Alberta Internal Load (AIL) Forecast Report

Yonghan (Rick) Qiu

24th Mar, 2025

Executive Summary

This report presents a comprehensive analysis and forecast of the Alberta Internal Load (AIL) based on historical system load data from the Alberta Electric System Operator (AESO). Using Prophet forecasting models with seasonality adjustments and outlier removal, we project load patterns for the upcoming year. Key findings include an expected annual growth rate of 2.9% and peak load days concentrated in the winter months.

Methodology

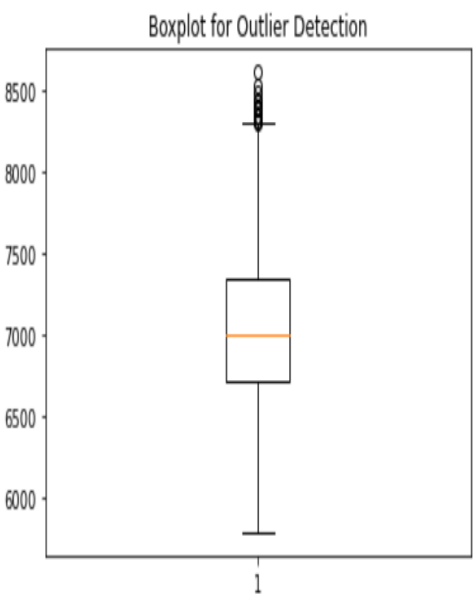
Data Preparation

- Historical data was sourced from AESO Alberta Internal Load (AIL) records
- Daily system load averages were calculated from the raw data
- Outlier detection and removal was performed using the Interquartile Range (IQR) method

Outlier Analysis

The IQR method identified 15 outlier days with unusually high loads (above 8,296 MW), including:

- Several days in February 2025 (Feb 2-5, 10, 14, 17-19)
- January 2025 (Jan 3, 11-12)
- Historical extreme loads from December 2016, January 2018, and December 2022



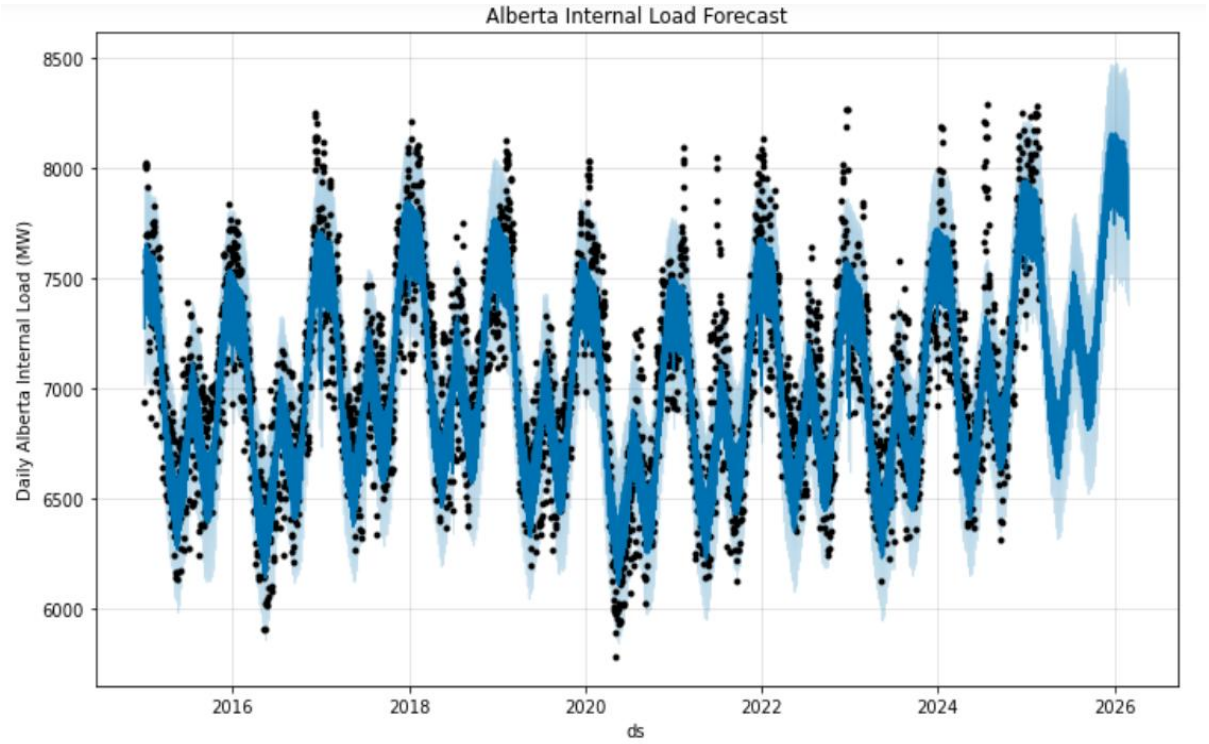
IQR outliers:

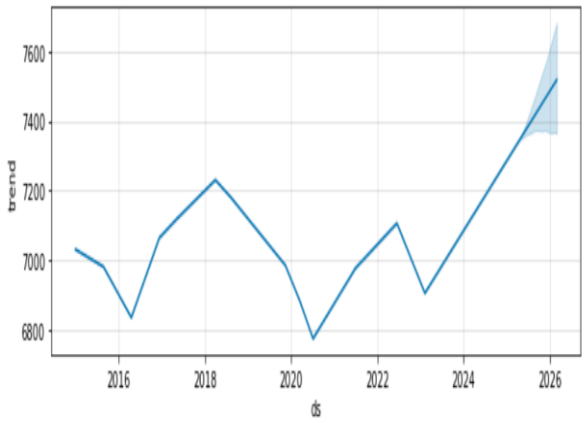
	ds	y
date_only		
2016-12-16	2016-12-16	8340.835252
2018-01-11	2018-01-11	8336.892767
2022-12-21	2022-12-21	8310.619839
2024-01-11	2024-01-11	8392.514099
2024-01-12	2024-01-12	8317.848949
2025-01-03	2025-01-03	8342.754112
2025-02-02	2025-02-02	8296.998988
2025-02-03	2025-02-03	8428.375517
2025-02-04	2025-02-04	8378.604853
2025-02-05	2025-02-05	8402.431294
2025-02-10	2025-02-10	8437.919133
2025-02-14	2025-02-14	8487.597299
2025-02-17	2025-02-17	8387.497787
2025-02-18	2025-02-18	8518.271742
2025-02-19	2025-02-19	8606.615871

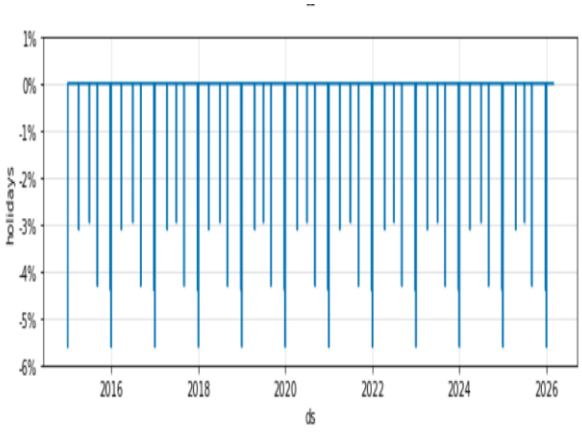
Forecasting Model

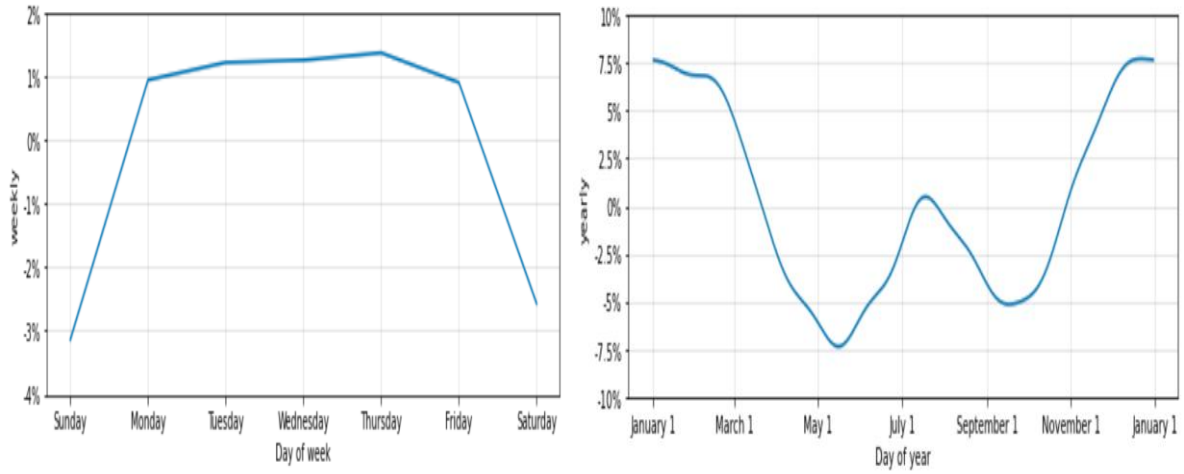
The Prophet forecasting model was configured with the following parameters:

- Yearly and weekly seasonality enabled
- Multiplicative seasonality mode to account for growing trend with seasonal patterns
- Changepoint prior scale of 0.05 to control trend flexibility
- Seasonality prior scale of 10 to allow for flexible seasonal patterns
- Canadian holidays included


Alberta Internal Load Forecast
Daily Alberta Internal Load (MW)
8500
8000
7500
7000
6500
6000
2016
2018
2020
2022
2024
2026
ds


trend
7600
7400
7200
7000
6800
2016
2018
2020
2022
2024
2026
ds


holidays
1%
0%
-1%
-2%
-3%
-4%
-5%
-6%
2016
2018
2020
2022
2024
2026
ds

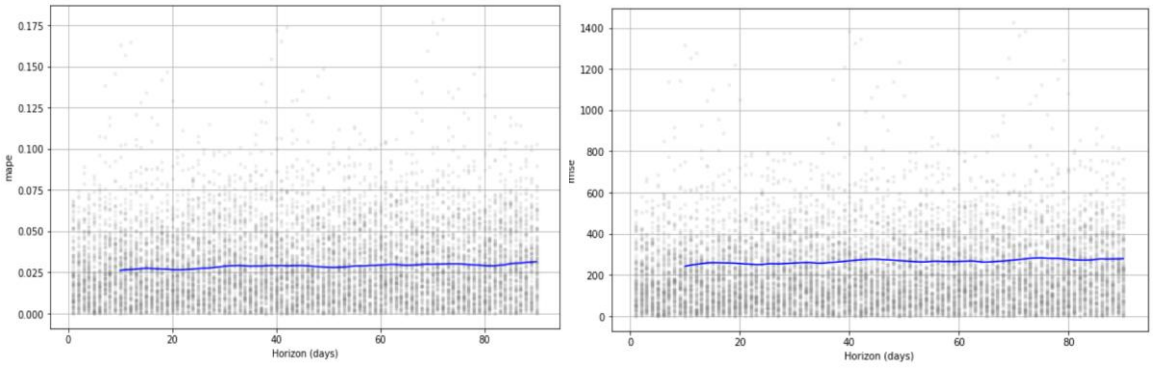


Model Validation

Cross-validation was performed with:

- Initial training period of 365 days
- Prediction periods of 30 days
- Forecast horizon of 90 days

```
Cross-validation metrics:
   horizon          mae         rmse      mape
0  10 days   184.882409   242.418699  0.026143
1  11 days   188.181621   247.764094  0.026610
2  12 days   189.095985   251.435955  0.026724
3  13 days   190.533353   254.643874  0.026908
4  14 days   193.030644   258.266144  0.027270
..     ...          ...          ...       ...
76 86 days   217.474249   278.064229  0.030569
77 87 days   218.028849   276.705134  0.030690
78 88 days   220.291416   277.660647  0.031032
79 89 days   221.511220   277.920013  0.031240
80 90 days   223.416129   278.974640  0.031542
```



Key Findings

```
Forecast Insights:
Current average daily load: 7037.10 MW
Forecasted average daily load (1 year from 2025-02-28): 7415.13 MW
Expected annual growth: 2.9%

Top 5 peak load days forecast:
1. 2026-01-08: 8158.38 MW
2. 2025-12-18: 8157.29 MW
3. 2025-12-31: 8154.52 MW
4. 2025-12-24: 8154.20 MW
5. 2025-12-30: 8151.92 MW

Month with highest average load: December (7597.71 MW)
Month with lowest average load: May (6574.94 MW)
```

Current and Projected Load

- Current average daily load: 7,037.10 MW
- Forecasted average daily load (one year ahead): 7,415.13 MW
- Expected annual growth rate: 2.9%

Peak Load Days

The top 5 peak load days forecast for the upcoming year:

1. January 8, 2026: 8,158.38 MW
2. December 18, 2025: 8,157.29 MW
3. December 31, 2025: 8,154.52 MW
4. December 24, 2025: 8,154.20 MW
5. December 30, 2025: 8,151.92 MW

Seasonal Patterns

- Month with highest average load: December (7,597.71 MW)
- Month with lowest average load: May (6,574.94 MW)
- Seasonal variation of approximately 1,023 MW between peak and trough months

Model Performance Metrics

The cross-validation produced the following accuracy metrics:

- Mean Absolute Error (MAE): Ranging from 184.88 MW (10-day horizon) to 223.42 MW (90-day horizon)
- Root Mean Square Error (RMSE): Ranging from 242.42 MW to 278.97 MW
- Mean Absolute Percentage Error (MAPE): Ranging from 2.61% to 3.15%

Implications

Grid Management

- Winter months, particularly December and January, will require additional capacity planning
- Holiday periods show significant load peaks and should be monitored closely
- Spring months (particularly May) show lower demand, presenting opportunities for maintenance scheduling

Resource Planning

- The 2.9% annual growth rate suggests continued investment in generation capacity will be needed
- Seasonal variations of over 1,000 MW between peak and low demand months require flexible resource planning
- Peak day forecasts exceeding 8,150 MW indicate potential system stress points that merit attention

Recommendations

1. Ensure sufficient capacity and reserves for winter peak periods, particularly around holidays
2. Consider demand-side management initiatives to smooth seasonal variations
3. Plan system maintenance during lower-demand periods in spring
4. Continue monitoring for outlier events that may signal changing consumption patterns
5. Update forecast quarterly to incorporate new data and refine predictions

Appendix

The analysis was performed using Prophet forecasting models with cross-validation to ensure reliability. Further details on methodology and complete forecast data are available upon request.