ENERGY SECURITY BOARD

POST 2025 FUTURE MARKET PROGRAM

TECHNICAL FOCUS GROUP
AHEAD MARKETS

26 JUNE 2020

IMPORTANT NOTES

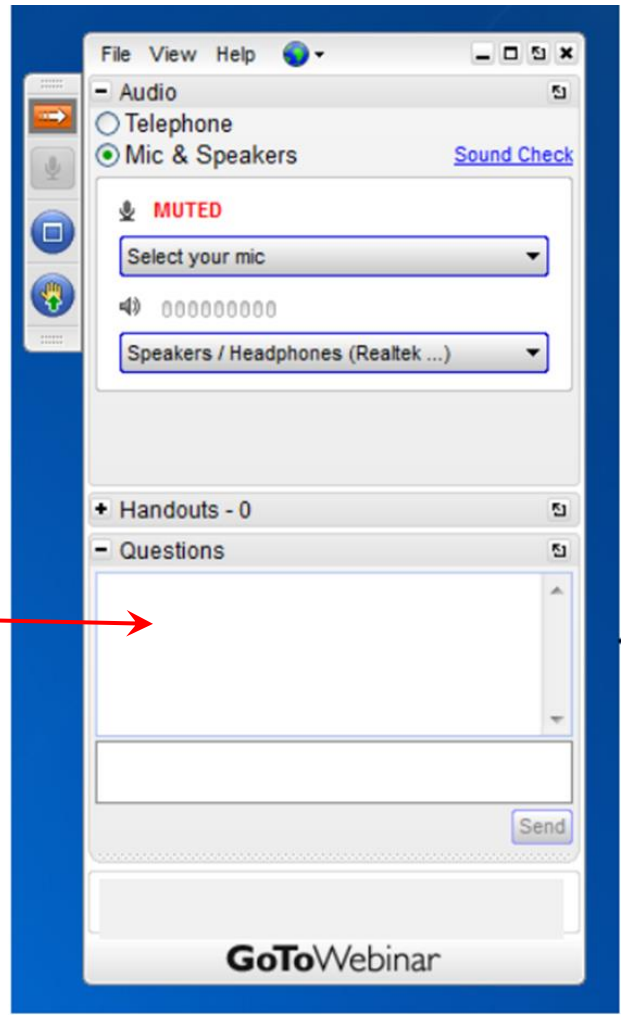
- These slides are solely for workshop purposes only. The content provides general information to support informed stakeholder engagement and foster a diversity of thinking and feedback.

- 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.

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

Overview

Primer

Objectives

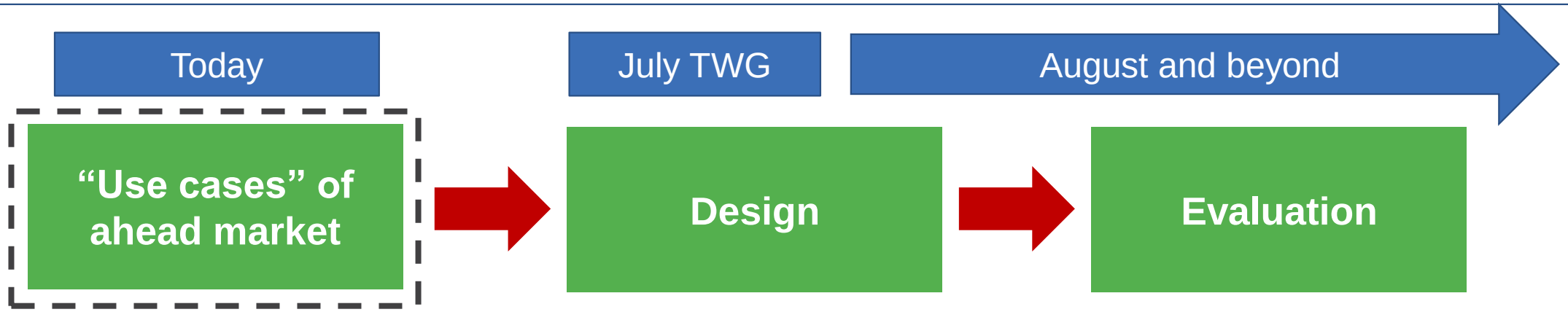
Use cases

Discussion points

OVERVIEW

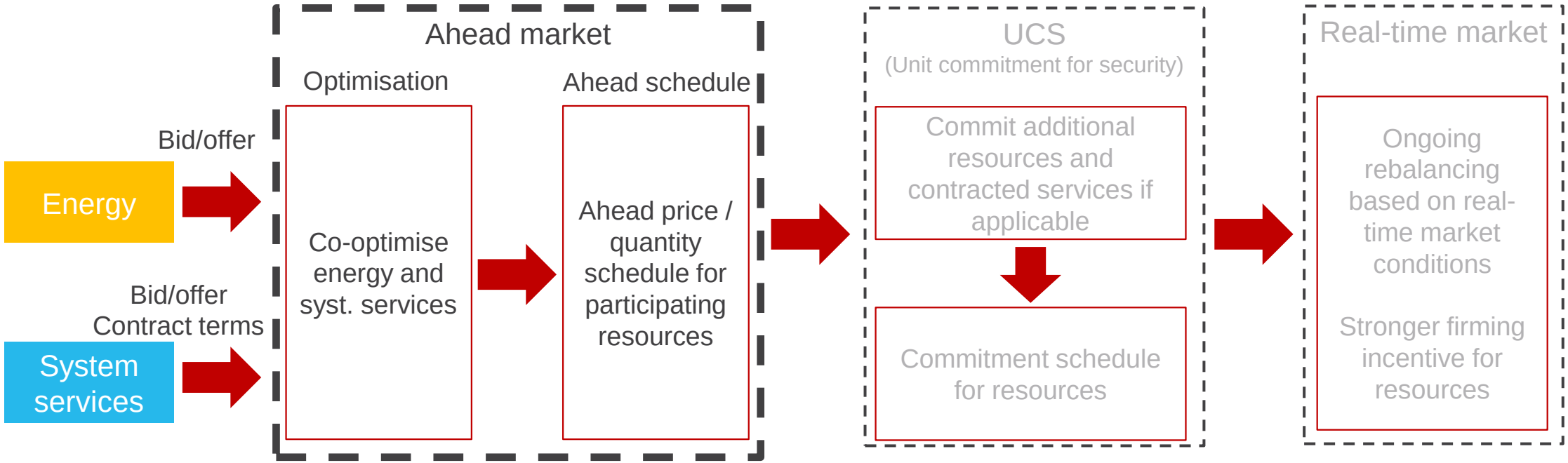
THE PURPOSE OF TODAY'S SESSION

- In response to stakeholder request for more information on why we are considering an ahead market beyond the UCS-only option, this presentation will focus on potential "use-cases" of ahead markets in the post-2025 context.
- This is not intended to be a cost-benefit analysis of ahead markets, but outlines the potential cases where ahead markets could be a candidate solution (among other options).
- We provide high-level responses and clarifications to issues and questions previously raised to facilitate future discussion.
- We seek focus group feedback on:
  - Additional challenges that could be addressed by an ahead market
  - Additional drawbacks that could occur with the introduction of an ahead market, or potential issues to consider in design.
- The various design options (to be discussed in the July focus group meeting) will refer back to use cases presented here.



FOCUS OF TODAY'S DEEP DIVE

- Today the focus is on the ahead market / scheduling
- The ahead market takes in bids and offers for energy and system services (and contracts where applicable) and produces a schedule of price and quantities for delivery of those services ahead of real-time.
- Today we discuss the use cases for an ahead market and welcome participants' feedback including any potential drawback. Next session will look at the design in more detail.



AHEAD MARKET ELEMENTS IN THE SPECTRUM

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	Opportunity to trade energy or system services (including contracted services) before real-time. Individual markets might or might not be co-optimised.	Co-optimised ahead scheduling of energy and system services.	Mandatory participation for all energy and system service resources.
UCS	Commit additional units to fill system gaps based on PDS and system forecasts Potential scheduling of contracted system services	Similar to option 1, with PDS expected to be updated to reflect VFM outcome	Similar to option 1, with PDS expected to be updated to reflect ahead scheduling outcome	
RT balancing	Stays as per now - mandatory gross pool scheduling. PCP affects payment and operation of relevant resources	Similar to option 1, with VFM schedule included in settlement	Similar to option 1, with ahead market schedule included in settlement	

SOME ASSUMPTIONS TO FOCUS OUR DISCUSSION TODAY

We will focus on the common design parameters applicable to features in option 2 and option 3.

For services (energy and system services) that can be traded through a spot-market (i.e., not procured through NSCAS-style contracts), the current thinking is that both options would require:

1. **Voluntary participation** from both the demand and supply side. This means that participants will only trade in the ahead market if they choose to do so. Those who prefer not to participate in the ahead market can continue to trade just in the real-time market.
2. **Financial commitment** under the ahead market schedule. This means participants can choose to deviate from their ahead schedule in the real-time market, and will pay (or be paid) for the difference between ahead schedule and real-time output at real-time price.

We assume additional system services markets (spot or contractual mechanism) will be established alongside existing energy and FCAS markets in all ahead mechanism options investigated. The work to define the system services and their procurement framework is being progressed in the ESS workstream. In this presentation we discuss potential scheduling and trading options that could be utilised for those services.

There is a catch-22 in that it is difficult to discuss some of these concepts without further developing the design of the ahead market framework, but we acknowledge that it is difficult to progress the design without understanding its purpose. Today we aim to present enough information to facilitate a conversation about the use cases and hope to receive feedback from participants including their drawbacks, and next time we will delve deeper into the design details.

A PRIMER ON AHEAD MARKET

Fundamentals of ahead markets

Ahead market for system services

THE AHEAD MARKET FOR WIDGETS

Why Widgets?

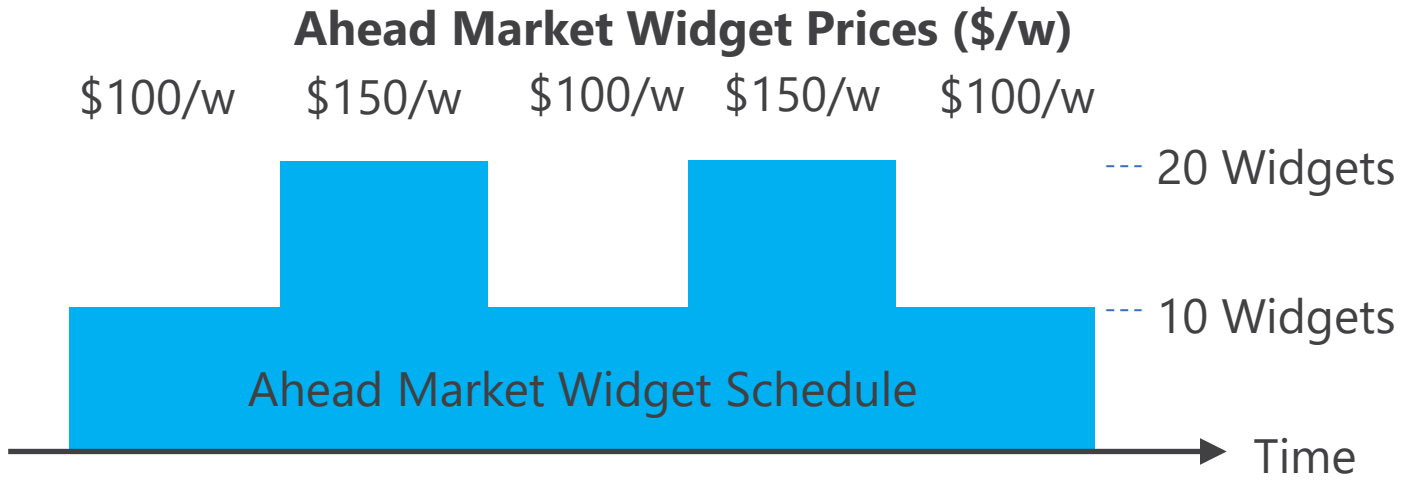
- A widget could be energy or a system service.
- Using widgets allows us to focus on core concepts

The Problem

- The widget maker is competing with others to supply widgets
- Widget demand will vary by period through day
- Widget maker has a contract position to cover
- It must plan today how to run its machine tomorrow and must buy fuel to cover that plan.
- The machines start cost is $1000
- The machine running cost is $80/w (per widget)
- When turned on, the machine can supply at minimum 10 and at most 20 widgets per period.

The Ahead Market

- Widget maker offers with expectation to run for 5 hrs
- Offer: 10w@$90/w +10w@$120/w per period



- Income: 3×10w×$100/w + 2×20w×$150/w = $9,000
- Cost: $1000 + 70w × $80/w = $6,600
- Profit: $2,400 *All before buying fuel or starting the machine!*
- Buyer/seller only takes up this hedge if happy with price!
- Most supply ultimately priced based on financial contracts.

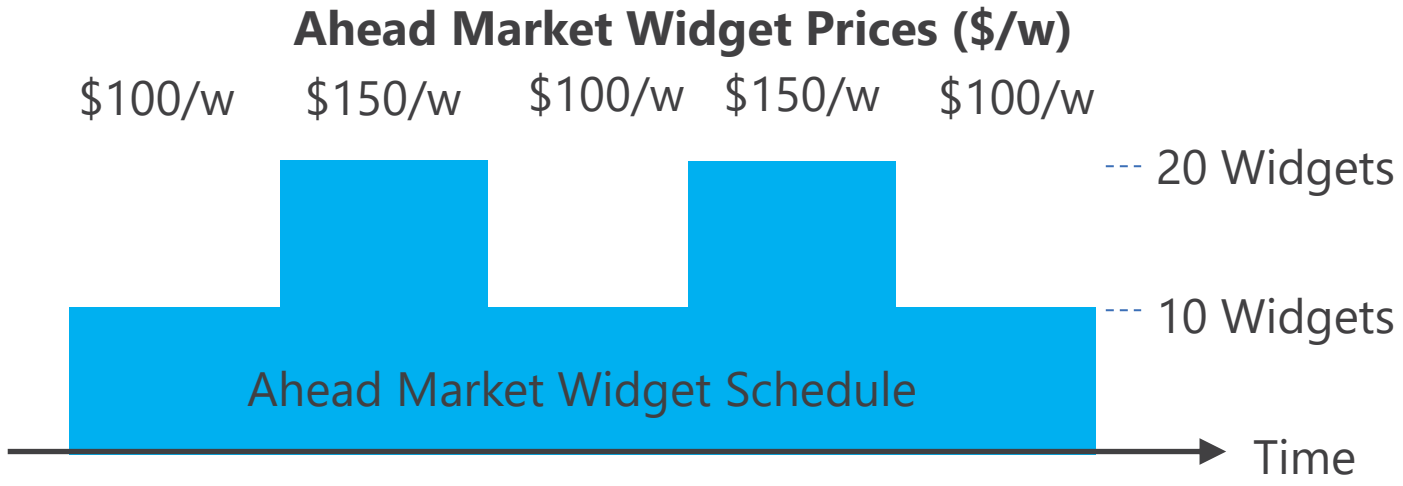
THE REAL-TIME MARKET FOR WIDGETS

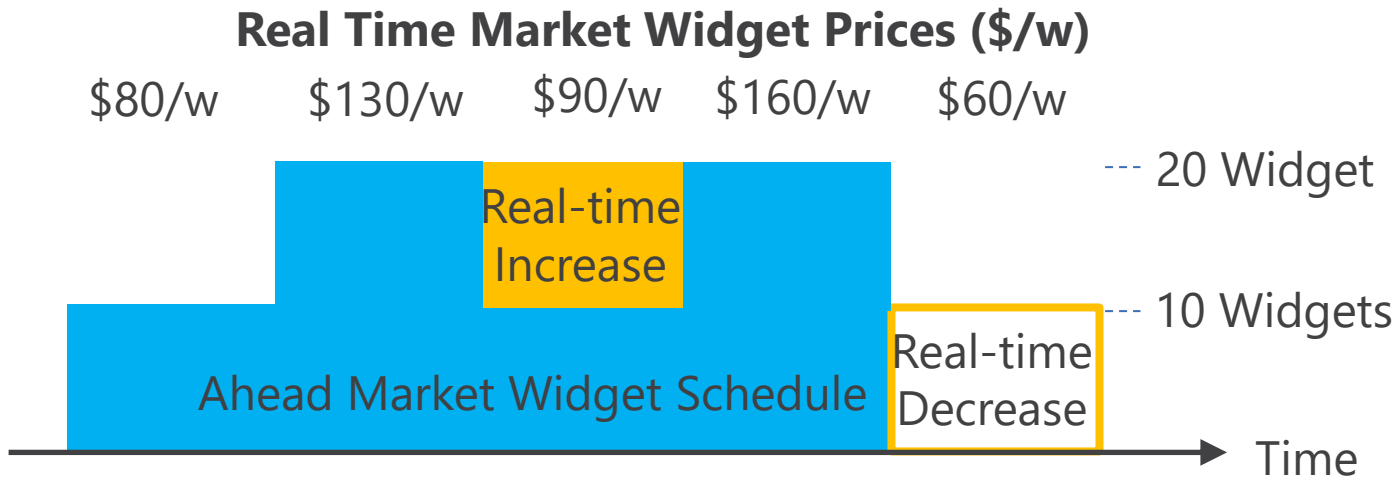
The Problem

- In real-time the widget maker wants to cover its ahead market position, but wants to take advantage of any new efficient trade opportunities as well.

The Real-Time Market

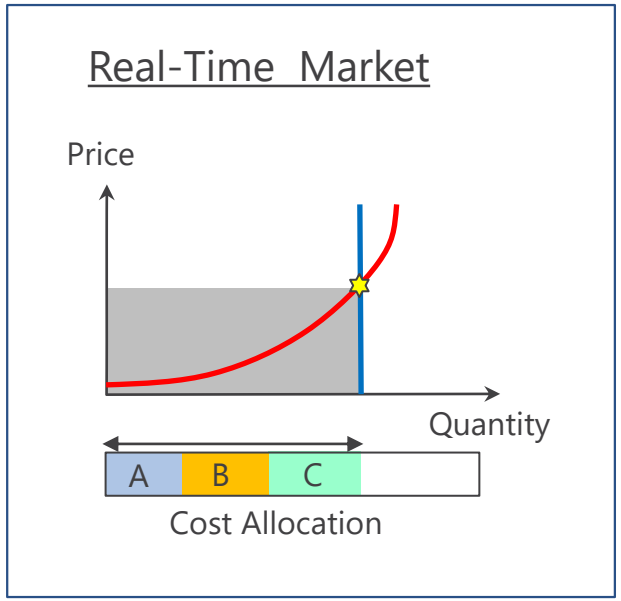
- AM Offer was 10w@$90/w +10w@$120/w per period
- It has already recovered its $1000 start-up cost in ahead market and has committed to start, so it is rational to price supply at its $80/w running cost
- Offer now 20w@$80/w per period.
- This offer has it scheduled to provide 10 more widgets in period 3, while lower prices in period 5 reduces its schedule by 10 widgets to zero.
- ΔIncome: $90/w×(20w-10w)+ $60/w×(0w-10w)= +$300
- ΔCost: $80/w ×(20w-10w) + $80/w ×(0w-10w) = $0
- ΔProfit: +$300
- Rewarded for flexibility & firmness/predictability





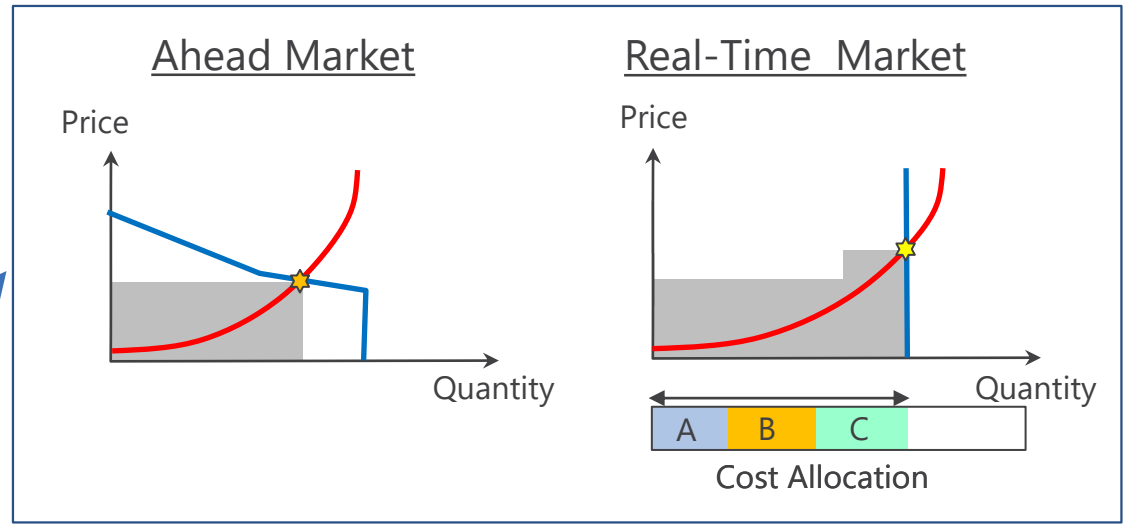
WHAT MIGHT TRADING OF SYSTEM SERVICES IN AHEAD MARKET LOOK LIKE?

SYSTEM SERVICES TODAY



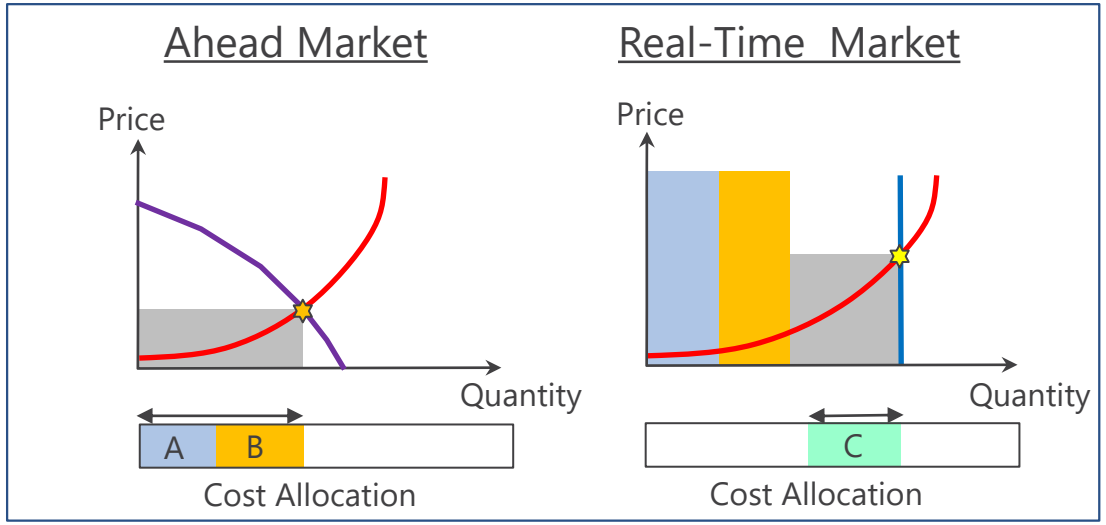
AEMO buys services in real-time and allocates costs (grey area) to participants (A, B & C)

While the energy market is not shown, all system service supply is assumed to be co-optimised with energy



AEMO buys services in ahead market if costs favorable, but still buys in real-time. Allocates total cost of purchases to participants (A, B & C).

Ahead market suppliers offer in real-time to cover position.



Participant can buy in ahead market. AEMO buys all service in real-time, but only allocates its costs to those who have not procured services directly.

Ahead market suppliers offer in real-time to cover position.

OBJECTIVES OF DESIGNING AHEAD MECHANISM

OBJECTIVES OF INTRODUCING AN AHEAD MECHANISM FOR THE NEM

Enhance reliability and security	• Resources are available when needed to supply energy and other system needs. Can be either provided through a market mechanism or, as a last resort, through AEMO action as a backup. • Any potential risk to system visible to AEMO and participants to allow for timely and effective responses. • More efficient process to address system gaps.
Improve scheduling efficiency and lower cost to consumers	• All resources committed and scheduled through market mechanism (spot or regulated contract) to deliver system needs with minimal SO intervention. • Optimal resource mix in operation through co-optimisation between energy and system services, with efficient utilisation of existing fleet and unlocking the potential of new technologies. • Appropriate options for participants to manage and trade risks associated with delivering energy and multiple system services.
Facilitate transition, consumer engagement and DER integration	• Support the long-term goal of moving to a resource mix with as high VRE penetration and demand participation as physically and economically viable. • Promote consumer engagement and DER integration by facilitating the uptake and coordination of DR and DER resources. • Utilise existing fleet during the transition, but does not prolong asset life beyond what is economically efficient.

- *Do participants agree these should be the objectives for the design of an ahead mechanism?*

UCS-ONLY VS APPROPRIATELY DESIGNED AHEAD MARKET IN ACHIEVING THESE OBJECTIVES

- *The UCS-only option will provide AEMO with an enhanced tool to maintain system security and reliability.*
- *An ahead market based on financial firming could have additional efficiency benefits:*
  - *For the market, if it leads to less out-of-market commitment through the UCS.*
  - *For AEMO, as control room and planning staff will have greater certainty that resource availability in PDS will be firm if backed by an ahead schedule that aligns with physical conditions.*

Enhance reliability and security

- Resource available when needed
- Early identification of risks
- Better process to address system gaps

- In a more variable and uncertain operational environment with greater operational risk to the system, AEMO has an enhanced tool to identify, communicate and address system gaps if a market response is absent.
- However, whether "out-of-market" commitment will happen frequently depends on the system service and scheduling mechanism design, and whether the resource mix required to keep the system secure and reliable is available and online.

- *Do participants agree with the above assessment of the UCS-only option and ahead markets in terms of maintaining system security and reliability?*

UCS-ONLY VS APPROPRIATELY DESIGNED AHEAD MARKET IN ACHIEVING THESE OBJECTIVES

- *The following are the potential "use cases" where ahead market could be an option (among others) to lower total wholesale electricity costs and facilitate the transition and DR & DER integration.*

Improve scheduling efficiency and lower cost to consumers & Facilitate transition, consumer engagement and DER integration	Activate additional system service for market benefit	• Coordinate resource mix to provide additional system services to improve dispatch efficiency via a market mechanism. • More relevant if slow-start plant are major contributors to some services (e.g., system strength).
	Platform to hedge system service costs	• The value of system services costs will likely increase in the future. • Currently there is no formal market mechanism to hedge their costs.
	Facilitate greater DR and DER participation	• Some DR and DER resources have long notification time and lumpy characteristics. • Uncertainty and risks in the RT-only market might restrict their ability to participate.
	Improve scheduling of storage	• Storage faces unit commitment problems due to managing their state of charge • Complexity and risk of operating in RT market could be a barrier for some storage participants
	New mechanism to hedge against short-term variability	• Increasing variability and uncertainty potentially might lead to greater need to re-tune contract or portfolio positions to better align with real-time operational need for participants
	Better coordination between electricity and other markets	• An ahead market for electricity naturally aligns with daily gas markets, and could provide additional certainty for participants with gas portfolios to manage their resources. • Alignment with daily schedules for other markets where electricity is an input, eg. DR and EVs

- *Do participants consider that improvement on each use case identified would contribute to the objectives of lowering cost to consumers and facilitating transition?*

AHEAD MARKETS – USE CASES

Scheduling system services

Facilitating DR and DER participation

Alternative for storage scheduling

Other benefits

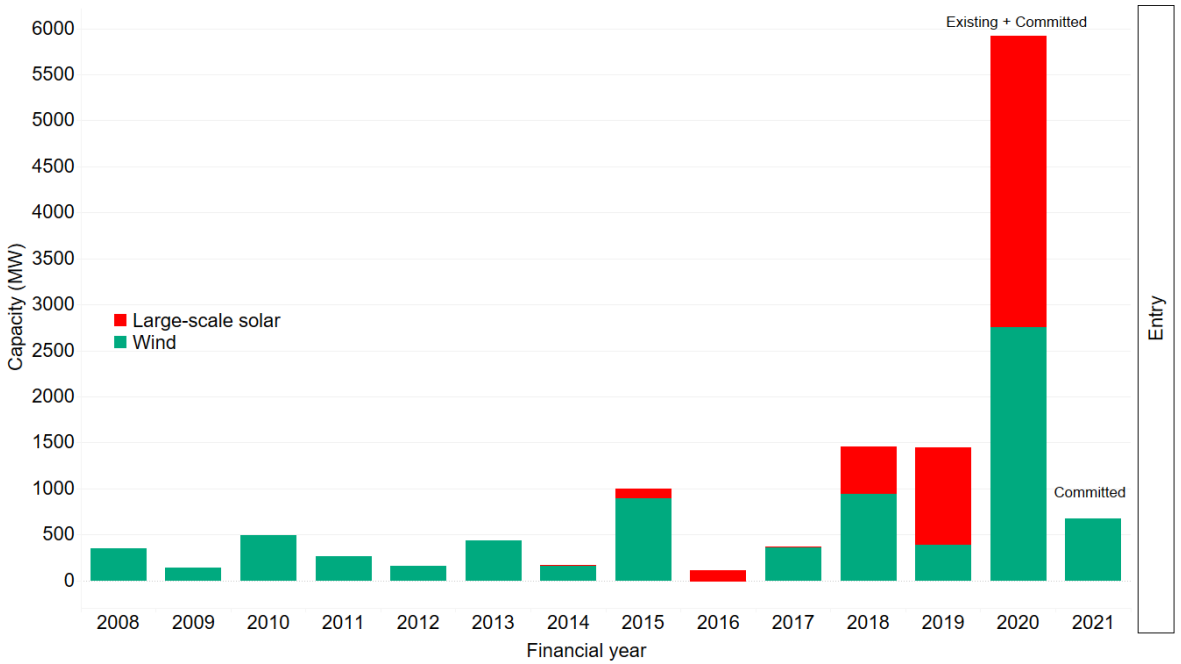
WHAT IS CHANGING IN THE SYSTEM THAT IS LEADING US TO CONSIDER REFORM?

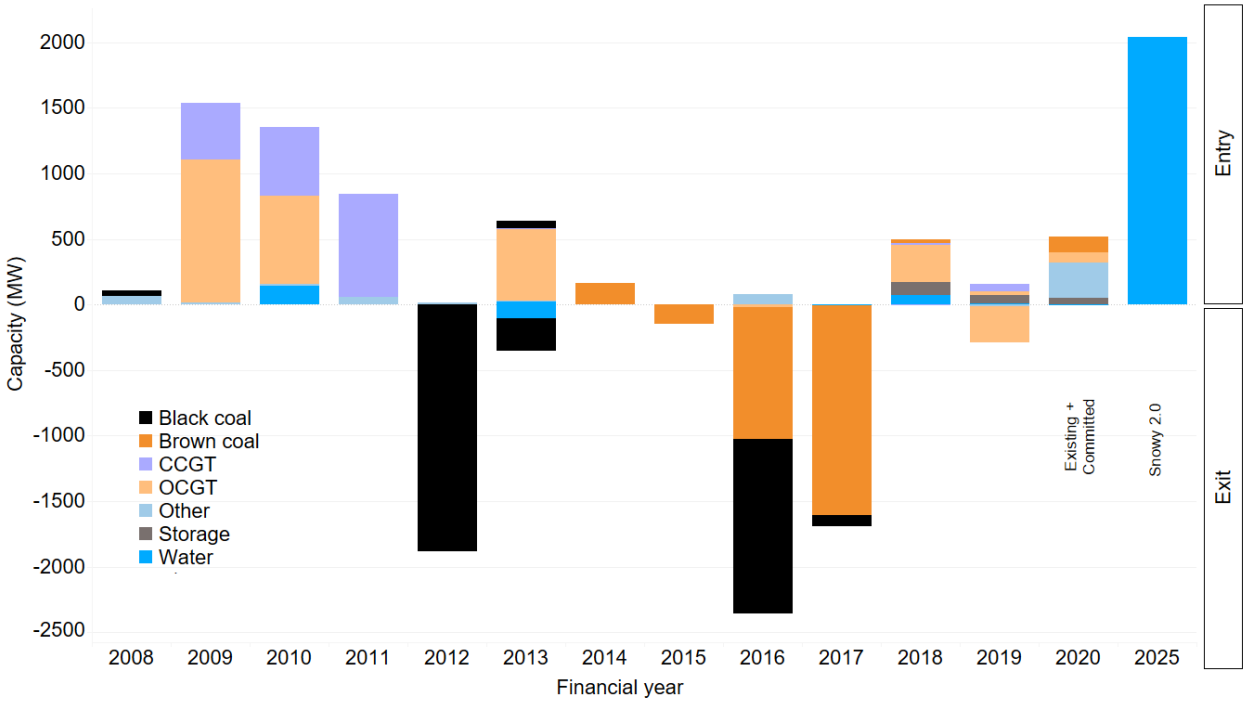
Renewable penetration is increasing

- In the period 2016-2020, over 9,300 MW of renewable capacity has entered the market or been committed.
- In the period 2016-2020 over 80 projects reached financial close (completed and committed projects).

Thermal, synchronous generation is exiting the system

- During the same period, over 4,300 MW of thermal generation has been withdrawn.
- We have started to see storage enter the system – 210 MW in the last 3 years.





THE CHALLENGE OF EFFICIENTLY OBTAINING "SYNCHRONOUS" SYSTEM SERVICES

Impetus for change: Under the current technology, some system services such as system strength and inertia are predominantly produced by synchronous generators. Scheduling these services has become more challenging in a system with diminishing levels of synchronous generation and increasing uncertainty and variability.

Challenges:

- At this point in time, system strength and inertia are heavily determined by the commitment decisions of synchronous generators, many of which take more than 30 minutes to start.
- Additional system services (e.g., system strength) could lead to market benefit by improving dispatch efficiency (e.g., alleviating VRE curtailment), but there is no market-based mechanism to activate them.

What are some options to address this problem?

- Extension of current model would suggest real time markets for all these service. This has been proposed as an option by AEMC for system strength, but they have identified some significant challenges (e.g., may not be appropriate for providing the minimum service level).
- Activating services beyond minimum level for market benefit through the UCS is also problematic as it is a non-market process. (e.g., the basis for assessing market benefit in the UCS; incentive to inflate benefit to activate contracts if non-binding PDS bids do not lead to direct obligation to fund the additionally activated contract.)
- Another option is to give AEMO or TNSPs responsibility for obtaining these services through network options (e.g., "building out the problem" with synchronous condensers).

AN AHEAD MARKET IS ANOTHER OPTION TO SOLVE THE CHALLENGE

Challenges:

- At this point in time, system strength and inertia are heavily determined by the commitment decisions of synchronous generators, many of which take more than 30 minutes to start.
- Additional system service (e.g., system strength) could lead to market benefit by improving dispatch efficiency (e.g., alleviating VRE curtailment), but there is no market-based mechanism to activate them.

An ahead-market is an alternative option to address these challenges

- Ahead-markets are well-suited to organise commitment decisions, rather than the current real-time markets which internalise commitment costs into real-time bids.
- It also provides a market based mechanism (as opposed to UCS) to fund additional system service beyond minimum level. For example, participants who benefit from the additional services does so by making financially binding bids in the ahead market.

THE CHALLENGES OF MANAGING SYSTEM SERVICE COST RISKS

Impetus for change: As uncertainty and variability in the system continue to increase, system services costs will likely represent a greater proportion of the overall wholesale electricity costs (as demonstrated by the recent FCAS costs in SA). This could lead to additional risks that participants need to manage.

Challenges:

- System services that have a real-time spot market (e.g., FCAS and operating reserve) could reach very high prices. If this happens often, it could represent additional risks to participants if there is not a mechanism to hedge against these costs.
- At the moment there is no formal hedging contract market for system services.

What are some options to address this problem?

- Do nothing, and participants will continue to either stay exposed to the volatility of system service costs, or enter bilateral OTC- style agreements, noting that the ability for participants to manage this might depend on their portfolio setup.
- Establish formal hedging contract markets for these services, noting that such a market has not developed for FCAS over a decade, and long-term hedging contracts might not reflect short-term volatile operational conditions.

AN AHEAD MARKET IS ANOTHER OPTION TO SOLVE THE CHALLENGE

Challenges:

- System services that have a real-time spot market (e.g., FCAS and operating reserve) could reach very high prices. If this happens often, it could represent additional risks to participants if there is not a mechanism to hedge against these costs.
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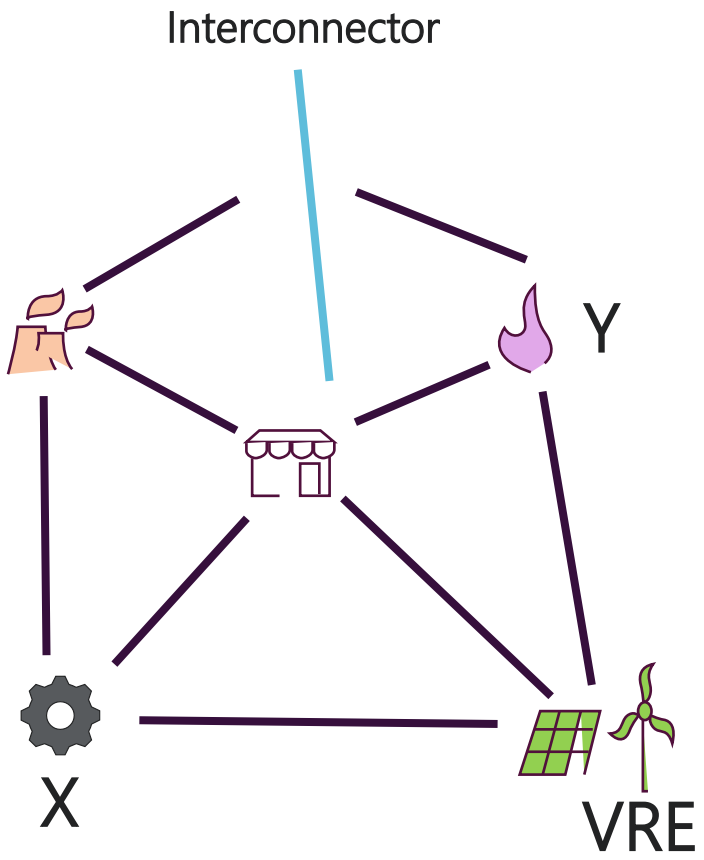
An ahead-market is an alternative option to address these challenges

- An ahead market provides an additional platform to allow participants to manage and hedge their costs before real-time.
- Buyers who prefer to cover their exposure of RT system service price volatility, and sellers who want revenue certainty for providing the services can voluntarily participate in the ahead market if they consider that makes them better off.
- The ahead market could therefore be a ***two-sided market*** for participants to trade system services on a voluntary basis.

AN EXAMPLE OF WHERE AN AHEAD MARKET CAN PROVIDE AN OPPORTUNITY TO HEDGE SYSTEM SERVICE COSTS

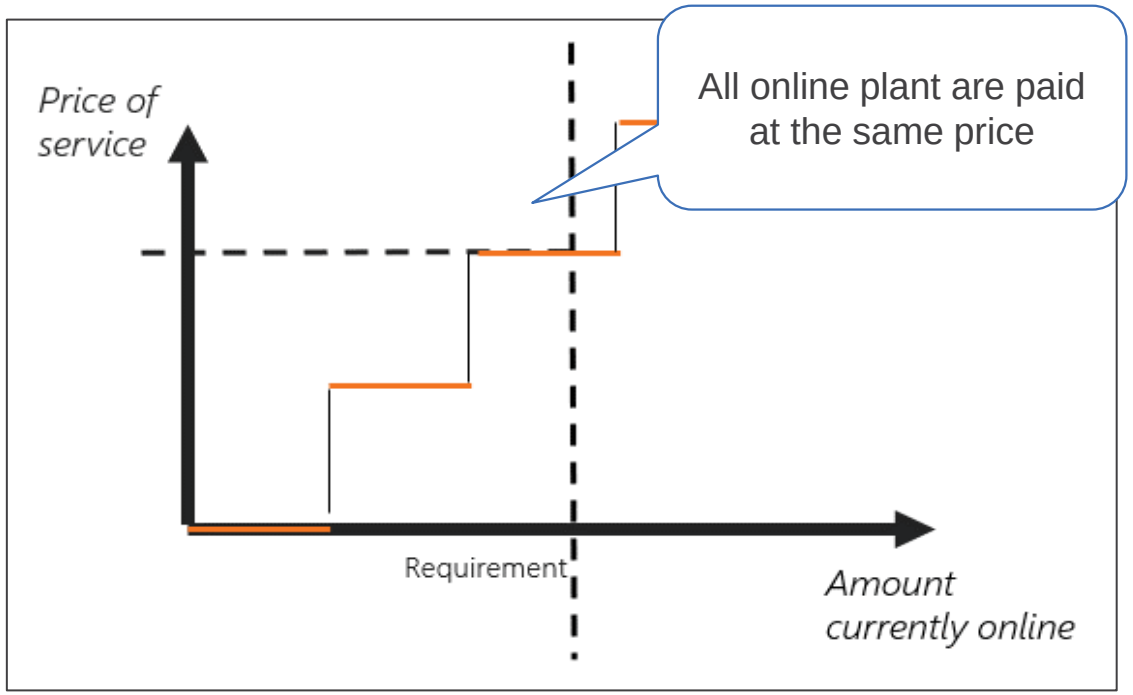


Consider a region with the following plants with various capabilities.
The region is interconnected with another, but for the simplicity of the example, the interconnector can only import / export energy – it does not contribute to system service provision.

Plant	Characteristics	Size (MW)	Min gen (MW)	Provision of system service (units)
VRE	VRE	500	0	0
Plant A	Mid-merit gen	500	200	100
Plant Y	Fast-start gen	100	50	50
Plant X	Can provide system service without providing energy	0	0	50
Interconnector	Interconnector	-800 to +800	0	N/A

SYSTEM SERVICE REQUIREMENT

Valuation of the service



Requirement

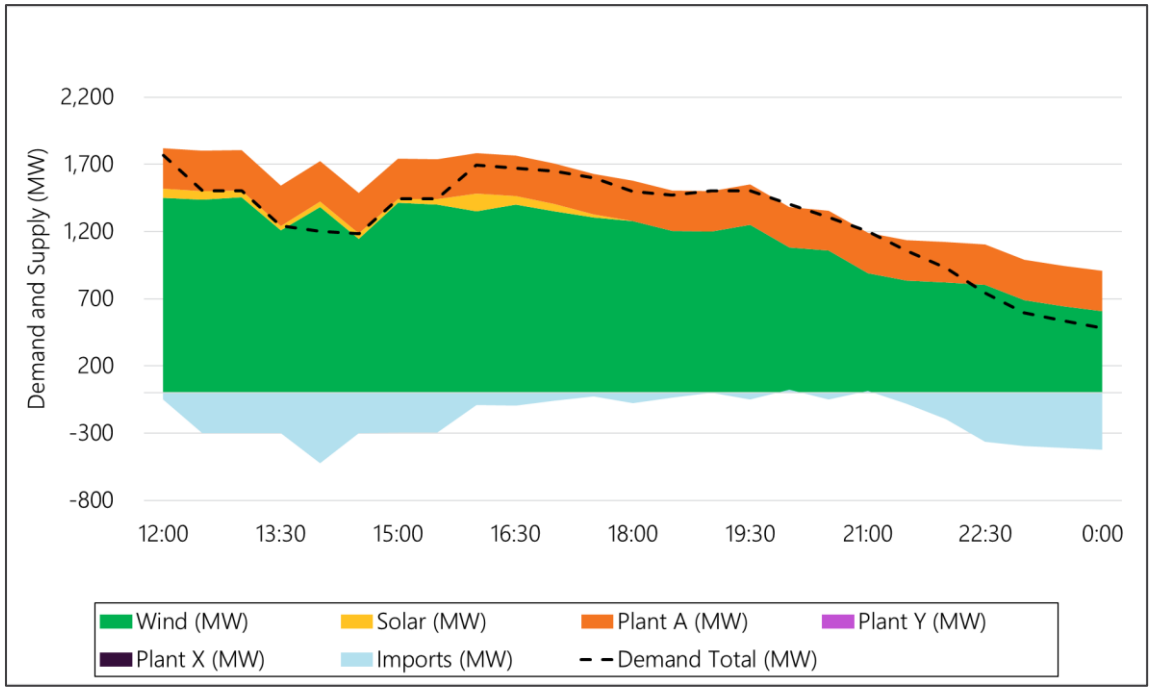
Requirement for the service is set by AEMO.

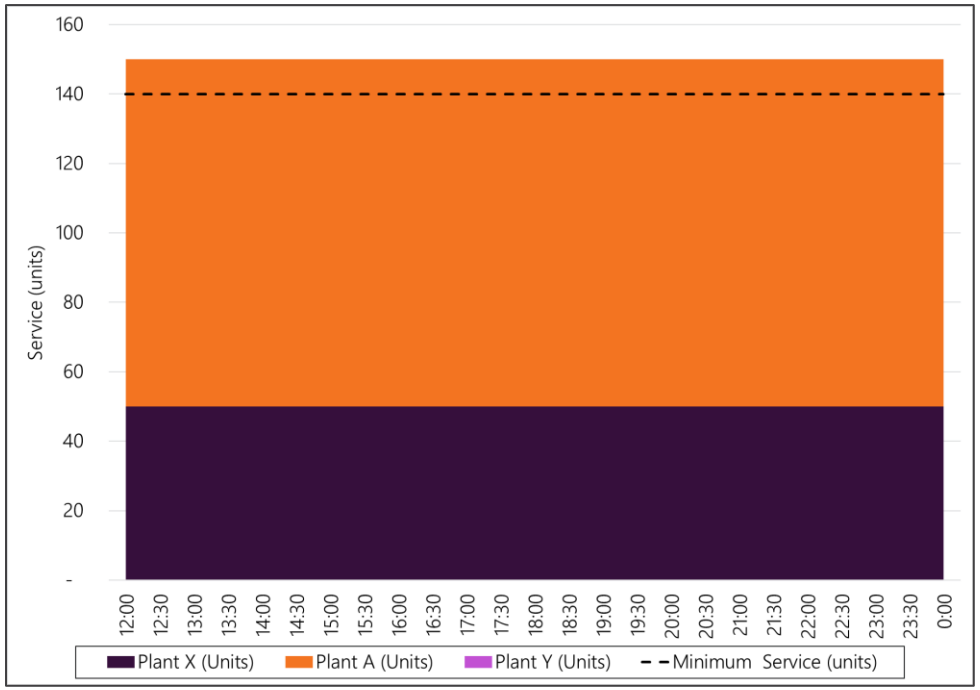
Who pays?

- Provision of the service is paid for by the retailers, as per energy load proportion.
- In this illustrative example, there is only one retailer covering all demand.
- In a two-sided market, the retailer would be able to explicitly bid for the service (see ahead market component).

This example assumes there is a real-time price for the provision of the system service.
Even when the services are contracted, there could be benefit to let participants bid to activate more such services if there is a market benefit in an ahead, but market-funded process, but this is not the focus of this example.

CONDITIONS OF THE DAY





- Graph shows energy generation (MW) by each resource throughout the day including imports/exports vs regional demand
- High VRE day with Plant A online to provide system service requirements (see right).
- Regional surplus energy from VRE and minimum generation of synchronous generator, exported via interconnect, and meets inter-regional demand.
- Plant X is “online” – providing the system service - but not generating any energy.

- Graph shows system service (units) provided by each resource throughout the day vs the minimum regional requirement
- System service requirements (140 MW) expected to be met throughout the day by Plant A and Plant X.
- For simplicity, assume none of the system service can be met via the interconnector.

PRICES

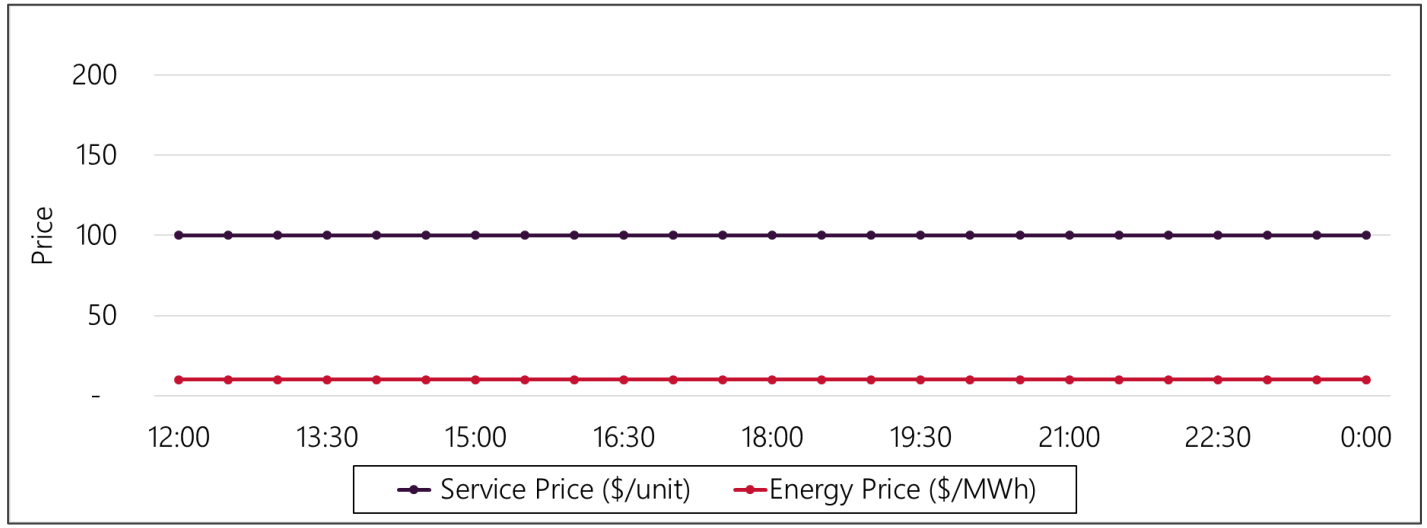
Energy

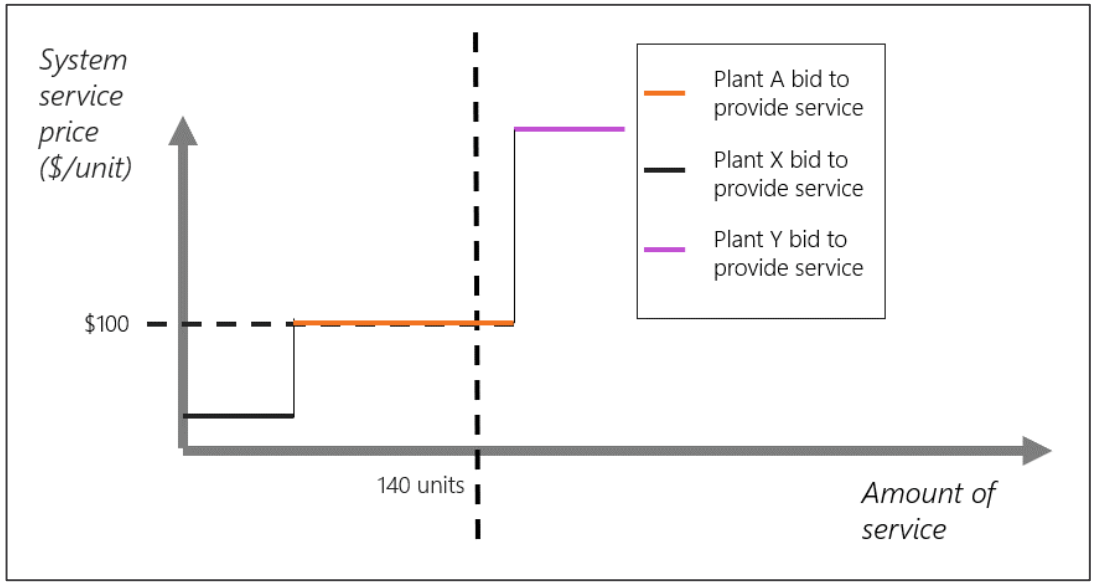
- Region is exporting, energy price low, flat all day.

System service

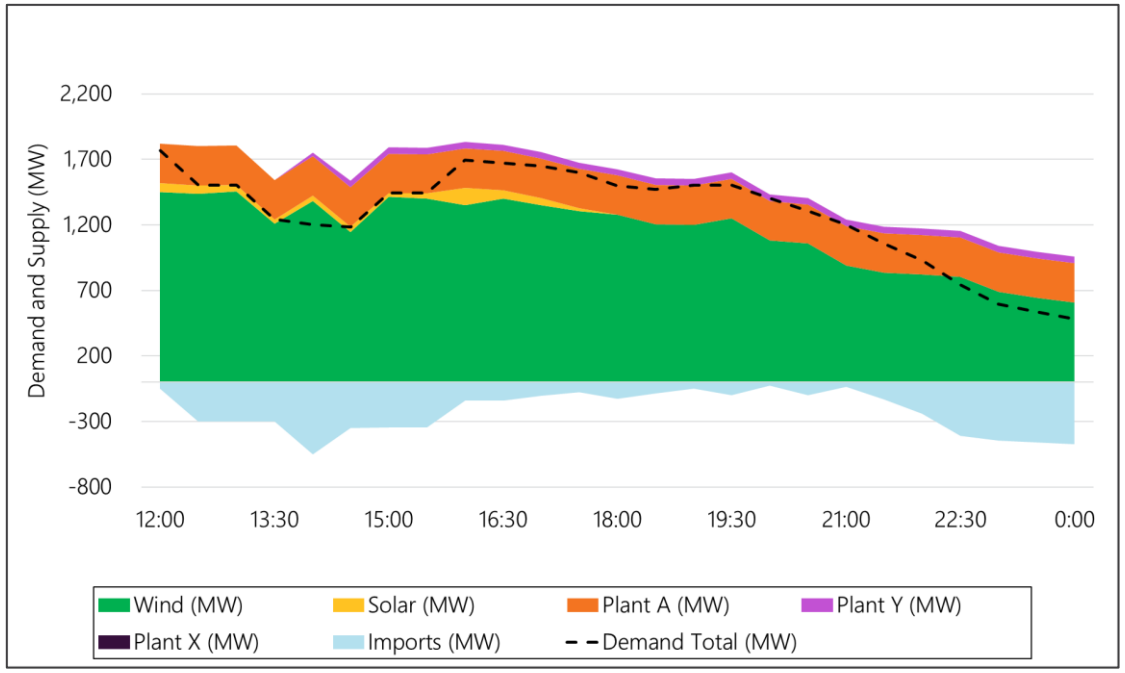
- Plant X and Plant A are online providing service, meeting the minimum requirement.
- Price of the service set by Plant A (see offer chart at right), and both plants will receive this amount for providing the service.
- Since the energy price is low, the price set by Plant A for the system service is to recover all costs.
- Retailer will be required to fund this cost.

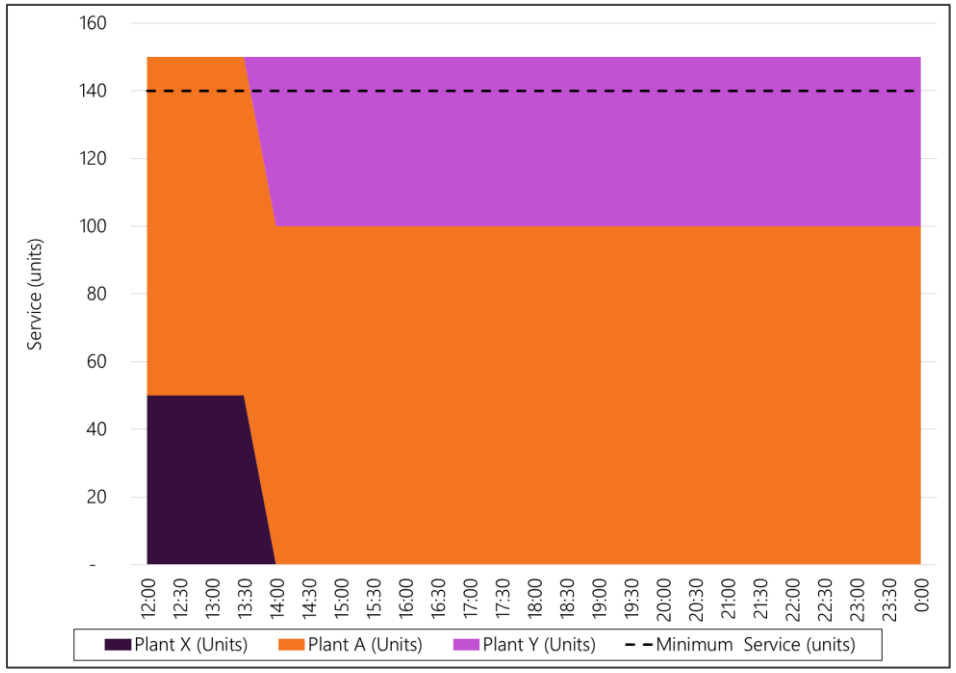
Prices flat throughout the day for simplicity.





REAL-TIME ONLY MARKET – UNEXPECTED OUTAGE OF PLANT X AT 13:30





- Graph shows energy generation (MW) by each resource throughout the day including imports/exports vs regional demand
- Plant Y comes online when Plant X has an outage to meet service requirement.
- Regional energy exports increase due to Plant Y coming online, absorbed by inter-regional supply-demand.

- Graph shows system service (units) provided by each resource throughout the day vs the minimum regional requirement
- When Plant X fails, Plant Y is able to start up to fill the otherwise potential system service gap.
- Plant Y is incentivised to come online by higher prices of the system service, which it sets.

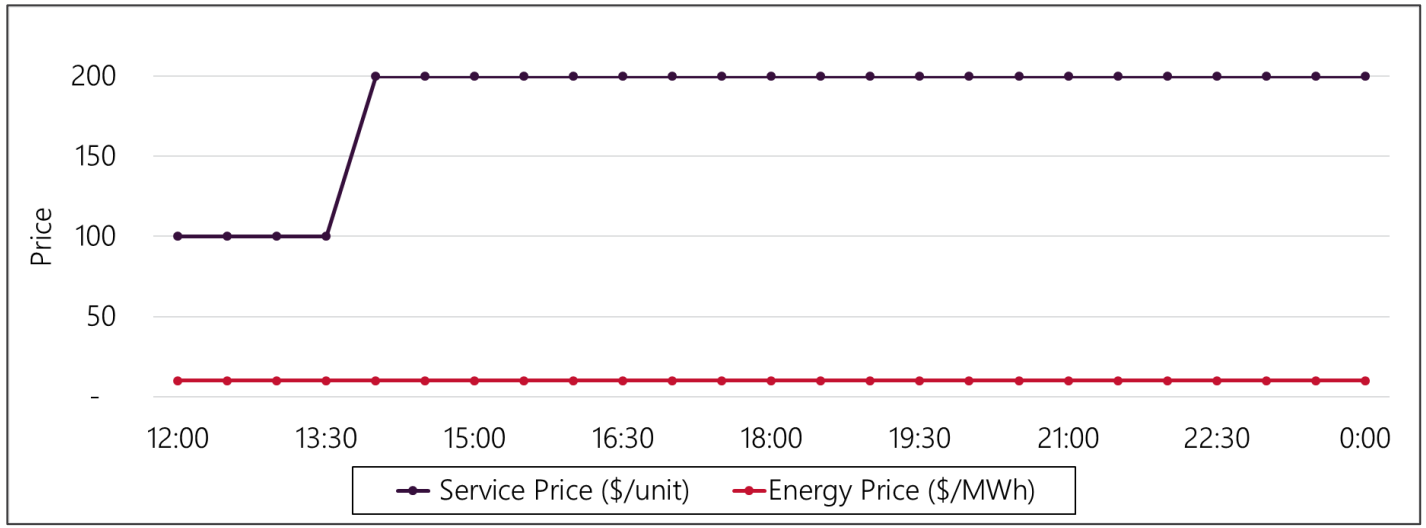
PRICES WITH AN OUTAGE

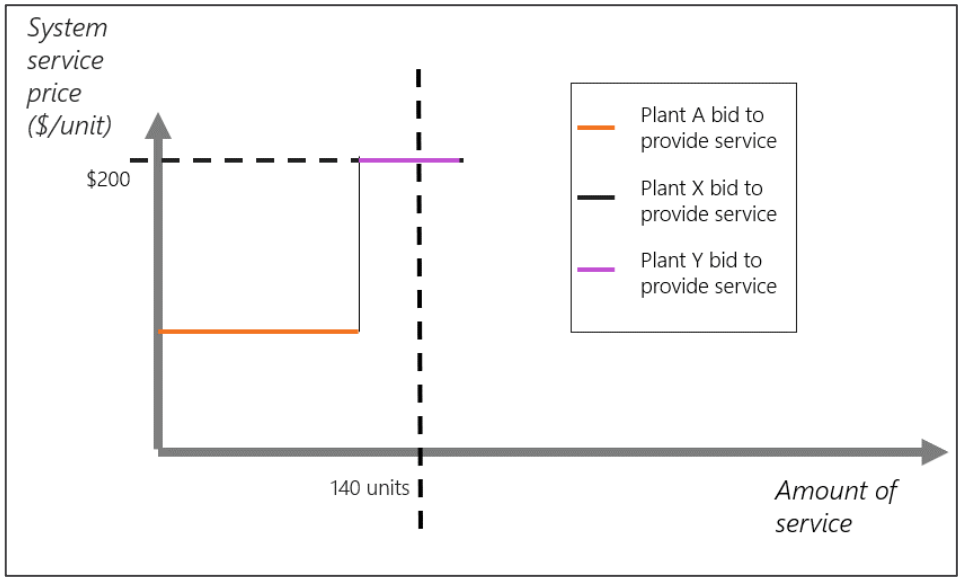
System service

- Plant X has an outage at 1:30pm.
- Plant Y comes online to fill system service gap.
- Price of the service now set by Plant Y (as per offer chart on right), and both Plant A and Plant Y will receive this amount for providing the service for the hours that Plant Y is setting the price.
- Retailer will be required to fund this cost.

Energy

- Region is still exporting, energy price remains low.





WHAT IF THERE WAS AN AHEAD MARKET FOR THE SYSTEM SERVICE?

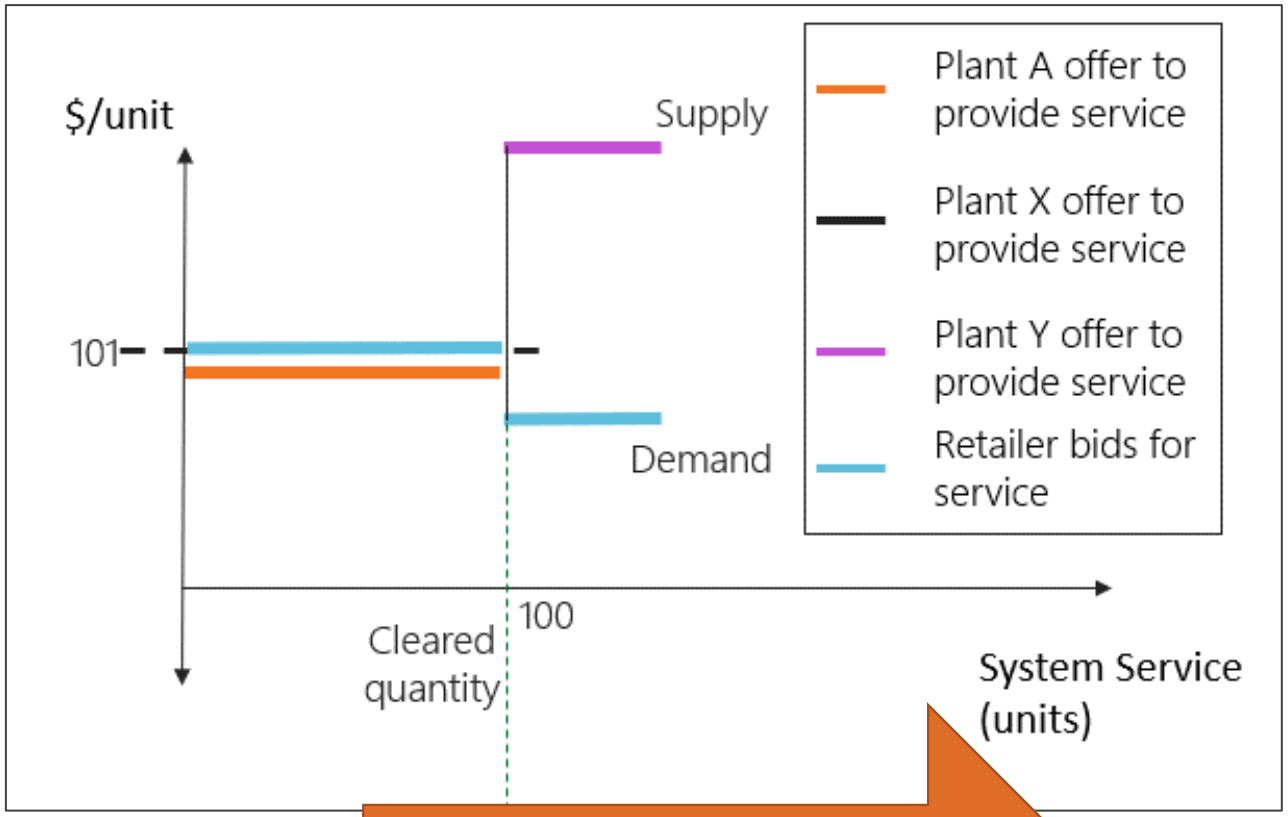
Financial ahead markets could be two-sided even for system services such that the market is able to secure a position to hedge likely obligations ahead of time.

Demand side (retailer)

- Know will be required to fund 140 units of the system service in real-time.
- Bid for 140 units, but at different price bands.
- First price band for 100 units at $1 above expectations for cost expected in real-time.
- Second price band for 40 units at lower price.

Supply side

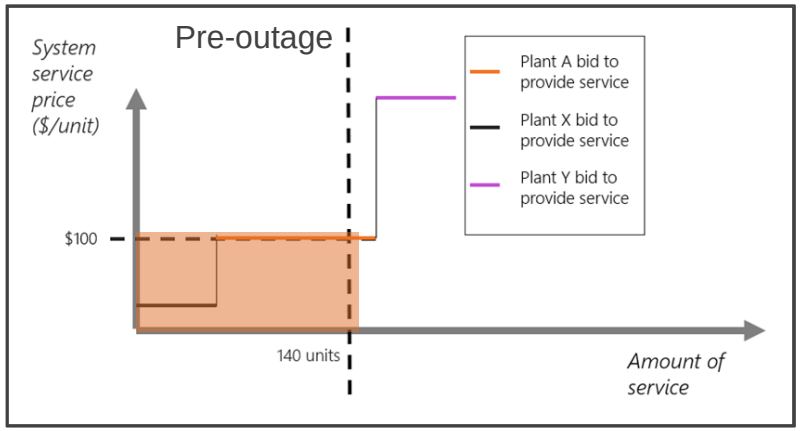
- **Plant A:** Looking to guarantee funding of commitment decision via receiving an ahead award for providing service. Offers at same price as in real-time market.
- **Plant X:** Does not participate in ahead market.
- **Plant Y:** Offers high, happy to get ahead award to provide the system service if market willing to fund.

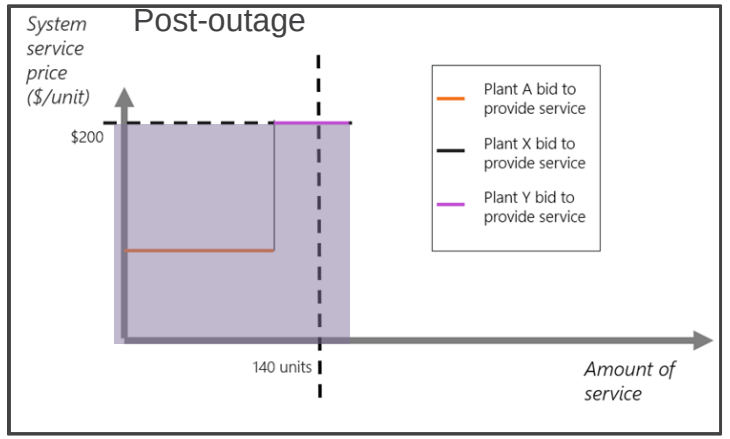


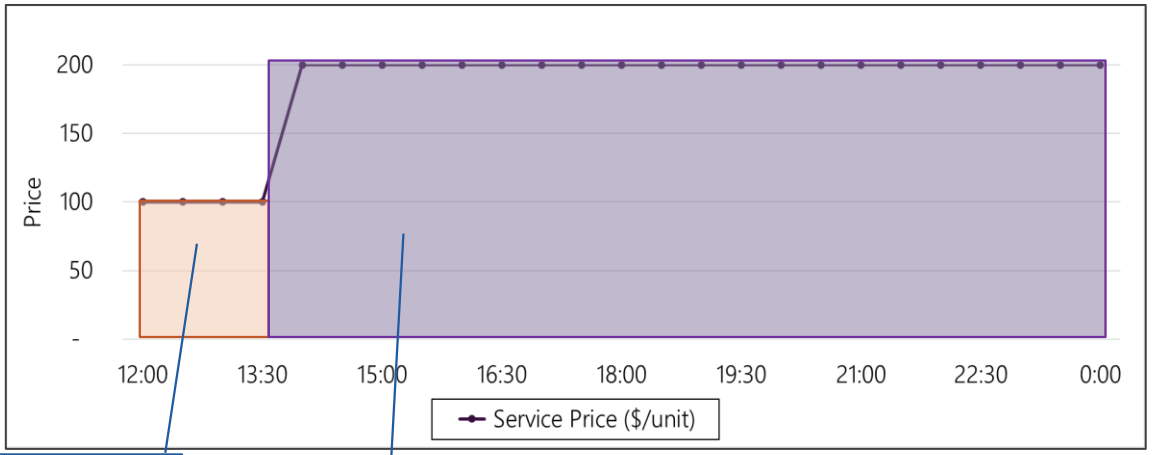
Plant A receives day ahead award to provide service at $101 for 100 units of the service

DIFFERENCE WHEN RETAILER HAS HEDGED SOME OF THE COSTS OF SYSTEM SERVICE PROVISION IN AN AHEAD MARKET WHEN THERE IS AN UNEXPECTED OUTAGE

Recall the retailer's settlement outcome under a real-time only market







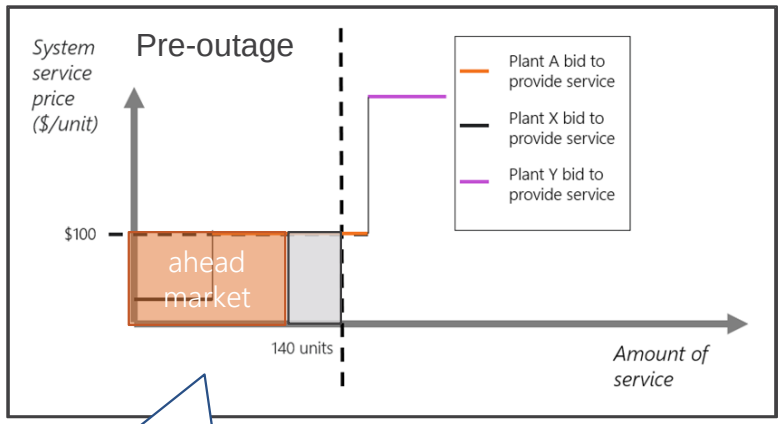
Retailer exposed to funding cost of system service at real-time prices that have increased due to unexpected outage.

For brevity, only the retailer's settlement outcome is shown

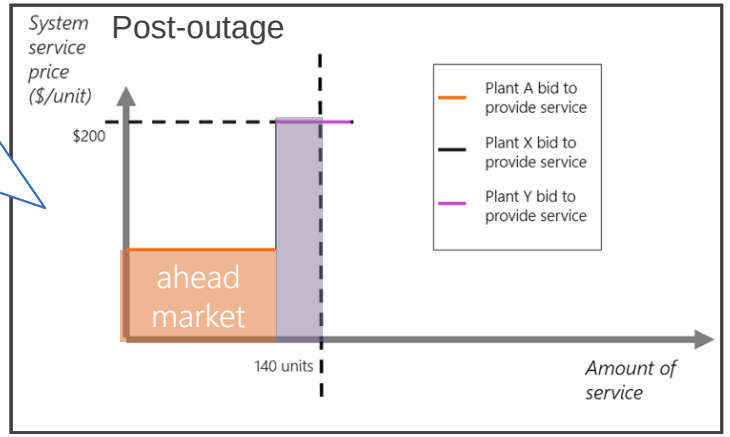
140 units x $100 x 1.5h + 140 units x $200 x 10.5h = **315,000**

DIFFERENCE WHEN RETAILER HAS HEDGED SOME OF THE COSTS OF SYSTEM SERVICE PROVISION IN AN AHEAD MARKET WHEN THERE IS AN UNEXPECTED OUTAGE

Compare to the retailer's settlement outcome under the ahead market

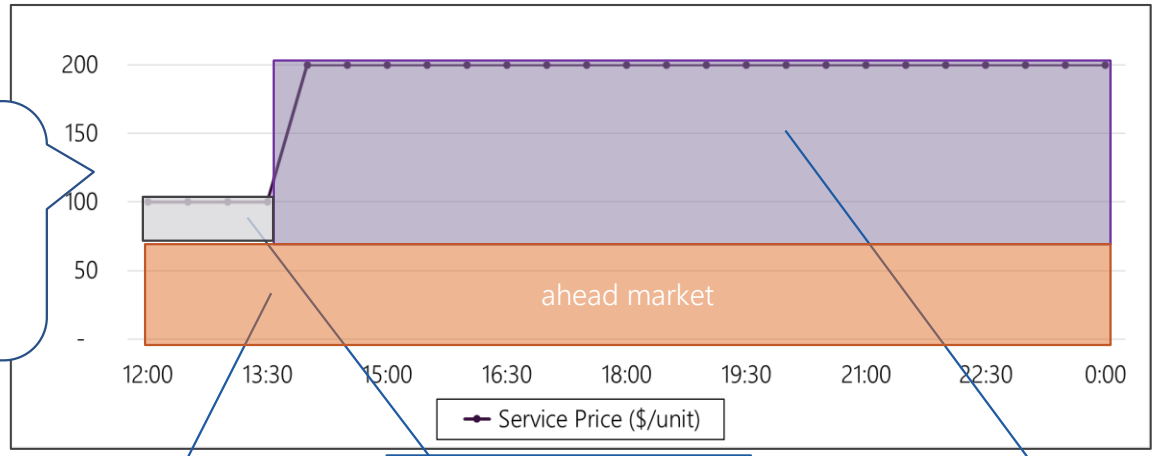


Having hedged the first 100 units at the day ahead price, the retailer is only exposed to paying for the additional 40 required at the higher price for the plant that came online due to the outage.



Plant A still needs to be scheduled in RT market, and sets the price for the hours before the outage.

RT price remains the same as the RT-only market outcome so scarcity signal is preserved.



Retailer total settlement significantly reduced by hedging costs in the ahead market.

($222k compared to $315k)

For brevity, only the retailer's settlement outcome is shown

100 units x $101 x 12h + 40 units x $100 x 1.5hrs + 40 units x $200 x 10.5h = **222,000**

SUMMARY

- Both the retailer and Plant A traded away their risk in the ahead market in this example:
  - The retailer is willing to pay for a slightly higher ahead prices but is able to (partially) protect itself against high RT prices due to unexpected events.
  - While Plant A received a smaller revenue overall *given outage has occurred*, the ahead award gave it the certainty to commit to supply the service. In cases where there was no outage, Plant A would have received a slightly higher revenue overall due to the risk premium the retailer is willing to pay in the ahead market.
- If Plant X had participated in the ahead market and also received an award, it would have been responsible for paying for the undelivered quantities after outage at the higher real-time price. As it was, it received a revenue from the real-time market for the hours it was online.
- Plant Y was indifferent under either scenario.

SOME DR AND DER RESOURCES FACE BARRIERS PARTICIPATING UNDER THE CURRENT MARKET

Impetus for change: greater variability in generation increases the potential value of technologies that can shift or reduce energy demand to match the profile of energy generation. In the future it will be increasingly more challenging to manage minimum demand to support system security and reliability without having to involuntarily curtail DER output.

Challenge: discussions with some DR and DER stakeholders suggest that the current real-time only market structure is a barrier to unlocking the value that can be provided by DR and other emerging DER technologies.

- Many DR and DER resources require hours lead-time (e.g., a manufacturer has to plan its schedule and staff roster a day before).
- Some are restricted by their operating nature to be less flexible in real-time (e.g., A factory that has sent its shift workers home cannot immediately restart production even if pool prices unexpectedly drop).
- Operation of many DER resources requires coordination with DNSP ahead of real-time to activate resources.

What are some of the options to address this problem?

- Do nothing, and accept demand response resources less able to respond to real-time prices due to their operating challenges continue to face challenges participating in the market.
- Modify the wholesale demand response mechanism to allow it to incorporate resources with longer lead times.
- Leave current wholesale market arrangements in place, but provide out-of-market payments for demand response.

AHEAD MARKET IS ANOTHER OPTION TO FACILITATE PARTICIPATION OF DR & DER RESOURCES

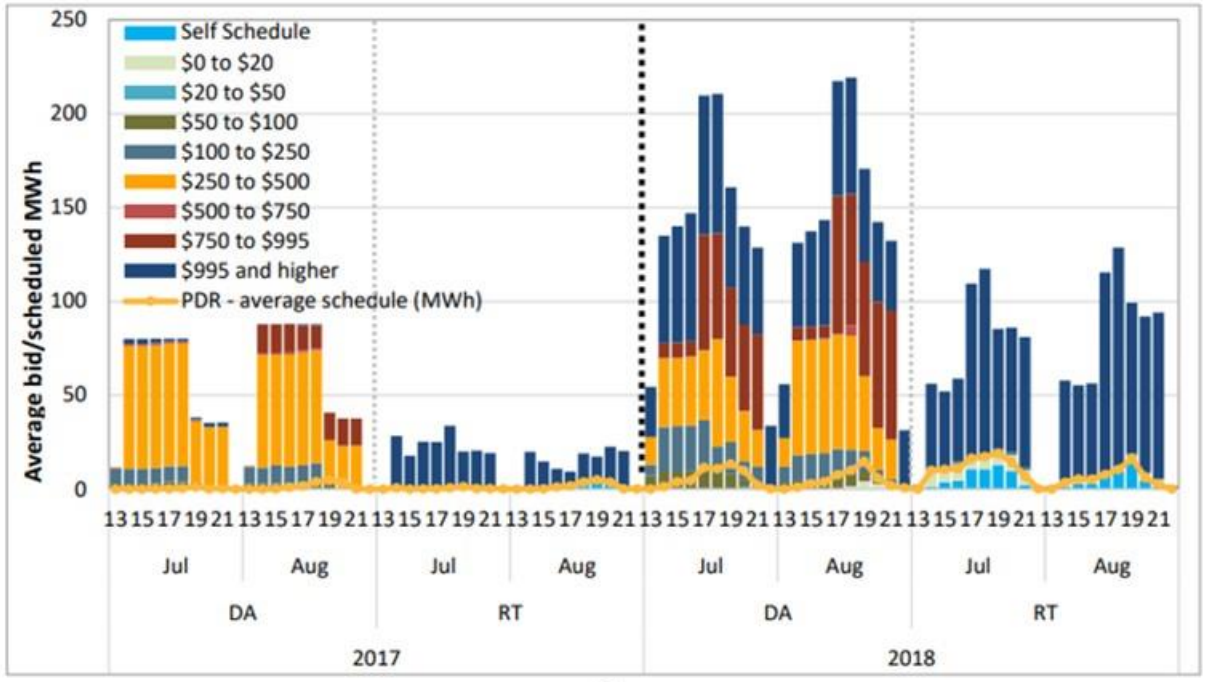
Challenge: discussions with some DR and DER stakeholders suggest that our current real-time only market structure is a barrier to unlocking the value that can be provided by demand response and other emerging technologies.

An ahead-market is another option to address this problem

- Some demand response and DER providers have suggested that overcoming these challenges could unlock significant amounts of new demand-side resources.
- An ahead market is well-suited to incorporate these resources, because its scheduling naturally captures the identified operational constraints in its optimisation (i.e., notification lead, high activation costs, min/maximum run times, etc).
- Just like any other resources and services, ahead market allows DR providers facing uncertainties due to operational constraints to trade away their risks with voluntary counterparties in a transparent market process.
- There is evidence that extending the trading timeframe means demand is more elastic, facilitating its participation (see below)
- Enable better coordination with DNSP ahead of real-time.
- ESB is also progressing the **two-sided market workstream** – an ahead market could enable additional DR and DER resources to participate in the two-sided market.

AN AHEAD MARKET IS ANOTHER OPTION TO UNLOCK VALUE OF DR & DER RESOURCES

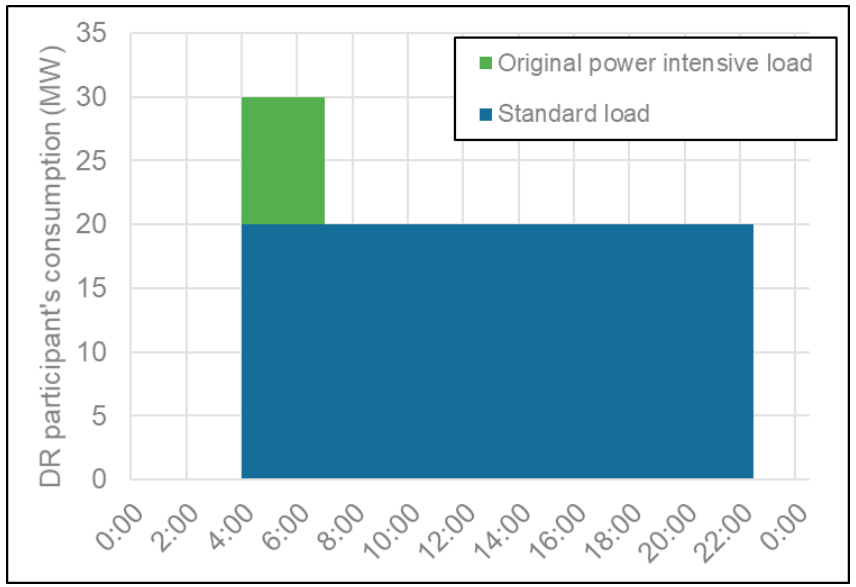
More elastic demand as the result of being able to trade ahead of real-time – evidence from CAISO

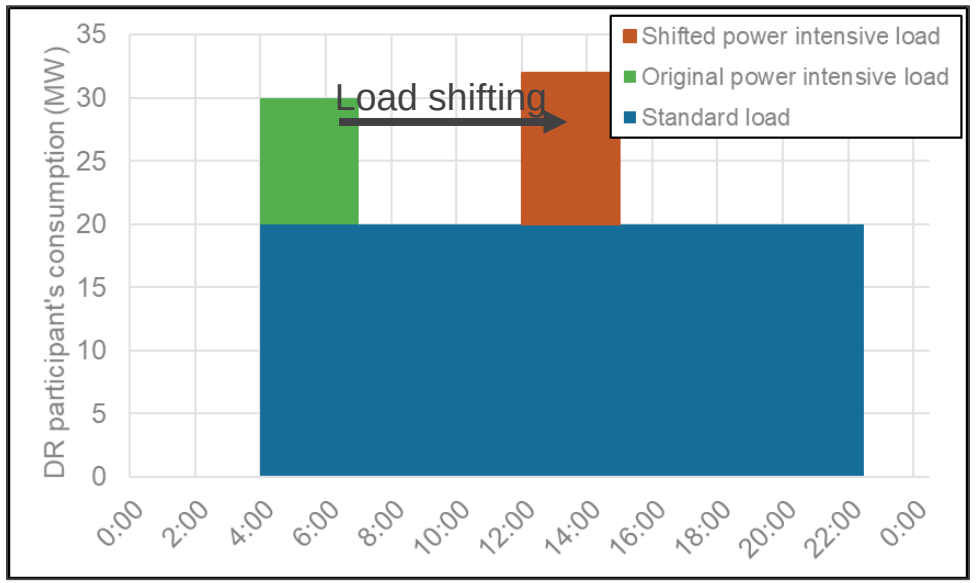


- The figure shows the total average volume of bid energy by price range from all proxy demand response resources and average energy schedules in the DAM and RTM, in July and August 2017 and 2018 in CAISO.
- A large proportion DR resources bid into ahead market at below $500/MWh.
- In contrast, almost all non self-scheduled DR resources bid into real-time market at, or near the CAISO price cap.
- Showing demand is able to respond more flexibly at lower prices when given longer notification time.

AN EXAMPLE WHERE AN AHEAD MARKET CAN UNLOCK VALUE OF DEMAND RESPONSE

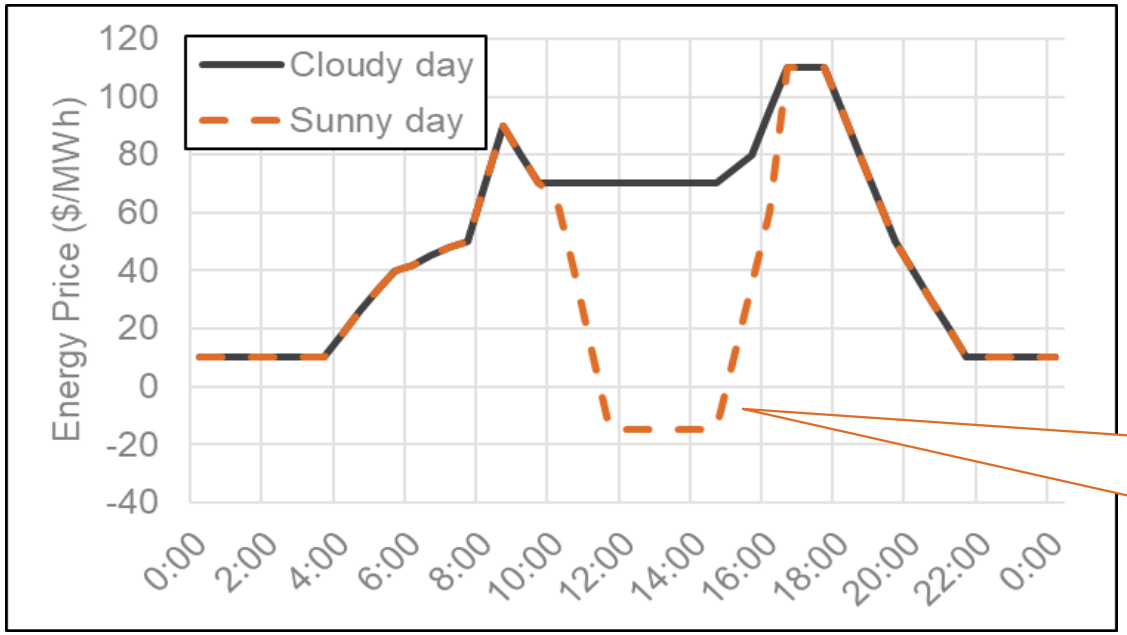
- Consider a factory which has a flat load for the majority of a day (20 MW), with an additional power intensive load (10 MW) that it typically runs between 4am and 7am when prices are low.
- The factory can shift its power intensive load to the middle of the day, but to do so:
  - 20% additional power is consumed by the process such that it is now 12 MW for the 3 hours (due to start up and other inefficiencies later in the day).
  - A decision needs to be made by 5pm the day before to arrange staff and other processes.
  - Once a decision is made, it cannot shift again, and the process must be run.





AN EXAMPLE WHERE AN AHEAD MARKET CAN UNLOCK VALUE OF DEMAND RESPONSE

- Consider typical cloudy days with limited solar and sunny days where the price drops in the middle of the day.
- On sunny days, the factory could shift its load and take advantage of the cheap energy, but on cloudy days it would pay more (assuming it is exposed to the wholesale price).
- There is also a greater risk of unexpected price spikes in the middle of the day (eg. due to unexpected cloud over) compared to early in the morning.



Day type	Middle of the day price	Load shifts?	Outcome
Cloudy	> $20/MWh	No	N/A – base case
Cloudy	> $20/MWh	Yes	Incurs additional costs
Sunny	< $20/MWh	No	Could have reduced costs
Sunny	< $20/MWh	Yes	Reduces costs compared to not load shifting

If the middle of the day price is expected to be $20/MWh or less, the factory will reduce its costs by load shifting.

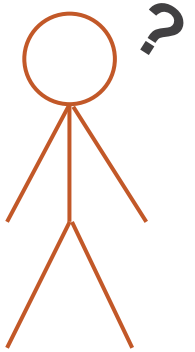
AN EXAMPLE WHERE AN AHEAD MARKET CAN UNLOCK VALUE OF DEMAND RESPONSE

Benefit to the DR provider	The ahead market allows DR providers to trade their capability and associated risk in a more transparent market process that is closely aligned with the expected short-term market conditions.

Real-time only

- The factory needs to make a decision by 5pm the day before based on predicting the weather and/or relying on pre-dispatch.
- The process of making a decision is risky and laborious, and so the factory decides not to shift its load.
- The factory could have a contract with a third-party, which might allow the latter to organize the load shifting on its behalf. But such a bilateral agreement only shifts the underlying risk of making the 5pm commitment decision to the third party.
- DR will only take place if the third party is willing to accept the risk of shifting the load.

DR providers or third party



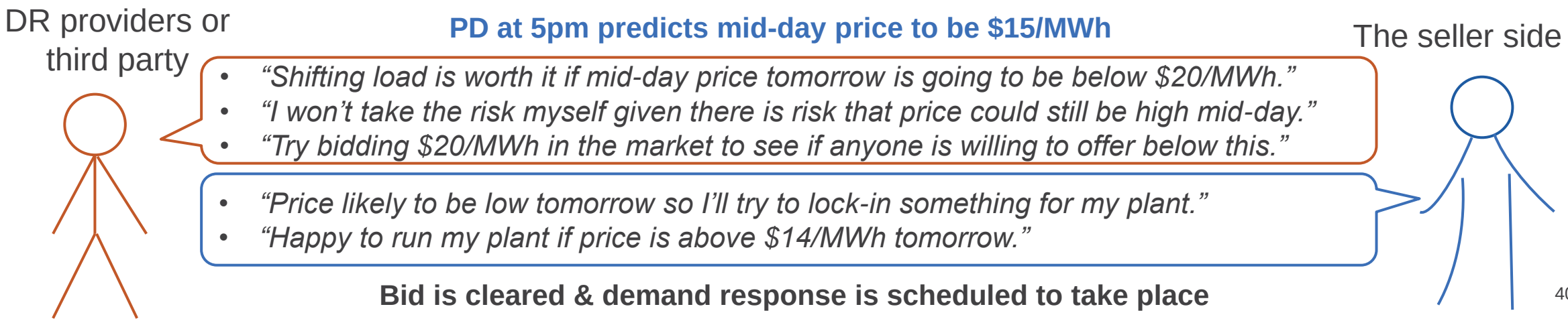
- *"Shifting load is worth it if the price mid-day tomorrow is going to be below $20/MWh."*
- *"Pre-dispatch at 5pm predicts it to be $15/MWh, but this is too early and a lot can change."*
- *"There is a risk of unexpected cloud cover tomorrow mid-day and the price could go above $100/MWh, and I have no way to stop then but have to ride through the high price event."*
- *"Given everything I know now, it is too risky to shift load tomorrow."*
- ***"Let's give it a pass for today."***

AN EXAMPLE WHERE AN AHEAD MARKET CAN UNLOCK VALUE OF DEMAND RESPONSE

Benefit to the DR provider	The ahead market allows DR providers to trade their capability and associated risk in a more transparent market process that is closely aligned with the expected short-term market conditions.

Ahead market

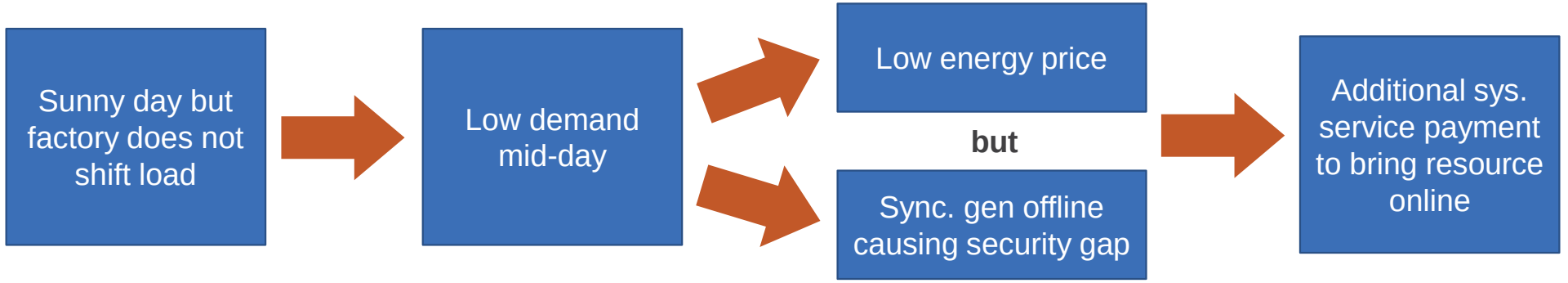
- With an ahead market, the factory or the third party can bid to run its intensive load in mid-day at an expected low price.
- If the market takes the same view that prices are likely to be low in the middle of the day, that bid will clear and the factory receives the schedule to run during the middle of the day, allowing it to organize its process in-time to provide the DR.
- The risk is traded in a wider and more transparent market process. DR is more likely to take place, because the bid will be cleared as long as there is a matching offer from other participants on the market.



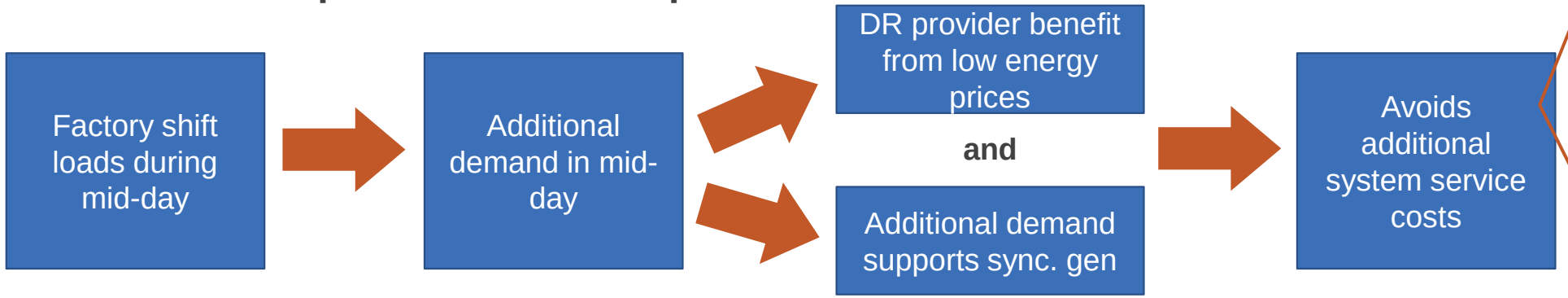
AN EXAMPLE WHERE AN AHEAD MARKET CAN UNLOCK VALUE OF DEMAND RESPONSE

Benefit to the system	Unlocking more demand response lead to more efficient utilisation of the entire resource mix to supply system needs through a market process.

Without demand response in this example



With demand response in this example



The case <u>with</u> demand response is more efficient because:

- The shifted demand is supplied at lower prices
- Less system service cost is incurred

Afterall such load shift should/would have taken place if the DR provider was able to overcome the ahead of time uncertainty when making the decision

ALTERNATIVE STORAGE SCHEDULING PROCESS PROVIDING VALUE TO SOME STORAGE PROVIDERS

- Storage resources are incredibly fast to respond, but they too have to make complex **inter-temporal commitment decisions** to manage their state of charge.
- Currently battery storage derives a large proportion of revenue from FCAS, but this market is relatively small and could be saturated quite quickly. As the penetration of storage rises, and when storage starts to participate more in the energy market, the power system will become increasingly influenced by their operational decisions.
- The current business model for storage is to earn revenue from the real-time market. This could be challenging for smaller scale providers and aggregators due to the complexities involved.
- An ahead market could provide an alternative option that could be attractive to smaller scale providers. By its design, an ahead market solves the intertemporal commitment problem and will schedule the battery to maximise its value across different services and over time.
- A storage provider can indicate its willingness to charge/discharge in ahead market bid/offers. Alternatively, it could *choose* only to specify its technical/commercial limitation (e.g., number of cycles, end-day storage level or minimum revenue) and leave the ahead scheduling algorithm to work out the optimal ahead schedule. This feature may also benefit larger-scale storage providers like pumped hydro.
- The storage provider still can actively participate in the RT market to respond to profitable opportunities if it prefers, but the ahead schedule gives it some certainty in revenue.

WHAT ARE THE OTHER OPPORTUNITIES THAT AN AHEAD MARKET CAN PROVIDE?

- **Additional platform for participants to trade before real-time to improve scheduling efficiency**
  - As penetration of renewables rises, there will be increasing uncertainty in the lead-up to real time, increasing the risk that a participant would be unexpectedly long or short relative to their contract position shortly before real-time.
  - While participants can continue to manage such risks when entering into contracts weeks/quarters before real-time, an ahead-market gives them an additional platform to manage short-term uncertainty, allowing participants to retune their contract position a day or several hours ahead of real-time based on their operational need.

- **Improved cross-coordination between electricity and gas as well as other sectors participating in DR**
  - Opportunities for improve efficiency of both gas and electricity markets. An ahead market creates a platform for participants to manage their risk by locking in a price for their output.
  - Natural alignment between daily gas markets and ahead market for electricity. An ahead market for electricity could provide certainty for participants with gas resources as part of their portfolio to manage their resources. Ahead market could also include intra-day trading to further coordinate activities between electricity and gas markets.
  - With greater participation from DR and DER, coordination in activities in these sectors as well (e.g., EV charging or production planning)

SUMMARY – WHY ARE WE CONSIDERING AN AHEAD MARKET?

Impetus for change

- ↓ Synchronous generation
- ↑ Penetration of renewables
- ↑ Enable demand side and DER participation
- ↑ Storage

Use cases

- Activate system service beyond min level for dispatch efficiency
- Potential need for a formal platform to hedge system service costs
- Unlocking increasingly valuable demand-side resources
- Potential alternative mechanism for storage scheduling to facilitate uptake
- Fine tune short-term contract and portfolio position to deal with increasing variability
- Coordination between electricity and other markets

What can an ahead market provide?

- A market based process to procure system service beyond min level for dispatch efficiency
- A platform for hedging system service cost
- Facilitates participation by long-lead and lumpy supply-side and demand-side resources
- Coordination of storage/cycling
- Trading and adjusting contract positions with greater alignment with RT operations
- Cross-coordination by providing certainty between electricity and gas and sectors providing DR

QUESTIONS TO STAKEHOLDERS

- **Have we captured the key potential "use cases" to facilitate the objectives described?**
- **Do stakeholders consider ahead market represents an option among others to address each use case?**
- **Is there any potential drawback of using an ahead market to address any of the use cases?**

QUESTIONS AND POINTS RAISED REGARDING AHEAD MARKET DESIGN

Centralised unit commitment in ahead market

Ahead market and RT price volatility

Ahead market and hedging contract

CENTRALISED UNIT COMMITMENT IN AHEAD MARKET DESIGN

Points and questions raised

- An ahead market implies centralised unit commitment, diverging from the fundamental self-commitment principle of the NEM.
- Uplift/make-whole payment might be needed to fund central commitment, with concerns that it could be detrimental to forward contract market.

Discussion: Ahead market *vs.* centralised unit commitment

- Ahead market does not have to introduce any additional central commitment, as it, in theory, could be designed to have incremental-only bids, although some extra technical inputs might be required to ensure feasibility.
- Alternatively ahead market can give participants the choice to self-commit if they wish to
  - Participants can choose to stay in the real-time market only if they wish to
  - Participants can have the choice of incremental-only or three-part bidding structure in ahead schedule as they see fit
- In many international ahead markets (e.g., ERCOT), participants have the option of submitting three-part or incremental-only bids. Some participants (e.g., cycling plant) *prefer* to use three-part bids as they can be confident of start up cost recovery with the potential make-whole payment. (next slide)

- *If a voluntary ahead market was designed to give participants the choice of using incremental-only or three-part bidding, do participants still have concerns that it could unduly centrally commit resources?*
- *Would three-part (or other non-incremental-only) bidding be helpful to certain existing or emerging technologies in the NEM where the ahead market can take into consideration lumpy costs or make explicit intertemporal trade-offs?*

CENTRALISED UNIT COMMITMENT IN AHEAD MARKET DESIGN

Discussion: make-whole payments

- In many international ahead markets, participants who submit three-part bids could receive a make-whole payment if their revenue from ahead schedule (typically over a day) does not cover their total cost, especially due to starting up the unit.
- Note uplift due to make-whole payment in ahead scheduling typically is a very small portion of total costs. In PJM it accounts for ~0.25% of total cost (~$0.2/MWh NEM equivalent).
- Make-whole payment is more of a design *choice* than a *necessity.* Ahead scheduling could be designed without make-whole payment:
  - Alternative designs exist (with some mathematical ingenuity and computational limitation) to ensure units are scheduled only if they achieve a certain minimum revenue in the ahead schedule.
  - Alternatively the design can preserve the current NEM philosophy of letting participants manage the risk of cost recovery by bidding part of their capacity into high price bands.

- *Considering other "unhedgeable costs" in the NEM such as FCAS costs or direction costs, are there particular concerns about make-whole payments associated with three-part bidding in ahead markets that are not considered here?*
- *Would participants find the design options to eliminate make-whole payment (e.g., putting cost recovery risk on participants as per the current NEM design philosophy) more attractive?*

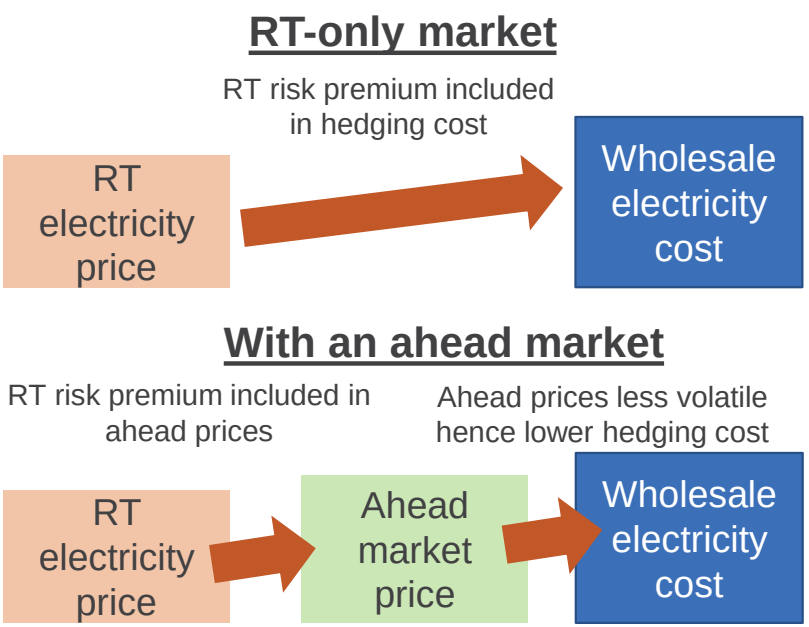
AHEAD MARKET AND REAL-TIME PRICE VOLATILITY & SCHEDULING RESOURCES

Points and questions raised

- Ahead market could reduce volatility in the real-time prices.
- A reduction in volatility may reduce incentive for flexible resources.
- Do ahead markets favour slow-start units at the expense of fast-start units and if so, should that be considered to be inefficient?

Discussion: Real-time price volatility

- RT price should be *allowed* to reach a high level to reflect the true cost of scarcity (no change from now). With an ahead market, the RT price continues to provide an important signal for resources to respond to changes in the real-time.
- The objective of wholesale electricity market design is to deliver low (but efficient) wholesale electricity cost (energy + system service) to end consumers. Everything else held constant, more volatile real-time prices tends to increase risk premium, leading to higher wholesale electricity cost.
- The design of ahead market should ensure that it does not of itself increase the wholesale electricity cost, including the cost of hedging, to end consumers. We have not found any evidence that the introduction of an ahead market of itself leads to higher wholesale costs.



- *With the RT price still providing a signal for flexibility, is there any specific concern if an ahead market reduces volatility in the RT market?*
- *Is there evidence that the introduction of an ahead market leads to higher expected/average wholesale costs?*

AHEAD MARKET AND REAL-TIME PRICE VOLATILITY & SCHEDULING RESOURCES

Discussion: Ahead market and scheduling the resource mix

- The ahead market is an additional platform for buyers and sellers of energy and system services to trade and hence is a form of a two-sided market. Importantly it allows participants to trade risks:
  - Sellers can secure revenue for its service to be delivered at a price it is willing to accept
  - Buyers can remove uncertainty and risk of its costs at a price it is willing to pay.
- When participation is voluntary, buyers and sellers who are cleared in the ahead market are better off from their perspective of receiving this ahead award than leaving themselves to uncertainties in the RT market.
- Some resources (e.g., DR with long notification time or other lumpy structure) and buyers benefit more from trading ahead, while others prefer remaining in the RT. Allowing participants to trade ahead or in RT to best suit their operating characteristics would seem to lead to better utilisation of resources, whereas restricting trade to RT-only will likely limit options for some resources.
- It should follow that having a voluntary platform for participants to trade will lead to lower overall resource costs and lower prices to consumers.

- *Do participants think having an additional ahead option for resources to trade and manage their risk (including energy and system service costs) could lead to a more efficient outcome? If not, what is the likely cause of inefficiency?*

AHEAD MARKET AND HEDGING CONTRACT

Points and questions raised	• Ahead market is not needed because hedging contracts are linked to real-time, protecting resources from operational risks. • Ahead market could undermine the hedging contract market

Discussion: Ahead market and hedging contract

- In many international ahead markets, hedging contract is linked to ahead prices, which in turn is linked to real-time prices. In the NEM electricity hedging contracts are linked to real-time prices. However, no hedging contract market exists for system services, including the FCAS market which has existed for over a decade.
- An ahead energy schedule is not the same as long-term hedging contracts, as the former is made much closer to real-time operation and is more tightly aligned to the actual operational conditions. Participants with hedging contracts might still benefit from trading in the ahead market to adjust for very short term portfolio changes that cannot be captured when striking the hedging contracts.
- As existing contracts gradually roll off, new contracts could potentially be made with reference to ahead prices, but this might lead to a temporary split in liquidity during the transition. But existing hedging contract could change with or without ahead market due to other market reforms. There could be synergy in managing any potential transitions at the same time.

- *Do participants consider ahead markets provide value in facilitating hedging system service costs in a post 2025 world?*
- *What transitional approaches, including exploring synergy with other reform initiatives, could minimise the disruption to contract markets?*
- *Other than the transitional disruption identified above, are there any other examples that an ahead market could undermine hedging contracts?*

SEEKING YOUR INPUT

Some topics we specifically want feedback on

- Objectives of an ahead mechanism.
- Are there additional use cases for an ahead market that should be considered?
- Application of an ahead market in each of the use cases.
- Any potential drawbacks of an ahead market and its application in any of the use cases?
- The choice of incremental-only or three-part bids and their use by existing and or emerging technologies in the NEM.
- Any specific concerns in relation to an ahead market and its implications for volatility in the RT market.
- Any additional implications for the contract market and transitional approaches that could be considered.

How you can provide feedback

Please provide initial feedback to info@esb.org.au with email subject heading titled '*TWG Ahead Market briefing'* by **Tuesday 7 July**.

Please get in contact if you have further questions.

- Upcoming focus group meetings:

  30 June – Ahead market feedback session

  30 July – Ahead market design, feedback and issues