Welcome to AEMO's WA DER Market Participation Forum

1 December 2021

Please note that this meeting is being recorded for note-taking purposes only.

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Welcome

Overview and objectives today

Tom Butler, Manager – Distributed Markets WA

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ACKNOWLEDGEMENT OF COUNTRY

We would like to acknowledge the Traditional Owners of country throughout Australia and recognise their continuing connection to land, waters and culture.

Today I would like to acknowledge that this presentation is being given on the land of the **Whadjuk** people of the Noongar Nation. I pay my respects to their Elders past, present and future.

AEMO Competition Law Meeting Protocol

AEMO is committed to complying with all applicable laws, including the Competition and Consumer Act 2010 (CCA). In any dealings with AEMO regarding proposed reforms or other initiatives, all participants agree to adhere to the CCA at all times and to comply with this Protocol. Participants must arrange for their representatives to be briefed on competition law risks and obligations.

Participants in AEMO discussions **must**:

1. Ensure that discussions are limited to the matters contemplated by the agenda for the discussion
2. Make independent and unilateral decisions about their commercial positions and approach in relation to the matters under discussion with AEMO
3. Immediately and clearly raise an objection with AEMO or the Chair of the meeting if a matter is discussed that the participant is concerned may give rise to competition law risks or a breach of this Protocol

Participants in AEMO meetings **must not** discuss or agree on the following topics:

1. Which customers they will supply or market to
2. The price or other terms at which Participants will supply
3. Bids or tenders, including the nature of a bid that a Participant intends to make or whether the Participant will participate in the bid
4. Which suppliers Participants will acquire from (or the price or other terms on which they acquire goods or services)
5. Refusing to supply a person or company access to any products, services or inputs they require

Under no circumstances must Participants share Competitively Sensitive Information. Competitively Sensitive Information means confidential information relating to a Participant which if disclosed to a competitor could affect its current or future commercial strategies, such as pricing information, customer terms and conditions, supply terms and conditions, sales, marketing or procurement strategies, product development, margins, costs, capacity or production planning.

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Online forum housekeeping

1. Please mute your microphone to avoid distracting background noises.
2. Video is recommended for presenters only, as this helps with webinar performance and minimises distractions. However, we encourage you to turn it on via Q&A.
3. We encourage you to ask questions and provide feedback.
   - Raise your hand during Q&A and wait till you're called upon. Don't forget to unmute and lower your hand after.
   - Use the chat function at any time during the presentation, we aim to respond to as many questions as possible.

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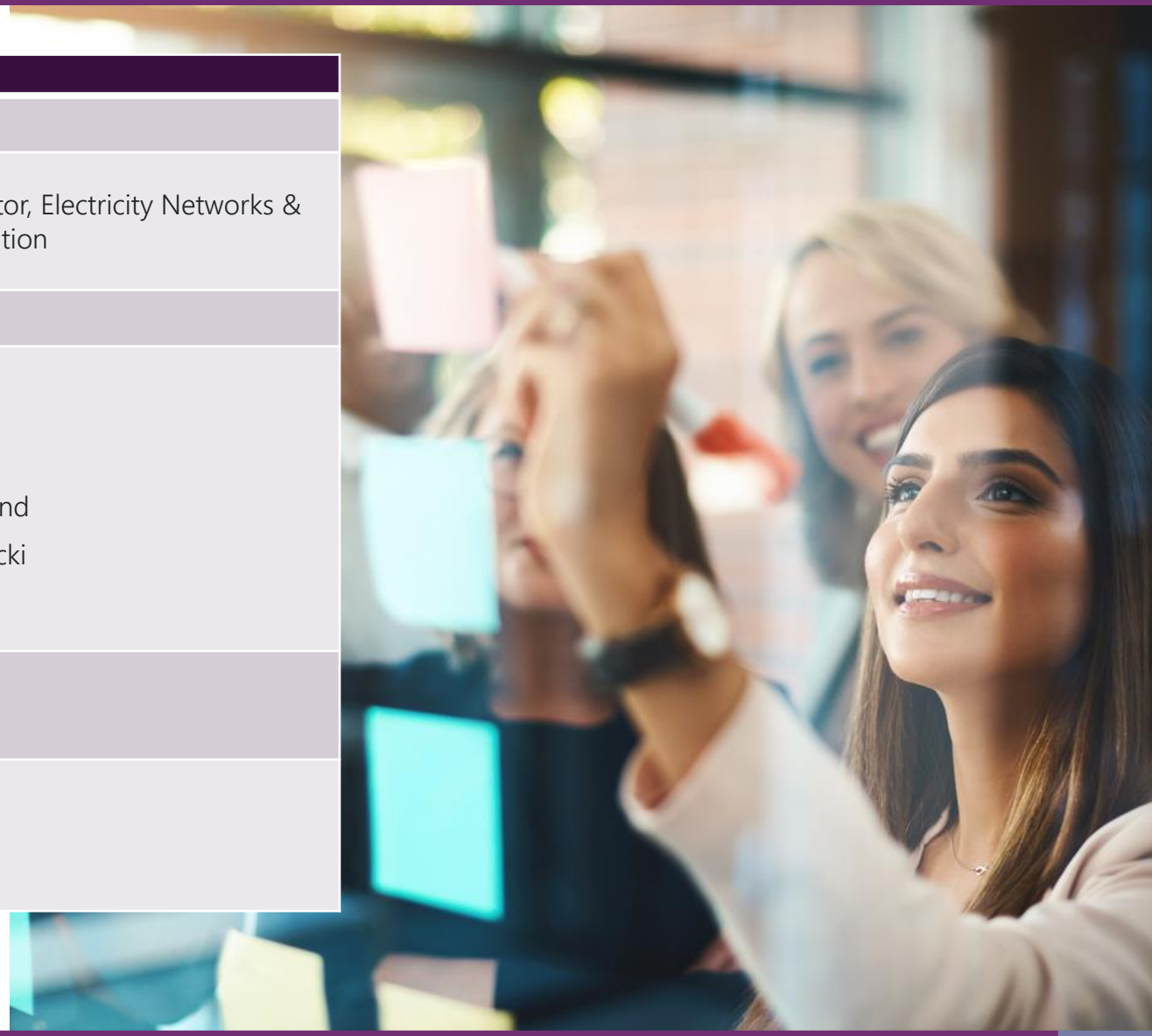
Agenda

Time approx. (AWST)	Item	Speaker
09.30am – 09.40am	Welcome	Tom Butler
09.40am – 09.45am	Guest speaker: Energy Policy WA	Aden Barker, Director, Electricity Networks & Customer Participation
09.45am – 09.55am	WA DER Program activities	Tom Butler
09.55am – 10.40am	Project overviews - DER Register - Technology Integration - Project Symphony - DER Participation Q&A	 - Roy Kaplan - Tom Glyde - Bruce Redmond - Natalia Kostecki
10.40am – 10.55am	Allowable revenue submission Q&A	Tom Butler
10.55am – 11.00am	Next steps Thank you & close	Christina Madsen Tom Butler



Aden Barker

Director, Network Regulation & Customer Participation,
Energy Policy WA

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Government of **Western Australia**
Energy Policy WA

DER Integration

EPWA Update

1 December 2021

Aden Barker

Director Network Regulation & Customer Participation

Working together for a **brighter** energy future.

The ‘journey’ thus far …

Energy Transformation Strategy

Wholesale Electricity Market (WEM changes

- Essential System Services framework (incl. Non-Cooptimised Essential System Services)
- Security Constrained Economic Dispatch
- Rules for large-scale storage participation
- Registration and participation framework
- Generator Performance Standards framework

Distributed Energy Resources (DER) Roadmap

- DER Register
- ‘Project Symphony’ commencement
- Updating forecasting, System Restart, and Under Frequency Load Shedding Schemes in response to evolving DER standards
- *Distributed Photovoltaic (PV) Management*

… to where we are going

DER Integration and Participation – implementing the DER Roadmap vision and determining how:

- roles and responsibilities are allocated (follow-on from August 2020 Discussion Paper);
- participation of aggregated DER is phased over time;
- dispatch works alongside other Market Participants;
- platforms across aggregators, AEMO, and Western Power interact and transfer data;
- aggregators, AEMO and Western Power obtain appropriate levels of visibility of DER; and
- aggregated DER can provide useful services to the market as it matures.
- *'Project Eagle' – reform to governance of energy regulation*

AEMO is critical to the success of the Energy Transformation Strategy

Introduction

State of play and progress under the DER Roadmap

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WEM: System outcomes and drivers

Rooftop PV is now the largest single generator in the SWIS with approximately 1.72 GW of grid-connected PV installed in the SWIS, exceeding the combined coal-fired capacity at 1.67 GW

Minimum demand event	14 March 2021	5 September 2021	23 October 2021	14 November 2021		Record
Time	12:05	12:25	12:45	11:30		-
Operational demand window	953 MW 12:00 – 12:30	866 MW 12:30 – 13:00	858 MW 12:30-13:00	761 MW 11:30-12:30		761 MW
System demand	1075 MW	985 MW	980 MW	870 MW		870 MW
DPV generation	1200 MW	1430 MW	1,470 MW	1,450 MW		1630 MW
NSG fraction	61%	61%	63%	65%		70%

Operational demand is the half hourly average market demand
System demand is a SCADA value on a 5 min average
DPV generation a 5 min average
NSG fraction = total VRE / (system demand plus DPV fraction + embedded generation) on a 5 min average

Transformation: Changing generation mix

- These conditions are escalating, AEMO's control rooms are now seeing in real time how Australia's energy transition is happening at pace
- AEMO CEO Daniel Westerman has set a priority "to develop grids that are capable of running at up to 100 per cent instantaneous renewable penetration by 2025"*

Figure 15 Change in average generation by fuel types, 2018 to 2020

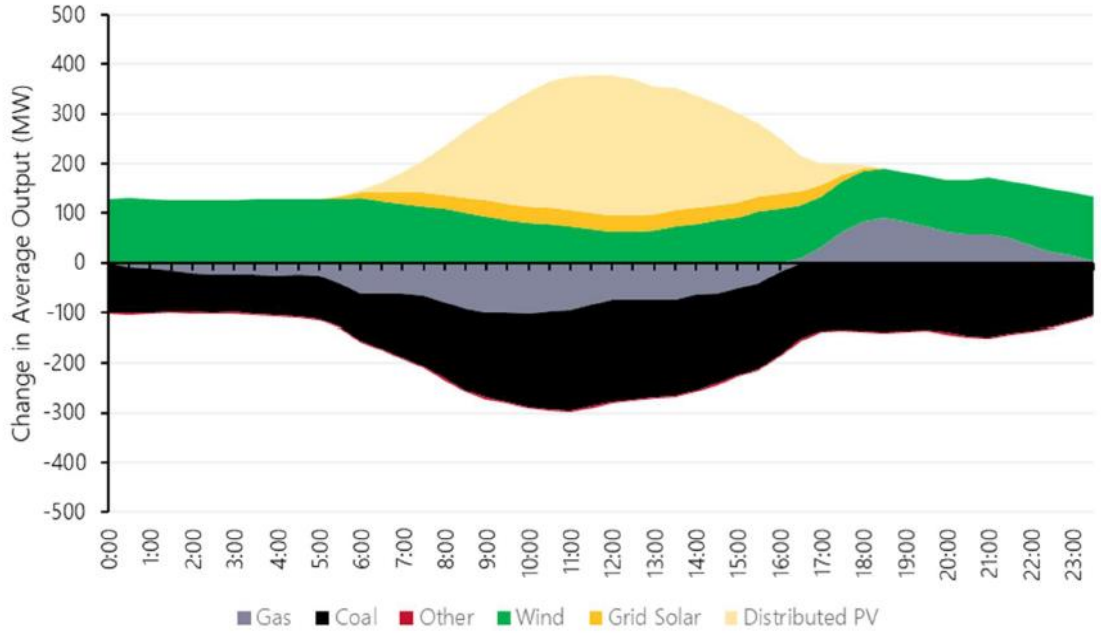
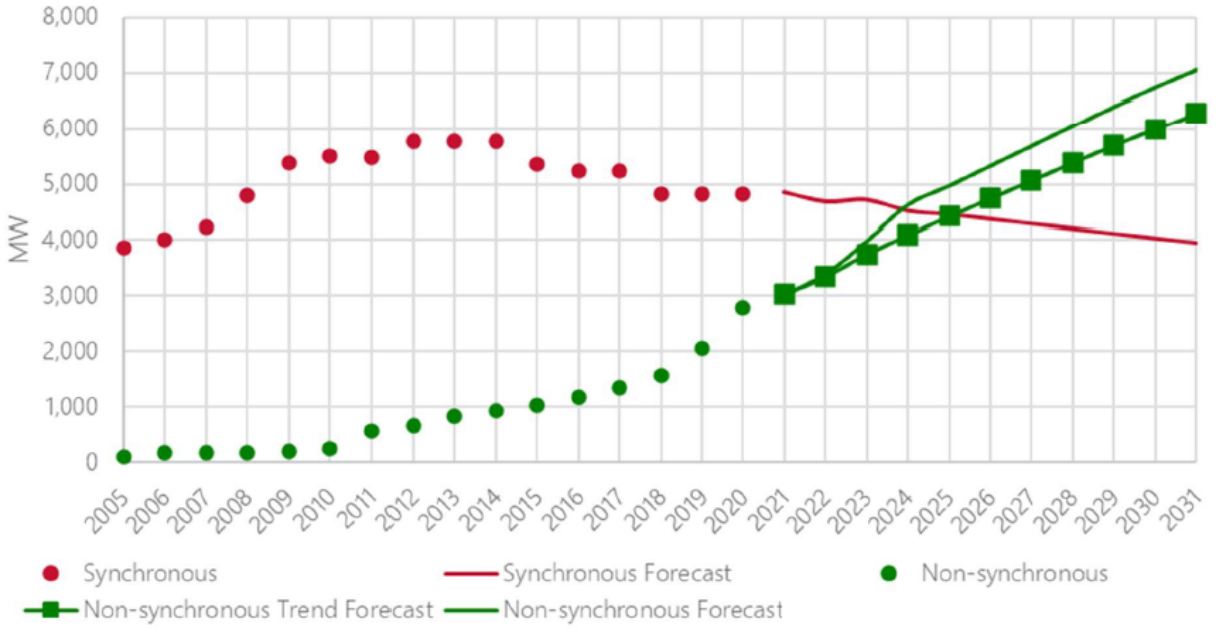


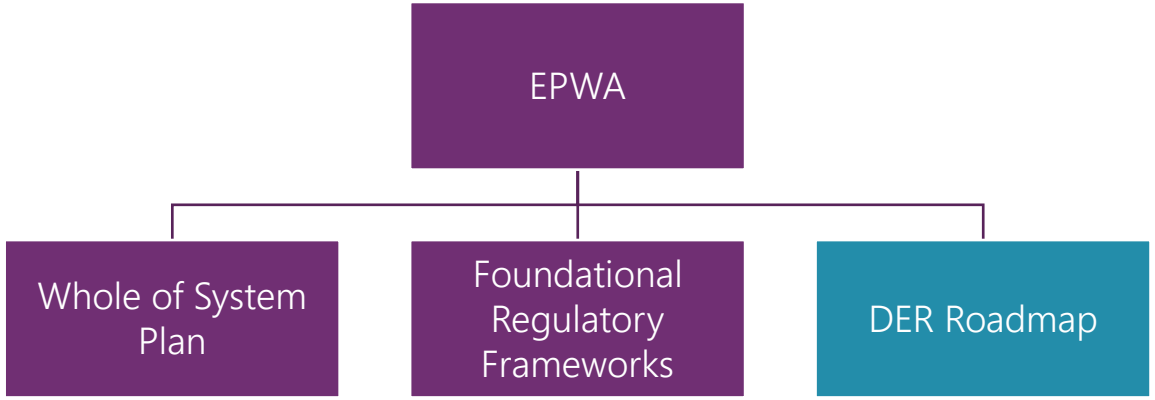
Figure 9 SWIS synchronous and non-synchronous generation mix, actual and forecast, 2005 to 2031



*https://aemo.com.au/newsroom/media-release/2021-esoo

Energy Transformation Strategy

The DER Roadmap forms the third pillar of the WA Government's Energy Transformation Strategy

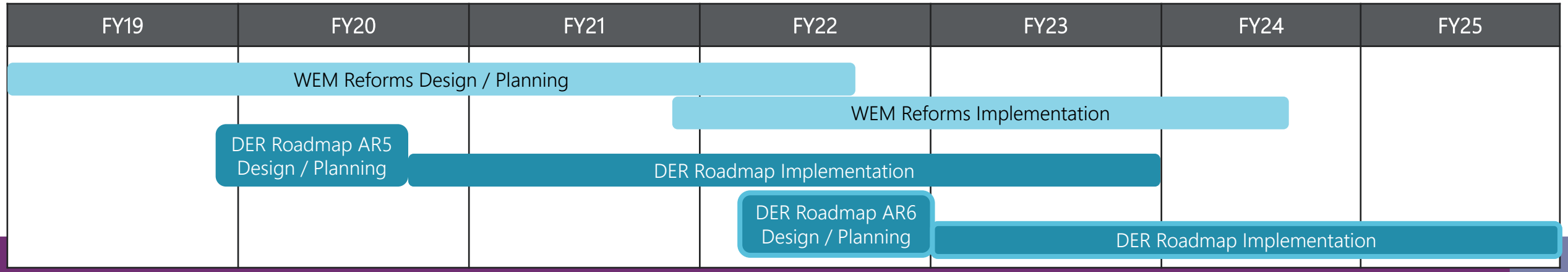


Energy Policy Western Australia

Leads WA's energy transformation and reform, providing policy advice to government and implementing changes to WEM/GSI rules to implement reforms.

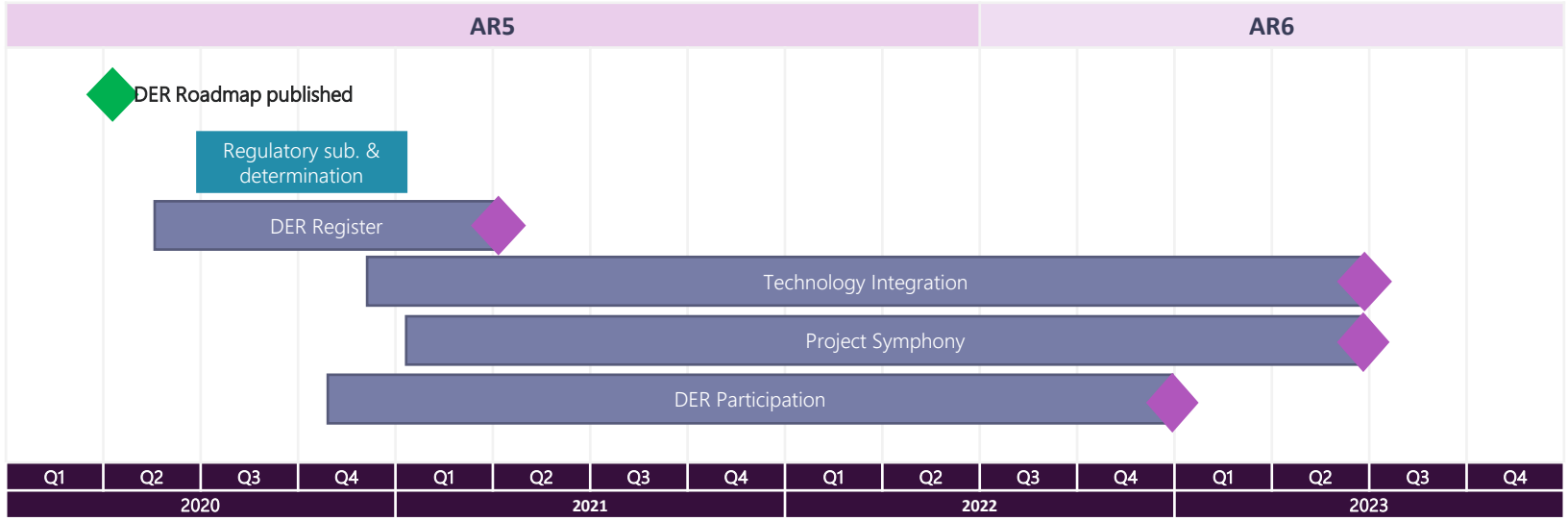
Australia Energy Market Operator

AEMO is the independent market and system operator for the WEM and SWIS. AEMO provides technical advice to EPWA in relation to market design and implementation of reforms, implements systems to enact new arrangements and manages those ongoing.



DER Program: project recap

Project	DER Roadmap Actions	AEMO Project Goals	Status
DER Register	15	Extend AEMO's DER Register systems to receive static DER device data from the Network Operator to enable visibility of DER devices installed across the WEM and SWIS.	Complete
Technology Integration	1-14	Facilitate the secure integration of DER technologies into the SWIS, by enhancing standards and AEMO's tools for the management of power system security and reliability in light of increasing DER penetration.	In-flight
Project Symphony	22-23	Demonstrate the role and requirements for AEMO's future distribution market operations on the WEM and SWIS through the implementation and piloting of platforms, systems and integration, whilst proving the capability of DER Aggregators to provide services to the WEM alongside the network.	In-flight
DER Participation	24-30	Design and implement forms of customer participation via DER in the WEM, to deliver efficient market outcomes while maintaining power system security	In-flight



AEMO WA DER Team

Tom Butler, Manager Distributed Markets WA

Christina Madsen, Communications and Engagement lead

Workstreams

Technical Program Delivery
- Project Management
- Design & develop

Architecture

Bruce Redmond, Project Symphony Product Owner

Tom Glyde, Power Systems Engineering Lead, DER

Natalia Kostecki, Regulatory & Market Analyst

Max van Someren, Project Manager

Eddy Etyngold, Program Manager

Nilesh Kevat, IT Lead

Jean-Philippe Montandon, Principal Analyst DER Market Systems

Alireza Fereidoun, Senior Engineer

Gary Eisner, Analyst Regulation

Karen Eagling, Scrum Master

Andrei Costache, Market Analyst

Rachel Tandy, Analyst Operational DER Management

Jason Hart, Senior Analyst

King Ho, Senior Business Analyst

ohn Armstrong, Business Analyst

+ more

DER Register

Enabling visibility of DER devices

Roy Kaplan, Specialist Metrology Regulation

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What is the DER Register?

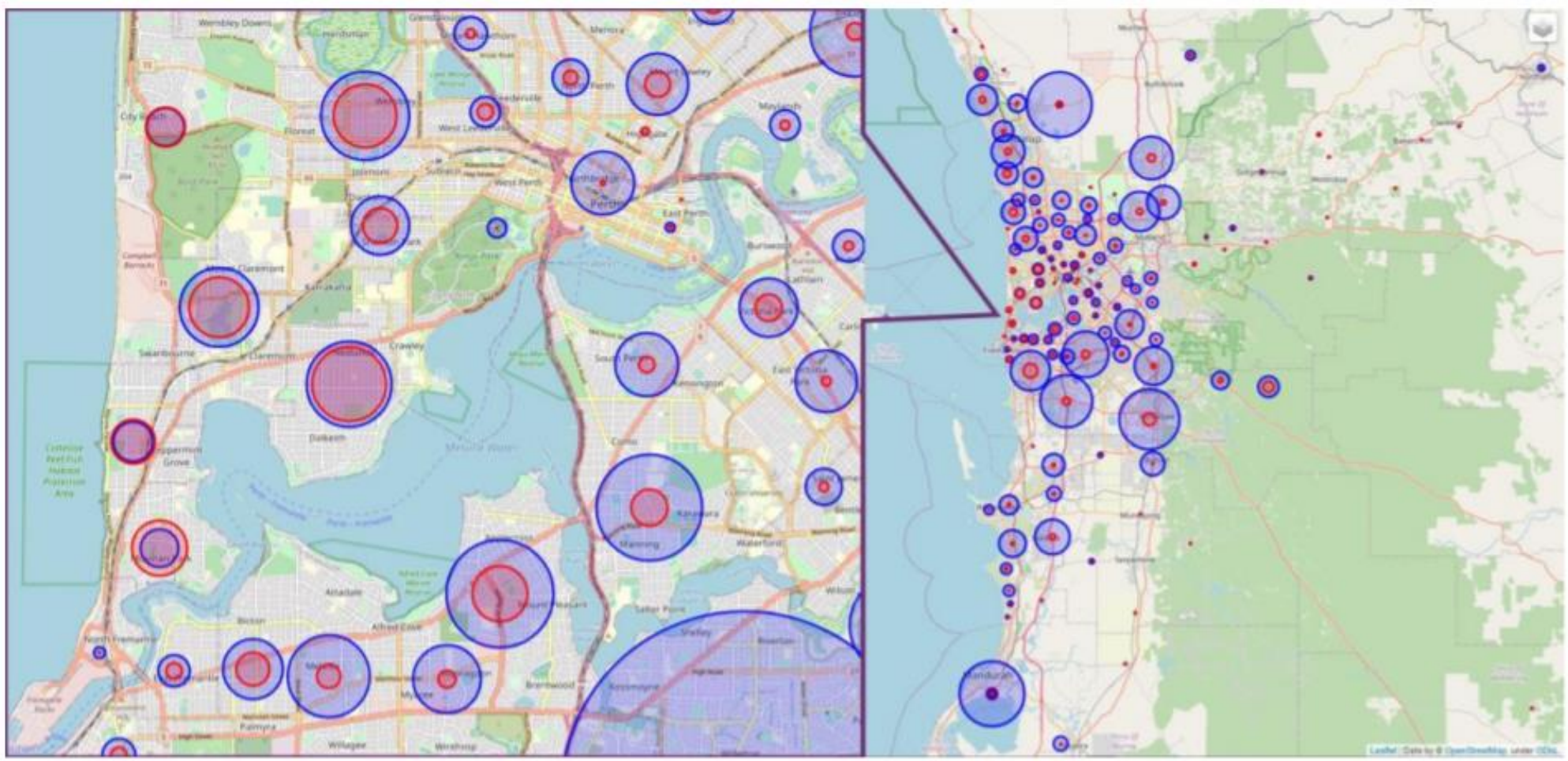
- The DER Register is a database that contains technical information about all customers' small generating or battery systems installed on the electricity distribution network. DER includes the following types of small generators.
- The DER Register is an enabling mechanism for DER installations in the SWIS. Accessing high quality information about DER devices helps AEMO to understand the performance of the 'fleet', and to forecast the affects of this performance of DER on the power system.

DER generation information is defined in the WEM Rules as standing data in relation to:

- A small generating unit being a generation system which has a rated capacity of less than 10 MW; or
- Storage works with an export capacity of less than 5 MW

https://aemo.com.au/en/energy-systems/electricity/der-register

DER Register data sample



Proportion of PV installed capacity (total = 1.72 GW)
Proportion of battery installed capacity (total = 13.8 MWh)

Moving forward – standing data

Standing data requirements change as distribution networks and DER becomes more active.

DER

- Generation, and storage device information

EV's

- Charging equipment information

Aggregation

- Market participation information

Technology Integration

Managing a secure and reliable power system

Tom Glyde, Power Systems Engineering Lead

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Inverter Standards

Performance

- LVDRT capability
- AS 4777.2:2020

Interoperability

- IEEE 2030.5
- CSIP-AUS

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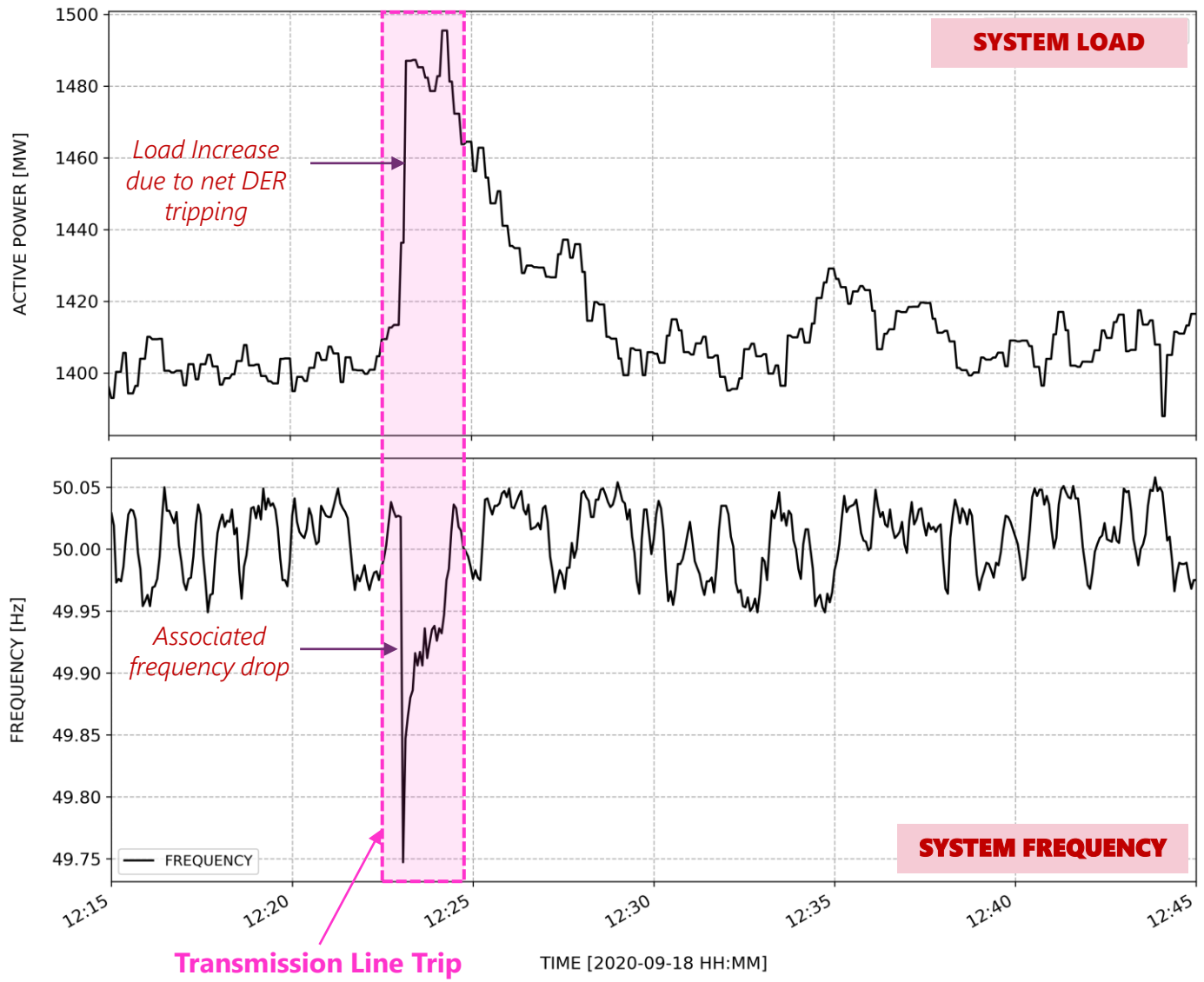
DPV Response

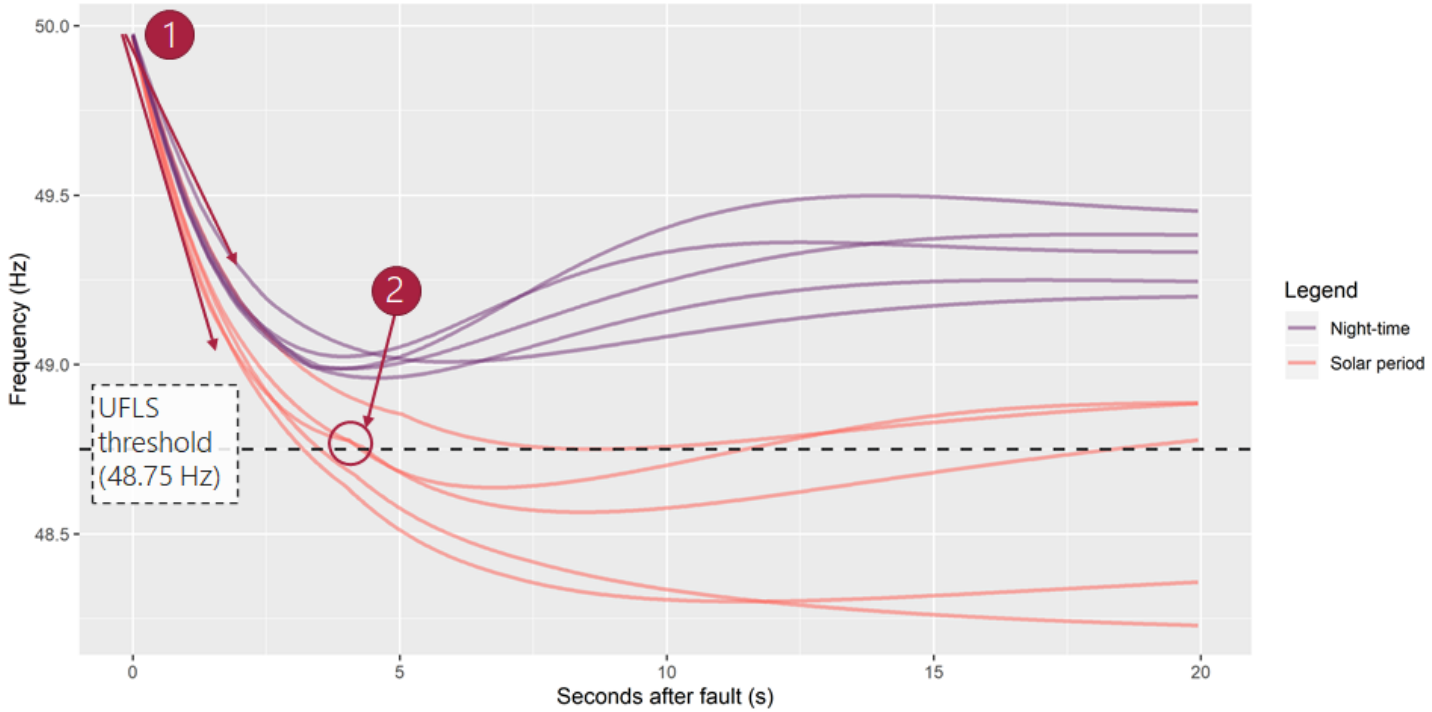
- During system disturbances (e.g. network faults), a portion of rooftop PV inverters in the system have been observed to trip unintentionally.
- This was not a significant problem in the past when there was lower penetration of DER in the system (ie DER < load tripping for network faults) and we now have single network contingencies resulting in loss of utility scale generation.

  AEMO continuing to build on work done in the NEM to develop models to refine DER tripping estimates and scenarios, including working with UNSW (Project MATCH).
- Case study: on 18th September 2020, there was a transmission line trip south of Perth at around noon, which resulted in a system load increase due to DER tripping (~100 MW) and, in turn, a frequency drop in the system.



Grid Response

Example of modelled frequency traces during solar and non-solar periods



1. DPV under-voltage trip increases initial contingency size

2. DPV under-frequency trip occurs several seconds after the initial fault and results in further declines in frequency

Under Frequency Load Shedding

- DPV reduces available traditional feeder level UFLS availability
- DPV increases the initial contingency size
- Under certain circumstances DPV can exacerbate the frequency depression requiring further load shedding

System Restart

- **Current processes**
  - Plan comprehensively refreshed to incorporate near term forecast for installed, uncontrolled DPV
- **Future role for DPV**
  - Higher installed DPV
  - Controllable DPV

Dynamic Model

- Model system events with load and DER tripping
- Validated using historical event data
- Tool for power system analysis

Continuing Work

- **Ongoing refinement of work completed**
  - Development of DPV tripping analysis
  - DER performance standards
- **Ongoing work with remaining DER Roadmap Actions**
  - Future System Restart Plan questions
  - Development of dynamic system model

Work will continue to be prioritised according to actual system needs

Project Symphony

Bruce Redmond, Principal DER Product Owner

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Project Symphony

Our energy future

WA largest orchestration pilot

In partnership with:

western power synergy AEMO GOVERNMENT OF WESTERN AUSTRALIA Energy Policy WA

Project Symphony has received support from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Advanced Renewables Program.

Project Symphony

Vision

A future where DER integration supports a safe, reliable and efficient electricity system, and where the full capabilities of DER benefit and provide value to all customers

Project Symphony is an exciting and innovative project where **customer distributed energy resources** like rooftop solar, battery energy storage and other major appliances, like air conditioning and pool pumps, will be orchestrated as a virtual power plant to **participate in a future energy market and unlock greater economic and environmental benefits** for customers and the wider community.

Project Symphony
Our energy future

In partnership with:
western power
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Energy Policy WA

At a glance

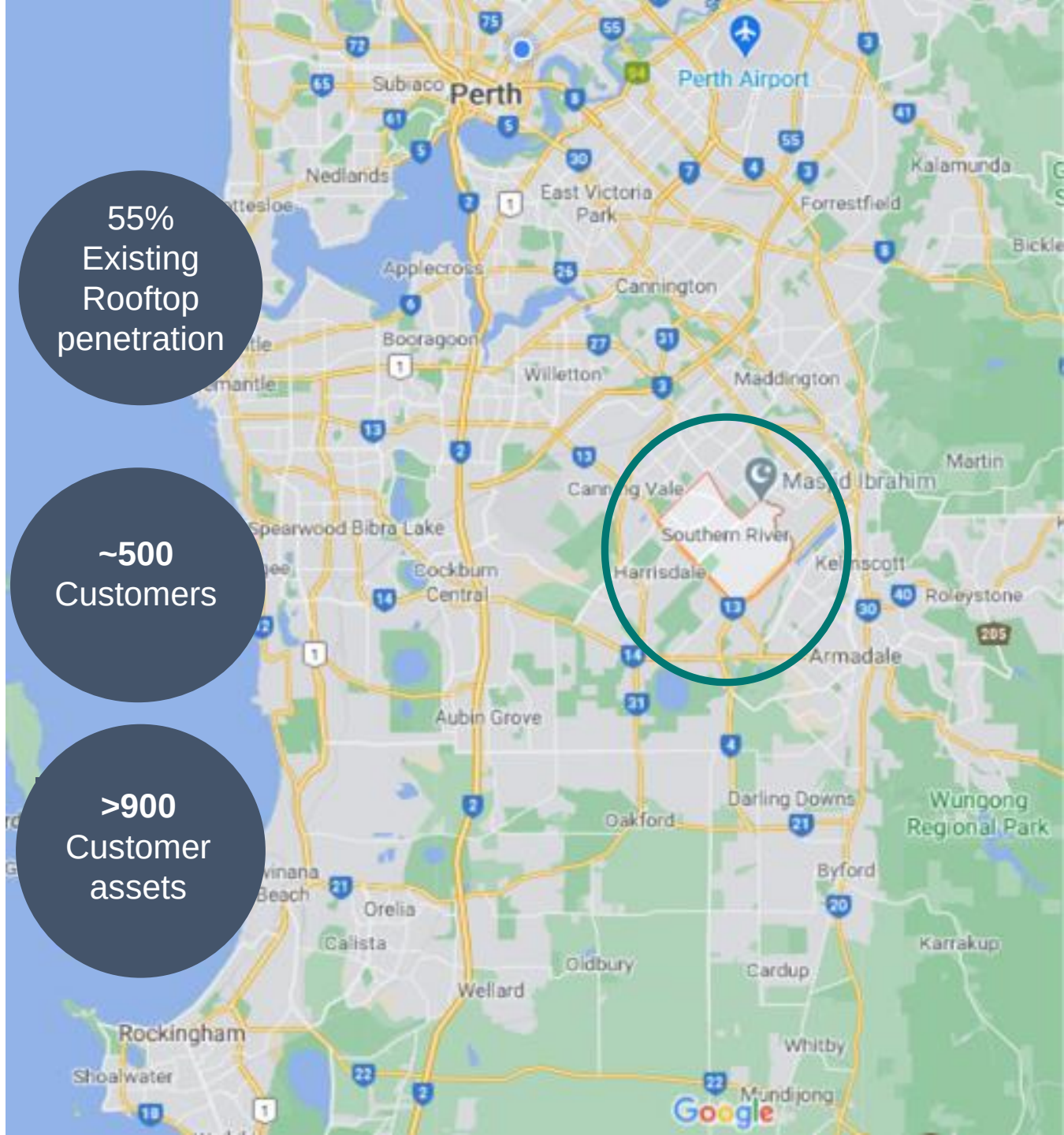
Overarching Project Objectives

- Technical Capability Pilot
- New Energy Market
- The Customer Experience
- Roles and Responsibilities
- Policy & Regulation

Asset Type	Target Capacity
Solar PV (curtailable)	1,500 kW residential 200kW commercial
HVAC (controllable)	6,000 kW residential 180kW commercial
Hot Water (controllable)	425 kW residential
Behind the Meter (BTM) Storage	750 kW residential 550kW commercial

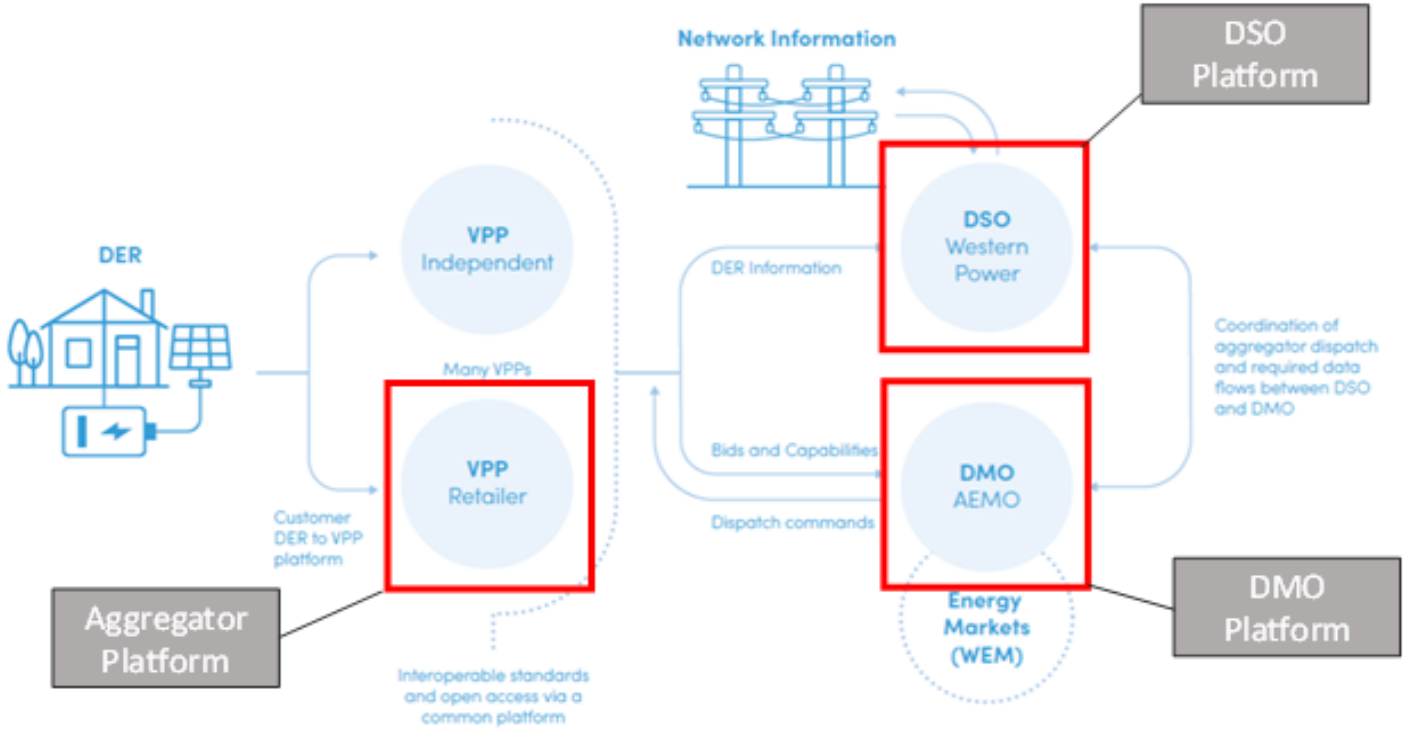
Project Symphony

Our energy future



What is AEMO's role in Project Symphony?

Fulfil the role of the **Distribution Market Operator (DMO)** as per a version of the "Open Energy Networks" (OpEN) Hybrid Model*



- The DMO organises and optimises all DER bids received from the Aggregator for participation in the markets for whole of system optimisation based on economic merit order.
- The DMO optimises the dispatch of energy resources in consideration of transmission network and distribution network constraints (as provided by the dynamic operating envelope published by the DSO, Western Power).
- The DMO sends out dispatch instructions to DERs via their Aggregator to be fulfilled, and then verified and settled.

*https://www.energynetworks.com.au/assets/uploads/open_energy_networks_-_required_capabilities_and_recommended_actions_report_22_july_2019.pdf

What is AEMO hoping to achieve?

Key Technical Functionality & Policy Solutions

1. **Data Exchange**: how to exchange data between all actors in an efficient and scalable way.

2. **Wholesale integration of DER**: how to schedule, dispatch and confirm performance of DER fleets as a type of scheduled resource for wholesale markets, whilst considering distribution network limits in the dispatch process (the pilot will not facilitate market participation).

3. **Local Network Services**: how to facilitate visibility and coordination of network services alongside market services, to enable DER aggregators to stack value streams efficiently.

4. **Definition of market arrangements and actor roles**: defining the roles, responsibilities, and interactions between and requirements applicable to actors for the operational DER orchestration model.

5. **Develop technical and policy solutions** aimed at enabling the future implementation of AEMO's role in DER Orchestration as the market operator and system manager, supported by DER Aggregators that provide AEMO with visibility and control of DER in reward for participation.

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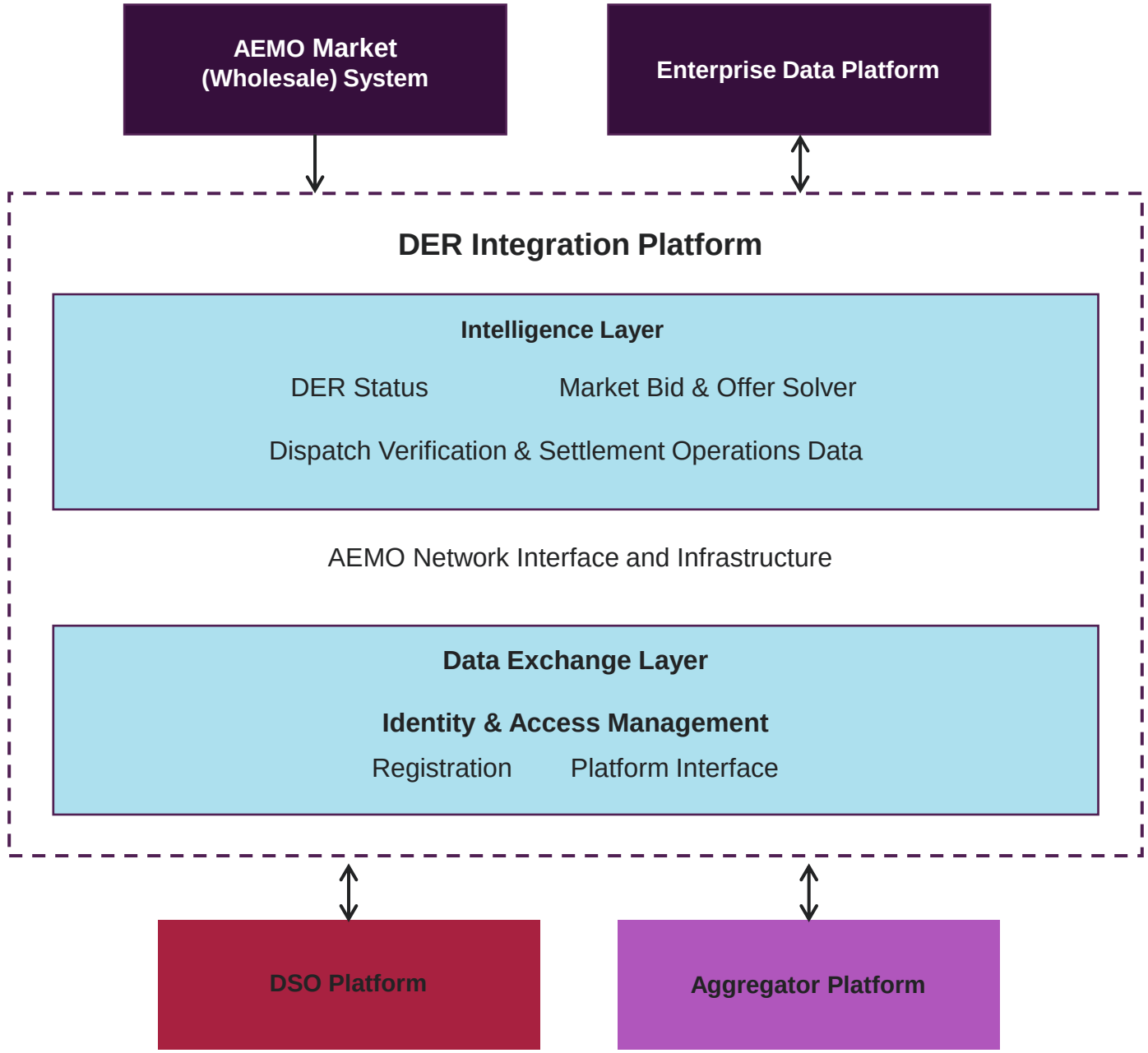
What are we Building?

Project Symphony
Market Platform Overview



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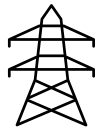
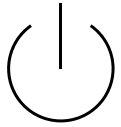
Project Symphony – Test scenarios

Balancing (Bi-Directional) Market



Network Services



Constrain to Zero

Contingency Raise

Energy Services - Bi-Directional - Balancing Market Offer (BMO): Offering (Sell) or bidding (Buy) energy into the balancing market, issuing, receiving & responding to dispatch instructions and settlement to determine the most economically efficient dispatch of generation to meet system electricity demand at a given time.

Network Support Services: a contracted service provided by a DER aggregator to help manage network constraints such as distribution level peak demand or reverse power flow and/or voltage issues as identified by the Distribution System Operator (DSO).

Constrain to Zero: AEMO dispatches an instruction to the Aggregator to constrain energy output from DER to zero export (net) or zero output (gross). This could be offered as a market service, or incorporated into normal dispatch arrangements if customers are remunerated appropriately.

Essential System Services (ESS) Contingency Raise: Market provision of a response to a locally detected frequency deviation to help restore frequency to an acceptable level in case of a contingency event (such as the loss of a large generator or load).

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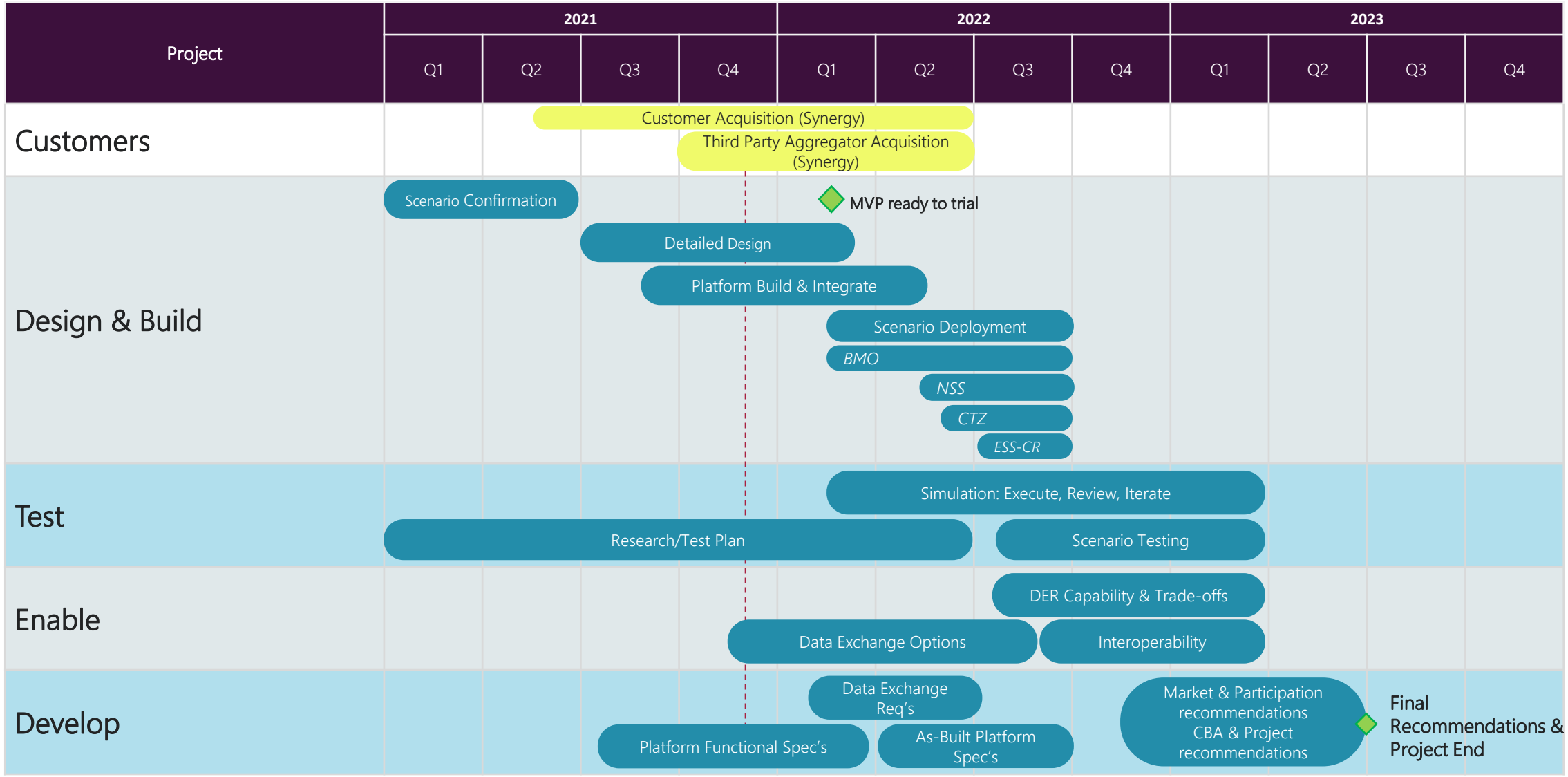
What have we achieved so far and what's next



DER Participation

Enabling aggregated DER services within a secure system

Natalia Kostecki, Principal Analyst – Policy & Market Development

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Integration & Orchestration

Supporting EPWA in the development of roles and responsibilities, participation models, services and implementation pathways

AEMO to facilitate the identification and implementation of -

- New / revised roles and entities
  - Distribution Market Operator
  - Distribution System Operator
  - DER Aggregator
  - DER Aggregation / VPP
- Operational interactions between entities to support DER service offerings in the market
- Simultaneous participation 'modes' and enabling mechanisms
  - On-market (Direct) – Registration regime
  - On-market (Indirect) – Market-based contract
  - Off-market – Non-market arrangements
- DER solutions to Immediate System Needs and how to deliver Future Needs under the participation modes
- Glidepath to full market participation

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Glidepath to full market participation

Transitioning from 'here' to 'there' without breaking anything on the way

- Identify 'end point' market design
- Prioritise delivery of Immediate System Needs
  - DPV Management
  - Visibility
  - Initial 'controllable' DER service offering
- Leverage reformed market design and timings on commencement of new arrangements for implementation pathways
- Incorporate learnings from the Project Symphony technology trial and other initiatives (i.e. DPV Management)
- Co-ordinate with DER service offerings provided via off-market arrangements
- Determine requisite regulatory arrangements
  - Embed entities and coordinate roles and interactions
  - Apply technical, interoperability and cyber requirements
  - Enable DER service offerings via the market
  - Enable the integration and coordination of DER service offerings across multiple instruments (i.e market and non-market arrangements)
  - Provide AEMO with ongoing capability to keep the power system secure during the transition

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Highlights of deliverables so far…

- Q2 2020 feedback to Energy Transformation Taskforce (ETT)'s proposed changes to the *Electricity Networks Access Code 2004* aimed at:
  - increasing opportunities for new technologies;
  - maximising the utilisation of the existing Western Power network; and
  - providing regulatory certainty and streamline the access arrangement process
- September 2020 -
  - feedback to ETT's ***Energy Transformation Strategy: Proposed Changes to the Electricity Networks Access Code Improving access to the Western Power network Consultation Paper*** (September 2020)
  - response to ETIU's ***Issues Paper - DER Roadmap: Distributed Energy Resources Orchestration Roles and Responsibilities*** (14 August 2020)
- December 2020 delivered *First Preliminary Design Paper for DER Participation* (December 2020) to EPWA
- April 2021 delivered *Second Preliminary Design Paper for DER Participation* (April 2021) to EPWA
  - Design log – output from internal AEMO workshops (January to March 2021)
  - Strawman – three participation pathways
  - Overview - metering and settlement options
- Q2 2021 participation in Western Power's *Technical Rules* workshops
- Q3 2021 co-drafted ***Renewable Energy Integration – SWIS Update*** (September 2021)
- November 2021 response to EPWA's Discussion Paper ***Low Load Responses – Distributed Photovoltaic Generation Management*** (19 October 2021)

AR6 – allowable revenue submission

Stakeholder overview

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WEM Transformation is already underway

Market conditions and outcomes influenced by DER (i.e. DPV) include:

- Low market demand events becoming more frequent
- Price outcomes spread more widely
- Increasing frequency of negative prices and market clearing at the floor price
- Afternoon ramping increasing as solar irradiance declines
- Increasing system volatility

These conditions increase…

- The need and costs of essential system services
- The need for AEMO to intervene in the market to maintain the security of the power system
- The need for integration of DER into the WEM to limit the growing gap in controllability, and to incentivise behaviours that lead to efficient outcomes for all electricity customers

https://aemo.com.au/-/media/files/electricity/wem/security_and_reliability/2021/renewable-energy-integration--swis-update.pdf?la=en

The need beyond FY22, and implications for AR6

- During 2020 AEMO prepared and an in-period regulatory submission for ERA assessment with scope, projects and timelines consistent with the DER Roadmap and WA Energy Minister's direction at that time
- Early implementation of some activities was required, to meet roadmap timelines and in response to system needs (e.g. DPV tripping behaviour)
- AEMO's DER projects in the AR6 submission are based on three main needs for further investment:
  - Project dependencies have impacted AEMO's project timing over the last 12 months, and some of the AR5 approved CAPEX will now extend into AR6
  - High uncertainty DER Roadmap actions were not included in the in-period submission, as the scope and timing was not expected to align to AR5, these are now considered in AR6
  - System needs have influenced scope and prioritisation

AR6 project overview

Project	Status	Overview / Objectives	Current Budget	AR6 Funding Request	Timing (FY)
Technology Integration	In-flight	**DER Roadmap Actions 1-14:** Facilitate the secure integration of DER technologies into the SWIS, by enhancing standards and AEMO's tools for the management of power system security and reliability in light of increasing DER penetration.	$3.2 M	$1.2 M (within current budget)	2021-23
DER Participation	In-flight	**DER Roadmap Actions 24-30:** Design and implement forms of customer participation via DER in the WEM, to deliver efficient market outcomes while maintaining power system security.	$2.6 M	$0.9 M (within current budget)	2021-23
Project Symphony (DER Orch. Pilot)	In-flight	**DER Roadmap Action 22-23:** Demonstrate the role and requirements for AEMO's future distribution market operations on the WEM and SWIS through the implementation and piloting of platforms, systems and integration, whilst proving the capability of DER Aggregators to provide services to the WEM alongside the network.	$10.2 M	$2.2 M (within current budget)	2021-24
DER Participation (implementation)	Not started	**DER Roadmap Action 30:** Implementation of DER orchestration model for participation of DER Aggregators in the WEM and SWIS, including planning, early implementation activities and development of an in-period submission to ERA for full implementation funding.	-	$2.0 M	2023-24
EVs in DER Register	Not started	**DER Roadmap Action 16 & EV Action Plan:** Expand the DER Register systems to collect data capture for electric vehicles for the purposes of forecasting and management of the system and market efficiently with an increasingly active distribution network.	-	$0.6 M	2024
DER data access and management	Not started	Improved access to DER-level data to improve forecasting systems by including DER dynamics leading to more efficient market outcomes and operational decision-making.	-	$2.1 M	2023-24
Enhanced visibility of DER participation	Not started	Enhanced information and support to enable DER Aggregators to access and understand opportunities from the WEM.	-	$1.5 M	2024-25
Network services market design & trial	Not started	**DER Roadmap Actions 31-32:** A trial to test and demonstrate the technical and regulatory capability for AEMO to implement a marketplace for network services in the WEM, alongside wholesale services.	-	$2.3 M (opex)	2024-25
		Total already approved AR6 funding:		$4.3 M	Capex
		Total new AR6 capex funding:		$6.2 M	Capex
		Total new AR6 opex funding:		$2.3 M	Opex
		Total AR6 funding:		$12.8 M	Totex

Questions?

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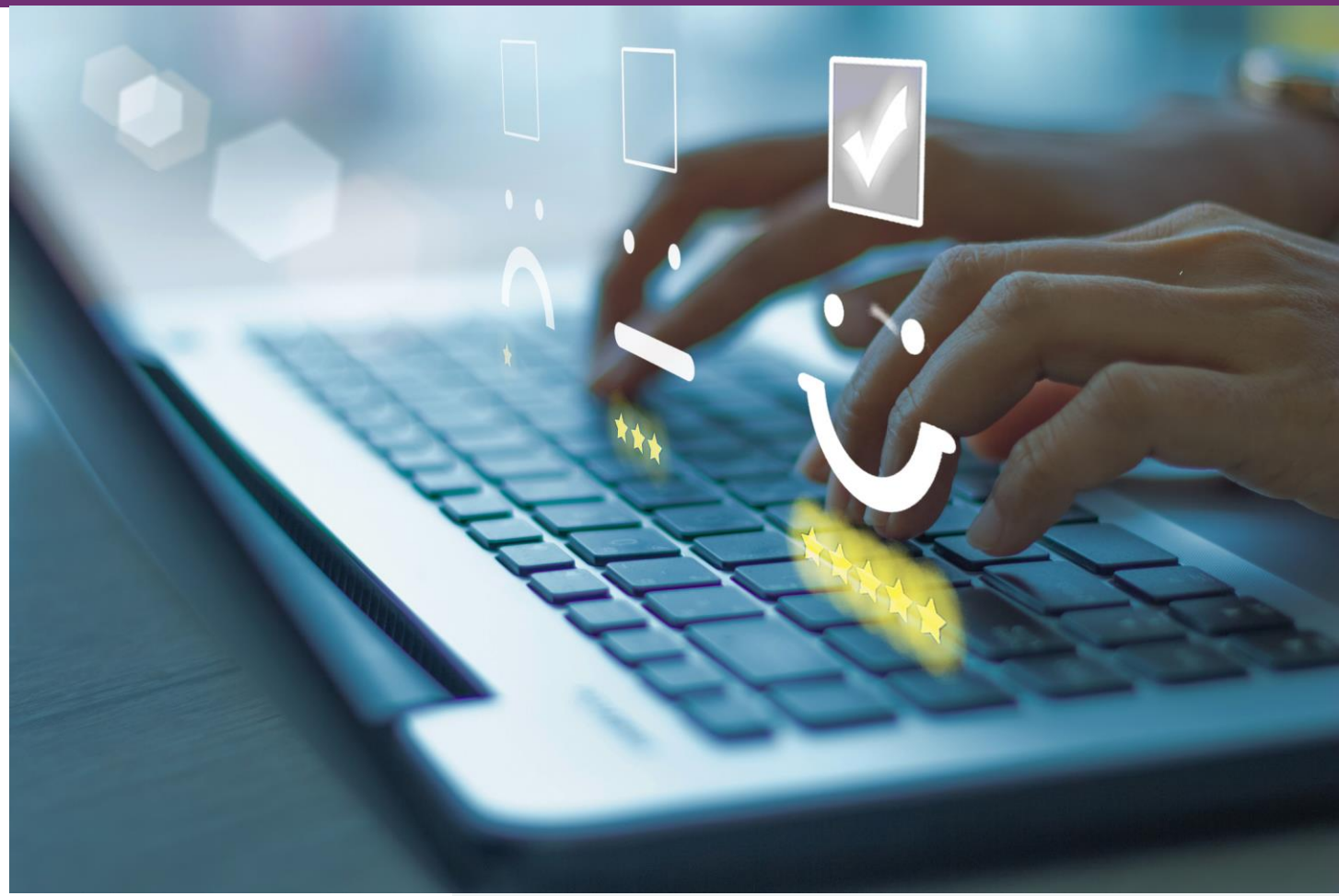
WA DER Market Participation Forum

- Terms of Reference (ToR) – your feedback is welcome.
- Scheduled quarterly – pending your feedback.
- Presentations, the ToR and other meeting documents will be available on the webpage: WA DER Market Participation Forum
- Please complete our post forum survey.



Thank you for attending the WA DER Market Participation Forum

For any queries or questions to today's session please email us at:
WADERProgram@aemo.com.au

For more information

please visit www.aemo.com.au

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