Bidirectional EV charging

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What is bidirectional EV charging?

Bidirectional charging ('bidi') allows for the two-way flow of electricity between an EV and an external electricity system. This means that EV electricity loads can be shifted in time (unidirectional smart charging), and they can also act as a generator that produces power for a home or building and/or, to support the grid.

Types of bidi include:

- **Vehicle to grid (V2G)** - EVs supply power to a mains electrical circuit that is electrically connected to the grid
- **Vehicle to homes and buildings (V2H/B)** – EVs supply power to local electrical distribution system that is electrically separated from the grid, such as during a power outage
- **Vehicle to load (V2L)** – EVs supply power directly to one or more electrical appliances.

Australia's bidirectional future

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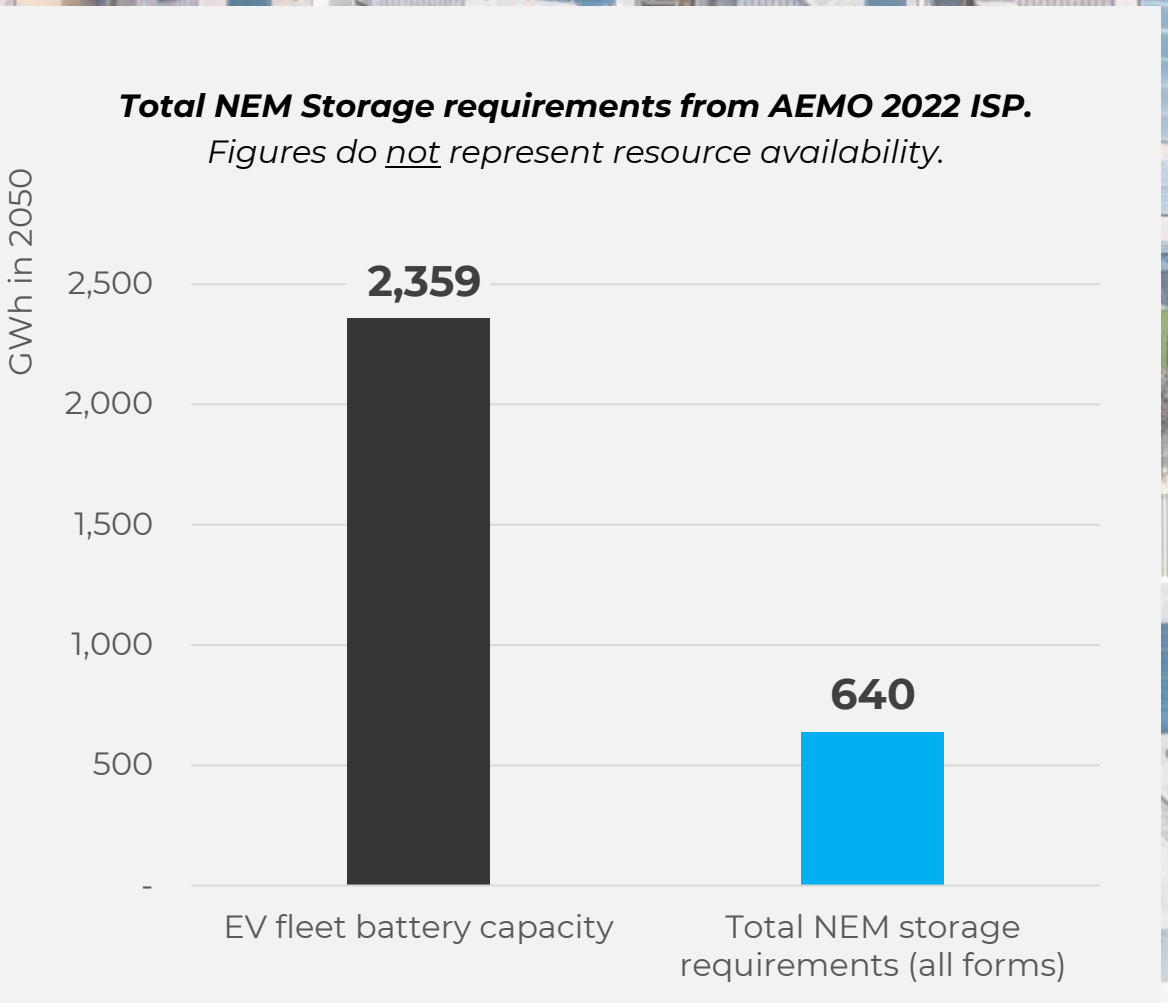


Bidirectional EV charging has the potential to exceed the uptake rates experienced for rooftop solar in Australia, achieving over 4 million installations by 2040

Accounting for vehicle availability

Key factors affecting the utility bidirectional charging from a power system perspective:

1. The **supply of bidi-capable vehicles** is the critical path in the medium term. This will be shaped by national policy.

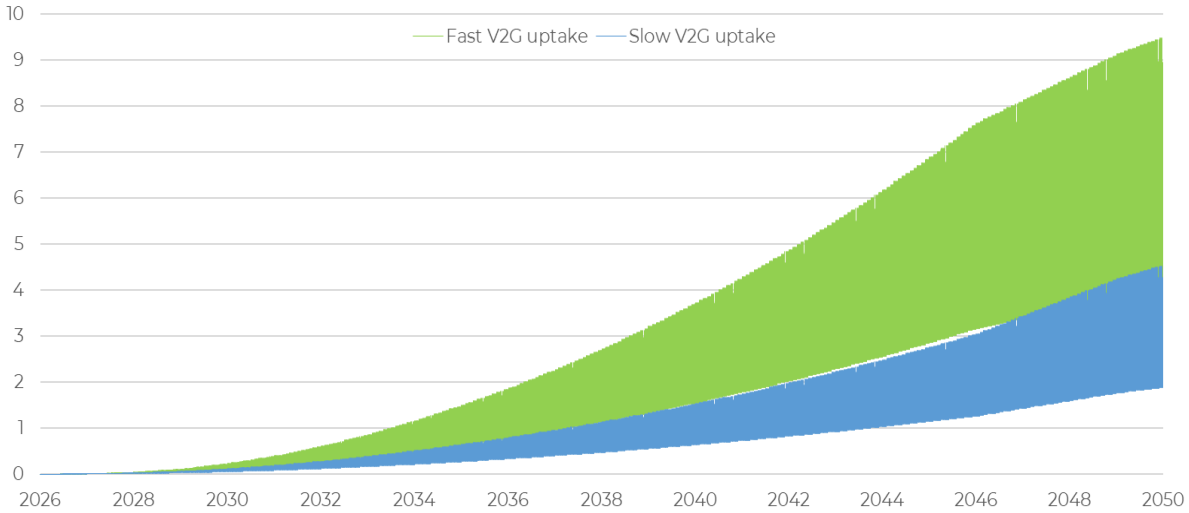
2. The level of **customer uptake** of bidirectional charging in different transport sector contexts. This will be determined by effective productisation.

3. The **transport and plug-in behavior** of EV drivers impacts when the vehicle is available to charge and discharge, and their overall ability to optimise charging against available incentives. This can be shaped by infrastructure availability and product incentives.

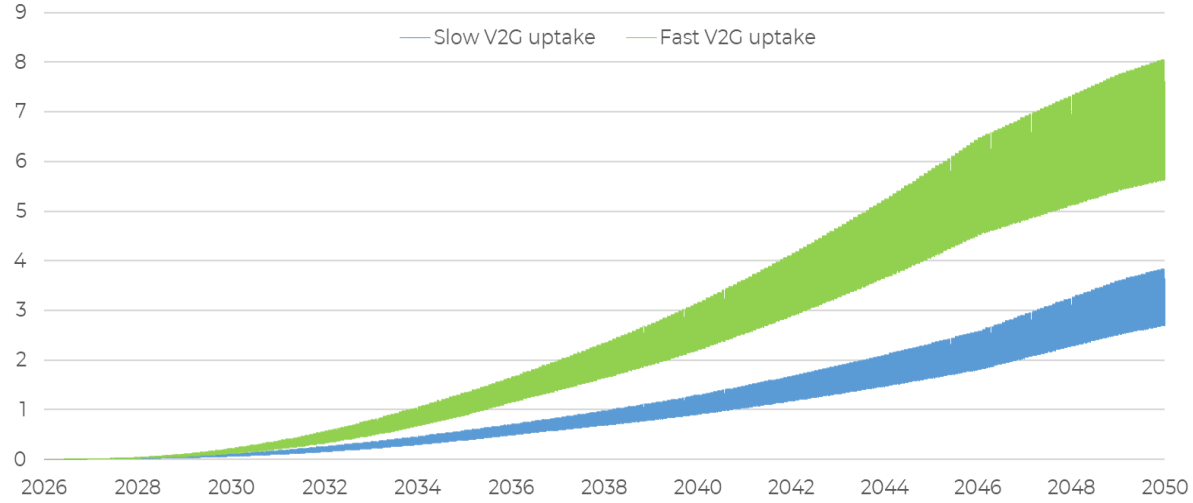
4. Effective and **smart grid integration** will determine export capacity limitations (e.g., via CSIP-Aus).

5. The shift toward **dynamic network tariffs** will undermine the achievement of efficient battery utilization and local network capex savings.

Available capacity (GW) for default charging



Available capacity (GW) for day-weighted charging



State of the market

International **shift in focus from technology demonstrations to preparing early-stage mass-market products** especially for V2G for residential customers (with a greater focus on V2H in the US).

Many (possibly all) EV automakers are currently in the process of developing bidirectional charging products and many EVs already in our market have been demonstrated to be bidi capable.

While the core technology to enable bidi is well demonstrated, **the focus of automakers and EVSE OEMs is now on *productisation* and *homologation* against standards in priority end markets.**

Examples of EVs with demonstrated bidi capability

Make	Vehicle platform	Configuration	Count of models
Alpine	CMF-EV	AC	1
Audi	MEB	DC	1
BMW	CLAR	DC	2
Citroen	EMP2	DC	1
Cupra	MEB	DC	1
Ford	Ford T3	DC	1
GM	Ultium	DC	3
Honda	Honda e	DC	1
Hyundai	E-GMP	DC	1
Kia	E-GMP	AC	1
Lucid	LEAP	DC & AC	1
Mitsubishi	CMF-EV	DC	1
Nissan	CMF-EV	DC	2
Polestar	SPA2	DC & AC	1
Porsche	J1	DC	1
Renault	CMF-EV	AC	1
Rivian	Skateboard	DC	2
Skoda	MEB	DC	1
Tesla	Various	DC	3
Volkswagen	MEB	DC	5
Volvo	SPA2	DC & AC	2

Technical standards as critical infrastructure

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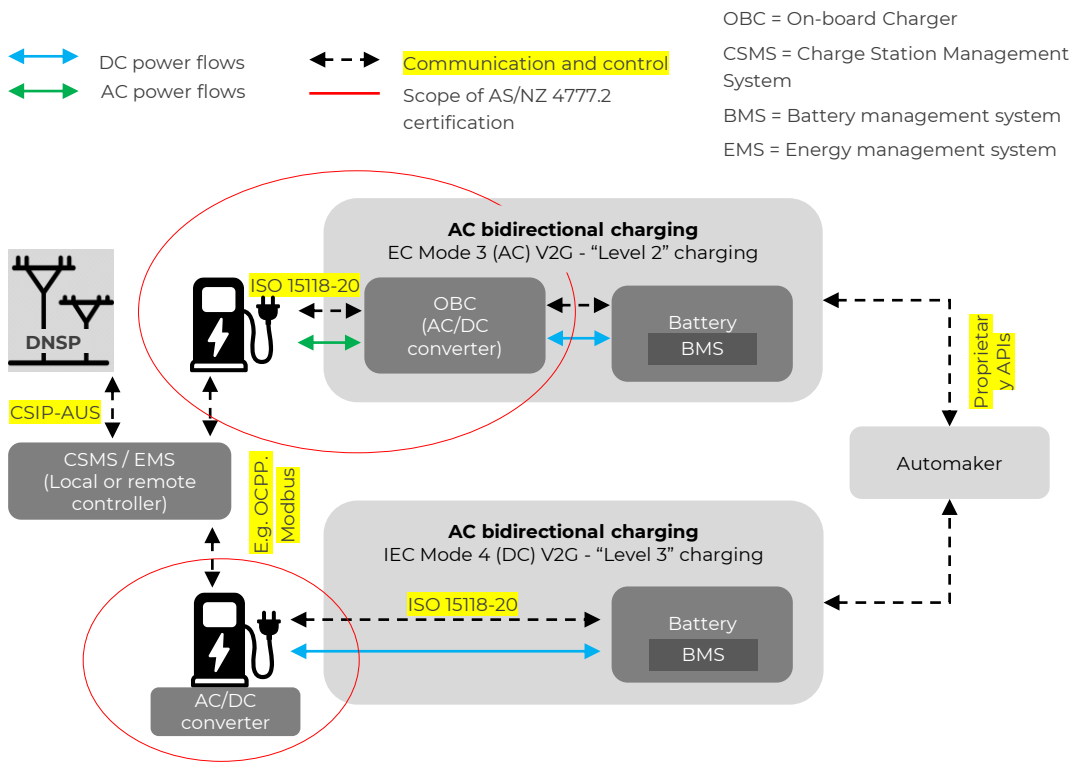
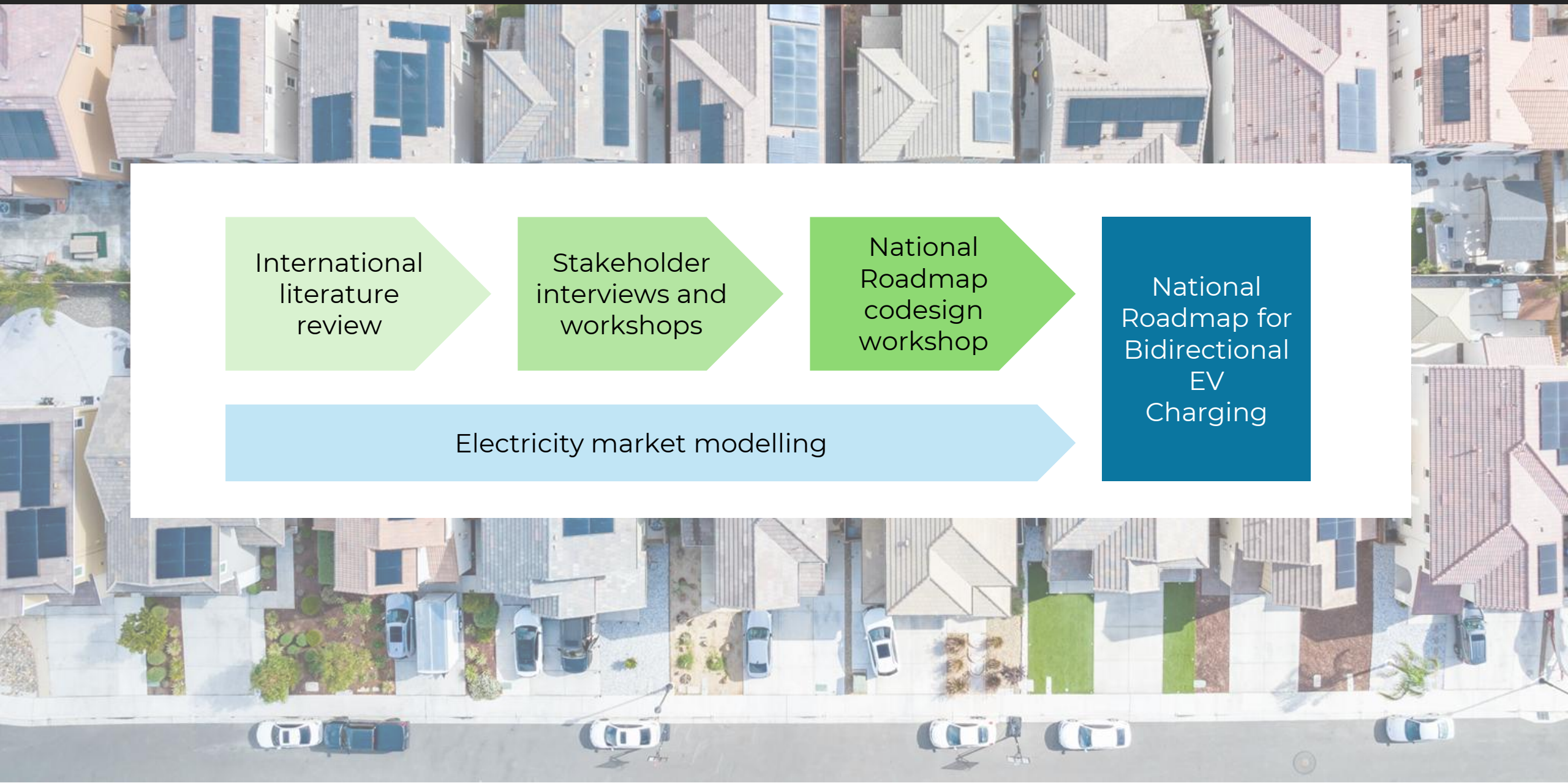
Key technical standards

IEC 62196	IEC 62196 and the **Combined Charging System (CCS Type 2)** and its derivative **Megawatt Charging System (MCS)** is the apparent market direction in Australia. CHAdeMO represents a shrinking market share and is not a focus in current product development.
ISO 15118	**ISO 15118-20** is required for interoperable CCS-based V2G. Whilst production-ready for DC V2G, significant revisions are underway to enable AC V2G. Early products may be based on custom extensions to the older ISO 15118-2 standard.
OCPP	Version 2.1 of the **Open Charge Point Protocol (OCPP)** framework is required for *standardised* V2G interoperability. Version 2.1 will be backwards-compatible with 2.0.1 (collectively '2.x'), but not with 1.6 which is used widely today.
IEEE 2030.5	Australia is adopting **CSIP-AUS**, based on IEEE 2030.5, as the national profile for communicating dynamic operating envelopes from distribution network businesses to customer premises. These will typically be received by a proxy or site gateway device with local communication to the EVSE via OCPP or Modbus. IEEE 2030.5 is not widely used outside of Australia.
AS/NZ 4777	V2G is subject to the same grid code requirements that apply to all inverter-based generating systems. In Australia, these requirements are set out in the recently updated AS/NZ 4777.1:2024 (installation requirements) and AS/NZ 4777.2:2020 (inverter equipment requirements).

AC vs DC configurations



National bidi roadmap process



International literature review

Stakeholder interviews and workshops

National Roadmap codesign workshop

Electricity market modelling

National Roadmap for Bidirectional EV Charging