# Sustaining Reliability Through the Transformation

August 11, 2022

# Welcome

- Recording of session
- Using Zoom

# Notice

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- Two ways to ask questions if you are accessing the webinar using your computer or smartphone
  - Click “Raise Hand” and the host will be notified that you would like to ask a question. 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.
  - 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.
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# Enabling Transformation

The transformation of the province's electricity system will support economic growth and help shape Alberta's future. We play a leadership role in enabling this transformation while maintaining system reliability, acting in the public's interest, and providing guidance to policy-makers and industry.

## STRATEGIC ACTIONS

- Ensure our framework can enable electrification and is flexible and adaptable to integrate technological change on a level playing field.
- Proactively provide information and insights to government at both the provincial and federal level regarding policies that impact the electricity sector, with a focus on carbon policy.
- Continue to assess system reliability needs and proactively identify and implement required changes.
- Complete modernization of the tariff to ensure appropriate price signals for use of the transmission system, enable optionality without undue cross-subsidization and reduce barriers to entry.

# Objectives for the Session

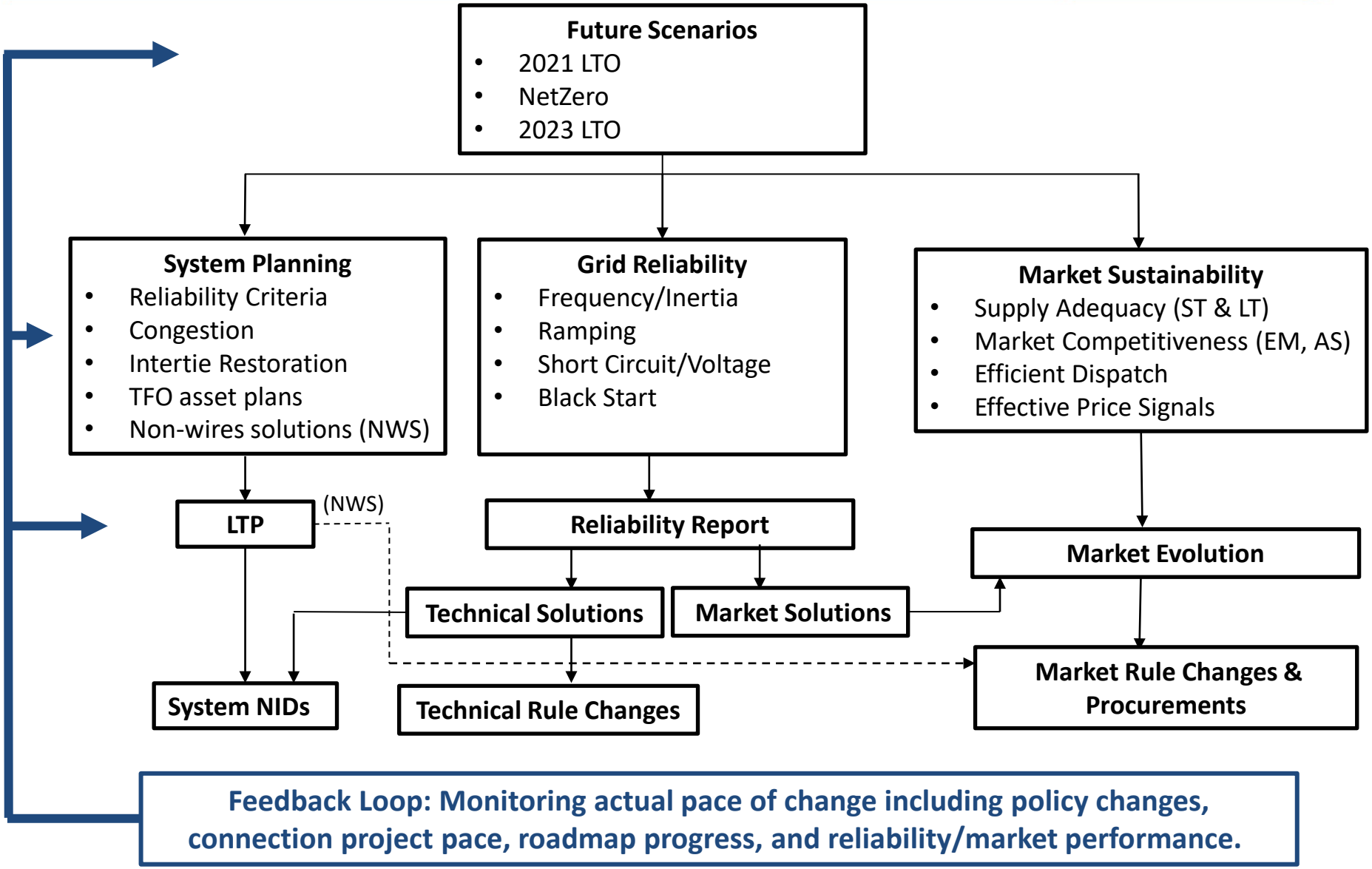
- Share our process and plans to sustain reliability through the transformation
- Explain our reliability need areas and how we currently address them
- Share how our reliability need areas are impacted by increasing renewable penetration
- Share our priority for action in the frequency response need area and explain the connection to other AESO initiatives

# Our Guiding Principles

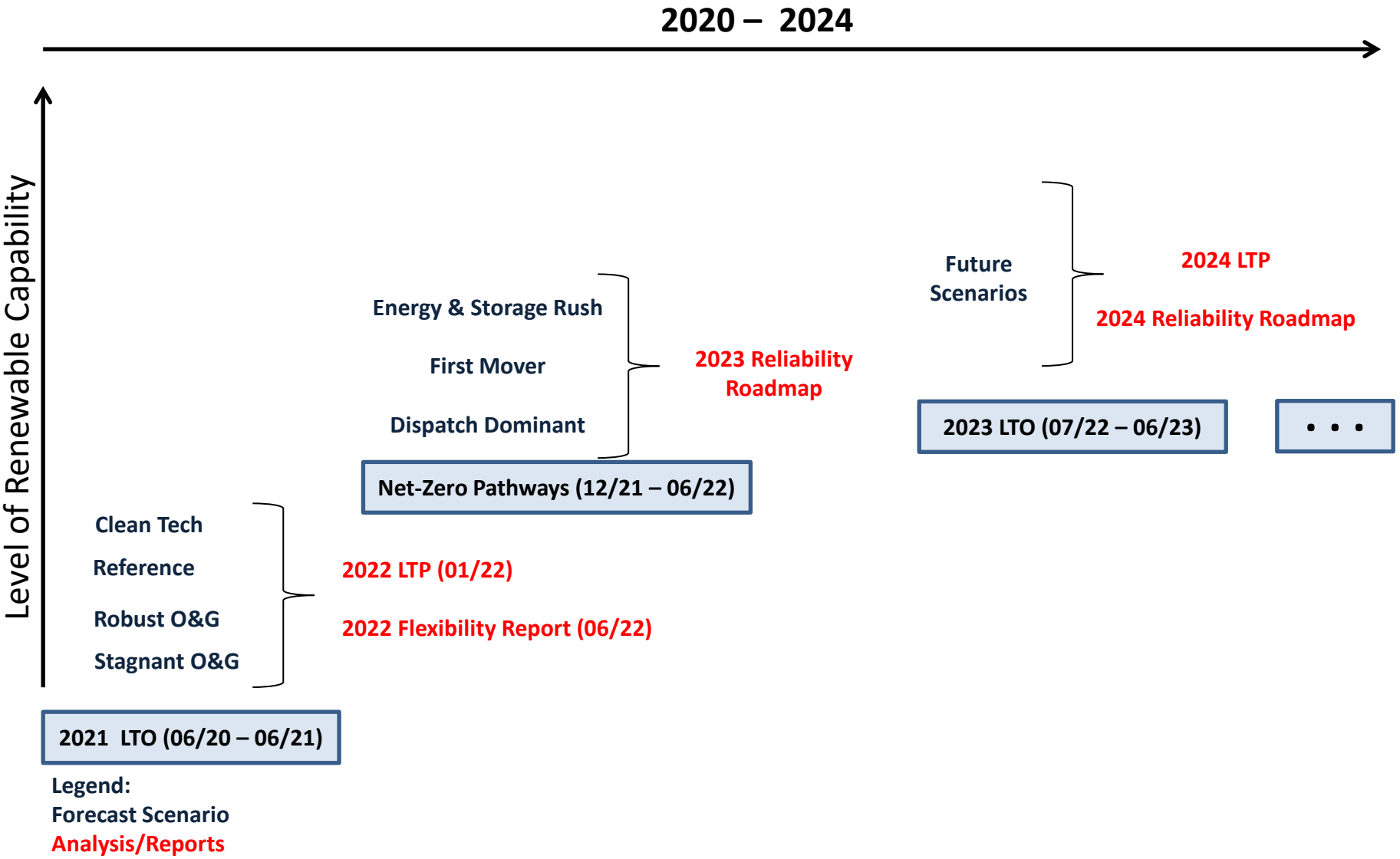
- Sustain reliability through the transformation, at lowest cost to ratepayers
- Deliver reliability needs through competitive forces, where practical
- Preserve FEOC markets that continue to attract needed capital investment, including the energy-only market
- Allocate costs in alignment with long-term drivers of those costs

# The Process We Use to Sustain Reliability

# Our Scenario-based Process and Roadmap Will Sustain Reliability Through the Transformation



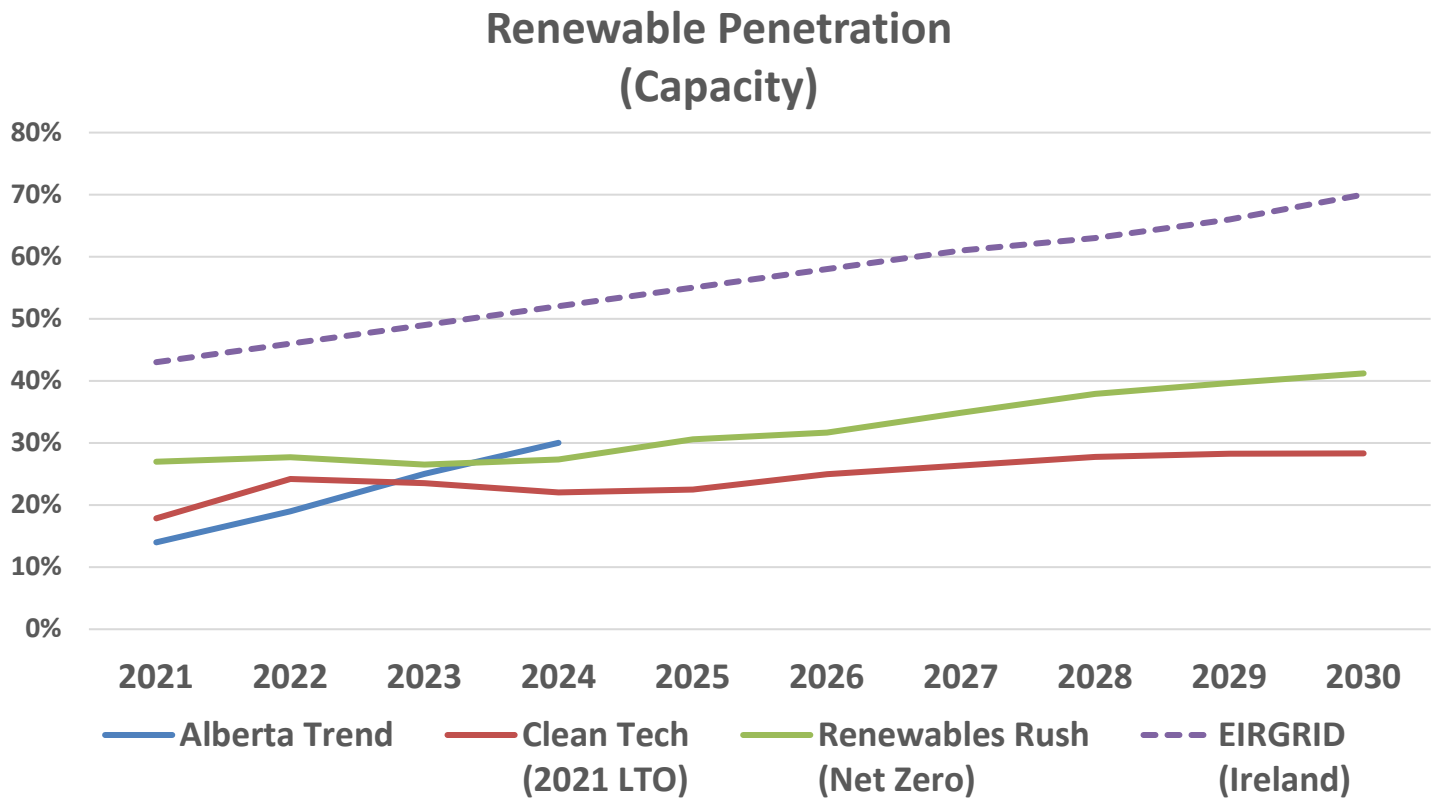
# Our Scenario-based Process Follows a Regular Cycle; Pace is Adjusted Based on Our Feedback Loop



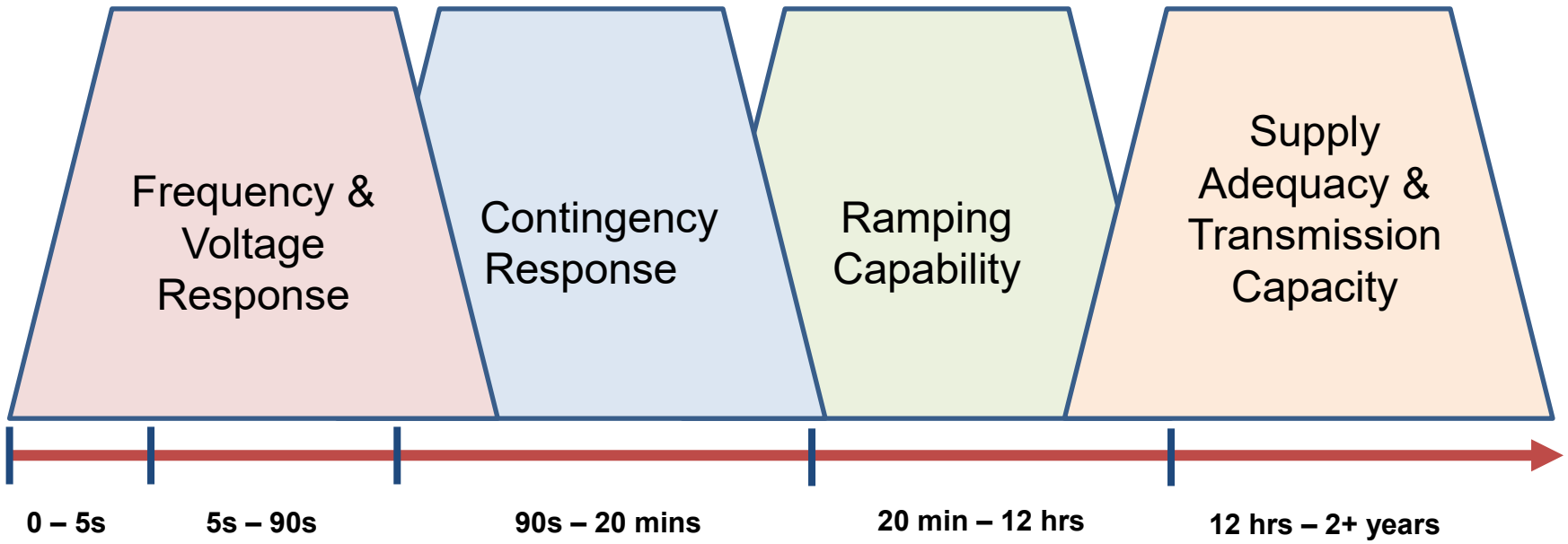
# Impact of Accelerating Renewable Penetration on Reliability

# Increasing Renewable Penetrations Will Create Reliability Challenges Around 2024-2026

- Ireland (EIRGRID), a similar system to Alberta, is currently at 43% capacity, growing to 50% by 2024, and targeting 70% by 2030
- Our Alberta Trend is accelerating and is expected to reach 30% capacity by 2024, close to the Renewables Rush (Net Zero) capacity scenario trend
- Per Dispatchable Renewables & Energy Storage Study, 30% Energy metric (35% to 40% capacity metric) is the range where reliability challenges require targeted action

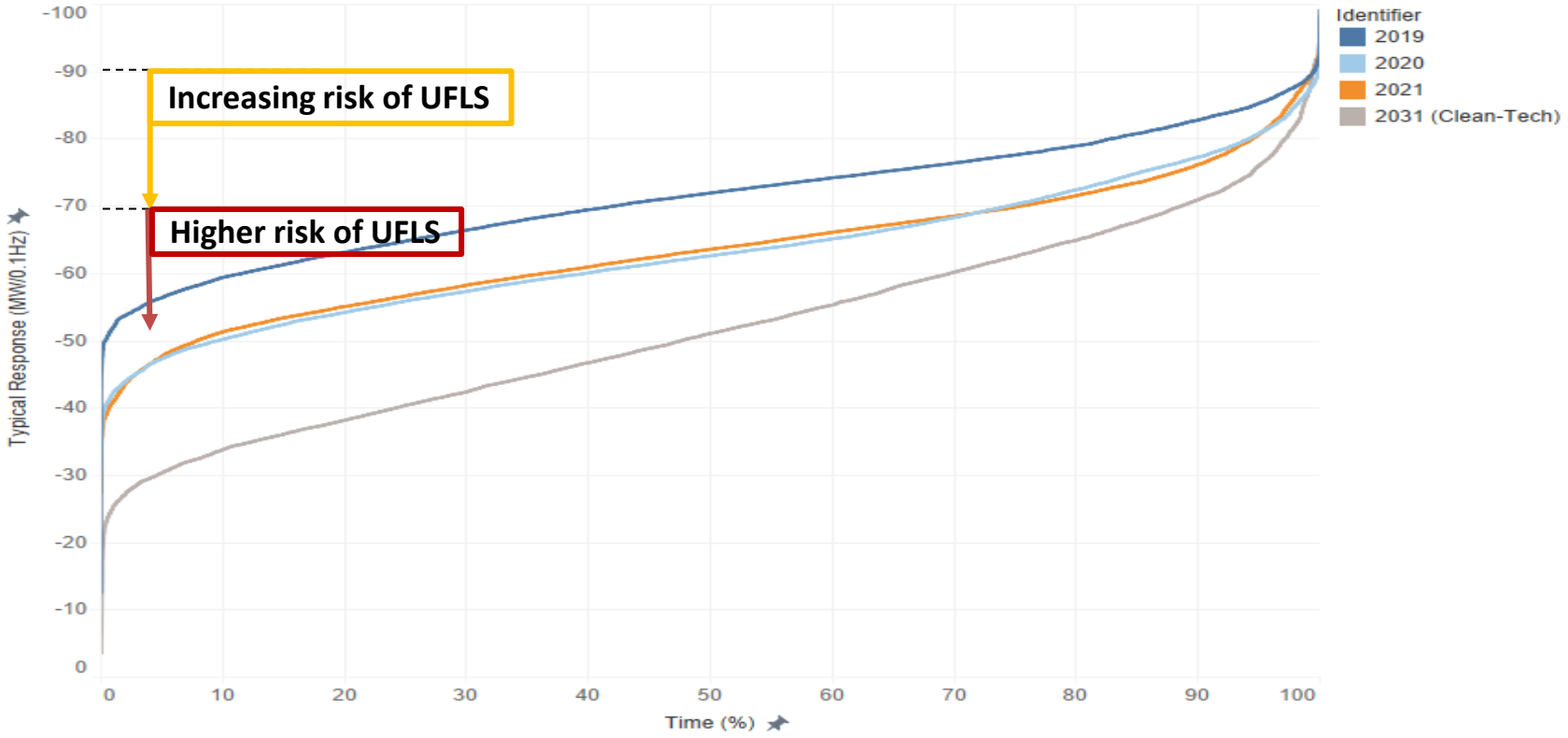


# The AESO Delivers Reliability Across the Entire Time Spectrum, from Milliseconds to Years



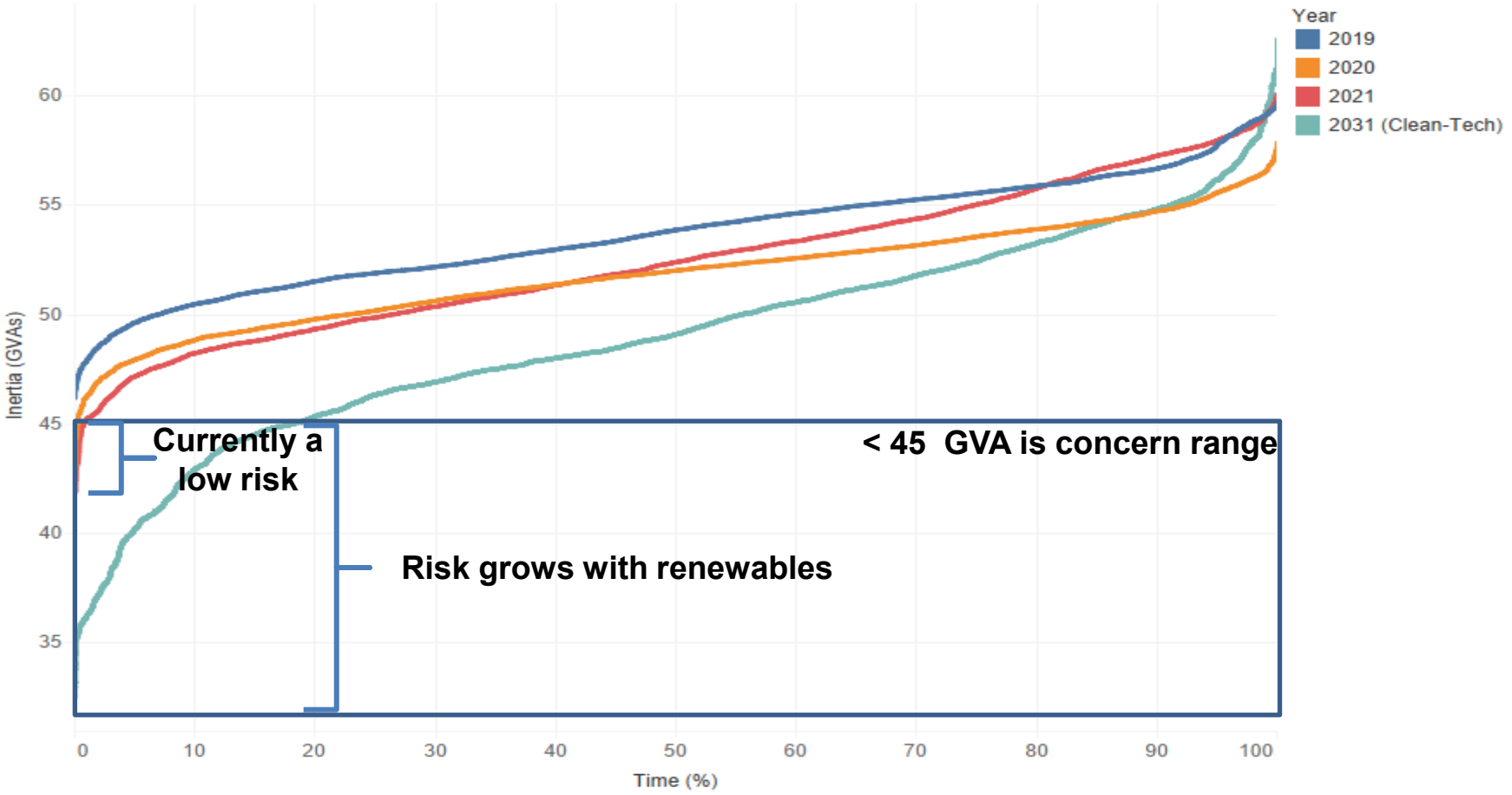
# Frequency Response Capability is a Current Challenge and Degrades Further as Renewable Penetrations Increase

- Primary frequency response (PFR) has declined from 2019 to 2021 and is expected to continue to decline as renewable penetration continues to increase
- The time per year is growing where there is frequency response capability risk of Underfrequency Load Shed (UFLS), following a contingency



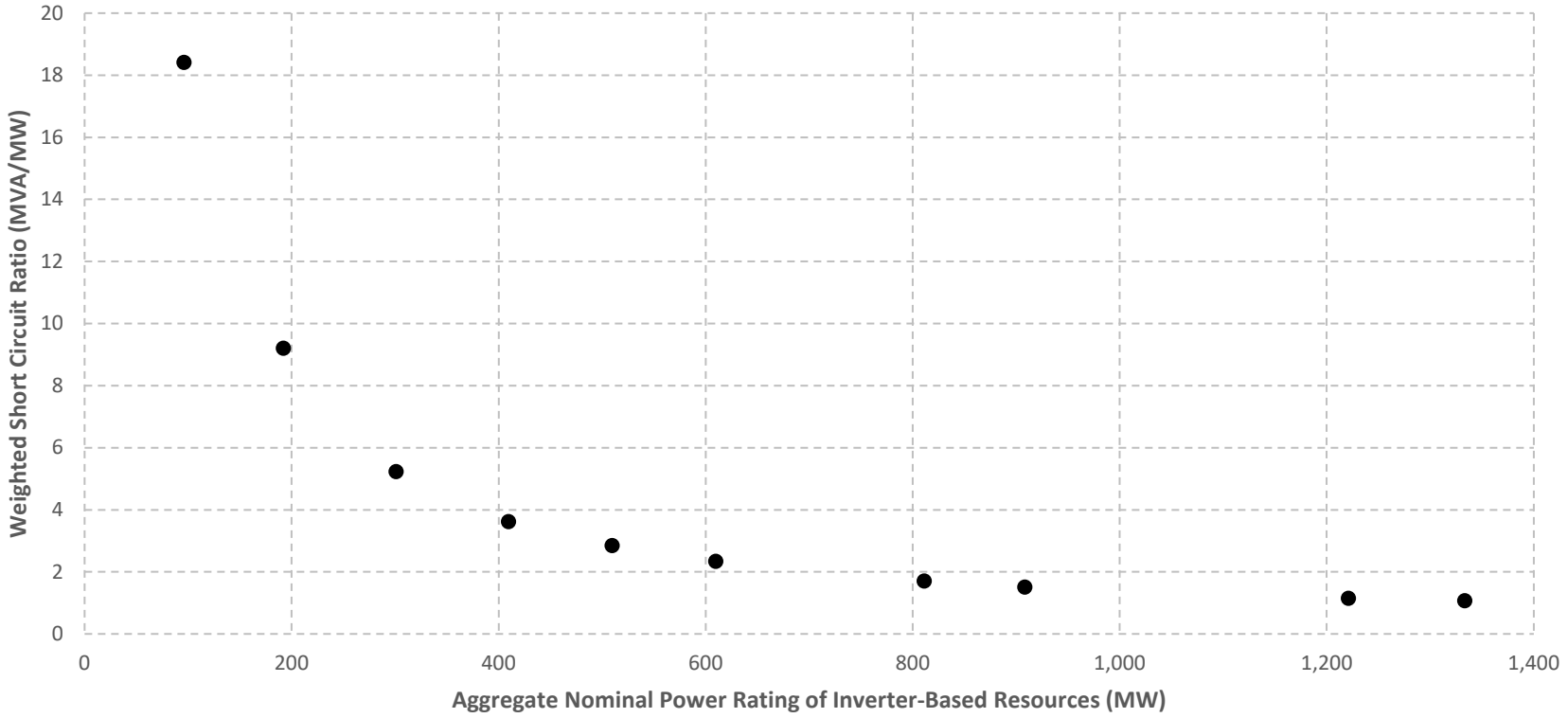
# Inertia Levels Will Continue to Decline With Growing Renewables; Expect Growing Challenges

- The time per year is growing where there is inertia-related risk of UFLS, following a contingency



# System Strength Will Decline in Regions of Higher Renewable Penetration

- One key metric of system strength is the short circuit ratio (SCR)
- In regions of high renewable penetrations, SCR can decline considerably
- Weaker system strength (lower SCR) in regions can cause reliability challenges
  - Voltage instability, system protection mis-operation, plant control instability, plant tripping for disturbances



# Net Demand Variability and Ramping Requirements Will Grow

- Net demand ramp sizes increase and the frequency of occurrences per year increases as renewable penetrations grow
- Increasing ramp sizes and frequency may require improved ramping capability in order to effectively match supply with demand

NET DEMAND VARIABILITY

| Clean-Tech Scenario | 2022 | 2026 | 2031 |
|---|---|---|---|
| Ramp Size +/- 50 MW or > (Avg MW) | 79 | 85 | 93 |
| %/year | 25.0% | 31.8% | 41.5% |
| Ramp Size +/-100 MW or > (Avg MW) | 246 | 275 | 327 |
| %/year | 60.4% | 66.5% | 73.0% |
| Ramp Size +/- 500 MW or > (Avg MW) | 595 | 619 | 647 |
| %/year | 3.0% | 5.9% | 12.6% |

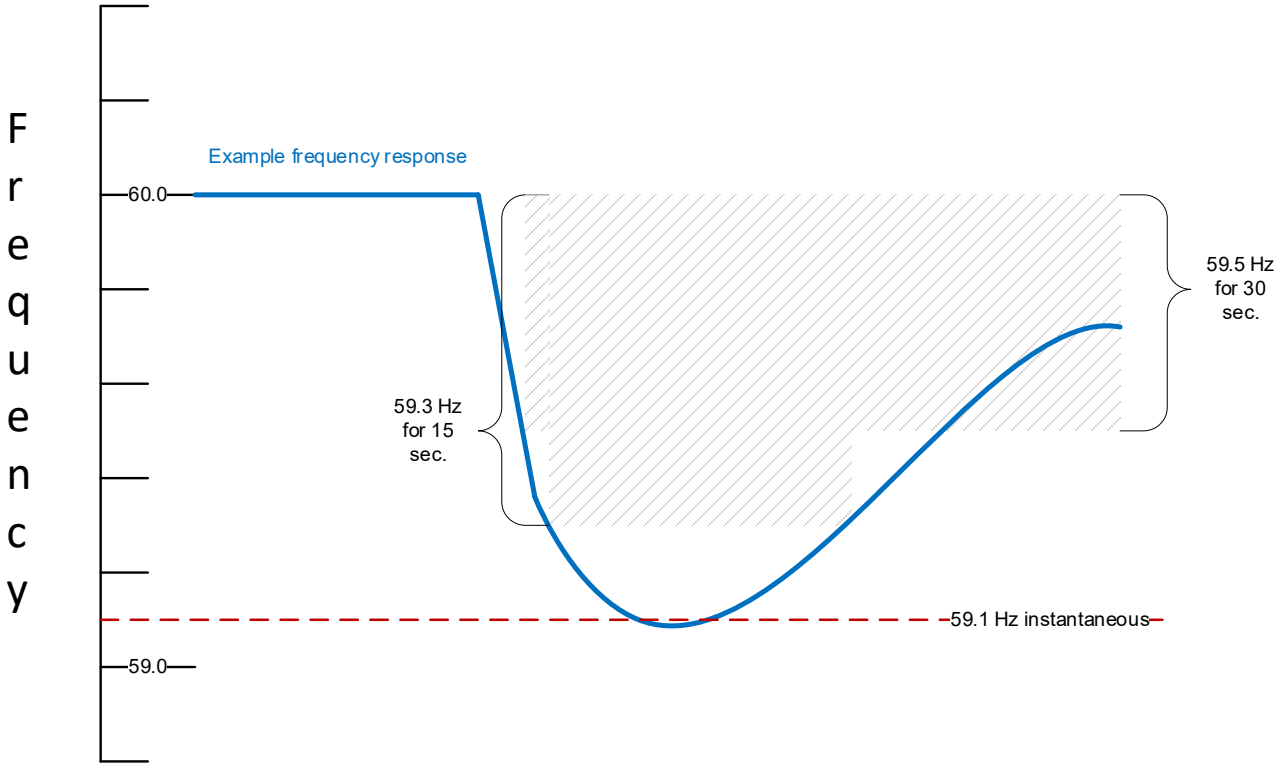
# Frequency Response Capability is Our First Priority

# First Priority is Frequency Response Capability

- UFLS events are a violation of our reliability standards
- Frequency deviations can result in cascading events, with broader reliability impact
- Increasing number of UFLS events are already occurring due to declining primary frequency response (PFR) and inertia
- Higher renewables will increase the risk of more UFLS events as PFR and inertia decline further
- UFLS events trip a large number of customers

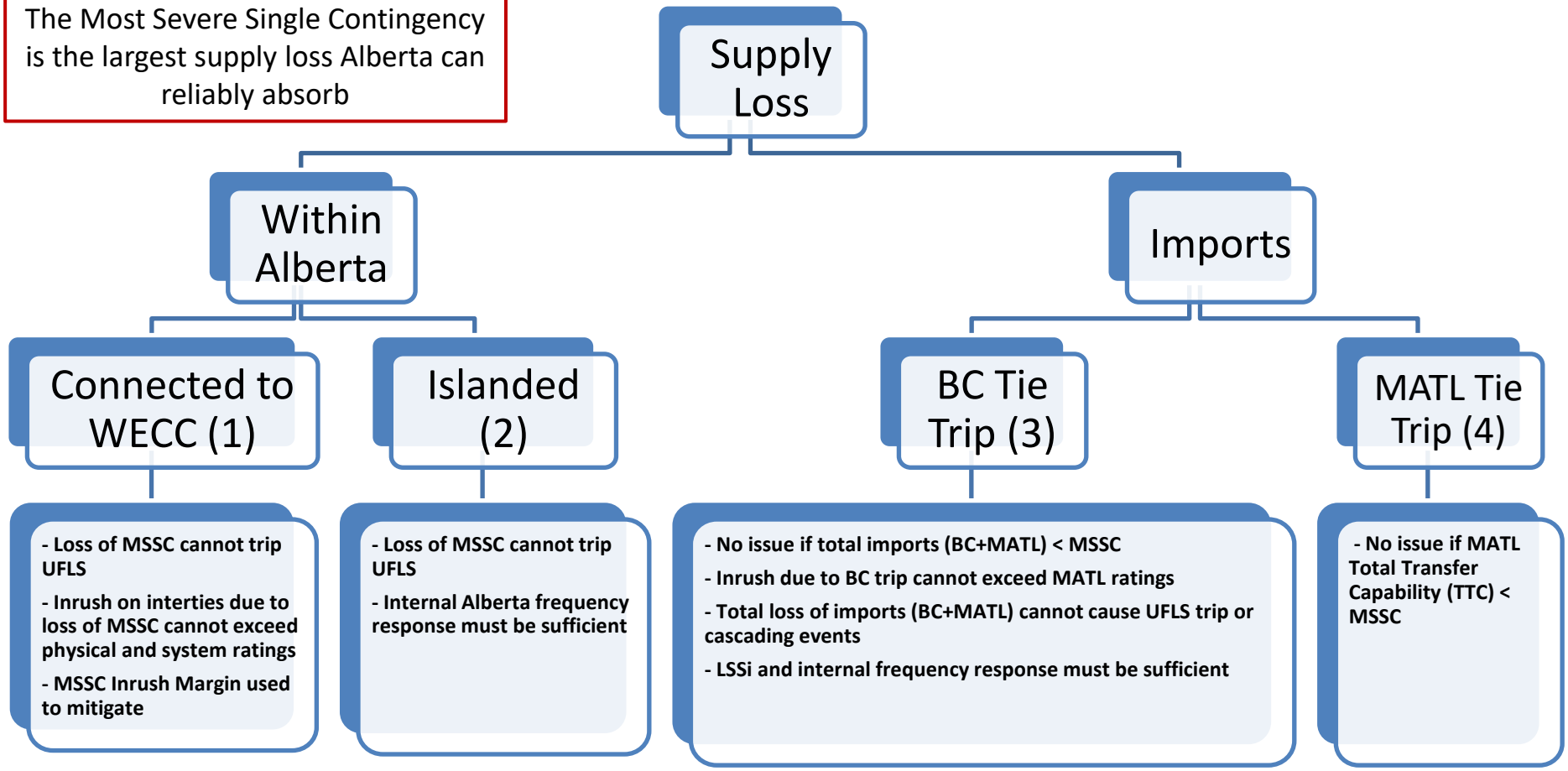
# Underfrequency Load Shedding (UFLS) is a Reliability "Safety Net" That Trips Off Load Customers and Must be Avoided

- Tripping off load customers for a single contingency is a violation of our Reliability Standards
- A sudden supply loss (imports or within Alberta) causes frequency to drop rapidly
- The larger the supply loss, the farther the frequency will drop, and the longer to recover to 60 Hz
- Amount of inertia connected at the time impacts how fast and how far the frequency drops
- Online generators and other frequency services, such as Load Shed Service for Imports ("LSSi"), must respond quickly to offset the lost supply, in order to halt the frequency drop before UFLS "safety net" triggers



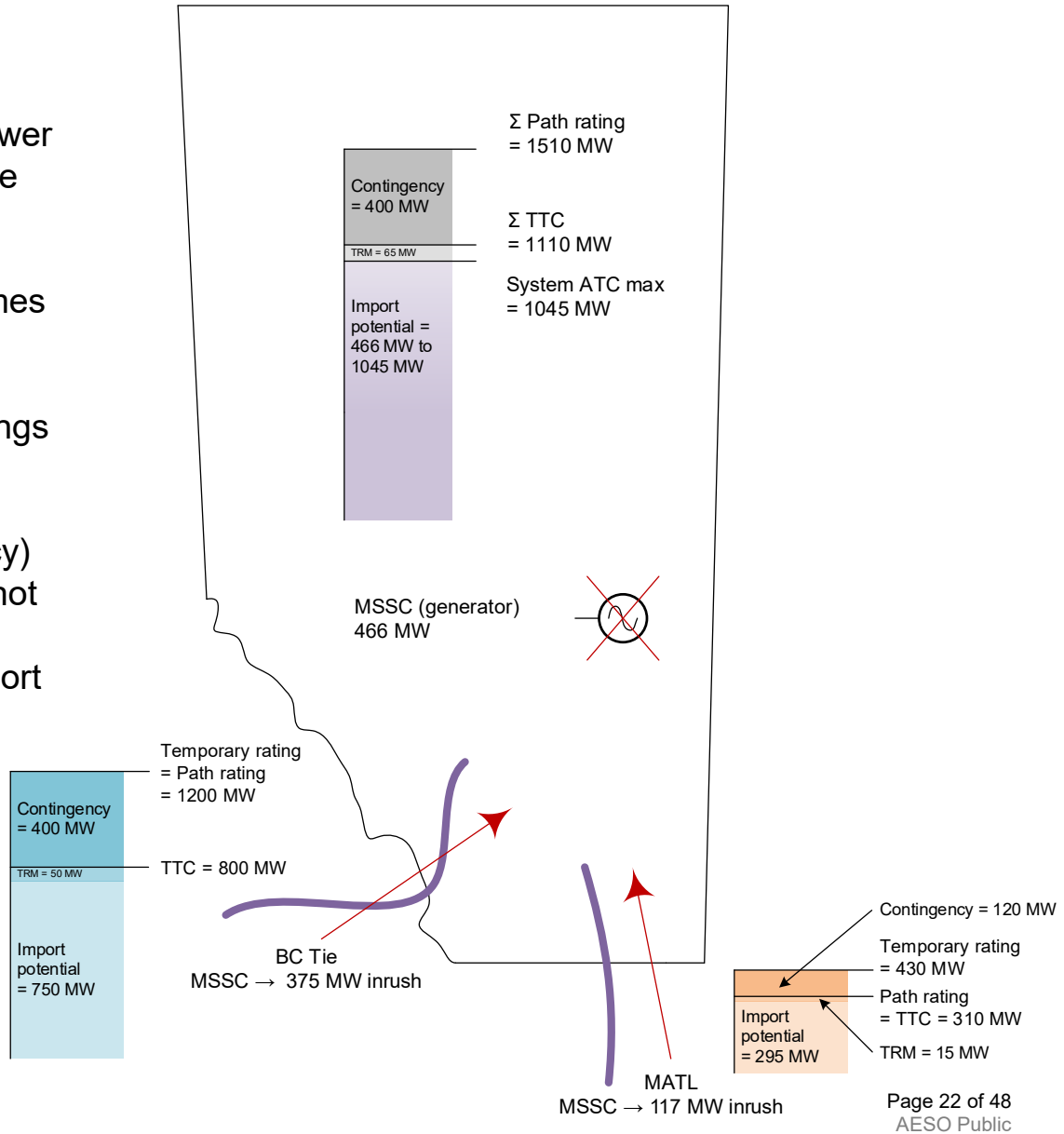
# Need to Sustain Reliability Under Four Different Supply-Loss Scenarios

**MSSC Limit**
The Most Severe Single Contingency is the largest supply loss Alberta can reliably absorb



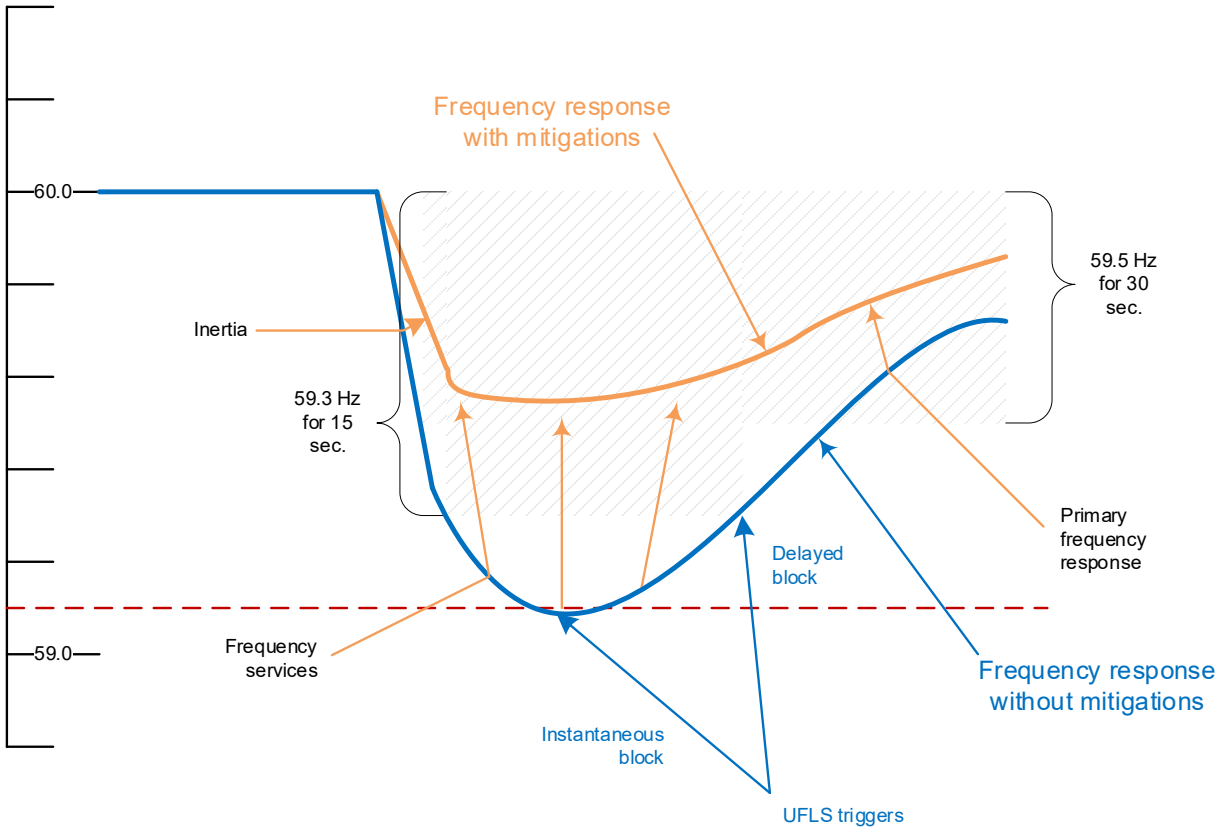
# Scenario 1: When Connected to WECC and Loss of MSSC, Intertie Inrush is the Constraining Reliability Factor

- When connected, a sudden loss of internal supply is instantly offset by power rushing in from our neighbours over the AC interties
- Physics dictates how much inrush comes over the BC and MATL interties
- The inrush cannot result in intertie ratings and system limits being exceeded
- The MSSC Inrush Margin (Contingency) ensures intertie ratings and limits are not exceeded by the inrush levels, maintaining reliability but reducing import capability



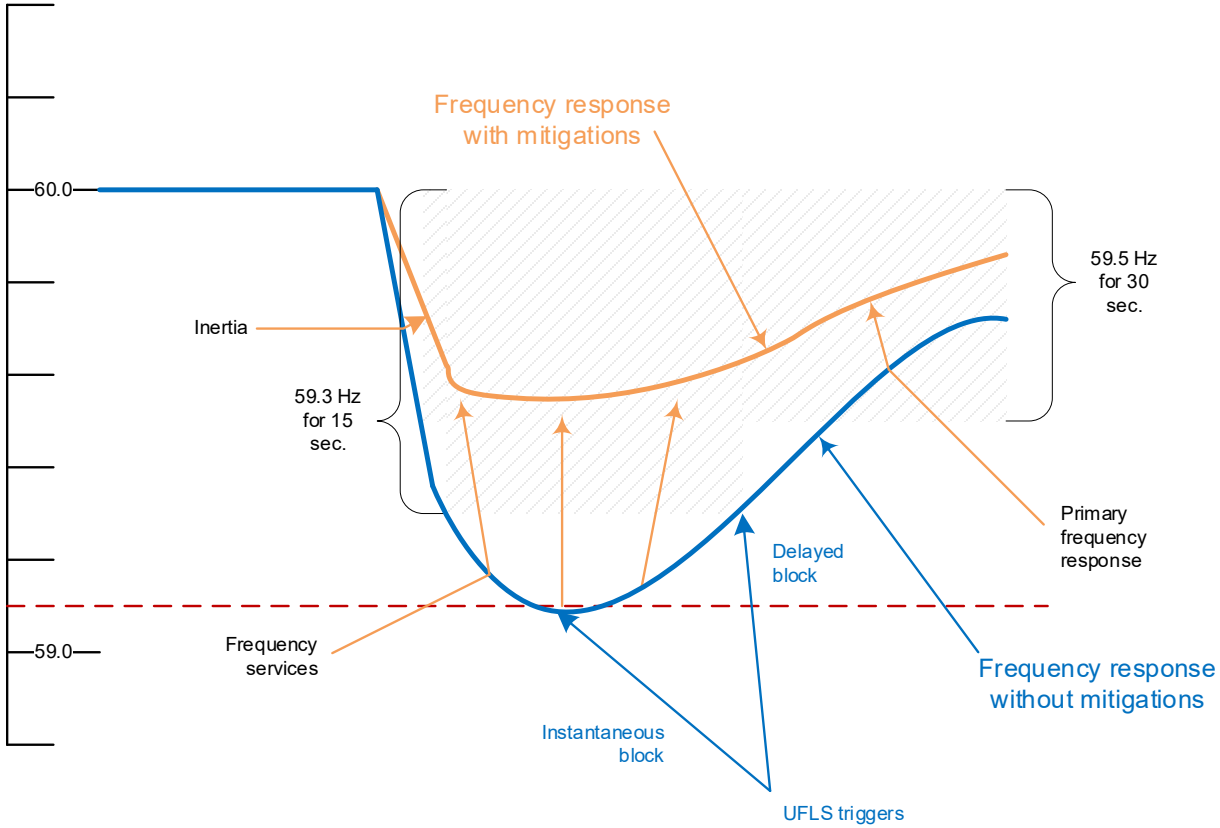
# Scenario 2: When Connected to WECC and Loss of the BC Intertie, Frequency is the Constraining Reliability Factor

- When connected, a sudden loss of the BC intertie results in tripping the MATL intertie as MATL cannot handle the instantaneous inrush levels
- The resulting loss of both interties causes the frequency to drop rapidly
- Per reliability standards, the frequency drop cannot cause UFLS or cascading outages
- Internal Alberta frequency response, including inertia and any special frequency services like LSSi, must be sufficient to offset loss of imports and recover the frequency



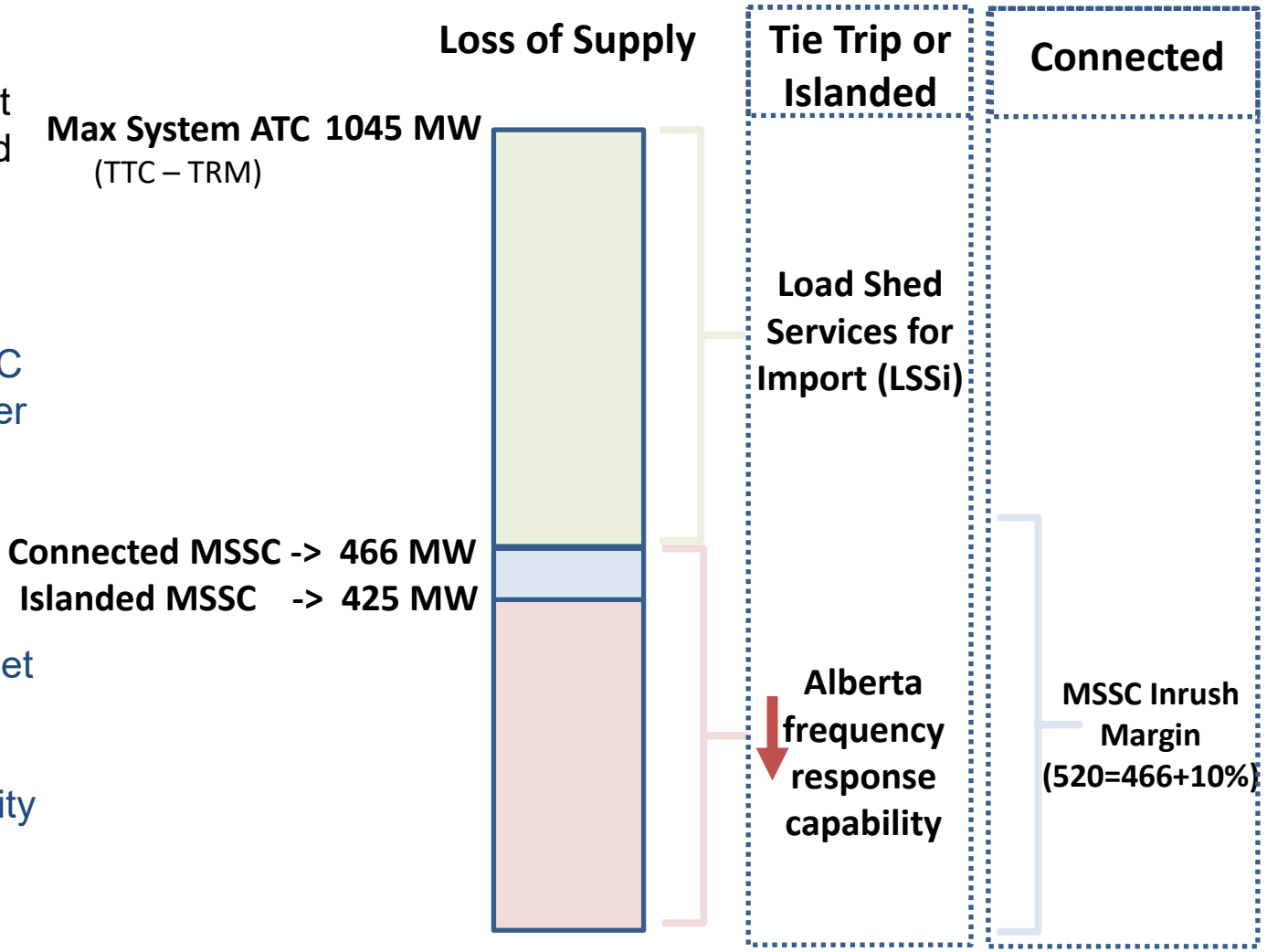
# Scenario 3: When Islanded and Loss of MSSC, Frequency is the Constraining Reliability Factor

- When islanded, a sudden loss of MSSC results in a rapid drop in frequency
- The frequency drop cannot cause UFLS or cascading outages
- Internal Alberta frequency response, including inertia response, must be sufficient to offset loss of MSSC and recover the frequency



# Declining Inertia and Frequency Response Capability Increases Risk of Triggering UFLS "Safety Net"

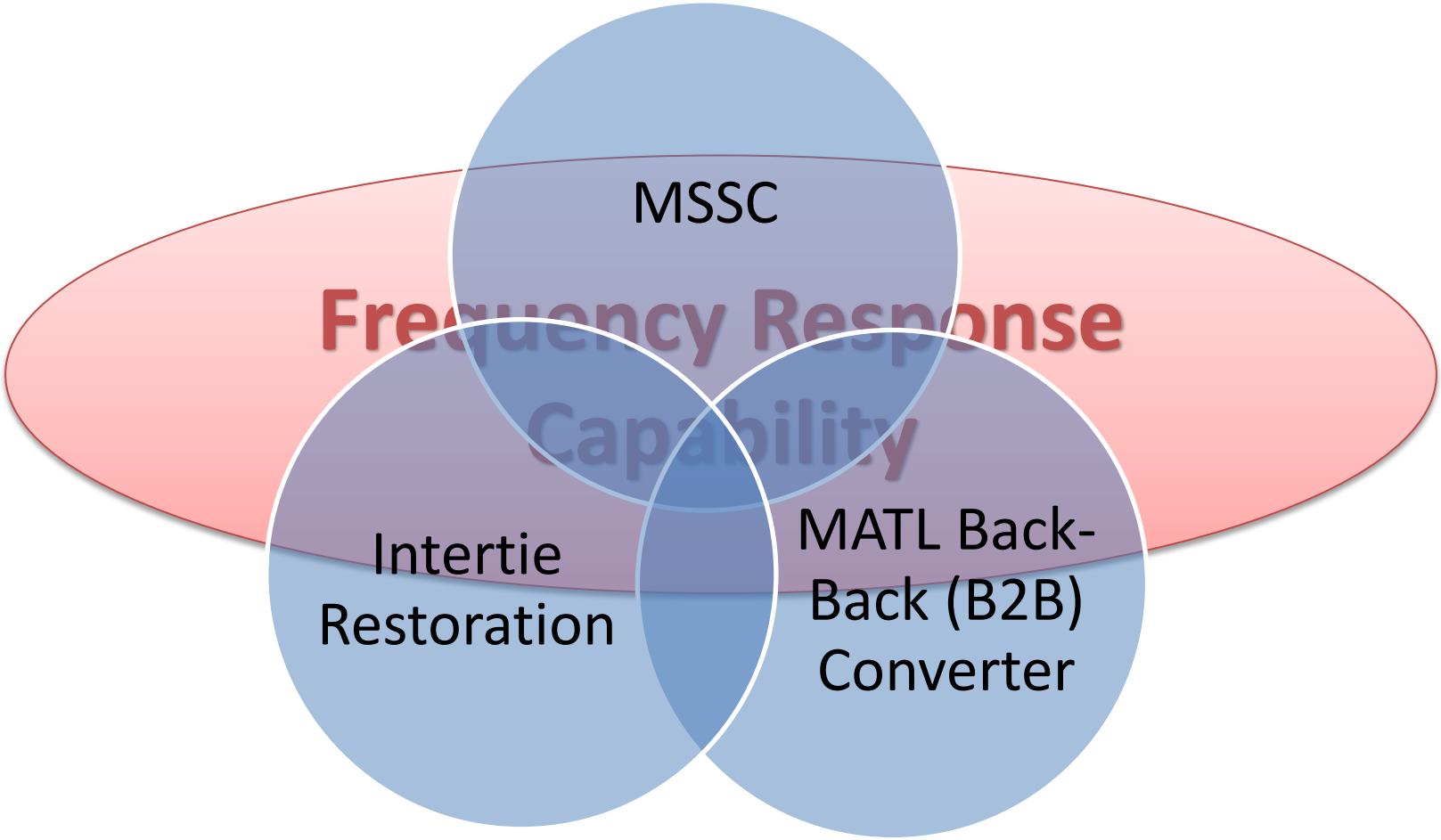
- Higher renewable penetrations will result in declining inertia and frequency response capability
- As a result,
  - the existing MSSC Limit will be harder to reliably absorb when islanded
  - existing import levels will require more LSSi to offset the declining frequency response capability




ATC = Available Transfer Capacity
TRM = Transmission Reliability Margin
TTC = Total Transfer Capacity

# Interrelated Activities and Frequency Response Capability

# Frequency Response Capability Connects to Several Other AESO Activities

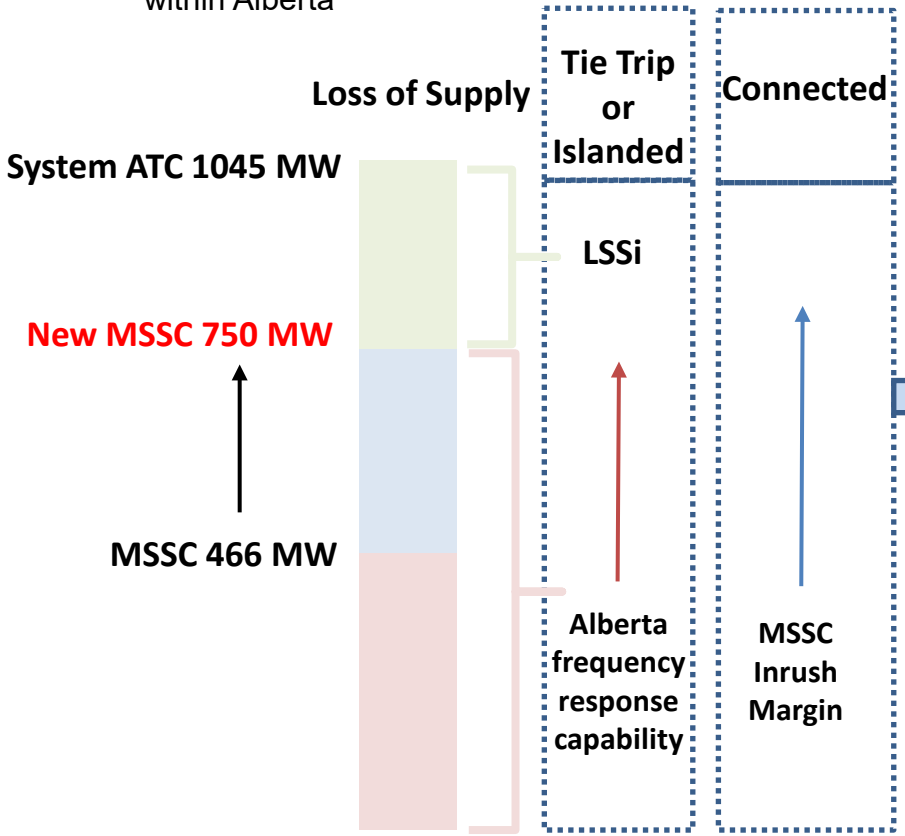


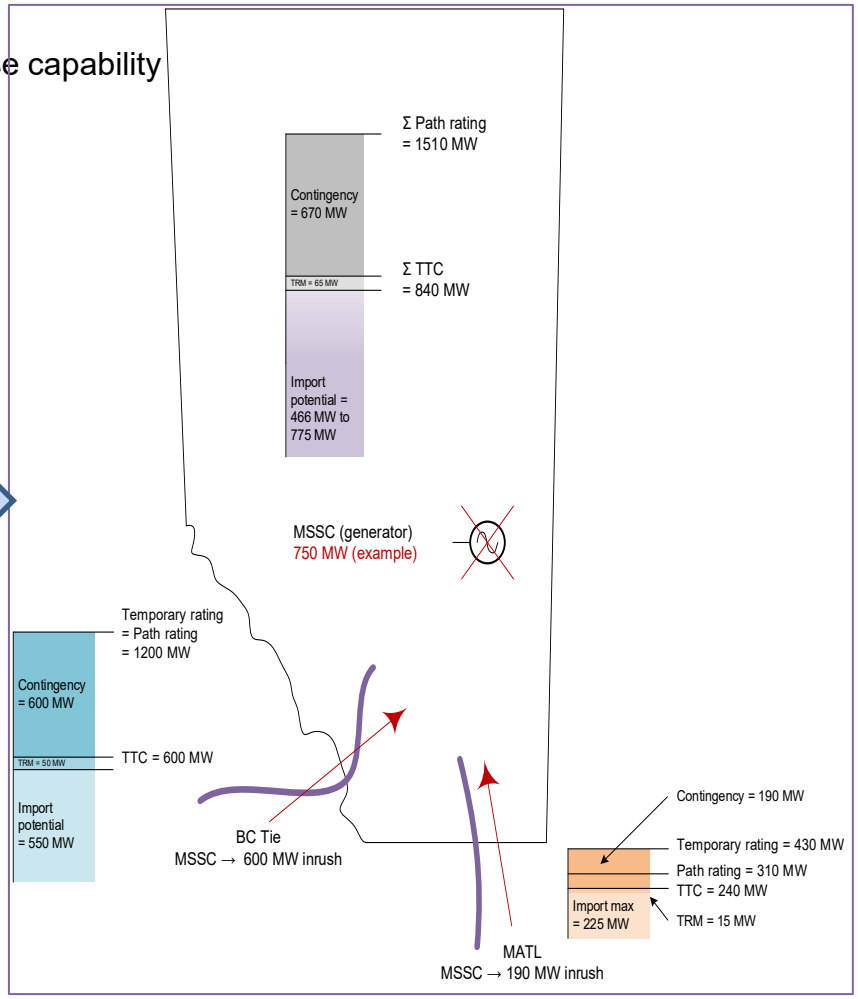
# MSSC

# Increasing the MSSC Limit Will Require Additional Reliability Mitigation Measures

- Increasing the MSSC Limit will require two different mitigation measures:
  - When connected to WECC, it would require an increase in MSSC Inrush Margin lowering the import TTC, or else some type of very fast supply injection within Alberta to reliably offset the intertie inrush

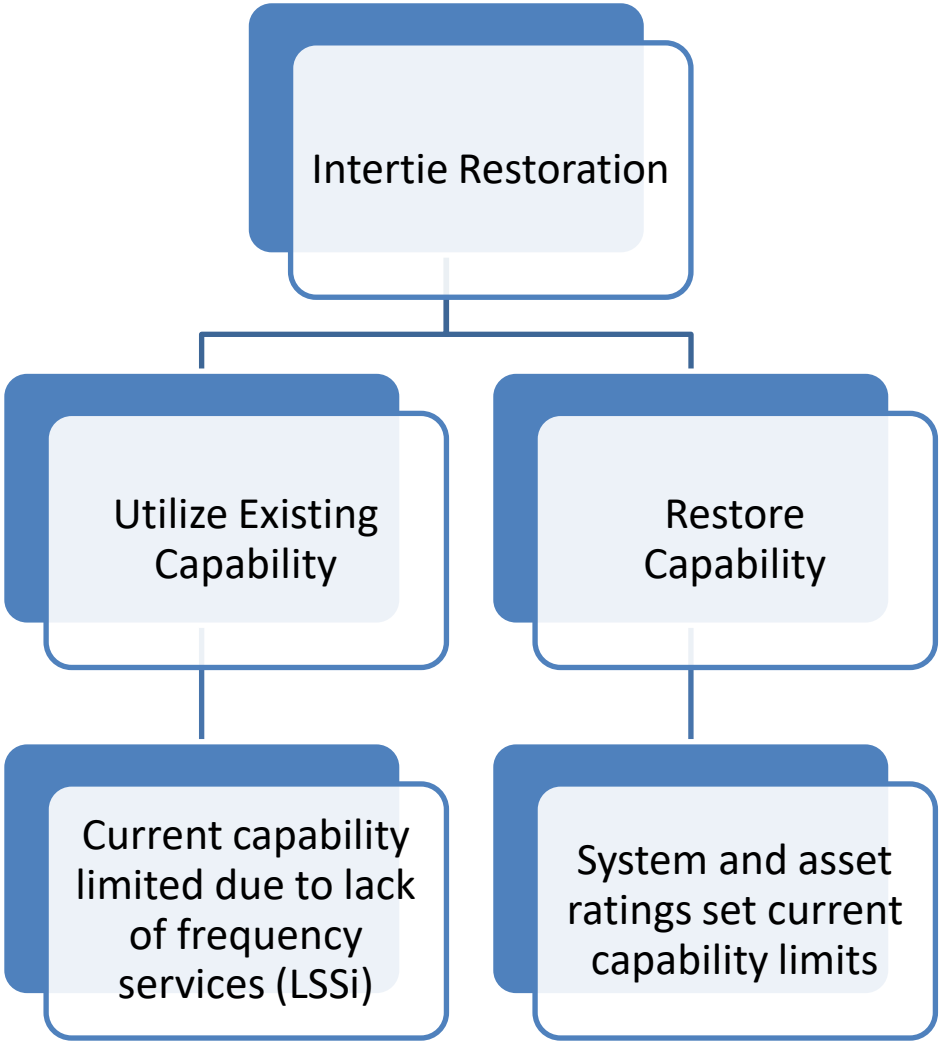
    **and**
  - When islanded, it would require additional frequency response capability within Alberta



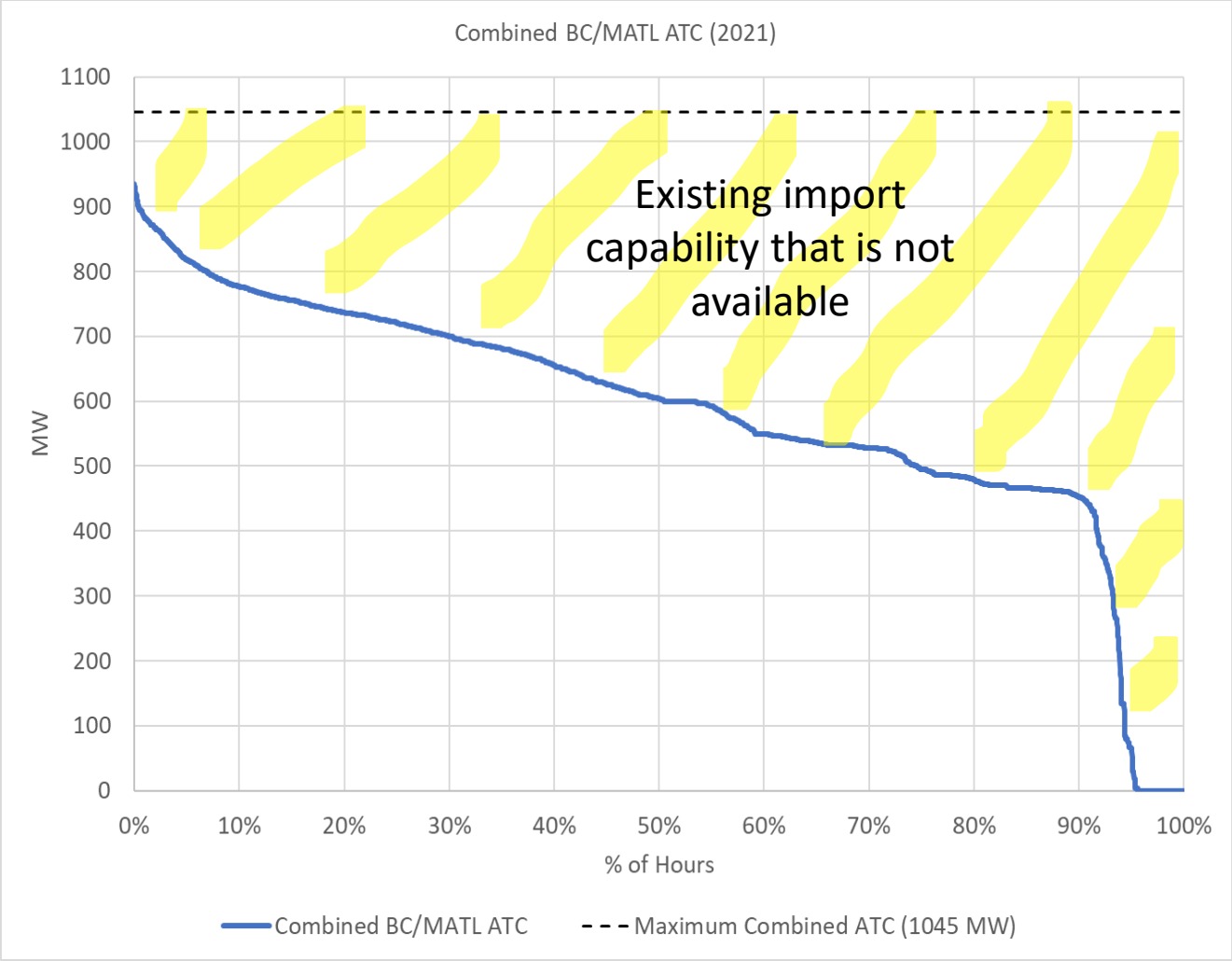
# Intertie Restoration

# Intertie Restoration Includes Better Utilization of Existing Capability as well as Increasing Intertie Capability



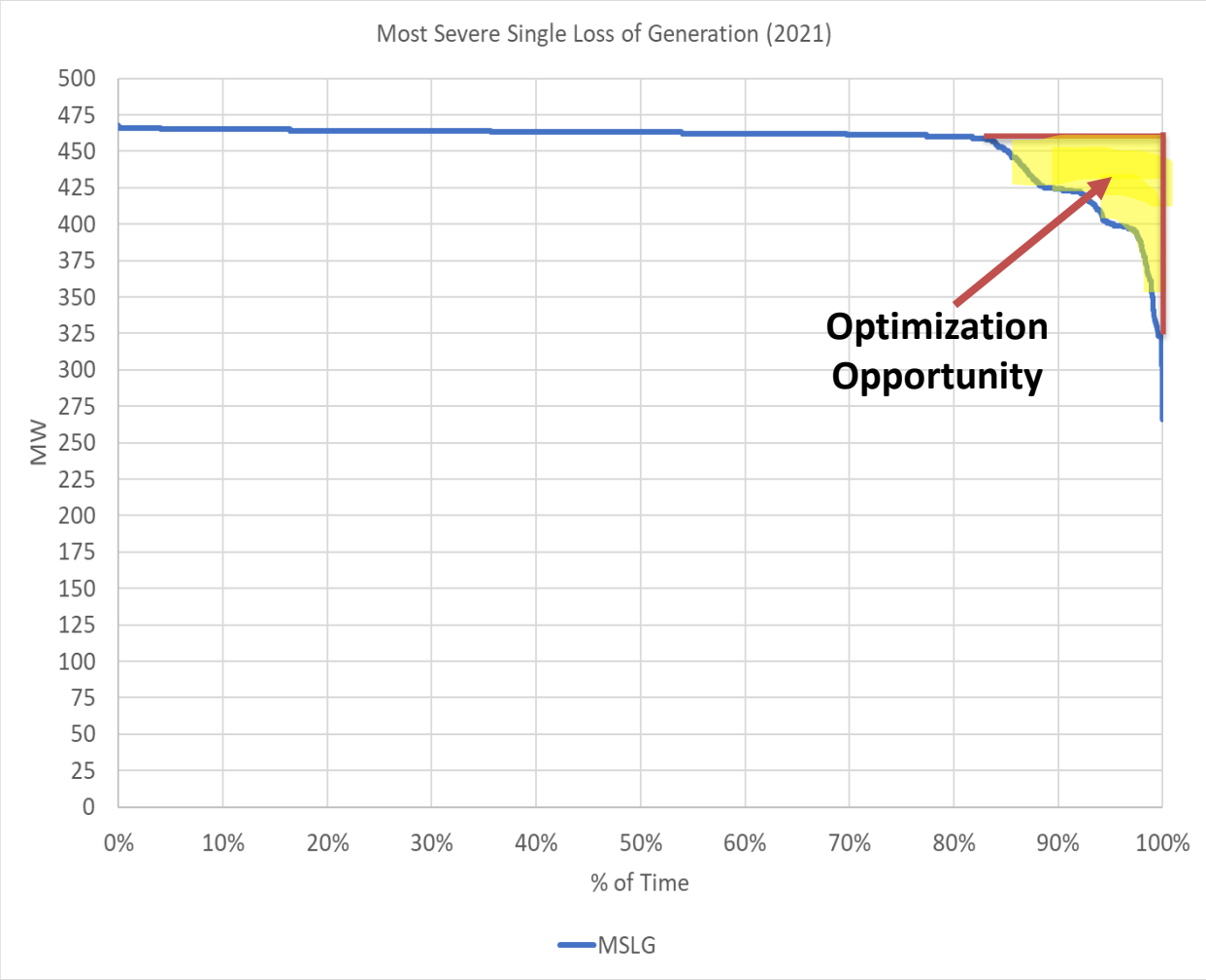
# Existing Import Capability is Currently Limited by Availability of Load Shed Service for Imports

- Maximum System ATC = 1045 MW
- System ATC is shared between the BC and MATL interties, based on how much LSSi is available to insure against their combined loss
- LSSi availability often limits Actual ATC below 1045 MW
- Additional LSSi or similar frequency services would enable greater utilization



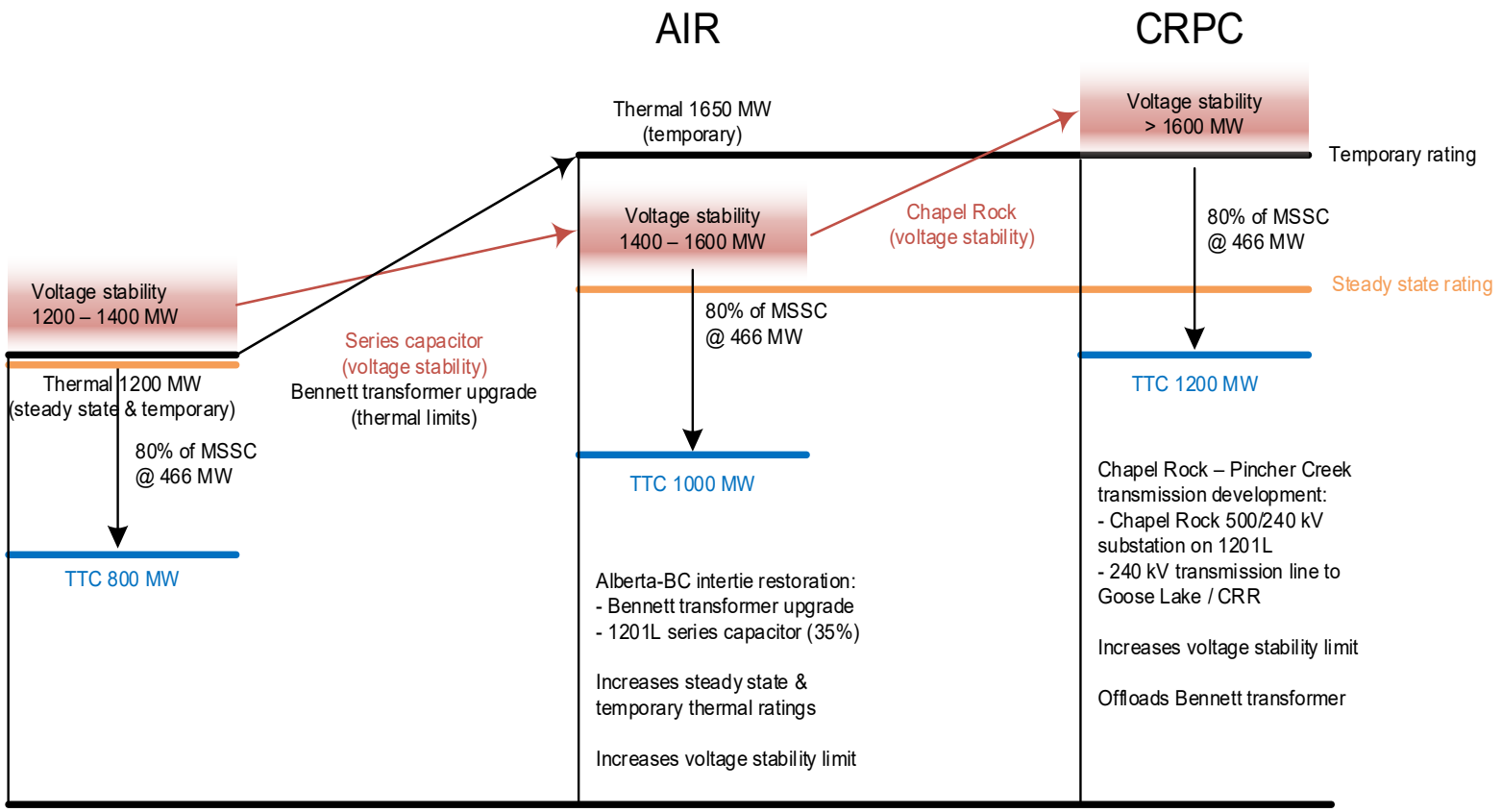
# Existing Import Capability is also Limited "Statically" due to MSSC Inrush Margin Year Round

- MSSC Inrush Margin is held at 8,760 hours per year to manage loss of MSSC
- Actual MSSC in any hour is determined by the loss of the actual most severe supply contingency in that hour, usually the output of the largest generating unit
- Import capability could be optimized by setting the MSSC limit "dynamically" based on actual conditions



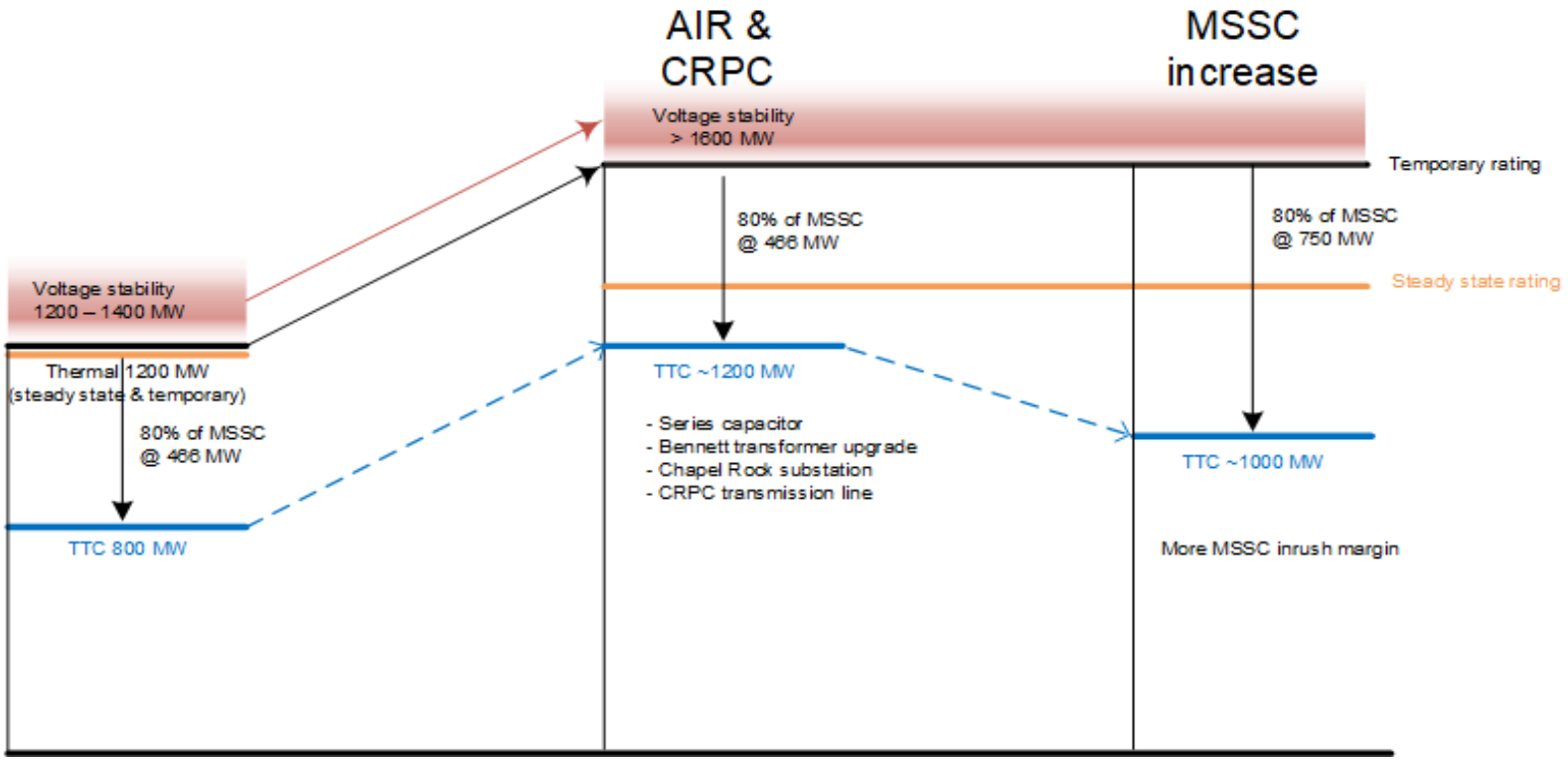
# Increasing BC Intertie Capability Can be Phased Based on Removing Successive Constraints

- Alberta – British Columbia Intertie Restoration (AIR) project increases BC TTC by about 200 MW
- Chapel Rock Pincher Creek (CRPC) project increases BC TTC by another 200 MW



# Possible Effect of MSSC Increase

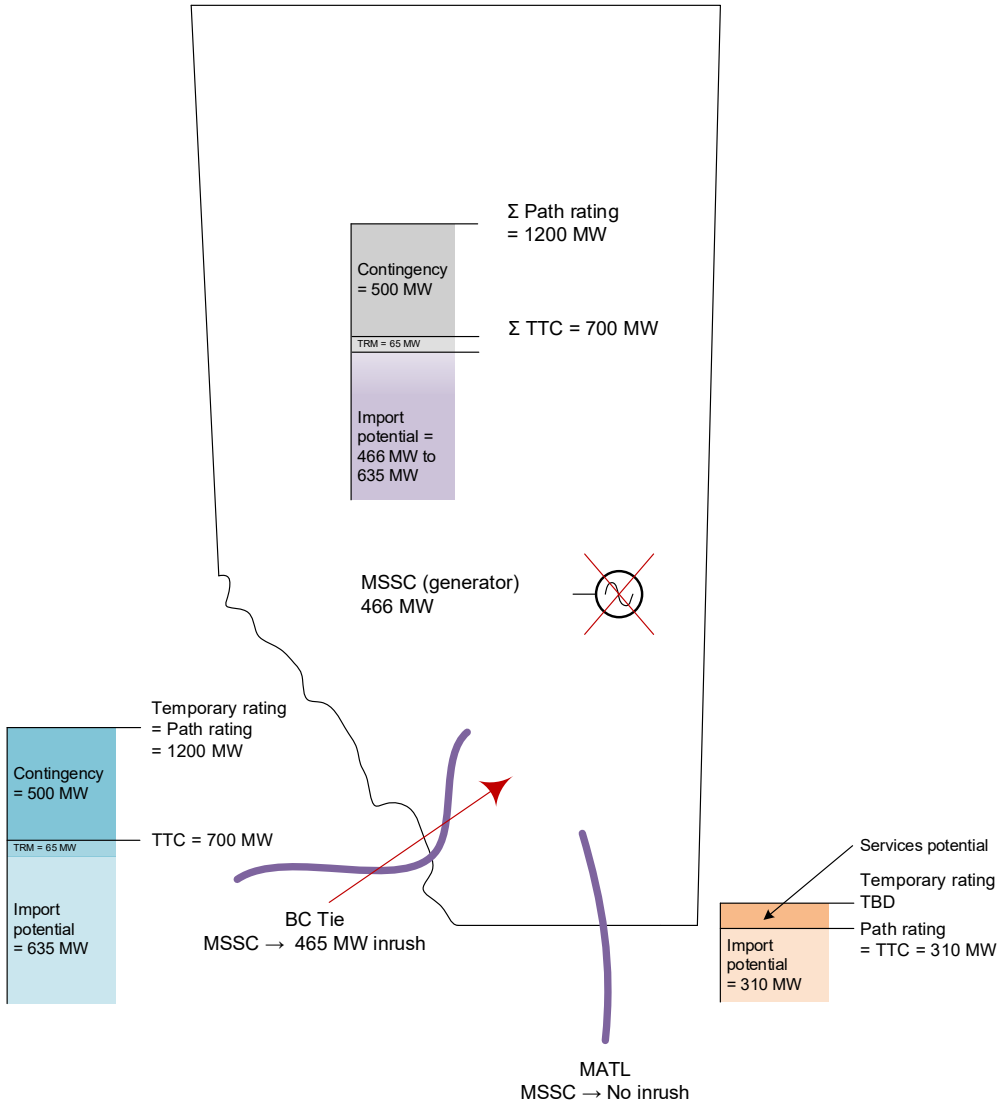
- Increasing the MSSC will result in the need for a higher MSSC Inrush Margin, resulting in a lower TTC, unless something else fast enough can reliably offset the inrush



# The effect of a MATL B2B DC Converter

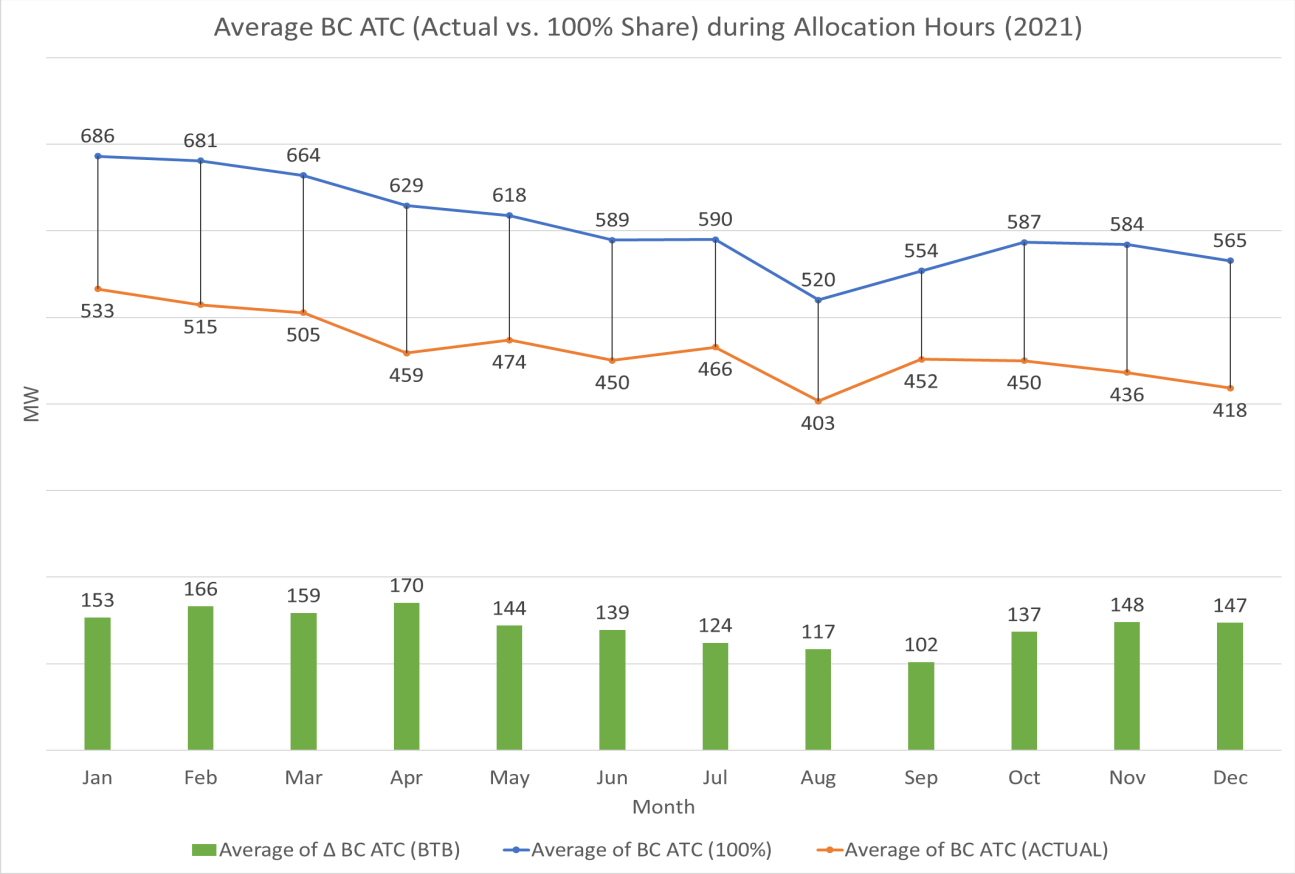
# MATL B2B will Reduce Frequency Service Requirements But Will Not Reduce MSSC Inrush Margin Requirements

- All MSSC Inrush Margin would be supplied via the BC tie, lowering the BC intertie TTC from about 800 MW to 700 MW
- Frequency services would only be needed to support BC import levels, not the combined imports of MATL + BC
- ATC allocation would no longer be required
- MATL has the potential to also provide loss-of-supply mitigation services, via special DC controls



# MATL B2B Increases the BC Intertie ATC

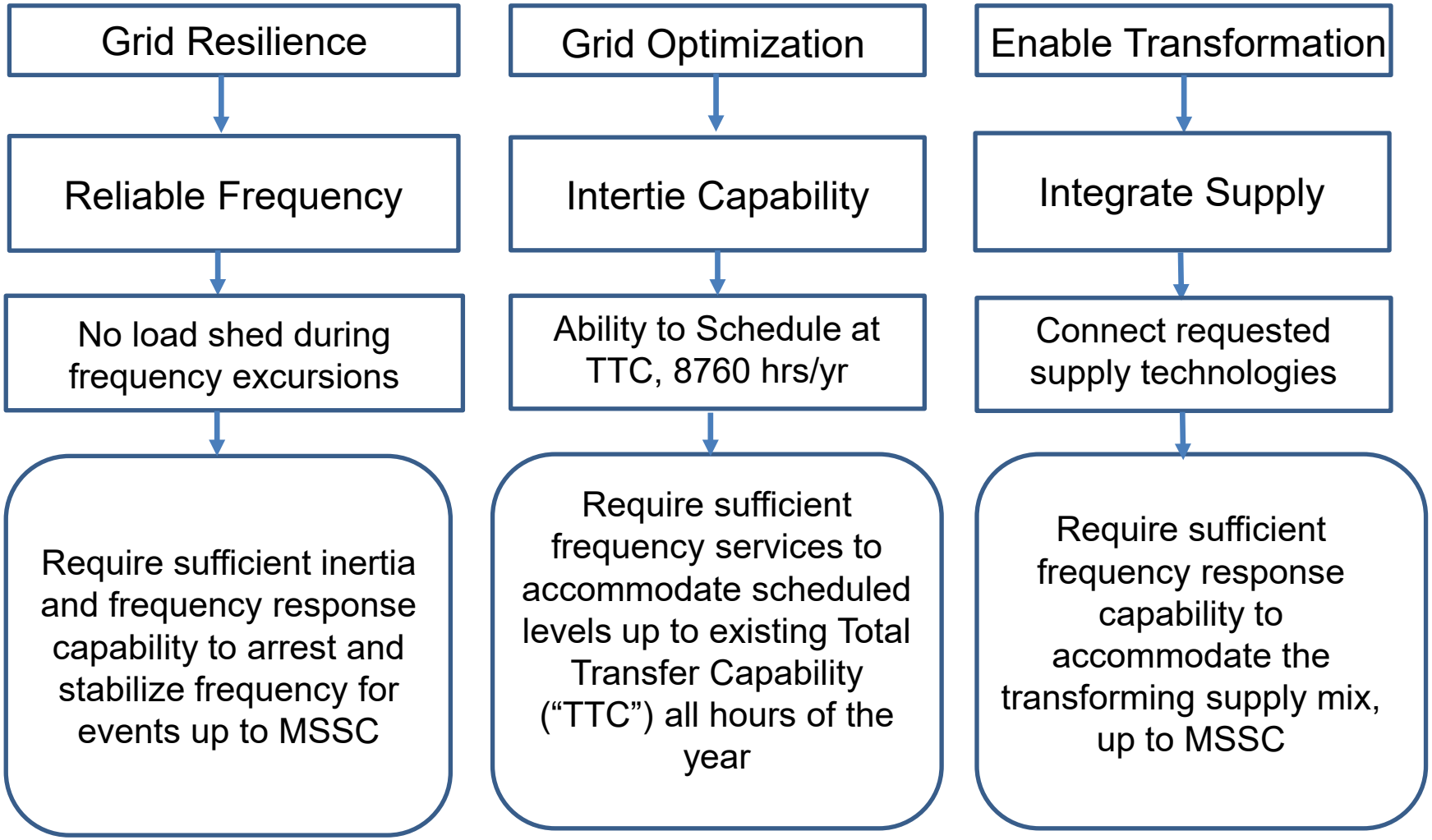
- BC and MATL interties act as a single contingency and must therefore share System ATC (i.e. LSSi) when demand to import is high; adding an HVDC converter to MATL would decouple it from BC and give the BC intertie 100% share of System ATC



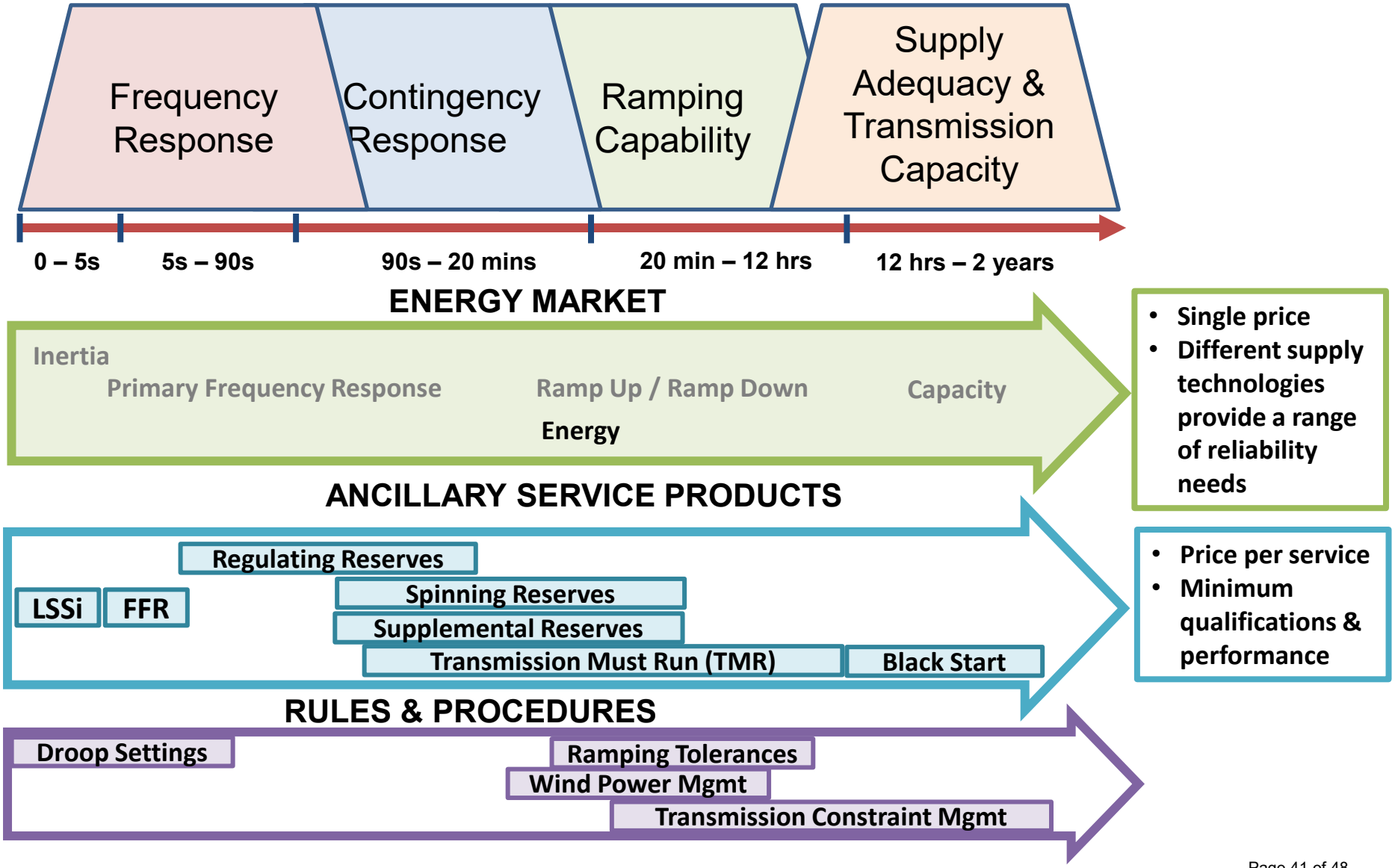

Note: incorporates reduced BC TTC if MATL B2B in place

# How to Improve Frequency Response Capability

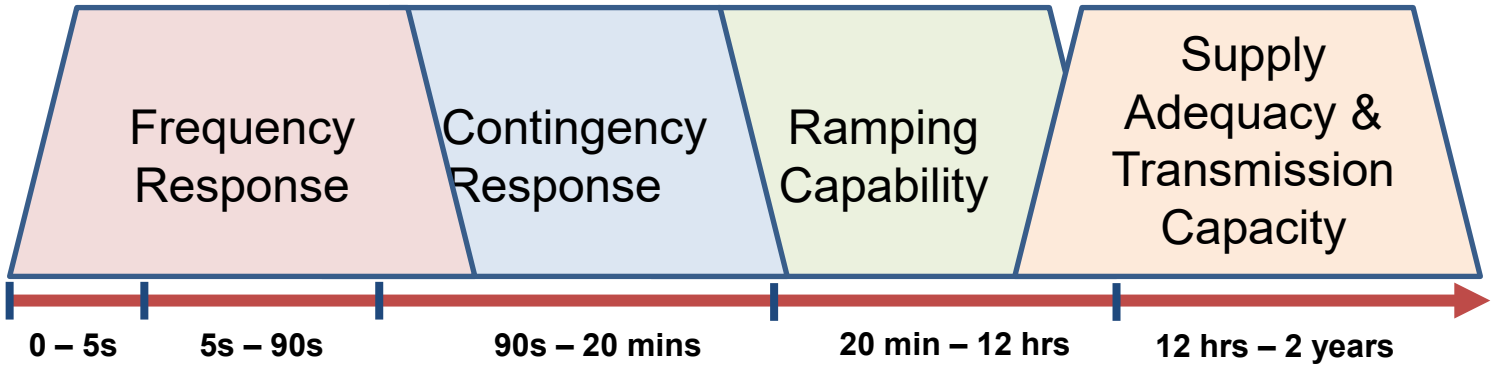
# Additional Frequency Response Capability Will Help to Enable Three AESO Objectives



# Numerous Reliability Needs Are Currently Provided via Three Tools: the Energy Market, Targeted Ancillary Service Products and Rules/Procedures



# As Renewable Penetrations Increase and Reliability Needs Are Challenged Across the Time Domains, We may Require New Mitigations, the First will be for Frequency Response Capability




## ENERGY MARKET

Inertia
Primary Frequency Response
Ramp Up / Ramp Down
Capacity
Energy

- Single price
- Different supply technologies provide a range of reliability needs

## ANCILLARY SERVICE PRODUCTS

Regulating Reserves
Spinning Reserves
Supplemental Reserves
Transmission Must Run (TMR)
Black Start

LSSi
FFR
Frequency Services

- Price per service
- Minimum qualifications & performance

NEW

## RULES & PROCEDURES

Droop Settings
PFR Performance
Ramping Tolerances
Wind Power Mgmt
Transmission Constraint Mgmt

# Next Steps

# Develop 2023 Reliability Roadmap

- Update reliability analysis in H2 2022 for each reliability domain, using the Renewables and Storage Rush Net Zero scenario
- Create and share with industry the 2023 Reliability Roadmap in H1 2023
- Continue to engage and extract learnings from similar jurisdictions
- In parallel in H2 2022, develop action plans to ensure frequency response capability meets current and future reliability requirements

# Share MSSC Options Paper in Q3/Q4 2022

- The AESO is developing a more detailed paper focused on the MSSC initiative, the implications of potentially raising the MSSC Limits and the various mitigation options that could be considered to address reliability challenges associated with higher MSSC Limits

- The AESO will release the paper to stakeholders in Q3/Q4 2022 for engagement and feedback

- Stakeholder feedback will be incorporated into decision-making on changes (if any) to the current MSSC Limits and any corresponding implications for obtaining future frequency response capability to support changes

# Obtain Additional Frequency Response Capability

- In Q3 2022,
  - Determine whether the energy market can deliver the required future frequency response capability
  - Determine which, if any, additional technical rules will provide improved frequency response capability and pursue them through the rules process
  - Determine if additional frequency response capability will be needed; if so, how much and what types
- In Q4 2022,
  - Seek potential technology options and innovative proposals to provide any needed additional frequency response capability via an RFI to market participants
  - Assess and incorporate RFI learnings into a potential procurement process, if required
- If required, launch a procurement for incremental frequency response capability in 2023
- Have required frequency response capability in place for 2025

# Key Takeaways

- The AESO will be developing and publishing a Reliability Roadmap, updated regularly with new scenarios (likely annually to start), to ensure reliability is sustained throughout the transformation. The first will be released in H1 2023.

- Frequency response capability impacts several interrelated AESO activities which will require careful coordination

- Frequency response capability will be our first priority to action as challenges exist today and will only grow in the future

- Stakeholders will have an opportunity to engage in an MSSC Options paper and an RFI before the end of 2022

# Thank You