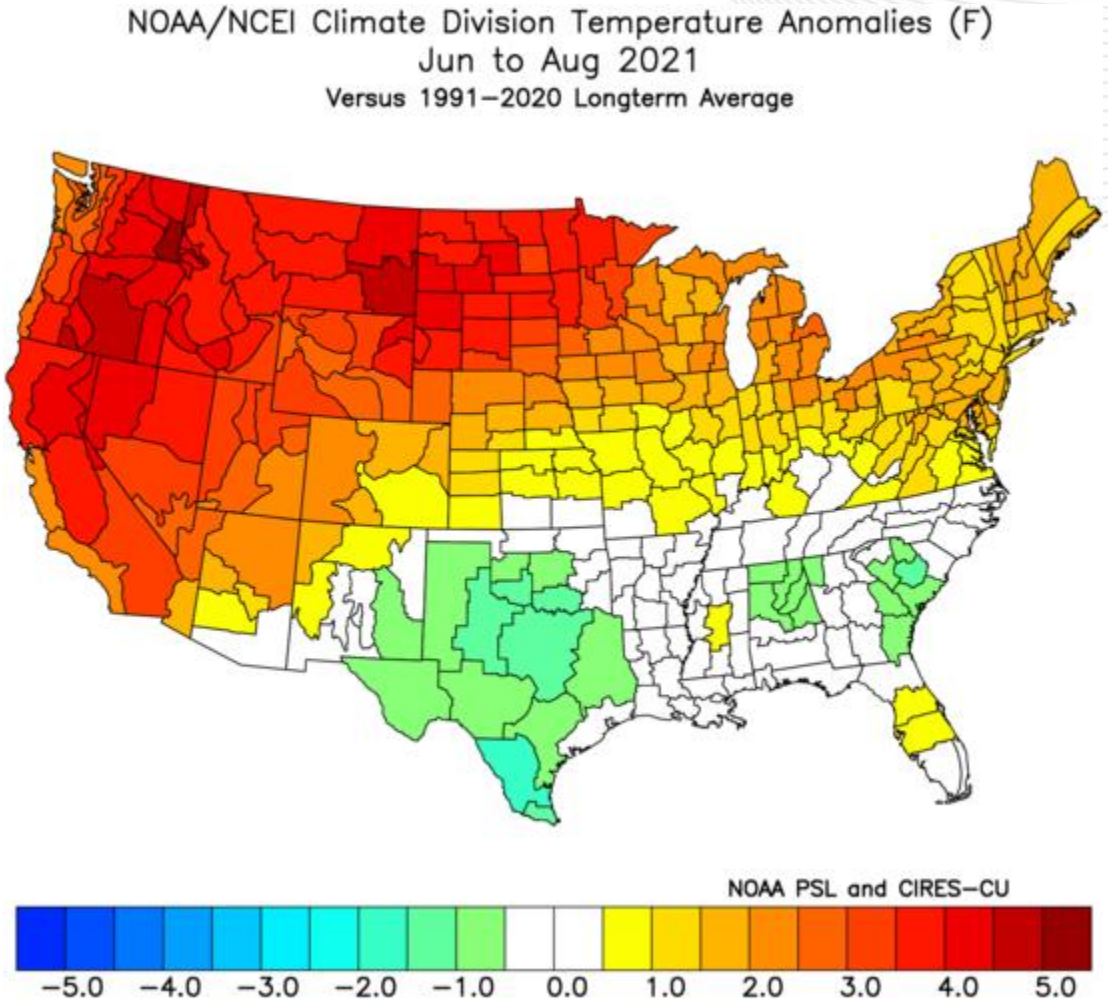
Summer Operations of the PJM Grid: June 1, 2021 – September 15, 2021

Operating Committee

October 7, 2021

Summer 2021 Overview

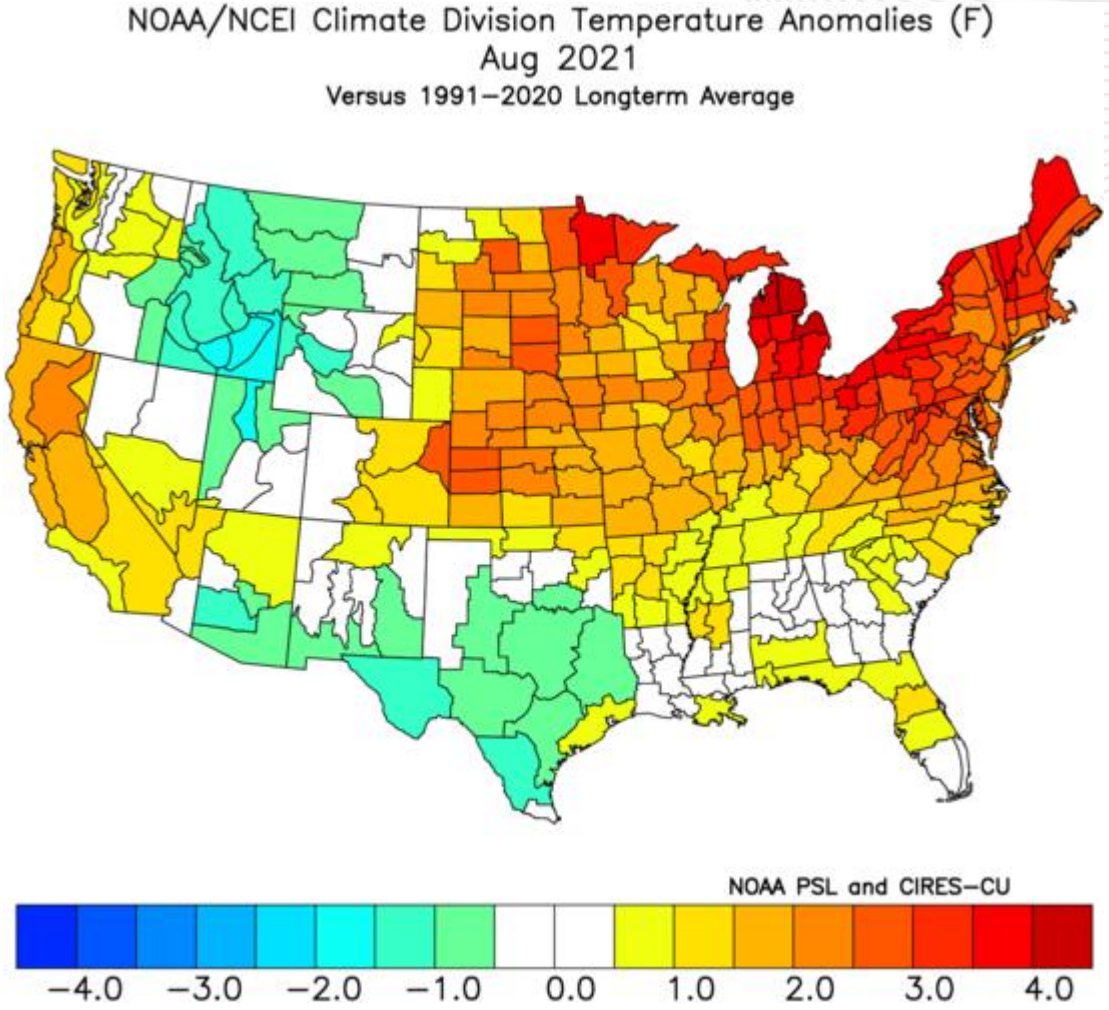
Average Temperature Jun. 1 – Aug. 31



- Temperatures were above normal across the RTO this summer.
- Overall, overnight temperatures were more above average than the daytime highs, driving up the average temps.
- Twenty Hot Weather Alerts were issued between June 1st and August 31st, with an additional two between September 1st and September 15th.

Source: https://www.esrl.noaa.gov

Average Temperature Aug. 1 – Aug. 31



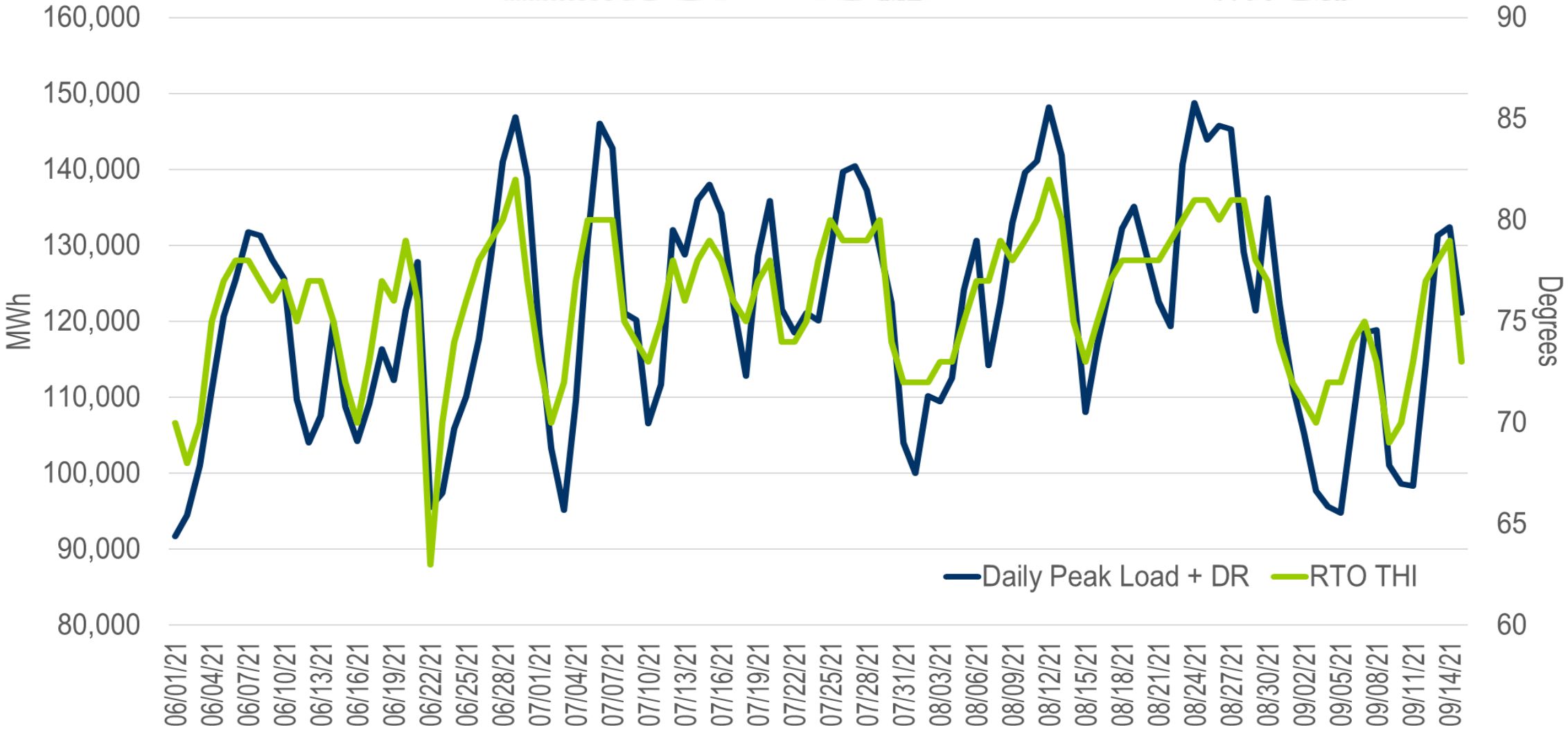
Source: https://www.esrl.noaa.gov

- Of the three months, August's temperatures had the largest positive difference from average.
- 9 Hot Weather Alerts (40% of all issued this summer) were issued in August.
- August was also wetter than average for much of the PJM region, driven in part by tropical activity.

Daily RTO Peak Load and Temperature Humidity Index

- There is a strong relationship between load and Temperature Humidity Index (THI), a measure that accounts for the combined effects of temperature and relative humidity.
- In the summer, as THI goes up, the load goes up (and vice versa), exhibiting a strong, positive relationship.
- The following slide shows the close tracking between load and THI.

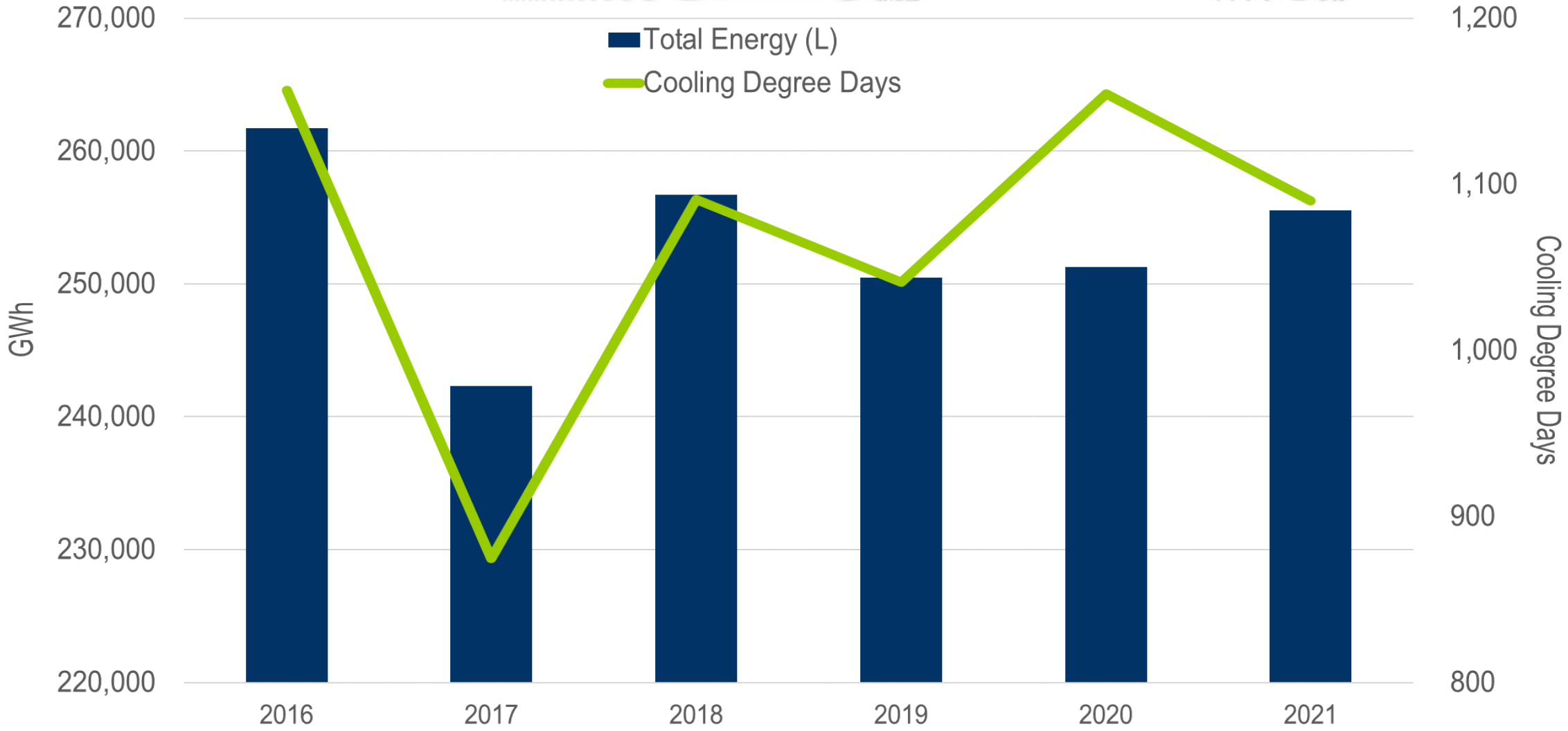
Daily RTO Peak Load and Temperature Humidity Index



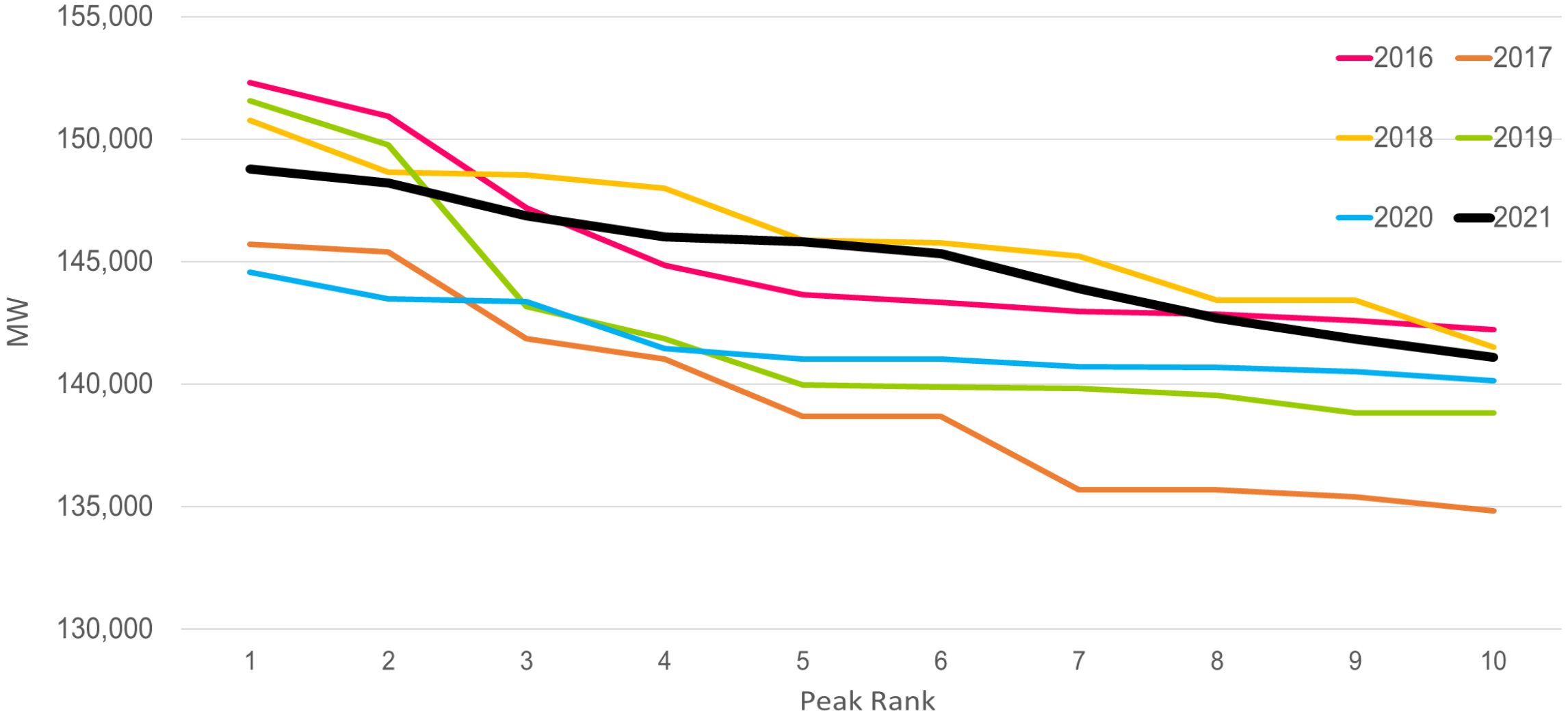
Historic Load and Weather

- The following slides show the historic relationship between cooling degree days and total energy, and historic summer peak loads, respectively.
- Cooling degree days measure the temperature's cumulative deviation from a base point, in this case 65 degrees, over a specified time period.
- Cooling degree days in 2021 were lower than they were in 2020, however, total energy use was higher in 2021 due to dampened load levels as a result of the Corona Virus in 2020.

Historic Total Energy and Cooling Degree Days



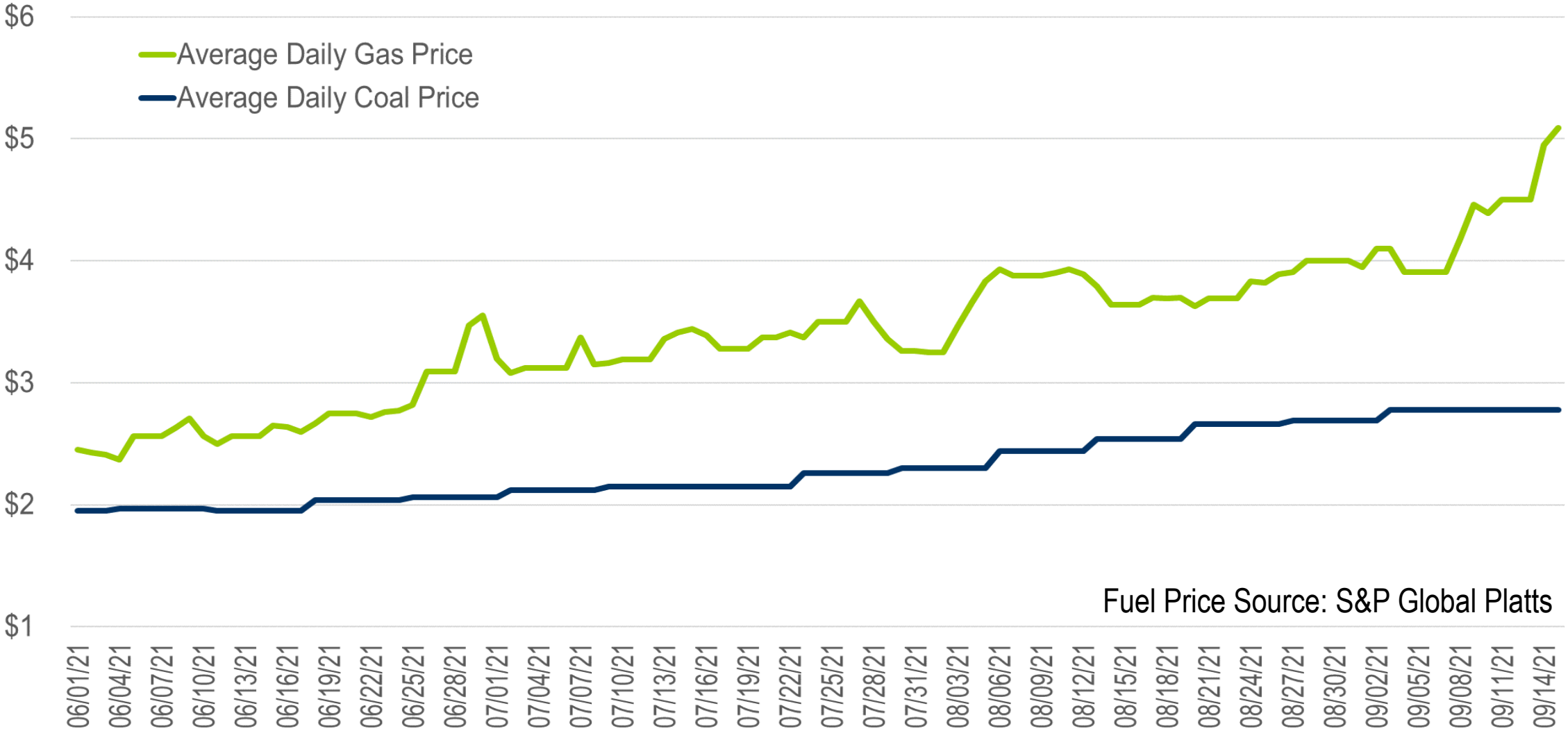
Top 10 Summer Peaks by Year



Fuel Prices

- The following slide shows the daily average fuel prices for coal and natural gas.
- These fuel prices are straight averages of a selection of representative fuel pricing hubs in PJM's footprint. Averages are not load weighted, nor are they meant to represent the price that any particular market participant may have experienced.
- Steady demand, strong LNG exports, and low natural gas storage levels all contributed to rising natural gas prices over the course of the summer.

Fuel Prices

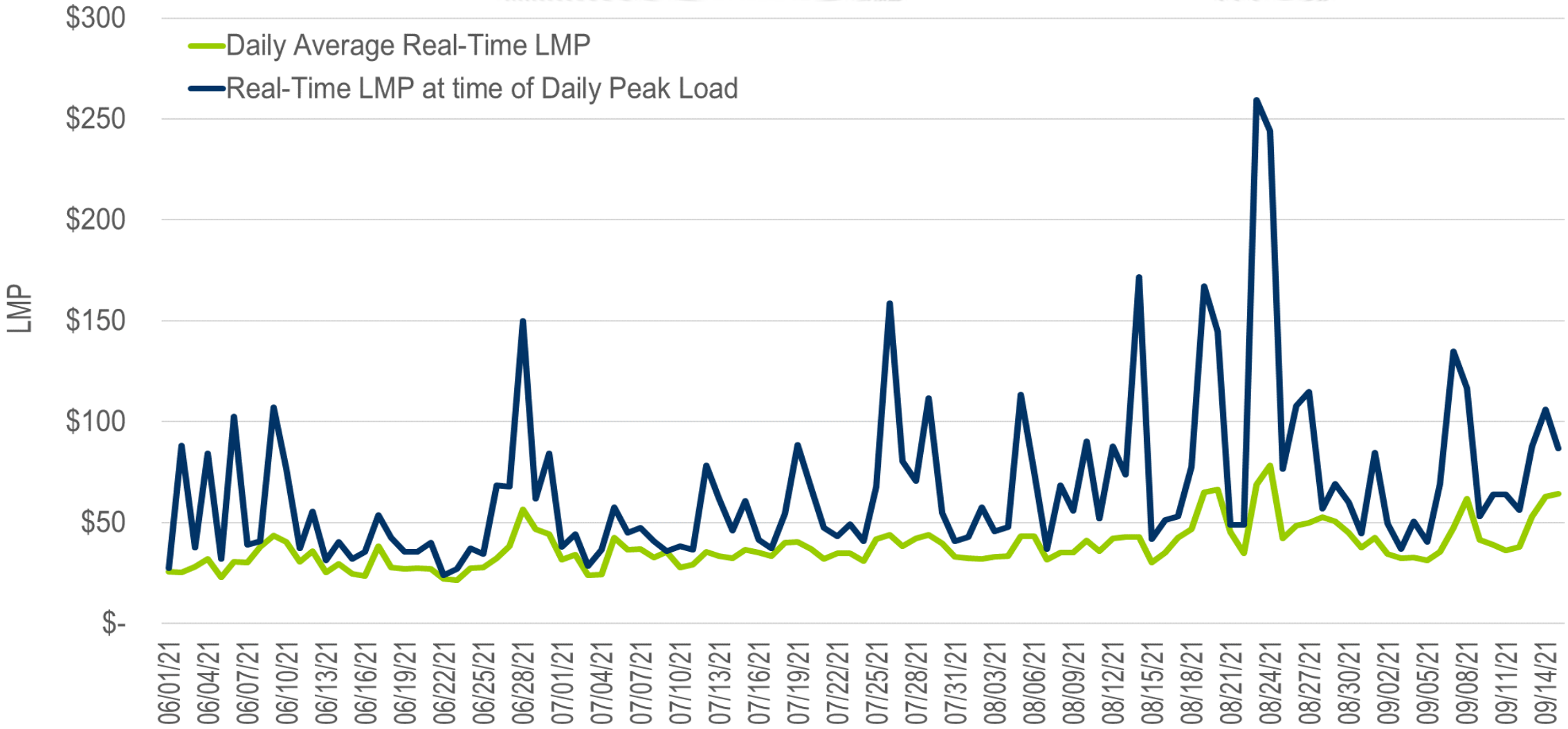


Fuel Price Source: S&P Global Platts

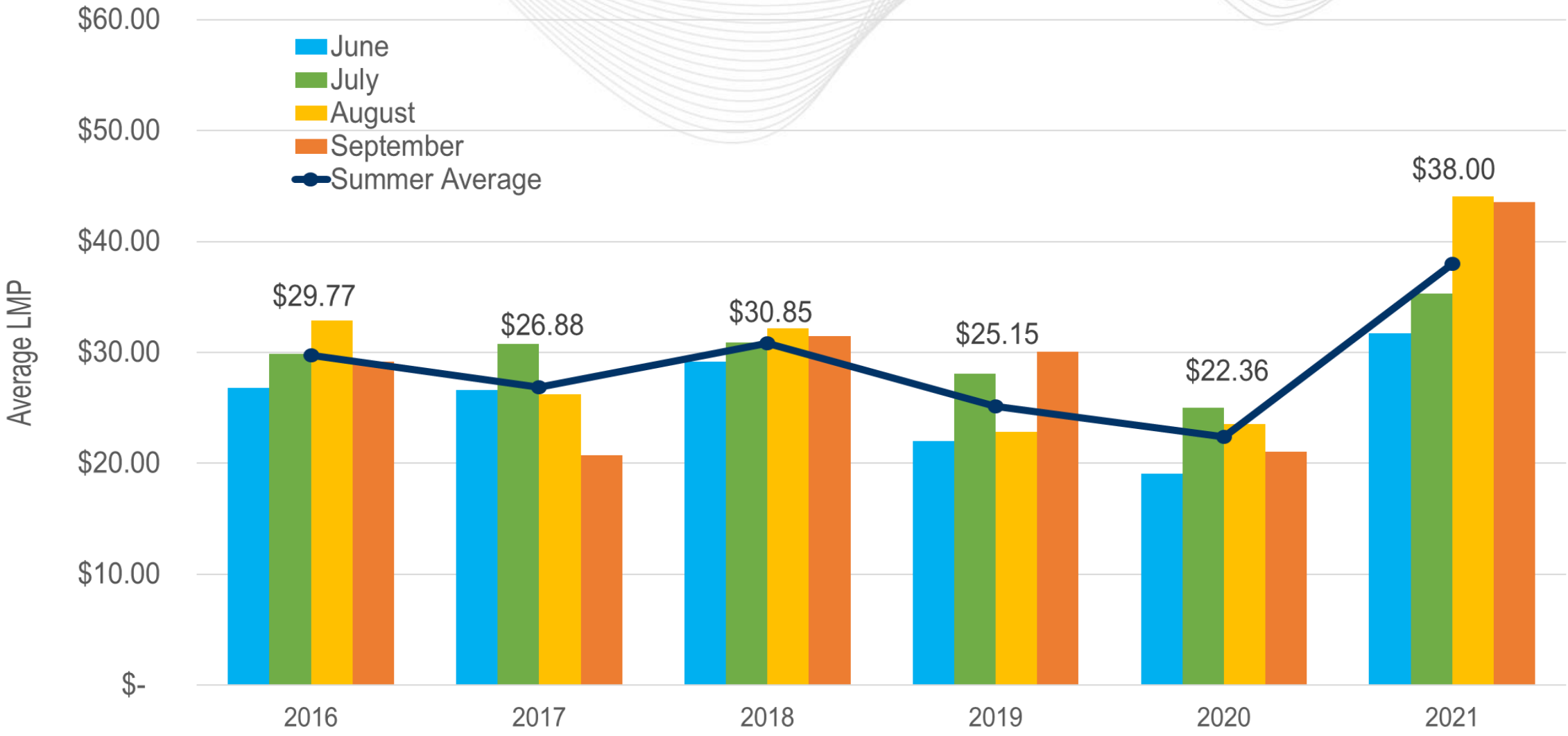
Real Time Locational Marginal Prices

- The following slides show the daily average LMP and the LMP at the time of the daily load peak, and the historic monthly average LMPs, respectively.
- LMPs were higher this summer than in recent years. There were 16 hours in which LMP exceeded $100.
- Increasing natural gas prices, rebounding electricity demand relative to 2020, and sustained hot weather were all contributing factors to higher LMPs this summer.

Daily Average and Peak Real Time LMPs



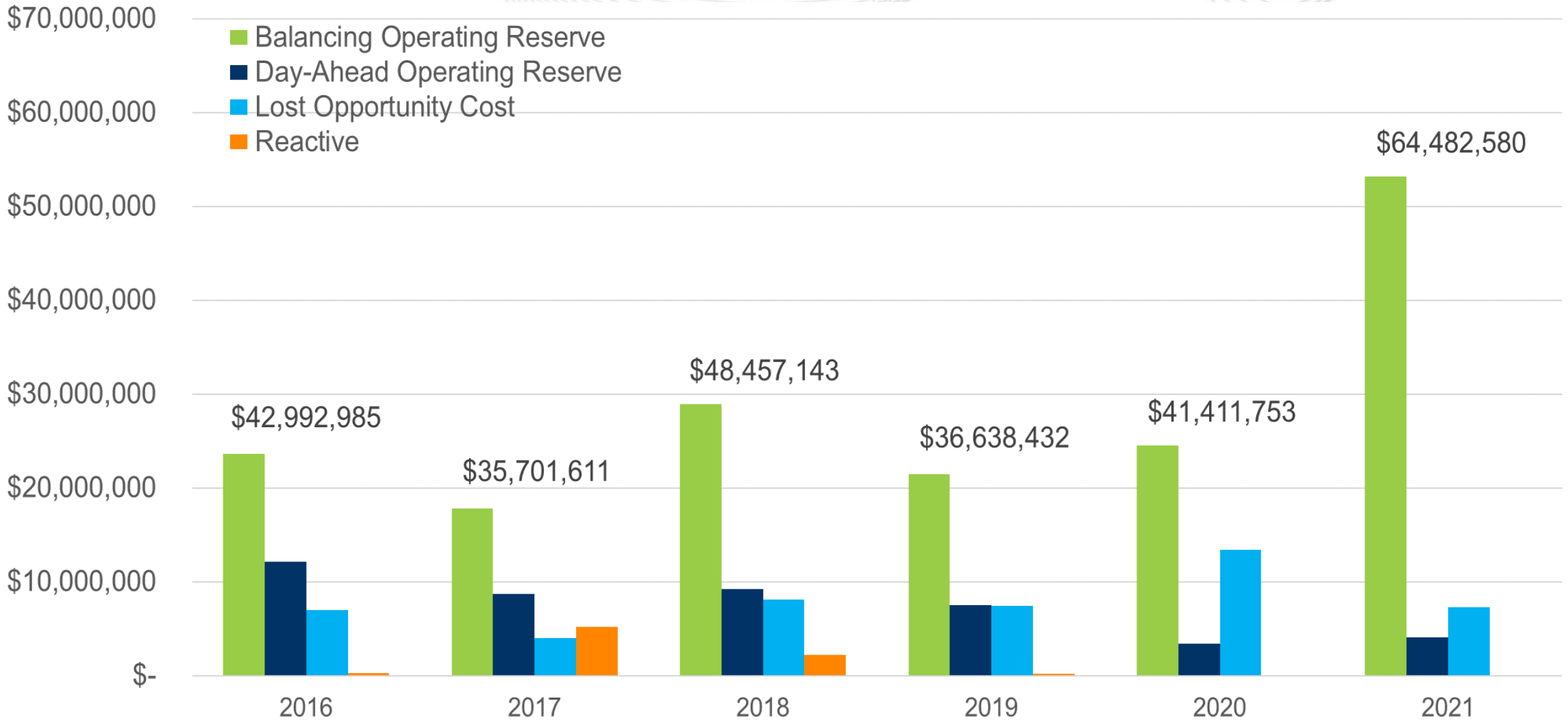
Historic Summer Average Real Time LMPs



Summer Uplift

- The following slide shows uplift for the past six summers.
- Total uplift, and more specifically, Balancing Operating Reserves (BOR) were up over recent summers.
- Given the higher load levels, hot weather, and constraint control dynamics, additional flexible resources were called throughout operating days. This resulted in higher levels of BOR when congestion and/or load patterns reduced localized LMP for the units in question.

Summer Uplift



Operations

Emergency Procedures

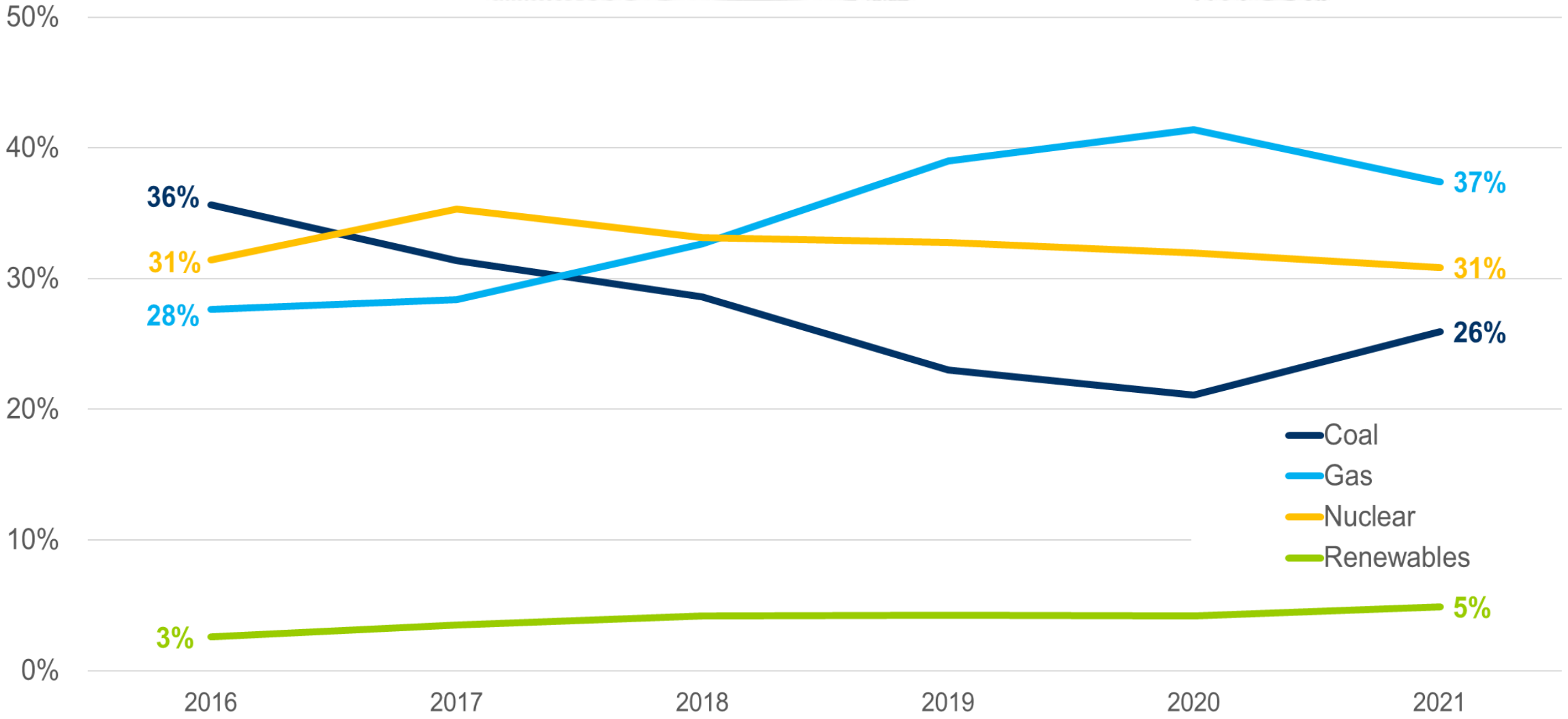
Emergency Procedure	2016	2017	2018	2019	2020	2021
100% Spinning Reserve - RTO and/or MAD	7	4	11	3	4	6
High System Voltages	5	8	1	0	1	5
Minimum Generation Alert	12	20	3	0	0	0
Manual Load Dump Warning or Action	0	0	1	0	0	0
Hot Weather Alert - Any Region	23	15	19	13	20	22
Total	**47**	**47**	**35**	**16**	**25**	**33**

- Hot Weather Alerts accounted for 2/3 of the Emergency Procedures enacted this summer.
- The high number of Hot Weather Alerts corresponds with the high number of Cooling Degree Days on slide 8.

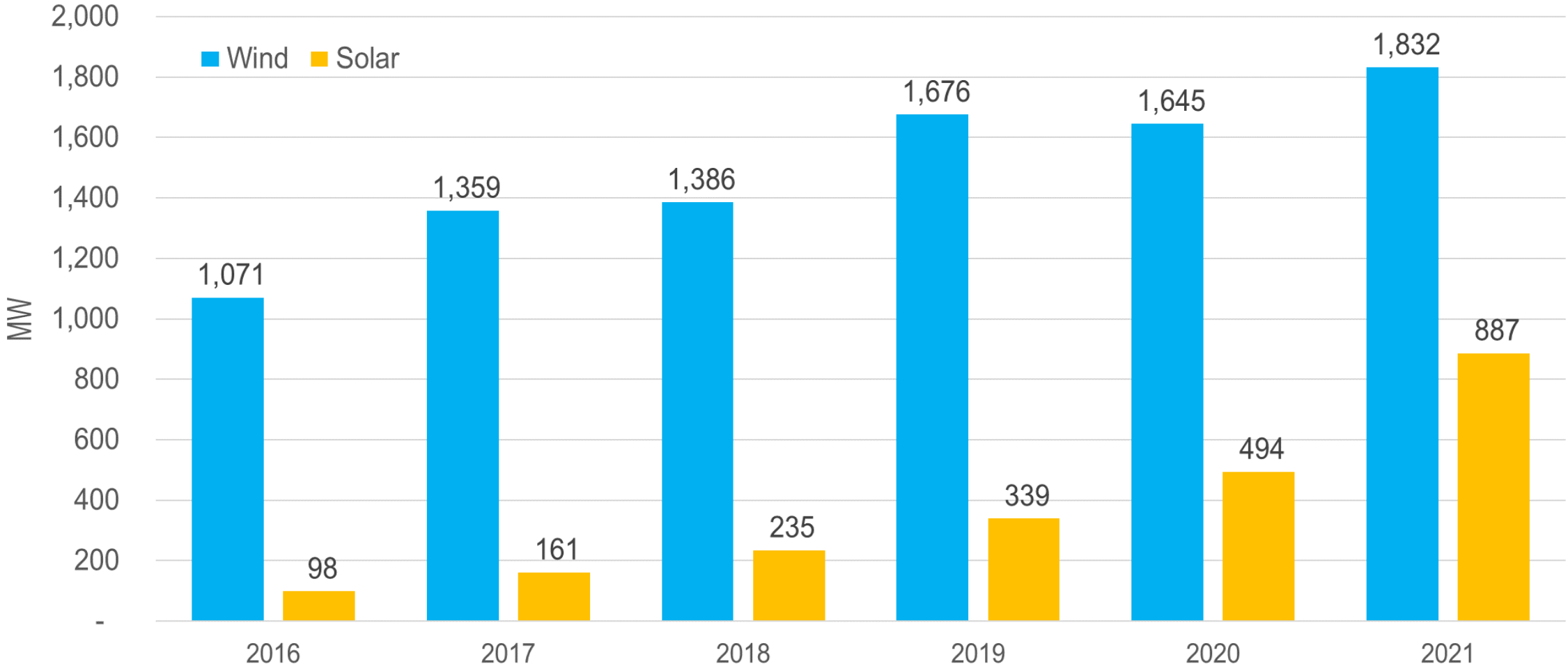
On-line Generation

- The following slide shows the fuel mix of on-line generation for the past six summers for all hours. Following that is a slide breaking out average wind and solar performance for all hours.
- Patterns are very similar when examining only peak hours.
- Since the summer of 2016, natural gas has overtaken coal as the most utilized online fuel across all hours of the summer.
- Since the summer of 2016, renewables have increased their share of the on-line fuel mix both during peak hours and all other hours.

Historic Online Fuel Mix for all Summer Hours



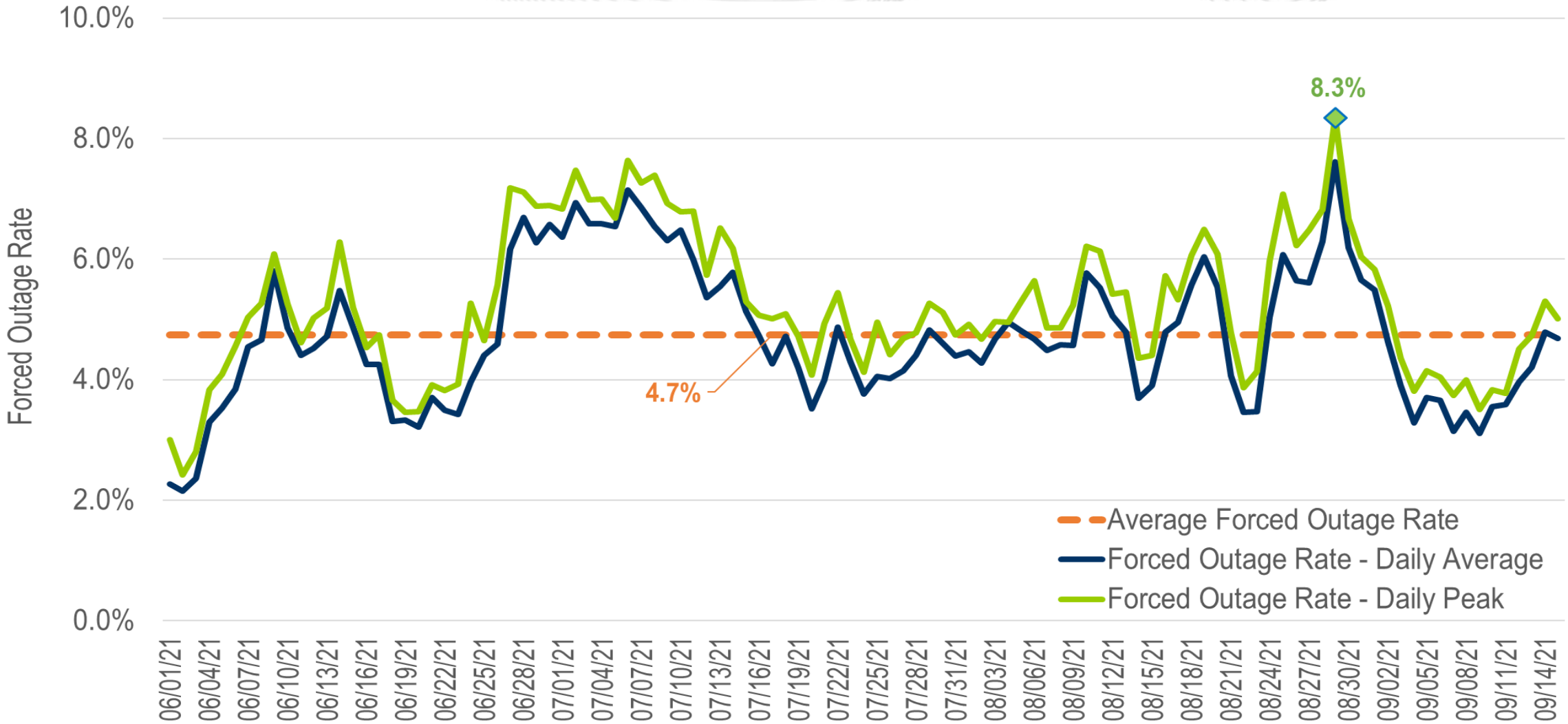
Renewable Performance for all Summer Hours



Forced Outage Rates

- The following slides show the daily average and daily maximum forced outage rates, as well as the historic average forced outage rates, respectively.
- The 2021 daily data is sourced from eDART, however, historical data is from GADS.
- GADS data for September is for the entire month of September, not just September 1-15.
- Final GADS data for September 2021 is not yet available.

Daily Forced Outage Rates - eDART



Historical Forced Outage Rates - GADS