NEM power system design and engineering framework

Consumer Forum update

November 2020

Agenda

Item	Item
1	Context setting
2	Discussion questions
	• Framing and representation of this framework in relation to ongoing industry processes
	• Any other work (organizational level) that needs to be included
	• Obvious gaps in problem statement or focus areas
	• Red flags, concerns and blockers
	• Suggestions to improve the value of the discussion paper and subsequent consultation process
	• Is the emphasis on consumer outcomes clear enough?

Engineering Framework Overview | Defining the Focus Areas

The Engineering Framework builds on the work done in the RIS Stage 1 report. The RIS Stage 1 report was the first step in a multi-year plan focused on a specific study question, exploring potential limits to *secure* system operation under increasing penetrations of wind and solar. The purpose of the RIS Stage 1 was not to lay out an *operability* plan for the future, nor did the scope extend to questions of *efficiency* or *resilience*. It did however provide actions to address specific *security* limits that arose as part of the study. This Engineering Framework is the next step.

Following the RIS Stage 1, we listened to feedback from a variety of industry stakeholders on the usefulness of the RIS and future focus areas. Since the RIS, AEMO has also conducted a review on its engagement model.

The RIS Stage 1 actions described in the action update section were one key input to the Engineering Framework structure, as they are important first steps in moving towards an operable future system.

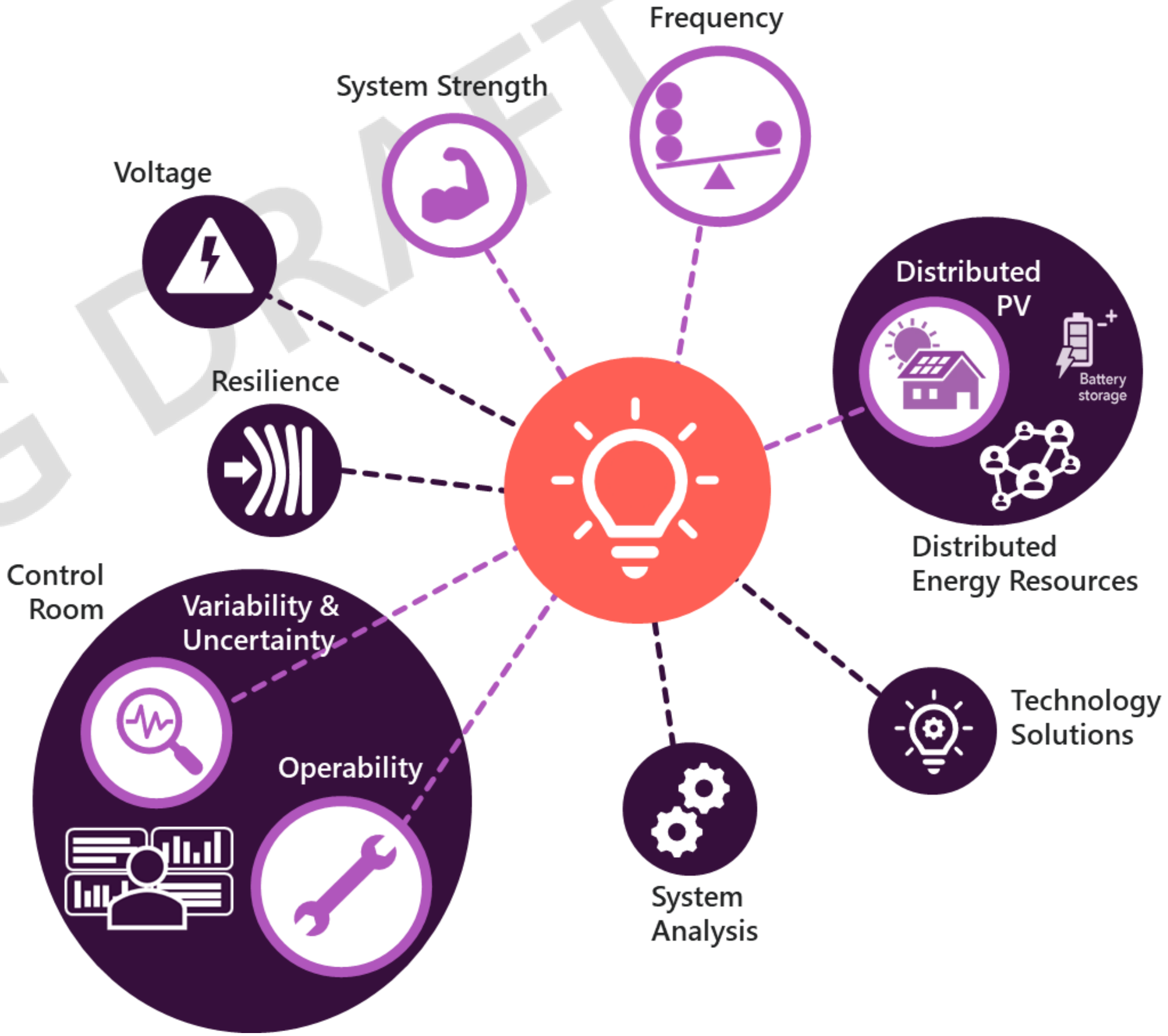
However, this transition is greater than the integration of renewables alone and requires a broader perspective.

Figure x shows how the RIS Stage 1 actions are incorporated into the eight workstreams, which are spread across the three themes of the Engineering Framework.

- **System Strength and Frequency** have been retained as separate workstreams.
- **Distributed PV** has been incorporated into the broader Distributed Energy Resources workstream.
- **Variability and Uncertainty** and **Operability** have been incorporated into the Control Room tools workstream.

Additional workstreams have been included to reflect the broader scope of the Engineering Framework. These additional priority focus areas are based on the other work in progress across AEMO and the wider energy sector. They also reflect the need for integrated system design, the accelerated changes and the forecast and unforecast changes that are emerging.

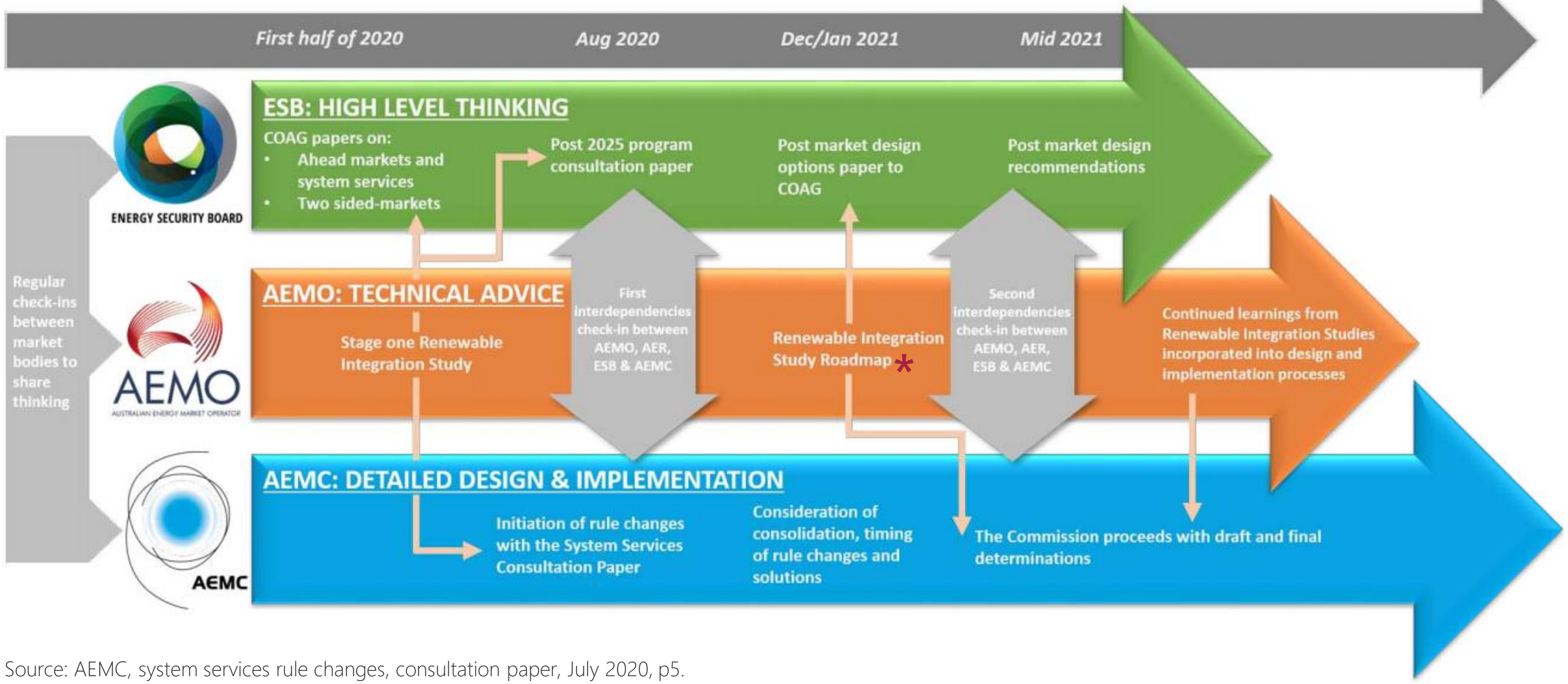
Figure x: placeholder description



This Engineering Framework complements existing work that is being progressed across industry. It is a vehicle to provide transparency to the current technical work and thinking around future system operability and to promote informed industry discussion around the prioritisation and accountability of future tasks that are important to transitioning the NEM.

In managing this transition, no one organisation has all the answers and different focus areas will require leadership from different areas of industry. Agreeing roles, responsibilities and linkages across industry will be critical to the success of operating the future system in a way that is secure, reliable, efficient and in the long term interests of consumers.

Figure x: Coordination between market bodies on essential system services



Source: AEMC, system services rule changes, consultation paper, July 2020, p5.

* Renewable Integration Roadmap has been superseded by this Engineering Framework.

AEMC and ESB linkages

The AEMC and ESB have a responsibility for high level thinking and detailed design and implementation of the National Electricity Rules (NER) that govern the NEM, in accordance with the National Electricity Objective (NEO).

In 2019 the COAG Energy Council requested the Energy Security Board (ESB) to advise on a long term, fit for purpose market framework to deliver a secure, reliable and lower emissions electricity system at least cost. This is being progressed through the ESB's post 2025 market design project, which is detailed on their dedicated website[2].

The AEMC have recently received several rule change requests[3] that relate to both the ESB's program of work and this Engineering Framework.

Figure x, shows the AEMC's view on the linkages between the ESB, AEMC and AEMO around essential system services. It shows that in this state of change we need to work closely together as an industry to plan and develop market and regulatory frameworks, in a way that is grounded in the latest technical advice.

The issues raised between the ESB, AEMC and AEMO are interdependent and complementary, and there needs to be a balance between pragmatism and efficiency to ensure that we can navigate a changing system while delivering secure and reliable supply to customers.

Linkages between the specific Engineering Framework workstreams and current AEMC and ESB packages of work is drawn out in Appendix X.

Proposed Engineering Framework Objective:

"To drive secure, efficient and resilient design and operation of the NEM out to 2025 and beyond in a way that supports the long term interests of consumers."

1. It should take a broader perspective than just power system ***security***, considering how to ***efficiently*** invest in and operate the future system and make it as ***resilient*** as possible.

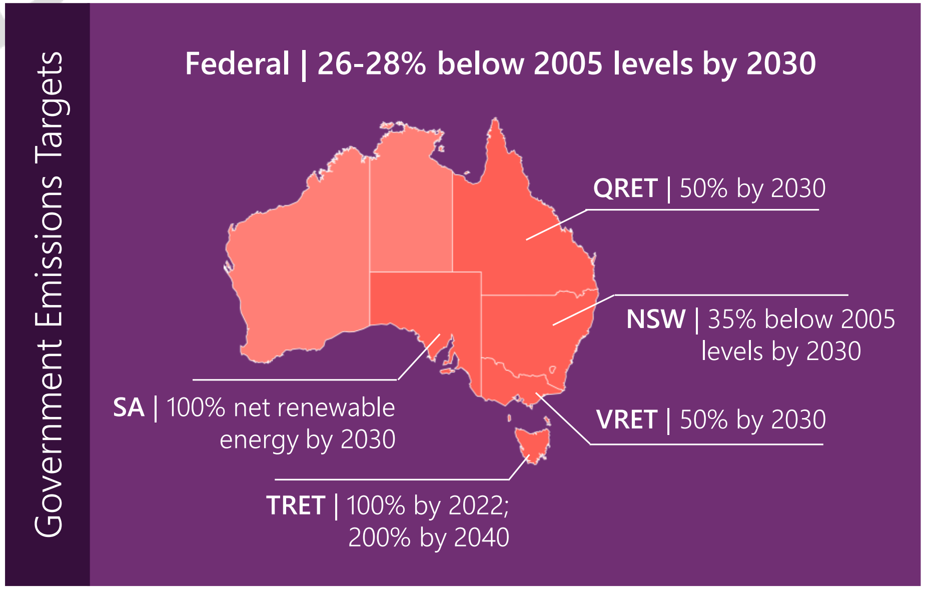
2. It should highlight the **current and future system operability challenges**, informed by the Integrated System Plan (ISP) and Electricity Statement of Opportunities (ESOO) scenarios, industry intelligence and operational experience.

3. It should be **a 'living' plan** that routinely explores and reprioritises areas to maintain future operability.

The focus of this work should be in clarifying key challenges for future system operation and identifying important next steps for industry and policymakers. An important benefit from progressing these issues is through such a framework that clearer and more transparent evidence will be available to refine analysis and underpin more informed decisions going forward.

Industry agreement on the strategic objective that underpins the Engineering Framework will be fundamental to its success. The Stakeholder Engagement section of this Discussion Paper sets out a range of questions related to this strategic objective.

Figure x: placeholder description



Engineering Framework Overview | Proposed Focus Areas

As a starting point for discussion, AEMO has identified eight workstreams spread across three interconnected themes: System Stability, System Integration and System Tools. An explanation of how we came to these groupings is presented under defining focus areas.

Together with the ongoing work in market and regulatory reform, Integrated System Planning and the addition of new generation capacity, the Engineering Framework is critical to ensuring an operable future NEM.

Each of these themes work together to ensure the success of the Engineering Framework so the NEM can be operated across all ISP scenarios out to 2025 and beyond, in a way that supports the long term interests of consumers.

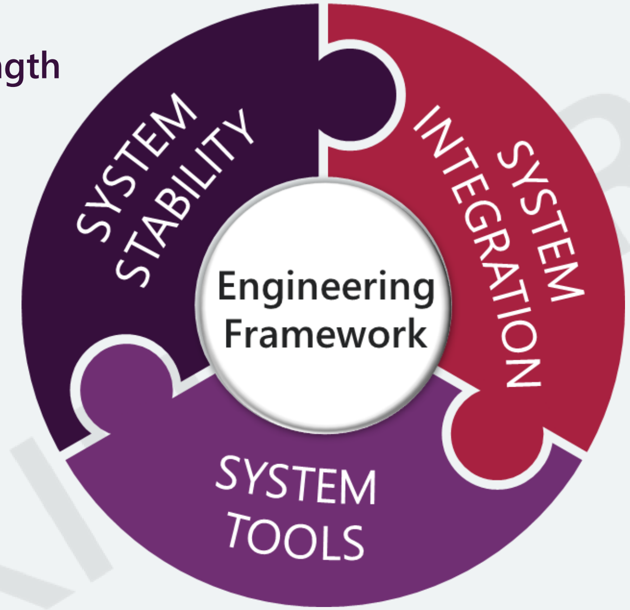
System Stability

These are **technical attributes of power system operation**. While the future power system may look very different to today, the underlying physics of the system will remain. Considerable work needs to be directed to ensuring these physical attributes are maintained both now and into the future. The main aims of this group of workstreams are:

- To identify what changes are occurring in the performance of these technical attributes.
- To understand what the minimum requirements are for the future system to operate.
- To support the necessary technical uplift and market reforms that incentivise the system services required to operate a secure power system with a significant level of inverter-based resources.

Figure x: placeholder description

- Frequency
- System Strength
- Voltage
- Resilience



- Distributed Energy Resources
- Technology Solutions

- Control Room
- System Analysis

System Integration

Refers to the **combination of elements that make up the power system.** Each element must operate in a way that supports the secure operation of the system.

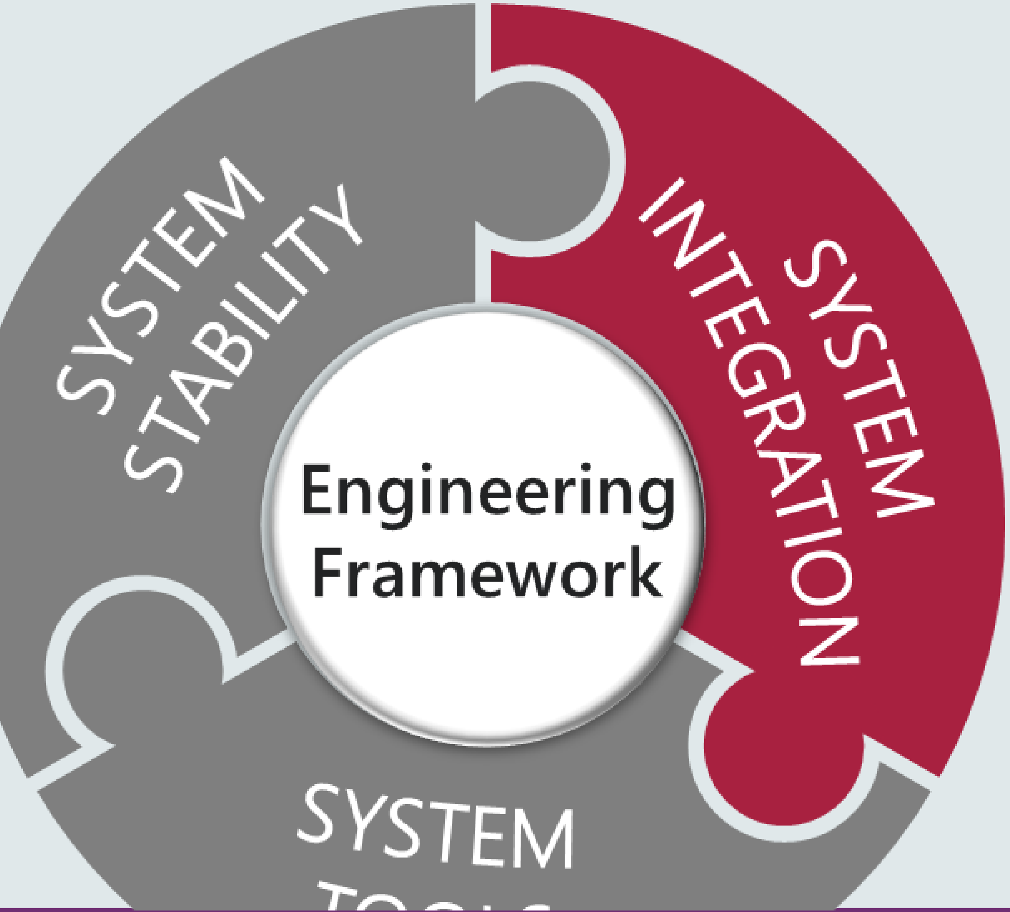
Australia is leading the world with some of the highest levels of variable, inverter-based resources, including one of the highest levels of small distributed solar PV. A coordinated and transparent approach is needed in industry to make proactive changes and pave the way to enabling two-way participation.

System Tools

The future power system will require new operational practices. This, in turn, means that we must **evolve our operational tools and system models**.

As complexity of system operation increases, increased automation, model uplift, enhanced tools for decision making and the translation of uncertainty into risk are key to enabling system operability.

System Integration



- Distributed Energy Resources
- Technology Solutions

System Integration | Distributed Energy Resources

Maintaining power system operability and maximising the opportunities of consumer DER uptake will require these devices to be better integrated with the power system and market. This will require an unprecedented level of collaboration across industry given the complexity and number of actors involved.

This focus area outlines our latest thinking on the stages for the efficient integration of DER, the work already underway across industry, and pre-empts a further discussion paper in early 2021 dedicated to DER integration stages and priorities.

DER consists of generation, storage and demand sources located behind the customer meter or embedded within the distribution network. As a result of the consumer uptake of distributed PV (DPV) since 2010, Australia is at the forefront of DER uptake globally. The ISP projects this consumer-led decentralisation to continue through:

- ongoing growth of DPV coupled with significant adoption of other DER, including batteries, electric vehicles and demand response; and
- increasingly sophisticated coordination and management of DER devices enabled by digitalisation and new technologies.

This means the future power system will need to serve the diverse needs of millions of industrial, business and residential end users, supporting devices and systems developed and operated by many different networks, retailers, aggregators and other solution providers. This will include increasingly diverse and complex behind-the-meter interactions.

Serving these diverse needs will require an architectural consideration of the future power system and its key actors, devices and key interactions.

Proposed DER integration objectives:

AEMO's objectives for DER integration should be considered within the broader ESB objective "to optimise the benefits of DER for all electricity system users."

- Secure and reliable system operation: as the aggregate size and impact of DER on the supply-demand balance continues to grow.
- Market integration: DER participation aligned with system needs and contributing to efficient market outcomes.

DER Integration Stages

Significant historical demand-side shifts, such as the mass adoption of air conditioners from 2000 to 2010 and the growth of DPV since, have involved consumer uptake of passive devices generally not responding to network or power system conditions and not visible or controllable to DNSPs or AEMO.

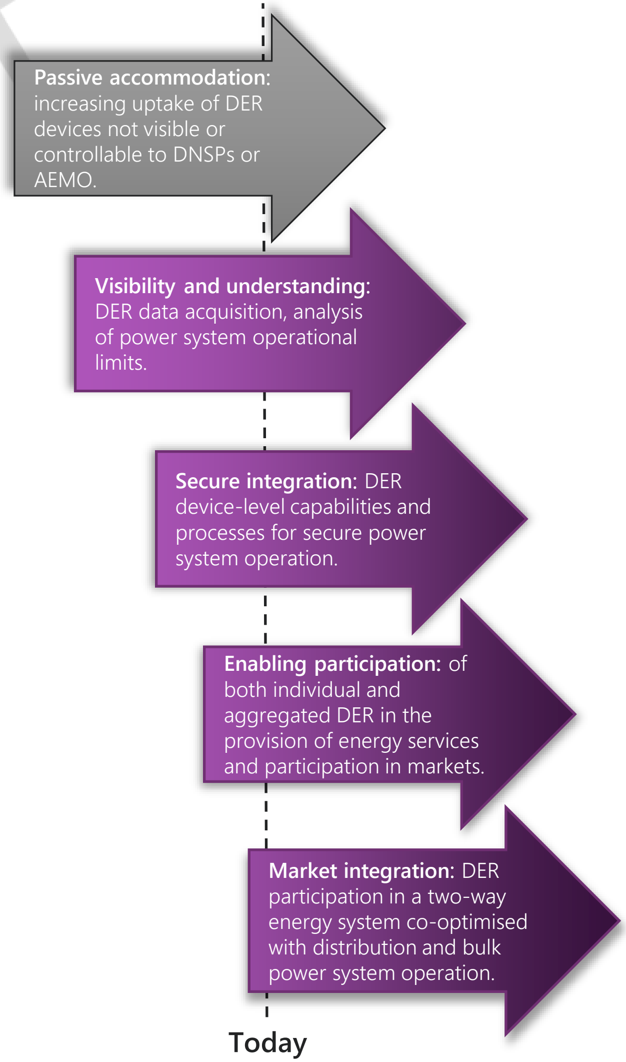
Accommodating the impact of this uptake across the electricity supply chain has come with significant costs to consumers. Today, the digital revolution enabled by the internet means there is significant opportunity to better integrate the future DER fleet, co-optimising it within the wider energy system for the benefit of all end users.

Figure x sets out a high-level view of the sequence of stages necessary to transition from the accommodation of passive devices to empowering and enabling more active DER participation. Stages inter-relate and overlap.

This will require empowering, incentivising, and enabling DNSPs and consumers to become more active participants in our power system and market.

In this Engineering Framework and upcoming DER discussion paper will focus on the *technical* enablers that support the proposed DER integration objectives and how they interact with the *regulatory* and *market* enablers.

Figure x: Sequence of stages for DER integration



Work in progress

There are several existing roadmaps for the integration of DER, including the ENA's Network Transformation Roadmap (with CSIRO), Open Energy Networks review (with AEMO) and Smart Grid Roadmap, the ESB DER Integration Roadmap, ARENA's Distributed Energy Integrated Program (DEIP), and the WA DER roadmap.

Given the complexity, pace of change, and number of actors involved in successfully integrating DER into the power system, AEMO sees a need to work with industry to ensure these existing roadmaps are complemented with the latest available information on power system needs

This section provides a snapshot of the extensive work already underway across industry to support DER integration, organised in terms of the DER integration stages in Figure x. It concludes by pointing to the need for a dedicated industry discussion on future DER integration priorities. AEMO is in discussions with the other market bodies as to the best way to coordinate this work.

Visibility and understanding

AEMO's ASEFS2 system currently estimates regional DPV generation for the dispatch process using data on installed systems, measurements from a sample monitored systems and weather inputs. The DER Register, launched in 2020, is a database of installed DER devices for DNSP and AEMO planning and forecasting.

AEMO, through an ARENA funded collaboration with UNSW and Solar Analytics, has also been analysing monitored DPV system output data to better understand their behaviour during disturbances. This work, summarised in the Technical Integration of DER report, has provided an evidence base for updates to standards and improvements to how this behaviour is represented in power system models.

Many DNSPs have programs underway to improve visibility of their low voltage assets (including dedicated network monitoring and access to third-party monitoring data) to enable them to better understand the impact of growing DER uptake and quantify DER hosting capacity.

The DER Visibility and Monitoring Best Practice Guide is a collaborative industry effort to standardise DER monitoring data between technology vendors and service providers, enhancing its usability for different purposes.

Secure integration

AEMO's ongoing DER Operations workstream is focussed of the operational impact of increasing DER uptake on the power system. Work-to-date (summarised in the RIS, analysis for SA and 2020 ESOO) has identified an urgent need in SA, also emerging in other regions, for improved DER device performance standards and emergency curtailability.

This has informed the introduction of new technical requirements for DER in South Australia, through the SA government's Regulatory Changes for Smarter Homes. Nationally, AEMO is working closely with industry through the Standards Australia process to update the Standard for DER inverters (AS/NZS 4777.2) and the ongoing AEMC consultation on technical standards for DER.

The AER's is reviewing how it assesses DNSP investment to manage increasing DER penetrations in its DER integration expenditure consultation, with questions on the role of DNSPs to facilitate DER export being explored in the AEMC's Access, pricing and incentive arrangements for DER rule change consultation.

Enabling participation

Interoperability - the extent to which different devices and systems can work together - is a key enabler for both individual and aggregated DER participation. It comprises a chain of inter-related elements including device capability, systems interfaces, communication and data exchange.

Technological advances and digitalisation mean that consumers will not need to monitor electricity prices and decide how or when to participate. Should consumers wish to participate more actively in the energy market, these decisions could be set up to happen autonomously or in an agreed way via their retailer or aggregator

Different interoperability questions are being explored in DER management trials, and with industry collaboration through the DEIP Standards, Data and Interoperability Working Group to identify priorities for standardisation and consensus approaches.

The ENA's Smart Grid Roadmap identifies actions necessary for DNSPs to transition to system optimisation enabled by dynamic operating envelopes [link], a key technical enabler for efficiently integrating increasing DER participation in the future. The DEIP Dynamic Operating Envelopes Workstream is considering necessary reforms, drawing on learnings from different trials.

Market integration

Aggregation trials and demonstrations continue to explore how DER can deliver energy and ancillary services - e.g. Virtual Power Plant demonstrations have demonstrated the ability of aggregated DER to provide FCAS.

The ESBs P2025 market design work is considering the role of DER in the provision of different system services. Initiatives being considered to activate the demand side of the market (Wholesale Demand Response mechanism and the a two-sided market) would enable end users with installed DER and responsive load to actively participate and trade in energy and ancillary services in a way that supports the underlying needs of the power system.

DER power system integration plan

As part of the Engineering Framework, see a need for a dedicated broad engagement process with industry and the other market bodies aimed at sequencing key technical actions necessary to enable full participation and market integration of DER.

AEMO is working with the other market bodies to coordinate a more detailed discussion paper focused on DER integration that could be released in early 2021, and will be followed by further stakeholder engagement. An updated forward plan of priority actions for technical enablement of DER would then be published following stakeholder engagement.

This plan will focus on establishing an agreed set of technical priority actions to ensure the continued safe and reliable operation of the power system for all consumers, and providing a platform for effective participation and market integration of DER.

For more information

please visit www.aemo.com.au

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