ENERGY SECURITY BOARD

POST 2025 FUTURE MARKET PROGRAM

TECHNICAL FOCUS GROUP
AHEAD MARKETS – MEETING #5 – 19 AUG 2020

IMPORTANT NOTES

- These slides are solely for workshop purposes only. The content provides general information to support informed stakeholder engagement and feedback.

- The presentation does not represent the official position of the Energy Security Board or any related body.

- The webinar is being recorded and a link to the recording will be provided after the webinar.

- All previous webinar recordings and slides are available here for your reference.

WEBINAR-WORKSHOP LOGISTICS

- All participants are currently in listen-only mode
- We will pause periodically for discussion. Please use the **Raised Hand** to signal that you would like to speak.
- If you would like to record a comment without discussion, feel free to type it into this field.

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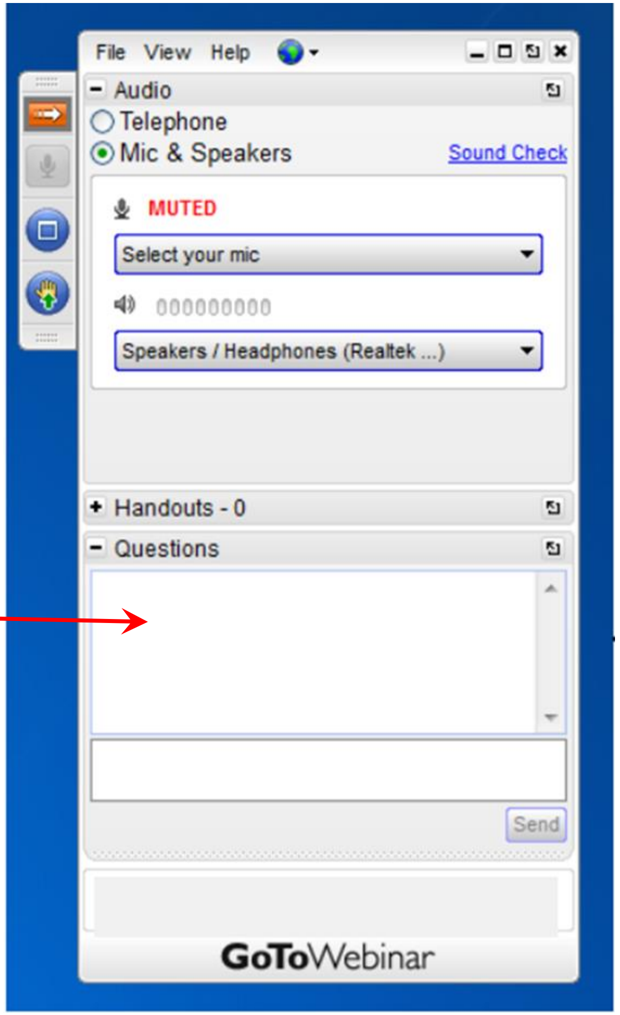


AGENDA

- Context
- Ahead market for system services that are not priced in the real-time market
- Scheduling system services that are not priced in the real-time market for market benefit.

CONTEXT

- Work done so far
- Why are we considering an ahead market for services not traded in the real-time market?

THE STORY OF THE SCHEDULING AND AHEAD MARKETS MDI SO FAR…

1. A spectrum of options broken into components

Minimum change from current NEM → Enhance firming through ST contracts → Co-optimised energy + system services ahead schedule → Most firm commitment

	1. Unit Commitment for Security (UCS - only)	2. UCS plus voluntary forward market	3. System security ahead market	4. Compulsory ahead market design
Ahead scheduling	N/A	Trade short term contracts ahead of RT	Co-optimised ahead scheduling	Mandatory participation
UCS	Schedule system service contracts PDS forms basis for committing additional units to fill system gaps	PDS, updated to reflect ahead scheduling outcome, forms basis for committing additional units to fill system gaps		
RT dispatch	As per now	Ahead trades included in settlement outcomes		

2. Consideration of the UCS

The UCS can be used to:

- Schedule system service contracts (in the UCS-only option)
- Support identification of intervention actions more efficiently and transparently when system requirements shortfalls exist.

Input

1. AEMO forecast of system conditions and constraints
2. PDS and/or ahead market solution (if applicable)
3. Plant economic costs & technical information
4. Information on contracted system services

→ **Optimisation**

1. Least cost commitment outcome to meet demand and system services over forecast period
2. Commitment based on PDS or ahead scheduling taken as fixed
3. Activate system service contracts to fill system gaps and potentially provide market benefit

→ **Output**

1. ***Indicative*** commitment schedule including:
   I. Additional commitment by UCS
   II. Contracts activated by UCS
2. Pivotal units identified (see later)
3. Other technical solution related information
4. Potential system gap and contract activation communicated to market

→ **Commitment instruction and contract activation**

1. Out-of-market commitment instruction made on last minute to intervention basis
2. Contract activated and communicated to market in accordance with terms and conditions, as per indicated in UCS solution

3. Use cases for ahead markets

Improve scheduling efficiency and lower cost to consumers & Facilitate transition, consumer engagement and DER integration	Activate additional system service for market benefit
	Platform to hedge system service costs
	Facilitate greater DR and DER participation
	Improve scheduling of storage
	New mechanism to hedge against short-term variability
	Better coordination between electricity and other markets

4. NOW: Design of potential ahead markets / scheduling

?

What does an ahead market look like for each of these use cases?

- How can you use it to schedule system services without a real-time price?
- How does the market interact with this scheduling process?
- What does it mean to have an ahead market as a platform to hedge system service costs, and what are the requirements / implications?
- What happens when energy is not traded in the ahead market vs the more standard AM design with energy?
- What does co-optimisation mean in ahead scheduling?
- How does scheduling work when you have only partial participation in the ahead market?

FOCUS FOR THE NEXT PHASE AND TODAY

The focus of the next phase is to discuss the potential design of the ahead markets.

- We are developing a series of more sophisticated worked examples to demonstrate the end-to-end process of ahead markets including bids/offers, the scheduling process, actual dispatch, and settlement outcomes.
- Worked examples are designed to illustrate how ahead markets can be applied to some use cases identified in the last focus group workshop, and will cover high-level ahead markets design and processes for
    - System services purchased ahead but not traded or priced in real-time.
    - Energy and system services traded both in ahead and real-time market

Today:

- In response to stakeholder requests, we will first focus on the design of an ahead market for system services that do not have a real-time price, including those that may be procured under a structured framework.
- We have less content than in the past, so will be more time for discussion at the end of the session today.

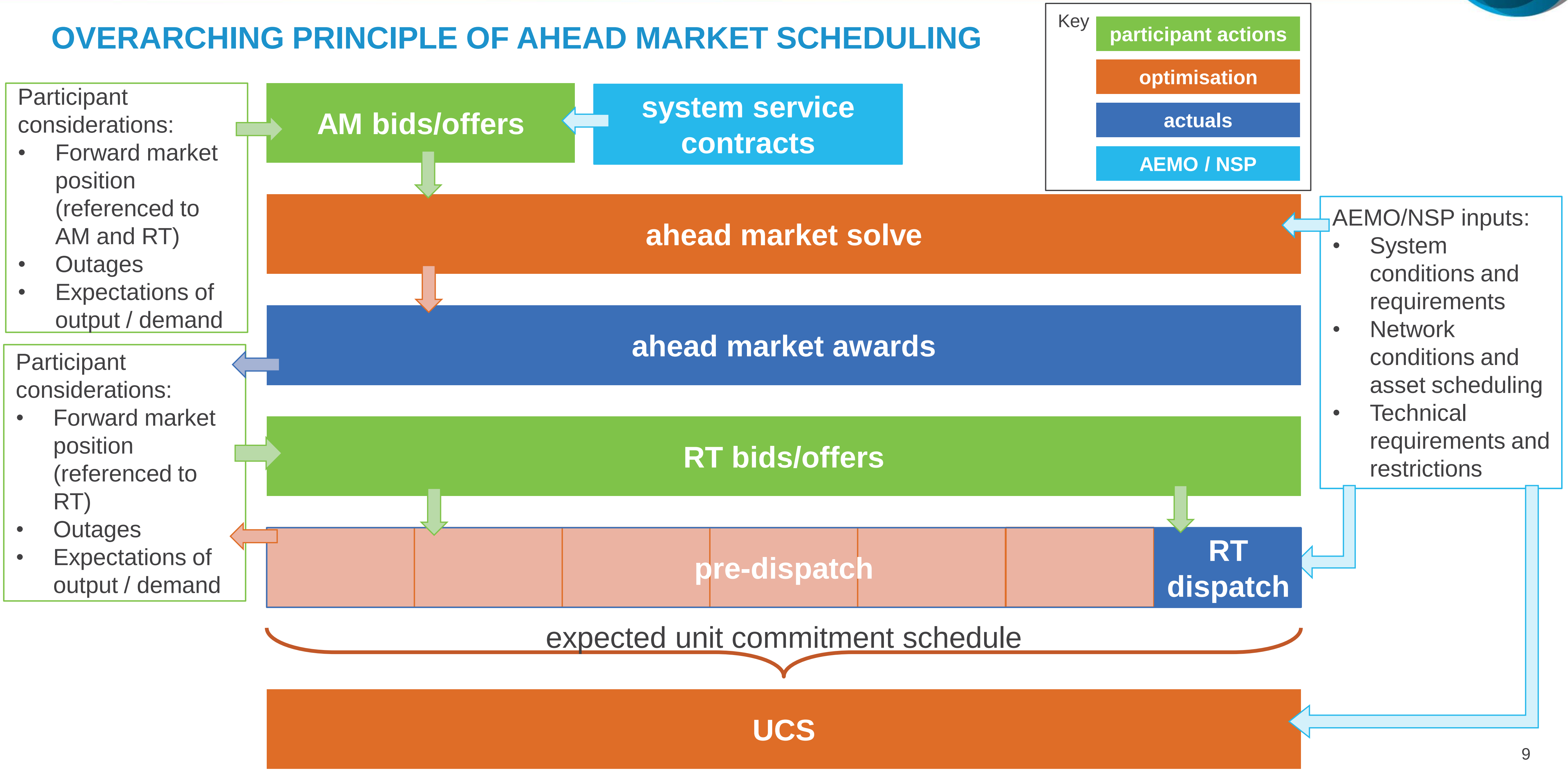
Future:

- The example for the system service that has a real-time price is still under construction.
- We aim to cover system services with a real-time market examples at a later technical focus group session.

ASSUMPTIONS AND TERMINOLOGY FOR TODAY’S DISCUSSION

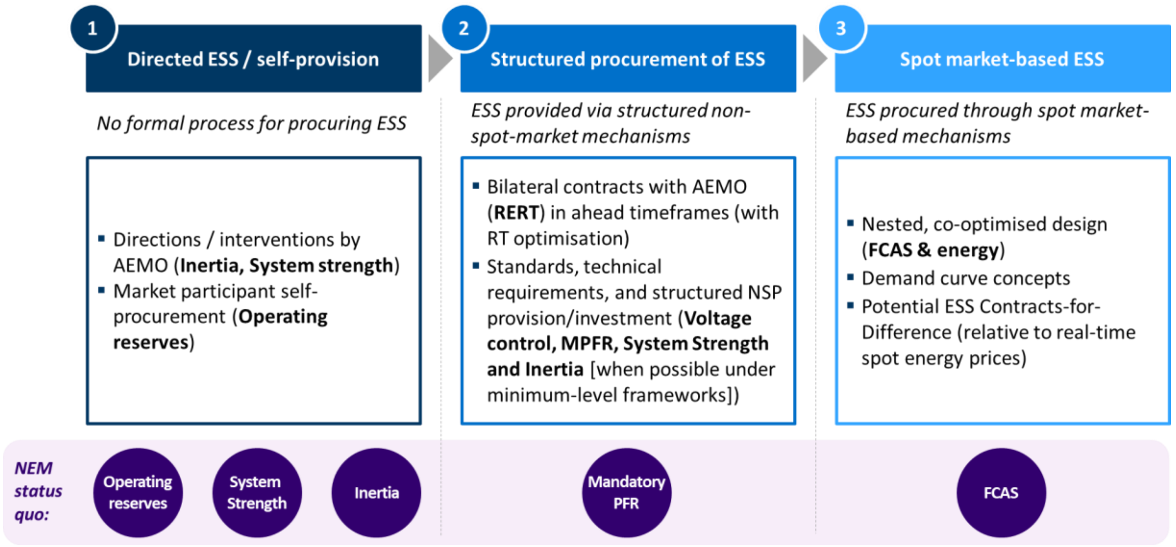
- As when we presented the use cases for ahead markets, we’ll be focusing on the common design parameters applicable to features in option 2 and option 3:
  - **Voluntary participation** in the ahead market from both the demand and supply side for resources not covered by system service contracts.
  - **Financial commitment** under the ahead market schedule.
- In line with this focus, we have refined our consideration of these options (and renamed them) as follows:
  - **Option 2: System service ahead scheduling**
    - Adds the ability to trade or procure system services (including system services contracted under a structured procurement framework).
    - Design options for the structure of the ahead market process including central procurement, 2SM, daily and intraday auctions.
  - **Option 3: Integrated ahead market**
    - Co-optimised scheduling of energy and system services.
  - Zooming in on these options, there is a spectrum of potential options between these as well, depending on the design choices that are made.
- **Terminology**: system services that don’t (in 2025) have a real-time price/market = system services that can’t be traded / priced in the real-time market = potentially system services procured under a structured framework, e.g. “synchronous services”

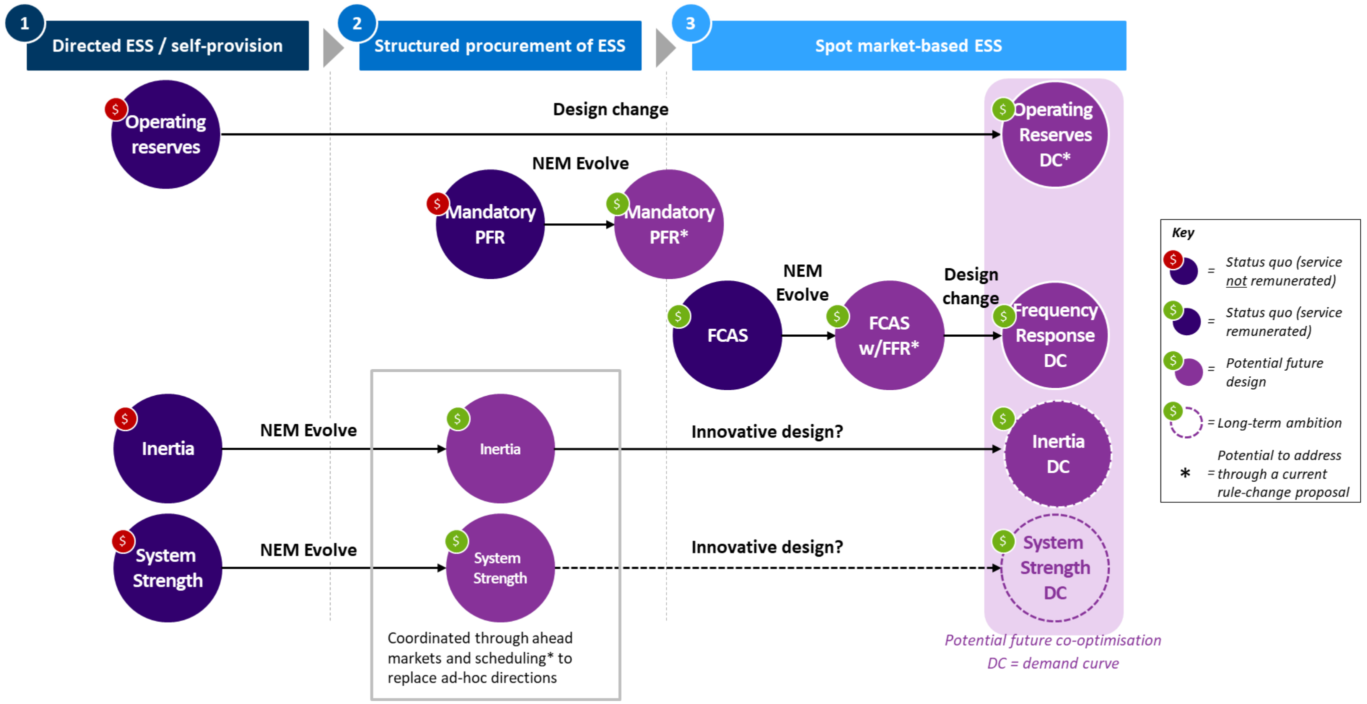
OVERARCHING PRINCIPLE OF AHEAD MARKET SCHEDULING



WHAT ARE SYSTEM SERVICES WITHOUT A REAL-TIME PRICE?

In MDI C (ESS), FTI have presented a framework and roadmap for the consideration of ESS.





- Under structured procurement inertia and system strength can be coordinated through ahead markets and scheduling to replace ad hoc directions.
- Innovative design is necessary to move these towards spot market-based.
- This section discusses a worked example for a potential design of the scheduling of system strength in an ahead market concept.

WHY ARE WE PROPOSING AN AHEAD MARKET BEYOND THE UCS-ONLY OPTION TO SCHEDULE SYSTEM SERVICES WITHOUT A REAL-TIME MARKET?

We previously proposed the UCS-only design option, which would address system security gaps:

1. By scheduling contracted system services providers, or
2. Through AEMO directing out-of-market resources as a last resort. Directed participants are remunerated based on some regulated compensation approach (e.g., cost based on current 90th percentile historical energy prices)

Schedule system services not traded in RTM

UCS-only option

Contracted resources	Uncontracted resources
Scheduled in the UCS	Committed via out-of-market direction as a last resort
↓	↓
Paid as per contract	Compensated via regulated remuneration approach

Without a spot market, uncontracted resources cannot compete and offer their services through a market-based mechanism, which could deter their efficient utilisation during the transition.

WHY ARE WE PROPOSING AN AHEAD MARKET BEYOND THE UCS-ONLY OPTION TO SCHEDULE SYSTEM SERVICES WITHOUT A REAL-TIME MARKET?

- As presented in the previous workshop, one of the use cases of ahead markets is to provide a market-based option to schedule these uncontracted synchronous services (among other options, see next slide).
  - The example here is built on rule change proposals submitted to the AEMC.
  - Participants with and without system service contracts can all enter, increasing competition.
  - Allowing uncontracted participants to offer their services and be remunerated through a market process rather than being directed and paid based on a regulated compensation approach.

Schedule system services not traded in RTM	Contracted resources	Uncontracted resources
UCS-only option	Scheduled in the UCS → Paid as per contract	Committed via out-of-market direction as a last resort → Compensated via regulated remuneration approach
Ahead market for services not traded in RTM	Offers into a market-based mechanism → Paid as per contract	Offers into a market-based mechanism → Market based compensation

UCS remains as a tool to assist AEMO to monitor the system and undertake out-of-market intervention if needed.

We will illustrate this with an example…

OTHER POTENTIAL OPTIONS TO PROCURE AND SCHEDULE SYNCHRONOUS SERVICES

- There are other potential options that can procure and schedule resources to provide “synchronous services”, as have been discussed under the ESS MDI.
- They can be substitute for, or work along side various ahead market designs
- Assessment of the options including the ahead market design will be carried out in the ESB post 2025 and AEMC rule change processes

	Overview	Interaction with ahead market design
Network solution	• TNSP contracting resources or building network assets • This could include existing generation assets, new network assets, synchronous condensers or new emerging technologies	• Appears complementary to this AM proposal unless only fast-start resources can provide services. • If slow-start synchronous gens form part of the contract mix, some “ahead-of-RT” mechanism appears needed to schedule and commit them. • What to do with uncontracted slow-start resources?
Developing a real-time market for synchronous services	• Develop a RTM for synchronous services • Rule change proposal being considered by the AEMC	• Appears to be a substitute to this AM proposal • Could be complementary to the more standard ahead market design where products are traded both in ahead and real-time.

Questions:

- *Have we captured all the potential alternative options for scheduling system services that cannot be priced in the RTM and their relationship to this ahead market design proposal?*

Q&A

AHEAD MARKET FOR SYSTEM SERVICE WITHOUT REAL-TIME PRICES

- Model setup and assumptions
- Ahead market process
- Other discussions

HIGH LEVEL AHEAD MARKET DESIGN FOR SERVICES NOT TRADED IN RTM – SOME WORKING ASSUMPTIONS FOR THE EXAMPLE

- The focus of this presentation is the high-level end-to-end process of an ahead market for system services that cannot be priced in real-time.
- As we are still at the early stage of design development, we will make some assumptions on some design components such as deviation cost or the optimisation window to enable us to walk through the high-level process. We will discuss some of them later in the presentation and would like to hear your feedback.
- As the system services design details are progressed in parallel in the ESS workstream, we will also make some working assumptions on their features in this presentation.
- Where possible we have *explicitly labelled* these assumptions in the presentation.
- For the rest of the presentation we will use system strength as an example, but the concept presented should be applicable to other system services that are not priced in real-time.

DELIVERING SYSTEM STRENGTH IN ENERGY MARKET

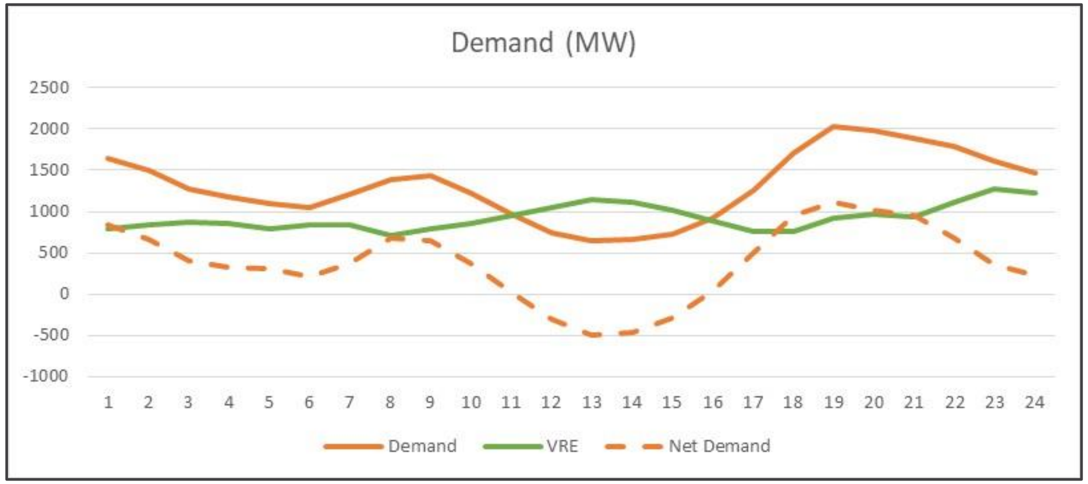
Dispatchable Generation

- Slow-start synchronous gens can provide system strength
- Minimum system strength supplied if any two or three of the slow start gens (A, B and C) online

Plant	Type	Capacity (MW)	Min Gen (MW)	SRMC ($/MWh)	Start up cost ($)	Provide syst. strength?
A	Slow-start sync. gen	300	100	80	200,000	Yes
B		300	100	90	200,000	
C		300	100	100	200,000	
X (Simplified representation of all peaking units)	Fast-start sync. gen	2000	0	160	0	No
VRE	Inverter based	Variable	NA	0	NA	

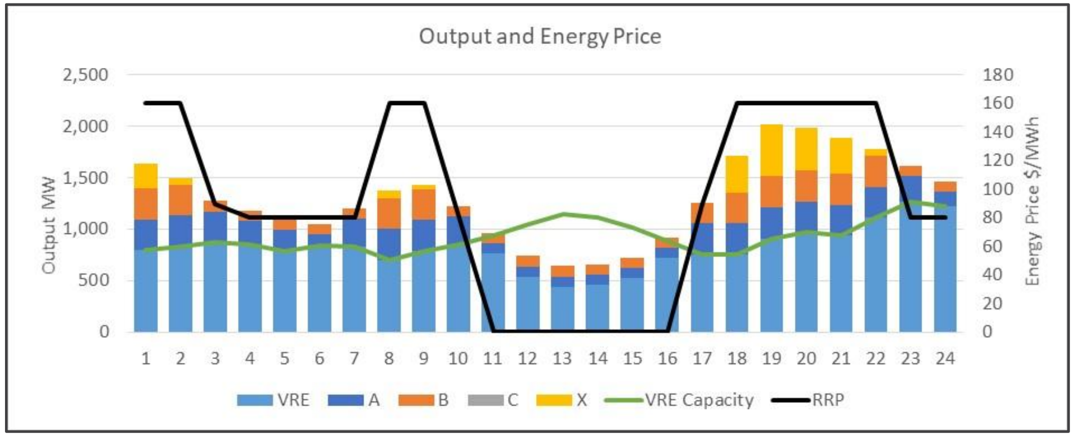
Demand and VRE

- High VRE throughout the day hence low net demand
- Energy prices too low for more than one slow-start unit to be on line for the whole day.



ENERGY PRICES TOO LOW TO SUSTAIN TWO “SYSTEM STRENGTH” GENS ONLINE

Example of price and output with A & B online



- A potential solution is to provide some form of “system service compensation payment” for generators min-gen output so that it can recover its cost when providing system strength
- The payment can take many forms. In our example, we *assume it is a $/MWh payment on generator’s min-gen output in addition to energy price*.
  - The generator is still exposed to energy price risk and might not recover fixed / min-gen cost if energy prices turn out to be lower than expected.
  - However, generators could price in such risk and include a premium in their offer
- The table below shows the amount of missing money depending on the combination online and the required min-gen compensation payment.

System strength combination	Plant	Missing money	Min-gen output (MWh over 24 hours)	Additional payment on min-gen ($/MWh, *over 24 hours*, rounded up to nearest $)
A and B	A	-$26,000	2400	$11
	B	-$72,000	2400	$30
A and C	A	-$20,000	2400	$9
	C	-$112,000	2400	$47
B and C	B	-$59,000	2400	$25
	C	-$10,5000	2400	$44

THE OVERALL PROCESS FROM AHEAD MARKET SCHEDULING TO REAL-TIME

AM Bid/Offer

System service compensation offer

- additional payment on min-gen output for the required period

PDS information

- Demand
- VRE forecast
- Energy and other system services bids

AM scheduling and award

Optimisation based scheduling mechanism

Find the optimal combination of sync. units to be scheduled so that:
- Min. system costs over the required period, incl. system service compensation payment
- Subject to meeting all reliability and security requirement. incl. system strength.

System strength ahead market awards

- Units in cleared combination receive a compensation payment

Via PDS Bids

RT operation

Real-time operation

- Units (with or without sys service comp payment) self-commit into PDS
- Non-delivery of system service by units cleared in the AM (i.e., not online) might attract deviation payment (see next slides)

- Need to consider the impact of cleared combo on the whole system, as the commitment pattern could impact on other units and hence energy and system service markets.
- In the absence of ahead market for energy and other system services, PDS is used as an alternative input.

AHEAD PAYMENT AND DELIVERY – HOW FINANCIAL COMMITMENT WORKS

Deviation is priced at the real-time market price, as it is the actual cost of supplying the imbalance.

How financial commitment works for services that can be traded in both ahead and real-time market

AM schedule
X
AM price

+

RT deviation
X
RT Price

- But there is not a real-time price to cost the non-delivery of system strength
- Using real-time energy prices to settle the non-delivery of system strength (the cleared generator being offline) will be ineffective
  - Lower energy price =>
  - stronger incentive not to deliver min-gen output & buy energy at pool=>
  - shortage of system strength
- So it appears an alternative settlement approach is needed when cleared generator does not come online

AHEAD PAYMENT AND DELIVERY – APPLYING TO THIS DESIGN

- Participant cleared in the AM gets this payment
- No other payment in RT (except energy revenue) if participants runs at least at min-gen.

An assumption on deviation cost as a starting point

If cleared generator fails to run at min-gen to deliver system strength, it will bear the cost of SO's action to address the shortfall

AM schedule (*running at min-gen for x intervals*)
X
AM price (*$/MWh system service compensation payment*)

+

Deviation (not being online) paid at the cost of rectifying the shortfall (e.g., cost of AEMO directing another unit)

- Without a RT price, this is the actual cost of addressing the shortfall in system strength.
- This could be 0 if AEMO does not have to take any action despite the unit not online (e.g., market condition changed or some other units self-committed in RT for other commercial reasons)
- Presented here as a "strawman", will discuss some alternative options in later slides…

We will illustrate this with the following example…

EXAMPLE: AM BID AND OFFER

AM Bid/Offer
- System service compensation offer
- PDS information

AM scheduling and award
- Optimisation based scheduling mechanism
- System strength ahead market awards

RT operation
- Real-time operation

In this example, we assume all three generators are offline when making the offers. The design could accommodate both online and offline generators offering services, which can be investigated later.

- *AEMO announces (example only) that it needs to procure system strength over for a 24 hour period (for example)*.
- Based on PDS and AEMO's announcement of system strength gap, participants form a view of the additional compensation needed to run at to provide system strength (*assuming assessment over a continuous 24-hours period*).
- The amount of missing money could depend on the combo online (see table to the right). Based on their own estimate and risk preference, *we assume participants make the following (example only) offer* for additional compensation on their min-gen output over 24 hours.
    - A: $11/MWh
    - B: $30/MWh
    - C: $47/MWh
- All participants continue to make offers into the PDS for energy and other system services.

System strength combo.	Plant	Missing money	Min-gen output (MWh over 24 hours)	Additional min-gen payment ($/MWh, rounded up to nearest $)
A and B	A	-$26,000	2400	$11
	B	-$72,000	2400	$30
A and C	A	-$20,000	2400	$9
	C	-$112,000	2400	$47
B and C	B	-$59,000	2400	$25
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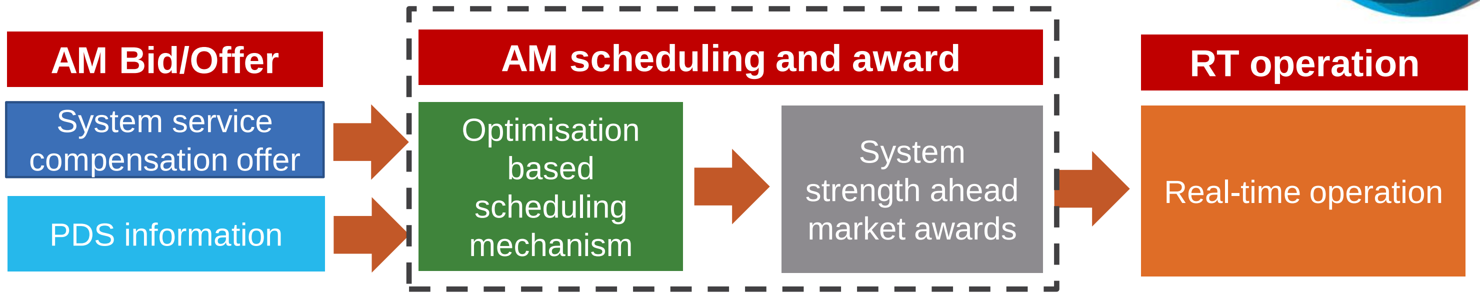
EXAMPLE: AM SCHEDULE AND AWARD



- The AM schedule aims to minimise the total system cost over the relevant period while satisfying all reliability and security requirements, including system strength.
- Need to consider impact of committed plant on the rest of the system (e.g., total energy and other service costs, impact on constraints, etc). In the absence of ahead market for energy and other system services, PDS is used as an alternative input.
- Participants receive their ahead market schedule, which is their schedule of online period and associated system service compensation payments. (*Assuming there is no other ahead markets in this model.*)
- In this example Plant A and B get cleared in the ahead market for system strength.

Plant	System service comp. payment offer ($/MWh)	Energy offer ($/MWh, via PDS)	AM award quantity (MW min-gen for 24 hours)	AM award price for min-gen compensation payment ($/MWh)	AM revenue ($)
A	11	80	100	11	26,400
B	30	90	100	30	72,000
C	47	100	0	0	0
X	NA	160	NA	0	0
VRE	NA	0	NA	0	0

As it is a combination that is cleared to deliver system strength rather than individual units, *we assume "pay-as-bid".*

EXAMPLE: REAL-TIME OPERATION

AM Bid/Offer
- System service compensation offer
- PDS information

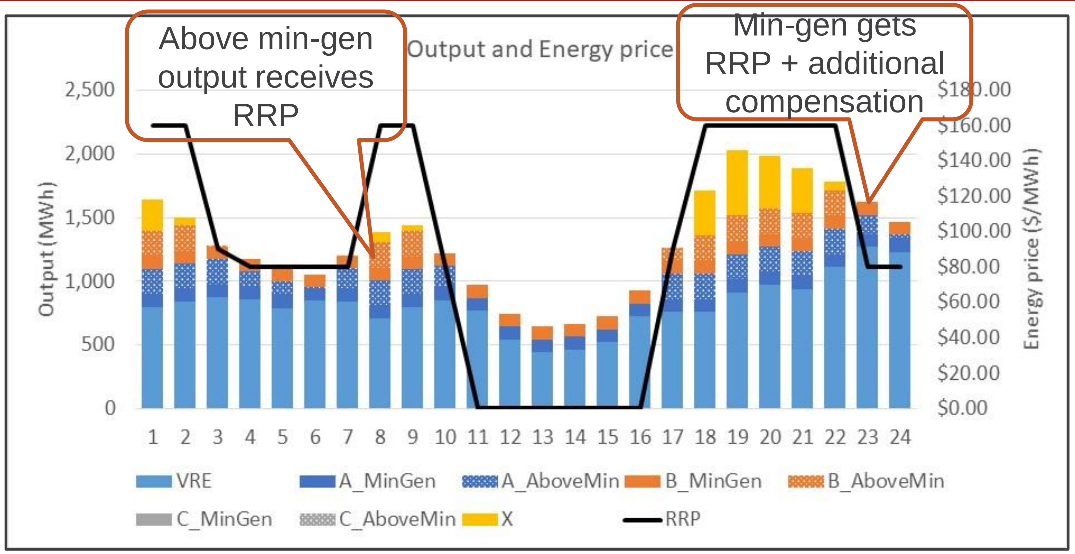
AM scheduling and award
- Optimisation based scheduling mechanism
- System strength ahead market awards

RT operation
- Real-time operation

- All units self-commit into the real-time operation via PDS, including plant cleared for system strength in the AM (A and B in our example)
- A and B receives the AM compensation payment.
- In addition, their entire energy output (including min-gen) receives the normal pool prices in real-time.
- In this example, they are online for the whole period and there is no deviation payment for not delivering system strength.

Output and final payoff if both A and B are online in RT for the whole period

	A	B	C
System service compensation payment (AM payment)	$26,400	$72,000	$0
RT non-delivery cost	$0	$0	$0
Variable Cost	-$428,446	-$387,445	$0
Start Cost	-$200,000	-$200,000	$0
Energy Pool Revenue	$602,446	$515,445	$0
Net profit	$400	$0	$0



EXAMPLE: RT NON-DELIVERY

AM Bid/Offer
- System service compensation offer
- PDS information

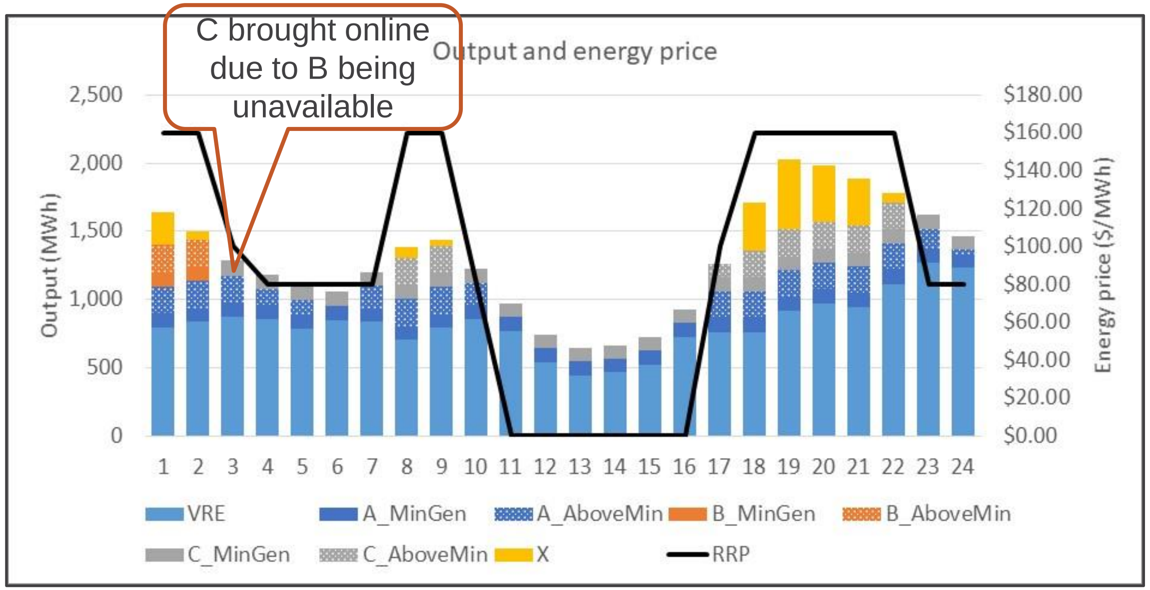
AM scheduling and award
- Optimisation based scheduling mechanism
- System strength ahead market awards

RT operation
- Real-time operation

- Suppose B deviates (commercially or physical outage) and becomes offline after 2am
- SO brings on generator C to provide system strength
- C receives RRP for its entire output, but no compensation payment on min-gen as it is not cleared in the ahead market
- SO pays C a make-whole payment (*assumed to be based on cost here*) to cover its cost (start + variable)
- B retains its AM payment, but has to fund the direction make-whole payment made to C

Output and final payoff if B does not deliver its ahead schedule and C is required

	A	B	C
System strength uplift payment (AM payment)	$26,400	$72,000	$0
System strength deviation payment (RT)	$0	-$148,000	$0
Variable Cost	-$428,446	-$54,000	-$370,494
Start Cost	-$200,000	-$200,000	-$200,000
Energy Pool Revenue	$608,446	$96,000	$422,494
Intervention Make-whole payment	$0	$0	$148,000
Net profit	$6,400	-$234,000	$0



DESIGN CONSIDERATIONS: THE NON-DELIVERY COST DESIGN

- In the example above, participants who do not deliver their ahead market system strength schedule will pay the cost of rectifying the shortfall, which could be small (or even not needed) or very large depending on the RT condition.

- Does this appropriately balance the risk to the participants with that to the system?
  - Shortfall of system strength could expose the system to risk of large disruption, so the penalty needs to reflect such cost and risk
  - But it could also lead to very large liability and risk to participants in the AM, which could translate into large risk premium in offers, or deter incentive to participate in the first pace.

- In some instances it could also be difficult to work out the exact cost. For example, there might not be another participants available for direction leaving the system in an insecure state.

- Some alternative options:
  - Pay the cost of rectifying shortfall but with some administratively determined cap (similar to MPC in energy market).
  - Claw back (part or the entirety of) the ahead market payment if participant does not follow the system strength schedule.
  - Administratively set deviation payment which might not be linked to real-time market conditions.

- Note for participants who are under a system services contract, the contract could specify the deviation payment.

Questions:

- *What is stakeholder's view on the options to cost non-delivery of system services scheduled in the ahead market?*

DESIGN CONSIDERATIONS: BALANCING RISK TO PARTICIPANTS AND THE SYSTEM

- In the example above, the cleared generator effectively receives a fixed $ amount payment, but
  - It is exposed to energy risk for its entire generation.
  - If RT energy price is low, it either has to ride-through the low price period, or goes offline but pays for the cost of rectifying shortfall.
  - Overall it faces the risk of making a loss despite receiving the compensation payment.
- In the case of system strength, frequent deviation by resources cleared in the AM could expose the system to risk as well, as the SO could be left to scramble for intervention in RT, potentially with limited options.
- To the extent possible, the design should
  - Encourage participants to deliver system strength cleared in the AM when they are physically capable of doing so to minimise AEMO intervention and risk to the system.
  - Not expose participants to undue commercial risks.

DESIGN CONSIDERATIONS: BALANCING RISK TO PARTICIPANTS AND THE SYSTEM

	Risk to participants		Risk to system and end consumers
Ex-post (real-time) risk	Exposure to energy price risk when running at min-gen	Might go offline and not deliver system strength → deviation cost risk, hard to predict without an RTM	Risk to system if deviation occurs frequently
Ex-ante (participation) risk	Risk of making a loss entering the AM	Add higher risk premium in offer *OR* Don’t participate	Higher overall cost and risk, due to • Higher AM payment • More frequent intervention in RT with associated cost and risk to system

Balancing the risks

Modifying some design elements could have different impact on different parties. For example:

- Make the penalty regime more stringent – could reduce incentive for RT deviation but might increase risk to participants
- Change the ahead payment to a CFD conditional on physical min-gen output – this could remove the participants’ energy price risk and potentially mitigate the risk to the system if they have less incentive to deviate in RT.

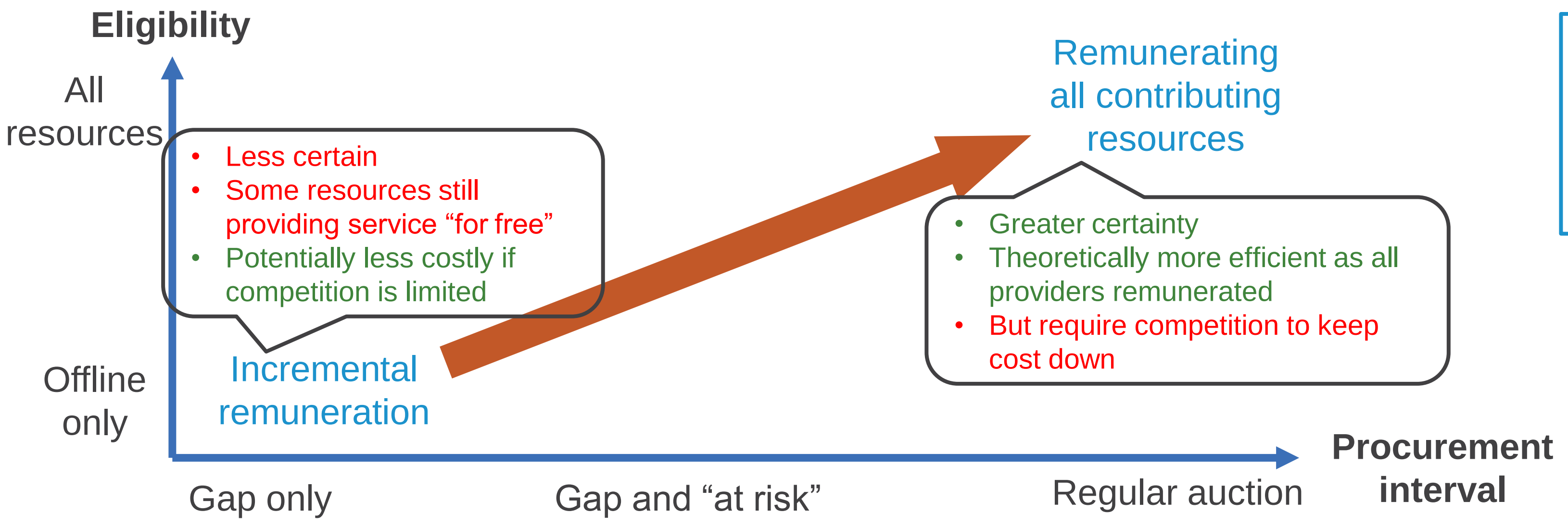
Questions:

- *Have we appropriately characterised the potential risk trade-off in the design?*
- *Do participants have suggestions on how changing certain design element could improve the overall risk outcome?*

DESIGN CONSIDERATIONS: WHEN TO RUN THE AM PROCESS AND ELIGIBILITY TO BID BY ONLINE RESOURCES

When to procure	• Should AEMO procure the services at a regular interval (e.g., daily, x times a day) or only if there is a gap indicated in the PDS? • What if there is no explicit gap in the PDS yet, but the system "is at risk" (e.g., one more decommitment would lead to a gap)?
Online resource eligibility*	• Should we only allow offline resources to participate? • Definition of offline: at the time of the auction *vs* as indicated in the PDS related to the gap period?

** NB: all resources still can self-commit in RT through PDS regardless if they participate in the AM and/or gets cleared for payment*



These design considerations potentially overlap with the ESS workstream and we will continue to work in collaboration with MDI-C on these issues.

Questions:

- *We welcome participants comments and suggestions on these design aspects …*

Q&A

PROCURING SYSTEM SERVICES WITHOUT RTM FOR MARKET BENEFIT

- What is market benefit
- Central vs two-sided procurement
- A preliminary assessment

PROCURING SYSTEM STRENGTH FOR MARKET BENEFIT

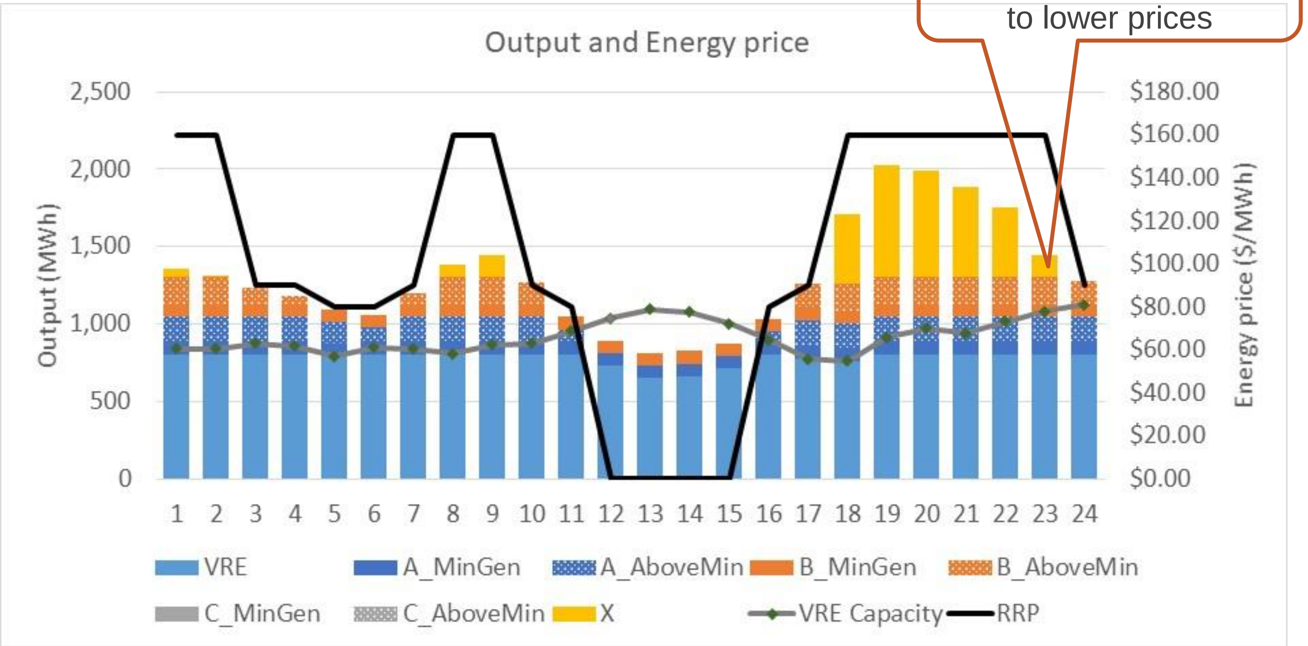
- Sometimes additional system services beyond minimum level could lead to greater market benefit, if they result in lower total dispatch cost, which will likely lead to lower prices for end consumers.
- For example, AEMO’s “Transfer Limit Advice – System Strength” shows that some combinations of synchronous units could allow more VRE output in the system.
- However, as buying more system services incurs additional cost and could impact on energy supply, there is often an “efficient amount”.
- For some services this can be represented as a downward sloping demand curve beyond the minimum security level.
- For some services such as system strength, currently forming such downward sloping demand curve appears to be very challenging.
- So can we build on the model presented above to procure efficient level of system strength for market benefit?

PROCURING SYSTEM STRENGTH FOR MARKET BENEFIT

Reducing VRE curtailment could lead to lower prices

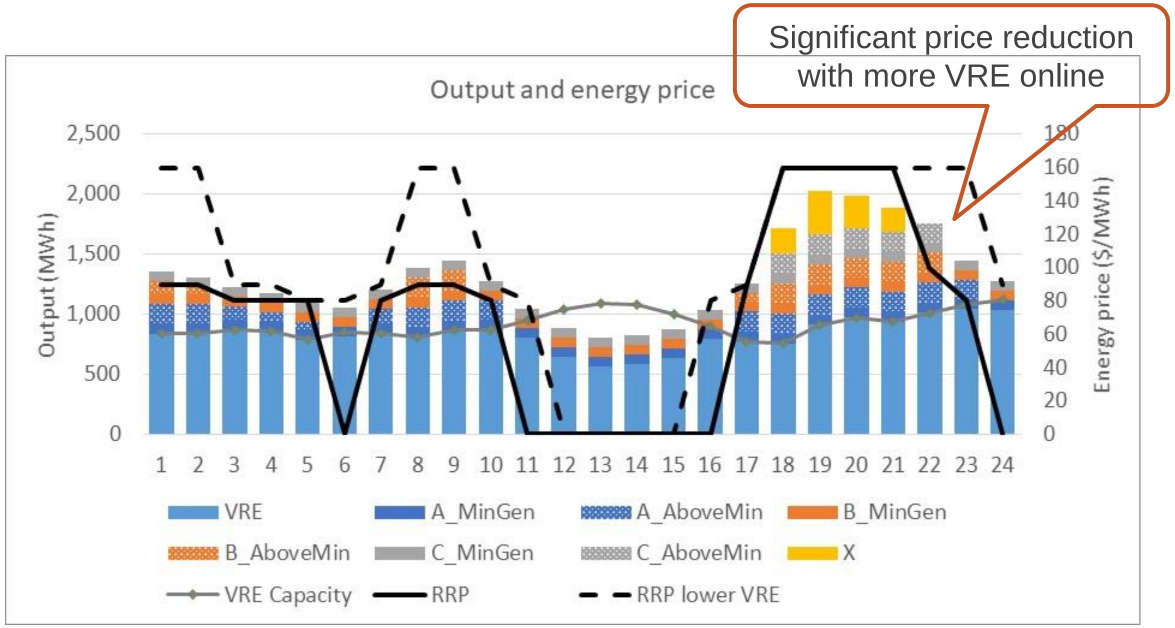
Tweak the assumptions a bit

- Minimum system strength supplied if any two or three of the slow start gens (A, B and C) online
- Maximum VRE = 800 MW with two sync generators
- Maximum VRE = 1000 MW with three sync generators



The main trade-off is the cost of scheduling additional units for system strength vs the benefit of allowing more VRE

CENTRAL VS TWO-SIDED PROCUREMENT



- Major design choice - how is the cost for providing market benefit funded?

- Option 1 – central procurement. SO buys the efficient amount of system strength on behalf of end consumers

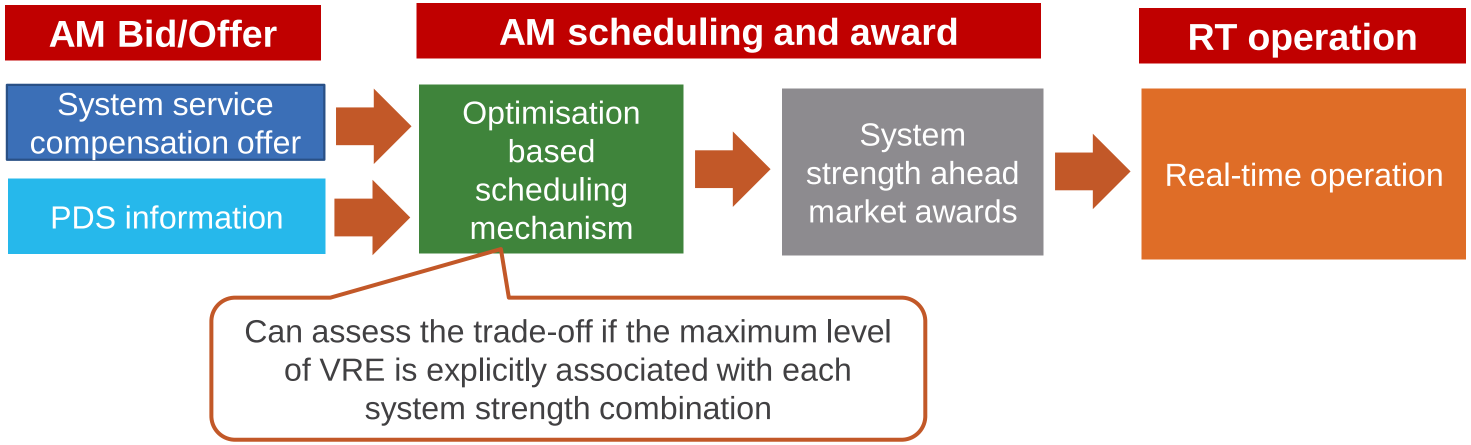
- Option 2 – two-sided procurement, e.g.,
  - VRE buys “curtailment alleviation right”
  - Load funds the additional system strength on a voluntary basis

Assessment metric

- **Incentive to free-ride** – Participants might want to wait for others to fund the additional service, but receive the benefit once it is provided for free.
- **Alignment of incentive –** Buyer might not procure efficient quantity if their incentive does not closely align with the total system benefit (or that of end consumers).
- **Cost (benefit) reflective –** Are participants who pay for additional system services the same as those who receive market benefit?
- **Implementation challenge –** How complex is the design?

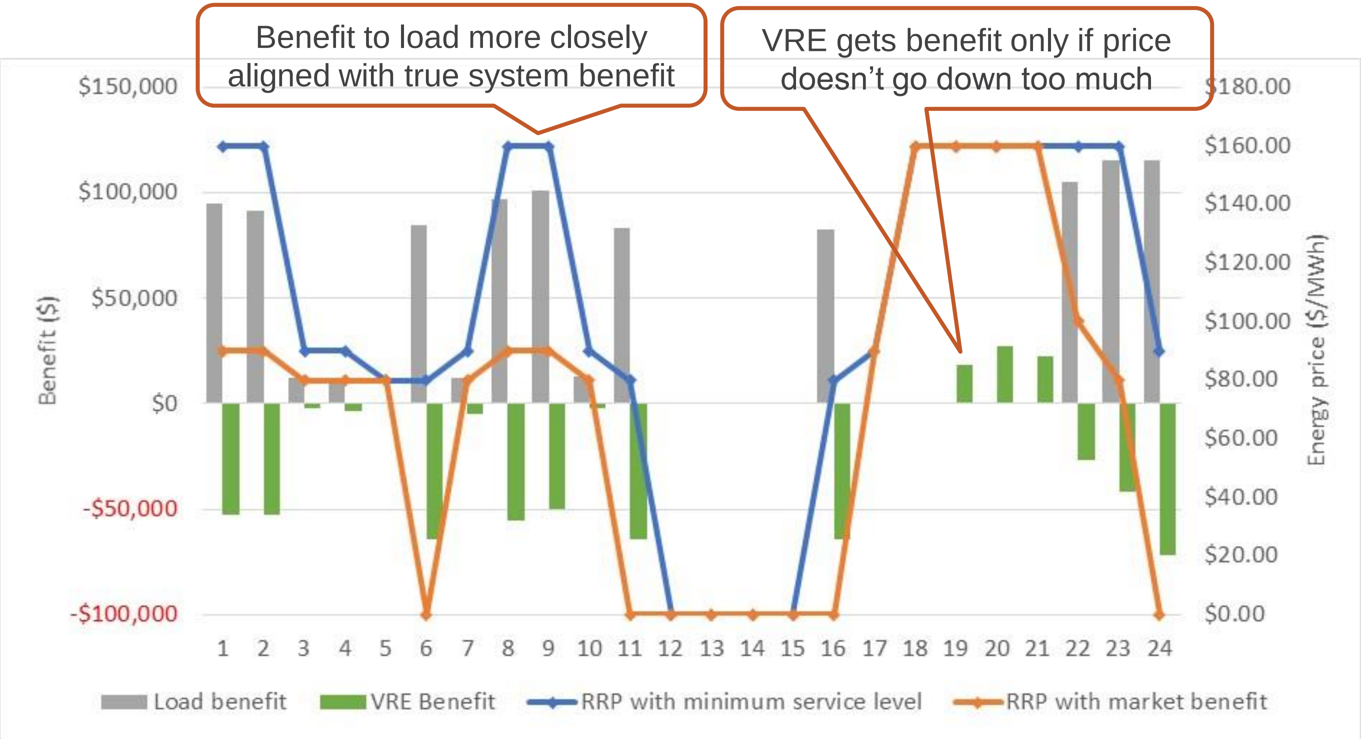
CENTRAL BUYER APPROACH

- The model described above can be used to procuring system strength for market benefit.
- This can be done by explicitly associating the level of max VRE with each candidate system strength combination
- As the optimisation algorithm minimises the total system cost, it will assess the benefit of more VRE *vs* the cost of scheduling additional synchronous services.
- The system operator buys on behalf of all end consumers, with the total cost for compensating synchronous units (minimum level + additional cost for market benefit) smeared over all participants.



TWO-SIDED PROCUREMENT APPROACH

- Since system strength does not have a measurable quantity, one could proxy its benefit via the "alleviation of VRE curtailment".
- Let participants bid (e.g., $/MWh) for alleviating VRE curtailment.
- Procure more system strength if total willingness to pay > cost of additional system strength.



Who funds it matters…

- VRE as buyer
  - Pro: Might overcome public good issue – VRE who bought alleviation rights would be dispatched first when VRE output is constrained in RT.
  - Con: Benefit for VRE could be very limited despite potential lower system cost, more output is good for VRE only if prices are high. Also other generators could see a "cost" if they get dispatched down
- Load as buyer (on a voluntary basis):
  - Pro: Benefit for load directly related to lower pool prices. Market benefit could be purchased closer to the efficient quantity
  - Con: Public good problem – How to (or should we?) exclude load that did not bid for market benefit from lower pool prices?

TWO-SIDED PROCUREMENT APPROACH

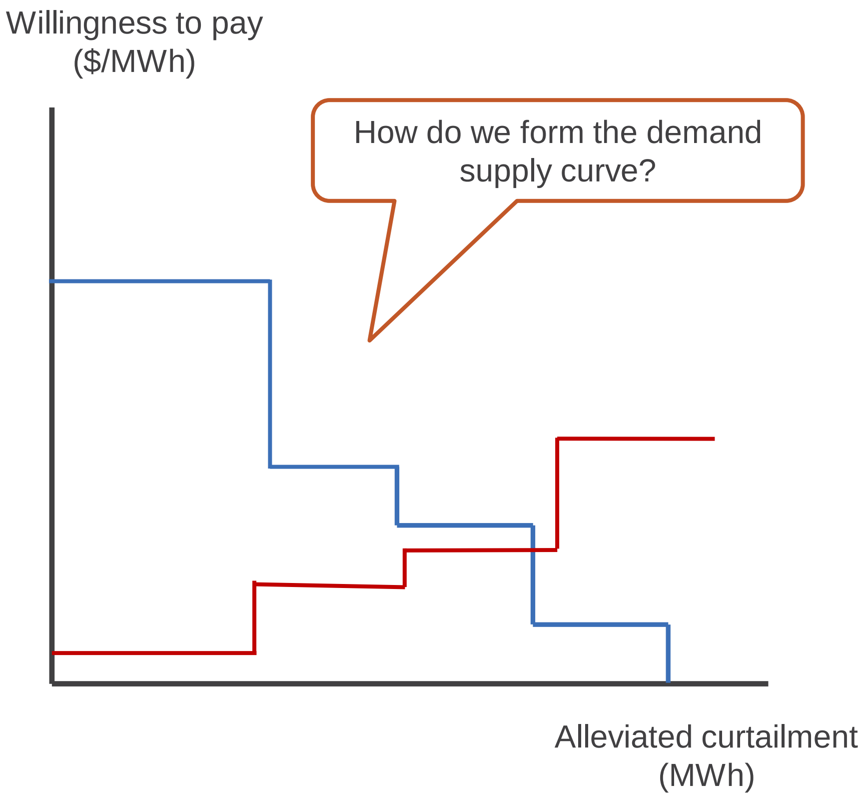
There is also major challenges in forming a workable demand supply curve for curtailment alleviation

1. Market benefit needs to be assessed against a baseline uplift cost and VRE output - What is the “base combination”?

2. Since the optimisation chooses over combinations of generators, it seems difficult to construct a $/MWh based alleviation supply curve

3. Given the inter-temporal nature of the optimisation, should demand and supply be constructed for each interval, or across the entire optimisation period?

4. How to seamlessly integrate the demand and supply for curtailment alleviation into the overall optimisation problem?



PROCURING SYSTEM STRENGTH FOR MARKET BENEFIT – AM ASSESSMENT

	Central buyer approach	Two-sided VRE funding	Two-sided load voluntary funding
Free-rider problem	• No free-rider problem	• No free-rider problem	• Difficult to exclude non-funding load
Alignment of incentive to end consumer	• Min system cost typically translates to low prices for end consumers	• Limited incentive for VRE to reduce prices	• Load benefit from low prices
Cost/benefit reflective	• System-based smearing	• Beneficiary funds the cost	• Beneficiary funds the cost but hampered by free rider problem
Implementation complexity	• Low additional complexity beyond proposed AM model	• Very complex in forming demand-supply curve and integrate with the rest of the system optimisation	
Other issues	• SO’s forecast could have a large impact on outcome	• Any other issues here?	

Q: Have we captured all the relevant metric in assessing the procurement approaches?

PROCURING SYSTEM STRENGTH FOR MARKET BENEFIT – AN ASSESSMENT

- On balance it appears that the central buyer approach is more appropriate for procuring system strength for market benefit due to its relative simplicity to implement, its alignment with end consume benefit, and its ability to overcome free-rider problem.

- Another challenge to work through, but is common to all options**, is how to cost non-delivery?** If a resource scheduled for market benefit does not deliver, but does not cause a system gap so there is no corrective action by SO, what is the cost for non-delivery?
  - One option is that no deviation cost would be paid given there is no explicit real-time cost.
  - Need to consider the incentive for cleared participants to stay online and deliver market benefit, which tends to drive energy price down.
  - Potentially can be strengthened with modification to ahead payment regime?

- *Do participants agree with our preliminary assessment of using a central buyer approach for procuring system strength for market benefit?*
- *Are there any alternatives to improve the two-sided procurement approach to overcome the issues identified?*
- *Are there any other major challenges that we have not identified here?*

SEEKING YOUR INPUT

Some issues we specifically want feedback on

- Are there any other potential options for scheduling system services that cannot be priced in the real-time market?
- Options to cost non-delivery of system services scheduled in the ahead market
- Risk trade off for participants and the system when scheduling system services in the ahead market
- When to run the ahead market process
- Eligibility for resources to participate in the ahead market process
- Relevant metrics for assessing procurement options for procuring market benefit for system services without a real-time price, the preliminary assessment, any other alternatives and challenges.

How you can provide feedback

Please provide initial feedback to info@esb.org.au with email subject heading titled '*TFG AM system services without a RT price*'.

Please get in contact if you have further questions or ideas.

- Upcoming focus group meetings:

  25 August – Standard ahead market design (optional knowledge sharing session on detailed end-to-end standard ahead market process)

  Next session – Ahead market design for services that do have a real-time price