

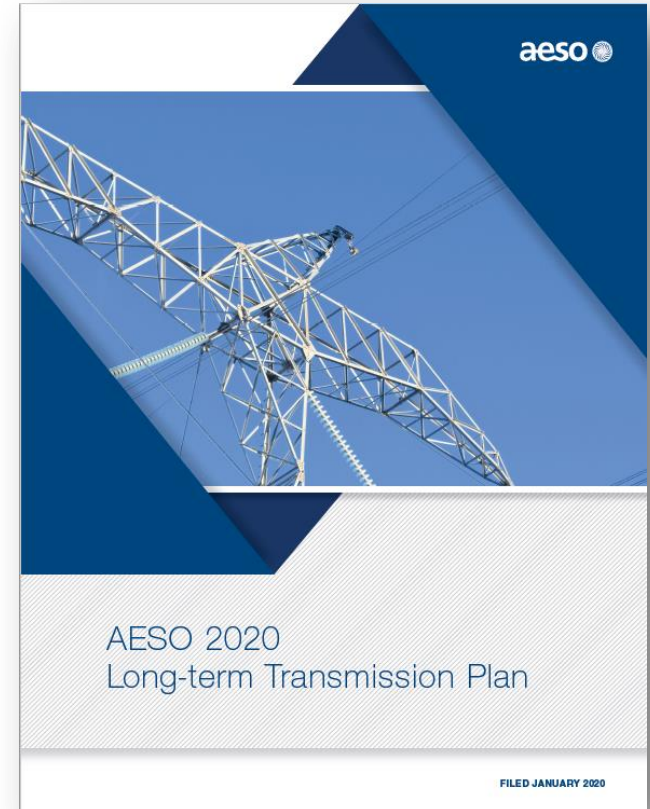
2020 Long-term Transmission Plan

Stakeholder Information Session

Dennis Frehlich, P. Eng.
Vice-President, Grid Reliability

February 5, 2020

- Welcome & housekeeping
- AESO 2020 Long-term Transmission Plan (2020 LTP) Highlights
- Transmission Planning Process
- AESO 2019 Long-term Outlook (2019 LTO)
 - Input to the 2020 LTP
- 2020 LTP
 - Near-term developments (within 5 years)
- Distributed Energy Resources (DER) and Energy Storage
- 2020 LTP
 - Longer-term developments (5 -20 years)
- Generation Integration Capabilities
- Questions & Answers



- Defines a flexible future plan:
 - Meets near-term needs while being flexible by adopting scenario-based planning utilizing the 2019 LTO
 - Considers staged transmission developments, using milestones
- Identifies 20 near-term transmission developments:
 - All require further regulatory approval
 - Total \$1.4 billion
 - Potentially increase average transmission rates by about \$0.50—\$0.70 per megawatt hour, starting in 2025
- Incorporates expanded generation integration capability assessments to include all regions of the province, providing guidance to assist developers
- Includes the consideration of emerging technologies and the potential future impacts to the grid

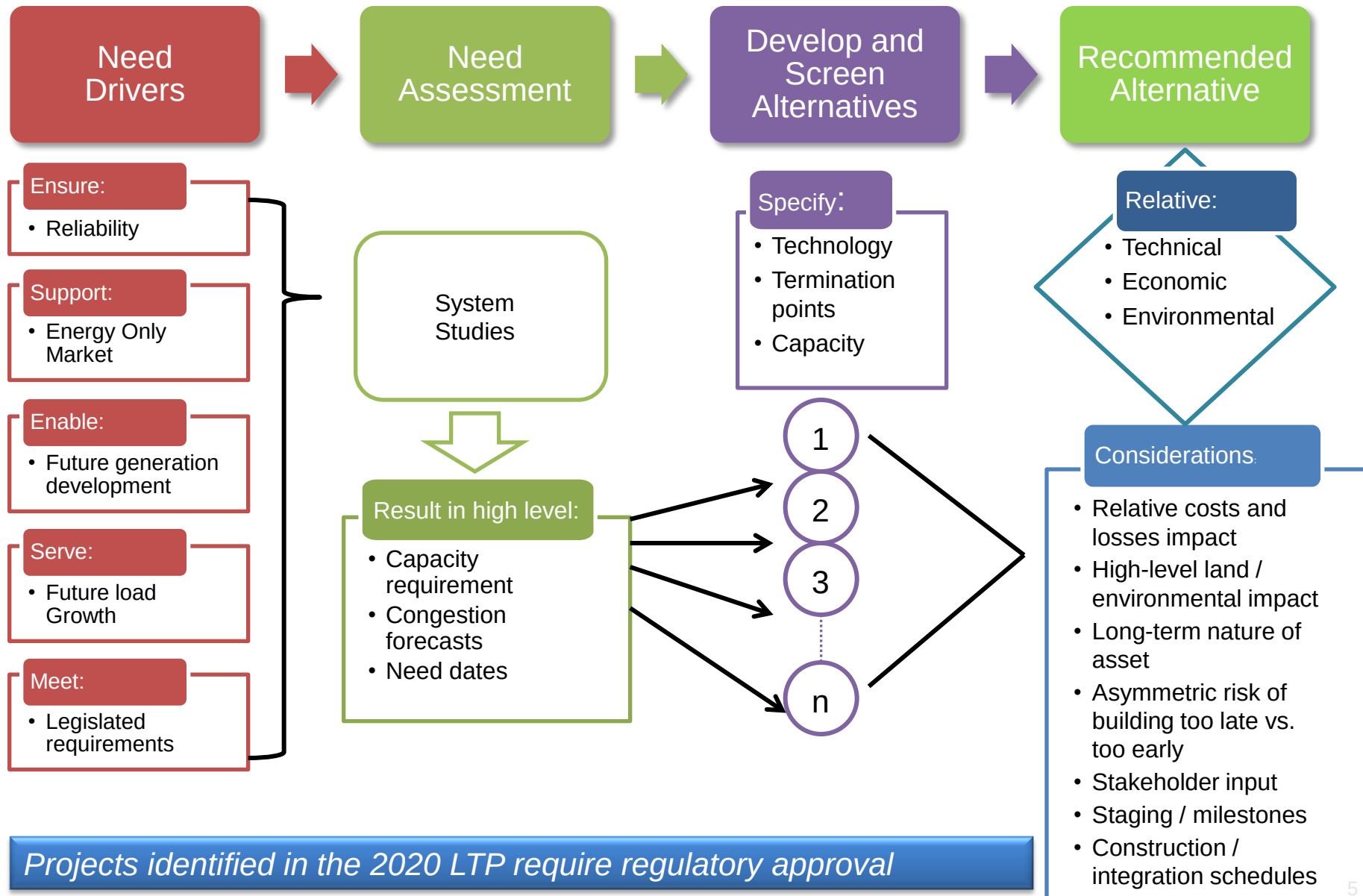


Transmission Planning Process
2020 LTP Stakeholder Consultation
AESO Stakeholder Engagement
Framework

Ata Rehman, P. Eng.
Director, Grid Planning & Ops Eng.



Planning Process



- Objectives:
 - Ensure LTP accurately captures transmission needs for Alberta
- Stakeholders:
 - Transmission facility owners, distribution facility owners, industry associations, regional municipalities (council and/or administration)
- Approach:
 - Consultation meetings
 - Engagement through Public Involvement Programs (PIP) for transmission development projects
- Timing
 - Q1-Q2 2019: review LTP planning process & obtain input for consideration
 - Q3-Q4 2019: update on transmission development plans



The background of the slide is a blue-tinted image. It shows a close-up of two hands shaking in a firm grip, symbolizing agreement or partnership. In the background, a city skyline is visible, with various buildings and structures. Overlaid on the image is a network of thin white lines connecting various points, suggesting a global or interconnected theme.

OUR ENGAGEMENT PRINCIPLES

Inclusive and Accessible

Strategic and Coordinated

Transparent and Timely

Customized and Meaningful

AESO 2019 Long-term Outlook (LTO)

2020 LTP Near-term developments

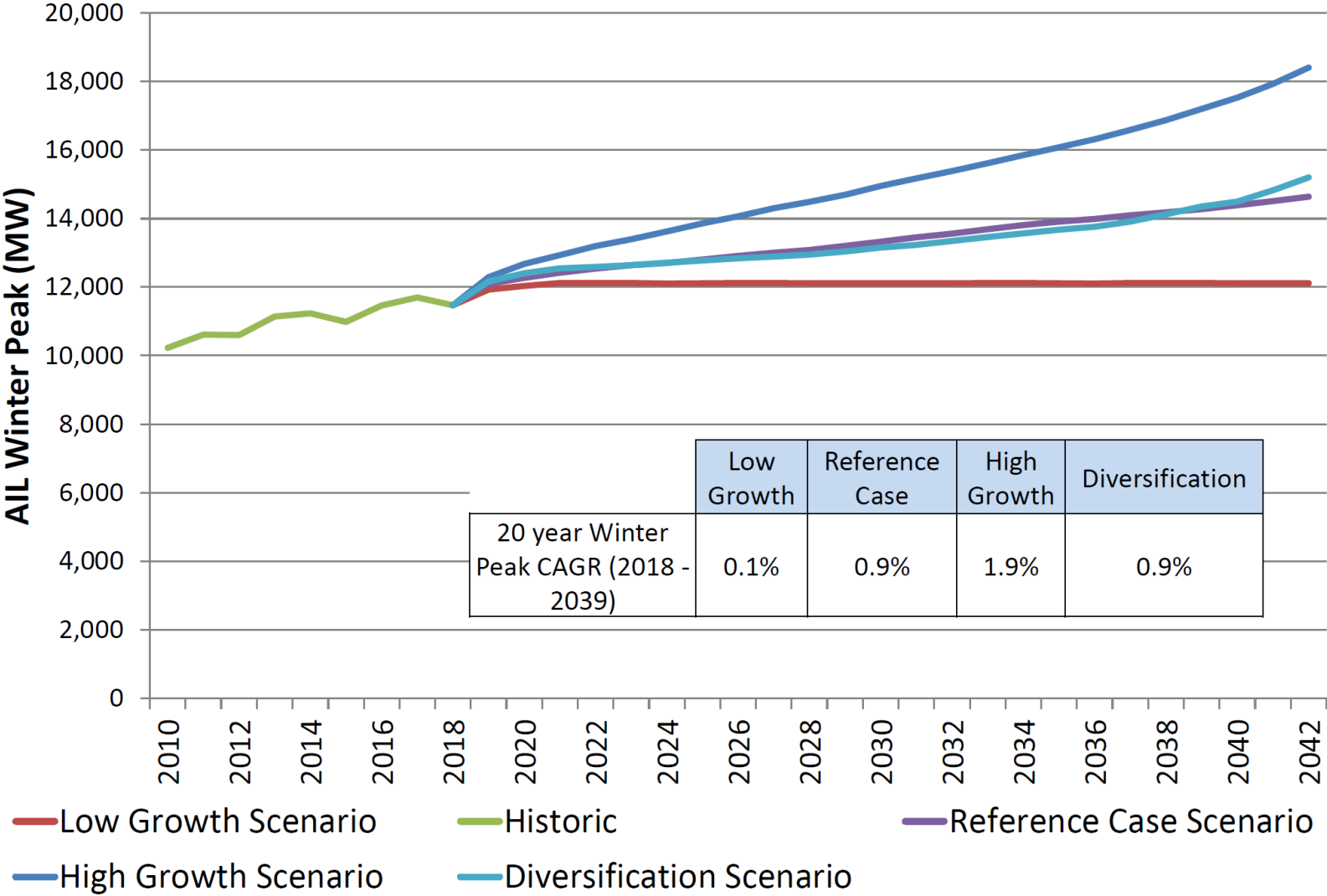
Peter Huang, P. Eng.
Senior Engineer, System Planning

AESO 2019 Long-term Outlook (LTO)

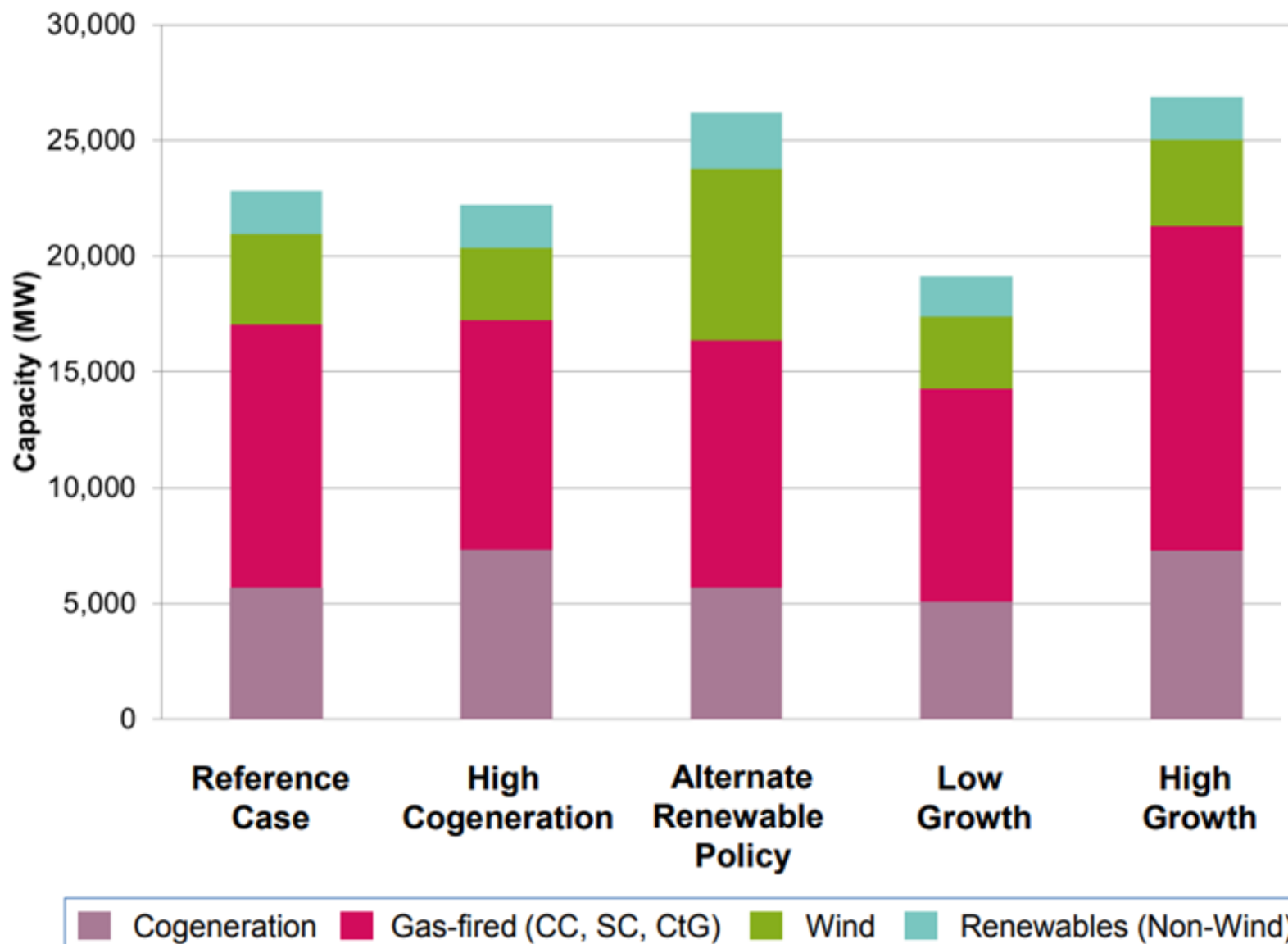
Load Scenarios	Generation Scenarios / Sensitivity	High-Level Description
Reference Case	Reference Case	AESO's main corporate forecast
	Alternate Renewables Policy	Tests higher renewable target or policy
	High Cogeneration Sensitivity	Tests increased cogeneration adoption at existing and future oil sands sites
Low Growth	Low Growth	Tests lower economic and generation growth due to limited oil sands growth
High Growth	High Growth	Tests higher economic and generation growth due to strong oil sands growth
Diversification*	Diversification*	Tests greater penetration of new technologies in an economy not driven by oil sands

* Not studied by the 2020 LTP

2019 LTO Load Forecast



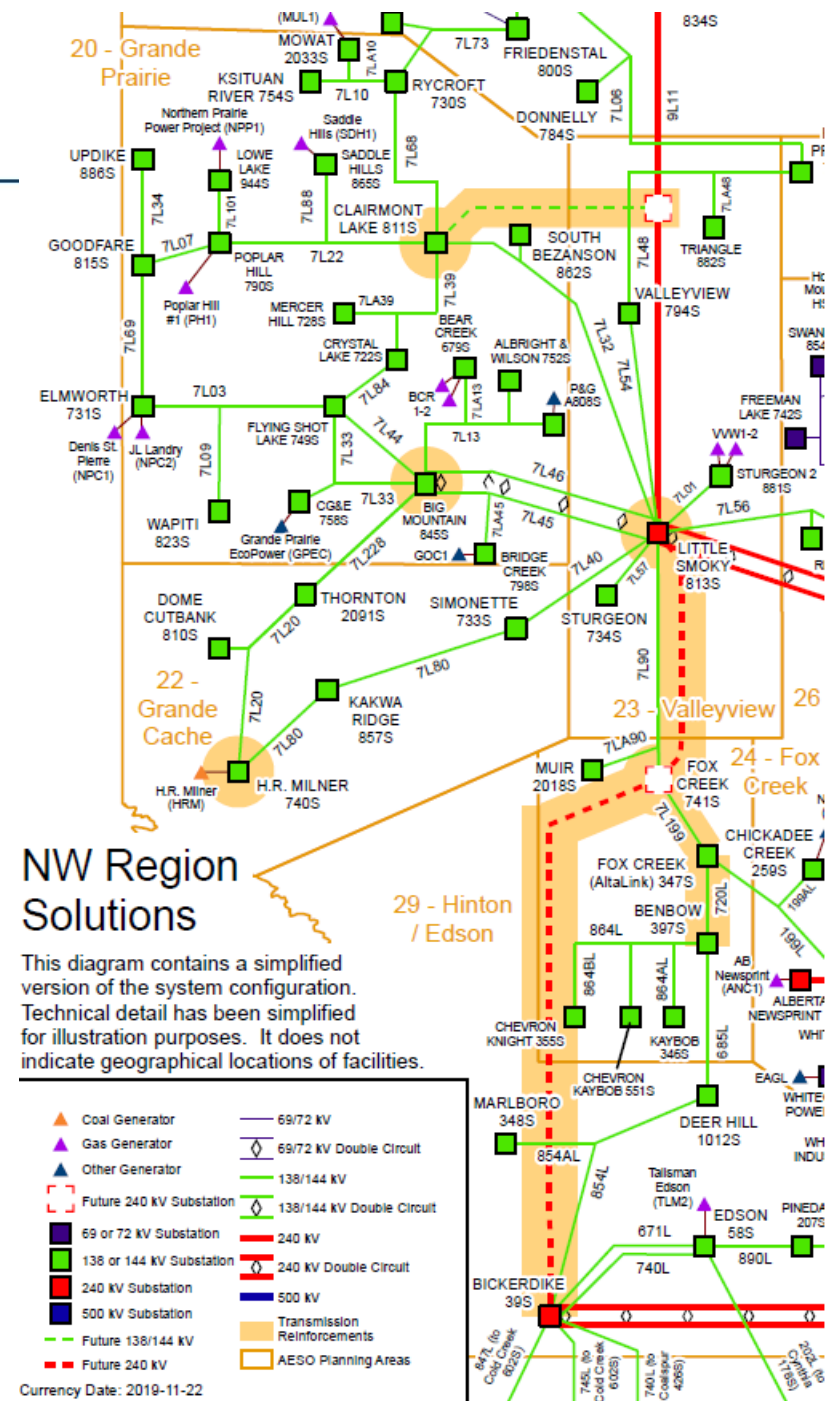
Generation Capacity (2039)



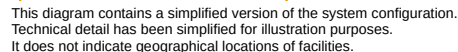
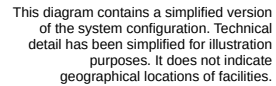
2020 LTP Near-term developments

Northwest Region

- Staged developments to enable long-term growth
- Fox Creek 240 kV developments to support transfer into the NW
 - Load: thermal
- Grande Prairie area developments to support growth in the area
 - Load: thermal
- Grande Cache area developments for voltage support
 - Load: voltage
- Additional 240/144 kV transformation at Little Smoky
 - Load: thermal

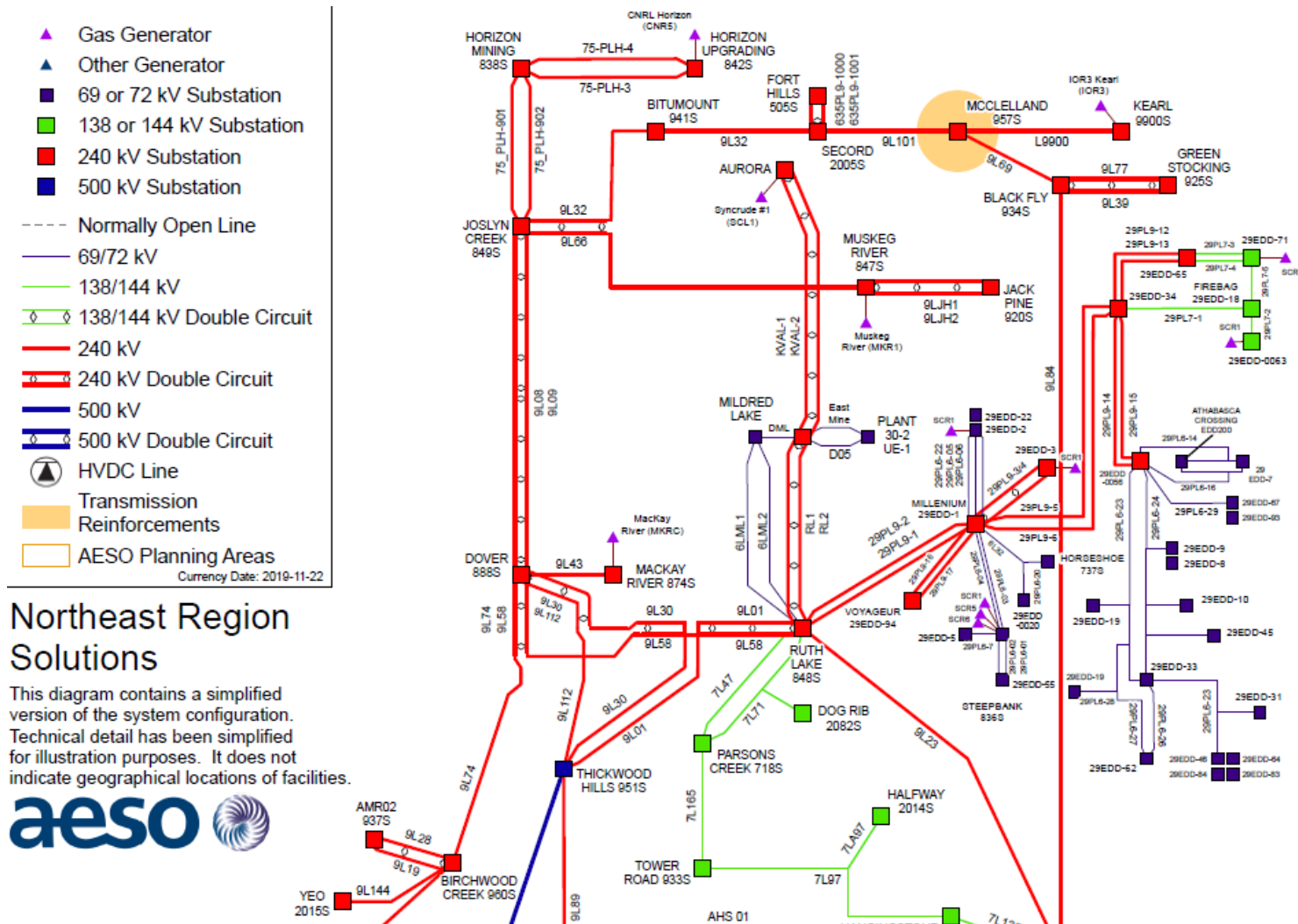


- Voltage support at Kinuso or new transformer at High Prairie area
 - Load: voltage
- Increase line rating in the Rainbow Lake area
 - Load: thermal



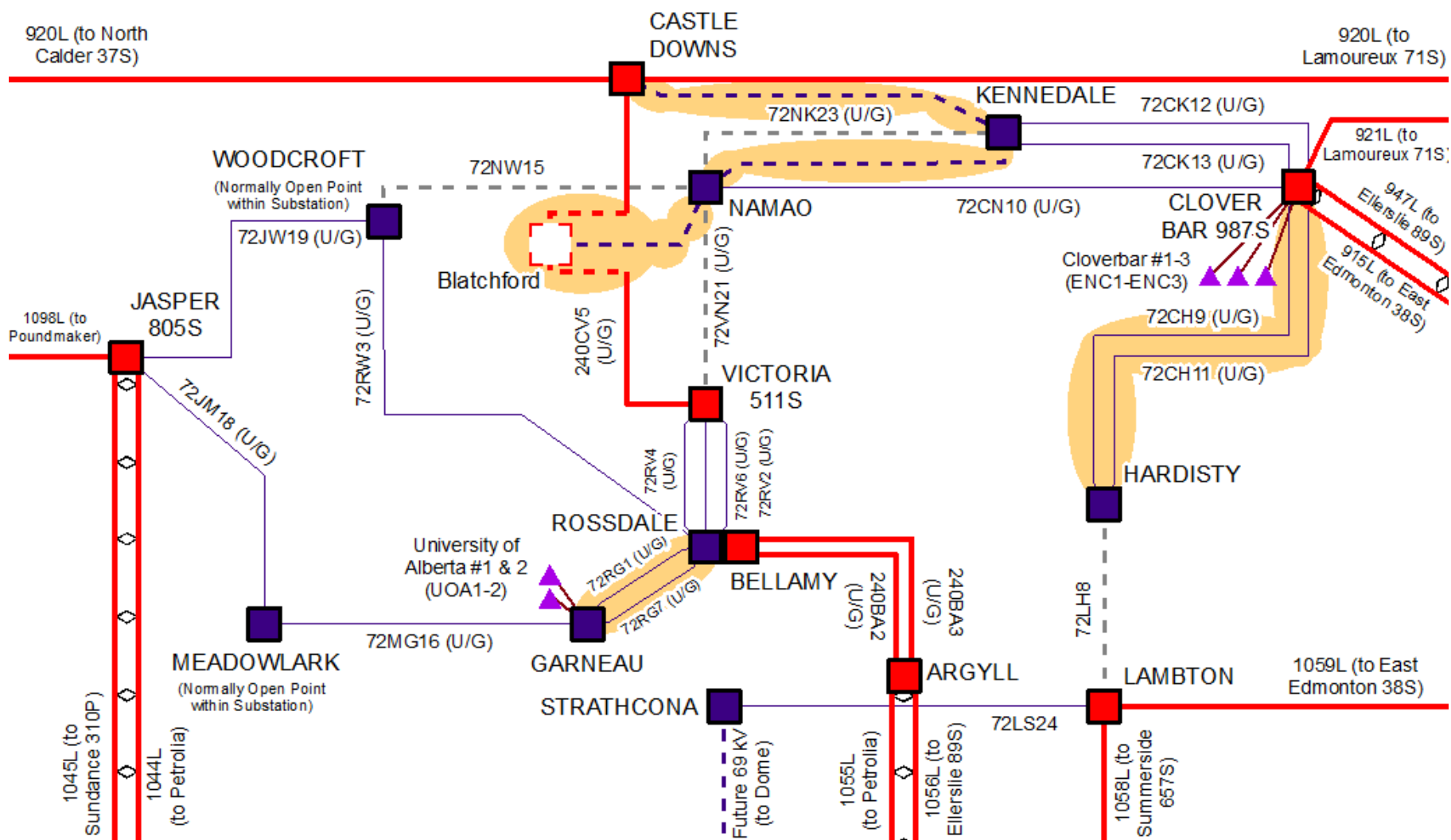
Northeast Region

- Voltage support in the Fort McMurray area - Load: voltage



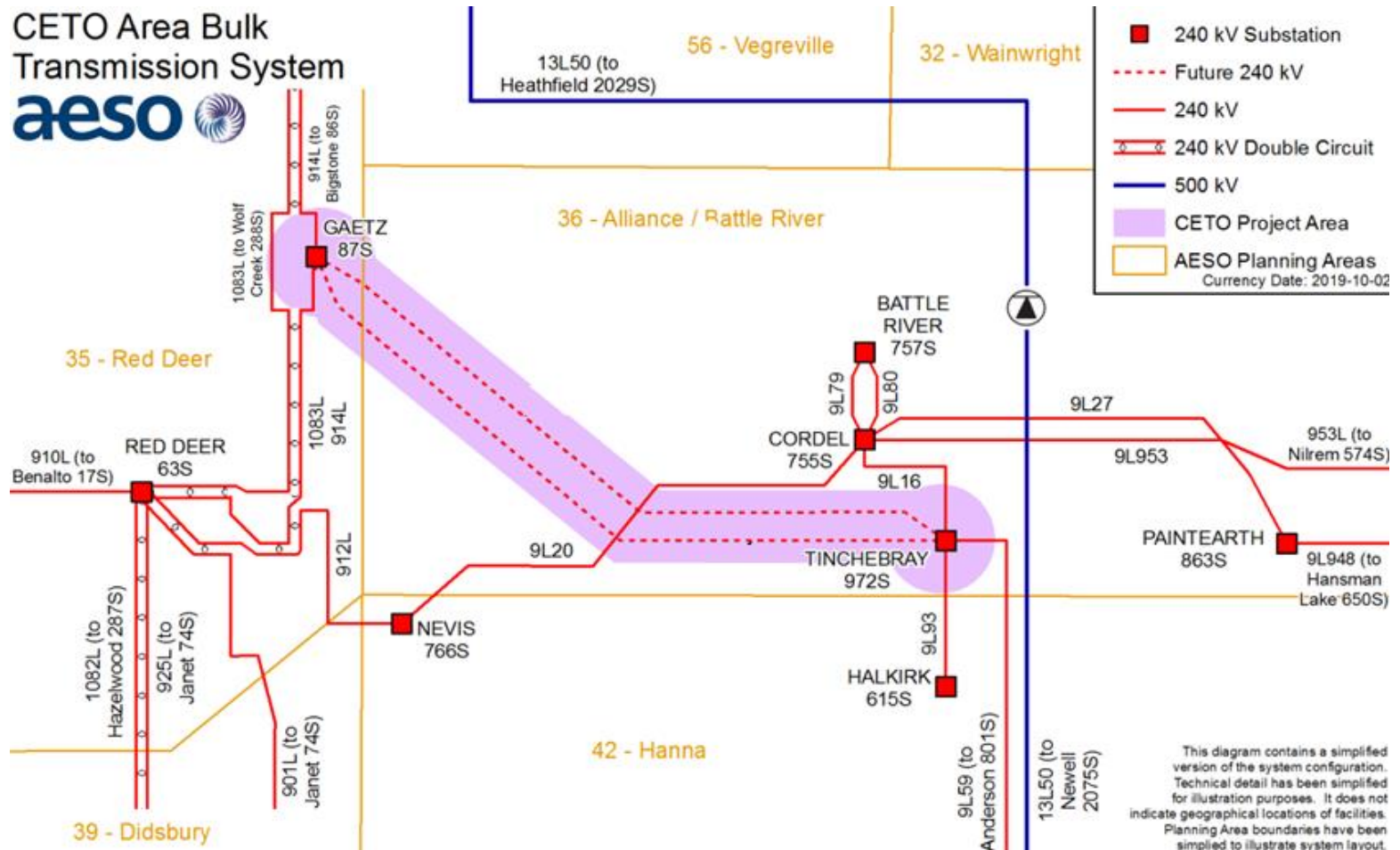
- Additional 500/240 kV transformation for the Keephills/Ellerslie/Genesee (KEG) Loop
 - Generation: thermal
- Increase line rating for 138 kV lines north of Edmonton
 - Load: thermal
- Increase line rating for 138 kV line and new voltage support device near Leduc
 - Load: thermal and voltage
- Additional transmission reinforcement for the Fort Saskatchewan area 138 kV system
 - Load: thermal
- Reinforcements for the City of Edmonton system
 - Load: thermal





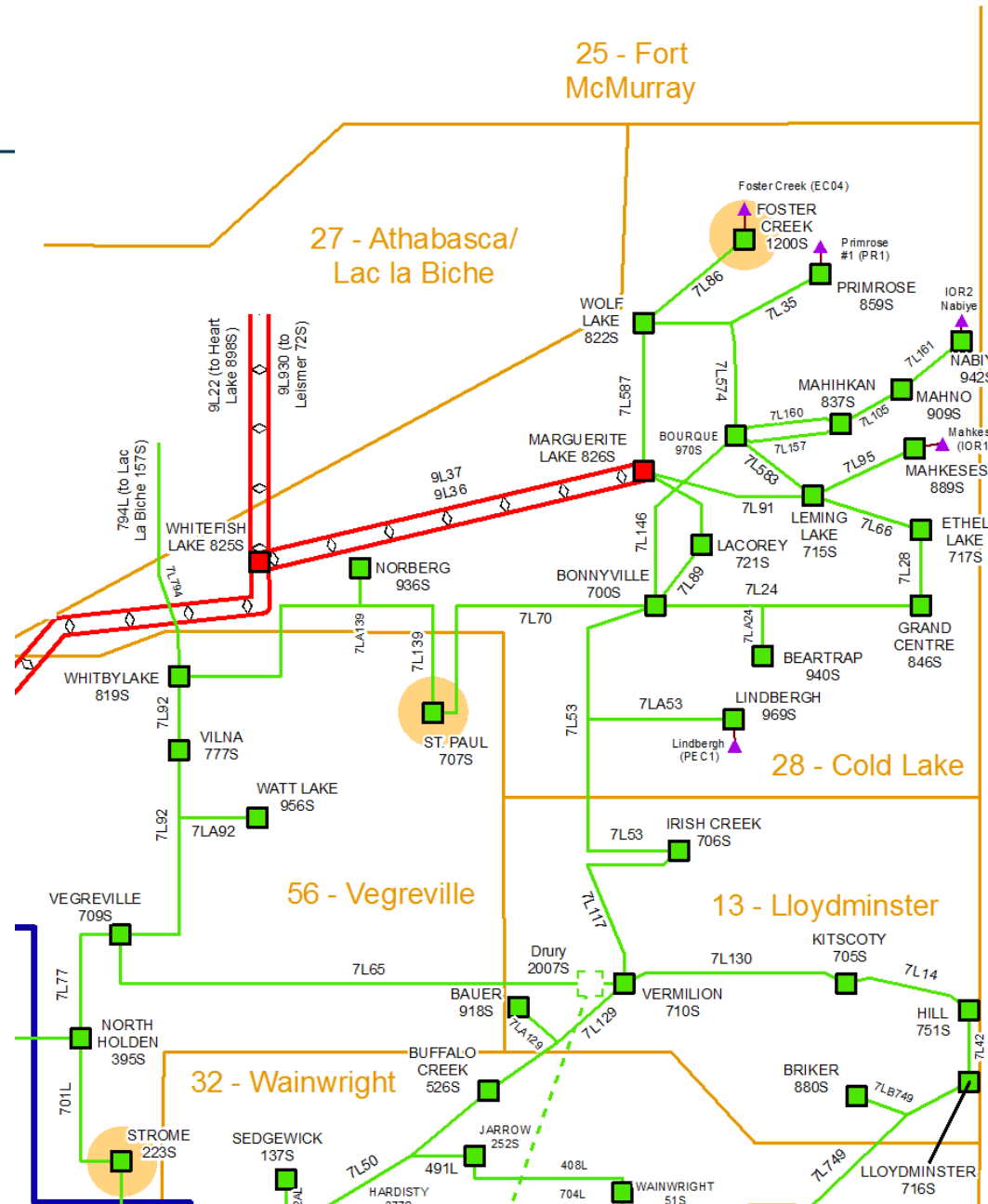
Central Region

- Central East Transfer-out (CETO)
 - To strengthen transfer-out capability for integrating new generation
 - Generation: thermal



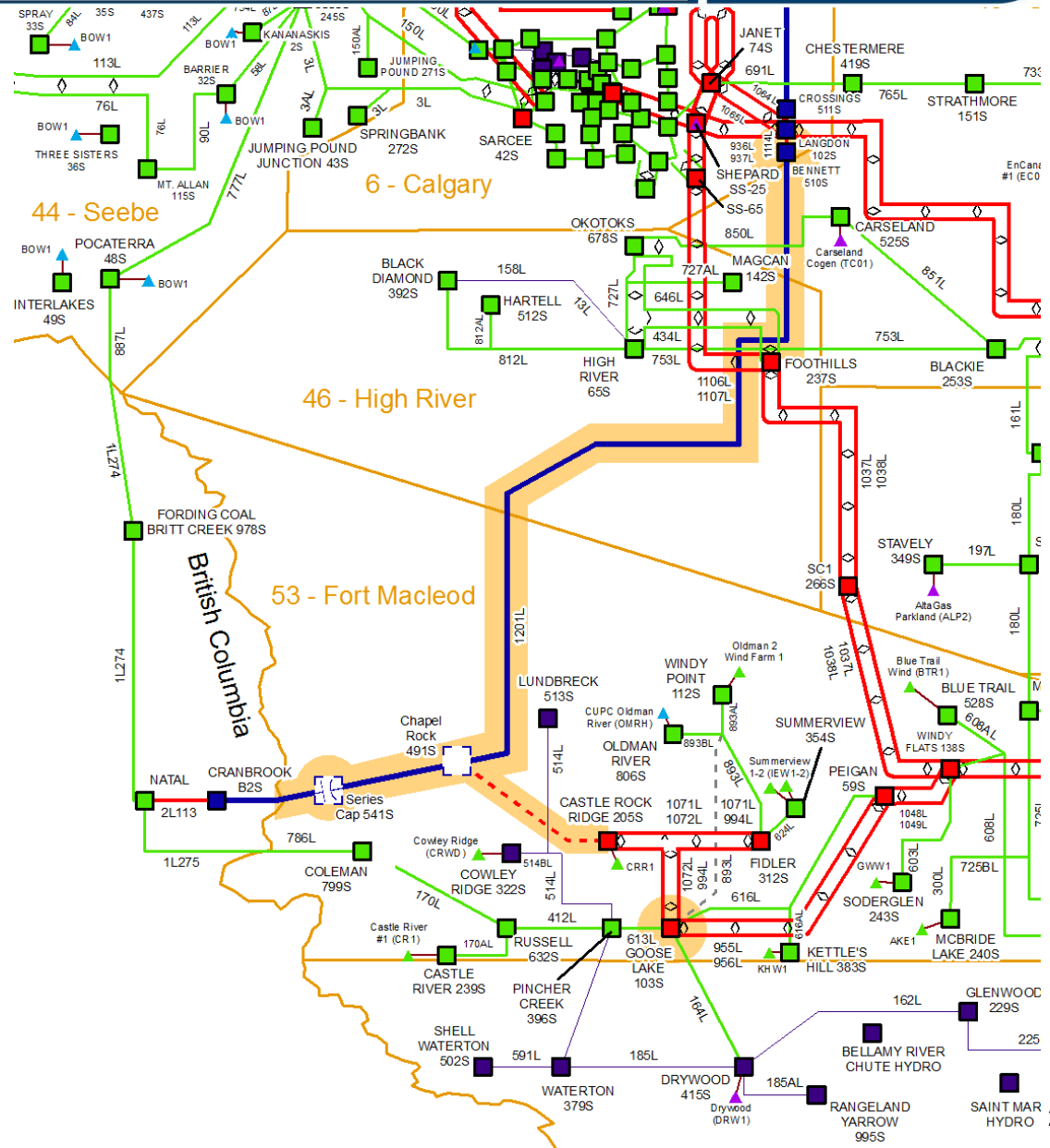
Central Region (cont.)

- Voltage support devices at Strome, Foster Creek, and St. Paul substations
 - Load: voltage
 - To mitigate load driven N-1 violations



South Region: AIR & CRPC

- Alberta–British Columbia intertie restoration (AIR)
 - Intertie
- Chapel Rock–to–Pincher Creek (CRPC) area transmission reinforcement
 - To provide additional transfer out capability for integrating new generation in SW region
 - Generation: thermal

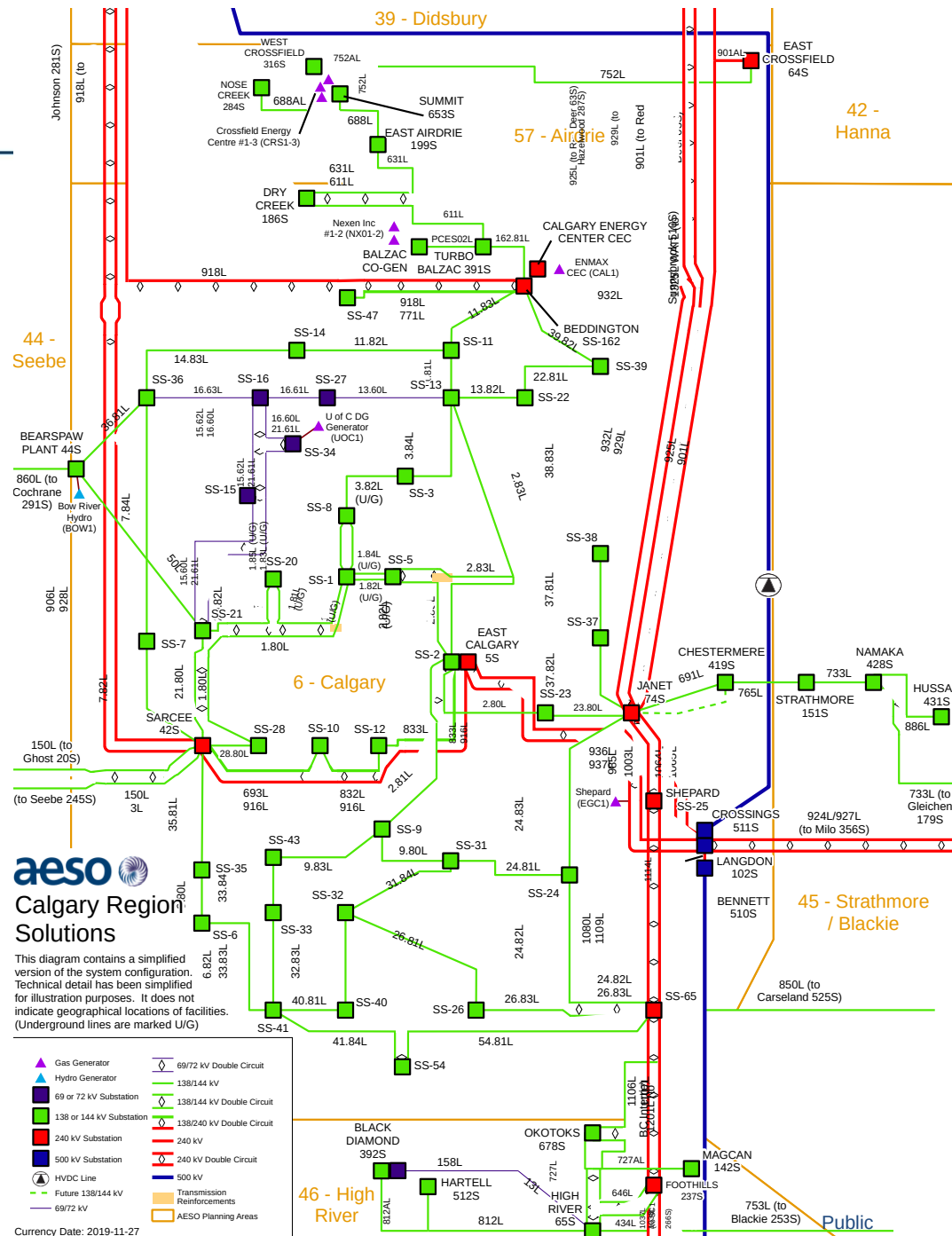


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-
- 45 - Strathmore / Blackie**
- 43 - Sheerness**
- 47 - Brooks**
- 48 - Empress**
- 49 - Stavelly**
- 52 - Vauxhall**
- 54 - Lethbridge**
- 4 - Medicine Hat**
- 55 - Glenwood**
- South Region Solutions**
- This diagram contains a simplified version of the system configuration. Technical detail has been simplified for illustration purposes. It does not indicate geographical locations of facilities. For detail on the Calgary Area please see the Calgary Sub-Region diagram.
- Legend:
- ▲ Coal Generator
 - ▲ Gas Generator
 - ▲ Hydro Generator
 - ▲ Solar Generator
 - ▲ Wind Generator
 - ▲ Other Generator
 - 69 or 72 kV Substation
 - 138 or 144 kV Substation
 - 240 kV Substation
 - 500 kV Substation
 - Future 240 kV
 - Normally Open Line
 - 69/72 kV
 - 69/72 kV Double Circuit
 - 138/144 kV
 - 138/144 kV Double Circuit
 - 240 kV
 - 240 kV Double Circuit
 - 500 kV
 - HVDC Line
 - Transmission Reinforcements
 - AES0 Planning Areas
- Currency Date: 2019-11-22

Calgary Region

- Downtown Calgary short-circuit mitigation
 - Load: short circuit
- New 138 kV transmission line between Janet and Chestermere substations
 - Load: thermal and voltage



Distributed Energy Resources & Energy Storage

2020 LTP Longer-term developments

Generation integration capabilities

Amir Motamedi, P. Eng., Ph.D.
Manager, System Planning

Distributed Energy Resources & Energy Storage

- To further understand the impact of DER integration on available transmission system capability, the AESO studied the following conditions:
 - Focused on the three major urban centres (Edmonton, Red Deer & Calgary) and renewable rich areas within Alberta
 - Up to 25 per cent of homes are assumed to have rooftop solar PV in these urban centres
 - City of Calgary: approx. 300 MW
 - City of Edmonton: approx. 300 MW
 - City of Red Deer: approx. 70 MW
 - 200 MW of DER in central east and southern Alberta
 - DER modeled by scaling down loads in the distribution system



- DER integration in the Cities of Edmonton and Red Deer does not impact transmission system capability to integrate renewables
- There is a reduction of approximately 60 MW in transmission system capability for renewable integration for every 100 MW of DER integrated in the City of Calgary
- Integration of 100 MW of DER in the south and central east areas will reduce 100 MW of transmission system capability for renewables in these regions
- However, CETO and CRPC will also mitigate the above concerns and help to enable integration of DERs in Calgary, SE and CE regions

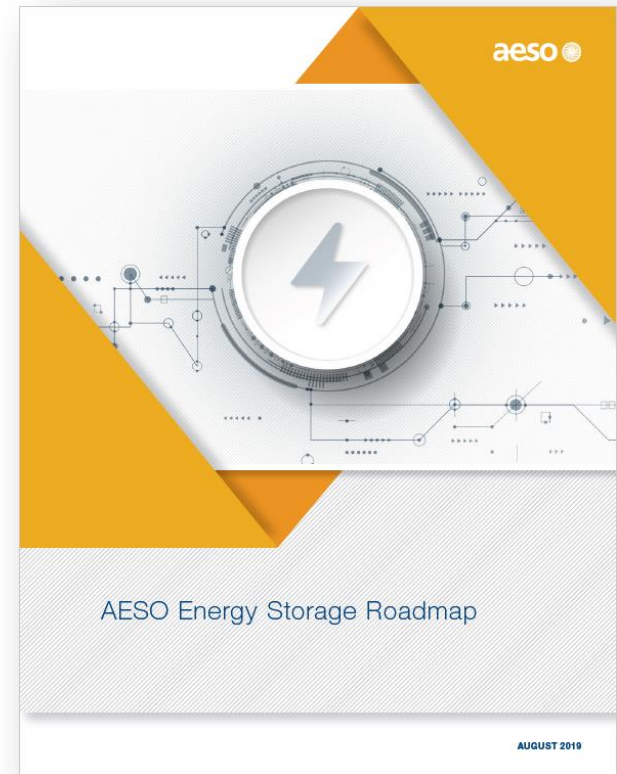


Solar



Wind

- The AESO published an Energy Storage Roadmap in August 2019:
 - Sets out the AESO's plan to facilitate the integration of energy storage technologies
 - Objective is to enable energy storage in Alberta following guiding principles that include treating energy storage as its own unique asset class and removing barriers to its integration
- The AESO is currently:
 - Working with market participants and stakeholders on integrating storage projects
 - Evaluating storage as a transmission deferral tool (e.g., in the Fort Saskatchewan area)
- Energy storage may be competitive for fast frequency services needed for imports (loss of inertia)



2020 LTP Longer-term developments

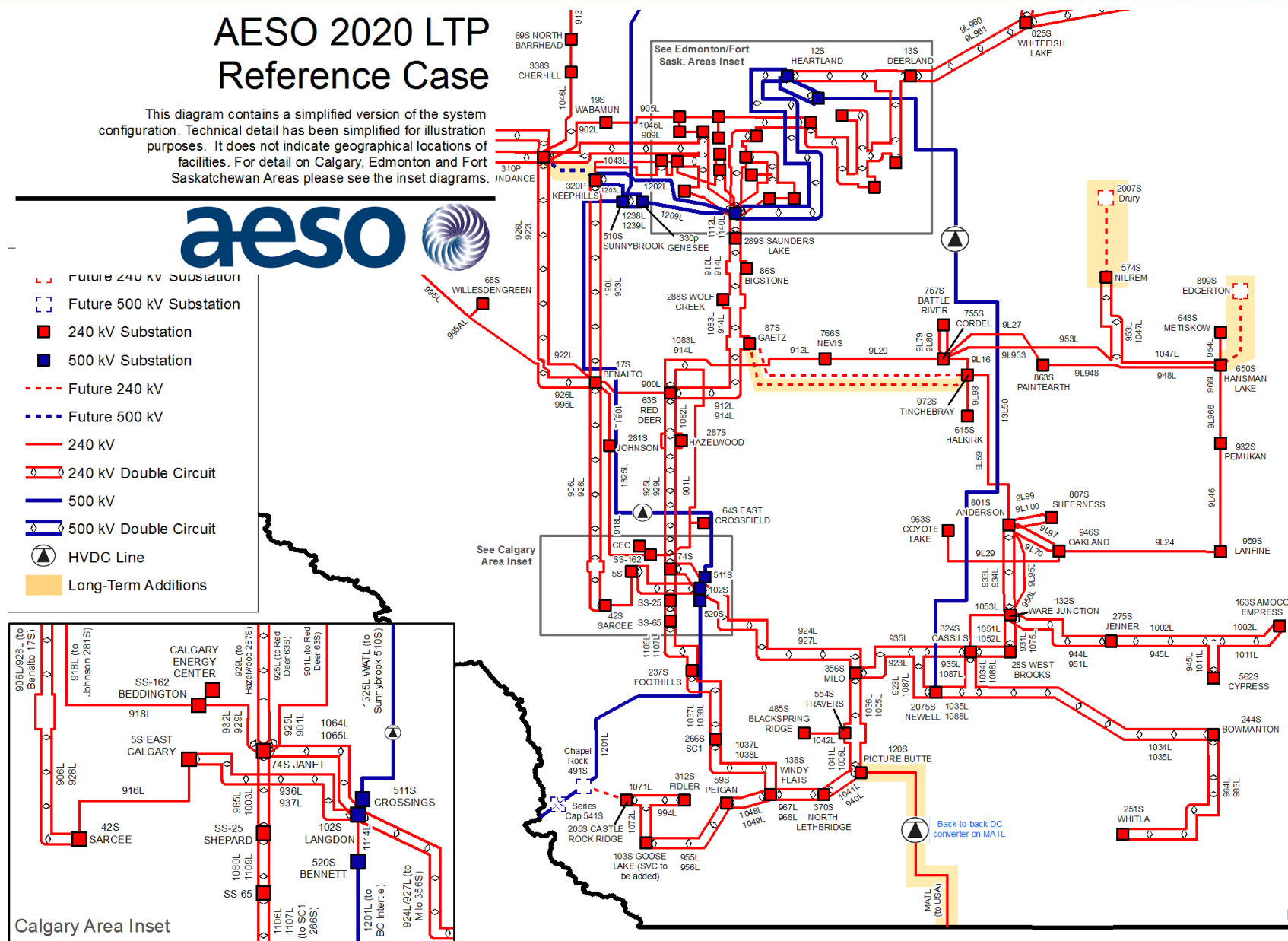
Scenario	Transmission Developments
Reference Case	• PENV 240 kV conversion for additional renewable integration capability • MATL back-to-back HVDC converter (as part of AIR Block 3) • Keephills to Sundance 500 kV line or 240 kV transmission line upgrades in the Edmonton region
Alternate Renewables Policy (faster-pace renewables)	• Including Reference Case developments • Potential EATL bi-pole for additional transfer capability
High Growth	• Including Reference Case developments • Significant 240 kV developments are required in NW areas for load growth
High Cogen	• Including Reference Case developments • 240 kV enhancements (Dover to Birchwood Creek substations) and 500 kV Fort McMurray East (FME) line between Heartland and Thickwood Hills substations to enhance transfer capability to/from Fort McMurray

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This diagram contains a simplified version of the system configuration. Technical detail has been simplified for illustration purposes. It does not indicate geographical locations of facilities. For detail on Calgary, Edmonton and Fort Saskatchewan Areas please see the inset diagrams.



-  Future 240 kV Substation
-  Future 500 kV Substation
-  240 kV Substation
-  500 kV Substation
-  Future 240 kV
-  Future 500 kV
-  240 kV
-  240 kV Double Circuit
-  500 kV
-  500 kV Double Circuit
-  HVDC Line
-  Long-Term Additions

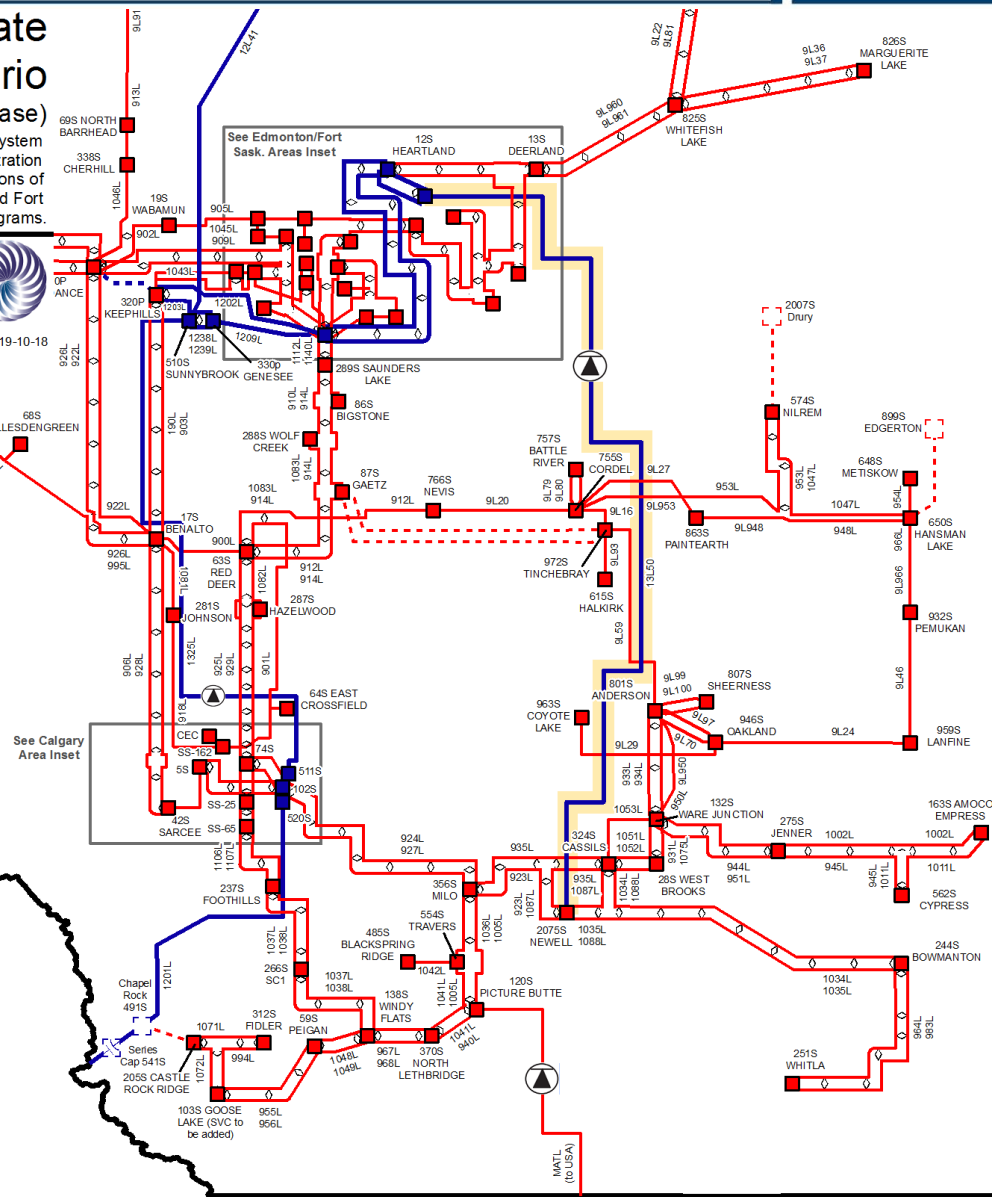
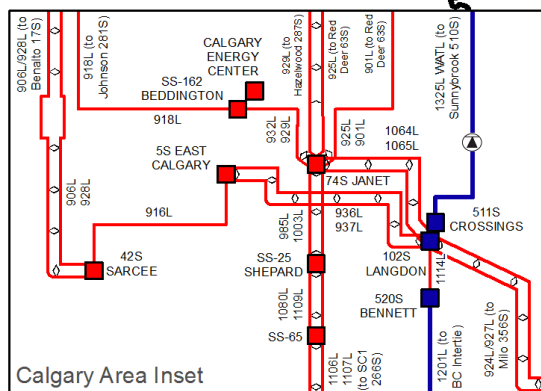


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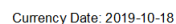
(in addition to Reference Case)

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-  Future 240 kV Substation
-  Future 500 kV Substation
-  240 kV Substation
-  500 kV Substation
-  Future 240 kV
-  Future 500 kV
-  240 kV
-  240 kV Double Circuit
-  500 kV
-  500 kV Double Circuit
-  HVDC Line
-  Long-Term Additions



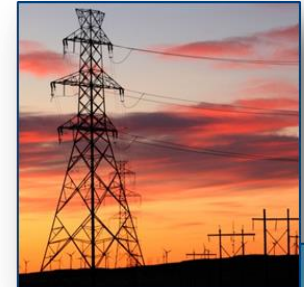
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Generation Integration Capabilities

South and Central Regions

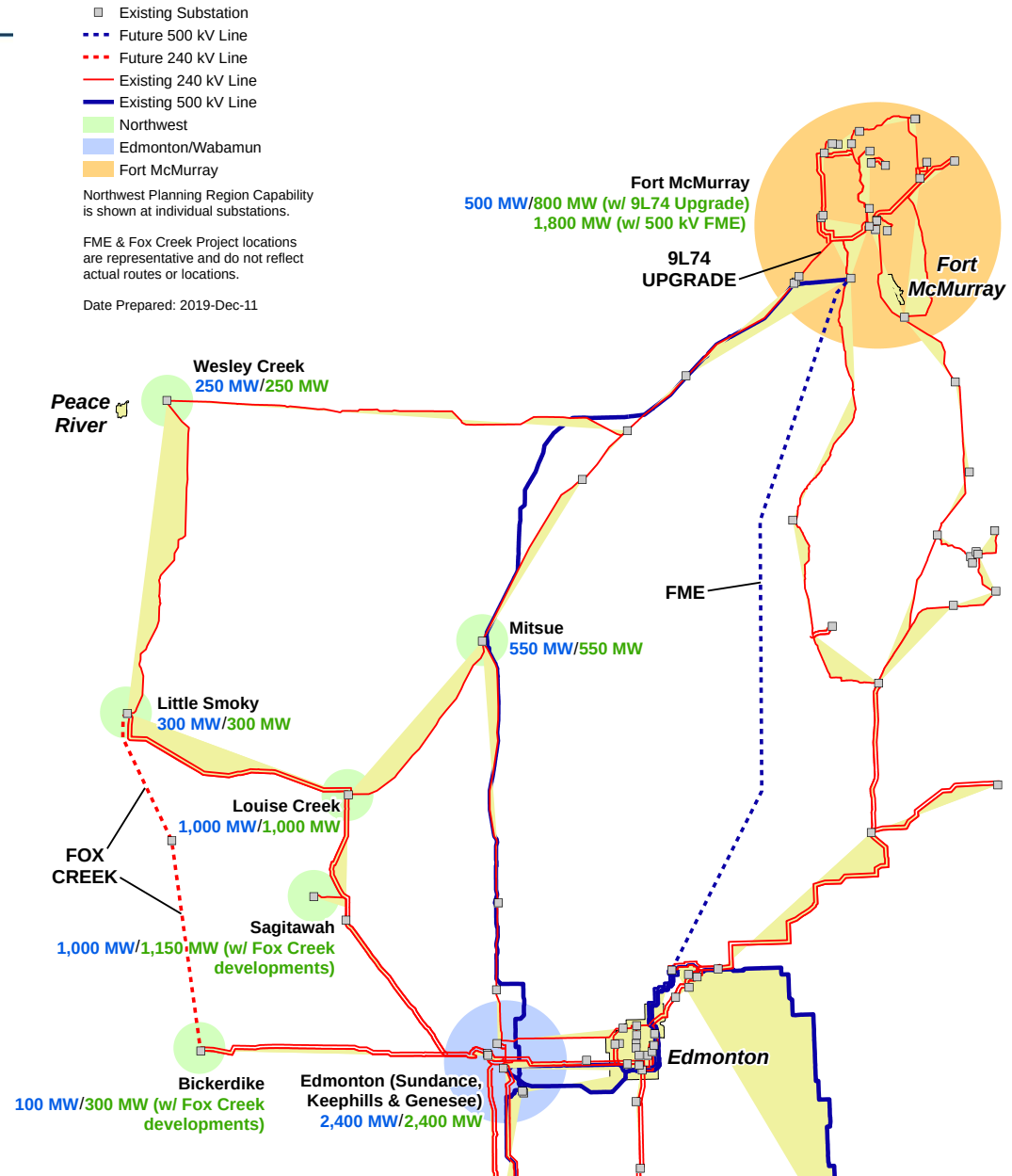
- These regions are rich in renewables
 - However, the capabilities shown here are for renewable as well as conventional generations
- The existing transmission system has approximately 450 MW of maximum remaining capability in southern and central east areas
- Planned capability enhancements for PENV/CETO/CRPC
 - PENV enables up to additional ~350 MW in the system
 - CETO can provide additional 700 MW of integration capability in SE and CE
 - CRPC can provide additional 600 MW of integration capability in the SW
 - These capabilities could also be utilized by thermal generation capacity additions
 - Assumes optimized integration; 240 kV and optimal locations



Northern Regions

- The capability shown is based on N-1 considerations
- The planned capability requires the following developments:
 - 240 kV 9L74 upgrade between Dover and Birchwood Creek substations in the NE enables 300 MW (incremental to the existing)
 - 500 kV Fort McMurray East transmission development enables 1300 MW (incremental to the existing)
 - 240 kV Fox Creek area transmission development

Northern Alberta Regional Capabilities: Existing/Planned



Questions?