

**Joint Stakeholder Engagement
Session on Energy Storage and
Distributed Energy Resources (DER)**

October 14, 2020

In accordance with its mandate to operate in the public interest, the AESO will be audio recording this session and making the session recording available to the general public at www.aeso.ca. The accessibility of these discussions is important to ensure the openness and transparency of this AESO process, and to facilitate the participation of stakeholders. Participation in this session is completely voluntary and subject to the terms of this notice.

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- The AESO's top priorities are the health and well-being of our employees and stakeholders and continuing to meet the electricity needs of all Albertans
- All business meetings with external stakeholders will be via phone or webinar indefinitely (this includes stakeholder engagement sessions)
- Based on stakeholder feedback, the AESO's own security assessment and the use of Zoom for governments, post-secondary institutions and other companies, the AESO has decided for now to continue using Zoom for our stakeholder engagements until such time that face-to-face engagements are allowed
- The AESO will continue to monitor developments and provide updates to our stakeholders as necessary
- For additional information, please visit the AESO website at www.aeso.ca and follow the path Stakeholder Engagement > COVID-19

How to Ask Questions

- All attendees join the webinar in listen-only mode and the host will have attendee cameras disabled and microphones muted
- When asking or typing in a question, please state
 - **The organization you work for and your first and last name**
- Two ways to ask questions if you are accessing the webinar using your computer or smartphone
 - If you would like to ask a question during the Q&A portion, click the icon to raise your hand and the host will see that you have raised your hand. The host will unmute your microphone, you in turn will need to unmute your microphone and then you can ask your question. Your name will appear on the screen but your camera will remain turned off.
 - You can also ask questions by typing them into the Q&A window. Click the “Q&A” button next to “Raise Hand.” You’re able to up-vote questions that have been already asked.

- Using a 2-in-1/PC/MAC Computer
 - Hover your cursor over the bottom area of the Zoom app and the Controls will appear.
 - Click “Raise Hand” and the host will be notified that you would like to ask a question.
 - Click “Lower Hand” to lower it if needed.
 - You can also ask questions by tapping the “Q&A” button and typing them in. You’re able to up-vote questions that have been already asked.
- Using a Smartphone
 - Tap “Raise Hand.” The host will be notified that you’ve raised your hand.
 - Tap “Lower Hand” to lower it if needed.
 - You can also ask questions by tapping the “Q&A” button and typing them in. You’re able to up-vote questions that have been already asked.

- If you are accessing the webinar via conference call
 - If you would like to ask a question during the Q&A portion, on your phone's dial pad, hit *9 and the host will see that you have raised your hand. The host will unmute your microphone, you in turn will need to unmute your microphone by hitting *6 and then you can ask your question. Your number will appear on the screen.
- Phone controls for attendees
 - To raise your hand, on your phone's dial pad, hit *9. The host will be notified that you've raised your hand.
 - To toggle between mute and unmute, on your phone's dial pad, hit *6.

- The participation of everyone here is critical to the engagement process. To ensure everyone has the opportunity to participate, we ask you to:
 - Listen to understand others' perspectives
 - Disagree respectfully
 - Balance airtime fairly
 - Keep an open mind

Welcome & Introductions

The background of the slide is a blue-tinted image of two hands shaking in a firm grip. The hands are positioned in the center-left of the frame. The background also features a faint, geometric network of lines and nodes, suggesting a digital or interconnected theme. The overall color palette is a range of blues, from light to dark.

OUR ENGAGEMENT PRINCIPLES

Inclusive and Accessible

Strategic and Coordinated

Transparent and Timely

Customized and Meaningful

Time	Agenda item
8:30 – 8:40	Welcome & Introduction
8:40 – 9:10	Energy Storage Roadmap Progress Update
9:10 – 9:40	DER Roadmap Progress Update
9:40 – 9:50	Break
9:50 – 11:05	<p>Review of Long-term Energy Storage Market Participation Options Paper</p> <ul style="list-style-type: none">• Review of issues and options presented in the Long-term Energy Storage Market Participation Options paper and provide an opportunity for stakeholders to ask clarifying questions prior to the written comment submission• Stakeholder questions throughout
11:05 – 12:25	<p>DER Market participation</p> <ul style="list-style-type: none">• Threshold and aggregation considerations• Seek input from stakeholders on issues identified for DER Markets participation and exploration of options to resolve• Stakeholder questions throughout
12:25 – 12:30	Closing Remarks

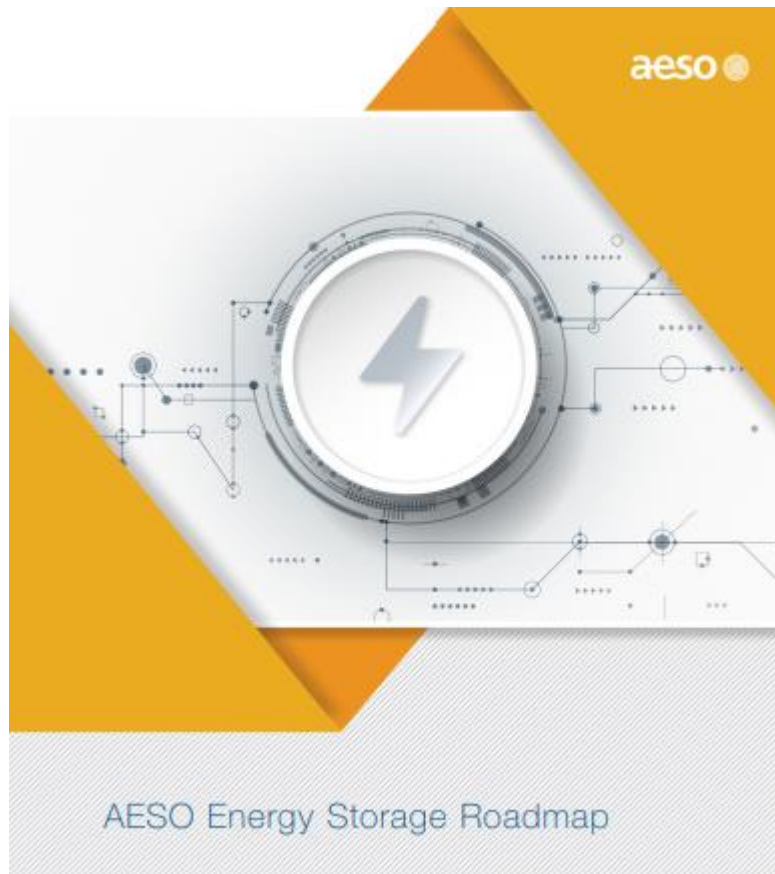
Energy Storage Update

Ata Rehman, Director, Grid Planning &
Operations Engineering

- Provide a quarterly progress update on energy storage activities:
 - Energy Storage Roadmap Overview
 - Share progress update on the Energy Storage Roadmap integration activities since July update;
 - Provide an update on activities planned for Q4 2020 and into 2021;
 - Provide an update on interrelated initiatives; and
 - Provide an opportunity for stakeholders to submit questions on the update information provided.

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Energy Storage Roadmap Update



- The AESO Energy Storage Roadmap sets out a plan to facilitate the integration of energy storage in Alberta.

What's new since July?

- First transmission-connected energy storage project:
 - ✓ TransAlta Summerview 2 successfully implemented Sept 10, 2020
- There are 10 projects currently on the connection list
 - ENMAX Crossfield
 - ATCO Rycroft
 - Fortis Alberta Buffalo Creek
 - Fortis Alberta Killarney Lake
 - EDTI DG Solar
 - ATCO Longspur
 - Fortis Alberta Metiskow
 - Fortis Alberta Burdett
 - TPG Canyon Creek
 - TCE Saddlebrook
- Two of these projects currently have in-service dates (ISDs) in 2020
 - ENMAX Crossfield
 - ATCO Rycroft

- Integration of Energy Storage into the AIES in the interim
- The project encompassed, but was not limited to, the following:
 - Current framework and resulting IDs
 - System Access Service Request (SASR) form updated to include ES
 - Active connections projects and configurations
 - Software solutions (EMS)

- ESILF first workshop held on Sept 18, 2020 with the attendance of majority of the members, Alberta Energy, Market Surveillance Administrator (MSA) and the Alberta Utilities Commission (AUC)
- Scope of the workshop included presentations from ESILF members on their expertise and experiences in the selected topics
- Workshop topics included:
 - Market opportunities in the energy and ancillary services markets, or other potential revenue streams
 - Connection options;
 - ES configuration options
- Presentations and summary of the workshop will be posted on www.aeso.ca

- Future workshop topics are as follows:
 - **Workshop 2:**
 - Sharing learnings from other jurisdictions on legislation, regulation and policy
 - Storage as a transmission alternative (or a distribution alternative)
 - Market qualification parameters, process, models and data (SCADA) requirements
 - **Workshop 3:**
 - Sharing of experiences in commissioning and testing of new technologies or configurations
 - Economic modelling
 - Process efficiencies within existing framework

Looking ahead

2020 Q3 → 2021 Q2 Plan – Timeline

Classification	ES Roadmap Integration Activities	2020 Q3			2020 Q4			2021 Q1			2021 Q2		
		J	A	S	O	N	D	J	F	M	A	M	J
Education and Awareness	ES Progress Updates – UPDATED Share progress on the Energy Storage (ES) Roadmap integration activities, interrelated initiatives as well as provide a forum to address stakeholder questions.	E			E			E			E		
	ES Industry Learnings Forum (ESILF) – UPDATED Organize forum to provide expertise and key learnings to the AESO on targeted matters related to the integration of energy storage in Alberta.			E		E			E			E	
Phase 1 Short-term Implementation	ISO Tariff Design – RESUMED Work in concert with ISO tariff design to ensure ES is considered.	Progress will align with Bulk and Regional Tariff Design											
Phase 2 Long-term Implementation	Forecasting, Planning and Market Reports Develop and implement forecasting and planning models to support Long-term Outlook (LTO) and Long-term Transmission Plan (LTP).	A						C					
	Configuration, Qualification and Connection Requirements Develop appropriate functional specification documents; identify market participation options, permissible configurations and metering requirements.	A	C						D				
	Market Participation Evaluate long-term options for energy storage participation in the Energy and Ancillary Service markets.	A		C, D						D			
	Operations Perform technical studies for the review of the operating parameters and requirements for the different types and configurations of ES; identify the impact to the connection processes and system applications to enable full range of ES operation.	A		C						D			
	Storage as a Transmission Alternative (SATA) Develop evaluation criteria and quantification of benefits of SATA as a non-wire solution; identify technical parameters and configurations, asset ownership and market participation options for SATA.	A	C						D				

- AESO cross-functional groups continue to work on:
 - Forecasting, planning and market reports
 - Configurations, market qualification and connection requirements
 - Market participation
 - Operations
 - Storage as a transmission alternative

- Integrate ES into the forecasting, planning and market reporting processes at the AESO
- Review of the Facility Modelling Data for ES was completed
- Reviewed the energy storage reporting practices for public facing market reports in other jurisdictions. Currently, reviewing reporting options with consideration for Fair, Efficient, and Openly Competitive (FEOC) regulation requirements
- Ongoing activities (priorities for Q4 2020)
 - Continue incorporating ES in the Long-term Outlook

- Reviewed potential configurations and determining associated connection and qualification options
- Establishing a consistent approach for technical considerations including:
 - modeling and studies, metering, qualification requirements to participate in markets and provide services, applicability of technical requirements
- Enabling the connection process for active ES projects
- Ongoing activities
 - Continuing to monitor active connection projects for learnings applicable to long-term recommendations
 - First ES project energized in September 2020
 - Establishing qualification and technical requirements for the energy and ancillary service markets
 - Determining technical requirements and ARS applicability

- AESO initiating stakeholder engagement on the long-term market participation
 - Market Participation Options Paper Released October 1st
 - The evaluation of the long-term energy market participation includes:
 - *Hybrid participation*
 - *Half-range energy offers versus full-range participation*
 - *Defining State of Charge*
 - *Commissioning requirements for storage*
 - AESO will be engaging stakeholders on Market Participation options and the draft recommendation; once the recommendation of ES Market Participation is finalized the process will shift to ISO Rule development process if required.

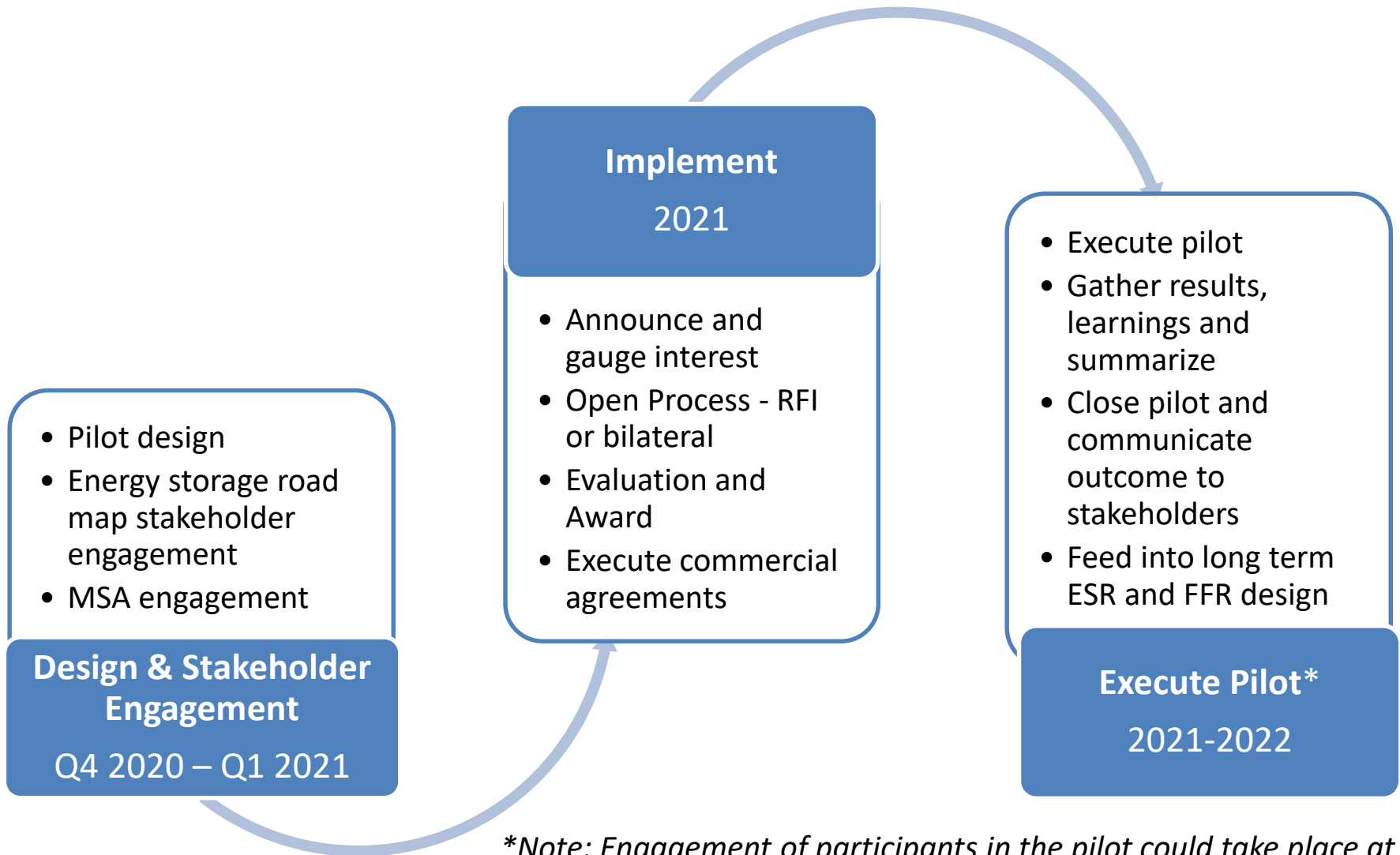
- Evaluate how ES assets can operate in the various markets to develop a framework to reflect various potential configurations in support of a reliable AIES
- Ongoing activities
 - Technical assessments on ES configurations and market participation options
 - Technical studies to understand ES performance capabilities and potential grid reliability impacts from ES participation in the long-term
 - Requirements for ancillary services (e.g., fast frequency response
 - LSSi, blackstart services)
 - SCADA requirements

- Ongoing activities
 - Review of policy, technical and economic assessments, market impacts, procurement, transmission planning process and associated requirements for regulatory processes related to SATA

- The AESO's long-term integration of ES will cover the development of recommended changes to AESO authoritative documents that capture the unique attributes of ES
- Technical studies and learnings from the short-term activities will feed into the long-term activities
- Tariff – all ES tariff-related activities will continue to be part of the Bulk and Regional Tariff Design

- Fast Frequency Response (FFR) is
 - A fast-acting transmission reliability service facilitating the arrest and recovery from frequency decay caused by the sudden loss of imports on the British Columbia / Montana interties
 - Designed to prevent under frequency load shed (UFLS) operation
 - Providers need to respond within 12 cycles (0.2 seconds) when a system frequency of 59.5 Hz is detected
 - Currently provided by load through Load Shed Service for imports (LSSi)

- The AESO is planning a technology pilot project targeted at any new technology that is capable of meeting the FFR technical requirements
 - Will be procured through an open process
 - Targeting 20-40 MW of capability from 1-3 service providers
 - Demonstrate and validate technical capability
 - Ability to participate in the energy and operating reserve markets and provide FFR
 - Requires alignment amongst the AESO, the service provider and the Market Surveillance Administrator (MSA)
 - Lessons learned will be publicly disseminated and will inform Long Term FFR design and the Energy Storage Road Map



**Note: Engagement of participants in the pilot could take place at different times based on the in service date of each facility*

Interrelated Initiatives Update

- AESO re-started engagement on Bulk & Regional Rate Redesign
 - Tariff treatment for energy storage remains in scope of this engagement

<https://www.aeso.ca/stakeholder-engagement/rules-standards-and-tariff/bulk-and-regional-tariff-design/>
- Further information on energy storage treatment options discussed at September 24th, 2020 session

<https://www.aeso.ca/assets/Uploads/Bulk-and-Regional-Tariff-Design-Session-2-Presentation.pdf>

Next Steps

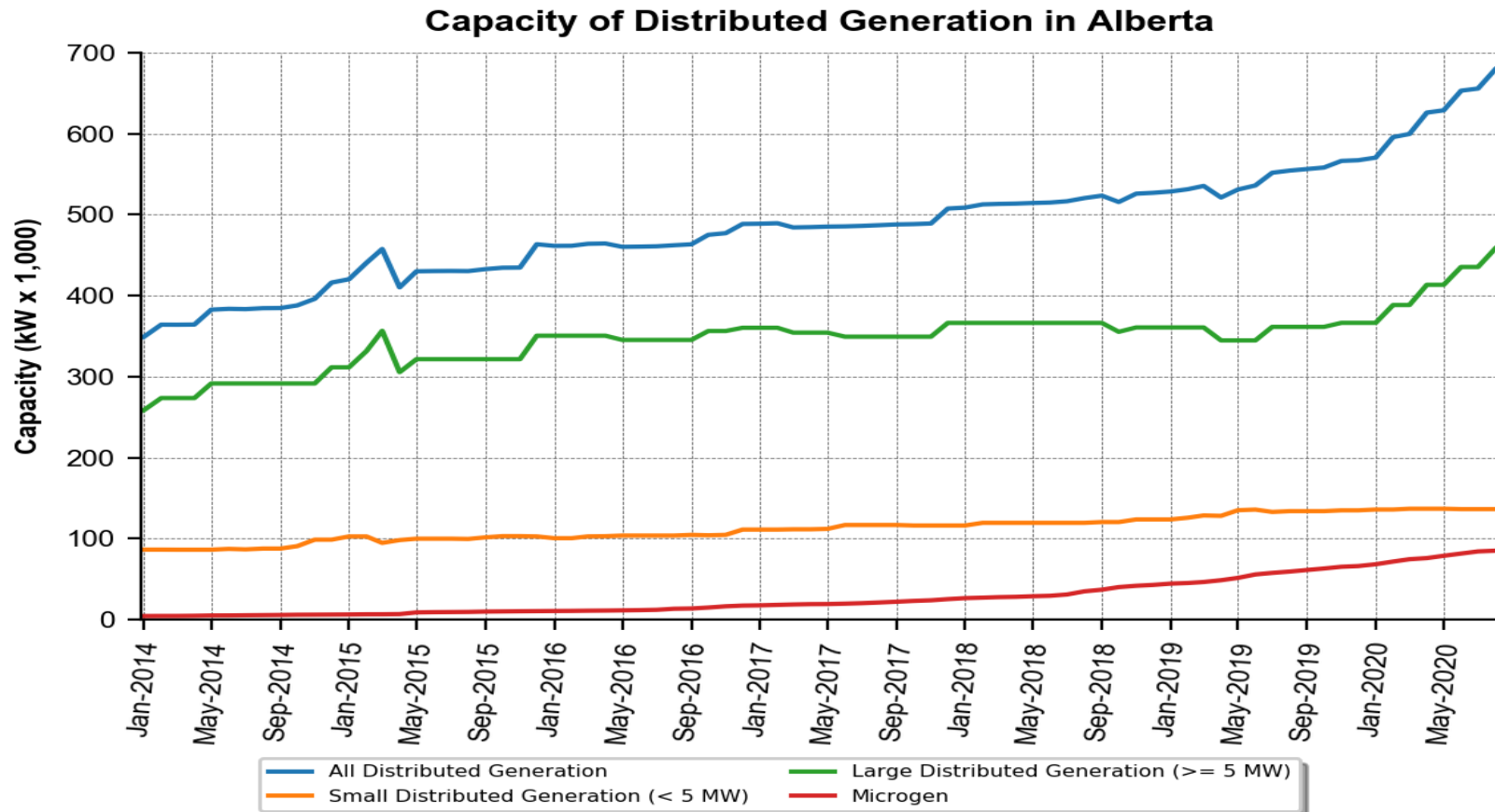
- If you have questions related to this update, please complete the comment matrix and email to EnergyStorage@aeso.ca with the subject *ES Q3 Update* by Oct 30, 2020
- ESILF workshop 2 planned for November 2020
- Next update session on Q4 progress planned for Q1 2021

DER Roadmap Update

Robert Davidson, Director, Customer Grid Access

- Provide overview of the AESO DER Roadmap and Integration Plan
- Provide summary of stakeholder feedback received
- Share progress on the priority DER integration activities
- Share AESO plan for prioritization of future DER integration activities
- Provide an opportunity for stakeholders to submit questions and provide feedback on the information shared

- DERs statistics at the end of August 2020



- June 2020 – Published AESO DER Roadmap
 - DER volumes are growing across the AIES, at different rates in different regions
 - April DERs = 625MW → Aug DERs = 679MW
- July 2020 – Published AESO DER integration activities
 - Provides further detail of activities for the next 12 months
 - Identifies when we plan to engage stakeholders
 - Quarterly update to industry aligned with the Energy Storage updates

- Energy Storage Roadmap
 - Energy Storage modeling
- Markets
 - Market participation thresholds and aggregation
- Tx/Dx Coordinated Planning
 - Alignment of AESO Transmission capability maps with DFO hosting capability
 - Coordination of the AESO's long-term transmission plans and system NIDs with DFO planning
- ISO Tariff
 - The AESO will progress ISO tariff-related changes that may impact DER through tariff design engagement
 - 2020-2021 Plan for ISO Tariff-Related Activities

- Majority of stakeholders are supportive and found the AESO DER Roadmap to be proactive, useful and informative
 - Improved system visibility, data, forecasting, modeling and planning
- Remain flexible / coordinated with outcomes from AUC Distribution System Inquiry, Energy Storage Roadmap and aligned with other market initiatives
- Desire for additional information regarding specific activities and engagement opportunities
- Request to expand DER to include DSMR
- Important to focus efforts and resources on areas that have the most impact on the transmission system

- Priority Activities
 - DER BTF Process
 - Frequency and voltage ride through
 - DER static data and SCADA data
 - 25kV bus and feeder impedance modeling activities
- Exploration Activities
- Prioritization Process

DER Integration Activities

Detailed DER Roadmap Integrated Plan

AESO Distributed Energy Resources Roadmap

ROADMAP ACTIONS

RELIABILITY

Connection process

AESO should perform a DER-focused Connection Process (specifically BTF) review

• DER BTF

Forecasting

DER forecast by technology

DER forecast separate from gross load and incorporate hourly variability

DER forecast will be geographically based down to the POD level

Near term/real-time forecast incorporate meteorological into DER and variable generation

DER forecast include DFO forecast knowledge

End-to-end forecasting process review from LTO to real time

Modeling

Energy storage model

DFO advancement in real time model

DER model directly connected at 25 KV bus

• 25kV bus and feeder impedance modeling

Assess feeder impedance to be included into models

Data

Define DER data and central database

• DER Static & SCADA Data

Define data sharing and transfer

Coordinated planning

Incorporate DER into transmission planning

Tx/Dx coordinated planning framework

Coordinated operations

Incorporate DER into net demand forecasting processes

Enhance real-time operator's supply/demand requirements and displays

Technical interconnection

Voltage and frequency ride through

• Voltage and Frequency Ride Through

UFLS program

Transmission and protection, island and black start

Cyber security

MARKETS

Market participation

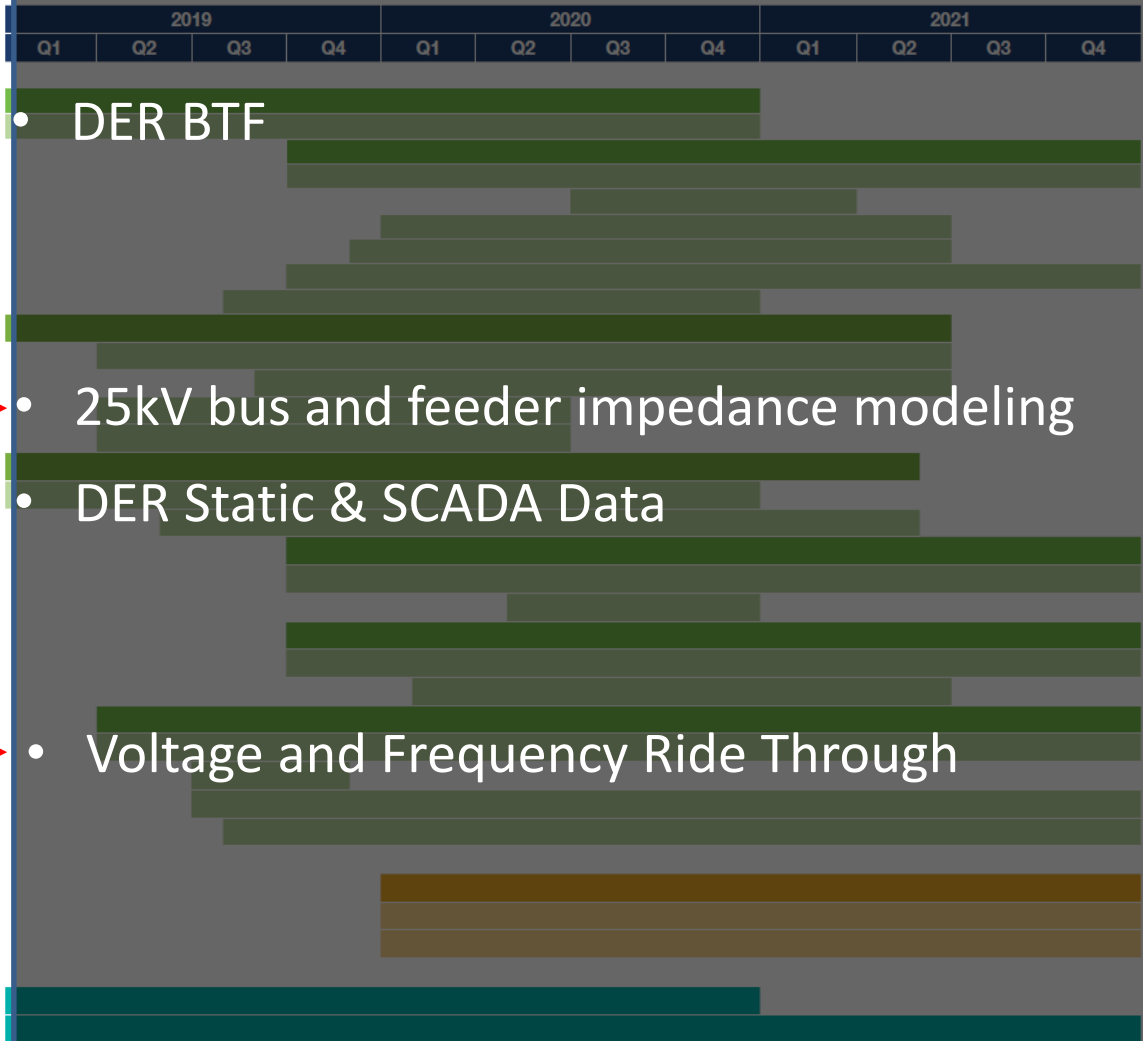
Review lowering the current market participation thresholds

Review options for further aggregation of DER resources

TARIFF

2018 GTA approval & implementation

Bulk & regional rate design



Priority DER Integration Activities

Frequency and Voltage Ride Through

- Current state:
 - Ride-Through is the capability of DER to remain connected during abnormal conditions
 - DFOs do not have Frequency Ride-Through (FRT) requirements for DERs
 - The majority of DFO do not have DER Voltage Ride-Through (VRT) requirements
- Future state:
 - Identify FRT and VRT requirements and implement in DFO interconnection requirements
- Progress Update and Next Steps
 - AESO has been working with DFOs and TFOs
 - Finalize AESO approach and path forward
 - Post AESO website Q4 2020

- Current state:
 - AESO receives limited DER static data from DFOs in PDFs format
 - Manual data entry from PDFs into spreadsheets by AESO
 - DER facility data is not kept up to date
- Future state:
 - Identify data points and implement a common electronic data transfer of static data from DFOs to AESO
- Progress Update and Next Steps
 - Finalizing DER static data points and post to AESO website Q4 2020
 - Exploration phase and engagement with DFOs for an electronic data transfer portal between DFOs and AESO

- Current state:
 - AESO SCADA Rule 501.4 applies to ≥ 5 MW
 - No SCADA rule or requirements for DERs < 5 MW
 - DER < 5 MW SCADA requirements are defined by DFOs
- Future state:
 - SCADA remains aligned with Market Participation level
- Progress Update and Next Steps
 - Exploration phase and engagement with DFOs for a low cost way to access data via DFO / AESO communication links

- Current state:
 - DER \geq 5MW submit project specific modelling data as part of AESOs Connection Process Project Data Update Package (PDUP)
 - DER $<$ 5MW no model data is provided to the AESO
- Future state:
 - Simplified process for selecting DER models (\geq 5MW)
 - AESO is to develop and publish generic typical models per technology
 - AESO will use static data to build appropriate aggregated models for DERs $<$ 5MW
- Progress Update and Next Steps
 - Update external documents

- Develop a DER activity prioritization process (external engagement)
 - Impact assessment matrix

IMPACT	High	Medium	High	High
	Medium	Low	Medium	High
	Low	Low	Low	Medium
		Low	Medium	High
		LIKELIHOOD		

- Publish the updated DER integration plan with prioritized activities

- If you have questions or comments related to this update, please send your feedback by email to stakeholderrelations@aeso.ca with the subject *DER Roadmap Update* by Oct 30, 2020

Break & poll

Energy Storage Market Participation

Long-term Energy Storage Implementation - Options Analysis

Steve Waller, Senior Market Advisor

Ruppa Louissaint, Manager, Market Implementation

- Provide an overview of the Energy Storage Long-term Market Participation Options Paper published on October 1, 2020 on www.aeso.ca
- Provide an opportunity for clarifying questions
- Discuss the issues and options to address them
 - Are there market participation issues the AESO did not address?
 - Are there options the AESO did not consider?



Transmission

Forecasting & Market Analytics
Transmission Planning
Transmission Engineering
& Standards
Transmission Connection



Markets

Market Design
Tariff Design
Operations Planning
& Engineering



Tools

Operations Systems
Grid & Market Operations
Finance & Settlement
IT Systems



Regulatory

Legal & Regulatory

Scope of the market design component of the markets pillar

- Market participation includes offer and dispatch requirements along with the corresponding reporting and compliance requirement, and treatment of AS within energy market participation
- Market participation is described within Part 200 of the ISO rules. Part 200 includes:
 - Submissions
 - Dispatching
 - Restatements
 - Dispatch Down Service
 - Ancillary Services
- Outage Notification Rules under Division 306 were also evaluated,
- Any associated glossary changes (CADG)

**Problem/
Opportunity
Identification**

**Options
Identification**

**Recommendation
and Rationale**

**Rule
Drafting**

Distribution System Inquiry

The current assumption is that DER and TCG will have consistent treatment in the market, and the energy market continues to extend into the distribution system for the dispatch and settlement of DERs.

Energy Storage

Self-supply and Export

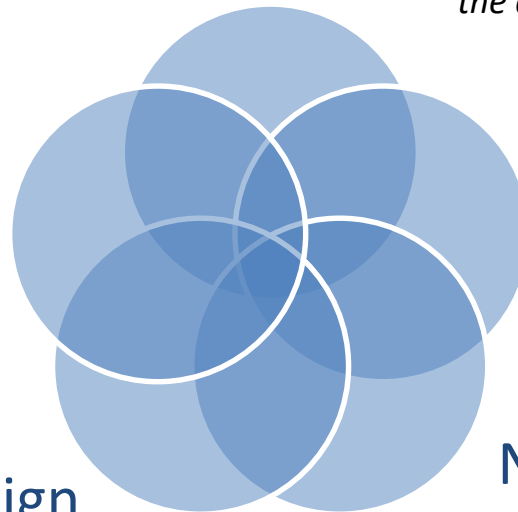
The current assumption is sites made up of solely a combination of generation and storage (no on-site end-use load) are not offside the regulatory framework regarding self-supply.

Tariff Re-design

The assumption is the rate designed applicable to storage will not result in conflicting behaviors caused by competing price signals

Non-Wire Solutions

The current assumption is storage will be a market asset that may provide non-wires solutions, rather than a regulated asset capable of participating in the energy and AS markets



- On June 19, 2020 the AESO released updated and newly developed series of information documents providing additional clarity in consideration of energy storage.
- Regarding market participation these information documents describe:
 - How storage will offer and be dispatched in the energy market
 - Storage treatment in the ancillary service markets
 - Acceptable operating reasons for restatement of energy offers considering the nature of storage and storage configurations
 - Stand-alone
 - In combination with other technologies

Long-term energy storage market participation solution

- The long-term solution must provide clarity for energy storage assets given their unique operating characteristics
 - Allow operators of these energy storage facilities to easily and clearly offer into and operate their assets in the markets.
 - Offers, bids, restatement and dispatch that support the operation of the facility.
 - Enable a coordinated ‘one ask’ approach that applies to all energy storage configuration versus a ‘case by case’ approach
- Support the AIES needs for reliability
 - Provide the AESO system controllers the necessary software applications to monitor and control these energy storage facilities in support of power delivery and balancing across the AIES
 - Allow operators of these energy storage facilities to offer into and operate their assets in the markets to support grid reliability.
 - Ability for inclusion in Ancillary Services provision
- Ensure the FEOC operation of the markets
 - Allow operators of these energy storage facilities to easily and clearly offer into and operate their assets in the markets in a FEOC manner.
 - Minimize the need to grandfather assets to existing rules.
 - Designing the rules to be as technology agnostic as possible

Design Principles	Rationale
Technology Agnostic	In order to facilitate FEOC principles the market treatment needs to be consistent across all participating technologies and applies to all storage applications
Minimizes Complexity	Strive for a simple elegant solution that is effective. Allow participants to intuitively submit bid and offer data into and operate their assets in the energy and ancillary services markets in a manner that supports the operation of the facility while at the same time provides a coordinated approach to the market rules. Complex designs lead to confusion and acts as a barrier to entry
Maximizes Participation	Maximizing participation in the market improves competition, and price fidelity
Participation Flexibility	Allow some flexibility to how the asset can best participate given its technical configuration in order to remove barriers to entry and prevent overly constraining rules while maintaining the FEOC principles
Dispatch-ability	Reduce the variability in delivered volumes resulting from System Controller dispatch. The design should give the system controller the ability to monitor and control energy storage facilities in support of power delivery and balancing across the AES
No Grandfathering required	The solution should avoid the need to grandfather existing assets as much as possible

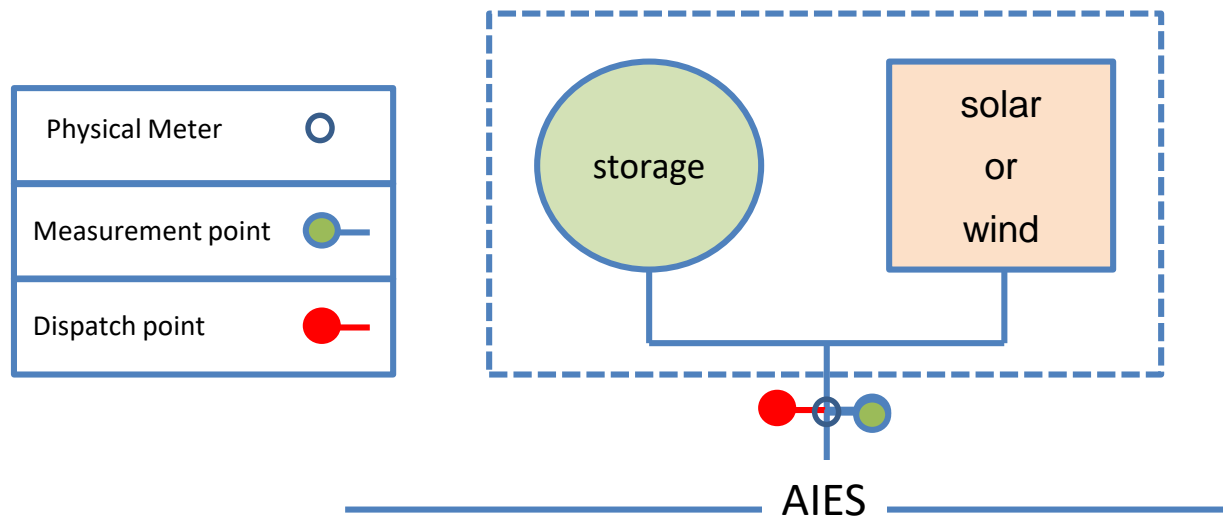
Using these principles the AESO is able to assess the validity of the design options.

1. Variable Energy Resource (VER) (wind or solar) + Storage Hybrid participation – assess issues caused by VER + S aggregation as a single market asset and possible implementation options – How can the issues be addressed?
2. Energy offer submissions – Maintain half range or implement full range.
3. No clear definition of “state of charge” and how state of charge will be considered in dispatch and for restatement of energy market offers
4. Current commissioning rules were designed for generators or loads and don’t consider need to commission across the full range of the resource.

- Any questions regarding the scope of work?
- Are there additional issues related to market participation that were not addressed in the options paper?
- There will be an opportunity for clarifying questions specific to each issue later in the session.

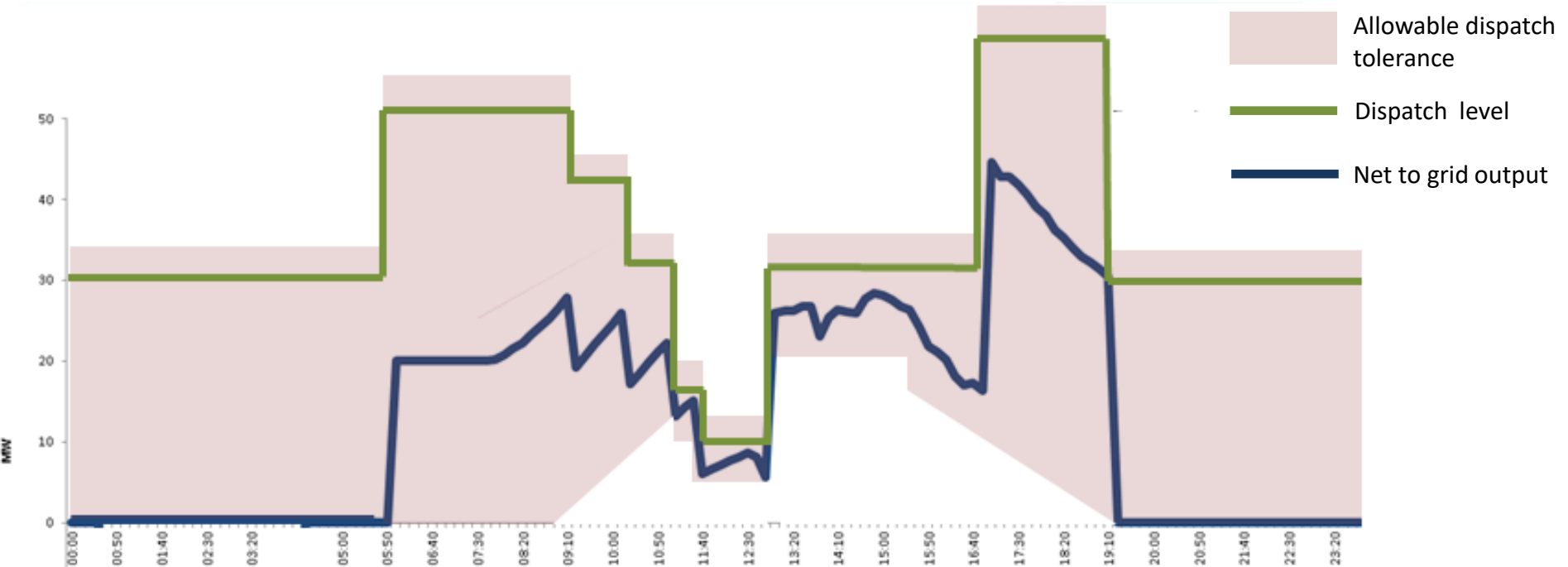
- Within the current market design there are two possible market configurations for facilities that have multiple generators on a single site:
 - a) Define a source asset for each on-site generator that participates independently
 - b) Define a single market asset that participates as an aggregate (often called net-to-grid)
- Typically “like” generation technologies are combined to a single asset, i.e. multiple gas fired generators
- Storage technology installed alongside other generation technologies has introduced the concept of a hybrid source asset made up of different technologies and the possible need for participation rules specific to this configuration

- VER+S Hybrid participation means an aggregation of variable energy resources (VER) with storage participating in the electricity markets as a single asset



- This configuration presents additional challenges when comparing dispatch levels to actual flows as shown in the following example

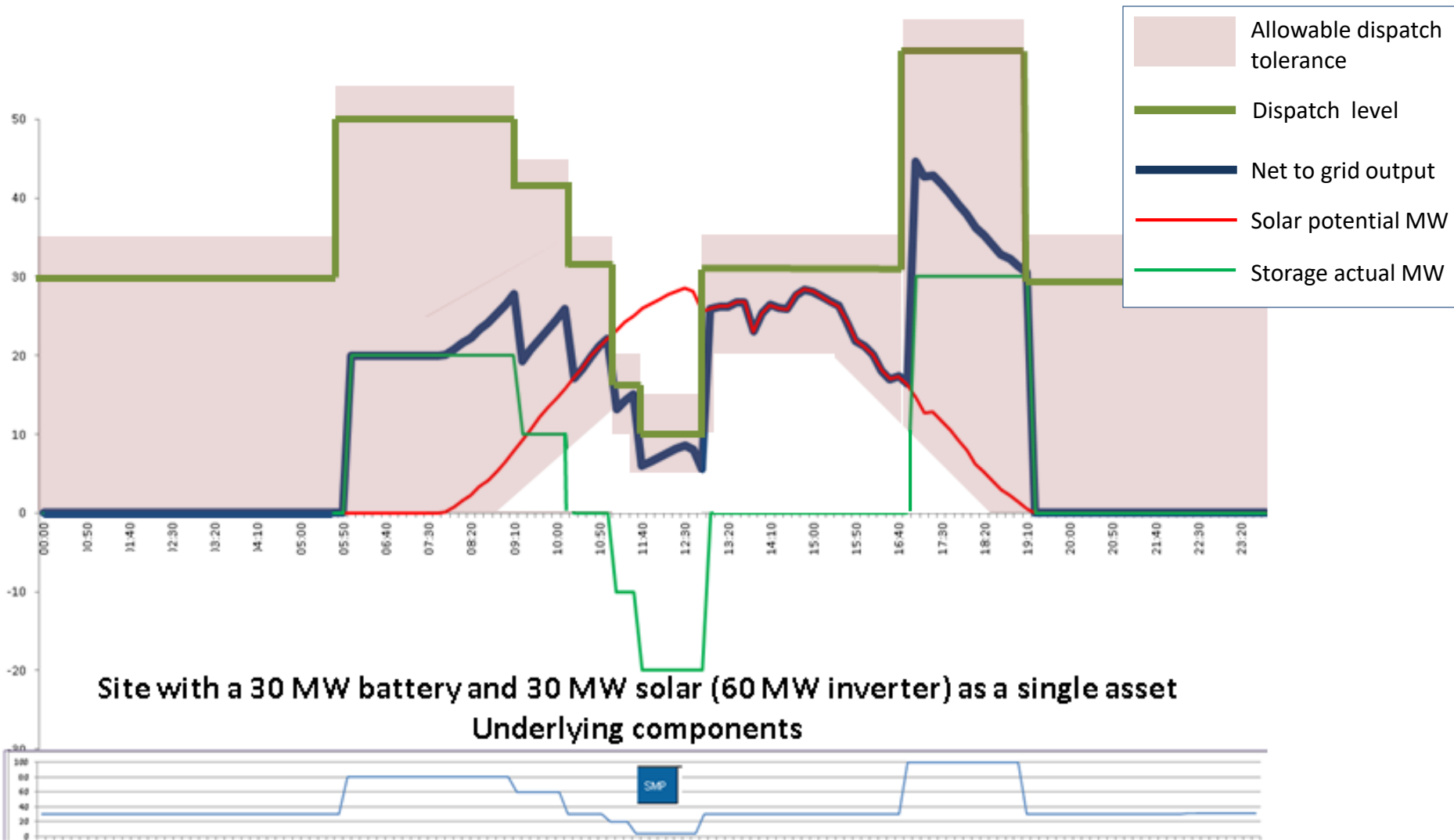
Example: VER+S hybrid dispatch concern



Site with a 30 MW battery and 30 MW solar (60 MW inverter) as a single asset



Example: VER+S hybrid dispatch concern



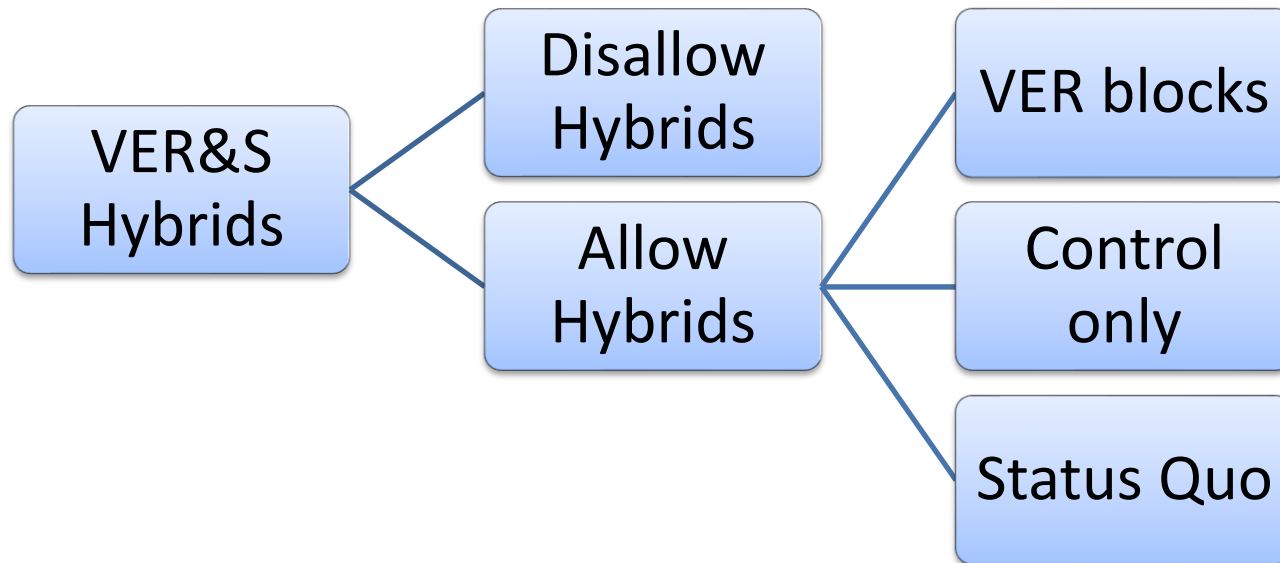
Arguments for disallowing VER+S hybrids:

- FERC 841 requires all storage be independently metered – disallows hybrid participation
- Efficiently resolves dispatch response variability by separating the controllable resource from the non-controllable resource

Arguments for allowing VER+S hybrids:

- Limits allowable storage applications as some hybrid configurations would be difficult to meter independently
- There are mechanisms that the AESO could put in place to resolve the dispatch response variability without restricting configurations (cost and complexity)

VER & Storage Hybrid design decision tree



- VER block volume - Add additional information within the offer indicating the volume of Variable Energy Resource energy within each block MW of the offer;
- Controllable-only Participation – Offers are only submitted for the storage component of the hybrid asset. Wind and solar output is assumed to be at the offer price floor (\$0/MWh);
- Status Quo – Allow the participant to choose whether the hybrid asset is to be considered a Generating Unit or a Wind or Solar Aggregated Generating Facility that continues to permit a large dispatch variance.

- Was the issue clearly articulated?
- Are there other alternatives the AESO did not consider for addressing the issue?
- Any additional considerations to add?

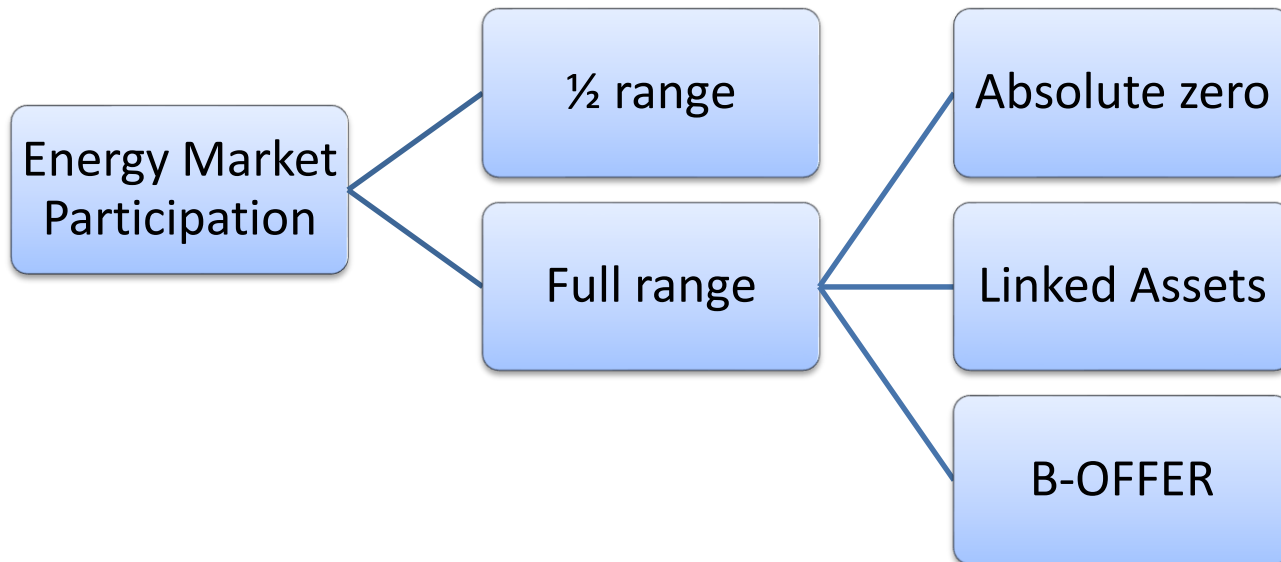
2) Full range vs ½ range participation

- In the ½ range option only the discharge capacity participates in the energy market
- With full range participation the charge and discharge capability participates
 - Rules enhanced to include bidding requirement for storage
- There are pros and cons with either option

Full-range vs. 1/2 range

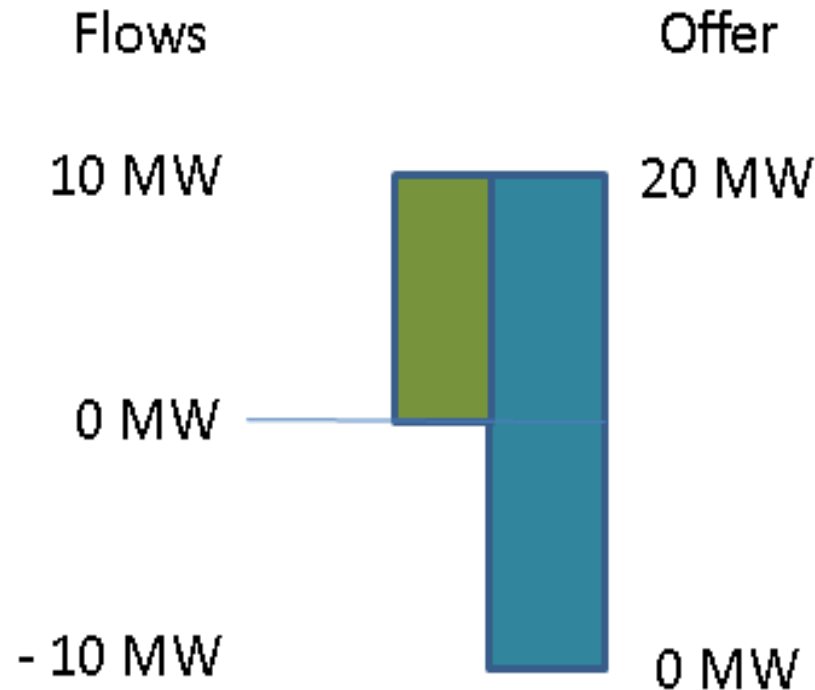
	Full Range participation	1/2 Range participation
Market	<ul style="list-style-type: none">• Able to distinguish physical withholding with economic bidding• Allows better price fidelity and forecasting	<ul style="list-style-type: none">• No rule changes, simple• Minimal IT system changes
Reliability	<ul style="list-style-type: none">• Reduces net demand variability• System Controller has full control of the asset<ul style="list-style-type: none">• No large dispatch deltas• Allowable dispatch variance applies to full range	<ul style="list-style-type: none">• Full range Operating Reserve operation still allowed
Participation	<ul style="list-style-type: none">• Provides charging signals through dispatch	<ul style="list-style-type: none">• No participation requirements for charging<ul style="list-style-type: none">• No compliance for charging• No must-bid requirement

Note: Participation rules only apply to assets over 5 MW maximum capability



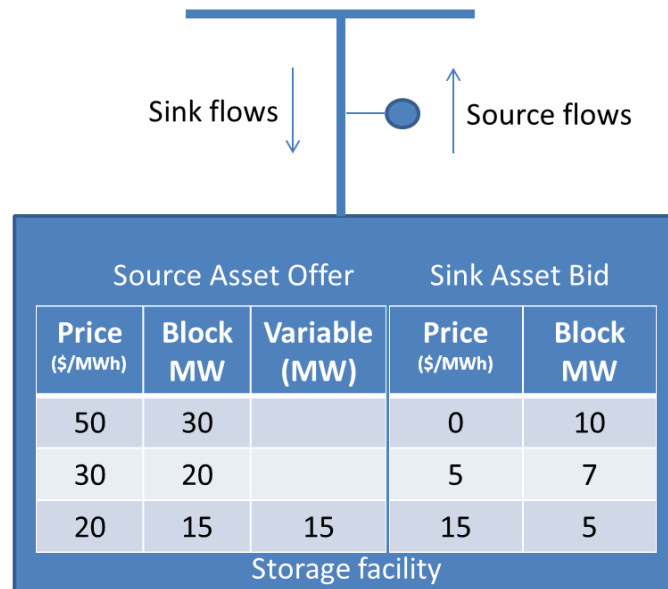
Participation Option 1 – Absolute Zero

- This submission structure is simply to convert the entire range of operation to a positive value offer.



Participation Option 2 – Linked assets

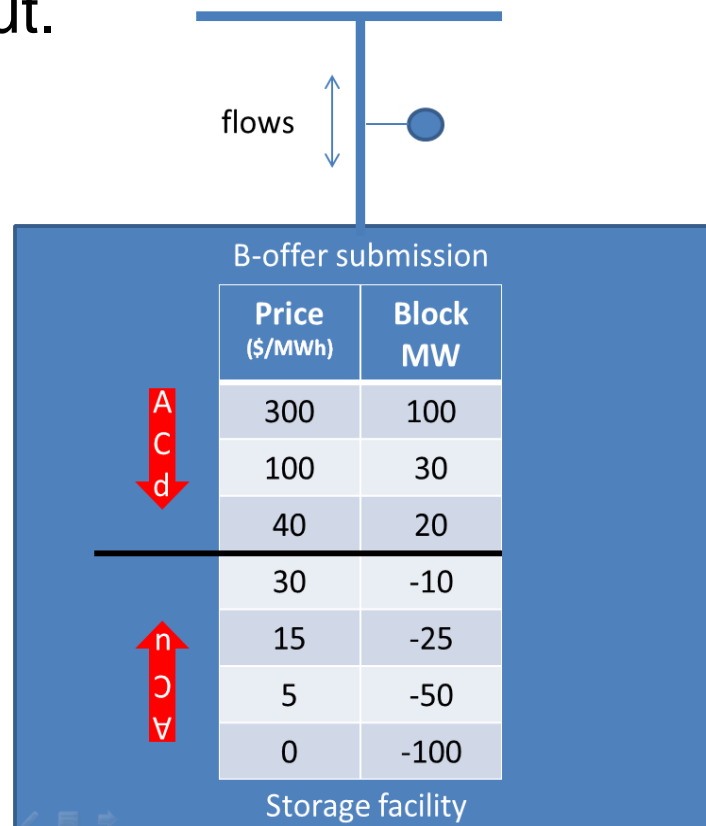
- This implementation option leverages the current source and sink asset model to integrate storage. A source asset is created to offer energy exports from the storage asset to the grid and a sink asset is used to bid any energy imports to the storage asset due to charging.



- 15 MW wind farm with a 15 MW storage
- Participant chooses the hybrid asset configuration
 - One source asset representing the combined wind/storage export (30 MW), and;
 - one sink asset representing the grid charging requirement (10 MW)

Participation Option 3 – B-OFFER

- Submission of a combined bid/offer for the entire range of the facility that does not require the conversion factor when translating between the submission and the expected net-to-grid output.



100 MW storage (stand-alone)

- Must Boffer/Must Comply applies to the asset
- Only the new asset type is permitted to offer this way
- Available capability top down (ACd) and Available capability bottom up (ACu) required to allow for derates
- If SOC is 100% may restate ACu to zero
- If SOC is 0% may restate ACd to zero

Full range vs ½ range participation

Comments and questions?

- Was the issue clearly articulated?
- Are there other alternatives the AESO did not consider for addressing the issue?
- Any additional considerations to add?

3) State of charge

- The introduction of storage introduces new terminology related to storage devices. State of charge is one such term.
- This term will likely show up in the market rules with respect to acceptable operating reasons for restatements and will need to be formally defined.
- Real-time visibility for state of charge is currently included as a connection requirement.
- Should state of charge be made transparent to all participants?

4) Commissioning requirements for storage

- Current commissioning rules were designed for generators or loads and don't consider the need to commission across the full range of the resource.
 - Rule 203.6 sub 5 doesn't permit multiple offer or bid blocks while commissioning
 - In order to test charging capability and remain in compliance with ISO rules, the asset owner must put the asset out-of-merit in order to discharge under the current ½ range participation model.
 - Current commissioning rules only allow energy be submitted under a single \$0 block. There is no ability to put the asset out of merit with the current rules.
 - Energy Storage assets need to use prices and economic withholding in order to charge while commissioning

Next steps for long-term storage market participation

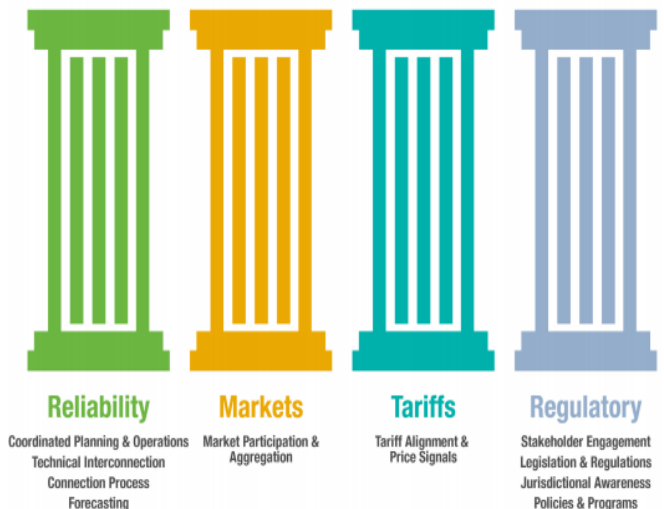
Timeline	Step
Oct 30, 2020	<ul style="list-style-type: none">• Stakeholder comments on options paper due
Nov/Dec 2020	<ul style="list-style-type: none">• AESO to consider written feedback• Host further engagements as necessary• Develop draft recommendation
Jan 2021	<ul style="list-style-type: none">• Release long term energy storage market participation draft recommendation• Stakeholder session on Long term energy storage market participation draft recommendation• Stakeholders have the opportunity to ask clarifying questions on the draft recommendation prior to submitting written comments• Stakeholders to provide written comments• AESO to consider stakeholder feedback to finalize recommendations
Q1, 2021	<ul style="list-style-type: none">• Initiate development of draft rules (if recommended) in coordination with the Energy Storage Roadmap

Distributed Energy Resources Market Participation

Darren Gogol, Senior Market Implementation Analyst
Ruppa Louissaint, Manager, Market Implementation

- DER Roadmap
 - The DER Roadmap integrated plan (June 2020) was created to enable the AESO to help proactively lead the industry forward with DER integration as DER penetration in Alberta grows.
 - The Markets pillar will focus on the review of the current market participation thresholds in the energy and operating reserve market, options for further aggregation of DER, as well as any other market-related matters that arise.
 - Any changes to market rules identified will be consulted on as part of the AESO's market initiatives.

DISTRIBUTED ENERGY RESOURCE



Facilitate DER access, without undue burden, to AESO administered electricity markets, by removing barriers to entry while ensuring fair, efficient, open and competitive markets, specifically:

Market Participation

- *Energy Market* - Review of current MOMC threshold of 5MW
- *Operating Reserves Market* – Review of current asset participation threshold levels

Aggregation

- How can the AESO enable aggregation to meet minimum size participation thresholds?

- In Scope:
 - Identify barriers to entry for market participation for small DER (<5 MW), if any, in the energy and operating reserves market
 - Review current DER connected to the AIES considering market participation
 - Review minimum size threshold of 5MW, and assess whether it should be maintained or lowered
 - Consider opportunities for increased DER aggregation
 - Obtain stakeholder input on the above, including the exploration of options

- Out of Scope:
 - Other DER roadmap integration activities (data gathering, forecasting, modelling, coordinated planning, operations, technical interconnection requirements, and the tariff)
 - Other market related initiatives (energy storage long term market participation, dispatch tolerance, ramp table submissions, mothball rule review, sub-hourly settlement, price cap)

- Distributed Energy Resources (DER):
 - From the AESO’s perspective, the concept of DER includes any distribution-connected resource that can potentially supply energy onto the AIES. This includes resources such as residential solar panels, EVs, home battery storage, distribution-connected generation, or distribution-connected energy storage of any type– *AESO Distributed Energy Resources (DER) Roadmap June 2020*
- Small Distribution Connected Generation (DCG):
 - For the purpose of this review: Small DCG refers to small generating units and facilities up to 5MWs that may be capable of actively participating in AESO administered markets, specifically the energy and operating reserve markets
 - DCG 5MW and greater already participate in the market and are not the focus of this review

Small generation (<5MWs) classification

Type	Size	Compensation	Notes
Small micro-generation (renewable or alternative energy)	<150KW	Rate the service provider charges for energy supplied to the site	
Large micro-generation (renewable or alternative energy)	>150KW to <5MW	Hourly pool price	
Small scale generation (as defined by Small Scale Generation Regulation)	Less than distribution system hosting capacity at the interconnection point	Hourly pool price	Balancing Pool is the market participant (unless producer requests otherwise); deemed to have standing offer of zero dollars
Other (not covered by Micro-Generation Regulation and Small Scale Generation)	<5MW	Hourly pool price for net to grid generation	

The following principles are considered throughout this review:

- **Market Efficiency**
 - Competition - Can small DCG participate and increase competition?
 - Price Fidelity – What is the impact to price from increased competition from small DCG?
- **Cost**
 - Does the benefit of increased market participation out weigh the cost of compliance for small DCG?

Small Generation & the Energy Market

Section 203.1 Offers and Bids for Energy

Obligation to Offer and Offer Content

3(1) A **pool participant** must, for each **settlement interval**, submit an **offer** for each of its **source assets** with a **maximum capability** of five (5) MW or greater.

(2) A **pool participant** must not, notwithstanding subsection 3(1), submit an **offer** for:

- (a) any of its **source assets** with a **maximum capability** of less than five (5) MW; and
- (b) capacity that is committed under a contract for **long term adequacy**.

- Generation 5MW or greater is under Must Offer Must Comply (MOMC) meaning they must submit offers into the power pool and comply with all associated rules, including but not limited to dispatch compliance, outage scheduling, operational testing, and event reporting
- Generation with an MC below 5MW are not permitted to submit offers into the energy market. These generators receive pool price (or credit) but are not able to set pool price

The AESO energy market has two informal “participation” models:

Direct/Active Participation:

- All generation above 5MW (net to grid) is required to submit bids and offers into the energy market. This is commonly known as Must-Offer-Must-Comply (MOMC).

Indirect/Passive Participation:

- Small generation below 5MW are not permitted to submit energy market offers. The MOMC obligation does not apply. Participation is through registration and settlement only.

1. Require energy market participation through changes to ISO rules
 - Should the AESO lower the current MOMC 5MW threshold, to what value? 1MW?
 - Can and would these assets compete in the energy market?
 - What effect would increased competition from these assets have on the market?
 - Would the incremental cost and requirements for these assets be manageable?

2. Remove the <5MW restriction by allowing voluntary participation
 - Should the AESO allow small DCG to participate in the energy market?
 - Do small DCG want to participate?

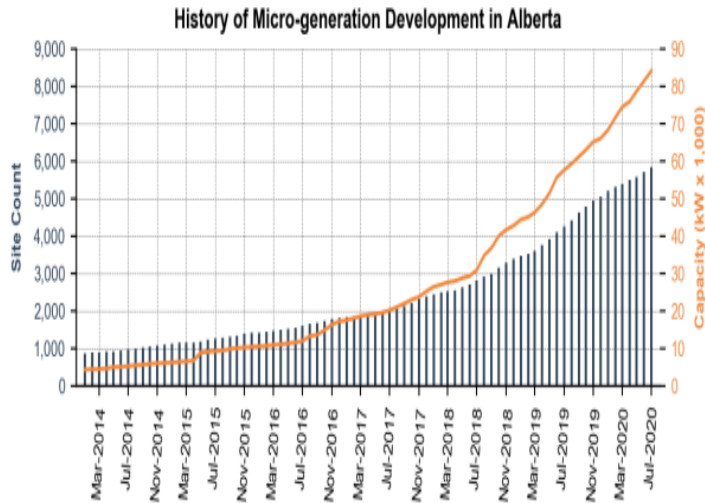
3. Status Quo
 - Is the current energy market framework sufficient for small DCG?

Current inventory of small generation in AB

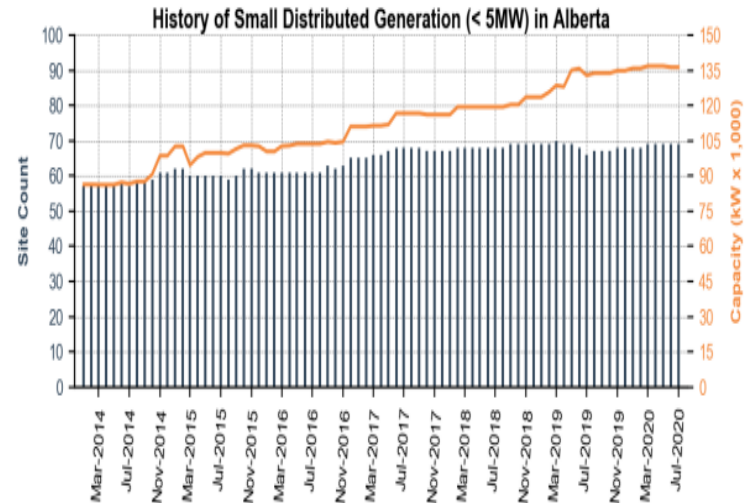
- DCG above 5MW are excluded
- Of the ~220MW total installed capacity:
 - ~135MW (~61%) are renewable energy including both Microgen and DCG
 - ~62MW (~28%) are traditional “controllable” gas excluding cogeneration

July-2020	Micro-generation		Distributed Generation		Total	
	Number of Sites	Installed Capacity (kW)	Number of Sites	Installed Capacity (kW)	Number of Sites	Installed Capacity (kW)
Biomass	1	1,692	6	13,453	7	15,145
Gas	5	382	24	61,705	29	62,087
Gas Cogen	6	1,098	6	18,280	12	19,378
Hydro	1	73	5	9,400	6	9,473
Other	12	1,340	2	2,065	14	3,405
Solar	5,724	77,842	1	990	5,725	78,832
Solar/Wind	34	284	0	0	34	284
Wind	55	1,359	25	30,425	80	31,784
Total	5,838	84,069	69	136,318	5,907	220,387

Micro-generation & Small distributed generation – Historical growth 2014-2020

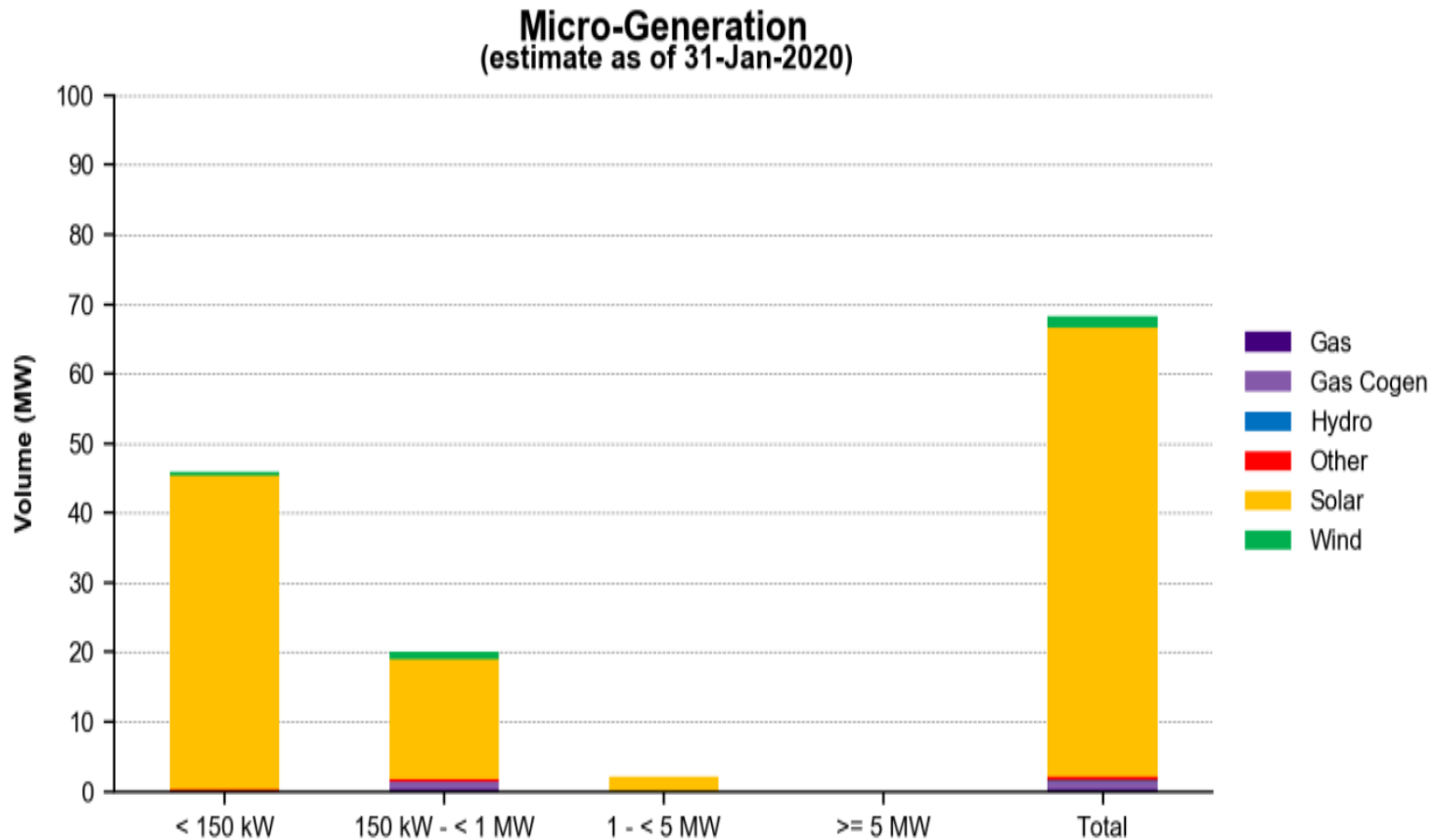


- Growth of micro-generation (renewable) has outpaced non-renewable DCG for past 6 years

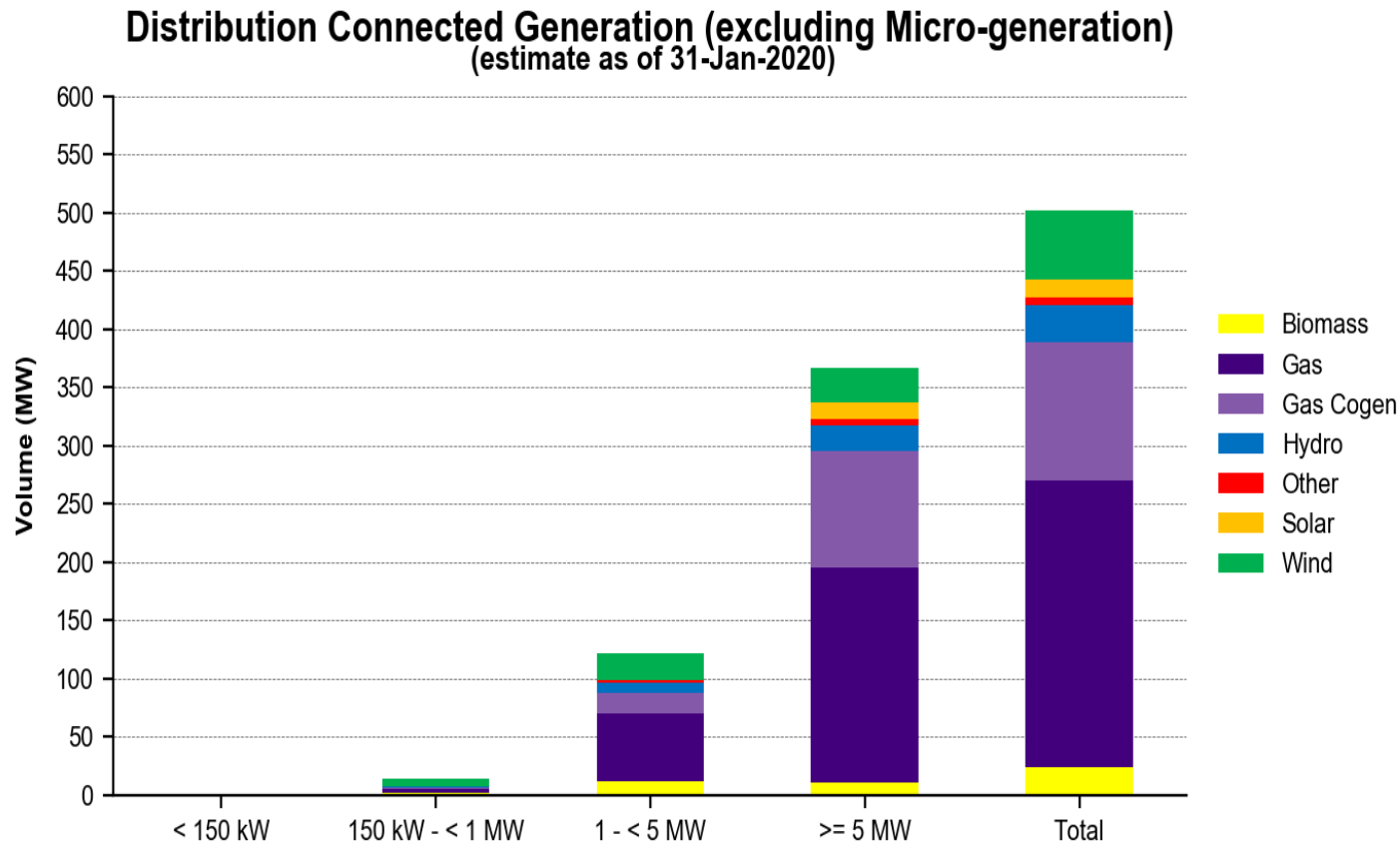


- Small DCG growth moderate however installed capacity steadily increasing faster than site count indicating generators are getting larger

- The majority of micro-generation is solar generation
- The vast majority of solar installations are less than 1MW



- The majority of DCG between 1MW and 5MW are fueled solely by natural gas (~62MW)



Growth rates by asset type and asset size for small DER in Alberta (<5MW 2015-2019)

- The highest growth rates by asset type over the past 5 years is Solar and other renewables
- The majority of growth by asset size has been in 1MW generation and smaller

Asset Type	2015	2016	2017	2018	2019
Biomass	4.8%	-4.8%	0.0%	-31.9%	0.0%
Gas	-4.1%	9.1%	0.6%	3.7%	-1.3%
Gas Cogen	23.2%	2.2%	1.3%	3.4%	11.1%
Hydro	0.0%	2.2%	0.0%	0.0%	39.4%
Other	0.0%	-25.8%	0.0%	0.0%	3.4%
Solar	75.1%	68.4%	129.4%	44.8%	38.3%
Wind	93.1%	-1.0%	-8.7%	1.3%	1.4%

Asset Size	2015	2016	2017	2018	2019
< 150 kW	38.3%	53.9%	52.2%	67.6%	59.0%
150 kW - < 1 MW	15.9%	86.8%	13.2%	26.4%	25.3%
1 - < 5 MW	5.5%	3.1%	4.8%	7.8%	10.0%
>= 5 MW	12.5%	2.8%	1.7%	-1.5%	1.6%

- Most growth in small DER is coming from intermittent renewable energy
 - Deemed \$0 offer
 - By site count, of small DCG and Micro-gen, solar is the fastest growing energy type, with an asset size of <1MW accounting for more than 80% of the growth (2015-2019)
 - Energy generally shows up as negative load
- There appears to be ~60+MW of “controllable” distribution-connected gas generation (excluding ~18MW of co-gen)

- The AESO is considering changing the energy market participation threshold to promote:
 - Integration of new technologies into the Market: signal to investors the long-term treatment of this growing technology in Alberta's market
 - Market Efficiency & Price Fidelity: enable small DCG to offer to guide their efficient dispatch and potentially influence pool price
 - Market Visibility: provide market with greater visibility of the small DCG availability & operation
 - Increased Competition: a greater amount of priced supply in the market with equal delivery requirements

Jurisdictional review – DER market participation size

- As a result of FERC Order 841 and 2222, RTOs/ISOs across America are generally working, where possible, to reduce minimum size requirements across energy, capacity, and ancillary service markets. Below is a brief representation of the varied requirements across select US markets:

Energy Market	PJM	CAISO	NYISO	NEISO	AESO
Non-Aggregated Minimum Size Requirement(s)	100KW	100KW	100KW	5MW must offer; if connected to TX system must offer Smaller units on Distribution System – Optional / settlement only	5mw min size requirement. Units >5MW must offer

Note:

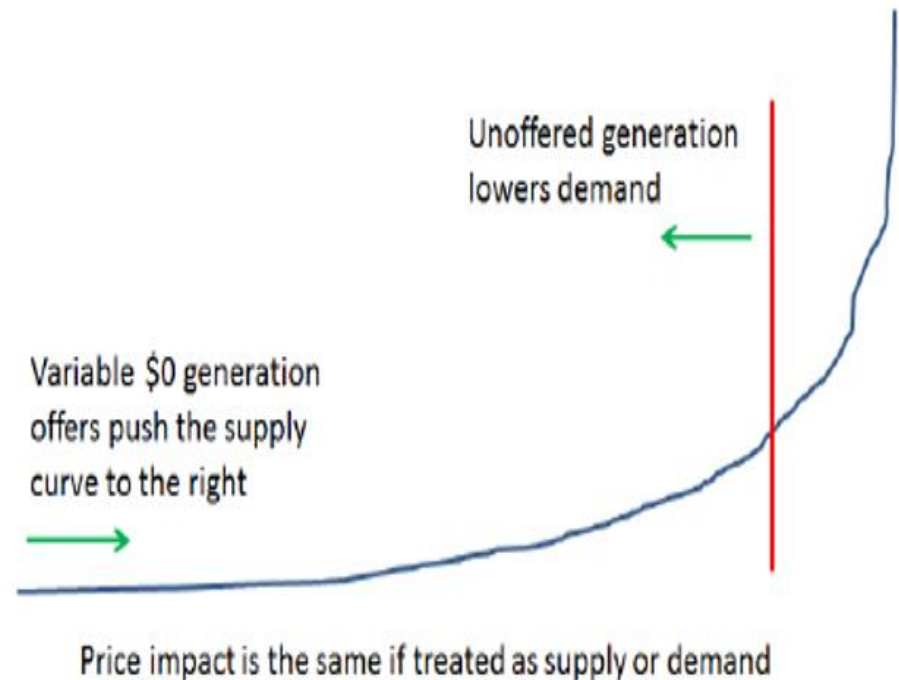
- Not all compliance filings with FERC have been approved yet
- Most US ISO's have some form of day-ahead commitment or obligation, and as such if you have an obligation you are required to submit an offer
- For example, CAISO requires all generators at or above 1 MW to be fully available to the wholesale market; however, they are not required to bid into the market unless they have a commitment. Small units, even if not participating in market, must respond to manual directives/dispatches if so ordered by CAISO.

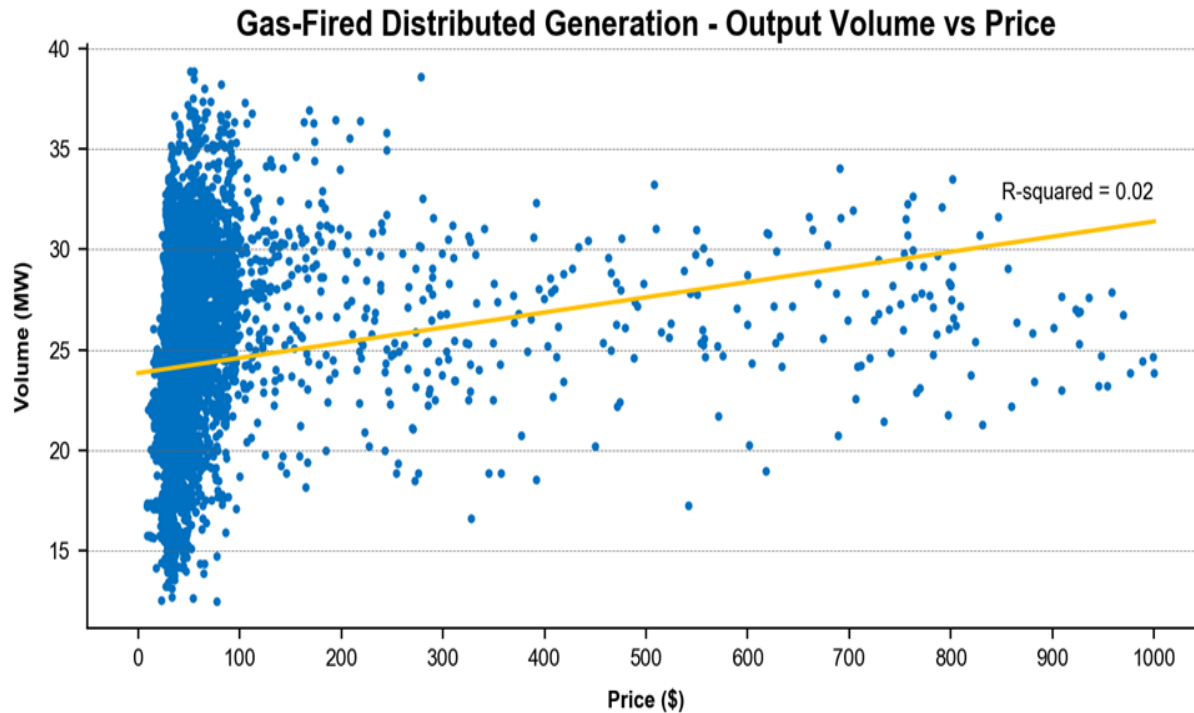
Small renewable generation price impact in the energy market

- A large portion of generation below 5MW is renewable or alternative fuel generation
- Compensation by credit or pool price (Micro-Gen Regulation)
- Most Micro-Gen is intermittent renewable generation
- Negligible impact on pool price* as it mostly shows up as negative load

*assumes \$0 offers

Price Impact of Unoffered \$0 Generation:





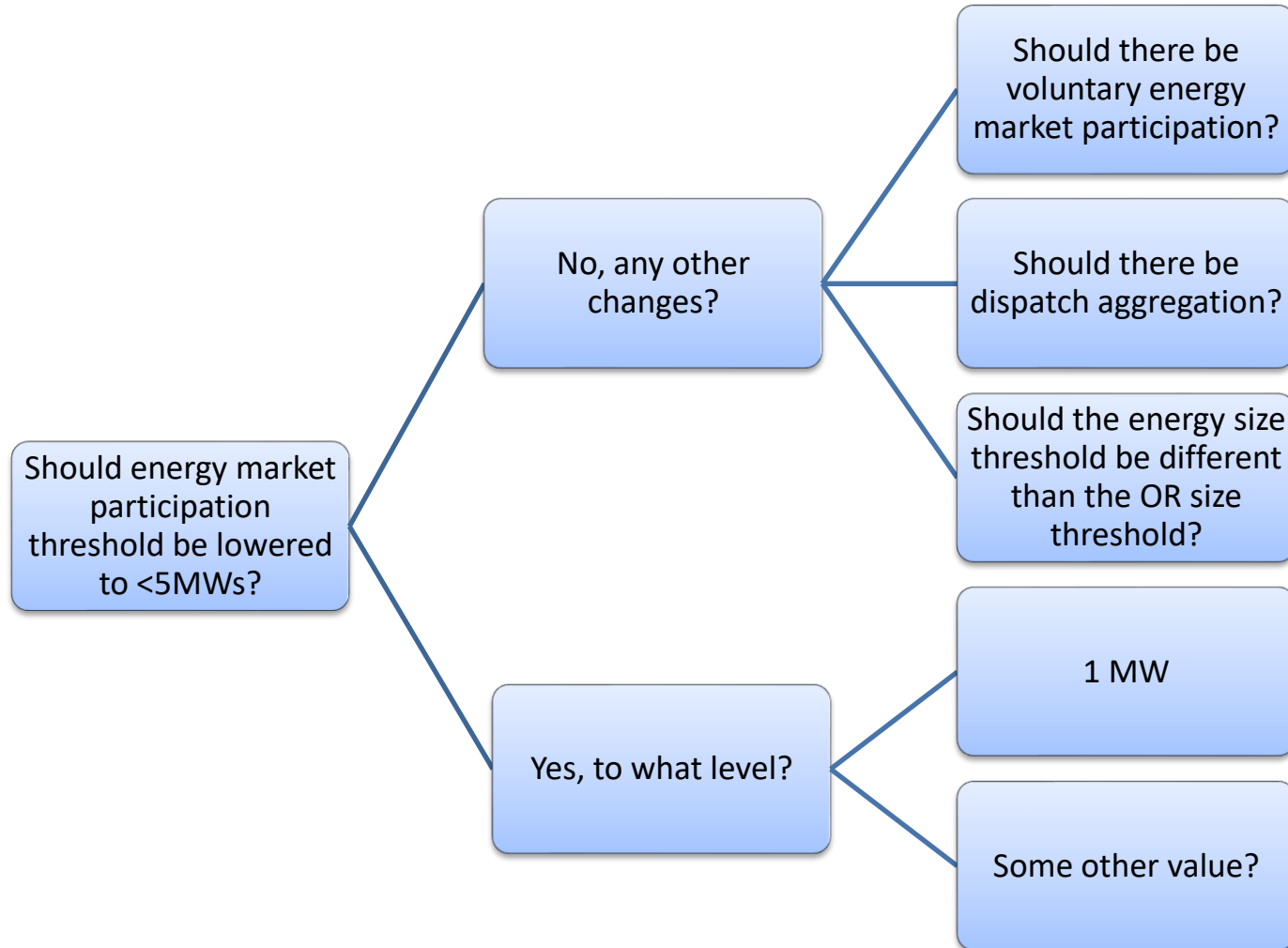
Dispatchable Gas <5MW (2015-2019)

- Graph represents total output of all <5MW gas generation at every settled hourly price 2015-2019
- Wide disparity of when gas shows up with low correlation between price and output ($R^2=0.02$)
- Indicating operation largely driven by factors other than pool price

Dispatchable Gas <5MWs Market Considerations

- Does pool price matter? Compensation matters but is pool price only one piece in the equation?
- Why does the combined output fluctuate so much? Are there other factors? I.e. coincident peak incentives, environmental restrictions (flare gas), voltage, energy offset, cogeneration (heat) etc.
- Would MOMC for small DCG gas generation (1MW-5MW) add much benefit from a market efficiency lens?

Principle	Considerations
Market Efficiency	<ul style="list-style-type: none">• Increased competition enhances market efficiency<ul style="list-style-type: none">• Assets below 5MW are currently not allowed to participate• This may prevent potential competitors from entering the market• A lower MOMC may not tangibly affect competition<ul style="list-style-type: none">• Renewable likely offers at zero dollars (currently acts as negative load)• Small gas respond to price but not sole factor in output decision• Total volume of DER/DCG currently small – but could grow• Asymmetric costs can create a competitive advantage<ul style="list-style-type: none">• Regardless of where the participation threshold is set there will be similar assets within a small increment on either side that will be subject to different rules• Aggregation may allow more assets to participate in the market.
Cost	<ul style="list-style-type: none">• The cost of participant rule compliance and AESO implementation must be weighed against the market benefit<ul style="list-style-type: none">• Infrastructure and personnel costs may be substantial for participants• For small DCG these costs could be an additional barrier to entry



Lowering MOMC to 1 MW

Pros:

- Increased visibility for all market participants, including AESO
- AESO's ability to forecast generation increased
- Increase in assets participating in the market increases competition
- Greater pool price certainty for small generators with energy market participation

Cons:

- Assets below 5MW do not currently pose a significant reliability or visibility concern
- Minor impact on price, most may offer at \$0 (similar to not submitting an offer)
- Increased cost and burden to comply with market rules that accompanies active market participation may not be commensurate with market benefit as a whole (very small efficiency gain for the market as a whole)

Maintaining MOMC
remain unchanged
at 5MW

Pros:

- Market/Rule Stability
- Avoids additional cost for rule compliance for smaller generation
- Most assets under 5 MW are not solely responding to pool price
- While small DERS are steadily growing, most of the growth is in renewable generation which has the least effect on price fidelity and competition (deemed \$0 offer)

Cons:

- Lack of visibility into small DER for market participants
- Dispatch uncertainty for the SC, currently not an issue, could become an issue if price responsive DCG under 5 MW significantly increased.
- Imperfect price fidelity – but the effect is likely minimal considering the low correlation between controllable gas output and pool price.

Permitting voluntary participation in Energy Market for assets <5MW

Pros:

- Reduction in barriers to entry to energy market
- Additional participation creates greater competition leading to more efficient outcomes
- Increased market visibility for all market participants including the AESO
- Dispatch certainty

Cons:

- There appears to be little benefit for small DER to participate in the energy market (already receive pool price without the cost of rule compliance)
- Other rules such as dispatch tolerance will need to be reviewed and likely changed as current ADV tolerance would be equal to or greater than small participating units.
- Cost to implement changes may not be commensurate with benefits to Albertans without considerable voluntary participation.- would anybody really voluntarily participate?

- Should any changes be made to the energy market participation thresholds?
- Any additional options or considerations to add?

Small Generation Participation - Thresholds in OR

Section 205.1 Offers for Operating Reserves

- (i) in the case of the first **offer** in an **on peak**, **off peak** or **super peak** period, is a minimum of five (5) MW per **pool asset** or approved virtual asset in each **hour ending** and for each type of **operating reserve** service;

Section 205.3 Restatements for Operating Reserve

- (5) A **pool participant** that submits a restatement must restate to zero (0) or to no less than five (5) MW for each **pool asset**.

Section 205.4 Regulating Reserve Technical Requirements

Eligibility to Provide Regulating Reserve

3(1) A **pool participant** seeking to have its **pool asset** qualified by the **ISO** to provide **regulating reserve** must ensure that its **pool asset** has at least one (1) **regulating reserve resource** that is:

- (a) at a minimum, capable of providing:
 - (i) 15 MW of **regulating reserve**;

Section 205.5 Spinning Reserve Technical Requirements

Eligibility to Provide Spinning Reserve

3(1) A **pool participant** seeking to have its **pool asset** qualified by the **ISO** to provide **spinning reserve** must ensure that its **pool asset** has at least one (1) **spinning reserve resource** that is:

- (a) at a minimum, capable of providing:
 - (i) 10 MW of **spinning reserve**; and

Section 205.6 Supplemental Reserve Technical Requirements

Eligibility to Provide Supplemental Reserve

3 A **pool participant** seeking to have a **pool asset** qualified by the **ISO** to provide **supplemental reserve** must ensure that its **pool asset** has at least one (1) **supplemental reserve resource** that is at a minimum, capable of providing:

- (a) 5 MW of **supplemental reserve**; and

Jurisdictional review – DER OR market participation size

RTOs/ISOs across America are generally working, where possible, to reduce minimum size requirements across energy, capacity, and ancillary service markets. Below is a brief representation of the varied participation thresholds for OR across select US markets:

Ancillary Reserves Market	PJM	CAISO	NYISO	NEISO	AESO
Minimum Asset Size Requirement(s)	100KW	500KW	100KW	5MW (must aggregate up to 5MW if unit less than 5mws)	15MW Regulating 10MW Spinning 5MW Supplemental

Operating reserves Market Participation:

Current asset size threshold requirements for OR range from 5MW (SUPG/SUPL) to 15MW (Regulating Reserve)

Considerations:

- 1) AESO currently studying the ability to lower the threshold for assets to provide OR (Reg, Spin, Sup); Dispatch and Directive tolerances would need to be reviewed
- 2) Other market design barriers to entry for small DCG/Load participation in the OR Market other than size thresholds (SCADA & Communication protocols are out of scope and will be part of other DER roadmap initiatives)

Note – The AESO will be conducting a review of the OR market in 2021 as part of our Market Initiatives package. Any changes to the OR market regarding recommendations for small generation participation will be further contemplated at that time in a holistic manner with all other market design options.

- Should the minimum size thresholds be consistent in the Energy and OR Market, or can the minimum size thresholds be different?
- Any other considerations?

Small Generation Participation – Dispatch Aggregation

Issue:

On it's own, small DER are often unable to participate in energy and OR markets due to minimum size requirements.

Current State:

The loss factor rule, [Section 501.10 Transmission Loss Factors](#), imposes certain requirements on the aggregation of units, specifically that generating units or aggregated generating facilities (AGF) which choose to aggregate must be at a common physical location or generating units and AGF's located:

- Within an industrial system (while the units may be some physical distance apart)
- On an electric distribution system downstream of a single point of delivery (same feeder)
- Within the City of Medicine Hat

Exemptions include Bow River Hydro, Suncor, Imperial Oil, Shell Scotford

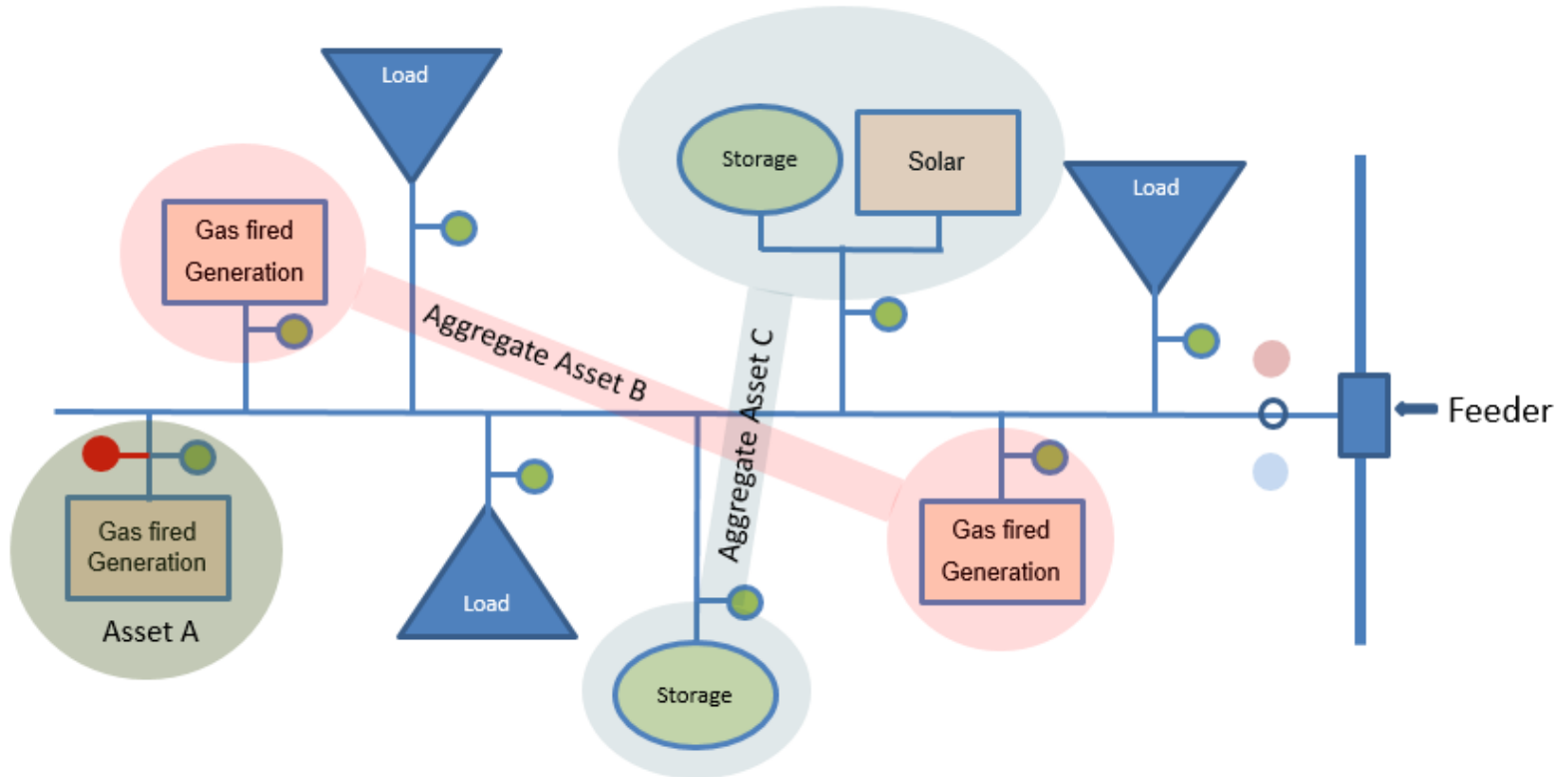
Small generation & aggregation – Other jurisdictions

Aggregation	PJM	CAISO	NYISO	NEISO	AESO
Aggregation Size Requirement(s) and Limitations	1MW max size cap. (single collector bus)	No single aggregator can exceed 1MW Total aggregation $\geq 20\text{MW}$ Same sub-LAP	Must aggregate up to a minimum of 100KW Must map to the same transmission node	100KW min size for aggregation	Proximity: TX System – common physical location Distribution system – same feeder

While the size requirements vary slightly across jurisdictions, the need for reasonable proximity is prevalent across most jurisdictions

- Short of removing all size restrictions, one solution is to consider cross-site aggregation for dispatch
- Cross-site aggregation for dispatch allows multiple sites on a common distribution feeder to receive a single dispatch that applies to the aggregate
- Dispatch aggregation is for the purpose of meeting the minimum size thresholds for market participation:
 - Applies to dispatch only - NOT settlement
 - Energy and/or AS market participation is consolidated into a single submission per aggregate
 - Dispatch is issued to the aggregate in the form of a single asset
 - Settlement is performed at each individual resource as it is today
 - Dispatch compliance is determined on the sum of the SCADA points of the individual components of the aggregate

Energy market settlement is still performed at the measurement point



Physical Meter		Measurement point		Dispatch point for "A"		Dispatch point for "B"		Dispatch point for "C"	
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- Aggregations over 5MW would be subject to MOMC requirements in the energy market
- Different asset types have different offer requirements – aggregations may need to be limited to similar technologies. i.e. controllable vs. non-controllable
- Maximum allowable aggregation size limits
- Offer control
- Operational challenges such as the effects of proximity on congestion management

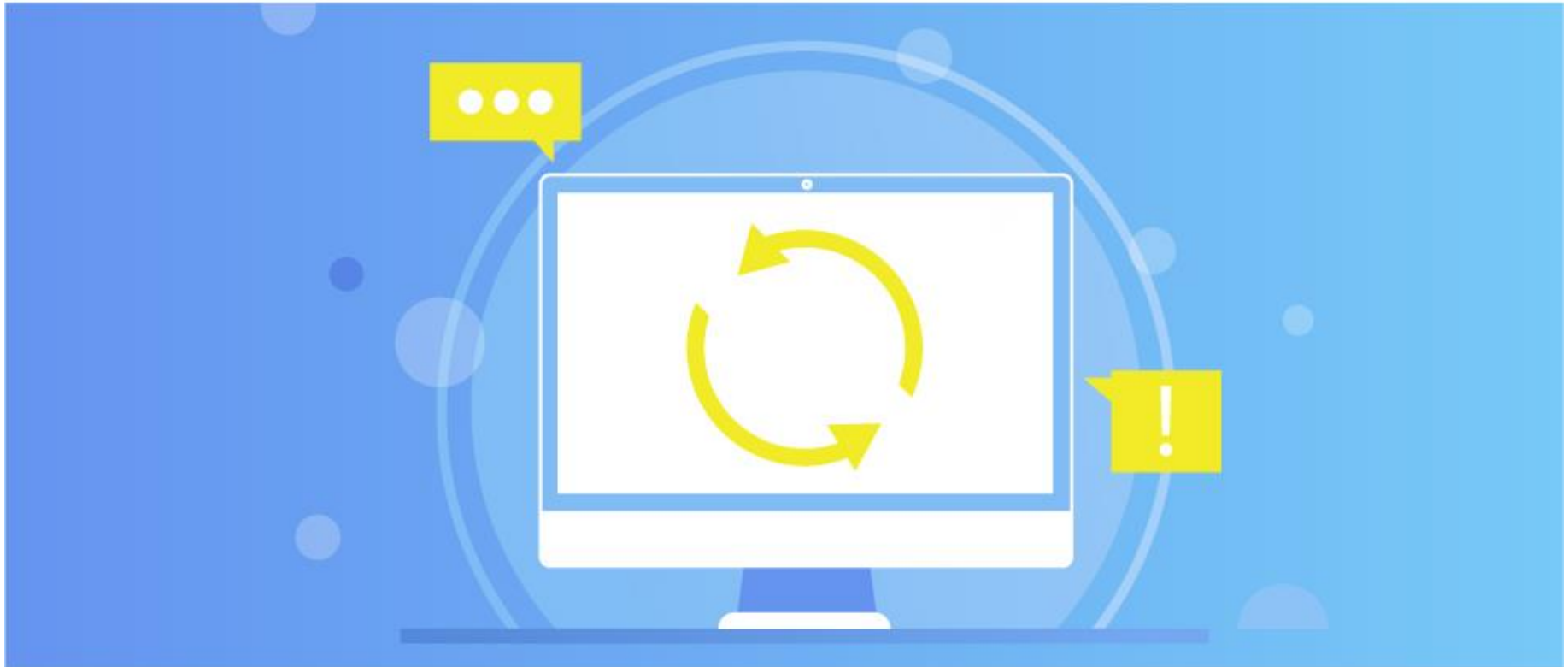
Questions?

Next Steps

Timeline	Step
Oct 30, 2020	<ul style="list-style-type: none"> • Written Stakeholder comments due (follow up to the Oct 14, 2020 session)
Nov/Dec 2020	<ul style="list-style-type: none"> • AESO consider written feedback • Host further engagements as necessary • Develop draft recommendation
January 2021	<ul style="list-style-type: none"> • Release DER market participation draft recommendation, considering stakeholder feedback • Stakeholder session on DER market participation draft recommendation • Stakeholders to provide written comments on the draft Recommendation • AESO to consider stakeholder feedback and finalize recommendations
Q1 2021	<ul style="list-style-type: none"> • Initiate development of draft ISO rules (if recommended) in coordination with the DER Roadmap

Thank you & poll

- We want to thank you for attending the Joint Stakeholder Engagement Session for Energy Storage and Distributed Energy Resources and we would appreciate your feedback on the session
- We value stakeholder feedback and we invite all interested stakeholders to provide their input on this session and the questions set out in the ES Markets Stakeholder Comments Matrix and the DER Markets Comment Matrix, both are available by following the path:
www.aeso.ca> Energy Storage> Energy Storage Long-term Markets Participation
- To limit stakeholder fatigue, we are modifying how we collect your initial feedback on the session by conducting a Zoom poll during the session rather than emailing you a short session survey following the session.



- **Twitter:** @theAESO
- **Email:** energystorage@aeso.ca
- **Website:** www.aeso.ca
- Subscribe to our stakeholder newsletter