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2025-12-15

Cluster 2 Congestion Assessment

Central Cluster [CTRL-02]

PERMIT TO PRACTICE
INDEPENDENT SYSTEM OPERATOR
RM SIGNATURE:
RM APEGA ID #: 238436
DATE: 2025-12-15
PERMIT NUMBER: P008200
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Date: December 15, 2025

Version: V1

Classification: Public

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Contents

1. Introduction

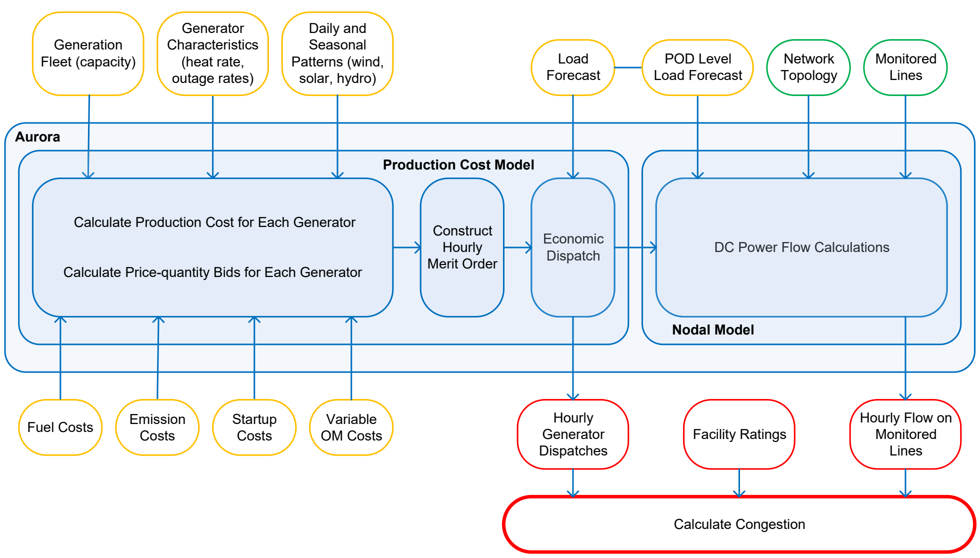
This report documents the Congestion Assessment for the projects in the Central cluster region.

Congestion occurs when the transmission system cannot accommodate all in-merit generation, because the resulting power flows would contravene reliability standards and/or ISO rules.[1] This Congestion Assessment forecasts congestion that may occur in the cluster region under three scenarios.

2. Method

The congestion assessment combines a production cost model with a transmission system network model. The production cost model simulates the hourly energy market economic dispatches required to supply the forecasted hourly demand. Then, the transmission system network model calculates the hourly power flows on each transmission facility that result from the hourly energy market dispatches and demand. Finally, congestion is calculated by comparing the hourly power flows on each transmission facility with its respective facility rating. Figure 1 illustrates the inputs and processes involved in the congestion assessment.

Figure 1 - Congestion Assessment Process



The Congestion Assessment forecasts the potential congestion resulting from thermal violations of normal facility ratings under the Category A condition. Generation is dispatched as if the transmission system had no constraints and then the resulting power flows are compared to their respective facility ratings to identify congestion.

The assessment does not forecast the potential congestion caused by curtailment to prepare for contingencies, most severe single contingency limits, or congestion associated with voltage or transient stability criteria violations. These items could increase

[1] The reliability standards and ISO rules are available on the AESO website.

the risk of congestion. In addition, supply surplus can also impact a generating unit's ability to provide energy to the market. Supply surplus creates an unbalanced supply-demand situation where generation may be curtailed due to excess supply offered to the market rather than transmission constraints.

3. Assumptions

The Congestion Assessment forecasts congestion that may occur in the cluster region for the following assumptions.

3.1 Study Period

The Congestion Assessment studied all 8760 hours in the study year of 2029 to forecast congestion.

The Congestion Assessment assumes any modelled generating unit or transmission system project are in service prior to January 1st, 2029. Thus, every modelled generating unit and transmission system project were simulated as in-service for all of calendar year 2029.

3.2 Scenarios

The Congestion Assessment forecasts congestion that may occur in the cluster region within three scenarios:

i) **Post-PIC**: assumes projects that have met the project inclusion criteria[2] (PIC) across the entire province are energized;

ii) **Pre-cluster**: assumes post-PIC plus all Connection Assessment (CA) modelled projects[3] within the cluster region are energized; and

iii) **Post-cluster**: assumes pre-cluster plus Cluster 2 projects within the cluster region are energized.

Projects were included in the different scenarios as per the *AESO Connection Project List*[4] from August 2025. The scenarios are reiterated in Table 1.

[2] The definition of project inclusion criteria is available in the Connection Project List Guide on the AESO website.

[3] For the purpose of this assessment, CA Modelled projects are the non-Cluster 2 projects which are included in the assessment. The definition of CA modelled projects is available in the Connection Project List Guide on the AESO website.

[4] The AESO Connection Project List is available on the AESO website.

Table 1 – Projects Included in each Scenario

	In-flight Projects[5]		Cluster Projects[6]
Scenario	Projects that have met PIC across the province	CA Modelled Projects in the cluster region	Cluster Projects in the cluster region
Post-PIC	Yes	No	No
Pre-Cluster	Yes	Yes	No
Post-Cluster	Yes	Yes	Yes

[5] CA Modelled projects located outside the geographic region may be considered part of that region for cluster assessment if they have a significant impact on its system.

[6] Cluster projects located outside the geographic region may be considered part of that region for cluster assessment if they have a significant impact on its system.

3.3 Generation and Demand

Generation

Table 2 provides the generation capacities modelled in each scenario. The post-PIC scenario includes all existing generators and those that have met the AESO's inclusion criteria. However, the pre-cluster and post-cluster scenarios only add generating units to the cluster region.

Table 2 – Assumed Installed Generation Capacity

Technology	Post-PIC (MW)	Pre-Cluster (MW)	Post-Cluster (MW)
Wind[7]	6,257	+630	+1,147
Solar[8]	5,255	+2,783	+868
Energy Storage[9]	286	+1,158	+1,794
Thermal	14,448	+586	+987
Hydro	894	0	0
Other	509	0	0
Additions		+5,157	+4,796
Total	27,649	32,806	37,602

Wind generating units were dispatched following forecasted hourly wind profiles which account for varying weather patterns and geographic locations.

Solar generating units were dispatched following forecasted hourly solar profiles which account for varying solar irradiance, weather patterns, geographic locations, and solar panel characteristics.

Energy storage assets were divided into three groups:

1. Storage assets co-located with generating units. These storage units were modelled to only charge from their respective co-located generating units and discharge based on pool price.
2. Storage assets that are assumed to provide ancillary services. These storage generating units were modelled to not dispatch in the energy market.

[7] This includes wind generating units with hybrid storage. The storage, which charges from the wind generating unit, is not included in the wind total generation capacity.
[8] This includes solar generating units with hybrid storage. The storage, which charges from the solar generating unit, is not included in the solar total generation capacity.
[9] This includes the storage component of hybrid generating units with either wind and energy storage or solar and energy storage.

3. Storage assets that are assumed to provide energy market dispatches. These storage generating units were modelled to optimize charging and discharging based on pool price arbitrage.

Each remaining generating unit was dispatched using production cost modelling which accounts for the costs and characteristics of its technology type.

In the event of supply surplus, partial volume dispatches of $0 offers were assigned pro-rata to the generating units according to Section 202.5 of the ISO Rules, *Supply Surplus*.[10]

Demand

Base demand was modelled at each point of delivery following the *2024 Long Term Outlook*.[11]

In addition, two large data center loads from Phase 1 of the Large Load Integration program have been added to the base demand.[12] Their total size is 1200MW.

Table 3 – Large Data Center Loads

Project Name	Contract Size (MW)
P2936 GLDC Load	970
P3083 Keephills Data Centre Phase I	230

3.4 Transmission Topology

The transmission system topology was modelled as per the existing transmission system with the following additions:

1. Connection projects were included using the AESO-preferred connection alternative.
2. *Central East Transfer-Out Transmission Development*[13] (CETO) Stage 2 was included.

All of the above transmission system topology additions were assumed in-service before January 1st, 2029.

The existing facility ratings, provided by the legal owners of transmission facilities, were assumed in the transmission system model, except for the facility ratings that will be modified by any of the above additions.

Congestion is reported for transmission facilities in the cluster region that operate at 69 kV and above. Transformers are only reported if both sides of a transformer's voltage are at 69 kV and above.

[10] *ISO Rule 202.5 – Supply Surplus* is available on the AESO website.
[11] The *2024 LTO* is available on the AESO website.
[12] Phase-1 Large Load Integration program information is available on the AESO website.
[13] AUC Decision 25469-D01-2021

4. Results

The Congestion Assessment forecasts the potential congestion resulting from thermal violations of normal facility ratings under the Category A condition. The assessment does not forecast the potential congestion caused by pre-contingency curtailment, most severe single contingency limits, or congestion associated with voltage or transient stability criteria violations.

The Congestion Assessment provides forecasted congestion frequency and congested energy on lines within the cluster region.

> *Note: The total amount of congested energy in a cluster region is not the sum of all of the congested energy on the transmission facilities. This is because when a generating unit is curtailed, it may affect flows on multiple lines with different effectiveness. For example, 1,000 MWh of curtailed energy at a specific generator may prevent overloads on two transmission facilities that report 1,000 MWh and 500 MWh of congested energy. In this hypothetical example, taking 1,000 MWh of action at a generator leads to 1,500 MWh of Congested Energy relief on transmission facilities.*

The Congestion Assessment does not consider which generating units would be curtailed; all real-time curtailments are subject to Section 302.1 of the ISO Rules, *Real Time Transmission Constraint Management.*[14]

The results are provided in the following sections for the three scenarios (as defined in Section 3.2): post-PIC, pre-cluster, and post-cluster.

[14] *ISO Rule 302.1 – Real Time Transmission Constraint Management* is available on the AESO website.

4.1 Post-PIC Scenario

Figure 2 illustrates the forecasted congestion frequency and Figure 3 illustrates the forecasted congested energy. The results are provided in tabular format in Attachment A.

In the Central West, in the post-PIC scenario, material congestion is observed on 138 kV transmission lines 890L (58S Edson-207S Pinedale) and 740L (58S Edson-39S Bickerdike); in the Central East, material congestion is observed on 138 kV transmission lines 174L (197S Bardo-395S North Holden), 7L159 (7LA159 Tap-770S Three Hills), 7L159 (7LA159 Tap-948S Heatburg), 7L171 (802S Michichi Creek-804S Wintering Hills), 7L132 (767S Oyen-959S Lanfine), 7L137 (770S Three Hills-768S Rowley), 7L16 (766S Nevis-948S Heatburg), 7L25 (768S Rowley-802S Michichi Creek) and 7L760 (7LC760 Tap-767S Oyen). Material congestion is also observed on 240 kV lines 9L59 (801S Anderson-9LA59 Tap), 9L59 (972S Tinchebray-9LB59 Tap), and 9L59 (9LA59 Tap-9LB59 Tap).

Figure 2 – Post-PIC Congestion Frequency Heatmap

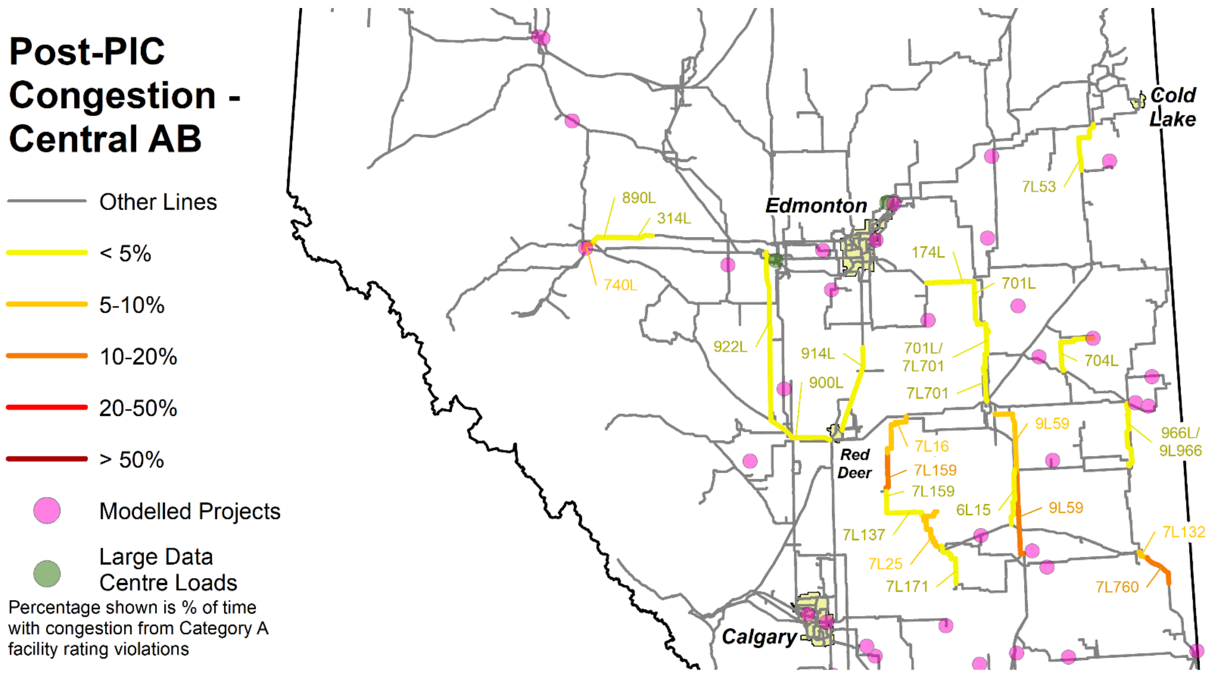
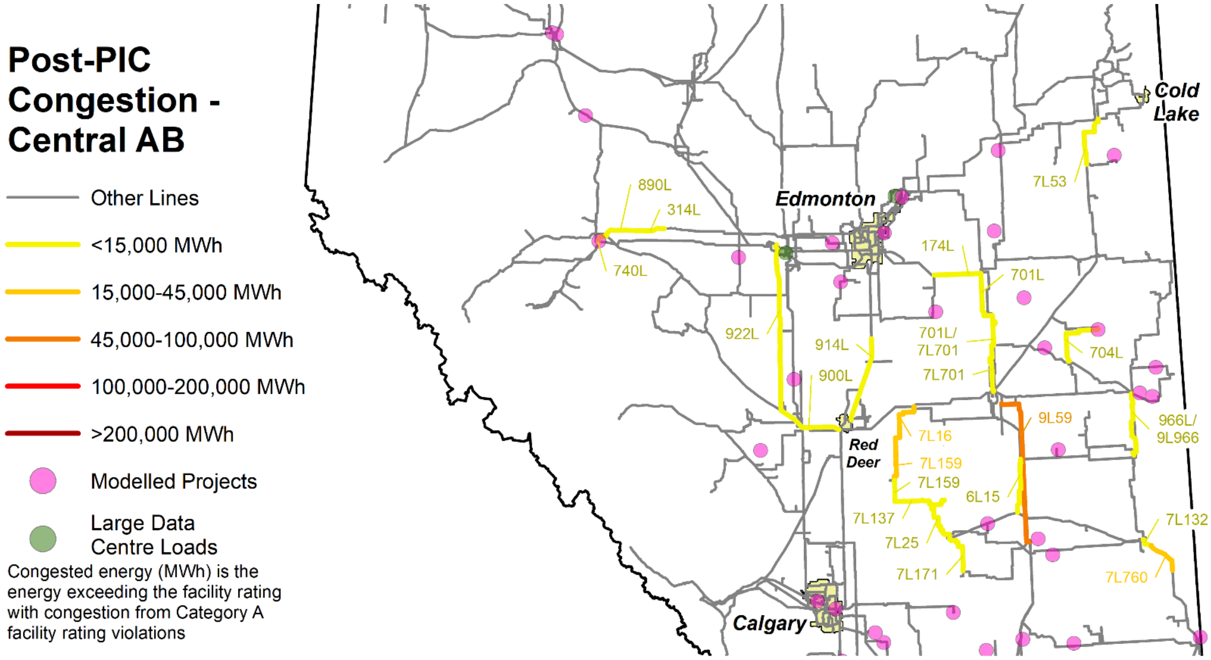


Figure 3 – Post-PIC Congested Energy Heatmap



4.2 Pre-Cluster Scenario

Figure 4 illustrates the forecasted congestion frequency and Figure 5 illustrates the forecasted congested energy. The results are provided in tabular format in Attachment A.

In the Central West, relative to the post-PIC scenario, material congestion increase is observed on 138 kV transmission lines 890L (58S Edson-207S Pinedale), 314L (228S T.M.P.L. Niton-207S Pinedale), 744L (228S T.M.P.L. Niton-744AL Tap) and 202L (61S Lodgepole-62S Brazeau). Material congestion increase is also observed on 240kV lines 922L (310P Sundance-17S Benalto), 914L (87S Gaetz-914AL Tap), 914L (914BL Tap-914AL Tap) and 900L (63S Red Deer-17S Benalto).

In the Central East, relative to the post-PIC scenario, material congestion increase is observed on 138 kV transmission lines 174L (197S Bardo-395S North), 408L (252S Jarrow-51S Wainwright), 472L (648S Metiskow-472AL Tap), 701L (395S North Holden-223S Strome), 701L/7L701 (223S Strome-7LA701 Tap), 703L (377S Hardisty-703BL Tap), 704L (51S Wainwright-478S Tucuman), 749L/7L749 (899S Edgerton-7LB749 Tap), 7L50 (526S Buffalo Creek-491L Tap), 7L53 (7LA53 Tap-700S Bonnyville), 7L65 (7LA65 Tap-709S Vegreville), 7L701 (7LA701 Tap-757S Battle River) and 7L749 (7LB749 Tap-716S Lloydminster). Material congestion increase is also observed on 240kV lines 966L/9L966 (650S Hansman Lake-932S Pemukan), 9L20 (766S Nevis-9LA20 Tap), 912L (63S Red Deer-766S Nevis), 9L59 (801S Anderson-9LA59 Tap), 9L59 (972S Tinchebray-9LB59 Tap), 9L59 (9LA59 Tap-9LB59 Tap) and 948L/9L948 (863S Paintearth Creek-948AL Tap).

Some lines experienced decreased congestion, as detailed in Attachment A.

Figure 4 – Pre-Cluster Congestion Frequency Heatmap

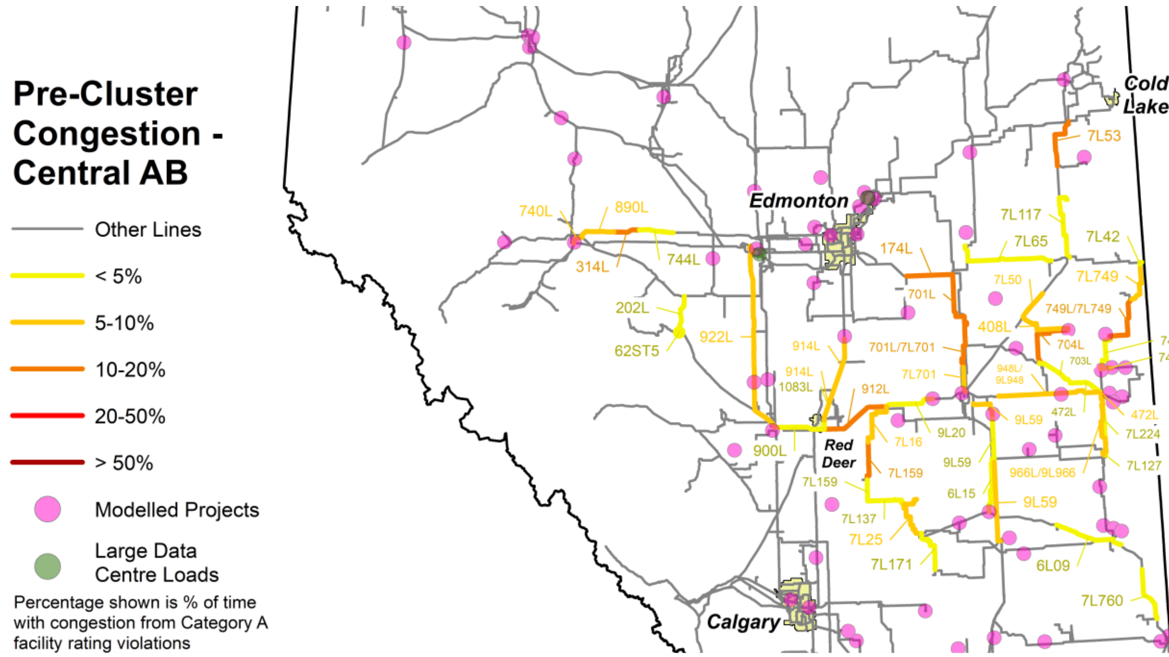
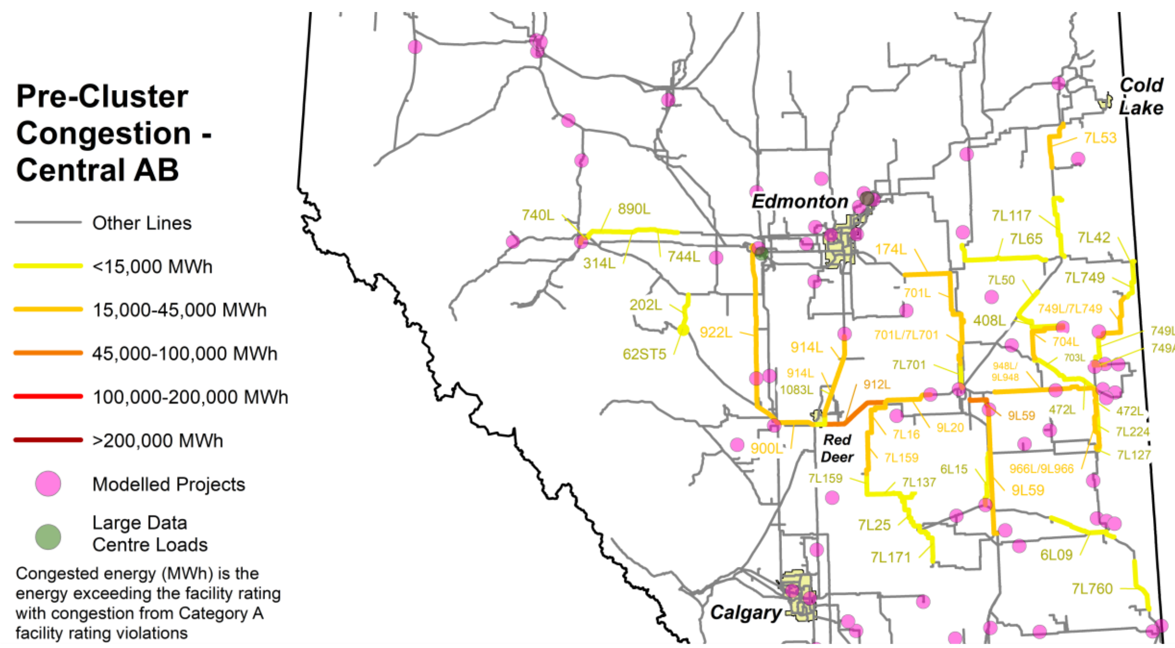


Figure 5 – Pre-Cluster Congested Energy Heatmap



4.3 Post-Cluster Scenario

Figure 6 illustrates the forecasted congestion frequency and Figure 7 illustrates the forecasted congested energy. The results are provided in tabular format in Attachment A.

In the Central West, relative to the pre-cluster scenario, material congestion increase is observed on 138 kV transmission lines 890L (58S Edson-207S Pinedale), 744L (228S T.M.P.L. Niton-744AL Tap) and 202L (61S Lodgepole-62S Brazeau). Material congestion increase is also observed on 240kV lines 922L (310P Sundance-17S Benalto), 914L (87S Gaetz-914AL Tap), 914L (914BL Tap-914AL Tap) and 900L (63S Red Deer-17S Benalto).

In the Central East, relative to the pre-cluster scenario, material congestion increase is observed on 138 kV transmission lines 174L (197S Bardo-395S North), 408L (252S Jarrow-51S Wainwright), 472L (213S Hughenden-472AL Tap), 472L (648S Metiskow-472AL Tap), 701L (395S North Holden-223S Strome), 701L/7L701 (223S Strome-7LA701 Tap), 7L701 (7LA701 Tap-757S Battle River), 703L (377S Hardisty-703BL Tap), 704L (51S Wainwright-478S Tucuman), 749L (899S Edgerton-749AL Tap), 749L/7L749 (899S Edgerton-7LB749 Tap), 7L50 (526S Buffalo Creek-491L Tap), 7L53 (7LA53 Tap-700S Bonnyville), 7L65 (7LA65 Tap-709S Vegreville), 7L701 (7LA701 Tap-757S Battle River), 7L117 (706S Irish Creek-710S Vermilion), 7L127 (774S Monitor-932S Pemukan), 7L129 (526S Buffalo Creek-7LA129 Tap), 7L129 (7LA129 Tap-710S Vermilion), 7L159 (7LA159 Tap-948S Heatburg), 7L16 (766S Nevis-948S Heatburg), 7L224 (650S Hansman Lake-774S Monitor), 7L42 (751S Hill-716S Lloydminster), 7L760 (7LC760 Tap-7LA760 Tap) and 7L749 (7LB749 Tap-716S Lloydminster). Material congestion increase is also observed on 240kV lines 966L/9L966 (650S Hansman Lake-932S Pemukan), 9L20 (766S Nevis-9LA20 Tap), 912L (63S Red Deer-766S Nevis), 9L59 (801S Anderson-9LA59 Tap), 9L59 (972S Tinchebray-9LB59 Tap), 9L59 (9LA59 Tap-9LB59 Tap) and 948L/9L948 (863S Paintearth Creek-948AL Tap).

Some lines experienced decreased congestion, as detailed in Attachment A.

Figure 6 – Post-Cluster Congestion Frequency Heatmap

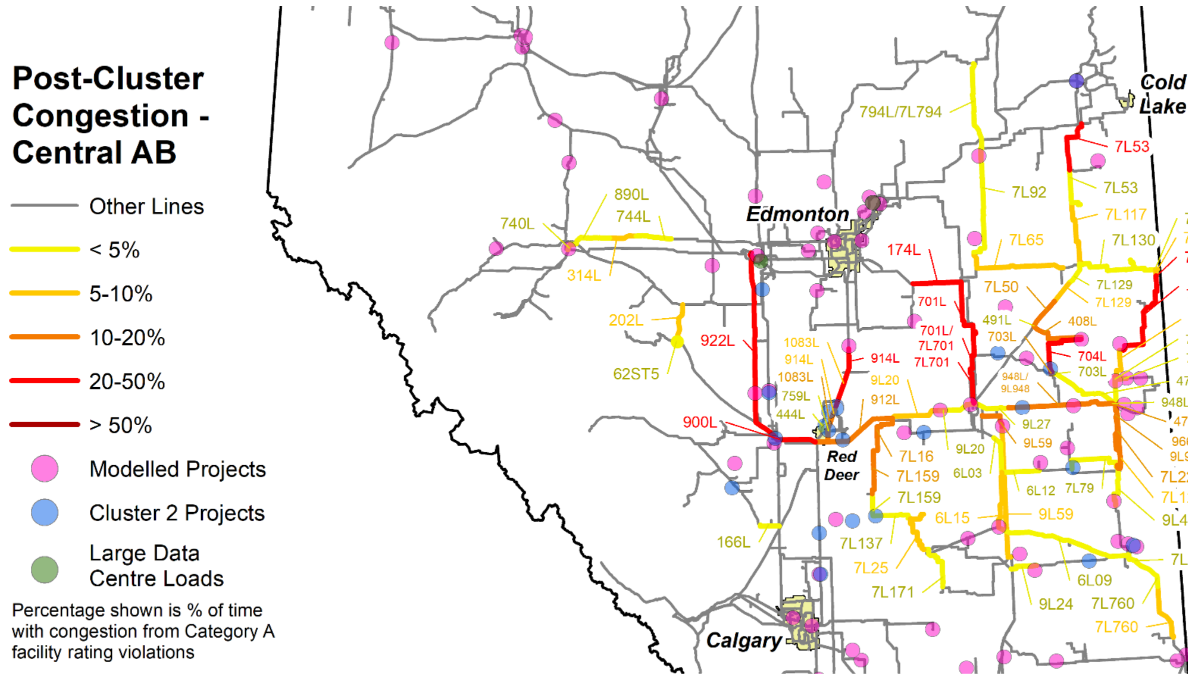
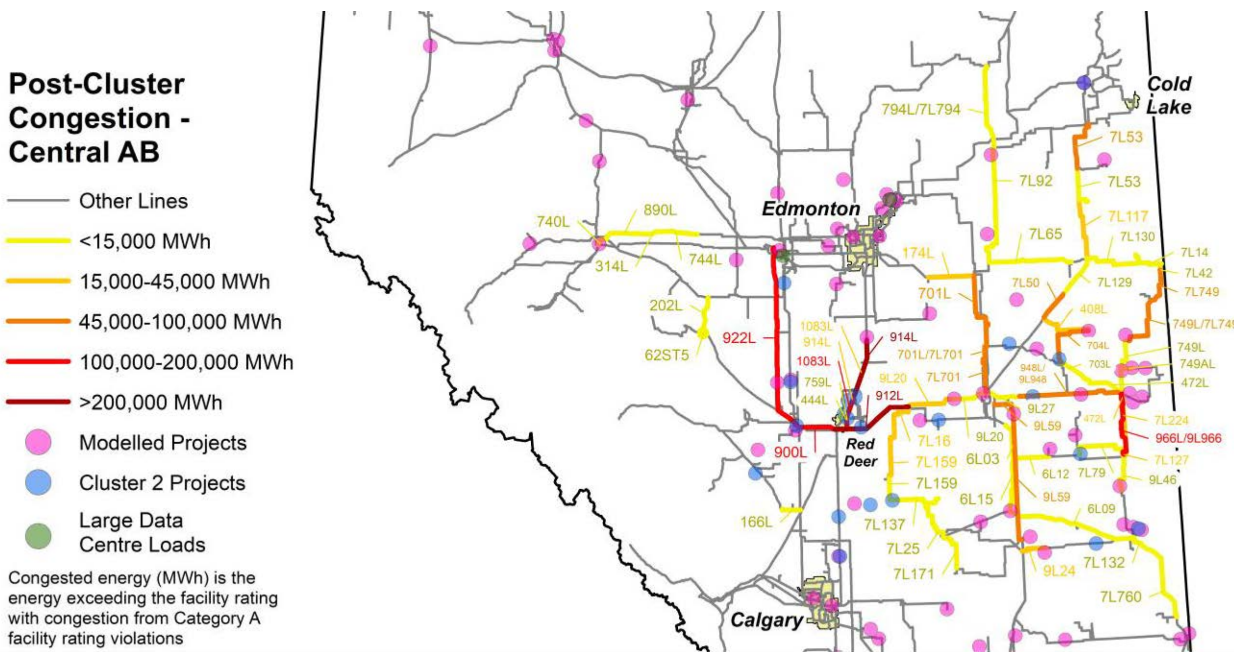


Figure 7 – Post-Cluster Congested Energy Heatmap



5. Conclusions

The Congestion Assessment forecasts the congestion for three scenarios: post-PIC, pre-cluster, and post-cluster.

- Congestion is forecasted in post-PIC scenario, primarily in the Central East.
- The addition of in-flight and cluster projects would increase congestion on many transmission facilities and introduce new congestion risks across the Cluster Region.

Attachment A

Table A1 – Congestion Assessment Detailed Results

Transmission Line	Post-PIC		Pre-Cluster		Post-Cluster	
	Frequency (%)	Energy (MWh)	Frequency (%)	Energy (MWh)	Frequency (%)	Energy (MWh)
1083L (63S Red Deer-1083AL Tap)			1	2,800	17	160,000
166L (256S Harmattan-166AL Tap)					1	350
166L (281S Johnson-166AL Tap)					1	300
174L (197S Bardo-395S North Holden)	3	3,100	13	25,000	21	43,000
202L (61S Lodgepole-62S Brazeau)			3	2,300	7	8,500
314L (228S T.M.P.L. Niton-207S Pinedale)	1	100	14	6,400	8	3,700
408L (252S Jarrow-51S Wainwright)			7	4,900	19	33,000
444L (217S North Red Deer-444AL Tap)					2	310
472L (213S Hughenden-472AL Tap)			1	820	4	4,400
472L (648S Metiskow-472AL Tap)			10	13,000	18	31,000
491L (252S Jarrow-491L Tap)					3	1,800
62ST5 (62S Brazeau)			1	1,100	5	5,800
6L03 (775S Sullivan Lake-6L17 Tap)					2	680
6L09 (6L21 Tap-772S Youngstown)					1	75
6L09 (763S Hanna-776S Richdale)					1	170
6L09 (767S Oyen-6L21 Tap)			1	220	5	1,200
6L09 (772S Youngstown-776S Richdale)					1	260
6L12 (775S Sullivan Lake-6L25 Tap)					1	120
6L15 (775S Sullivan Lake-763S Hanna)	3	970	3	1,200	6	2,300
701L (395S North Holden-223S Strome)	2	2,400	16	32,000	28	92,000
701L/7L701 (223S Strome-7LA701 Tap)	2	2,500	15	31,000	27	89,000
703L (213S Hughenden-703BL Tap)			1	360	3	2,700
703L (377S Hardisty-703BL Tap)			5	3,800	10	13,000
704L (51S Wainwright-478S Tucuman)	1	480	20	25,000	30	73,000
740L (58S Edson-39S Bickerdike)	9	3,800	10	8,900	4	2,900

744L (228S T.M.P.L. Niton-744AL Tap)			3	410	1	210
749AL (749AL Tap-749AAL Tap)			1	290	1	400
749L (648S Metiskow-749AL Tap)					2	1,600
749L (899S Edgerton-749AL Tap)			2	990	8	13,000
749L/7L749 (899S Edgerton-7LB749 Tap)			16	26,000	27	70,000
759L (87S Gaetz-759AL Tap)					2	1,300
794L/7L794 (157S Lac La Biche-819S Whitbylake)					1	730
7L117 (706S Irish Creek-710S Vermilion)			1	1,100	9	17,000
7L127 (774S Monitor-932S Pemukan)			1	1,800	9	16,000
7L129 (526S Buffalo Creek-7LA129 Tap)					9	13,000
7L129 (7LA129 Tap-710S Vermilion)					4	4,300
7L130 (710S Vermilion-705S Kitscoty)					2	1,400
7L132 (767S Oyen-959S Lanfine)	9	14,000			2	2,800
7L137 (770S Three Hills-768S Rowley)	5	6,900	4	4,400	4	5,600
7L14 (705S Kitscoty-751S Hill)					3	2,800
7L159 (7LA159 Tap-770S Three Hills)	3	3,500	2	1,400	5	5,500
7L159 (7LA159 Tap-948S Heatburg)	11	27,000	11	23,000	15	34,000
7L16 (766S Nevis-948S Heatburg)	9	20,000	8	16,000	12	24,000
7L171 (802S Michichi Creek-804S Wintering Hills)	3	2,400	3	2,100	2	1,900
7L224 (650S Hansman Lake-774S Monitor)			2	2,100	11	18,000
7L25 (768S Rowley-802S Michichi Creek)	6	10,000	5	6,900	6	8,400
7L42 (751S Hill-716S Lloydminster)			1	760	7	8,300
7L50 (526S Buffalo Creek-491L Tap)			7	7,600	18	50,000
7L53 (7LA53 Tap-700S Bonnyville)	1	700	10	17,000	23	69,000
7L53 (7LA53 Tap-706S Irish Creek)					3	4,000
7L65 (7LA65 Tap-709S Vegreville)			5	4,500	7	7,200
7L701 (7LA701 Tap-757S Battle River)	1	1,100	10	14,000	21	53,000
7L749 (7LB749 Tap-716S Lloydminster)			10	14,000	21	47,000
7L760 (7LC760 Tap-767S Oyen)	13	32,000			1	1,300
7L760 (7LC760 Tap-7LA760 Tap)			2	2,100	8	14,000
7L79 (771S Veteran-932S Pemukan)					4	6,400
7L92 (777S Vilna-7LA92 Tap)					1	630

7L92 (7LA92 Tap-709S Vegreville)					2	1,800
7L92 (819S Whitbylake-777S Vilna)					2	2,100
890L (58S Edson-207S Pinedale)	3	310	8	5,300	4	2,600
900L (63S Red Deer-17S Benalto)	1	1,800	5	23,000	20	180,000
912L (63S Red Deer-766S Nevis)			12	99,000	18	210,000
914L (87S Gaetz-914AL Tap)	1	5,500	6	26,000	7	24,000
914L (914BL Tap-914AL Tap)	1	4,600	5	22,000	30	220,000
922L (310P Sundance-17S Benalto)	2	7,000	8	31,000	21	110,000
948L/9L948 (650S Hansman Lake-948AL Tap)			1	1,200	2	6,200
948L/9L948 (863S Paintearth Creek-948AL Tap)			8	34,000	14	90,000
966L/9L966 (650S Hansman Lake-932S Pemukan)	2	6,500	7	41,000	18	150,000
9L20 (755S Cordel-9LA20 Tap)					1	2,900
9L20 (766S Nevis-9LA20 Tap)			4	16,000	8	38,000
9L24 (946S Oakland-9LA24 Tap)					3	19,000
9L27 (863S Paintearth Creek-755S Cordel)					1	1,500
9L46 (932S Pemukan-9LB46 Tap)					2	12,000
9L46 (9LA46 Tap-9LB46 Tap)					1	2,500
9L59 (801S Anderson-9LA59 Tap)	11	86,000	6	39,000	9	77,000
9L59 (972S Tinchebray-9LB59 Tap)	7	56,000	8	58,000	12	98,000
9L59 (9LA59 Tap-9LB59 Tap)	7	62,000	3	24,000	6	45,000