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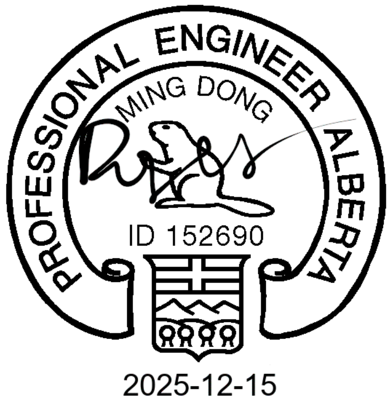

Cluster 2 Congestion Assessment

Edmonton Cluster [EDM-02]

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Contents

1. Introduction

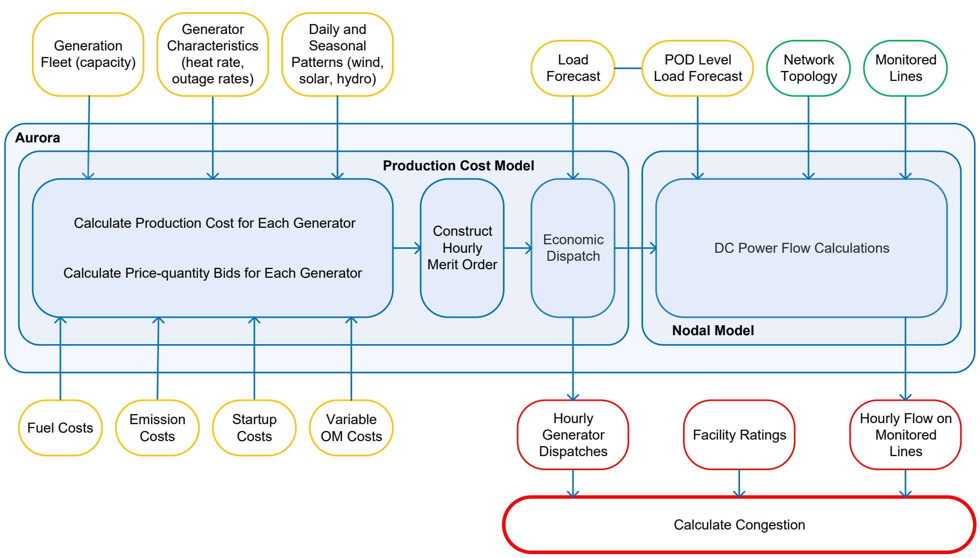
This report documents the Congestion Assessment for the projects in the Edmonton cluster region.

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

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

associated with voltage or transient stability criteria violations. These items could increase 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

Scenario	In-flight Projects		Cluster Projects
	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

[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.

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

Table 1.

Table 1 – Projects Included in each Scenario

Scenario	In-flight Projects[5]		Cluster Projects[6]
	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	0	0
Solar[8]	5,255	+642	+347
Energy Storage[9]	286	+165	+675
Thermal	14,448	+124	+1,470
Hydro	894	0	0
Other	509	0	0
Additions		+931	+2,492
Total	27,649	28,580	31,072

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.
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.

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

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.

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

[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

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 **Error! Reference source not found.**): 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 post-PIC scenario, congestion is observed on 138 kV line 174L (197S Bardo-395S North Holden) and 240 kV lines 922L (310P Sundance-17S Benalto), 914L (86S Bigstone-914BL Tap), and 914L (914BL Tap-914AL Tap).

Figure 2 – Post-PIC Congestion Frequency Heatmap

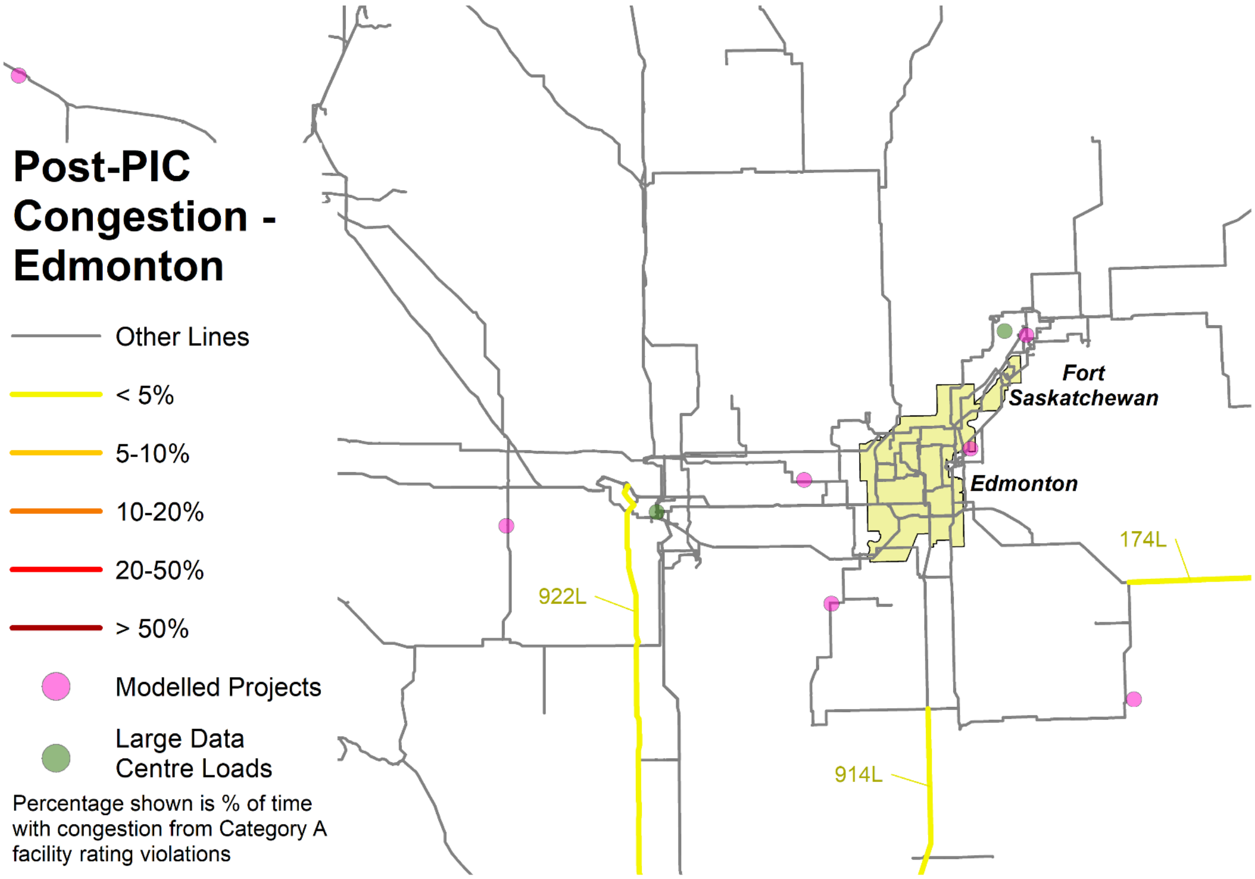
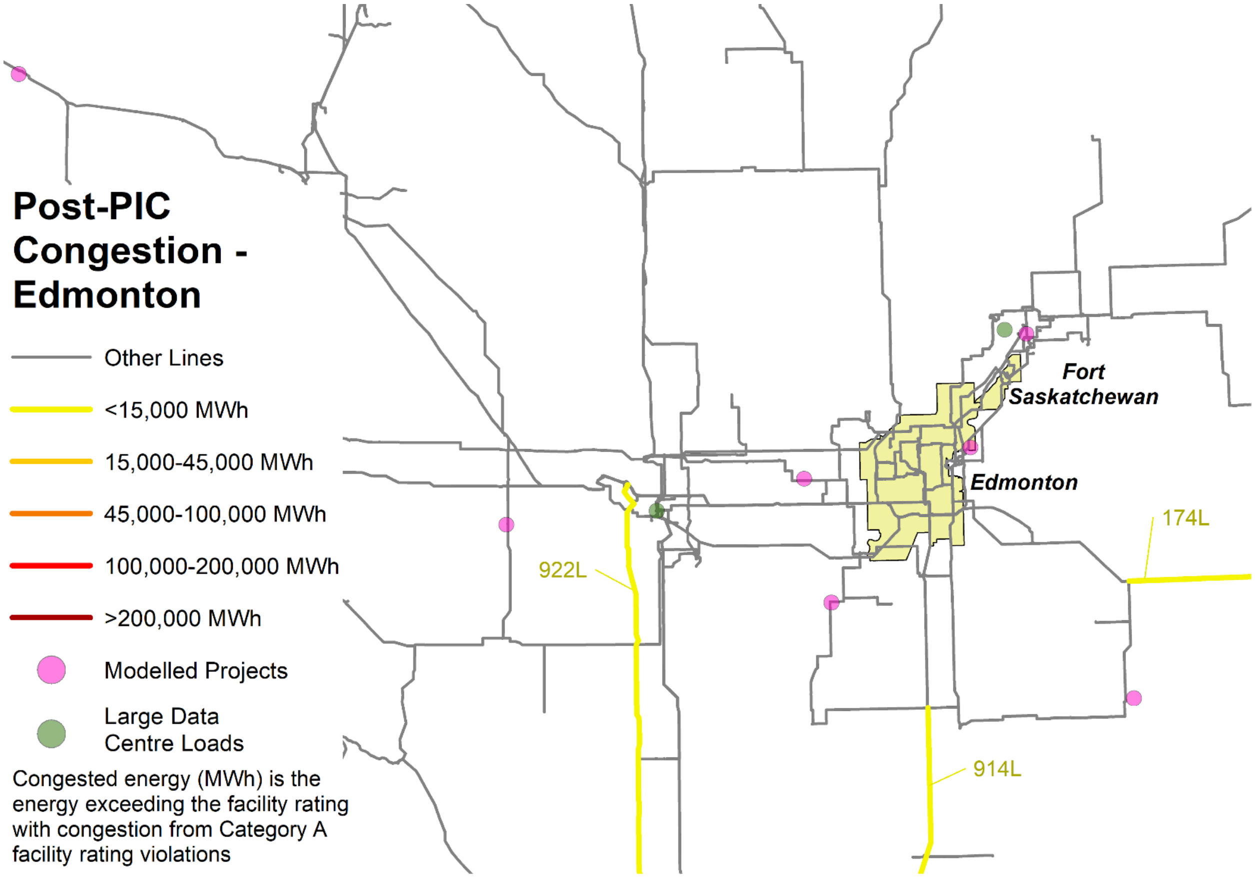


Figure 3 – Post-PIC Congested Energy Heatmap



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 pre-cluster scenario, relative to post-PIC scenario, material congestion increase is observed on lines 138 kV lines 711L (37S North Calder-711AL Tap) and 792L (191S N.W. Cardiff-792AL Tap).

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

Figure 4 – Pre-Cluster Congestion Frequency Heatmap

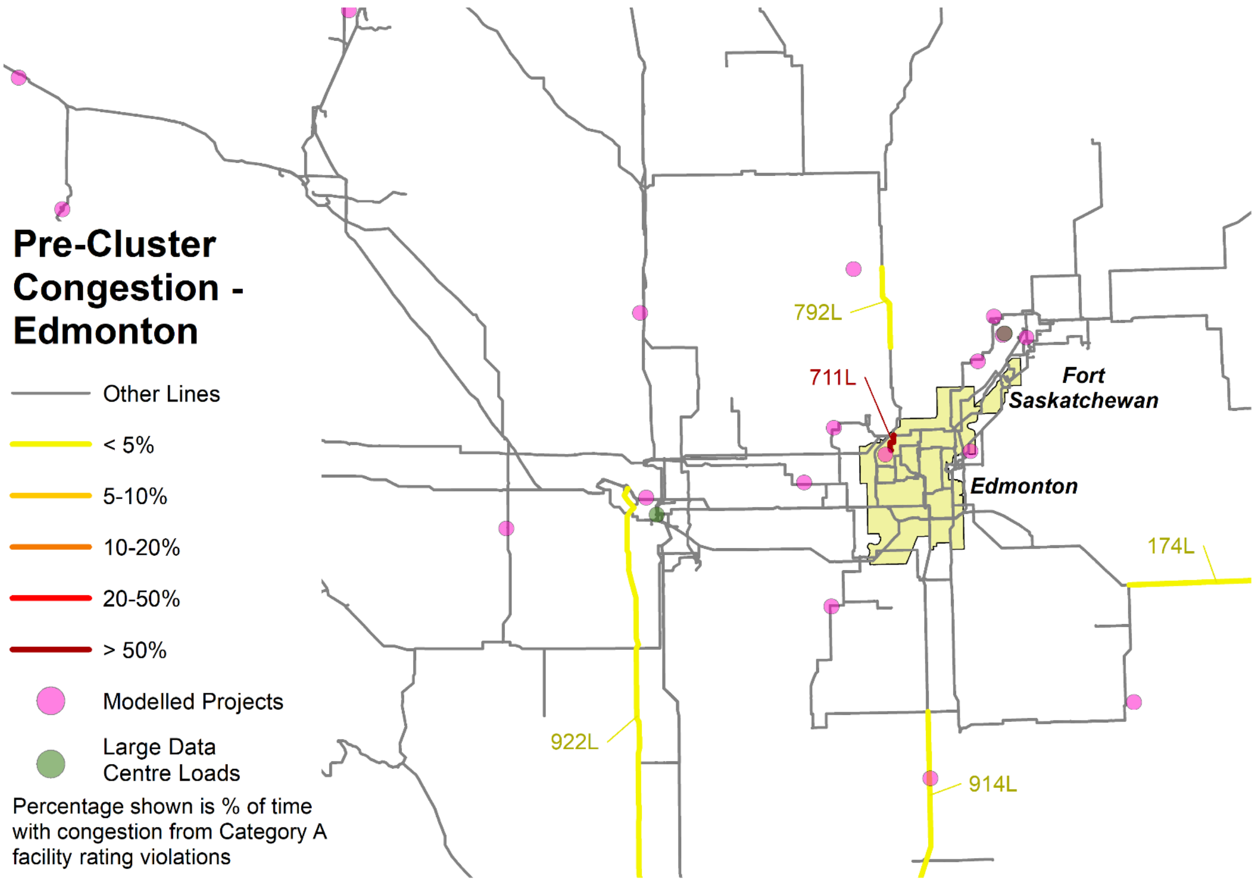
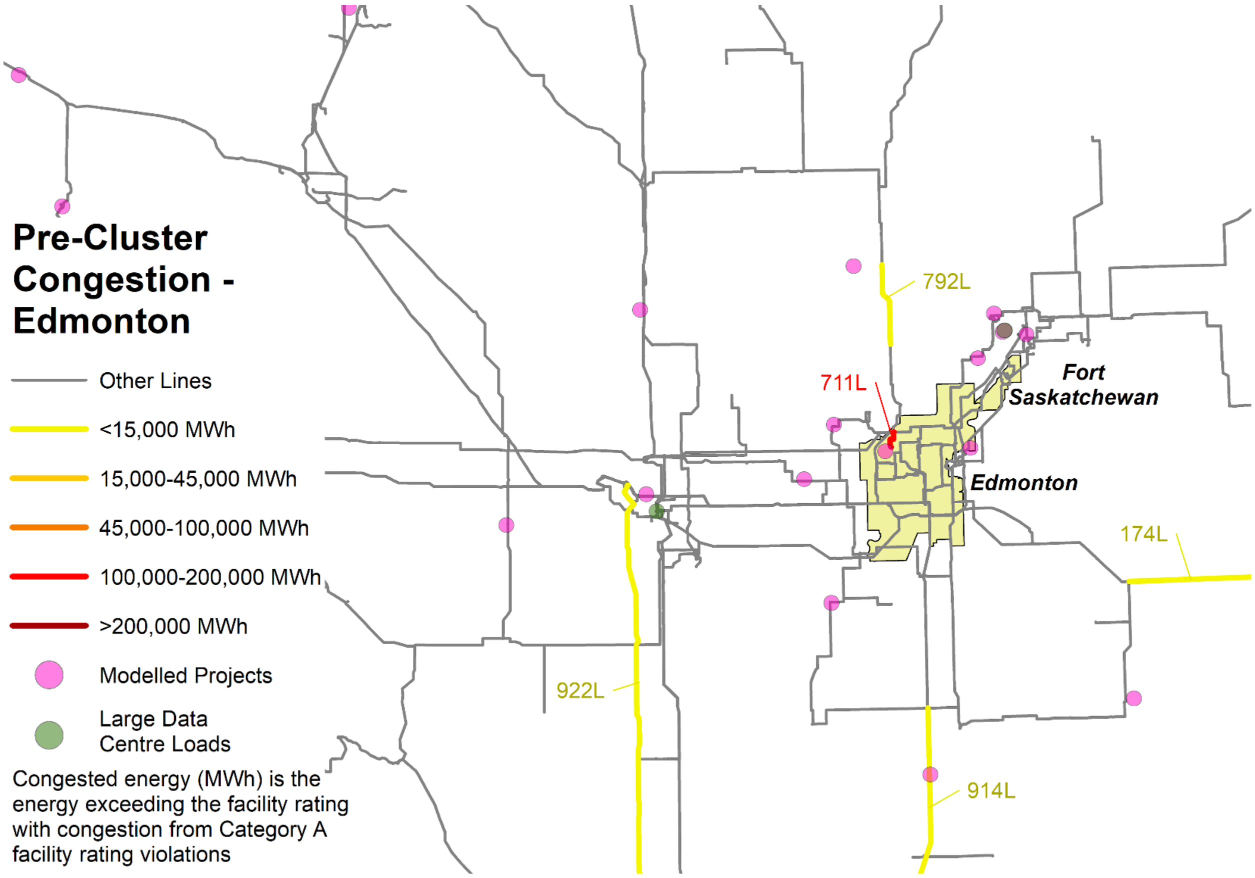


Figure 5 – Pre-Cluster Congested Energy Heatmap



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 post-cluster scenario, relative to the pre-cluster scenario, material congestion increase is observed on the 240 kV transmission line 1083L (288S Wolf Creek-1083AL Tap).

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

Figure 6 – Post-Cluster Congestion Frequency Heatmap

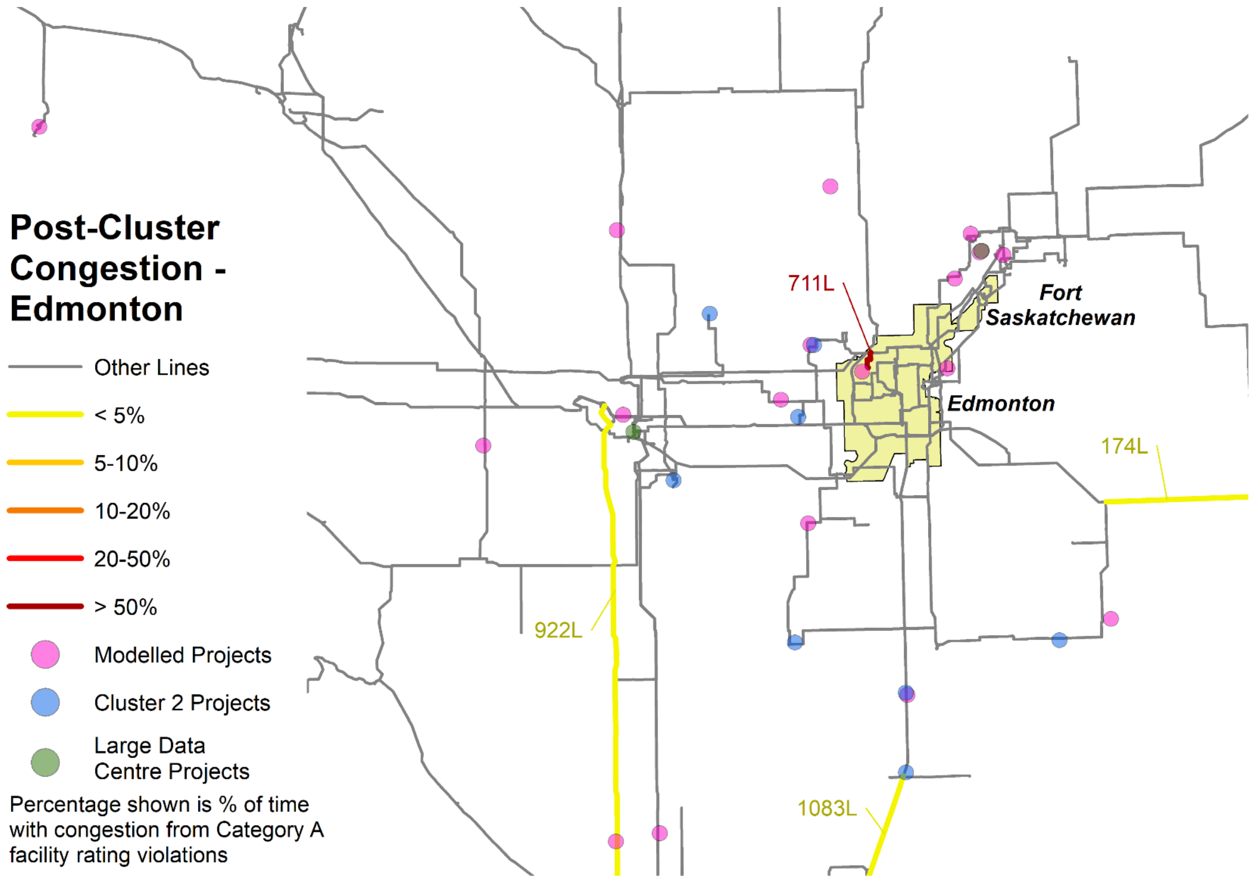
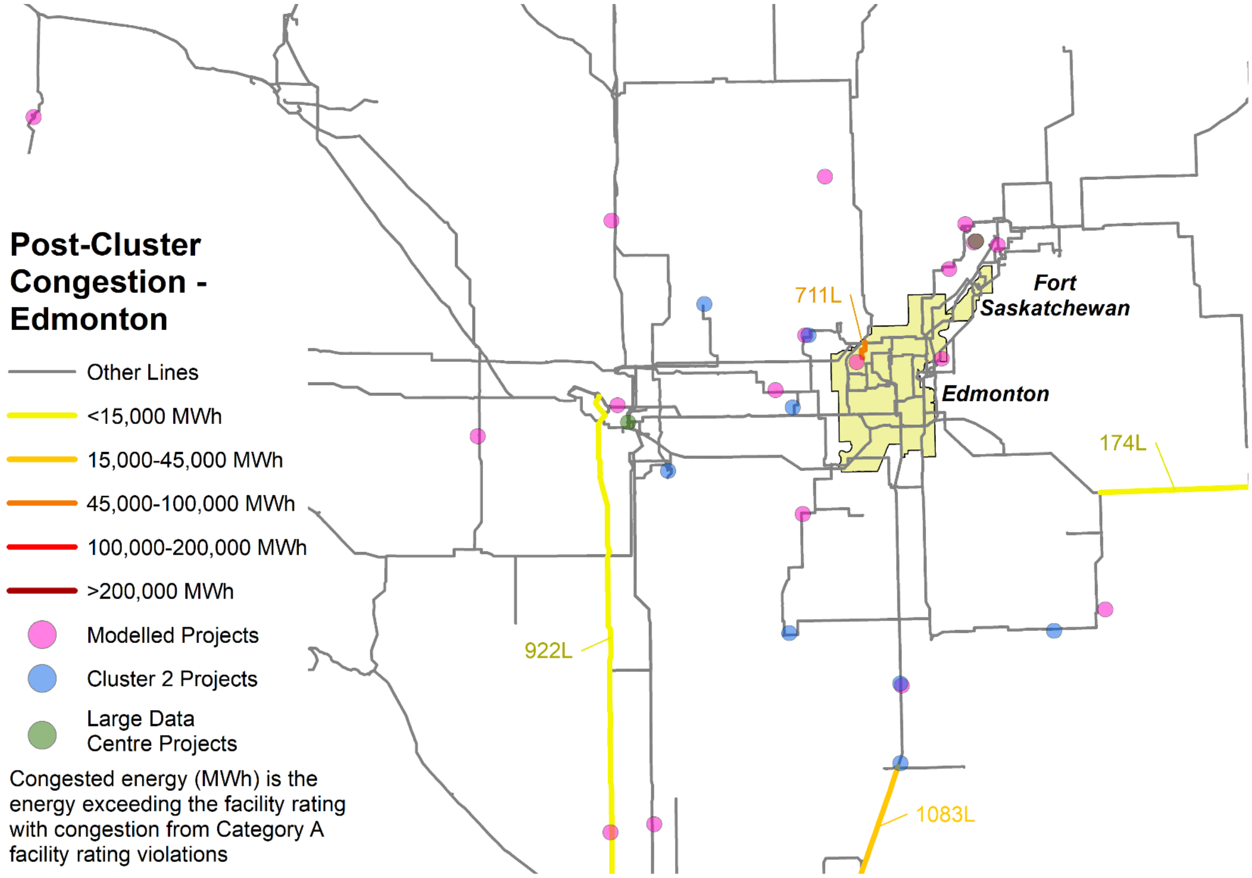


Figure 7 – Post-Cluster Congested Energy Heatmap



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 in both 138 kV and 240 kV systems of the Cluster Region.
- The addition of in-flight and cluster projects would increase congestion on some transmission facilities and introduce new congestion risks in 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 (288S Wolf Creek-1083AL Tap)					3	18,000
174L (197S Bardo-395S North Holden)	3	3,100	2	2,200	1	1,800
711L (37S North Calder-711AL Tap)			84	100,000	78	85,000
792L (191S N.W. Cardiff-792AL Tap)			3	2,700		
914L (914BL Tap-914AL Tap)	1	4,600	1	2,800		
914L (86S Bigstone-914BL Tap)	1	3,800	1	3,600		
922L (310P Sundance-17S Benalto)	2	7,000	1	5,400	1	5,100