2017 Long-term Transmission Plan
An Overview

Transmission System Planning

Feb 7, 2018

Welcome

- Overview of 2017 Long-term Transmission Plan (2017 LTP)
- Questions will be answered at the end of the presentation
  - Please use microphone when asking questions so webinar participants can hear discussion
- Today's presentation will be published on AESO.ca by end of day

Agenda

- LTP Highlights
- Transmission Planning Process
- The 2017 Long-term Transmission Plan
- Integrating Renewables
- Transmission Development Plans

Overview

- The 2017 LTP provides a comprehensive vision of the transmission system developments required to meet the future needs of Alberta over the next 20 years
- Current transmission system serves to meet the needs of Albertans in the near term, though some new regional transmission projects will be required to continue to meet the needs of the province
- The 2017 LTP offers a comprehensive, flexible approach to planning Alberta's electricity grid that optimizes the existing and planned transmission system

2017 LTP highlights

- Less transmission development proposed compared to 2015 LTP
- Identified 15 near-term regional developments totaling $1B
  - All require regulatory approval
- Climate leadership targets possible through use of existing system and planned developments
  - Two previously planned projects in addition to anticipated small-scale hydro-generation and distributed energy resources (DER)
- Plan for future growth and build incremental capacity when and where needed
  - Staging planned developments
  - Monitoring needs and adjusting in-service dates accordingly
- Scenarios provide picture of potential possibilities such as large hydro and major intertie additions

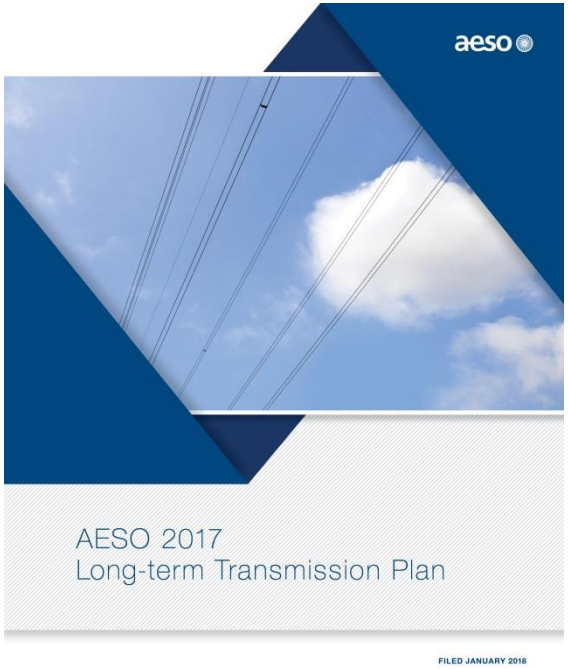
Unconstrained Transmission with Optimization

- Use existing and planned capacity enhancements and propose transmission where it adds the highest value
- Plan to utilize the existing transmission capability at or near brownfield sites including coal replacement
- Plan for transmission capability additions in areas of high renewable potential
  - Enhanced transparency through the publishing of the 2017 LTP and consequent transmission capability reports
  - Reduced system access complexities when connecting near existing capacity and planned incremental capacity additions
  - Enable simultaneous access in all renewable-rich areas and enhanced competition in areas of high renewable potential

Transmission Planning

Transmission planning – overview

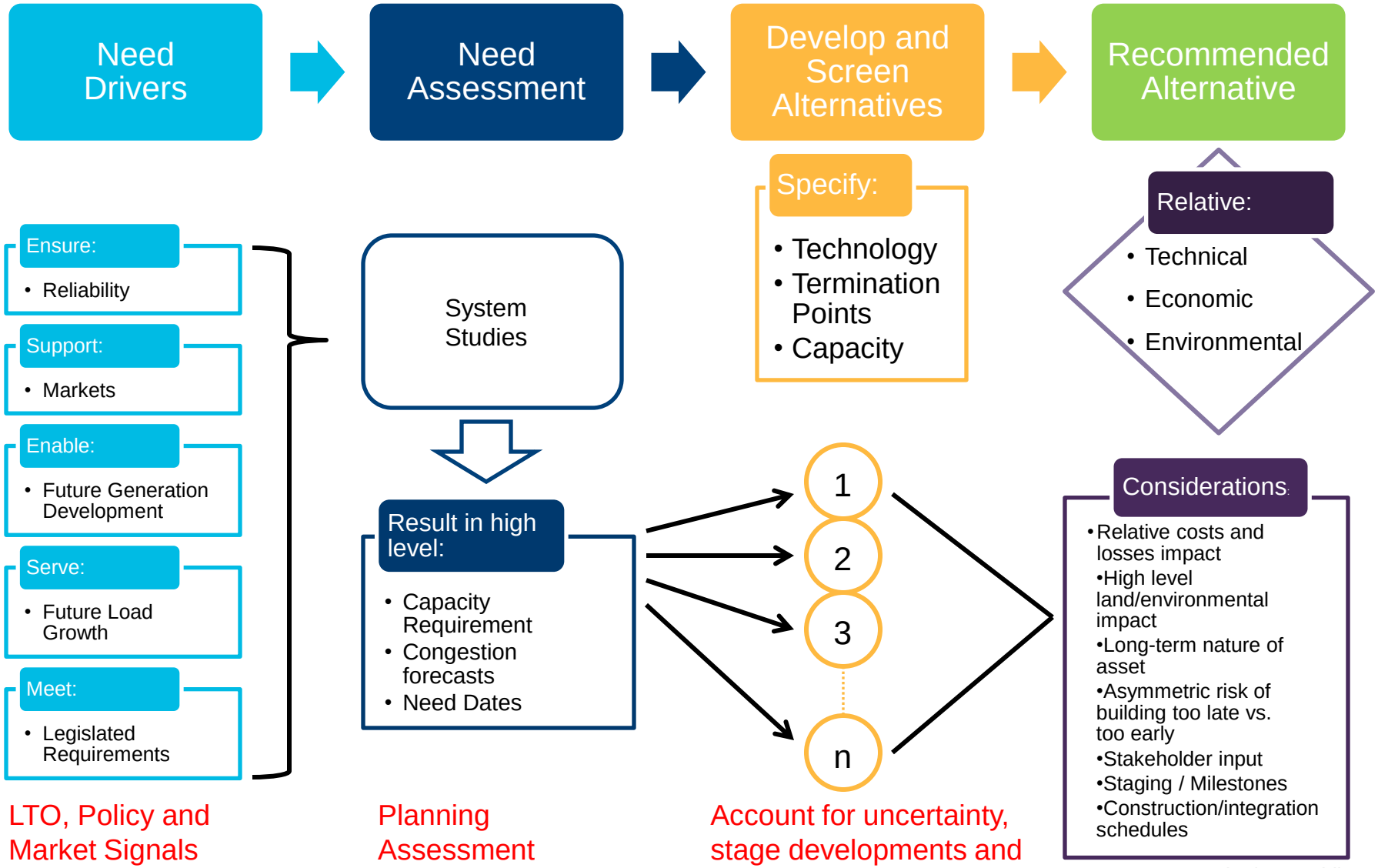
- Transmission system
  - Enables growth
  - Supports generation additions
  - Provides access for investors
- Long-term planning essential to providing a safe and reliable grid
- LTP
  - 20-year vision for Alberta's transmission system
  - Not a decision document; regulatory approval of projects required
  - Updated every two years



Developing the Long-term Transmission Plan

- Planning is purposefully flexible with upgrades planned in stages to accommodate changes in demand or generation

Transmission planning process



The 2017 Long-term Transmission Plan

Approach to 2017 LTP

- Flexibility
  - Can adjust and accommodate several future scenarios
- Optimization
  - Make use of existing facilities to the fullest extent possible
- Staged developments
  - Opportunities for gradual introduction of facilities
    - Consideration of transmission rate impact
    - Allows for opportunities to priorities developments as needs/pace shift in the future

Considerations

- Significant change in Alberta's generation fleet
  - Renewable integration of 30 per cent by 2030 (5,000 MW)
  - Coal-fired generation emissions phase-out
- Growth in electricity demand
  - 2017 LTO: Just below ~1% annual load growth (system-wide) until 2037
- Stakeholder feedback
- Emerging technologies (i.e., energy storage, DER)
  - Ongoing initiative under direction from GOA to investigate potential impacts and benefits of dispatchable renewables

Scenario-based planning

- Scenario-based planning prepares us well for a number of potential future developments
- A single reference-case load scenario
- Five generation scenarios considered
  - Reference Case
  - No Coal-to-Gas Conversion
  - Large Hydro Generation
  - Western Integration
  - High Cogeneration

Transmission developments underway

- Thickwood Hills 240 kV Transmission Development and Reactive Power Reinforcement
- Fort McMurray West 500 kV Transmission Project
- Provost to Edgerton and Nilrem to Vermilion Transmission Development
- Rycroft area voltage support
- Downtown Calgary Transmission Reinforcement
- Rebuild 807L,138 kV Beamer to Shell

Load driven developments

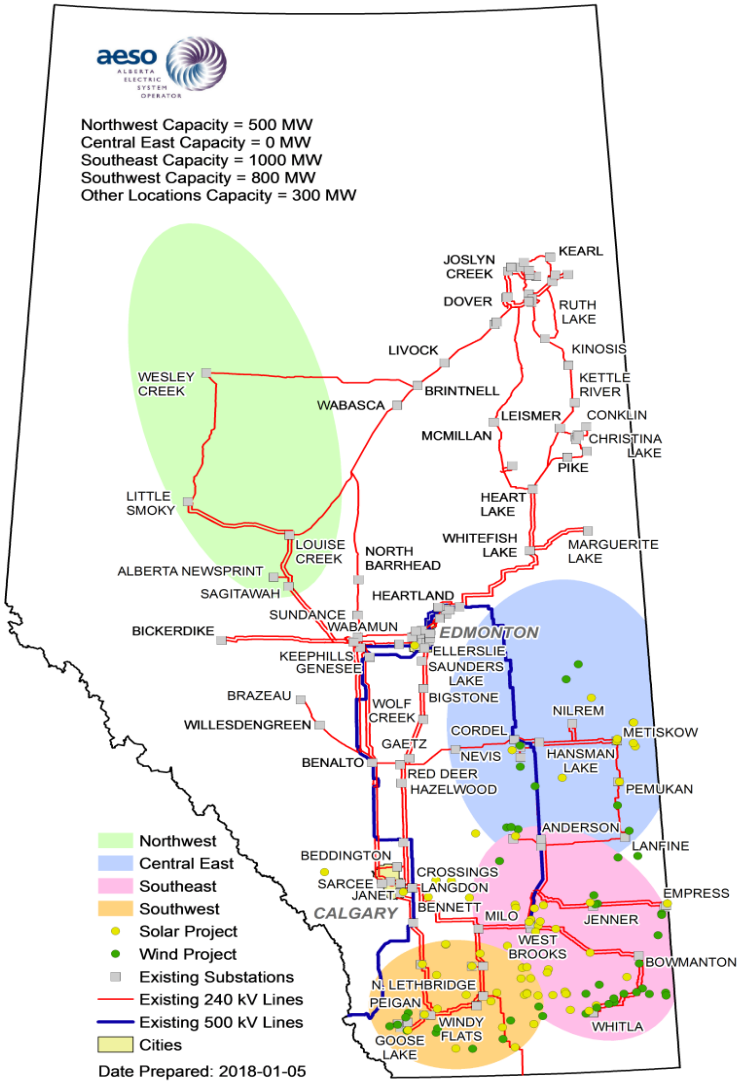
Development Name	Area	Driver	ISD Current Forecast	Current Status
PENV Development	Central	Load / Generation	2021	Filed with the AUC
Rycroft Voltage support	Northwest	Load	2020	Filed with the AUC (Dec 2017)
Alberta-B.C. Intertie Restoration	South	Intertie	2021	Under development
Restore Chappice Lk-Cypress 138 kV line	South	Generation	2022	Proposed development
Janet to East - Chestermere 138 kV enhancement	Calgary	Load	2022	Proposed development
Calgary Short Circuit Level Mitigation	Calgary	Load / Generation	2022	Proposed development
Fox Creek Reinforcement	Northwest	Load / Transfer-in	2022	Proposed development
Little Smoky sub – capacity increase	Northwest	Load	2022	Proposed development
Grande Prairie / Rycroft Developments	Northwest	Load	2022	Proposed development
East Edmonton 138 kV developments	Edmonton	Load	2022	Proposed development
City of Edmonton 72 kV Upgrades	Edmonton	Load	2022	Proposed development
North Calder to Viscount – 138 kV rebuild	Edmonton	Load	2022	Proposed development

Integrating Renewables

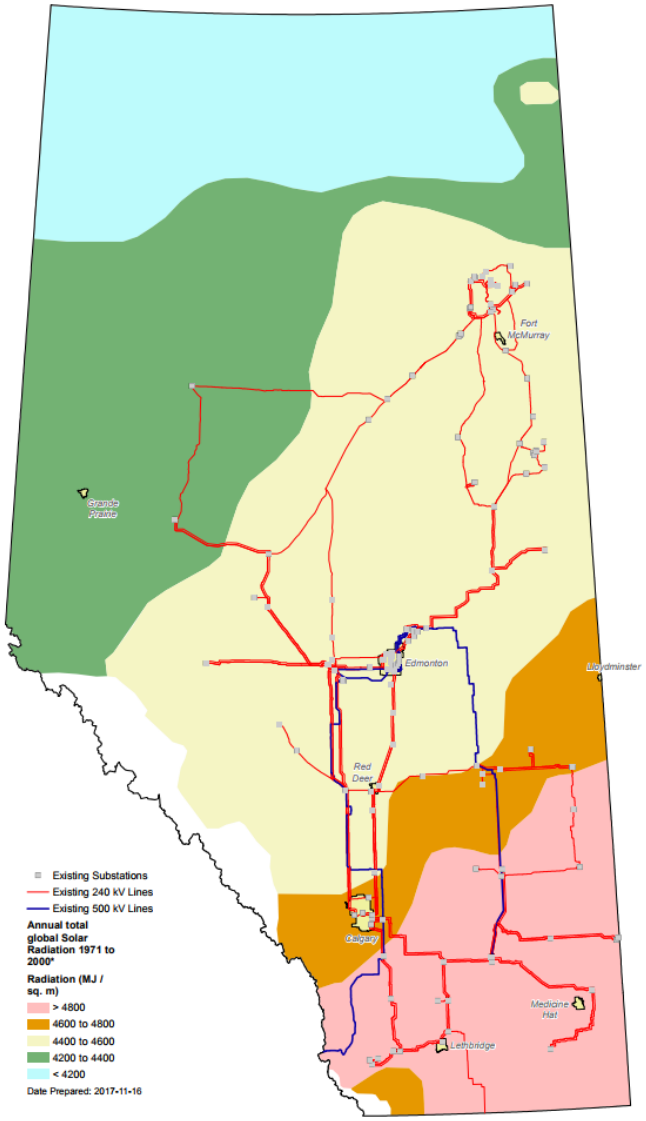
Integrating renewables - optimized

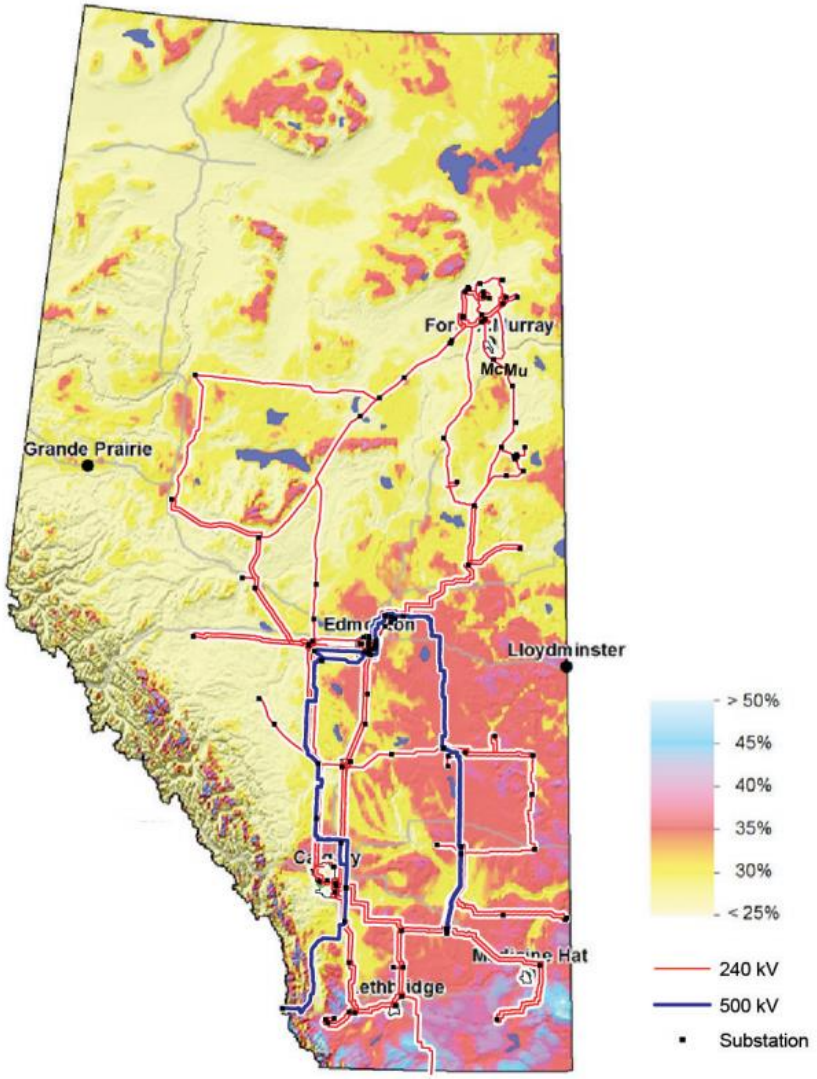
- Existing transmission capacity at time of LTP development was 2,600 MW (in renewable-rich areas)
  - Reduced to about 2000 MWs following REP round-1
- Use existing and planned capacity enhancements and propose transmission where it adds the highest value
- Renewable targets most efficiently enabled by the following previously planned developments
  - Chapel Rock – Pincher Creek
    - To be developed in two stages based on construction milestones
    - Utilizes existing 240 kV collector loop in the south
  - Central East Transfer Out
    - To be developed in two stages based on construction milestones
    - Utilizes Hanna (existing 240 kV) and PENV (filed 240 kV)
- Add incremental capacity as existing capacity is utilized

Existing transmission capability & current renewable generation applications

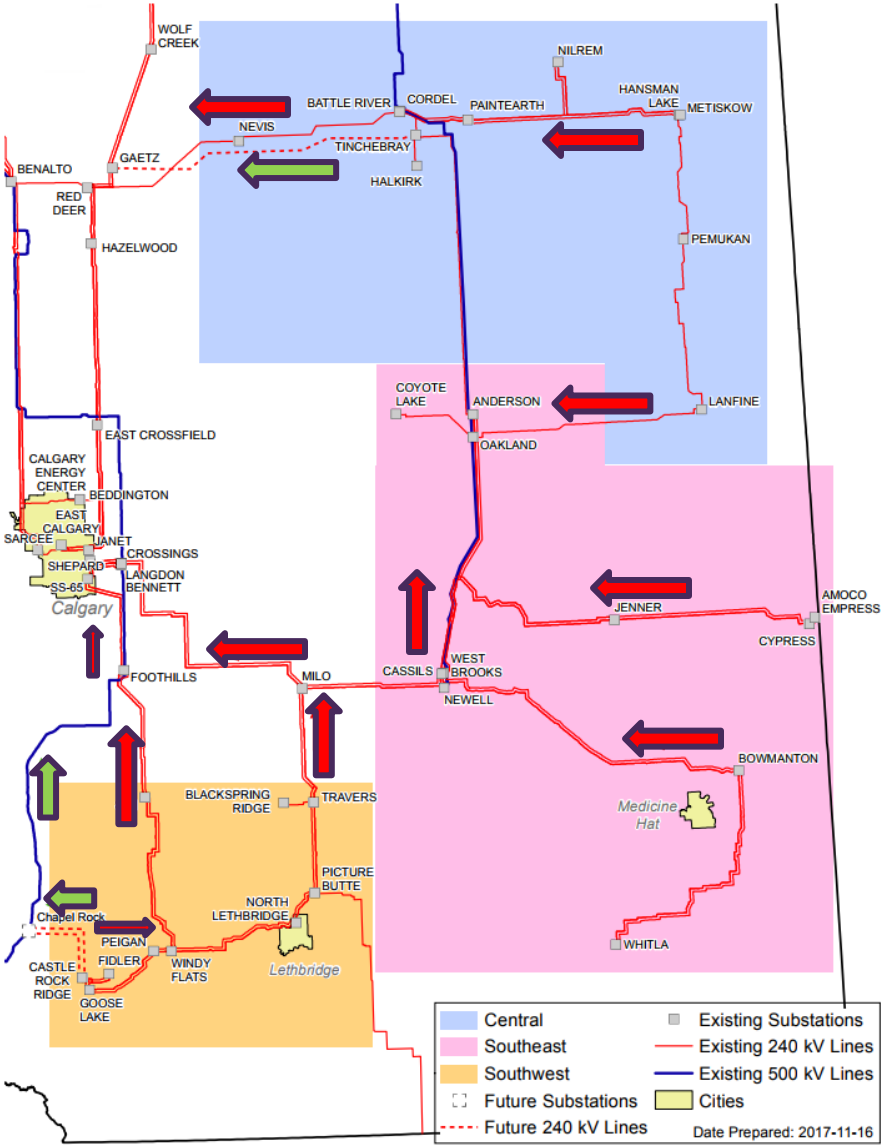


Solar & wind resource potentials map





Developments planned for anticipated renewable generation additions

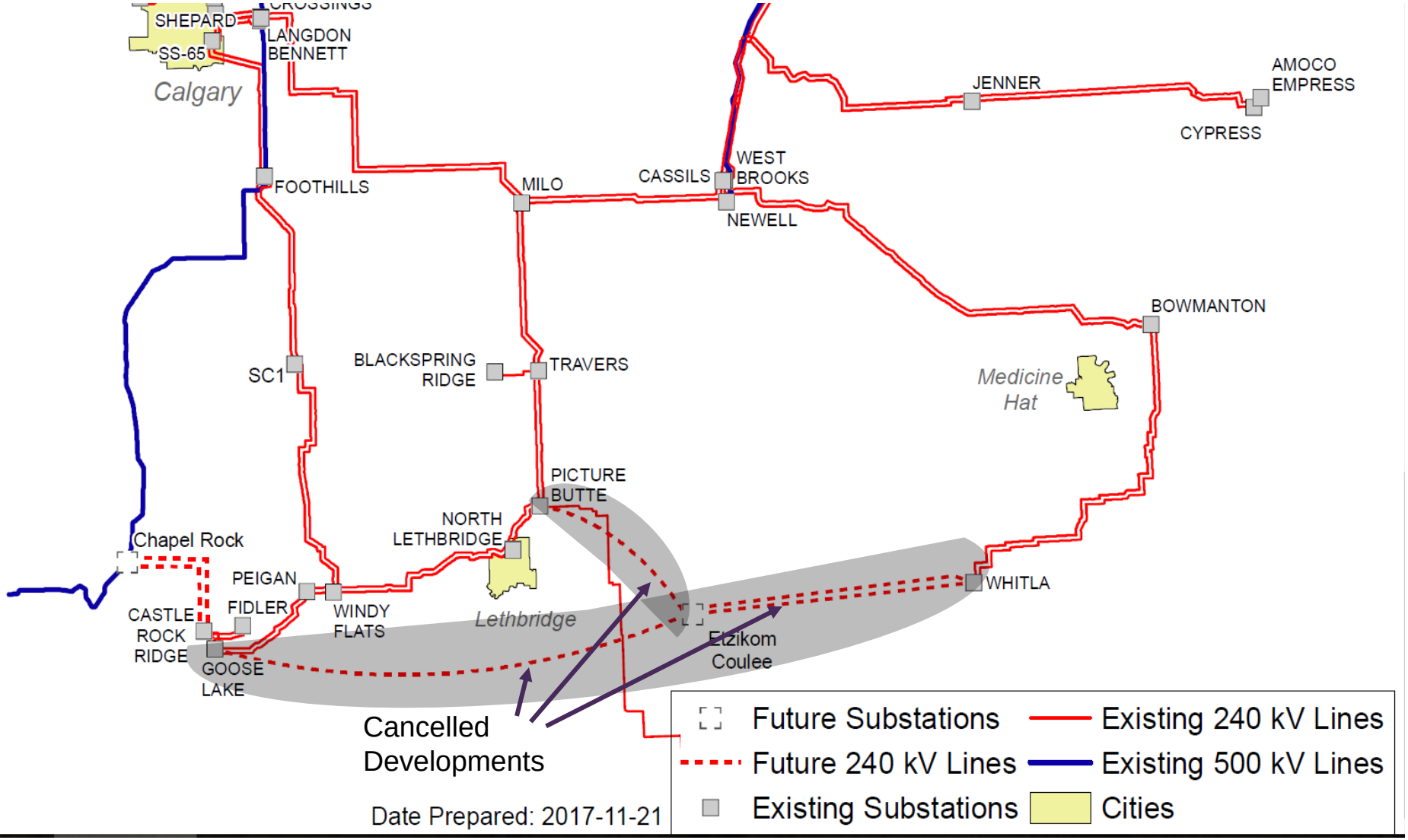


Near-term
Transmission Development Plans

South region

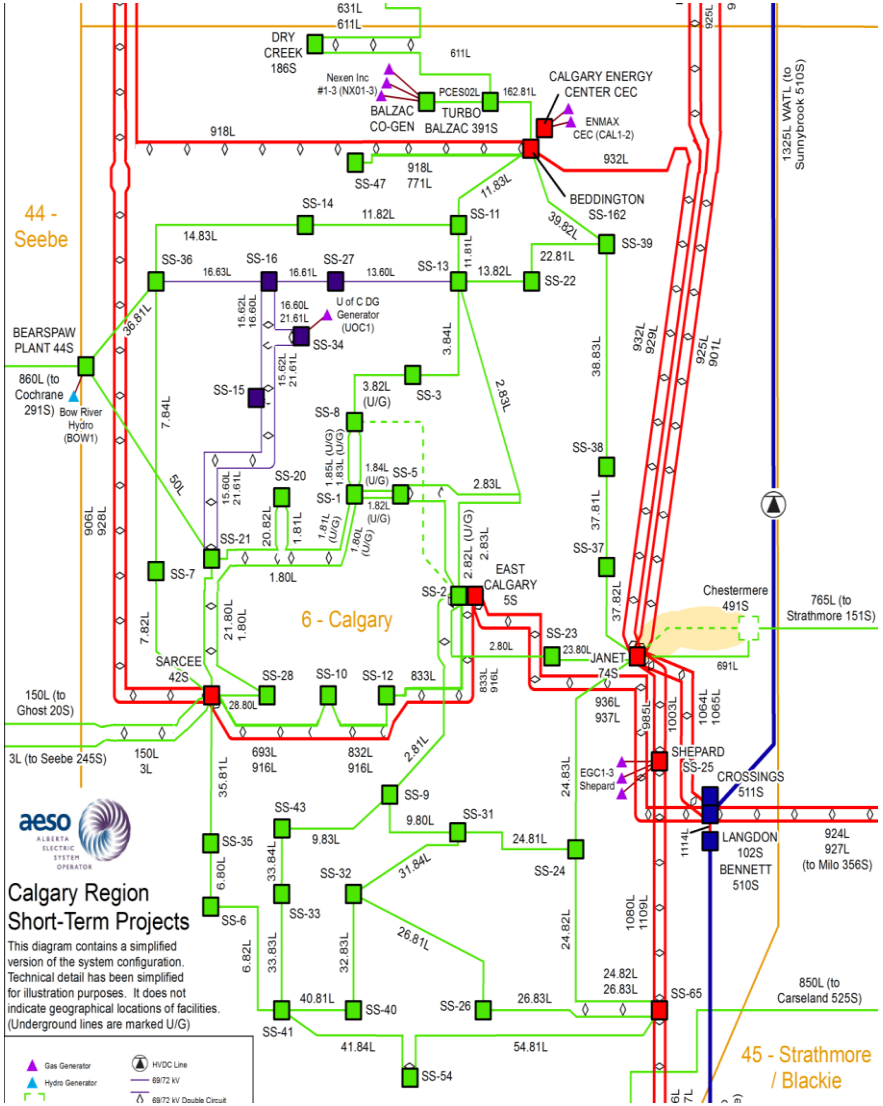
- Two developments planned by 2022
  - Restore Chappice Lake to Cypress 138 kV line
  - BC-Alberta Intertie Restoration
- Developments no longer required
  - Following Southern Alberta Transmission Reinforcement Stage 2
    - Goose Lake to Etzikom Coulee (GLEC)
    - Picture Butte to Etzikom Coulee (PBEC)
    - Etzikom Coulee to Whitla (ECW)
    - Cypress substation upgrades
  - Directs the potential ~1.5B of transmission investment towards other areas where collectors systems already exist and where transfer capability is needed.

South region developments



Calgary region developments

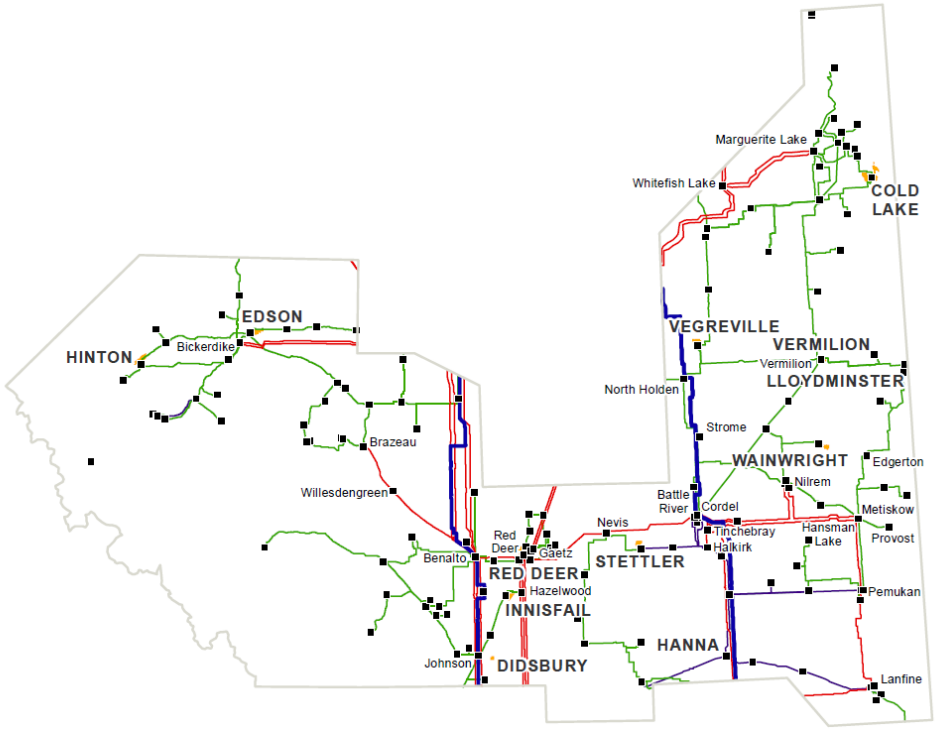
- Two developments required by 2022
  - Janet to Chestermere new 138 kV
  - Calgary Short Circuit Level Mitigation

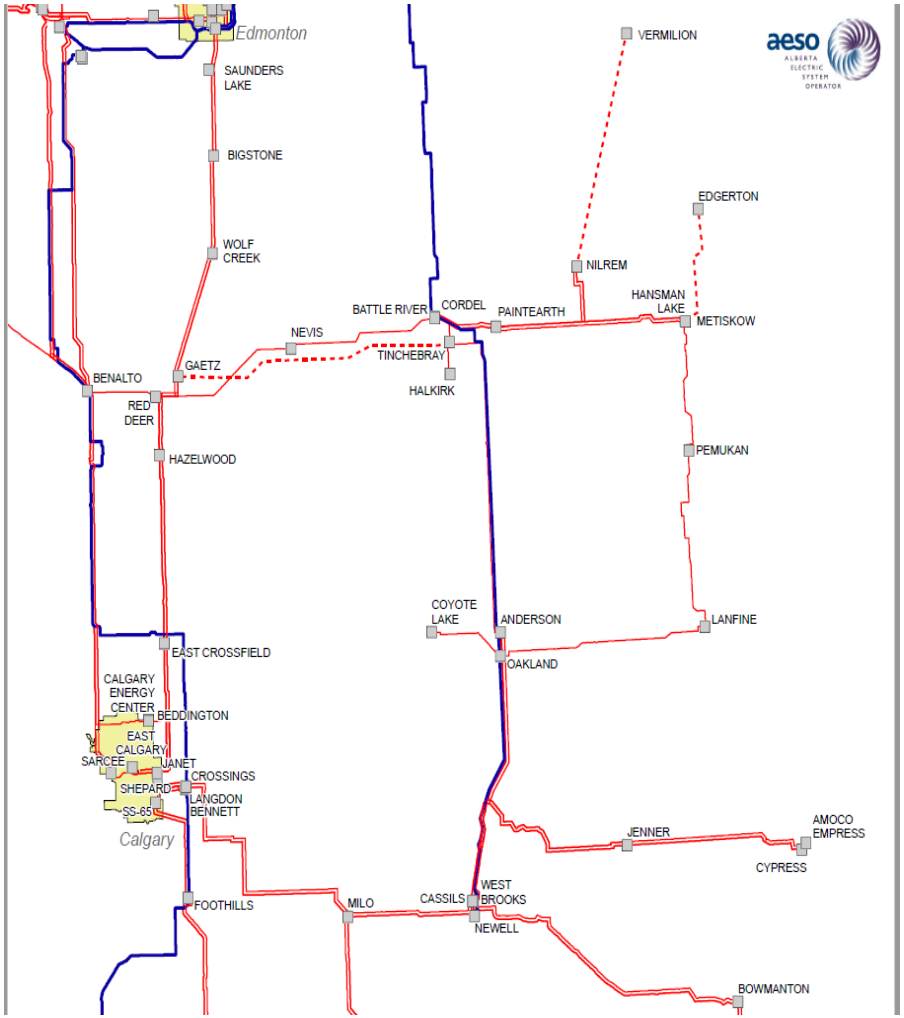


Central region

- One development required - filed with AUC for approval
  - Provost, Edgerton and Nilrem to Vermillion (PENV) Transmission Development (Expected ISD: 2021)
- One development on hold pending further review
  - Hanna Area Transmission Development Phase 2
- Longer-term transfer-out capability enhancements planned

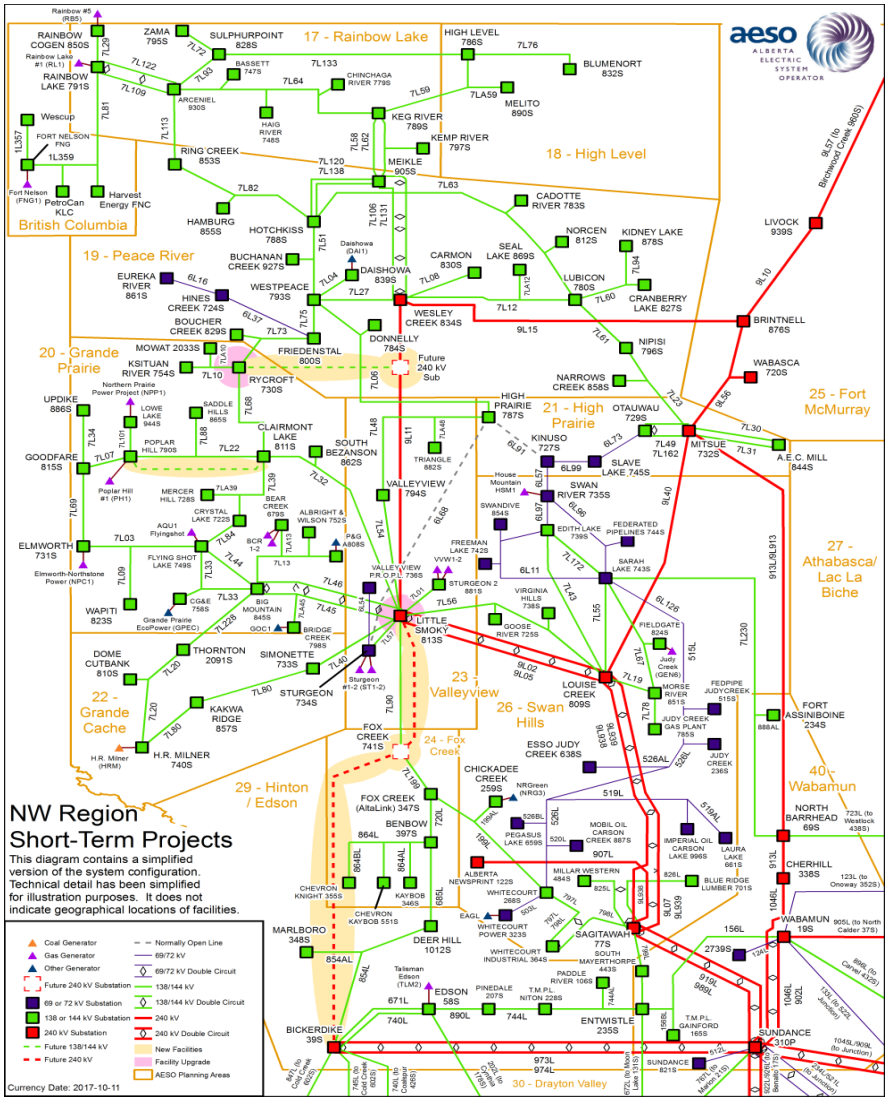
Central region developments





Northwest region

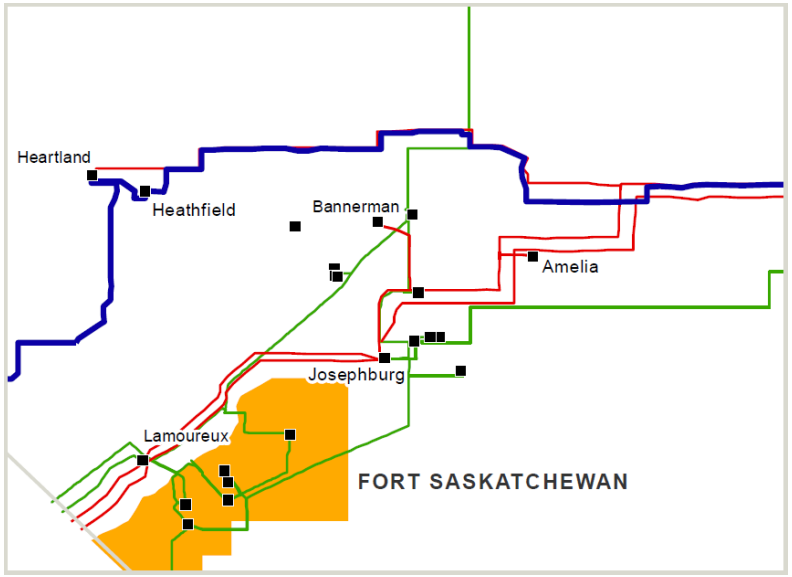
- Five developments required by 2022
  - Fox Creek Reinforcement
  - Little Smoky Substation – increase transformer capacity
  - Grande Prairie Supply
  - Rycroft Voltage Support
  - Grande Prairie Loop
- A number of these developments may shift depending on future generation development in the NW

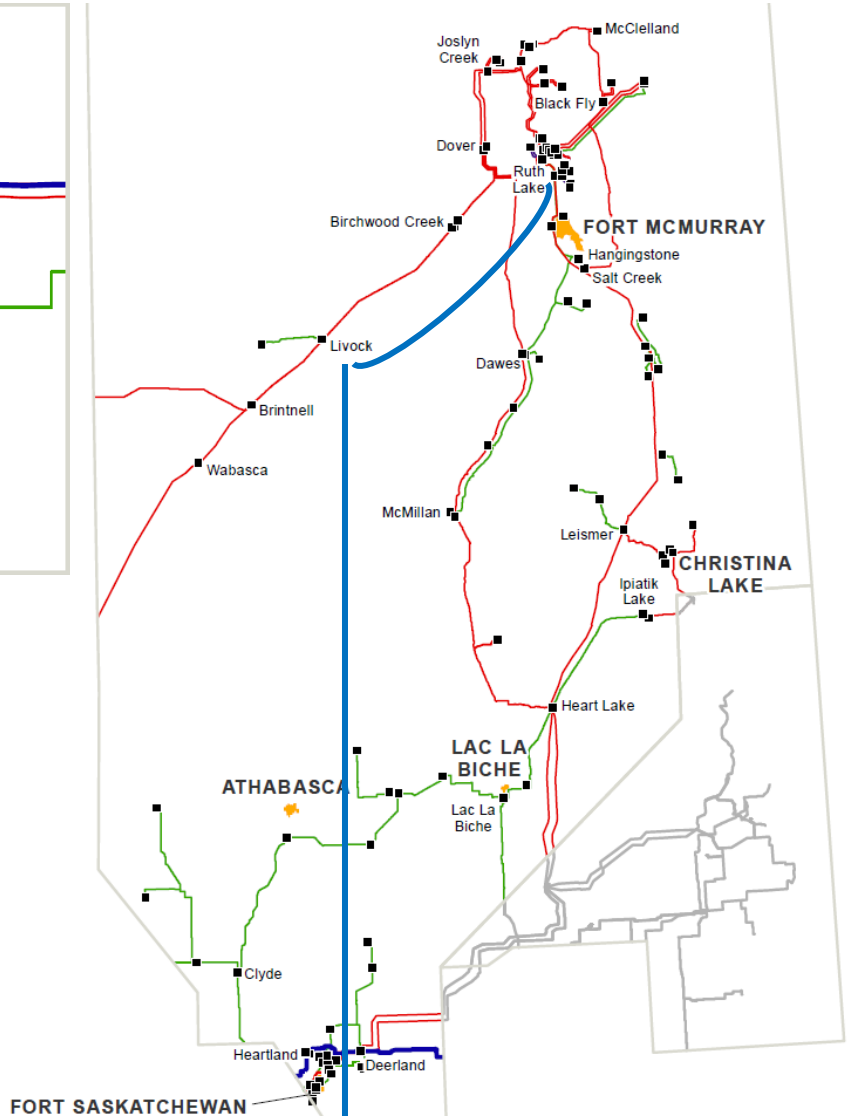


Northeast region

- No near-term transmission developments required
- Project deferred
  - Fort McMurray East
  - Will depend on pace of oil sands development in the long term
- Development no longer required
  - Northwest of Fort McMurray
  - Defers ~$329M development until interest in developing new oil sands projects in the area

Northeast region developments

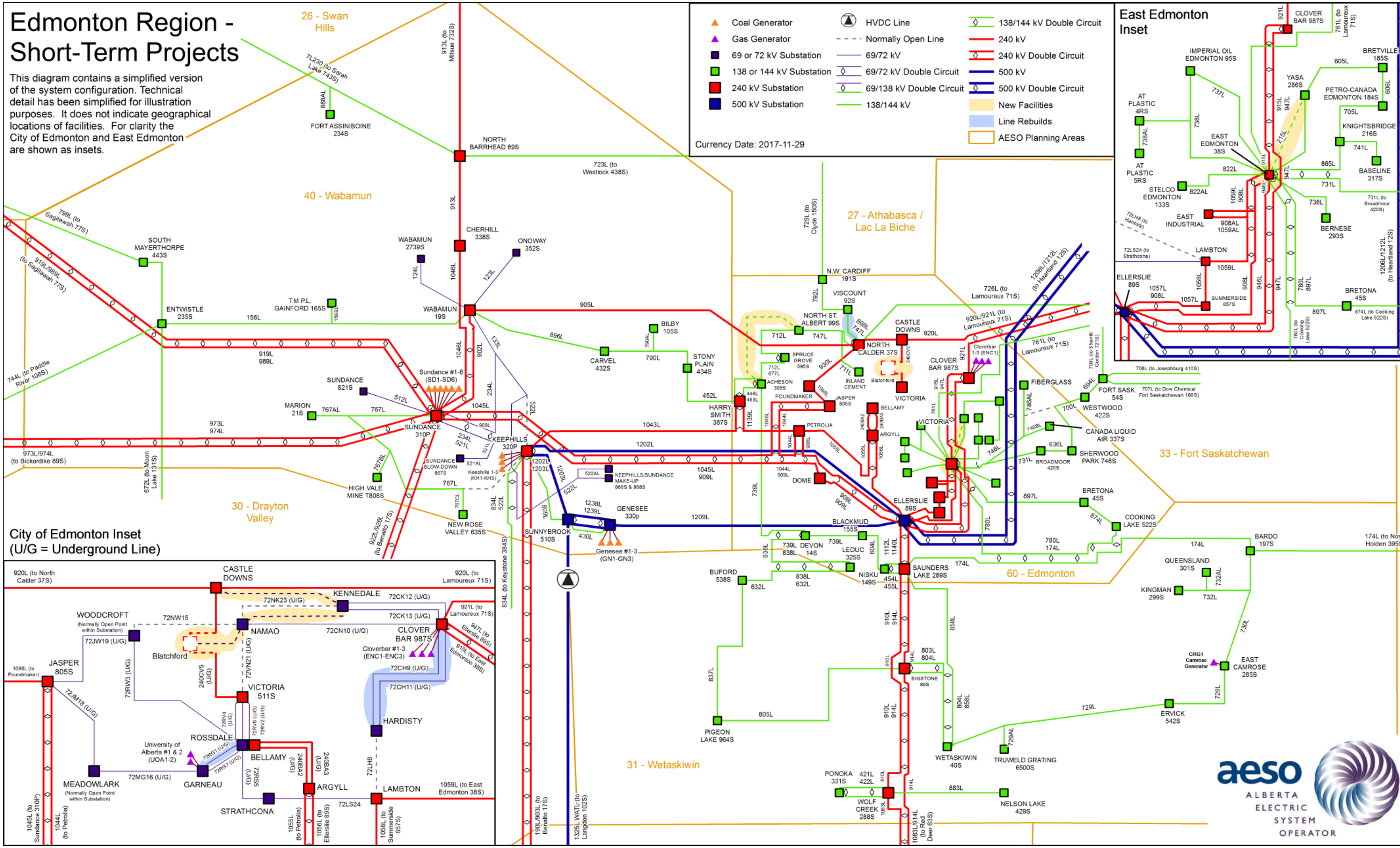




Edmonton region

- Five developments required by 2022
  - Yasa to East Edmonton 138 kV Circuit
  - East Edmonton transformer capacity increase
  - Acheson to North St. Albert 138 kV circuit
  - City of Edmonton 72 kV upgrades
  - North Calder to Viscount Rebuild of 138 kV line
- Developments where scopes reduced
  - East Edmonton developments
  - City of Edmonton 72 kV

Edmonton region developments



Long-term transmission development summary

Scenario	Transmission Developments
Reference Case	• Southeast 138 kV enhancements • Chapel Rock-Pincher Creek 240 kV development • Central East transfer out development • Northwest 240 kV and 144 kV enhancements
No Coal-to-Gas Conversion	Same as reference case
Large Hydro Generation	Same as reference case plus • 500 kV to connect Slave River Hydro • 240 kV and 138 kV enhancements for Brazeau
Western Integration	Same as reference case plus • 500 kV to Livock and internal upgrades (northern option) • 500 kV to parallel existing tie line (southern option)
High Co-gen	Same as reference case plus (Replacing FME) • 240 kV and 138 kV enhancements in Athabasca area • 240 kV enhancement in Fort McMurray area

Conclusion

- The 2017 LTP
  - Provides a comprehensive vision to meet Alberta's needs over the next 20 years
  - Offers an unconstrained yet optimized transmission plan that optimizes the existing and planned transmission system capability
  - Is flexible through the consideration of several potential scenarios of the future
  - Effectively and efficiently utilizes existing and planned transmission to integrate renewables and replace coal fired facilities

Long Term Time Horizon Scenario Assessment

Scenarios studied (medium & long term time horizons only)

- All the scenarios account for Climate Leadership Plan (CLP)
  - Phase-out of coal generation by 2030
  - 30 per cent of electricity produced in Alberta will come from renewables by 2030
- Scenarios
  - Reference Case: Publicly announced generation changes by the end of 2016
  - No Coal-to-Gas Conversion: All coal fired units retired and replaced with combined cycle
  - Large Hydro: 1,500 MW of hydro added
  - Western Integration (New Large Intertie): 500 kV intertie to BC
  - High Cogeneration: Approximately 2,000 MW of cogeneration added in Fort McMurray area

Reference case assumptions

- Coal retirement
  - HR Milner, Sundance 1&2 and Battle River #3 retire by 2022
  - Sundance 3-6 and Keephills 1&2 (2,400 MW) converted to gas fired thermal generation between 2021 and 2023
  - Remaining coal units retired between 2025 and 2030
- Renewables
  - Wind – 5,000 MW by 2030
  - Solar – 500 MW by 2030 plus 500 MW post 2030
  - Hydro – 350 MW by 2030 (Amisk/Dunvegon)

Reference case enhancements

- Grande Prairie Supply – new 240/144 kV sub and 144 kV line to Rycroft
- Fox Creek Reinforcement – 240 kV Bickerdike - Fox Creek-Little Smoky
- Tinchebray-Gaetz 240 kV line and Cordel-Red Deer 240 kV rebuild
  - Cordel-Gaetz rebuild will depend on ability to maintain reliability under a long-term outage
- Chapel Rock – 500/240 kV sub and 240 kV line to Pincher Creek
- Rebuild 138 kV Bowmanton-Tilley and Chappice Lake-Cypress

No coal-to-gas conversion assumptions

- Same as Reference Case except
  - Sundance 3-6 and Keephills 1&2 retired 2021 and 2023
  - Sun 3-6 and KH 1&2 are replaced by combined cycle in this scenario
- This change will impact the merit order compared to the Reference Scenario due to the lower heat rate of CGC
- In the Reference Scenario, Shepard and Foothills are dispatched ahead of Sun 3-6 and KH 1&2 due to the lower efficiency of the CGC
- This reduces south generation that reduces some of the stress on the south and Calgary systems

No coal-to-gas enhancements

- Same as Reference Case
  - Overloads were not as severe and not as many, but the required mitigation measures were the same

Large hydro assumptions

- Same as Reference Case except for the following additions
  - 170 MW near Brazeau by 2030
  - 1000 MW Slave River Hydro after 2030
- Conceptual planning studies were also performed for hydro developments of approximately 900 MW in the Brazeau area
  - Required transmission would be two 500 kV lines from Brazeau to the 500 kV system in the Lake Wabamun area; preferably near Sundance

Large hydro enhancements

- In addition to Reference Case
  - Two 500 kV lines from Slave River to Thickwood Creek
  - New 240 kV Brazeau-Red Deer and 138 kV Brazeau-Lodgepole upgrade

Western integration assumptions

- All generation assumptions same as reference case
- New Intertie Options
  - North – BCH Site C to Wesley Creek
  - South – BCH Selkirk to Chapel Rock
- Study conducted as part of Regional Electricity Cooperation and Strategic Infrastructure (RECSI) initiative
  - Examined only one year – 2032
  - Only examined impacts on the system caused by a new intertie

Western integration enhancements

- North tie – 500 kV line from Wesley Creek to Livock with series compensation on both Wesley Creek-Livock and Wesley Creek-Site C
- Fort McMurray West 500 kV line was assumed to be in place which provides the necessary connection of the north intertie to the rest of the system

High cogeneration assumptions

- Same as Reference Case except:
- Cogeneration
  - 1,095 MW by 2027 (Reference Case: 405 MWs)
  - 1,455 MW by 2032 (Reference Case: 405 MWs)
  - 1,725 MW by 2037 (Reference Case: 405 MWs)
  - Replacing existing steam boiler plants
    - Reflective of higher outflow, not associated with new load additions
  - All of the co-generations except 90 MW are assumed in Fort McMurray area – 90 MW in Cold Lake area

High cogeneration enhancements

- In addition to Reference Case
  - Athabasca Reinforcement – 240 kV Heart Lake-Heartland with 240/138 kV sub near Plamondon and 138 kV lines from new sub to Lac La Biche and Waupisoo
  - Rebuild 240 kV Dover-Birchwood Creek to higher capacity

Transmission cost estimate summary

NEAR-TERM	2015 LTP ($M)	2017 LTP ($M)
In flight/approved	2,920	2,150
Planned (2020/22)	2,495	1,032

	Average Transmission Cost ($/MWh)		Monthly Residential Transmission Charge ($/month)		Average Growth (%)
	2017	2035	2017	2037	
Current Transmission Rate Projection (TRP)	34.25	48.42	20.55	29.05	2.3
2018 ISO Tariff Application TRP	34.25	53.68	20.55	32.21	3.2
Updated TRP – Incl. 2017 LTP/LTO	34.25	45.57	20.55	27.34	1.8

Questions?

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