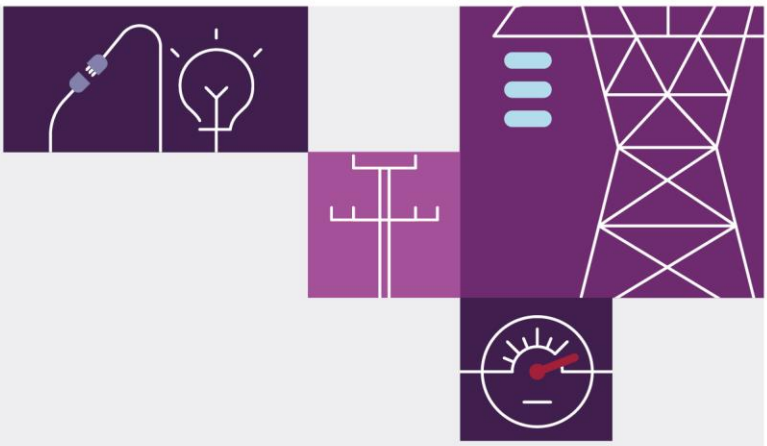
DRAFT
IESS implementation strawperson

July 2022

Integrating Energy Storage Systems project



Important notice

Purpose

AEMO has prepared this document to provide information about process and system changes required to implement and support new market and power system arrangements under the Integrating Energy Storage Systems Final Rule Determination.

Disclaimer

This document or the information in it may be subsequently updated or amended. This document does not constitute legal or business advice, and should not be relied on as a substitute for obtaining detailed advice about the National Electricity Law, the National Electricity Rules, or any other applicable laws, procedures or policies. AEMO has made every effort to ensure the quality of the information in this document but cannot guarantee its accuracy or completeness.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees and consultants involved in the preparation of this document:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this document; and
- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this document, or any omissions from it, or for any use or reliance on the information in it.

Version control

Version	Release date	Changes
0.1	07/07/2022	Draft version, released for stakeholder feedback

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

Contents

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

Tables

Figures

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

1 Introduction

To support the implementation of the Australian Energy Market Commission's (AEMC) Integrating Energy Storage Systems (IESS) Rule (Rule), the Australian Energy Market Operator (AEMO) published its High Level Design document (HLD) in its:

- Draft version in December 2021.
- Final version in July 2022.

This straw person document (Strawperson) is designed to be read in conjunction with the HLD, to provide the industry with greater context in respect of the implementation of the Rule.

1.1 Document purpose

This Strawperson presents an overview of system and process changes required to implement the Rule.

This Strawperson:

- Enables participants and other stakeholders to:
  - Understand IESS implementation at a more detailed level
  - Understand AEMO's system and process changes
  - Plan for their own system, process and operational changes.
- Provides transparency on the stakeholder and consultation processes that allow industry to input to the implementation decisions.
- Where appropriate, provides transparency to participants on the options which will be available to stakeholders once the Rule comes into effect.

1.2 Consultation process

AEMO has established a comprehensive engagement program to enable effective consultation between AEMO and stakeholders on matters relating to the Rule's implementation, consisting of:

- IESS Working Group (IESS-WG) for affected participants and other related bodies.
- Focus groups, information sessions and Q&A on technical matters undertaken by the IESS-WG as required.
- Formal procedure consultations and more informal calls for feedback on for example technical specifications.
- Discussion with individual stakeholders, as required.
- Dedicated webpage[1] and IESS mailbox (IESS@aemo.com.au) for stakeholder enquiries.

[1] https://aemo.com.au/initiatives/major-programs/integrating-energy-storage-systems-project

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

- Additional forums to be established in second half of 2022 for the broader implementation of the NEM2025 Implementation Roadmap.[2]

The key stakeholder engagement milestones in relation to the HLD and Strawperson are:

	Action	Timing	Status
1	Publication of Draft High Level Design	16 December 2021	Complete
2	Stakeholder Q&A Forum	4 February 2022	Complete
3	Written stakeholder feedback on Draft HLD	12 February 2022	Complete
4	Engagement through the IESS Working Group	Ongoing	In progress
5	Publication of Draft Strawperson and HLD update	7 July 2022	Complete
6	Written stakeholder feedback on Draft Strawperson	12 August 2022	Not started
7	Publication of Final Strawperson	1 September 2022	In progress

[2] For current version of the Roadmap: https://aemo.com.au/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/reform-delivery-committee

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

2 Current arrangements

The existing arrangements and system capabilities are important to understand when developing the agreed list of design priorities and scope of work for the IESS project. The relevant aspects of managing dispatchable units are described below for this purpose, with a summary in italics of the IESS-related changes.

AEMO's current registration process involves classifying and aggregating facilities for dispatch at a DUID level.

- Small units of identical technology and identical or similar design can be aggregated to a single unit for dispatch. For example, ten 5 MW wind turbines, under a single Energy Conversion Model (ECM), will typically be aggregated upon participant request, to a 50 MW semi-scheduled generating unit and represented in AEMO's systems as a single DUID.
- The bi-directional flow from a Battery Energy Storage System (BESS) or pumped hydro generator is currently represented with two DUIDs, one scheduled generation, the other scheduled load. Registration as both a market generator and market customer is required.

The IESS project will allow for registration and classification of one or more units (aggregated or otherwise) that includes a bi-directional unit (BDU) as an integrated resource system (IRS). Consequently, participants with BDUs will no longer need to register in two categories.

It is common to have more than one DUID in a generating system with a single connection point, where each DUID will often be managed and dispatched independently.

- Bidding, dispatch, conformance, constraints and Automatic Generation Control (AGC) are designed to be applied at the DUID level.
- A participant may wish to separate its system into multiple DUIDs for the purpose of partitioning to satisfy sales arrangements.

The IESS project will allow for aggregate conformance (unless the participant elects to have individual DUID conformance). Aggregate conformance processes will account for interactions with regulation and contingency FCAS provision, and will likely require bidding system updates and control system updates by participants.

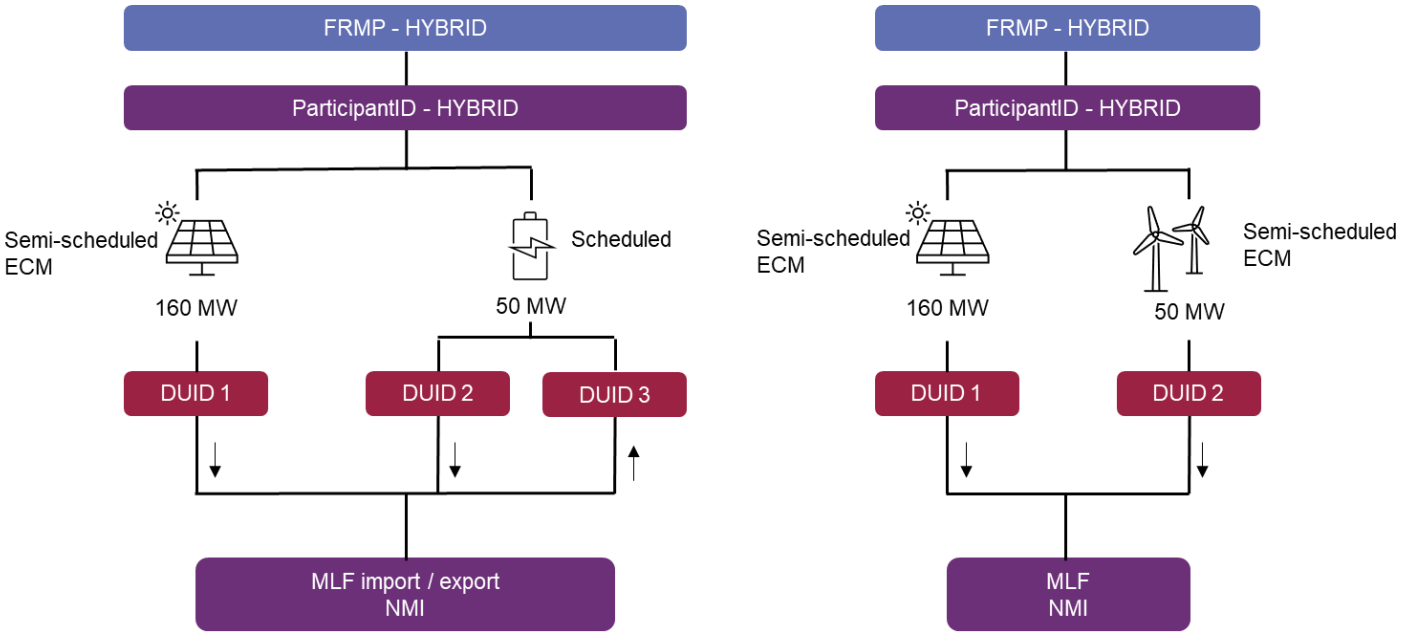
Settlement occurs for all participants based on energy at all connection points for which they are the financially responsible market participant (FRMP).

- The energy used in most calculations is a single net value i.e., the generation and consumption are offset against each other. In some instances, this allows for non-positive consumption or generation, depending on the connection point classification.

The IESS project includes changes to the settlement process that will clearly distinguish between consumed and sent-out energy where this is available through metering data. This is a fundamental change to how settlement occurs. Participants should understand the flow on impacts to various settlement outcomes.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

Figure 1 Illustration of hybrid arrangements that can be managed in AEMO systems currently



AEMO has existing arrangements to manage hybrid systems.

A hybrid system has more than one technology unit aggregated to one or more DUIDs behind the connection point. Table 1 describes AEMO's existing market arrangements for hybrid systems.

Table 1 National Electricity Market arrangements currently in place to manage hybrids.

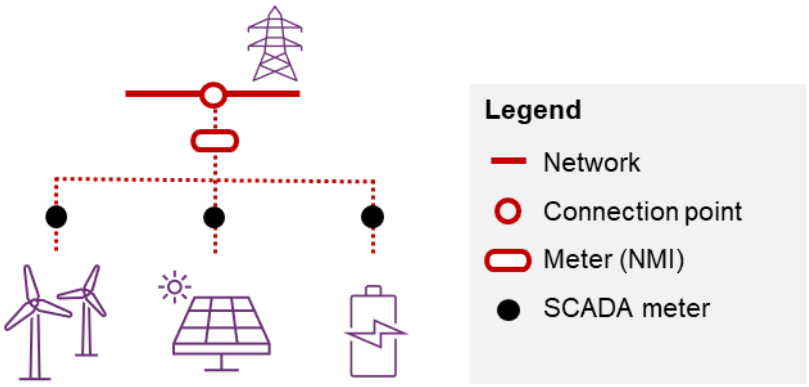
Process	Current arrangements
Registration, connection & classification	Provisions: • Allow multiple DUIDs in a system behind a single connection point • Allow DUIDs in a system to be made up of different types of units and of different classification Participant requirements: • All DUIDs in a system are required to have appropriate SCADA streams and to provide data to AEMO and Network Service Providers. • All scheduled and semi-scheduled units must be AGC capable
Dispatch	Arrangements: • Allow constraints at the individual DUID level • Allow constraints at the connection point level (by defining all DUIDs that are behind the connection point) • In certain instances, allow dispatch conformance as an aggregated cap, if approved by AEMO[3]
Forecasting & operational planning	• Use of dispatch self-forecasts for semi-scheduled units, where provided - if a participant self-forecast is provided, AEMO uses this instead of UIGF
Settlements and prudentials	• National Metering Identifier (NMI) at the connection point (shared with any other technology units in the system) • Transmission Node Identifier (TNI) if connected to the transmission system • Connection point identifier (CPID) with dual MLFs if required (noting that typically only storage has dual MLFs)

[3] This is limited to certain hybrids that requested an aggregate conformance cap in accordance with AEMO's (now withdrawn) "Registering a Hybrid Generating System in the NEM" fact sheet, and would require that AEMO contact the farm operator if individual DUID conformance is required.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

Process	Current arrangements
	• Two NMIs per bi-directional connection point (e.g. for a BESS) in the distribution system to manage the settlement of market fees
Retail and metering	• Metering and telemetry arrangements (Figure 2)

Figure 2 Example metering and telemetry arrangements for hybrid systems.



IESS implementation will further progress the management of bi-directional units and hybrid systems. It will clarify the classification and management of DUIDs within a single bidirectional system based on unit size and type.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

3 Design priorities

The following design priorities are key to successfully implementing the Rule.

- Management of hybrid systems (a non-NER term):
  - Hybrid systems have more than one technology unit aggregated to one or more DUIDs behind the connection point.
- Introduction of the IRS which is a system that has bi-directional flow at the connection point (not including auxiliary load):
  - Not all hybrid systems are to be defined as IRS. HLD Section 2.2 provides further information.
- The new registered market participant category, the *integrated resource provider* (IRP), to classify and/or connect:
  - Scheduled loads
  - Non-exempt generating units e.g., a grid scale generating system
  - Non-exempt BDUs e.g., a grid-scale BESS
  - Integrated resource systems
  - Market connection points ('retail' and small resources i.e., registration exempt generating units and BDUs).
- A new DUID type for BDUs with bi-directional bidding within a single bid.
- Dispatch conformance capability for a hybrid system at the aggregated DUID and individual DUID level with a conformance flag included in dispatch instructions.
- Systems and processes that can efficiently manage:
  - Hybrid systems, including IRS (more than one technology behind the connection point)
  - DC coupled hybrid systems (more than one technology behind the inverter) i.e., coupled production units (NER term)
  - BDUs and other IRS within medium term, short-term and pre-dispatch forecasting processes
  - Settlement processes based on gross consumed and sent out energy data including non-energy cost recovery
  - Market fee recovery for IRPs
  - IRP activity visible to market participants, AEMO and AER.

Examples of hybrid and DC-coupled systems are provided in the HLD.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

4 Overview of system and process changes

The IESS implementation scope requires material changes to many existing applications as well as a significant number of procedural updates.

The primary IESS system changes are provided in Table 2.

Table 2 Primary IESS-related changes to AEMO's systems

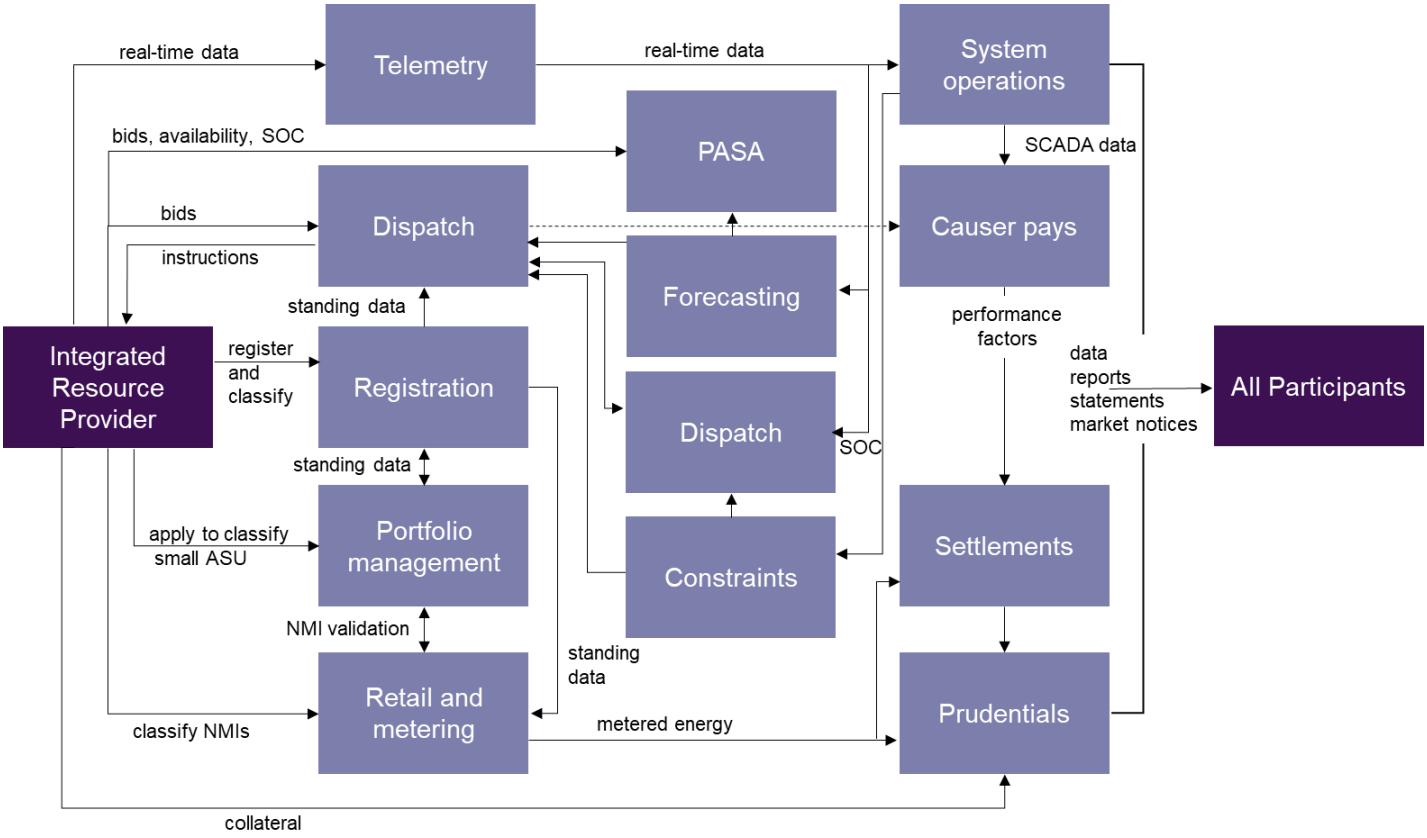
Process	Primary changes
Registration, connection & classification	• New registration category – the IRP – that can classify integrated resources (includes a bi-directional unit (BDU)), market generators, market scheduled loads and market connection points (previously market loads and small generating connection points) through AEMO registration processes and systems. • New dispatchable unit type, the BDU, which has the capability to send out and consume energy (that is not considered auxiliary load). • Removing the market small generation aggregator (SGA) registered participant category and transitioning all registered SGAs to the IRP participant category. An IRP will classify a small resource connection point rather than a small generating unit (SGU), in its capacity as a small resource aggregator (SRA). • Cater for the transitional rules that allow Market Small Generation Aggregators to participate in FCAS markets in respect of their SGUs. (HLD Section 2.3.2 provides further information regarding transitional arrangements).
Dispatch	• New bidding format for BDUs through a single bid form with 20 energy bid bands (10 for load-side capacity and 10 for generation-side capacity). • An option to have aggregated dispatch conformance for two or more DUIDs behind a connection point (or individual DUID dispatch conformance) with conformance information issued in dispatch instructions.
Forecasting & operational planning	• System changes to account for the new bidding formats, BDU information, and forecasting of VRE in a DC-coupled production unit.
Settlements and prudentials	• Collection, storage and use of settlement energy data based on direction of energy rather than category of energy source i.e., consumption and sent-out energy, not customer load and generation. • Modification of several non-energy cost recovery (NECR) mechanisms to utilise consumption and sent out energy values. • Update the Maximum Credit Limit (MCL) calculation to include values for ancillary services recovery in the credit limit calculation.
Retail and metering	• Refinement of the embedded network settlement by difference calculations to cater for consumed energy and sent-out energy changes.

The relevant procedures will be updated across each of the processes which are listed in Table 2. Where material changes to procedures are required, the standard consultation process will be followed. Other procedures will be updated with minor or administrative changes (such as terminology updates) in discussion with the IESS-WG.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

Figure 3 represents the main data flows between the functional areas affected by the Rule.

Figure 3 IESS functional model



The main IESS changes to each of these systems and processes are detailed in the following sections of this Strawperson.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

5 Registration and classification

Affected stakeholders	• Existing and prospective integrated resource providers • Participants with scheduled bidirectional units • Market small generation aggregators

A company may apply to connect plant to and provide services in the NEM through the registration process. It requires AEMO to validate a series of technical and business capabilities through an application process. Once registered, the participant and any classified resources are configured in AEMO's systems, and the participant conducts its business relevant to its participant category and plant or connection point classification.

The Rule introduces the IRP participant category which will be able to take on a range of roles that are currently separated. This necessitates changes to AEMO's registration and classification procedures and systems to enable the IRP participant category.

5.1 Overview of changes

The IRP is a market participant that may register and classify:

- a generating unit;
- plant as scheduled load;
- a BDU;
- end user's connection point (non-scheduled load); and/or
- A small resource connection point (previously SGU).

HLD Section 2.1[4] provides further information.

AEMO may require an IRP to notify AEMO if and once the IRP commences a retail business, for the purpose of managing prudential requirements.

A range of changes will be made to AEMO's registration systems to provide the new registration and classification options.

5.2 Changes to AEMO's registration system capability

AEMO's two key registration systems - registration manager client (RMC) and portfolio management system (PMS)[5] – will be updated to:

- Cater for participants to be an IRP.

[4] Available at https://www.aemo.com.au/initiatives/major-programs/integrating-energy-storage-systems-project

[5] The two key registration systems are registration manager client (RMC) and portfolio management system (PMS). RMC contains the standing data for registered participants and their classified units leveraged in dispatch, settlements, metering etc. PMS holds information on the classified ancillary service load and wholesale demand response (WDR) units aggregated under DUIDs that provide FCAS and WDR through AEMO's dispatch processes.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

- Cater for a new type of DUID to represent a BDU, which will include the following standing data required of participants:
    - Minimum (charge) and a maximum (discharge) capacity
    - Two pairs of ramp rates (maximum and minimum when consuming, maximum and minimum when sending out).
- Capture necessary information, if appropriate at the point of registration, to facilitate the introduction of IRSs, DC-coupled production units and aggregate dispatch conformance.
- Cater for the transitional arrangements as described in HLD Section 2.
- Remove the SGA category, with these aggregators to fall under the IRP category (with the label of SRA) – HLD Section 2.3 provides further information.
- Rebrand ancillary service load (ASL) as an Ancillary Service Unit (ASU) – HLD Section 2.4 provides further information.

5.3 Participant data model changes

The participant data model will be updated to account for new or modified data fields including:

- Conformance flag – to identify at the point of registration whether an IRP is opting in or out of aggregate dispatch conformance.
- Participant type – IRP will become a new participant type.
- DUID type – a new DUID type will be made available to represent a BDU.

AEMO understands this may result in a follow-on impact to participants, depending on their customised internal reporting and processes.

5.4 Procedural updates

The procedures listed below in Table 3 will be updated to reflect the identified changes to registration, classification and connection systems and processes.

Table 3 Procedures to be updated to reflect registration, classification and connection changes

	Procedure		Timing
1	System Strength Impact Assessment Guidelines V1.0	Minor and Administrative	Jun-24
2	Power System Design and Setting Data Sheets V1.1	Minor and Administrative	Jun-24
3	Guide to generator exemptions and classification of generating units (name change likely) - Classifying a DC-coupled System as a Semi-Scheduled Unit	Standard	Jun-24

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

6 Dispatch

Affected stakeholders	• Existing and new participants with BDUs and/or hybrids • Participants that use the dispatch data model for analytics

6.1 Overview of changes

Bidding and dispatch system changes are required to **accommodate the introduction of the BDU** classification, enabling storage units to submit a single bid covering generation and consumption. This will require changes to participant bidding formats for existing BDUs, and changes to AEMO's dispatch systems to integrate the new BDU bid structure.

The other major change to dispatch systems is the introduction of (the option for) **aggregated dispatch conformance** for two or more DUIDs behind a connection point. The implementation of aggregate dispatch conformance raises several issues which currently AEMO is working through with the industry. DUIDs participating in aggregate dispatch conformance will receive a new DUID flag in the dispatch instruction which identifies if the DUID is on individual or aggregate conformance. Additionally, aggregate dispatch conformance is likely to require participant control system changes for the purpose of managing ancillary service enablement and dispatch, depending on the final implementation solution.

Participant testing of new systems and processes for dispatch will take place as part of a market readiness program.

6.2 The introduction of the bidirectional unit

The introduction of the BDU classification will enable storage units to submit a single bid, and to receive a single dispatch instruction, in comparison with the current arrangements, where bidding and dispatch is in respect of a scheduled generating unit and a scheduled load. (HLD Section 3.1 provides further background.)

Participants will be required to adopt bidding format changes (across API, FTP and web channels) that accommodate the following:

- 20 energy bid bands for a BDU DUID and two pairs of ramp rates (with bands 1 to 10 for consumption, and 11 to 20 for generation).
- Two sets of availability for BDUs (reflecting consumption and production availability).
- State of Charge (SOC) information for BDUs (as submission of SOC information may be required in the future).

Participants with a DC-coupled production unit that comprises multiple DUIDs will be required to ensure that the maximum availability in their bids does not exceed total inverter maximum capacity. AEMO will not be applying a validation (at the inverter level) to verify DC-coupled production units bid within their inverter maximum capacity, as this is a particular circumstance that is not easily accommodated in AEMO's systems.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

Other changes AEMO will make to the bidding system include:

- Applying validation that manages the pricing aspects of dual MLFs (HLD Section 3.1 describes the impact of different MLFs on price and that price must increase step-wise across the 20 bands).
- Remove logic associated with ramp rates and the 6 MW limit for aggregation (which is being removed).

AEMO's dispatch systems, including its dispatch engine (NEMDE), will be modified to consume and process the new format BDU bidding information from participants, and to integrate BDU bidding.

6.3 Aggregate dispatch conformance

The IESS project introduces the concept of aggregate dispatch conformance. Participants with hybrid systems will – subject to some exceptions – be able to use aggregate dispatch conformance to firm the output of VRE resources.

HLD Section 3.2 describes the mechanics of aggregate conformance.

There are complexities associated with aggregate dispatch conformance which currently AEMO is working to address, including through discussion with the IESS-WG, as well as the wider industry. In July 2022, AEMO plans to release an issues paper that will propose arrangements for aggregate dispatch conformance.

6.3.1 Complexities to be managed

System and process changes will be required to manage complexities created by the introduction of aggregate dispatch conformance. These include:

- Managing the need for individual conformance in particular circumstances.
- Potential inclusion of non-IRS in aggregate conformance i.e. mono-directional and mono-technology hybrids.
- Managing complications associated with FCAS provision in a hybrid, particularly in cases where not all DUIDs in a hybrid are enabled for FCAS and/or, in the case of regulation FCAS, are not all on AGC control.

Managing individual conformance in particular circumstances

Certain constraints (such as system strength constraints) are applied at the DUID level, where required, as they are intended to constrain the sent-out energy from a specific DUID, for example in relation to their technology-type. The types of constraints that may be applied at the DUID level will be specified in AEMO's operating procedure for dispatch[6]. The IESS updates to this procedure will be made available for stakeholder feedback as part of the IESS implementation. When these constraints are applied, the constrained DUID needs to conform on an individual basis.

AEMO's dispatch processes will be changed to include a new hybrid conformance flag in dispatch instructions which will indicate whether a DUID within a hybrid is on aggregate or individual conformance.

This will be managed by maintaining a single aggregate conformance assessment, as well as any individual conformance assessments for DUIDs that are individually constrained. AEMO's conformance monitoring system will be updated accordingly, to account for switching between states of individual and aggregate conformance.

[6] See "SO_OP_3705 Dispatch Procedure" at https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/power-system-operation/power-system-operating-procedures

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

Participant control systems will need to manage the various permutations of individual and aggregate conformance.

Inclusion of non-integrated resource systems in aggregate conformance

Currently, the Rule does not allow for non-IRS hybrids (such as multiple-DUID mono technology, mono-directional systems) to elect for aggregated dispatch conformance. AEMO is in discussions with the AEMC with respect to updating the Rule to include the option for mono-technology generating systems and/or mono-directional hybrids to participate in aggregate conformance.

Management of aggregate dispatch conformance, AGC and FCAS enablement

AEMO recognises the importance to industry of allowing for aggregate dispatch conformance and FCAS[7] provision. AEMO is considering whether and under what circumstances a DUID on AGC could provide regulation FCAS, while also participating in aggregate dispatch conformance.

Changes to the way AGC operates may be required to accommodate aggregate dispatch conformance

Currently, AEMO's AGC system:[8]

- Does not cater for aggregate conformance and will always attempt to control a DUID to conform individually, even if the participant wants to take advantage of aggregate conformance.
- Will control an individual DUID providing regulation FCAS to move away from its linear ramp (based on its dispatch target) in a way that improves power system frequency. The AGC system must be changed to account for a hybrid that can deliver regulation FCAS and energy in aggregate.

FCAS is currently enabled at the DUID level

- In order to provide FCAS, a unit must maintain the appropriate enabled MW as head room (i.e. generation output can be increased, or load can be decreased, for raise service) and tail room (i.e. generation output can be decreased, or load can be increased, for lower service).
- As DUIDs move away from their individual dispatch targets to conform in aggregate, this gives rise to situations where DUIDs with different FCAS trapeziums could lead the aggregate to have insufficient head room or tail room to meet their contingency FCAS enablement in aggregate.
- FCAS and energy management for a hybrid in aggregate is complex in cases where not all DUIDs in a hybrid are enabled for FCAS, do not have similar trapezium parameters (such as maximum lower and upper angles), and are not all on AGC (for regulation FCAS).

AEMO is actively working internally, and externally with stakeholders, to navigate these complexities. Irrespective of the nature of the final implementation details, it is likely that changes to the participant control and bidding systems will be required to participate in aggregate conformance, particularly where AGC and/or FCAS market participation is also desired.

[7] See https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/ancillary-services

[8] Automatic Generation Control (AGC) is a centralised AEMO system which allows generators to be remotely controlled via SCADA by AEMO.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

6.4 Procedural updates

Table 4 Procedures to be updated to reflect dispatch changes

	Procedure	Consultation type	Timing
1	Regulation FCAS Contribution Factors Procedure	Standard	Mar-23
2	SO_OP_3705 Dispatch Procedure	Issues Paper (for feedback purposes)	Mar-23
3	AWEFS Energy Conversion Model	Minor and Administrative	Mar-23
4	ASEFS Energy Conversion Model	Minor and Administrative	Mar-23
5	Market Ancillary Service Specification	Minor and Administrative	Mar-23
6	Guide to FTP Energy, FCAS, and MNSP Bids and Offers	Information Paper	Jun-24
7	Forward Looking Loss Factor Calculation Methodology	Minor and Administrative	Jun-24
8	SO_OP_3708 Non-market ancillary services	Minor and Administrative	Jun-24
9	SO_OP_3717 Procedure for the exercise of RERT	Minor and Administrative	Jun-24
10	Constraint Formulation Guidelines	Minor and Administrative	Jun-24
11	Spot Market Operations Timetable	Minor and Administrative	Jun-24
12	Intervention Pricing Methodology	Minor and Administrative	Jun-24
13	Market Suspension Compensation Methodology	Minor and Administrative	Jun-24
14	Inter-network test guidelines V2.0	Minor and Administrative	Jun-24
15	Power System Model Guidelines V1.0	Minor and Administrative	Jun-24

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

7 Forecasting and operational planning

Affected stakeholders	All participants with generating, bidirectional or scheduled load units

7.1 Overview of changes

The Rule does not require significant direct changes to AEMO's various Projected Assessment of System Adequacy (PASA) and forecasting systems, though BDUs and hybrid/coupled systems will need to be integrated with these systems.

7.2 PASA

AEMO undertakes and publishes several forecasting and operational planning studies broadly referred to as a PASA, which consider different levels of detail and time horizons.

PASA processes and/or systems, where required, will be updated to:

- Consume and process BDU standing data and bids for the generation side only, as occurs for other energy constrained scheduled generating units.
- Consume and process DC-coupled unit standing data.
- Consider inverter and turbine values in a DC-coupled unit (as appropriate).
- Enable participants to submit SOC information (if included in scope) and AEMO's PASA systems will be changed accordingly to consume this information.

Both ST PASA and MT PASA forecast load information is to exclude the consumption availability of scheduled BDUs and scheduled loads, including BDUs classified as both scheduled load and scheduled generation DUIDs. This aligns with the treatment of scheduled loads in current ST PASA and MT PASA processes.

7.3 Operational Forecasting

Forecasts of intermittent generation are critical to maintaining both power system security and an efficient market. AEMO operates the AWEFS and ASEFS systems to forecast wind and solar power respectively. AWEFS and ASEFS produces forecasts from the following inputs:

- Real time SCADA measurements from the wind and solar farms.
- Numerical weather predictions from weather forecasters from around the world.
- Standing data from the wind and solar farms.
- Availability information provided by the wind and solar farms, that includes turbines and inverters unavailable and upper MW limits on the wind and solar farms.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

Changes to AEMO's operational forecasting processes include:

- Adopting processes for managing DC-Coupled facilities that are registered as semi-scheduled generators (under NER 3.7B(c)(3)), which could have multiple technologies behind one connection point registered as one DUID.
- Adopting processes for DC-coupled facilities to ensure appropriate unit capacities are input to forecasting models, that is semi-scheduled, scheduled or inverter-limited.

No changes to operational forecasting systems have been identified as a result of hybrids and aggregate dispatch conformance, or DC-coupled facilities (currently, AEMO's position is that it will not facilitate the registration of a single semi-scheduled generating unit that includes more than one VRE source – HLD Section 3.2.3 provides further context).

DC-coupled facilities must meet the following requirements to allow AEMO to perform its operational forecasting functions and meet its obligations under the NER:

- For a scheduled DC-coupled facility with VRE (for example, solar plus BESS), the ability to forecast availability in the ST PASA timeframe (7 days out) must be demonstrated to AEMO.
- For a semi-scheduled DC-coupled facility, real-time SCADA measurements must be provided to AEMO for use in producing forecasts, including:
    - measurements from the AC output of the DC-coupled facility.
    - measurements for each technology within the facility e.g. MW DC for solar and MW DC for BESS.

7.4 Longer term forecasting

No major changes to requirements of participants have been identified to allow for AEMO to perform its longer-term forecasting functions, including the Electricity Statement of Opportunities[9] and Integrated Systems Plan[10].

DC-coupled facilities must satisfy the following requirements, to allow AEMO to perform its longer-term forecasting functions:

- Availability of standing data for BDUs and DC-coupled units.
- Actual SCADA measurements per Section 7.3 .

Forecasting of intermittent resources in DC-coupled production units will need to consider both inverter capacity and intermittent capacity.

7.5 Procedural updates

Table 5 Procedures to be updated to reflect forecast and operational planning changes

	Procedure	Consultation type	Timing
1	Connection point forecasting methodology	Minor and Administrative	Jun-24
2	MT PASA process description	Minor and Administrative	Jun-24

[9] See https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo

[10] See https://www.aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

	Procedure	Consultation type	Timing
3	ESOO & Reliability forecasting methodology	Minor and Administrative	Jun-24
4	Electricity demand forecasting methodology information paper	Minor and Administrative	Jun-24
5	DSP forecasting methodology	Minor and Administrative	Jun-24
6	Energy Adequacy Assessment Projection guidelines	Minor and Administrative	Jun-24
7	Reliability forecast guidelines	Minor and Administrative	Jun-24
8	Reliability standard implementation guidelines	Minor and Administrative	Jun-24
9	Generation information guidelines	Minor and Administrative	Jun-24
10	Demand Side Participation Information Guidelines	Minor and Administrative	Jun-24
11	SO_OP_3707 Procedures for issue of directions and clause 4.8.9 instructions	Minor and Administrative	Jun-24

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

8 Settlements and prudentials

Affected stakeholders	All market participant categories

The **wholesale settlement system** settles NEM financial transactions, typically in 5-minute increments, between all market participants on a weekly settlement cycle, including:

- Energy.
- Ancillary services.
- Interventions, directions and the Reliability and Emergency Reserve Trader (RERT).
- Fees, reallocations and other services e.g., market shortfall / surplus, compensation, suspension.

8.1 Overview of changes

The Rule changes the framework for NECR, which will now be calculated on the share of gross measurements of consumed and sent-out energy for all participant categories. These measurements will be recorded as data streams for Adjusted Consumed Energy (ACE) and Adjusted Sent Out Energy (ASOE).

AEMO's prudentials system collates data for all settlement weeks that have yet to be paid, based on best available information, to estimate (and subsequently manage) each Market Participant's financial position in the NEM.

These systems need updating:

- For the introduction of the IRP participant category.
- To align with the concepts of:
    - Sent out energy rather than generation which is net of load.
    - Consumed energy rather than load that is net of generation.

AEMO is also taking the opportunity to update its settlement estimation process for days D-1 and D-2. This is because the calculations have not been reviewed for many years and the implications of the new data structure needs to be properly considered.

8.2 System changes for settlements and prudentials

The settlement and prudentials systems will be updated to accommodate the new energy data streams, new NECR calculations and to accommodate BDUs.

Table 6 below describes the major changes to AEMO's settlement systems that are required for IESS implementation. The sections below provide further detail on each change.

Participants will need to update any customised systems for settlements data to account for the IESS changes to AEMO's wholesale settlements data and engine. Changes to AEMO's Credit Limit Engine will reflect an updated methodology for the MCL calculation, to be consulted on with participants.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

Table 6 Key changes to AEMO's settlement systems to accommodate IESS

System	Key system changes
Wholesale settlements engine	Receive and store aggregated consumed and sent out metering data to replace existing generation and load data Settle each NMI on a consumed energy and sent out energy basis Implement new non-energy recovery calculations based on consumed and sent out energy
Settlement Estimation	Reflect the new settlement recovery calculations and data model in estimation calculations Update the calculation of D-1 and D-2 estimation
Credit Limit Engine	Inputs to MCL calculation to reflect new data model for consumed and sent out generation Update the MCL calculation to include values for ancillary services recovery in the credit limit calculation

Participants will be able to test new systems and processes as part of a market readiness program.

8.2.1 Future non-energy cost recovery calculations

The Rule will result in a fundamental change to settlements with a move away from the current category-based approach to a directional approach i.e., generator and customer energy will become sent out and consumed energy, regardless of the type of connection point from which it derives.

This change has a significant impact on non-energy cost recovery which now includes recovery from cost recovery market participants (CRMPs) based on their proportion of ASOE or ACE). The CRMPs are:

- Market Generators.
- Integrated Resource Providers.
- Market Customers.

HLD Section 6.1 describes current and future non-energy cost recovery arrangements. The standard recovery calculation determines an amount for each CRMP as the total amount charged for the region, multiplied by the CRMPs proportion of energy.

Accumulation meters will continue be settled on net flows until they are replaced with interval meters. They will be apportioned to ACE or ASOE depending on net direction of energy flow over the period of the reading (most likely ACE). This allocation is performed by the Profiling and Allocation Engine (PAE) in AEMO's Enterprise Metering Data Management (eMDM) database.[11]

8.2.2 Managing non-energy cost recovery carve-outs

In the Directions and RERT cost recovery calculations, it is a challenge to implement the cost compensation within AEMO's systems, due to the specific scheduled load carve-outs under the NER.[12] This is for two reasons:

- A scheduled load connected to the distribution system is not always simple to identify or the energy data associated with the connection point is not easy to access.
- A scheduled load in a hybrid system may not be measured directly, but rather as an aggregate of loads.

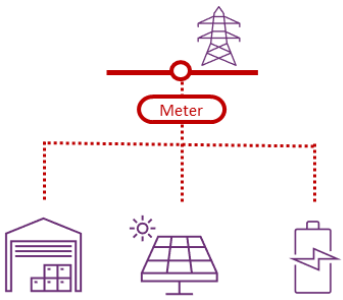
These complications are illustrated below:

[11] The eMDM component of MSATS is used for the receipt, storage, and aggregation of metering data.

[12] Recovery arrangements for Directions (energy), Directions (FCAS) and RERT are per NER clauses 3.15.8(b), 3.15.8(g), and 3.15.9(e) respectively.

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

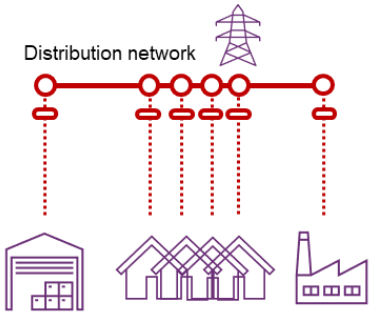
Figure 4 Scenarios requiring consideration of scheduled loads to calculate non-energy costs



The scheduled load from the BESS is measured as part of all load – scheduled load from the BESS, unscheduled load from the data centre and auxiliary load from the solar farm – at the (NMI) meter at the connection point to the grid.

The settlement system manages this by utilising SCADA data from the BESS to determine it's scheduled load values.

To manage this long term would require something akin to DUID sub-metering that is available to AEMO.



The industrial scheduled load connected in the distribution system might not be transparent within the settlement system. This is because all NMI meter values of consumed energy for the FRMP at the TNI are aggregated to the FRMP-TNI level (in this case including a data centre and small customer premises).

Options to manage this issue are under consideration by AEMO.

AEMO proposes to:

- Review the policy intent from when this was established to be comfortable it is still appropriate.
- Assess the options for scheduled load consumption reads that are not currently available for wholesale settlement.

In managing these complications, AEMO will ensure that AEMO is transparent to the market about instances where SCADA data is substituted for NER-compliant revenue meter data.

8.3 Procedural updates

Table 7 Procedures to be updated to reflect settlements and prudentials changes

	Procedure	Consultation type	Timing
1	Carbon Dioxide Equivalent Intensity Index Procedures	Standard	Jun-24
2	NEM Settlements Estimation Policy	Standard	Jun-24
3	Electricity Fee Structures	Standard	Jun-24
4	Credit Limit Procedures	Minor and Administrative	Jun-24
5	Settlements guide to ancillary service payments and recovery	Minor and Administrative	Jun-24
6	NEM Direction Compensation Recovery	Minor and Administrative	Jun-24
7	WDR Baseline Eligibility Compliance and Metrics Policy	Minor and Administrative	Jun-24
8	NEM Settlements Revision Policy	Minor and Administrative	Jun-24
9	RRO PoLR Cost Procedures	Minor and Administrative	Jun-24

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

9 Retail and metering

Affected stakeholders	All participant categories

The retail and metering systems are used to store and process metering data which is used in the settlement of the market. These system functionalities include:

- User rights management for participant access to AEMO's systems.
- Connection point meter standing data e.g., NMI, meter type, classification.
- B2B and B2M systems that process changes in standing data (such as customer transfers).
- Metering data that is provided for each NMI by the Metering Data Provider (MDP).
- Profiling and allocation of metering data that is aggregated and sent to wholesale settlement.

9.1 Changes required

HLD Section 7.1 describes the manner in which that new functionality in AEMO's Market, Settlements and Transfer Solution (MSATS) system will:

- allow IRPs to be treated similarly to retailers; and
- incorporate NMI classification changes to identify bi-directional or small resource connection points.

Participants can anticipate the need for system updates to align with B2B system changes and will be able to test new systems and processes as part of a market readiness program.

Embedded networks are settled by difference between the parent and on-market child connection points. The adoption of gross consumption and sent out energy values for settlement creates the need to update the calculations for these connection points. Any changes are likely to be adopted through calculation updates in eMDM.

9.2 Procedural updates

Table 8 Procedures to be updated to reflect retail and metering changes

	Procedure	Consultation type	Timing
1	Retail Electricity Market Glossary and Framework	Standard	Jun-24
2	MSATS Procedure: CATS	Standard	Jun-24
3	MSATS Procedure: WIGS	Standard	Jun-24
4	Standing Data for MSATS	Standard	Jun-24
5	Metrology Procedure Part A National Electricity Market	Standard	Apr-24
6	Metrology Procedure Part B Metering Data Validation, Substitution and Estimation Procedure for Metering Types 1–7	Standard	Apr-24
7	MSATS Procedure: MDM	Standard	Jun-24
8	NEM RoLR Processes - Part A (MSATS)	Standard	Jun-24

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

	Procedure	Consultation type	Timing
9	Service Level Procedure: Embedded Network Manager Services	Standard	Jun-24
10	Service Level Procedure: Metering Data Provider (MDP) Services	Standard	Jun-24
11	NMI Procedure	Minor and Administrative	Jun-24
12	Service Level Procedure: Metering Provider (MP) Services	Minor and Administrative	Jun-24
13	NMI Standing Data Schedule	Minor and Administrative	Jun-24
14	Meter Data File Format Specification NEM12 and NEM13	Minor and Administrative	Jun-24
15	MDM File Format and Load Process	Minor and Administrative	Jun-24

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

A1. Abbreviations

This document uses many terms and acronyms that have meanings defined in the National Electricity Rules (NER). The NER meanings are adopted unless otherwise specified.

Abbreviation	Term
AGC	Automatic generation control
API	Application programming interface
ASL	Ancillary service load
ASU	Ancillary service unit
B2B	Business to business
B2M	Business to market (AEMO)
BDU	Bidirectional unit
BESS	Battery energy storage system
CompMon	Compliance monitor
DC	Direct current
DUID	Dispatchable unit identifier
ECM	Energy conversion model
EMS	Energy management system
eMDM	Enterprise meter data management
FCAS	Frequency control ancillary service
FTP	File transfer protocol
FRMP	Financially responsible market participant
IESS	Integrating energy storage systems
IRP	Integrated resource provider
IRS	Integrated resource system
MSATS	Metering settlement and transfer solution
MT PASA	Medium term projected assessment of system adequacy
NEM	National electricity market
NEMDE	NEM dispatch engine
NER	National electricity rules
PAE	Profiling and allocation engine
PASA	Projected assessment of system adequacy
PMS	Portfolio management system
RMC	Registration manager client
SCADA	Supervisory control and data acquisition
SGA	Small generation aggregator
SGU	Small generating unit
SOC	State of charge
SRA	Small resource aggregator
ST PASA	Short term projected assessment of system adequacy

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

Abbreviation	Term
UIGF	Unconstrained intermittent generation forecast
VRE	Variable renewable energy

© 2022 Australian Energy Market Operator Limited
The material in this publication may be used in accordance with the copyright permissions on AEMO's website.