DER Market Integration Consultative Forum

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

28 July 2022

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**:

- Ensure that discussions are limited to the matters contemplated by the agenda for the discussion

- Make independent and unilateral decisions about their commercial positions and approach in relation to the matters under discussion with AEMO

- 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:

- Which customers they will supply or market to

- The price or other terms at which Participants will supply

- Bids or tenders, including the nature of a bid that a Participant intends to make or whether the Participant will participate in the bid

- Which suppliers Participants will acquire from (or the price or other terms on which they acquire goods or services)

- 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.

Today's meeting

Time	Item	Speaker
11:00 – 11:05	Welcome and introductions	Rachel Rodrigues McGown (AEMO)
11:05 - 11:15	Project EDGE Trial Update & Market Suspension Tests Results	Nick Regan (AEMO)
11:15 – 12:15	CBA Methodology Presentation	Dr Alina Dini (Deloitte)
12:15 – 12:25	Q&A	All
12:25 – 12:30	Future Meetings & Close	Rachel Rodrigues McGown (AEMO)

Project EDGE Trial Update

Nick Regan (AEMO)

Project EDGE update

Current position

- Formally writing up of results from Market Suspension tests

- Stakeholder Consultation - CBA Detailed Methodology

- Ongoing development of platform capability and sophistication

- Ongoing customer acquisition (including additional) C&I customers

- Two new aggregators being onboarded for participation from September

Key upcoming activities

- Publication of CBA Methodology Consultation Paper

- Further consultation on data exchange problem statements and use cases

- Wider sharing of results from Market Suspension tests

- Ongoing results analysis and input into reform

Market Suspension Preliminary Results

Nick Regan (AEMO)
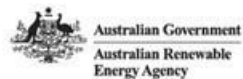
EDGE Market Suspension field tests

To operate the system AEMO needs:
1. **Visibility**: Telemetry in real time
2. **Predictability**: Generator forecasts
3. **Controllability**: Dispatch instructions
4. **Measurement**: Telemetry (settlement)

The AEMO, AusNet and Mondo team reacted quickly to establish a test plan to learn from this rare event

Why specific Market Suspension tests?

In Market Suspension AEMO was directing large scale generators. **What should this look like in a high DER future (via VPPs)?**

Hypothesis 1:
AEMO Dispatch Instructions that give a 'target' are more reliable than DOEs which give 'permissible limits'.

Hypothesis 2:
These two signals together will conflict at times and this needs to be understood to be managed in future operations.
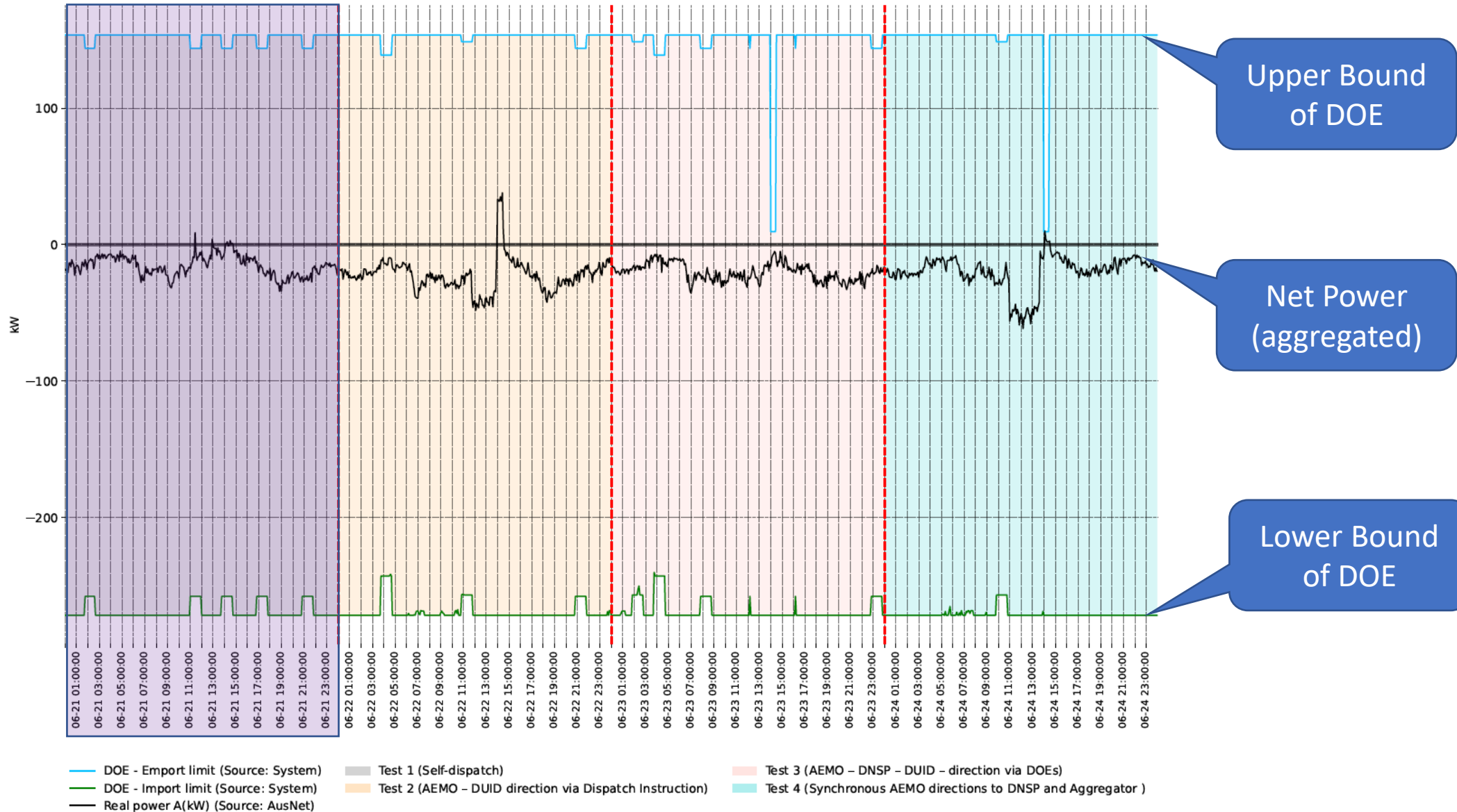
What did we do?

Test	Summary
Test 1 **Self-Dispatch (no AEMO direction)**	• In lieu of capability to dispatch VPPs at scale ('Controllability') i.e. current state, AEMO needs visibility (telemetry) and predictability (forecasts via boffers) to consider when directing large scale resources • **Q: What do VPPs do without AEMO direction?**
Test 2 **AEMO -> DUID direction via Dispatch Instructions**	• Under market suspension AEMO instructs generators/loads test is for future where controllability exists for VPPs (i.e. test will provide setpoints for aggregators to follow). • **How reliably can VPPs follow AEMO directions that differ from market incentivised behaviour?**
Test 3 **AEMO –> DNSP –> DUID direction via DOEs**	• Currently AEMO instructs NSPs to maintain a profile within their network, NSPs currently do this by shedding load or generation. • **Are DOEs a better mechanism than directing VPPs under a non-market use case (e.g. market suspension) ?**
Test 4 **Synchronous AEMO directions to DNSP and Aggregator (Test 2+3)**	• Testing synchronous instructions from AEMO to DNSP and Aggregator to see if this helps reduce potential conflicts. Test 2 & Test 3 together. • **Is it worth building capability to do both mechanisms for redundancy?**

Findings to be shared in coming weeks and relate to some gaps as highlighted in the Engineering Frameworks Paper[1]

Test 1 – Actual Net Active Power from Portfolio

Upper Bound of DOE

Net Power (aggregated)

Lower Bound of DOE

Legend:
- DOE - Export limit (Source: System)
- DOE - Import limit (Source: System)
- Real power A(kW) (Source: AusNet)
- Test 1 (Self-dispatch)
- Test 2 (AEMO – DUID direction via Dispatch Instruction)
- Test 3 (AEMO – DNSP – DUID – direction via DOEs)
- Test 4 (Synchronous AEMO directions to DNSP and Aggregator)

Test 1
Q: What do VPPs do without AEMO direction?

Self-Dispatch (no AEMO direction)
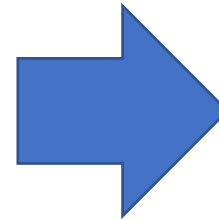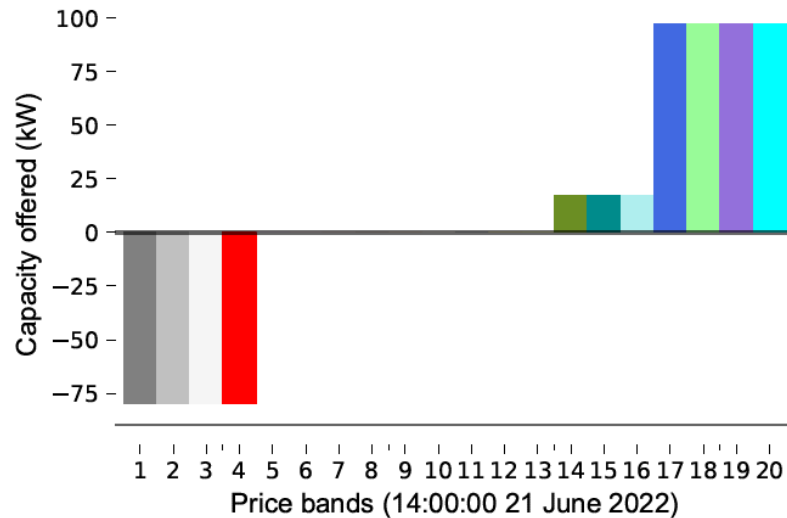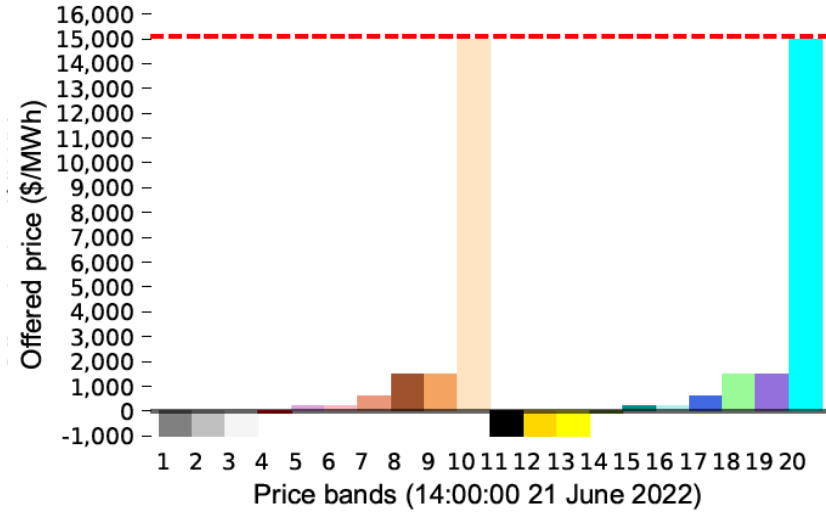In lieu of capability to dispatch VPPs at scale ('Controllability') i.e. current state, AEMO needs visibility (telemetry) and predictability (forecasts via boffers) to consider when directing large scale resources

Test 2 – Actual Net Active Power from Portfolio

—— DOE - Emport limit (Source: System)	Test 1 (Self-dispatch)
—— DOE - Import limit (Source: System)	Test 2 (AEMO – DUID direction via Dispatch Instruction)
—— Real power A(kW) (Source: AusNet)	Test 3 (AEMO – DNSP – DUID – direction via DOEs)
	Test 4 (Synchronous AEMO directions to DNSP and Aggregator)
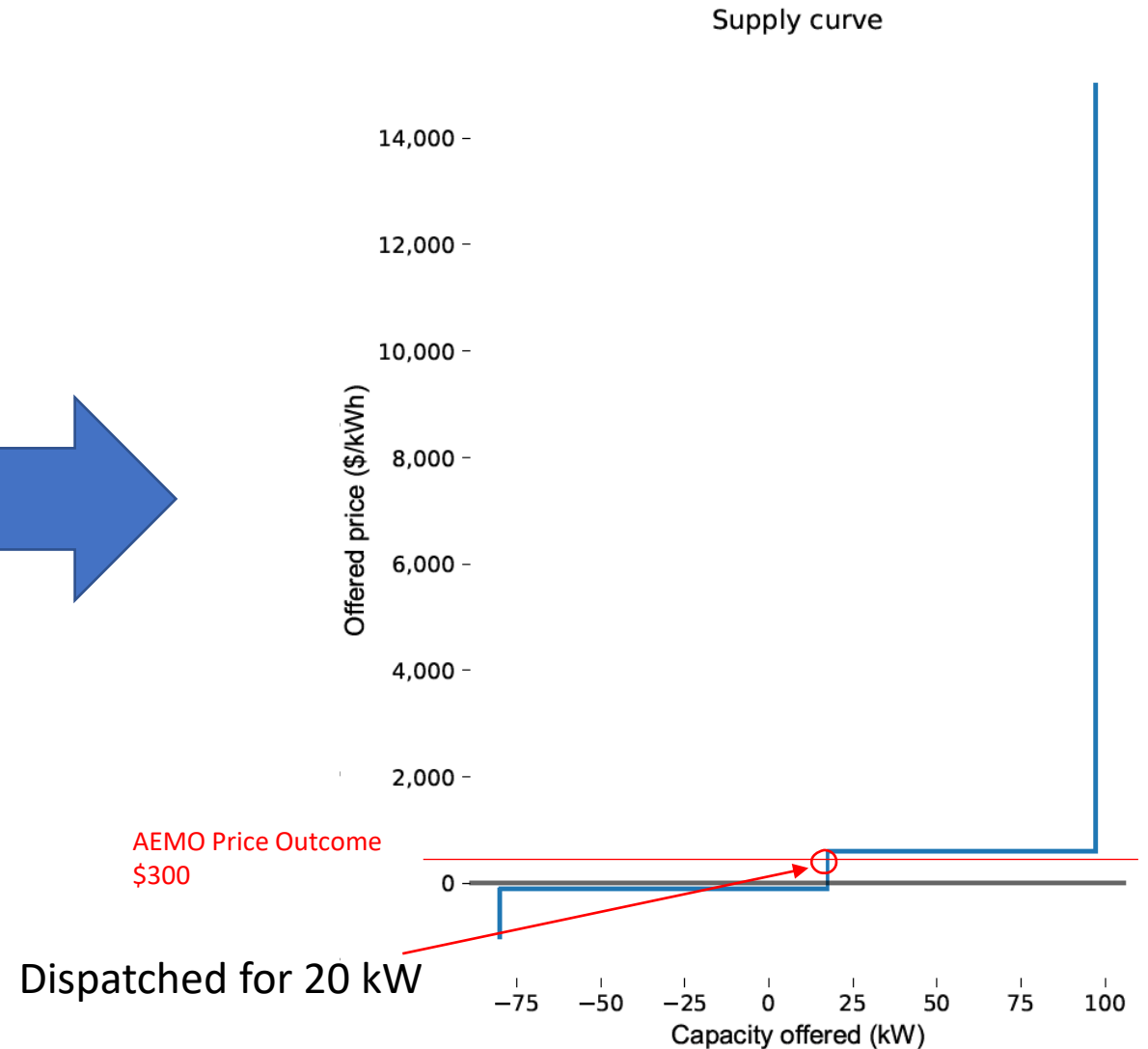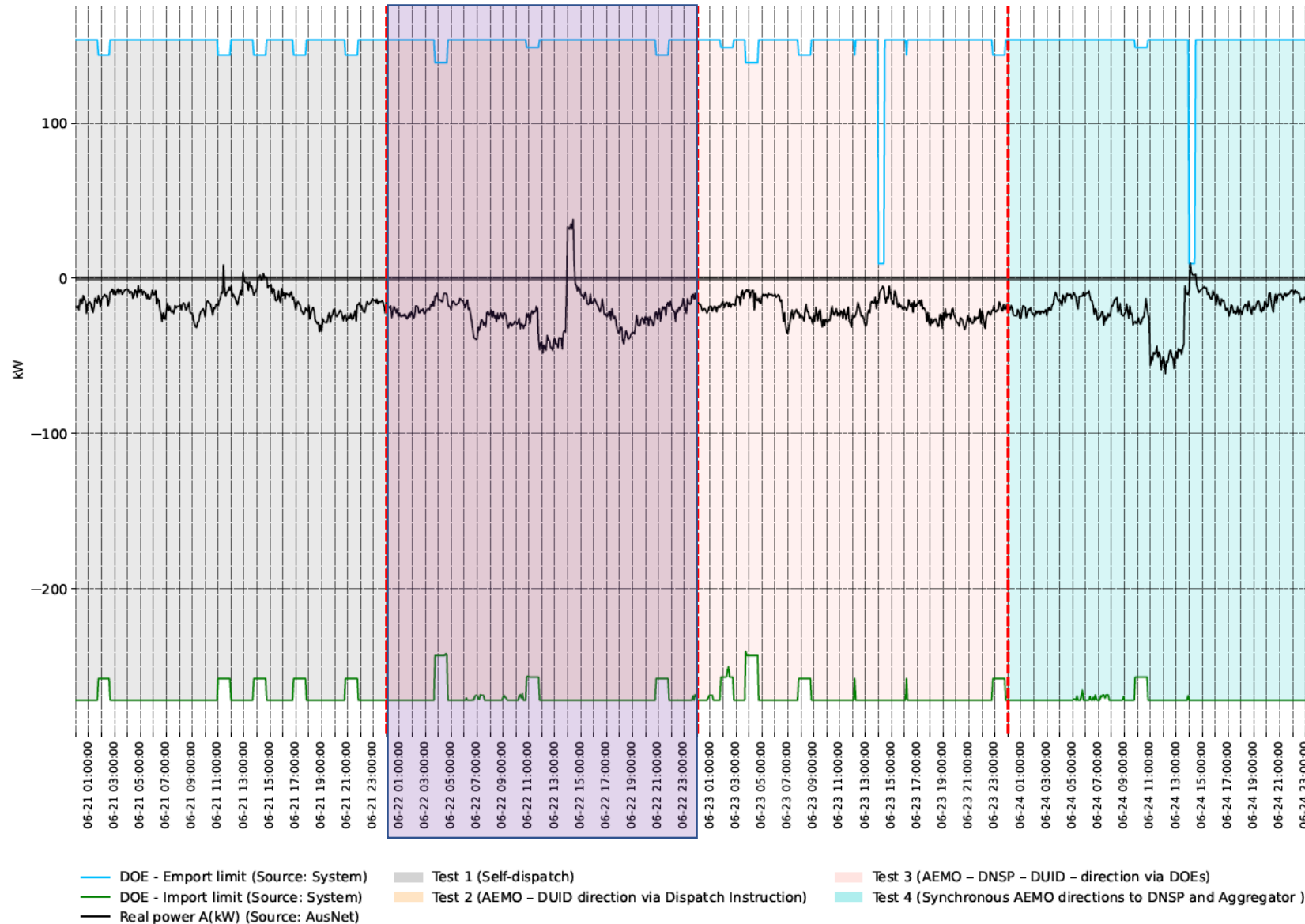
Test 2
Q: How reliably can VPPs follow AEMO directions that differ from market incentivised behaviour?

AEMO -> DUID direction via Dispatch Instructions
Under market suspension AEMO instructs generators/loads test is for future where controllability exists for VPPs (i.e test will provide setpoints for aggregators to follow).
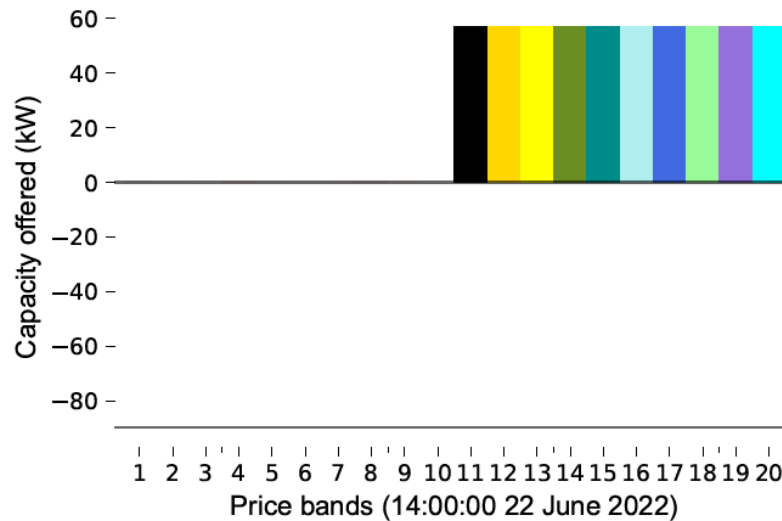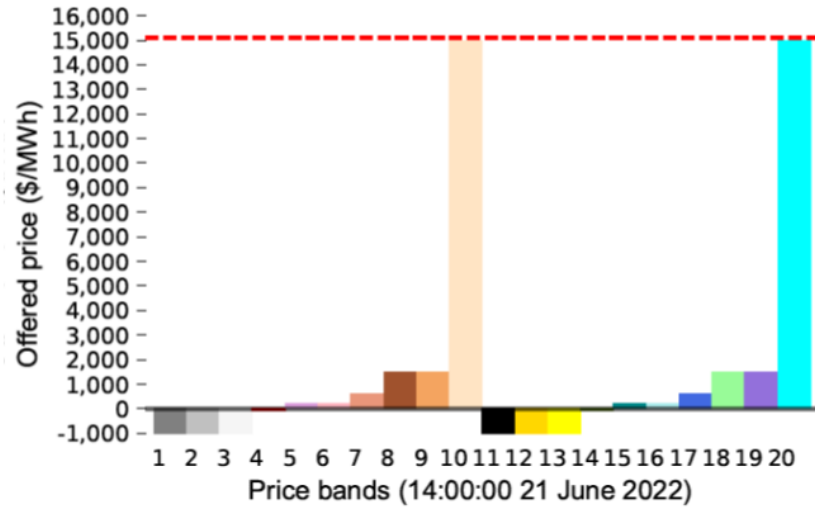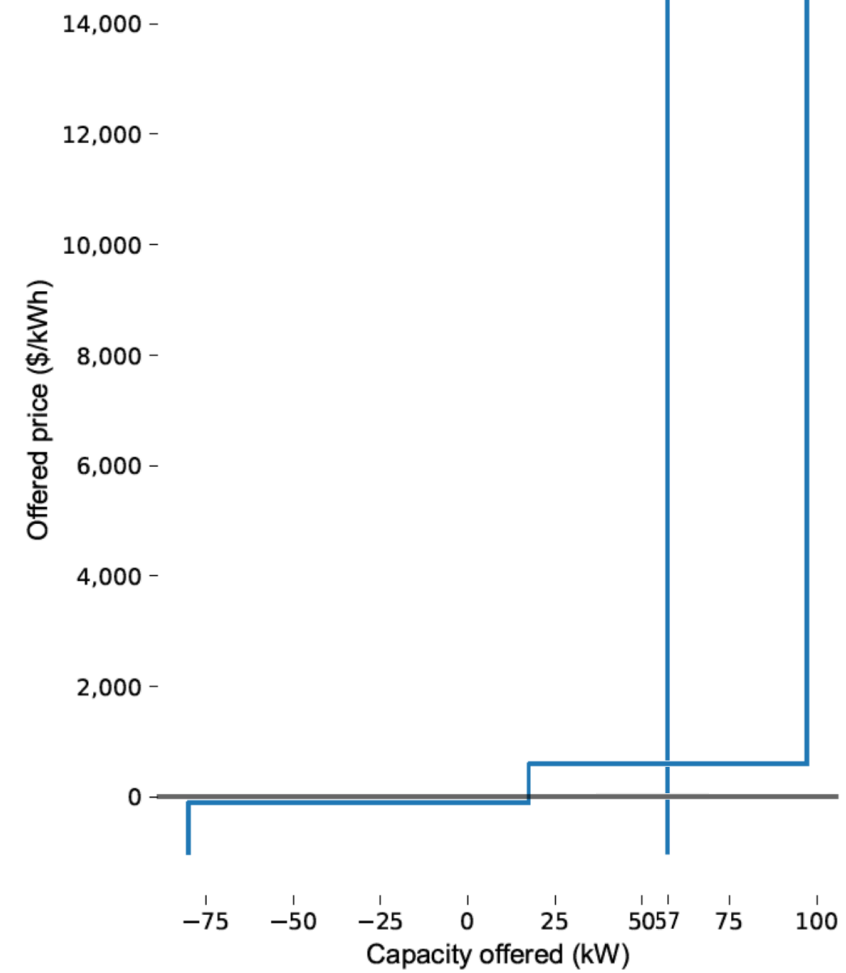
Finding Question:
How should boffers which have been directed by AEMO be formed.

Trial simulated a directions for 57kW of flexible export from 14:00-14:30.

Energy Fixed Loading a better Boffer?
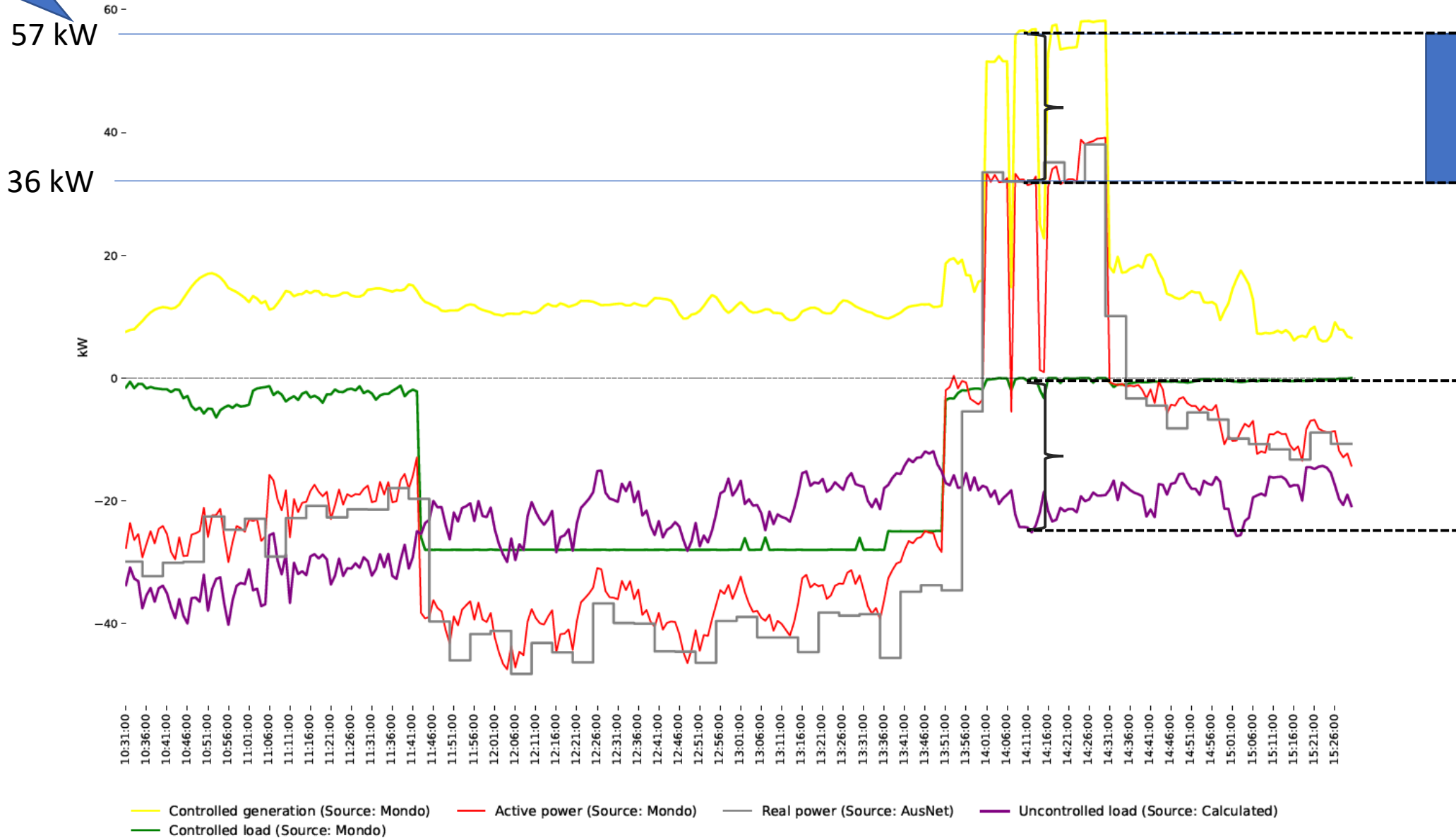
Test 3 – Actual Net Active Power from Portfolio
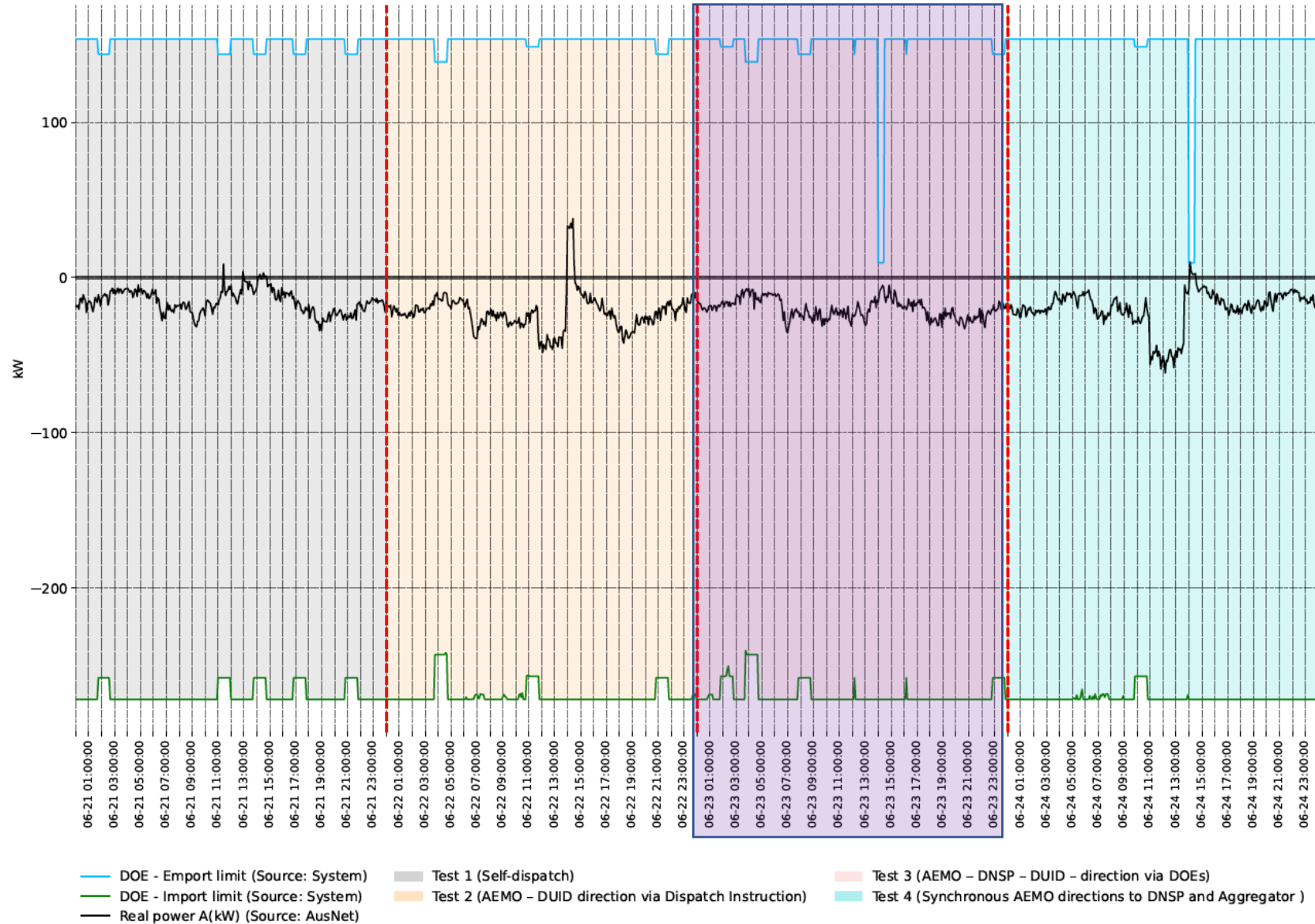
Test 3
Q: Are DOEs a better mechanism than directing VPPs under a non-market use case (e.g. market suspension) ?

AEMO –> DNSP –> DUID direction via DOEs
Currently AEMO instructs NSPs to maintain a profile within their network, NSPs currently do this by shedding load or generation.

Upper Bound of DOE

DOEs

Lower Bound of DOE

Hypothesis 1:
AEMO Dispatch Instructions that give a 'target' are more reliable than DOEs which give 'permissible limits'.

Supply curve

Test 3 – Actual Telemetry Active Power from Portfolio

Test 3: AEMO – DNSP – DUID – direction via DOEs (23 June 2022)

DOEs
9.5 kW
(aggregated)

Test 3 demonstrated that DOEs can be set calculated to limit aggregation export and this was tested alongside directions to aggregator (Test 4)

This would require either control load to decrease or generation to increase
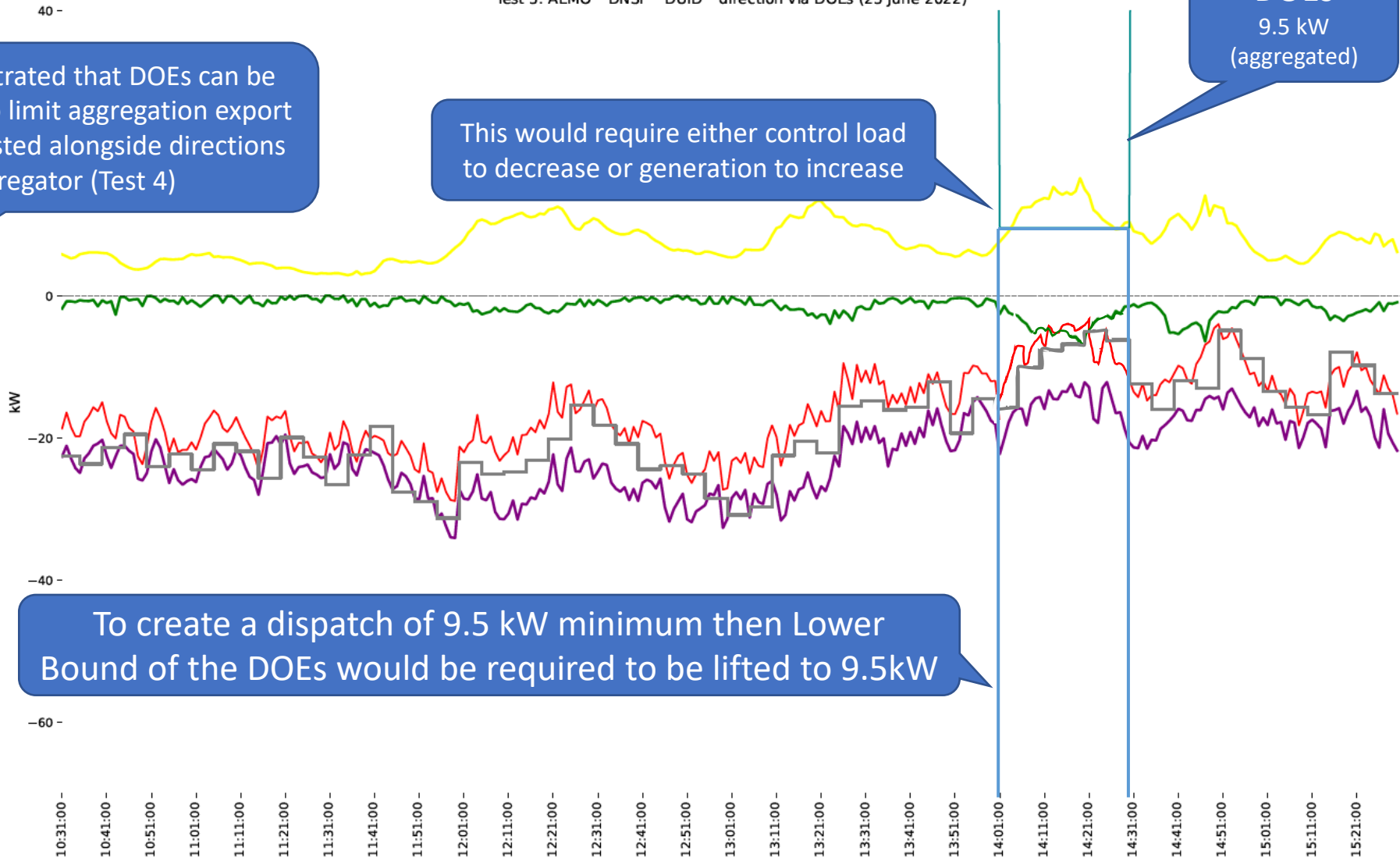
To create a dispatch of 9.5 kW minimum then Lower Bound of the DOEs would be required to be lifted to 9.5kW

Controlled generation (Source: Mondo)
Controlled load (Source: Mondo)
Active power (Source: Mondo)
Real power (Source: AusNet)
Uncontrolled load (Source: Calculated)
DOE: Export limit(Source: System)

Test 4 – Actual Net Active Power from Portfolio

DOE - Emport limit (Source: System)
DOE - Import limit (Source: System)
Real power A(kW) (Source: AusNet)

Test 1 (Self-dispatch)
Test 2 (AEMO – DUID direction via Dispatch Instruction)

Test 3 (AEMO – DNSP – DUID – direction via DOEs)
Test 4 (Synchronous AEMO directions to DNSP and Aggregator)
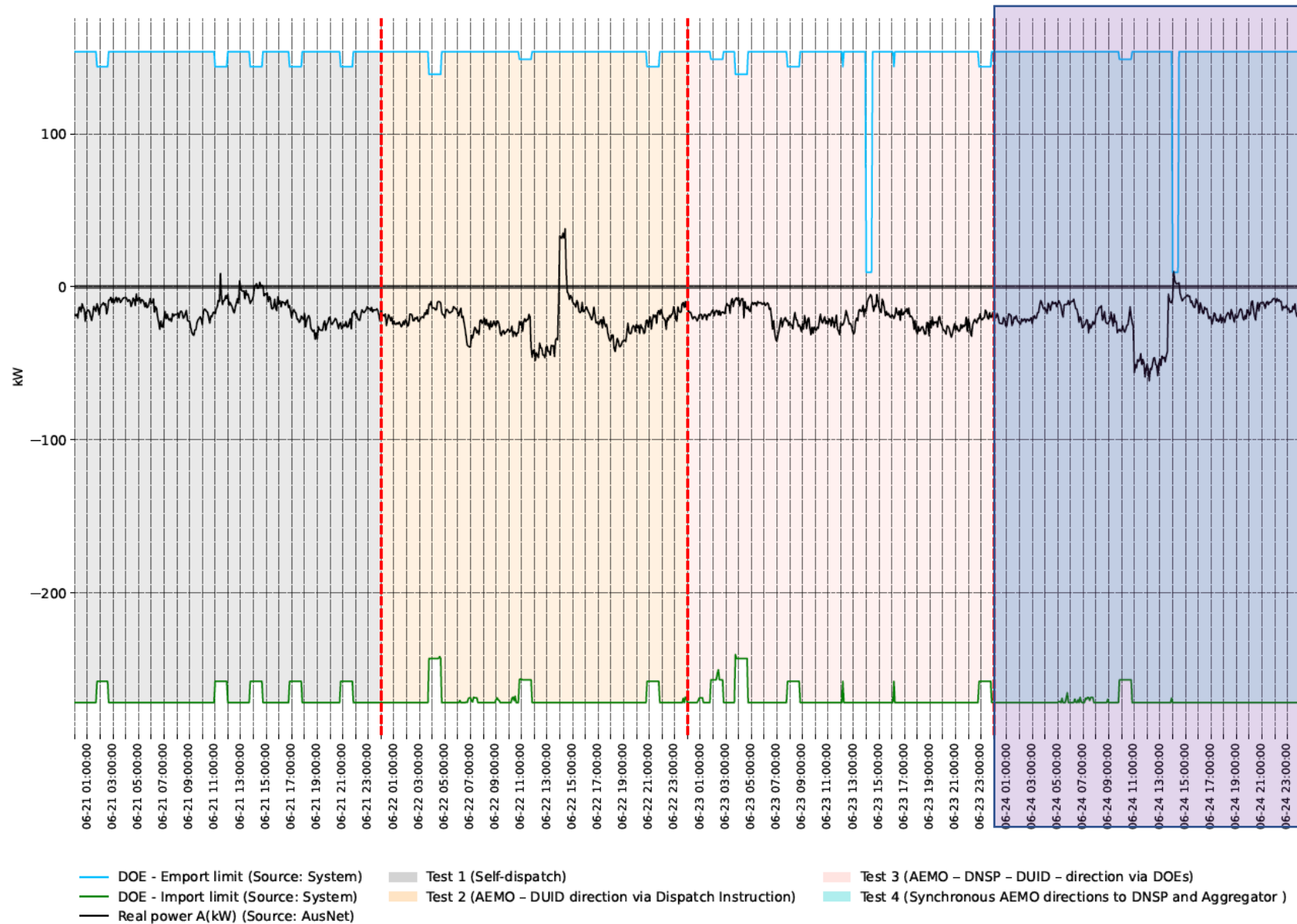
Test 4
Q: Is it worth building capability to do both mechanisms for redundancy?

Synchronous AEMO directions to DNSP and Aggregator (Test 2+3)
Testing synchronous instructions from AEMO to DNSP and Aggregator to see if this helps reduce potential conflicts. Test 2 & Test 3 together.

DOEs
9.5 kW
(aggregated)

Boffer (FLEX)
57 kW
(aggregated)

Hypothesis 2:
These two signals together will conflict at times and this needs to be understood to be managed in future operations.

Kilowatt

Time Period ID(Friday, 24 June)

Supply curve

Capacity offered (kW)
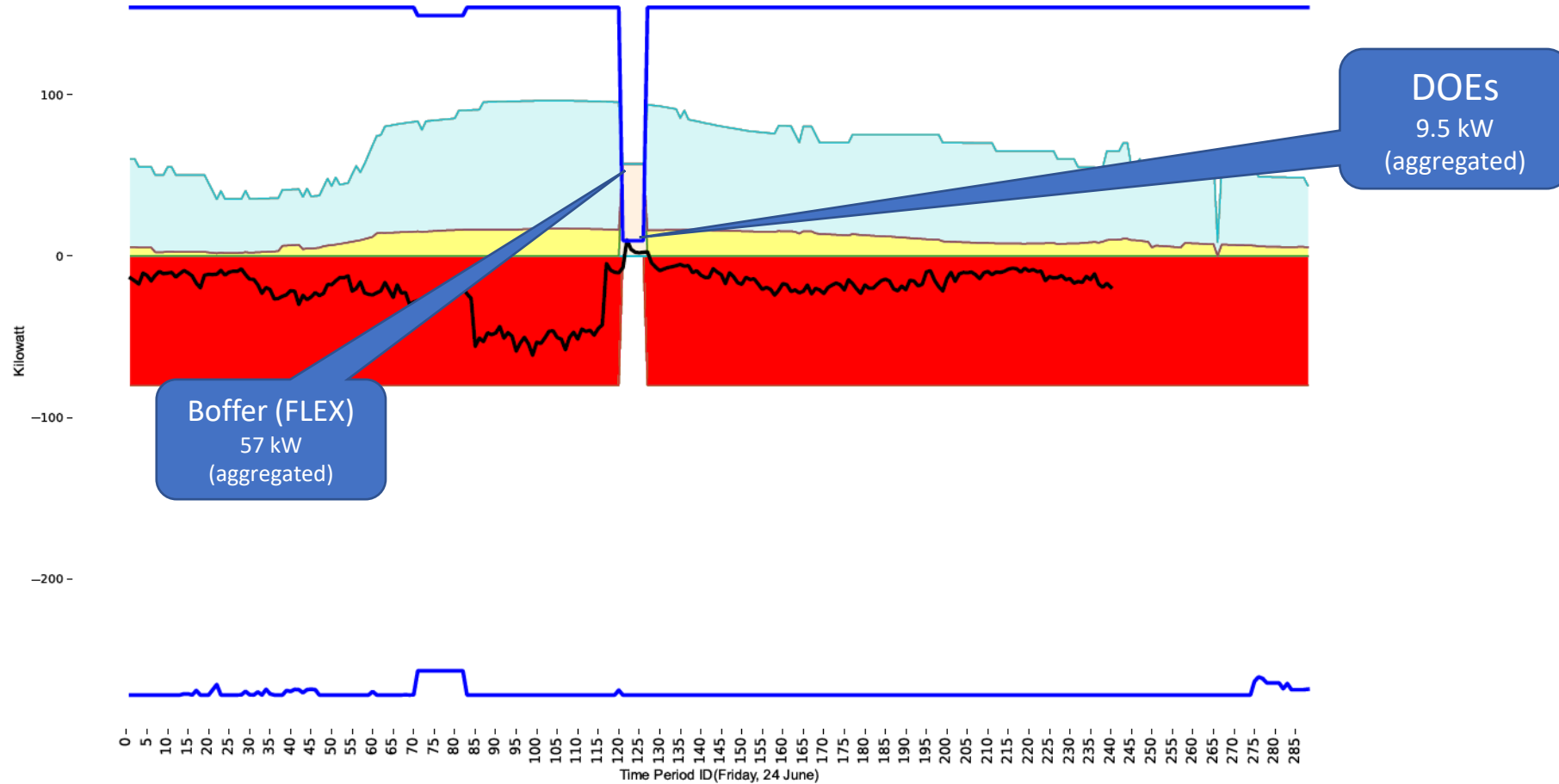
Prices between band1 (-999) and band2 (-998)	Prices between band8 (1497) and band9 (1498)	Prices between band15 (228) and band16 (229)
Prices between band2 (-998) and band3 (-997)	Prices between band9 (1498) and band10 (14999)	Prices between band16 (229) and band17 (600.01)
Prices between band3 (-997) and band4 (-100)	Prices between band10 (14999) and band11 (-999)	Prices between band17 (600.01) and band18 (1497)
Prices between band4 (-100) and band5 (228)	Prices between band11 (-999) and band12 (-998)	Prices between band18 (1497) and band19 (1498)
Prices between band5 (228) and band6 (229)	Prices between band12 (-998) and band13 (-997)	Prices between band19 (1498) and band20 (14999)
Prices between band6 (229) and band7 (600)	Prices between band13 (-997) and band14 (-99.99)	Real power A(kW) (Source: AusNet)
Prices between band7 (600) and band8 (1497)	Prices between band14 (-99.99) and band15 (228)	DOE - export limit (positive) and import limit (negative) (Source: System)

Trial simulated directions for 57kW of flexible export from 14:00-14:30.

Test 4: Synchronous AEMO directions to DNSP and Aggregator (24 June 2022)
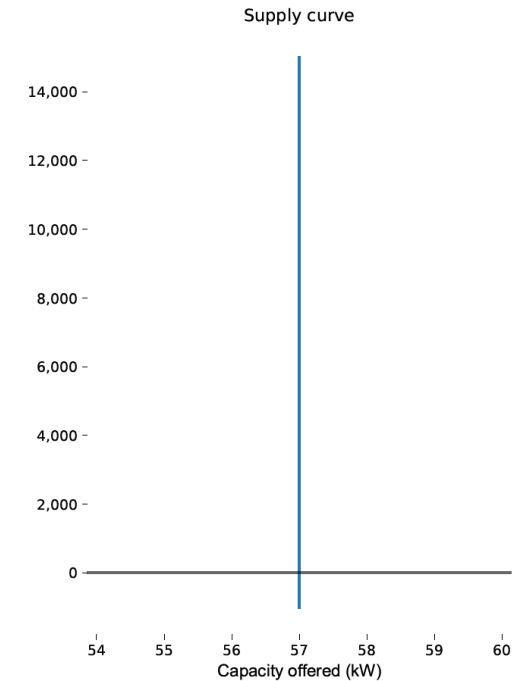
Unable to achieve 57kW of flex

36 kW

9.5 kW

Difference between Flex and Net equals the amount of non-controlled load

— Controlled generation (Source: Mondo)
— Controlled load (Source: Mondo)
— Active power (Source: Mondo)
— Real power (Source: AusNet)
— Uncontrolled load (Source: Calculated)
— DOE: Export limit(Source: System)

Deloitte.
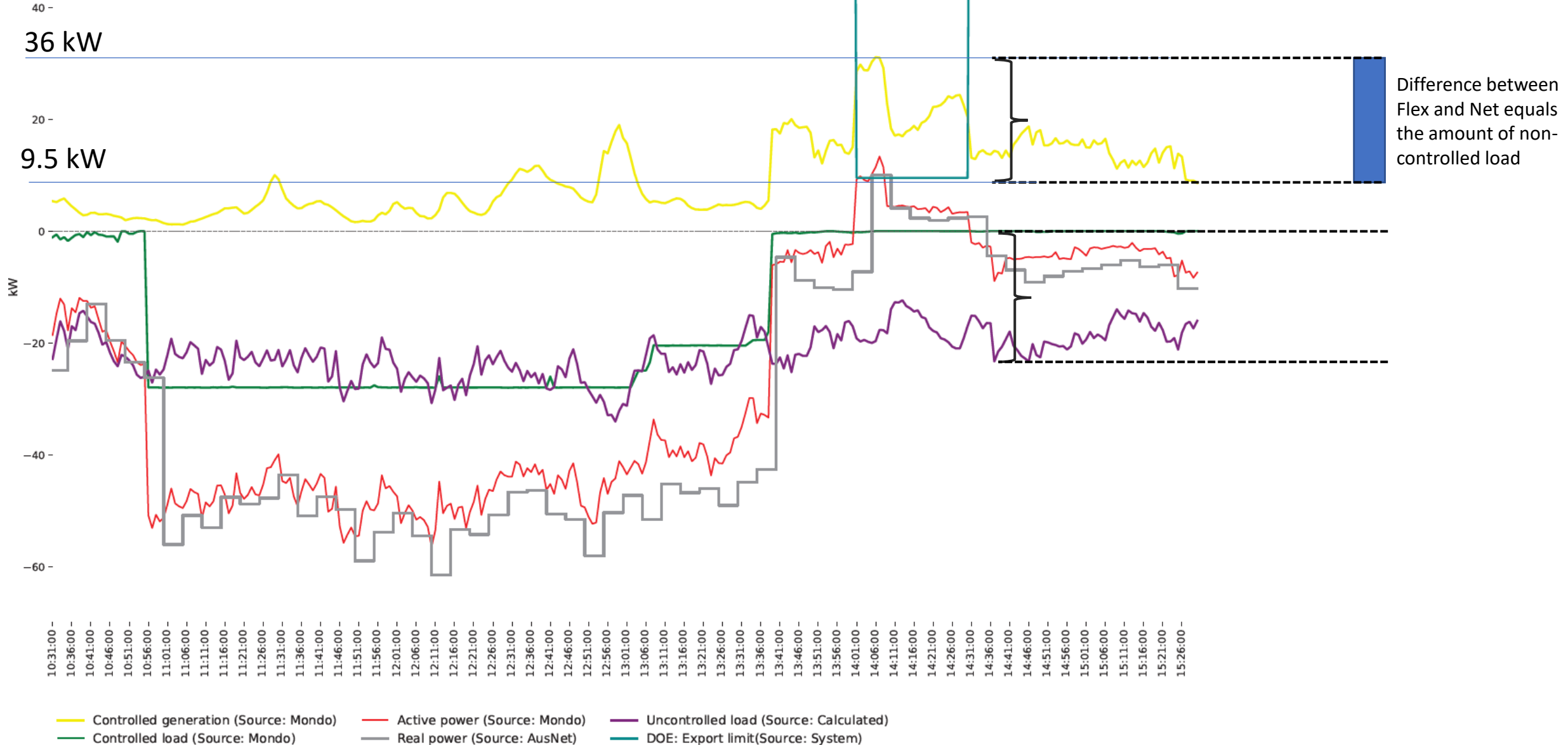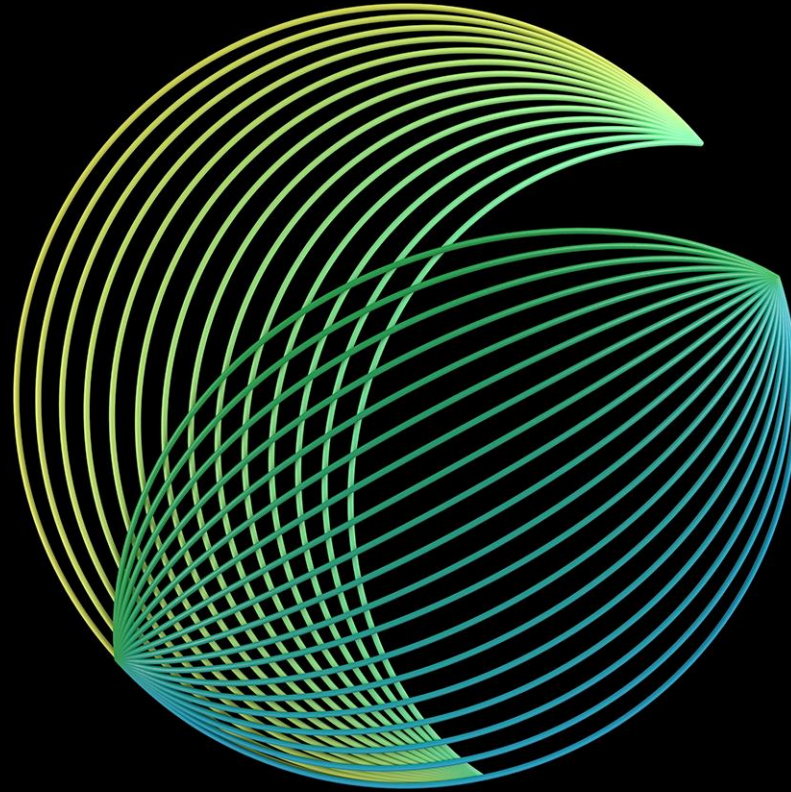
Project EDGE CBA

Market Integration Consultative Forum (MICF)

28 July 2022

Deloitte
Access **Economics**

Overview

Objectives for today

- Overview EDGE CBA Draft Methodology

- Detail Focused Considerations

- Consult for Feedback

What does this session include

- Presentation

- Mural sessions – where you are invited to provide answers to questions

- Interaction welcome!

Open for Consultation

Project EDGE CBA – Draft Methodology for Consultation

Released: 21 July 2022

Consultation paper can be found on the AEMO Project EDGE webpage until 5 August 2022

[AEMO | Project EDGE](#)

Deloitte.

Project EDGE CBA - Draft Methodology for Consultation
Australian Energy Market Operator
21 July 2022
Deloitte Access Economics
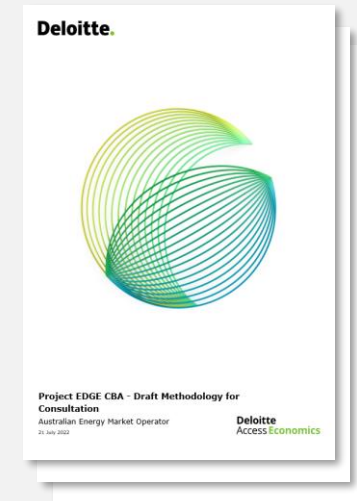
Use Mural to document answers to questions

M U R A L

How does Mural work?

We give you a white board to provide your thoughts

Please list your organisation after your comment

You will have 5 minutes per question

Project EDGE Overview

Project EDGE (Energy Demand and Generation Exchange) is a multi-year project to demonstrate an off-market, proof-of-concept Distributed Energy Resource (DER) Marketplace that efficiently operates DER to provide both wholesale and local network services within the constraints of the distribution network

- A collaboration between AEMO, AusNet Services and Mondo

- ARENA-funded

- Field trials in AusNet Services area

Purpose: identify capabilities that can be replicated efficiently at scale across the National Electricity Market (NEM)

Deloitte is responsible for the cost benefit analysis (CBA)

Aim: Identify the approaches that can deliver long-term value (as per the NEO) to the NEM and all actors interacting with the DER Marketplace.
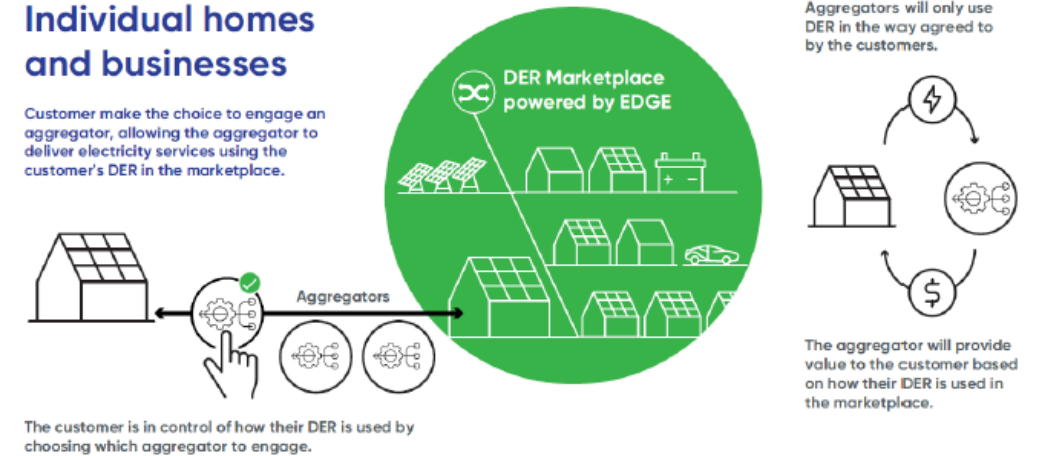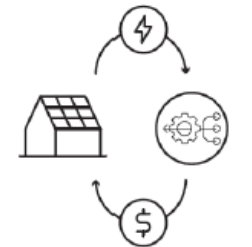
Timeline

CBA Research & Market Sounding (Jan – July 2022)
Research and stakeholder input on key identified focal areas for the CBA (including roles and responsibilities, data hubs and visibility)

Technoeconomic Modelling (August 2022)
Energeia modelling using inputs from University of Melbourne

CBA Results Report (March 2023)
CBA results and report

CBA Draft Methodology Consultation (July 2022)
Public consultation on draft CBA methodology

CBA Development (August 2022 - February 2023) Final quantification and scenario testing

Related Reforms and Industry Activities

Roadmap of key reforms and industry development that Project EDGE is informing and will inform in the future

Stakeholder engagement

National Electricity Objective (NEO)

| Research Plan | → | CBA Methodology | → | Design process | → | Test DER Marketplace Concept | → | Collate evidence and deliver CBA |

Regulatory reform and development of business capabilities (example reforms below)

Prior Work

Roles and responsibilities	**ESB Scheduled Lite reforms**	**Dynamic Operating Envelopes**	**Data Exchange**	**ESB Data Strategy**	**DER Register**	**Registration**	**Flexible Trading Arrangements**
Help define DSO and Market and System Operator Interactions	Visibility, forecast-ability and dispatchability design feeding into AEMO's draft rule change for Scheduled Lite	Nationally consistent approach to calculation and communication of DOEs and identify the business capabilities needed to enable them	The EDGE data exchange model can inform recommendations an information and operational data exchange, interoperability	Continued input into the design and implementation of various initiatives	Inform the evolution of the DER Register to make it more dynamic	Enable scalable view of portfolio standing data for market registration and switching	EDGE insights can inform (and has informed), the Flexible trading models intended to maximise DER participation and delivery of services

Inform ESB DER Implementation Plan

Inform development of business capabilities

Support consumers through an efficient transition

Inform industry technology investment decisions

Drive business model innovation

Stakeholder Engagement Process
Transparency and broad consultation are key

Stakeholder engagement is a critical activity for the Project EDGE CBA, ensuring that the assumptions that underpin it are refined independently, in line with stakeholder views and reflect the latest information available. Over the course of the CBA, all project stakeholders will have an opportunity to review and consult on the methodology, research plan, assumptions, and draft findings.

Guiding Principles

- Independent (of project team) data collection
- Transparency in data collection, approach, results
- Stakeholders are part of the journey/broader team
- Feedback is considered and processed and responded to where appropriate
- Targeted stakeholders receive specific consideration – ensure little risk of missing out
- Consultative approach reduces project outcome risk
- Staged approach allows regular consideration
- Gateways for decision making achieve clear finality on decisions, move-forward points.

External Stakeholders

Group 1 Stakeholders	Group 2 Stakeholders	Group 3 Stakeholders
Market institutions whose day-to-day functions shape energy market and operating environment now and in future	Energy market actors represented in EDGE whose buy-in is required to shape CBA inputs	Key reference groups whose expertise and broader energy market knowledge is valued
Audience	**Audience**	**Audience**
• Project EDGE participants • Key market bodies: AER, AEMC, ESB, ENA	• DNSPs, including trials (SAPN, Symphony, etc) • Aggregators • Consumer groups	• Researchers • Governments • Peak bodies & Local community groups • Industry
Method	**Method**	**Method**
• 1:1 consultations post key consultation touchpoints	• Presentations at Forums (DIF, NAG, MICF, etc) • Data collection from AEMO post project discussion at other forums • Periodic 1:1 as required	• Presentations at DIF • Data collection from AEMO post project discussion at other forums • Other, as needed

CBA Overview and Key Concepts

(Chapter 3 in Draft Consultation CBA Methodology)

Consultation Questions

Roles & Responsibilities
- Should additional alternative arrangements of roles and responsibilities with regards to the Hybrid Model of the Open Energy Networks project be considered?

Visibility
- Do you agree with the identified costs and benefits of increased visibility (across different market participants)? How are they best quantified?

Scalable Data Exchange
- What should be the governance arrangement for the Data Exchange Hub Decentralised solution? Whare are the benefits associated with shared infrastructure under the Data Exchange Hub Decentralised solution?

Local Services Exchange
- Is the assumption that LSE will be most efficient from a whole of system perspective if facilitated through a data hub reasonable?

Anything else?
- Are there additional considerations that should be incorporated in the CBA that are not mentioned?

Project EDGE CBA Overview
Steps in a CBA

1

Base case definition

The identification of a plausible base case is key to a CBA, as it provides the datum from which the impact of changes to market arrangements can be quantified, i.e. the benefits and costs of scenarios under consideration are measured as an incremental change from the specified base case

2

Identification of alternative scenarios and assessment period definition

The identification of a set of plausible scenarios

The assessment period is usually selected to reflect the estimated useful life of the asset or duration of the policy or market intervention

3

Benefit specification and estimation

The specification of benefits involves identifying the impacts of the scenario that result in positive or desirable effects

Ideally benefits can be monetised; if not they should be able to be quantified; at a minimum they should be capable of being described

4

Cost specification and estimation

The specification of costs should take into account all the impacts that produce negative or undesirable effects

A useful way of looking at the costs is to identify the individuals or groups within the community that would be worse off as a result of the investment. All costs that are incurred in achieving the benefits should be captured

5

Modelling costs and benefits

Modelling is undertaken to estimate the present values of those future costs and benefits that can be quantified in monetary terms.

The discounting of future costs and benefits reflects the time value of money and uncertainty of future cash flows

6

Review, sensitivity testing and reporting

Review preliminary results and refine benefit/cost specification and estimation. Results are expressed in the form of two key metrics: the benefit-cost ratio (BCR) and the net benefit

BCR = Total present value benefits divided by total present value costs

Net benefit (or cost) = Total present value benefits less total present value costs

The Project EDGE CBA Overview
Delivering a robust and transparent CBA process

Field Trial

Operational Field Trial in AusNet Services area (will scale to ~1,000 customers and 10MW of DER

THE UNIVERSITY OF **MELBOURNE**

Bespoke Modelling to support quantification of the costs and benefits of operating envelope limits provided to DER in the LV networks

Desktop research on Grouped DOEs

Energeia

Techno- economic modelling of 10 scenarios

Deloitte.

Ad-hoc and off model analysis (e.g. data hubs, visibility, LSE and roles and responsibilities)

Deloitte.

Cost Benefit Analysis

Informs

Findings

A subset of Project Edge Objectives and Research Questions

Key concepts
CBA Base Case

What is a CBA base case?

- A point of reference from which the impact of changes can be quantified
- Two base cases used:
    - Scenario 1 uses AEMO Step Change Load and DER assumed conditions
    - Scenario 6 is uses the Renew/ECA condition

Key Load and DER Scenario Drivers

	AEMO Step Change[1]	Renew/ECA[2]
Distributed Technology Prices		
Solar PV	AEMO Step Change	Trend
Storage	AEMO Step Change	Trend
Distributed Technology Adoption Rates		
Solar PV	39% by 2030	90% by 2030
	49% by 2040	93% by 2040
Storage	14% by 2030	80% by 2030
	24% by 2040	90% by 2040

Base Case	Scenario 1	Scenario 6
Load and DER Assumptions		
Solar Uptake		Renew/ECA
Battery Uptake		
Electricity Consumption Growth	AEMO Step Change (Final 2022 ISP)	AEMO Step Change (Final 2022 ISP)
EV Uptake		
VPP Uptake		
Customer Connection Growth		
Heat Pump Water Heating Uptake	Energeia will develop equivalent figures	Energeia will develop equivalent figures
DOE and Market Arrangements		
Constraint Optimisation Frequency	Daily	Daily
Co-optimisation Model	VPP Only	VPP Only
DOE Optimisation Methodology	Approximation	Approximation
DOE Objective Function	Nameplate Pro-rata	Nameplate Pro-rata
VPP Standard and Point-to-Point Integration	✓	✓
Data Hub	⊗	⊗
Local Services Exchange (LSE)	⊗	⊗

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Key concepts
CBA Scenarios

The Project EDGE CBA scenarios are designed to provide a framework for measurement of incremental benefit of the project marketplace in different future external market environments.

Key scenario elements for the 10 different CBA scenarios

Scenario Element	AEMO Step Change Load and DER Assumptions					Renew/ECA Load and DER Assumptions				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Load and DER Assumptions										
Solar Uptake	AEMO Step Change (2022 ISP)					Renew / ECA				
Battery Uptake										
Electricity Consumption Growth						AEMO Step Change (2022 ISP)				
EV Uptake										
VPP uptake										
Customer Connection Growth										
Heat Pump Water Heating Uptake	Energeia will develop equivalent figures					Energeia will develop equivalent figures				
DOE / Market Arrangements										
Constraint Optimisation Frequency	Daily	Daily	Daily	Intra-day	Intra-day	Daily	Daily	Daily	Intra-day	Intra-day
DOE Co-optimisation Model	VPP Only	VPP Only	VPP Only	100%	100%	VPP Only	VPP Only	VPP Only	100%	100%
DOE Optimisation Methodology	Approximation	Approximation	Approximation	LV Data Driven	LV Data Driven	Approximation	Approximation	Approximation	LV Data Driven	LV Data Driven
DOE Objective Function	Nameplate Pro-rata	Max Service	Max Service	Max Service	Max Service	Nameplate Pro-rata	Max Service	Max Service	Max Service	Max Service
VPP Standards and Point to Point Integration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Data Hub	✗	✗	✓	✗	✓	✗	✗	✓	✗	✓
Local Services Exchange	✗	✗	✓	✗	✓	✗	✗	✓	✗	✓

Key concepts
CBA reference groups and assessment period

Reference Group
Reference groups are the groups for which we consider costs and benefits for the CBA.

Establishing appropriate reference groups is important in determining which costs and benefits we are interested in and what is or isn't a transfer payment.
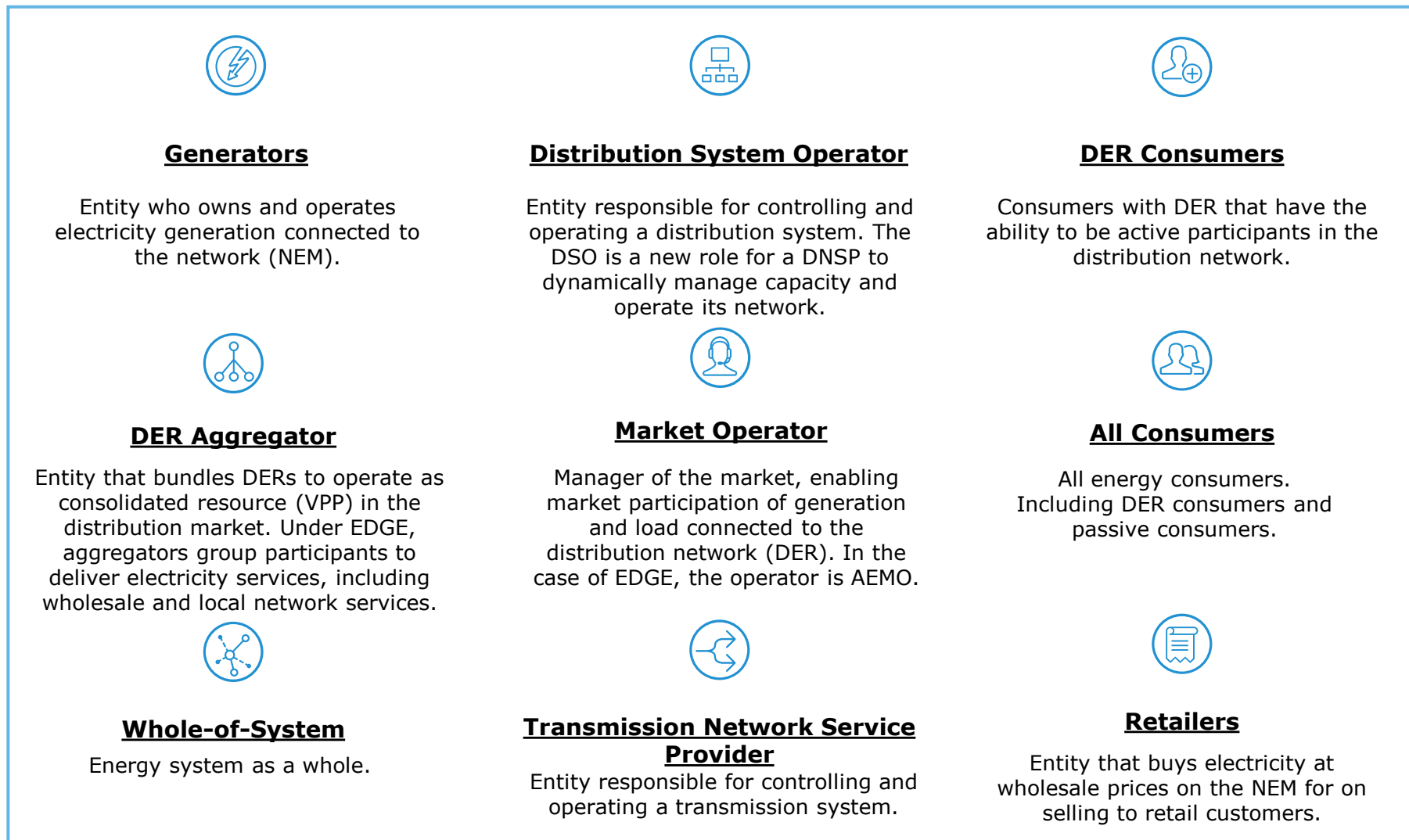
Assessment Period
The assessment period reflects the time period over which benefits and costs are measured.

Project EDGE CBA Assessment Period

Period of analysis	20 years
Base year	FY23

Generators
Entity who owns and operates electricity generation connected to the network (NEM).

Distribution System Operator
Entity responsible for controlling and operating a distribution system. The DSO is a new role for a DNSP to dynamically manage capacity and operate its network.

DER Consumers
Consumers with DER that have the ability to be active participants in the distribution network.

DER Aggregator
Entity that bundles DERs to operate as consolidated resource (VPP) in the distribution market. Under EDGE, aggregators group participants to deliver electricity services, including wholesale and local network services.

Market Operator
Manager of the market, enabling market participation of generation and load connected to the distribution network (DER). In the case of EDGE, the operator is AEMO.

All Consumers
All energy consumers. Including DER consumers and passive consumers.

Whole-of-System
Energy system as a whole.

Transmission Network Service Provider
Entity responsible for controlling and operating a transmission system.

Retailers
Entity that buys electricity at wholesale prices on the NEM for on selling to retail customers.

Cost and benefit quantification approach

Results will be produced per reference group

Reference Groups	Costs / Benefits	Quantification
Generators	Generation Build Out Costs (Capex)	Techno-economic Modelling Output
	O&M Costs	Techno-economic Modelling Output
	Energy Revenue	Techno-economic Modelling Output
	LRET Certificate (LGCs) Revenue	To be calculated based on expected demand for LRET certificates
Market Operator	Data Exchange Platform Costs (Capex)	Scenario comparison with and without the hub $ value of upfront costs with potential incremental changes based on complexity and size of a marketplace
	Data Exchange Platform Costs (Opex)	Scenario comparison with and without the hub $ value per annum with potential incremental changes based on complexity and size of a marketplace
Transmission and Distribution System Operator[1]	DERMS Platform (Capex)	$ value of upfront platform development costs
	DERMS Platform (Opex)	$ value per annum
	DER Enablement Costs (e.g. LV sensors and AMI)	DNSPs to be consulted to define input costs for sensors etc.
	Network Service Provider (NSP) System Capex and Opex	Techno-economic Modelling Output
	Cost of complying with laws, regulations, and administration	$ value for operators to comply with relevant laws/regulations
Retailers	Transfer payment	$ value of additional revenue potential
	Retailer Obligation (RRO) Revenue	Techno-economic Modelling Output
DER Aggregator	Aggregator Platform Development Costs	$ value of upfront costs for platform deployment Including $ value of integration costs with the Data Exchange Platform
	Program Revenue	Techno-economic Modelling Output
	Cost to Serve (including customer acquisition and support costs)	$ value of costs for customer acquisition/marketing, customer management and hardship provisions.
	Cost of complying with laws, regulations and administration	$ value of aggregator complying with relevant laws/regulations
DER Consumers (Active)	DER Technology Costs	Techno-economic Modelling Output
	Revenue from sale of DER services	Techno-economic Modelling Output
All Consumers (Active + Passive)	Electricity Bill Impact	Techno-economic Modelling Output
Whole-of-System	Visibility for DSOs on distributed generation leading to more efficient system operations	$ value of change in reduced control cost
	Predictability, and control for DMO and network operators	Somewhat quantified by Techno-economic modelling, AEMO to be consulted.
	CO_2 emissions	Techno-economic Modelling Output

[1] - will be separated in the results

Focused Consideration Topics

(Chapter 4 in Draft Consultation CBA Methodology)

Five focused considerations divided into discrete work streams under the CBA - increased complexity and sophistication require independent thought and consideration prior to CBA integration

1. Roles and Responsibilities

Project EDGE tests one of many potential arrangements described under the Hybrid Model of Open Energy Networks (OpEN)

Map the roles and responsibilities tested in Project EDGE

The Hybrid Model is as far as the industry has agreed on future roles.

Key functions include:

- Co-optimisation of local and wholesale services
- Facilitating data exchange
- Local service verification data collection
- Local services settlement
- DOE compliance monitoring
- DOE compliance enforcement

To remain consistent with industry agreement on roles and responsibilities to date, we will define comparison cases of roles and responsibilities within the Hybrid Model from the OpEN project.

Identify potential alternatives to Project EDGE

There are several discussed or viable alternatives to the Hybrid Model tested in Project EDGE.

Project EDGE 'alternatives' for a subset of the key functions have been selected based on stakeholder feedback through the OpEN process and Project EDGE consultation to date, and with the aim of minimising significant deviations from the market's current roles and responsibilities (i.e., instead focusing on enhancing or extending current roles within the existing regulatory framework to optimise costs, in line with the NEO).

Review comparator jurisdictions

Project EDGE is pioneering the Hybrid Model within Australia, but other jurisdictions have gone through similar OpEN processes or are dealing with similar challenges around high DER uptake.
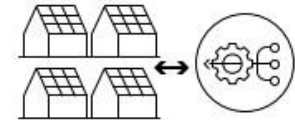
We have identified and reviewed potential comparison jurisdictions that align with either roles and responsibilities at a system level, or aligned to specific functions.

Multi- Criteria Analysis

To move the dial on the discussion regarding arrangements described under the Hybrid Model of OpEN we will undertake a multi-criteria analysis (MCA) on the identified potential alternatives to the Project EDGE allocation of roles and responsibilities.

1. Roles and Responsibilities

Project EDGE Roles and Responsibilities

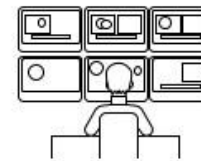The functional view illustrated in this diagram summarises, at a high-level, the key functions for each actor in the DER Marketplace as they relate to wholesale market integration, data exchange and the local services exchange.

1. Roles and Responsibilities

Understanding the Open Energy Networks functions (most relevant to guiding Project EDGE implementation) required to progress towards a Hybrid Model

Function	Function description	Activity	Activity description
Distribution constraints development	New function: To develop distribution network constraints in the form of long-term operating envelopes that will be a key input into distribution level optimisation	DER engagement	Identify long-term requirements for DER services to alleviate distribution network constraints and engage with DER to understand the availability and capability of resources to provide services
Aggregator DER bid and dispatch	Aggregates local DER installation to provide bids into the markets (within provided operating envelopes).	Aggregator Market Engagement	Aggregator bids into the wholesale, FCAS, NSCAS and SRAS markets within its provided operating envelope and responds to dispatch instructions.
Wholesale-distributed optimisation	Enhanced function: Integrate distribution level optimisation results into existing wholesale market optimisation	Receive distribution network market offers and run dispatch engine	Receive market offers from distribution network end customers and run the dispatch engine for wholesale market optimisation
Data and settlement (network services)	Enhanced function: Financial settlement of network support and control ancillary services at distribution and transmission level	Settlement of bilateral contracts for network services	Gathering data and ensuring the co-optimisation of wholesale and local services
DER register	New function: AEMO to provide DER register based on rule requirements	Establish, maintain and publish or share DER register data	Periodically gather up to date DER information from market participants. Share disaggregated data and publish aggregated locational and technical data of DER with relevant market participants
Connecting DER	Enhanced function: Regulatory, technical and commercial arrangements on the connection of DER to the distribution network	Manage DER connections	Manage arrangements for the commercial and technical control of connections – as allowed by the signed connection agreement and regulatory frameworks.

[1] Function descriptions based on OpEN Energy Networks Project

1. Roles and Responsibilities

Project EDGE alternative arrangements of roles and responsibilities and criteria for assessment

Function	Project EDGE Arrangement	Alternative Arrangement
Data and settlement (network services)	**1. Aggregators:** Transmit to DSOs DER service-delivery verification data for use in LSE settlement via the EDGE data exchange hub	**3rd party** (e.g., metering coordinators), **as opposed to an aggregator,** transmits patent approved standardised metering data as service-delivery verification data to DSOs
Data and settlement (network services)	**2. DSOs:** simulate settlements for LSE following verification of service via telemetry data, and communicate through the EDGE data exchange hub	**AEMO, as opposed to DSOs,** uses existing market arrangements to manage settlements and prudentials associated with LSE services
Connecting DER	**3. DSOs:** monitor and enforce compliance with the DOEs	**3rd party** (e.g., metering coordinator or retailer (participant needs to have the data), **as opposed to DSOs,** uses patent approved standardised metering data to calculate compliance outcome. **AER, as opposed to DSOs,** establishes and maintains an approved framework of DOE compliance rectification measures (enforcement measures deemed by the AER are carried out either by a 3rd party or the DSO depending on the severity).
Wholesale-distributed optimisation	**4. Aggregator -** constructions wholesale bi-directional offer with knowledge of portfolio capacity committed to successful LSE bids, placing these at low price bands to ensure dispatch by AEMO.	No feasible alternative identified under the Hybrid Model.

Criteria	Description
01 **Delivers value to consumers (35%)**	Does the framework encourage competition between parties that promotes the long-term interests of consumers (e.g. lower costs and pricing, innovation, quality services and more consumer choice).
02 **Efficiency (20%)**	Does the framework encourage efficient investment, operation, and use of electricity services.
03 **Adaptability (20%)**	Is the framework responsive and adaptable to market changes over time (e.g. shifts in accountability in response to changes in DER penetration and market participation).
04 **Opportunities and incentives (15%)**	What are the opportunities, market signals and commercial incentives for businesses and do they align with the long-term interests of consumers.
05 **Allocation of risk (10%)**	Does the framework allocate risks and accountabilities to the parties who are in the best position to manage them and have incentives to do so.

We will use Mural to facilitate the Q&A session and gather relevant feedback

Link: CBA Methodology Feedback

Process:

1. Post questions, comments, or feedback using post-it notes in the relevant topic
2. Any and all feedback is welcome
3. We will use this to guide our thinking for the CBA Methodology

CBA Focus Questions:

1. **Roles and Responsibilities**: *Should additional alternative arrangements of roles and responsibilities with regards to the Hybrid Model of the Open Energy Networks project be considered?*
2. **Visibility**: *Do you agree with the identified costs and benefits of increased visibility? How are they best quantified?*
3. **Scalable Data Exchange**: *What should be the data governance arrangement for the Data Exchange Hub Decentralised solution? Where are the benefits associated with shared infrastructure under the Data Exchange Hub Decentralised solution?*
4. **Local Services Exchange**: *Is the assumption that LSE will be most efficient from a whole system perspective if facilitated through a data hub reasonable?*

Roles and Responsibilities

Focused Question: Should additional alternative arrangements of roles and responsibilities with regards to the Hybrid Model of the Open Energy Networks project be considered?
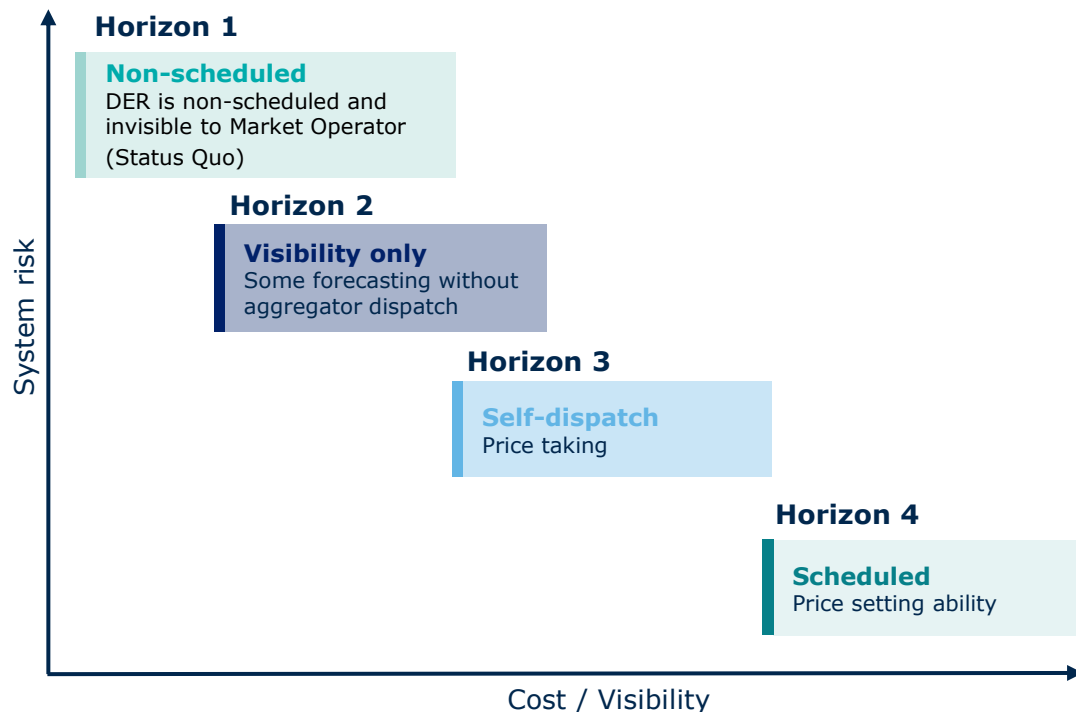
Activity:
Mural Board
(5 minutes)

2. Visibility

Visibility refers to knowing where DER are installed and how they behave to provide situational awareness (e.g., in real time) and forward-looking network planning and forecasting

Network visibility across multiple timescales is critical to the integration of DER. A power system without visibility of high penetrations of price responsive DER would lead to reduction in demand forecast accuracy, making managing operational risk to the power system (e.g., system security and blackouts) more difficult.

The ultimate intent of greater visibility is to support increased market certainty through more accurate scheduling and enable AEMO to operate the market more efficiently and facilitate broader participation in dispatch. In addition, an understanding of the current and future operating state of the network (e.g., visibility) is a requirement for calculating and publishing operating envelopes.

Progressive Value of Visibility

Horizon 1

Non-scheduled
DER is non-scheduled and invisible to Market Operator (Status Quo)

Horizon 2

Visibility only
Some forecasting without aggregator dispatch

Horizon 3

Self-dispatch
Price taking

Horizon 4

Scheduled
Price setting ability

System risk (vertical axis) / Cost / Visibility (horizontal axis)

Costs and Benefits associated with a progression towards Horizon 4

Market Participant	Costs	Benefits
AEMO	• Dealing with the increased frequency and granularity of information	• Increased situational awareness improving accuracy in reconstitution of supply/demand balance • Forecasting improvements allowing improved decision making in control rooms (fewer interventions) • Lower FCAS costs
DNSP	• LV monitoring capabilities	• Better understanding of the network resulting in more accurate spec'ing of network equipment • Less conservative DOEs (given more certainty around load requirements)
Aggregators	• Increased information reporting standards and requirements	• Additional market opportunities
Consumers		• Enhanced data enabling consumers to make better and more decisions (and potentially troubleshoot issues faster)

Visibility

Focused Question: Do you agree with the identified costs and benefits of increased visibility (across different market participants)? How are they best quantified?

**Activity:**
Mural Board
(5 minutes)

3. Data Hubs

Project EDGE has identified three scalable data exchange approaches for evaluation

1. **Point-to-Point solution (standardised):** An extension of BAU applied to DER, with the application of agreed industry standard communication processes and terminology between all parties.

2. **Data Exchange Hub Centralised solution:** Data is exchanged through a centralised data hub via a centralised broker (assumed to be AEMO in Project EDGE) who operates the hub and receives and transfers data according to agreed rules.

3. **Data Exchange Hub Decentralised solution:** Uses open source and decentralised technology that is hosted by nominated participants in nodes. Removes the need for a centralised broker role, both in terms of hosting and operation.

Specifically, Project EDGE aims to test two core hypotheses:

A data hub model provides a scalable and long-term approach for DER marketplace data exchange compared with a web of many point-to-point interactions between industry actors

A decentralised data hub model is the most efficient solution that could deliver the most net benefit to NEM customers.
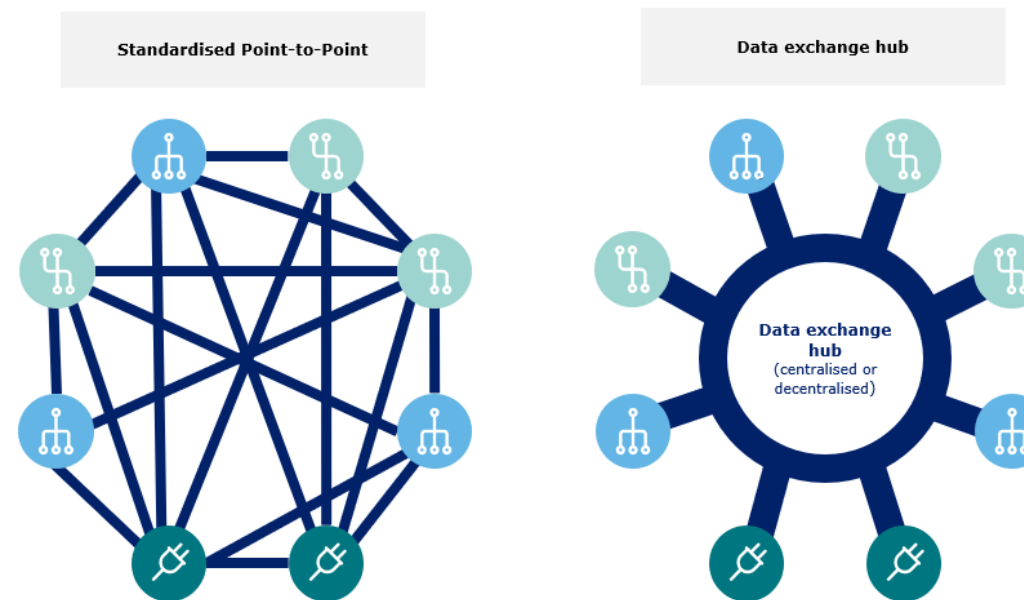
	Point-to-Point solution (standardised)	**Data Exchange Hub Centralised solution**	**Data Exchange Hub Decentralised solution**
Integration	Point-to-Point with Standards	Centralised Hub (integration)	De-centralised Hub (pass-through messages)
Identity Management	Point-to-Point Identity (using Azure Active Directory)	Distributed Ledger (DLT) for Identity Management (external certificates and Hash on DLT)	DLT for Identity Management (external certificates and Hash on DLT)
Data Storage	Localised – NoSQL, Relational (no DLT)	Centralised – NoSQL, Relational (no DLT)	Decentralised - hosted by a few select organisations and also included on DLT

3. Data Hubs

Costs and benefits associated with scalable data exchange approaches

To support the functions of a digitised, decentralised marketplace as proposed by Project EDGE, the data exchange approaches considered must allow at a minimum the following use cases:

- Dynamic Operating Envelopes (DOEs) – enabling DNSPs to offer a new dynamic export limit option to DER customers and VPPs whose systems have the technical capability to self-manage.

- Dynamic Export Limits – dynamic export limits could be originated by retailers and enable dynamic adjustment of export by customer DER at times of negative wholesale prices

- DER Register - an accurate and dynamic registry of all DER located across all networks (assumed in Project EDGE to include portfolio or fleet-based information (e.g. which aggregator or consumer controls devices).

- LSE for DER - a solution to facilitate structured, scalable, bilateral procurement of local network services between the DNSP and aggregators.

Benefits by scalable data exchange approach

Point-to-Point solution (standardised)	• Flexibility and autonomy for DNSPs in procuring local services solution • DNSPs have flexibility and control over DER database for their own territory.
Data Exchange Hub Centralised solution (compared to Point-to-Point)	• Reduces complexity and cost by reducing the number of integrations • Simplifies reporting, reconciliation, and incident management • Easier to coordinate and perform maintenance and system updates over time.
Data Exchange Hub Decentralised solution (compared to Point-to-Point)	• Eliminates bottleneck for data exchange and retrieval from a central broker • Open-source solution is a common industry framework allowing participant application building • Flexible service provision and resilience can eliminate single failure points • Dedicated channels: participants can configure exchange with many (broadcast) or directly (unicast) • Self-managed identity • Shared governance • Innovation potential: participants can build custom apps and new use cases can be established • Single source of truth (DLT) with DIDs and verifiable credentials enabling all participants (and 3rd parties) to read/write (based upon permissions) the DER register.

Costs categories associated with scalable data exchange

Cost Category	Description
Initial Infrastructure Build	Initial platform development costs
Integration Costs	Costs associated with retailers/aggregators managing integration with multiple DNSPs (each NEM region it wants to access) – will be impacted by economies of scale
IAM	Cost associated with verifying participants and ongoing management of platform security/ resilience
Data Storage (DER Register)	Establishing and maintaining DER database and electronic registration process
Transition and Project Management Costs (FTEs)	FTEs to manage transition from BAU processes
Hosting and Licence Fees	Provision of hosting and licensing services
Support Services	Ensuring data exchange approach remains fit for purpose

Scalable Data Exchange

Focused Question: What should be the governance arrangement for the Data Exchange Hub Decentralised solution? Whare are the benefits associated with shared infrastructure under the Data Exchange Hub Decentralised solution?

MURAL

Activity:
Mural Board
(5 minutes)

4. Local Service Exchange

The Local Service Exchange acts as the interaction platform for aggregators and DSOs to trade local services

With growing penetration of DER, there is increasing opportunity for aggregation of DER to provide services to the local distribution networks.

The Project EDGE trials will test some functionality of the local service exchange. This includes bidding of services, transactions, and settlement of the transactions.
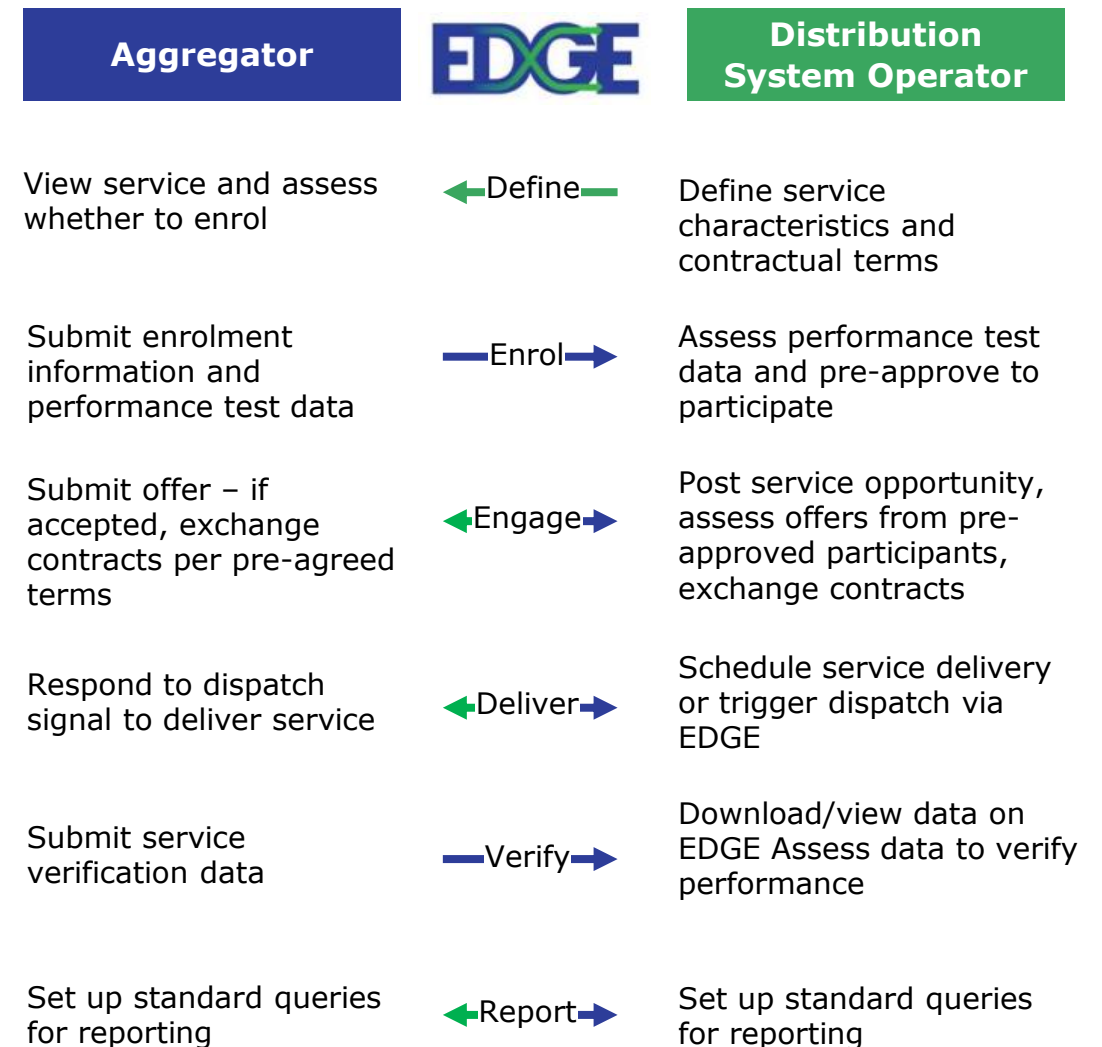
The classification of services to be provided includes:

- Demand increase / reduction

- Voltage management

The LSE is hypothesised to encourage greater benefits by way of DSOs realising lower DER-based network support service costs and firmness of response through having access to a greater, more liquid, pool of service providers (aggregators). Aggregators are expected to use EDGE to access and deliver local network services to DSOs on behalf of consumers ("value stacking").

The cost of the LSE is related to the platform development, integration and verification cost for participants and the costs for provision of data which may be required to actively participate, if different from that required for monitoring of DOE's.

Proposed local services process

Aggregator	EDGE	Distribution System Operator
View service and assess whether to enrol	←Define—	Define service characteristics and contractual terms
Submit enrolment information and performance test data	—Enrol→	Assess performance test data and pre-approve to participate
Submit offer – if accepted, exchange contracts per pre-agreed terms	←Engage→	Post service opportunity, assess offers from pre-approved participants, exchange contracts
Respond to dispatch signal to deliver service	←Deliver→	Schedule service delivery or trigger dispatch via EDGE
Submit service verification data	—Verify→	Download/view data on EDGE Assess data to verify performance
Set up standard queries for reporting	←Report→	Set up standard queries for reporting

Local Services Exchange

Focused Question: Is the assumption that LSE will be most efficient from a whole of system perspective if facilitated through a data hub reasonable?

Activity:
Mural Board
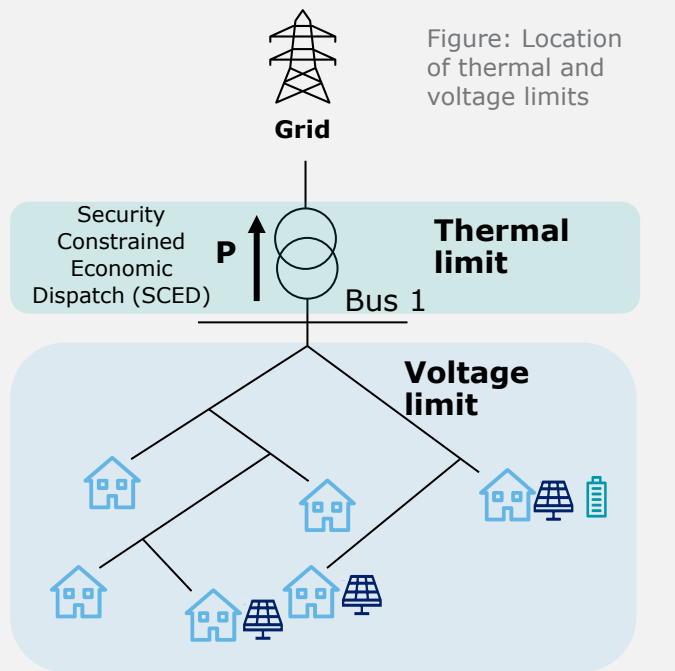(5 minutes)

5. Dynamic Operating Envelopes

As the prevalence of DER rapidly increases in the NEM, the optionality (e.g., flexibility, time intervals, data requirements, social and economic considerations) associated with operating envelopes has emerged as a key area for assessment

Project EDGE is investigating several methods for DOE calculation, allocation and market dispatch operating models.
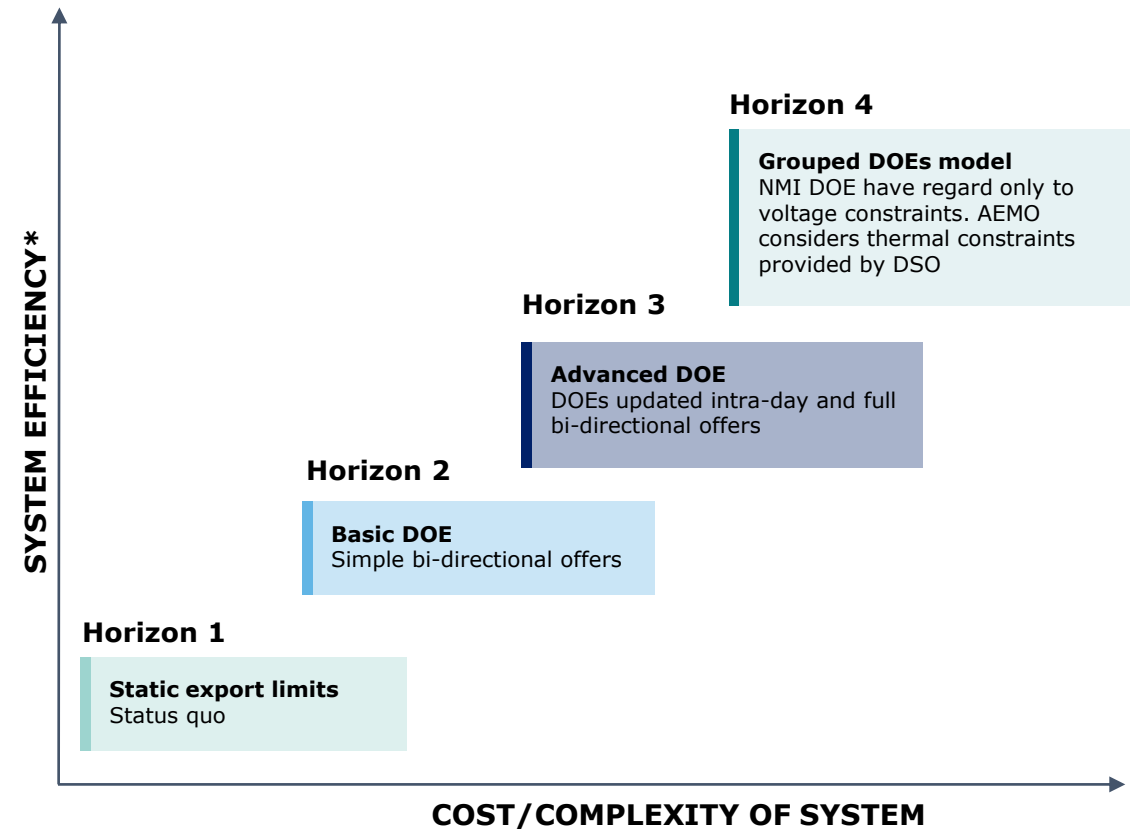
The Project EDGE field trial will test the Basic DOE and Advanced DOE 'target operating models' whereas the Technical performance of the Grouped DOE model will be assessed via desktop analysis by UoM as it was not feasible to build this capability within the project timeline. This desktop analysis will be an input into the CBA.

Grouped DOEs

Aggregators are provided NMI DOEs with respect to voltage constraints while AEMO considers thermal constraints of an upstream network element provided by the DSO (e.g., local voltage limits, nodal thermal limits linked to market optimisation).

Figure: Location of thermal and voltage limits

Grid

Security Constrained Economic Dispatch (SCED)

P

Thermal limit

Bus 1

Voltage limit

Spectrum of the simplicity-efficiency trade-off for distribution network limits and wholesale dispatch

SYSTEM EFFICIENCY*

Horizon 4

Grouped DOEs model
NMI DOE have regard only to voltage constraints. AEMO considers thermal constraints provided by DSO

Horizon 3

Advanced DOE
DOEs updated intra-day and full bi-directional offers

Horizon 2

Basic DOE
Simple bi-directional offers

Horizon 1

Static export limits
Status quo

COST/COMPLEXITY OF SYSTEM

System efficiency = network and market efficiency

Anything else?

Focused Question: Are there additional considerations that should be incorporated in the CBA that are not mentioned?

Activity:
Mural Board
(5 minutes)

Next Steps

How to Get Involved
Methodology Report and Consultation Timeline

Landmark	Timing
Public Methodology Report Consultation Opens	**21 July**
NAG Forum	26 July
MICF Forum	28 July
Public Methodology Report Consultation Ends	**5 Aug (5pm)**
Final CBA Methodology Publication	Late 2022

For further information on the project, or to get involved, contact EDGE@aemo.com.au
or visit AEMO's Project EDGE web page, at: AEMO | Project EDGE

Any other business

Next meeting:
25 August 2022

Future Meetings & Close

Project EDGE Publications

Publications	Publication Date
Project EDGE CBA Methodology Consultation Paper	July 2022
Project EDGE Public Interim Report	June 2022
Project EDGE Customer Insights Study	June 2022
Project EDGE Research Plan	March 2022
Project EDGE MVP Showcase	December 2021
Project EDGE Lessons Learned Report #1	May 2021
Project EDGE Public Webinar #1	March 2021
Project EDGE Factsheet	January 2021

For further news and knowledge sharing publications, please visit the Project EDGE website

For any questions, comments or feedback please contact: EDGE@aemo.com.au

For more information visit

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