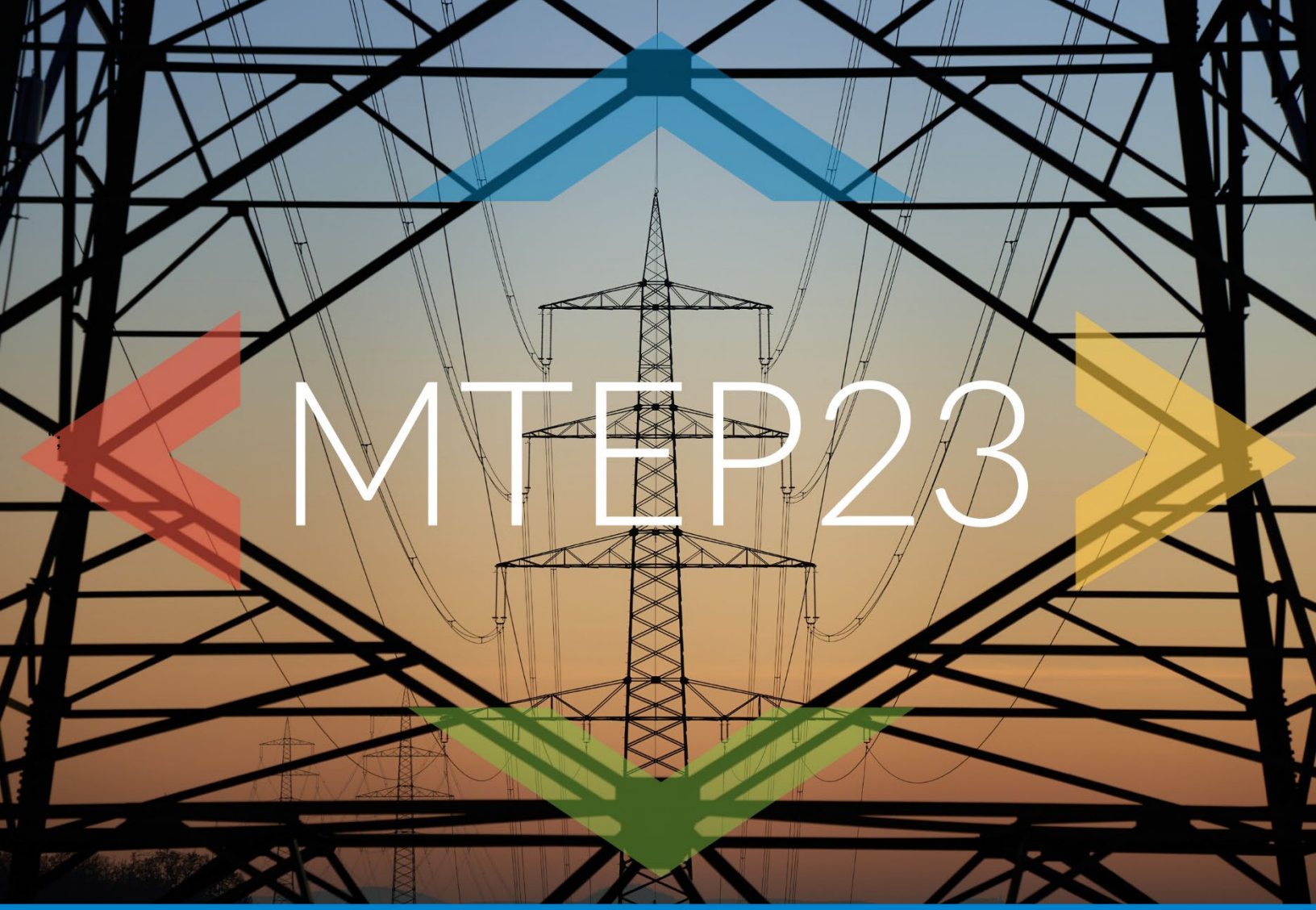



# MTEP23 REPORT

## Highlights

- 572 new projects with an estimated $9 billion investment
- $34 billion in projects constructed in the MISO region since 2003
- Grid evolution drove significant records in MTEP23

MISO

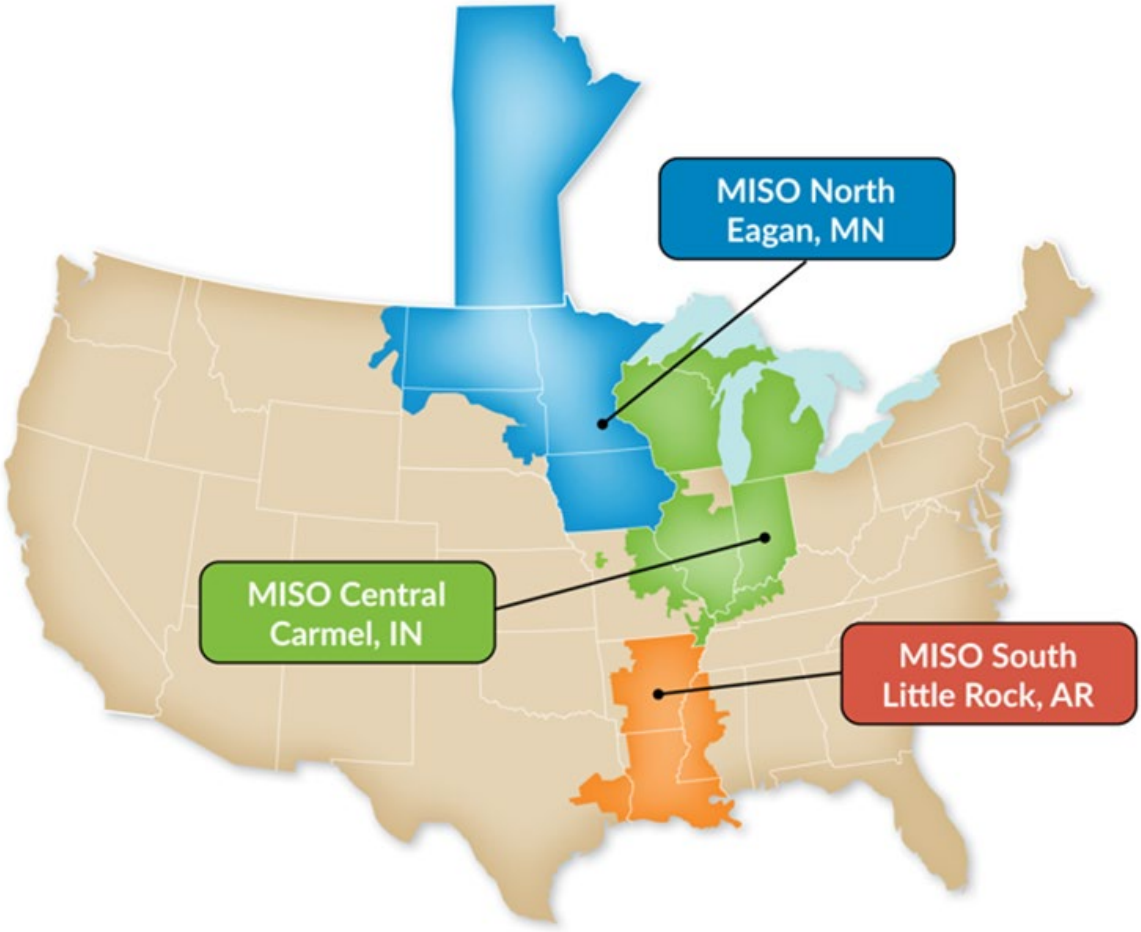
misoenergy.org

# MTEP23 Table of Contents

# About MISO

Midcontinent Independent System Operator (MISO) is an independent, 501(c)(4) not-for-profit, member-based organization, approved as a Regional Transmission Organization (RTO) by FERC in 2001, with responsibility for keeping the power flowing across its region reliably and cost effectively. The system MISO manages is the largest in North America based on geographical scope, with 471 market participants serving approximately 45 million people across all or part of 15 states and one Canadian province. The MISO energy markets are also among the largest in the world, with more than $40 billion in annual gross market charges.

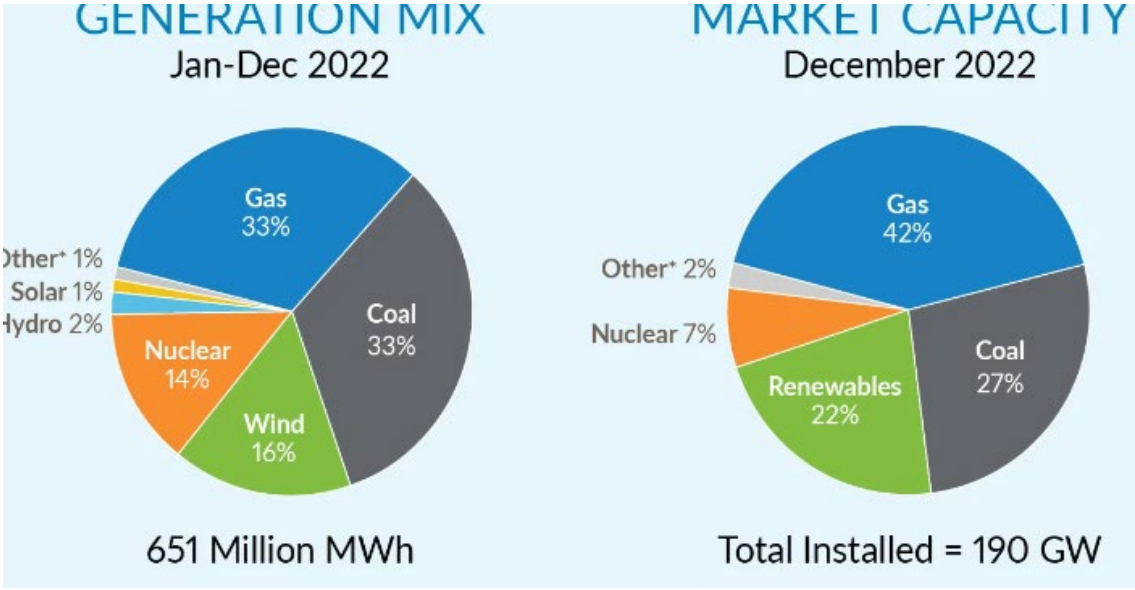
## MISO Reliability Footprint and Regional Control Center Locations



Currently, the MISO region contains nearly 75,000 miles of high-voltage transmission, as well as roughly 199,000 megawatts of electricity generating capacity. MISO does not own any of these assets. Instead, with the consent of our asset-owning members and in accordance with our FERC-approved tariff, MISO exercises functional control over the region's transmission and generation resources with the aim of managing them in the most reliable and cost-effective manner possible. The MISO region is predominantly comprised of traditionally structured, state-regulated utilities.

## KEY FACTS

| | |
|---|---|
| Area Served | 15 U.S. States and Manitoba, Canada |
| Population Served | 45 Million |
| Transmission Line** | 75,000 Miles |
| Generating Units* | 6,800+ |
| Record Demand | 127.1 GW 7/20/2011 |
| Wind Peak | 24.1 GW 11/30/2022 |
| Solar Peak | 2.2 GW 8/31/2022 |
| Members | 57 Transmission Owners<br>135 Non-transmission Owners |
| Market Participants | 500+ |
| Carbon Reduction | Approximately 32% since 2014 |




*Corporate data as of August 2023*
**Network Model*
***Market Footprint*

# CHAPTER 1: TRANSMISSION PLANNING OVERVIEW

## 1.1 Planning for the Future

Since MISO's articulation of the Reliability Imperative, its members have accelerated the rate of fleet change, demonstrating a need for a stronger, regionally coordinated transition plan. Flexible, thermal resources are retiring more rapidly than expected along with attributes which have historically helped to ensure reliability.

At the same time, regulations, policies and economics create an uncertain environment for the future of thermal generators. Potential future technologies that can provide flexible attributes, such as hydrogen, long-duration storage and small modular nuclear reactors, are not yet commercially available nor deployed at scale. The interconnection queue is predominantly weather-based resources, and resources with interconnection agreements are requesting delays of 36 months and more due to supply chain and regulatory issues, among others.

The MISO region needs a coordinated transition plan to ensure an orderly, efficient transition and the ability to manage the risks associated with a massive change in resources. At the same time, the region is facing an increase in the number and intensity of severe weather events, which further magnify the need to coordinate the transition.

During this time, MISO remains focused on working with states, regulators and stakeholders on the response to the Reliability Imperative, which is designed to:

- Ensure the totality of the resource portfolio can be operated reliably under all conditions;
- Enable the construction of appropriate transmission to integrate changing resources;
- Redesign the market to ensure proper signals are sent to all market participants to inform efficient investment and reliable operations; and
- Transform its systems and processes in anticipation of the regional needs.

### Resource Adequacy

While resource sufficiency was demonstrated through this year's Planning Resource Auction, the first conducted under the new seasonal construct, it was primarily achieved through resource decisions that are difficult to repeat. These include delayed resource retirements, new firm imports committed to MISO load, accreditation increases for wind resources, a lower Planning Reserve Margin Requirement, and decline in summer peak load.

Looking forward, there is a continued risk of resources retiring faster than replacement resources are able to come online due to supply chain delays and permitting constraints. Additionally, new, replacement resources will need to bring sufficient characteristics to balance the system. Further, additional work may be needed to ensure that future load estimates that apply to transmission planning and resource adequacy processes reflect actual load increases. And the concept of "resource adequacy" must be expanded to not only include capacity but also the various grid services that different technologies and resource types can bring to the system.

## Acceleration of the fleet transition

MISO continues to work with its members to better understand the future resource fleet and the pace at which this change will occur. Policy goals made in public announcements and Integrated Resource Plans, verified through interviews with member utilities, are reflected through MISO's most recent projection of the fleet transition, known as Future 2A (Figure 1.1-1). This Future, reflecting current trajectory of member carbon and renewable energy goals, is accordingly more ambitious than MISO's earlier Future 2. Significant growth in renewable generation (with subsequent modest growth in accredited capacity owing to lower capacity factors of wind and solar generators compared to legacy resources), retirements of thermal resources, and load growth owing to electrification are hallmarks of this new future. Some 250 GW (installed capacity) of resource additions, mostly renewable, are expected.

Put into perspective, MISO's interconnection queue process has historically added 2 to 2.5 GW installed capacity of resources to the system each year. To reach the buildout suggested in Future 2A, such additions to the system would require additions five to ten times that size each year over the course of twenty years. The approximately 50 GW of approved resources in the current queue, which have delayed commercial operation by an average of 650 days (owing primarily to supply chain, regulatory and contractor issues), suggest that existing approval processes and supply chains are already strained.

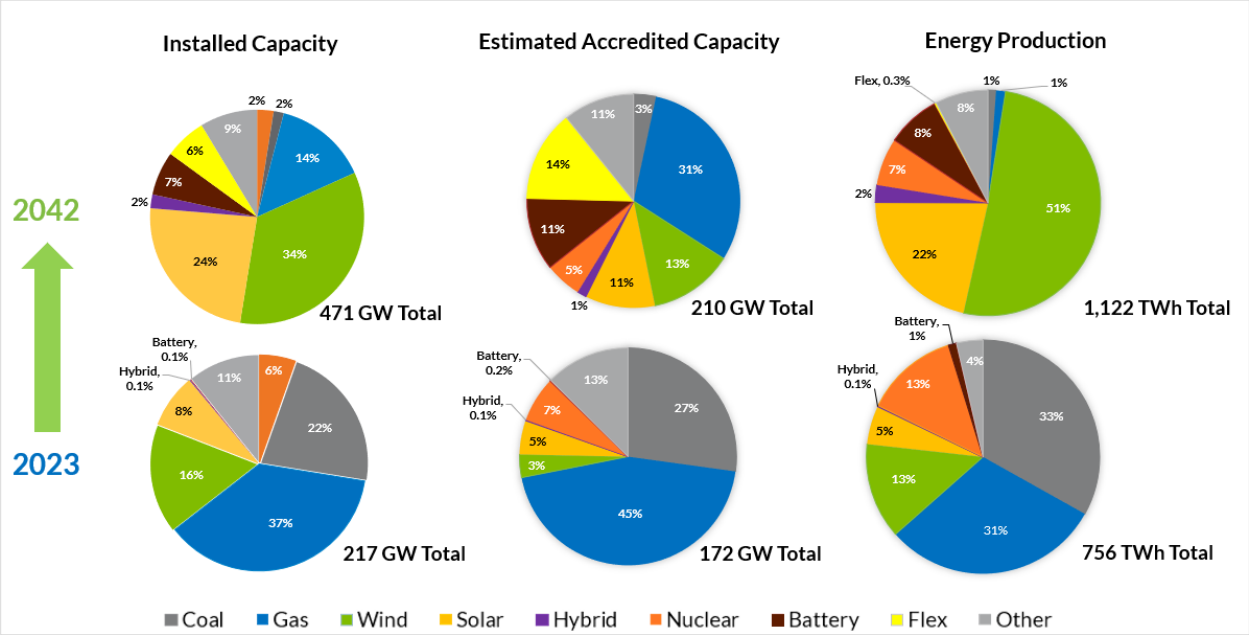



Figure 1.1-1: MISO's Future 2A anticipates significant renewable additions, controllable retirements and load growth.[1]

In addition to the magnitude of the resource shift, the timeline in which these changes are to be realized has shortened. Future 2A suggests that renewable penetration milestones will be achieved much sooner than initial estimates (Figure 1.1-2). MISO's earlier Renewable Integration Impact Assessment (RIIA) found that in annual energy penetrations above 30%, operational complexity dramatically increases and local reliability issues become more widespread as energy adequacy and system stability risks grow (see below.) Further adding to uncertainty are future load growth projections. For example, multiple load additions totaling 100+

[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.

MW have been submitted through the Expedited Review Process throughout MTEP23. An accelerated pace of change suggests that work to prepare for the implications must also hasten.

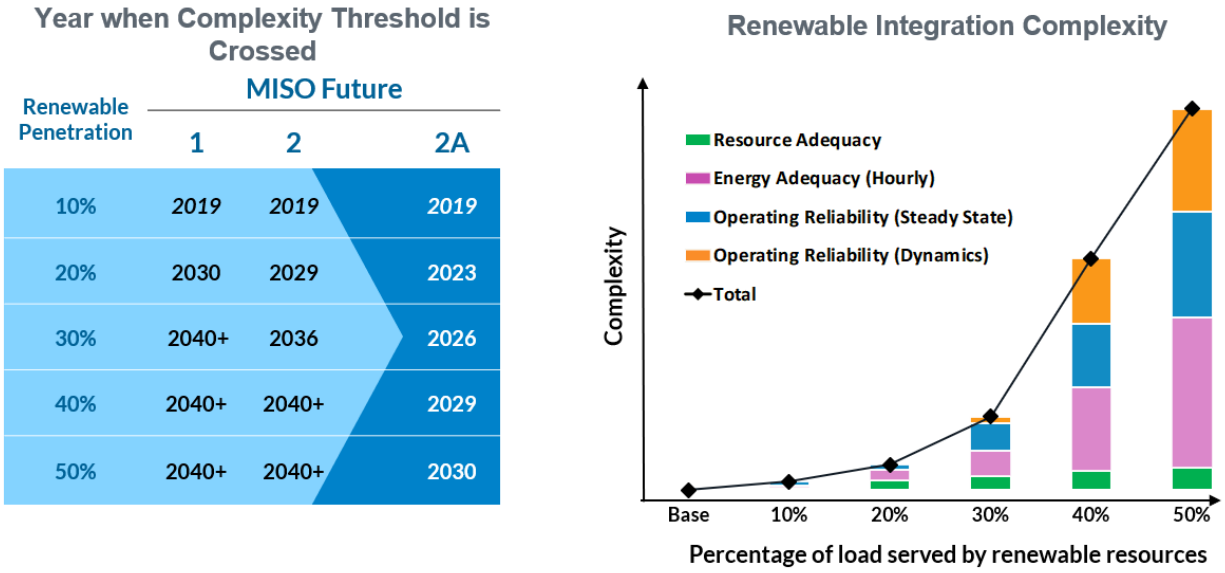



Figure 1.1-2: Reaching renewable penetration milestones more quickly than initial models implies greater system integration complexity earlier than anticipated. Left – MISO Future 2A shows renewable penetration milestones accelerated. Right – Renewable Integration Impact Assessment (RIIA) shows that as penetrations exceed 30%, integration complexity on the system dramatically increases.

## Energy Adequacy

Weather is impacting resources in ways not previously experienced, and energy adequacy is becoming a growing concern. Recent weather events, including Storms Uri, Elliott and this summer's heat, are increasingly frequent, and are having broader impacts on the fleet, often in the form of correlated outages. Wind output varies significantly between weather events, as it did between Winter Storms Uri and Elliott. Gas resources see numerous unplanned outages, as they did during Winter Storm Elliott, in which almost half of those reported were due to fuel supply or transportation issues. Load volatility has also proven to be an emerging issue as models without similar historic weather data can be prone to significant forecast errors, as occurred during Storm Elliott.

Results from the recent 2023 OMS-MISO Survey also point to ongoing energy adequacy concerns. The first survey, conducted on a seasonal basis following the implementation of the seasonal resource adequacy construct, showed a 1.5 GW capacity surplus for the 2024/25 planning year. However, like the Planning Resource Auction results, these gains were made by actions that will be difficult to replicate in the coming year. Additional resources with the necessary attributes and other changes – like market rules – are needed to avoid potential capacity shortfalls in the future.

Looking forward, significant growth in resources that are either variable or energy-limited in the MISO footprint, inaccuracies in long-term load forecasts along with changing weather impacts and operational practices, are shifting risk profiles in highly dynamic ways with implications to resource adequacy and system planning. Ongoing analysis and enhancements are critical to ensure that the resources with needed capability and attributes will be available during the highest risk periods across the year. It is in this context that the MTEP23 transmission planning efforts are undertaken to ensure a reliable and efficient system.

# 1.2 Planning Process

The MISO Transmission Expansion Plan (MTEP) report must identify and support development of cost-effective transmission infrastructure that is sufficiently robust to meet reliability needs, enable a competitive energy market, support policy goals, and allow for competition among transmission developers in the assignment of transmission projects. MTEP must be created through an inclusive, independent, open process which allows opportunities for stakeholders to participate and provide input on the transmission system. MISO works with its stakeholders and Board of Directors to adopt MISO's Planning Guiding Principles. The most recent Principles, which were reviewed and approved by the Board of Directors in June 2023, are shown below in Figure 1.2-1.

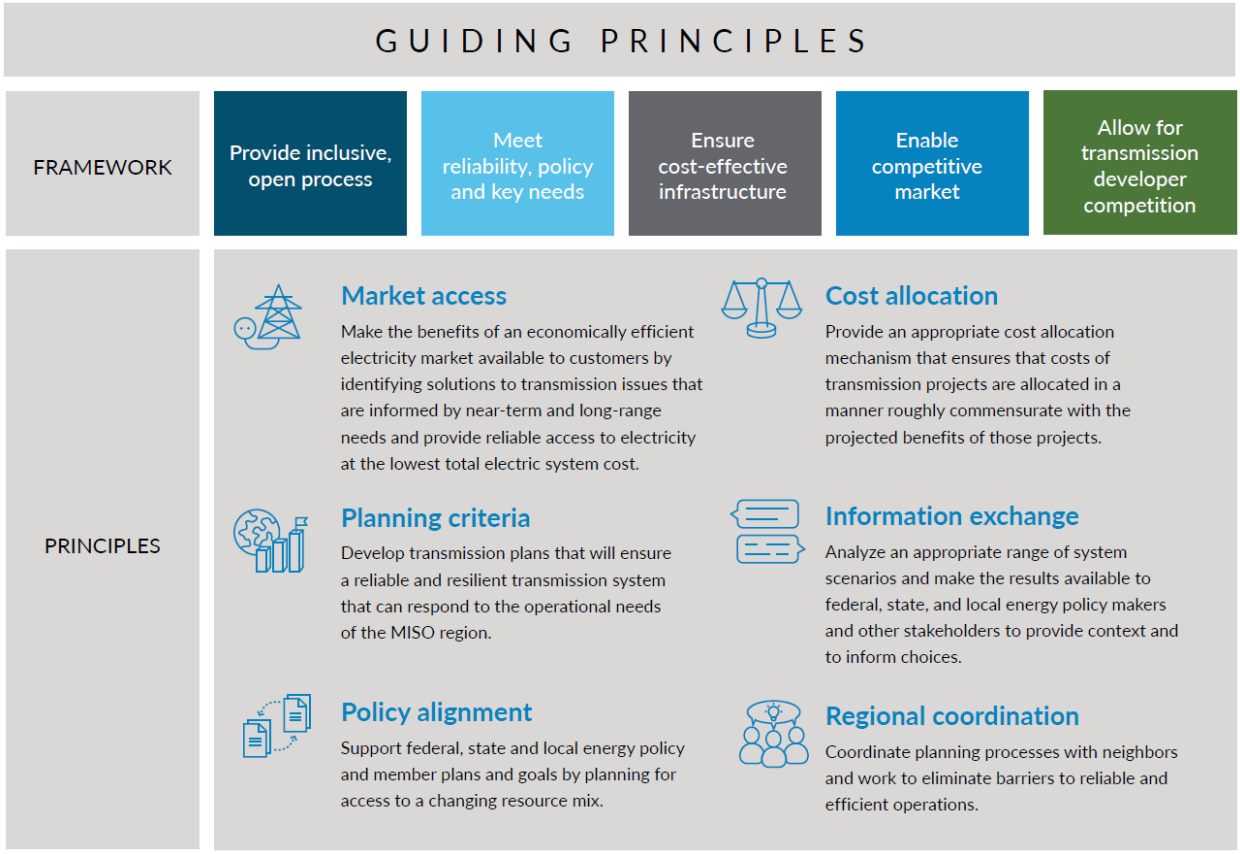



Figure 1.2-1: MISO's Planning Guiding Principles (as adopted June 2023) are shaped by state and federal policy, stakeholder needs and cost efficiency targets.

## System Planning

These principles are enacted through MISO's value-based planning approach (Figure 1.2-2), which ensures that local needs are integrated with regional requirements. Its processes consider a range of issues and viewpoints, including analyzing:

- For **local planning,** review and provide transparency on member plans, evaluate system against reliability standards, consider alternatives and verify needs as applicable

- The long-term, broader system needs through MISO's **regional planning** processes, including its Long Range Transmission Planning efforts
- The impact of policies on the transmission system and resource mix in **policy studies**
- System changes needed to accommodate new resources in **resource planning, and**
- Planning issues shared with its neighbors in **interregional planning**

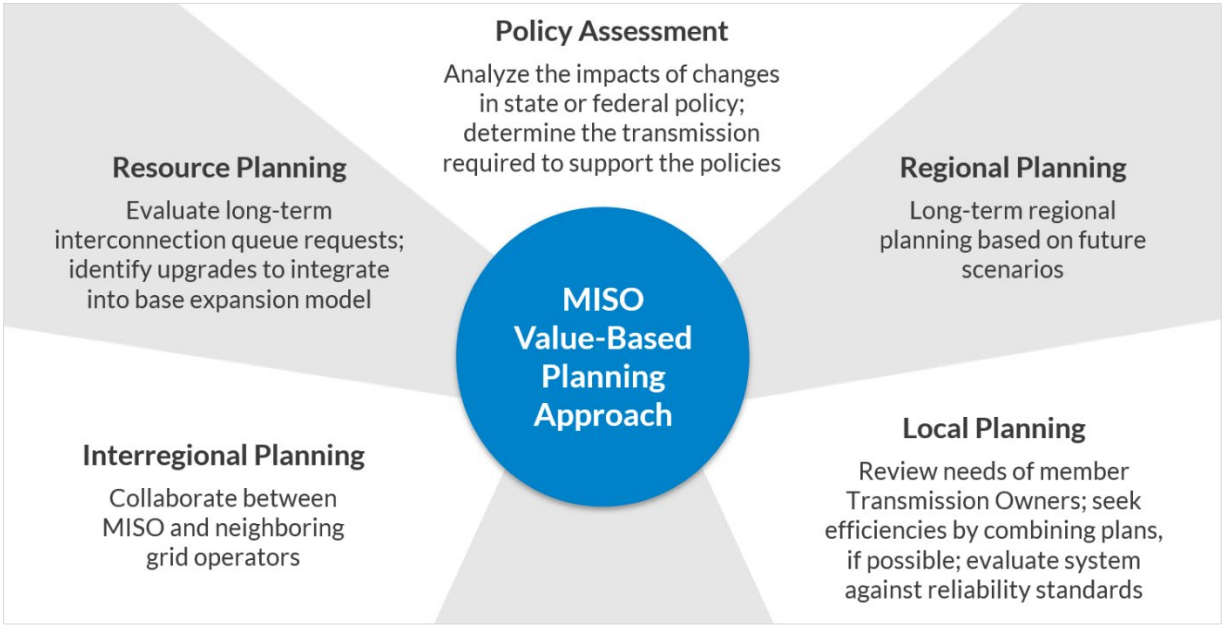



Figure 1.2-2: MISO's Value-Based Planning Approach

MISO's various planning approaches cannot operate independently of each other. The goal of the transmission planning process is to identify a least-regrets outcome that meets its member plans, provides reliable power delivery, and appropriately balances local versus regional solutions to ensure a cost-effective outcome for customers.

MISO's comprehensive planning process spans short to long term horizons depending on study objectives and need drivers (see Figure 1.2-3). The process encompasses multiple planning functions that address different timelines and aspects of transmission and resource planning. Each process informs the others to cover the entire planning horizon.


Figure 1.2-3: MISO Value-Based Planning Approach Study Horizons

## Transmission Planning & Coordinated Process

MISO develops this annual regional expansion plan, which is known as the MISO Transmission Expansion Plan ("MTEP"), based on expected use patterns and analysis of the performance of the Transmission System in meeting both reliability needs and the needs of the competitive bulk power market, under a wide variety of contingency conditions. MISO uses both a near-term and long-term planning horizon in its processes with the near-term planning horizon (i.e., less than 10 years) mainly focused on local reliability planning, while the long-term planning horizon (i.e., up to 20 years) is focused on broader regional planning. This recommended plan is then subjected to stakeholder scrutiny and feedback to refine it further before it is eventually presented to the MISO Board of Directors ("MISO Board") for review and approval.

MISO strategically set up our local planning processes to assume FERC Order 890 transparency requirements for Transmission Owner submissions, with MISO's role ranging from alternative assessment, need validation, no-harm tests and/or transparency depending on the project submissions. MISO's transmission planning rules are set forth in Attachment FF of the Tariff, which contains MISO's transmission expansion planning protocol, and Appendix B of the MISO Agreement, which contains MISO's planning framework. In addition, MISO maintains a Business Practices Manual ("BPM") that covers the transmission expansion planning processes, which is known as BPM-020, including the study approaches applied by MISO. Finally, some of MISO's local planning approach is driven by North American Electric Reliability Corporation (NERC) reliability standards and reliability standards adopted by Regional Reliability Organizations integrated as part of MISO's role as a Planning Coordinator.

## Project Input and Stakeholder Coordination

The planning process, in conjunction with an inclusive, transparent stakeholder process, must identify and support development of a sufficiently robust transmission infrastructure to meet local and regional reliability standards as well as enable competition among wholesale capacity and energy suppliers. Each planning cycle commences with regional model development (see Figure 1.2-4 for MISO footprint planning

regions); identification of potential expansions from the local planning processes of the Transmission Owners; identification of transmission issues driven by reliability (e.g., NERC criteria), economic, and public policy requirements; and identification by stakeholders or MISO staff of potential expansions that address the transmission issues. Each cycle concludes with recommendations to the MISO Board of Directors of recommended solutions to the transmission issues evaluated.

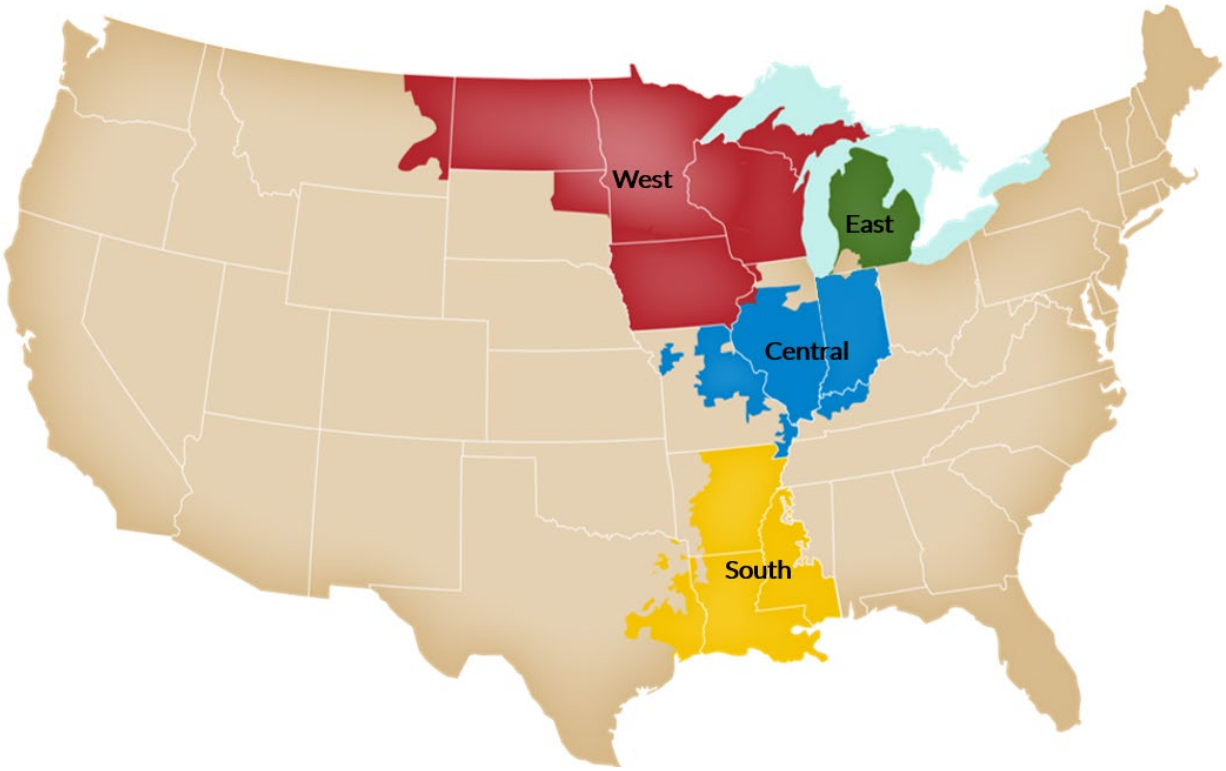



Figure 1.2-4: MISO footprint planning regions

Transmission Owner plans developed through local planning processes are included in the beginning of each regional planning cycle as potential solutions to local transmission issues identified by the Transmission Owners to meet the FERC Order 890 transparency requirements.

MISO's regional planning process makes evaluations — with stakeholder input from the Sub-regional Planning Meetings, the Planning Subcommittee, and the Planning Advisory Committee — throughout the cycle to develop expansion plans to meet the needs of the system. This multi-party collaborative process allows analysis of all projects with regional and inter-regional impact for their combined effects on the Transmission System. Moreover, the design of this collaborative process ensures that the MTEP addresses transmission issues within the applicable planning horizon in an efficient and cost-effective manner, while considering the input of stakeholders.

These various planning functions occur at different times and begin the year before an MTEP report is finalized (see Figure 1.2-5). For example, assessments of generator interconnection and retirements occur on a continuous basis. Others repeat on a regular cycle, but the actual MTEP report is produced once every 12 months. Each MTEP cycle's scope definition actually begins in the summer of the prior year. The months of in-depth research and analysis, combined with many interactions between various work streams and stakeholders culminates in Appendix A.

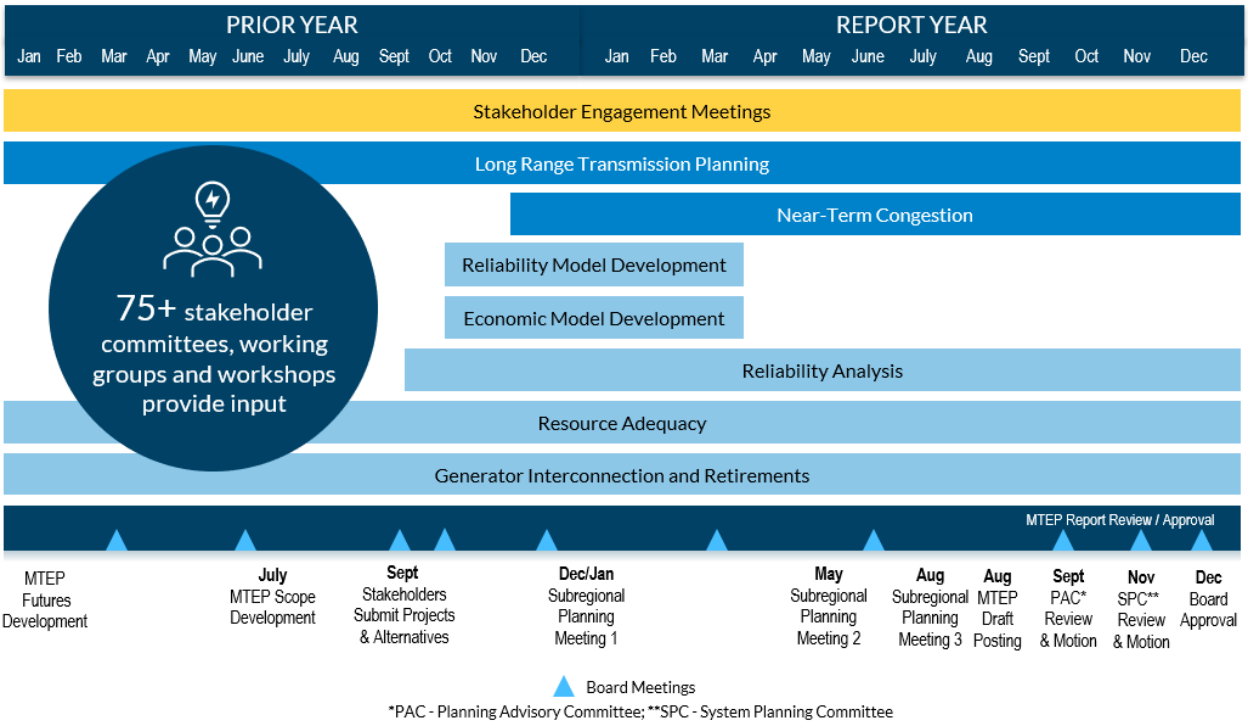



Figure 1.2-5: Typical MTEP cycle is developed in overlapping cycles and delivered annually

## Planning Analysis Methods

Planning analyses performed by MISO test the transmission system under a wide variety of conditions using standard industry applications to model key items, such as steady state power flow, voltage stability, and economic parameters, as determined appropriate by MISO to be compliant with applicable criteria and the Tariff. MISO collaborates with Transmission Owners, other transmission providers, transmission customers, and other stakeholders to develop appropriate planning models that reflect expected system conditions for the planning horizon. The local reliability planning process relies on known and committed inputs into the process, while the long-term planning process considers projected inputs (Figure 1.2-6).


Figure. 1.2-6: Summary of inputs into reliability and long-term planning processes

Models are available to stakeholders with security measures as provided for in the Transmission Planning Business Practices Manual. MISO provides the opportunity for stakeholders to review and comment on the posted models before commencing planning studies.

MISO's review of projects varies depending on project drivers, system needs, opportunities for alternatives, and other factors. Specific to local planning MISO may verify the need, complete a no-harm analysis, or post information for stakeholders.

- **Verify need**: Confirmation of system need identified in project submission, including to meet compliance with applicable National Electric Reliability Organization reliability standards and reliability standards adopted by Regional Reliability Organizations, and applicable within the Transmission Provider Region. MISO must verify the need for alternatives to adequately examine their effectiveness.
- **No harm**: Ensure a submitted project does not create a system issue. Includes projects that create model changes like contingency definitions, line ratings, or line impedances.
- **Post only**: Provided for FERC Order 890 transparency provisions. May include controls equipment to communicate remotely with the facility. This information is not able to be represented with model changes.

Additionally, alternative assessments for projects may be completed by Transmission Owners prior to project submission to MISO, proposed by MISO, or proposed through stakeholder submissions. In MTEP23, MISO identified and evaluated alternatives for facilities that are larger in cost and/or have higher potential impact on the system; staff also evaluates alternatives provided by stakeholders. For example, projects that propose new lines are prioritized for analysis because MISO's experience shows that addressing existing infrastructure is typically a more cost-effective investment than building new lines. Alternatives would be assessed in this situation to ensure that the additional benefits justify the potential higher cost. Some of the criteria to select an alternative considers cost comparisons, feasibility to construct and how reliability needs are resolved. Alternatives do not always result in one project replacing another, but instead tend to be additive to the original project, even when submitted with the thought that they would directly compete. MISO considers alternatives in multiple forms, including like-for-like replacement, regional reliability projects, the combination of multiple local solutions, and other options identified through either MISO analysis or submitted by stakeholders.

## Long Range Transmission Planning

Long Range Transmission Planning (LRTP) is an essential element of planning the regional grid to be reliable and efficient with a focus on the long-term (i.e., 20 years) planning horizon. LRTP efforts are launched periodically when needed to address significant changes to future conditions that the grid must be prepared to address. Long Range Transmission Planning results in projects that are regional backbone facilities needed to move bulk power between geographically dispersed areas within MISO. While they provide for a reliable and efficient grid based on forecasted resource developments, they are not intended to resolve all connection issues associated with precise siting of future generation or load.

Long Range Transmission Planning follows MISO's well-established seven-step value-based planning process and is part of MISO's overall MTEP process. Outlined below are the high-level descriptions of each step:

1. **Develop Future Scenarios** – develop scenario-based Futures with resource forecast and siting
2. **Develop Resource Plan and Site Future Resources** – development of planning models utilizing Futures
3. **Identify Transmission Issues** – identify potential transmission issues
4. **Integrated Transmission Development** – proposals for solutions to issues
5. **Transmission Solution Evaluation** – evaluate the effectiveness of various solutions
6. **Project Recommendation and Justification** – recommend preferred solutions for MTEP implementation
7. **Project Cost Allocation** – apply appropriate cost allocation

MISO is working to identify potential grid needs in support of the resource transformation underway and as contemplated under our member's resource plans and defined in the MISO Futures. This extensive stakeholder process includes regularly scheduled workshops, periodic discussions at the Planning Advisory Committee, plus additional stakeholder meetings addressing cost allocation through the Regional Expansion Criteria and Benefits Working Group. Project recommendations resulting from this process will then be presented for Board of Director review and approval over several MTEP cycles as analyses proceed and recommendations are developed.

Details of MISO's Long Range Transmission Planning study progress are summarized in Section 3.1 of the MTEP23 Report.

## Project Types and Approval

MTEP Appendix A projects are vetted by MISO through the planning process and project types are determined by criteria in MISO's Tariff. Below is an overview of Tariff-defined project types[2]:

- **Baseline Reliability Project (BRP) -** Projects are Network Upgrades identified in the base case as required to ensure that the Transmission System is in compliance with applicable National Electric Reliability Organization reliability standards and reliability standards adopted by Regional Reliability Organizations, and applicable within the Transmission Provider Region. Baseline Reliability Project costs are allocated to the local Transmission Pricing Zone(s) and recovered through Attachment O by the Transmission Owner(s) developing the projects.
- **Generator Interconnection Project (GIP) -** Projects are New Transmission Access Projects that are associated with interconnection of new generation or the capacity modification of existing generation. Costs are primarily paid for by the interconnection customers with certain exceptions as specified in Attachment FF. Costs of network upgrades rated at 345 kV and above are eligible for 10 percent cost recovery from load on a system-wide basis.

[2] Additional details on project types are in Section 2.3.1 of the Business Practice Manual.

- **Market Efficiency Project (MEP)** - Projects meet Attachment FF requirements for reduction in market congestion and are eligible for regional cost allocation. Projects qualify as Market Efficiency Projects based on cost and voltage thresholds and are developed to produce a benefit-to-cost ratio of 1.25 or greater. Costs are distributed to benefiting pricing zones, in accordance with Attachment FF of the Tariff.

- **Market Participant Funded Project (MPFP)** - Projects are defined as Network Upgrades fully funded by one or more market participants but owned and operated by a Transmission Owner.

- **Multi-Value Project (MVP)** - Projects meet Attachment FF requirements to provide regional or sub-regional public policy, economic and/or reliability benefits. Costs are shared with loads and export transactions in proportion to energy withdrawals or export schedules.

- **Other** - Projects to address local reliability issues and/or provide local economic benefit, which do not qualify as Baseline Reliability Projects, New Transmission Access Projects, Targeted Market Efficiency Projects, Market Efficiency Projects, or Multi-Value Projects. Project costs are allocated to the local Transmission Pricing Zone(s) and recovered through Attachment O by the Transmission Owner(s) developing the projects.

- **Targeted Market Efficiency Project (TMEP) -** Projects are designed to alleviate historical market-to-market congestion between MISO and PJM Interconnection, while meeting certain cost and construction requirements. The costs of Targeted Market Efficiency Projects are allocated first between MISO and PJM Interconnection by the ratio of each RTO's Day-Ahead and Excess Congestion Fund congestion, offset by historical market-to-market payments. The MISO share of costs for the project is then allocated to beneficiaries using historical nodal load congestion contribution data.

- **Transmission Delivery Service Project (TDSP) -** Projects are required to satisfy a transmission service request. The costs are generally assigned to the requestor.

MISO staff formally recommends a set of projects to the MISO Board of Directors for review and approval after all projects have been posted for transparency. MISO has completed its independent review of proposed projects for need or no-harm as applicable, and staff has addressed any stakeholder feedback received. These projects make up Appendix A of the MTEP report and represent the preferred solutions to the identified transmission needs of the MISO transmission planning process.

Proposed transmission upgrades with sufficient lead times are included in Appendix B for further review in future planning cycles.

## Interregional Coordination and Planning Studies

On an annual basis MISO works with the neighboring transmission planning regions, Southwest Power Pool (SPP) and PJM Interconnection (PJM), to identify issues on the seams, perform studies, and jointly evaluate transmission solutions that may be more efficient or cost effective than a corresponding regional solution. While MISO has a separate Joint Operating Agreement (JOA) with both SPP and PJM that details specific processes and criteria, the high-level interregional coordination activities are similar on each seam:

1) Exchange modeling data and other system information (typically performed in Q4).
2) Review identified issues on the seam (typically performed in Q1).
3) Evaluate whether to perform an interregional study based on the identified issues.

MISO performs joint coordinated system plan (CSP) studies with SPP and PJM on a regular basis, in accordance with the timelines and frequencies dictated in their respective JOAs. A CSP study may have a targeted scope or a more complex scope requiring a longer study period, and can include reliability, economic and/or public policy issues. All interregional issues and CSP study efforts are coordinated through a public Interregional Planning Stakeholder Advisory Committee (ISPAC) consisting of representatives and interested parties from each RTO community.

In addition to the joint study efforts with SPP and PJM, MISO performs studies as needed with neighboring entities of the Southeastern Regional Transmission Planning (SERTP) group and the Independent Electricity System Operator of Ontario (IESO). While the study process is less formal, MISO and these entities still meet regularly to review interregional issues and possible areas of collaboration.

Details on planning procedures, on-going studies and stakeholder meetings can be found on the Interregional Coordination page of the MISO public website (misoenergy.org).

## New Planning Portal

In October 2023, MISO will deploy a new MTEP Project Portal that will be accessed through the Help Center. This will replace the current Project Portal, accessed through the Market Portal. This new portal will provide a robust user-friendly experience that will support the submission and management of MTEP projects throughout their lifecycle while enabling the integration capabilities for future MISO technologies (see Figure 1.2-7 for a list of enhancements).

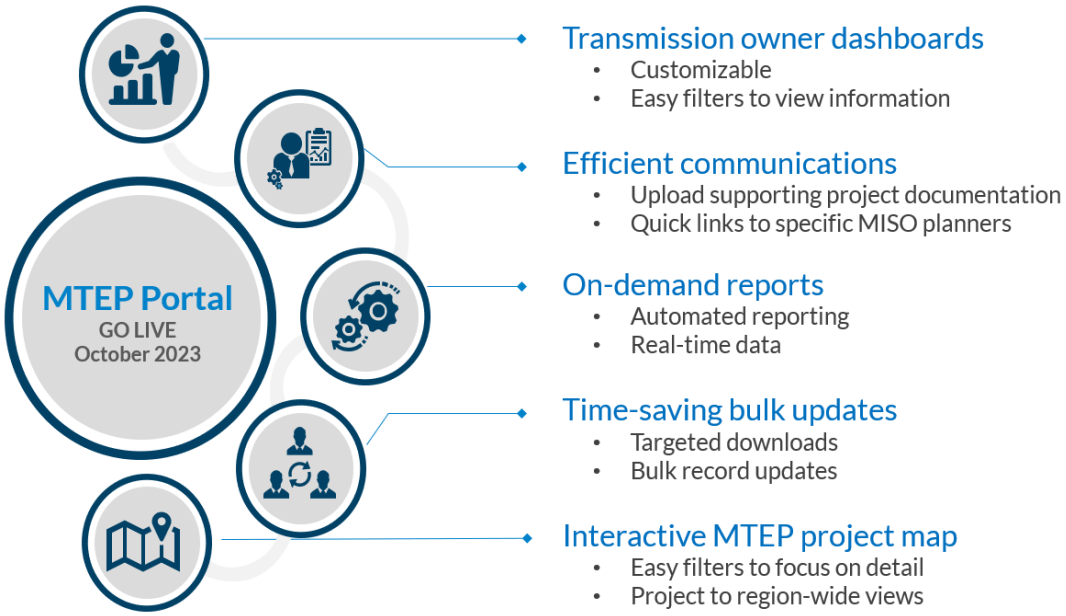



Figure. 1.2-7: Enhancements coming soon with the new MTEP Planning Portal

# 1.3 Historical Background

## MISO Transmission Infrastructure Investment

This iteration of the MTEP report, MTEP23, builds and expands on the 19 prior years of projects since 2003 totaling over $58 billion of investment in the United States (Figure 1.3-1). MISO's proposed new projects for this MTEP cycle would add an additional estimated $9 billion and are detailed in Section 1.4, Chapter 4, and Appendix A of this report.

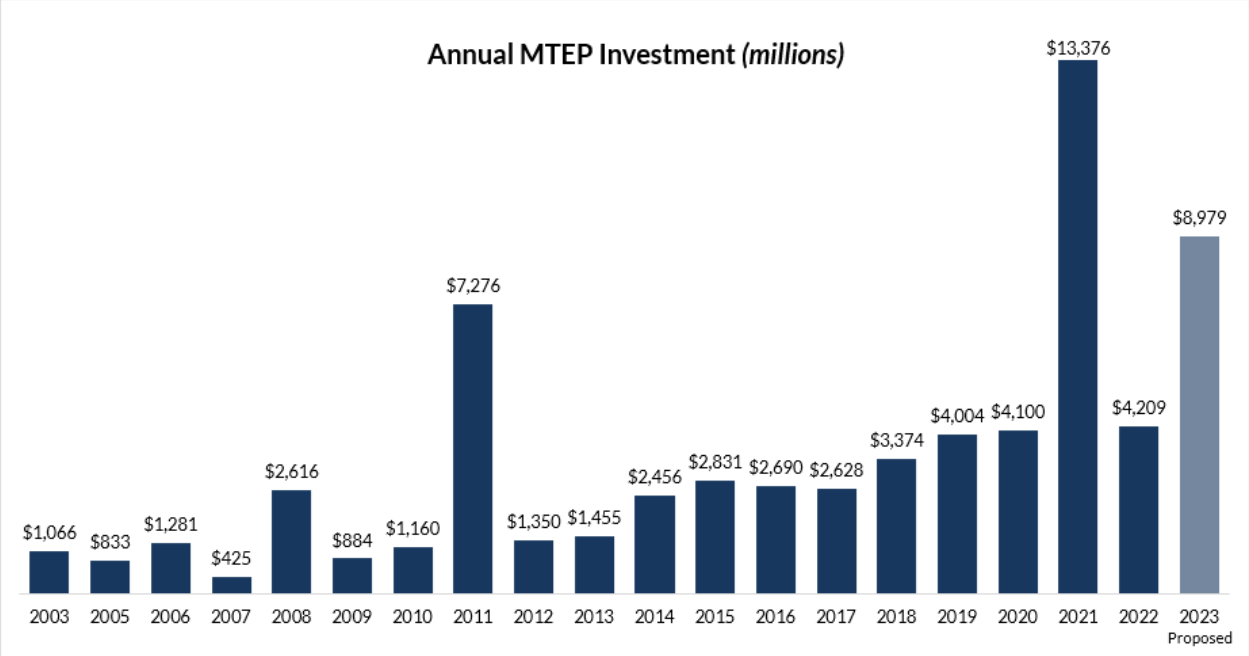



Figure 1.3-1: MTEP annual investment

Highlights in prior MTEP cycles include:

- MTEP11 reflects the approval of the Multi-Value Project portfolio, which accounts for the significantly higher investment totals compared to other MTEPs.
- MTEP14 reflects the inclusion of the new MISO South region projects.
- MTEP21 reflects the MTEP21 Addendum approval of the LRTP Tranche 1 portfolio, which accounts for $10.3 billion of the total.

MISO's transmission planning responsibilities include the monitoring of previously approved Appendix A projects. MISO surveys all Transmission Owners and Selected Developers every quarter to determine the progress of each project. These status updates are reported to the MISO Board of Directors and posted quarterly to the MISO Transmission Expansion Plan page at misoenergy.org[3].

## MTEP Approved Projects Status

Since MTEP03, over $34 billion of investment has gone into service and nearly $24 billion of approved projects are yet to be fully placed into service (Figure 1.3-2).

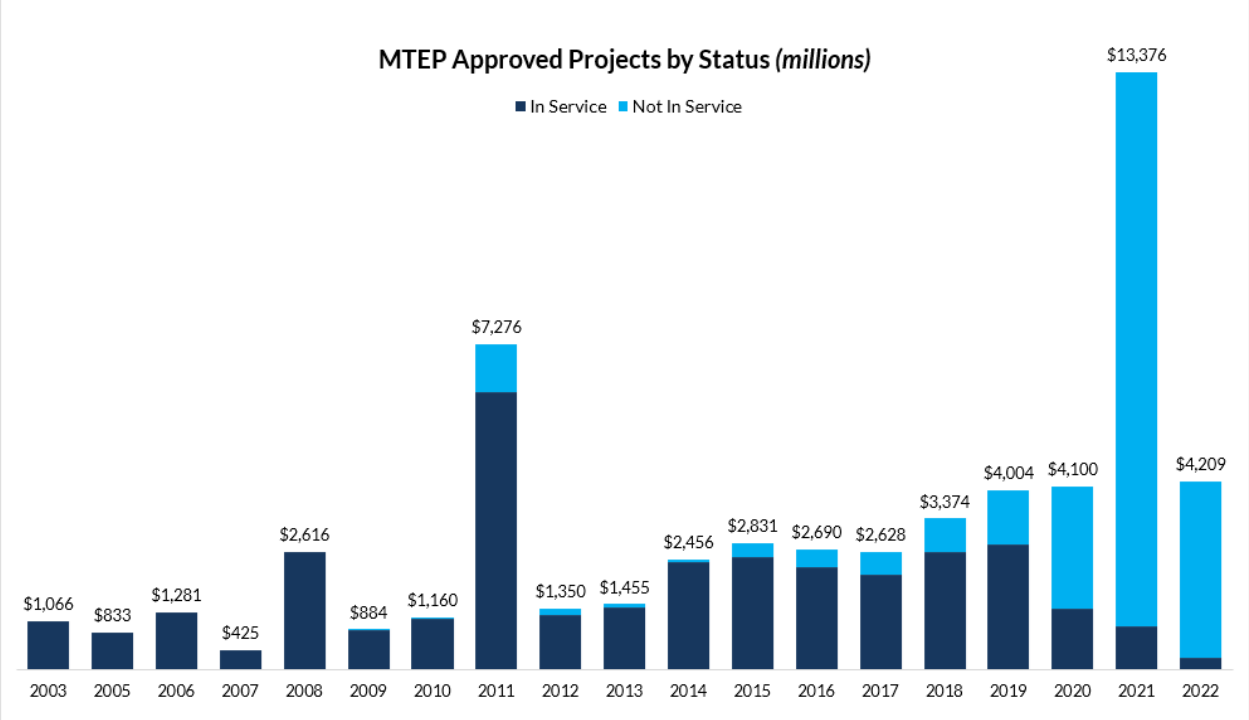



Figure 1.3-2: Appendix A project status (excluding withdrawn)

## LRTP Investment Status – Tranche 1

The $13.4 billion investment in MTEP21 as shown above was the result of MISO approval of Tranche 1 of its Long Range Transmission Planning Study comprised at an estimated cost of $10.3B (2022$). Table 1.3-1 reflects those 18 approved projects as of October 2023. Going forward, as engineering and construction plans are finalized and applicable regulatory proceedings complete, MISO anticipates receiving more substantive quarterly project updates from the constructing Transmission Owners, including updates on project cost and in-service dates. Transmission Owners will continue to provide quarterly project updates until the project is placed into service.

[3] MISO Transmission Expansion Plan website address: https://www.misoenergy.org/planning/planning/

| MVP No. | Project Name | State | Estimated in Service Date | | Status | | Cost | | Explanation |
|---|---|---|---|---|---|---|---|---|---|
| | | | MTEP Approved | Current Date | State Regulatory Status | Construction | MTEP Approved ($M) | Current Cost ($M) | |
| 1 | Jamestown - Ellendale | ND | 12/31/2028 | 12/31/2028 | ○ | | $439 | $439 | |
| 2 | Big Stone South - Alexandria - Cassie's Crossing | SD/MN | 6/1/2030 | 6/1/2030 | ◐ ○ | | $574 | $574 | |
| 3 | Iron Range - Benton County - Cassie's Crossing | MN | 6/1/2030 | 6/1/2030 | | | $970 | $970 | |
| 4 | Wilmarth - North Rochester - Tremval | MN/WI | 6/1/2028 | 6/1/2028 | ○ | | $689 | $689 | |
| 5 | Tremval - Eau Clair - Jump River | WI | 6/1/2028 | 6/1/2028 | ○ | | $505 | $505 | |
| 6 | Tremval - Rocky Run - Columbia | WI | 6/1/2029 | 6/1/2029 | ○ | | $1,050 | $1,050 | |
| 7 | Webster - Franklin - Marshalltown - Morgan Valley | IA | 12/31/2028 | 12/31/2028 | ○ | | $755 | $755 | |
| 8 | Beverly - Sub 92 | IA | 12/31/2028 | 12/31/2028 | ○ | | $231 | $231 | |
| 9 | Orient - Denny - Fairport | IA/MO | 6/1/2030 | 6/1/2030 | ○ | | $390 | $390 | |
| 10 | Denny - Zachary - Thomas Hill - Maywood | MO | 6/1/2030 | 6/1/2030 | ○ | | $769 | $769 | |
| 11 | Maywood - Meredosia | MO/IL | 6/1/2028 | 6/1/2028 | ○ | | $301 | $301 | |
| 12 | Madison - Ottumwa - Skunk River | IA | 6/1/2029 | 6/1/2029 | ○ | | $673 | $673 | |
| 13 | Skunk River - Ipava | IA/IL | 12/31/2029 | 12/31/2029 | ○ | | $594 | $594 | |
| 14 | Ipava - Maple Ridge - Razewell - Brokaw - Paxton East | IL | 6/1/2028 | 6/1/2028 | ○ | | $572 | $572 | |
| 15 | Sidney - Paxson East - Filman South - Morrison Ditch | IL | 6/1/2029 | 6/1/2029 | ○ | | $454 | $454 | |
| 16 | Morrison Ditch - reynolds - Burr Oak - Leeburg - Hiple | IL/IN | 6/1/2029 | 6/1/2029 | ○ | | $261 | $261 | |
| 17 | Hiple - Duck Lake | IN/MI | 6/1/2030 | 6/1/2030 | ○ | | $696 | $696 | |
| 18 | Oneida - Nelson Rd. | MI | 12/31/2029 | 12/31/2029 | ○ | | $403 | $403 | |
| | | | | | | Total | $10,324 | $10,324 | |

| State Regulatory Status Indictor Scale | | |
|---|---|---|
| ○ Pending | ◐ In regulatory process or partially complete | ● Regulatory process complete or no regulatory process requirements |

Table 1.3-1: LRTP Tranche 1 approved project status dashboard as of Oct. 2023.

## Future Line Miles Appendix A Projects

Spanning from 2023 -2030, there are approximately 6,250 circuit-miles of planned new or upgraded transmission lines projected in Appendix A (Figure 1.3-3).

- 3,915 circuit-miles of upgraded transmission line on existing corridors are planned of which 59% are ≤230 kV and 41% are ≥345 kV.
- 2,335 circuit-miles of new transmission line on new corridors are planned of which 37% are ≤230 kV and 63% are ≥345 kV.

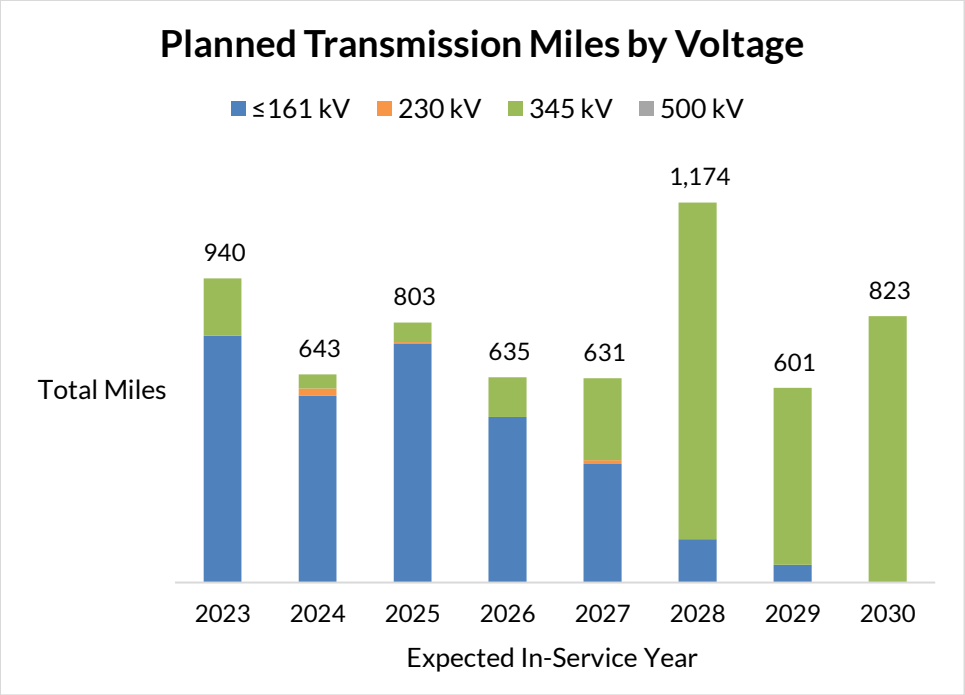



Figure 1.3-3: Active, not yet in-service, project circuit line miles by voltage and expected in-service year.

## Existing Line Miles Summary

MISO has approximately 75,000 circuit-miles of transferred functional control transmission lines serving as the backbone of the footprint (Figure 1.3-4) in the United States. Currently, the West region holds 45% of total footprint line miles, the South region holds 22%, the Central region holds 20%, and the East holds 13%.

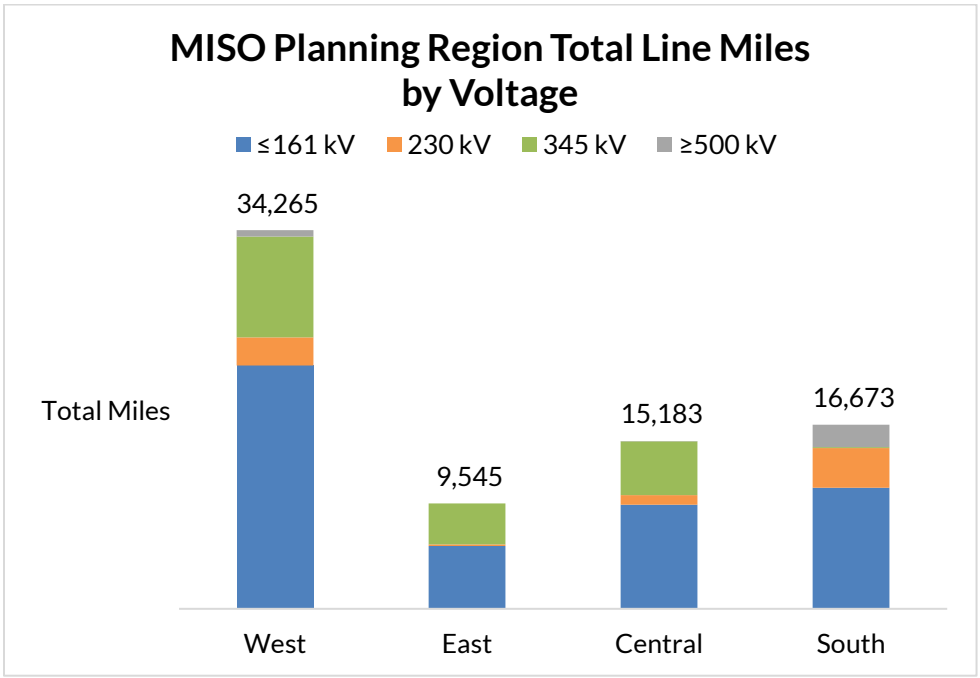



Figure 1.3-4: 2023 in-service transferred circuit miles by voltage class

## Transmission Facility Investment

Of the over $58 billion total investment that remains active or in-service, $29 billion of that investment, or 50%, has occurred in the last five MTEP cycles. In the first 13 MTEP cycles, the predominant investment was in new line assets at 53% or $15.3B. There was a shift in investment in the last 6 cycles (MTEP17-MTEP22), including the approval of the Tranche 1 portfolio of projects, with the leading investments in substation (38%) and line upgrades (35%), and new lines only representing 27% of the total investment. Looking back in total (MTEP03-MTEP22), Figure 1.3-5 below reflects the current asset investments at substations representing 34%, new lines at 39% and line upgrades at 27% of the total investment.

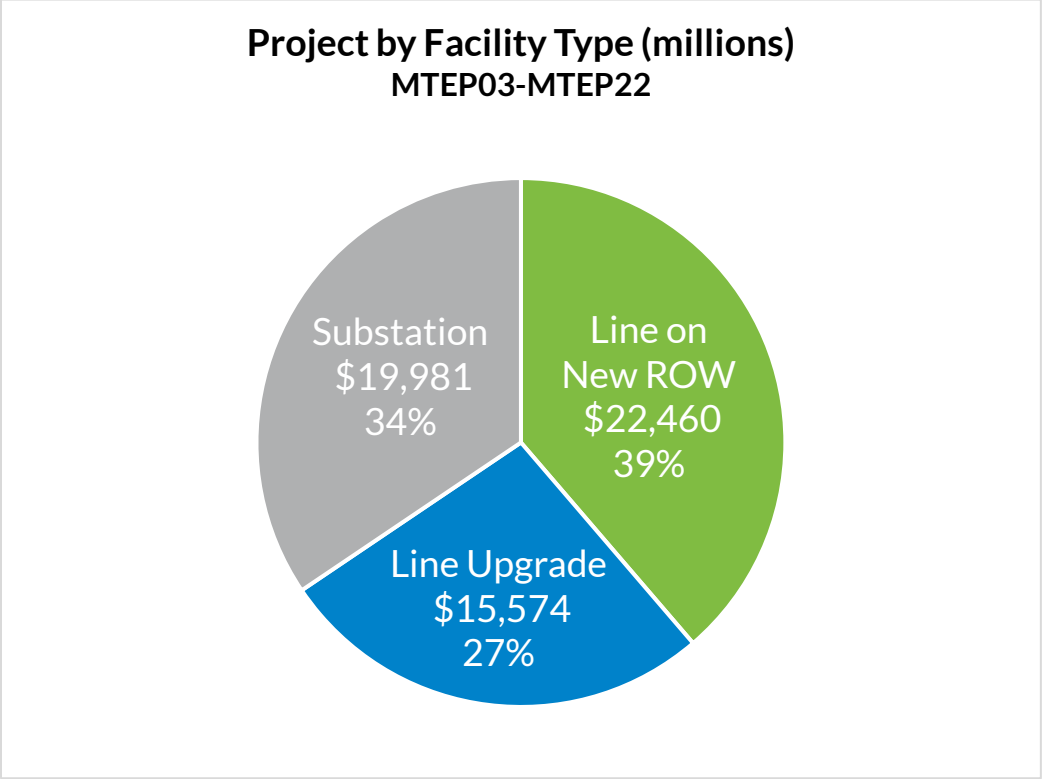



Figure 1.3-5: Appendix A project facility investment dollars in all MTEP cycles.

Full archived files of previous MTEP Reports can be accessed via the MISO Transmission Expansion Plan page at misoenergy.org.

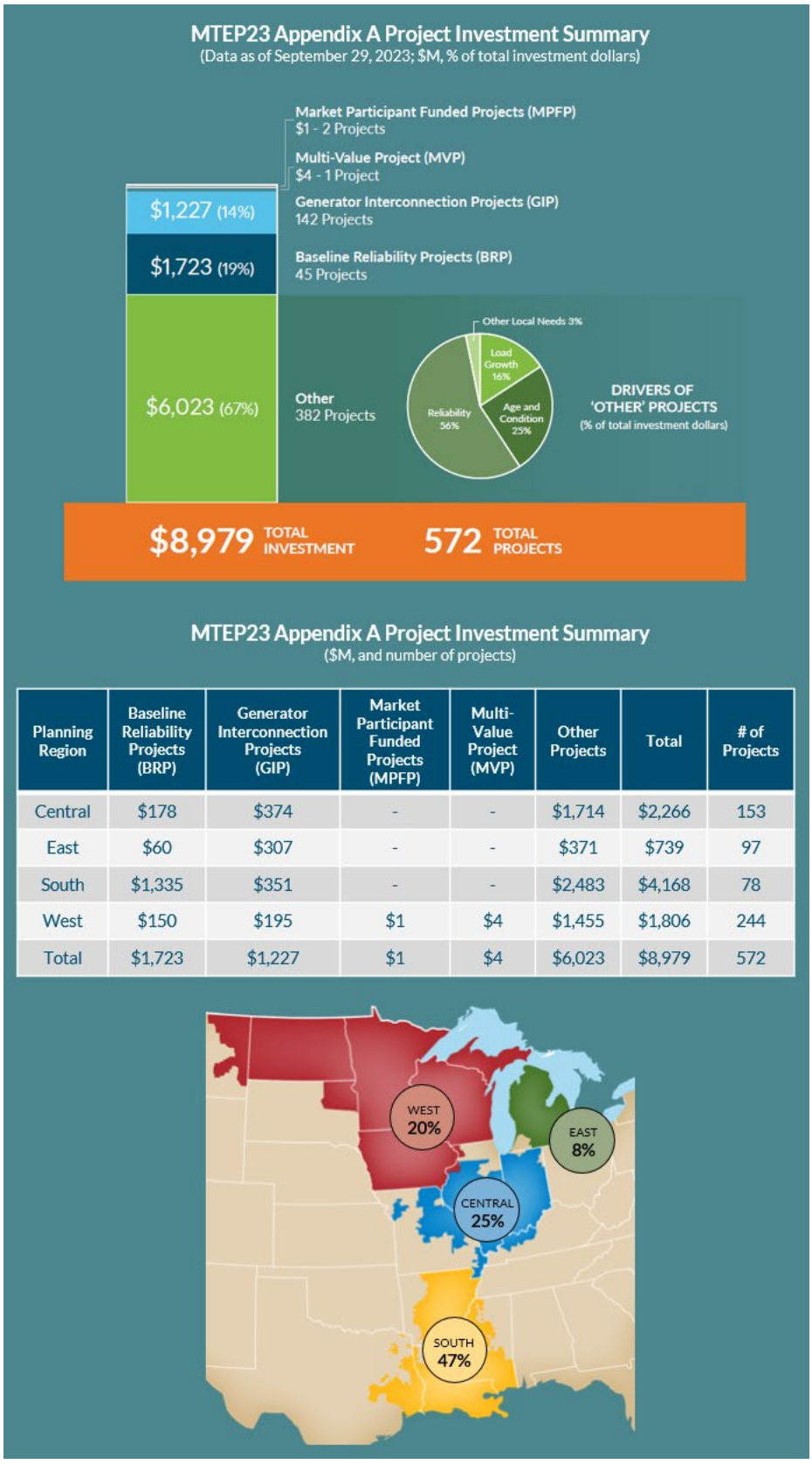
## 1.4 MTEP23 Investment Summary

The MTEP23 cycle proposes 572 new Appendix A projects (Figure 1.4-1) and represents roughly $9 billion in transmission infrastructure investment for the MISO region. This is the largest investment in MISO's history, except for the two MTEP cycles that included Multi-Value Project portfolios, due to significant projects to serve new load. Forty-seven percent of the investment is located in the South region.

Of the 572 new Appendix A projects proposed in MTEP23, 382 are classified as Other projects, 142 as Generator Interconnection Projects, 45 as Baseline Reliability Projects, two as Market Participant Funded Projects, and one Multi-Value Project. The single Multi-Value Project is a like-for-like replacement of communication equipment for a MTEP11 Multi-Value Project.

Of the roughly $6.0 billion investment in Other projects, 56% are driven by reliability issues, including those caused by a reliability of load additions and generation retirements, and 25% by age and condition. The majority of Other projects address localized reliability issues that are due to load serving needs, local specific reliability needs, and aging transmission infrastructure.

Except for the larger than usual 47% share of total investment dedicated to projects in the South subregion, the distribution of investment across MISO's footprint is generally consistent with recent MTEP cycles – 25% of the total Central subregion projects, 20% for the West and 8% for the East.




**MTEP23 Appendix A Project Investment Summary**
($M, and number of projects)

| Planning Region | Baseline Reliability Projects (BRP) | Generator Interconnection Projects (GIP) | Market Participant Funded Projects (MPFP) | Multi-Value Project (MVP) | Other Projects | Total | # of Projects |
|---|---|---|---|---|---|---|---|
| Central | $178 | $374 | - | - | $1,714 | $2,266 | 153 |
| East | $60 | $307 | - | - | $371 | $739 | 97 |
| South | $1,335 | $351 | - | - | $2,483 | $4,168 | 78 |
| West | $150 | $195 | $1 | $4 | $1,455 | $1,806 | 244 |
| Total | $1,723 | $1,227 | $1 | $4 | $6,023 | $8,979 | 572 |




Figure 1.4-1: Appendix A project investment summary (data as of 9-29-2023)

MISO considered alternatives (see Figure 1.4-2) and verified the need for a portion of the Other projects in addition to verifying the need for all the Baseline Reliability Projects.

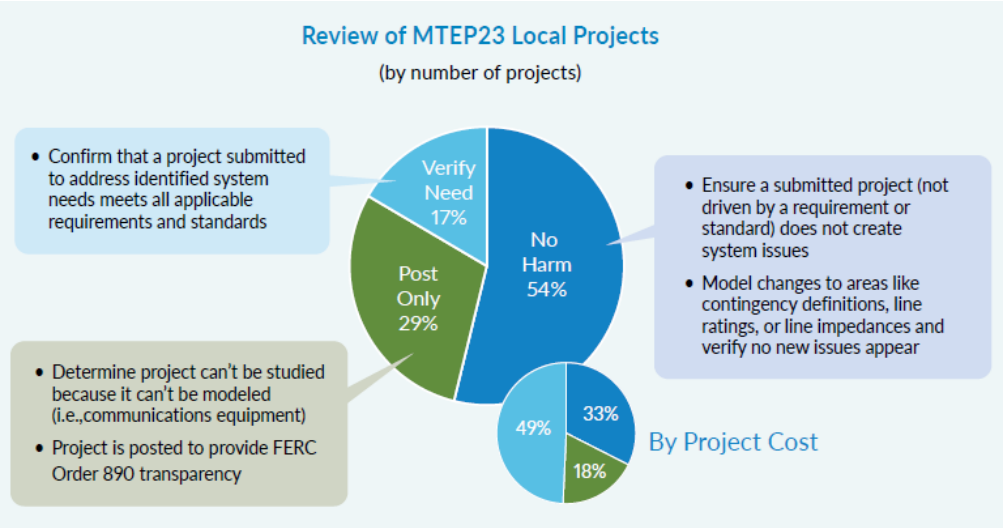



Figure. 1.4-2: Types of reviews MTP23 local projects went through.

Analysis of twelve MTEP projects for alternative solutions resulted in the re-submission of one project to address a larger set of needs, one lower-cost project, and one project that is pending further analysis.

Within MTEP23 proposed projects, the top ten projects represent roughly 43%, or $3.9 billion of the total $9 billion investment (Figure1.4-3).

## Top 10 Projects in MTEP23 Appendix A

| Rank | Project Name | Project Driver | Cost *(millions)* |
|---|---|---|---|
| 1 | Amite South Reliability Project - Phase 1 - Alternative | Other – Reliability | $1,700 |
| 2 | Southeast Texas Area Reliability Project | Baseline Reliability | $1,111 |
| 3 | Amite South Reliability Project - Phase 2 | Other – Reliability | $290 |
| 4 | New Baldwin Area Reactive Support | Other – Reliability | $170 |
| 5 | New South Central Illinois Transmission Expansion | Other – Reliability | $168 |
| 6 | New Slugger 138 kV Load | Other – Load Growth | $124 |
| 7 | New Kokomo Fusion Phase 1 – 230/69 kV Substation | Other – Load Growth | $92 |
| 8 | Rebuild Sioux-Meppen North-Hull 138 kV Line | Other – Age and Condition | $78 |
| 9 | New Seminary – Wittenberg – Grand Tower 138 kV | Baseline Reliability | $68 |
| 10 | Southland Expansion and Upgrades | Other – Load Growth | $58 |

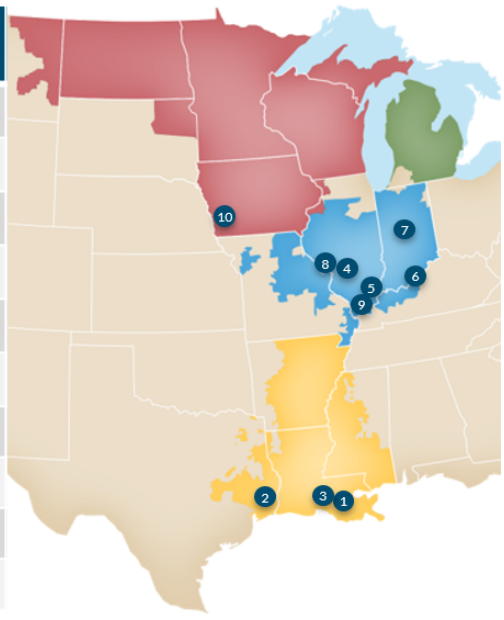



Figure 1.4-3: List of top ten proposed MTEP23 projects as of September 29, 2023, blanket renewal projects excluded from ranking.

Of the total projects proposed for MTEP23, over 70% percent are projected to go into service within the next three years (Figure 1.4-4).

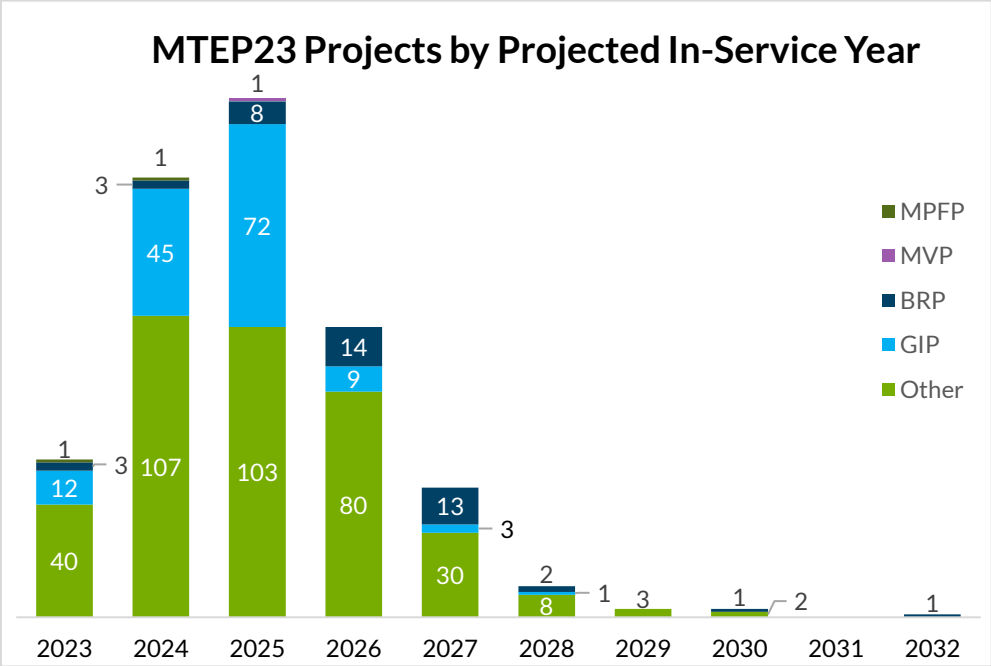



Figure 1.4-4: MTEP23 Projects by In-Service Year (data as of 9-29-23)

New Appendix A projects are spread over 14 states, with two states in the south scheduled for approximately $3.9 billion in new investment (Figure 1.4-5). These geographic trends vary greatly year to year as local planning dictates blanket asset renewal programs or as existing transmission capacity in other parts of the system is consumed and new build becomes necessary.

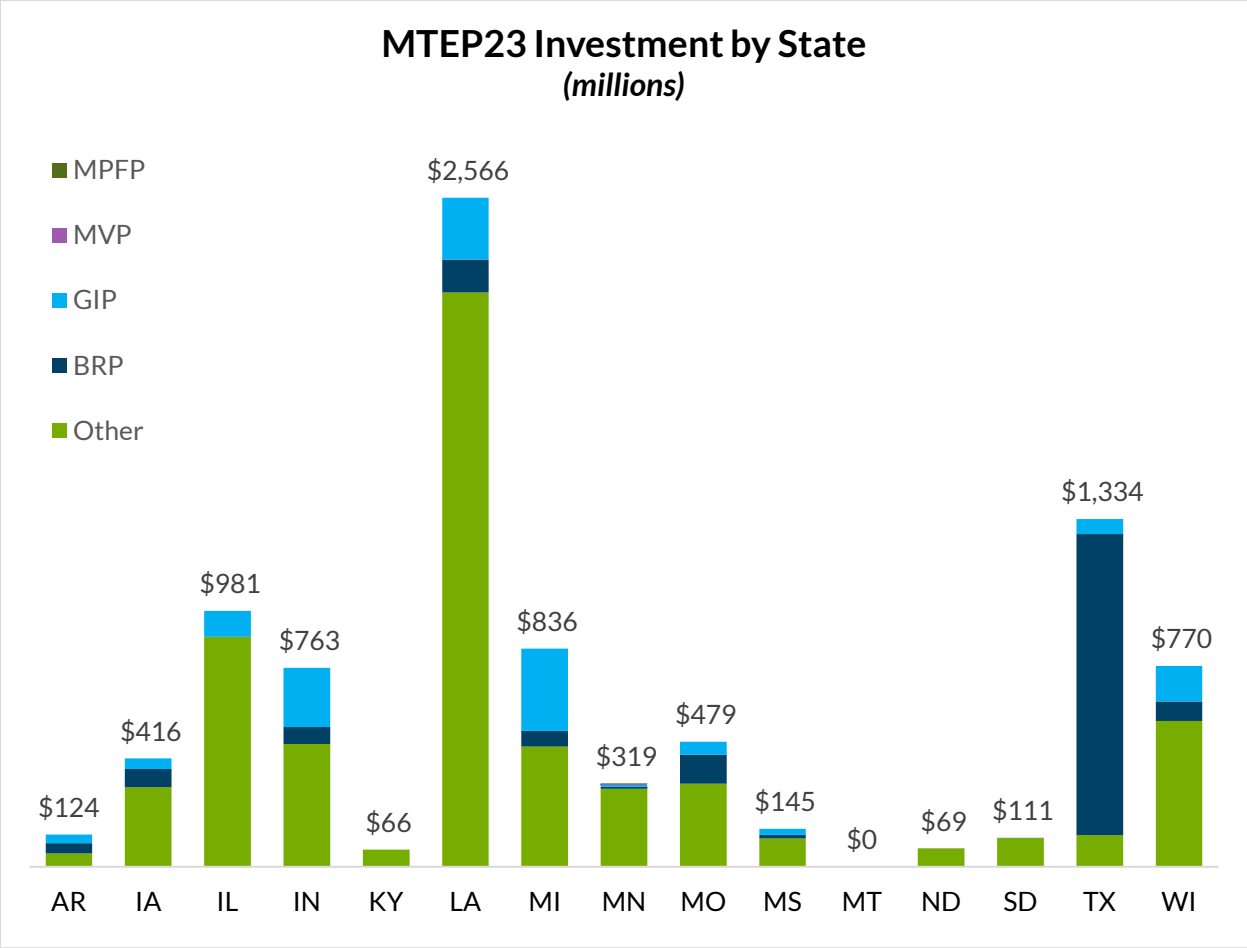



Figure 1.4-5: MTEP23 Appendix A investment categorized by state (data as of 9-29-23)

## Facility Type

Each MTEP project is composed of one or more facilities, where each facility represents an individual element of the project. Examples of facilities include substations, transformers, voltage devices, circuit breakers or various types of transmission lines (Figure 1.4-6).

The largest share (44%) of facility investment in the MTEP23 cycle is dedicated to new lines on new right-of-way in MISO. Thirty percent is dedicated to substation or switching station related construction and maintenance. This includes completely new substations as well as terminal equipment work, circuit breaker additions and replacements. Twenty percent is dedicated to line upgrades which includes rebuilds, conversions, and relocations. The remaining six percent of facility costs are dedicated to voltage devices, transformers, and miscellaneous categories.

## MTEP23 Transmission Investment by Facility Type

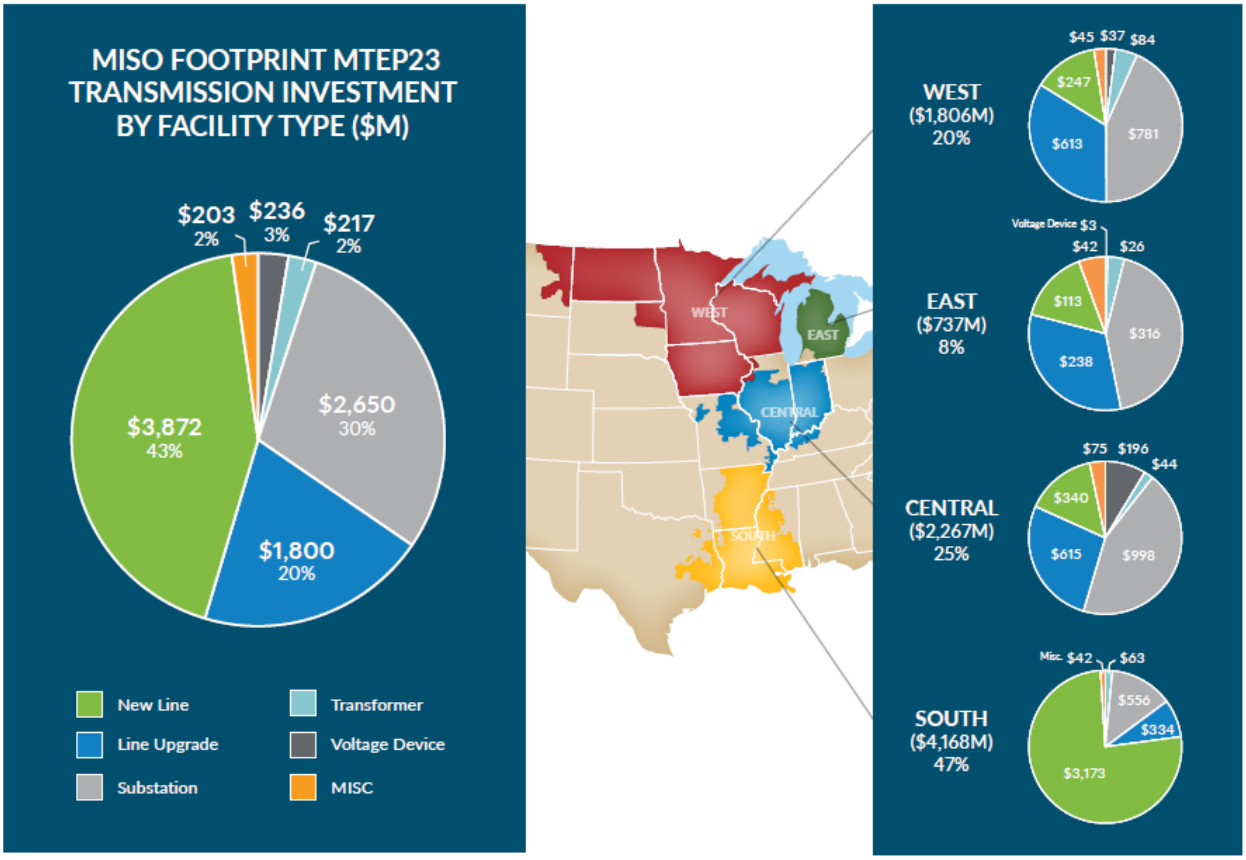



Figure 1.4-6: Facility type investment for new MTEP23 Appendix A projects by planning region (data as of 9-29-23)

MISO receives projects each year, each project has multiple facilities and the facilities determine the impact a project may have on a powerflow model (which is what we use to assess system impact) and our ability to review alternative solutions. MISO considers the facilities that make up a project to understand what type of analysis may be required, including verifying a project's need, ensuring the project does not create reliability concerns (e.g., no harm), or providing transparency (e.g., post only). In general, post only projects consider miscellaneous and substation projects that do not impact the physics of the transmission system. Alternative analysis is targeted primarily at larger projects in areas with multiple future need drivers; smaller projects to serve radial load or 'like for like' replacements are unlikely to have economic alternatives. Alternatives analysis also requires a defined reliability need, as MISO must verify this need to adequately examine alternatives and their effectiveness. The remaining projects include a combination of projects verifying needs and no harm.

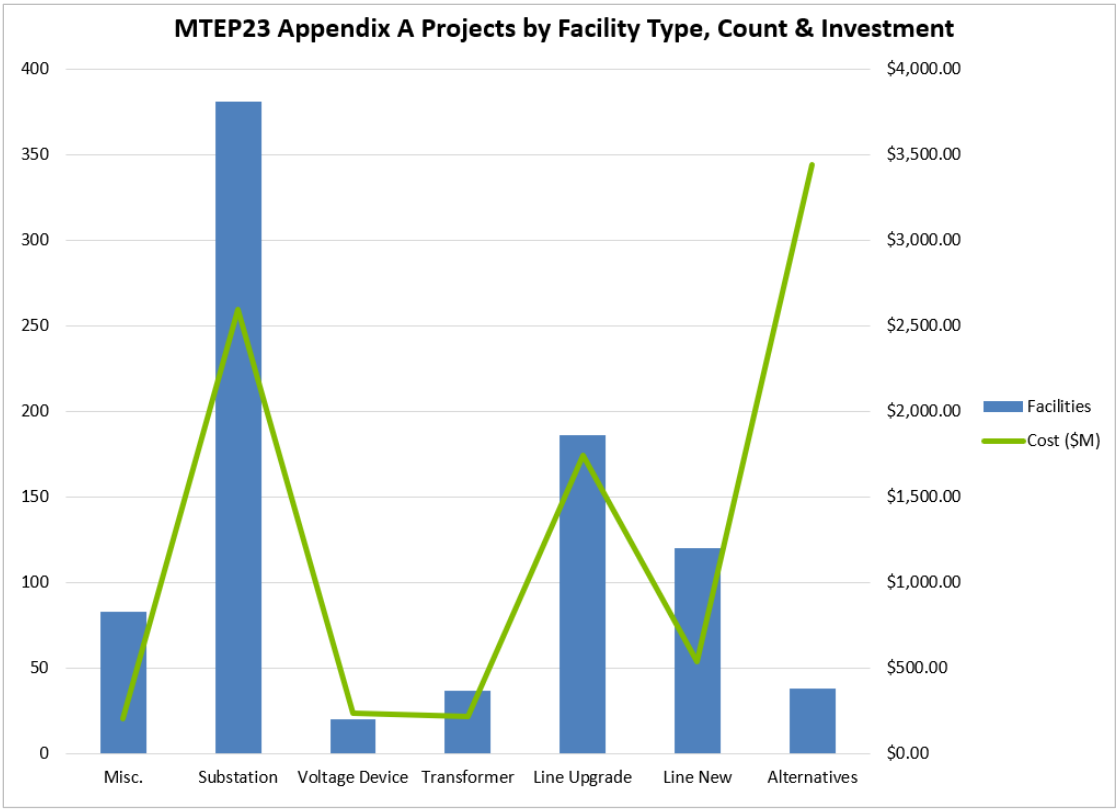



Figure 1.4-7: MTEP 23 Appendix A projects by facility type, count and investment

In addition to system adjustments allowed by NERC, MISO focuses analysis for alternative solutions on facilities that are larger in cost and in their potential impact on the system. Figure 1.4-7 demonstrates this as a small number of facilities with a large total investment of $3.4 billion are analyzed for alternative solutions resulting in alternatives selected for two projects.

## MTEP23 New and Upgraded Line Miles

MTEP23 Appendix A projects total approximently 742 miles of new or upgraded lines (shown in Figure 1.4-8). Of the total, fifty-five percent of new or upgraded line miles will go into service within the next three years, or 86% within five years. There are 643 line miles, or 87% of the total line miles, that are 161 kV or below. Seventy-six line miles are projected at 230 kV or above.

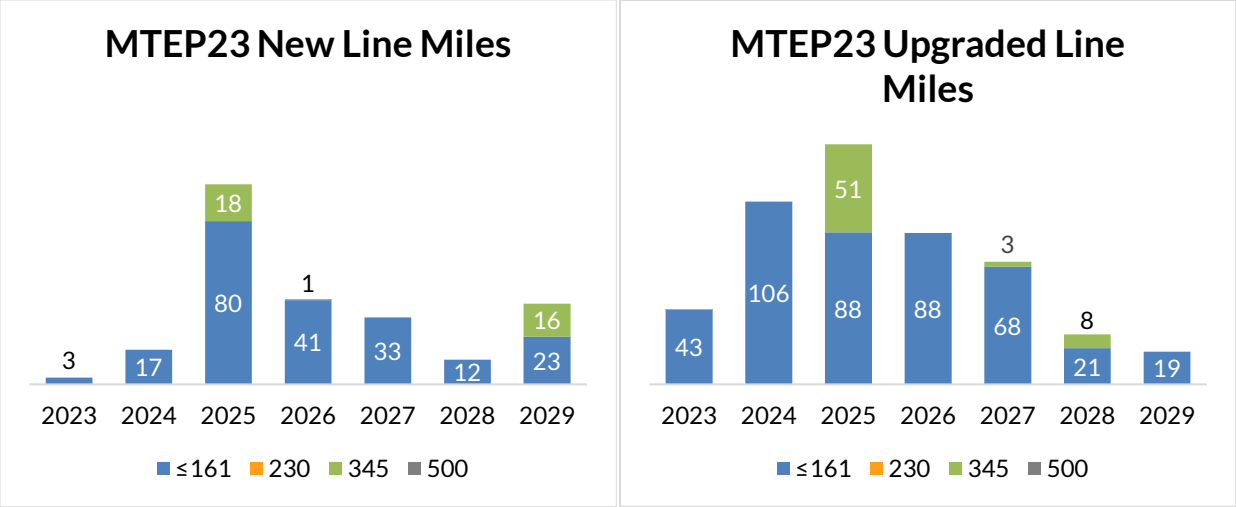



Figure 1.4-8: New and upgraded line miles proposed in MTEP23 Appendix A (data as of 9-29-23)

## Allocation of Costs

MTEP23 includes a total of 62 new cost-share eligible Generator Interconnection Projects (GIPs) for Appendix A. GIP costs are primarily paid for by the interconnecting customer (generator), however, a portion of the costs for certain network upgrades are eligible for regional cost allocation under Attachment FF of the MISO Tariff. Detailed allocations by pricing zone are provided in Appendix A1.

Indicative rates related to past MTEP cost-shared projects are calculated on an annual basis. Please refer to the reports (indicative forecasts of annual charges) posted on the MISO public website[4].

## MTEP Appendix B

MTEP Appendix B contains all projects that have been validated by MISO as the preferred solution to address an identified system need based on current information and forecasts, but where it is prudent to defer the final recommendation of a solution to a subsequent MTEP cycle.

This generally occurs when the preferred project does not yet need a commitment based on anticipated lead-time and there is still some uncertainty as to the prudence of selecting this project over an alternative project given potential changes in projected future conditions. MTEP Appendix B is limited to Baseline Reliability Projects and Other Projects and will be reviewed by MISO in subsequent cycles.

[4] Cost Allocation updates web address: https://www.misoenergy.org/planning/planning/schedule-26-and-26a-indicative-reports/