MTEP23 Table of Contents

CHAPTER 2: PORTFOLIO EVOLUTION

2.1 MISO Futures

To perform analysis on the bulk electric system twenty years into the future, many assumptions must be made to bridge what is known about the system today to what it could be two decades from now. Complicating matters is the uncertainty of future developments.

MISO has developed a method to address this uncertainty—the use of forward-looking scenarios to provide a range of future outlooks. Within MISO, these forward-looking scenarios are called the "Futures". These Future scenarios establish ranges of economic, policy, and technological possibilities—such as load growth, electrification, decarbonization, generator retirements, renewable energy levels, fuel prices, and generation capital costs—over a twenty-year period.

Future Scenarios

MISO Futures are the inputs for multiple MTEP cycles, the LRTP initiative, and other planning studies. These Futures form the basis for the Reliability Imperative, such that MISO and its stakeholders can plan to a consistent set of scenarios across transmission, markets, and operations. In 2023, MISO introduced a new naming convention for the MISO Futures. Cohorts of Futures are now referred to by series.

The Series 1 MISO Futures developed in 2019-20 culminated an 18-month joint effort between MISO and its stakeholders. This effort aligned Futures development with the ongoing fleet transformation and incorporated the plans of MISO's members and states, while also creating future scenarios that can be utilized over several years. Therefore, the Series 1 MISO Future scenarios were used in LRTP Tranche 1.

Within this context, no new Future scenarios were developed specifically for MTEP23. Rather, within the framework of LRTP Tranche 2, the development of Series 1A commenced in Summer 2022. Originally known as the Futures Refresh, Series 1A focused on refreshing certain input data around generation and economics while maintaining the load, number, and definition of Futures established in Series 1. Specifically, LRTP Tranche 2 will develop a portfolio that meets the needs of Future 2A (F2A) within Series 1A.

The following figures show effects from refreshed input data in F2A. Driven largely by updated member plans, F2A illustrates the continuing impacts of the energy transition, with significant acceleration in thermal retirements, renewable capacity buildout and energy production, and decarbonization.

Series 1A and subsequent Futures Series will continue to capture transformation within the MISO footprint, reflecting the system's evolution and serving as the foundation for forthcoming MISO initiatives. Iterations of Futures are a product of continued collaboration between MISO and its stakeholders.

More information on the MISO Futures, including reports and Series 1A assumptions, is found here. Additionally, the 2023 Series 1A Futures Report will be incorporated once published.

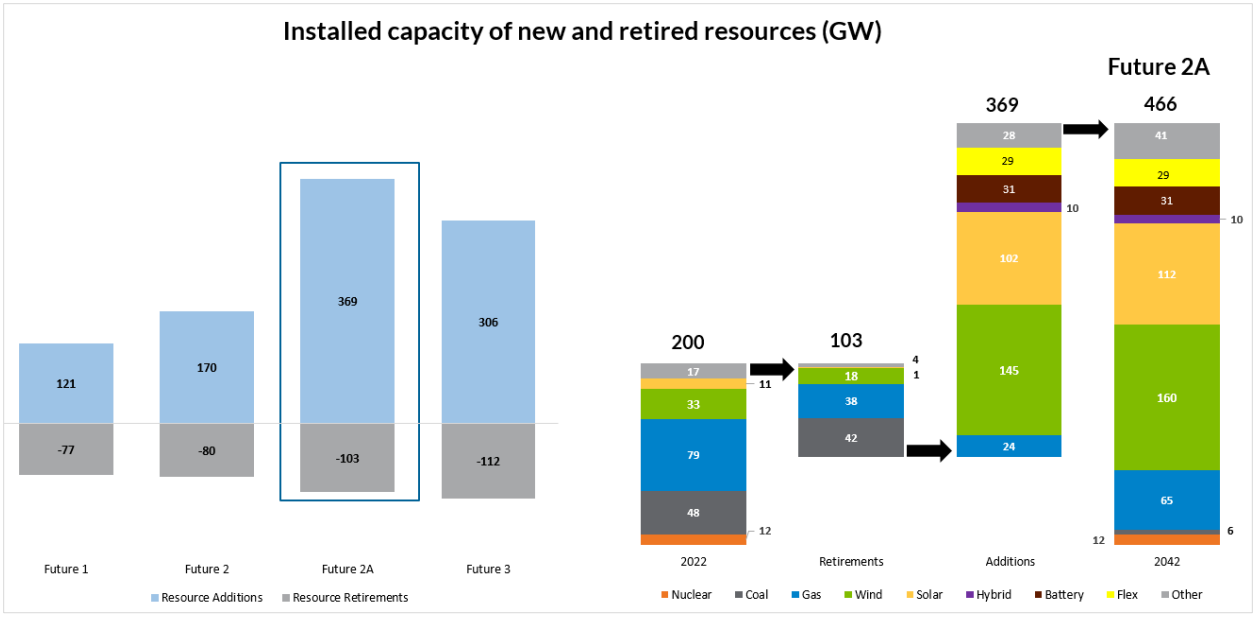

Figure 2.1-1: This figure from Future 2A analysis shows that F2A's expansion surpasses those of Series 1 Future 3, while F2A's retirements approaches those of F3.[1]

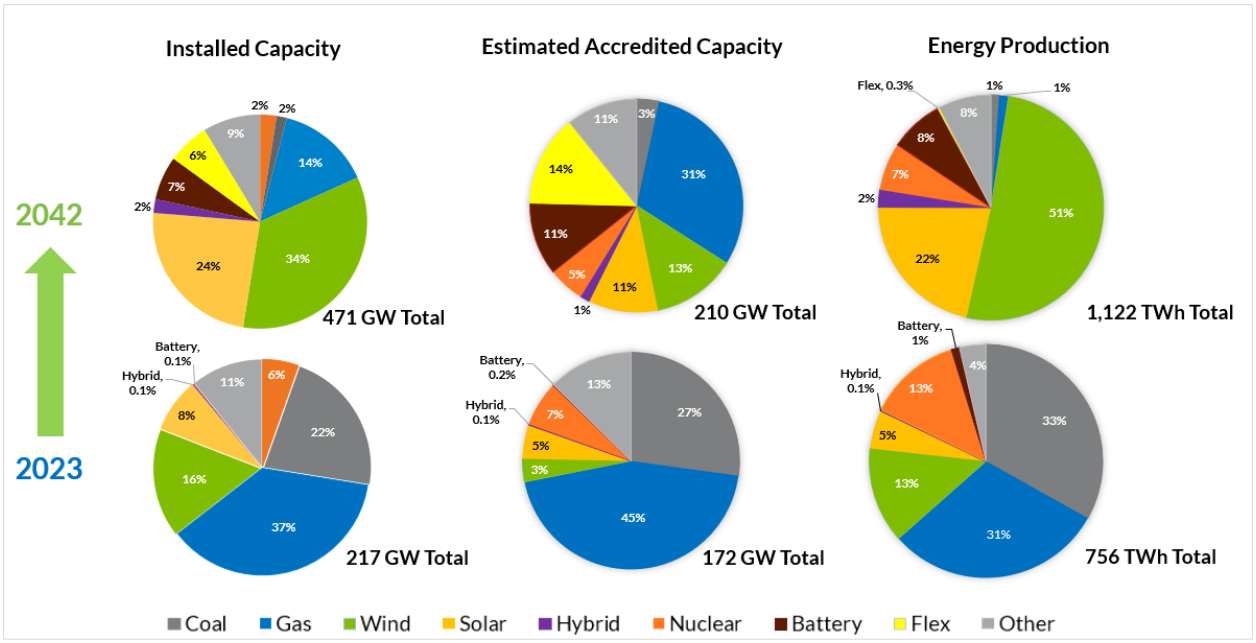

Figure 2.1-2: This figure from Future 2A analysis shows the changing energy and capacity mix as the generating fleet continues to evolve.[1]

[1] Data as of April 26, 2023. Futures do not account for all operational-level reliability needs and attributes that may require different levels of dispatchable resources. Resource additions may be subject to adjustment based on new accreditation rules. "Other" includes biomass, geothermal, hydro, oil, pumped hydro storage, demand response, non-solar distributed generation, and energy efficiency. Battery energy production includes battery discharging only. However, overall energy production pie graph includes the energy required to charge storage.

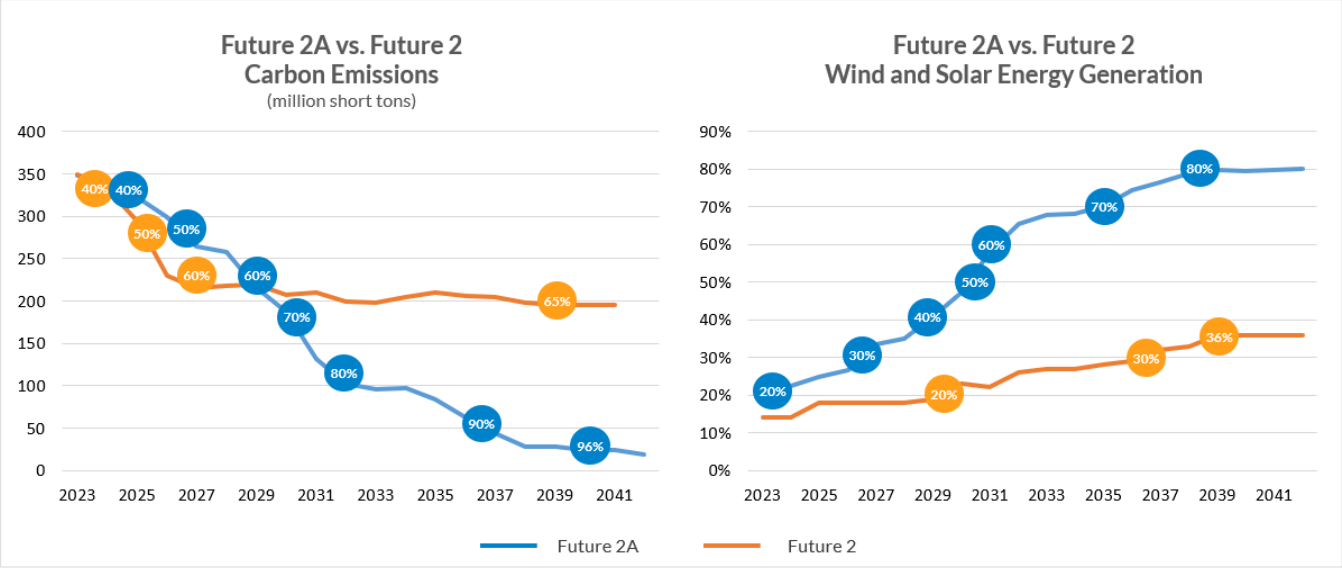

Figure 2.1-3: This figure from Future 2A analysis shows that F2A's decarbonization and renewables generation far outstrips that of Series 1 Future 2.[2]

2.2 Retirement Trends and Future Outlook

One aspect of resource evolution that MISO assists its membership in managing is the retirement of generation facilities, to ensure that the broader MISO footprint remains reliable after resources are removed from service. Through the process articulated in Module C Section 38.2.7 of the MISO Tariff, resource owners submit a request to retire generation resources for MISO approval, which triggers an assessment into the impact that the requested resource would cause once it is retired from service. As a result of these analyses, any reliability issues are addressed through transmission reinforcements or other needed mitigation measures. If the reliability issue cannot be addressed prior to the planned retirement date, MISO may require the resource to remain in service as a system support resource (SSR) until the upgrade is complete, or mitigation is available. As the generation mix continues to evolve, more generating resources are expected to retire, increasing the number of Attachment Y requests MISO receives. This may increase the need for SSR-designated units. Since September 2022, MISO has established two SSR units to maintain reliability of the region.

In 2022, MISO proposed improvements to the Attachment Y process. These improvements were accepted by FERC, which extended the advance notice timeline from 26 to at least 52 weeks to allow MISO more time to process the increased number of Attachment Y requests. MISO also proposed and gained approval for a quarterly study period system. These changes better allow for forecasting workload internally. MISO made other proposals around the studies included in the retirement process and the mitigations used in the studies have reduced reliance on load shed and redispatch. While MISO has not proposed any new studies for the base reliability study process, the extended advance notice timeline will allow for additional studies as situationally necessary. Lastly, MISO appreciates the need for greater transparency into the retirement process while maintaining a great deal of confidentiality for its members. As part of the Attachment Y

[2] Data as of March 7, 2023. Futures do not account for all operational-level reliability needs and attributes that may require different levels of dispatchable resources. Resource additions may be subject to adjustment based on new accreditation rules.

improvements, MISO will be communicating the number of requests received by quarter and the number of megawatts requesting suspension or retirement.

Aging coal-fired generating resources have experienced increased retirements in recent years due to cost pressures of operation and competition from gas-fired generation. Renewable generating resources have become more economically and environmentally attractive sources of generation in recent years, putting further pressure on carbon-based generation. Since 2010, MISO has experienced the retirement of 30.8 GW, of which 21.9 GW was coal-based (Figure 2.2-1). The age of generating facilities retired in 2021 declined to an average of 32 years compared to an average of 44 years in 2011. Advancements in technology and interest in renewables are expected to continue the current trend.

A trend since 2020 is the utilization of the new Generating Facility Replacement process. This process was approved by FERC in 2019 to allow the owners of an existing facility to use their existing interconnection service to replace the existing generator with a new generating facility at the same injection point without going through the MISO Generator Interconnection queue. Since 2020, MISO has received 32 generator replacement requests to replace a total of 6.1 GW of existing generation, which otherwise would have been retired through the traditional resource retirement process.

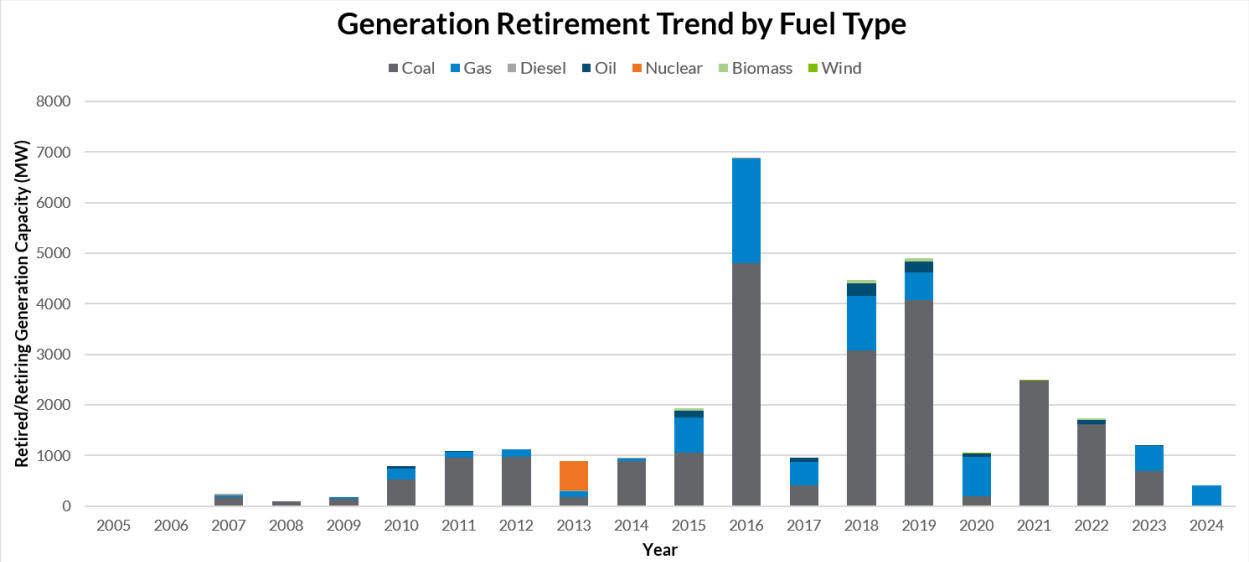

Figure 2.2-1: MW Generation Retirement by Fuel Type

2.3 Resource Outlook

Load Serving Entities (LSEs) in the MISO region must have sufficient resources to meet their forecasted demand plus their required levels of reserves. Every year, MISO administers a Planning Resource Auction (PRA) that LSEs may use to purchase or sell resources for that purpose. LSEs can also opt out of the PRA and use their own resources or negotiate bilateral contracts with other entities. Regardless of how LSEs procure their needed resources, all this information is rolled up into the PRA to demonstrate whether the region will be resource-adequate for the upcoming MISO Planning Year, which runs from June 1 to May 31 of the following year.

This year's PRA was the first to reflect MISO's new four-season resource adequacy construct, which is designed to plan for and address risks beyond the traditional summer peak-load months. This first-ever

seasonal PRA demonstrated that all parts of the MISO region have adequate resources for the 2023-2024 Planning Year. More details on this year's PRA results are available here.

It is important to note that demonstration of adequate capacity for the 2023-2024 Planning Year does not imply that the region will continue to have adequate resources going forward. Actions taken by LSEs such as delaying some previously announced resource retirements, and the region obtaining additional capacity via imports contributed to the positive results this year. Such actions may not be repeatable over the longer-term. Therefore, unless more generation is built—especially controllable resources that have the attributes the system needs—the risks of capacity shortfalls and other reliability issues will continue to grow.

OMS-MISO Survey

The region's forward-looking resource picture is further illustrated by a planning tool called the OMS-MISO Survey, which asks LSEs to provide information on demand forecasts, new generation they plan to build and existing resources they plan to retire. MISO administers the survey once a year in partnership with the Organization of MISO States (OMS), which consists of state regulatory agencies in the region. The survey is a "snapshot in time" instrument that focuses on a five-year forward view, but it also includes 10-year forward data with an understanding that uncertainty increases in the latter five years.

In recognition that forward-looking resource plans can and do change, the survey allows LSEs to indicate different levels of certainty to the information they provide. Taking that uncertainty into account, the survey shows how anticipated resource levels compare to the Planning Reserve Margin Requirement (PRMR) across MISO as a whole and in each of the region's 10 Local Resource Zones (LRZs). Like this year's PRA, this year's survey reflects MISO's new four-season resource adequacy construct. Survey results are expressed in terms of seasonal PRMRs and Seasonal Accredited Capacity (SAC), which reflects the availability of resources during times of highest reliability need in each of the summer, fall, winter, and spring seasons.

This year's survey indicates the MISO region as a whole will have sufficient resources for the 2024-2025 Planning Year, with a surplus of 1.5 GW in the summer (expressed in terms of SAC, as described above). Similar to this year's PRA results, the survey's forecasted surplus in the 2024-2025 Planning Year is based on actions such as delayed retirements and increased imports that may not occur again going forward. In the figure below, the survey shows the region could have a capacity deficit of 2.1 GW (SAC) in the summer of the 2025-2026 Planning Year, with that deficit increasing in subsequent years, which supports the view that actions taken this year to provide capacity may not be available in the future.

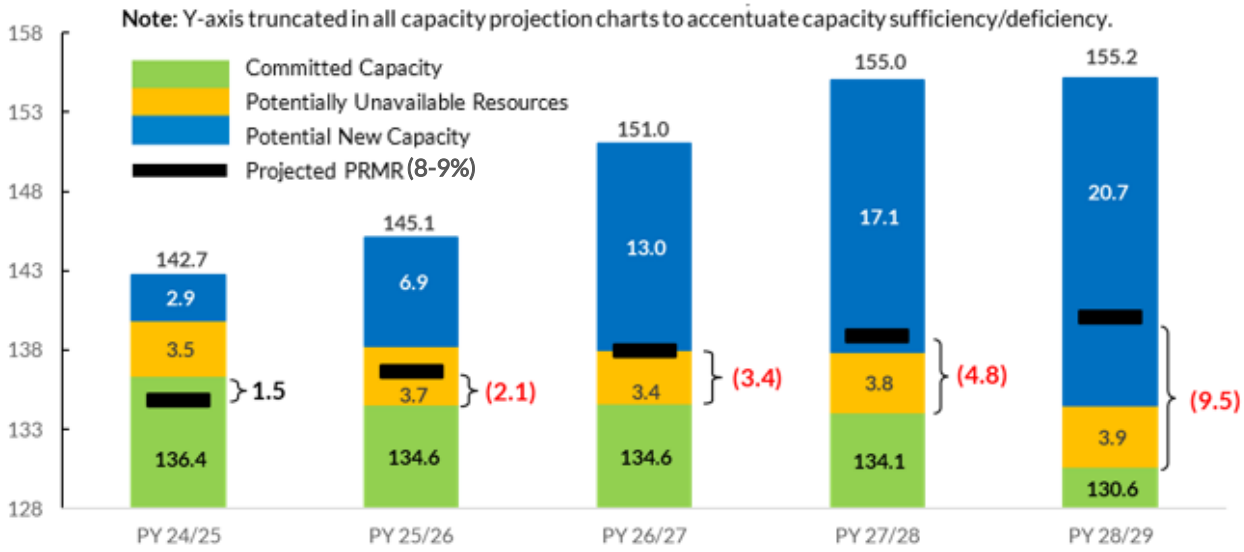

Figure 2.3-2: 2023 OMS-MISO Survey - 5-Year Summer Results

More details about this year's OMS-MISO Survey are available here, including projected capacity levels for the fall, winter, and spring seasons, as well as LRZ-level results.

Regional Resource Assessment

Another tool MISO uses to develop a holistic, forward-looking view of the grid is the Regional Resource Assessment (RRA). The RRA is a recurring study that models how the region's fleet of generating resources might evolve based on the goals that utilities and states have publicly announced to reduce their carbon emissions and/or increase their use of renewable energy. The RRA also models public announcements that utilities and states make to retire specific existing resources and to build new resources going forward.

While the RRA is similar to the OMS-MISO Survey in some regards, there are key differences in their respective designs, purposes, and modeling assumptions. For example, while the OMS-MISO Survey primarily focuses on the next five years, the RRA looks out 20 years. Another difference is that the RRA allows LSEs to submit information about their aspirational decarbonization and/or renewable energy goals. The RRA then uses computer modeling software to "predict" what resources LSEs might build to meet their goals when they have not yet publicly identified enough actual resources. The OMS-MISO Survey does not perform this type of resource-expansion modeling, and instead only includes resources that LSEs specifically identify themselves.

The most recent iteration of the RRA (published in November 2022) yielded findings and insights that align with the results of this year's PRA and OMS-MISO Survey. The key findings of the 2022 RRA are as follows:

- The 2022 snapshot of MISO member plans indicates an increase in the overall amount of installed capacity, but a decline in accredited capacity compared to current levels.
- The RRA modeling indicates a continued near-term capacity risk, highlighting the urgent need for coordinated resource planning and additional investment.
- Wind and solar generation are projected to serve 60% of MISO's annual load by 2041, which would reduce emissions by nearly 80% relative to 2005 levels, but also sharply increase the complexity of reliably operating and planning the system.

- As the solar generation fleet grows, the system will have a much greater need for controllable ramp-up capability. Maximum short-duration up-ramps increase by three times by 2031 and four times by 2041 compared to current levels.

- The capacity contribution of solar generation is forecast to decline rapidly as more solar capacity is added to the system, impacting the region's overall capacity outlook. The contribution of wind generation remains relatively stable as more wind capacity is added.

2.4 Current State of the Queue

The MISO Generator Interconnection (GI) queue provides an active and competitive mechanism to enable resource interconnections that will serve future energy and capacity needs. Projects submitted in the annual queue cycle are evaluated by MISO through an iterative study process to determine the reliability impacts and to identify transmission upgrades needed to support resource integration. Project viability is often tied to the costs of network upgrades, with the most viable candidates successfully executing a Generator Interconnection Agreement (GIA).

The Generator Interconnection queue has experienced extremely high volume over the last several years. In 2022, MISO received 956 individual project requests. Solar, storage, and hybrid applications make up the bulk of the queue.

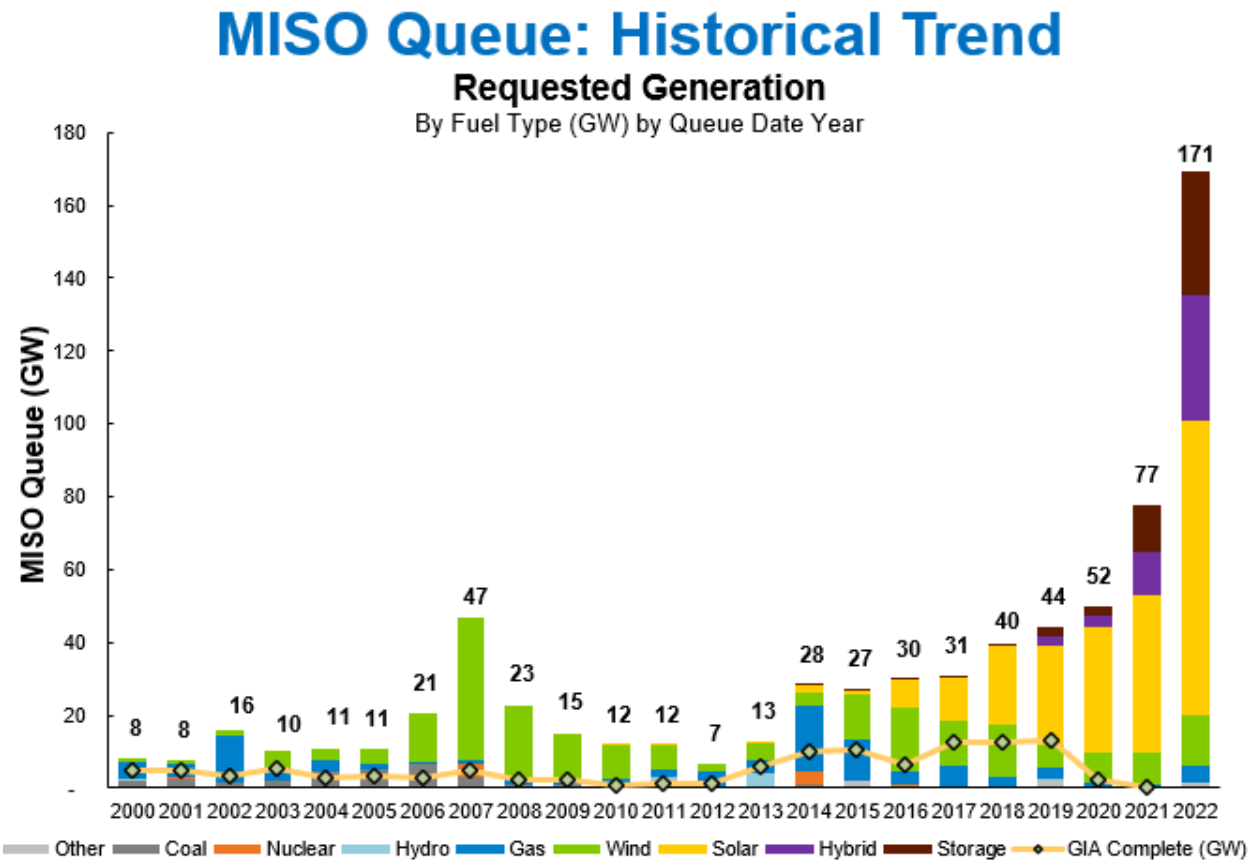

Figure 2.4-1: As of August 2023, the current state of the queue has 1,365 projects representing 235.23 GW of total capacity.

The MISO Active Queue by study area and fuel type (Figure 2.3-2) is available on the MISO website under the GIQ Web Overview link on the Generator Interconnection Queue page. A list of all active projects can also be reviewed on the page. The five study regions in the GI queue currently have 24 active cycles in various stages of the process from the start of the Definitive Planning Phase (DPP) to GIA negotiations.

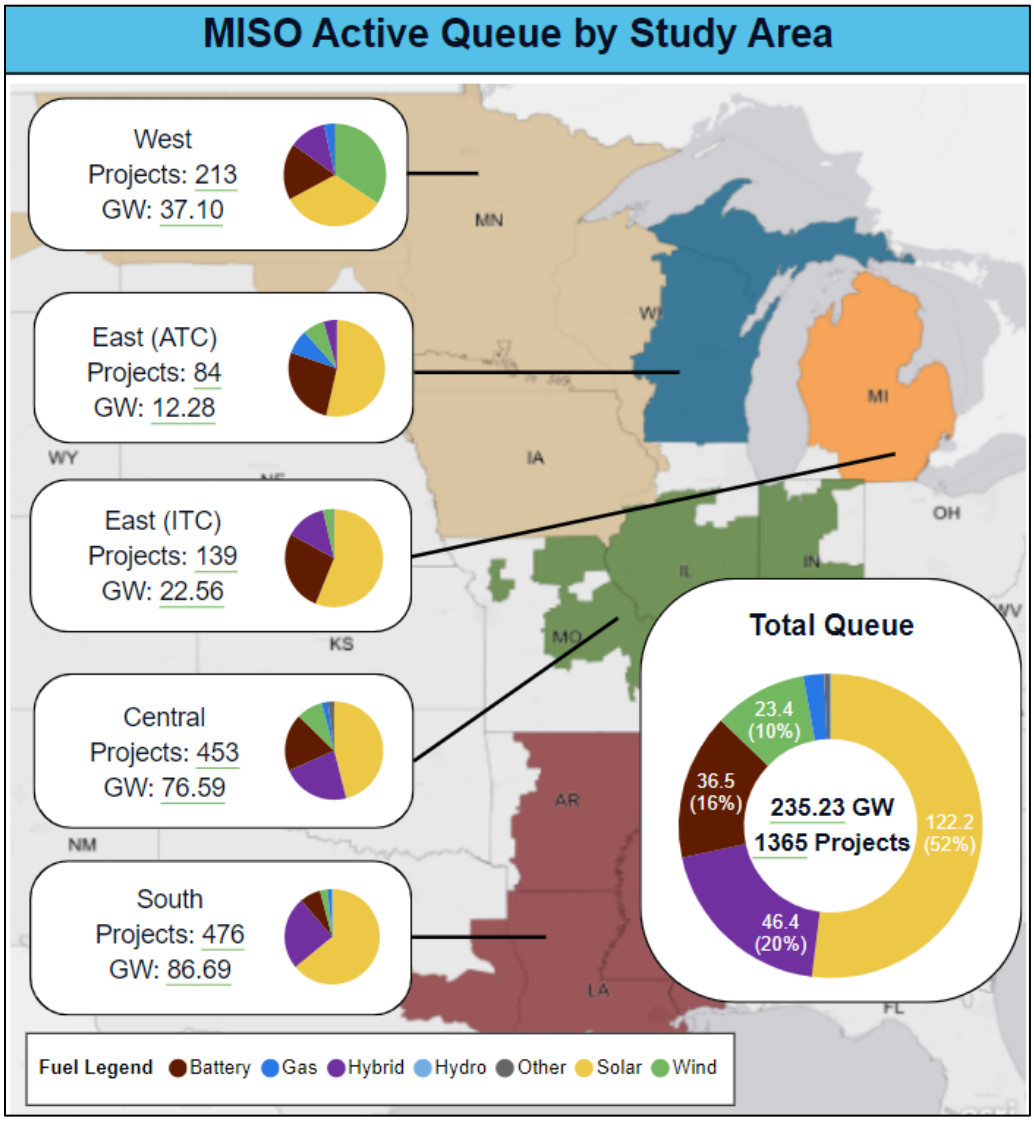

Figure 2.4-2: Active Generation Interconnection Queue by Fuel Type as of August 8 ,2023

Since the pandemic, a troubling new trend has emerged for generators that exit the queue with a GIA. Supply chain and regulatory issues have increased the time it takes for new generators to be built and reach commercial operations. As of August 2023, MISO has nearly 50 GW of new generators with a GIA and not yet online. MISO expects this number to increase to as much as 63 GW by end of 2023. Interconnection Customers and Transmission Owners report that supply chain issues on both the generator and transmission equipment are the main reason for the extended timelines. MISO will continue to track this trend and work with stakeholders on these issues, as this generation will be necessary to support potential resource adequacy shortfalls in the future.

MISO Seeking Additional Queue Reforms

MISO's queue process is constantly being assessed and refined to make improvements and has undergone eight substantive reforms since being instituted. These reforms have made the queue process quicker, more efficient, and less burdensome to our members. In fact, MISO has the shortest end-to-end queue time within our tariff among our peer RTOs and ISOs.

In March 2022 FERC approved MISO's last reform, which reduced the MISO queue timeline schedule from 505 days to either 373 or 463 days, depending on whether a Network Upgrade Facilities Study (NUFS) is conducted in parallel with or prior to the Generator Interconnection Agreement (GIA) negotiation and execution. In either case, the NUFS must be completed before interconnection takes place. Achieving these timelines is contingent upon MISO Transmission Owners completing their studies on time and our neighboring regions completing their Affected System Study (AFS) on schedule. To date, MISO and its TOs have been unsuccessful in meeting these timelines due to the sheer volume of requests in the queue.

In addition to implemented improvements, MISO is now tackling additional reforms to improve entry and exit into the queue to further streamline the GI process and MISO's need to bring new resources onto the system quickly. In May 2023, MISO introduced the need to pursue additional queue reforms in advance of the 2023 queue cycle. Without additional improvements, the 2023 queue cycle could well exceed the record 171 GW that entered the queue in 2022.

MISO continues to work with stakeholders on what rules should be adjusted and what the specifics of those rules should be. The current proposal before stakeholders is to increase the milestone payments needed to enter and stay in the queue, improve site control requirements around the point of interconnection, adjust the calculations around penalty free withdrawal, introduce a mandatory penalty schedule if a project withdraws, and introduce a cap on the size of each queue cycle. These new rules are expected to be filed with FERC within Q4 of 2023 and apply only to new queue submissions. MISO will not announce the 2023 queue submission deadline until after FERC's action on the future filing.

In addition to these future reforms, MISO is also reviewing the recent FERC Order 2023 to improve generator interconnection rules. Order 2023 will certainly improve the interconnection procedures in non-market areas of the United States that have yet to adopt cluster studies. MISO believes the Order does not go far enough, as most of the rules FERC adopted are ones that MISO already uses, but are not as prescriptive as MISO's Tariff. Because of this, MISO believes our additional queue reforms are still needed to further refine our requirements to ensure the efficient processing of the future requests.