Arcus Power Trading Intuition Case Study:

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As the new Senior ML at Arcus, you provide coverage for an existing ERCOT model, which forecasts real-time settlement price forecasting tool for the North Zone. The model makes predictions for the next 48 hours and is used by a trader to make decisions for the next day. Yesterday, the model had a significant forecast miss between 4 PM and 8 PM as real-time prices spiked far beyond their normal levels for late spring. Your team has asked you to briefly analyze market activity and factors that may have contributed to the model miss and identify any areas for future improvement in the model.

The selected background on the scenario is provided below. If there is data you would have but were not provided, please note it in your analysis. All input forecasts are snapshots of ERCOT-provided data from the last published interval before the trading window closes.

Market Overview:

ERCOT (Electric Reliability Council of Texas) operates the electric grid and manages the deregulated market for about 90% of Texas's electric load. Key features include:

1. Historical peak load in excess of 83,000 Mw.
2. Zonal pricing: Four zones (North, South, West, Houston) with different prices based on transmission constraints.
3. Day-ahead and real-time markets: Co-optimized energy and ancillary services.
4. High price cap: Currently $5,000/MWh, among the highest in the US.
5. Operating Reserve Demand Curve (ORDC): Administratively determined scarcity pricing mechanism.
6. Unique interconnection: Largely isolated from other US grids, limiting import/export capabilities.
7. The majority of wind generation in ERCOT is in the West Zone
8. The majority of solar generation in ERCOT is in the South Zone
9. Rapidly evolving generation mix: Significant wind and solar growth, retirement of thermal units.

Model Information:

The model is an XG-Boost model trained on one year of history, with the following inputs:

i. Thermal generation forecast
ii. Total load forecast
iii. North load forecast
iv. North wind forecast
v. Total wind forecast
vi. Solar Forecast
vii. South -> North transmission limit
viii. Houston -> North transmission limit
ix. West -> North transmission limit

Daily Outage Report:

On the day in question, no new plants entered scheduled maintenance or resumed operation from scheduled maintenance. Unplanned outages from the day are shown in the table below, and you may assume any unit that trips offline remains offline the entire day:

Time:	Unit Type:	Zone:	Unit Size:
11:00 AM	Wind	West	50 MW
2:00 PM	Combined Cycle	Houston	500 MW
5:00 PM	Thermal Peaker	Houston	20 MW
6:00 PM	Combined Cycle – In North	North	750 MW

Recent News Stories:

1. Five months ago: ERCOT Solar generation is growing at a breakneck pace. By spring, ERCOT will add 5 GW of solar generation, a 50% YoY increase.
2. Two months ago: A Dry Year in Texas – Reservoirs across the state at historically low levels after low rainfall this winter.
3. Ten days ago: Natural gas prices skyrocketed due to increased LNG demand. Natural gas prices have more than doubled, breaking out of their multi-year range of $2 - 4 as geopolitical tensions drive increased LNG exports to Europe.

4. Two days ago: Summer come early? - An unseasonably warm week ahead as temperatures spike across Texas.

Graphs:

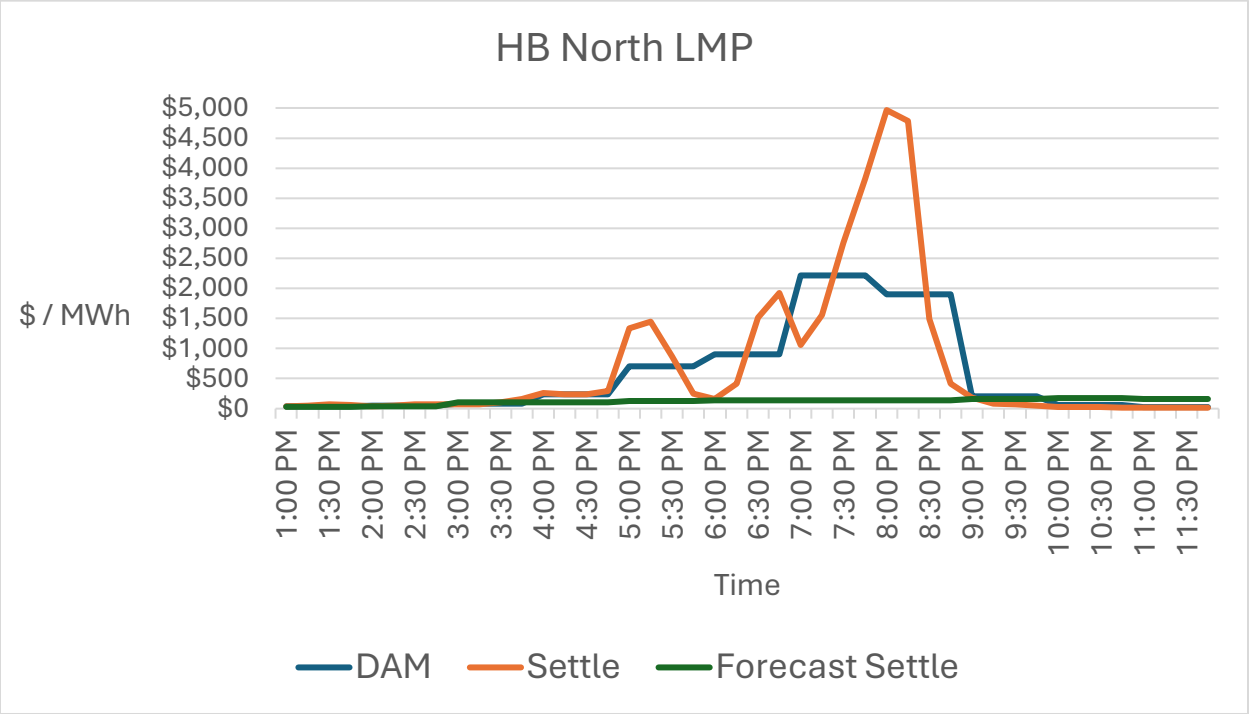

Fig 1. LMP for the day in question. Actual DAM, actual Settle, and your model's forecast Settle price.

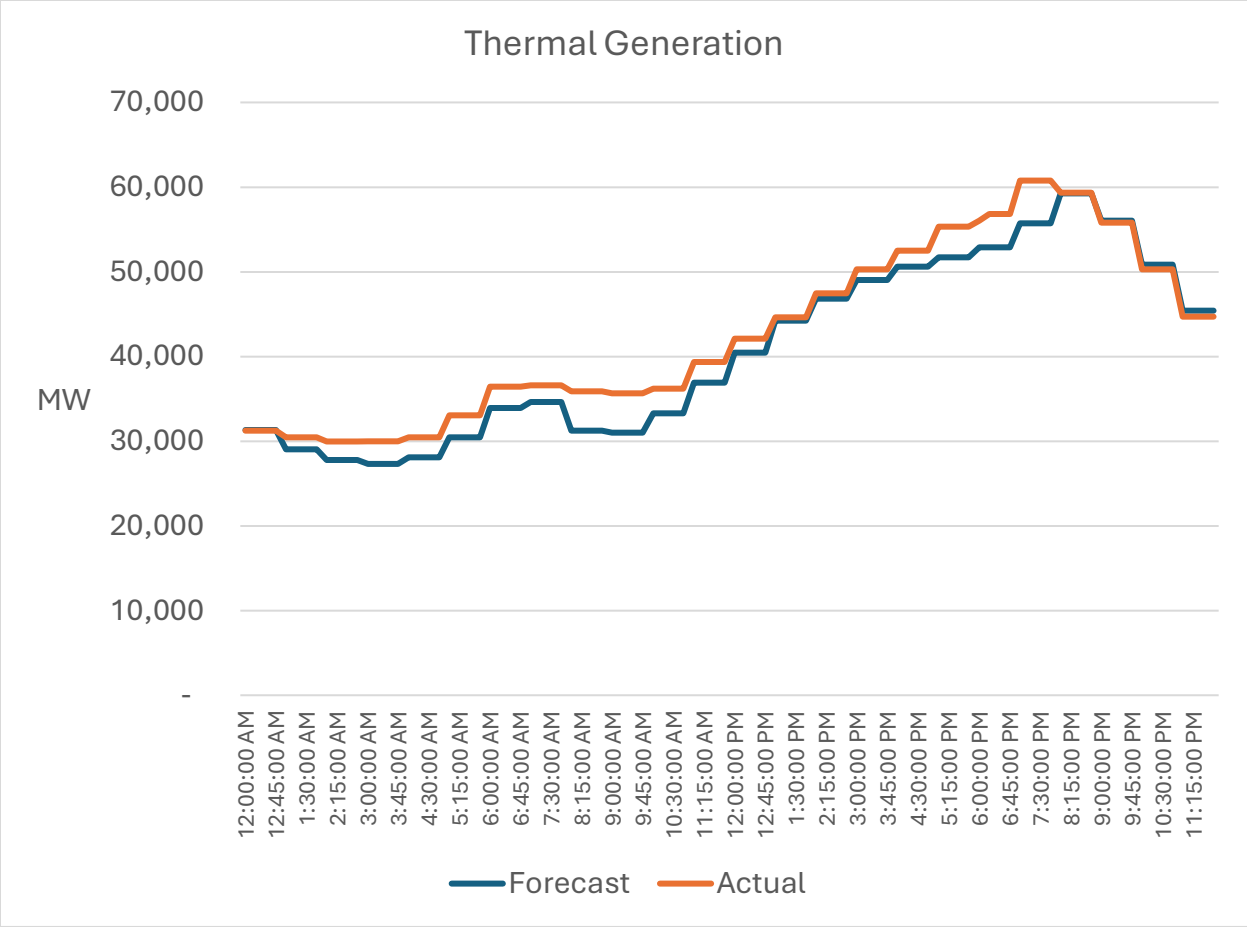

Fig 2. Thermal Generation forecast and actual. Calculated as load net of renewables.

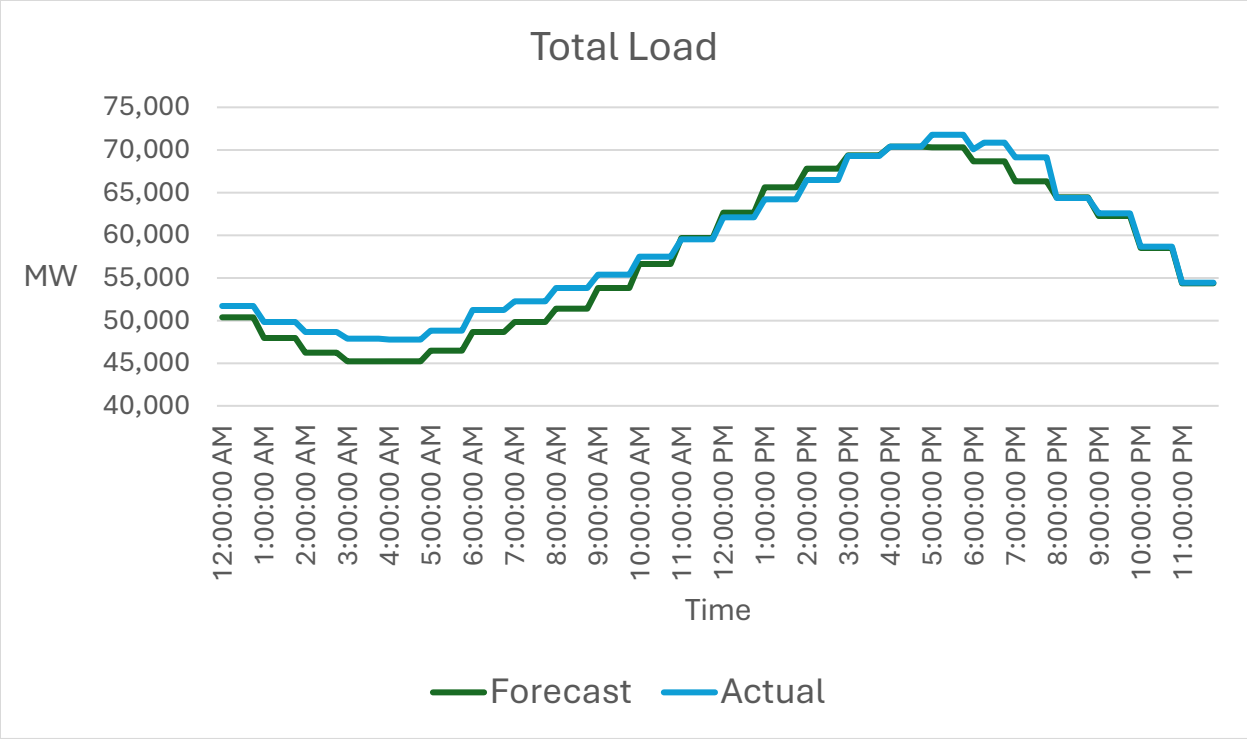

Fig 3. System-wide load forecast and actual for the target region.

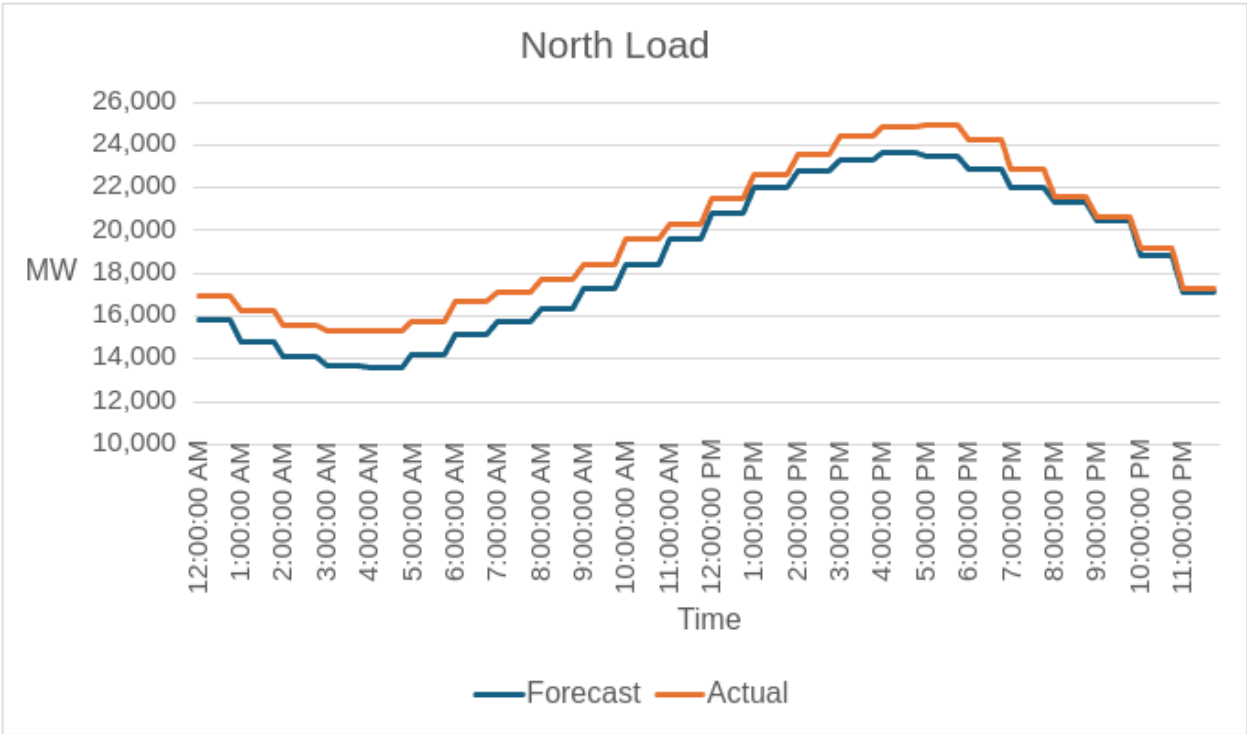

Fig 4. North Load. Load forecast and actual for the target region.

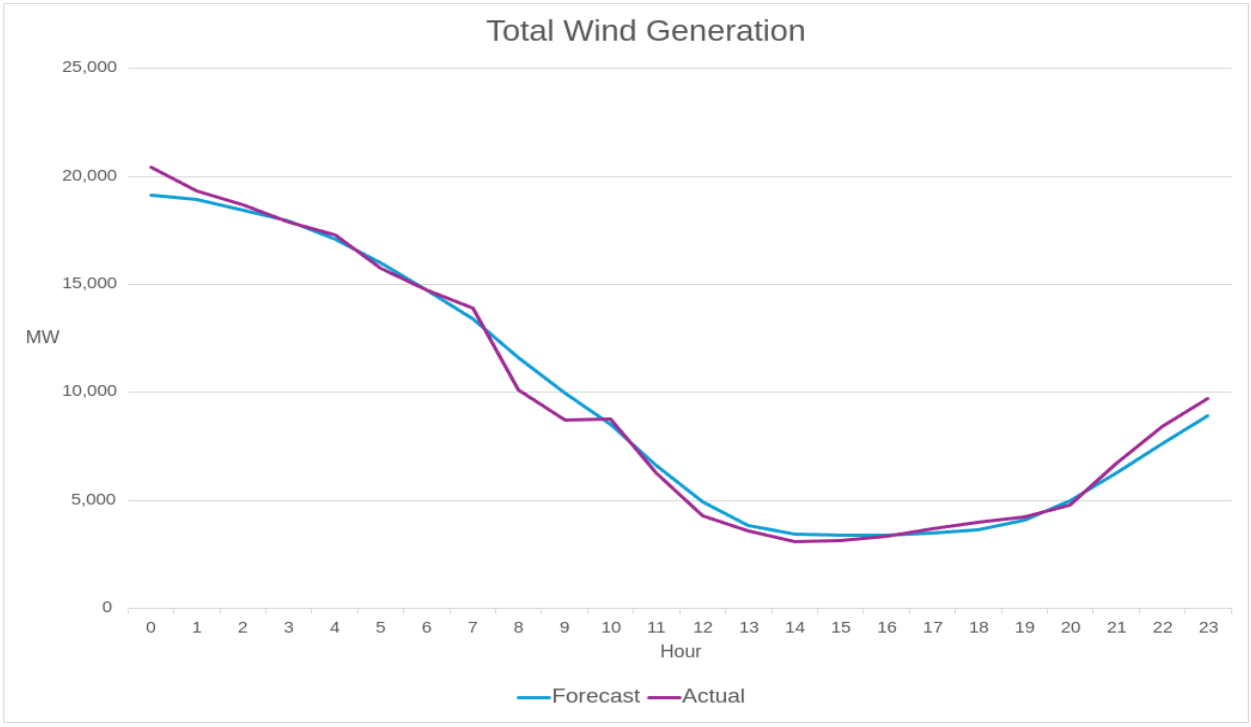

Fig 5. Forecast and actual system-wide wind generation.

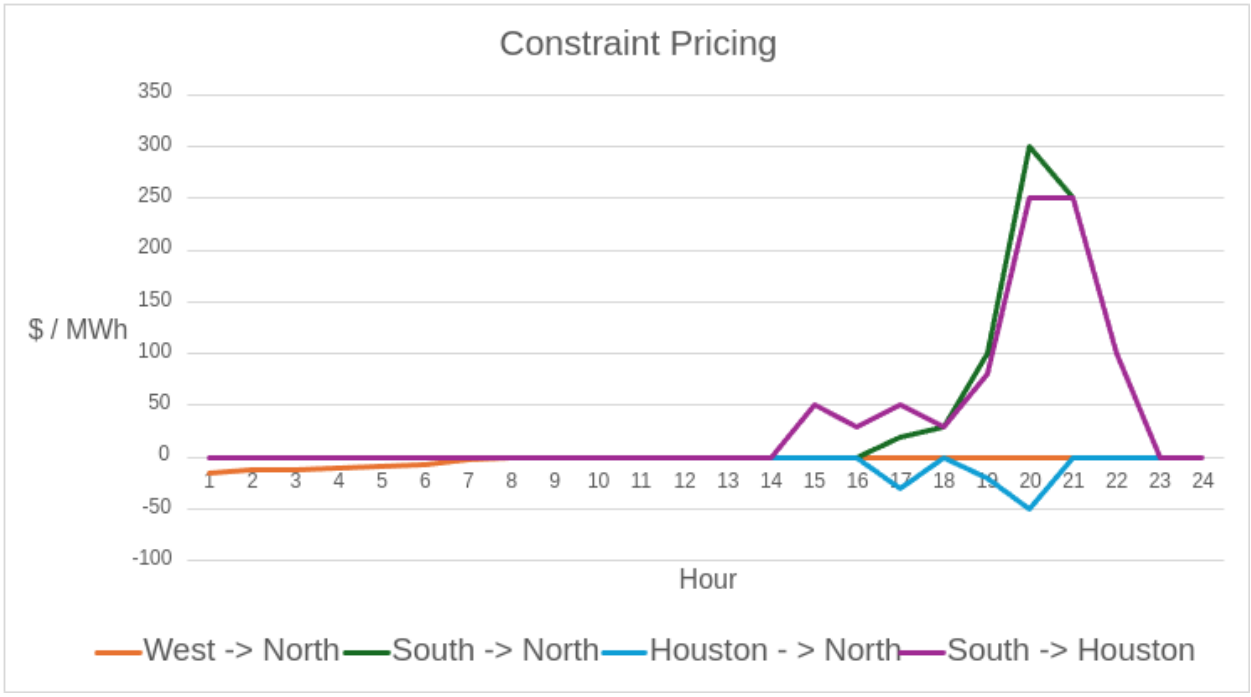

Fig 6. Actual constraint pricing for selected zones.

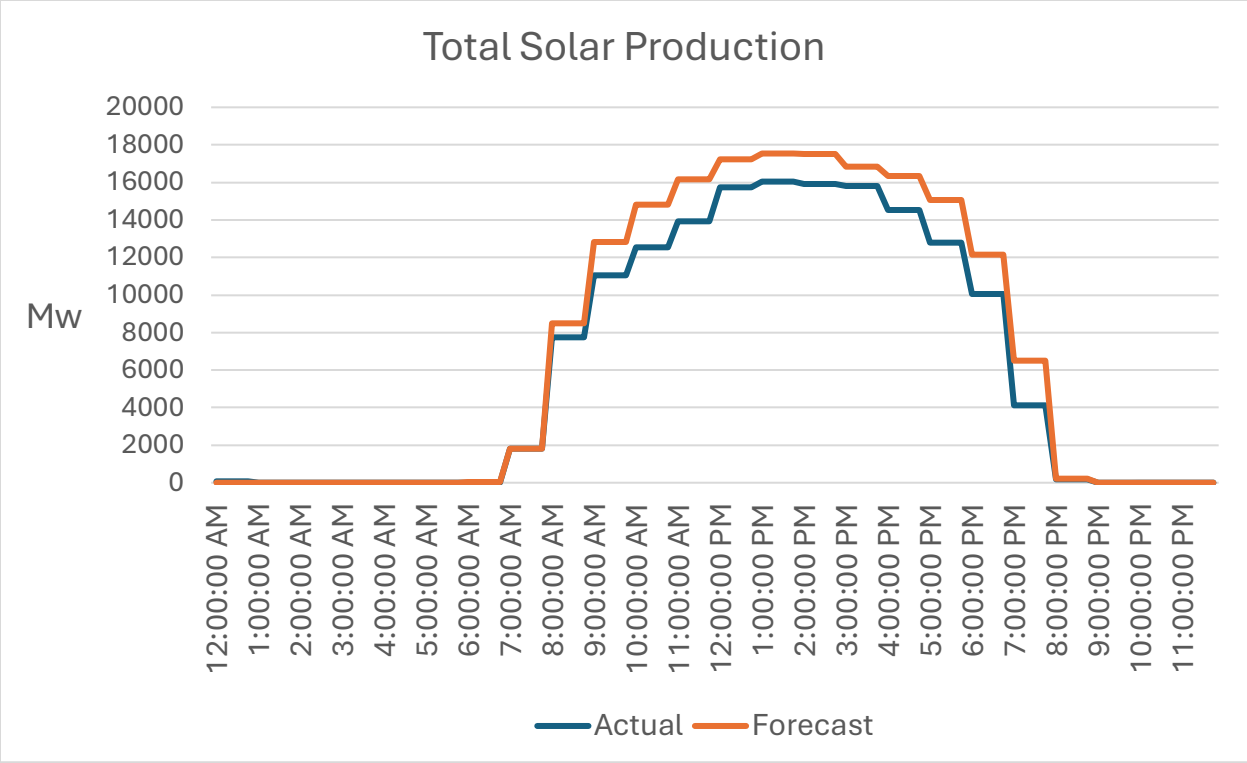

Fig 7. System-wide solar

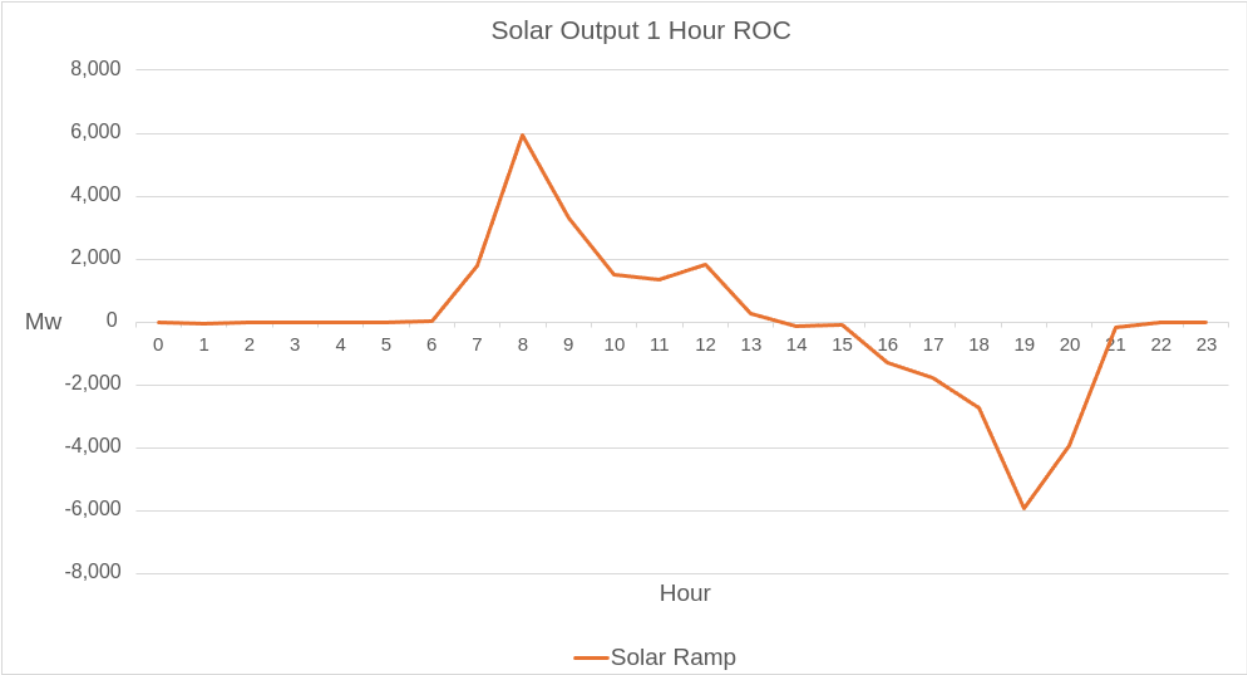

Fig 8. Hourly first derivative of system-wide actual solar output.

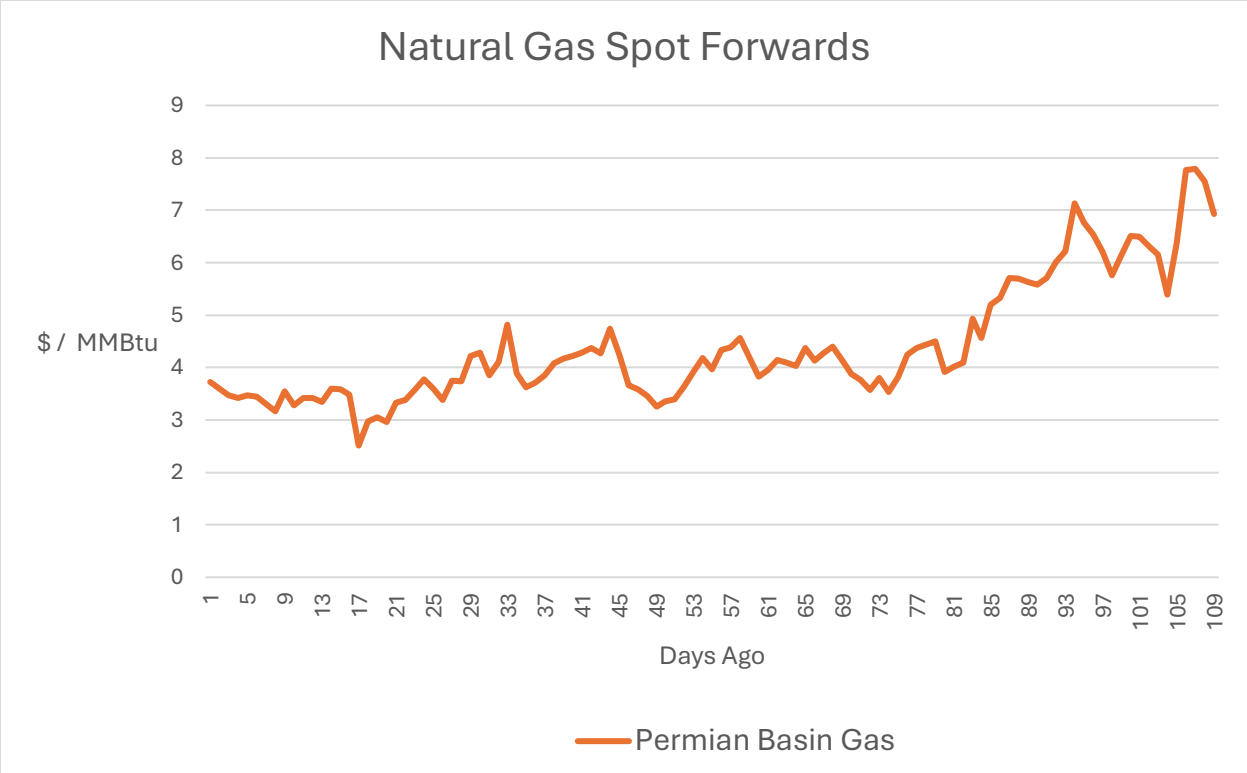

Fig 9. Recent history of natural gas spot prices.

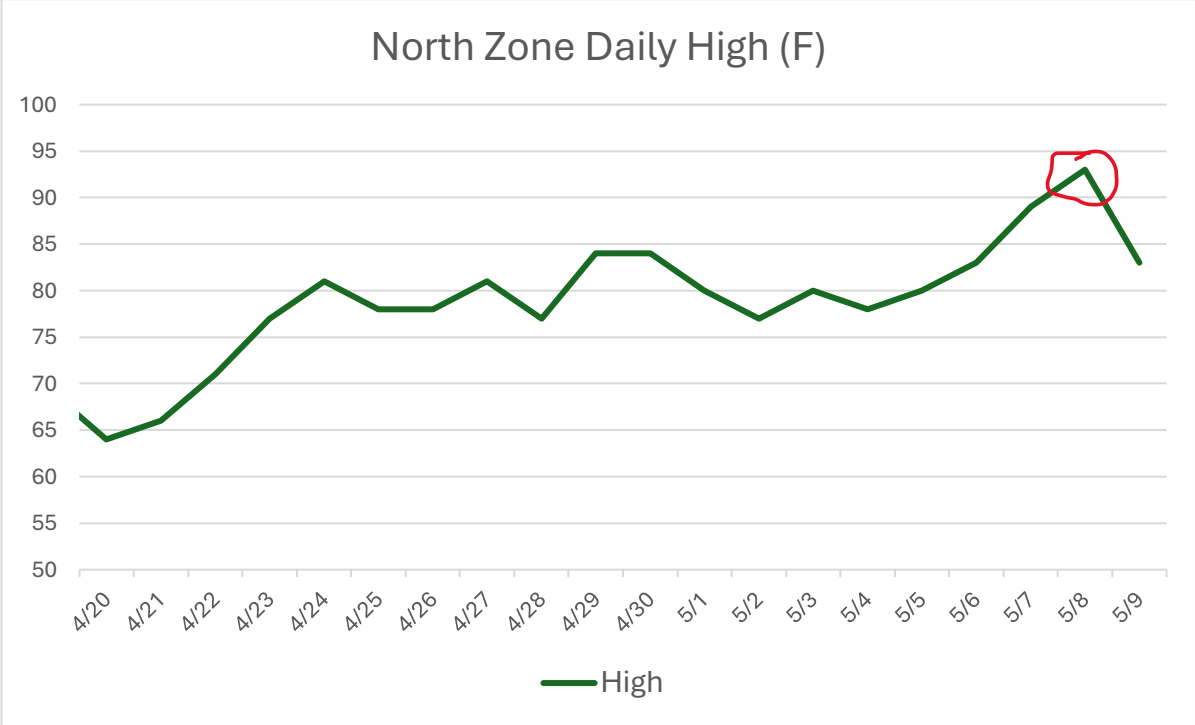

Fig. 10. Recent North Zone Actual Daily Highs. Target day circles in red (92 deg)

Average Generation Mix: