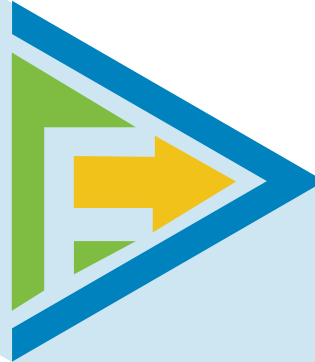


# MISO VALUE PROPOSITION

## FORWARD VIEW



Creating value for the region now and beyond

JUNE 2022

## Highlights

- MISO consistently delivers substantial value for the footprint in excess of cost. Forward looking analysis of a high renewables future suggests, the ratio of benefits-to-costs could more than double between now and 2040, from 11:1 to 26:1
- The Forward View forecasts that MISO will bring roughly \$5.0 billion in annual value to the MISO region by 2030 and \$12.9 billion by 2040
- The Forward View of the Value Proposition includes the additional benefits of shared Flexibility and Decarbonization across the MISO footprint



# Contents

Executive Summary .....	2
What is the MISO Value Proposition? .....	3
State of the Energy Landscape .....	5
Enhancing MISO's Value Proposition in Response to the Changing Energy Landscape.....	7
Key Takeaways.....	10
Forward View Details .....	11
Improved Reliability .....	11
Compliance .....	12
More Efficient Use of Existing Assets .....	13
Energy and Ancillary Services.....	13
Carbon Benefits from Dispatch .....	14
Reduced Need for Additional Assets .....	17
Renewable Resource Optimization (formerly Wind Integration) .....	17
Resource Capacity Sharing (formerly Footprint Diversity) .....	20
Demand Response .....	22
Cost Structure .....	22



# Executive Summary

By participating in MISO, members and their customers have benefited from increased reliability, a more efficient and cost-effective dispatch of energy, and the ability to share resources across the region to reduce overall reserve requirements. As renewable investments continue to accelerate, traditional thermal generation retires, and severe weather events increase in magnitude and frequency, MISO membership is expected to provide significantly greater value.

In 2007, MISO began to quantify the annual value provided to the region, including the entire set of MISO market participants and their customers. This annual, retrospective evaluation is known as MISO's [Value Proposition](#), and is the result of extensive collaboration with stakeholders on the structure and calculation of each of the value components. Since this evaluation began, the value of MISO participation has increased and the cumulative benefit to the region is estimated to exceed \$36 billion. Each year MISO membership costs have remained a small fraction of total benefits.

This year, for the first time, several groups within MISO teamed up to forecast the value proposition in future years to capture an expected trend of increasing value of MISO membership in the coming decades of the energy transition. The purpose of this Forward View report is to document the methodology, analysis, and results of this forecasting effort.

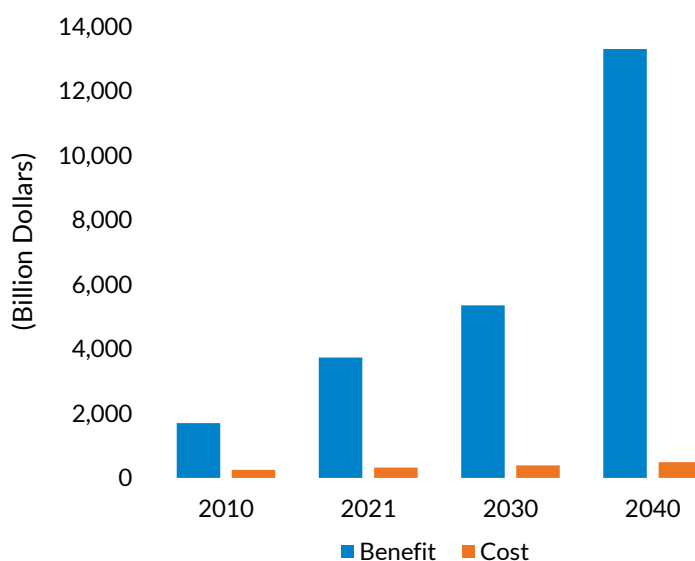
MISO projects that the value of MISO membership will more than double in the coming decades – increasing from an 11:1 benefit-to-cost ratio today to a 26:1 benefit-to-cost ratio by 2040.

To predict a range of future values, the Forward View analyzed each of the existing Value Proposition components and incorporated new Flexibility and Decarbonization components for the years 2030 and 2040. Flexibility benefits are captured within the Resource Capacity Sharing component while Decarbonization benefits are captured within the Carbon Benefits from Dispatch and Renewable

Resource Optimization. For the purpose of this report, MISO has conservatively assumed a nominal growth in membership cost of 4.9% per year, well above recent levels of inflation and historical MISO costs.

MISO will continue to conduct the traditional Value Proposition study on a yearly basis to keep track of the region's collective benefits from planning and operating the grid efficiently and reliably. However, given the magnitude of change the industry is undergoing, it is important to provide indications for the future value range MISO may bring to the region. To achieve this objective MISO developed a Forward View of the Value Proposition as a supplemental report to support MISO's Reliability Imperative efforts.

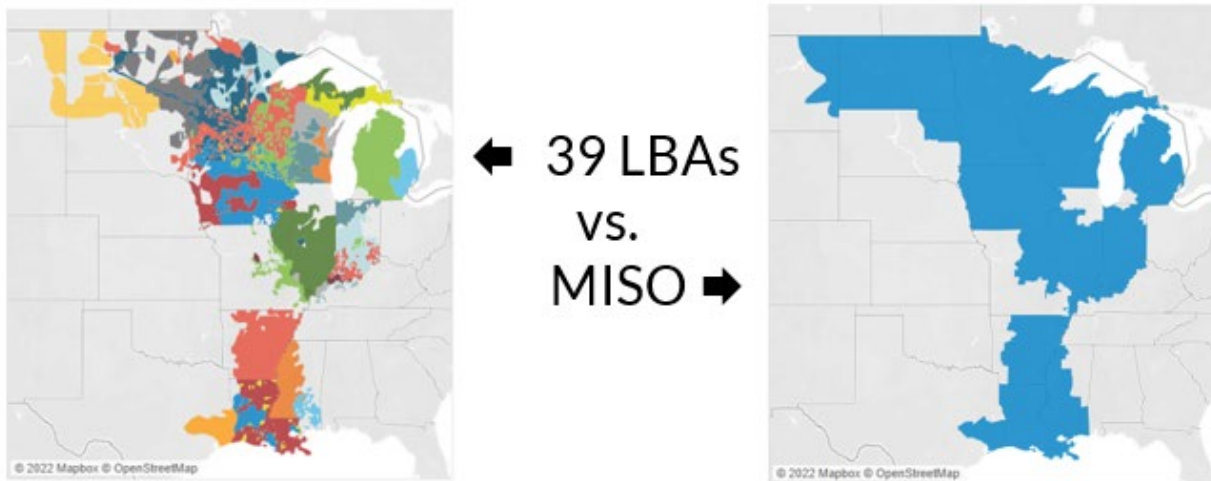
While the exact value MISO will provide to the region is not known at this time, the Forward View takes a conservative approach to develop a meaningful and sensible view of the future.





## What is the MISO Value Proposition?

Since its creation in 2001, MISO has delivered to the region a range of performance benefits, and since 2007, the Value Proposition study has calculated the annual benefits received—net of administrative costs—from being a part of MISO. Development of the current Value Proposition undertook an extensive stakeholder process including workshops, follow up conversations, and incorporation of feedback from MISO members. The Value Proposition compares two cases to determine value: with MISO and without MISO (i.e. the comparison of regional versus local<sup>1</sup>). The terms “with MISO” and “without MISO” will be referred to throughout this report.



The Value Proposition benefit metrics convey the value of geographic, generation, and load diversity benefits that MISO membership brings. In 2021, this study showed that MISO provided between \$3.0 and \$3.8 billion in annual economic net benefits. To date, MISO has documented over \$36 billion in cumulative benefits, spread across more efficient use of existing assets, reduced need for additional assets, and improved reliability and compliance. Additional qualitative benefits of interregional coordination, price and information transparency, and planning coordination are described in the Value Proposition study.

<sup>1</sup> While the current Value Proposition refers to the 39 Local Balancing Areas within MISO, the Forward View utilizes the 10 Local Resource Zones due to siting uncertainty in the future. This change in assumption means that the Forward View is a conservative estimate of future value.



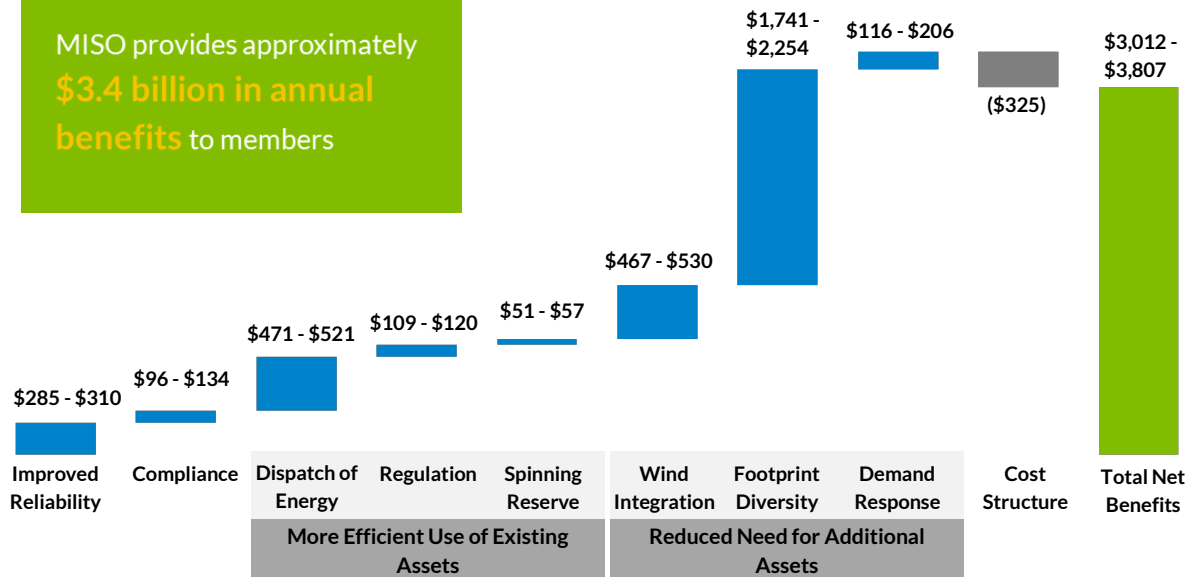
### Cumulative Benefits



### QUANTITATIVE BENEFITS

MISO provides approximately  
**\$3.4 billion in annual  
benefits** to members

### 2021 Benefit by Value Driver (2021 million \$)



Over time, the composition of the Value Proposition, the magnitude of benefits across the different Value Proposition categories, and the categories themselves have changed. For example, in the first few years of the study, benefits were driven by improved generator availability and the optimization of the region's resources to provide energy and ancillary services. In 2010, as wind resources were being planned in earnest to meet State Renewable Portfolio Standards, a Wind Integration category was added to the Value Proposition study to capture the benefit of MISO's effect on the location of wind resources. In conjunction with its members, MISO helps identify the most productive areas for wind generation on the regional transmission system, resulting in fewer wind turbines required to produce equivalent energy output. In the mid-2010s, MISO's primary value driver became the ability to transfer and share resources to meet peak demands that occur at different times across the large geographic footprint, allowing certain capacity investments to be avoided. These are just a few of the ways the Value Proposition has evolved over time in response to the changing energy industry.



## State of the Energy Landscape

The electric power sector is undergoing a profound transformation, and the MISO resource fleet is no exception. Existing thermal “baseload” power units, with predictable outage schedules, are retiring and being replaced in large part by weather-based, variable resources like wind and solar, and nascent technologies like battery storage. While MISO, as the grid operator, is accustomed to balancing reliability and efficiency, MISO members are increasingly prioritizing a third component—clean, low-carbon energy. Challenges that stem from these changes include:

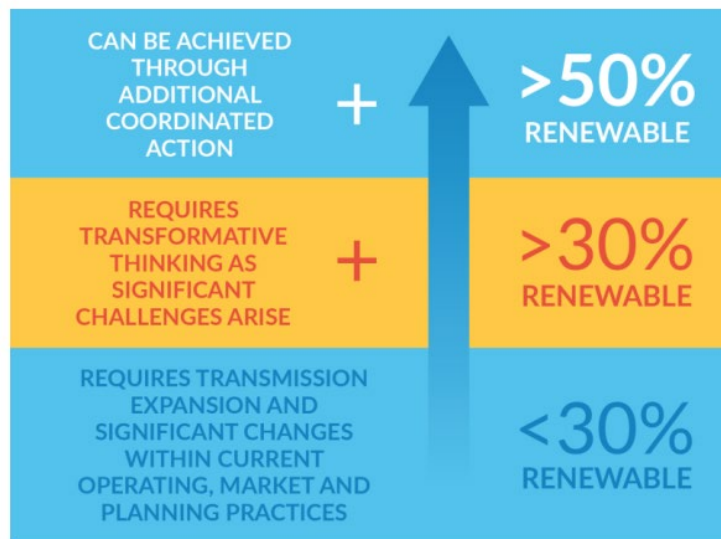
- Declining reserve margins due to retirements of baseload thermal units
- Aging resources that remain in service can be more prone to outages, rendering them potentially unavailable when they are needed most
- Wind and solar resources are not always available to provide energy during times of need. Additionally, renewables must sometimes be curtailed due to transmission constraints
- The fleet of natural gas resources may not be able to procure all the fuel they need at key times, often seasonally based<sup>2</sup>
- The region’s penetration of distribution-level and behind-the-meter resources is increasing, yet MISO does not have functional control or visibility into how these resources may affect the larger grid system

MISO expects recent trends to continue and likely accelerate. In order to plan for a future that is significantly different than the historical system, MISO worked extensively with stakeholders to develop three reasonable bookend future scenarios that provide a range of potential outcomes. MISO’s [Futures](#), refined in 2020, forecast the potential fleet evolution twenty years forward. The Futures scenarios project coal generation to fall from 76% of the energy mix in 2005 to 1-3% by 2039, while renewable generation will grow from 13% in 2021 to approximately 30-50% by 2039.

This transition is happening quickly and is already requiring refinements to planning and operating processes as MISO operates closer to its reserve margin requirements. Ensuring reliability is more challenging than in the past; sources of volatility and variability are growing more rapidly. Not only does the MISO footprint face increasing variability from weather-dependent generation, it also faces increasing severe weather events that are driving outages. Moreover, dispatchable generation performance has become less predictable and load itself is increasingly varied.

---

<sup>2</sup> This is due to limitations in contractual gas services, lack of dual-fuel capabilities, and reliance on a pipeline system that is shared with heating and manufacturing uses



MISO's [Renewable Integration Impact Assessment](#) found that as renewable integration increases, the variety and magnitude of bulk electric system needs and risks also increase. As renewables surpass 30% of annual system energy, transformational changes in planning, markets, and operations are needed. To reach 50% of annual energy, coordinated action with MISO stakeholders is required.

While this transition is underway, an understanding of how these changes will take place to achieve clean energy goals is critical to determine what changes are needed and by when. In 2021, MISO's

[Regional Resource Assessment \(RRA\)](#) studied public plans and goals of its members and found several insights. Among these included the following:

- Current announced renewable and decarbonization goals will require nearly 140 GW of new generation, two-thirds of which must be renewable or other non-carbon emitting resources, by 2040
- Seasonal reliability contribution will become more important as the reliability risk shifts outside of the summer season and net-load peak shifts to later in the day
- The RRA shows a decline in thermal resource energy over the next 20 years, even as installed capacity of natural gas generation in the MISO system could increase. Natural gas capacity, or a different resource with similar attributes, is needed to meet increased flexibility requirements
- The RRA and MISO Futures project the amount of energy provided by renewables would surpass an inflection point of 30%, at which certain additional complexities could emerge to cause difficulty in configuring and operating the grid in a reliable manner



# Enhancing MISO's Value Proposition in Response to the Changing Energy Landscape

Given the changes in the energy landscape that are underway and their anticipated future acceleration, MISO expects members, states, and customers to rely more heavily on the coordination and integration of the MISO system. The significant diversity in supply and demand within MISO's large geographic footprint, along with broad changes being made under the Reliability Imperative, will allow member clean energy goals and fleet strategies to be achieved more efficiently and reliably. Membership of an RTO provides access to a more diverse portfolio of resources to ensure energy security and manage uncertainty, this will remain crucial as fleets become more complex to manage.

To assess these impacts, MISO is incorporated two additional sources of value into this Forward View Value Proposition study:

1. The value from *sharing carbon-free energy* from areas with higher levels of renewables to regions with lower levels
2. The value from *sharing flexibility resources* needed to integrate those new renewables while maintaining reliability

While these new sources of value are present today, their value streams become increasingly important to the region as resource mixes continue to change.

MISO will continue to conduct the traditional Value Proposition study on a yearly basis to keep track of the region's collective benefits from planning and operating the grid efficiently and reliably. Given the magnitude of change the industry is undergoing, it is important to provide indications for the future value range MISO may bring to the region. To achieve this objective, MISO developed this Forward View of the Value Proposition as a supplemental report of the Reliability Imperative.

To predict a range of future values, the Forward View analyzed each of the existing Value Proposition components and incorporated new Flexibility and Decarbonization components for the years 2030 and 2040. Flexibility benefits are captured within the Resource Capacity Sharing component while Decarbonization benefits are visualized within the Carbon Benefits from Dispatch and Renewable Resource Optimization. Although the exact value MISO will provide is not known at this time, the Forward View takes a conservative approach to develop a meaningful and sensible view of the future.

Details for the calculation of each Forward View value components can be found in the Forward View Details section of this report. Below is a high-level explanation of the future indications of each component:





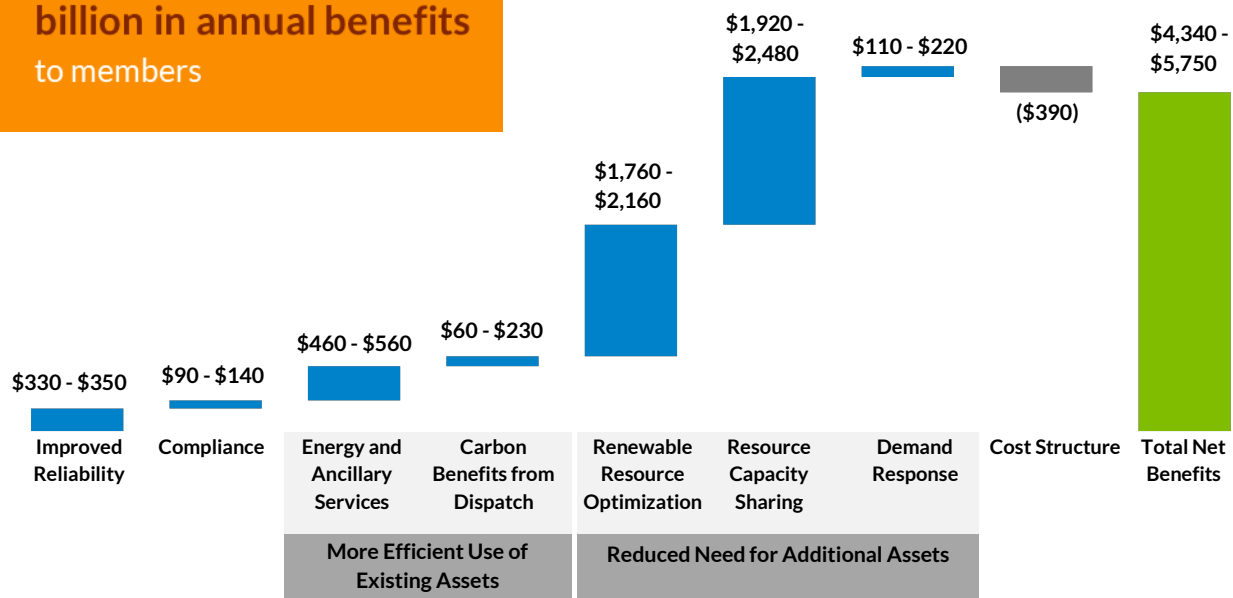
Category	Description	Projection
<b>Improved Reliability</b>	Benefit of the reliability of MISO's transmission system compared to that of non-RTO areas and other RTOs	Uses a growth trend derived from recent years
<b>Compliance</b>	Efficiencies gained through consolidation and coordination of compliance efforts	Uses a growth trend derived from recent years
<b>Energy and Ancillary Service</b>	Benefits from MISO's co-optimization of Energy and Ancillary Service Markets	Uses the difference between Future 1 with and without MISO production cost modeling cases to calculate projected value
<b>Carbon Benefits from Dispatch</b>	Additional benefit realized through energy and ancillary services from the annual reduction of carbon emissions	Derived from the difference in carbon emissions between the with and without MISO cases in the Energy and Ancillary Service category multiplied by an assumed cost of carbon
<b>Renewable Resource Optimization</b>	Benefits of reduced renewable capacity needed across the footprint to achieve member renewable and decarbonization goals	Informed by the results of the 2021 RRA to determine an optimized regional renewable buildout when compared with a local buildout design
<b>Resource Capacity Sharing</b>	Benefits from the sharing of flexible resources to reduce needed reserves at the MISO region level	Informed by the results of the 2021 RRA to determine a future buildout scenario with and without MISO
<b>Demand Response</b>	Lower realized costs for demand response (DR) market participants from MISO's transparent price information	Uses a growth trend derived from recent years
<b>Cost Structure</b>	MISO's administrative cost	Projected using a nominal annual growth rate of 4.9%



#### QUANTITATIVE BENEFITS

By 2030, MISO will provide approximately **\$4.3-\$5.8 billion in annual benefits** to members

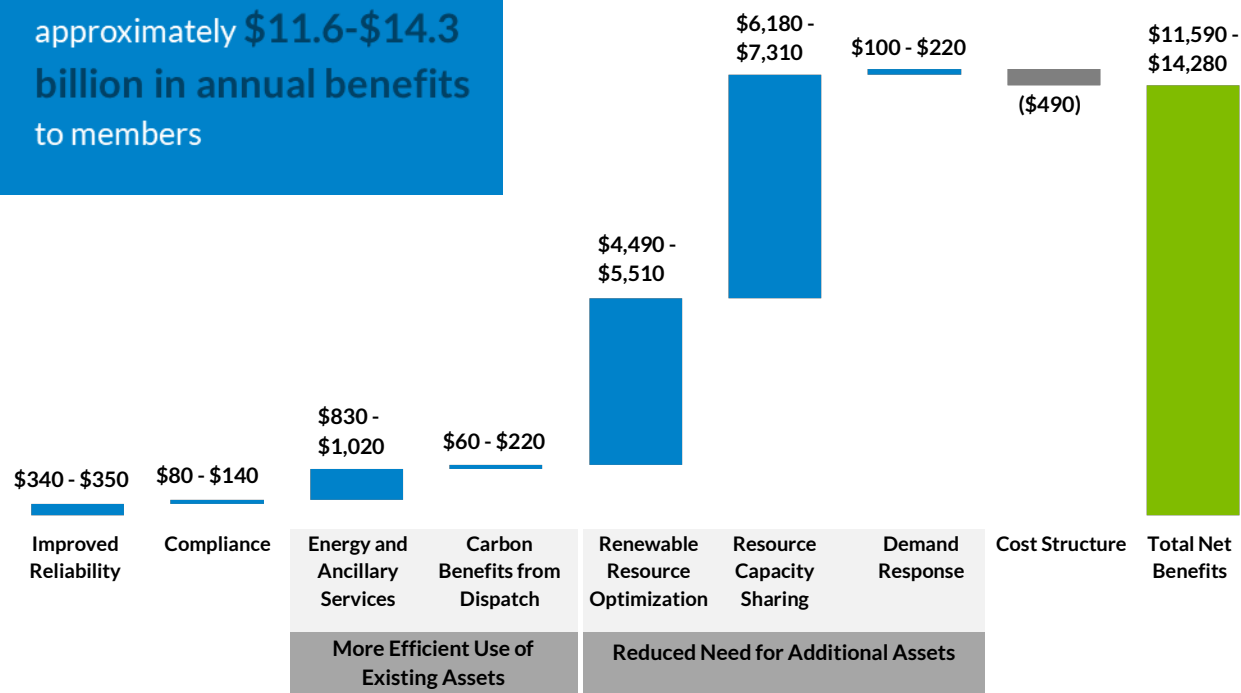
#### 2030 Benefit by Value Driver (2022 million \$)



#### QUANTITATIVE BENEFITS

By 2040, MISO will provide approximately **\$11.6-\$14.3 billion in annual benefits** to members

#### 2040 Benefit by Value Driver (2022 million \$)





## Key Takeaways

- As described in the Reliability Imperative, the accelerated transition to a low carbon future will create challenges, which can be more reliably and efficiently solved using the region's scope and diverse resources, creating even more value for customers in the future
- The MISO Forward View analysis looks at two reasonable future snapshots of the Value Proposition to show how members and customers can benefit under a future with substantially more renewable resources. As the energy industry undergoes transformative changes, it's anticipated that the value of MISO membership will increase from a benefit-to-cost ratio of 11:1 to a ratio of 26:1 by 2040
- Federal and state policies, along with member goals and consumer preferences, are driving significant fleet changes that are enabled and optimized by MISO's regional approach to planning and operations
- MISO facilitates decarbonization goals by helping ensure renewable energy resources are placed in high output locations and by efficiently utilizing these assets every day
- As the MISO system continues to decarbonize, complex flexibility needs (e.g., ramping and increased reserve requirements) arise and the sharing of diverse resources available across MISO's large footprint can help efficiently meet those needs



# Forward View Details

The following section describes the methodology behind each calculation for the Value Proposition Forward View categories:

1. Improved Reliability
2. Compliance
3. More Efficient Use of Existing Assets
4. Reduced Need for Additional Assets
5. Cost Structure

For more background information, see the [2021 Value Proposition](#).

## Improved Reliability

MISO has roughly 20 years of experience as a Regional Transmission Operator (RTO), maintaining a reliable transmission system. The Improved Reliability metric compares MISO's transmission system reliability with that of non-RTO areas and with other RTOs. MISO believes that the value produced through Improved Reliability will continue to grow.

In a future with substantially more intermittent renewables, more frequent severe weather events, and growth in electrification and emerging technologies, MISO will continue to provide greater value by leveraging its transmission capacity and vast geographic footprint to manage variability and uncertainty in resource supply. As a conservative measure, MISO used a trend of the last five years historical growth patterns to project Improved Reliability.

Annual Values (2022, Million \$)	2021	2030	2040
Low Estimate	\$285	\$330	\$340
High Estimate	\$310	\$350	\$350

### Future Consideration for Benefit Value

MISO's draft [Long Range Transmission Planning \(LRTP\) Tranche 1 Portfolio Report](#) analyzes value of the Avoided Risk of Load Shedding or increased system resiliency provided by transmission reinforcements and considers the effects of high impact winter weather events on system reliability. Throughout the past ten years, severe weather events (e.g., 2021 winter storm URI) have greatly affected the MISO system; however, with coordination, transmission access, and resource diversity, MISO has managed to mitigate and



respond quickly to these events to resolve and maintain member reliability. While MISO recognizes this resiliency benefit exists, this value will not yet be quantified in the Forward View at this time<sup>3</sup>.

## Compliance

MISO's Compliance benefit represents efficiencies gained through consolidation and coordination of compliance efforts. These efficiencies include reductions in the number of full-time employees involved with standards development, NERC compliance, tariff compliance, system planning compliance, and operations compliance. The value of Compliance will continue to rise with the cost of attracting and retaining talented compliance professionals. Additional value may also be realized as the compliance requirements themselves increase in complexity, but that impact has not been captured in the Forward View.

Forecast benefits were determined through a trend using growth patterns from the most recent ten years. Low Estimate values in 2040 appear lower than 2021 and 2030 because historical trend growth has been less than the average inflation rate of 2.5%, while High Estimates have averaged a 2.5% growth rate over the last ten years.

Annual Values (2022, Million \$)	2021	2030	2040
Low Estimate	\$96	\$90	\$80
High Estimate	\$134	\$140	\$140

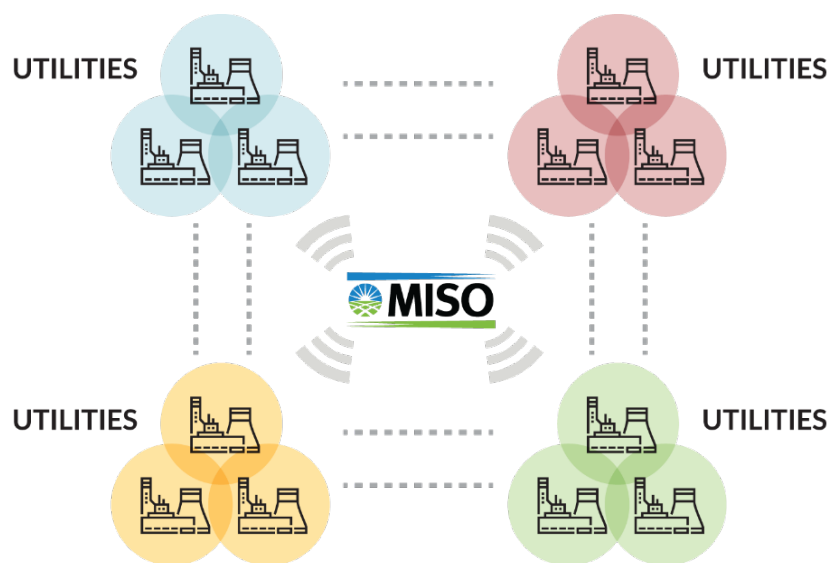
<sup>3</sup> The LRTP Tranche 1 analysis focuses on the MISO North and Central Regions, this component results in cumulative present value benefits of between \$1.2B and \$11.6B.



## More Efficient Use of Existing Assets

### Energy and Ancillary Services

MISO co-optimizes its Energy and Ancillary Service Markets, leading to cost savings across the footprint and a reliable commitment and dispatch of energy with regulation and spinning reserve requirements. The operations of MISO's market enable the most cost-effective resources to be committed to ensure reliability.



Annual Values (2022, Million \$)	2021	2030	2040
Low Estimate	\$632	\$460	\$830
High Estimate	\$698	\$560	\$1,020

### Forecasting Value Requires a Modified Approach

In this report, Dispatch of Energy, Regulation, and Spinning Reserves are combined into “Energy and Ancillary Services” since they represent a co-optimized set of efficiency and reliability objectives. The value realized through Energy and Ancillary Services is driven by characteristics including fuel prices, fleet change/fuel mix, membership changes, and annual system needs.

In the annual Value Proposition, these values are calculated by analyzing the prior year's dispatch results through production cost modeling for two cases: with and without MISO. In this Forward View, MISO's Future 1 resource expansion and siting results were used to calculate annual energy dispatch benefits in the years 2030 and 2040. This method recognizes the uncertainty around exact siting of the Future 1 resources and is therefore conservative.



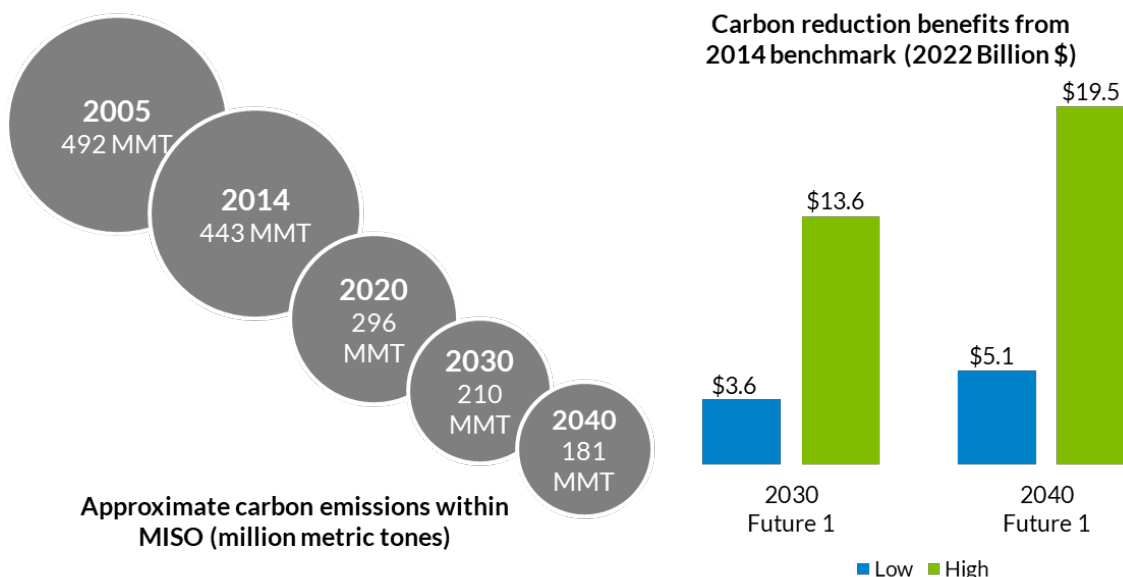
### Calculation, Assumptions, and Inputs

The without MISO case includes a 10% derate on all transmission lines to replicate pre-market inefficiencies, hurdle rates between zones to mimic local generation without MISO, and zonal-level reserve requirements. The with MISO case removes the derate and hurdle assumptions to allow the free flow of energy throughout MISO's footprint. In addition, reserve requirements are maintained at the footprint level.

- Production cost modeling analysis performed
- Without MISO market analysis<sup>4</sup>
  - Existing (2021) transmission system modeled
  - Transmission system utilization was de-rated by 10%
  - Hurdle rates between control areas: \$3/MWh for dispatch hurdle rate and \$10/MWh for commitment hurdle rate
- With MISO market analysis
  - Existing (2021) transmission system modeled
  - Improved transmission system utilization by removing 10% de-rate
  - Hurdle rates between control areas were eliminated
  - 3,000 MW contract path transfer limit from MISO N/C to MISO South and 2,500 MW transfer limit from MISO South to MISO N/C

### Carbon Benefits from Dispatch

Since 2014, carbon emissions within the MISO footprint have declined over 30%. MISO Futures show carbon emissions declining between 53-60% in 2030 and 59-79% in 2040, from 2014 levels.<sup>5</sup> The graphic below displays the approximate emissions of the MISO fleet in million metric tons (MMT) and a snapshot of the total cost of carbon savings incurred from 2014 with respect to Future 1 2030 and 2040 results.



<sup>4</sup> Without MISO analysis analyzed the system at the Local Resource Zone level

<sup>5</sup> MISO utilized 2014 carbon values as a benchmark for cumulative benefits since it includes the integration of MISO South



MISO acknowledges that fleet transition and decarbonization would happen without MISO. However, it's expected that the utilization of the MISO transmission network will continue to aid more efficient dispatch and annual carbon reductions. The calculation shown here is conservative in that it only represents the savings associated with *dispatching* the resource fleet in a single year – not decarbonizing the resource fleet itself over time. The *cumulative* benefit of this metric is anticipated to grow over time if fossil generation continues to be displaced by carbon-free energy. However, it is important to note that as the cumulative value increases, the *annual* value of this benefit will decrease each year. This is because there will be less fossil based generation on the system than there was in the previous year to receive emission reduction benefits from.

### Forecasting Value Requires a Modified Approach

Clean energy resources offer unique value to the MISO system—renewable resources have lower marginal costs and tend to lower overall market prices. This benefit is captured in the Energy and Ancillary Services metric described above. However, clean energy resources also provide an added benefit of reducing carbon emissions in the atmosphere and improving air quality. Today, electricity customers continue to expect lower-emitting power options, and there is a history of abatement of multiple pollutants from the power generation industry. Since the 1990s, sulfur dioxide has decreased by 94%, nitrogen oxides by 88% and mercury emissions by 95% across the U.S. electric power sector.<sup>6</sup>

In the Forward View, MISO has quantified the value of lower carbon emissions by applying a cost of carbon to the reduced emissions from our dispatch model. This benefit is calculated by comparing the carbon savings between the with and without MISO production cost models for the Energy and Ancillary Services component and then multiplying them by a range of costs, matching those in the LRTP. Since there is currently no market price for carbon utilized across the MISO footprint, MISO did not calculate a Carbon Benefits from Dispatch value for 2021.

The analysis conducted here is consistent with what MISO released as part of the draft LRTP Tranche 1 Portfolio Report after extensive stakeholder review and input. Note that the carbon savings differ between the two studies—LRTP Tranche 1 examined the cumulative carbon savings of the specific Tranche 1 portfolio of projects, whereas this Forward View of the Value Proposition is looking at annual snapshots of carbon savings facilitated by MISO membership across the footprint without the utilization of future transmission projects and upgrades. However, the methodology and the range of carbon prices are consistent between LRTP and the Forward View of the Value Proposition.

Annual Values (2022, Million \$)	2021 <sup>7</sup>	2030	2040
Low Estimate	N/A	\$60	\$60
High Estimate	N/A	\$230	\$220

<sup>6</sup> [Edison Electric Institute: Climate and Clean Air](#)

<sup>7</sup> There is currently no market price for carbon in effect in the MISO region, so for 2021 MISO will not show any quantitative benefit. In addition, the electric industry saw high natural gas prices in relation to coal prices, resulting in an efficient dispatch of energy that was relatively high in carbon emissions. Because of this relative price fluctuation, total carbon-intensive generation increased for 2021 but it's anticipated to decrease over the longer term as gas prices stabilize and the fleet continues to transition to carbon-free and lower-emitting resource types.





### Calculation, Assumption, and Inputs

This benefit was calculated utilizing the same generation output models as the “Energy and Ancillary Services” value component previously described in this document. These generation output models include with and without MISO carbon emissions in metric tons, which were then multiplied by a range of carbon costs. As previously described in this document, annual net carbon emission reductions (i.e., how much less carbon was emitted in a single year with the utilization of the MISO transmission network) will naturally decline over time as the generation fleet’s percentage of low/no-carbon energy technologies continue to increase. Therefore, the High Estimate for 2040 is slightly less than the High Estimate for 2030: there is simply more low/no-carbon energy expected in the 2040 fleet when compared to the 2030 fleet. The equation used to calculate this benefit is as follows:

#### **Decarbonization Benefit =**

$$\text{Metric Tons of Carbon} * \frac{\$}{\text{Metric Ton}}$$

Cost of Carbon (Real 2022 \$/Metric Ton)	2022	2030	2040
Low	\$12.6	\$15.3	\$19.6
High	\$47.8	\$58.2	\$74.6
Annual Net Carbon Emission Savings (Million Metric Tons)	N/A	3.95	2.93

For the High carbon price, MISO blended the 45Q tax credit for carbon capture projects with the Social Cost of Carbon (SCC) estimated by the Interagency Working Group.<sup>8</sup> Across the industry there are many estimates of reference; however, MISO chose to reference federal policy and information to develop this price. The High carbon prices represent average annual values of 45Q and SCC, beginning in 2022 at \$47.8/metric ton in 2022 dollars.<sup>9</sup>

The Low cost of carbon values come from the Minnesota Public Utility Commission (MN PUC).<sup>10</sup> These costs were converted into metric tons for 2022 dollars and produced a cost of \$12.6 per metric ton.

<sup>8</sup> Federal: [45Q Tax Credit](#), [Social Cost of Carbon](#)

<sup>9</sup> MISO believes that the following range of carbon costs represent a reasonable yet conservative estimate of future benefits. Across the country over a dozen states have implemented carbon pricing for cap-and-trade market and/or planning purposes, informed in some cases by modeled estimates of social costs of carbon. While more specifically economic market/planning costs and social costs are clearly linked, social costs take a more holistically economic approach, including additional factors such as impacts to health and air, water and soil quality.

<sup>10</sup> Minnesota Public Utility Commission

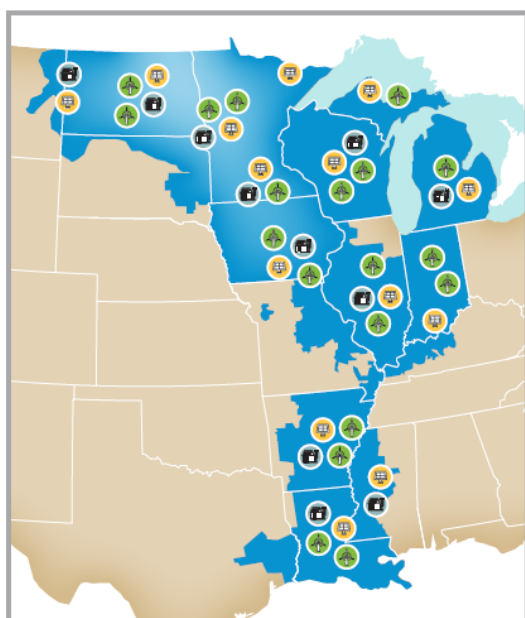


## Reduced Need for Additional Assets

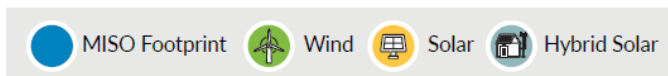
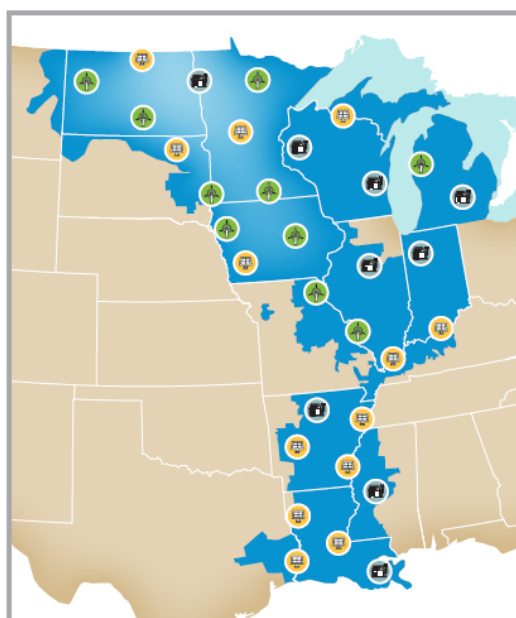
### Renewable Resource Optimization (formerly Wind Integration)

MISO's regional planning allows for a more economic placement of wind, solar, and hybrid resources. Previously called 'Wind Integration', this category of value captures the future benefits of reduced renewable capacity needed across the footprint to achieve member goals.

#### Local design of renewable generation build-out



#### MISO renewable build-out optimizes high output locations



*Illustrative Only*

### Forecasting Value Requires a Modified Approach

Similar to other components, the current annual Value Proposition calculation for Wind Integration compares a with and without MISO scenario of wind resource buildout. In MISO's annual Value Proposition calculation, the benefit value is determined through the product of wind capacity savings, overnight cost of capital for a wind turbine, and an annual fixed charge rate that incorporates project rate of return, property tax rate, insurance cost rate, fixed operations and maintenance (O&M), and depreciation.

Historical buildout was analyzed in MISO's 2010 Regional Generation Outlet Study II (RGOS II). This study included transmission offset values with assumptions about transmission upgrades needed to enable the dispatch of energy capabilities required. These offset values were subtracted from the annual benefit.



For the Forward View, MISO compares the buildout of wind, solar, and hybrid solar resources. Over the past several years, the amount of all renewable installations, announcements, and queue applications by MISO members has grown to support stated decarbonization goals. MISO continues to provide opportunities to build resources in higher output locations and therefore reduce investment costs throughout the footprint while providing greater access to all forms of renewable resources in the future.

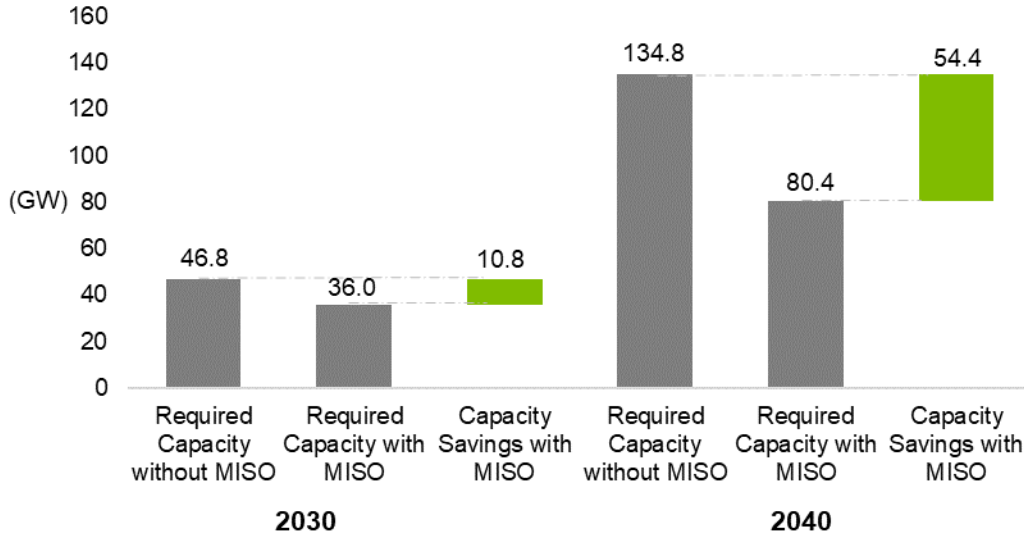
Annual Values (2022, Million \$)	2021	2030	2040
Low Estimate	\$467	\$1,760	\$4,490
High Estimate	\$530	\$2,160	\$5,510

### *Calculation, Assumption, and Inputs*

Informed by the results of the 2021 Regional Resource Assessment (RRA), MISO determined an optimized regional renewable buildout when compared with a local buildout design. Although the expansion in the RRA differs from that of the Futures, MISO believes these resources will be enabled with the LRTP projects as proposed.

The benefit metric used expansion results through both 2030 and 2040. Like the annual calculation of Wind Integration, the Renewable Integration benefit is determined as the sum of annual savings for each of the deferred capacity savings (the product of capacity savings, overnight cost of capital for a wind, solar, or hybrid solar unit, and an annual fixed charge rate that incorporates a project rate of return, property tax rate, insurance cost rate, fixed O&M, and depreciation). Utilization of the MISO system defers 10.8 GW of renewable capacity by 2030 and 54.4 GW by 2040.

Consistent with the previous Wind Integration benefit, MISO recognizes that additional transmission costs would be incurred in the regional generation siting approach compared to a local buildout design. To avoid overstating the estimated benefits, the Forward View will continue the practice of subtracting a transmission cost offset value from the annual benefit to account for the higher expected transmission upgrade requirements. For the first iteration of the Forward View, MISO scaled the previously calculated RGOS offset value by 1.4%. This scaling factor was determined by evaluating the cost of the 2011 multi value projects (MVP) and the 2021 LRTP projects. In future iterations of the Value Proposition, this offset value may be refined as the LRTP process and other forward-looking studies continue to evaluate the on-going resource evolution.



Note that the local and regional buildout of future resources differ. When building resources locally, solar and hybrid solar resources tend to be more favorable due to lower energy requirements and installation costs. While building resources regionally, larger energy and demand requirements typically require the installation of resources with higher capacity factors, making wind more favorable to meet system needs.

Due to the timeline of many member goals reaching large carbon reductions, carbon-free, net-zero, or carbon-neutral by 2050, analysis shows that much more renewable installations will continue after 2030.

- Analysis performed in through modular production costing and generation expansion
- Utilized Cost of Capital values from NREL's 2021 Annual Technology Baseline (ATB) report
- Cost of capital (\$/MW): C
- Annual revenue requirement: ARR

**Renewable Integration Benefit =**

$$\left( \sum_{k=\text{year}}^{\# \text{ of years}} \left( (\text{local buildout}_{(\text{wind}, \text{solar}, \text{hybrid})} - \text{regional buildout}_{(\text{wind}, \text{solar}, \text{hybrid})}) * C * \text{ARR} \right) \right) - \text{Transmission Offset}$$



<b>Wind Turbine Build</b>	
2030 - Cumulative wind savings, 2021-2030	-18.8 GW
2040 - Cumulative wind savings, 2021-2040	-10.4 GW
<b>Solar Build</b>	
2030 - Cumulative solar savings, 2021-2030	5.2 GW
2040 - Cumulative solar savings, 2021-2040	18.4 GW
<b>Solar Hybrid Build</b>	
2030 - Cumulative solar hybrid savings, 2021-2030	24.4 GW
2040 - Cumulative solar hybrid savings, 2021-2040	46.5 GW
<b>Total Renewable Build</b>	
2030 - Cumulative savings, 2021-2030	10.8 GW
2040 - Cumulative savings, 2021-2040	54.5 GW
<b>Cost of Capital (\$/MW)</b>	
Wind Turbine, 2021-2040	1.34 - 1.42
Solar, 2021-2040	1.37 - 1.18
Solar Hybrid, 2021-2040	1.99 - 1.55
<b>Transmission Offset Costs (Million \$)</b>	
2030 and 2040	160

## Resource Capacity Sharing (formerly Footprint Diversity)

MISO's large geographic footprint allows members to lower planning reserve margins (PRM), ultimately reducing the amount of required installed capacity.

Annual Values (2022, Million \$)	2021	2030	2040
Low Estimate	\$1,741	\$1,920	\$6,180
High Estimate	\$2,254	\$2,480	\$7,310

## Forecasting Value Requires a Modified Approach

Much of the value MISO creates has historically come from the value of sharing capacity—by setting requirements for a system peak instead of each Balancing Authority keeping reserves for their own region. Savings have been generated because MISO members do not need as much capacity for the same level of reliability. This value will persist in the future, but the MISO system will also become increasingly dependent on flexible resources, as there will be more weather-dependent resources.

Flexible capacity will be needed, for example, during periods of low renewable generation (wind 'droughts' or when the sun sets overnight). Flexibility may be needed for predictable daily ramps and to meet contingencies as large amounts of renewable resources are subject to the same weather conditions. RIIA analysis, experiences at MISO, and in other RTOs and ISOs give us confidence that this category of value will be substantial for the region going forward.

However, at this time the MISO market does not have clear visibility into the types or values of flexibility that will be needed in the future, which makes forecasting this benefit category a challenge. As a conservative approximation, MISO used expansion results from its 2021 RRA to inform a future resource mix for both 2030 and 2040 with and without MISO. Like the annual calculation of Footprint Diversity, the Resource Capacity Sharing benefit was determined through the product of generation capacity savings,



overnight cost of capital for a combustion turbine, and an annual fixed charge rate that incorporates project rate of return, property tax rate, insurance cost rate, fixed O&M, and depreciation. MISO chose to utilize the cost of a combustion turbine because future resource installations to replace retiring coal units remain uncertain. MISO assigned the difference in expansion between the with and without MISO case as the flexible resource savings for the Forward View.

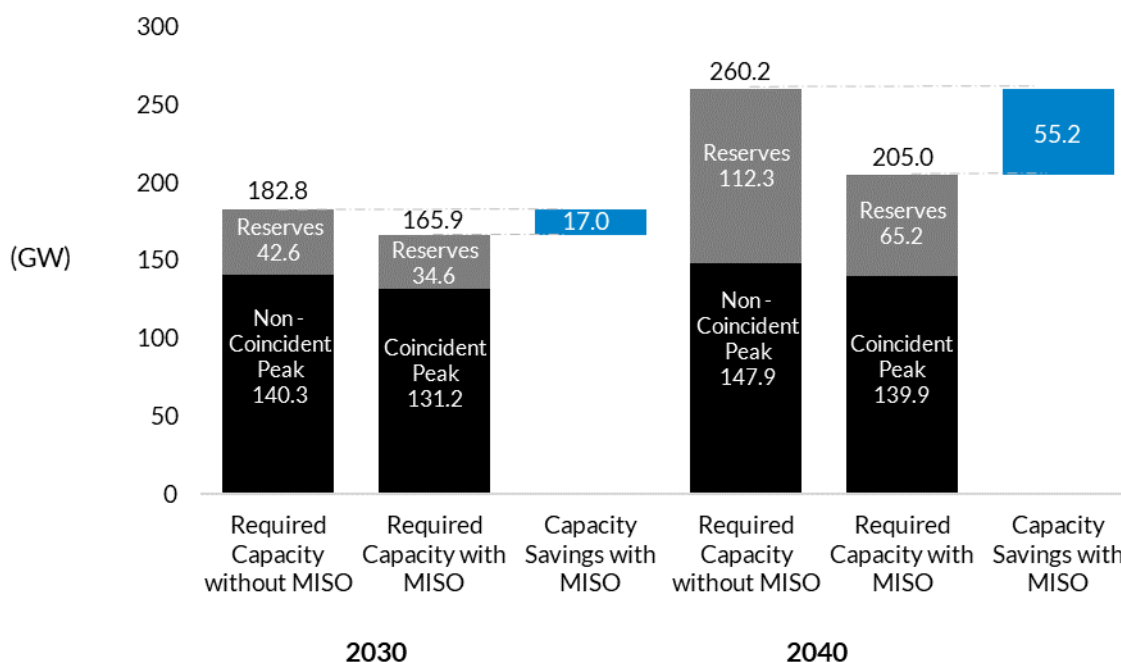
Currently and into the future, MISO members can share capacity to meet system PRMs and flexibility attributes needed for ramp requirements. With increasing buildout of intermittent resources, it is expected that these flexibility needs will greatly increase after 2030 as members work to achieve goals set forth by their leadership.

Until new requirements are defined, this value will estimate a 'but-for' PRM at a with and without MISO level, using the delta as a proxy flexibility value. These builds, along with the non-coincident and coincident peak forecasts, are used to calculate the reliability requirement and needed reserve capacity for each region. The difference between these scenarios is the savings that MISO brings to the region.

### Calculation, Assumptions, and Inputs

For this component (as well as the Renewable Integration component described above) MISO utilized the results of the 2021 RRA to inform a future buildout scenario with and without MISO.

MISO's Resource Capacity Sharing defers 17.0 GW of additional capacity in 2030 and 55.2 GW in 2040.





## Demand Response

MISO believes that the value of Demand Response (DR) will continue to grow as enabling technology improves, consumer preferences limit the appetite for greenhouse gas (GHG) emitting energy production during tight operating conditions, and economic and policy support for DR continues to grow.

It is difficult to predict exactly how MISO's DR value will grow through time, so forecasted benefits were determined through a trend using growth patterns from the most recent five years. Low values in 2040 appear lower because historical trend growth has been less than the average inflation rate of 2.5%, while high estimates have averaged a 2.5% growth rate over the last five years.

Annual Values (2022, Million \$)	2021	2030	2040
Low Estimate	\$116	\$110	\$100
High Estimate	\$206	\$220	\$220

## Cost Structure

MISO believes that costs of membership will increase over time, especially in the near term as MISO works to adapt to the changing resource mix. However, MISO membership costs will continue to remain a small fraction of total benefits. In a discussion with MISO's Board of Directors in June of 2021, MISO forecasted operating costs to increase by an average of 4.9% per year for the next five years, with lower annual increases after 2026<sup>11</sup>. In the Forward View, MISO made the conservative assumption to use that higher estimated growth in cost with an average nominal increases of 4.9% annually through 2040. Consistent with the rest of this analysis, the values displayed are adjusted to real 2022 dollars.

The ratio of benefits-to-costs for MISO membership is expected to increase from 11:1 in 2021 to 26:1 in 2040.

Annual Values (2022, Million \$)	2021	2030	2040
Estimate	\$325	\$390	\$490

<sup>11</sup> June 2021 BoD [presentation](#)