions are made with the view that the International Standard will be used in Australia. In the absence of an International Standard, Standards Australia looks to relevant regional standards for adoption.

At a regional level, harmonisation of Australian and New Zealand standards is critically important. Australia and New Zealand are close trading partners with a common economic market and strong trade flows. The Trans-Tasman Mutual Recognition Act supports the harmonisation of standards in Australia and New Zealand by promoting bilateral integration and economic convergence. Standards Australia and Standards New Zealand work together to deliver joint standards appropriate for our economies across a range of sectors, including construction, consumer goods and electrical equipment. The identification of joint initiatives is a priority for Standards Australia, and we will continue to work with Standards New Zealand and relevant stakeholders to ensure harmonisation.

In some cases, relevant international standards do not exist, or are inappropriate for the Australian context. When this occurs, it may be necessary to develop an Australian Standard. Standards Australia has established processes for the development of Australian Standards to ensure all relevant impacts are considered. Proposals for the development of new standards are assessed under strict criteria, with consideration for:

- Potential impacts on competition and innovation
- Potential economic impacts across various domestic sectors
- Potential impacts on international alignment and global markets

This assessment is used as part of the evaluation process to determine whether appropriate international standards are available for adoption, or whether an Australian Standard should be developed.

A proposal must be submitted to Standards Australia to adopt an international standard, to revise or amend an existing standard, or to develop a new standard. A proposal can be submitted by any member of the public and is reviewed on four key criteria: evidence that there is a need for the work, a robust scope, a well-defined net benefit case and comprehensive stakeholder support, considering many different stakeholders interest categories.

Proposals that meet all key quality criteria will be assessed and resourced monthly. Once a proposal is approved, generally, if a proposal is received to revise/amend an existing standard, the project will be assigned to the technical committee that initially developed the standard. Similarly, if a proposal is approved to adopt international standard, the adoption(s) will be facilitated by the Australian technical committee that mirrors the international technical committee. For a proposal to develop a new standard, Standards Australia will ultimately decide

(in consultation with the proponent and relevant stakeholders) on which technical committee the project will be assigned to, or if a new technical committee is required.

In 2023, Standards Australia implemented alternate standards development pathways to accelerate standards development efforts in new and emerging areas of endeavour where traditional models of standards development may not be fit for purpose. A major pillar of the alternate standards development pathways is the establishment of 'Project Committees', which may be formed to develop an Australian Standard under the alternative path or where technical specifications or handbooks are desired, but no technical committee exists. Project Committees are not formally constituted but aim to engage a broad group of stakeholders.

In addition to standards, Standards Australia also publishes other types of documents such as handbooks and technical specifications. There are instances where a normative or informative technical document is required, and traditional standardisation processes may not deliver the optimal solution. These are referred to as 'lower consensus solutions' due to the lower degree of consensus and consultation required to publish such documents, as compared to Australian Standards. The initiation of a new document such as a handbook or technical specification is still subject to a proposal being submitted to and approved by Standards Australia.

Benefits of international standards adoption

Adopting international standards is vital for Australia to implement safe and reliable EV charging infrastructure. These standards ensure consistent quality, reliability, and interoperability, enhancing consumer trust and ensuring national infrastructure is equipped to manage EV uptake. They align Australian EV products with international requirements, facilitating market entry, reducing trade barriers, and simplifying the approval process. By incorporating the latest technological advancements and best practices, these standards support innovation and provide a clear roadmap for research and development, allowing Australia to match global benchmarks. Operationally, standards streamline processes, reduce costs, and optimise supply chains through guidelines and efficient resource use.

Economically, compliance with international standards can attract foreign investment, support job creation, and integrate Australian manufacturers into global supply chains. Additionally, international standards ensure the interoperability of EV chargers with different vehicles and charging systems, enhancing their appeal and usability in global markets. Overall, adopting international standards will strengthen Australia's reputation as a leader in the clean energy transition by facilitating the implementation of high-quality, reliable EV charging infrastructure, aligned with national and international policy objectives.

Case study – EV Plug War in the United States

In Australia, Type 2 vehicle couplers are primarily used for the AC charging of an electric vehicle, while CCS2 vehicle couplers are used for DC charging. This market consolidation and alignment with European charging standards has enhanced interoperability and accessibility for Australian consumers, while reducing costs and uncertainty for both manufacturers and EV buyers.

By contrast, the United States faces a critical challenge in achieving widespread EV adoption due to two competing EV charging plug standards: SAE J3400, commonly known as the North American Charging Standard (NACS), and the Combined Charging System 1 (CCS1). The existence of competing standards creates significant obstacles for consumers, EV manufacturers, and charging infrastructure providers, hindering market growth and consumer confidence.

From 2025, most EV manufacturers will begin equipping electric vehicles destined for the US market with NACS charging ports. However, the CCS1 charging port remains prevalent among non-Tesla EVs in the United States. The current lack of a unified EV charging standard has slowed EV uptake in the US and created confusion among consumers about which charger plugs they can use.

Sources:
AP News, July 2023
AP News, December 2023
VESR, February 2024

Standards mapping overview

To gain insight into the current standards landscape, research was conducted on standards related to EV charging infrastructure both in Australia and internationally. Table 1 details the scope and results of this standards mapping research. The aim of this research was to equip the advisory group with essential data to identify gaps and opportunities within Australia's standards framework across the EV charging infrastructure.

No. of Standards	Total of 268 standards • 232 distinct standards, and 36 international adoptions. • 168 standards developed by international organisations. • 38 are under development and not yet published.
Australian Standards	Total of 50 standards • 4 under development. • 14 developed nationally by Standards Australia. • 36 international adoptions (identical, modified or planned for adoption).
Regions Covered	International, Europe, US, UK, Australia, Japan, South Korea.
Standards Development Organisations	Standards Australia (SA) International Organization for Standardization (ISO) International Electrotechnical Committee (IEC) Institute of Electrical and Electronics Engineers (IEEE) The European Committee for Standardization (CEN-CENELEC) Underwriters Laboratories (UL) British Standards Institution (BSI) Korean Agency for Technology and Standards (KATS) Japanese Industrial Standards Committee (JISC) European Automobile Manufacturers' Association (ACEA) OpenADR Alliance Open Charge Alliance Japan Electric Vehicle Fast Charger Association
Areas Covered	Electrical wiring and switchboard requirements EV charger and installation Electricity grid and grid connection protocols Charger scheduling, control, and smart charging Interoperability
Types of Publications	Standards, Technical Reports, Technical Specifications, Workshop Agreements, Publicly Available Specifications, Handbooks.

Table 1: Standards mapping scope

The standards development organisations featured in this report were selected based on Australia's existing bilateral agreements, international trade partnerships, technological advancements, and recommendations from the Advisory Group. Although the mapping is not exhaustive, it has been specifically tailored to address the project's needs and objectives.

The mapping research identified a total of 268 standards, including 232 distinct standards and 36 international adoptions, from 13 international and national standards development organisations. Most of these standards were created by prominent international bodies like ISO and IEC, with a significant number also originating from U.S.-based organisations. Of the 268 standards mapped, 50 standards were mapped in Australia, 12 of which were developed in Australia plus two currently under development and 34 are international standards that have been adopted

in Australia with an additional two planned for adoption. Figure 1 illustrates the composition of Australian Standards. The Australian Standards have been developed or adopted as either Australian Standards or joint Australia/New Zealand standards.

Figure 1: Mapped Australian standards relating to EV charging infrastructure. UD=under development, PA=planned adoption

Of the total mapped standards, the majority (147) were developed by the IEC (Figure 2 and 3). The IEC catalogue of standards relating to EV charging infrastructure is well developed, and regional standards organisations such as KATS, BSI and CEN-CENELEC have adopted a significant number of IEC standards. To prevent duplication across the standards map, the mapping data excludes regional adoptions of international standards, except for those adopted in Australia, where international adoptions are included to provide a complete overview of the Australian standards landscape.

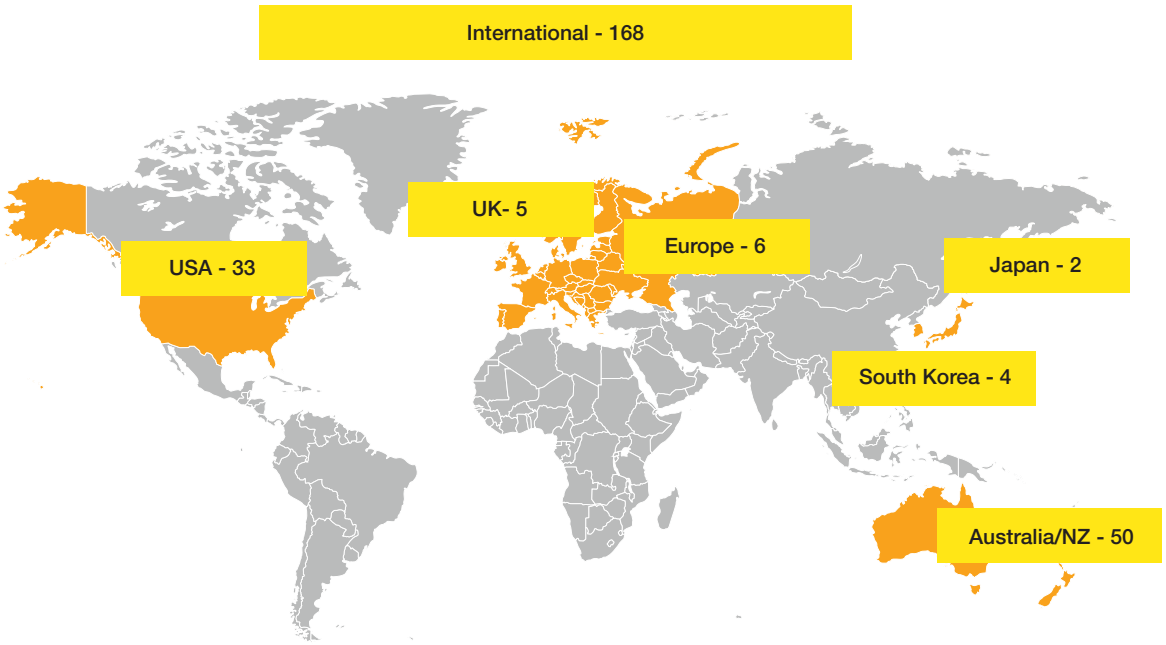


Figure 2: Number of standards mapped by region

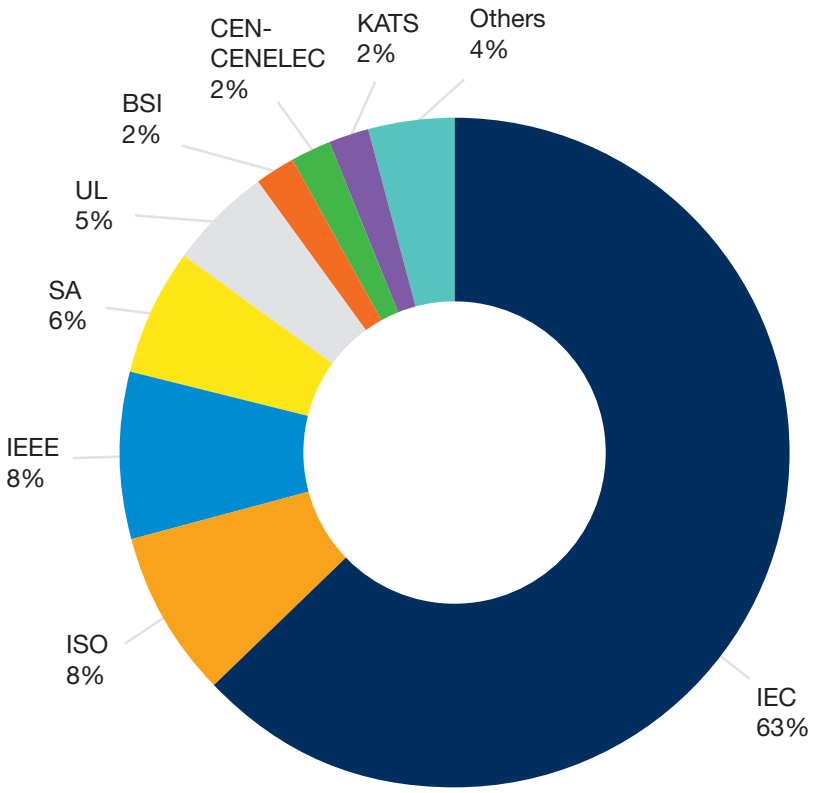


Figure 3: Percentage of standards mapped (excludes adoptions), by standards development organisations

In line with the project scope, standards were organised into four categories: Electrical Wiring and Switchboard Requirements; EV Charger and Installation; Electricity Grid and Grid Connection Protocols; and Charger Scheduling, Control and Smart Charging (Figure 4). Additionally, standards related to interoperability were specifically categorised to emphasise their critical role in ensuring the effective operation of EV charging infrastructure.

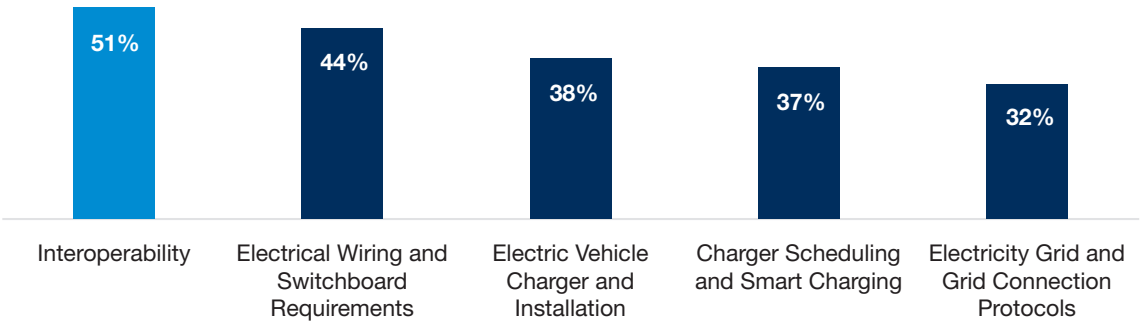


Figure 4: Percentage of standards mapped by topic area.
Note: Standards may be included in multiple categories based on their content, so the percentages in the chart do not sum to 100%.

International

Over half of the international standards identified in the mapping were developed by the IEC. Among these, 78 pertain to electrical wiring and switchboards, 65 address interoperability, 43 focus on EV chargers and installation, 41 cover charger scheduling, control, and smart charging, and 38 are related to electricity grid and grid connection protocols.

The IEC standards cover diverse aspects of EV charging infrastructure, including safe installation, compatibility requirements, vehicle-to-grid connection, and communication between EVs and EV chargers.

In addition to the IEC standards, 19 ISO standards were mapped for this project. There was significant overlap across the topics, with some ISO standards falling under multiple categories. For example, ISO 15118, *Road vehicles – Vehicle to grid communication interface*, encompasses EV charger and installation, grid connection, charger scheduling, and interoperability.

Acknowledging the breadth of standards work happening at a regional level, the mapping research also identified relevant regional standards from North America, Europe, UK, and Asia.

North America

The North American standards landscape for EV charging infrastructure is quite robust, making up 33 of the total standards mapped as illustrated earlier in Figure 1. Three North American standards development organisations were included in the mapping scope: UL, IEEE and OpenADR Alliance.

The mapping exercise identified 12 UL standards, with half relating to electrical wiring and switchboard requirements. These standards cover safety requirements for EV charging supply circuits and functional requirements for EV charging cables and connectors. The other half focus on EV charger installation, addressing areas such as wireless power transfer, bidirectional charging, and safety requirements for EV supply equipment. Two UL standards are related to charger scheduling, control, and smart charging, while none pertain to electricity grid and grid connection protocols.

Additionally, 18 IEEE standards were identified, primarily focusing on electricity grid and grid connection protocols (15 standards). These standards outline various test methods and specifications for interconnection and interoperability between distributed energy resources and electric power systems. Of the total IEEE standards mapped, 15 are related to charger scheduling, control, and smart charging, with 13 overlapping with those categorised under electricity grid and grid connection protocols. The remaining two standards include specifications for bidirectional charging and control for direct current (DC) quick charging.

Three OpenADR Alliance standards were identified, with all three relating to electricity grid and grid connection protocols, and charger scheduling, control and smart charging. These standards primarily focus on communication protocols needed for the exchange of energy demand management information between DNSPs and consumers.

Europe

European standards are relatively few, with only 2% of the mapped standards originating from European standards development organisations (Figure 2). Among these, three standards relate to EV charger installation, including the prominent CCS (Combined Charging System) standards, CCS1 and CCS2, both developed by ACEA. CCS2 is the primary EV charging standard in the European Union and is mandatory for EV charging networks. These standards address various aspects of EV charging, such as communication between the vehicle and charging station, authentication, and load balancing.

In the area of charger scheduling, control, and smart charging, two standards were identified, along with two additional workshop agreements. Although not formal standards, these workshop

agreements offer guidance for integrating smart charging services into existing infrastructure. Notably, no European standards identified in the research pertain to electricity grid or grid connection protocols.

Asia

Six published standards from the Asia region were identified in the mapping, including two from Japan and four from South Korea. All six standards pertain to EV charger installation and address areas such as the testing efficiency of charging systems, charging station management systems, and charging service roaming. Among these, the CHAdeMO Protocol from Japan stands out as a notable standard for DC charging of electric vehicles. Although CHAdeMO was initially widely adopted by Japanese automakers, it is now being gradually phased out in favour of globally recognised standards like CCS2.

Case study – The Future of EV Charging

By 2030, the EV inductive charging market is projected to reach approximately $1.3 billion USD[5]. Companies such as BMW, Mercedes-Benz and Volkswagen have begun investing in inductive charging research and development.

The success of wireless charging will rely on the implementation of inductive charging infrastructure and the development of relevant standards. SAE International, a standards development organisation based in the United States, is leading the global standardisation of inductive charging technology.

In 2022, SAE International published a wireless power transfer standard for light-duty plug-in EVs. The standard covers aspects of wireless charging, including safety, electromagnetic compatibility, interoperability and performance. Future editions of the light-vehicle standard may include specifications for bidirectional charging and dynamic applications, which would allow an EV to charge while in motion.

Meanwhile, the IEC has developed IEC 61980-1:2020, *Electric vehicle wireless power transfer (WPT) systems - Part 1: General requirements*, which provides foundational guidelines for the design, development, and operation of electric vehicle wireless power transfer systems.

Given the promising potential of inductive charging, Australia should assess its EV infrastructure and standards landscape in preparation for this emerging technology.

Sources:
Bloomberg, February 2024
Markets and Markets, October 2023
SAE International, August 2022

Standards mapping insights

Mapping both international and Australian standards offers a detailed overview of the EV charging infrastructure landscape, highlighting potential gaps and opportunities for standards development in Australia.

As Australia primarily imports EVs and charging equipment, aligning with international standards is crucial for market integration and trade facilitation. The mapping research reveals that Australia's EV charging infrastructure is largely aligned with global standards, with 72% of Australian Standards being international adoptions. Nonetheless, there are areas where additional alignment may be necessary. This section will explore Australia's current standards landscape for EV charging infrastructure, focusing on the four key topics outlined in the project scope.

A significant proportion of the Australian Standards mapped pertain to electrical wiring and switchboard, with 34 out of 50 standards focusing on this area. This reflects a strong national emphasis on electrical safety. These 34 standards address various aspects of electrical wiring, including safety, testing, and installation. Notably, 27 of these standards are internationally adopted from ISO and IEC, underscoring Australia's dedication to aligning with global best practice for the electrical safety of EV infrastructure.

EV charger and installation standards make up 14 of the 50 Australian Standards mapped, highlighting their critical role in EV charging infrastructure and adoption in Australia. Of these, eight are internationally adopted from ISO and IEC, while the remainder are Australian or joint Australian/New Zealand Standards.

Australia also has a robust set of standards for electricity grid and grid connection protocols, accounting for 13 of the 50 Australian Standards mapped. These standards address various aspects such as transmission protocols, inverter installation, and smart grid terminology. Seven of these standards are internationally adopted from IEC and IEEE, including IEEE 2030.5-2018, *Smart Energy Profile Application Protocol*, which sets requirements for EVs to interact with the electricity grid.

Charger scheduling, control, and smart charging standards represent 14 of the 50 Australian Standards mapped. There is significant overlap with standards related to electricity grid and grid connection protocols, reflecting the close integration of EV charging with the broader electricity grid. Of these 14 standards, eight are internationally adopted from IEC and IEEE, demonstrating strong alignment with global best practices in this area.

Current status and needs

The following section is based on insights from the Advisory Group. It details the current standards landscape and needs for each of the four focus areas, providing insights that form the basis of the report's recommendations.

Electrical wiring and switchboard requirements

Electrical wiring and switchboard requirements can ensure the safe and reliable connection of EV charging systems by establishing safety and installation protocols that protect users and mitigate the risk of electrical shocks.

There are several existing Australian Standards relating to electrical wiring and switchboard requirements that may support the implementation of EV charging infrastructure (Table 2). These standards cover electrical wiring requirements more broadly and are not specific to EVs, such as AS/NZS 3000:2018, *Electrical installations.* To support the growing EV industry, there are several international standards currently being developed outlining specific electrical requirements for EV charging, as illustrated in the International Standards section of Table 2.

Australian Standards
AS/NZS 3000:2018, *Electrical installations*
DR AS/NZS 62423:2009, *Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses*
DR AS/NZS 62752, *In-Cable Control and Protective Device for mode 2 charging of electric road vehicles (IC-CPD)*
DR AS/NZS 62955, *Residual direct current detecting device (RDC-DD) to be used for mode 3 charging of electric vehicles*
AS/NZS 61439-1:2016, *Low-voltage switchgear and controlgear assemblies, Part 1: General rules (IEC 61439-1, Ed. 2.0 (2011), MOD)*
AS/NZS 4777.1:2024, *Grid connection of energy systems via inverters, Part 1: Installation requirements*
AS/NZS 62196-1:2022, *Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles, Part 1: General requirements*
International Standards
IEC 60364-1:2005, *Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions*
IEC 60364-7-722:2018, *Low-voltage electrical installations - Part 7-722: Requirements for special installations or locations - Supplies for electric vehicles*
IEC 60364-8-1:2019, *Low-voltage electrical installations - Part 8-1: Functional aspects - Energy efficiency*
IEC TS 60364-8-3:2020, *Low-voltage electrical installations - Part 8-3 : Functional aspects - Operation of prosumer's electrical installations*
DR IEC 60364-8-81 ED, *1 Low-voltage electrical installations - Part 8-81: Functional aspects - Energy efficiency*
DR IEC 62955 ED 2, *Residual direct current detecting device (RDC-DD) to be used for mode 3 charging of electric vehicles*
DR IEC 63053-2 ED 1, *Residual current operated circuit-breakers for household and similar uses for dc systems - Part 2: Residual current operated circuit breakers without integral overcurrent protection (DC-RCCBs)*
DR IEC 62196-1 ED 5.0, *Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 1: General requirements*
DR IEC 62196-2 ED 4.0, *Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 2: Dimensional compatibility requirements for AC pin and contact-tube accessories*
DR IEC 62196-3 ED 3.0, *Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 3: Dimensional compatibility requirements for DC and AC/DC pin and contact-tube vehicle couplers*
DR IEC 62196-7 ED 1.0, *Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 7: Vehicle adapters*
DR IEC 63445, *System referencing conductor switching device*

Table 2: Key standards relating to electrical wiring and switchboard requirements. DR = Draft

The Australian Standards landscape for electrical wiring and switchboards is well established, covering aspects including safety, design, installation and testing. There are numerous standards development projects underway both nationally and internationally to integrate EV charging infrastructure into existing electrical wiring and switchboard requirements.

At a national level, the Wiring Rules technical committee is responsible for the development of Australian or joint Australian/New Zealand Standards for electrical wiring and related matters. This includes essential requirements for ensuring the safety of persons, livestock, and property from fire and shock, and for safe electrical installations of buildings, structures and premises. The technical committee has established a working group for EV charging installations to

ensure existing electrical wiring and switchboard standards like AS/NZS 3000:2018, *Electrical installations,* consider and incorporate electrical requirements for EVs.

Standards Australia's national subcommittee for Circuit Breakers and Residual Current Devices is enhancing Australia's EV charging infrastructure across three main areas. Regarding charging cables, the subcommittee is working to adopt IEC 62752, *In-Cable Control and Protection Devices (IC-CPDs) used in Mode 2 charging.* This standard ensures that EV charging cables are safe and reliable, protecting both the vehicle and charging infrastructure from the risk of overcurrent, short circuit, and overvoltage.

The committee is also looking to adopt IEC 62423:2009, *Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses,* for Australia. Adopting this standard will help strengthen the safety and effectiveness of residual current devices, an important component of EV charging stations.

To further ensure the electrical safety of EV charging equipment, the technical committee is in the process of adopting IEC 62955, *Residual direct current detecting device (RDC-DD) to be used for mode 3 charging of electric vehicles*, pending the release of its second edition. The standard outlines requirements for safety devices typically integrated within mode 3 EV chargers, which protect users by disconnecting the power supply to the EV when a smooth residual direct current equal to or above 6 milliamps (mA) is detected.

The IEC's Electrical Energy Efficiency products subcommittee is responsible for standardisation in the field of energy efficiency products, systems and solutions which seek to optimise the efficient use of electrical energy for households and similar applications. Australia is in the process of joining this subcommittee as a participating member. Representation will help strengthen national alignment with international standards and facilitate access to the latest developments in energy efficiency systems such as smart grids. Australia's participation will be confirmed at the IEC Annual General meeting in late 2024.

While significant work is underway to ensure electrical wiring and switchboard standards can support the implementation of EV charging infrastructure, Australia's earthing requirements will need to be considered in future standards development.

Electrical Standards for EV Supply Equipment

Electrical wiring and switchboard standards play a crucial role in the safety and protection of electric vehicle supply equipment. Electrical standards relating to the earthing, protection, maximum demand and distribution for EV supply equipment are of particular importance.

From a safety perspective, earthing systems ensure excessive electrical current is diverted and dissipated to the earth, preventing dangerous voltages from building up and reducing the risk of electric shock. Earthing systems also protect EV supply equipment components from overheating and malfunctioning, thus reducing the risk of electrical fires.

Australia has a TN-C-S earthing system that will need to be considered in the development of EV supply equipment standards and application of existing standards. The TN-C-S earthing system is used by only a few countries, including Britain and New Zealand. Recently, the British Standards Institution (BSI) amended the national standard for electrical wiring and installation requirements (BS 7671:2018) to include specific requirements for EV supply equipment. These requirements address the risks and hazards associated with EV charging installations, including specific earthing, protection, and maximum demand requirements for EV supply equipment safety. Given the common earthing system shared by Australia and Britain, amendments to the BS 7671:2018 could be used to inform the modification of Australia's electrical wiring standards.

EV chargers and installation

Best practices for EV charger installation, including location considerations, wiring configurations, and compliance testing procedures, can provide guidance to stakeholders and ensure the compatibility, reliability and safety of EV chargers.

Compared to electrical wiring and switchboard requirements, there are relatively few Australian Standards for EV chargers and installation (Table 4). However, the adoption of important international standards and development of new guidance has put Australia in a strong position. Australia has adopted IEC 61851.23:2014, *Electric vehicle conductive charging system, Part 23: D.C electric vehicle charging station,* which is one of the key international standards for installing direct current charging stations. At a national level, the relevant technical committee is currently developing two new technical specifications (Table 4), which are intended to serve as best practice guidance for EV charging installation in residential settings and commercial premises.

Australian Standards
DR SA TS 5396, *Technical Specification – Electric vehicle (EV) chargers for residential use*
DR SA TS 5397, *Technical Specification – Electric vehicle (EV) chargers for commercial applications*
AS IEC 61851.23:2014, *Electric vehicle conductive charging system, Part 23: D.C electric vehicle charging station*
AS/NZS 3100:2022, *Approval and test specification - General requirements for electrical equipment*
International Standards
DR IEC 61851-1 ED 4.0, *Electric vehicle conductive charging system - Part 1: General requirements*

Table 4: Key standards relating to EV chargers and installation. DR = Draft

Harmonisation of EV Supply Equipment Standards

The installation of EV supply equipment is challenged by the diverse factors that need to be considered, such as building type, charger type, location, and jurisdictional regulations. In Australia, disparate standards for the installation of EV supply equipment have resulted in inconsistent practices, increased costs, and potential safety risks. A large financial burden is placed on EV supply equipment installers in Australia who currently need to demonstrate compliance with multiple standards including IEC 61851-1:2017, *Electric vehicle conductive charging system - Part 1: General requirements*, elements of AS/NZS 60335.1:2020, *Household and similar electrical appliances — Safety, Part 1: General requirements*, and Open Charge Point Protocol (OCPP).

A potential solution to address the fragmented standards landscape would be a national adoption of IEC 61851-1:2017 that includes resistance to heat and fire requirements from AS/NZS 60335.1:2020, *Household and similar electrical appliances — Safety, Part 1: General requirements*, Clause 30.2. The incorporation of heat resistance requirements will help reduce fire hazards associated with EV supply equipment, reduce costs, and simplify the certification process for EV supply equipment manufacturers and installers. A modified adoption of IEC 61851-1:2017, *Electric vehicle conductive charging system - Part 1: General requirements*, elements may also help harmonise national best practice with international guidelines, reducing market barriers for EV and EV supply equipment exporters while also considering Australia's unique needs.

Electricity grid and grid connection protocols

Grid connection protocols support the seamless integration of EV chargers with the electricity grid. Communication protocols, voltage levels, frequency requirements, and grid stability measures can ensure grid interoperability and scalability.

Australia's world-leading uptake in photovoltaic solar energy has contributed to four key Australian/New Zealand Standards published in this area (Table 5). There are two standards developed by the national committee that are of particular importance to the safe installation of bidirectional EV charging infrastructure:

1. AS/NZS 4777.1:2024, *Grid connection of energy systems via inverters, Part 1: Installation requirements*; and
2. AS/NZS 4777.2:2020, *Grid connection of energy systems via inverters, Part 2: Inverter requirements.*

Together, these grid connection standards facilitate connection and interoperability between the electricity grid, EVs capable of bidirectional charging, and other electrical devices and inverter energy systems. They enable bidirectional charging in the form of Vehicle-to-Grid (V2G), Vehicle-to-Home (V2H), or Vehicle-to-Everything. Both standards are critically important in ensuring the efficient supply of electricity from vehicle-to-grid and in managing the performance of inverters at low voltages. To ensure AS/NZS 4777.1:2024, *Grid connection of energy systems via inverters, Part 1: Installation requirements* remains relevant in a rapidly evolving sector, the committee recently revised the standard to align with the requirements covered by existing standards, such as AS/NZS 3000:2018, *Electrical installations,* and to improve alignment with electrical installation standards. In 2024, the committee also amended AS/NZS 4777.2:2020, *Grid connection of energy systems via inverters, Part 2: Inverter requirements,* to clarify specific requirements which will help ensure the consistent performance of inverters.

Standards such as AS 5385:2023, *Smart Energy Profile Application Protocol,* also support the interoperability of EV charging infrastructure by allowing EVs, EV supply equipment, and other distributed energy resources to exchange information such as demand response, energy usage and pricing in a secure and reliable way.

Australian Standards
AS/NZS 4777.1:2024, *Grid connection of energy systems via inverters, Part 1: Installation requirements*
AS/NZS 4777.2:2020, *Grid connection of energy systems via inverters, Part 2: Inverter requirements*
AS 5385:2023, *Smart Energy Profile Application Protocol*
SA HB 218:2023, *Common Smart Inverter Profile — Australia with Test Procedures*
International Standards
PWI TR 8A-21, *Roadmap of grid integration of renewable energy generation*
PWI TR 8A-22, *General requirements for grid-forming control of renewable energy*
PWI 23K-1, *Standard series for prosumer electrical installation (PEI) equipment*
PNW 23K-97 ED 1, *Energy Efficiency Systems - Smart Grid - Customer Energy Management Systems - Interface between the Energy Management Gateway and BEM / CEM - Data model and messaging*
DR IEC 63402-1 ED 1, *Energy efficiency systems - Smart grid - Application specification - Interface and framework for customer; Interface between the CEM and Home/Building Resource manager - General Requirements and Architecture*
DR IEC 63402-2-2 ED 1, *Energy efficiency systems - Smart grid - Customer energy management systems - Interface between the home/building CEM and resource manager(s) - Data model and messaging*
Other International Work
OCPP 2.0.1, *Open Charge Point Protocol* DR OCPP 2.1, *Open Charge Point Protocol*

Table 5: Key standards relating to electricity grid and grid connection protocols. DR = Draft. PWI = Preliminary Work Item (IEC). PNW = New Work Item Proposal (IEC)

As Australia undergoes a significant energy transformation, standards that support the deployment of Distributed Energy Resources (DER) are vital. Electric vehicles are an example of a DER that can provide power back to the grid to stabilise demand during periods of heavy use. SA HB 218:2023, *Common Smart Inverter Profile — Australia with Test Procedures* is a critical handbook for the Australian energy sector that provides a framework for the communication and interaction of DERs with the electricity grid. The handbook is currently being revised to include guidance and test procedures for energy industry stakeholders seeking to demonstrate conformance with Australia's Common Smart Inverter Profile.

Vehicle-to-Grid Technology

Vehicle-to-Grid (V2G) technology enables electric vehicles to function as small-scale energy storage units, capable of both drawing power from and feeding electricity back into the grid. This bidirectional capability offers numerous benefits, including grid stabilisation, demand side flexibility, potential revenue generation for EV owners, and reduced reliance on fossil fuels. The benefits of V2G can be capitalised on by increasing industry awareness of existing standards and developing an international vehicle labelling standard to accelerate the uptake of V2G technology.

There is an opportunity to support the EV industry by raising awareness on existing V2G standards. Mapping research conducted by Standards Australia reveals several V2G standards available for use, including: ISO 15118-20, *Road vehicles — Vehicle to grid communication interface Part 20: 2nd generation network layer and application layer requirements*; AS 5385:2023, *Smart Energy Profile Application Protocol*; and OCPP 2.1 which will be released in late 2024. Informative documents and guidelines on EV charging and vehicle-to-grid standards should be developed to help educate industry on the existing standards available and how they can be applied. This will uplift industry capabilities by addressing potential knowledge gaps relating to existing V2G standards and promote best practice among Australian EV manufacturers.

Consumers can face uncertainty when purchasing EVs due to inconsistent information provided by car manufacturers on V2G and V2H. EV manufacturers use a range of approaches to incorporate V2G and V2H capabilities into their electric vehicles, which can create confusion for consumers seeking to purchase an EV. While most EVs currently only officially support unidirectional charging, the growing potential of V2G and V2H technology highlights the need for clear consumer information on whether a vehicle is equipped to interact with external devices, such as the grid. To empower informed decision-making, the development of an Australian labelling standard that classifies electric vehicles equipped with V2G or V2H capabilities is recommended. This standard would lead the way internationally, promoting transparency about bidirectional charging capabilities and reducing confusion among EV purchasers.

Electric Vehicle Infrastructure and Energy Management Integration

Distribution Network Service Providers (DNSPs) are essential entities in the electricity distribution network. They are responsible for the safe and reliable delivery of electricity to consumers within a defined geographic area. DNSPs own and maintain the infrastructure, including poles, wires, and transformers, that transport electricity from substations to homes and businesses. They also manage network connections, fault repairs, and implement network upgrades to accommodate increasing electricity demand and the integration of renewable energy sources.

DNSP service and installation rules (SIRs) set out the requirements and processes for the connection of electrical installations to a DNSP distribution network. These requirements are enforced by DNSPs and energy regulators. In Australia, there are over 16 DNSPs, each with their own service and installation rules. The lack of consistency in DNSP requirements creates barriers for electrical and computer systems engineering as electrical installers may be subject to multiple testing procedures from various DNSPs, leading to increased costs of testing and certification which could be passed on to consumers through higher purchase and installation prices. Harmonisation of DNSP service and installation rules is needed to facilitate the efficient

integration of EVs and EV supply equipment into the grid. A uniform approach taken by DNSPs would ensure consistency regarding grid connection and installation requirements across states and territories.

In addition to harmonising DNSP service and installation rules, standardisation is needed to integrate EV supply equipment with building management systems (BMS). The integration of EV supply equipment into BMS is a rapidly growing area of interest due to the potential benefits it offers for both building owners and EV users. Building management systems have the capacity to monitor and control EV charging, coordinating it with the building's overall energy usage. By scheduling charging during off-peak hours or when renewable energy is abundant, building management systems can reduce electricity bills, lower carbon emissions and decrease demand placed on the electricity grid. For EVs with bidirectional charging capabilities, energy stored in an EV battery can be integrated into the building's energy system as a form of energy storage, discharging power back to the building during peak demand periods.

Charger scheduling, control and smart charging

Charger scheduling, control, and smart charging functionalities help optimise energy usage, grid management, and user experience. Protocols for dynamic load management, demand response, tariff integration, and data exchange can accelerate the uptake of smart grid systems.

While Table 6 suggests a limited number of standards relating to EV charger scheduling, control and smart charging, this reflects strong international alignment on existing standards, rather than a lack of standards. International standards are predominantly developed by the IEC Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks technical committee (IEC TC 69), of which Australia is a participating member. Currently, the committee is developing the IEC 63382 series, *Management of Distributed Energy Storage Systems based on Electrically Chargeable Vehicles (ECV-DESS).* The series aims to establish a standardised framework for the use of EV batteries as energy storage resources.

In addition to the IEC 63382 series, the committee is developing IEC 63584, *Open Charge Point Protocol*. The IEC 63584, *Open Charge Point Protocol (OCPP),* is expected to become the global default communication protocol for EV charging, allowing critical data exchange between the EV, charger and grid for smart charging purposes.

Australian Standards
DR AS 5438, *Interoperability Requirements for Inverter Energy Systems*
International Standards
DR IEC 63382, *Management of Distributed Energy Storage Systems based on Electrically Chargeable Vehicles (ECV-DESS)*
DR IEC 63584 ED1, *Open Charge Point Protocol (OCPP)*
Other International Work
OCPP 2.0.1, *Open Charge Point Protocol* DR OCPP 2.1, *Open Charge Point Protocol*

Table 6: Key standards relating to charger scheduling, control and smart charging. DR = Draft

Smart charging relies on clear communication, security and data exchange standards for inverters, EVs and EV chargers. Existing gaps in Australian inverter interoperability standards are currently being addressed through the development of an interoperability standard for inverter energy systems (Table 6). The standard will bridge existing gaps by providing definitions for interoperability specifications, in addition to functionality, testing and conformance requirements for inverters and inverter energy systems such as EVs and EV supply equipment capable of reverse power transfer.

Reflecting Standards Australia's ongoing commitment to align with international standards where possible, the core requirements of DR AS 5438, *Interoperability Requirements for Inverter Energy Systems,* will be based on those outlined in Section 10 of the IEEE 1547:2018, *Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces*, which covers interoperability, information exchange, information models, and protocols. Additional requirements may be incorporated where necessary to reflect the Australian environment, and emphasis will be placed on aligning with existing national standards, including AS/NZS 4777.2:2020, *Grid connection of energy systems via inverters, Part 2: Inverter requirements*, SA HB 218:2023, *Common Smart Inverter Profile — Australia with Test Procedures*, and Australian DNSP requirements. Once published, the standard will provide a coherent framework for energy management system manufacturers and will likely increase the uptake of interoperable inverter energy systems that facilitate smart charging.

Leverage International Standards for Charger Scheduling, Control and Smart Charging

There is a suite of international standards under development by IEC TC 69 Working Groups that may support scheduled charging and smart charging in Australia. For example, standardisation of electric vehicle wireless power transfer systems (Working Group 7), and standardisation of automatically connected EV supply equipment (Working Group 14). Despite being a participatory member of IEC TC 69, Australia is not currently represented on any of the IEC TC 69 Working Groups. This presents an opportunity for Australia to increase involvement in international standards development efforts by contributing national expertise and collaborating with international counterparts. Greater participation in IEC TC 69 and relevant Working Groups would allow Australia to influence standardisation for smart charging technologies, anticipate emerging trends in EV charging, and ensure the needs of local industries are reflected in international frameworks.

Australian Standards for scheduled charging, control, and smart charging are limited, emphasising the need to align with and adopt relevant international standards where possible. Internationally aligned communication protocols such as OCPP are a key enabler of smart charging technology, and facilitate interoperability between EVs, EV supply equipment, building management systems and the electricity grid.

Beyond OCPP, there are several ISO, IEEE and IEC standards that may be of relevance to the Australian context. For example, IEC 63110-1:2022, *Protocol for management of electric vehicles charging and discharging infrastructures - Part 1: Basic definitions, use cases and architectures*, is an international standard that addresses the general requirements for establishing an EV charging eco-system, covering the communication flows between different EV supply equipment actors as well as data flows with the electric power system.

Variations in building management systems should be considered in the development of charger scheduling and smart charging standards. Detached houses (Class 1) generally contain simple home energy management systems interacting with a single EV charger. Conversely, apartment buildings (Class 2) typically contain complex building management systems interacting with a multitude of energy consuming devices, of which EVs and EV supply equipment are just one part. Energy management systems in shopping centres (Class 6) are even more complex due to the size of building and high energy consumption for various commercial purposes. The complexities of Class 2 and Class 6 buildings present challenges for the installation of smart charging infrastructure due to the scale of electrical installation required, strict regulations, metering considerations, and limited EV charger placement options. To strategically address the challenges associated with smart charging and ensure building energy needs are met, Australia should leverage existing international standards that address aspects of smart charging rather than developing its own unique requirements. Adopting international standards for demand response, tariff integration and data exchange, for example, can help ensure Australia's smart charging infrastructure is safe, interoperable and globally aligned.

Future outlook

Emerging technologies, such as inductive charging, may create a need for further standardisation. This section details future considerations for EV charging infrastructure in Australia, based on insights from the Advisory Group meetings.

Inductive Charging Requirements

Inductive charging, also known as wireless charging or wireless power transfer, has the potential to revolutionise EV charging by enabling a cable-free alternative to current EV charging methods. Inductive charging involves the transfer of energy through a coil embedded in a charging pad, which creates a magnetic field. The magnetic field induces an electric current in a corresponding coil in the vehicle's underside, that is converted to DC power to charge the EV battery.

Anticipated to be more convenient, time-efficient, and safer than traditional methods, inductive charging has also shown promise in terms of energy efficiency, potentially matching the efficiency of DC fast chargers (Mode 4). Real-world applications of inductive charging are currently limited to electric forklifts, buses, and light vehicles, as the technology is in its nascent stages and not yet commercially widespread. The eventual commercialisation of EV inductive charging will require specific standards to support the safe manufacture and installation of this technology to ensure it is deployed correctly.

The latest edition of the National Construction Code (NCC 2022) includes provisions for EV charging infrastructure, specifically addressing Mode 3 charging with a Type 2 connector. Inductive charging is so far absent from these regulations. As this technology matures and becomes more cost-effective, future NCC editions should consider incorporating standards and requirements for EV inductive charging to ensure its safe installation and use. For example, IEC 61980-1:2020, *Electric vehicle wireless power transfer (WPT) systems - Part 1: General requirements,* can support the implementation of wireless EV charging methods at up to 1500 volts (DC).

Recommendations

Recommendation 1: Strengthen electrical safety standards

Recommendation: Standards Australia should support revisions currently being undertaken to strengthen existing electrical safety standards. These revisions are being done to ensure the safety and reliability of EV charging infrastructure. Electrical standards such as AS/NZS 3000:2018, *Electrical installations* will be updated to include earthing, protection, maximum demand and distribution board requirements for electric vehicle supply equipment.

Rationale: Revising existing electrical safety standards to include specific electrical requirements for EV supply equipment will streamline installation, reduce electrical safety risks, and boost consumer confidence in EV charging.

Expected benefits:

- **Streamline installations:** Clear and consistent electrical requirements will simplify EV supply equipment installation processes, reducing time and costs for industry.
- **Improved safety measures:** Updated electrical wiring standards ensure all aspects of electric vehicle installation adhere to rigorous safety protocols.
- **Consumer confidence:** Standardised safety measures can instil trust in consumers that EV charging equipment is safe and reliable.

Recommendation 2: Modified text adoption of IEC 61851-1:2017, *Electric vehicle conductive charging system - Part 1: General requirements*, for EV supply equipment

Recommendation: Standards Australia and the Australian Government should collaborate to propose a modified text adoption of IEC 61851-1:2017, *Electric vehicle conductive charging system – Part 1: General requirements*, to include resistance to heat and fire requirements from AS/NZS 60335.1:2020, *Household and similar electrical appliances — Safety, Part 1: General requirements*, Clause 30.2.

Rationale: Adopting a modified IEC 61851-1:2017, *Electric vehicle conductive charging system – Part 1: General requirements*, which incorporates the resistance to heat and fire requirements from AS/NZS 60335.1:2020, *Household and similar electrical appliances — Safety, Part 1: General requirements,* and the requirements from IEC 62955:2018, *Residual direct current detecting device (RDC-DD) to be used for mode 3 charging of electric vehicles* will create a robust and locally relevant standard that balances international harmonisation with national safety needs. The modified text adoption is designed to ensure that, in the event of a critical failure within the EV charger, the plastic components do not sustain fire. This approach will support the growth of the electric vehicle industry by reducing compliance costs and protecting consumers.

Expected benefits:

- **Reduced costs:** Minimises compliance costs, facilitating market access by addressing industry needs.
- **Enhanced safety measures:** Ensures that electric vehicle charging equipment meets
- Australian environmental conditions, mitigating fire risks.
- **Increased confidence:** Instils confidence in the manufacturer, electrical installer and
- consumer that the product meets all relevant requirements.

Recommendation 3: Guidelines for EV charging standards to support industry

Recommendation: Standards Australia and industry stakeholders should work together to develop informative documents and guidelines for the EV industry to raise awareness about existing standards for EV charging and vehicle-to-grid technologies.

Rationale: Developing informative documents and guidelines on EV charging and vehicle-to-grid standards will help raise awareness among industry about the existing standards available and how they can be applied. This initiative aims to enhance industry knowledge, facilitate supply of safe EV chargers and promote best practice.

Expected benefits:

- **Enhance industry understanding:** Empowers industry by providing a clear explanation of EV standards, empowering industry to make informed decisions that lead to optimal market outcomes.
- **Facilitate compliance:** Simplifies the process of adhering to standards, such as electrical installation standards for EV supply equipment, reducing the risk of non-compliance and associated costs.
- **Promote best practice:** Offers guidance on the effective implementation of standards, ensuring safe and efficient EV charging systems.

Recommendation 4: Develop international labelling regulation for vehicle-to-grid and vehicle-to-home classification

Recommendation: The Australian Government should propose the development of an international labelling regulation that classifies EVs with vehicle-to-grid (V2G) or vehicle-to-home (V2H) capabilities. Developed through Commonwealth participation in the UNECE World Forum for Harmonization of Vehicle Regulations (WP.29), this standard would lead the way internationally by promoting transparency about vehicle capabilities and reducing confusion among EV purchasers.

Rationale: A harmonised international regulation will ensure consumers in Australia and around the world are informed about the vehicle's V2G or V2H capabilities when purchasing an EV. This initiative addresses concerns relating to consumer misconceptions about EV capabilities and promotes transparency between EV manufacturers and purchasers. Relevant standards such as ISO 15118, *Road vehicles — Vehicle-to-Grid Communication Interface,* and IEC 63584, *Open Charge Point Protocol (OCPP),* should be used to guide the development of this labelling regulation at the United Nations World Forum for Harmonization of Vehicle Regulations (WP.29).

Expected benefits:

- **Consumer confidence:** Transparent information about V2G/V2H capabilities can increase consumer trust in electric vehicles and protect consumers from misleading claims about vehicle capabilities.
- **Market access:** The development of international labelling regulation would create a unified understanding of V2G capabilities across global markets.
- **Increased grid integration:** Widespread adoption of V2G/V2H capable EVs can contribute to a resilient and sustainable electricity grid.

Recommendation 5: Harmonise DNSP requirements in Australia

Recommendation: The Australian Government, state and territory governments, and electricity suppliers should work together to harmonise the various Service and Installation Rules outlined by Distribution Network Service Providers (DNSPs) across Australian states and territories.

Rationale: Unifying DNSP Service and Installation Rules will reduce barriers to installation and create consistency across Australia. This initiative seeks to reduce costs associated with the installation of EV charging infrastructure and enhance the overall reliability of the electricity network.

Expected benefits:

- **Improved reliability:** Consistent Service and Installation Rules can contribute to a more reliable electricity network and enhance grid resilience.
- **Reduced costs:** Alignment will simplify compliance processes, reducing costs for businesses operating in multiple jurisdictions.
- **National alignment:** Harmonisation can streamline regulatory processes across Australian states and territories, reducing administrative burdens.

Recommendation 6: Support Australian representation on international standards committees

Recommendation: Standards Australia should proactively support Australia's application to become a participating member of the IEC subcommittee responsible for the standardisation of Electrical Energy Efficiency products (IEC TC/23 SC 23K).

Rationale: Australian participation on IEC TC/23 SC 23K will provide access to the latest trends and innovation in energy efficiency, such as smart grid customer energy management systems.

Expected benefits:

- **International alignment:** Ensure Australian Standards are aligned with international requirements for electrical energy products, reducing barriers to trade.
- **Competitive advantage:** Ability to shape international standards in line with national interests and strategic priorities.
- **Innovation:** Access to knowledge sharing and collaboration to drive innovation.

Recommendation 7: Align EV charging infrastructure standards with National CER Roadmap

Recommendation: Standards Australia, the Australian Government, and industry should work together to deliver on EV infrastructure standards priorities outlined in the Australian Government's National Consumer Energy Resources (CER) Roadmap. This includes standards for device interoperability, and vehicle-to-grid charging.[4]

Rationale: Ensuring alignment with, and delivering on, CER priorities through the development of nationally consistent standards will create reliable EV infrastructure, facilitate access to new technologies, and establish future-leading energy systems that deliver benefits to all.

Expected benefits:

- **Consumer protection:** Ensures CER is cyber-safe, reliable, and trusted by consumers.
- **Interoperability:** Supports CER device interoperability and V2G capabilities through nationally consistent standards.

4 National Consumer Energy Resources Roadmap p18, Department of Climate Change, Energy, the Environment and Water (2024)

- **Market acceleration:** Promotes the widespread availability of fast and harmonised CER connection processes, such as EV chargers.

Recommendation 8: Increase Australian participation in IEC technical committees

Recommendation: Standards Australia and technical experts should work together to increase committee involvement in international standardisation projects conducted by IEC TC 69 working groups, the international committee responsible for standards development relating to electrical power and energy transfer systems for electrically propelled road vehicles and industrial trucks.

Rationale: Actively participating in IEC TC 69 projects will help establish Australia's role as a global leader in the standardisation of EVs and EV supply equipment products, while also ensuring the quality, safety and interoperability of EVs.

Expected benefits:

- **National representation:** Positions Australia as a leader of the EV transition, committed to developing quality standards that advance EV technologies.
- **Support innovation:** Australian participation can help drive innovation through global collaboration and knowledge sharing on EV supply equipment.
- **Promote interoperability:** Ensures EV charging systems and supporting infrastructure are globally compatible, reducing inconvenience and accelerating innovation.

Recommendation 9: Adopt international standards for communication between EVs and charging management systems

Recommendation: Standards Australia and the Australian Government should collaborate to consider adopting IEC 63584, *Open Charge Point Protocol (OCPP) (Fast track)*, when published. The standard is a direct fast-tracked adoption of the Open Charge Point Protocol (OCPP), an application protocol for the communication between EVs and charging management systems.

Rationale: Adopting IEC 63584, *Open Charge Point Protocol (OCPP)*, will be crucial for the successful deployment and operation of EV charging infrastructure in Australia. It would provide EV customers with choice and flexibility to use any charging network and encourage competition among charging station manufacturers and network providers. This initiative seeks to ensure that Australia's EV charging infrastructure is globally harmonised and interoperable.

Expected benefits:

- **Global alignment:** Adopting an internationally recognised standard will integrate Australia into the global EV market, facilitating trade and technology exchange.
- **Industry competitiveness:** OCPP enables communication between EV charging stations and charging management systems regardless of the manufacturer, promoting a competitive market and consumer choice.
- **Compatibility assurance:** Standardised communication protocols facilitate the integration and compatibility of EV charging infrastructure into the electricity grid, optimising energy management and grid stability.

Standards Pathway

Standards Adoption			
Designation	**Recommendation**	**Title**	**Proponent**
IEC 61851-1:2017	2	Electric vehicle conductive charging system	Australian Government

Standards Revision			
Designation	**Recommendation**	**Title**	**Proponent**
AS/NZS 3000:2018	1	Electrical installation	Industry

Additional Recommendations Pathway

International Participation			
Description	**Recommendation**	**Rationale**	**Proponent**
Develop international labelling regulation for vehicle-to-grid and vehicle-to-home classification	4	Addresses concerns relating to consumer misconceptions about EV capabilities and promotes transparency between EV manufacturers and purchasers.	Australian Government
Support Australian representation on international standards committees	6	Provides access to the latest trends and innovation in energy efficiency, such as smart grid customer energy management systems.	Standards Australia
Increase Australian participation in IEC TC 69	8	Helps establish Australia's role as a global leader in the standardisation of EVs and EV supply equipment products, while also ensuring the quality, safety and interoperability of EVs	Standards Australia

Alignment and Harmonisation			
Description	**Recommendation**	**Rationale**	**Proponent**
Harmonise DNSP requirements in Australia	5	Seeks to reduce costs associated with the installation of EV charging infrastructure and enhance the overall reliability of the electricity network.	Australian Government
Align EV charging infrastructure standards with National CER Roadmap	7	Supports the creation of reliable EV infrastructure, access to new technologies, and future-leading energy systems.	Australian Government
Align with international standards for communication between EVs and energy management systems	9	Ensures Australia's EV charging infrastructure is globally harmonised and interoperable.	Australian Government

Industry Guidelines			
Description	**Recommendation**	**Rationale**	**Proponent**
Guidelines for EV charging standards to support industry	3	Enhances industry knowledge, facilitates supply of safe EV chargers and promotes best practice.	Industry

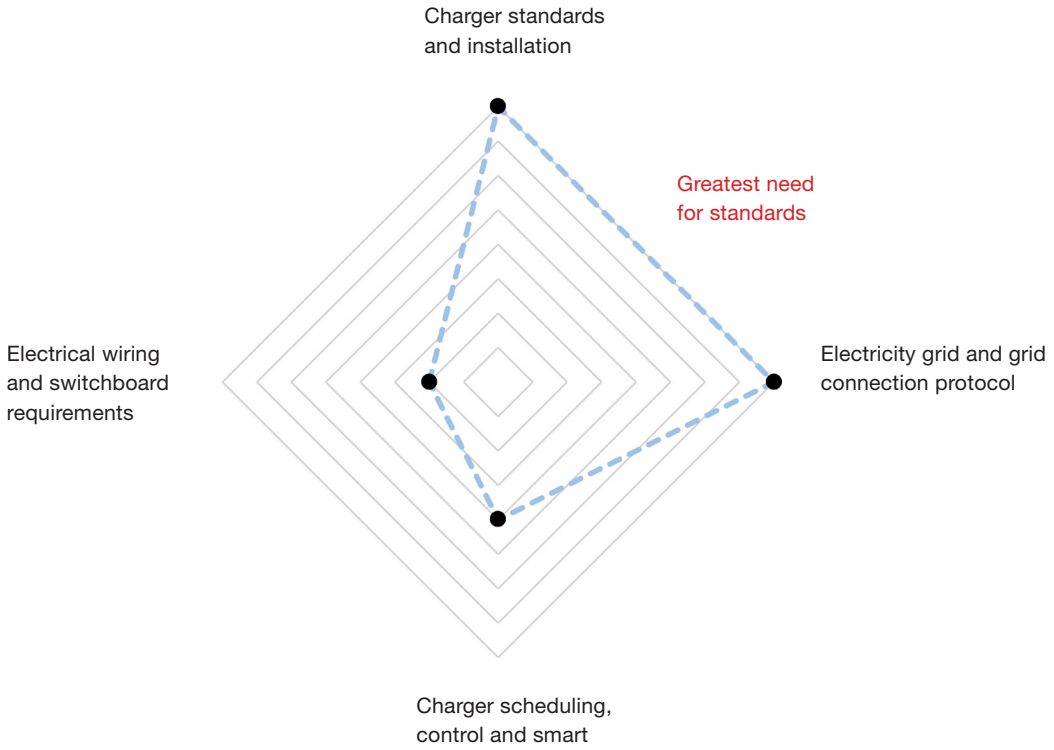
Advisory Group Survey

In addition to the insights gathered throughout the Advisory Group meetings, the Advisory Group members were asked to complete a short survey following Meeting 2. The following section provides an analysis of the responses collected.

Q1. Which topic has the greatest need for standards?

Survey results indicate two key areas where further standardisation is critically needed to support EV charging infrastructure in Australia. These two areas are electricity grid and grid connection protocols; and charger standards and installation.

Standards for grid connection are necessary to ensure the safe, reliable and efficient integration of EV chargers into the energy grid, while installation guidance is important for the performance and interoperability of EV chargers.



Q2. Please explain the reason for your ranking in Q1

Charger standards and installation

"Lack of safety guidelines for EV chargers, including their location and wiring configuration seems to be a critical limitation to their deployment in residential buildings Class 2."

"The product needs to be safe before covering any other topics. Once you have a safe product you can cover the installation risks."

Electricity grid and grid connection protocol

"This is the least nationally harmonised. Others can lean more on."

"Consistent connection requirements and ensuring they align with international equivalents (as much as practical) is critical to smoothing the path for EVSE uptake and have already been established as roadblock historically (e.g. V2G & AS/NZS 4777 prior to the latest update)"

Charger scheduling, control and smart charging

(Although no respondent placed 'Charger Scheduling, Control & Smart Charging' as the number one area in greatest need for standards, 4 out of 5 respondents placed it as their second choice.)

Electrical wiring and switchboard requirements

"I think this is important because it is where the EV ultimately connects to the electrical installation."

Q3. What are the key barriers to adopting electric vehicles in Australia?

Grid Integration

"Grid integration/ V2G/V2H opportunities to use EV batteries to feed residential energy needs."

"Need grid control management."

"Payment methods at EV public chargers."

Standards/Regulatory Framework

"Lack of standardised integration requirements (particularly connection requirements)"

"Inconsistency of... requirements with international equivalents"

Public Perception

"Community and fleet manager perceptions about EV charging, range, safety, total cost of ownership."

"Price and range anxiety."

"Price, range of vehicles and negative media."

Appendix 1. Advisory Group Members and Participants

EV Charging Infrastructure – Advisory Group Members	
Schneider Electric	Lucy Finlay
Federal Chamber of Automotive Industries	Ashley Sanders
Energex and Ergon Energy Network	Peter Kilby
Energy Safe Victoria	Sandy Atkins
Clean Energy Council	Robbie Nichols
NHP Electrical Engineering Products	Daniel Nathanson
Federal Chamber of Automotive Industries	Richard Delplace
The Australian National University	Tim Moore

EV Charging Infrastructure – Participant Members	
Department of Climate Change, Energy, the Environment and Water	Albert Dessi
Department of Finance	Alan Balino
Department of Finance	Martin Jones

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