Operating Reserves Market Review Session #3

Sept 8, 2022

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Introductions & Session Overview

Agenda

Topic	Presenter(s)	Time	Duration
Welcome, introductions, session overview	Ruppa Louissaint	9:00 am	10
Equilibrium pricing & AESO bid price	Brendan Jewitt	9:10 am	20
Offer transparency	Brendan Jewitt	9:30 am	20
Minimum qualification & offer size	Brendan Jewitt	9:50 am	20
Break	N/A	10:10 am	10
Hourly procurement	Brendan Jewitt	10:20 am	20
Contingency reserve procurement	Brendan Jewitt	10:40 am	20
Standby reserve pricing	Brendan Jewitt	11:00 am	20
Next steps	Ruppa Louissaint	11:20 am	10

Introductions

- Markets
  - Ruppa Louissaint, Manager, Markets
  - Brendan Jewitt, Economist

- Grid Reliability
  - Dan Wiebe, Manager, Operations Engineering and Market Support

- Legal and Regulatory Affairs
  - Kristin Barham, Legal Counsel
  - Brij Modha, Regulatory Analyst
  - Valerie Anasco, Legal and Regulatory Coordinator

Initiative summary

- Purpose of this initiative:

> Assess opportunities to enhance competition and price fidelity in the existing OR markets to improve efficiency

- At the highest level the market is functioning, but there are several design elements that are not performing in a way that promotes efficiency
- Incremental change should be sufficient to address the concerns
  - Ensuring an efficient market design is essential, especially given the importance of OR both economically and operationally as the system and fleet evolve

Initiative process

Session 1	Nov 30, 2021	• Background • Purpose and scope • Initial discussion of alternatives and considerations for group 1 design elements • Introduction of group 2 design elements
Session 2	Apr 7, 2022	• Continued discussion of group 1 design elements, including stakeholder feedback and initial recommendation • Initial discussion of alternatives and considerations for group 2 design elements
Session 3	Sep 8, 2022	• Share final recommendations for some design elements • Discuss where further feedback is needed to inform remaining recommendations
Session 3 feedback	Sep 30, 2022	Subject to change as initiative progresses
Initiate rule consultation	Q4 2022	
Application filing with AUC	Q1 2023	
Implementation	2022/2023	

Session summary

- Our objectives in this session are to:
  - Share final recommendations based on the draft recommendations shared in session 2
  - Share and discuss the AESO's draft recommendations on hourly procurement, standby pricing, and a small number of supporting design decisions
  - Provide an update on the timing and format for the remainder of the engagement

AESO Stakeholder Engagement Framework

Design Recommendations

Design element status

Status	Interpretation
Final decision	Analysis and stakeholder feedback have been considered to inform a design. Initial rule impact analysis suggests that rule changes **are not** required. This is subject to change as we begin comprehensive rule drafting.
Final recommendation	Analysis and stakeholder feedback have been considered to inform a design. Initial rule impact analysis suggests that rule changes **are** required, needing AUC approval. This is subject to change as we begin comprehensive rule drafting.
Draft recommendation	Enough information is available to support a preferred alternative, but further input from stakeholders is required to inform a recommendation. The recommendation will be integrated with proposed rule language.
Further feedback needed	More stakeholder feedback will be necessary before a preferred alternative is identified. The recommendation will be integrated with proposed rule language.

Equilibrium pricing & AESO bid price

Current practice

- The equilibrium price in the active OR markets is determined by averaging the marginal offer and the AESO bid price
  - AESO bid prices are not visible to parties outside the Watt-Ex platform
  - The AESO bid price currently acts as an offer cap
- Dispatched active reserve providers are paid the energy pool price + the equilibrium price

AESO proposed alternative

- Remove equilibrium pricing and set the uniform price at the marginal offer price
  - The index to the energy pool price would remain
- Review and publicly disclose the AESO bid price

Equilibrium pricing & AESO bid price

- Marginal pricing
  - Some stakeholders were supportive, some were indifferent, and few expressed concerns
- Concerns about increased volatility
  - The price floor for OR is $0/MWh regardless of where the price index settles
    - Participants can manage their exposure to low prices through their offer behaviour
  - Volatility is not inherently undesirable if it reflects competitive market conditions
- One stakeholder provided analysis of OR revenues under marginal pricing while holding offer behaviour constant
  - While this is a helpful comparison, we expect that participants will adjust offer behaviour to account for marginal pricing
  - To the extent that offer behaviour does not change, this would indicate that equilibrium pricing was unduly influencing market outcomes

Equilibrium pricing & AESO bid price

- Marginal pricing decision

Remove equilibrium pricing and set the uniform price at the marginal offer price

- Marginal pricing produces accurate price signals that reflect the competitive outcome

Equilibrium pricing & AESO bid price

- Current AESO bid prices

Product	Time Block	AESO Bid Price ($/MWh)
RR	AM super peak	$100
	PM super peak	$30
	On peak	$40
	Off peak	$100
SR	On peak	$40
	Off peak	$40
SUP	On peak	$40
	Off peak	$5

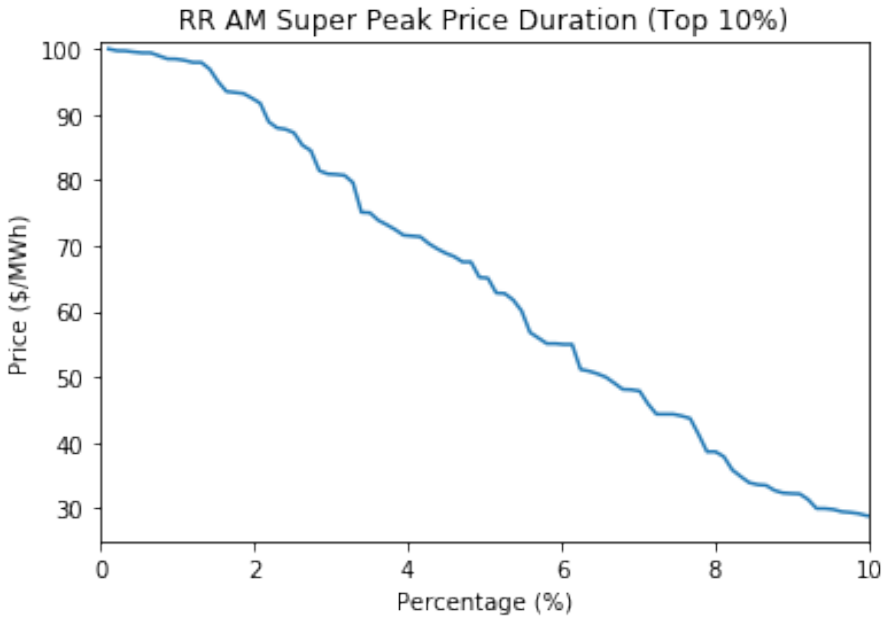
- As part of this assessment, the AESO wants to ensure that the bid prices reflect the relative value of each OR product
  - Mismatch between some RR and CR blocks

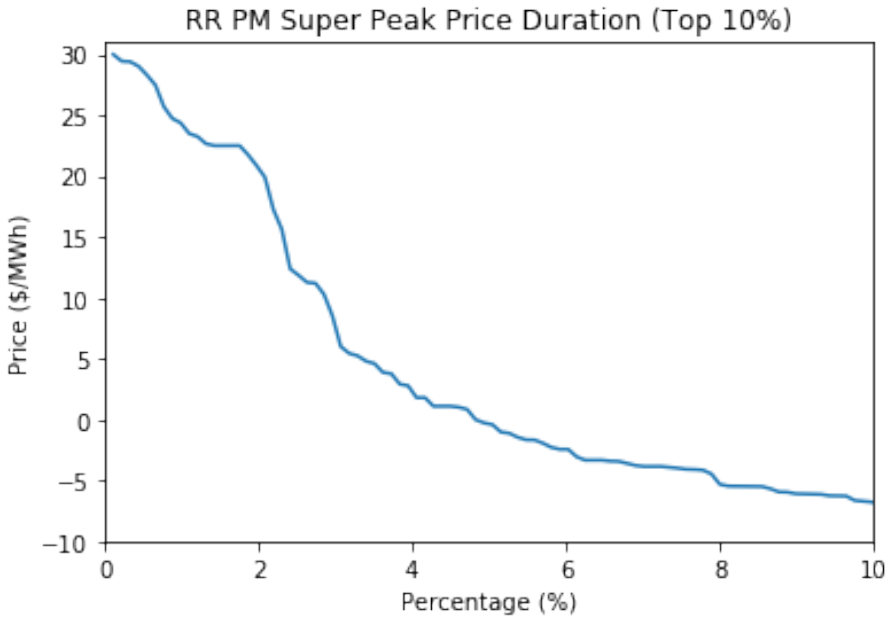
Equilibrium pricing & AESO bid price

- Price duration curves were analyzed for each OR product over each time block
  - Data from January 1, 2020 – March 31, 2022
  - Used to evaluate the frequency of high prices and assess whether current OR bid prices are restricting competitive outcomes
- Prices at or near the AESO bid price are currently rare
  - Price reached the AESO bid price under 1% of the time for all products and time blocks

Equilibrium pricing & AESO bid price

Regulating Reserves – Super peak

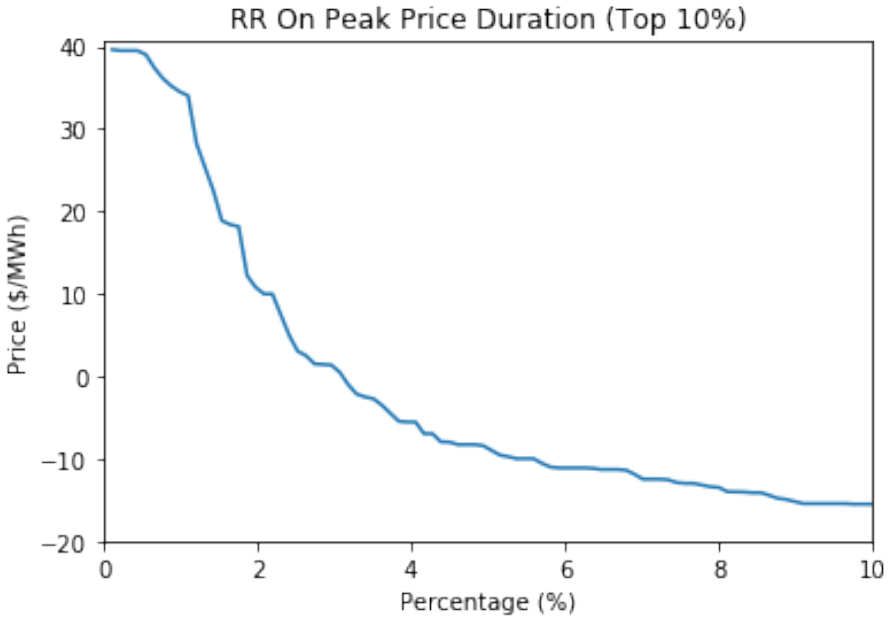


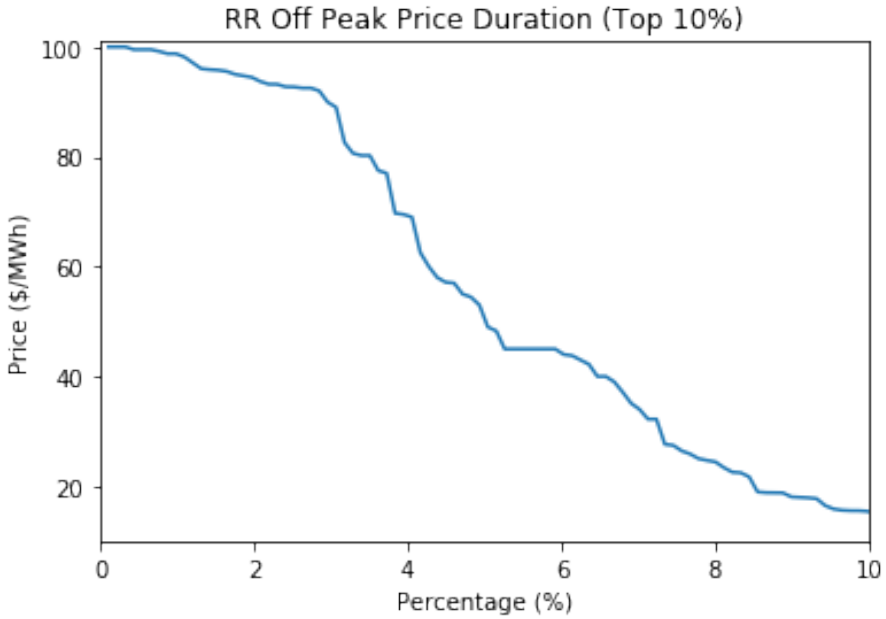


- Bid prices are $100/MWh for AM super peak and $30/MWh for PM super peak
- AM super peak regulating reserve prices exceeded $95.00/MWh roughly 1.4% of the time
  - The upper 10% of AM super peak prices are relatively linear in comparison to other blocks
- PM super peak prices exceeded $25.00/MWh less than 1% of the time

Equilibrium pricing & AESO bid price

Regulating Reserves – On and off peak

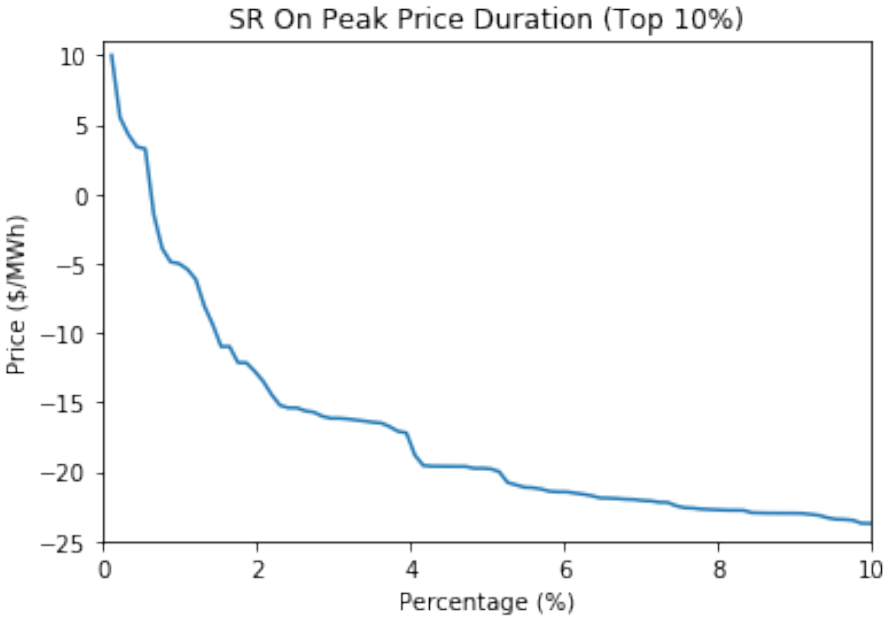


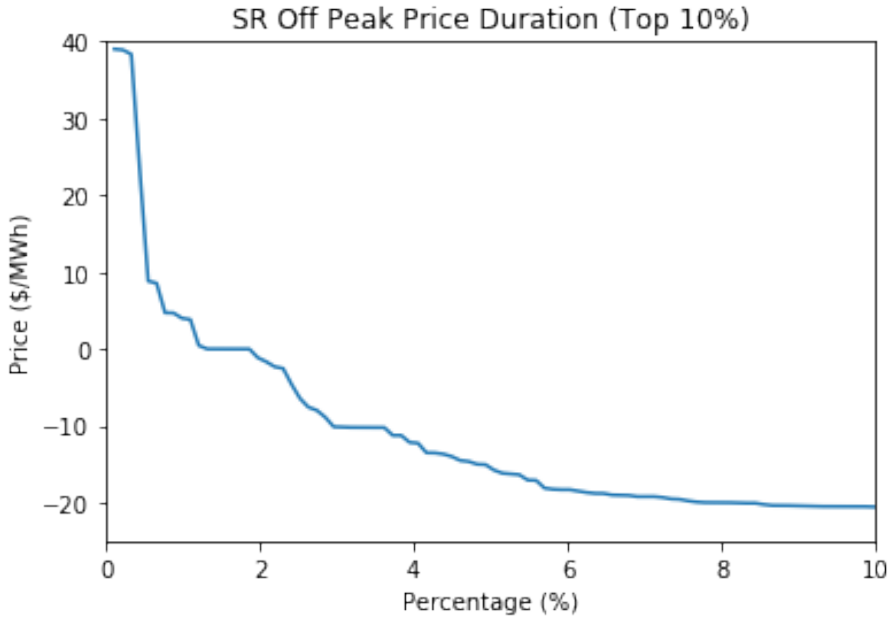


- Bid prices are $40/MWh for on peak and $100/MWh for off peak
- The maximum on peak regulating reserve price was $39.62/MWh
  - On peak regulating reserve block prices exceeded $0.00/MWh 27 times
- Off peak regulation reserve prices reached a maximum price of $99.99/MWh three times

Equilibrium pricing & AESO bid price

Spinning Reserves

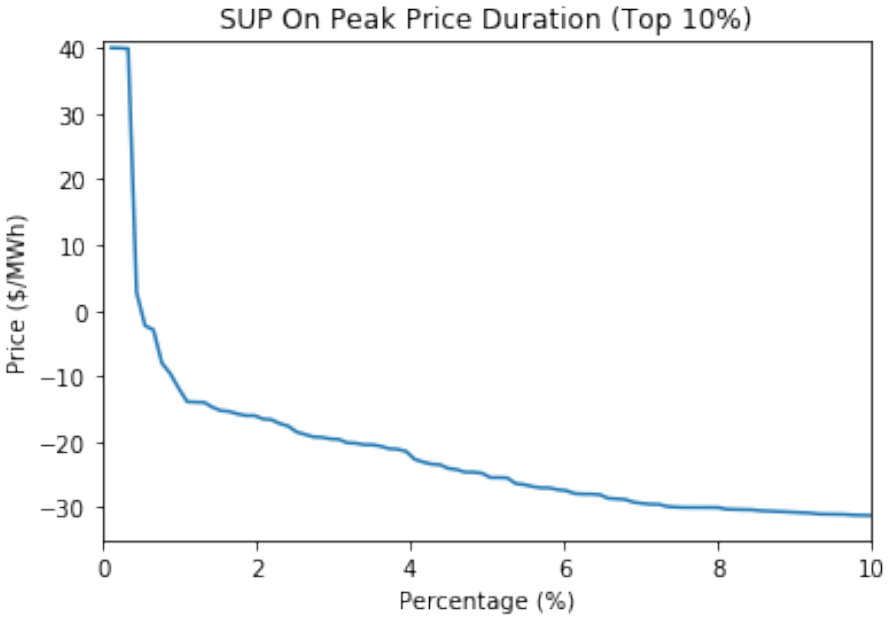


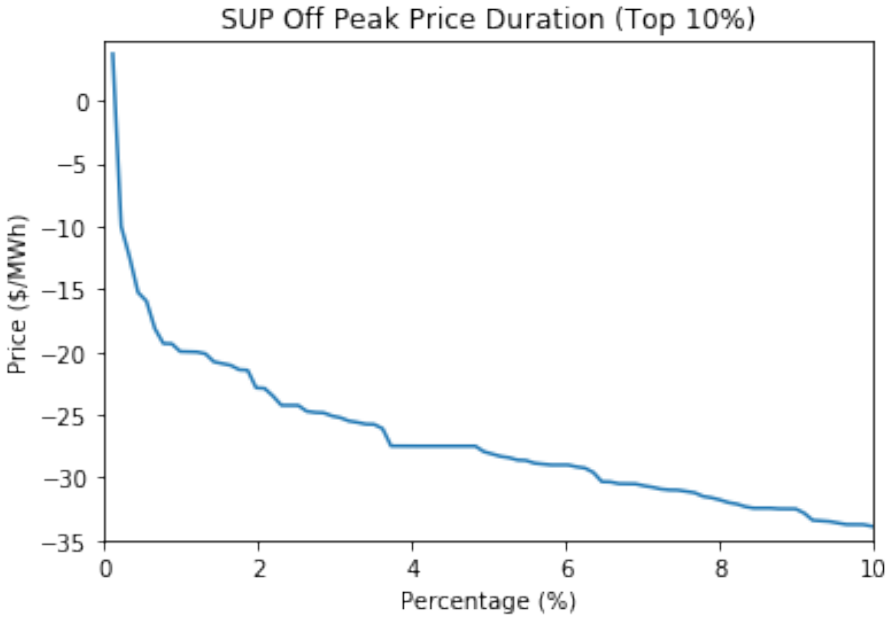


- Bid price is $40/MWh for on peak and off peak
- Spinning reserve on peak products were priced above $0.00/MWh less than 1% of the time
  - AESO bid price was not reached during the time frame of this analysis
- Off peak spinning reserve prices exceeded $0.00/MWh approximately 2% of the time
  - A maximum price of $39.00/MWh was reached for off peak spinning reserves on Dec 30, 2021

Equilibrium pricing & AESO bid price

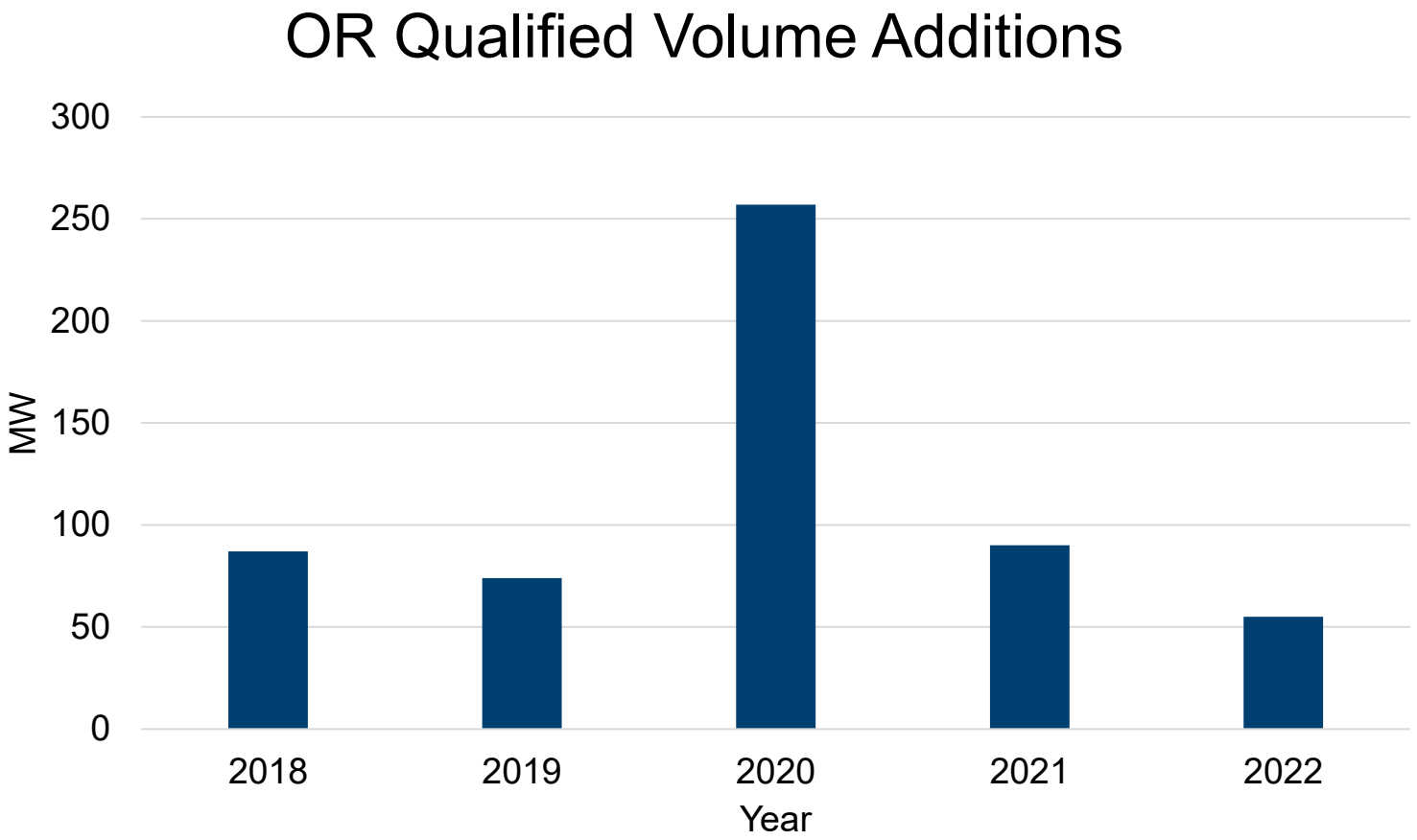
Supplemental Reserves





- Bid prices are $40/MWh for on peak and $5/MWh for off peak
- On peak prices for supplemental reserves exceeded $39.00/MWh three times, and the AESO max bid price of $40.00/MWh was reached once on April 1, 2020
  - There were only four occurrences in which supplemental reserve on peak prices exceeded $0.00/MWh
- The highest off peak supplemental reserve price was $3.72/MWh

Equilibrium pricing & AESO bid price



- There have been steady volume additions in the OR market in recent years under the current bid prices

Jurisdictional OR Price Cap Review

Jurisdiction	OR Price Cap
ERCOT	The offer cap is $9,000/MWh for energy offer curve and ancillary services. The offer floor is -$250/MWh for energy offer curve and $0/MWh for ancillary services, respectively. An Operating Reserve Demand Curve (ORDC) is utilized for scarcity pricing.
IESO	The Maximum Operating Reserve Price (MORP) is $2,000/MWh. All operating reserve offer prices must be greater than or equal to $0 per MWh and less than the Maximum Operating Reserve Price.
NYISO	Prices determined through the ORDC vary based on product, region and shortage volume. Maximum reserve clearing prices for Spin, 10 Total and 30 Min are: $3,725/MWh, $2,875/MWh and $1,300/MWh.
SPP	The offer caps for regulation reserves, contingency reserves and energy are: $500, $100, and $1,000/MWh. The scarcity price cap for regulation is $600/MWh, which is the sum of the contingency reserve cap, and the regulation offer cap. The scarcity price cap for operating reserves is $1,100/MWh, which is the sum of the energy offer cap and the contingency reserve offer cap.

Equilibrium pricing & AESO bid price

- To assess the potential for cost recovery under the current bid prices, the AESO calculated average cycling costs over the shortest block for each product
  - 3 hour AM super peak for RR and 8 hour off peak for CR
  - Used characteristics of aeroderivative simple cycle reference unit from this report prepared by Brattle and Sargent & Lundy
    - https://www.aeso.ca/assets/Uploads/CONE-Study-2018-09-04.pdf
  - Used AECO natural gas July 2022 monthly index price of $6.83/GJ.
  - Used carbon price of $50/tonne
  - Assumed pool price of $0/MWh
- Analysis shows cycling cost recovery for RR at $121 and for CR at $45

Equilibrium pricing & AESO bid price

- Bid price conclusions
  - The current AESO bid prices do not all reflect the relative value of different OR products
  - Historical market outcomes suggest that the current AESO bid prices are not restricting competitive outcomes
  - The current AESO bid prices have been sufficient to attract new competition
  - Other jurisdictions have minimal applicability due to their fundamentally different co-optimized frameworks
    - The most comparable design is SPP, which has a maximum scarcity price cap of $1,100/MWh
  - Cycling cost analysis suggests that the current AESO bid prices do not always provide the opportunity for cost recovery

Equilibrium pricing & AESO bid price

- Bid price recommendation:

> Set the AESO bid price to $150/MWh for all RR blocks and $50/MWh for all SR and SUP blocks

- Results in effective price caps of $1,150/MWh for RR and $1,050/MWh for CR after including the energy price
- Allows the competitive market to establish the price differential between time blocks
- The AESO will make AESO bid prices transparent by reporting them through the Energy Trading System (ETS)

Equilibrium pricing & AESO bid price

Current Practice	AESO Proposed Alternative	Status
Equilibrium price in active OR market determined by averaging marginal offer and AESO bid price	Remove equilibrium pricing and set the uniform price at the marginal offer price	Final decision
AESO bid prices listed on slide 18	$150/MWh for RR and $50/MWh for SR and SUP AESO will publish AESO bid prices through ETS	Draft recommendation

Discussion and Q&A

Offer transparency

Current practice

- Offers to the Watt-Ex platform are visible to all participants as soon as they have been submitted
- 60-day lagged offer information is available with clearing price, asset, and participant attribution for cleared volumes only

AESO proposed alternative

- Move to a sealed-bid format
- Align OR offer disclosure with the energy offer disclosure stipulated by the FEOC regulation
  - Publish offer price, volume, and offer control party with a 60-day lag
  - These changes would align the OR market with the energy market by reducing real-time transparency and increasing ex-post transparency

Offer transparency

- In session 2, the AESO shared a high-level comparison of the benefits and risks of open vs sealed auctions
  - Some participants emphasized the potential benefits in their feedback
- The AESO conducted a more comprehensive survey of available peer-reviewed literature and expert reports
- The AESO has not undertaken an empirical analysis of the effects of transparency in the OR market, as:
  - There is no ‘natural experiment’ with which to empirically compare OR market outcomes with and without transparency
  - It would be very challenging to reliably distinguish the positive and negative effects of transparency from the multitude of other factors that impact market conditions and outcomes

Offer transparency

- Stakeholders seeking further information on the benefits and risks of transparency may wish to refer to the following report prepared for the MSA
  - https://www.albertamsa.ca/assets/Documents/CRA-Transparency-Report-for-MSA-11-17-2011_FINAL.pdf
- This report is focused on the Alberta energy market and the unique characteristics of the OR market need to be considered when interpreting it
  - The energy market is already sealed
  - There is generally less information available outside the trading platform for OR than for energy
  - The OR market is smaller than the energy market and participation is voluntary

Offer transparency

- The Competition Bureau uses the following indicators to assess the potential for lessened competition

Market characteristic	OR market relative to energy market
High market concentration	Comparing OR concentration shared in session 2 with the MSA's Market Share Offer Control report shows that the OR market has higher concentration than the energy market
Frequent transactions	The energy market is arguably more frequent, as offers are hourly; however, interaction in the OR market is still repeated and frequent
Homogenous products	OR and energy are both homogenous as the markets do not differentiate between suppliers
Predictable demand and similar cost structures	The AESO procures a fixed volume determined by reliability standards. Similar factors influence the opportunity cost of OR and the direct cost of energy for many participants.
Transparency	The OR market is more directly transparent while the energy market generally has more information available outside the trading platform

https://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/vwapj/cb-meg-2011-e.pdf/$FILE/cb-meg-2011-e.pdf

Offer transparency

- The characteristics of the energy market and the OR market suggest that the risks of reduced competition are equal or greater in the OR market
- As stakeholders have noted, there are also benefits of greater transparency, including:
  - Reduced risk and uncertainty
  - Reduced information asymmetries
- The AESO has considered how different forms of disclosure in the OR market can promote these benefits while reducing risks

Offer transparency

- With respect to transparency in the long- and medium-term:
  - Long-term transparency needed for investment will continue through comprehensive price reporting and can be enhanced by disclosing full offer curves
  - Medium-term transparency is promoted through ETS reporting such as the Daily Active & Standby Operating Reserve Price Reports, seven-day OR Volume Forecast, Daily Outage Report, 7 Days Hourly Available Capability and Supply Adequacy report

Offer transparency

- With respect to short-term (day-ahead) transparency:
  - Only qualified providers that are actively engaged with the Watt-Ex platform currently benefit from short-term transparency
  - While sophisticated participants can learn from offers submitted early in the auction, substantial volumes are submitted late enough that it is not possible to initiate a competitive response
  - Demand response is not possible with the AESO procuring a fixed volume as the sole buyer
  - When consulting on implementation of standing offers, participants were clear that submitting offers is not burdensome
- The AESO has concluded that the potential risks of the open auction format outweigh the potential benefits
  - There are sufficient alternative mechanisms to promote transparency

Offer transparency

- Offer transparency decision

Move to a sealed-bid format

- The price and volume of the AESO bid will continue to be visible in the auction
- The cumulative offer volume will be visible in the auction, which will continue to allow participants to assess supply conditions
- The clearing price and volume will be visible in Watt-Ex immediately at auction close and through ETS daily

Offer transparency

Current Practice	AESO Proposed Alternative	Status
Offers to the Watt-Ex platform are visible to all participants as soon as they have been submitted	Move to a sealed-bid format The AESO bid price and volume and the cumulative offer volume will continue to be visible during the auction. The clearing price and volume will be visible to participants immediately after the auction closes.	Final decision
60-day lagged offer information is available with clearing price, asset, and participant attribution for contracted volumes only	Publish offer price, volume, asset, and offer control party with a 60-day lag for all offered volumes	Final decision
Marginal offers may be partially cleared	Participants may opt to not be partially cleared. If such an offer is marginal and the full volume is not needed, it will be skipped.	Draft recommendation
Tie-break for equal priced marginal offers based on earliest submission time	Clear equal priced marginal offers on a pro-rata basis	Draft recommendation

Discussion and Q&A

Minimum qualification & offer size

Current practice

- The minimum qualification size for regulating reserves (RR) is 15 MW, spinning reserves (SR) is 10 MW and supplemental reserves (SUP) is 5 MW
- The minimum offer size for all OR is 5 MW
- Dispatch tolerance is currently 1 MW for assets <= 20 MW and 5% for assets > 20 MW

AESO proposed alternative

- Reduce minimum qualification and offer size to 1 MW for all products
  - Enables participation from new technologies and supports increased competition in the operating reserve market
- Change dispatch tolerance to 5% for all assets

Minimum qualification & offer size

- The AESO has received comprehensive feedback on the draft recommendations shared in sessions 1 and 2
- Three outstanding items
  - Participants requested more details on the technical study supporting our recommendations
  - Participants expressed continued concerns with directive practices for contingency reserves
  - The AESO shared a recommendation on dispatch tolerance but not on directive tolerance

Minimum qualification & offer size

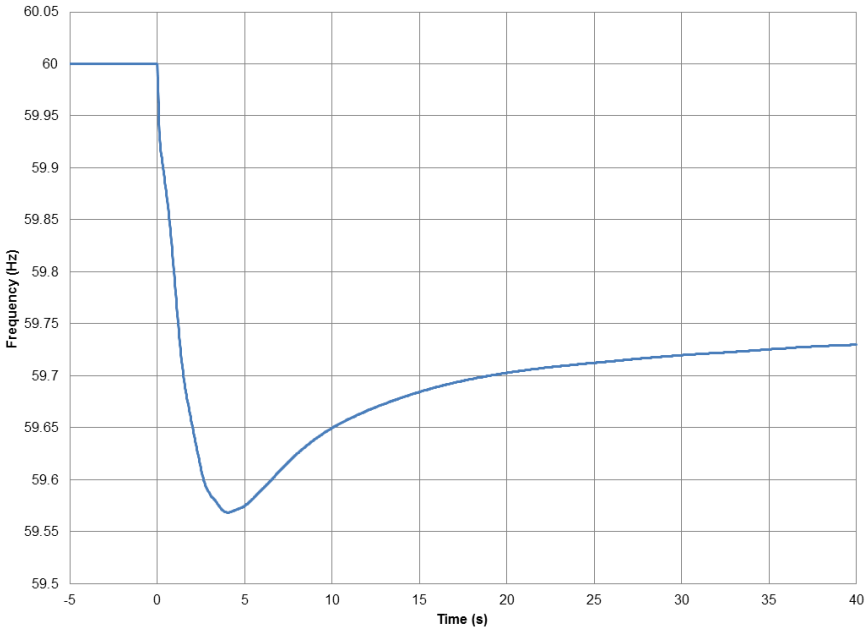
Operating Reserve Minimum Size Assessment

- Assets providing regulating and spinning reserve contribute to the system's overall primary frequency response
- The AESO investigated what would happen to the system's frequency response in an islanding event, if the existing assets that were providing RR & SR ceased being frequency-responsive, and RR & SR were procured from new, smaller assets instead
- The assessment showed smaller assets can provide equally effective primary frequency response
- We conclude frequency response concerns do not preclude smaller assets from participating in the RR & SR markets

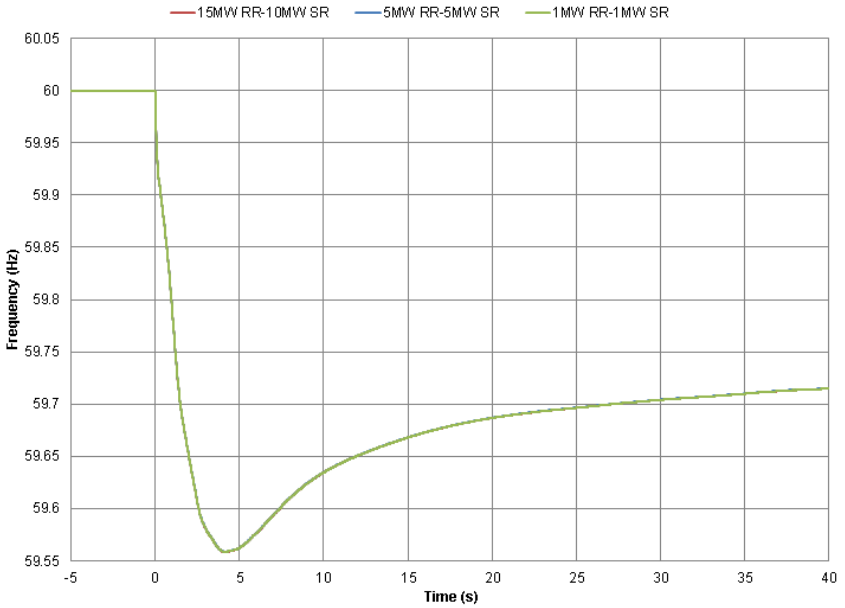
Minimum qualification & offer size

Frequency Response Comparison

Baseline



Smaller units



- Unit size does not intrinsically have an adverse effect on primary frequency response
- As shown above, the system can have essentially unchanged frequency response when SR & RR are provided by smaller generators, provided their governors are configured similarly to the larger units they displace

Minimum qualification & offer size

- The AESO shared in session 2 that it was initiating updates to directive practices
- This update will establish a priority for directives that ranks providers based on the time elapsed since their last directive
  - Time elapsed will only accrue when dispatched
- The update will also introduce the ability for system controllers to send directives to multiple assets with a single action
- System controllers retain final discretion and may override the priority in unforeseen circumstances
- This update is scheduled to be deployed by early October 2022

Minimum qualification & offer size

- Directive tolerance is currently specified over three time frames:
  - 0-10 minutes: Must reach the directive quantity.
  - 10-15 minutes: Must maintain response equal to or greater than the directive quantity.
  - 15 minutes onwards: For each 10-minute interval, average response must equal the directive volume plus or minus:
    - 5 MW for maximum capability of 200 MW or less; or
    - 10 MW for maximum capability of greater than 200 MW
- The current practice for directive tolerance beyond 15 minutes will not be effective for small assets
  - Tolerance is materially different just below or just above the 200 MW threshold

Minimum qualification & offer size

- Draft recommendation

Apply directive tolerance of 5% of maximum capability for assets with maximum capability <= 200 MW and 10 MW for assets with maximum capability > 200 MW

- Ensures effective response from small assets
- More consistent treatment of assets near the 200 MW threshold

Minimum qualification & offer size

Current Practice	AESO Proposed Alternative	Status
Minimum qualification sizes of 15 MW for RR, 10 MW for SR, and 5 MW for SUP	Minimum qualification size of 1 MW for all products	Final recommendation
Minimum offer size of 5 MW for all products	Minimum offer size of 1 MW for all products	Final recommendation
SCADA only required for assets >= 5 MW	SCADA required for all assets providing OR	Final recommendation
Dispatch tolerance of 1 MW for dispatch <= 20 MW and 5% for dispatch > 20 MW	Dispatch tolerance of 5% of dispatch volume for all assets	Final recommendation
Directive tolerance of 5 MW for asset MC <= 200 MW and 10 MW for asset MC > 200 MW	Directive tolerance of 5% of MC for asset MC <= 200 MW and 10 MW for asset MC > 200 MW	Draft recommendation

Discussion and Q&A

Break

Hourly procurement

Current practice

- The AESO procures reserves in four time blocks, as follows:
  - On peak means the period from 07:00 to 22:59:59
  - Off peak means the period from 00:00 to 06:59:59 and from 23:00 to 23:59:59
  - AM super peak means the period from 05:00 to 07:59:59
  - PM super peak means the period from 16:00 to 23:59:59 in November, December, and January and from 17:00 to 23:59:59 in all other months
- Only active RR are purchased for super peak blocks, while all reserves are procured for on peak and off peak blocks

AESO proposed alternative

- Move to hourly reserve procurement
  - May enable increased participation from new technologies such as energy storage

Hourly procurement

- The AESO solicited feedback on hourly procurement in session 2
  - Stakeholders were split between preferring block procurement and hourly procurement
- The nature of some stakeholder comments suggested that the AESO was not clear that hourly procurement would still be done on a day-ahead basis
  - Instead of hours being grouped in blocks, participants would submit separate offers for each hour in the day-ahead market
- Maximizing competition remains the focus of this initiative and is the best way to ensure efficient outcomes
  - The priority in deciding between hourly and block procurement is minimizing barriers to entry

Hourly procurement

- The AESO completed an hourly counterfactual analysis of procurement cost for contingency reserves
  - Volume requirements are already calculated on an hourly basis
  - Used operating reserve data from April 1, 2021 – March 31, 2022 to capture a full year of data with the most recent volumes
  - Estimated cost savings of $4.4M by moving to hourly procurement
    - Hourly approach allows for more flexible procurement which more closely follows actual load shape and system needs
- Regulating reserve analysis would be a more substantial undertaking as block definitions are integrated into the study process that determines volume
  - Savings would likely be smaller as the super peak blocks already allow for a more granular procurement shape
- The potential for cost savings with standby reserves is much smaller, as the activation price is only paid when the reserves are dispatched
  - Therefore, the AESO proposes to continue procuring standby reserves in on peak and off peak blocks

Hourly procurement

- The day-ahead auction format currently procures reserves two blocks at a time in 10-minute increments from 9:00 am through 10:10 am
- The AESO is seeking feedback on whether 10-minutes would still be sufficient to submit offers for each hour individually

Hourly procurement

Current Practice	AESO Proposed Alternative	Status
OR is procured day-ahead in AM super peak, PM super peak, on peak, and off peak blocks	Move to day-ahead procurement of hourly active reserves Retain day-ahead block procurement for standby reserves	Further feedback needed
Each OR auction procures for two blocks in a 10-minute window	Longer duration to accommodate more offers	Further feedback needed

Discussion and Q&A

Contingency reserve procurement

Current practice

- Spinning (SR) and supplemental (SUP) reserves are procured through separate sequential auctions
- BAL-002-WECC requires that the AESO hold a minimum of 50% of total contingency reserves (CR) as SR
  - The AESO currently procures 50% of CR as SR

AESO proposed alternative

- Carry uncleared SR volumes forward into the SUP procurement
  - Retain current sequential approach
  - SR offers that do not clear the market will be submitted into SUP auction
  - Participants may improve their position in SUP (increase volume, lower price)
  - Previous SR volumes that clear as SUP will be treated as SUP

Contingency reserve procurement

- We heard from stakeholders that:
  - Declining price inversions reduce the justification for this change
  - The mechanism would add considerable complexity to the market
  - Combined procurement may undermine the may-offer framework
- After considering stakeholder feedback along with the analysis presented in session 2, the AESO has decided to not pursue this change at this time

Discussion and Q&A

Standby reserve pricing

Current practice

- Standby reserves are procured to meet reserve requirements when the active portfolio is insufficient
- Market participants submit a premium and an activation price to Watt-Ex
- These prices are combined using the following blended price formula to determine which offers clear the market

Blended Price = Premium + (Activation % x Activation Price)

- The activation % is determined by the AESO
- Participants that clear the market are paid the premium and, if dispatched, the activation price on a pay-as-bid basis

Standby reserve pricing

- The AESO proposed two alternatives for pricing of standby reserves in session 2
- A supplementary document was published along with the stakeholder invitation on Aug 18, 2022
  - This document can be used to aid stakeholders in providing their feedback
  - https://www.aeso.ca/assets/LARA-Rules-and-ARS/OR-Market-Review-Standby-Pricing-Alternatives.pdf
- The AESO decided to propose a third alternative in response to stakeholder feedback, including:
  - More detail on how the premium price reflects costs of contracted standby reserves that have not been dispatched
  - Support for how two-part pricing reflects the economic fundamentals of standby reserves

Standby reserve pricing

- The following terminology will be used to refer to the different states of standby reserves
  - Participants that have entered into a contract by successfully selling standby reserves in the day ahead market will be referred to as **contracted**
  - When the AESO requires reserves from a contracted standby provider, it activates standby reserves by issuing a dispatch through the Automated Dispatch and Messaging System (ADaMS) and the provider is now **dispatched**
  - If the AESO requires real power from a dispatched provider of contingency reserves, it will issue a directive through ADaMS and the provider is now **directed**

Standby reserve pricing – Option 1

Single-part offers with only an activation price

- Offer: Activation price index
- Dispatch: Lowest to highest activation price index offer

Reserve Type	Contracted Payment	Dispatched Payment	Directed Payment
Contingency reserves (Spinning & Supplemental)	No payment for contracted standby reserves Participant may still participate in the energy market	Receive the uniform indexed activation price (activation price + pool price) per dispatched MW	Continue receiving the uniform indexed activation price (activation price + pool price) per dispatched MW Receive the pool price for the real power provided
Regulating Reserves	No payment for contracted standby reserves Participant may still participate in the energy market	Receive the uniform indexed activation price (activation price + pool price) per dispatched MW Receive the pool price for the real power provided	N/A

Standby reserve pricing – Option 2

Single-part offers with only a premium price

- Offer: Premium price
- Dispatch: Rotation between contracted providers

Reserve Type	Contracted Payment	Dispatched Payment	Directed Payment
Contingency reserves (Spinning & Supplemental)	Receive the uniform premium per contracted MW during the relevant time block Participant may still participate in the energy market	Continue receiving the uniform premium per contracted MW Receive the prevailing active reserve price (equilibrium price + pool price) per dispatched MW	Continue receiving the uniform premium per contracted MW Continue receiving the prevailing active reserve price (equilibrium price + pool price) per dispatched MW Receive the pool price for the real power provided
Regulating Reserves	Receive the uniform premium per contracted MW during the relevant time block Participant may still participate in the energy market	Continue receiving the uniform premium per contracted MW Receive the prevailing active reserve price (equilibrium price + pool price) per dispatched MW Receive the pool price for the real power provided	N/A

Standby reserve pricing – Option 3

Two-part offers with an indexed activation price

- Offer: Premium price and indexed activation price
- Dispatch: Lowest to highest activation price index

Reserve Type	Contracted Payment	Dispatched Payment	Directed Payment
Contingency reserves (Spinning & Supplemental)	Receive the pay-as-bid premium per contracted MW during the relevant time block Participant may still participate in the energy market	Continue receiving the pay-as-bid premium per contracted MW Receive the pay-as-bid indexed activation price (activation price + pool price) per dispatched MW	Continue receiving the pay-as-bid premium per contracted MW Continue receiving the pay-as-bid indexed activation price (activation price + pool price) per dispatched MW Receive the pool price or the real power provided
Regulating Reserves	Receive the pay-as-bid premium per contracted MW during the relevant time block Participant may still participate in the energy market	Continue receiving the pay-as-bid premium per contracted MW Receive the pay-as-bid indexed activation price (activation price + pool price) per dispatched MW Receive the pool price for the real power provided	N/A

Standby reserve pricing

- Under options 1 and 3, the recommended AESO bid offer caps of $150/MWh for RR and $50/MWh for SR and SUP would apply to standby activation index prices
  - Similarly, the effective price caps would be $1,150/MWh and $1,050/MWh respectively
- In options 2 and 3, the current premium price cap of $99/MWh would remain

Standby reserve pricing

Option	Pros	Cons
Option 1 – *Single-part pricing with only an activation price*	• Reduced complexity • Uniform pricing • Indexed activation price	• No opportunity for payment for contracted reserves
Option 2 – *Single-part pricing with only a premium price*	• Reduced complexity • Uniform pricing • Indexed activation price	• No flexibility in activation payment • Requires new dispatch order
Option 3 – *Two-part pricing with an indexed activation price*	• Most similar to current practice • Maximum offer flexibility • Indexed activation price	• Complex clearing mechanism • Pay-as-bid

Standby reserve pricing

- Some stakeholders asked for more information about pay-as-bid vs. uniform-price auctions

> "…pay-as-bid pricing causes profit maximizing suppliers to estimate the clearing price and bid as closely to the clearing price as possible… The result is as-bid supply schedules that are all very flat and close to the expected clearing price… Sometimes a low-cost supplier bids higher than a high-cost supplier, so that the high-cost supplier is asked to supply and the low-cost supplier is not. This happens because the supplier's bid has much to do with its guess about the clearing price and little to do with its cost… As a result, *dispatch inefficiencies are much more common under pay as-bid pricing than under uniform-pricing* [emphasis added]."

Cramton, Peter and Stoft, Steven. "Why We Need to Stick with Uniform-Price Auctions in Electricity Markets." *The Electricity Journal 20:1.* 2007. PDF pg 9.
https://www.econ.umd.edu/sites/www.econ.umd.edu/files/pubs/cramton-stoft-clearing-price-markets.pdf

Standby reserve pricing

Current Practice	AESO Proposed Alternative	Status
Two-part pricing with a premium and activation price	Option 1 – *Single-part pricing with only an activation price* Option 2 – *Single-part pricing with only a premium price* Option 3 – *Two-part pricing with an indexed activation price*	Further feedback needed
No offer cap for activation prices	Apply the recommended AESO bid offer caps of $150/MWh for RR and $50/MWh for CR	Further feedback needed

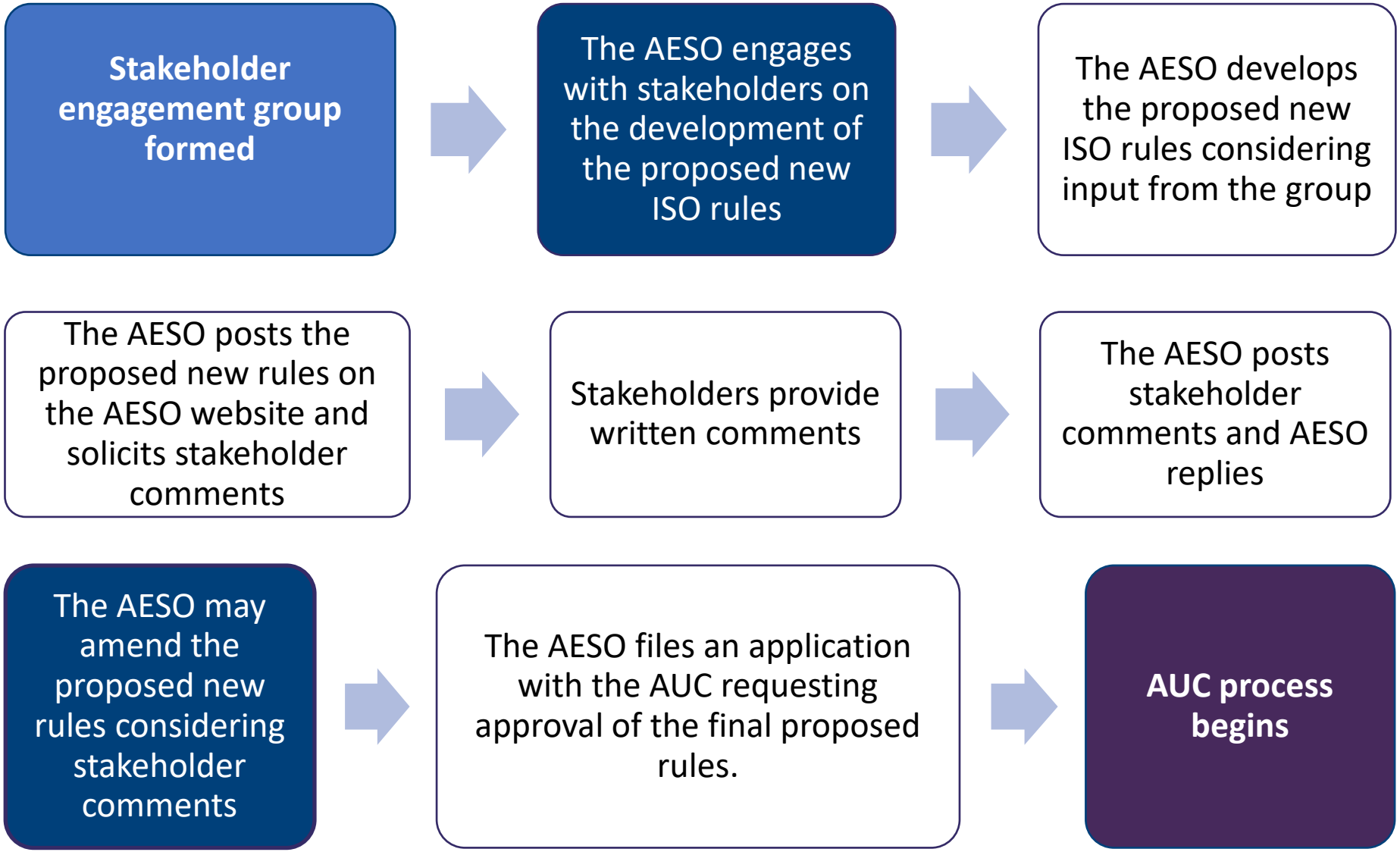
Discussion and Q&A

Next steps

Path forward

Session 1	Nov 30, 2021	• Background • Purpose and scope • Initial discussion of alternatives and considerations for group 1 design elements • Introduction of group 2 design elements
Session 2	Apr 7, 2022	• Continued discussion of group 1 design elements, including stakeholder feedback and initial recommendation • Initial discussion of alternatives and considerations for group 2 design elements
Session 3	Sep 8, 2022	• Share final recommendations for some design elements • Discuss where further feedback is needed to inform remaining recommendations
Session 3 feedback	Sep 30, 2022	Subject to change as initiative progresses
Initiate rule consultation	Q4 2022	
Application filing with AUC	Q1 2023	
Implementation	2022/2023	

ISO Rule Process



Implementation

- Implementation is currently scheduled through 2023
- The AESO estimates that the package of changes resulting from this initiative will have a total implementation cost under $1 million
- A more precise estimate will depend on the final design decisions and will require further collaboration with Watt-Ex

Thank you