Standards Australia

Flexible Loads Interoperability Guide

Consumer Energy Resources (CER) Interoperability for Flexible loads

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Supporting interoperable flexible loads across Australia's consumer energy resources ecosystem

This Guide is an industry-led, ***non-prescriptive*** *resource that supports a consistent understanding of how and why flexible loads fit within emerging consumer energy resource interoperability requirements. It draws together device characteristics, functional requirements, communication interfaces, and test approaches relevant to flexible loads.*

The Guide ***does not*** *create compliance obligations or develop or amend any Australian Standard. It is intended to provide clarity and practical direction, and to inform future standards development, while the broader regulatory framework for consumer energy resources continues to develop.*

Disclaimer: *This Guide was developed with input from individuals with current knowledge and experience in consumer energy resources, flexible load technologies, communication protocols, and related standards and frameworks. It does not claim to address all interoperability, safety, or compliance matters across all device types, system configurations, or jurisdictions.*

The information is provided for general guidance only and does not override any legislative obligation, standard, or contractual duty applying to participants in the consumer energy resources ecosystem. Users of this Guide are responsible for obtaining their own technical, legal, and professional advice to ensure they meet all applicable requirements. To the extent permitted by law, the authors disclaim all liability for any loss, damage, cost, or expense incurred due to reliance on this Guide.

This is a rapidly evolving area of practice. Requirements and standards may change as the National Consumer Energy Resources Roadmap progresses, as technical standards are developed or revised, and as industry practice matures. The Guide is intended as a living document that may be updated as the landscape evolves.

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Section 1: Target Audience

The Guide is written for a technical and industry audience and assumes readers have working knowledge of consumer energy resources, demand response, and communication concepts. It is not a consumer-facing document, but anyone interested in flexible load interoperability is welcome to use it.

Section 2: Purpose and Scope

2.1 Purpose

This Guide provides clear, practical, and non-prescriptive guidance on how flexible loads can participate in an interoperable consumer energy resources ecosystem, and why that participation matters. It supports consistent industry understanding and implementation, and is intended to inform future standards development rather than to create obligations.

Five guiding principles shape the Guide.

- **Interoperability by design: It promotes consistent, reliable communication across technologies.**
- **Technology neutrality: Specific solutions or vendors are not prescribed.**
- **Practicality: The guidance is actionable and implementable.**
- **Alignment: The Guide builds on existing standards and frameworks wherever possible.**
- **Future readiness: The outputs support ongoing evolution and scalability.**

2.2 In Scope

The Guide addresses flexible load devices and the interface through which they are coordinated. It treats device families functionally, based on the flexibility they offer, rather than on their internal technology. The following are in scope:

- The flexible load device families: electric vehicle supply equipment (EVSE), treated as unidirectional, that is, load only; hot water systems, including electric resistive, heat pump, and solar-boosted; heating, ventilation, air conditioning (HVAC) and other space conditioning; pool pumps; and other such devices. Appendix A.3 gives an indicative list of device types.
- Non-smart devices that are made controllable through an external or dedicated resource manager.
- The S2 interface, between a resource manager or appliance and the site energy management function, which is the primary focus, and the M1 interface, a parallel path from a third party such as an original equipment manufacturer, retailer, aggregator, or network operator to the energy management function or a resource manager. Section 5.2 describes both interfaces, and Sections 9 and 10 cover the two interfaces and their primacy.

Several of these device families are also addressed in the AS/NZS 4755 series, which the Guide draws on for device coverage, though not for its protocol approach.

2.3 Out of Scope

The following are out of scope.

- The development of formal Australian Standards, compliance enforcement or certification schemes, and detailed product-level design specifications, consistent with the Terms of Reference.
- Rooftop photovoltaic generation.
- Inverter and inverter energy systems, which DR AS 5438, *Local Communication Requirements for Inverter Energy Systems*, addresses. DR AS 5438 is at the draft stage and is expected to be published in late 2026.
- Bidirectional vehicle-to-grid charging, which DR AS 5438 addresses. In this Guide, EVSE is treated as unidirectional, that is, load only.
- Home energy management systems (HEMS). A HEMS performs the energy management function this Guide relies on, but defining how a HEMS behaves is a larger task than a flexible loads guide can cover. This gap has been identified and recorded in Section 12 as future work that would reference this Guide, DR AS 5438, and CSIP-AUS.
- Information and data models. The Guide describes communication interfaces and the telemetry that must pass across them, but does not specify or develop information or data models.
- Interfaces beyond the S2 and M1 interfaces at the resource manager, such as the network-to-gateway interface, which sit outside the scope boundary shown in the reference architecture.
- General smart home and Internet of Things devices that offer no electrical flexibility. The device families named in Section 2.2 are indicative rather than exhaustive; other flexible loads are not excluded, but the Guide does not attempt to cover the broader smart home or Internet of Things market.
- Site-level and aggregated fleet coordination. Device-level measurement is in scope, but measurement and orchestration at the whole-of-site level, and anything upstream of the connection point such as community batteries, sit with the energy management function above the device rather than with the flexible load.
- Developing test methods. Rather, the Guide points to the conformance pathways of the referenced protocols, as set out in Sections 5 and 11.
- Privacy. This Guide leaves privacy obligations to relevant cyber security and privacy legislation rather than addressing them.
- Building and facility energy management systems, given the residential focus of this work.

2.4 Application

The Guide is advisory. It is intended to be read alongside DR AS 5438, which provides conformance requirements for inverters and for the resource managers of inverter energy systems within an electrical installation, and alongside future work on energy management systems. It does not assume a particular market design or address roles, responsibilities, or market structures.

Section 3: Background and Context

Consumer energy resources, which include rooftop solar, battery storage, electric vehicles and their charging equipment, and controllable appliances, are a growing part of the Australian energy system. Energy and Climate Ministers are working to improve consumer outcomes from these resources, including by giving consumers greater control over their devices and better access to data. Interoperability, the ability of different devices and systems to exchange information and work together to produce an expected outcome, is central to that aim because it supports consumer choice and avoids devices being locked to a single provider.

In December 2025, the Energy and Climate Change Ministerial Council endorsed a list of 18 initial minimum requirements for consumer energy resource devices to support interoperability. These provide guidance on the expected minimum functionality of devices ahead of a technical regulatory framework and serve as the reference set for this Guide. The 18 requirements are voluntary at this stage, and existing devices are not expected to be retrofitted. This background is drawn from the Department of Climate Change, Energy, the Environment and Water (DCCEEW) industry information on the initial requirements.

Much of the existing interoperability work has focused on inverter-based resources. DR AS 5438, *Local Communication Requirements for Inverter Energy Systems*, specifically addresses inverters. Public comment on DR AS 5438 and the DCCEEW consultation both identified gaps for non-inverter-based devices, including the minimum functionality of EVSEs capable only of charging, energy management systems, and local communication between consumer energy resources. This Guide addresses interoperability gaps for flexible consumer loads that are not inverter-based, including EVSEs capable only of charging.

Section 4: Terms and Definitions

Clear, shared definitions are needed to avoid ambiguity across the Guide. The Guide adopts a working definition of interoperability and, for other terms, aligns with existing international definitions unless there is a reason not to.

The following definitions apply throughout the Guide and are listed alphabetically. The Source column cites the external standard or document that a definition aligns with, where applicable. Where a standard is cited, the working definition is a paraphrase aligned with that standard, and the standard's own text is not reproduced.

Table 1: Terms and definitions used in this Guide

Term	Working definition	Source (if external)
Aggregator	An entity that coordinates multiple consumer energy resources and presents them to a market or network as a single controllable resource.	IEC 63402-1:2025, Customer energy management systems, Part 1.
Behind the meter	On the customer side of the connection point, within the premises.	Project working definition.
Consumer energy resource	A consumer-owned or operated device that generates, stores, flexibly consumes, or manages electricity behind the meter. This broad term spans devices and functions.	DCCEEW industry information, Initial 18 CER Device Requirements.
Controllable load	A load whose energy consumption can be increased or decreased, including switched on or off, through control actions by an entity other than the consumer, such as an energy management function.	AS IEC 61850-7-420:2025 (adopting IEC 61850-7-420:2021), distributed energy resource definition.
Distributed energy resource	A generation, storage, or controllable load resource connected to the distribution network or behind the meter. Consumer energy resources are the consumer-owned subset of distributed energy resources.	AS IEC 61850-7-420:2025 (adopting IEC 61850-7-420:2021).
Energy management function	A function that coordinates resources at a site, taking account of external signals, sometimes described as a customer energy management function combined with an energy management gateway.	IEC 63402-1:2025, Customer energy management systems, Part 1, clauses 3.1.1 and 3.1.3 (customer energy manager and energy management gateway).
Flexible load	A consumer device whose electricity consumption can be shifted, reduced, or modulated in response to a signal, without unacceptable loss of the service it provides to the consumer.	Project working definition.
Interoperability	The ability of devices, systems, and platforms to exchange information and respond to that information in a consistent, reliable, and predictable manner across different technologies, vendors, and use cases.	DCCEEW industry information.
Resource manager	A function that manages the operation of a device or resource. It is a function rather than a device and may be integrated into a product or provided separately.	IEC 63402-1:2025, Customer energy management systems, Part 1, clause 3.1.9.

Section 5: Standards Framework and Reference Architecture

5.1 Standards framework

The DCCEEW industry information maps the 18 requirements against applicable standards and identifies gaps. The standards most relevant to this Guide, drawn from that mapping, include AS 5385:2023, *Smart energy profile application protocol*, which identically adopts IEEE 2030.5-2018; the SunSpec Modbus data models for distributed energy resources; OpenADR 2.0b, published as IEC 62746-10-1, *Systems interface between customer energy management system and the power management system*, Part 10-1: Open automated demand response; the Open Charge Point Protocol (OCPP), published as IEC 63584:2024, *Open Charge Point Protocol (OCPP)*; and, for electric vehicles, the ISO 15118 series, *Road vehicles: Vehicle to grid communication interface*, and IEC 61851-1, *Electric vehicle conductive charging system, Part 1: General requirements.*

The AS/NZS 4755 series, *Demand response capabilities and supporting technologies for electrical products*, addresses demand response for HVAC, pool pumps, and battery storage, and AS/NZS 4777.2, *Grid connection of energy systems via inverters, Part 2: Inverter requirements*, is referenced for several requirements. The mapping notes information and data model standards such as IEC 61968-9 and IEC 61970, but, as recorded in Section 2.3, they are out of scope for this Guide. Two further documents inform the Guide but do not appear in that mapping: the S2 standard, EN 50491-12-2, which provides the flexibility patterns used in Section 6.2, and PAS 1878 and PAS 1879, which provide the United Kingdom demand side response framework drawn on in Sections 8 and 10. Section 9 sets out the full set of protocols and standards considered.

DR AS 5438, *Local Communication Requirements for Inverter Energy Systems*, is the closest related work and is expected to be published in late 2026. This Guide does not duplicate DR AS 5438; it addresses flexible loads and is intended to interact with it.

5.2 Reference architecture

The Guide uses a functional reference architecture, drawn from IEC 63402-1 on customer energy management systems, which DR AS 5438 also references. This architecture describes functions rather than devices, and it suits the Australian market's divided-actor structure, in which network operators, system operators, retailers, and aggregators are separate parties.

In this architecture, a resource manager manages a device or resource, and an energy management function coordinates resources at a site while accounting for external signals. The interfaces between actors are described as S interfaces. The network-to-gateway interface is one such interface, and the interface between appliances or their resource managers and the site energy management function is described as the S2 interface. This Guide focuses on the S2 interface, consistent with the approach taken for inverters in DR AS 5438. These functions correspond to the model in IEC 63402-1, in which a customer energy management function coordinates the resources in the premises, an energy management gateway carries signals to and from the grid, and a resource manager presents each device, or group of devices, to that function across the neutral S2 interface (paraphrased from IEC 63402-1).

The M1 interface operates in parallel with S2. It is the path by which a third party, commonly an original equipment manufacturer or an authorised third party such as a retailer, aggregator, or network operator, communicates with the energy management function or directly with a resource manager. A device may therefore be reachable on both interfaces simultaneously, and Section 10 sets out how the Guide addresses that case. The M1 interface appears at two points in the architecture: between a third party and the energy management function, and between a third party and a resource manager. It is the second of these, the path to the resource manager, that this Guide addresses, and the scope boundary shown on Figure 5 is drawn accordingly. That path is expected t o remain active regardless of what is carried on S2, which is why the order of precedence in Section 10 matters.

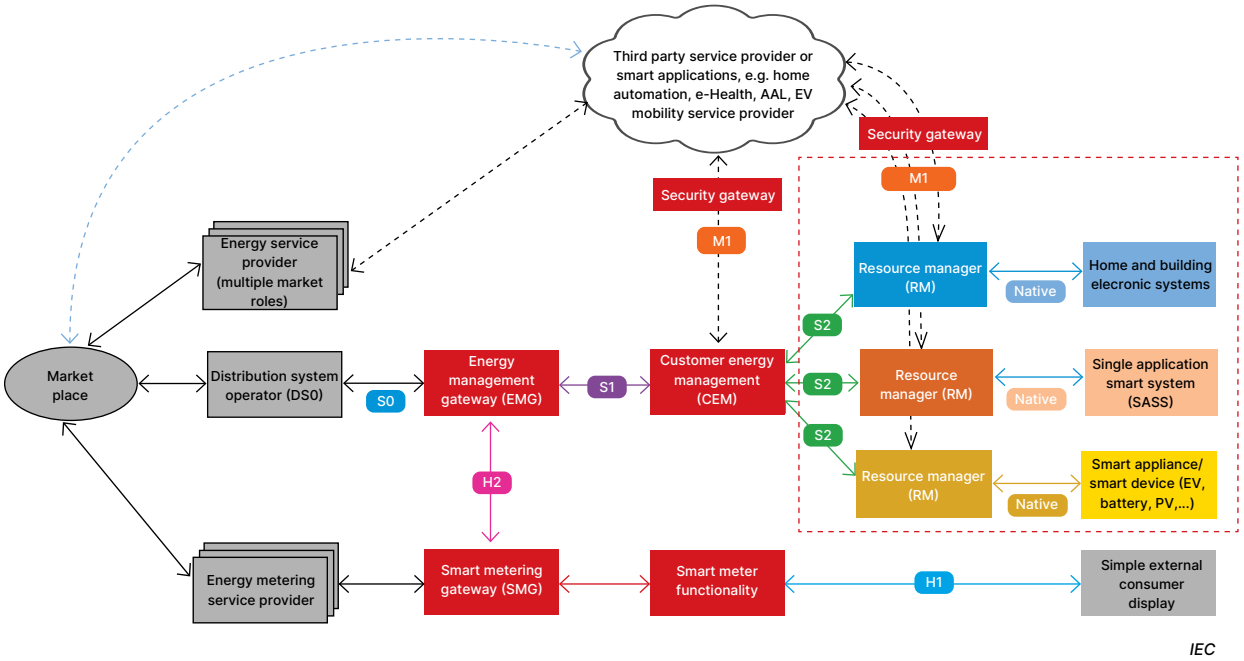


Figure 5 - Single CEM energy management architecture with a divided Actor B[1]

Source: IEC 63402-1:2025, reproduced with the permission of the IEC. The figure shows the S0, S1, S2, M1, H1, and H2 interfaces, the customer energy management (CEM) function, and the resource managers (RM) that present devices to it.

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Figure 5 is reproduced from IEC 63402-1:2025 with the permission of the IEC and is otherwise unaltered. The **red box** *shown on the figure is* **not** *part of the original. It has been added for the purposes of this Guide only, to indicate the part of the architecture that this Guide addresses, and it carries no meaning within IEC 63402-1. The addition is explanatory and does not change the interfaces, actors, or relationships shown in the original figure. Readers should refer to IEC 63402-1:2025 for the published figure. All labels, including the spelling of the security gateway label, are reproduced as they appear in the original.*

Section 6: Flexible Load Devices and Characteristics

The Guide starts with the device and the outcome required, that is, what a device must be able to do, before considering how it communicates. The communication interface is a means of delivery; it cannot deliver an outcome unless the device itself can measure, respond, and modulate appropriately.

1 IEC 63402-1 ed. 1.0 “Copyright © 2025 IEC Geneva, Switzerland. www.iec.ch”

This section describes the in-scope device families listed in Section 2.2 and the physical and functional characteristics that are relevant to interoperability. These characteristics include the ability to measure energy flow, respond to a signal, modulate or ramp power within a defined time, and provide granularity and accuracy; include a manual consumer override; and report telemetry.

6.1 Device and resource manager physical requirements

The physical requirements below describe what a flexible load device, or the resource manager function acting on its behalf, should be able to do at the device level. They are organised into seven areas. The requirements are indicative and may differ by device family.

Data collection: sensors and tolerance: The device gathers the physical measurements that underpin interoperability.

- **Sensors:** Hardware that measures physical quantities such as power (including voltage, current, frequency, and power flow) and, where relevant, temperature, humidity, pressure, motion, or light.
- **Actuators:** Components that carry out a physical change in response to a command, such as a motor, valve, switch, or relay, and that can return an on/off or yes/no status.
- **Collection tolerance:** Components that measure physical quantities should do so within a defined accuracy, duration, and regularity.
- **Measurement:** accuracy for power thresholds references AS/NZS 4777.2 Table 2.5.

Processing and storage: The device runs local logic and holds the data and firmware it needs.

- **Microcontrollers or microprocessors:** The processing component that manages operations, runs local logic, and coordinates data capture.
- **Storage and memory:** Used for firmware, the real-time operating system, configuration data, and temporary telemetry buffers before transmission.
- **Resource frugality:** Processing power is typically much lower than a desktop system, so efficient programming and lightweight encryption are needed.

Network connectivity: The device connects to a local network and to an energy management function.

- **Communication modules:** Built-in hardware, such as Wi-Fi, cellular, Bluetooth, Zigbee, or Ethernet, to connect to a local network, the internet, and an energy management system or home energy management system.
- **Antennas:** Integrated or printed antennas designed to sustain transmission range.
- **Lightweight protocols:** Support for bandwidth-efficient transmission protocols to reduce power use and network overhead.

Power management: The device manages its energy use to ensure reliable operation in the field.

- **Power source:** Most flexible loads are supplied from the grid, and some are also subject to minimum energy performance requirements, such as the Greenhouse and Energy Minimum Standards. When a device or its resource manager runs on battery, solar cells, or energy harvesting instead, it needs very low power consumption for long-term reliability without frequent manual maintenance.
- **Power regulators:** Components that manage energy states, for example, placing the device into

deep sleep and waking it only to transmit data.

Physical security and authentication: The device protects its data and resists tampering. This supports the trusted communication pathway (requirement R-12, see Section 7).

- **Hardware roots of trust:** Built-in cryptographic modules to handle encryption securely and protect the device against tampering.
- **Secure interfaces:** Manufacturing debug ports and unused physical interfaces are disabled by default.
- **Firmware integrity:** Support for secure boot and over-the-air updates so that newly discovered cyber security vulnerabilities can be patched in the field.

Environmental enclosure: The device withstands the conditions of its installation.

- **Robustness:** Devices in outdoor, industrial, or remote locations require ruggedised housing, resistance to extreme temperatures, and waterproof and dustproof ratings, expressed as ingress protection, or IP, ratings.
- **Tamper detection:** Enclosures that trigger an alert if opened or damaged.

Customer override: The customer can take direct control of the device. This supports the consumer override capability (requirement R-16).

- **Direct control:** A physical mechanism, such as a button, that lets a customer turn the device output on or off.
- **Function identification:** A physical indicator, such as a light or LED, that shows whether the device is on or off.

6.2 Flexibility patterns (aligned with the S2 standard)

The characteristics that matter most for interoperable flexible loads are the kinds of flexibility a load can offer. This classification describes flexible loads by their behaviour rather than by product name or electrical load type, and aligns with the flexibility patterns in the S2 standard. We use the S2 categories because they come from an existing standard and align closely with an emerging IEC flexibility-patterns document.

The S2 standard (EN 50491-12-2) defines the S2 interface between an energy management system and smart devices and abstracts a device's capabilities into a set of flexibility patterns. This section paraphrases those patterns and does not reproduce the standard's text. The approach is consistent with technology-neutral interoperability principles and with related work, including the OpenADR resource and reporting model and the demand-side response framework in PAS 1878 and PAS 1879.

Each pattern describes a kind of flexibility a load can offer. The patterns are paraphrased from the S2 standard and are listed alphabetically rather than in the order used by that standard; examples are written without device names, in keeping with the device-independent intent.

Table 2: Flexibility patterns and corresponding S2 control types

Flexibility pattern	What it means	Example (device-independent)	S2 control type
Alternative power profiles	The same task can run through different power profiles using the same energy type.	A task that can run fast at high power or slow at low power.	Power Profile-Based Control
Buffer energy	Energy is put into a buffer in one form and later drawn out after conversion.	A thermal store is filled now and drawn on later.	Fill Level Based Contro
Limit production or consumption	Production or consumption that is otherwise not controllable can be held below a set ceiling when needed (curtailment).	A source that runs when its input is available but can be capped.	Power Envelope-Based Control
Pause a task	A task can be paused at arbitrary or set points, usually with a maximum pause time or a deadline.	A multi-stage cycle that can wait between stages.	Operation Mode-Based Control
Power modulation	Consumption or production can be modulated up or down without affecting the task.	A source or sink that can follow a target within its range.	Operation Mode-Based Control
Shift production or consumption in time	An entire consumption or production pattern can be moved earlier or later.	A task with a delayed-start option.	Power Profile-Based Control
Store energy	Energy is stored and later retrieved in the same form.	A store charged now and discharged later.	Fill Level Based Control
Switch energy type	A task can be met using different energy sources.	A service that can draw on one input or another to meet the same need.	Demand-Driven Based Control

The S2 standard condenses these eight patterns into five control types, shown in the right column: Power Envelope-Based Control, Power Profile-Based Control, Operation Mode-Based Control, Fill Level-Based Control, and Demand-Driven Control. In each case, the resource manager also provides power and energy measurements and forecasts, where the device supports them, so observability is a baseline capability rather than a separate class. Source: S2 white paper (S2 standard, EN 50491-12-2); paraphrased, not reproduced.

Overlays, not separate patterns: Some characteristics apply across every pattern rather than defining a pattern of their own:

- criticality (whether the service is essential, quality-sensitive, comfort-sensitive, or readily deferrable);
- ownership (owner-operated or aggregator-mediated); and telemetry fidelity (directly read or estimated).

A separate observable-only pattern is not needed. As noted above, observability is treated as a baseline capability of the resource manager, not as a form of flexibility in its own right. Appendix A.2 sets out the characteristics that a flexible load description could carry alongside these patterns.

Section 7: Mapping Flexible Loads to the 18 CER Requirements

In August 2026, Standards Australia delivered the Consumer Energy Resources (CER) Interoperability Report. It maps the minimum requirements to relevant technical standards.

A core task of the project is to map flexible load characteristics against the 18 initial minimum requirements endorsed by the Energy and Climate Ministerial Council. The 18 requirements are a reference set to map against, not a checklist that a device must meet in full to be in scope. Few products would meet all 18, and requiring this could exclude products from a small market.

The table below lists the 18 requirements with a short statement of intent, paraphrased from the DCCEEW industry information. The final column shows each requirement's relevance to flexible loads. Where DCCEEW has identified a requirement as interrelated with local CER-to-CER coordination (R-11), this is noted. Requirements shaded in light red are out of scope for flexible loads.

Table 3: The 18 CER device requirements and their relevance to flexible loads

ID	Requirement	Intent (paraphrased from DCCEEW)	Working relevance to flexible loads
R-1	Disconnect. Out of scope	Isolate the device from the grid in response to a signal or condition, with controlled reconnection.	Reduction to zero is covered by R-3; disconnection or isolation is a safety and generation function better suited to inverters and batteries, and the term isolate is avoided.
R-2	Modulate power in response to grid conditions. Out of scope	Automatically adjust power in a standardised response to grid conditions; primarily a generation capability.	An autonomous power-quality response to grid conditions, such as Volt-VAr, better suited to inverters and is treated as possible future work.
R-3	Modulate power in response to external signal. In scope	Adjust generation or consumption in response to an external signal, including reducing load.	The core control capability for flexible loads, including response to a dynamic operating envelope.
R-4	Remote reading of device telemetry. In scope, optional	Collect and transmit device and site operating data to an authorised agent.	Device telemetry is valued for flexible loads and forecasting, but is not mandated.
R-5	Remote reading of device settings. In scope	Allow an authorised agent to read device settings.	Reading settings, including defaults (R-13).
R-6	Remote updating of device settings. In scope	Allow an authorised agent to update device settings securely.	Updating settings from their defaults; firmware updates are not treated as an interoperability function and sit with trusted communication.
R-7	Remote provision of price signals. Out of scope	Communicate tariffs or prices to the device.	The energy management function coordinates price response rather than sending a price to the device; a direct-to-device price use case is emerging but not yet established.

R-8	Monitor site-level power generation and loads. Out of scope	Track generation and consumption at the connection point.	A whole-of-site monitoring function for the energy management system rather than the flexible load
R-9	Switch providers. In scope	Communication portability so the device is not locked to one provider.	The consumer can move a device between providers and is not locked in; S2 primacy supports this without forcing an interoperable M1.
R-10	Uniquely identifiable. In scope	A distinct identifier for each device.	In scope, at the resource manager function level, which may but need not be the device; the internet-facing element is uniquely identifiable, as in AS/NZS 4755.
R-11	Local CER to CER coordination. In scope	Enable resources at a premises to exchange information and coordinate their operation.	Within a site, always mediated by the energy management function rather than peer-to-peer, in this Guide's architecture.
R-12	Trusted communication pathway. In scope	Secure, authenticated, and reliable data exchange.	The Guide points to protocols that provide authenticated, secure exchange and notes gaps; most options in DR AS 5438, Local Communication Requirements for Inverter Energy Systems, use Transport Layer Security (TLS).
R-13	Default CER settings. In scope	Consumer-configurable default settings that allow use without external control.	Default settings, particularly relevant to EVSE; simple devices operate normally without external control per AS/NZS 4755.
R-14	Fail-safe. In scope	Revert to a known safe state on a failure such as loss of communication.	A safe state on failure, drawn from PAS 1878.
R-15	Monitor collective behind-the-meter CER. Out of scope	Monitor all resources at a premises collectively.	A collective, site-level function for the energy management system.
R-16	Consumer override. In scope and core	Allow the consumer to manually override automated or remote actions.	The consumer can override automated or remote actions; the Guide highlights the benefits of S2 protocols and provides feedback on overrides.
R-17	Respond with power quality capabilities to grid conditions. Out of scope	Provide power quality support in response to grid conditions.	A smart inverter, power-quality capability that moves into product-standard territory for loads.
R-18	Respond with power quality capabilities to external signals. Out of scope	Provide power quality support in response to external signals.	As for R-17, a smart-inverter power-quality capability.

Section 8: Functional Requirements for Flexible Loads

This section sets out the functional requirements for flexible loads as outcomes, that is, what a device must be able to do, expressed independently of any particular protocol. The Guide defines the outcome required and allows more than one way to achieve it.

The Guide presents the outcomes as a single, common set that applies to all flexible loads, rather than a separate set for each device family. The device families named in Section 2.2 are not exhaustive, so a common set applies to families the Guide does not name. Where a family cannot meet an outcome, note that rather than treating it as a separate set of requirements.

8.1 Control signals

Flexible loads should be able to respond to a set of control signals, expressed as outcomes rather than a particular protocol. These are: an on or off, or curtail-to-zero, instruction; a power limit, including a dynamic operating envelope (requirement R-3); a setpoint or a percentage of rated capacity; a forward schedule of limits or setpoints; a change of operating mode, such as an economy or boost mode; and a pause or resume instruction. These correspond to the five S2 control types used in Section 6.2: power envelope, power profile, operation mode, fill level, and demand-driven.

The signals are listed as a common set. Each device family indicates which of them it supports, and none is marked as required. A control signal that suits one family may have no meaning for another, and a signal that is mandatory in principle can produce an unwanted outcome for a consumer in practice, so the Guide sets out the set and leaves the selection to the implementer. Where signals overlap, the order of precedence in Section 10 applies.

Setpoint and percentage instructions may be expressed as absolute or relative to rated capacity, or relative to the power the device is drawing at the time. A resistive load is not continuously variable, and a compressor already operating well below its rating cannot resolve a further proportional reduction of its current draw. Expressing the instruction against a fixed reference keeps the response predictable across device types.

8.2 Response thresholds

The response characteristics that matter include response time, granularity, and accuracy, and these differ for devices that consume rather than generate energy. Where an instruction is expressed as a proportion, the reference point matters. Many loads cannot resolve an instruction expressed as a proportion of a value that is itself already reduced, because a resistive load is not continuously variable and a compressor already operating well below its rating cannot reduce its draw further in the same proportion. Expressing the instruction against a fixed reference, such as rated capacity, therefore keeps the response more predictable for those device types. Response timing is designed to avoid many devices acting at the same moment.

Where a flexible load acts on a shared signal, such as a price or a frequency condition, the Guide encourages diversification so that a population of devices does not switch together. A randomised delay before entering or resuming service and a ramped rather than stepped change in power are two common approaches, drawn from DR AS 5438, *Local Communication Requirements for Inverter Energy Systems*, the United Kingdom smart charge point rules, and AEMO guidance on ramp rates.

Diversification measures should be capable of being set to zero. Where a device is responding to an emergency condition, such as under-frequency load shedding, a randomised delay runs counter to the purpose of the instruction, so the delay should be reduced to zero for those conditions.

8.3 Telemetry and measurement requirements

To support interoperability and visibility, a flexible load, or the resource manager acting for it, should be able to report: its present power; its operating state and mode; the reason for its last change of state, whether a schedule, a third-party signal, a consumer action, or a default; and the flexibility it can currently offer, including any upper and lower bound on how far its power can change. Where the device supports it, a short availability forecast is valuable. The Guide sets out what is reported, not the information or data model, which is out of scope.

Reporting cadence should suit the service. A fast service such as frequency response calls for denser reporting than an event-based demand response program. Cadence also depends on the context in which the device operates, not on the device alone: a resource manager working in a setting with rapidly changing uncontrolled load needs more frequent reporting than one that is not. The Guide does not give indicative figures.

8.4 Measurement and verification

This section verifies performance against functional outcomes, not against a mandated protocol. A product may demonstrate performance in two ways: by conformance to the test procedure of a referenced protocol, where one exists (see Section 11), or by demonstrating equivalent performance through an agreed test. The delivered response can be measured against a baseline, using a measurement-and-verification approach. The Guide does not create a certification scheme.

The Guide does not nominate a party to carry out verification. Where a referenced protocol defines a verification pathway, follow that pathway. Where a protocol does not define one, the arrangement between the parties determines who verifies, and the resource manager, the site energy management function, or an independent testing or certification service may each be appropriate.

8.5 Limits on what a device can deliver

A common set of outcomes does not mean that every device can deliver every outcome. The limitations below are provided as an exemplar only. They are indicative rather than exhaustive, and you should expect similar constraints in devices the Guide does not name. Water heating illustrates the point because its constraints are well documented; comparable constraints, including compressor protection and frost protection modes, apply to air conditioners and other device types.

- Electric resistive water heating responds to an on-or-off, or curtail-to-zero, instruction, but is not continuously variable, so power modulation is generally not available. Demand response for water heaters is commonly expressed as off, or as operation at 50 per cent or 70 per cent of rated load.
- Heat pump water heaters share those constraints and add compressor protection. Minimum on and minimum off times mean a device may not act on an on or off instruction the moment it receives it.
- A device in a safety or protection mode does not respond to external instructions. Examples include Legionella inhibition cycles in water heaters and oil recovery and start-up frequency restrictions in heat pumps. Where a device must reach a given state on a defined schedule for safety reasons, coordination above the device must allow that behaviour.

- Raising stored water temperature above its normal setpoint to absorb energy is possible and is used in practice. Its manufacturer sets the product's operating limits, and raising the setpoint can affect the appliance's service life and operating efficiency, as described in Section 8.6.
- A consumer override may also apply to any device, and may prevent a device from acting on an instruction it would otherwise be able to deliver.

8.6 Considerations of energy efficiency

Flexing a device changes when and how hard it runs, and for many products, operational efficiency varies with those conditions. When efficiency is not taken into account, a flexibility action can reduce the benefit to the consumer and the wider electricity system because the device consumes more energy to complete the same task. The following examples illustrate the point.

- **Electric vehicle supply equipment**: Charging efficiency can fall below about 20 per cent of rated capacity. A device flexed below that point draws less power but may consume more energy overall to complete the charge and, depending on the tariff, cost the consumer more.
- **Heat pump water heaters**: Efficiency depends on outdoor air temperature, the water setpoint, and inlet water temperature. A unit that is switched off at peak and switched back on overnight operates at a lower ambient temperature, which reduces both efficiency and output capacity, so the task takes longer and uses more energy. Raising the setpoint to absorb low-priced energy can also bring a resistive element into operation, which lowers efficiency for the same reason.
- **Air conditioners**: Efficiency and capacity both depend on outdoor temperature and setpoint. Pre-heating a space because energy is cheap, when it is cold outside, is done at low efficiency and low capacity, so more energy is used to complete the task.

The balance between flexibility and efficiency is not fixed. In some circumstances, the value of flexing a device outweighs a reduction in efficiency; in others, it does not. Product providers and flexibility providers are encouraged to consider efficiency when deciding how and when to flex a device.

Section 9: Communication Protocols and Interfaces

This section addresses how the functional outcomes in Section 8 can be delivered between the parties that coordinate a flexible load. It is placed after the device characteristics and functional requirements so that protocols are treated as a means of delivery rather than the starting point. Consistent with technology neutrality, the Guide describes reference pathways without mandating a single protocol, and allows an equivalent, demonstrably interoperable pathway.

The Guide covers two interfaces. The S2 interface between the resource manager and the site energy management function is the primary focus. The M1 interface is a parallel path by which a third party, such as an original equipment manufacturer, retailer, aggregator, or network operator, communicates with the energy management function or directly with a resource manager. These interfaces follow the IEC 63402-1 model.

The reference pathways below are the protocols and standards relevant to flexible loads. Where a protocol suits one interface more than the other, we note it. No protocol currently addresses all 18 requirements, which is one reason the requirements are treated as optional. Rather than repeat a protocol-by-protocol analysis, the Guide draws on Section 3 of Standards Australia's CER Interoperability Report, which maps the protocols against the requirements; some, such as EEBus and the S2 standard, may need additional work there.

Table 4: Protocols and standards relevant to flexible loads

Protocol or standard	Interface	Notes for flexible loads
Matter	S2	An application-layer connectivity standard for smart-home devices; a fit for the S2 interface.
EEBus	S2	A European energy-management interface (the SPINE data model over the SHIP transport), internet-protocol based and needing no additional hardware; confirmed as a fit for the S2 interface.
OpenADR	S2 and M1	A protocol for exchanging demand response and distributed energy resource control and information signals. OpenADR 2.0b is adopted as IEC 62746-10-1; OpenADR 3.0 is a freely available specification and is the recommended version for any future Australian adoption.
OCPP	M1 and S2 (EV)	The Open Charge Point Protocol for EV charging. Version 1.6J is widely deployed; version 2.0.1 is the preferred target version. EVSE is treated as a load-only, unidirectional device, so the Guide leans on OCPP rather than DR AS 5438, Local Communication Requirements for Inverter Energy Systems. OCPP can also be used locally across the S2 interface, not only as a cloud-facing M1 path.
IEEE 2030.5	S2	Adopted in Australia as AS 5385:2023 (IEEE 2030.5-2018); IEEE 2030.5-2023 may also be referenced. CSIP-AUS is a grid-facing (S0) profile and is not recommended for the local interface. A new DER Direct Profile of 2030.5, designed for S2 local communication, is under development.
AS 4755.2	M1	Demand response for air conditioners and pool pumps, applied over the internet in some jurisdictions; typically an M1 path signalled by a network operator or aggregator. It draws on OpenADR and CSIP-AUS. Appendix G of the standard covers SA HB 218; Appendix H covers OpenADR via AHRI 1380 and OpenADR via IEC 62746-10-1:2018 (OpenADR 2.0b). The standard also sets cyber security requirements for the control path. The standard also covers electrical energy storage systems, which sit outside the scope of this Guide.
CTA 2045	Module	A modular hardware interface, a socket for a plug-in communications module, rather than a protocol; the module runs a protocol such as OpenADR 2.0b or OpenADR 3.0. Retained as relevant because it gives low-compute devices a way to participate, with the reservation that it mandates specific hardware and has limited adoption outside North America.
PAS 1878 and PAS 1879	Reference	A UK framework for interoperable demand-side response by energy smart appliances. Not a protocol, but relevant for its capability model and its operational priority hierarchy.
S2 standard (EN 50491-12-2)	Reference	Defines the S2 interface and a set of flexibility patterns; it is the basis for the flexibility classification in Section 6.2.

The Guide does not prescribe the physical connectivity between the parties. A signal may travel locally, for example, over Ethernet, Wi-Fi, Bluetooth, Zigbee, or a serial connection, or it may travel via a vendor cloud and return over an M1 path. Both are supported. Some loads, such as water heaters, are hard to hardwire and are typically on Wi-Fi, so do not assume local wired connectivity.

Section 10: Local CER to CER Coordination (Requirement R-11)

Local CER-to-CER coordination (requirement R-11) is the central driver of this Guide. DCCEEW describes R-11 as enabling resources at a premises to exchange information and coordinate their operation, so they work together to optimise energy use, and consumers can choose and change who manages their devices.

In practice, although the requirement is described as CER-to-CER, devices generally do not coordinate directly with one another. Coordination is mediated through a resource manager or an energy management function, across the S2 interface described in Section 5. A hot water system and an air conditioner, for example, would not exchange instructions directly; one or more resource managers, coordinated by a site energy management function, would manage them. A layered approach is possible, in which a site energy manager coordinates resource managers, and sub-managers coordinate the resources beneath them.

The Guide describes, at a high level, the role of the energy management function that sits above the devices, sometimes combined with a gateway and customer energy management function. An electrical energy management system (EEMS) performs these functions; the EEMS is the device, not the function itself. This function receives external signals and coordinates on-site resources. The Guide describes what this function does, not how it does it; the detailed functionality is expected to be addressed in separate work, as is the case for inverters under DR AS 5438, *Local Communication Requirements for Inverter Energy Systems*.

A resource manager may receive more than one instruction at the same time, on the same interface or on different interfaces. W here those instructions conflict, the resource manager needs a consistent basis for deciding which one to follow. The table below sets out an order of precedence for that purpose.

Table 5: Order of precedence for conflicting instructions

Priority	Level	What it means
1 (highest)	Failsafe	A safe state that protects people and equipment always takes precedence. Drawn from PAS 1878 and requirement R-14.
2	Consumer override	The consumer can override automated or remote actions, so that comfort and essential use, such as cooling on a hot day, are protected. Whether an override is available and how far it extends depends on the device and the operating mode. Under AS 4755.2, for example, an air conditioner cannot be overridden in modes that still permit limited operation, and can be overridden only partially in the mode that switches it off. Where a device offers an override, and the consumer is paid not to use it, that is a contractual matter rather than a technical one. Requirement R-16.
3	S2 interface	Local coordination and any network constraint carried on S2, such as a dynamic operating envelope, take precedence over M1.
4 (lowest)	M1 interface	Follow a third-party or market instruction only where it does not breach or conflict with a higher level. Where there is no S2 pathway, M1 applies directly.

The table above is a guide only. It is informative rather than prescriptive, and is offered to make behaviour predictable where signals overlap. It is not intended to settle every case: circumstances arise in which a third-party instruction carried on M1 is the one that should be followed, and the ordering shown does not displace the judgement of the energy management function that sits above the devices. Where a protocol allows a priority value to be set and communicated alongside an instruction, that value gives the resource manager the context it needs to resolve overlapping schedules within an interface.

Section 11: Existing Test Methods and Evaluation

Developing rigorous test methods is beyond the scope of this Guide. Instead, the Guide points to existing test methods where they exist and flags where additional work is needed.

The referenced protocols differ in the maturity of their conformance and certification pathways. The Guide points to these pathways rather than developing its own test methods.

For EV charging, the Open Charge Alliance runs an OCPP certification program in which approved independent laboratories, such as DEKRA, DNV, and the Korea Smart Grid Association, test an implementation against the OCPP 1.6 or 2.0.1 specification using the OCPP Compliance Testing Tool, after which the Alliance issues a certificate and lists the product.

For smart-home connectivity, the Connectivity Standards Alliance certifies Matter devices through accredited test laboratories. Certification covers the Matter application layer and requires that the underlying transport, such as Wi-Fi, Thread, or Ethernet, also be certified.

For demand response, the OpenADR Alliance certifies OpenADR implementations. The OpenADR Alliance and the Connectivity Standards Alliance recently agreed to align OpenADR 3.0, from the grid to a gateway, with Matter inside the home, pointing to an end-to-end pathway relevant to flexible loads.

For the IEEE 2030.5 family, adopted as AS 5385, conformance is based on the Common Smart Inverter Profile test procedures, and DR AS 5438, *Local Communication Requirements for Inverter Energy Systems*, relies on the IEEE 1547.1 test procedures. For plug-in module devices, CTA-2045 capabilities are verified through the AHRI 1380 program for air conditioning and the AHRI 1420 program for water heating. EEBus operates its own testing and certification programme. For flexible loads specifically, the AS/NZS 4755 series provides demand response test procedures, although those procedures address discrete demand response modes rather than continuous modulation. Section 12 records the absence of test methods for continuously modulated demand response as a gap.

Passing a protocol conformance test does not, by itself, guarantee that two products will work together in the field. Conformance testing confirms that an implementation follows a specification; it does not confirm that two conforming implementations interoperate. Interoperability testing between products, including supervised multi-vendor test events, establishes that.

Section 12 Interoperability Gaps

This section flags gaps rather than undertaking a deep protocol-by-protocol gap analysis, which is beyond this Guide's scope.

The DCCEEW industry information on pages 11 and 12 already identifies relevant gaps, including local CER-to-CER communication, energy management systems, and the minimum functionality of EVSE only capable of charging. Its mapping also shows several requirements with no applicable standard for flexible loads, such as remote provision of price signals and remote telemetry reading for some device types.

The Guide draws on Standards Australia's CER Interoperability Report, which has reviewed the protocols against the DCCEEW requirements, rather than repeating that analysis.

A specific gap concerns charge limits. State of charge, as a percentage, is available through SunSpec Modbus, AS 5385 (IEEE 2030.5-2018), OpenADR, and the Open Charge Point Protocol. However, SunSpec Modbus and IEEE 2030.5-2018 currently support power output or discharge limits but not charge limits. DR AS 5438, *Local Communication Requirements for Inverter Energy Systems*, offers setpoint target controls for charging and discharging as a workaround. This gap matters for flexible loads that draw power to charge or store energy, and the national technical committee EL-042, Renewable Energy Power Supply Systems and Equipment, has invited guidance on it.

The gaps most relevant to flexible loads include the following: the absence of a settled pathway for delivering a price signal to simple devices where that is wanted; limited support in current protocols for reporting a consumer override back over the S2 interface; charge-limit control, as distinct from discharge control, in some protocols; the minimum functionality of EVSE only capable of charging; the local CER-to-CER coordination function itself, which depends on an energy management function that is not yet the subject of an Australian standard; the absence of device-level telemetry in some device types; the capability of a resource manager to resolve conflicting instructions and apply an order of precedence; and the absence of test methods for continuously modulated demand response.

A further gap concerns what the consumer is told. A device may act on a schedule, a network instruction, a price signal, or its own defaults, and at present the reason for a change of state is reported, where it is reported at all, only to the system managing the device. Any future home energy management system standard or guide should require that the consumer is told why a device acted, whether that was a tariff signal, a network instruction, a scheduled timer, or a device default, in the interest of transparency.

Section 13 Implementation Considerations

This section collects practical considerations that support consistent adoption without creating obligations. Consistent with the guiding principle of technology neutrality, the Guide avoids prescribing solutions. The Guide addresses security by reference to the trusted communication pathway requirement (R-12) rather than by developing new security requirements. Consumer protection considerations, such as the consumer override (R-16) and fail-safe behaviour (R-14), are noted as characteristics that flexible loads should support.

Practical considerations that support consistent adoption, without creating obligations, include the following.

- **Certification and conformance:** Where a certification pathway exists for a chosen protocol, using a certified implementation reduces integration risk; Section 11 lists the pathways.
- **A local interface:** Providing a local interface as well as a vendor cloud interface protects the consumer if a cloud service is withdrawn.
- **Fail-safe and consumer override:** Implementing a safe state on failure (R-14) and a consumer override (R-16), including reporting an override back over S2 where the protocol supports it, supports both safety and consumer trust.
- **Diversification:** Applying a randomised delay or a ramped response avoids many devices reacting

to the same signal at once.

- **Trusted communication:** Using authenticated, encrypted communication (R-12), typically Transport Layer Security (TLS), is expected by most of the referenced protocols.
- **Device-level telemetry:** Where a device or associated resource manager can report its own operating data, this supports coordination and forecasting, though it is not mandated and adds cost for simpler devices.
- **The priority order:** Implementing the priority order in Section 10 keeps behaviour predictable where signals overlap or conflict.

Section 14: Guide Maintenance and Currency

This Guide is intended to be a living document. It will need to be reviewed as the related work develops, including the publication of DR AS 5438, *Local Communication Requirements for Inverter Energy Systems*, expected in late 2026, any changes to the 18 requirements, and future work on energy management systems. Alignment with New Zealand's work on regulatory smart-charging requirements and with voluntary end-use product demand-flexibility requirements may also be relevant. Confirm review triggers, review responsibility, and how the Guide signals its currency date.

Section 15: References

The following sources inform this Guide.

1. ASHRAE/NEMA Standard 201, Facility Smart Grid Information Model, an abstract, protocol-independent facility information model (referenced in Section 6.2).
2. CSIP-AUS, Common Smart Inverter Profile (Australia), an IEEE 2030.5 implementation profile.
3. CTA 2045, modular communication interface for energy management (noted as an example interface).
4. Department of Climate Change, Energy, the Environment and Water (DCCEEW), Initial 18 Consumer Energy Resource Device Requirements, Technical Standards on CER Interoperability, industry information, 2026. Available at www.dcceew.gov.au.
5. Department of Climate Change, Energy, the Environment and Water (DCCEEW), Consumer Energy Resources (CER) Interoperability, 2026. Available at www.energy.gov.au/sites/default/files/2026-08/consumer-energy-resources-cer-interoperability.pdf.
6. EEBus, an energy-management interface for devices in buildings (the SPINE data model over the SHIP transport), Internet Protocol-based; relevant to the S2 interface.
7. AS 62786.1 (under development), technical requirements for the connection of sub-5 MW distributed energy resources, including recommended ramp rates for frequency response.
8. The Electric Vehicles (Smart Charge Points) Regulations 2021 (United Kingdom), which require randomised delays for smart charge points.
9. Analysis of high photovoltaic penetration in the German electric grid and the 50.2 Hz frequency response issue.
10. WattClarity, analysis of distributed energy resource effects on system frequency (2026).
11. Mercury Consortium, certification pathway for interoperable consumer energy products using existing protocols (first products using OCPP 1.6J).
12. PAS 1878 and PAS 1879, framework for interoperable demand side response by energy smart appliances (British Standards Institution).
13. S2 standard (EN 50491-12-2), interface between an energy management system and smart devices for energy flexibility (CENELEC TC205); described in the S2 white paper.
14. Flexible Loads Interoperability Guide Project, Terms of Reference, endorsed by DCCEEW and Standards Australia.
15. IEC 61850-7-420:2021, Communication networks and systems for power utility automation, Part 7-420: Distributed energy resources and distribution automation logical nodes (adopted in Australia as AS IEC 61850-7-420:2025).
16. IEC 62746-10-1, Systems interface between customer energy management system and the power management system, Part 10-1: Open automated demand response. OpenADR 2.0b is published as this IEC standard; OpenADR 3.0 is a freely available specification and is the recommended version for any future Australian adoption.
17. IEC 63402-1:2025, Energy efficiency, Customer energy management systems, Part 1: General requirements and architecture.
18. IEC 63584:2024, Open Charge Point Protocol (based on OCPP 2.0.1).
19. IEEE 1547, interconnection and interoperability test procedures (referenced by DR AS 5438).
20. IEEE 2030 series, interoperability of energy technology and information technology with the electric power system and end-use applications and loads (referenced in Section 6.2).
21. ISO 15118 series and IE C 61851-1, electric vehicle and EVSE communication.
22. Lawrence Berkeley National Laboratory and United States Department of Energy, demand flexibility research, including the shed, shift, and modulate framing (referenced in Section 6.2).
23. Matter, application-layer connectivity standard for smart home devices (Connectivity Standards Alliance).
24. Standards Australia, AS 5385:2023, identically adopting IEEE 2030.5-2018 (Smart Energy Profile application protocol); IEEE 2030.5-2023 and the DER Direct Profile of IEEE 2030.5 (under development, for S2 local communication) are also referenced.
25. Standards Australia, DR AS 5438, Local Communication Requirements for Inverter Energy Systems (prepared by the national technical committee EL-042, Renewable Energy Power Supply Systems and Equipment).
26. Standards Australia, AS/NZS 4755 series, demand response capabilities and supporting technologies for electrical products, including AS 4755.2 applied over the internet for air conditioners and pool pumps (using OpenADR and CSIP-AUS, and AHRI 1380). The series also covers electrical energy storage systems, which are outside this Guide's scope.
27. Standards Australia, AS/NZS 4777.2, grid connection of energy systems via inverters.
28. SunSpec Alliance, SunSpec Modbus data models.

Appendix A: Use-Case Mapping and Device Types

This appendix maps the flexibility patterns described in Section 6.2 to common grid and market use cases, sets out the characteristics a load description could carry, and gives an indicative list of device types and the pathway by which each is typically controlled.

A.1 Mapping patterns to use cases

The table maps the flexibility patterns to common grid and market use cases. For each use case, it shows the best-matched patterns, the characteristics that matter most, the implications for the Guide, who typically requires the service, the primary communication pathway, and the CER requirements it draws on.

Suitability always depends on the program and the device, so the mapping is indicative rather than prescriptive.

Table 6: Flexibility patterns mapped to grid and market use cases

Use case	Best-matched patterns	Most important characteristics	Implication for the Guide	Who requires this	Primary pathway	CER requirements
Demand response	Limit, shift, pause, buffer, store	Enrolment status, notice, duration, baseline, rebound, telemetry	Support both event-based and price-based programs, and both opt-in and intermediary (M1) models.	DNSP/DSO or via aggregator	System operator via S2 and aggregator via M1	R-3, R-5, R-6, R-9, R-10, R-11, R-12, R-13, R-14, R-16
Frequency regulation	Power modulation, limit	Very low latency, ramp rate, telemetry rate, sustained duration, availability confidence	Separate loads that can modulate from those that can only be limited or shed, and require tighter control and observability.	DNSP/DSO	S2	R-3, R-14,
Peak shaving	Limit, shift, buffer, store	Power magnitude, duration, rebound, coincidence, predictability	Support day-ahead and intra-day peak targeting, not just emergency events.	DNSP/DSO	S2	R-3, R-4, R-5, R-6, R-11, R-12, R-14, R-16
Local congestion relief	Limit, shift, buffer, store, with locational metadata	Location, feeder or zone tagging, targeting, verification, forecastability	Locational tags and target scopes matter where the Guide is used for local flexi-bility.	DNSP/DSO	S2	R-3, R-5, R-6, R-9, R-10, R-11, R-12, R-13, R-14, R-16
Resilience	Buffer, store, switch energy type	Criticality, restoration order, autonomy duration, emergency limits, manual override	Let operators distinguish what must stay on, what may be shed first, and what may be sequenced back.	DNSP/DSO	S2	R-3, R-4, R-5, R-6, R-11, R-12, R-13, R-14
Operating envelope	Limit	Telemetry, power consumption, voltage	Let operators distinguish what must stay on, what may be shed first, and what may be sequenced to control import or export.	DNSP/DSO	S2	R-3, R-4, R-5, R-6, R-11, R-12, R-13, R-14, R-16

Maximise self-consumption	Limit, shift, buffer, store, with locational metadata	Telemetry, power consumption, voltage, autonomy duration, emergency limits, manual override	Let customers distinguish what must turn or stay on, and what may be sequenced to avoid export.	Customer via HEMS	S2	R-11, R-12, R-13, R-14, R-16
Storm Guard	Store, switch energy type	Telemetry, power consumption, voltage, autonomy duration, emergency limits, manual override	Let customers distinguish what must turn or stay on, and what may be sequenced to prioritise storage.	Customer via HEMS	S2	R-11, R-12, R-13, R-14, R-16
Load prioritisation	Limit, shift, buffer, store, with locational metadata	Telemetry, power consumption, voltage, autonomy duration, emergency limits, manual override	Distinguish what must turn or stay on, what may be shed first, and what may be sequenced to control import or export.	Customer via HEMS	S2	R-4, R-11, R-12, R-13, R-14, R-16
Respond to price signal	Limit, shift, buffer, store	Enrolment status, notice, duration, baseline, rebound, telemetry	Support both event-based and price-based programs, and both opt-in and intermediary (M1) models.	Aggregator, customer	M1	R-3, R-4, R-5, R-6, R-11, R-12, R-13, R-14, R-16
Wholesale market participation (IPRR) via aggregator	Limit, shift, buffer, store	Enrolment status, notice, duration, baseline, rebound, telemetry	Support both event-based and price-based programs, and both opt-in and intermediary (M1) models.	DNSP/DSO or via aggregator	M1	R-3, R-4, R-5, R-6, R-9, R-11, R-12, R-13, R-14, R-16
Energy arbitrage via VPP	Limit, shift, buffer, store	Enrolment status, notice, duration, baseline, rebound, telemetry	Support price-based programs, and both opt-in and intermediary (M1) models.	Aggregator, customer	M1	R-3, R-4, R-5, R-6, R-9, R-11, R-12, R-13, R-14, R-16

A.2 Characteristics a flexible load description could carry

Underlying the patterns is a set of characteristics that a flexible load could declare. A load may also need to communicate an upper and lower bound on how far its power can change, which is captured by the limit production or consumption pattern:

- controllability: not controllable, on or off, discrete states, or a continuous band;
- flexibility mechanism: curtailment, time-shift, or modulation;
- criticality and priority, including which control objective wins when signals overlap;
- temporal performance: notice, response time, ramp, minimum and maximum duration, recovery, and rebound;
- magnitude and energy budget: controllable power range and controllable energy over a stated horizon;
- predictability and observability, including whether a value is measured, estimated, or forecasted;
- safety, regulatory, ownership, and market-participation context, kept separate from control capability;
- aggregation behaviour and cyber security or privacy needs, including targeting and data minimisation.

A.3 Indicative device-type list

The list below is indicative and is ordered alphabetically. It lists device types commonly encountered

as flexible loads, provides an abridged definition and the product standards that typically apply, and indicates whether the device is usually controlled directly, through a resource manager, or by either route. It is provided so that other work can use consistent definitions, and it neither restricts the device families in scope nor creates any obligation. The list is not exhaustive, and a device type that does not appear is not thereby excluded. Definitions are abridged for readability; the applicable standard governs in each case. Inverters and inverter energy systems, which DR AS 5438, Local Communication Requirements for Inverter Energy Systems, addresses, are not listed, consistent with Section 2.3.

Table 7: Indicative device types, definitions, and control pathways

Device type	Definition (abridged)	Applicable standards	Typical control pathway
Air conditioner	A household appliance incorporating motor compressors, designed to deliver conditioned air to an enclosed space, room, or zone, and including a refrigeration system for cooling, heating, or dehumidifying the air, including hydronic room fan coil systems; portable, transportable, or fixed.	AS/NZS 60335.2.40	Direct control and, or, resource manager
Blanket	A flexible appliance with a fabric enclosure for applying heat to a bed, with a projected surface area exceeding 0.6 square metres, including any associated power supply or controller.	AS/NZS 60335.2.17	Direct control and, or, resource manager
Clothes dryer	A household appliance for drying textile material. Does not include a heated towel rail or a gas appliance having electrical connections.	Rotary type, AS/NZS 60335.2.11 Cabinet type, AS/NZS 60335.2.43	Direct control and, or, resource manager
Control or conditioning device	A portable, self-contained household device that controls or conditions the electrical input to electrical apparatus through its own outlet facilities, including devices that receive inputs from external sensors. This is the category through which a non-smart appliance is commonly made controllable.	AS/NZS 3105	Direct control and, or, resource manager
Dishwashing machine	A household appliance for washing eating and cooking utensils.	AS/NZS 60335.2.5	Direct control and, or, resource manager
Electric vehicle supply equipment (EVSE)	Equipment intended to supply electric vehicles and plug-in hybrid vehicles, such as passenger cars, sport utility vehicles, and motorcycles.	IEC 61851 series, electric vehicle conductive charging system IEC 62196 series, plugs, socket-outlets, vehicle connectors and vehicle inlets IEC 62752, in-cable control and protection device for mode 2 charging	Direct control and, or, resource manager
Evaporative cooler	A fixed appliance with one or more vents that cools air through the evaporation of water and incorporates a fan for moving air.	AS/NZS 60335.2.98	Direct control and, or, resource manager
Fan	A self-contained household appliance whose primary function is moving air in its vicinity for comfort or extraction purposes, including duct fans and associated ancillary equipment.	AS/NZS 60335.2.80	Direct control and, or, resource manager
Heat pump water heater	An appliance that heats and stores water for bathing, washing, or similar purposes using a refrigeration cycle. Listed separately because not all heat pump water heaters incorporate a heating element.	AS/NZS 60335.2.21 Applicable parts of AS/NZS 60335.2.40	Direct control and, or, resource manager

Immersion heater	A self-contained household appliance for heating liquid in which it may be immersed, including aquarium types.	Aquarium type, AS/NZS 60335.2.55 Portable, other than aquarium type, AS/NZS 60335.2.74 Fixed type, AS/NZS 60335.2.73	Direct control and, or, resource manager
Liquid heating appliance	A portable household appliance with a capacity not exceeding 10 L that heats liquid for humidifying room air, for use in or as a hot beverage, or for cooking.	Humidifier, AS/NZS 60335.2.98 Other, AS/NZS 60335.2.15	Direct control and, or, resource manager
Over blanket, duvet, or wrap	A flexible appliance with a fabric enclosure for applying heat to a person by placing or draping it over them, containing no heated liquid, with a projected surface area exceeding 0.6 square metres, including any associated power supply or controller.	AS/NZS 60335.2.17	Resource manager
Resource manager	A function that manages the operation of a device or resource, may interface with other resource managers or with a home energy management system, and provides load control, capability reporting, or both.	IEC 63402-1:2025	Direct control and, or, resource manager
Room heater	A household appliance for heating by electrical energy for comfort purposes, including appliances accommodating heat lamps. Does not include an air-conditioning appliance, a system that primarily heats a room by raising the temperature of a floor, wall, or ceiling, or an under-carpet heating system.	Thermal storage type, AS/NZS 60335.2.61 Other, AS/NZS 60335.2.30	Direct control and, or, resource manager
Submersible pump	An appliance for pumping liquids at a temperature not exceeding 90 degrees Celsius, with electrical parts wholly or partly immersed in the liquid during normal use, portable or fixed. Does not include shower boost pumps or swimming pool and spa equipment.	AS/NZS 60335.2.41	Direct control and, or, resource manager
Swimming pool and spa equipment	An appliance or device that is a transportable spa pool or spa bath, circulates air or water in a conventional bath, or is used in the operation or cleaning of a swimming pool or non-transportable spa pool or spa bath. Does not include equipment promoted exclusively for commercial use, or a heat pump.	Pump, AS/NZS 60335.2.41 Spa pool, spa bath, or bath circulation, AS/NZS 60335.2.60 Ultraviolet water treatment, AS/NZS 60335.2.109 Other, AS/NZS 3136	Direct control and, or, resource manager
Washing machine	A household appliance used for washing clothes and other textile materials.	AS/NZS 60335.2.7	Direct control and, or, resource manager
Water bed heater	An appliance for installation under a water bed envelope that heats the water contained in that envelope, including any associated control device.	AS/NZS 60335.2.66	Direct control and, or, resource manager
Water heater	An appliance for heating and storing water for bathing, washing, or similar purposes, incorporating a heating element, unvented, with a storage capacity of not less than 4.5 L and not more than 680 L; or for heating water, of the instantaneous type, incorporating live parts in contact with water. Does not include a heat pump water heater.	Pressure storage, AS/NZS 60335.2.21 Instantaneous, AS/NZS 60335.2.35	Direct control and, or, resource manager

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