Energy Storage Industry Learnings Forum
Workshop 6

March 21, 2023

Using Teams – Asking questions

- Asking questions and participating (virtual attendees)
  - Click “Raise Hand” and the hosts will be notified that you would like to ask a question or participate. The facilitator will then call your name and you will be able to unmute yourself.

AESO Stakeholder Engagement Framework

ESILF transparency

- The ESILF recognizes not all of the AESO's stakeholders will be represented within the ESILF and to support the AESO's commitment to transparency, the following is regularly updated on the AESO website on www.aeso.ca:
  - Forum membership
  - Agendas
  - AESO or member presentations
  - Relevant discussion materials
  - Meeting summaries

Stakeholder participation

The participation of everyone here is critical to the learning 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 and Introductions

Ata Rehman

Director, Grid Planning & Operations Engineering,

AESO

Agenda

Est. Time	Agenda Items	Presenter
8:30 – 9:00	Registration and greetings	NA
9:00 – 9:05	Welcome & Introduction	Dan Wiebe, *Manager, Operations Engineering & Market Support*
9:05 – 9:30	Presentation 1 "Energy storage developments in Canada and the US"	Geoff Osborne and Nathan Cox *Capstone*
9:30 – 10:00	Discussion	Leon Weinstein
10:00 – 10:05	Break	
10:05 – 10:30	Presentation 2 "Congestion relief and energy storage resources"	Robert Tremblay, *Energy Storage Canada* Travis Lusney, *Power Advisory*
10:30 – 10:55	Discussion	Leon Weinstein
10:55 – 11:00	Wrap up and next steps	Dan Wiebe, *Manager, Operations Engineering & Market Support*

Energy storage development in Canada and the US

Geoff Osborne and Nathan Cox
Capstone

Energy Storage: Alberta's next great infrastructure play

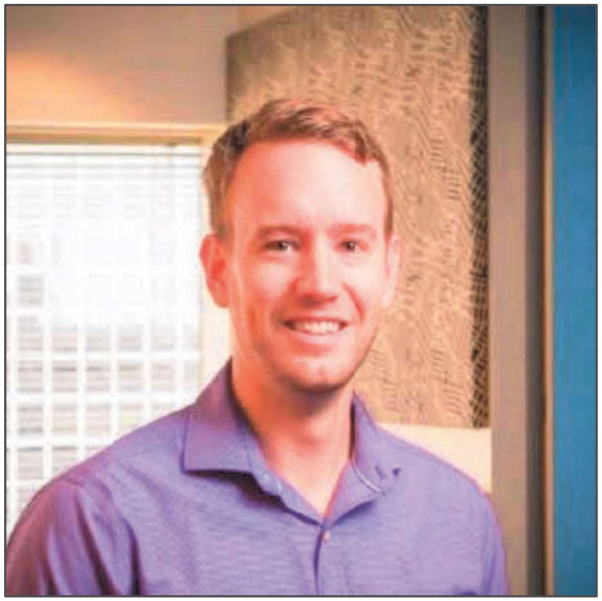
Presentation to AESO ESILF

March 21, 2023

Intros

Geoff Osborne, LLM, MBA

Director, Business Development



Nathan Cox, P.Eng.

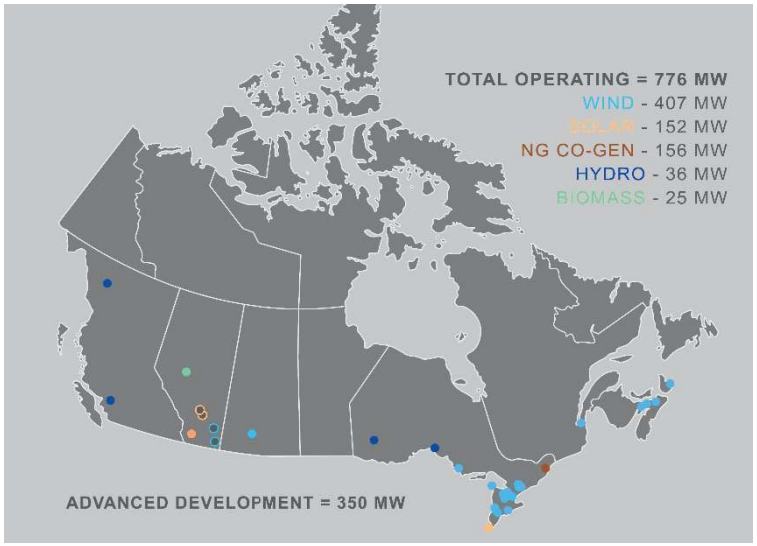
Senior Market Analyst

Capstone at a Glance

Generating our low-carbon future.

Clean and renewable energy is our business, and our people are our greatest asset.

We're here to drive the energy transition forward through creative thinking, strong partnerships, and a commitment to doing things right.



PROFILE

Canadian developer and long-term owner-operator of renewable and thermal power projects, including wind, solar, run-of-river hydro, biomass, & natural gas cogeneration.

KEY STATS

776 MW

Gross installed capacity across Canada

2 GW

Current development project pipeline in Canada & US

30 Facilities

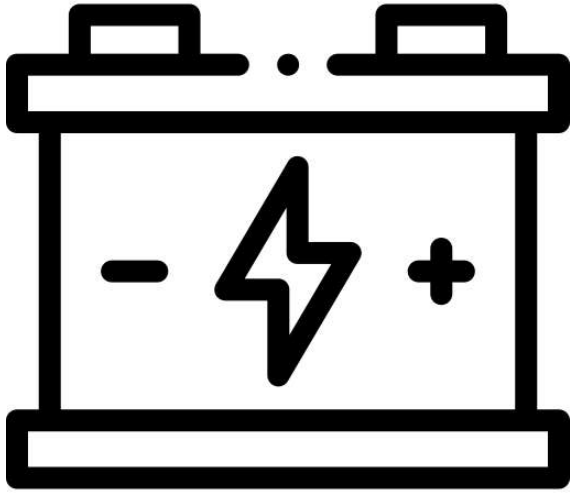
Proven track record of Operational and HSE Excellence

RECENT ACTIVITY

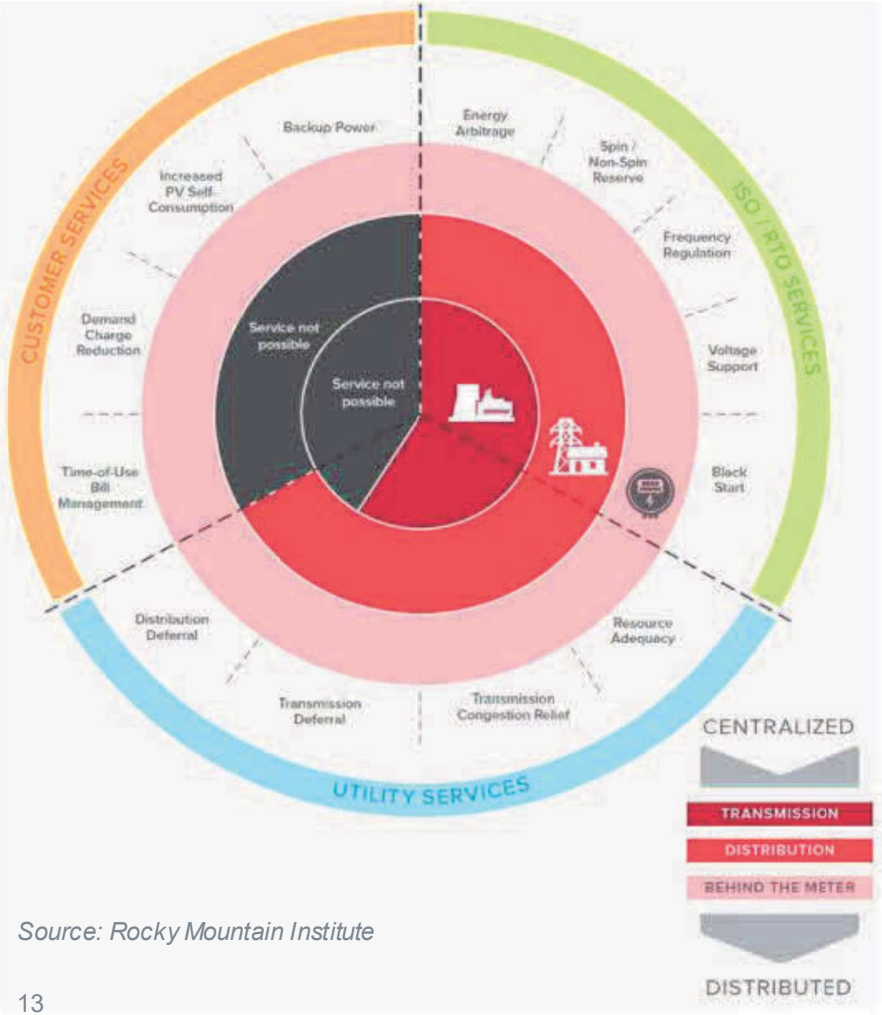
- Acquired 192 MW Wild Rose 2 Wind in Nov 2021
- Signed Corporate PPAs with Pembina Pipelines & City of Edmonton for Wild Rose 2 in 2022
- Multiple wind solar projects in construction in Alberta (300+MW)
- 10 MW Riverhurst wind farm COD in December 2021
- 132 MW Claresholm solar farm achieved COD in April 2021
- 29 MW of operating Ontario wind acquired in January 2021

Storage… It Goes With Everything…

=



Storage Value Propositions

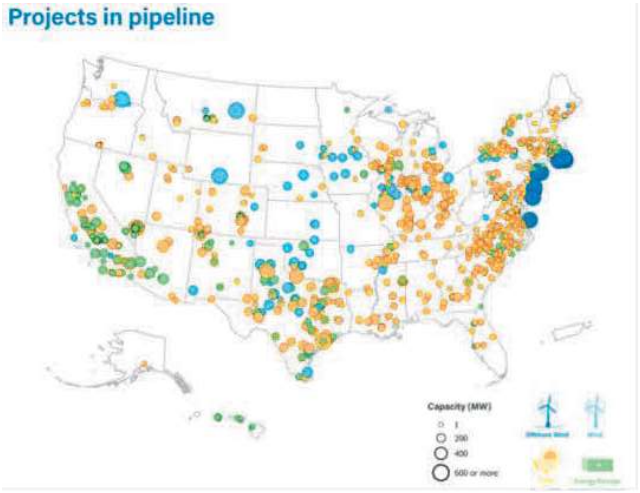


Source: Rocky Mountain Institute

Unlocking the "value-stack" of fast-acting, flexible and non-emitting storage in Alberta…

Impacts of the IRA In the US (2022)

- Industry **installed 25.1 GW of clean power capacity** across the United States, representing a **$35 billion capital investment**.
- A confluence of policy and market headwinds such as **supply chain constraints**, lengthy **delays connecting** projects to the grid, unclear **trade restrictions**, longstanding **permitting obstacles** and **uncertainty over IRA implementation** slowed project development in 2022.
- **Battery storage set a record** for annual installations in 2022, **commissioning 4GW/12.2GWh of new capacity**. Solar led annual installs with 12.6 GW coming online. Land-based wind finished the year with it's strongest quarter, but annual installs were still the lowest since 2018.



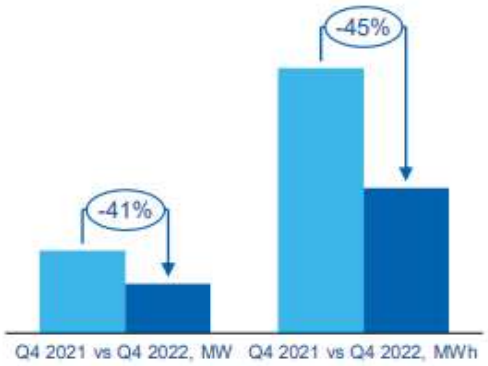
How will a storage ITC play out in Alberta and across Canada?

Source: American Clean Power

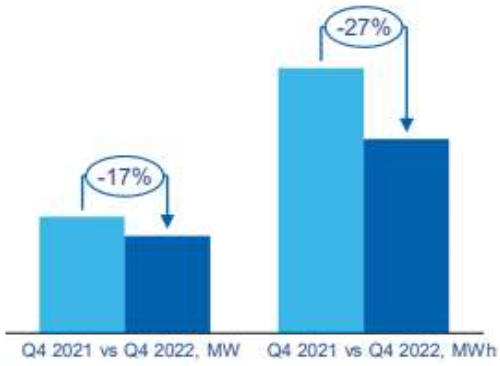
Q4 2022 US Storage Deployments

Q4 2022 U.S. energy storage deployments scorecard

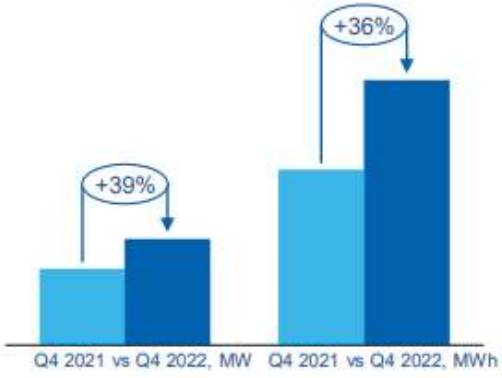
Grid-scale segment, YoY changes



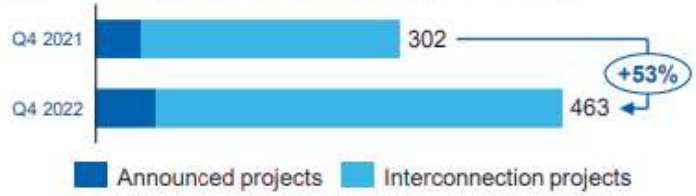
CCI segment, YoY changes



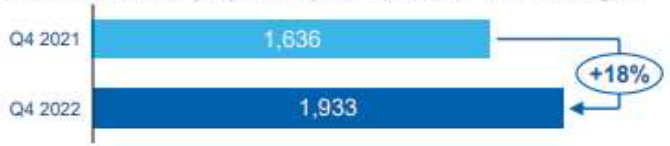
Residential segment, YoY changes



Grid-scale segment pipeline (GW), YoY changes



Grid-scale battery system price ($/kW), YoY changes

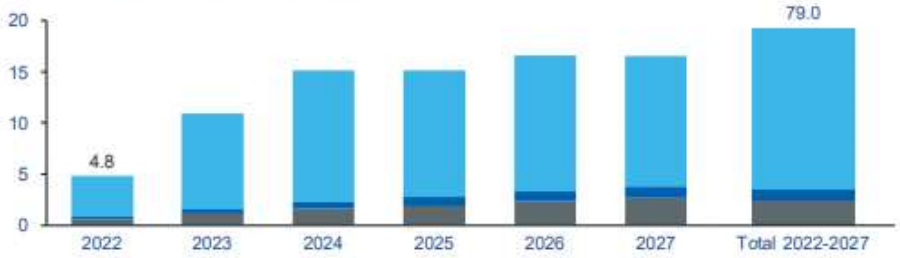


Source: Wood Mackenzie

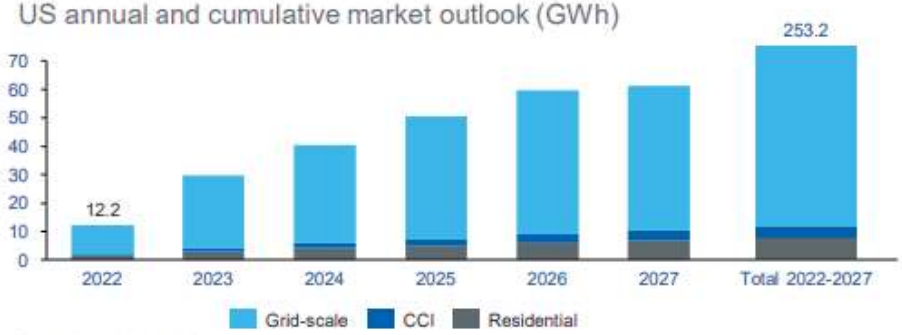
US Storage Outlook

Cumulative capacity across all segments in GW and GWh will more than double between 2022 to 2023

US annual and cumulative market outlook (GW)



US annual and cumulative market outlook (GWh)



Source: Wood Mackenzie

Grid-scale market headwinds fail to slow capacity growth, but have pushed volumes into later years of the forecast

- Announced project capacity in the short-term combined with expected supply chain and interconnection queue delays in the short/medium-term drive the five-year outlook to 2027.
- Despite an outsized Q4, utility-scale solar volumes dropped 31% from 2021, displaying the impact of uncertainty on project deployment. This turbulence has subsequently trickled into the solar-paired storage market, causing delays and cancellations in the near-term pipeline.

Residential segment climbs to over 2.7 GW in annual installations by 2027, while CCI is projected to grow to 1.4 GW

- The residential storage forecast is largely driven by the residential solar forecast, due to the high number of paired systems, while the CCI forecast is more dependent on a variety of factors such as state incentives, community solar programs, and standalone potential in various states.
- In 2022, the residential solar market grew 40% over 2021 and is expected to grow through 2027, contributing to the growth in the residential storage segment.
- Despite a rather lackluster 2022 overall, the CCI segment still grew 3% over 2021 and will grow substantially over the forecast period.

US energy storage five-year market outlook: <u>Significant Growth</u>

Source: Wood Mackenzie

California Energy Storage Alliance (CESA)

California Energy Storage Alliance Priorities

Strategic Priority	Objective(s)
Continue to create and expand storage markets and opportunities	• Connect planning models with timely procurement orders • Ensure planning models highlight storage needs in tech-neutral way
Ensure healthy markets for all types of storage	• Ensure appropriate storage valuation in RA reforms • Advance funding for emerging tech • Ensure valuation of BTM storage export QC • Recognize value of LDES capabilities
Reduce barriers and resistance at local levels of permitting and execution	• Streamline ad hoc permitting and approval processes • Address county concerns over revenue • Address battery safety concerns
Reduce storage interconnection delays and/or costs and improve interconnection processes	• Enable faster, cheaper, and better storage interconnection • Ensure timely storage deployment with timely upgrades construction • Advance plug-and-play system
Enhance and further develop wholesale market participation and products	• Fix and improve market participation and bidding models for energy storage and hybrid resources • Develop new market products

Active industry lobbying efforts underway in California

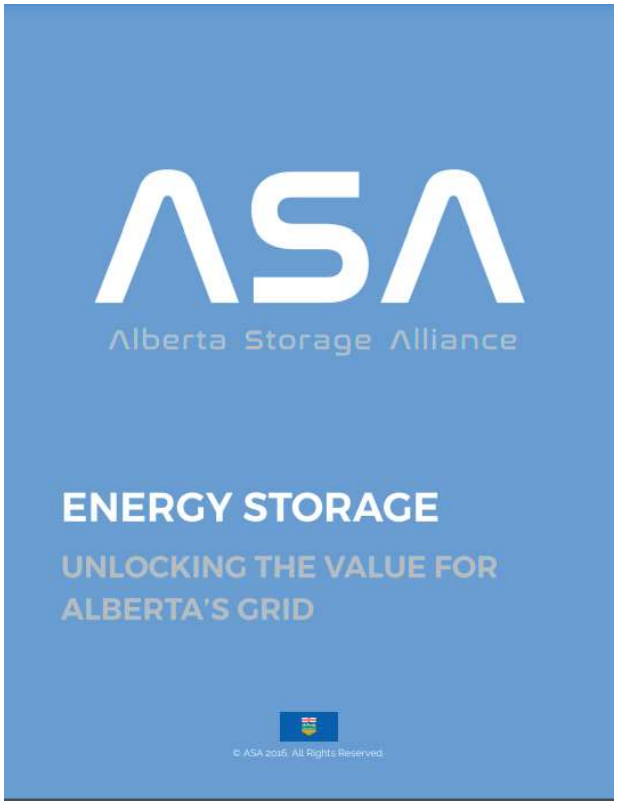
Source: California Energy Storage Alliance

Energy Storage Canada (ESC), formerly ASA / ESO

KEY RECOMMENDATIONS

The Alberta Storage Alliance (ASA) recommends the following solutions be considered:

Grid Balancing	1) The ASA will work with the AESO and regulators to identify services and applications where energy storage can offer benefits to Alberta's electric grid. As part of this collaboration, we recommend conducting a *Needs Identification Process* to determine what services (existing or new) are required to help maintain a reliable electric grid going forward. 2) The ASA and AESO should conduct an assessment regarding whether assets solely providing system stability services should be exempt from certain investment prohibitive tariffs. For example, a standard Transmission Service rate for grid-connected storage offering only Operating Reserves (OR) would avoid "double charging" such assets under existing regulations and tariffs. 3) Energy storage should be allowed to participate in the energy and ancillary services markets, via small revisions to the AESO market rules, as any other capable technology that satisfies appropriate technical requirements. This rule development should be accelerated to allow energy storage inclusion in the Alberta market.
T&D Deferral	4) During system planning, the AESO should give due consideration to other assets (such as energy storage) that can alleviate system burden as an alternative to "wires" solutions for transmission upgrades.
Behind-the-Meter	5) The ASA can help develop a straightforward and transparent process to expedite behind-the-meter energy storage interconnections (for both residential and industrial customers).
Emissions Reduction Services	6) The Alberta Department of Energy should continue to allocate funds from its carbon emissions levies to accelerate the deployment of technologies offering greenhouse gas emissions reduction benefits. Funding energy storage projects is an important means of enabling the integration of more renewable energy.



Active industry lobbying efforts underway in Alberta for some time…

Source: Alberta Storage Alliance 2016 White Paper

Energy Storage Canada (ESC)

#1 PRINCE EDWARD ISLAND
10 MW Slemon Park Microgrid
& Summerside Sunbank BESS

#2 QUEBEC
2.5 MW - EVLO storage & solar

#3 NIAGARA FALLS
OPG 174 MW Pumped Storage

#4 ONTARIO BTM
200+ MW BTM storage installed
2500 MW Procurement announced

#5 SASKATCHEWAN
20 MW Utility Scale BESS

#6 ALBERTA
10 MW ENMAX Crossfield
20 MW Enfinite Rycroft
10 MW TransAlta WindCharger
20 MW Enfinite Clairmont
20 MW Hughenden
20 MW Buffalo Creek
17 projects in AESO connection queue

#7 YUKON
40 MW Yukon Energy & Sungrid

Snapshot of active ESC regulatory efforts: AUC Bulk Regional Tariff, Bill 22, Storage ITC, Ontario RFPs, NB Power EOI, etc.

Source: Energy Storage Canada

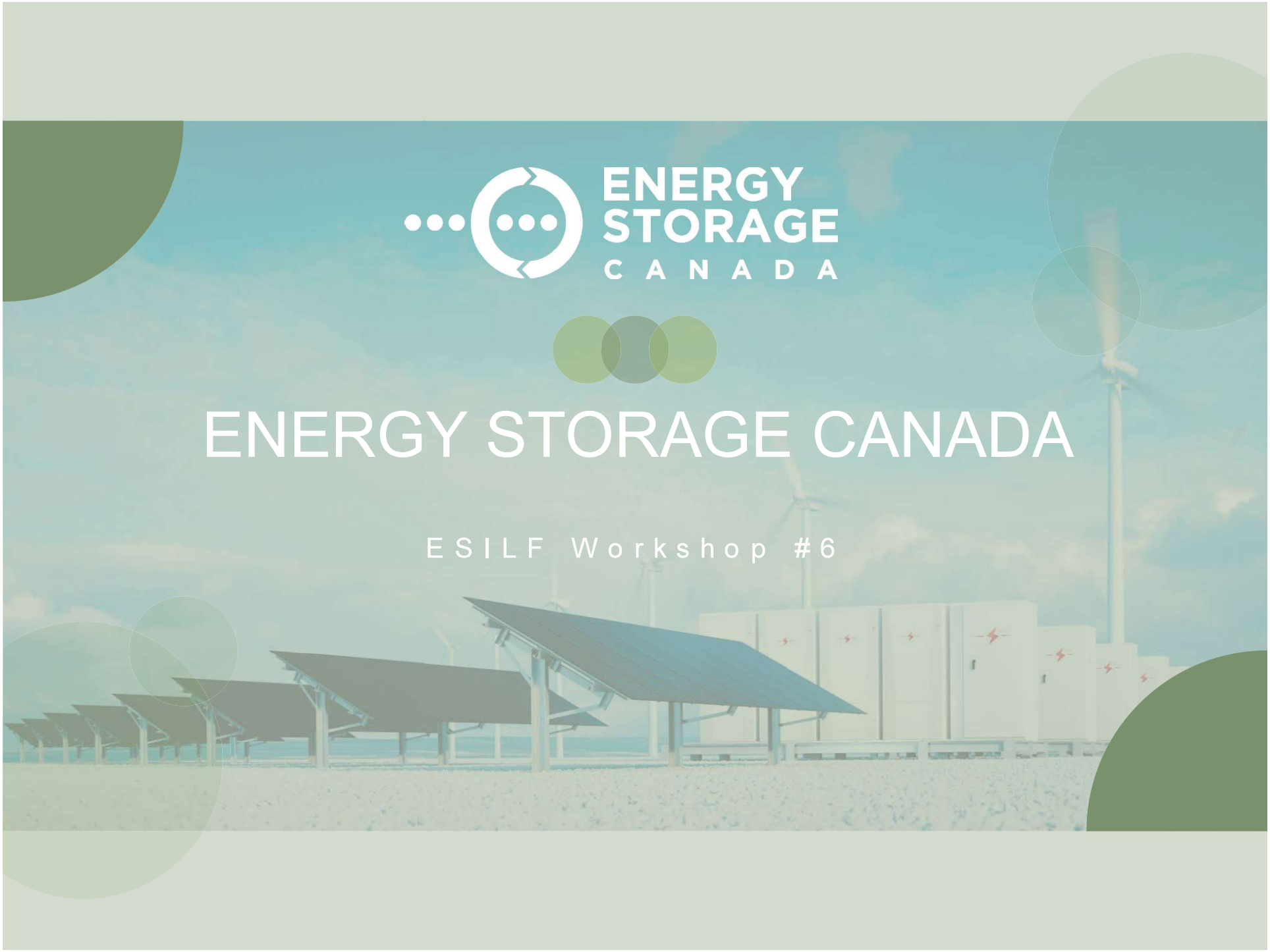
Thank you!

Discussion

Leon Weinstein
AESO

Congestion Relief and Energy Storage Resources

Robert Tremblay, Energy Storage Canada
Travis Lusney, Power Advisory



ENERGY STORAGE CANADA

ESILF Workshop #6

About Energy Storage Canada

Represent Canadian Storage Industry

•Energy Storage Canada is the voice of the energy storage industry in Canada

•Represents the industry at all levels: Grid Level, Distribution Level, and Behind the Meter

•Technology-agnostic and support all durations of energy storage

Advance Policy & Regulation

•Work with decision makers to develop Canada's energy storage market to create a more reliable, flexible, sustainable & affordable energy grid

•Ensure regulatory policies reflect the value provided by energy storage and advocate to remove barriers to its integration

•Outline the role energy storage can play in Canada's energy transition & net-zero future

Engage Members & Industry Stakeholders

•Host the only national energy storage-only conference in Canada

•Provide opportunities for leadership, access to experts & government representatives

•Host and facilitate forums on current policy & regulatory issues related to energy storage across the country

•Membership represents the entire energy storage value chain

2023 LEADERSHIP COUNCIL

alectra utilities
Discover the possibilities

AMERESCO
Green • Clean • Sustainable

BLG
Borden Ladner Gervais

BrucePower NetZero

CAPSTONE INFRASTRUCTURE

CONVERGENT

EDF renewable energy

elexicon ENERGY

enfinite

ENBRIDGE

EVLO by Hydro-Québec

e-ZINC

FLUENCE
A Siemens and AES Company

hydro one

HYDROSTOR

NORTHLAND POWER

NRSTOR

ONTARIO POWER GENERATION

TC Energy

TORONTO HYDRO

2023 ESC MEMBERS

2023 ESC INDUSTRY PARTNERS

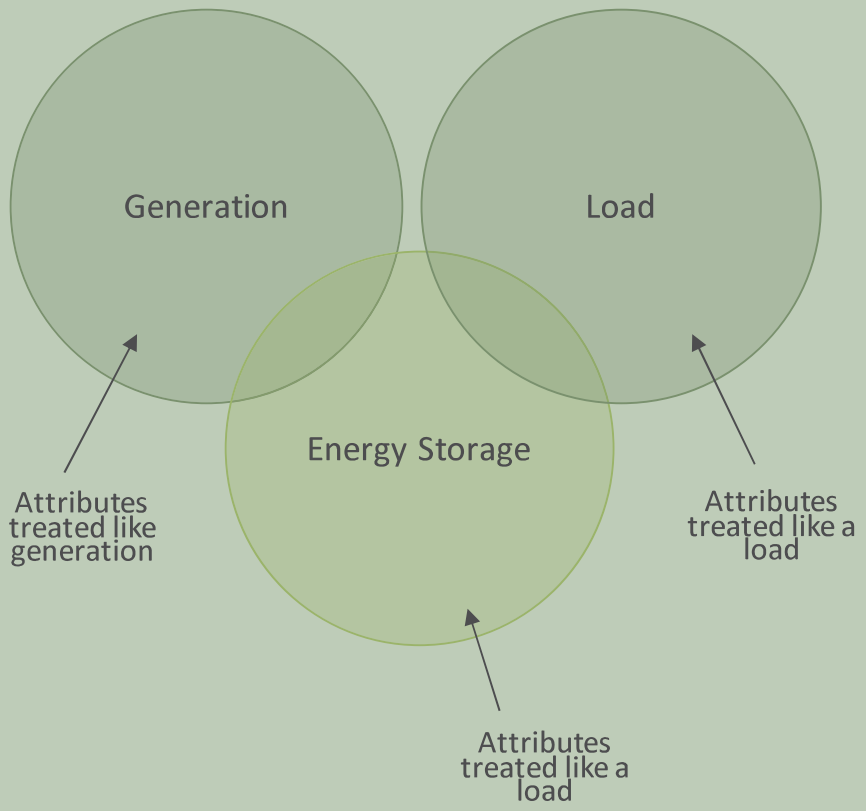
What Is Energy Storage?

Energy storage is any technology or process that captures energy when it is not needed and stores it for later use, eventually discharging it.

Chemical	Batteries (*lithium-ion, zinc, sodium, etc.*) Power-to-Clean Fuels *(1-way power flow)*
Electrical	Capacitors / Supercapacitors
Thermal	Steady State Materials *(1-way power flow)* Phase Change Materials *(1-way power flow)*
Mechanical	Pumped Hydro Compressed Air / Liquids / Gases (CAES, LAES, CO_2, etc.) Flywheel Gravity
Industrial Process	Demand response enabled by storage of commercial/industrial manufacturing and product fabrication processes *(1-way power flow)*

Real-Time	Inertia	• Electrical • Chemical • Mechanical
Seconds	Frequency Response	• Chemical • Mechanical
Minutes	Operating Reserve	• Chemical • Mechanical
Hours	Capacity Load Following	• Chemical • Mechanical • Thermal • Industrial Process
Days	Time-Shifting	• Chemical • Mechanical • Thermal • Industrial Process
Seasonal	Long-Duration	• Chemical • Mechanical • Thermal • Industrial Process

The Value Proposition of Energy Storage



- The electricity supply mix is changing
- Demand patterns are changing
- Grid operators will need additional resources and tools to maintain safety, reliability and affordability.
- Energy storage resources offer versatility and flexibility
- Energy storage resources can increase the utilization & efficiency of existing assets
- Energy storage can help support Net Zero & Decarbonization efforts

POWER ADVISORY

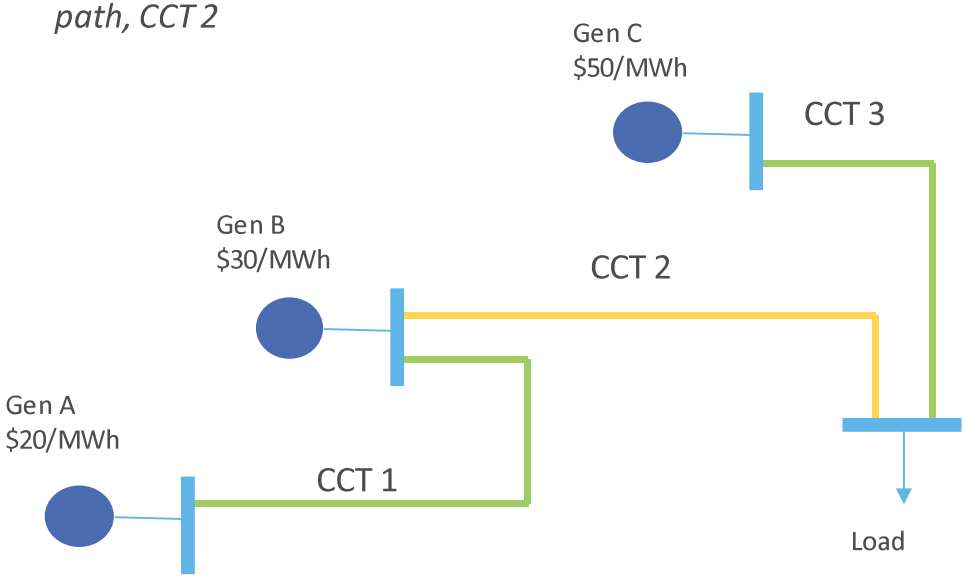
Congestion Relief and Energy Storage Resources

ESILF Workshop #6

March 21, 2023

What is Congestion

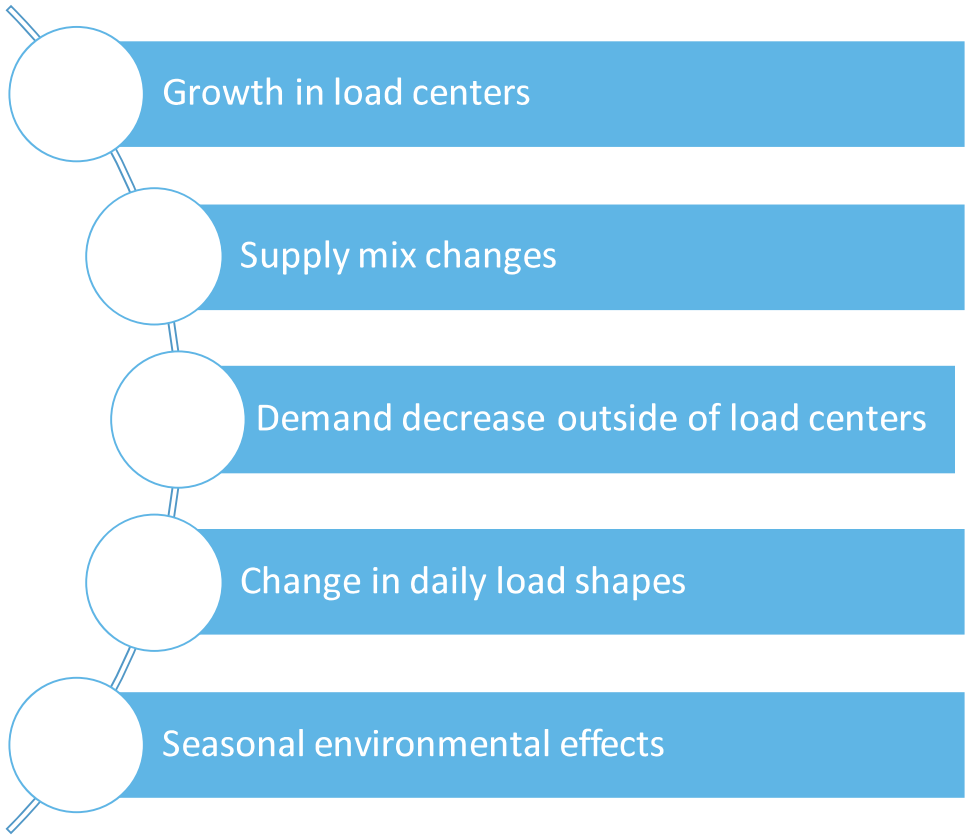
Gen A and Gen B are the most economic supply to dispatch to supply the load; however, they share a common transmission path, CCT 2



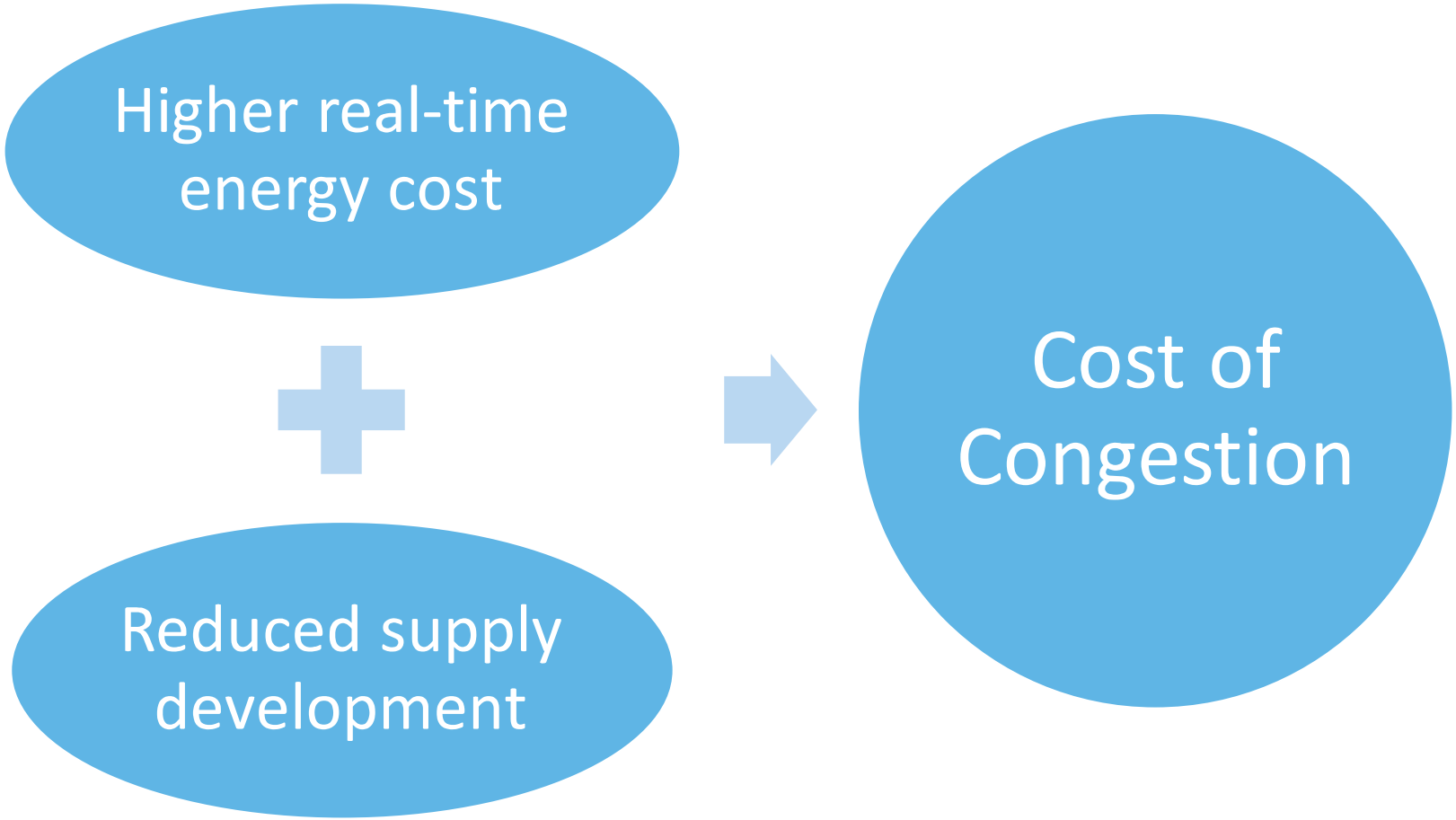
When CCT 2 is overloaded, congestion of output from Gen A and Gen B occurs; more expensive energy from Gen C must be dispatched to supply the load

- Congestion occurs when a transmission path cannot accommodate economic dispatch of in merit order resources to supply load
  - The dispatch of more expensive resources increases cost to customers and can compound quickly
- Congestion is an economic event that is independent of reliability events
  - While reliability events (e.g., transmission outage) can cause congestion, under normal and abnormal operating conditions congestion can occur

Causes of Congestion



Cost of Congestion



Challenges Addressing Congestion

01

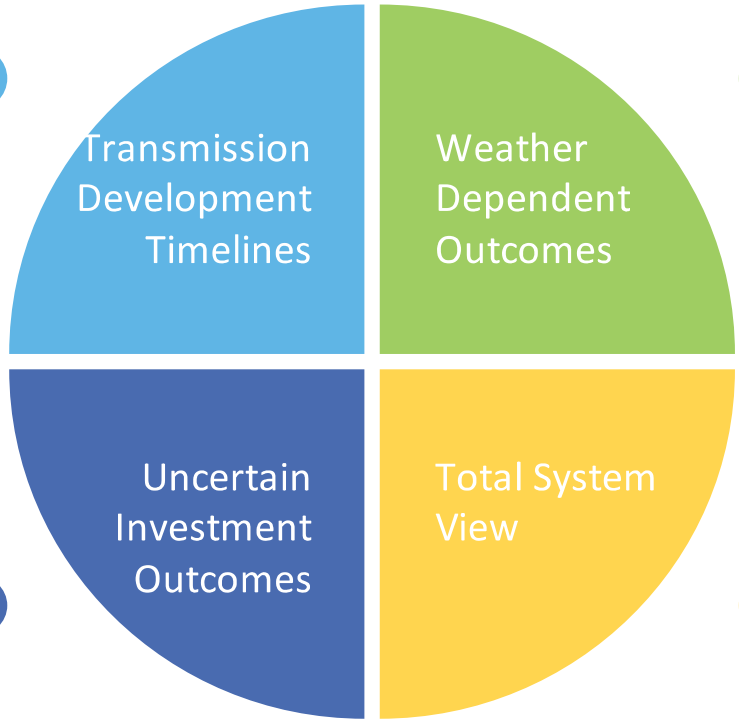
7-10 Years for Bulk Transmission Build

Typical bulk transmission build from conception to energization takes up to a decade

02

Load is a Function of Weather

Extreme weather that exposes congestion can be difficult to predict



03

Future Drivers for Congestion Uncertain

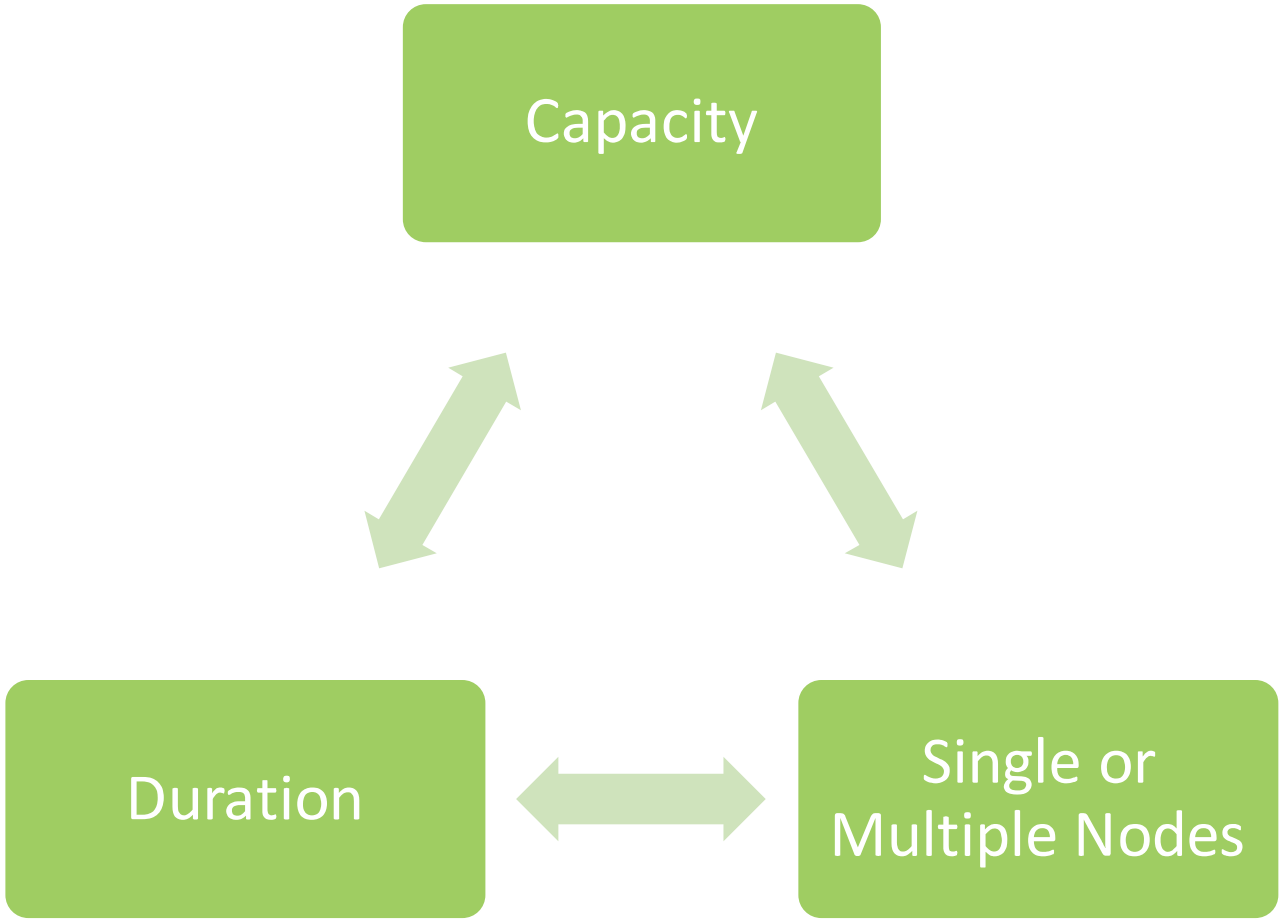
How much new supply or demand that would cause congestion difficult to forecast

04

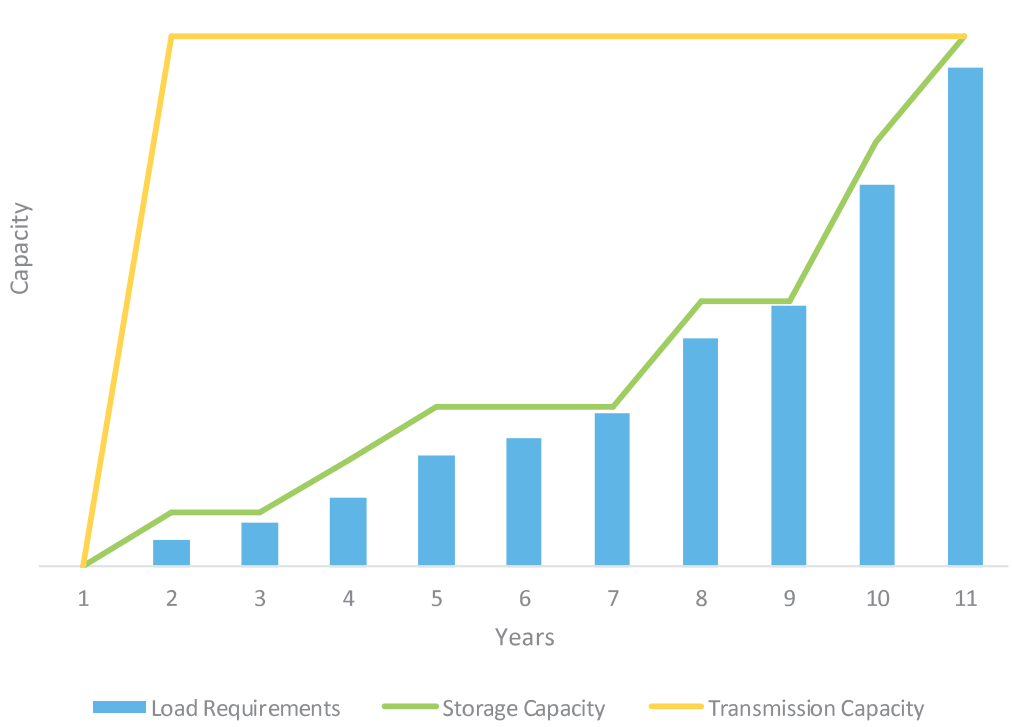
Complex Infrastructure

Understanding and addressing congestion requires a total electricity network view

Energy Storage Congestion Relief Attributes



Energy Storage Resource Scalability Benefits



- Wires solutions offer a blunt, large-scale solution to congestion
  - Land use is significant for new transmission paths
- Energy storage resources offer a scalable solution where the attributes the storage resources can be adjusted to more finely implemented to better align with congestion expectations
  - Energy storage resources can be sited with small land use impacts

Potential Compensation Structure for Energy Storage

To extract the scalability benefits of energy storage, a flexible compensation framework can be adopted

Fixed Capacity Payment

Primary compensation structure would be based on a fixed capacity payment (i.e., $/MW-year) for initial energy storage development with a term that aligns with expected permanent transmission buildout

Optional Expansion Payment

As expectations for congestion change, pre-determined optionality in the contract could be used to expand capacity (i.e., if congestion accelerates) or extend the term (i.e., if congestion slows) potentially offering transmission deferment savings

Variable At-Cost Recovery

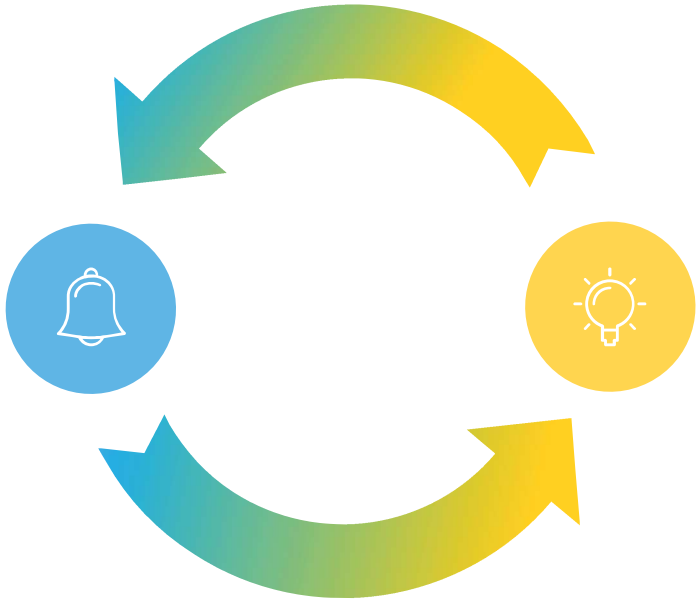
Congestion cycling costs can be compensated at-cost under pre-determined values

Managing Impact on Pool Prices

Use of energy storage for transmission can impact pool price formation

System Operator Directed

Operation of the energy storage resource would be directed by the system operator based on real-time expectations of congestion, removing potential market participation manipulations



Manually Adjust Pool Price Impact

Similar to transmission-must run service, the impact of the energy storage cycling can be manually adjusted by the system operator and shifted to transmission service costs; therefore, maintaining the principles of pool price formation

Conclusions

- Congestion restricts the flow of economic supply resources to load centers, raising costs for customers and decreasing the incentive for new development
- Energy storage resources offer a flexible and scalable solution that can be used as both a bridging mechanism and a permanent deferment option for bulk transmission development
- The attributes of energy storage resources can be designed to align with congestion relief needs and uncertainty of forecasting future system conditions
- Compensation framework can provide system operators with optionality while minimizing impact on pool price formation
    - Need to address tariff structure as cycling costs will flow through to customers adding to congestion relief costs
- In Alberta, energy storage resources are one of the few options that can maintain the zero congestion objectives of the Transmission Regulation without major system overhauls

Travis Lusney

Director, Power Systems

tlusney@poweradvisoryllc.com

647.680.1154

Discussion

Leon Weinstein
AESO

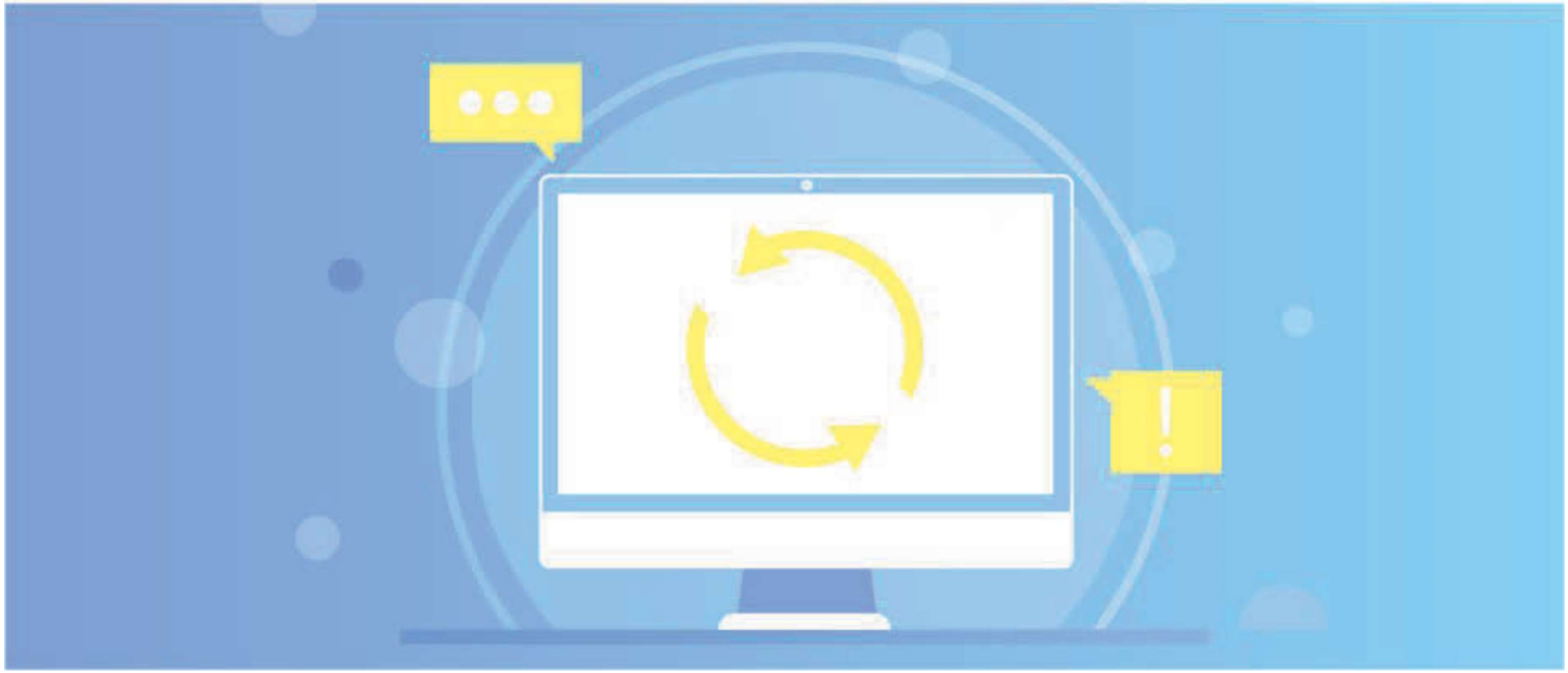
Wrap Up

Ata Rehman
Director, Grid Planning & Operations Engineering
AESO

Wrap up and next steps

- ESILF will continue in 2023 with another session in the Fall
- **Please send your Energy Storage questions or comments to:**
  - Email: energystorage@aeso.ca

Contact the AESO



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

Thank you