Optimizing the Transmission System

September 15, 2020

Welcome

- WEBINAR INFO

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Key messages

- Considerable transmission investment has been made in past years to enable continued system reliability and to support a fair, efficient, and openly competitive wholesale electricity market
- The AESO is seeking ways to optimize the transmission system, while respecting the existing market and policy framework, by:
  - maximizing the use of the existing system
  - closer timing of new transmission infrastructure to when it is needed
- The AESO is enhancing its methodologies, tools and approaches accordingly
- For those familiar with the past Collaborative Industry Dialogue and Issue Resolution (CIDIR) work, we have incorporated the feedback and recommendations into the actions we are taking
- We remain open to additional feedback on our journey to continuously improve in this area

Objectives for this session

- Share the AESO's evolving approaches to optimizing the transmission system
  - Create awareness of the congestion assessment tools the AESO is using
  - Create understanding on how the AESO will measure congestion
  - Understand how the AESO will utilize congestion assessments in deciding on the timing of new transmission
  - Create understanding of the AESO's use of milestones
  - Create awareness of the AESO's proposed approach to the use of Section 15(2) Exception Applications

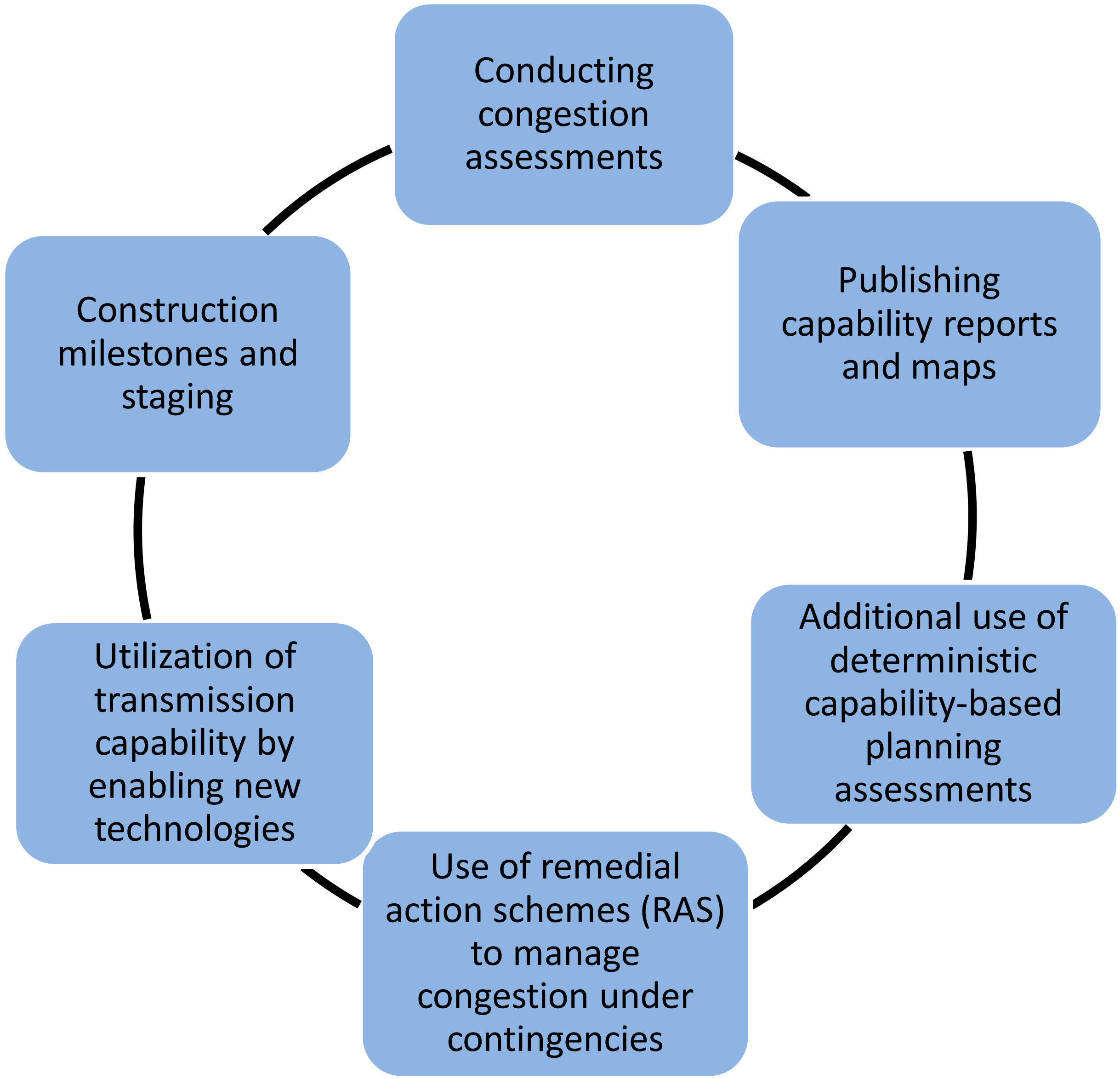
What will be out of scope

- Project-specific questions
- Potential changes to the regulatory framework
- Any items currently in scope in a regulatory process (e.g., 2018 GTA)
- AESO Connection Process

AESO Stakeholder Engagement Framework

Optimizing the Transmission System

Various tools and approaches to optimize the transmission system



Various tools and approaches to optimize the transmission system

- Publishing capability reports and maps
  - Provides information to stakeholders on the regional capability of the system to accept additional generation without building new transmission
  - In 2021, will be working to enhance by:
    - ➢ Working towards substation level capability information
    - ➢ Improving visualization of capability through GIS mapping
- Utilizing deterministic capability based planning assessments
  - Further use of capability based planning studies in deterministic assessments, as opposed to only highlighting system violations under specific system conditions
  - This presents a more flexible approach, which provides robust information to stakeholders that is not subject to frequent changes (for example when there is a change to forecast)

Various tools and approaches to optimize the transmission system

- Use of remedial action schemes (RAS) to maximize the use of existing transmission capability
  - Used primarily to address system performance issues under abnormal system conditions, typically N-1
  - Effective particularly for congestion related N-1 issues
  - There are limits to how much supply can be connected to a single RAS or the number of RAS in region due to complexities
- Enabling new technologies
  - Investigating technology to more effectively control power flow to optimize the existing transmission system
  - Exploring methods to more dynamically adjust line ratings, with confidence
- Application of non-wires solutions to defer timing of new transmission

Various tools and approaches to optimize the transmission system

- Utilize staged development and construction milestones to time new system project construction
  - Where practical, used staged developments balancing reliability, cost, social and environmental impacts
  - Where practical, use triggers for construction to defer largest cost component and de-risk timing of transmission need

Congestion Assessments

AESO congestion related terminology

- A **constraint** limits the flow of power to protect equipment and system reliability
  - a constraint is the reason **why** congestion occurs
- **Congestion** is the inability for the system, when managing a constraint, to transfer all in-merit supply without contravening reliability requirements
  - congestion is **what** impact a constraint has on in-merit energy
  - congestion results from a constraint, not all constraints lead to congestion
- **Curtailment** refers to the act of reducing a source asset's output below the in-merit energy level
  - curtailment is **how** congestion is managed

An illustrative example of congestion

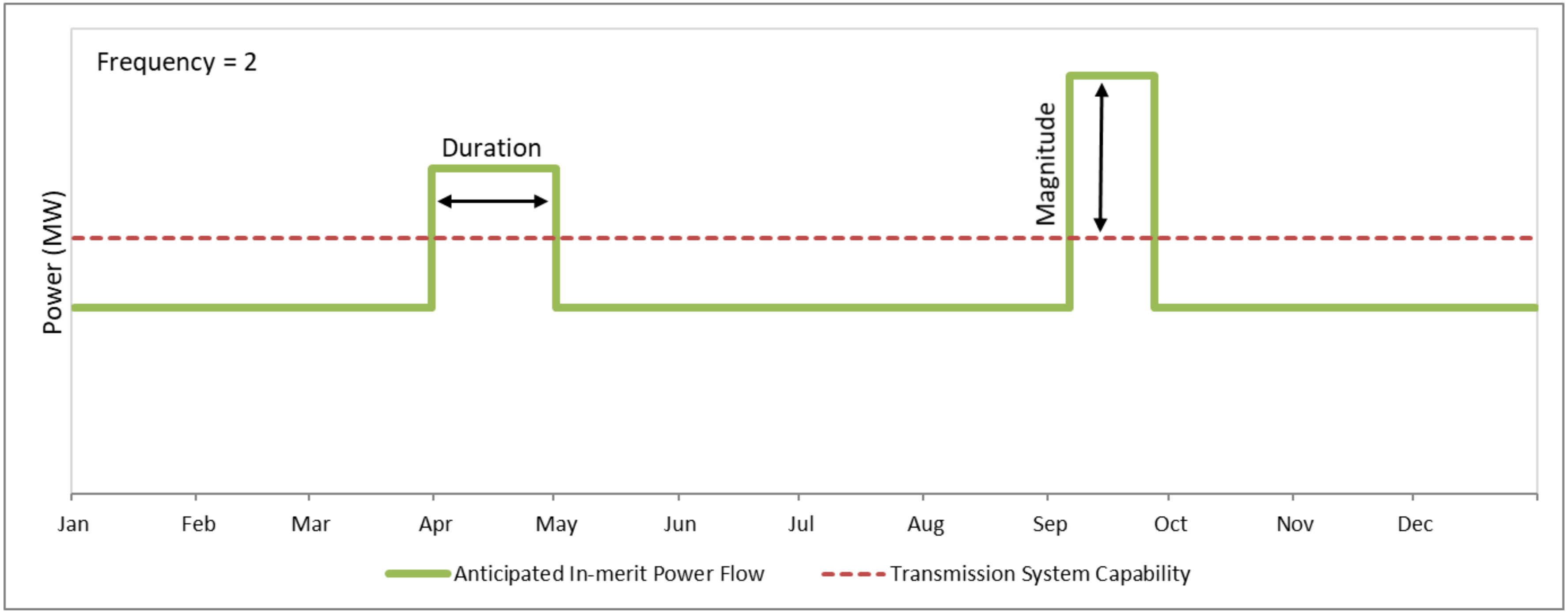
- Scenario (hypothetical)
  - A study area is connected to the Alberta Interconnected Electric System (AIES) via several high-capacity transmission lines and a single low-capacity transmission line
  - The study area transfers power to the AIES
  - A contingency (unexpected loss of a system component) would result in thermal criteria violations on the low-capacity transmission line
- Real-time operational options to manage the impact of the contingency include:
  1. **Reconfiguring** the transmission system by opening the low-capacity line (no congestion occurs)
  2. **Curtailing** in-merit generation (congestion occurs)

Congestion Assessments

- Congestion assessments enhance the use of existing and planned transmission capability by identifying the probability of constraints and the degree of potential congestion
- For a study period, a congestion assessment:
  - Simulates the Alberta electricity market to construct an hourly merit order
  - Determines the hourly generator dispatch using load and merit order data
  - Calculates the hourly power flows that result from the point-of-delivery load forecast and corresponding generation dispatch
  - The calculated hourly power flows are used to quantify the degree of congestion by monitoring when asset ratings are exceeded
  - Frequency, duration, and magnitude are congestion measurements to assist in quantifying the degree of congestion

Congestion measurements

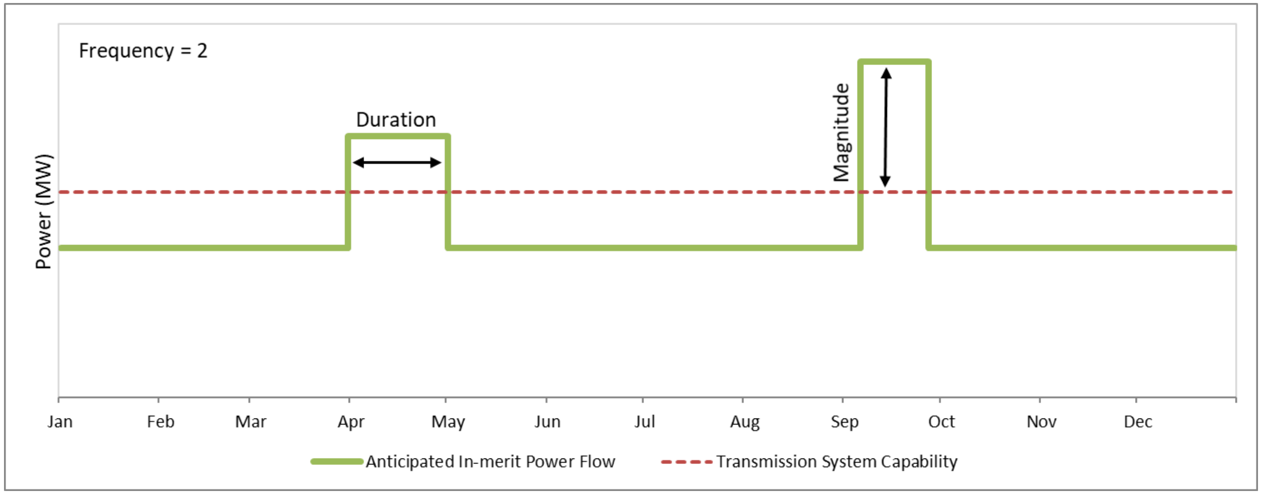
- **Event:** a single occurrence of a constraint or congestion
- **Frequency:** the number of times an event occurs per year
- **Duration:** number of hours per event
- **Magnitude**: the size (usually in MW or MWh) of the event



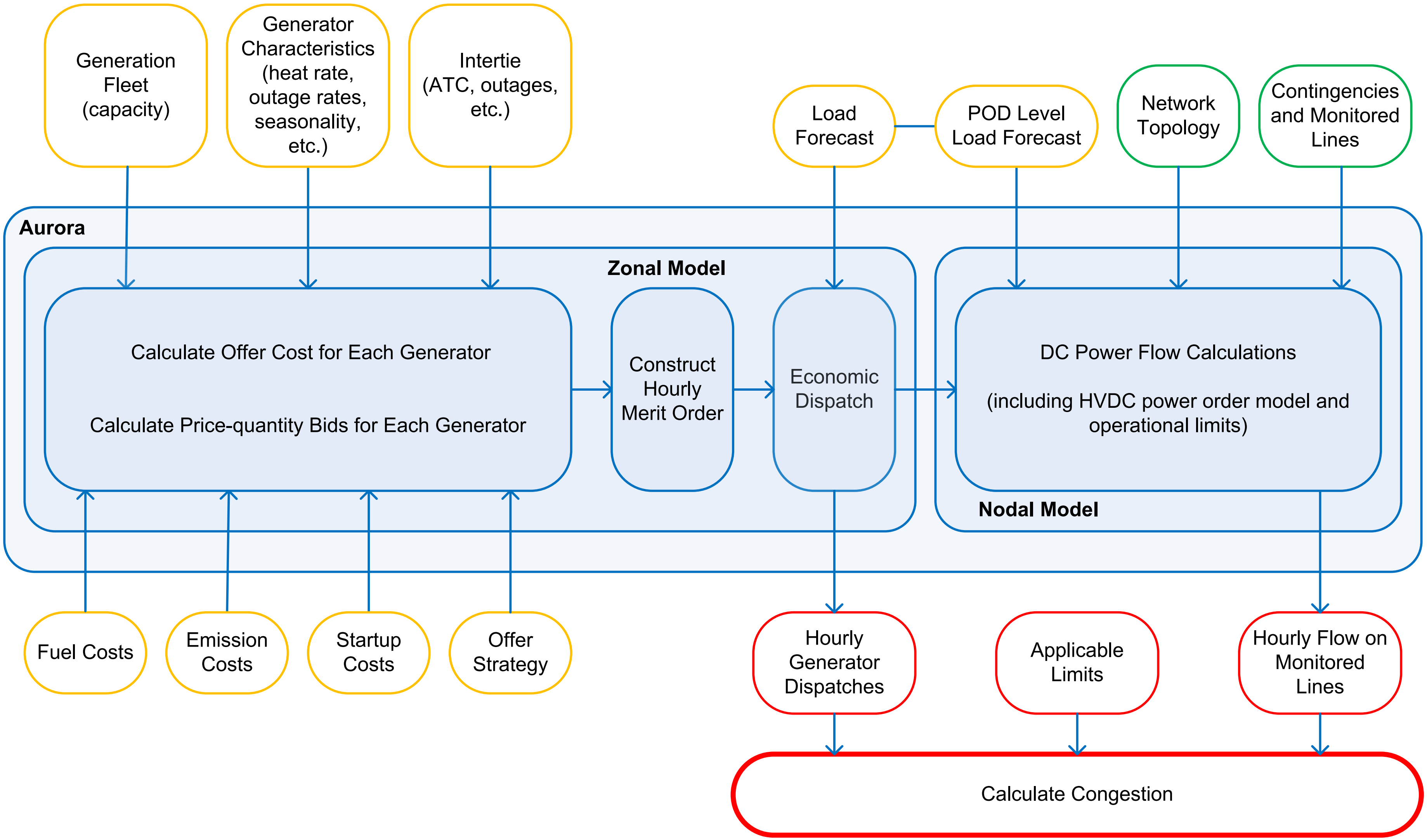
Congestion measurements - magnitude

– **Magnitude**: an instantaneous size, typically measured in MW or MWh. It can be conceived of in various ways, including:
  - a constraint, measured as the difference between a limit (eg. asset rating) and the unconstrained flow of electricity (MW)
  - congested energy on a transmission line, measured as the in-merit electricity unable to freely move on a congested line (MWh)
  - congested energy associated with a generating unit, measured as the electricity unable to be freely produced by in-merit supply

Magnitudes will vary during an event so statistics such as average and maximum magnitude can be calculated on a per-event or yearly basis.



Congestion assessment block diagram



Market simulation

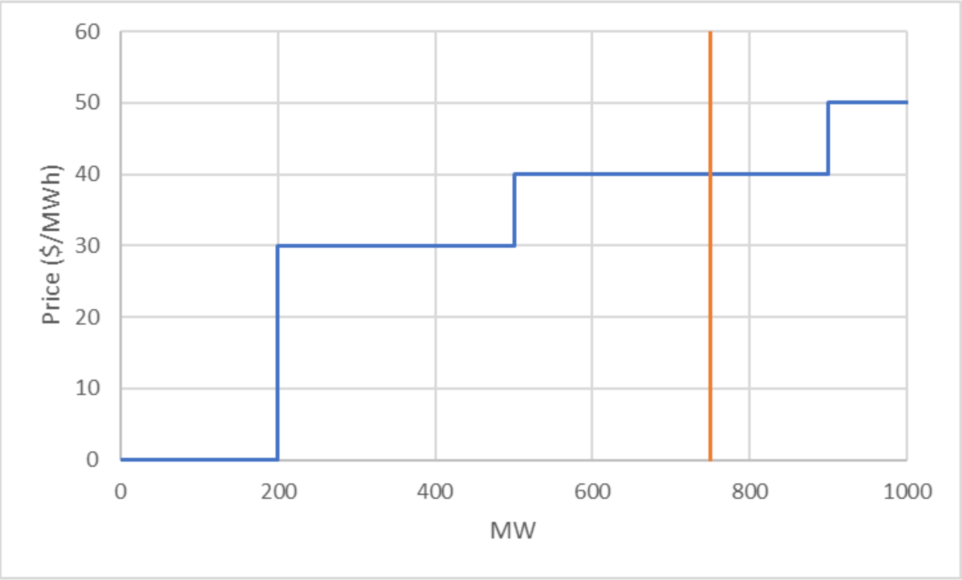
Wind - 200 MW
$0/MWh

Gas 1 - 300 MW
$30/MWh

Gas 2 - 400 MW
$40/MWh

Gas 3 - 100 MW
$50/MWh

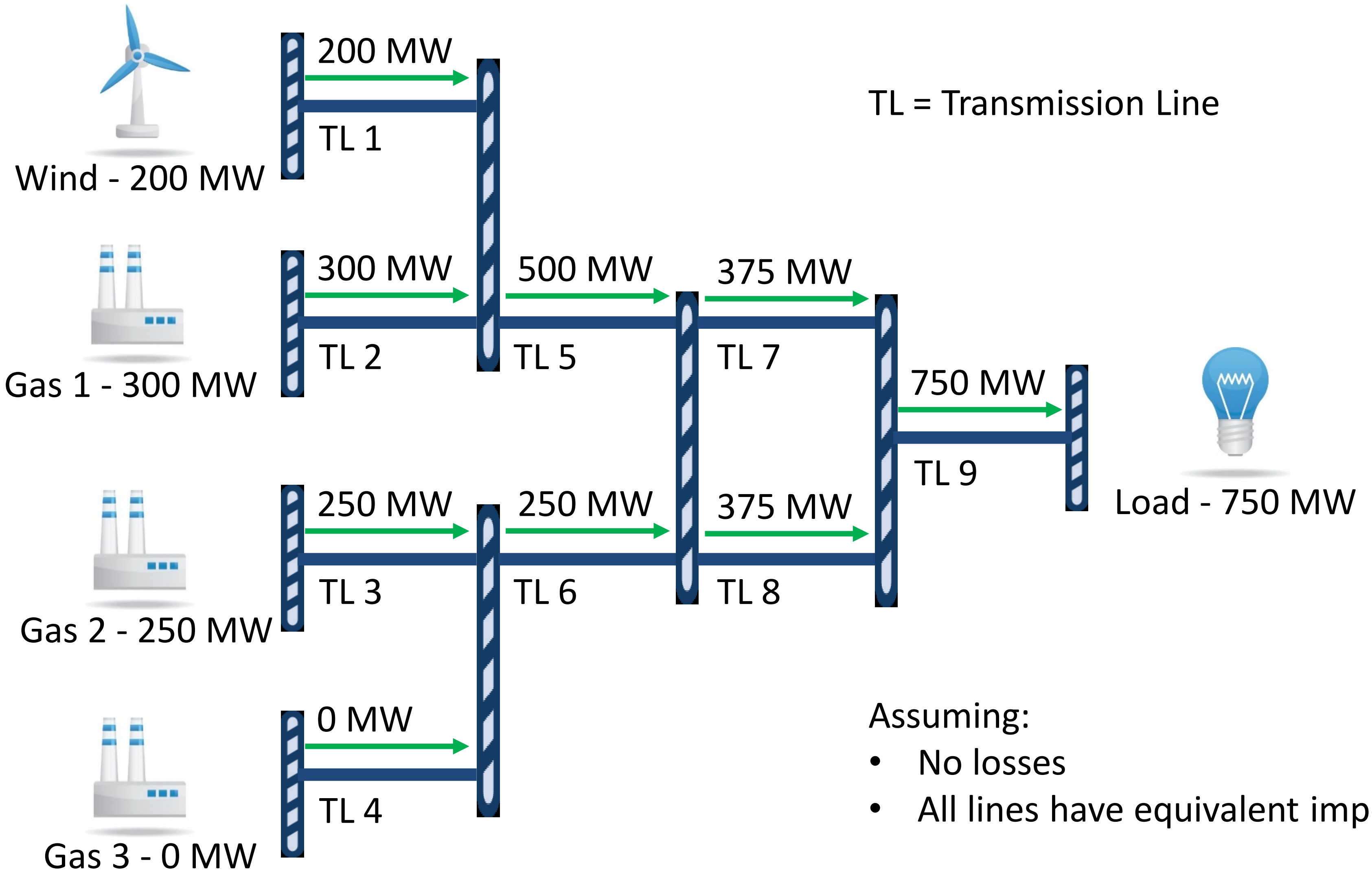
Load - 750 MW



	Offer (MW)	Bid ($/MWh)	Cumulative Offer (MW)	Dispatch (MW)
Gas 3	100	50	1000	0
Gas 2	400	40	900	250
Gas 1	300	30	500	300
Wind	200	0	200	200

Pool price = $40/MWh

Nodal model



TL = Transmission Line

Assuming:

- No losses
- All lines have equivalent impedance

Congestion is assessed for different system conditions

- **N-0 congestion**, including:
  - Congestion that occurs during normal system operating conditions
    - *Assumes there are **no** system elements out of service (a state that rarely, if ever, occurs)*
  - Due to *pre-contingency* generation curtailment
    - Occurs when a potential contingency requires the AESO to pre-curtail generation before the contingency occurs, such as due to the contingency tripping more than the most severe single contingency (MSSC) level
    - This would effectively be N-0 congestion
- **N-1 congestion**
  - Congestion that occurs due to a single contingency

Resource intensive process that takes months

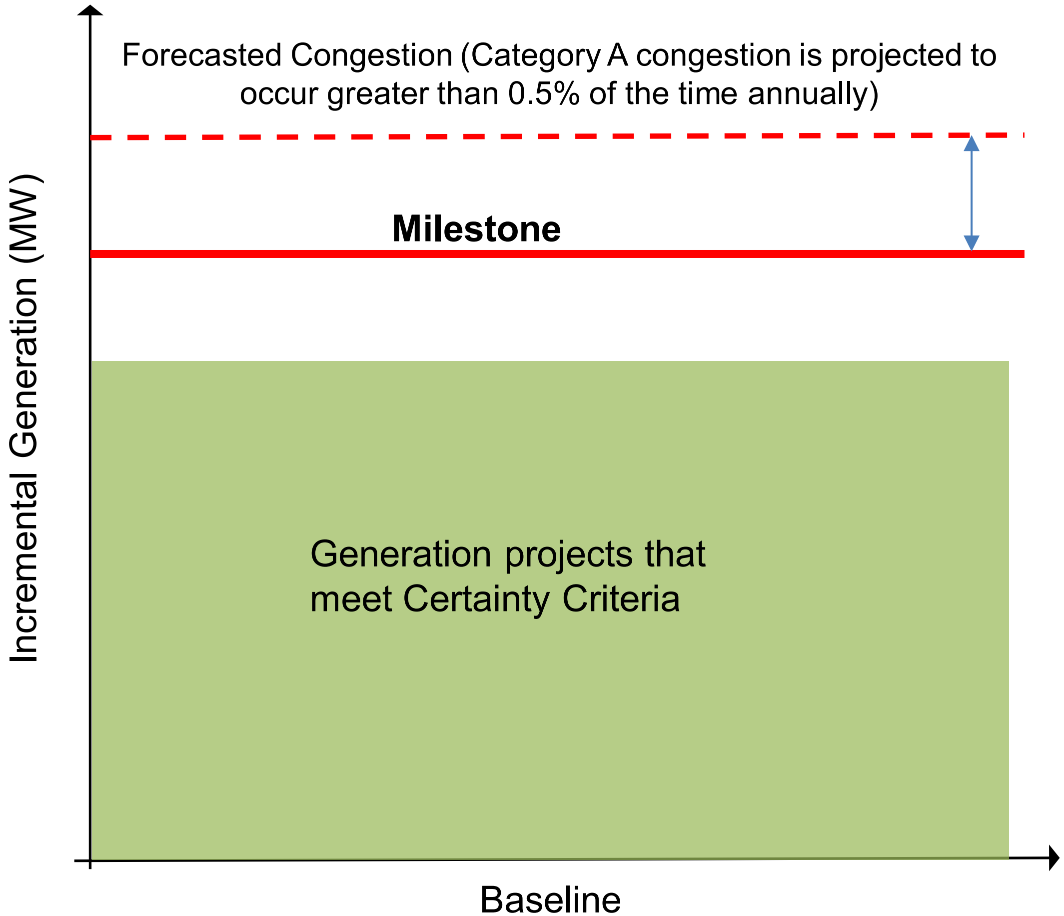
- Developing the market simulation and nodal model
- Determining the scenarios
- Running the studies and capturing the results
- Assessing and presenting the results
- Incorporating results into planning decisions
- AESO will continue to enhance and refine this process

Application of Congestion Assessments

Congestion Assessments in System Planning

- Used in ***system planning*** (i.e., longer-term system planning studies and "system needs" identified by AESO) to:
  - Prioritize transmission developments identified in LTPs
  - Evaluate and determine the detailed need for the transmission development
  - Inform transmission planning study conditions and scenarios
  - Help select the AESO's preferred transmission development option (in combination with other assessments, such as economic efficiency evaluations)
  - Design appropriate milestones to control timing of transmission developments

Utilizing congestion assessments to design milestones



Incorporate a margin to take into account difference in construction time between transmission and generation

Congestion assessments in connection planning

- Used in limited circumstances in **connection planning** (i.e., “need” is to respond to a SASR) to:
  - Assess supply type connection SASRs and only when congestion is a potential concern
  - Inform transmission planning study conditions and scenarios
  - Help with the selection of preferred connection alternative decision in conjunction with an economic efficiency assessment
  - Support, as required, an exception application under section 15(2) of the *Transmission Regulation*.

Distinctions between different congestion patterns in the system

- Congestion in the system could impact an individual market participant, or the impacts could be regional, affecting multiple market participants
- Addressing regional congestion is generally a high priority
  - For example, the Central East Transfer-out Transmission Development (CETO) proposed development addresses regional congestion in central east and southeast Alberta
- The AESO takes into account many other factors in making decisions on prioritizing its development plans, including market interest, forecasted future congestion trends, and the forecasted degree of congestion

Options for connection projects with forecasted congestion

- Proceed in alignment with the timing of an existing planned AESO future development and defer the requested connection in-service date (ISD)
  - if the AESO determines a new system development plan is needed to alleviate the anticipated congestion, the option to defer the connection ISD to coincide with the new system development plan
- Accept a congested connection with a 15(2) application, considering the timing of a future system development
- Accept an uncongested connection which may be higher cost to connect to a stronger hub
- Connect and operate at a reduced contract (STS) capacity

Section 15(2) Exception Applications

Key *T-Reg* provisions and concepts

- **"Section 15(1) Conditions":** The conditions for which the AESO is required to plan and make arrangements under sections 15(1)(e) and 15(1)(f) of the *T-Reg*
  - **Section 15(1) Conditions** are conditions that allow for the transmission of all anticipated in-merit electric energy
    - (i) 100 per cent of the time when all transmission facilities are in service, and
    - (ii) At least 95 per cent of the time (on an annual basis) under abnormal operating conditions

- **"100/95 requirement":** Collective reference to the requirements set out in sections 15(1)(e) and 15(1)(f) of the *T-Reg*

- **"Excess Congestion":** congestion in excess of the congestion permitted under the 100/95 *T-Reg* requirement

Key concepts related to 15(2) Exceptions

- As contemplated by the *T-Reg*, the AESO may choose to categorize the driver(s) for a specific Section 15(2) Exception application by describing the type of exception being sought
  - "**Planning Exception**" reflecting 15(1)(e) re: "planning"
  - "**Arrangements Exception**" reflecting 15(1)(f) re: "making arrangements"

- **"Planning":** The AESO considers that "planning" generally refers to conceptual development plans contained in the AESO's *Long-term Transmission Plan* (LTP)

- **"Making arrangements":** The AESO considers that "making arrangements" includes transitioning plans in the LTP into system projects, and includes the development of NIDs, the regulatory approval processes, up to energization

Approach to Planning Exceptions

- The AESO will seek Section 15(2) Exceptions only for reasonably anticipated congestion

- Planning Exceptions
  - The AESO does not foresee relying on Planning Exceptions
  - The AESO will continue to *plan* the transmission system to meet the 100/95 requirement
  - If the AESO determines that no system plans are required for an area, it is because the AESO has determined that the transmission system in that area is reasonably expected to satisfy the 100/95 requirements into the future

Approach to system project Arrangement Exceptions

- Arrangements Exceptions for **system projects**
  - Milestones associated with system transmission projects (in particular, construction milestones) are used to control the timing of system development
  - The timely implementation of transmission development through the use of milestones helps to mitigate Excess Congestion on the system
  - However, there are situations where Excess Congestion and the requirement for a Section 15(2) Exception may arise
    - While the AESO will plan to manage Excess Congestion, such Excess Congestion may nevertheless arise as a result of project delays or forecast uncertainty

Approach to connection project Arrangement Exceptions

- Arrangements Exceptions for **Connection projects**
  - Used in circumstances where, on account of lack of certainty that a connection project will proceed, the AESO may not be prepared to make immediate arrangements until the connection project reasonably achieves an acceptable level of certainty
  - Under such circumstances, the AESO's arrangements may be delayed, leading to a corresponding delay in construction and energization of the development required to potentially mitigate any forecasted Excess Congestion associated with the connection project
  - In this case, the AESO would file a Section 15(2) Exception application if and when the AESO determines with reasonable certainty that:
    1. the connection project is proceeding, and
    2. the development required to mitigate the Excess Congestion will not be energized in time

Information to support an exemption

- On a case by case basis, but generally expected to include:
  - Details of reasonably anticipated congestion, such as:
    - Study assumptions
      - *Load and generation forecasts*
      - *System topology*
    - Study results
      - *Location of reasonably anticipated congestion*
      - *Timing of reasonably anticipated congestion*
      - *Frequency, magnitude, duration of congestion*
  - Plans to resolve the reasonably anticipated congestion, including:
    - description, timing, and cost of the proposed development(s)
    - options considered

Closing remarks

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Thank you