Australian Government

Department of Climate Change, Energy, the Environment and Water

# Technical Standards for Consumer Energy Resources (CER) Interoperability

**Consumer Energy Resources Taskforce**

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**Acknowledgement of Country**

We acknowledge the Traditional Owners of Country throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past and present.

# 1. Executive Summary

*Consumer energy resources (CER) are an integral part of Australia's secure, affordable and sustainable future electricity systems, delivering benefits and equitable outcomes to all consumers through efficient use which smooths the transition, rewards participation and lowers emissions.*

**Australian consumers are driving one of the fastest transformations of electricity systems in the world through record breaking investment in CER.**

This is being accelerated by Australia's national commitment to net zero emissions by 2050, a 43% reduction on 2005-level emissions by 2030, with 82% of on-grid electricity supplied from renewable sources by 2030. Integrating CER into the electricity grid is a critical part of a renewable superpower economy where consumers can access clean, affordable and secure energy.

In 2024, Energy Ministers agreed to the National CER Roadmap (the Roadmap) which sets out an overarching vision and implementation plan to unlock CER at scale across Australia.

**This consultation paper seeks to support priority T1 of the Technology workstream in the CER Roadmap, to develop an initial set of agreed requirements and applicable technical standards for CER device interoperability and flexibility for consideration by Energy Ministers.**

For customers to have access to and choose from a wide range of energy providers and to maximise consumer returns on investment in CER, providers will require the ability to communicate with and operate these devices. This refers to the interoperability of devices. The role of interoperability standards is to enable seamless communication, integration and operation between different CER devices, systems, technologies and vendors or actors, including to enable vehicle-to-grid (V2G), under a common framework.

This paper acknowledges that the ability for consumers to switch providers is a key attribute of CER interoperability. It identifies the challenge posed by proprietary systems to consumer choice and the risk of creating stranded assets if the full standards framework is not effectively considered. This emphasises the risk of unintended consequences if the solution to a problem at a point in time has implications in the longer term.

**This consultation paper takes a first principles approach to interoperability for devices nationally linked to grid networks, by looking at CER device requirements and applicable technical standards and identifying priority gaps to be addressed.**

CER interoperability standards have been examined and progressed over recent years due to an emerging need identified from industry. This paper builds on previous work such as through the Energy Security Board (ESB), Distributed Energy Integration Program (DEIP) and State and Territory developments.

The paper includes sections that cover the following:

- Government priorities as identified through the Roadmap, including CER device interoperability (see Chapter 3).

- Use cases for CER and hierarchy challenges across CER devices (see Chapter 4).
- A set of CER device requirements that will enable both industry and government stakeholders to address technical and governance issues that emerge from the ever-growing uptake of CER, and that enable their interaction to support consumer choice and the distribution network (see Chapter 5).
- Priority gaps requiring additional standards development work to be undertaken (see Chapter 6).
- Governance and development approaches to developing standards in the Australian context (see Chapter 7).

Feedback from stakeholders will be crucial, as work under priority T1 represents a key outcome within the broader regulatory framework, a preliminary draft of which is also open for submission as part of this current consultation period.

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) invites submissions from interested parties to this consultation paper by 11.59pm AEST on Sunday 14 September 2025. See section 2.3 for details on how to submit.

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# 2. About this consultation paper

In 2024, the National Consumer Energy Resources Roadmap (the Roadmap) was agreed to by the Energy and Climate Ministerial Council (ECMC). The CER Taskforce was assigned responsibilities as outlined in the Roadmap to develop an initial set of technical standards for CER devices interoperability and flexibility under the Technology workstream, priority T1.

Priority T1 of the Roadmap aims to contribute to optimising energy system operation in a future where CER is an integral part of Australia's electricity systems. Future-ready architecture, holistic technical standards, compliance and enforcement will all work together to achieve this outcome.

Initial technical standards setting for CER has often considered network reliability needs and opportunities for suppliers, installers and market participants such as Distribution Network Service Providers (DNSPs), retailers and aggregators. They have been guided by a timely solution for a particular circumstance rather than a comprehensive framework that considers the full interrelationship between CER devices and participants in the Australian energy market.

Therefore, this consultation paper takes a 'first principles' approach by looking at CER device requirements and relevant applicable technical standards, and highlights gaps in standards. This approach reflects the importance of defining the function, or task, to be delivered by a standard and places consumers at the centre of decisions relating to CER technical standards.

In the evolving CER space, prescribing a set of technical standards without consultation on device requirements and use cases can risk unintended consequences such as locking in consumers to proprietary CER controls and tailoring delivery to a specific purpose without considering the interrelationship of multiple requirements across multiple devices.

This consultation paper is seeking feedback on:

- CER device requirements that are mapped to use cases from the Redefine roles for market and power system operations and Data Sharing Arrangements workstreams under the National CER Roadmap, with a particular focus on the requirement to enable consumers to switch providers.
- Identification of applicable technical standards that are available to meet those requirements and ensure there is appropriate coverage and redundancy for each use case.
- Potential gaps in current standards and prioritisation of further work to address them.

## 2.1. This consultation paper delivers and supports priorities in the National CER Roadmap

The CER Taskforce will deliver the outcomes from this consultation to the Energy and Climate Change Ministerial Council (ECMC) in late 2025. These outcomes are intended to include agreed requirements, applicable technical standards and a work program to address any gaps in standards to meet industry and importantly consumer needs.

Delivery of the T1 priority represents the first stages of an anticipated future regulatory framework under CER Roadmap Priority T2, to determine which aspects of the interoperability ecosystem should be enforced.[1]

As a first step, establishing requirements will enable an assessment of applicable technical standards and identify any gaps that require further standards development. The development of new standards, or further calibration of existing standards to meet interoperability requirements, will be undertaken by Standards Australia, or an equivalent body, based on the requirements for CER devices agreed and endorsed following this consultation process.

This will allow the necessary elements of an interoperable ecosystem to be included within a National Technical Regulatory Framework noting that mandating standards will be considered under the framework once established, depending on how the interoperability requirements are adopted voluntarily.

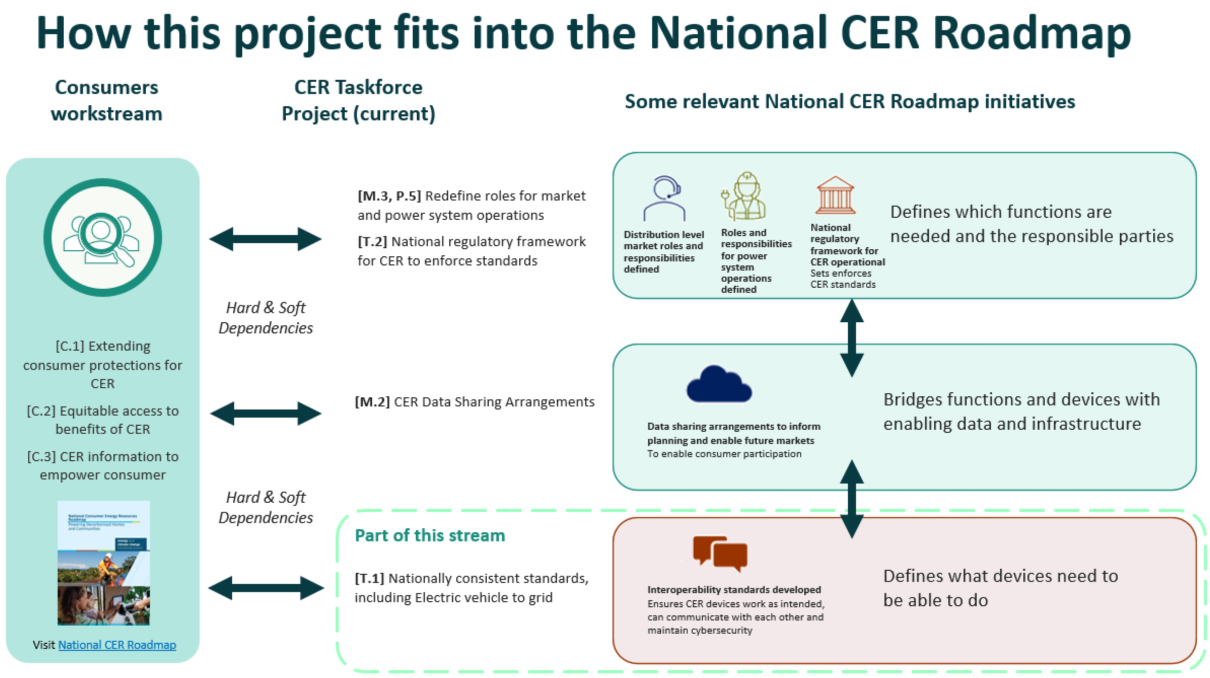


**Figure 1 How T1 fits into the CER Roadmap**

[1] An "interoperability ecosystem" is a broad term that encapsulates the development process, availability and implementation of interoperability standards that allow CER adopters, network operators and manufacturers to use CER hardware to maximise consumer benefit.

## 2.2. Scope of this paper

The scope of this consultation paper is based on the:

- Device requirements (use cases) to unlock CER interoperability
- Relevant applicable technical standards
- Gaps in standards.

This consultation paper covers smart devices. References to 'device(s)' further in the paper include CER hardware that have communications and coordination/orchestration capability.

CER devices that are not capable of communication and coordination/orchestration, for example non-smart electric vehicle (EV) chargers, are not included in scope for this consultation. Non-smart EV chargers have only one function, to charge an EV while plugged in. Smart EV chargers offer cost savings, convenience and grid stability through additional functionality such as energy load management, restricted access, remote start/stop and status/session monitoring.

The following cases/standards are out of scope for this paper:

**Table 1 Standards out of scope**

| Standard out of scope | Addressed by |
|---|---|
| **Installers** | CER Taskforce (Priority T2) |
| **Market Settlements** | AEMO |
| **Disposal and recycling** | Circular Economy (Australia's Circular Economy Framework and Product stewardship in Australia - DCCEEW) |
| **Conformance monitoring framework** | CER Taskforce (Priority T2) |
| **Networks and connection arrangements** | CER Taskforce (Priority T2) |
| **Data and payloads for Distributed Energy Resource Register (DERR) or Consumer Energy Resource Data Exchange (CERDE) arrangements** | Potential gaps are being considered through the CER Taskforce (Priority M2 - data sharing) |
| **Registration** | CER Taskforce (Priority T2) |
| **Safety (including fire safety standards for EVs)** | These are considered through alternative safety regulatory work |
| **Cybersecurity** | Cybersecurity is considered upfront as part of standards development supported by the ECMC Working Group; the Energy Security and Resilience Working Group (ESRWG). |
| **Existing devices** | The focus of requirements and standards is on new devices for CER. |

## 2.3. How to have your say

Questions for consideration by stakeholders are included throughout the paper and summarised in Chapter 8 of this paper. Your feedback and any relevant information you provide will be used to inform minimum CER device requirements, applicable technical standards and priority gaps to be considered by Energy Ministers in 2025.

To have your say on the consultation paper on Technical Standards for CER Interoperability:

- Read the T1 consultation paper on Technical Standards for CER Interoperability
- Read the reference papers (optional):
    - ANU Report - *Technical and Interoperability Standards for CER: Pathway for Implementation* and
    - Redefine roles for market and power systems operations workstream (M3/P5) – *Capability, use case and role-actor assignment*.
- Provide a written submission through the upload function of the Have Your Say platform.

Submissions are welcome until 11.59pm AEST on **Sunday, 14 September 2025**.

If you have any questions about the consultation process or would like to request an extension, please contact the CER Taskforce at certaskforceg@dcceew.gov.au

# 3. Background and context

## 3.1. CER has the potential to provide substantial benefits to consumers

CER are increasingly being acquired and deployed by Australians, with around 6,000 rooftop PV systems installed each week in 2024. In 2025, an estimated 2.9 Gigawatts (GW) to 3.2 GW of rooftop solar is expected to be added to the grid.[2]

This is being accelerated by Australia's national commitment to a 43% reduction on 2005-level emissions, 82% renewable energy in our electricity grids by 2030 and net zero emissions by 2050. With each jurisdiction having interim emissions and renewable energy targets to meet that deadline.

Integrating CER into the electricity grid is a critical part of a renewable superpower economy. Consumers need access to clean, affordable and secure energy during this transition. If CER is

**What are consumer energy resources (CER)?**

CER are made up of a diverse range of small to medium scale energy resources that are located behind the meter at residential, commercial and industrial premises and are owned or operated by the customer. These resources generate, store or shift consumption of electricity and include:

- **flexible loads** that can alter demand in response to external signals, such as shifting hot water heating to an off-peak time.
- **electricity generation** such as rooftop solar photovoltaic (PV) systems that meet customer demand and/or export electricity into the distribution network.
- **energy storage technologies**, such as small-scale batteries, community battery storage systems and electric vehicles with bidirectional charging capability.

CER includes:

- **Rooftop solar**: Photovoltaics (PV)
- **Household and community batteries**: Energy Storage Systems (ESS), such as batteries and fly-wheels.
- **Electric vehicles (EV)** – passenger and light commercial vehicles
- **Electric vehicle supply equipment (EVSE)** – the infrastructure and components that deliver electricity to charge EVs including EVSE load only and bidirectional EVSE.
- **Flexible Loads** – controlled loads including electric water heaters, pool pumps, air conditioners and smart devices.
- **Energy Management Systems (EMS)**

*Note: The interoperability standards covered in this paper apply to the inverter and not the PV panel. References to "device(s)" further in the paper include CER hardware that have communications and control capability.*

[2] CER (Clean Energy Regulator) 2024, *Quarterly Carbon Market Report December Quarter 2024*, CER Website

integrated and coordinated well, CER owners will see higher returns from their investment in CER and system energy costs will be lower.

CER technologies present opportunities for all grid network consumers to reduce their electricity costs. More sophisticated ways of managing CER are possible with advances in small scale energy generation, such as rooftop PV, and storage technologies, such as batteries, as well as communication technologies. Because CER can respond to local and remote signals, and coordinated at the group-level, it can be increasingly harnessed to:

- reduce network congestion on the distribution network much more precisely, in response to real-time network conditions. This can reduce the need for network augmentation more effectively than time of use or capacity tariffs.
- reduce wholesale market costs and large-scale generation requirements by enabling CER to participate on a level footing with utility-scale generation by generating electricity locally through rooftop PV and exporting electricity from storage during periods of high prices.
- contribute to system security services, for example battery storage providing frequency or voltage control.

The CER Roadmap specifically references vehicle-to-grid (V2G) under priority T1. This reflects the significant potential for V2G to support the electricity grid. The National Roadmap for Bidirectional EV Charging estimates that, with the right settings in place, Australia could have 300,000 V2G capable EVs by 2030. Interoperability standards, that can accommodate this uplift, are an essential feature of CER expansion.

## 3.2. The case for a harmonised approach to national CER interoperability – consumer choice

The role of interoperability standards is to enable seamless communication, integration and operation between different CER devices, systems, technologies and vendors or actors under a common framework. This comes with significant benefits such as:

- consumer choice in how they access and take up different products and services
- reduced costs across the energy system
- increased reliability when enabling interoperability within an ecosystem, for example:
    - adopting a standard for interoperability functions may be more cost-effective than vendors having to bilaterally develop their own unique solutions.
    - a shared understanding of how CER systems respond to signals, such as sending information or performing a physical response. This achieves enhanced compliance and reliability in delivering expected outcomes across interoperable systems.
    - supports smarter grid and reduced network augmentation.
- reducing the complexity and time associated with managing and maintaining equipment.

The primary benefit of interoperability, and the focus of this consultation, is to enable customer choice - the ability to easily access and adopt different products and services when they wish to do so. See section 3.8 Switching energy service providers for further detail. This approach reflects on earlier work by the former Energy Security Board (ESB) which sought for customers to be protected and have opportunities to access new products and services: consumers are rewarded for their flexible demand and generation, have options for how they want to engage (including the ability to switch between CER service providers).[3] This paper builds on the earlier work to apply product choice to a broad range of CER rather than the initial focus on solar inverters.

Interoperability will also be important for enabling uptake of V2G and vehicle-to-home (V2H) systems, as vehicle and charger manufacturers begin to make these features available. For V2G, harmonising with international standards is essential as all light vehicles are fully imported.

An initial set of technical standards for CER device interoperability will enable consumers to maximise returns on their investment in CER and allow the benefits of CER to flow to all customers when they interact with the electricity grid.

Ensuring a minimum level of 'open' interoperability functionality within CER devices can:

- help ensure owners of CER assets aren't locked-in to certain providers or offerings.
- provide the ability for contracted service providers to use those assets to maximise the benefits for the customer under an energy plan
- lower the barriers to entry of new participants such as aggregators or retailers to the market and stimulate competition and innovation by making it easier and less costly for those parties to remotely communicate with the existing fleet of CER devices. In turn, greater competition will see more value flowing back to customers, and a more flexible and lower cost system.

The accompanying report from the ANU further expands on these benefits and identified an initial list of standards to help maximise consumer benefits in an interoperable CER standards ecosystem. The ANU Report highlights some initial use cases which this consultation builds upon, as explained in Chapter 4 Use Case Mapping. See Chapter 7 for industry led implementation of interoperability and examples of connection pathways for AS 5385.

## 3.3. Overview of standards development

**What are CER technical Standards?**

Technical standards are operational parameters for a device or product and involve common and repeatable rules, guidelines, or characteristics.[4] CER technical and interoperability standards describe common methods for the installation, connection and operation of CER.

The development of technical standards generally involves several key steps and roles to ensure that they are developed or selected following an agreement of requirements. This sequencing of roles ensures that requirements are developed with stakeholders to support agreed use cases and set guardrails for standards development.

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[3] Energy Security Board (ESB) 2021, *Integrating DER and Flexible Demand – December 2021*, Energy.gov.au

[4] AEMC (Australian Energy Market Commission) 2023, *Review into consumer energy resources technical standards (RCERTS)*, AEMC Website

1. Regulatory requirement development: Requirements created with stakeholder engagement and testing.
2. Standards development and selection: Technical experts develop standards to meet these requirements or leverage existing standards that can support these requirements.
3. Stakeholder engagement and assessment: Stakeholder engagement undertaken to assess applicable technical standards' support of the requirements.
4. Policy Impact Assessments: Applicable technical standards evaluated against minimum requirements with a cost benefit framework.
5. Standards approval and monitoring: The relevant authority ensures standards meet minimum requirements and develops performance measures as part of the conformance monitoring framework.

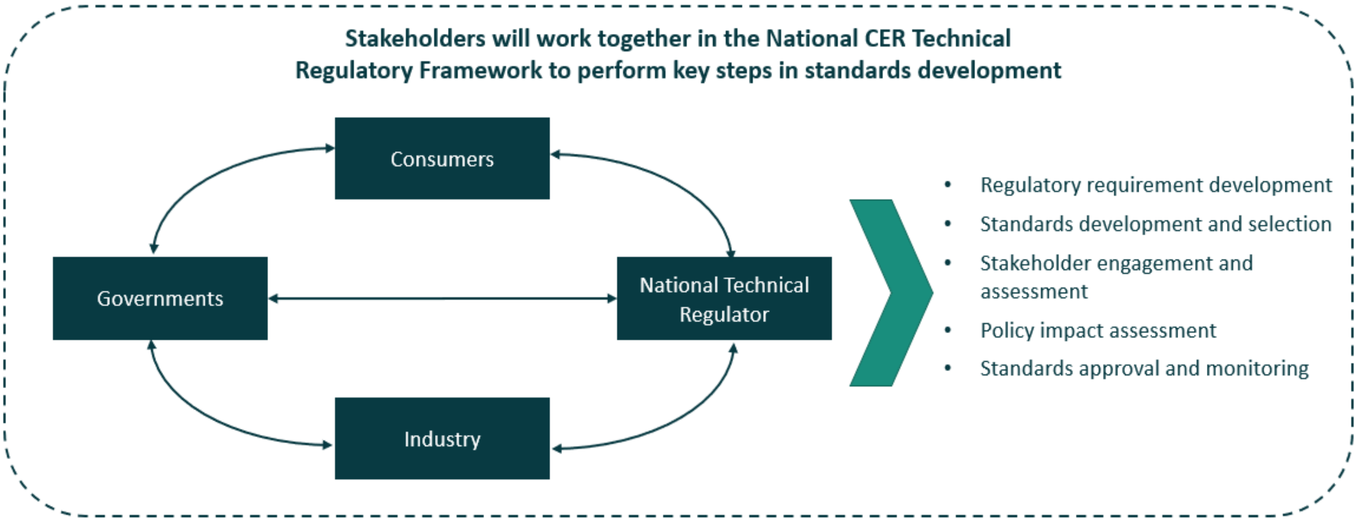


**Figure 2 Overview of standards development lifecycle**

The Technology Workstream canvassed in this paper contributes to a broader agenda articulated in the CER Roadmap. In parallel to this consultation process, officials from the Commonwealth, state and territory governments are working with stakeholders to develop options for a National CER Technical Regulatory Framework, which will create the framework for ongoing determination of roles and responsibilities for developing technical standards.

## 3.4. What is interoperability?

Interoperability is the 'capability of two or more networks, systems, devices, applications, or components to externally exchange and readily use information securely and effectively'.[5]

In the context of CER, interoperability refers to the ability of different CER devices and systems to work together seamlessly and exchange data to produce an expected outcome. This allows customers to have access to a wide range of devices, energy providers and plans to enable choice in

[5] IEEE SA (IEEE Standards Association) 2018, *IEEE 1547-2018*, IEEE SA website

how they use their assets. It also means that CER devices such as rooftop solar, batteries and EVs can communicate and share information with each other and with the electricity grid.

CER interoperability applies to many domains where different systems are communicating and coordinating with each other, for example:

- An electricity retailer scheduling EV charging at a consumer's home to minimise costs to charge the EV;
- Increasing the amount of electricity being exported to maximise a consumer's returns;
- The ability to easily verify the settings on a consumer's solar inverter to help keep the grid running safely;
- A consumer purchasing a device to integrate with their current home network, such as purchasing an EV charger to communicate with a solar inverter to efficiently charge an EV.

### 3.4.1. The role of technical standards in interoperability

The role of technical standards in respect to interoperability is to enable an open and consistent way for a task to be completed between different CER devices, systems, vendors or actors. This can reduce the costs for manufacturers or providers and increase usability of devices, for example:

- Adopting standards for interoperability functions may be more cost-effective than vendors having to develop their own unique solutions. This reduces duplication of effort and promotes consistency across the industry.
- Standards can create a shared understanding of how systems should respond to signals, such as sending information or performing a physical response. This clarity enhances compliance and reliability in achieving expected outcomes across interoperable systems.
- Common standards can reduce the cost and complexity of establishing systems and services that coordinate the behaviour of CER, known as orchestration. This can also reduce the barriers for new service providers to enter the market hence fostering competition and innovation for services.
- Common standards can facilitate faster and wider uptake of new technology that benefit consumers and the power grid as a whole, including the managed charging of EVs, virtual power plants and other new market offerings that improve consumer value and choice.

### 3.4.2. Effects of excessive standardisation

While interoperability standards can unlock a range of benefits, as outlined above, there are also likely to be limits to how much standardisation is desirable or economically efficient. This is because:

- Excessive standardisation runs the risk of locking in suboptimal technological choices, deterring innovation once a standard has been adopted, and limiting competition between companies, all to the detriment of consumers.
- Standards for interoperability may come at an unexpected cost if they are overly burdensome and prescriptive for OEMs and/or energy industries, particularly for markets in early stages of development.

- Implementation of standards may prove costly if consumer interests are not fully understood and accounted for.

A balance must be struck between forward planning standards that will provide social benefits in future versus creating potential barriers for industry participants and consumers today.

Optimal CER interoperability aims to achieve a balance between harnessing the benefits of CER (e.g. facilitating consumer switching, enabling consumers' CER devices to coordinate between themselves, giving the market operator visibility over CER assets to manage the system efficiently, enabling a more efficient use of existing networks), with the potential costs of technical standards (e.g. lock-in of suboptimal technologies, deterring innovation, and limiting competition).

### 3.4.3. Overview of different standards supporting various elements of interoperability

The challenge of assuring interoperability is complicated by the fact that interoperability for the CER ecosystem demands more than the mere exchange of data. There are several types of standards that can play different roles in supporting interoperability:

1. **Protocol standards:** define the physical media, information structure and parameters by which control signals and/or telemetry is exchanged between the communicating parties. A contemporary example is the CSIP-AUS guide for implementing the IEEE 2030.5 protocol in Australia.[6]

2. **Data model standards:** specify the data definitions which can be agreed upon by both parties. A contemporary example is the Common Information Model AKA IEC 61970[7] and IEC 61968.[8]

3. **Device standards:** define the physical operation that the device should undertake in response to a given signal. These requirements often form part of a broader device standard. Flexible load device standards include AS 4755 series of standards and parts of AS/NZS 4777.2.

4. **Performance standards:** define the parameters for which a device is expected to operate. Such standards often include significant focus on test procedures to validate the response of conforming devices. A contemporary example is AS/NZS 4777.2 standard for inverters.[9]

The development of robust and interoperable CER devices relies heavily on the harmonisation of the four critical elements of interoperability identified above. To ensure seamless communication and operation between various devices and systems, it is essential that these elements are carefully mapped to one another.

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[6] Standards Australia, 2025, *SA TS 5573:2025 (Current)*, Standards Australia website

[7] IEC (International Electrotechnical Commission) 2025, *IEC 61970 Series*, IEC Website

[8] IEC (International Electrotechnical Commission) 2024, *IEC 61968-9*, IEC Website

[9] Standards Australia 2020, *AS/NZS 4777.2:2020*, Standards Australia Website

This mapping enables the identification of gaps and overlaps, facilitating the development of standards which can work together to support interoperability. In some cases, a standard can cover more than one of the four elements of interoperability. For example a single standard can define both the data model and the protocol for communication, so the mapping between these elements is within the one standard. This is the case for IEEE 2030.5.

Cybersecurity must be integrated into considerations during the conception, design, development and operation of any physical system, energy or otherwise, to mitigate or even eliminate avenues for cyber-enabled attacks. The Australian Government will continue working with the market bodies and industry to mitigate cyber security risks.

## 3.5. The National Consumer Energy Resources Roadmap

Under the National Energy Transformation Partnership (NETP), Australian governments are working together to maximise economic opportunities from the clean energy transformation, to ensure reliable and affordable electricity, and to deliver the greatest benefits for Australian households, businesses and communities.

At the November 2023 ECMC meeting, Ministers recognised the need for a national CER roadmap to promote better coordination and optimisation of CER, which will put downward pressure on bills and overall system costs, reduce emissions and broaden access to CER across communities.

On 19 July 2024, Energy Ministers agreed to publish the National CER Roadmap (the Roadmap). The Roadmap sets out an overarching vision and plan to unlock CER at scale across Australia. It builds on the work of jurisdictions, the former Energy Security Board (ESB) and market bodies. The Roadmap's implementation plan outlines priority reforms through four workstreams; consumers, technology, markets and power system operations. These workstreams cover the full range of reforms that will be needed to maximise consumer outcomes in a high CER future. Progress against outcomes will be reviewed with an updated Implementation Plan considered by ECMC on an annual basis.

A CER Taskforce was established to deliver priorities under the Roadmap’s implementation plan. The interjurisdictional CER Working Group will oversee implementation of the Roadmap and the taskforce. It will also provide strategic direction and highlight priority reforms and sequencing considerations to achieve the vision and outcomes.

The Roadmap provides a national approach to reforms to ensure Australians can harness the full potential of CER. If consumer resources are coordinated effectively, they can help lower costs for all consumers by offsetting the need for billions of dollars in grid-scale investment.

### 3.5.1. This project seeks to establish an initial set of requirements and applicable technical standards for CER device interoperability

This consultation paper represents a key deliverable for the T1 Nationally consistent standards, including electric vehicle-to-grid national reform priority in the CER Roadmap.

The project description in the National CER Roadmap Implementation Plan is:[10]

- T.1 Nationally consistent standards, including electric vehicle-to-grid
  1. To develop an initial set of agreed requirements and applicable technical standards for CER device interoperability and flexibility for consideration by Energy Ministers.

To progress the project, the CER Taskforce has:

- Synthesised previous work and consultations on CER interoperability standards
- Identified use cases
- Outlined the requirements for each of the use cases
- Mapped requirements to applicable technical standards that can support them
- Identified gaps where no standards exist, highlighting the need for industry or standards organisations to develop new standards

The outcomes of this workstream will inform CER Working Group recommendations for Ministerial consideration by end of 2025 which includes an agreed set of CER device requirements and a list of prioritised gaps requiring additional standards development.

## 3.6. Defining what has been done for CER interoperability standards so far

CER interoperability standards have been examined and progressed over the last few years due to the emerging need identified by industry. Table 2 below highlights some key events.

**Table 2 Timeline of CER Interoperability Standards**

| Date | Activity |
|---|---|
| **March 2019** | AEMO published *Integrating Utility-scale Renewables and DER in the SWIS*. An update to this report was published in September 2021. |
| **April 2020** | WA released a DER Roadmap which outlined a plan through to 2025 to enable the uptake, integration and market participation of DER. WA has since published its third progress report. |
| **September 2020** | Department of Home Affairs established Standards for Internet of Things (IoT) technology (smart devices), including CER, such as basic security features by design, which will help prevent cyber-attacks on millions of Australian consumers. |
| **February 2021** | The AEMC publishes its final rule determination to create an initial set of Technical Standards for DER that will apply to DER across the NEM based on a request submitted by the AEMO in 2020. |
| **May 2021** | AEMO, working with the Vehicle-Grid Integration Standards Taskforce under ARENA's Distributed Energy Integration Program (DEIP), published Electric Vehicles Grid Integration report. The report identified relevant V2G integration standards gaps and developing an understanding of the international V2G integration standards landscape. The report focused on three domains: charging interoperability, energy and services market integration, and disturbance performance and grid support. |

[10] See Chapter 5 Roadmap Implementation Plan of the *National Consumer Energy Resources Roadmap* for more detail on specific workstreams

| Date | Activity |
| --- | --- |
| **December 2021** | AEMO published NEM Engineering Framework Initial Roadmap which summarised the breadth of potential efforts and decisions needed to prepare the NEM power system for the futures envisioned in the Integrated System Plan (ISP), including the need for national policy direction and industry alignment on device interoperability requirements. |
| **December 2021** | The former Energy Security Board (ESB) published the Post 2025 DER Implementation Plan. The plan sought stakeholder views on how interoperability standards should be applied in the NEM. The paper considered development of an assessment framework, relevant considerations for assessing trade-offs and applicability of CSIP-AUS to the NEM. |
| **December 2021** | The former ESB published the scope of work document 'Unlocking benefits of change for consumers: integration of distributed energy resources and flexible demand (2021)'. It included in scope - customer protection and rewards through participation in flexible demand and generation, innovations in market operation, system security and network development to accommodate two-way flows and cost-effective management of the network. |
| **February 2022** | WA Emergency Solar Management policy implemented. All new and upgraded rooftop solar systems with an inverter capacity of 5kW or less, must have the capability to remotely turn off. |
| **March 2022** | The AEMC published its final rule determination on the governance of distributed energy resources (DER) technical standards. The rule determination was not to make a rule. |
| **October 2022** | The former ESB released the Interoperability Directions Paper detailing the ESB's first priority for standardisation as interoperability for flexible exports through CSIP-AUS. The ESB engaged FTI Consulting to support development of its advice regarding the implementation of CSIP-AUS as a first step towards delivering CER interoperability. This built on prior work by FTI that developed an assessment framework for CER interoperability policy, which consulted the ESB in 2021 and provided the basis for feedback from a wide range of stakeholders.[11] |
| **May 2023** | DCCEEW engaged Ernst & Young to undertake an Electric Vehicle Market Reforms Gaps Analysis. This report advises on the gaps and barriers to effective EV grid and market integration, and to recommend policy, regulatory and non-regulatory interventions to address them. |
| **July 2023** | SA Government mandate flexible export capacity for all new and upgraded solar installations. |
| **September 2023** | The AEMC published Review into consumer energy resources technical standards. It made 10 recommendations related to simplifying device settings at manufacture and supply, promote compliance installation and support ongoing compliance. |
| **February 2024** | The ESB's final report Consumer energy resources and the transformation of the NEM is published. The former ESB, with their transition to the Energy Advisory Panel, worked with the AEMC to produce its final report. The report summarised the key insights and lessons learnt across the CER reform journey to date and outlined a forward pathway for CER integration through a series of priority areas. |
| **June 2024** | Standards Australia and DCCEEW publishes the Roadmap for Consumer Energy Resources Cybersecurity Report. |
| **June 2024** | AEMO's Integrated System Plan (ISP) published. The ISP highlighted the need for coordinated CER to help deliver more reliable and secure energy, at lower cost for all consumers, and contribute to |

[11] FTI Consulting 2021, *DER Interoperability Assessment Framework [PDF 1,739 KB]*, DatoCMS Website

| Date | Activity |
|---|---|
| | lower emissions. The ISP reiterates that without effective coordination of consumer batteries, around $4.1 billion of additional grid-scale investment would be needed, increasing the costs that are reflected in consumer bills. |
| **July 2024** | Energy Ministers agree to publish the National Consumer Energy Resources (CER) Roadmap. |
| **August 2024** | AEMC publishes rule determination on flexible trading arrangements. These arrangements will make it easier for energy service providers to offer products and services to households, businesses, and the public sector, to unlock the value of flexible CER. |
| **October 2024** | Victorian government mandate the emergency backstop mechanism for small and medium systems to commence on 1 October 2024. |
| **October 2024** | ANU report[12] commissioned by DCCEEW highlights behind-the-meter protocols for inverters (based on IEEE2030.5), Remote management of inverter energy systems (through CSIP-AUS), Inverter support for trader capabilities, management of EV charging, Options for flexible load standards, New standard for site controller performance, Conformance management, Device-level cybersecurity standards, Identity management via public key infrastructure (PKI). |
| **November 2024** | *Cyber Security Act 2024* becomes law. This Act provides for mandatory security standards for certain products that can directly or indirectly connect to the internet (called relevant connectable products) which include smart appliances and solar PV systems. |
| **May 2025** | WA Government released a Statement on Interoperability of Distributed Energy Resources, a WA DER Roadmap action. It commits to using CSIP-Aus for household DER communication in the state's main electricity grid, with initial implementation as part of the WA Residential Battery Scheme VPP product and for Emergency Solar Management. |

### 3.6.1. Jurisdictional CER standards implementations

Some states and territories have implemented, or are in the process of developing, initial standards to improve interoperability. The motivations for state and territory policy developments have varied across jurisdictions ranging from implementing trials and supporting backstop measures to manage how much solar can be exported to the grid. These are listed below in Table 3.

Jurisdictional implementation of interoperability standards to address specific needs can risk regulatory harmonisation across jurisdictions. This can create internal barriers to domestic trade and limits the ability for local businesses to develop economies of scale and scope. A harmonised effort to set minimum requirements can support a more cohesive and integrated approach to addressing interoperability.

[12] The CER Taskforce commissioned the Australian National University (ANU) to develop a pathway for interoperability standards and has been provided as further background to help define the initial interoperability ecosystem. This report titled *Technical and Interoperability Standards for CER: Pathway for Implementation* is available as a complement to this consultation paper.

To date, differing definitions of 'backstop' have led to different interpretations and implementation. Jurisdictions have differing requirements for remote disconnections, export limits and technical solutions. The absence of a unified definition and understanding of the requirement has made implementations challenging, resulting in varying minimum requirements.

**Table 3 Backstop implementation across jurisdictions**

| Date | Jurisdiction | Implementation | Details |
|---|---|---|---|
| 24 September 2020 | South Australia | Office of Technical Regulator | Remote disconnection and reconnection requirements; and export limit requirements |
| 14 February 2022 | Western Australia | State Government introduced Emergency Solar Management | API cloud solution, metering Solution |
| 6 February 2023 | Queensland | Queensland electricity connection manual | Generation Signalling Device |
| 1 October 2024 | Victoria | Victorian licence condition via Ministerial Order | Common Smart Inverter Profile Australia, SA HB 218:2023 |

## 3.7. CER to CER

A key foundation of CER interoperability is the ability to communicate between various market participants (DNSPs, aggregators, system operators) and the CER assets themselves. For example, the application of dynamic operating envelopes (DOEs) is predicated on the assumption that system operators can communicate with end devices to adjust the export limits in a dynamic way. Device manufacturers (OEMs) often have visibility and control over the CER device to communicate and deliver specific instructions, for example an EV manufacturer communicating to a vehicle to begin or end a charging session.

A challenge arises when a device receives instructions from multiple communications pathways. For example, a vehicle receiving an instruction from both a system operator and a vehicle manufacturer. Multiple communications pathways increase the risk of miscommunication of instructions which can have knock-on impacts on consumer trust, system security and reliability. Device control hierarchies will need to be in place in scenarios where multiple devices sit behind a single connection point. Regardless of whether multiple signals are sent to each device individually, a mechanism will need to be in place to ensure that the behind-meter devices respond in a coherent manner rather than, for example, trying to 'compete' for the export capacity.

The implementation of a hierarchy of assets within each household ensures that instructions such as DOEs are met, in aggregate, at the connection point level. This functionality adds complexity to the control system but is likely to be increasingly required as modes of communication and the number of devices behind a single connection point increase. This consultation focuses only on the device requirements rather than determining a hierarchy. Device control hierarchies will be considered when the CER regulatory framework comes into effect.

## 3.8. Switching energy service providers

Consumers can gain greater benefits from new markets if they are able to engage in the competitive processes, including switching between different energy services providers. To deliver the potential consumer benefits from CER, it is important that consumers can operate, or set-and-forget, their devices more effectively. For example, by improving coordination between CER devices within a household like a solar panel and a battery or allowing consumers to switch energy service providers easily to unlock greater choice and value.

The ability for consumers to smoothly switch their energy service provider is likely to encourage innovation and unlock additional value to consumers from greater choice from retail contracts. Switching providers can encourage the development of innovative products and retail contracts through which CER owners can provide flexibility services to DNSPs and the system operator, and be remunerated in return.

Table 4 below describes a range of benefits and potential challenges in enabling switching of providers, noting that a key outcome from the CER Roadmap is for economic opportunities for consumers to be maximised. Switching providers is also further considered in section 5.9 in Chapter 5 Requirements identification and through a case study for CSIP-AUS in section 7.1.

**Table 4 Costs and benefits in enabling customers to switch providers**

| | Benefits | Costs |
|---|---|---|
| **Consumer empowerment** | • Improved consumer trust and acceptability of CER.<br>• Consumer CER choice is simpler, as all devices can communicate with all aggregators.<br>• Avoid being locked-in to a service provider and end up with stranded assets if the service provider ceases to trade.<br>• Consumers may benefit from lower installation costs due to reduced burden on installers.<br>• Consumers able to access the best retail contracts. | • Decreased variability of service provider.<br>• Current CER owners may find themselves with outdated assets that do not allow them to access new markets. |
| **Market competition and innovation** | • Encourages competition and drive innovation among service providers and aggregators.<br>• Flexibility enabled that can be rewarded through innovative contracts with an aggregator.<br>• Facilitates the development of competitive markets where aggregators compete for consumers. | • Potentially limit innovation in the communication protocols.<br>• Requiring devices to use the same protocols and may remove cost-efficient hardware that would have been cheaper from the market.<br>• Device manufacturers and aggregators would need to ensure their hardware and software systems comply with a minimum standard.<br>• Risk of reducing competition between OEMs due to protocol compliance requirements.<br>• Overall market optionality may decrease leading to more a concentrated OEM market (which could in turn increase costs to consumers). |

| | Benefits | Costs |
|---|---|---|
| | | • If some device manufacturers are restricted in their ability to participate in the market due to lack of compliance with a new technical standard, this may restrict the pool of offers to prospective consumers. |
| **Operational efficiency** | • Improves operational efficiency for aggregators by reducing the need to support multiple communication protocols.<br>• Lowers long-term costs for aggregators by reducing the need for custom integrations.<br>• Decrease risk of miscommunications. | • Higher compliance and monitoring costs for ensuring interoperability.<br>• Potentially more expensive device hardware to meet interoperability standard. |
| **Grid and market integration** | • Encourages better integration of CER into the energy market, supporting grid stability.<br>• Supports the transition to renewable energy by enabling CER devices to participate in flexibility markets.<br>• Degree of consistency across the communications process. | • Increased regulatory burden to enforce and monitor compliance with interoperability standards.<br>• Potentially more intrusive if individual devices are subject to communications protocols, which gives third parties more visibility over consumers' activities.<br>• Potential for worse data privacy and security outcomes if alternative protocols would have been more secure. |

# Consultation Questions

**Question 1** - Should the capacity for consumers to switch energy service providers (churn) be prioritised and what are the impacts?

# 4. Use Case mapping

Building on the ANU standards report and the Distributed System and Market Operators (DSMO) (M.3), data requirements (M.2) and the CER regulatory framework (T.2) Roadmap work streams, this consultation paper highlights 13 relevant 'use cases', or individual activities.

The ANU standards report identifies some initial use cases. Since the development of the ANU report the taskforce has further developed a consolidated list of use cases to support CER implementation with input from the different Roadmap streams, including DSMO, data requirements and the CER regulatory framework. International examples of relevant use cases were also reviewed including UK - PAS 1878 (Energy Smart Appliances - System Functionality and Architecture).

Through the 'Redefine roles for market and power systems workstream' (M3/P5) and 'Data sharing arrangements workstreams' (M2), 232 use cases were identified as necessary to effectively integrate CER into the distribution system. These use cases were identified primarily in respect to NEM processes, however most of them will form necessary considerations for non-NEM jurisdictions.

This consultation paper highlights relevant use cases from the aforementioned capability modelling exercise and lists the associated device/system requirements necessary to enable CER interoperability. These relevant use cases, a summary of activities and corresponding CER device requirements have been mapped at Table 5 below. The CER device requirements are explained further in Chapter 5.

When reviewing use cases for general CER it should be noted that it was important to separate EVs and the EVSE (e.g. charging stations). EVSE have different requirements and activities compared to EVs and this permitted the exploration of the activities and requirements for an EV compared to EVSE.

### Table 5 M3/P5 and M2 use case analysis mapped to CER device requirements

Note: The use cases in this table are aligned with the use cases in M3/P5 and M2 consultation, some difference in wording is due to the language used in this paper. The M3/P5 and M2 consultations are available on the Have Your Say website.

| Lifecycle stage | Summary of Use Cases from M3/P5 and M2 stream (use case ID) | CER device/system requirements (see Chapter 5) |
|---|---|---|
| Connect | **Build and manage enabling CER infrastructure projects (CI13-16, CI27)**<br>• Monitor, manage, augment or remove CER enabling infrastructure.<br>• Install access/maintain equipment for corrective measure – like electronic controls. | R-1: Disconnect<br>R-8: Monitor site-level power generation and loads<br>R-13: Default CER settings |
| Connect | **Integrate CERs (CI12,26,30,34,41, 42)**<br>• Connect CER and customers to grid<br>• Configure installation and CER to requirements - Install, modify or remove CER<br>• Establish communication links - Establish communication pathway for emergency CER curtailment<br>• Ensure effective communication between CER and required roles such as DNO, Customer Agent to carry | R-2: Modulate power in response to grid conditions<br>R-1: Disconnect<br>R-3: Modulate power in response to external signal<br>R-8: Monitor site-level power generation and loads<br>R-10: Uniquely identifiable<br>R-13: Default CER settings<br>R-12: Trusted Communications |

| Lifecycle stage | Summary of Use Cases from M3/P5 and M2 stream (use case ID) | CER device/system requirements (see Chapter 5) |
|---|---|---|
| | out optimisation instructions and provide market services. | |
| **Connect** | **Signal to CER hardware manufacturers and suppliers (CI22,23)**<br>• Produce CER products to required standards<br>• Verify CER product compliance<br>• Register CER with required systems<br>• Comply with manufacturing standards and requirements<br>• Provides equipment and software solutions that enable CER functionality, such as inverters, batteries, or energy management systems | R-1: Disconnect<br>R-3: Modulate power in response to external signal<br>R-4: Remote reading of device telemetry<br>R-5: Remote reading of device settings<br>R-8: Monitor site-level power generation and loads<br>R-10: Uniquely identifiable<br>R-11: Local CER to CER Coordination<br>R-13: Default CER settings |
| **Connect** | **Onboard customers to products and services (CI01-09, 25)**<br>• Manage customer switching processes – consumers have the ability to switch CER services and deals<br>• Onboard customers and connect customers and CER to grid<br>• Pre-qualify CER – consumers have confidence in activating their CER device as they are secured by Installer from Supplier in order to install<br>• Support and service ongoing customers - facilitate control of their CER | R-3: Modulate power in response to external signal<br>R-5: Remote reading of device settings<br>R-6: Remote updating of device settings<br>R-7: Remote provision of price signals<br>R-9: Switch providers<br>R-10: Uniquely identifiable |
| **Operate** | **Engage and inform customers about CER operations (OTN48,62,63,69,97)**<br>• Tracking usage and receive alerts<br>• Receive service requests<br>• Issue messages to CER<br>• Provide operational data to Customer Agent<br>• Establish communication channel | R-3: Modulate power in response to external signal<br>R-4: Remote reading of device telemetry<br>R-5: Remote reading of device settings<br>R-8: Monitor site-level power generation and loads<br>R-10: Uniquely identifiable<br>R-12: Trusted Communications |
| **Operate** | **Operate CER per service requirements/directions (OTN50)**<br>• Manage CER in their voluntary<br>• scheduled resources (VSR) - receive telemetry, include dispatched and triggered network services, customer preferences and participants should be registered | R-2: Modulate power in response to grid conditions<br>R-3: Modulate power in response to external signal<br>R-4: Remote reading of device telemetry<br>R-5: Remote reading of device settings<br>R-8: Monitor site-level power generation and loads<br>R-12: Trusted Communications |
| **Operate** | **Operate CER under emergency conditions (OTE17,18,20,23)**<br>• Receive and track emergency alerts for CER usage - Alerts or messages about when and how the device will be used during emergency conditions<br>• Receive emergency commands to curtail generation<br>• Operate disaggregated resources per system restart<br>• Receive and action emergency backstop commands<br>• Receive and action emergency backstop commands to the customer - from DNSP or Customer Agent or cyber coordinator | R-1: Disconnect<br>R-2: Modulate power in response to grid conditions<br>R-3: Modulate power in response to external signal<br>R-8: Monitor site-level power generation and loads |
| **Operate** | **Optimise CER capacity/flexibility contributions (OTN44)**<br>• Ingest Dynamic Operating Envelopes (DOEs) | R-2: Modulate power in response to grid conditions<br>R-3: Modulate power in response to external signal<br>R-9: Modulate power, site-level signal<br>R-8: Monitor site-level power generation and loads |

## 4.1. Separation of EVSE and EVs in CER device requirements mapping

Electric vehicles and EVSE have been separated and treated as two separate CER devices. This decision was based on the different requirements which were identified as an outcome of the mapping exercise of activities to requirements (Table 5 above). We are interested in how both EVs and EVSE can meet interoperability requirements. Typically, an EVSE receives communication signals and instructs the EV to respond. The EV can act like a passive load and respond to the EVSE instructions within the vehicle’s physical limits. Alternatively, some EV manufacturers have systems that communicate directly with the vehicle’s on-board charge controller (OBCC). Therefore, it is important to consider interoperability requirements for both EVs and EVSE.

In some instances, both the EVSE and the OBCC could receive communications signals from different external entities, for example network operators, aggregators and retailers. Ensuring the EVSE and the vehicle respond in a consistent and predictable manner is important. It may be necessary to determine which devices, the EVSE or the OBCC, takes precedence in different configurations. Ultimately, the same requirements are applicable to both the EVSE and the EV and both ‘devices’ will need to reconcile communications signals and respond in the desired manner (see section 3.7). The intent of adopting interoperability standards is to ensure that both the EVSE and EV exchange information to meet the specified requirements.

The EVSE which have been considered in scope of this review are private EVSE equipment which can be categorised as Level 2, Level 3 charging equipment and Modes 2, 3, and 4 of operation as depicted in Table 6.

Requirements beyond devices themselves, such as entities that can control devices including charge point operators (CPOs) and aggregators, will be considered as part of the T2 National Technical Regulatory Framework for the CER Technology workstream. For example, the Open Charge-Point Interface (OCPI) is a protocol standard that facilitates payment reconciliation for EV roaming. It allows e-Mobility Service Providers (eMSPs) to exchange financial reconciliation data to streamline consumer interactions across providers.

**Table 6 EV charging levels and modes (Level 2 and level 3 are in scope)**

| **EV Charging Levels** | **Type** | **Power** | **Description** | **Mode 1** Standard socket outlet – domestic installation | **Mode 2** Standards socket outlet with an AC EVSE – domestic | **Mode 3** AC EVSE permanently connected to an AC supply network | **Mode 4** DC EVSE |
|---|---|---|---|---|---|---|---|
| **Level 1** **(Out of scope)** | Single phase domestic | ~1.4 - 2.4 kW | Level 1 EV charging requires a single-phase 230VAC connection and it is considered the slowest AC charging option. |  **Trickle Charging** | | | |
| **Level 2** **(In scope)** | Single phase domestic/public | ~3.6 - 7 kW | Level 2 EV charging requires a single-phase 230V connection for homes or a three-phase 400VAC connection for residential and commercial ones. | |  Portable EV Charging |  Fixed EV charging | |
| | Three Phase domestic/public | ~11 - 22 kW | | | |  Fixed EV charging | |
| **Level 3** **(In scope)** | Fast charging | ~25 - 350 kW | Level 3 EV charging features a complex electrical infrastructure to convert three-phase AC power to DC directly at the charging station. | | | |  Fast DC Charging |

## 4.2. International minimum requirements for EVs

Many international jurisdictions have opted for setting of requirements for CER/EVs. One such standard has been applied to EVs in the UK - PAS 1878 (Energy Smart Appliances - System Functionality and Architecture).

A comparison between the device/system requirements identified through this consultation and PAS 1878 requirements is provided in Table 7 below.

**Table 7 Comparison of CER device/system requirements with PAS 1878**

| Links to CER Device/system Requirements (see Chapter 5) | PAS 1878 Requirements |
|---|---|
| **R-3: Modulate power in response to external signal**<br><br>**R-4: Remote reading of device telemetry**<br><br>**R-5: Remote reading of device settings**<br><br>**R-7: Remote provision of price signals**<br><br>**R-8: Monitor site-level power generation and loads** | Including the ability to send and receive information, the ability to respond to signals to increase the rate or time at which electricity flows through the charge point but within the limits of the charger. |
| **R-13: Default CER settings** | Continued charging the EV even if the EV ceases to be connected to a communications network. |
| **R-4: Remote reading of device telemetry** | The EV should be able to measure or calculate the electricity imported or exported and the time the charging lasts, with visibility to the owner of this information. |
| **R-12: Trusted Communications** | EVs communication and cybersecurity requirements consistent with the existing cyber security standard ETSI EN 303 645. |
| **R-9: Switch providers**<br><br>**R-13: Default CER settings** | EVs should be able to incorporate pre-set, off peak, default charging hours and allow the owner to accept, remove or change these upon first use and subsequently with a randomised delay function. |

# Consultation Questions

**Question 2** - What are your views on interoperability hierarchy via the vehicle and an EVSE? Do you think the EVSE should take precedence over the vehicle or vice versa?

**Question 3** – Should minimum device/system requirements be applied to EV Level 1, Mode 1 and Mode 2 charging technologies, as per discussion in the section above?

**Question 4** – Should minimum device/system requirements be applied to public EVSE?

# 5. Requirements identification

As outlined in Chapter 4, the use case mapping identified relevant use cases and associated device/system requirements necessary to enable CER interoperability (Table 6). This chapter (see sections 5.1 to 5.13) describes each CER device/system requirement, its purpose and a pathway to deliver. This chapter then maps each requirement to applicable technical standards in Table 8.

Requirements are only applicable to devices that can practically perform the specified requirement. For example, load-only devices like hot water systems do not need to modulate exported power as they are not capable of generating power.

## 5.1. R-1 Disconnect

**Description**:

The disconnect requirement is a critical safety feature for CER devices. Disconnection functionality provides the capabilities for CER to isolate from the power system/grid in response to a signal or condition. This requirement also creates the options for this disconnection capability to be used automatically due to detection of adverse system conditions or device states. This disconnection requirement also covers the capabilities to control the reconnection.

**Purpose**:

There are several purposes for the requirement of disconnect:

- Safety – prevents CER from feeding power back into the grid during maintenance or fault conditions.
- Protection – protects people and equipment from CER during CER faults or malfunction.
- System/grid stability – assists in maintaining grid and system stability by allowing CER to be disconnected from the system/grid during faults or other abnormal conditions.
- Manual disconnection options for use during planned maintenance or emergency scenarios.

**Pathway to Deliver**:

The disconnect requirement can be implemented through various means such as designing CER with built-in disconnect functionality or external disconnection devices that receive control signals from the CER and/or control and monitoring equipment.

## 5.2. R-2 Modulate power in response to grid conditions

**Description**:

The requirement to modulate power in response to grid conditions is a particularly important capability for CER devices that can generate power. It requires CER to automatically adjust power input/output in a standardised response to grid conditions.

**Purpose**:

The purpose of modulating power in response to grid conditions is to:

- Maintain system/grid stability – CER adjusting power output or input in response to grid conditions assists in the maintenance of system/grid stability and can reduce power quality issues.
- Support grid reliability – CER with modulating power capabilities can help reliability of supply in response to grid conditions, such as frequency fluctuations or voltage variations.
- Ensure safe operation – by adjusting power output/input due to grid conditions, CER devices help prevent damage to equipment and 'themselves' on the grid.

**Pathway to Deliver:**

The ability to modulate power in response to grid conditions can be implemented as control functions within the CER device. These controls have several features including:

- droop control – a control method that adjusts power output/input based on grid frequency.
- voltage regulation – CER devices can adjust their power output to regulate voltage levels on the grid.
- power interruption – CER devices can reduce their power output/input in responses to grid conditions such as high frequency or low voltage.
- ramp rate – CER devices can adjust their power input/output in a linear fashion in response to grid conditions.

## 5.3. R-3 Modulate power in response to external signal

**Description**:

The requirement to modulate power (generation and/or consumption) in response to an external signal is critical for CER devices. This response can be considered in its simplest form as the CER device turning the generation or load off. CER reducing power generation/consumption to 0W can be in response to a signal from a remote or local agent.

**Purpose**:

The purpose of modulating power to 0W is to:

- Respond to Minimum System Load (MSL) emergency conditions – the main use case for this requirement to modulate power to 0W for generation type CER is in response to when the system is experiencing a MSL condition.
- Respond to Dynamic Operating Envelopes (DOE) – the use of DOEs is to signal the curtailment of generation/consumption to a percentage (e.g. dynamic or flexible export schemes).
- Response to electricity market conditions – further uses of these capabilities have been the use of energy retailers using the capabilities to reduce the amount of generation of their customers during negative electricity prices. Negative electricity prices typically occur when the supply of electricity on the market exceeds demand, resulting in a situation where producers pay to generate electricity.
- Respond to Lack of Reserve (LoR) – load-based CERs, such as EVs and flexible load can also respond to external signals by modulating consumption.

**Pathway to Deliver:**

The ability to modulate power in response to grid conditions or an external signal can be implemented as control functions within the CER device. These controls have several features including:

- Zero generation – a control method that adjusts power output/input to prevent generation CER devices from generating any power.
- Zero Export – a control method that adjusts power output/input to match the generation CER devices to the amount of load at a site or aggregation point.

## 5.4. R-4 Remote reading of device telemetry

**Description**:

The requirement for the remote reading of device telemetry involves collecting and transmitting data from the CER devices to a remote agent. This data can be device operation, such as energy generation, consumption or storage levels. Site conditions such as grid voltage, frequency or power quality information can be considered amongst this telemetry dataset. Status updates on the CER device operation, alarms and errors can be included.

**Purpose**:

The purpose of this requirement is to:

- Enable remote monitoring – allow operators or remote agents to monitor CER device performance and site conditions.
- Improve CER device management – provide insights into CER device operation and performance which enables optimisation and proactive maintenance of devices.
- Optimise device performance – use data to optimise CER device performance, reduce CER outages, and improve overall efficiency.

**Pathway to Deliver**:

Gathering the data from CER devices and CER performance has various methods:

- Device logging – collecting data from the CER device logs, which can provide information on CER device operation, errors and alarms.
- API integration – integrating with device application programming interface (APIs) or standardised open protocols to collect data on device performance.

## 5.5. R-5 Remote reading of device settings

**Description**:

The requirement for remote reading of the CER device setting is to allow an authorised agent to query and retrieve these settings. Settings that control how the CER device connects to the grid, such as voltage and frequency, are examples of grid connection settings. Power output or consumption input settings control the amount of power generated or consumed by the CER device. Protection settings control the CER device protection functions such as overcurrent or overvoltage protection.

**Purpose**:

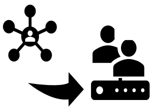
The purpose of remote reading of CER device settings is to:

- Enable grid management – allow networks and operators to request the current CER device settings, ensuring grid stability and reliability.
- Improve device coordination – coordination between CER devices and the grid can be improved if networks and operators are able to understand CER device and grid operation.
- Visibility – providing visibility into CER device settings enables faster response to potential security threats and can improve backup contingency operations plans.

**Pathway to Deliver**:

- Sensors and meters – installing or leveraging sensors and meters to measure device performance metrics such as energy generation, consumption and local power quality.
- Device logging – collecting data from the CER device logs, which can provide information on CER device operation, errors and alarms.
- API integration – integrating with device APIs or standardised open protocols to collect data on device performance.

## 5.6. R-6 Remote updating of device settings



**Description**:

The requirement for remote updating of CER device settings enables authorised agents to modify settings on CER devices remotely. This allows for remote adjustments to be made as needed, ensuring grid stability and reliability.

**Purpose**:

The purpose of remote setting of CER device settings is to:

- Enable grid management – allow networks and operators to request the update of CER device settings, ensuring grid stability and reliability.
- Improve device coordination – coordination between CER devices and the grid can be improved if networks and operators are able to adjust CER device settings to support grid operation.
- Predictability – ensure devices operate predictably, reducing uncertainty and potential issues with legacy or out-dated device settings.

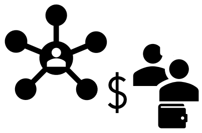
**Pathway to Deliver**:

The ability to update CER device settings remotely may require:

- Secure communications – establish secure communication channels for remote updates, ensuring data integrity and authentication.
- Device management systems – implementing device management systems that can remotely monitor and update device settings.
- Authorisation and authentication – ensuring only authorised agents can make changes to device settings, with robust authentication mechanisms in place.

- Testing and validation – thoroughly tested and validated remote updates are only applied to ensure minimum disruption to the CER devices and to the grid.

## 5.7. R-7 Remote provision of price signals



**Description**:

The remote provision of price signals including communicating tariffs and/or network prices to CER devices is a growing requirement. This enables CER devices to be further optimised in response to changing price signals.

**Purpose**:

The purpose of remote provision of price signals is to:

- Enable dynamic pricing – allow CER devices to respond to changing prices and optimise CER devices energy generation and consumption.
- Support system energy needs – CER devices can change energy generation and consumption during peak and trough periods when prices are high and low, respectively.
- Improve grid stability – CER devices can assist in the balancing of energy supply and demand with energy prices linked to auxiliary energy markets such as frequency control auxiliary services (FCAS).

**Pathway to Deliver**:

Contemporary examples of remote provision of price signals include:

- Demand Response Application Server (Japan) – Transmission System Operator hosts a server which is posting prices and opportunities. This server connects to aggregators and service providers via OpenADR (Automated Demand Response). [13]
- Market Informed Demand Automation Server (MIDAS) – a relational database of time-varying rates hosted by the California Energy Commission (CEC).[14] The database is populated by electric Load Serving Entities (LSEs) and other data source entities that register with the MIDAS system. The MIDAS database supports entry and retrieval of electric price schedules, California Flex Alert signals and marginal greenhouse gas (GHG) emissions. The database is publicly accessible in a standard machine-readable format through an API that supports both XML and JSON responses to queries.

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[13] Sakuma, Yasuhiro 2021, *Japanese Energy Market – Optimum Use of Distributed Energy Resources for Demand side response* *[PDF 2.8 MB]*, OpenADR Website

[14] California Energy Commission (CEC) 2021, *Market Informed Demand Automation Server (MIDAS)*, CEC Website

## 5.8. R-8 Monitor site-level power generation and loads

**Description**:

Monitoring involves tracking and measuring power generation and consumption at the local site level. The power flow is the flow of power between the local premise and the grid. R-10 is linked to the site level as the aggregated CER monitoring can provide site level visibility.

**Purpose**:

The purpose of this requirement is to:

- Optimise energy generation and consumption – enable site coordinators to optimise energy usage.
- Improve CER device management – provide insights into CER device operation and performance which enables optimisation and proactive maintenance of devices.
- Optimise device performance – using data to optimise CER device performance, reduce CER outages, and improve overall efficiency.

**Pathway to Deliver:**

The implementation of site monitoring can be achieved through gathering the data from CER and non-CER performance via various methods:

- Sensors and meters – installing or leveraging sensors and meters to measure device performance metrics such as energy generation, consumption and local power quality.
- Device logging – collecting data from the CER device logs, which can provide information on CER device operation, errors and alarms.
- Data analytics – using data analytics to gain insights into site-level energy usage.
- API integration – integrating with device APIs or standardised open protocols to collect data on device performance.

## 5.9. R-9 Switch providers

**Description:**

Consumers need to have the ability to switch CER service providers and not be locked-in or provisioned to a particular provider.

**Purpose**:

The purpose of this requirement is to:

- Promote competition – all consumers to choose their preferred service provider, promoting competition and innovation of service providers.
- Ensure flexibility – enable consumers to switch providers if they are not satisfied with the services or if a better option becomes available.
- Support consumer choice – give consumers control over their CER devices and the services they utilise.
- Consumer protections – provides the consumer with the ability to change to another provider if the current provider ceases to trade or to provide the service.

**Pathway to Deliver:**

The implementation of switching providers can be achieved through having standardised interfaces. These standardised interfaces can enable CER devices to communicate with different service providers. The protocols used should be open protocols which allow CER devices to switch between different service providers without being locked into a specific provider. This switching can be enabled via the CER device management systems through which consumers can initiate a switching request or actually re-provision the CER directly.

## 5.10. R-10 Uniquely Identifiable

**Description**:

This requirement for uniquely identifiable CER devices ensures that CER have a distinct identifier that sets a particular CER device apart from other devices.

**Purpose**:

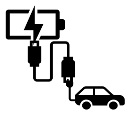
Uniquely identifiable properties for CER ensures devices can be tracked and performance and behaviour can be attributed to a specific CER device. This accountability capability is also important in a conformance monitoring framework for assessing devices conformity, troubleshooting and corrective actions. Uniquely identifiable CER support secure communication and authentication and can reduce the risk of unauthorised access or malicious activities.

**Pathway to Deliver**:

The implementation of unique identifiers for CER devices can be achieved through:

- Device serial numbers – assign a unique serial number to each device during manufacturing.
- Media Access Control (MAC addresses) – devices can be identified from the assigned uniquely obtained MAC addresses from the communication module used in CER.
- Device Identification – assign a unique device Identifier to each CER device which can be used for device management, registration and tracking.
- Public Key Infrastructure (PKI) – use PKI to assign unique digital certificates to each device.

## 5.11. R-11 Local CER to CER Coordination



**Description:**

Local CER coordination enables various CER devices to exchange information and coordinate their actions within a premise. This requirement also involves CER devices working together to optimise energy usage as the CER devices can coordinate their actions to achieve a common goal. This requirement will improve consumer experience by providing seamless integration and automation of their CER devices.

**Purpose:**

The purpose of this requirement is to:

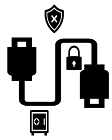
- Enable device-to-device communication – allow CER devices to exchange information and coordinate their actions in real-time.
- Support premise-level energy management – enable CER devices to work together to optimise energy usage and generation within a premise.
- Improve consumer experience – provide consumers with a seamless and automated experience, making it easier to manage their energy usage and generation.

**Pathway to Deliver**:

The implementation of this requirement can be achieved through:

- Wireless communication and protocols – device-to-device communication can be achieved with communication such as Wi-Fi, Zigbee, or Bluetooth provided it is present on both devices.
- Local area networks (LANs) – establish or leverage a LAN within a premise to enable communication between CER devices provided all CER have provisions for a LAN connection.
- Device integration, for example Home Energy Management System (HEMS) – integrate CER devices or enable non-CER devices with a central controller or hub to enable coordination and control.
- Standardised communication protocols – use open standardised protocols to ensure interoperability between devices from different suppliers (importers or local manufacturers).

## 5.12. R-12 Trusted Communication pathway



**Description:**

A requirement for a secure and reliable data exchange between devices, systems, or parties in the CER ecosystem is a trusted communications pathway.

**Purpose:**

The purpose of this requirement is to:

- Support Data Integrity – preventing tampering or alteration of data.
- Confidentiality – protecting sensitive information from unauthorised access.
- Authentication – verifying the identity of devices and parties.
- Authorisation – controlling access to data and device functionality so only permitted entities can perform specific actions.

**Pathway to Deliver**:

The implementation of this requirement can be achieved through:

- Secure communication protocols – examples that can be utilised include TLS (transport layer security), SSL (Secure Sockets Layer), or IPSec (Internet Protocol Security).
- Encryptions – using cryptographic techniques to protect data.
- Digital signatures – verifying authenticity and integrity (linked to R11).
- Secure authentication mechanisms – using credentials such as passwords, usernames or certificates.

- Access control mechanisms – implementing role-based access control or other authorisation frameworks.

## 5.13. R-13 Default CER settings

**Description:**

A requirement for default CER settings aims to empower consumers with control and choice over their energy usage and settings. Having default CER settings which can be changed and configured by the consumer ensures CER can be used without requiring active control from an external party.

**Purpose:**

The purpose of this requirement is to:

- Enable consumer control – empower consumers to make informed choices about their CER and settings if they wish to alter default settings.
- Provide flexibility – allow consumers to customise their settings to suit their needs and preferences.

**Pathway to Deliver**:

The implementation of this requirement can be achieved through:

- Consumer acceptance – ensuring consumers can accept, remove or change the default settings upon first use and have the option to change settings at any time within the safe operation of the CER.
- Authorisation and authentication – Ensuring only authorised agents can make changes to device settings, with robust authentication mechanisms in place.
- Wireless communication and protocols – direct to device communication can be achieved with communication such as Wi-Fi, Zigbee, or Bluetooth provided it is present on all devices.

## 5.14. Applicable technical standards

Following identification of each CER device/system requirement, explained in Chapter 4 and Chapter 5, a review of applicable technical standards that can support these requirements was undertaken (Table 8). This mapping helps to identify which requirements are met by existing standards and identifies gaps where there are currently no applicable technical standards, highlighting areas for further development.

Standards development is an ongoing process with standards being created and evolving as technology advances and as new challenges emerge. Ongoing development ensures that standards remain relevant and effective. For this consultation, only published standards have been included in Table 8. Other standards currently under development that may meet some of the identified requirements have not been included.

**Table 8 Requirements mapping to applicable technical standards**

<table>
<tr><th>ID</th><th>Requirement</th><th>Description</th><th>Information/Data Standards:<br><br>Data Model Standards</th><th>Communication Standards:<br><br>Protocol Standards</th><th>Operation and response to signals:<br><br>Device Standards</th><th>Performance parameters and testing:<br><br>Performance Standards</th></tr>
<tr><td>R-12</td><td>Trusted Communications</td><td>Trust in communications</td><td rowspan="6">NA</td><td rowspan="3">OCPP v1.6 and later or IEC 63584, IEC 61851-1 (EVSE Load only)<br>ISO 15118-20, IEC 61851-1 (EVSE V2G)<br>ISO 15118-2, ISO 15118-20, must include EVSE (EV)<br>AS 5385, Sunspec Modbus (PV)<br>AS 5385, Sunspec Modbus (ESS)<br>AS 5385, IEC 62746-10-1 ED1 (Flex Loads)<br>**Missing (EMS)**</td><td>NA</td><td rowspan="4">NA</td></tr>
<tr><td>R-7</td><td>Remote provision of price signals</td><td>Communicating network tariffs and/or energy prices</td><td rowspan="4">**missing (EVSE Load only)**<br>**missing (EVSE V2G) must include EVSE**<br>**missing (EV)**<br>AS4777.2 (PV)<br>AS4777.2, AS 4755.3.5 (ESS)<br>AS 4755 Air Conditioners, Pool Pumps, **missing hot water heaters** (Flex Loads)<br>**missing (EMS)**</td></tr>
<tr><td>R-3</td><td>Modulate power in response to external signal</td><td>Adjust power generation/consumption in response to communications signal (e.g. dispatch of individual CER device)</td></tr>
<tr><td>R-10</td><td>Uniquely Identifiable</td><td>CER device would have a distinct identifier that sets it apart from other devices</td><td rowspan="2">OCPP v1.6 and later or IEC 63584, IEC 61851-1 (EVSE Load only)<br>ISO 15118-20, IEC 61851-1 (EVSE V2G)<br>ISO 15118-2, ISO 15118-20, must include EVSE (EV)<br>AS 5385 **under native arrangement only**, Sunspec Modbus (PV)<br>AS 5385 **under native arrangement only**, Sunspec Modbus (ESS)<br>AS 5385 **under native arrangement only**, IEC 62746-10-1 ED1 (Flex Loads)<br>Missing (EMS)</td></tr>
<tr><td>R-9</td><td>Switch providers</td><td>Consumers have the ability to switch CER service providers and are not locked-in</td><td rowspan="3">SAE J2894, **missing ride-through capabilities (EVSE Load only)**<br>AS4777.2 (EVSE V2G) must include EVSE<br>**Missing, AS 4777.2 gap with onboard bi-directional chargers (EV)**<br>AS4777.2 (PV)<br>AS4777.2 (ESS)<br>**missing (Flex Loads)**<br>**missing (EMS)**</td></tr>
<tr><td>R-2</td><td>Modulate power in response to grid conditions</td><td>Automatically adjust power input/output in standardised response to grid conditions</td><td rowspan="7">OCPP v1.6 and later or IEC 63584, IEC 61851-1 (EVSE Load only)<br>ISO 15118-20, IEC 61851-1 (EVSE V2G)<br>ISO 15118-2, ISO 15118-20, must include EVSE (EV)<br>AS 5385, Sunspec Modbus (PV)<br>AS 5385, Sunspec Modbus (ESS)<br>AS 5385, IEC 62746-10-1 ED1 (Flex Loads)<br>**Missing (EMS)**</td><td rowspan="2">NA</td></tr>
<tr><td>R-5</td><td>Remote reading of device settings</td><td>Communicating grid-relevant device settings</td><td rowspan="5">IEC 61968-9 , IEC 61970<br>ISO 15118-20, IEC 61851-1, OCPP v1.6 and later or IEC 63584, IEC TS 60384-8-3</td></tr>
<tr><td>R-4</td><td>Remote reading of device telemetry</td><td>Communicating site and/or device operating data</td><td rowspan="5">**missing (EVSE Load only)**<br>**missing (EVSE V2G) must include EVSE**<br>**missing (EV)**<br>AS4777.2 (PV)<br>AS4777.2, AS 4755.3.5 (ESS)<br>AS 4755 Air Conditioners, Pool Pumps, **missing hot water heaters (Flex Loads)**<br>**missing (EMS)**</td><td rowspan="3">NA</td></tr>
<tr><td>R-8</td><td>Monitor site-level power generation and loads</td><td>Monitor the local site-level generation and loads power flows</td></tr>
<tr><td>R-11</td><td>Local CER to CER Coordination</td><td>Local CER communication enables various CER devices to exchange information and coordinate their actions within a premise</td></tr>
<tr><td>R-6</td><td>Remote updating of device settings</td><td>Remotely updating device settings including grid-relevant settings</td><td rowspan="3">**missing (EVSE Load only)**<br>**missing (EVSE V2G) must include EVSE**<br>**missing (EV)**<br>AS4777.2 (PV)<br>AS4777.2 (ESS)<br>**missing (Flex Loads)**<br>**missing (EMS)**</td></tr>
<tr><td>R-1</td><td>Disconnect</td><td>Ability to disconnect in response to a signal or condition</td><td rowspan="2">NA</td></tr>
<tr><td>R-13</td><td>Default CER settings</td><td>Consumers can accept default CER settings or change settings of the CER</td><td>NA</td><td>NA</td></tr>
</table>

*Notes:*

1. AS 5385:2023 identically adopts IEEE 2030.5-2018 which defines the application layer with TCP/IP providing functions in the transport and Internet layers to enable utility management of the end user CER.
2. IEC 62746-10-1 ED1 – OpenADR 2.0b published as IEC Standard.
3. IEC 63584:2024 is the published Open Charge Point Protocol (OCPP) which provides the communication between a Charging Station and a Charging Station Management System (CSMS) and is designed to accommodate any type of charging technique. It is based on OCPP 2.0.1.
4. Other normative referenced standards within a standard are not detailed specifically - e.g. IEC 62116 (test procedure to evaluate the performance of islanding prevention measures used with utility-interconnected PV) systems is referenced in AS/NZS 4777.2 AS 5385 extends IEC 61968-9.

# Consultation Questions

**Question 5** - Are there any CER device types or use cases not adequately captured in the 13 identified requirements?

**Question 6** - Are there any other standards that can support each identified requirement?

**Question 7** - In the mapping exercise in Table 8, do you agree with the identified gaps? Are there existing standards that could fill these identified gaps?

**Question 8** - Do you have views on the prioritisation of further standards work to address the identified gaps?

**Question 9** - How can Australia align with international standards while maintaining flexibility for local conditions?

**Question 10** - Are there any risks associated with the identified requirements, such as remote updating of device settings?

**Question 11** - Modulating power in response to grid conditions or an external signal can be implemented through zero generation or zero export. Is there a preference for either of these approaches or both?

**Question 12** - What are the risks of supplier (OEM) lock-in under current standards, and how might these be mitigated?

**Question 13** - What are costs and benefits for alternative applicable technical standards and how does this impact networks, suppliers and consumers?

# 6. Gaps and Future Development

This consultation paper reveals significant gaps in current standards for CER interoperability. Specifically, many CER device types lack defined performance parameters and testing standards, which hinders interoperability. It is important that these new controllable devices have defined operation bounds and predictable responses to both loss of communication and local grid conditions. Furthermore, device standards gaps exist with certain appliances such as electric water heaters.

While existing communications protocols provide a foundation for CER device interactions, additional work is necessary to ensure seamless integration and optimal performance. This work is for the mapping of standards together and form part of the implementation guide. For example, HB 218; HB 218 is an implementation guide for AS 5385 (IEEE 2030.5) and was developed from CSIP (see section 7.1).

Additional work is required in mapping the status and parameters definitions to communication protocols. These parameters require a data dictionary or lexicon for the meanings and definitions of monitoring physical observation and parameters. Mapping or implementation guides will assist in the development of a clear standardised approach for creating and reporting of these observations, which are critical to the successful integration of CER with the system.

A project under Standards Australia has commenced to build on the initial work from ARENA's Distributed Energy Integration Program (DEIP) DER API Technical Working Group (DERIAPITWG) for the development of a new standard AS 5438. The scope of the current draft for AS 5438 specifies local interoperability specifications, functionality, testing and conformance requirements for inverters and inverter energy systems (including EVs and EVSE capable of reverse power transfer) designed to facilitate connectivity between energy sources and/or energy storage systems and the grid, connected at low voltage with nominal values of 230 V/400 V that conform to AS IEC 60038. This draft standard will include defining and testing of requirements for hardware response to local communications with inverters and inverter energy systems and improve the information and operations for local CER to CER coordination. Once complete, this standard will map the settings of AS 4777.2 and definitions of physical observations to help ensure more consistency.

AS 4755.2 is another project under Standards Australia which is nearing its publication after completing the final stage of public comment. This standard also maps different communication protocols to minimum device performance of Demand Response Modes (DRMs). These DRMs are the basic building blocks for smart appliances such as air conditioners and pool pump controllers to have clear predictable performance on activation of each DRM.

Mapping of price signals to CER is also highlighted as a current gap. A new piece of work is required to provide manufacturers and operators with an implementation guide on how price signals can be communicated and actioned by CER.

Work is currently underway internationally to assess how EVs may provide grid support functions. International Electrotechnical Commission (IEC) systems reference deliverable (SRD) 63460:2025[15] looks to create the use cases for EVs acting as CER. Consistent with standards development processes, once the use cases are identified the requirements and technical specifications can be created. This work will also impact IEC 61851 and ISO 15118 and the associated data models may require updating to support additional use cases.

By highlighting potential gaps in the domestic standards landscape alongside applicable international standards, the Taskforce aims to identify the need for deeper investigation by standards bodies, government, and industry as to meet the proposed requirements.

[15] IEC (International Electrotechnical Commission) 2025, *IEC Systems Reference Deliverables 63460*, IEC Website

# 7. Industry response to interoperability

The Australian Renewable Energy Agency (ARENA) has been working to address specific needs in the Australian energy system through its Distributed Energy Integration Program (DEIP). A notable example is the development of the Australian adaptation of the Common Smart Inverter Profile (CSIP) implementation guide based on IEEE 2030.5 standard (USA), referred to as CSIP-AUS (see section 7.1 for details). CSIP-AUS, in its initial phase, was primarily developed for the specific use case of delivering emergency backstop mechanisms to reduce PV exports flowing into the grid.

The approach involved bringing together industry and electricity network service providers to support a consistent pathway. By doing so, the initiative aimed to facilitate a common and documented roll out and connection of CER, namely PV systems. However, challenges arose during the development process.

One of the primary challenges was the initial focus on a single use case, which limited the scope of the project. This narrow focus resulted in a lack of broader requirement scoping, which could be considered as a potential barrier to the standard's applicability to other use cases.

Before the inception of a formal framework under the CER Roadmap which was agreed by Energy and Climate Ministers in mid-2024, ARENA and the DEIP, through their technical working groups, drove requirements and solutions development.

To address these challenges, it is essential to ensure that future standards development initiatives adopt a more comprehensive approach. This can be achieved by engaging a broader range of stakeholders including industry, regulatory bodies and technical experts. Additionally, adopting a more formal process for requirement development and solution design can help ensure that the resulting standards are robust, flexible and adaptable to various use cases.

The industry and the DEIP have acknowledged the challenges of producing and publishing standards. Standards need to be written in a way that ensures consistency in format and language. One way to ensure consistent application, broader adoption and on-going maintenance of CSIP-AUS is to have the standard published under Standards Australia. Standards Australia Handbook 218 (SA HB 218:2023) is the controlled document ensuring that the standard follows style guides and uses unambiguous language which can be more easily adopted by rule makers or regulators.

The process in developing SA HB 218:2023, now superseded by SA TS 5573:2025, separated the requirement setting and technical drafting phases of the standards development processes. Future development of CSIP-AUS should follow the Standards Australia pathway with clear requirements set and agreed before technical standard development begins.

Standards development is sometimes seen as a slow and inefficient process. The consensus-based approach to standards development can be cumbersome and lead to delays. Accelerating standards development can be achieved through a collaborative approach, engaging industry and leveraging existing frameworks. One potential pathway involves establishing technical working groups to focus on specific use cases under a Standards Australia technical committee, noting there are other pathways for regulatory drafting. The technical working group constitution could be similar to the existing DER Integration API Technical Working Group (DERIAPITWG) under ARENA. This technical working group would sit under a Standards Australia Technical Committee and develop documents consistent with Standards Australia's Standards Guide as a more streamlined process. The technical committee would provide the oversight and decision-making role to ensure documents are produced to the agreed requirements.

There are examples where the speed of developing a standard by a working group can be accelerated through the appointment of a dedicated and potentially funded drafting-leader. This drafting-leader can be independently appointed and drives the process of modification, creation and publication of standards.

## 7.1. Common Smart Inverter Protocol for Australia (CSIP-AUS)

### 7.1.1. What is the problem?

The market for communicating with solar and battery-based inverters has been implemented through several approaches. Some of these are 'walled gardens' which utilise proprietary communications pathways that restrict consumer choice by limiting the ability to switch market providers. These closed or proprietary ecosystems are designed to work primarily within its own ecosystem, with limited ability to interact or integrate with external systems or services, resulting with a significant control over the services and equipment which the consumers have purchased and restricting access for others.

Individual jurisdictions have progressed specific CSIP-AUS implementation pathways to support specific requirements, such as flexible export limits. As detailed below, the international standards used to support CSIP-AUS were developed in energy markets that typically have a single company controlling both retail and distribution of electricity (vertically integrated) functions and are not subject to the market competition features in Australia.

### 7.1.2. What is the Australian Common Smart Inverter Profile (CSIP-AUS)?

Under ARENA's DEIP, the Interoperability Steering Committee (ISC) has been tasked to develop a set of potential technical standards, which leverage international standards and adapt them to the Australian context. This group developed a guide for the implementation of an international standard IEEE 2030.5 called the Australian Common Smart Inverter Profile (CSIP-AUS). CSIP-AUS is an extension of the CSIP developed in the USA.

The CSIP-AUS, serving initially as market guidance and implemented voluntarily, focused on the active management of CER by setting a recommended operational and communications protocol approach. There has been a number of versions posted on the ARENA DEIP website which are described in Table 9 below.

CSIP-AUS attempts to provide a documented consistent approach for manufacturers of solar and battery inverters which meets some of the highlighted requirements from Chapter 5, such as:

- Remotely interrupting/return (turning off/on) of devices;
- Remotely curtailing/adjust generation (turn down/up output) of devices;

- Provide a stable communication channel between DNSP servers and CER devices.

AS 5385:2023 is the identical adoption of IEEE 2030.5-2018. It defines the application layer, with TCP/IP providing functions in the transport and Internet layers, to enable a Utility Server management of the end user's CER. The server allows DNSPs to manage and communicate with CER devices.

More information can be found in the ANU report that accompanies this consultation paper.

**Table 9 CSIP-AUS Versions[16]**

| CSIP Version | Status | Description |
|---|---|---|
| **CSIP-AUS Version 1.0** | Posted on the ARENA DEIP website on Jan 2023 as CSIP-AUS v1.1a (2023). | An iteration of CSIP-AUS introduced to support DNSP control of inverters and tested through the South Australia Power Networks. In practice this version tested the products in other jurisdictions, such as Victoria, against the parameters of SAPN and introduced challenges to successful implementation. |
| **CSIP-AUS Test Procedures Version 1.0** | Posted on the ARENA DEIP website in July 2023 was the first iteration of the testing procedures of CSIP-AUS. | This document drafted the test procedures that are designed to assess whether a communications client conforms to the requirements of CSIP-AUS v1.1a (2023). |
| **CSIP-AUS Utility Server Test Procedures Version 1.2** | Posted on the ARENA DEIP website in May 2025 procedures for Utility Server Test Procedures | This option is designed to address challenges in version 1.1 and enable consistent application of the protocol for the client (OEMs) and the utility (DNSP) server. |
| **Proposal of works CSIP-AUS Client and Server Test Procedures Version 1.3** | Currently under a development pathway under DEIP | Proposed CSIP-AUS 1.3 – proposed extensions that build dynamic tariffs/pricing and VPP dispatch functions. This can incentivise trader capabilities for battery storage.<br>This battery extension module is being implemented in WA alongside the WA Residential Battery Scheme, to underpin the associated VPP customer product. |

[16] See www.csipaus.org/ for further information. This website received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Advancing Renewables Program.

**Standards Australia handbook (SA HB 218:2023)**

Standards Australia has developed a handbook on CSIP-AUS - SA HB 218:2023. HB218 is Standards Australia's adoption of CSIP-AUS and was based on the initial version of CSIP-AUS developed by DERIAPITWG. Since publishing HB218, it has undergone a review and changed into a higher consensus document to move closer to becoming an Australian Standard.

**Standards Australia Technical Specification (SA TS 5573:2025)**

The latest version of HB218 has been elevated into a higher consensus level type document (from a handbook to a technical specification) AS TS 5573:2025. This technical specification, which has been circulated for peer review as an Australian Standard adoption of CSIP-AUS 1.2 includes the client-side test procedures with changes to follow the Standards Australia standard guides. This recently published technical specification supersedes SA HB 218:2023 and provides greater clarity on the implementation of AS 5385 (the direct text adoption of IEEE2030.5) including a suite of test procedures which assists with conformity assessment of devices claiming conformance.

### 7.1.3. Current uses of CSIP-AUS

**Emergency Solar Backstop**

In practice, CSIP-AUS has been utilised by some jurisdictions to enable solar PV backstop mechanisms via their DNSPs. There are some circumstances where controls are needed to restrict solar exports to support energy security and safety. Given the increased uptake of rooftop solar and the increasing frequency of weather-related events which give rise to Minimum System Load (MSL) conditions then an Emergency Backstop Mechanism enables greater control of electricity supply within the grid to ensure grid security.[17]

**Flexible export limits (FELs)**

CSIP-AUS has also been used to support trialling and implementation of a DOE through a flexible export limits for solar PV into the grid. DNSPs have implemented FELs to manage the impact of solar PV on the network. These limits can be adjusted based on factors such as network capacity, demand and generation. One example is SA Power Networks (SAPN) which has introduced FEL that allows consumers to export up to 10kW per phase from their solar systems provided that the installed solar systems are compatible with their own Utility Server. [18]

### 7.1.4. Connection pathways for AS 5385 - IEEE2030.5 (CSIP-AUS)

During the development of the guide for implementing AS 5385 there has been several implementation approaches of Utility Servers across Australia. These were started as trials or pilots with a view to learn and make corrections to the standards and devices. There has been industry concern regarding the implementation, which includes the complexity and cost of the implementing AS 5385, as testing and development needs to be part of design and building of the devices. Ensuring seamless communication between devices and clients is crucial for the ecosystem. However, the standard's generic nature can lead to implementation nuances and use of XML as the primary data exchange format may create additional complexity. AS 5385 has a robust security requirement but

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[17] NSW Department of Climate Change, Energy, the Environment and Water 2025, *NSW Emergency Backstop Mechanism and Consumer Energy Resources Installer Portal Consultation Paper*, NSW Government Website.

[18] SA Power Networks (n.d.), *Flexible Exports*, SA Power Networks Website

device certificate revocation can be challenging due to indefinite lifetime validity. Managing blacklists effectively is essential to mitigate potential security risks.

As the IEEE2030.5 and its variants gain traction globally, industry is concerned about scaling deployments, particularly in managing larger more complex CER networks each with their own security requirements and regulation.

End-to-end testing of devices and utility servers is currently being highlighted as a concern as there are no minimum testing requirements or performance on utility servers. Manufacturers are required to conduct “shake-down” tests or individual integration with each separate utility server.

In Australia, AS 5385 has four configurations or implementation pathways. Each pathway has its own advantages and disadvantages. Figure 3 demonstrates different pathways between a home solar inverter and utility server.

Looking at the requirements discussed in Chapter 5, requirement 9 (switch providers) and 11 (local CER to CER coordination) may not be supported under different configurations of AS 5385 – IEEE 2030.5. These requirements are very important in the Australian energy market context due to its design to support a disaggregated energy market. This disaggregated energy market is unlike the design of other jurisdictions such as United States (US) where the electricity market is more vertically integrated; for example, the retailer and networks are the same company.

It is important to note that IEEE2030.5 was developed for US use cases and context. Consequently, the requirement of switching providers is not easily supported by the last 3 configuration pathways in the Australian context (see Figure 3).

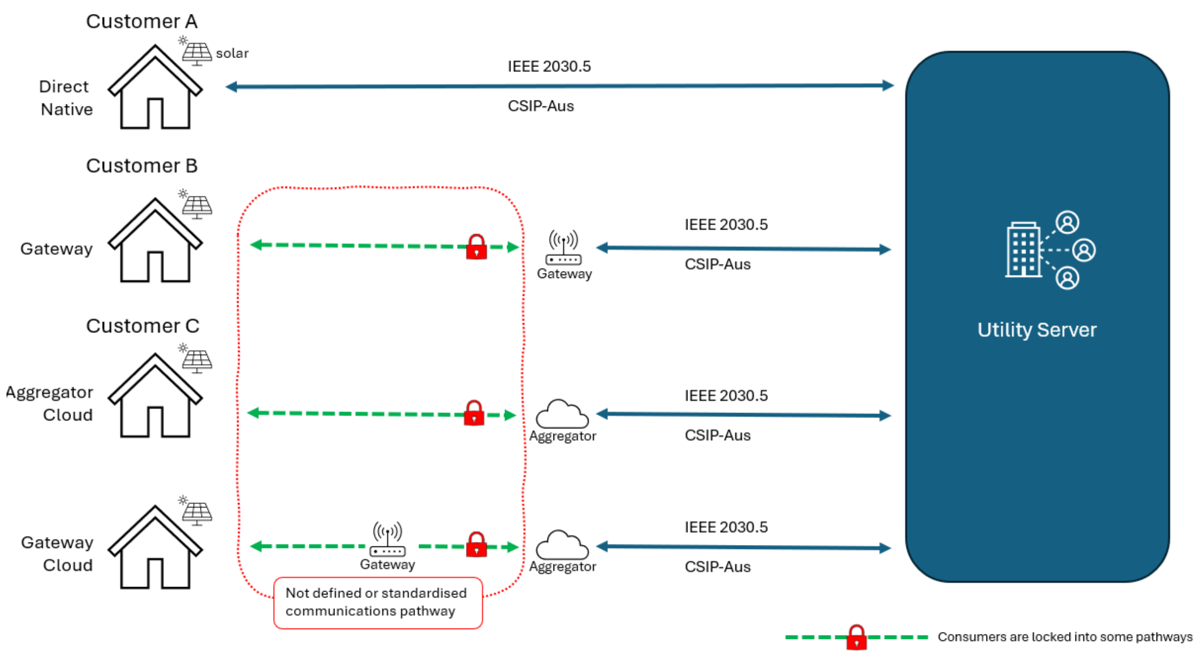


**Figure 3 Visualisation of connection pathways**

The support of proxy configurations (gateway, aggregator cloud, gateway cloud) are the main implementation pathways used within Australia; anecdotally the aggregator cloud pathway is this the most common solution deployed. This may be a result of the urgent need to invoke backstop capabilities in some Australian jurisdictions where manufacturers suggested that they could leverage their proprietary communication links from their cloud servers to the end device.

This approach is supported in the IEEE2030.5 standard. However, the communication pathway between the cloud and consumers end-device is undefined and out-of-scope of the standard. This means that the communication pathway between the home and the gateway or aggregator cloud in the gateway, aggregator cloud and gateway cloud pathways are not defined or standardised in the current context.

### 7.1.5. Impacts of different layers on different stakeholders

**Consumer A Journey: Direct native pathway allows for customer churn**
In the direct native example, Consumer A can change to any providers' server because there is a direct communication pathway which is defined from their solar and inverter system to standardised Utility Server.

- Consumer A has purchased a solar system from an OEM which talks direct natively within the solar system. Consumer A connects with the network as they don't want to export anything anymore as they have purchased a battery and EMS.
- Consumer A buys a new EMS. They connect the solar system to this EMS using the direct native communications following a factory reset of the system. The EMS then talks with the battery, and solar system.

**Consumer B Journey: Gateway pathway may limit consumer choice**
In the gateway pathway example, due to changes in systems operations, Consumer B is limited in their consumer choice to churn.

- Consumer B is a business owner. They have opted for a zero export limit but must support backstop provision of the local network service provider requirements.
- Consumer B decides that they want to start to export to the grid, as their retailer has given them a new energy deal. The retailer sends them a gateway device to connect to the system. The gateway device is installed and Consumer B is happy with the service.
- Two years into the contract, the energy retailer changes the operation of the system and Consumer B's business is required to pay more for their energy cost. Consumer B opts out and removes the gateway from their site.

**Consumer C Journey: Aggregator Cloud pathway may limit consumer choice**
In the aggregator cloud pathway example, due to changes in system operations, Consumer C is limited in this consumer choice to churn.

- Consumer C has just installed a solar system on their house purchased from an OEM. As part of the connection agreement with the network service provider, Consumer C has opted not to have a static default limit of no export to the grid. As a result, the solar system needs to support CSIP-AUS. This means that Consumer C can generate more energy and can export to the grid.
- The purchased system has implemented CSIP-AUS (see Aggregator Cloud Pathway). This means that their system, purchased from an OEM, runs their own cloud server which connects via CSIP-AUS compliant connection to the network's utility server. This purchased

solar system uses the OEM's propriety communication protocols to communicate to their own cloud server.

- Following a year of high growth, the OEM customer base grows and as a result, the OEM has a higher operational cost to recover. Consumer C receives a notification from the OEM that they are now going to charge $5 per month for their cloud service. And if Consumer C doesn't want to pay and opt out of the cloud service then they must return to a static default limit and not permitted to export.
- The following year the OEM ceases to trade and Consumer C is not able to export due to static default limits.

## 7.2. Electric vehicle charging interoperability

### 7.2.1. What is the problem

The number of EVs on Australian roads is predicted to increase dramatically over coming years, presenting both opportunities and challenges for Australia's electricity sector. Increased and clustered EV charging demand that is uncoordinated may increase peak demand on the system, create local infrastructure hotspots, modify the shape of the demand curve, and impose capacity challenges on distribution networks. In the worst-case scenario, excessive uncoordinated integration of EVs (without standards or market-driven solutions) into the electricity system could potentially introduce capacity challenges and voltage and frequency imbalances, inject harmonics, and influence transmission and distribution losses, which in turn increase the cost and complexity of keeping the network stable and reliable. If grid integration is managed well, the potential load-shifting, energy arbitrage, and grid-support capabilities of EVs and EVSE could support consumers in maximising the value of their investment and a more flexible and cost-effective electricity system.

Coordinated charging and discharging, where enabled, may also help manage the intermittency associated with renewable generation by leveraging the flexibility and storage capacity of EVs. Charging coordination, coupled with the provision of grid services from EVs, could also improve network and generation asset utilisation and could be an effective means to delay or reduce the need for power system augmentation. This outcome would benefit all grid-connected consumers, regardless of EV usership, through lower power bills reflecting lower capital investment in grid augmentation and lower operating reserves.

A rapid uptake of EVs, while representing a significant new source of demand, also represents a significant opportunity for consumers to maximise the value of their CER and minimise their costs.

Furthermore, EV drivers currently experience an inconsistent and often unreliable charging experience across different charging networks and locations. Charge Point Operators (CPOs) are often 'locked in' to using third-party vendors from hardware and backend providers. These challenges are due to multiple approaches being implemented to communicate between EV charging stations and charging station networks. Some of the communication approaches are 'walled gardens' and are not open and accessible to all providers in the market.

Multiple communication protocols, including proprietary protocols, can create barriers for new technologies or service providers to easily enter the market, preventing consumers from realising the full value of their flexible demand and energy resources. Reducing barriers to entry will support greater customer choice and product innovation. For EV drivers, standardised communication protocols can create a more reliable and efficient charging experience, improved charging station availability and transparent pricing.

### 7.2.2. What is Open Charge Point Protocol (OCPP)?

The Open Charge Point Protocol (OCPP) is an international application framework that aims to provide a standardised method of communication between EV charging stations and charging station networks. This allows charging stations and charging station networks to communicate effectively – comparable to communication between cell phones and cell phone networks.

Interoperability using standardised communication protocols could provide a pathway toward enabling market and network requests for demand shaping to be fulfilled by EVs. A common and interoperable communication platform would enable aggregators and network service providers (NSPs) to broadcast support requests and operating envelopes to EVs and/or EVSE at a whole-of-system level using a single common language. Standardisation could also ensure that EVs and/or EVSE have a minimum level of capability to respond to signals from any of these parties, lowering the barrier to entry for new entrants and simplifying customer transfer within a competitive market.

OCPP is the leading standard supporting managed EV charging for both local and remote applications. It can support smart and secure charging with a better end-user experience and can provide functionality such as Plug & Charge for a seamless end-user charging authentication experience. OCPP offers improved EVSE device management, cybersecurity features ensuring the safety of personal and transactional data, remote monitoring and diagnostics for improved uptime, and standardised messaging to display transaction information for consumers. It also provides the opportunity to communicate more complex information for energy-related functionality including operating envelopes, load balancing and bidirectional power flows.

### 7.2.3. Current state of OCPP

There are currently three versions of OCPP available (V1.6J, V2.0.1 and V2.1). OCPP version 1.6J is the EV-charging protocol with the most device-level support by EVSEs in the market currently. This version is already mandated in South Australia and is the easiest version for the market to meet. However, its ability to enact smart-charging is limited by its poorer support for dynamic management and its lack of support for advanced EV-EVSE communication capabilities that were developed in ISO 15118.

OCPP version 2.0.1 is supported by a small but steadily increasing share of EVSE being sold on the market currently and is the minimum requirement for government-supported public electric vehicle charging infrastructure. OCPP version 2.0.1 (as well as version 2.1) is inherently compatible with the relevant parts of ISO 15118 and is able to exchange significantly more enhanced control signals and operating data between the EVSE and management system. The IEC has adopted OCPP 2.0.1 as published standard IEC 63584:2024.

OCPP version 2.1 incorporates standardised support for the V2G capability, including alignment with ISO 15118-20 that was similarly developed with V2G capabilities in mind.

Later versions of OCPP are more technically advanced than earlier versions and offer increased functionality including integration with site-level Energy Management Systems and support for V2G. Versions 2.0.1 and 2.1 also include a security module at design, while the related security implementation for version 1.6J is an extension rather than a base component, and only a portion of EVSE support that extension.

OCPP version 2.0.1 is not backwards compatible with earlier versions including 1.6J, and as a consequence EVSE are unlikely to be able to support both (although some charge management systems may be able to). OCPP version 2.1 will be backwards compatible down to version 2.0.1. Some EVSE that support version 1.6J currently may be able to be software-upgraded to support later versions. However, it is expected that some devices would require hardware changes and so may not be able to be upgraded in this way.

Each version of OCPP includes numerous optional components such as the Security and Smart Charging components (termed functional blocks in version 2.0 and onwards). These optional components should be considered when assessing OCPP's ability to meet specified requirements.

Assessment of OCPP should also recognise the drive to integrate this framework into broader EV/EVSE interoperability, such as compatibility with the ISO 15118 standard which supports EV to EVSE communication.

# Consultation Questions

**Question 14** - What are potential pathways to accelerate the standards development and modification processes?

**Question 15** - The design of CSIP-AUS has 4 possible pathways (native, gateway, cloud, cloud/gateway). Only the native pathway enables consumers to switch providers. Do you have views as to the merit of the alternative pathways for CSIP-AUS?

**Question 16** - What are the benefits or disadvantages of facilitating control of a physical device or via the cloud?

**Question 17** - What are the benefits and disadvantages of applying interoperability standards at a site versus a device level?

**Question 18** - What lessons can be drawn from the current approach to CSIP-AUS in terms of testability and conformance?

**Question 19** - What are the net benefit and cost implications of adopting different standards pathways (e.g. native vs adapter/HEMS-based)?

**Question 20** - What are the benefits and costs implications of requiring all EVSE (both uni-directional and bidirectional chargers) to support OCPP 2.0.1 and ISO 15118-20 to promote V2G use cases?

# 8. Full List of Questions

**Chapter 3 Background and context**

Question 1 - Should the capacity for consumers to switch energy service providers (churn) be prioritised and what are the impacts?

**Chapter 4 Use Case mapping**

Question 2 - What are your views on interoperability hierarchy via the vehicle and an EVSE? Do you think the EVSE should take precedence over the vehicle or vice versa?

Question 3 - Should minimum device/system requirements be applied to EV Level 1, Mode 1 and Mode 2 charging technologies, as per discussion in section 4.1?

Question 4 – Should minimum device/system requirements be applied to public EVSE?

**Chapter 5 Requirements identification**

Question 5 - Are there any CER device types or use cases not adequately captured in the 13 identified requirements?

Question 6 - Are there any other standards that can support each identified requirement?

Question 7 - In the mapping exercise in Table 5.14, do you agree with the identified gaps? Are there existing standards that could fill these identified gaps?

Question 8 - Do you have views on the prioritisation of further standards work to address the identified gaps?

Question 9 - How can Australia align with international standards while maintaining flexibility for local conditions?

Question 10 - Are there any risks associated with the identified requirements, such as remote updating of device settings?

Question 11 - Modulating power in response to grid conditions or an external signal can be implemented through zero generation or zero export. Is there a preference for either of these approaches or both?

Question 12 - What are the risks of supplier (OEM) lock-in under current standards, and how might these be mitigated?

Question 13 - What are costs and benefits for alternative applicable standards approaches and how does this impact networks, suppliers and consumers?

**Chapter 7 Industry response to interoperability**

Question 14 - What are potential pathways to accelerate the standards development and modification processes?

Question 15 - The design of CSIP-AUS has 4 possible pathways (native, gateway, cloud, cloud/gateway). Only the native pathway enables consumers to switch providers. Do you have views as to the merit of the alternative pathways for CSIP-AUS?

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Question 17 - What are the benefits and disadvantages of applying interoperability standards at a site versus a device level?

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# 9. Abbreviations

| **Abbreviation** | **Definition** |
|---|---|
| AEMC | Australian Energy Market Commission |
| AEMO | Australian Energy Market Operator |
| ANU | Australian National University |
| ARENA | Australian Renewable Energy Agency |
| CEC | California Energy Commission |
| CER | Consumer Energy Resources |
| CERDE | Consumer Energy Resources Data Exchange |
| CERWG | Consumer Energy Resources Working Group |
| CPO | Charge Point Operator |
| CSIP-AUS | Common Smart Inverter Profile – Australia. CSIP-AUS is the Australian derivation/implementation of the IEEE 2030.5 standard that has been mandated for inverter-based resources in California. |
| DEIP | Distributed Energy Integration Program |
| DER | Distributed Energy Resources. DER covers network and neighbourhood batteries as well home installed inverter-based resources |
| DERIAPITWG | DER API Technical Working Group |
| DERR | Distributed Energy Resource Register |
| DNSP | Distributed Network Service Provider |
| DOE | Dynamic Operating Envelopes |
| DPV | Distributed Photovoltaic |
| DRM | Demand Response Modes |
| DSMO | Distributed System and Market Operators |
| ECMC | Energy and Climate Ministerial Council |
| EMS | Energy Management System |
| eMSP | E-Mobility Service Providers |
| ESB | Energy Security Board |
| ESRWG | Energy Security and Resilience Working Group |
| ESS | Energy Storage System |
| EV | Electric Vehicle |
| EVSE | Electric Vehicle Supply Equipment |
| FCAS | Frequency Controlled auxiliary services |
| FEL | Flexible export limits |
| HB | Handbook |
| HEMS | Home Energy Management Systems |
| IEC | International Electrotechnical Commission |
| IEEE | IEEE Standards Association |
| IoT | Internet of Things |
| IP | Internet Protocol |
| IPSec | Internet Protocol Security |

| | |
|---|---|
| LAN | Local Area Network |
| LSE | Load Serving Entities |
| MAC | Media Access Control |
| MIDAS | Market Informed Demand Automation Server |
| MSL | Minimum System Load |
| NEM | National Electricity Market |
| NSP | Network Service Providers |
| OBCC | On Board Charge Controller |
| OCCPI | Open Charge Point Interface |
| OCPP | Open Charge Point Protocol |
| OEMs | Original Equipment Manufacturers |
| PKI | Public Key Infrastructure |
| Rooftop Solar PV | Rooftop solar photovoltaic |
| SA HB 218:2023 | Standards Australia Handbook 218 |
| SAPN | South Australia Power Networks |
| SRD | Systems Reference Deliverable |
| SSL | Secure Socket Layer |
| T1 | Priority T1 in the Consumer Energy Resources Roadmap |
| TCP | Transmission Control Protocol |
| TLS | Transport Layer Security |
| TNSP | Transmission Network Service Provider |
| V2G | Vehicle-to-Grid |
| V2H | Vehicle-to-Home |
| VPP | Virtual Power Plant |
| VSR | Voluntary scheduled resources |

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