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Institute for Energy Economics and Financial Analysis

# Growing the sharing energy economy

How Energy Ministers can support cheaper, faster decarbonisation through distributed energy resources

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# Figures and Tables

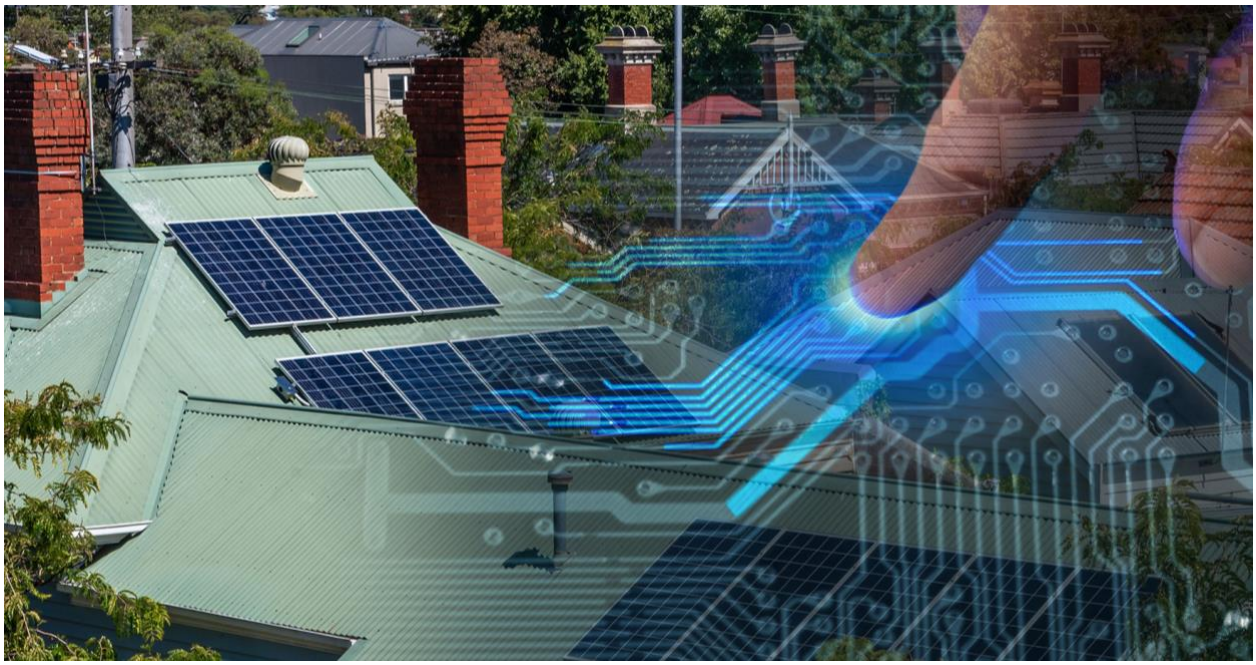
# Key Findings

**Distributed Energy Resources (DER) can unlock faster decarbonisation and lower energy bills by leveraging household and business investment, increasing the chances of Australia reaching 82% renewables by 2030.**

**A DER Authority should be established, responsible for technical standards, to optimise the value of DER, including electric vehicles.**

**To make the most of renewable power, accelerated action is needed to scale both flexible demand and storage.**

**A review of energy market governance is needed to support a sharing economy for energy, while a review of distribution network revenue regulation is necessary to ensure distribution networks are remunerated efficiently in a DER-rich world, and that DER can provide network services on a level playing field.**



# Executive Summary

If Australia is to meet its international commitments to a 43% emissions reduction by 2030, it needs to reach 82% renewable generation in the National Electricity Market (NEM), up from 37.7% in the year to 19 September 2023.[1] Both of these targets are at risk for two main reasons: the slow pace of electricity transmission infrastructure build; and the lack of new large-scale renewables investment meeting financial close. According to the Clean Energy Council, just 0.4GW of new renewables investment was financed in the first six months of 2023, in contrast to the 5GW that is required on average every six months to meet the government's 2030 target of 82% renewables.[2]

Meanwhile, in South Australia on 16 September 2023, rooftop solar generation rose above 100% of demand for a five-minute period.[3] On the same day the share of rooftop solar in the NEM reached another record of 46.7%.[4] For the past three years, almost 3GW of rooftop solar has been added annually, such that there is now more than 22GW of rooftop solar in the NEM.[5] This means consumers have purchased the equivalent of about one third of the capacity in the NEM.[6] Australian households have already spent at least $25 billion on rooftop solar and other Distributed Energy Resources (DER).[7] Not only has rooftop solar been reducing bills for the customers who own them, but it has reduced wholesale market electricity prices for all consumers.[8]

> **Rooftop solar and other Distributed Energy Resources – such as storage and demand responsive appliances – have a multitude of benefits for the system.**

Rooftop solar and other DER – such as storage and demand responsive appliances – have a multitude of benefits for the system. DER have the potential to provide electricity and services to the grid in times of need. They can decrease the necessity for centralised generation and can therefore reduce wholesale power prices. They can reduce reliance on high-cost electricity networks if managed well. They can also introduce resilience into the system and provide sustainable jobs and economic opportunities across Australia.

However, the full potential of DER is yet to be unlocked. For technical, regulatory and/or market design reasons, DER are not able to provide the full range of possible services to the grid. The desirable end state is a sharing energy economy in which DER are in communication with one another behind the meter (BTM) and with the grid, and can trade energy services with one another,

[1] OpenNEM. 19 September 2023.
[2] Sophie Vorrath. Extend the RET, expert says, and don't pay coal plants for a job they can't do. 15 September 2023.
[3] Giles Parkinson. Rooftop solar eats up all demand in South Australia, world's most renewable grid. 18 September 2023.
[4] Giles Parkinson. Rooftop solar smashes records, sends coal and demand to new lows as it reshapes the grid. 17 September 2023.
[5] IEEFA analysis of data from the Australian PV Institute and the Clean Energy Regulator. Details of calculations provided in the full report.
[6] AEMO. 2023 Electricity Statement of Opportunities. Page 44. Note: Current capacity of the NEM is 59.2GW.
[7] Gabrielle Kuiper. Faster Decarbonisation: What State Governments Can Do To Support Distributed Energy Resources. May 2022.
[8] Mountain, Bruce & Percy, Steven & Kars, Asli & Saddler, Hugh & Billimoria, Farhad. Does renewable electricity generation reduce electricity prices?. 2018.

the local distribution network and the grid, in a voluntary but profitable manner. This will benefit the grid and deliver lower costs for all users of the electricity system.

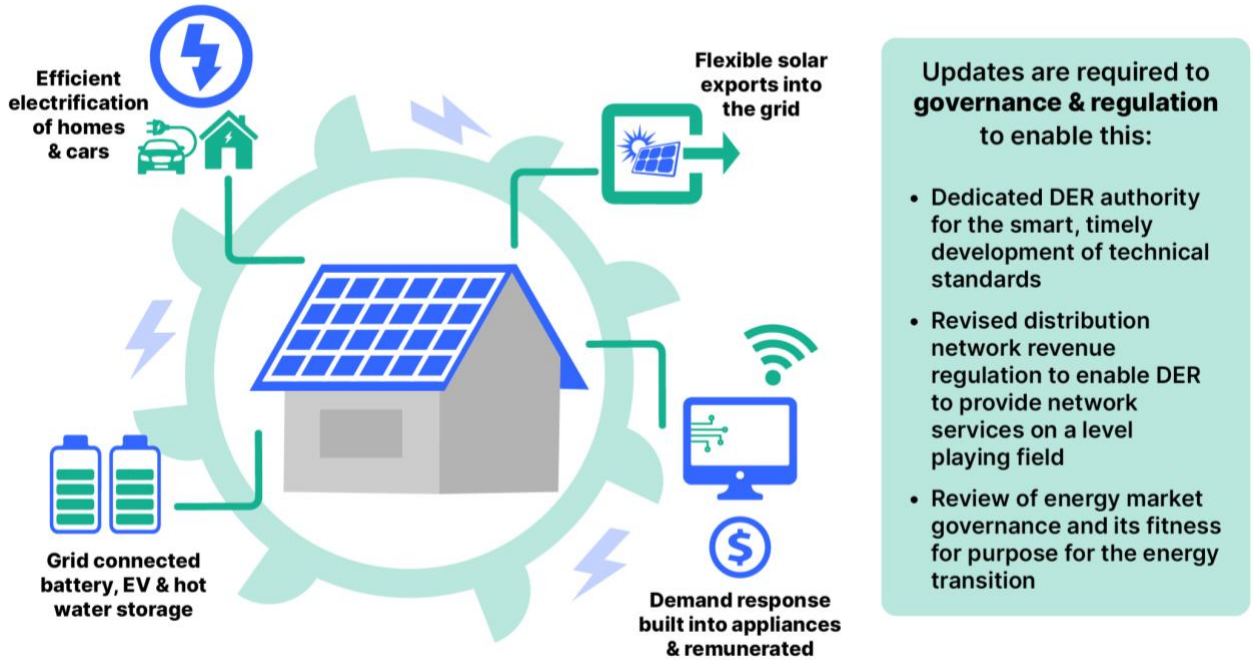
In order to optimise the benefits of DER for all electricity system users – and to get the most out of the significant consumer investments that have been made, there needs to be more DER with the capacity to "flex" its demand, more storage in the system (not just batteries and electric vehicles, but smart hot water systems and other appliances), and it needs to be made easy and profitable for DER owners to participate in Virtual Power Plants (VPPs) if they wish to. In VPPs, DER are coordinated with one another and with the wider grid to enable them to operate in ways that drive opportunity and efficiency across the system.

To achieve this requires the following steps:

1. **Ensure appropriate technical standards are in place**

**Create a body for the smart, timely development of technical standards.** Decision-making about planning for and deciding on DER technical standards and their compliance regimes needs to be centralised in one place. Smart technical standards will ensure that DER perform consistently have the necessary features to support consumer needs, and the ability participate in markets (such as by communicating with each other), as well as compliance with the needs of distribution networks.

**Figure 1: Optimising DER to enable a sharing energy economy**




*Source: IEEFA*

### 2. Remove static constraints on existing solar

**Maximise solar exports within the limits of the distribution network.** At present, many households and businesses are not able to export their full solar potential to the grid, with static export limits set at 5kW for most households in the NEM. Flexible export limits (also called Dynamic Operating Envelopes) enable greater solar exports at times that the grid can cope, and should be accelerated so consumers can get the greatest value from their solar power.

**Reduce consumer costs, improve appliance lifetime and solar exports through better voltage management.** Currently most distribution networks are operating at voltages above the 230V standard most of the time. This is costing consumers more than it should – an estimated $30m annually in Victoria for the additional supply alone. There are also additional costs in reducing the lifetime of appliances and increasing solar exports from higher than necessary voltages. All of these can be addressed by jurisdictions working collectively and following the Victorian Government's lead to address high voltages.

### 3. Unlock flexible demand

A vital role of the sharing energy economy is to have electrical appliances flex their power consumption up and down, in line the available renewable power supply. This is referred to as "flexible demand", of which "demand response" to a signal is one form. To facilitate flexible demand, standards need to be updated to enable appliances to respond to grid signals and enable consumers to opt out if desired, and consumers need to be adequately compensated for providing these services.

**Develop demand response requirements for major household appliances.** There are no requirements for large household appliances to be able to flex their demand or even to be able to communicate with other devices in the home. Research shows that the biggest aggregated opportunity for demand response is in households, especially hot water systems. While not efficient, a 300-litre tank on an existing electric storage hot water system has about the equivalent energy storage potential (15kWh) as a Tesla Powerwall.[9]

**Accelerate the efficient electrification of hot water systems.** Under the University of Technology Sydney's (UTS) rapid electrification of hot water scenario, developed for the Australian Renewable Energy Agency (ARENA), if all hot water systems are efficiently electrified and controllable by 2035, consumers could save up to an estimated $6.7 billion a year by 2040, while 22GW/45GWh/day of flexible demand would be created, equivalent to roughly two-thirds of peak demand in the NEM.[10] A national strategy for flexible domestic hot water should look to make the most of this opportunity.

**Enable demand response revenue streams.** The wholesale demand response mechanism (WDR mechanism) is currently limited to large commercial and industrial (C&I) customers with a base of flat

[9] Roche, D., Dwyer, S., Rispler, J., Chatterjee, A., Fane, S. & White, S. Domestic Hot Water and Flexibility. Report prepared for ARENA by UTS Institute for Sustainable Futures. June 2023.
[10] UTS Institute for Sustainable Futures. Domestic Hot Water and Flexibility. 5 June 2023.

demand. Aggregated household DER are not able to participate, and therefore consumers are missing out on an opportunity to earn revenue by voluntarily flexing their demand. This can be addressed by reforming and expanding existing baseline methods and changing the rules to include aggregated household demand and more dynamic forms of C&I demand in the WDR mechanism.

4. **Fast-track distributed storage**

**Prioritise and provide financial support for behind-the-meter (BTM) storage.** Rooftop solar generation is already reducing wholesale prices in the daytime, but it will further reduce overall costs for consumers if it can be stored and used at peak times (including the daily 4pm-8pm evening peak). To enable this, the government should prioritise and provide financial support for distributed battery systems where it can deliver significant system benefits. It should also support electric vehicle-to-grid services, and allow aggregated storage (and where possible, flexible demand response) to participate in the Capacity Investment Scheme.

5. **Create a level-playing field in network services**

**Ensure distribution network revenue regulation enables DER integration.** Network revenue regulation was designed to reward distribution businesses for delivering one-way flows of electricity, including the construction of assets to meet peak network flows. Networks now need to enable two-way flows and DER integration to support decarbonisation. A review of distribution network revenue regulation is needed to enable DER to provide network services on a level playing field with expenditure on network assets, and to make sure that in a DER-rich future, networks are used efficiently and that distribution network costs can be reduced for consumers.

6. **Ensure fit-for-purpose governance**

**Ensure energy market institutions are enabled to support a DER-rich future.** Major changes will be required to achieve all of the above goals. To enable an efficient sharing energy economy, energy market governance will need to be flexible, innovative and fit for purpose. A review of energy market governance would give confidence that there are the responsibilities, structures and resources to support rapid DER integration and the decarbonisation of the NEM.

If all of the above is addressed, DER – rooftop solar, distributed storage and demand response – can help Australia to meet the 82% renewables target, faster and cheaper.

This report makes a series of recommendations to support the deployment and integration of DER into Australian energy markets to unlock benefits for all electricity consumers. These recommendations have been written to inform the meeting of Energy and Climate Change Ministers in November 2023, where DER are on the agenda.

# Recommendations for Energy Ministers' November 2023 meeting:

1. **Ensure appropriate technical standards are in place:**
   - Create DER Technical Authority to set a vision for DER technical standards; develop a technical standards work program; monitor, review and set DER technical standards; consider issues related to compliance and enforcement of standards in their development; and provide advice on standards to other government and energy market bodies, and undertake related reviews.
2. **Remove static constraints on existing solar:**
   - Agree to prioritise the implementation of flexible exports (dynamic operating envelopes) across the NEM and the WEM by 2025.
   - Agree to work collectively to ensure distribution networks are being operated at voltages that reduce consumer costs and improve consumer outcomes, especially rooftop solar exports and appliance longevity.
3. **Unlock flexible demand:**
   - Make a rule to include aggregated household demand in the wholesale demand response mechanism.
   - Direct the Australian Energy Market Operator (AEMO) to develop more flexible baseline methods, for both commercial and industrial(C&I), and aggregated residential demand response in line with international best practice.
   - Agree to legislate a requirement for priority household appliances to be sold with "demand response capability" under the Commonwealth Greenhouse and Energy Minimum Standards (GEMS) Act 2012.
   - Agree to develop a national strategy for flexible domestic hot water with a priority on considering how best to support both the electrification of gas hot water systems and making existing electric hot water systems demand responsive.
4. **Fast-track distributed storage:**
   - Advocate to the Federal Treasurer that the Commonwealth's Small Business Energy Incentive run for three years, until 20 June 2026.
   - Advocate to the Federal Government to allow aggregated storage (and, where possible, flexible demand) to participate in the Capacity Investment Scheme.
   - Consider other ways to support behind-the-meter (BTM storage), including for reasons of resilience, and including through the Small-scale Renewable Energy Scheme (SRES).
   - Agree that the new DER Technical Authority develop an EV-grid integration workplan.
5. **Create a level-playing field in network services:**
   - Commission a thorough, independent review of distribution network revenue regulation with the objective to ensure the revenue regulation supports decarbonisation, the integration of DER and improved consumer outcomes, as well as economic efficiency.
6. **Ensure fit-for-purpose governance:**
   - Issue a Statement of Expectations to all energy market institutions (the Australian Energy Markets Commission (AEMC), AEMO, the Australian Energy Regulator (AER)) stating that the National Electricity Objective's emissions reduction objective requires rapid integration of both large- and small-scale renewables, storage and flexible demand, and ensuring Australia regulation and its implementation are world-leading.
   - Commission an independent review of energy market governance and its fitness for purpose for integrating DER and the energy transition. This could be completed within six months.

# Key Definitions

**DER**

Distributed Energy Resources (DER) comprise hardware and software located behind the meter (BTM) or on the distribution system that generate or store electricity or are able to be flexible in their demand. These include consumer purchased devices such as rooftop solar; batteries; electric vehicles (EVs), vehicle-to-home (V2H), vehicle-to-load (V2L) and vehicle-to-grid (V2G) services; smart (controllable) hot water systems; smart appliances (e.g. air conditioning, pool pumps); and energy management systems. DER also includes equipment in front of the meter, most commonly batteries owned and operated by distribution network service providers (DNSPs or distribution businesses) or third parties, such as local councils or businesses.

**VPP**

A Virtual Power Plant (VPP) is a network of DER – such as rooftop solar and battery systems, EVs and smart appliances – working together as a single power plant, aggregated via software to participate in the electricity system. The DER are plugged into the grid and, with an external or embedded hardware controller and sophisticated software, this supply and/or demand response can contribute to one or more markets.

VPPs have the potential to participate in several Australian energy markets, including:

- The wholesale energy market (WEM) and the wholesale demand response mechanism;
- Frequency Control and Ancillary Services (FCAS) markets;
- The Reliability and Emergency Reserve Trader (RERT); and
- Providing distribution network services (also known as “grid”, “non-network” or “non-wires” services), among them thermal, voltage or peak-demand management.

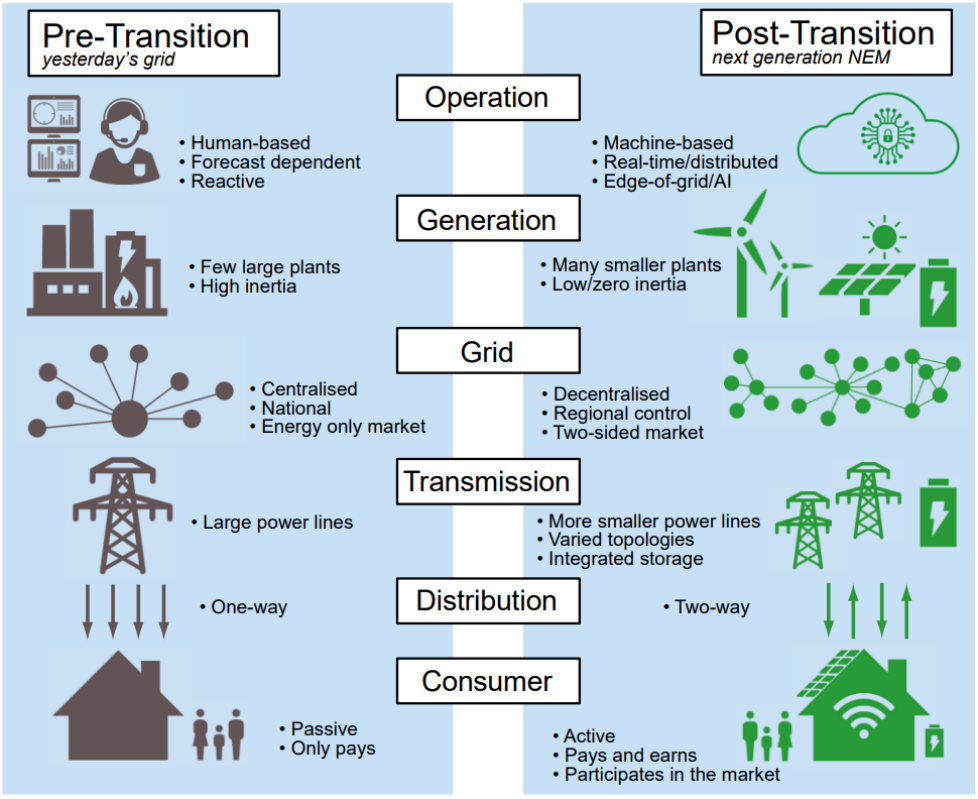
At present this market participation is limited due to a number of factors that will be outlined in this report.

# What are the Benefits of DER and the Sharing Energy Economy?

## How do DER lower electricity costs for everyone?

Faster than probably anywhere else in the world, Australia's electricity system is moving from centralised fossil-based generation, towards a renewables-based system with a large number of distributed energy resources. This profound transformation changes the way the National Electricity Market (NEM) and the Wholesale Electricity Market (WEM) in Western Australia operates and can change how consumers engage with the electricity system (see Figure 1).

**Figure 2: The Energy Transition**




*Source: Tim Finnigan IEEFA Contributor*[11]

It is widely understood that rooftop solar, appliances that can be used flexibly and storage reduce power bills for consumers who purchase them. The common perception is that rooftop solar, smart appliances, batteries or electric vehicles (EVs) are a family or business asset for private benefit. This is only the case when the owner is off-grid, unable to connect these DER to electricity networks. Whenever a home or business's DER are connected to the NEM via local poles and wires, they are providing a benefit to all energy system users by decreasing the need for utility-scale generation,

[11] IEEFA. Australia's Opportunity to Plan Ahead for a Secure Zero Emissions Grid. March 2021.

decreasing the use of the transmission network, probably decreasing the peak load on the local distribution network, and increasing the resilience of the system.

Ten years ago, many economists and energy market experts argued against rooftop solar subsidies; they rationalised that if you wanted to maximise the value from subsidising new renewable energy generation, you must do this by subsidising large-scale wind and solar, which would be far cheaper on a per kilowatt (kW) or kilowatt hour (kWh) basis. This is the levelised cost of energy (LCOE) comparison problem; it fails to take location into account. It forgets generators need to be attached to poles and wires.

Even without the coordination measures that this report will be discussing), DER offer a range of benefits for the energy system and consumers as a whole.

**Decreased need for utility-scale generation.** Even as passive generating assets without storage or flexible load, the 3 million homes and roughly 400,000 commercial businesses, not-for-profit and government buildings that have rooftop solar systems have bought down the price of wholesale electricity and helped allow old, polluting coal-fired power stations to exit.[12] Analysis by Bruce Mountain and colleagues estimated that production by rooftop solar reduced the average annual prices in the NEM by $3.1/MWh in 2017, $4.7/MWh in 2018 and $6.4/MWh in 2019 from what they otherwise would have been. This is significant to contemplate.

**Reduced reliance on networks**. What all BTM resources do is co-locate generation and load, reducing the reliance on transmission and distribution networks. Given that in 2022, the combined value of the Regulated Asset Base (RAB) of the transmission and distribution networks in the NEM was $105.4 billion, making the most efficient use of these networks and reducing further spending on what could be the most expensive machine in the country is a vital economic consideration.[13] As the combined transmission and distribution costs are 46% of household bills,[14] reducing network costs can be a major lever to put downward pressure on bills.

**Lower retail costs.** The use of BTM resources also doesn't incur retail costs; there is no marketing or billing required once the device has been purchased.

**Increased resilience.** DER also assists with resilience, a topic becoming increasingly important. During the NSW bushfires, some homes with rooftop solar and battery storage were able to provide electricity supply to their neighbours in areas where the distribution network had been destroyed.[15] BTM storage as batteries or EV (see Appendix A) can be vital in emergencies. Energy and Climate Change Ministers need to include resilience as a fundamental consideration in their planning and decision-making.

**Economic opportunities.** DER create economic opportunities across Australia, which has a strong and mature rooftop solar installation industry. Rooftop solar and related businesses are staffed by

[12] Bruce Mountain, Steven Percy and Kelly Burns. 'Rooftop Solar PV: In Whose Interests?'. 2021.
[13] AER. State of the Energy Market 2022. Page 81. September 2022. Note: Figure quoted is NEM-wide average.
[14] AER. State of the Energy Market 2021. Page 262. June 2021.
[15] Anecdotal reports from participants at the Smart Energy Summit, Canberra, 27 February 2020.

tens of thousands of Australians. Solar energy at all scales employed the equivalent of 25,500 full-time staff in Australia last year (Table 1).

**Table 1: Estimated PV-Related Full-Time Equivalent Jobs in Australia in 2022**

| Market Category | | Number of full-time labour places (FTE) | |
|---|---|---|---|
| Upstream | Research and development (not including companies) | 250 | 25,550 |
| | Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D | 300 | |
| Downstream | Distributors of PV products | 25,000 | |
| | System and installation companies | | |
| | Operation and maintenance companies | | |
| | Electricity utility businesses and government | | |

*Figure Source: PV in Australia Report 2023, APVI, July 2023*

## What is the sharing energy economy?

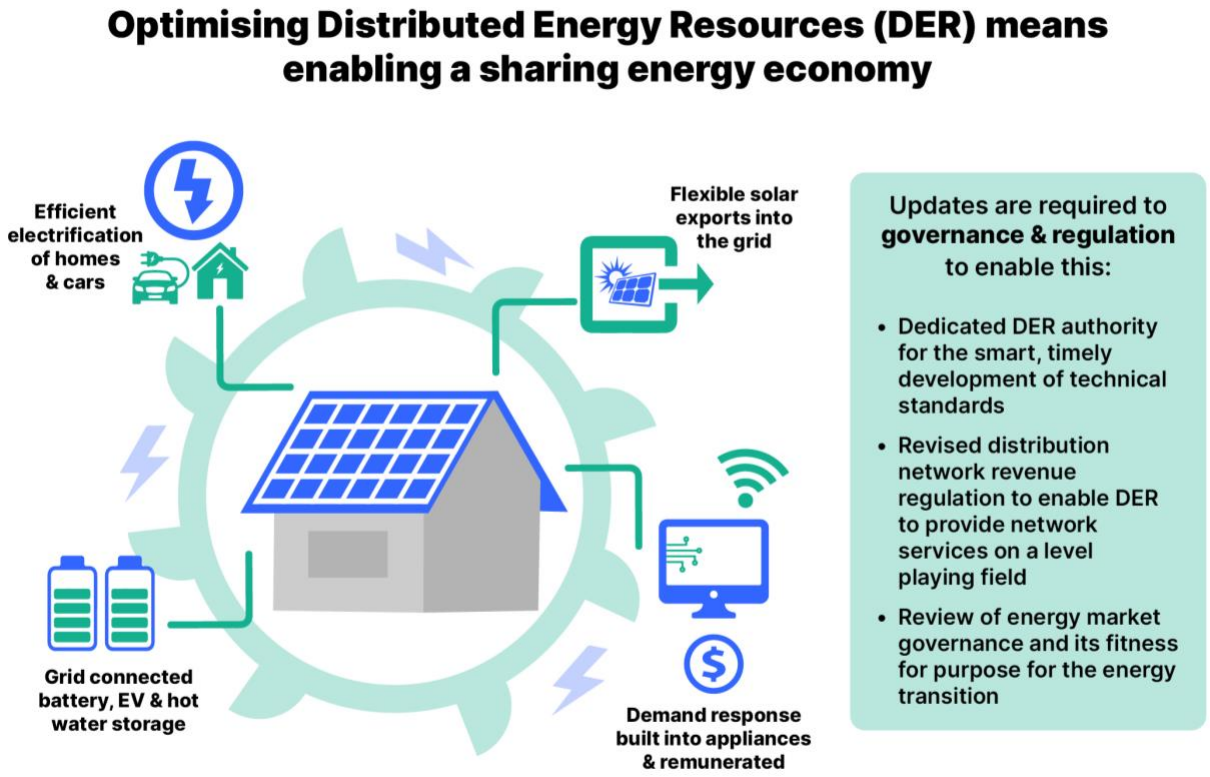
As more rooftop solar comes online, the benefits from reducing wholesale prices reduce, especially as the evening peaks, from 4-8pm, partly after sunset, remain. This is where the system starts to need more responsive DER, be that flexible demand, such as air conditioning or hot water systems or storage, such as batteries and EVs that can soak up the abundant solar generation during the day and release it for use in the evening.

The benefits of DER increase the more devices are configured for this “load shifting”. Ideally, there can be trading of the services from these consumer-owned resources when it’s valuable for the market to have extra supplies of electricity, and reductions in demand or Frequency Control and Ancillary Services (FCAS) for grid security or local network services (for example, easing congestion in the distribution network). That would be the optimal sharing energy economy: households and businesses making their energy devices available in return for payments for a variety of services.

This would be a voluntary sharing economy; there is no central master controller. Ideally, households and businesses can choose to sign up with their retailer, battery manufacturer, car manufacturer or other third-party aggregator. The consumer owners will have a choice just like they do about opting into Airbnb.[16] Each company that offers payments for consumers to be part of the sharing energy economy will have its own VPP. As Origin’s leadership noted last year, a VPP is a “capital- and cost-efficient tool to create capacity”.[17]

[16] Gabrielle Kuiper. How the consumer energy sharing economy can help Eraring close on time. 7 September 2023.
[17] Origin Energy. Our strategy presentation. 9 March 2022.

**Figure 3: What's Needed for the Sharing Energy Economy**



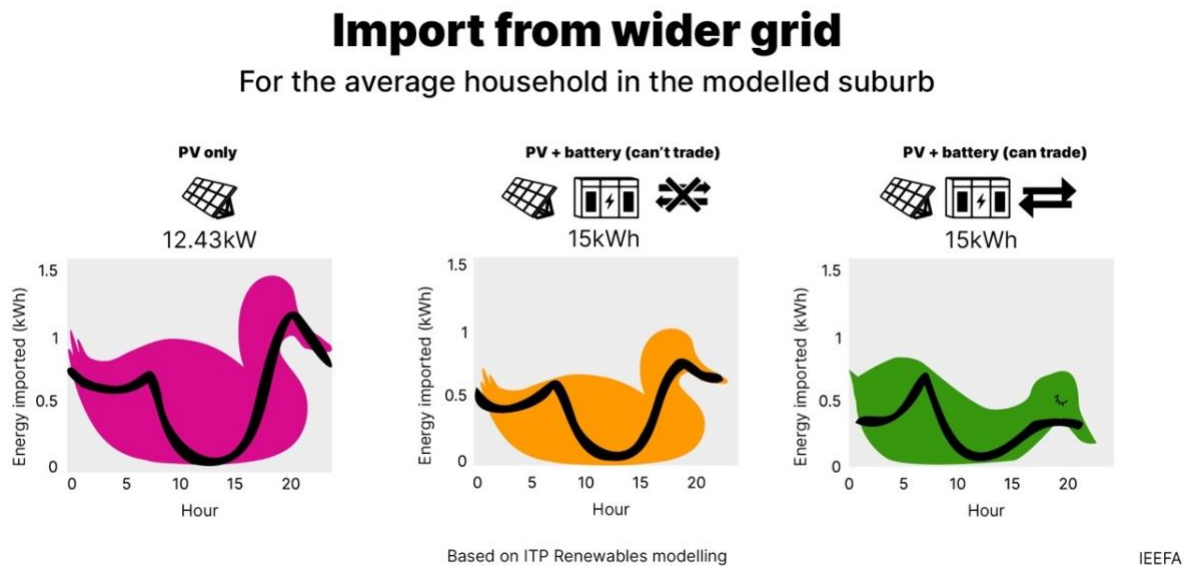

*Source: IEEFA*

## How would maximising the sharing energy economy change the energy system?

Many energy experts have speculated about the benefits of sharing DER. The only modelling that has been done anywhere in the world to show the consequences of the highest possible levels – saturation levels – of DER has been undertaken by ITP Renewables in Australia based on the concept developed by this report's author. [18] This modelling across a range of scenarios assumed 70% of households had solar systems, and then added flexible demand, battery storage, batteries that can trade, and so on, and examined the consequences at different sizes.

[18] IEEFA. Saturation DER modelling shows distributed energy and storage could lower costs for all consumers if we get the regulation right. 27 April 2023.

**Figure 4: ITP Renewables' 'Sleeping Duck Modelling'**




*Source: IEEFA graphic based on ITP Renewables modelling*[19]

In the scenario where rooftop solar is installed on 70% of households in a hypothetical suburb, there is usually more solar generated between 9am and 4pm than the household needs, so the energy imported from the grid by the suburb drops to zero in the middle of the day. In the evening, the households can no longer rely on their solar generation so the suburb imports more power from the wider grid. This is why the pink graph in Figure 4 is referred to as the "duck curve" – it forms the shape of a duck when charting the impact of rooftop solar on household demand.

In other scenarios, household battery storage systems were modelled alongside the solar, with and without the ability to trade any surplus with the grid. The most significant finding of the modelling was that in the scenario with rooftop solar plus easy battery trading, the 4pm-8pm wholesale market evening peak reduces by 67%-92% (the green 'sleeping duck' in Figure 4).[20] This evening peak has historically been the source of the majority of generator wholesale spot market revenue and therefore profits. Without large evening peaks, in theory wholesale prices should fall significantly. Wholesale costs make up 34% of customer bills.[21]

How much and how fast the duck sleeps will depend on the number and size of batteries and EVs per household, and the regulations impacting the trading of this capacity. The more batteries and flexible load owned and intelligently operated by households and businesses, the greater the likelihood of a sleeping duck – a smoother and lower demand and wholesale price profile throughout the day. In theory, with the right regulatory and policy settings, large numbers of smart appliances,

[19] The graphic shows scenarios with 12.43kW as an average size rooftop solar system, which is eminently possible given the average solar system size is current about 9kW.
[20] The graphic shows scenarios with 12.43kW as an average size rooftop solar system, which is eminently possible given the average size is about 9kW and there are, as yet, very few systems over 100kW.
[21] AER. State of the energy market 2020. Note: Figure quoted is NEM-wide average.

electric vehicles and BTM batteries able to interact effectively with the grid will have a significant impact on the future of household and business electricity bills.[22]

The same is true for the network component, which comprises 46% of bills.[23] In the ITP modelling, rooftop solar alone reduces the average summer network peak in the region modelled by 28% and shifts it 2.5 hours later in the day. In scenarios where household batteries can trade easily, the average summer network peak is reduced by 64%.

As long as network revenue regulation is amended to reflect the benefits of DER and these new realities, the network component of consumer bills should fall. With decreased network peaks driven by solar and battery uptake, reduced capital expenditure would be logical, and with that, lower distribution charges for customers. Network revenue regulation must ensure the system-level benefits of DER are passed on to all customers.

Stephen Pritchard, Evergen's principal VPP solutions engineer, conducted a similar small-scale exercise, modelling how solar-battery systems could respond to pricing change. He concluded: "With the right market and network signals, optimised residential batteries will be capable of doing some heavy lifting for stabilising the grid, and if done right, battery owners can be active participants in the market and benefit from offering this service, so that everybody wins!"[24]

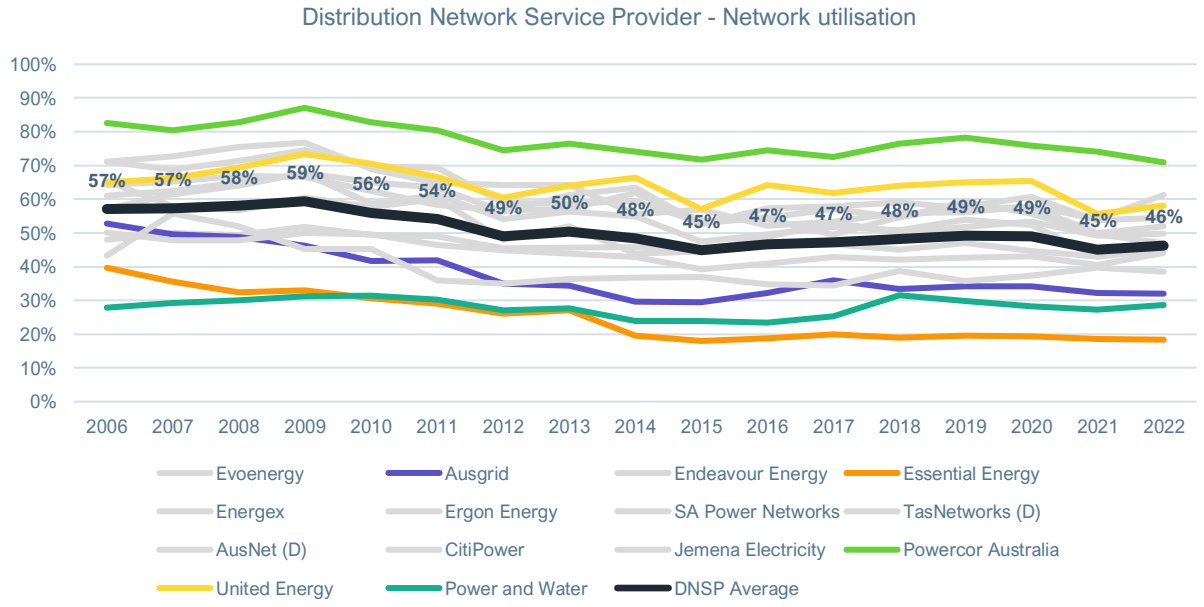
The Australian Energy Regulator's (AER) data shows that distribution network utilisation (a representation of peak demand compared with the network's capacity) has fallen significantly over the past 15 years (see Figure 5).[25] In 2021, the average household imported 23% less electricity from the distribution network (the local poles and wires) than in 2006.[26] This trend is clear across all distribution businesses (DNSPs), with 11 of the 14 distributors reporting declines of more than 17% since 2006.[27] This is in large part the consequence of rooftop solar, although improvements in energy efficiency and other factors have also played a role.

The significance of this change in network utilisation should not be underestimated given the $82.6 billion value of the collective distribution businesses' (DNSPs) Regulated Asset Bases.[28] DNSPs build their networks so they can manage peak usage, which in most locations occurs in summer when electricity use increases significantly. By 2022 per customer maximum demand across distribution networks had declined to the lowest it has been since the AER commenced measuring it in 2006. It increased slightly in 2022, but the AER noted that the overall trend is downwards and weather impacts some of the annual variation.[29]

[22] The NSW peak demand reduction scheme projects lower average wholesale prices by $4.30/MWh over 2022–2030, in addition to network investment benefits. Benefits of Saturation DER should ideally be modelled by government for the entire NEM.
[23] AER. State of the Energy Market 2021. Page 262. July 2022. Note: Figure quoted is NEM-wide average.
[24] Evergen. Do residential batteries ease minimum demand conditions when solar export is high? 31 August 2023.
[25] AER. Electricity performance report 2023. Page 26. July 2023.
[26] AER. State of the Energy Market 2022. Page 105. September 2022.
[27] Ibid. Page 105.
[28] Ibid. Page 61. Note: Transmission RAB is $22.8bn.
[29] AER. 2023 Electricity network performance report. Page 26. 2023.

Not only can the daily duck curve be flattened, but summer network peaks can decrease due to rooftop solar and storage with trading and/or flexible demand. DER can significantly change the shape of the demand profile, and what is required of networks. Therefore, we need to start thinking about the role of distribution networks differently, including their performance in supporting exports into the grid. In 2021 a rule change ensured distribution networks have responsibility for ensuring consumers can export to the grid, as well as import.[30]

**Figure 5: Utilisation of the Electricity Distribution Networks (DNSPs) 2006-2022**




*Source: AER Electricity Network Performance Report 2023*[31]

In summary, DER alone provide benefits for the energy system. They reduce wholesale generation requirements and can reduce the need for capital expenditure on the transmission and distribution grids. This will become particularly valuable as electricity demand is forecast by AEMO to increase due to electrification[32] – we may be able to avoid large network upgrades through smarter use of DER. The sleeping duck modelling emphasises when these DER exist and are allowed to trade easily, they can provide further value to the system. US consultancy Brattle's report on VPPs, states: "The VPP is the only resource with the potential to provide resource adequacy at a negative net cost to society."[33]

However, optimising the value of DER for all energy consumers requires significant action by policy makers and regulators.

[30] AEMC. Access, pricing and incentive arrangements for distributed energy resources. 2021.
[31] AER. Electricity DNSP Operational performance data. 2006-22.
[32] AEMO. National electricity and gas forecasting.
[33] The Brattle Group. Real Reliability: The Value of Virtual Power. Page 26. May 2023.

# The status and outlook for the sharing energy economy

## What is the current state of the sharing energy economy?

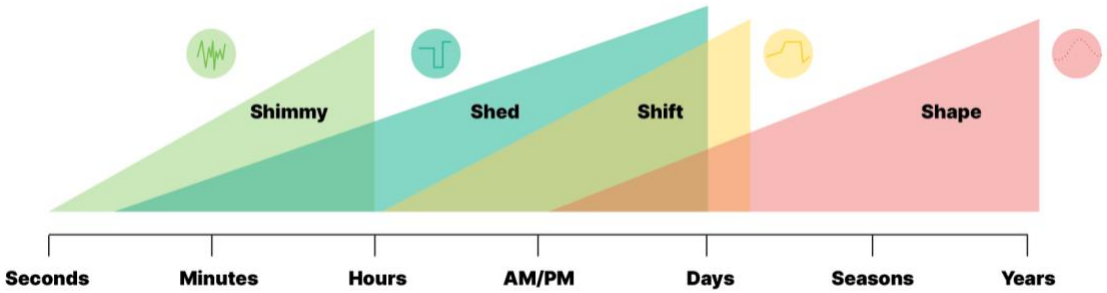
The sharing energy economy is already underway in the NEM, although it is at relatively early stages. Different types of DER are used to greater or lesser extents, especially in terms of their participation in various markets.

### Flexible demand

Flexible demand is the ability of appliances and devices to have their electricity use changed manually or automatically, which can occur over a range of timescales (see Figure 6) from seconds to months:

- Shimmy is demand on a very short time scale, usually to support frequency control and ancillary services (FCAS) to support the electricity system's security.
- Shed is curtailing demand by turning down or off equipment, usually at peak times, as occurs in the Reliability and Emergency Reserve Trader (RERT) scheme.
- Shift is moving demand, especially to soak up abundant renewable generation which is vital as we move to a majority renewables grid, such as through negative wholesale prices.
- Shape is modifying demand routinely to align better with a desired profile, such as soaking up solar and wind generation by pumped hydro or large batteries.

**Figure 6: The Types of Flexible Demand by Timescale**




| | | Wholesale Market & Grid Scale Renewable Support | Network Investment Savings | Contingency & Emergency Reserve | Distribution Network Support | Frequency Control Ancilary Services |
|---|---|---|---|---|---|---|
| **Shift** | Moving demand sporadically in response to an external signal | High | Medium High | Low | Medium Low | N/A |
| **Shape** | Moving demand routinely according to a standard long-term pattern | Medium High | Medium High | Low | Medium Low | N/A |
| **Shed** | Switching off equipment | Medium Low | High | High | Low | Medium Low (Lower only) |
| **Shimmy** | Moving demand over very short timescales in response to an external signal | N/A | N/A | N/A | High | High |

*Source: IEEFA graphic based on Lawrence Berkley National Laboratory (LNBL) and Race for 2030 CRC*

The concept of flexible demand is not new – consumer-owned resources have been responding to technical or price signals since the advent of ripple-controlled hot water in the 1950s in Australia which was developed to provide overnight demand for coal-fired generators which are slow to ramp up and down.

The biggest flexible demand capability in the NEM sits with Energy Queensland, which has at least 850MW of recorded demand that can be shifted or shed.[34] As of 2022, it had direct control of the air-conditioning units of more than 136,000 homes or small businesses, providing up to 150MW of flexible load.[35]

**Table 2: Energy Queensland Flexible Demand Capacity in 2018**

| | Energex (MW) | Ergon (MW) | Total (MW) |
|---|---|---|---|
| **T33 (hot water)** | 367 | 103 | 470 |
| **T33 other** | 0 | 48 | 48 |
| **T31 (hot water)** | 154 | 52 | 206 |
| **PeakSmart Aircon** | 58 | 0 | 58 |
| **Contracted Demand Response** | 24 | 27 | 51 |
| **Network mobile and embedded generation** | 0 | 17 | 17 |
| **Total** | 603 | 247 | **850** |

*Source: Peter Price presentation for Energy Queensland, February 2018*

Energy Queensland's controlled hot water systems turn on and heat up water at night, missing a significant opportunity to make the most of abundant solar generation during the day. Energy Queensland states it is developing new schedules for hot water systems on load control tariffs to ensure hot water systems are off during evening peak and heating during the middle of the day coincident with the solar generation peak. However, there is no detail or timeframe in Ergon Energy and Energex's Demand Management Plan on how it will provide "greater choice to customers with new solutions enabled through our DERMS [DER management system], DOE [dynamic operating envelopes] and new market platform".[36]

The wholesale demand response (WDR) mechanism commenced on 21 October 2021. It allows third-party aggregators to bid aggregated demand response (instead of generation) into the wholesale market. These are sometimes known as "negawatts".

Enel X remains the first and only registered demand response service provider in the WDR mechanism. It has 66MW of C&I demand participating in the demand response mechanism, and a further 40MW to be enabled.[37] In total, Enel X manages a 350MW VPP sourced from businesses ranging from mining and resources sites through to retail, water utilities, hospitals, food

[34] RACE for 2030 CRC. Flexible demand and demand control. October 2021.

[35] Most of this demand response capability uses an outdated additional Demand Response Enabling Device (DRED) as part of the Australian Standard for Demand Response in Appliances (AS/NZ 4755.3.1) for the air conditioning control, which will be discussed in the Barriers section. See IEEFA. Mandating AS4755 Ignores Households and Widely Supported International Solutions**.** August 2021.

[36] Ergon Energy and Energex. 2023-24 Demand Management Plan. Page 4. April 2023. Note: No full breakdown equivalent to 2018 available)

[37] Enel X. Enel X continues to lead wholesale electricity market demand-side participation 25 October 2022.

manufacturers and IT facilities.[38] Enel X is also seeking to aggregate 20.9 MW of commercial refrigeration flexible demand across 440 supermarkets and 13 refrigerated warehouses as part of an ARENA-funded project.[39]

## Rooftop solar

In terms of rooftop solar, the Clean Energy Regulator (CER) data shows there were 3,534,831 sites with small-scale PV installations (under 100kW) as of 30 June 2023 and 20.6GW of capacity. Unpacking this data shows more than 3 million households have solar systems smaller than 9.5kW on their roofs, and about 400,000 commercial and industrial-sized rooftop solar systems greater than 9.5kW have been installed.[40] There is no detailed data on the type of businesses or public buildings that have systems less than 100kW installed.

Using APVI definitions of system sizes, and analysing CER[41] and APVI data[42] for PV installations from 2010 to the end of June 2023, gives the following breakdown:

**Table 3: Rooftop PV Capacity in the NEM**

| | Residential <9.5kW | Small commercial >9.5kw – 100kW | Large commercial 100-250kW | Industrial rooftop 250kW+ | *Large C&I100kW – 11MW* | Total C&I (non-residential) rooftop solar | Total rooftop solar |
|---|---|---|---|---|---|---|---|
| **Total capacity** | 13,686MW | 6,750MW | 393MW | 547MW | *940MW* | **7,690MW** | **21,540MW** |
| **Sites** | 3,132,413 | 402,418 | 787 | 851 | *1638* | **404,056** | **3,536,469** |

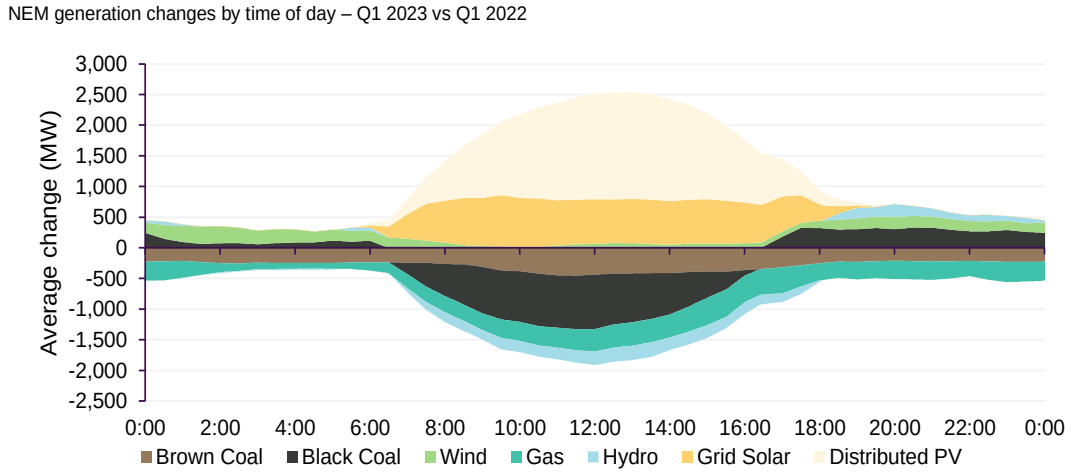
*Source: IEEFA analysis of CER and APVI data*

PV installations across the NEM, including utility-scale, total 32GW in capacity. Of these installations, 21.5GW are rooftop installations (noting that there are a number of ground-mounted installations less than 5MW and a handful of rooftop PV projects larger than 5MW, which total 37MW). By this accounting, only 11% of sites, but 36% or one-third of rooftop solar capacity (7.7GW of 21.5GW) is on non-residential buildings – commercial and industrial businesses, not-for-profit premises and public buildings (including schools). This suggests businesses, community organisations, local and state governments and their agencies are significant installers and owners of rooftop solar. That fewer than 2,000 of these rooftop solar installations exceed 100kW suggests there is significant potential for growth in C&I rooftop solar, a topic that will be explored in detail in a forthcoming IEEFA briefing note.

It is worth noting that rooftop solar is the type of renewable generation having the biggest impact on old coal-fired power stations, forcing them out of the market in the middle of the day (Figure 7).

[38] Renew Economy. "Huge milestone" as AEMO switches on demand response in major market reform,. 27 October 2021.
[39] ARENA., Enel X Commercial Refrigeration Flexible Demand Project. 25 July 2023.
[40] IEEFA analysis of Clean Energy Regulator data, assuming the vast majority of installations less than 9.5kW are on homes. 2023.
[41] Clean Energy Regulator. Postcode data for small-scale installations. 26 September 2023.
[42] APVI. Australian PV market since April 2001. 2023.

**Figure 7: Rooftop PV Impact on Daytime Generation Mix**




*Source: AEMO 2023 | Quarterly Energy Dynamics Q2 2023*

According to APVI, an estimated 15% of Australia's annual electricity demand was met by solar energy 2022.[43]

## Distributed Storage

Distributed storage comprises battery storage installations at households and on business premises. as of 30 June 2023, the CER only recorded 78,000 battery installations with small-scale systems since 2014, and small battery registration is essentially voluntary.[44] However, according to SunWiz, the number of home battery installations is 180,000 – with capacity nearing 2GWh. Batteries were installed on one in every seven solar power systems in 2022, up from one in 12 in 2021.[45] The total capacity of batteries installed alongside business rooftop solar installations is 191MWh.[46]

## Electric Vehicles

Batteries on wheels, otherwise known as electric vehicles (EVs), are the ultimate sharing energy economy technology or DER. EVs have the potential to be used to power loads, for example, plugging in power tools for tradespeople as an alternative to diesel generators on a building site – this is known as V2L (vehicle-to-load). Some cars have the ability to feed back into the building they are plugged into – this is known as V2H (vehicle-to-home). A few cars with the appropriate charger can already feed back into the grid – V2G (vehicle-to-grid). See Appendix A for more details.

[43] APVI. National Survey Report of PV Power Applications in Australia 2022. Page 10. July 2023.
[44] CER. Battery storage and the Small-scale Renewable Energy Scheme.
[45] Renew Economy. Home battery installs jump 55 pct as solar households turn to storage in record numbers. 30 March 2023.
[46] Sunwiz. Australian Battery Market Report 2023. 2023.

Currently, while there have been a number of managed EV charging trials and one V2G trial, Origin is the only company claiming to have included EVs in its VPP.

## Virtual Power Plant

A Virtual Power Plant (VPP) is a network of DER – such as rooftop solar and battery systems, EVs and smart appliances – working together as a single power plant, aggregated via software to participate in the electricity system – via selling power in the electricity market, providing demand response and/or providing grid services.

VPPs are still nascent in the NEM.[47] There are many offerings to customers, but only a few VPPs exceed 100MW. The largest is Origin's, at 815MW (of which 200MW is large business flexible demand). Origin plans to have 2000MW by 2026.[48] It has 400 EVs under management and has an ARENA grant to manage 1,000 EVs.[49] For business customers, Origin offers an "Origin Zero" product, which includes renewable power purchase agreements (PPAs), rooftop solar, batteries, EV fleet management, energy management, data analytics and demand response. For residential customers, Origin has in-sourced OhmConnect's "gamified" demand response capability. Under the voluntary "Spike" program, consumers who reduce their demand during Spike Hours can earn small financial rewards.[50] As Origin's management noted last year, a VPP is a "capital- and cost-efficient tool to create capacity".[51]

AGL states it has 210MW of C&I customer assets under management and monitoring, and a total 316MW under orchestration (excluding smelters)[52] with a "strategic ambition to grow decentralised assets under orchestration". AGL's 2023 annual report states its Peak Energy Rewards program has been expanded to more than 120,000 customers, and in the 2023 financial year it started hot water orchestration trials.[53]

There is no information publicly available on how many DER Energy Australia has under management in its VPPs. The other large announced VPP is the Tesla South Australian VPP on 50,000 Housing SA homes with a planned capacity of 250MW.[54] There is public data on the capacity of this VPP, but more than 4,000 homes are benefiting, which, with a 13.5kWh/7kW peak Powerwall each, is a 54MWh/28MW VPP. Interestingly, Reposit states it has more than 6,000 homes under its No Bill offer, which includes a Reposit Smart Controller, solar, batteries and inverters, which, if the batteries are Powerwall-sized is an 81MWh/41MW VPP.[55]

[47] IEEFA. What Is the State of Virtual Power Plants in Australia? From Thin Margins to a Future of VPP-tailers. March 2022.
[48] Origin. 2023 Annual Report. September 2023. Page 15.
[49] ARENA. Origin Accelerate EV Fleet Program. September 2023.
[50] IEEFA. What Is the State of Virtual Power Plants in Australia? From Thin Margins to a Future of VPP-tailers. March 2022.
[51] Origin. Our strategy presentation. 9 March 2022.
[52] AGL. FY23 Data Centre. September 2023.
[53] AGL. Annual Report 2023. 2023.
[54] Government of South Australia. South Australia's Virtual Power Plant. September 2023.
[55] Reposit. 2023.

There is also 1,422MW of flexible demand contracted under the Reliability and Emergency Reserve Trader (RERT), but this not included here due to risks of double counting.

## Capacity of DER and the sharing energy economy

Totalling all the DER capacity above we have 22GW of rooftop solar and 2.3MWh of distributed storage. Then there is the DER that is coordinated in some form, either as demand response or in a VPP capacity, the total current capacity of which is 2.4GW (Table 4). We have not summed these numbers because it is unclear what proportion of distributed batteries are enrolled in VPPs; therefore, to avoid the risk of double-counting, Table 4 lists the actively managed DER (VPPs) separately from distributed batteries.

**Table 4: Scale of DER in the NEM**

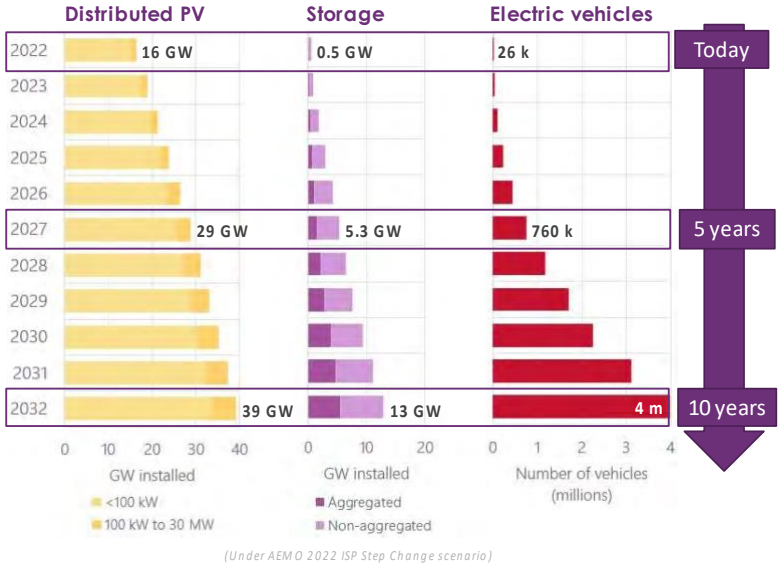
| Type of DER capacity | MW capacity | MWh |
|---|---|---|
| **Energy Queensland flexible demand** | 850MW | not available |
| **Enel X VPP** (largely demand response, but some storage, includes 66MW enrolled in the WDR mechanism) | 350MW | not available |
| **Origin Loop VPP** (includes 200MW business demand response) Spike household demand response program has 133,000 customers and a 66% response rate but it is unclear from Origin's reports if this is included in this figure or not) | 815MW | not available |
| **AGL VPP** | 210MW | not available |
| **Reposit VPP** (storage, *estimated*) | 41MW | 81MWh |
| **Tesla South Australian VPP** (storage, *estimated*) | 28MW | 54MWh |
| **ShineHub – 2,311 homes (2022)** | 9.4MW | 23.7MWh |
| **Simply Energy - 1,361 energy storage systems** (as of 2021) | 6MW | not available |
| **Other assorted VPPs** (*estimated*, based on the fact there are another 15 household VPP offerings established with say 2MW on average each – EnergyAustralia, Sonnen, Energy Locals, Mondo, Discover Energy, amber, netc, Powershop, SolarHub, arcstream/qcells, Tesla (outside SA), Project Edge, Project Symphony, Rheem-CET, Ausgrid) Figures from Sunwiz: Ausgrid has 750 customers with 3.4MW/7.3MWh as at December 2021(but this is likely to have some overlap with Reposit's VPP numbers) | 30MW | not available |
| **VPPs** (flexible demand and storage) | **2,339MW** | |
| **Household rooftop solar** | 14,300MW | n.a. |
| **C&I rooftop solar** | 7,690MW | n.a. |
| **Total rooftop solar capacity** | **21,500MW** | |
| **Household battery storage capacity – 180,000 systems noting that some of these will be included in VPP capacity above** (Sunwiz 2022 numbers) estimating 6kW average size | not available | 2,093MWh |
| **C&I battery storage capacity** (Sunwiz 2022 numbers) | not available | 191MWh |
| **Total distributed battery storage capacity** | not available | **2,284MWh** |

*Source: IEEFA analysis from varied data sources*

## What is AEMO's forecast for the sharing energy economy?

AEMO projects a significant role for the sharing energy economy in its 2022 Integrated System Plan (ISP).[56] The 2022 Step Change scenario has 69GW of rooftop solar (about 65% of households) by 2050. Assuming excess capacity is exported, this would meet approximately one-fifth of the NEM's annual demand. In the same scenario, there is 46GW of dispatchable storage by 2050, with 31GW, two-thirds, from VPPs, vehicle-to-grid and other "coordinated DER storage". More important for planning purposes is the more than 50GW of DER (across rooftop solar and batteries, excluding EVs) expected in the next 10 years under the Step Change scenario (Figure 8).

**Figure 8: Step Change scenario, 2022 Integrated System Plan**




*Source: AEMO*

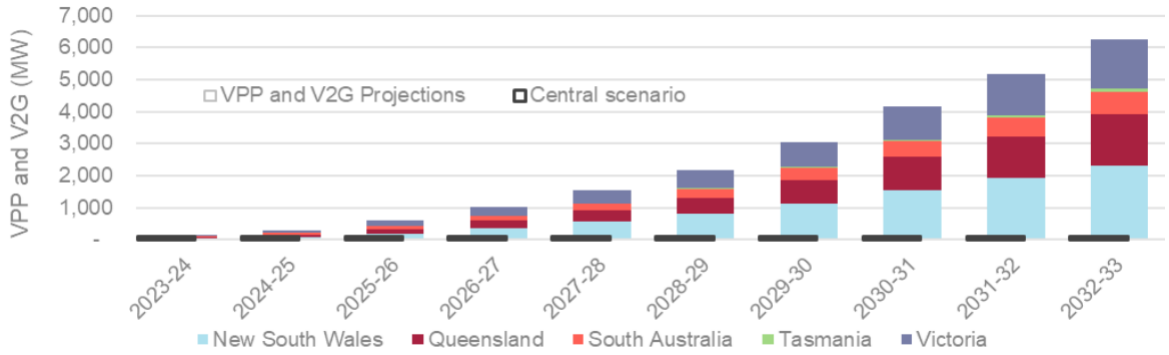
In its 2023 Electricity Statement of Opportunities (ESOO), AEMO changed its assumptions around DER, only including coordination of DER when an aggregator has demonstrated commitment to a relevant program.[57] It's unclear how this commitment was determined given VPPs are voluntary, so one can only assume all VPPs (other than coordinated DER participating in the WDR mechanism and RERT) are not included in the forecasts. Instead, projected VPPs and V2G are forecast separately (Figure 9) and included in sensitivity analyses.

The result is approximately 4GW of VPP projections by 2030 (6.3GW by 2033) are not included in the 2023 ESOO Central scenario. While VPPs have been slow to get under way, given the commitment of Origin to its shareholders to developing a 2GW VPP by 2026 and the other smaller VPPs already in place, AEMO's outlook is conservative.

[56] AEMO. Integrated System Plan 2022. June 2022.
[57] AEMO. 2023 Electricity Statement of Opportunities. Page 48. September 2023.

In addition, even the separately forecast levels of coordinated DER appear to be underestimated given the data in Table 4. On the most conservative reading, that data gives VPP capacity of 940MW, if we include Origin's 615MW of coordinated DER, which is not demand response,[58] and all other smaller VPPs. This exceeds the ESOO Central scenario, which puts VPP and V2G capacity at zero.

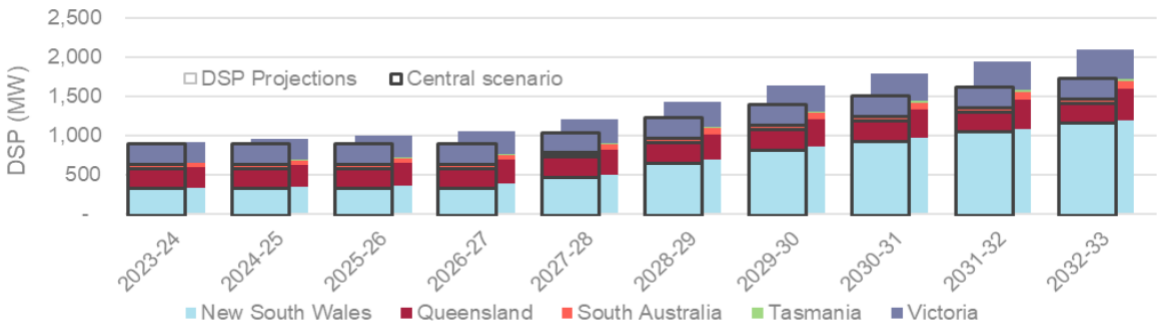
**Figure 9: AEMO's Sensitivity on VPP and V2G – Not Included in the Central Scenario**




*Source: AEMO*

The demand side projections in the ESOO are also conservative, with only 900MW currently and only about 1,600MW by 2030 (Figure 10).[59] This compares with 1,400MW of existing demand response that IEEFA has baselined in Table 4.[60] AEMO seems to assume in the ESOO that none of the electrification of appliances will be demand responsive, which would be an enormous missed opportunity to get flexible demand into the NEM, as discussed below.

**Figure 10: AEMO's Sensitivity on Demand Side Participation – Not Included in the Central Scenario**




*Source: AEMO*

Another change in the ESOO is to derate (reduce the rated capacity) the storage energy (MWh) for all orchestrated DER (VPP and V2G) and devices with less than 1.5 hours of storage by 50% on the

[58] AEMO forecasts demand side participation separately, hence it is excluded from this 'worst case' scenario.
[59] AEMO. 2023 Electricity Statement of Opportunities. September 2023.
[60] Includes 850MW Energy Queensland flexible demand, 250MW Enel X VPP, 200MW Origin Loop VPP business demand response.

basis of evidence from AEMO's VPP trials.[61] This may be reasonable in the short-term while VPPs are still working their way around the challenges of ensuring accurate responses and robust communications, but should be reduced over time with the expected improvements in the accuracy of battery responses, especially with vehicles.

### What more should be investigated?

Overall, the potential for the DER sharing energy economy is significant – AEMO forecasts there will be 69GW of rooftop storage and 31GW of "coordinated DER storage" by 2050.[62] However, in its ESOO, the potential of DER from 2023 to 2030 seems to have been underestimated, especially if battery storage in business premises takes off and more flexible demand is unlocked with electrification. There's scope in modelling the future power system with more sensitivity analysis on DER opportunities, including explorations of the potential for electrified demand to be flexible, greater demand-side participation by households, strong corporate commitments to VPPs and for managed electric vehicle charging and V2G to be significant before 2030.

## How Can We Maximise the Benefits of DER and the Sharing Energy Economy?

Having examined the value of DER, the sharing energy economy and saturation levels of DER, as well as the status of DER and the outlook for DER and coordinated DER, the remainder of this report examines how existing barriers to DER integration can be overcome to unlock the full value of DER and the sharing energy economy.

### 1. Ensure appropriate technical standards are in place

#### Create a body to set DER technical standards

There is currently no way for DER technical standards to be set consistently across the NEM, let alone have compliance of the DER and their installation against those standards enforced. The lack of governance arrangements for DER technical standards is a critical issue for the integration of DER into networks and markets.

One example of the consequences is that without a common interoperability standard across DER, including EV chargers, there is no guaranteed way for these devices to communicate with each other and any controller – be that a smart inverter or Home Energy Management System. The large potential of managing devices behind the meter, especially coordinating with rooftop solar supply, cannot be fulfilled without a common interoperability standard being included in the National Electricity Rules (NER). A report on flexible demand by the University of Technology, Sydney (UTS) for ARENA points out that, in the worst case, devices could be "fighting each other" for surplus solar,

[61] AEMO. 2023 Electricity Statement of Opportunities. Page 108. September 2023.
[62] AEMO. 2023 Electricity Statement of Opportunities. September 2023.

leading to misallocation of resources, such as a battery using surplus solar for storage rather than participating in an FCAS event or providing network services.[63]

Another example showing the need for clear and coherent standards is that EV charging requirements which currently:

> *"…vary across States and Territories, increasing complexity, cost, and confusion among stakeholders. Charging standards are still evolving with short-term fixes being implemented to enable vehicle grid integration. This is resulting in uncertain economic viability and leading to practical difficulties."*[64]

These are just two of dozens of possible examples of how coherent technical standards are critical to the effective operation of markets for DER services. In fact, the UTS flexible demand report states:

> *"The experiences of many ARENA-funded pilots to date underlines the urgency and importance of establishing modernised, common standards underpinned by effective governance – in particular there is a window of opportunity before widespread adoption of EVs and behind-the-meter storage to avoid a repeat of the issues experienced by other technologies such as air-conditioning units."*[65]

This issue was identified when the author of this report worked at the Energy Security Board (ESB), and despite years of work on the issue (Appendix B), it has yet to be addressed. On 21 September 2023, after having rejected the ESB's rule change to establish new governance arrangements for DER technical standards 18 months earlier, the AEMC put out a report suggesting the following options:

> **"*Option one: create a new national technical body.*** *Under this approach, jurisdictions would establish a new national body to oversee the setting of, and compliance with, CER technical standards for the NEM.*
>
> ***Option two: expand the role of the AER and the AEMC under the NEL.*** *Under this approach, jurisdictions would amend the NEL to expand the role of the AER and the AEMC to allow for the comprehensive setting and enforcement of CER technical standards in the NER.*
>
> ***Option three: expand the role of the Clean Energy Regulator.*** *Under this approach, the Commonwealth would expand the role of the Clean Energy Regulator to set and ensure compliance with CER technical standards on a nationally consistent basis. This could be done under the Renewable Energy (Electricity) Act 2000 (Cth).*

[63] UTS Institute for Sustainable Futures. ARENA Knowledge Sharing Demand Flexibility Portfolio Retrospective Analysis Report. Page 29. July 2023.
[64] Ibid. Page 23.
[65] Ibid. Page 7.

> ***Option four: enforce national requirements under jurisdictional frameworks.*** *Under this approach, jurisdictions would agree that existing and relevant bodies established under local jurisdictional frameworks apply and enforce CER technical standards.*"[66]

The AEMC suggested: "These options are not mutually exclusive and it is important for jurisdictions to further assess the options to determine which is the most appropriate."[67]

Having lost at least three years to the AEMC's ruminations on this issue, Energy Ministers need to make a rapid assessment and decision and expedite new arrangements. Given the lack of capacity within the energy market institutions to support DER integration, that the long-term future of the Clean Energy Regulator (CER) is unknown and the inefficiency of using separate jurisdictional arrangements, IEEFA recommends Option one: create a new national DER technical body.

Ministers should also consider whether the existing GEMS program should be housed within such a body, given the importance of ensuring that major household appliances are demand responsive and efficient and able to communicate with other BTM DER.

The creation of this DER technical body is already several years overdue, and should be undertaken with urgency. In the interim, until a new body is in place, work drafting the work program for the DER technical standards could be undertaken by the Commonwealth Department or a specialist team within the Net Zero Authority.

**Recommendations for the Energy Ministers' November 2023 meeting:**

- **Energy Ministers create a new DER Authority (an independent technical body)** through a change to the NEL or, more simply, through Commonwealth legislation. The body would: set a vision for DER technical standards; develop a technical standards work program; monitor, review and set DER technical standards; consider issues related to compliance and enforcement of standards in their development; advise on standards to other government and energy market bodies; and undertake related reviews.
- As a less preferred alternative, Energy Ministers could make the rule as set out in the ESB's Governance of Distributed Energy Resources (DER) Technical Standards rule change (Ref. ERC0319)[68] proposed to the AEMC on 16 September 2020, including the establishment of a new expertise-based DER Standards Committee under the AEMC to oversee the development of DER technical standards. Ministers have the ability to make the rule change themselves and should have every confidence in doing so given the level of support the ESB's consultation paper on the matter received.

[66] AEMC. Review into consumer energy resources technical standards. Information Sheet. 21 September 2023.
[67] AEMC. Review into consumer energy resources technical standards. Final report. 21 September 2023. Page 19.
[68] AEMC. National Electricity Amendment (Governance of Distributed Energy Resources Technical Standards) Rule Determination. 17 March 2022.

## 2. Remove static constraints on existing solar

### Maximise solar exports by accelerating the rollout of Flexible Exports (Dynamic Operating Envelopes)

Another barrier to optimising the value of DER is the static export limits set by most DNSPs. While the average size of installed household rooftop solar systems is 8kW- 9kW, most DNSPs restrict exports to 5kW, limiting the value solar households can earn from exporting to the grid. While in theory such limits encourage self-consumption, in practice it means many solar systems are curtailed by their inverters, especially if there are no residents home during the day. This is an inefficient use of rooftop solar in which households have invested over $15 billion since 2007.

The electricity distributor in South Australia, SA Power Networks has now introduced 10kW "flexible export" limits, which vary on a five-minute basis, set 24 hours in advance. SA Power Networks modelling shows that this dynamic operating envelope (DOE), as it is technically known, will bind below this new doubled limit at only 2% of the time or approximately 50 daylight hours per year.[69] This means solar households in South Australia have the potential to double their exports, and potential earnings from those exports, 98% of the time. Iimplementation of flexible exports was achieved for $32 million – less than 1% of SA Power Network's $3.9 billion five-year revenue.[70]

**Figure 11: Dynamic Operating Envelopes compared with Fixed Limits**


*Source: Melbourne Energy Institute.*

Energy Queensland (via Energex and Ergon Energy) has meanwhile set up DOEs to a different name and a different specification: "Dynamic Connections also enable you to connect up to 10kVA of solar PV and an additional up to 10kVA of battery energy storage on a single phase without upgrading your connection to three-phase."[71],[72]

No other DNSPs have flexible exports up and running, other than through small trials (Projects Converge – Evo, Symphony – Western Power, Project Edith – Ausgrid, and Project Edge – AusNet).

[69] SA Power Networks. Flexible Exports FAQs. March 2022.
[70] IEEFA. A Grid Dominated by Wind and Solar Is Possible. South Australia: A Window Into the Future. June 2021
[71] Energex. Dynamic Connections for energy exports.
[72] Unfortunately, Energy Queensland's requirements for rooftop solar equal to or above 1 kVA include the installation of a generation signalling device (GSD)/aka "ripple control" for "the Emergency Backstop Mechanism", for which – as in the case of the South Australian solar cut-off – there was no policy analysis of alternatives, let alone a cost-benefit analysis. See IEEFA. Blunt Instrument: Uncompensated Solar Cut-Off Isn't the Only Solution to the Minimum Demand 'Problem'. April 2021; and, Clean Energy Council submission to the Energy Queensland Consultation Paper: Enabling an Emergency Backstop Mechanism. 2022.

This highlights two issues: there is no harmonisation, with several different approaches to the definition, publication, communication and enforcement of DOEs underway; and a software innovation that could substantially increase consumers' earnings from their DER has not been implemented across the NEM, and there is no compulsion for all DNSPs to do so.

**Recommendations for the Energy Ministers' November 2023 meeting:**

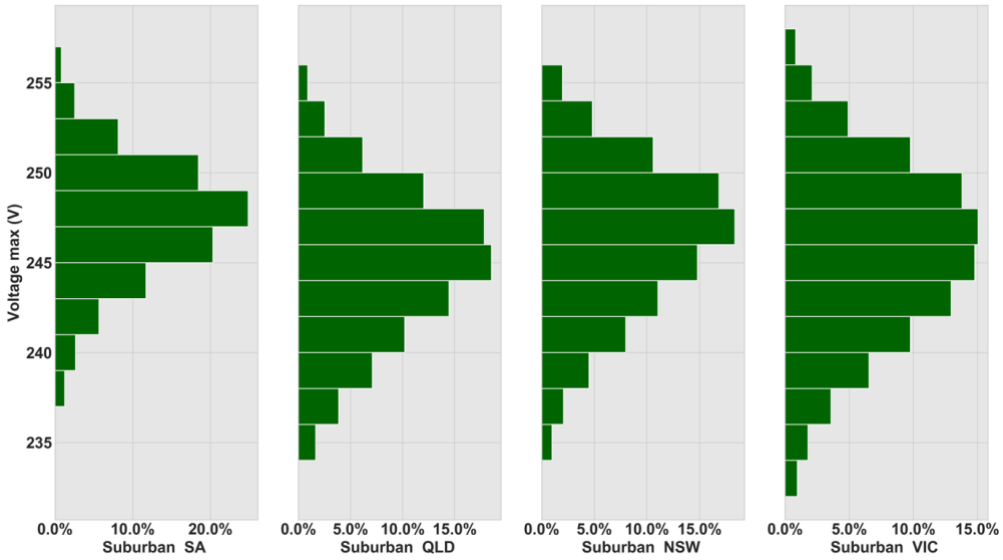
- **Energy Ministers agree to prioritise the implementation of flexible exports (dynamic operating envelopes) across the NEM and the WEM by 2025,** if necessary, through changes to the distribution network licensing conditions in each state and territory.
- Energy Officials should consider to what extent harmonisation of DOEs across distribution businesses is necessary and can be best achieved. This could be done through the new DER Authority.
- In addition, national reporting of DOEs through a central registry should be introduced. This should collate information on the DOE characteristics in each DNSP area so they are easily available to consumers, market participants and aggregators. This could also be managed by the new DER Authority.

## Reduce consumer costs and improve appliance lifetime and solar exports through better voltage management

In 2020, the Energy Security Board (ESB) commissioned the University of New South Wales (UNSW) to examine the state of voltage across the NEM and the possible extent of rooftop solar curtailment resulting from high voltages in the distribution network causing inverters to cease exports. The research found that even in the absence of rooftop solar exports, there was a significant level of high voltage across all DNSPs in all NEM states as highlighted in Figure 12. More than 95% of readings were found to be higher than the nominal voltage standard in the NEM of 230V. The report also found that many sites experienced higher voltages during the night when rooftop solar is not operational.[73]

[73] University of New South Wales. Voltage Analysis of the LV Distribution Network in the Australian National Electricity Market. 2020.

**Figure 12: UNSW Voltage Analysis in Four NEM Regions**



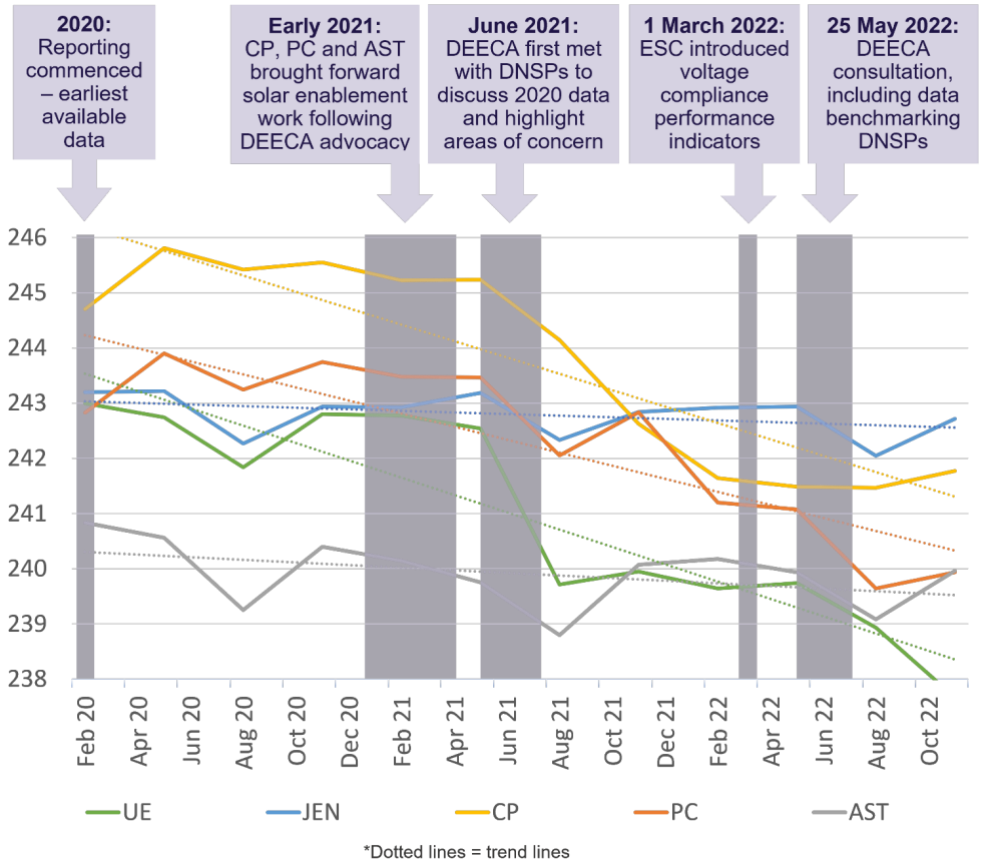

*Source: UNSW 2020*[74]

The consequences for consumers of running voltages high are potential quality of supply issues, increased electricity consumption for many appliances, appliances can degrade more quickly, and in some circumstances, solar exports will be curtailed.[75] Improving compliance with voltage would address all these issues and create additional 'head room' for solar PV and other DER exports to the grid.

Following the publication of the report, the Victorian government and regulator (the Essential Services Commission (ESC)) have taken a number of steps, shown in Figure 13, and average voltages are now falling across all distribution businesses in all time periods, including the middle of the day, the peak solar generation period. In addition, the ESC recently commenced regular public reporting on distribution businesses' voltage performance.[76]

[74] University of New South Wales. Voltage Analysis of the LV Distribution Network in the Australian National Electricity Market. 2020.
[75] Victorian Government. Voltage Management in Distribution Networks Directions Paper. 2023.
[76] Essential Services Commission. Voltage performance data. 2023.

**Figure 13: Average Voltage by DNSP and Main Victorian Government Actions**




*Source: Victorian Government*[77]

The Victorian government estimates the reduction in voltages to date has resulted in approximately $7 million in savings and up to 17,000 tonnes of greenhouse emissions reductions, per annum and ongoing, for all Victorian customers.[78] Should the voltages fall to be consistent with the standard 230 volts, the Victorian Government estimates Victorian electricity consumers would save over $30 million in ongoing additional consumption savings per annum.[79] This figure only represents savings from decreased electricity consumption, it does not include savings from reduced appliance degradation, or improved solar exports – so the potential savings on offer are even higher.

If this is the situation in Victoria, which current has a high proportion of household and business energy needs met by gas, clearly the per capita savings in other jurisdictions could be even higher. However, no other jurisdictions have acted on voltage so there is a need for collective action to follow in the Victorian Government's footsteps. The Victorian Government recommends, among other steps, AS 61000.3.100 be updated to allow for a 10% tolerance for both under and overvoltage, improved transparency of low voltage network data and reviewing notification and

[77] Victorian Government. Voltage Management in Distribution Networks Directions Paper. 2023.
[78] Victorian Government. Voltage Management in Distribution Networks Directions Paper. 2023.
[79] Victorian Government. Voltage Management in Distribution Networks Directions Paper. 2023.

compensation provisions for voltage excursions. All these actions could be taken collectively and separately for the NEM.

**Recommendations for the Energy Ministers' November 2023 meeting:**

- Agree to work collectively to **ensure distribution networks are being operated at voltages** which reduce consumer costs and improve consumer outcomes, especially rooftop solar exports and appliance longevity. This should be a package of measures including updating AS 61000.3.100 to allow for a 10% tolerance for both under and overvoltage, improving the transparency of low voltage network data and reviewing notification and compensation provisions for voltage excursions.

## 3. Unlock flexible demand

### Develop demand response requirements for major household appliances

Unless household appliances can have their power draw directly or remotely decreased or increased, they are unable to be part of the flexible demand resources needed in a high renewable energy system. More importantly, households are unable to save money through the smart operation of their devices directly or via a third party. The international evidence of the value aggregated household demand response can provide has been available for many years.[80]

In November 2019, Australian Energy Ministers decided various domestic appliances sold in the country must support demand response, including air-conditioners, electric storage water heaters (resistive), pool pump controllers and EV charger/discharger units. At this time, Ministers committed to using the AS4755 series of standards for this purpose, a decision IEEFA critiqued in detail, on five fundamental grounds:

1. Interactions with other policies and approaches to peak demand and minimum system load are unclear.
2. AS4755 is a very basic, out-dated approach to demand response.
3. The AS4755 series does not support interoperability.
4. Open interoperable international solutions are available.
5. The original decision regulatory impact statement (D-RIS), including the cost-benefit analysis, was flawed.[81] Full details of this critique are available in the IEEFA analysis. [82]

[80] RACE for 2030 CRC. Flexible demand and demand control. Page 3. October 2021.
[81] IEEFA. Mandating AS4755 Ignores Households and Widely Supported International Solutions. August 2021.
[82] IEEFA. Mandating AS4755 Ignores Households and Widely Supported International Solutions. August 2021.

**Recommendations for the Energy Ministers' November 2023 meeting:**

- **Agree to legislate "a demand response capability" requirement for priority household appliances under the Commonwealth Greenhouse and Energy Minimum Standards (GEMS) Act 2012.** This requirement would enable manufacturers, and the market, to offer a range of solutions, rather than locking Australia into the outdated AS4755 standard. [83]

In legislating a demand response capability, energy ministers should ensure solutions allow consumers to retain control (an override option), are certified to be interoperable, and support verification and validation over secure two-way communications.

Legislating this requirement nationally would bring down the flexible demand enablement costs of DER such as air-conditioning, water heating, pool pumps and the like. This means participation of those appliances as DER assets would reach across socio-economic backgrounds, enabling many more consumers to be able to monetise their DER assets for financial reward. It would also be important for these requirements to be in place as households electrify. It would be an enormous missed opportunity if newly electrified hot water were not able to be used as a flexible resource.

## Ensure hot water systems are electrified and demand responsive

About 25% of household load is in hot water, making hot water systems the biggest energy-using appliances that could be made demand responsive. A 300-litre tank on an existing inefficient electric storage hot water system has about the equivalent energy storage potential (15kWh) of a Tesla Powerwall.[84] RMIT researchers put the price of thermal energy storage (TES) at US$100/kWh compared with battery energy storage (BES) at US$600/kWh.[85]

If most of the 3 million existing electric storage hot water systems (70% of 1-person dwellings, 89% of 2-3 person dwellings and 92% of +4 person dwellings) were transitioned to real-time demand response, this would be 10.8GW of flexible demand and 5.94TWh/pa or 2% of Australia's annual electricity consumption.[86] RMIT estimates this would save 48%-85% of water heating costs. A trial is under way in the SA Power Networks area, using up to 20,000 existing smart meters to dynamically orchestrate hot water load, but this is not the only technology option available.[87] Home energy management systems (HEMS) and potentially other smart controllers can be used too.

UTS research shows if there were no sales of residential hot water after 2025, and all hot water systems are electrified and controllable by 2035, consumers would save of up to $6.7 billion per year

[83] IEEFA. Mandating AS4755 Ignores Households and Widely Supported International Solutions. August 2021.
[84] UTS Institute for Sustainable Futures. Domestic Hot Water and Flexibility. Page 1. 5 June 2023.
[85] Clift et al. Assessment of advanced demand response value streams for water heaters in renewable-rich electricity markets. 15 March 2023.
[86] Ibid.
[87] ARENA. PLUS ES South Australia Demand Flexibility Trial. 6 April 2023.

by 2040, and make available 22GW/45 GWh/day of flexible demand, roughly two-thirds of peak demand.[88]

However, the electrified hot water systems need to be smart. In September 2023, the Queensland government doubled the funding for rebates for upgrading to energy-efficient appliances, seemingly without any demand-response capability requirements.[89]

Under the Rapid Electrification scenario in the UTS report, phasing out gas hot water systems and installing majority demand-responsive heat-pump hot water systems will save up to $6.7 billion by 2040. For the minority of homes that lack the outdoor space for heat pump hot water systems, electric resistive systems can still deliver benefits due to their greater load shifting capacity.

> **The lowest-hanging fruit to unlock an enormous capacity of flexible demand is electrifying domestic hot water systems.**

The lowest-hanging fruit to unlock an enormous capacity of flexible demand is electrifying domestic hot water systems. Measures should also be implemented to ensure residential hot water systems are as efficient as possible, which makes standards, including GEMS, Minimum Energy Performance Standards (MEPS) and the National Construction Code (NCC), crucial, as the UTS report identifies.

**Recommendations for the Energy Ministers' November 2023 meeting:**

- **Develop a national strategy for flexible domestic hot water** with a priority on considering how best to support both the electrification of gas hot water systems and making existing electric hot water systems demand responsive. This should include all the recommendations regarding hot water system standards in the UTS hot water report. This could include national measures around trade literacy and regulations, for example, to ensure plumbers can install electric hot water systems, without requiring to obtain an electrical trade qualification.

## Develop revenue streams for flexible demand

The wholesale demand response mechanism (WDR mechanism) designed by the AEMC and AEMO has not reached its full potential. The WDR mechanism has been operational since October 2021, and almost two years later, in June 2023, only one company – Enel X – had registered 66MW of demand-response facilities across NSW, Victoria and South Australia. Peak demand in the NEM is 30GW-35GW, so this is equivalent to 2% of peak demand. By comparison, New Zealand began using

[88] UTS Institute for Sustainable Futures. Domestic Hot Water and Flexibility. Page 1. 5 June 2023.
[89] Jameela Timmins. Queensland government is giving rebates for upgrading to energy efficient appliances. Is it worth it?. 14 Sep 2023.

demand response in 2007, and now meets more than 16% of peak demand through demand response programs.[90]

There are two major barriers to the effective operation of the WDR mechanism. The first is that AEMO's baselining methods for both the WDR mechanism and the RERT are very restrictive. Baselining methods are used to specify what forms demand response must take in order to be able to be accurately measured and remunerated against business-as-usual A study by Oakley Greenwood found AEMO's baseline methods excluded 80%-95% of C&I loads because their load types are not flat and predictable.[91] Most C&I loads are temperature sensitive or variable. Examples provided to the UTS team included:

- *A metal recycling plant (4MW) with fluctuating load as material is fed into plant but could provide 4MW of demand response is effectively ineligible as the baseline is adjusted based on early fluctuations (AGL).*
- *A plant with an outage was effectively ineligible as its baseline adjusted downwards (Enel X).*
- *Inter-Cast Forge smelter found cases where there was no incentive to participate in demand response events because the baseline was adjusted downwards due to a period of non-production between shifts.*
- *Zen Ecosystems analysis of demand response for commercial buildings found 'the AEMO baseline seldom produced accurate results' and compared results using the AEMO baseline with an alternative 'line of best fit' methodology based on daily usage.*[92]

The second barrier is that participation in the WDR mechanism is limited to large customers (>100 MWh or, in Victoria >40 MWh), aggregated household DER is not able to participate.

A RACE For 2030 report found there was more flexible demand available in households (1,780MW) than in industry (1,511MW) at times of peak demand, particularly in hot water and air-conditioning, and this was based on existing numbers, without taking into account the potential of electrified hot water (see **Table 5**).[93] Changing thermostat settings by 2°C during a peak demand event has the technical potential to unlock or load-shift 970MW of residential air-conditioning demand and 190MW of commercial HVAC demand by these conservative estimates. None of these estimates include the potential that could be unlocked through smart electrification and smart uses of Vehicle-to-Home (V2H) or Vehicle-to-Grid (V2G). The storage capacity of EVs in V2G mode could provide enough energy to back up the NEM (by crude calculation, 5 million EVs discharging at 7kW is 35GW).[94]

[90] ARENA. What is Demand Response?.1 August 2023.
[91] AEMO. Phase 2 – Baseline Methodology and Participant Testing: Wholesale Demand Response Mechanism – Baseline Methodology Testing and Metrics. March 2021.
[92] UTS Institute for Sustainable Futures. ARENA Knowledge Sharing Demand Flexibility Portfolio Retrospective Analysis Report. Page 41. July 2023.
[93] RACE for 2030 CRC. Flexible demand and demand control. Page 3. October 2021.
[94] Bjorn Sturmberg. Owners of electric vehicles to be paid to plug into the grid to help avoid blackouts. 8 July 2022.

**Table 5: Flexible Demand (FD) Opportunities in the NEM**

| SECTOR/LOAD | COINCIDENT WITH PEAK DEMAND | | COINCIDENT WITH MINIMUM DEMAND |
|---|---|---|---|
| | EMERGENCY FD RESOURCE | MARKET PARTICIPATION FD RESOURCE | INDICATIVE ESTIMATE ONLY |
| | (MW SHED) | (MW SHIFT) | (MW) |
| **BUILT ENVIRONMENT** | | | |
| Residential hot water | 450 | 450 | 4,900 |
| Residential swimming pool pumps | 170 | 170 | 450 |
| Residential air-conditioning | 6,900 | 970 | 970 |
| Commercial HVAC | 1,500 | 190 | 190 |
| **Total** | **9,020** | **1,780** | **6,510** |
| **INDUSTRIAL** | | | |
| Other (non-coal) mining | Unknown | 1,044 | Unknown |
| Food, beverage & tobacco manufacturing | Unknown | 224 | Unknown |
| Other transport, services & storage | Unknown | 22 | Unknown |
| Water, sewerage & draining services | Unknown | 83 | Unknown |
| Agriculture, forestry & fishing | Unknown | 140 | Unknown |
| **Total (32 per cent industry consumption)** | | **1,511** | |

*Source: Brinstead et. al. 2021 (RACE for 2030 CRC).*

ARENA has co-funded $180 million for 55 residential and commercial demand flexibility projects. In 2022, the Institute for Sustainable Futures at UTS summarised the outcomes of ARENA's trials.[95] It found there was huge potential in demand flexibility, but a lack of standards, revenue streams and experience with demand response was hampering scaling.

There is significant potential for demand flexibility in commercial heating, ventilation, and air-conditioning (HVAC), with up to 25% reductions in peak demand available through thermal load shifting (pre-cooling), but as energy bills are not a major consideration for commercial building owners, there need to be greater cost savings or other incentives to engage commercial building owners at scale.[96]

The only reward currently available for a household to reduce demand when it's valuable to the market is through Origin's Spike program. While Origin's innovation is to be commended, demand response should be rewarded across the market, not just as a single retailer's hedging strategy.

As more and more renewable generation enters the NEM, demand flexibility becomes more and more important. Effectively we are going from a system where supply ramped up and down to match demand to one where supply is variable, based on the weather and the time of day, and demand

[95] UTS Institute for Sustainable Futures. ARENA Knowledge Sharing Demand Flexibility Portfolio Retrospective Analysis Report. July 2023.
[96] UTS Institute for Sustainable Futures. ARENA Knowledge Sharing Demand Flexibility Portfolio Retrospective Analysis Report. July 2023.

needs to be able to be more flexible for the system to operate effectively and efficiently. Of course, not all demand can be shifted, which is where storage, especially batteries, are important, but other than by Energy Queensland, Enel X and Origin, there has been little smart planning to make the most of demand flexibility.

If household aggregated demand were able to participate in the WDR mechanism this would provide an additional revenue stream for VPPs, and lower consumer bills in aggregate.

Given the urgency of getting more demand flexibility into the market, the standard 18-month to two-year AEMC rule change process, the AEMO implementation process is best avoided.

**Recommendations for the Energy Ministers' November 2023 meeting:**

- **Direct AEMO to develop more flexible baseline methods,** for both C&I and aggregated residential demand response in line with international best practice.
- **Make a rule to include aggregated household demand in the wholesale demand-response mechanism**.

# 4. Fast-track distributed storage

## Prioritise and provide financial support for BTM storage

To maximise the potential of rooftop solar requires partnering it with flexible demand (hot water, appliances, EVs, etc) and/or storage, especially for evening and overnight demand. Both rooftop and large-scale solar are constrained by grid operators in ways that are inefficient, failing to make the most of the solar resource. The installation of storage and flexible demand alongside solar can enable the "sleeping duck" future, in which the demand profile through the day is more even, enabling potential reductions in wholesale and network costs, if the relevant policy and regulatory changes are implemented.

Storage is a vital component of a DER-rich grid, but the existing 6-11 year payback period for battery storage is off-putting for most households and businesses.[97]

The Commonwealth's Small Business Energy Incentive goes some way to addressing this for businesses with aggregated annual turnover of less than $50 million. They will be eligible for a bonus 20% tax deduction for the cost of eligible depreciating assets that support electrification and more efficient use of energy, such as installing efficient fridges and heat pumps, up to a maximum of $20,000 in a bonus tax deduction for up to $100,000 in total expenditure.[98]

[97] ABC News. Household battery uptake surges to record high amid market turmoil, rocketing prices. 30 Mar 2023. News report references Sunwiz. Should quote original source.
[98] Australian Government Treasury. Small Business Energy Incentive. July 2023.

However, this incentive applies only for a year to 30 June 2024, not long enough to make a substantial difference to small business energy bills. Several organisations have suggested that the incentive's end date be extended to 30 June 2025.[99] However, programs to support major business investment are best to run for a minimum of three years to gain momentum and build capacity within industry. For example, in the installation of industrial heat pumps is still in the very early stages across Australian industry and will require time to develop economies of scale. Support for that industry for several years, through this tax incentive, will help it mature.[100]

**Recommendations for the Energy Ministers' November 2023 meeting:**

- **Advocate to the Federal Treasurer that the Commonwealth's Small Business Energy Incentive run for three years,** until 20 June 2026, and is then reviewed against its objectives.

Some commentators claim supporting household battery storage is "middle-class welfare" in an echo of concerns about the first subsidies for rooftop solar in the 2000s. Those critiques of household solar were wrong, as the first adopters were in lower-socio-economic status (SES) outer suburban and regional areas where home owners were concerned about rising power bills.[101] It would also be wrong in regard to household batteries and EVs with Vehicle-to-Home or Vehicle-to-Grid (V2G) because of the rationale for and the benefits of DER and the sharing energy economy outlined at the beginning of this report: that well integrated DER can provide benefits for all.

Only one in seven households installing rooftop solar are currently installing a battery storage system at the same time, which means most of this rooftop solar is unnecessarily constrained by 5kW static export limits, and is unable to store its solar for use during peak demand. Households are investing in underutilised assets, which could provide far greater collective benefits if they were supported to install battery storage in the form of a stationary battery or an EV with V2H or V2G capability.

There is also no reason aggregated storage, either at the household or C&I scale, with appropriate capacity factors, could not be incorporated into the Capacity Investment Scheme (CIS). This is a contracts-for-difference scheme through competitive tender for dispatchable capacity. It should include aggregated storage (and potentially even flexible demand). Consumers who own those assets should have the same opportunities to earn revenue from providing available capacity as large grid-scale batteries. That is the premise of the sharing energy economy and a tenet of fair competition.

[99] Ai Group, Business NSW, Energy Efficiency Council, Australian Chamber of Commerce and Industry, Council of Small Business Organisations Australia, Facility Management Association of Australia, Green Building Council of Australia, Property Council of Australia, Energy Consumers Australia. 18 July 2023.
[100] Australian Alliance for Energy Productivity (A2EP). Heat pumps for industrial and commercial applications, 2023.
[101] Victoria Energy Policy Centre. Is rooftop solar a play-thing of the well-to-do? June 2021.

**Recommendations for the Energy Ministers' November 2023 meeting:**

- **Advocate to the Federal Government to allow aggregated storage (and, where possible, flexible demand) to participate in the Capacity Investment Scheme.**
- Energy Ministers **consider other ways to support BTM storage**, including through the Small-scale Renewable Energy Scheme (SRES) or otherwise. This is important given the collective benefits to energy markets and networks of storing abundant solar generation during the day and consuming or exporting it in the evening peak and the resilience benefits offered by batteries.

## Support electric vehicles to be a game changer

If badly managed, charging of EVs could contribute to peak demand growth, and exacerbate the duck curve. If well managed, EVs can be the perfect partner to rooftop solar and play a major role in putting the duck to sleep. As detailed in Appendix A, V2G (vehicle-to-grid) charging enables EV batteries to provide electricity, frequency control and ancillary services, demand response and, where appropriate, network services.

Alongside forward planning for DER technical standards, there is a significant amount of work required to create the technical and regulatory environment to enable the operation and profitability of V2G services.[102] IEEFA recommends that the integration of EVs into the grid, including V2H and V2G be in the scope of a new DER Authority.

**Recommendations for the Energy Ministers' November 2023 meeting:**

- **Energy Ministers agree that the new DER Authority develop an EV-grid integration workplan.**

# 5. Create a level-playing field in network services

## Review distribution network revenue regulation in a context where DER are an effective substitute to poles and wires

The regulation that was originally written to determine how much revenue electricity networks would receive, every five years, known as CPI-X regulation, was largely copied from the United Kingdom. It was principally based on the simple constructions of allocations for capital expenditure, operating expenditure and a rate of return on the regulated asset base (RAB), and assumed no major changes would occur in how distribution networks would operate.

[102] RACE for 2030 CRC. My V2X EV: Informing strategic electric vehicle integration. April 2023.

Given that population growth and economic growth were expected to rise and with them electricity use, it made sense to reward distribution networks for building more assets. However, from 2007 onwards, with increasing energy efficiency through new technologies such as LED lighting and with the increasing generation from rooftop solar behind-the-meter, peak demand per customer and overall network utilisation have been falling, as discussed above. At the same time, distribution networks need new software and hardware to support two-way flows due to DER exports. Further, DER can now be aggregated to provide network services (what the Americans call "non-wires alternatives"). The job of owning and operating distribution networks has become more complex and more consumer-focused, but the network revenue regulation, the way networks are remunerated has not changed with these changed circumstances.

Professor Ross Garnaut raised concerns about the nature of distribution network revenue regulation in his 2011 Review for the Commonwealth Government, writing:

> *"There is an unfortunate confluence of incentives that has led to significant overinvestment in network infrastructure. It is clear from market behaviour that the rate of return that is allowed on network investments exceeds the cost of supplying capital to this low-risk investment.*
> *… Distribution networks are, of course, natural monopolies. So a strong regulatory regime is required to prevent price gouging.*
> *… The Ministerial Council on Energy, which is chaired by the Commonwealth minister and which supervises the regulatory arrangements, should bring forward the reform of the price regulation rules."*[103]

In 2017 KPMG was commissioned by a Council of Australian Governments (COAG) Energy Council working group to prepare a report that sought to answer the question: "What regulatory framework will deliver efficient and innovative electricity network and non-network solutions at an efficient price in the context of an evolving energy system?"[104] As the Senior Committee of Officials (SCO) bulletin at the time put it:

> *"In assessing the performance of the National Electricity Market (NEM), KPMG found that while existing efficiency and innovation incentives have had some impact, they may not be sufficient to manage the long-term network transition. It found the current incremental approach to reviewing the regulatory framework may be too slow to keep up with the pace of change in the energy sector."*[105]

While not asked to investigate what wholesale reform might look like, KPMG was clear that there were "ongoing expenditure biases" that "may become more acute as more non-network options become available". KPMG also showed there may be situations whereby there is a capex bias in the revenue regulation.

[103] Prof. Ross Garnaut. The Garnaut Review 2011. Page 155-6. 2011.
[104] KPMG. Optimising Network Incentives Report. 2018.
[105] COAG Energy Council. Senior Committee of Officials. Optimising Network Incentives Report Bulletin. 2018.

KMPG highlighted effective regulatory frameworks adopted overseas had a clear vision for the energy sector with a clear role for networks and the need for this in Australia. Other useful insights included that the current revenue regulation, including the length of the regulatory reviews, the flexibility of the regulator and the lack of incentive to innovate might not be fit for purpose under circumstances of transformation.

A 2022 IEEFA report identified that over 2014 to 2021 electricity network businesses received $10 billion in total extra profit above normal levels, or "supernormal profit", which were attributed to weaknesses in the regulatory system.[106] While this is an issue primarily about the AER's implementation of the revenue regulation, it suggests that there are substantial issues that need to be addressed in order to bring down network prices for consumers.

The author received a Churchill fellowship to North America and Europe in 2018 to examine the future of electricity distribution networks, understanding that we are in the midst of a one-in-200 years transformation of the electricity system, and that the most radical change was happening at the distribution level. The author's Churchill report found that other jurisdictions were changing their distribution network revenue regulation accordingly:

> *"The clear need to realign the objectives of distribution network owners with decarbonisation and consumer objectives suggests that performance-based regulation is a better model for the energy transformation than traditional rate-based economic regulation. Performance-based regulation needs to enable innovation and risk and reward sharing between distribution businesses and consumers (or tax payers). …*
>
> *"To create revenue regulation suited to the challenges of decarbonisation would mean moving not only to totex* [capex + opex]*, but to whole system analysis; a major reconsideration of what kind of incentives are needed for decarbonisation across electricity, transport and gas (in particular) at reasonable cost.*
>
> *"In addition, qualitative assessments may be a valuable tool for cultural change in utilities, as can benchmarking and ex-post reviews. And, regulators must be given sufficiently flexibility to change their regulation with changing technological and commercial circumstances."*[107]

As has been highlighted in the 2022 IEEFA report, *Regulated Electricity Network Prices Are Higher than Necessary*, there are a range of reforms that could improve the CPI-X form of regulation under which Australia currently operates.[108] These can and should be implemented as quickly as possible. However, there is also a need to consider whether the advancement and proliferation of DER technology creates the need for more fundamental, longer-term reform of how distribution networks are regulated and remunerated.

[106] IEEFA. Regulated Electricity Network Prices Are Higher than Necessary. 4 October 2022.
[107] Kuiper, Gabrielle. The future of electricity distribution networks. Report for Churchill Fellowship. 2019.
[108] IEEFA. Regulated Electricity Network Prices Are Higher than Necessary. 4 October 2022.

Several jurisdictions around the world are moving away from remunerating distribution networks for capital investment (poles and wires and substations), and towards remunerating them for their performance in providing energy services, including integrating DER into their system and decarbonisation (see Box below).

The NEM has incentive schemes, but these are on top of the CPI-X fundamentals. While distribution networks in the UK are rewarded for connection outcomes, the AER is only introducing a "reputational incentive" in the form of annual reporting on the speed of export connections that will begin this year.[109] The AER is also introducing a new small-scale incentive scheme for export services (the export service incentive scheme (ESIS)).[110] This will allow DNSPs to consult with customers and propose bespoke export service incentive arrangements, but is a tweak at the edges, rather than recognising the fundamental change to the role of distribution networks.

**British RIIO (Revenue = Incentives + Innovation + Outputs) regulation**

The RIIO (Revenue = Incentives + Innovation + Outputs) regulation comprises a revenue cap plus performance incentives. RIIO revenue is based on 'totex' (combined capex and opex) to reduces the capex bias that has sometimes arisen with RPI-X regulation. Performance Incentive Mechanisms (PIMS) are available for six outcomes: safety, environment, customer satisfaction, connections, social obligations and reliability/availability. In addition, RIIO has allocated high levels of innovation funding to approved pilots through a Network Innovation Allowance (NIA) and an annual Electricity Network Innovation Competition (NIC).

*Source: Kuiper 2019[111]*

Since 2018, British DNSPs have been procuring network services from DER, via a process of 'local flexibility' tendering. [112] For the 2023-24 year, Britain's electricity distribution networks tendered in advance for 4.6 GW of flexibility, of which nearly 2GW were contracted.[113]

Procuring network services from DER (rather than relying on building or upgrading network infrastructure) can prevent potential overinvestment in networks by DNSPs based on the claim that integrating DER is expensive. The AER's State of the energy market 2022 report states:

> *"Regulated network costs are expected to increase over the 4-year period ending 2023–24, driven by increases in distribution and transmission costs. This will include expenditure to*

[109] AER. Incentivising and measuring export services performance. 2023.
[110] AER. Incentivising and measuring export services performance. 2023.
[111] Kuiper, Gabrielle. The future of electricity distribution networks. Report for Churchill Fellowship. 2019.
[112] Energy Networks Association (ENA). Flexibility services. 2023.
[113] Energy Networks Association (ENA). ENA ON GB Flexibility Figures 2023/2024 2023.

*improve the networks' ability to handle higher levels of consumer energy resources, intending to lead to savings for consumers in the longer term."*[114]

Higher future distribution costs are questionable given that average distribution network utilisation has been decreasing (as discussed above), given the example that South Australia spent less than 1% of its capex[115] to develop and implement flexible exports, given that DER has the potential to provide network services and given the IEEFA analysis of network supernormal profits.[116,117]

Poor planning for EVs could increase network expenditure, with AEMO forecasting that EVs will be a significant contributor to demand post 2030[118], so action should be taken to manage EV charging well. The regulatory regime should ideally encourage appropriate EV charging and discharging management strategies. If EV charging is well managed, it need not be a burden on the grid, and could be a significant opportunity, as much of it could soak up abundant solar generation in the middle of the day and provide services to the grid. This is a very complex issue that needs to be well managed, which is why IEEFA is recommending the new DER Authority develop an EV-grid integration workplan. Appendix A gives an overview of EVs as an energy system resource.

Energy market bodies have some ability to make changes around the edges to incorporate DER – for example by adjusting guidelines on dynamic network pricing, or adjusting incentive schemes. However, there are limits to the scale of what the Energy market bodies can initiate themselves. Meanwhile, DER technologies have the capability to achieve vast reductions in overall energy system costs if they are effectively utilised, reducing the need for expenditure on poles and wires and substations as well as large, centralised generators. This is unlikely to happen under our current regulatory regime, where networks are primarily remunerated based on the value of the assets they own, rather than making use of consumers' DER technology. Therefore, Energy Ministers need to initiate a review into how distribution network revenue regulation needs to be substantively restructured for the long term in the context of a DER-rich future.

This is a significant step, but it is necessary to ensure fit-for-purpose distribution revenue regulation, especially to ensure DNSPs can prioritise decarbonisation, innovate to integrate DER and optimise the system as a whole, as well as ensuring efficient use of network assets.

Such a review needs to take a fresh view of how to reward distribution networks for providing services when a high proportion of capacity is behind-the-meter owned by consumers, when well-coordinated DER has the potential to reduce both wholesale and network peaks (as the sleeping duck modelling shows) and where rapid decarbonisation is an urgent priority. It is worth revisiting the KPMG report in setting the terms of reference for the review of network revenue regulation.

Such a review should consider network tariff design in principle, especially in light of Ausgrid's Project Edith which has been trialling real-time network pricing in support of DER providing network

[114] AER. State of the energy market 2022. Page 182. September 2022.
[115] IEEFA. A Grid Dominated by Wind and Solar Is Possible. South Australia: A Window Into the Future. June 2021.
[116] IEEFA. A Grid Dominated by Wind and Solar Is Possible. South Australia: A Window Into the Future. June 2021.
[117] IEEFA. Regulated Network Prices are Lower Than Necessary. October 2023.
[118] AEMO. National Electricity & Gas Forecasting. Accessed 5 October 2023.

services.[119] While Project Edith is currently a small-scale trial in one network area, if it is able to provide cost-reflective pricing by time and location in distribution networks, it will have implications across the NEM and WEM.

**Recommendations for the Energy Ministers' November 2023 meeting:**

- **Energy Ministers commission a thorough, independent review of distribution network revenue regulation** with the objective to ensure the regulation supports decarbonisation, the integration of DER and improved consumer outcomes, as well as economic efficiency.

# 6. Ensuring fit-for-purpose governance

## Enable energy market governance to support a DER-rich future

While energy market governance has been reviewed several times since the NEM was created, its fitness for purpose to meet Australia's decarbonisation goal of 43% by 2030 and 82% renewables by 2030 has never been evaluated. Crucially for the purposes of this report, the NEM is estimated to have 69GW of rooftop storage and 31GW, three quarters of NEM storage will be BTM "coordinated DER storage" by 2050 according to AEMO's step change scenario in its 2022 Integrated System Plan.[120] Energy market governance needs to enable rapid change to meet all these goals and to help Australians make the most of the significant opportunities presented by DER.

A rigorous review is needed given that the recent record of energy market institution action on DER integration reveals some shortcomings. For example, AEMO encouraged the South Australian government to introduce solar cut-off regulation without appropriate technical analysis of alternative options, economic analysis of costs and benefits or consultation, including with consumer organisations.[121] AEMO is still pressing ahead with solar cut-offs without examination of alternatives as outlined in its engineering roadmap.[122] AEMO designed a DER register without the provision to record EV charging installations, and has not yet amended it.

The AEMC introduced provisions to allow DNSPs to charge for solar exports, but the revenue regulation makes it uncompetitive for DNSPs to pay consumers for network services given the capex-bias discussed above. The current AEMC rule-making process takes 18 months to two years on average, despite numerous attempts to speed it up. The AEMC has suggested the need for reforms to network revenue regulation in several years of Electricity network economic regulatory framework (ENERF) reviews, stating for instance that: "The 2020 Review has highlighted a clear need

[119] Ausgrid. Project Edith. 2023.
[120] AEMO. 2023 Electricity Statement of Opportunities. September 2023.
[121] IEEFA. Blunt Instrument: Uncompensated Solar Cut-Off Isn't the Only Solution to the Minimum Demand 'Problem'. April 2021.
[122] AEMO. Engineering Roadmap to 100% Renewables. 2022.

for a holistic consideration of the regulatory framework for distribution networks."[123] However, the AEMC has not made explicit recommendations to ministers that network revenue regulation should be substantively altered to meet the needs of the energy transition.

As discussed above, the operation of the AER network revenue determinations has been such that an additional ~$27 billion has been added to the RABs of the distribution businesses over the last decade,[124] while utilisation of the distribution networks has been falling,[125] and peak demand in the networks has been more or less flat since 2005, despite increasing numbers of customers.[126] This does not appear to be an efficient outcome based on these high level figures.

There has also been no long-term comprehensive planning for electrification. The AER has allowed for accelerated depreciation of gas networks, and AEMO has scenarios with various levels of electrification in its Integrated System Plan (ISP), but there has been limited forethought about how to make the most of DER and electrification to provide flexible demand for a solar and wind-based electricity system. Instead, the energy market institutions, in the form of the ESB, argued that existing coal- and gas-fired power stations should be provided with capacity payments through the Capacity Mechanism, which could keep them open longer than necessary.

It is not certain that the change to the National Electricity Objective (NEO) to include emissions reduction will be sufficient to ensure the energy market institutions are the nimble, forward-thinking and proactive organisations that governments need to support its 82% renewables target by 2030. A governance review could clarify the roles and responsibilities of each energy market institution in enabling a DER-rich future, including the new DER Authority proposed earlier in this report. While this report has focused on the reasons for reviewing governance to support DER integration, an independent overall review of the electricity market governance would be beneficial to give a full picture of the current state and any changes needed to ensure Australia meets its emissions reduction targets and renewable energy goals.

There are also related questions that a governance review could consider. DER are usually consumer-owned resources, so there is an increasing need for consumer perspectives to be included in energy market decisions. A governance review could address whether, and if so how, consumers should be given a role in decision-making processes in the NEM. One possibility would be to establish a consumer advisory committee to Energy Ministers.[127] Such a body could assist Energy Ministers in their deliberations, including on matters of DER. Another would be for the AEMO Board to include at least two consumer representatives (one representing residential consumers and one representing small business) and that the government and industry representation decrease proportionally. [128] All such changes could be considered by a governance review.

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[123] AEMC. Electricity network economic regulatory framework 2020 review, Final report. 1 October 2020.
[124] $82.6billion in 2023 less $55billion in 2012. Source: AER. State of the Energy Market Report 2022. September 2022.
[125] AER. https://www.aer.gov.au/networks-pipelines/performance-reporting/electricity-network-performance-report-2023
AER - Electricity DNSP Operational performance data 2006-22.
[126] AER. Annual generation capacity and peak demand – NEM. Accessed 5 October 2023.
[127] Public Interest Advocacy Centre. From complex fragments to competitive consumer-focused markets. 7 May 2015.
[128] Public Interest Advocacy Centre. From complex fragments to competitive consumer-focused markets. 7 May 2015.

**Recommendations for the Energy Ministers' November 2023 meeting:**

- **Energy Ministers issue a Statement of Expectations to all energy market institutions** (AEMC, AEMO, AER) stating that now that the National Electricity Objective includes an emissions reduction objective, the expectations is that the institutions will make all due efforts to support decarbonisation of the National Electricity Market, including making timely decisions to support DER integration and to ensure Australian regulation and its implementation are world-leading.
- **Commission an independent review of energy market governance and its fitness for purpose for integrating DER and for the energy transition to be completed within six months.** While previous reviews have considered the governance of the energy market intuitions, none have done so when there was the current level of urgency of renewable energy, storage and flexible demand deployment.

# Conclusion

Where there is the clearest vision, articulated at the political, policy and regulatory levels, there is the most progress in developing clean, smart, customer-centric electricity networks. Innovation and the decarbonisation of the energy system cannot succeed in the time required without a long-term strategic vision.

The Integrated System Plan with its map of the NEM with "actionable projects" has excited politicians and the public alike with its "nation-building" vision. Sidelined in this picture is the true champion of the energy transition in Australia, rooftop solar, and the future champions of smart electrified hot water systems, smart demand-responsive appliances, distributed storage and electrified, efficient businesses and industry.

More than two-thirds of the solar generation in the NEM has been paid for by households and small businesses. Australian households have already spent at least $25 billion on rooftop solar and other DER.[129] Energy ministers can act to make sure that future household and business expenditure on DER is a worthwhile investment for all Australian electricity consumers and, indeed, for the economy as a whole, by implementing the recommendations set out in this report.

Given the limited time until 2030, consumer expenditure can be leveraged to create faster electricity decarbonisation through rapid action on technical standards, unlocking flexible demand, fast-tracking distributed storage, enabling DER to provide network services through reviewing network revenue regulation, and ensuring that the energy market governance arrangements support a rapid acceleration to enable the sharing energy economy and 82% renewables by 2030.

[129] IEEFA. Cheaper, Faster Decarbonisation: What State Governments Can Do To Support Distributed Energy Resources. May 2022.

# Appendix A: EVs as batteries on wheels

Batteries on wheels, otherwise known as electric vehicles, are the ultimate sharing energy economy technology, or DER. EVs have the potential to be used to power loads, for example, plugging in power tools for tradespeople as an alternative to diesel generators on a building site –known as V2L (vehicle-to-load). Some cars have the ability to feed back into the building they are plugged into – this is known as V2H (vehicle-to-home). A few cars with the appropriate charger can already feed back into the grid – V2G (vehicle-to-grid).

Because of the obvious fact that vehicles can be driven from place to place, in future, they will be able be used to charge from the grid or feed into the grid in different locations. A workplace or supermarket might offer free charging as an inducement. A parking station, say at an airport or a train station, might offer payment for the ability to access your car's battery while you are away, within a certain range, leaving you enough charge to meet your needs of course. The ANU REVS project estimates the in future, vehicle owners could earn between $2,500-$5,000 a year from feeding back into the grid, based on large use of the vehicle for providing frequency control and ancillary service (FCAS). A more modest average of up to A$1140 a year is the result of California Public Utilities Commission analysis of 240 different vehicle grid integration case studies.[130]

All this is possible because of the size of passenger car batteries, which range from about 110kW and 40kWh for a Nissan Leaf to 595kW and 93kWh for a Tesla model S. These capacities can be expected to increase over time.

The average vehicle travels 11,000km a year, which equates to 7kWh/day charging or 15%-25% capacity of a smallish 30kWh-50kWh battery.[131] In turn, the average household uses 16kWh/day so a smallish battery could run a house for 2-3 days. A more powerful vehicle could run a household for at least a week, longer with household efficiency measures. This is obviously potentially very important for resilience in the case of bushfires or floods, which disrupt local electricity supply.

A prime example of the combination of solar and EVs for resilience is the City of Newcastle. It developed a 5MW solar farm at the Summerhill Waste Management Centre. In future, electric garbage trucks will be able refuel from solar when they take waste to the site. Then, when there is a need for emergency power supply anywhere in the region, they will be able to drive to the location and feed electricity to the evacuation centre or other community facility using V2H technology.

There are numerous challenges with getting the standards for EV charging in place, ensuring that charging takes place in a way that doesn't create unmanageable loads on the grid and where consumers can all benefit from V2G technology. There is a decade's worth of work here and IEEFA

[130] California Public Utilities Commission. Final Report Of The California Joint Agencies Vehicle-Grid Integration Working Group. 2020.

[131] Race for Networks Project. Research Theme N1: Electric vehicles and the Grid Project. RACE for 2030. October 2021

will be looking to analyse these challenges and provide insights to support good decision making on EV-grid integration over the coming years.

Solar farm powering City operations and revenue


City of Newcastle unveils debut electric truck

# Appendix B: The wasted years on governance arrangements for DER technical standards

**In 2019:**

Stakeholders highlighted DER technical standards as a foundational challenge for DER integration and as a result the Energy Security Board (ESB) commissioned a review into the Governance of DER Technical Standards in December 2019.

**In 2020:**

The Sapere and CutlerMerz Review of governance of DER technical standards was published in March 2020.[132]

On 5 May 2020, the Australian Energy Market Operator (AEMO) submitted a rule change request seeking to establish a framework to enable it to set initial minimum technical standards for DER, principally inverter standard AS 4777.2:2020. The rule change request proposed to oblige AEMO to oversee a subordinate instrument under the National Electricity Rules (NER) that sets minimum technical standards for DER.

The July 2020 ESB Governance of DER Technical Standards Consultation Paper proposed the establishment of a new governance committee, convened under the AEMC, to oversee the development of DER technical standards to meet electrical system security requirements, support distribution network management and provide long-term affordability and choice for consumers, including through the sale of DER services.

As the ESB Governance of DER Technical Standards Consultation Paper stated:

> *"The Sapere/CutlerMerz review (the Review) found that the governance of DER technical standards is fragmented, lacking clarity of roles and coordination. In addition, the resources dedicated to the setting of standards is inadequate, and the pace of change is slower than needed given the rapid* deployment *of DER. The result is that DER systems deployed today are not necessarily able to deliver the performance levels and services required to support system security, efficient and effective distribution network management and the optimisation of DER benefits for all electricity system users.*[133]

ESB received 32 submissions to this consultation paper, the vast majority supportive of the proposal to establish a DER Standards Governance Committee and put standards in a subordinate instrument under the Rules:

- Twenty-eight were in full support of the ESB's proposal
- One wanted greater statutory control for the committee
- One would support the proposal with their organisation's involvement
- One supported the committee, but only as advisory.

[132] ESB. Review of governance of DER technical standards. March 2020.
[133] ESB. Governance of DER Technical Standards Consultation Paper. July 2020.

As a result, on 16 September 2020, Dr Kerry Schott lodged a rule change request with the AEMC on the Governance of Distributed Energy Resources (DER) technical standards.

The requirement for new governance arrangements for technical standards was included in the ESB's DER Integration Workplan that was published in October 2020.

**In 2021:**

On 25 February 2021, the AEMC made a "more preferable final rule" to put AEMO's proposed initial set of DER technical standards into the National Electricity Rules (NER), rather than a subordinate instrument under the rules, where they could be more easily updated.[134]

**In 2022:**

*Eighteen months* after the Dr Schott rule change was lodged, on 17 March 2022, the AEMC published its final rule determination "not to make a rule" to create new governance arrangements. The Commission's final rule determination was that "that using existing powers enables it to promptly commence its next stage of work on DER technical standards in a way that complements work already underway across other organisations".[135]

In other words, the ESB rule change proposal to address the gap in the governance of DER technical standards had an enormous level of stakeholder support, but was rejected by the AEMC, which decided it could manage the issue of DER technical standards without any changes to the rules and without upskilling its abilities in DER or technical standards.[136]

*Six months later,* on 29 September 2022, the AEMC issued a consultation paper on Review into consumer energy resources technical standards.

**In 2023:**

The AEMC commissioned Baker McKenzie to write a Review into consumer energy resource technical standards, which was published in April 2023.[137] This review covered in more legal detail the same ground as the Review of the governance of DER technical standards, undertaken Sapere/CutlerMerz for the ESB in 2020.

The AEMC's Draft Report into Consumer Energy Resource Technical Standards, issued on 27 April 2023, focused on issues of compliance with technical standards, of which there is only one in the NER, the AS 4777.2:2020, which applies to inverters. The AEMC stated, "more work is needed to determine if reform of national technical regulation is needed and, if so, the most appropriate reform model following implementation of the 12 immediate [compliance] draft recommendations".[138]

On 21 September 2023, the AEMC's final report recommended:

[134] AEMC. Technical standards for distributed energy resources, final rule determination. 25 February 2021.
[135] AEMC. Governance of distributed energy resources technical standards, final rule determination. 17 March 2022.
[136] IEEFA. AEMC fails to prioritise governance of distributed energy resources technical standards. December 2021.
[137] AEMC. Review into Consumer Energy Resources Technical Standards. April 2023.
[138] AEMC Draft Report into Consumer Energy Resource Technical Standards. 27 April 2023.

*"…jurisdictions lead the development of a national regulatory framework for CER technical standards.*

*"This may be progressed as part of the National Energy Transformation Partnership and would help ensure a more enduring national framework for CER technical standards.*

*"To assist jurisdictions, the AEMC has undertaken a preliminary assessment of four initial reform options for consideration.*

1. *Create a new national technical body.*
2. *Expand the role of the AER and the AEMC under the NEL.*
3. *Expand the role of the Clean Energy Regulator.*
4. *Enforce national requirements under jurisdictional frameworks."*[139]

The final report states: "Reform is needed to develop an enduring NEM-wide regulatory framework for CER technical standards." It recommends Energy Ministers lead the development of a national regulatory framework for CER technical standards.

In other words, 18 months after having rejected the ESB's rule change request to establish new governance arrangements for DER technical standards, and deciding that it was capable of managing the development of DER technical standards, and *three years* after the ESB's consultation showed there was overwhelming stakeholder support for the establishment of new arrangements for DER technical standards, the AEMC has proposed four new alternative governance arrangements, which it is handing over to jurisdictions for further discussion and consultation.

The result is that the governance of DER technical standards are at least three years behind where it should have been if the AEMC had made the original ESB rule change OR made an alternative rule for governance arrangements to enable DER technical standards to be decided and, where appropriate, included in the rules or a subordinate instrument under the rules. This raises a series of questions about the rule-maker's ability to "deliver timely, effective and enduring reforms when they are needed".[140]

The only significant progress on DER technical standards during this time has been the development of an inverter communication protocol (the Common Smart Inverter Profile Australia or IEEE2030.5 CSIP-Aus) through a *voluntary* group convened by ANU.[141] According to the AEMC, the former Energy Security Board (ESB) has developed recommendations to support implementation of CSIP-Aus, however the report detailing these has not yet been published.[142] Similarly, Standards Australia is considering how this interoperability standard will be adopted in a guideline but Australian Standards are voluntary unless incorporated into regulations by a rule change made by the AEMC or government regulation.

[139] AEMC. Review into consumer energy resources technical standards, Final report. 21 September 2023.
[140] AEMC. How the national energy objectives shape our decisions. September 2023.
[141] DER Integration API Technical Working Group. 'Common Smart Inverter Profile – Australia'. 2023.
[142] AEMC. Unlocking CER benefits through flexible trading. 3 August 2023.

# About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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