AUGUST 2023

August 2023 Midwest Heatwave

ENERGY VENTURES ANALYSIS

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ENERGY VENTURES ANALYSIS

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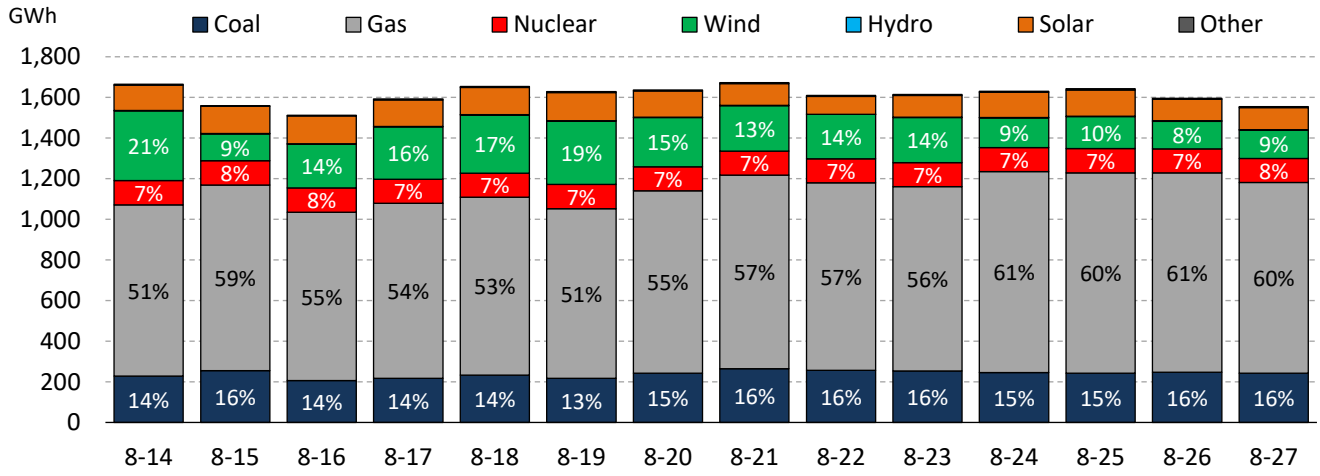
Introduction

During the period spanning August 23 to August 25, 2023, a severe heat wave gripped the Midwest and Gulf regions of the United States, affecting 19 states, including Iowa, Missouri, Arkansas, Louisiana, and Illinois, resulting in an estimated impact on 130 million individuals. Multiple Independent System Operators (ISOs), including the Southwest Power Pool (SPP), Midcontinent Independent System Operator (MISO), and Electric Reliability Council of Texas (ERCOT) experienced substantial electricity demand increases. In contrast, the other two ISOs on either coast (PJM and CAISO) saw virtually no impact. This report analyzes the operational profile of the three affected ISOs, including their performance during their peak electricity demand day and the week leading up to the extreme weather event.

ERCOT

ERCOT has experienced scorching temperatures and corresponding high electricity demand for most of the summer. In the week preceding the heat wave, the average electricity demand stood at 1.62 TWh, surging to 1.66 TWh on August 25. As temperatures soared, natural gas power plants stepped up, meeting the increased demand effectively and showcasing their adaptability in maintaining grid reliability during challenging times. On the other hand, wind generation mix share dropped from 19% on August 19 to just 10% and below during the peak of the August heatwave.

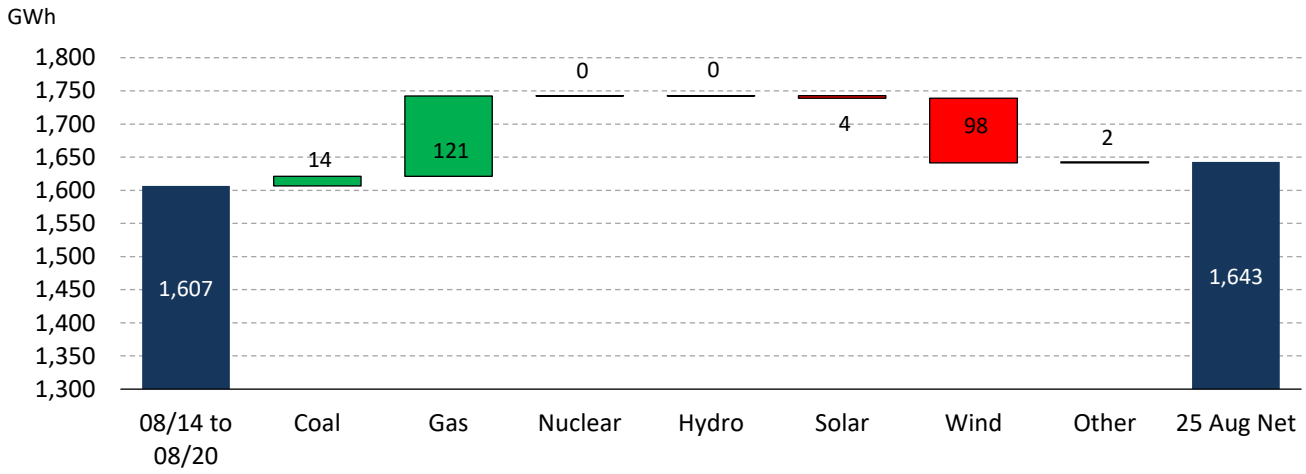
ERCOT August 14-27 2023 daily generation by fuel type



Source: ERCOT hourly operational data

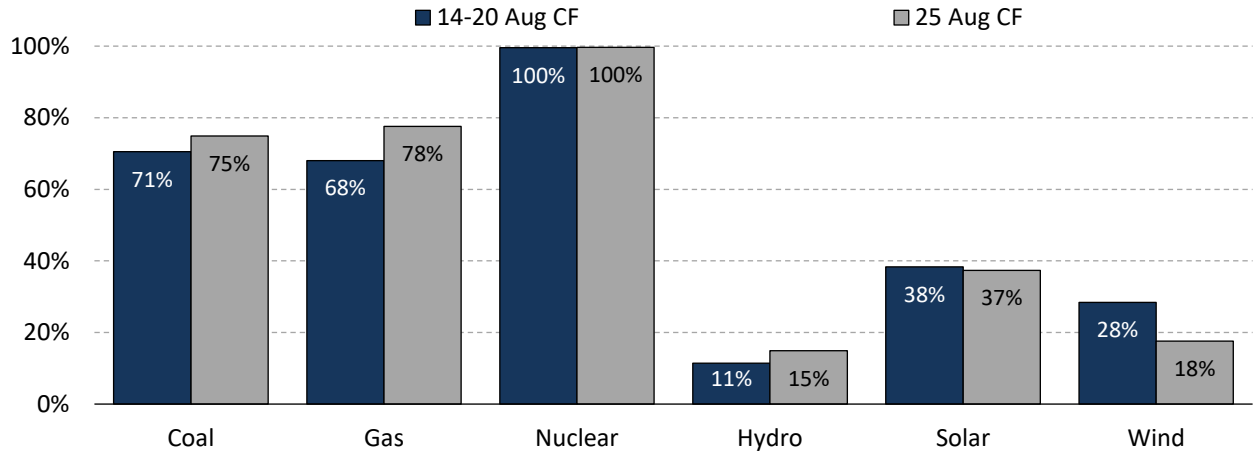
The heatwave led to a spike in electricity demand due to more cooling needs. Simultaneously, wind generation decreased, requiring more fossil fuel-based power from natural gas and coal to meet the heightened electricity needs on August 25. Coal and natural gas generation increased by 6% and 14%, respectively, during this critical time, while wind generation dropped by 38%. Natural gas played a vital role by contributing an additional 121 GWh of energy to bridge the gap caused by the drop in wind generation, emphasizing its importance in grid stability during challenging conditions. Coal generation, already operating at high capacity factors during these high electricity demand periods, increased by a modest 14 GWh compared to the week prior to the August heatwave.

ERCOT - increase in daily net generation by fuel type from Aug 14-20 to Aug 25



Source: ERCOT hourly operational data

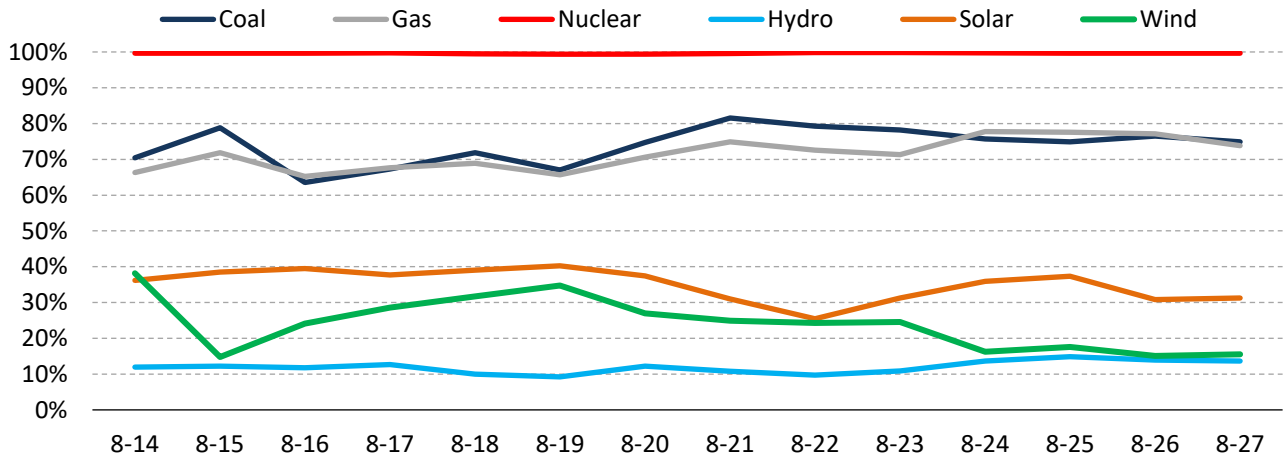
ERCOT capacity factor during and before heat wave by fuel type



Source: EVA analysis of ERCOT hourly operational data & EIA Form-860 data

The previous chart highlights the utilization rates by fuel type during the August heatwave compared to the week prior to the extreme weather event. As mentioned previously, coal-fired power plants operate at baseload for most of the summer when electricity demand is at its highest, as shown by the modest increase in utilization rate (71% to 75%). Due to their superior load-following capabilities, gas-fired power plants showed the greatest increase in utilization rate, increasing ten percentage points from 68% to 78% as the fuel group picked up most of the increased electricity demand and the loss of wind generation. Conversely, wind capacity factors dropped by ten percentage points as wind speeds dropped across the ERCOT footprint during the heatwave compared to the prior week.

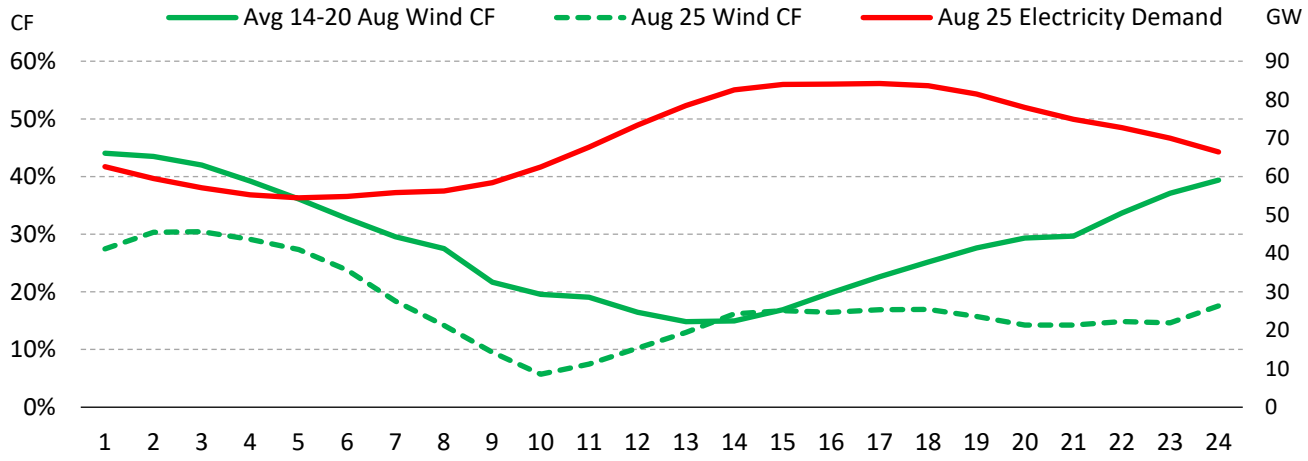
ERCOT capacity factor by fuel type for Aug 14-27 2023



Source: EVA analysis of ERCOT hourly operational data & EIA Form-860 data

Wind generation typically operated at about 40% capacity a week before the heatwave but dropped to 18% during the extreme conditions on August 25. In contrast, coal and natural gas increased their capacity factors to about 78%, ensuring uninterrupted grid operation.

ERCOT hourly wind generation & electricity demand on Aug 25



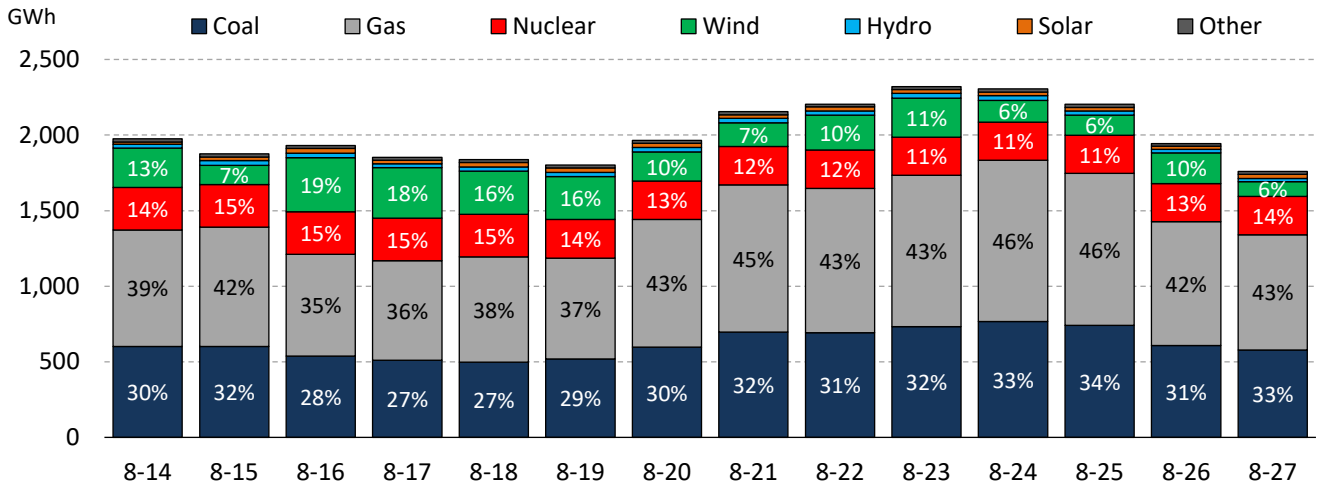
Source: EVA analysis of ERCOT hourly operational data & EIA Form-860 data

The ERCOT hourly data reveals that wind generation peaks in the early morning when demand is lowest. However, as the temperatures rise by the hour during hot summer days, wind speeds decline, leading to reduced power output from wind farms throughout the day. Therefore, electric power generation from fossil fuel-fired power plants, which do not rely on weather conditions, is needed to meet the increasing demand due to the higher temperatures during heatwaves and offset the loss of renewable energy, primarily from wind turbines.

MISO

In the week leading up to the heatwave, the average electricity demand in the MISO power market stood at 1.97 TWh, surging to 2.43 TWh at the peak of the extreme weather event on August 24 (net generation in MISO peaked on August 23). Natural gas and coal power plants responded exceptionally well, significantly increasing their electricity generation to meet the higher demand. Together, the fuels increased their market share from 63% on August 18 to 79% on August 24, as electricity demand increased, and wind generation collapsed.

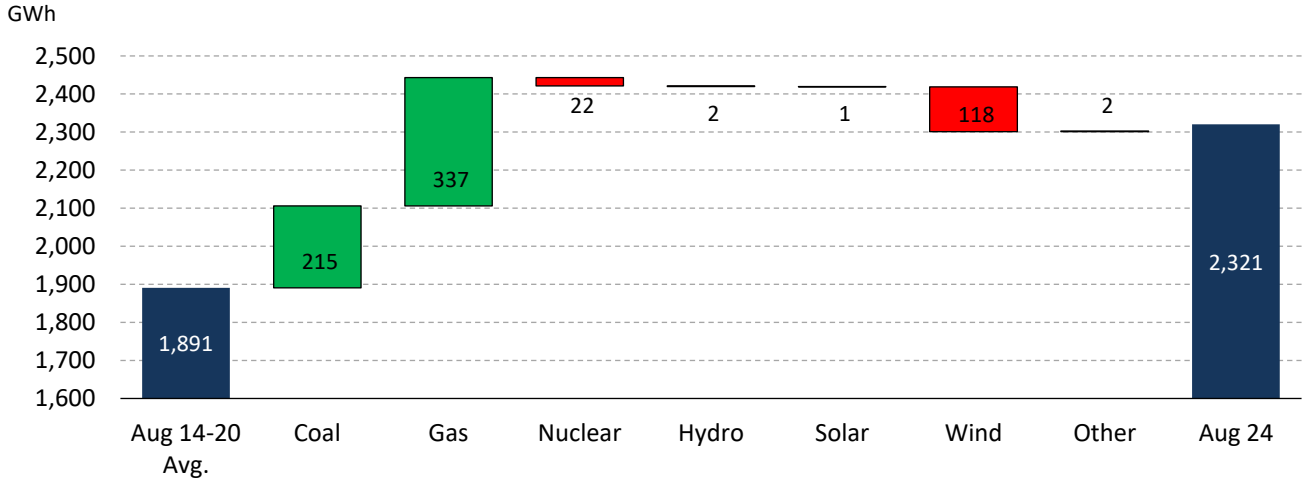
MISO August 14-27 2023 daily generation by fuel type



Source: MISO hourly operational data

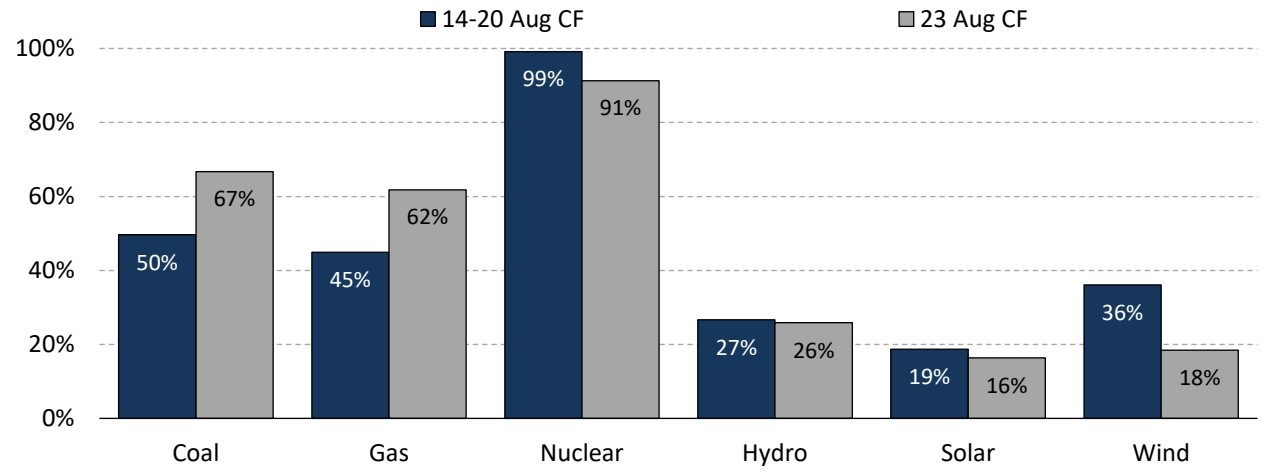
During the heatwave, demand surged due to increased cooling needs, while wind generation decreased significantly. This required more fossil fuel-based power from natural gas and coal on August 24. Coal and natural gas generation increased by 39% and 46%, respectively, while wind generation dropped by 45%. Natural gas and coal contributed an additional 337 GWh and 215 GWh of energy, respectively, compensating for the energy shortfall caused by the drop in wind generation and the 23% increase in electricity demand compared to the previous week.

MISO - increase in daily net generation by fuel type from Aug 14-20 to Aug 24



Source: MISO hourly operational data

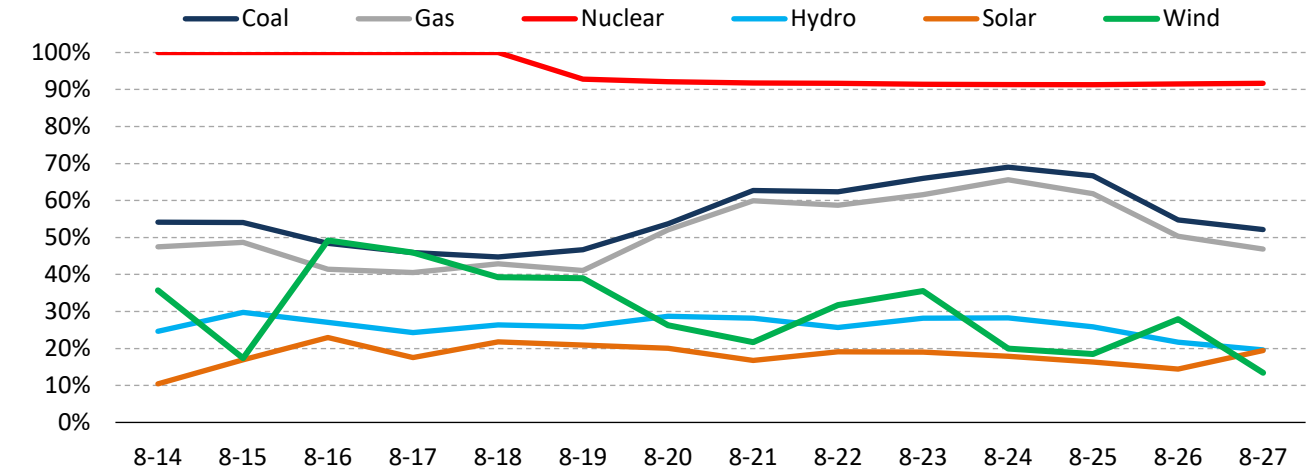
MISO capacity factor during and before heat wave by fuel type



Source: EVA analysis of MISO hourly operational data & EIA Form-860 data

Coal and natural gas-fired power plants across the MISO footprint significantly increased their utilization rates during the heatwave compared to the prior week to meet the increased electricity demand and offset the loss in electricity generation from wind turbines. As shown in the chart above, the capacity factor of wind turbines dropped by 50% during the peak of the heatwave, while coal and natural gas power plants saw substantial increases.

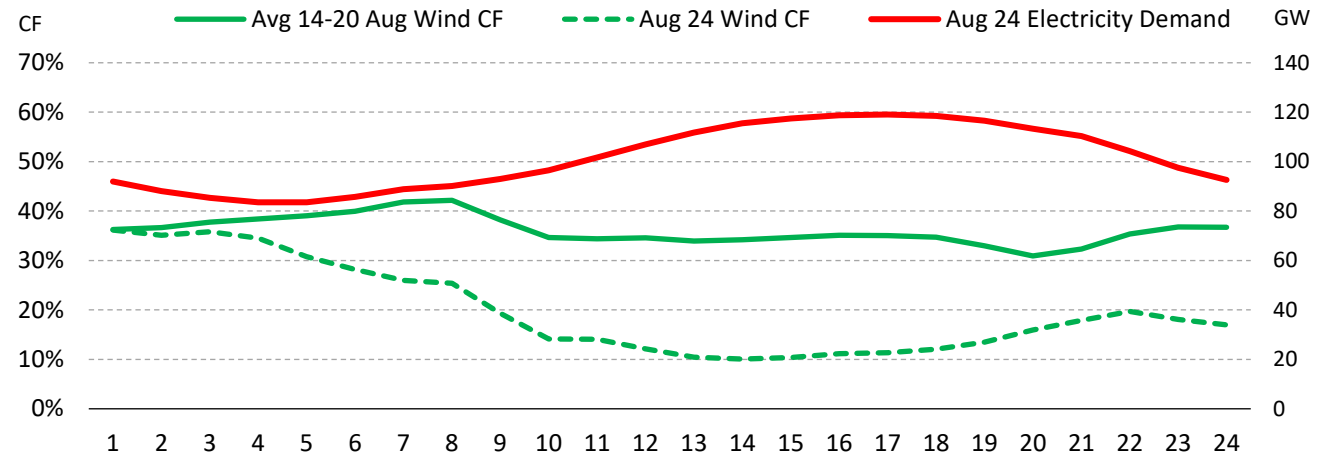
MISO capacity factor by fuel type for Aug 14-27 2023



Source: EVA analysis of MISO hourly operational data & EIA Form-860 data

Looking back over the two weeks prior to the August heatwave, wind capacity factors peaked at roughly 50% on August 16 before dropping below 20% on August 24. Conversely, coal and natural gas capacity factors increased from ~40-45% to over 65% over the same period.

MISO hourly wind generation & electricity demand on Aug 24



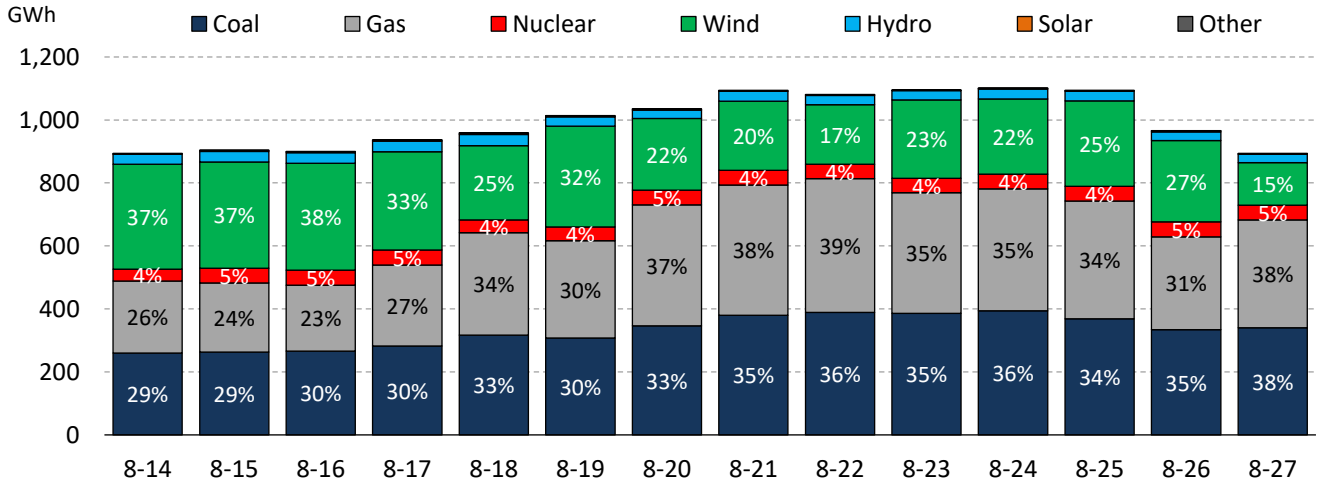
Source: EVA analysis of MISO hourly operational data & EIA Form-860 data

During peak hours on the highest-demand day, MISO experienced a substantial shortfall in wind energy generation, necessitating increased fossil fuel-based power generation to meet electricity demand and compensate for the loss in electricity generation from wind turbines.

SPP

In the week preceding the heatwave, the average electricity demand in SPP stood at 1.02 TWh, escalating to 1.11 TWh during the peak of the heatwave on August 24. With temperatures reaching record levels in many parts across the SPP footprint, resulting in near-record electricity demand levels, natural gas, and coal power plants demonstrated sufficient adaptability and responsiveness, significantly increasing their electricity generation to meet the rising demand.

SPP August 14-27 2023 daily generation by fuel type

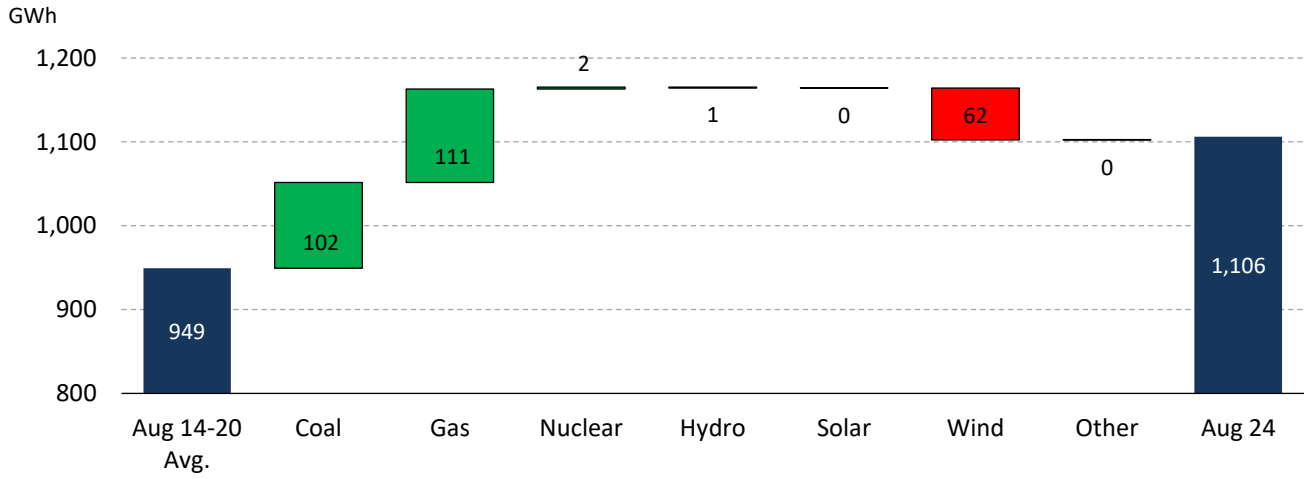


Source: SPP hourly operational data

During the heatwave, demand increased due to heightened cooling needs, while wind generation decreased significantly. This required more fossil fuel-based power from natural gas and coal leading up to and on August 24, when electricity demand peaked in SPP. Coal and natural gas generation increased by 35% and 40%, respectively, while wind generation dropped by 21%. Natural gas and coal contributed an additional 111 GWh and 102 GWh of energy, respectively,

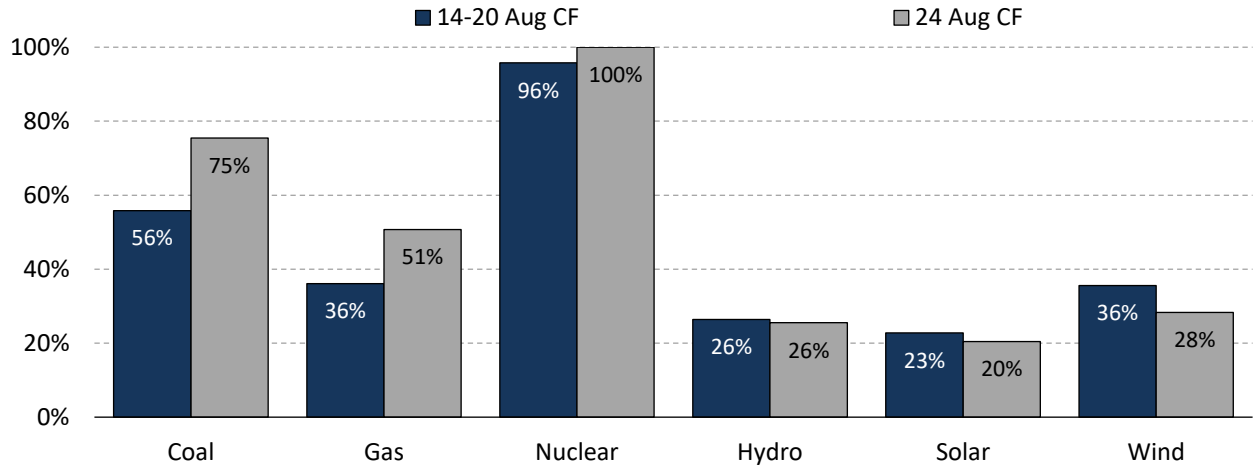
compensating for the energy shortfall caused by the loss of wind generation and an 18% increase in electricity demand compared to the previous week.

SPP - increase in daily net generation by fuel type from Aug 14-20 to Aug 24



Source: SPP hourly operational data

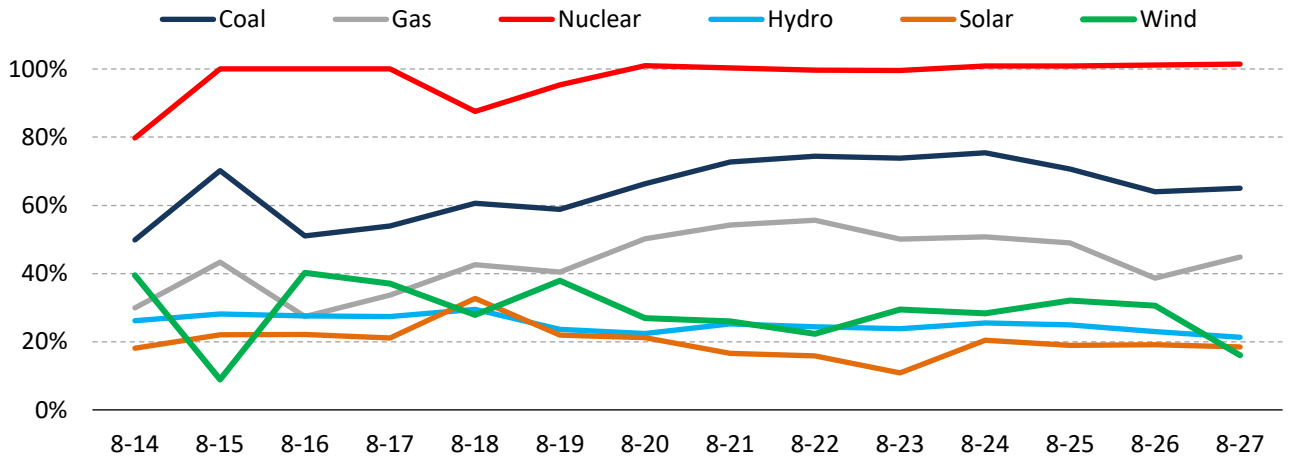
SPP capacity factor during and before heat wave by fuel type



Source: EVA analysis of SPP hourly operational data & EIA Form-860 data

As electricity demand rose and wind generation dropped, utilization rates for coal and natural gas plants across SPP rose to meet the region's electricity needs. Coal utilization rates increased from 56% during the week leading up to the August heatwave to 75% on August 24, while natural gas capacity factors rose from 36% to 51%. Conversely, wind turbine capacity factors dropped from 36% to 28% over the same period.

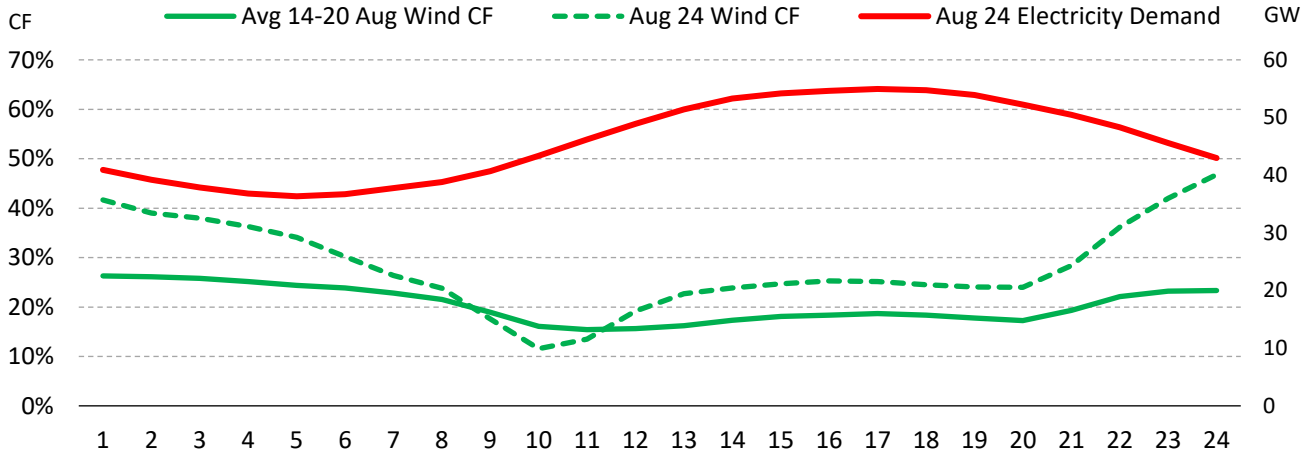
SPP capacity factor by fuel type for Aug 14-27 2023



Source: EVA analysis of SPP hourly operational data & EIA Form-860 data

Similar to ERCOT and MISO, in SPP, during the peak hours of the highest-demand day, wind generation experienced a substantial shortfall as wind speeds dropped across the region. Fossil fuel-fired power plants were called upon to meet the increased electricity demand and offset the electricity generation shortfall created by the drop in wind turbine power output.

SPP hourly wind generation & electricity demand on Aug 24



Source: EVA analysis of SPP hourly operational data & EIA Form-860 data

Conclusion

The August heatwave affecting the ERCOT, MISO, and SPP ISOs underscores the recurring reliance on incremental fossil generation to meet peak electricity demand during extreme weather events due to their dispatchability and independence from the weather (i.e., wind speeds or solar radiation). Given the challenges posed by the reduced reliability of renewable sources like wind and solar during extreme weather events, the U.S. electric power grid's resiliency during these events undeniably relies on the sustained contribution of coal and natural gas power plants. The current trend of retiring these crucial assets raises concerns about the grid's future ability to handle the demands posed by these extreme weather

events. Until a robust energy storage infrastructure can mitigate renewables' intermittency, power plant retirement decisions must prioritize grid reliability over policy objectives.