The Environmental-Other Sector appreciates the willingness of the MISO Advisory Committee and Board of Directors to explore the broad, evolving opportunities for market design and grid planning necessary to support the delivery of low-cost, reliable, and clean electricity to customers. The industry is in the midst of rapid, fundamental change in how electricity is generated and delivered to customers that are more engaged and exerting more influence over investment decisions, often looking for resources that minimize environmental impact. Utilities across the region are responding to this customer demand, as shown by growing commitments to renewable energy and carbon reduction goals. We commend MISO for examining these trends, while strongly encouraging MISO to move more quickly to adapt markets and related planning/resource adequacy rules to stay head of them.

1. **Industry trends:** Three broad change-driving trends are discussed in MISO Forward—Demarginalization, Decentralization and Digitalization. How are these trends shaping your sector and business models? Are there additional trends that should be incorporated into the discussion?

We agree that the “Three Ds” accurately describe three major trends influencing MISO’s direction. Another trend is “Decarbonization,” which both influences the other Ds and exists separately from them. These trends should be viewed in the context of shifts to electrify the transportation, buildings, and other elements of our life. They are moving quickly, which requires a commensurate response from MISO. We appreciate that MISO has several important processes underway to help staff and stakeholders better understand the important dynamics resulting from the Three Ds being driven primarily by the proliferation of low-cost renewable generation (both utility-scale and distributed) and other technologies coming to the grid. For example, the Renewable Integration Impact Assessment (RIIA) has already provided valuable lessons on the transmission system investments, ramping and system support services that will be required as the system evolves. Likewise, MISO’s Integrated Roadmap process now includes pathways for new technologies to participate in the wholesale markets, including distributed energy resources (DERs) and storage.

However, the problem is that these initiatives at MISO are woefully behind the pace of change of technology. A primary example is MISO’s effort to accommodate hybrid resources. The emergence of “near-firm capacity” resulting from the strategic integration of multiple technologies into hybrid projects is occurring rapidly. As of August 2019, MISO’s queue includes nearly 3,000 megawatts of hybrid projects. The incremental cost of adding battery storage to solar projects is now below the additional market value that adding storage can bring, therefore leading to a tipping point at which most new solar projects are likely to include some storage component. How these new technologies are valued in both MISO and state-level processes is critical in shaping the future of the system in the MISO footprint.
Yet MISO’s market systems currently do not treat these resources in a holistic manner that would maximize their benefits to the system, and there is no reliable timeline in place to implement the needed changes to accommodate and optimize these uniquely controllable, flexible resources. The unfortunate result of these implicit market barriers to new technology is that their integration into the system is stalled or these assets are developed around MISO’s markets, instead of through them, which also creates further complexity in system operations.

We urge MISO to quickly implement market and planning reforms to accommodate new technologies and ensure that new market entrants are able to provide the values they are technically capable of providing. These reforms include planning for and utilizing storage and other advanced transmission technologies, market rules to enable the efficient operation of hybrid resources, market products or a new market structure that values essential reliability services.¹

**Demarginalization**

Effective, appropriate price formation that fully incorporates the cost of energy and supporting ancillary services should be a foundational component of MISO markets. Some express concern over the consequences of lower LMPs driven by a market dominated by resources with low production costs. The concern is misplaced, both in the short and long term. In the short term, prices will fluctuate more significantly and may even rise during significant ramp periods or in hours when low-marginal-cost resources are not generating. In the longer term, flexibility and reliability services will increase in value while energy prices fall.

More generally, efficient price formation should focus on reliably serving customers/load at the lowest possible cost. Tapping into flexible demand will improve price formation. Unfortunately, state and utility policies prohibiting aggregation of distributed energy resources currently limit market participation from price-responsive demand. Yet technological progress is inexorable, and the increasing deployment of smart devices like thermostats, growth in flexible loads like electric vehicles, and the increasing desire by customers to control their energy choices (especially larger customers) should lead regulators and MISO to reconsider and expand the role of dispatchable demand in MISO’s markets. These assets can drive price formation during times of energy or ancillary service scarcity, contributing to the efficient dispatch of all resources to meet the needs of the region (and reduce the need for large supply sources). Under this construct, prices are dictated less by short-run marginal cost of supply resources and instead by the combined effect of all system constraints and resources.

The market construct relies on the assumption that all technologies and resource types will participate and contribute to efficient price formation. With the proliferation of new and variable resource generation, and retirements, the need for essential reliability services, such as primary frequency response and voltage control will grow, yet current market rules may not be sufficient

to encourage their use, especially from customer-controlled flexible demand or load resources (e.g., electric vehicles, storage).

MISO also needs to increase its level of coordination with the states, as many of the reliability services that must accompany the shift in generation mix will be procured through resource adequacy decisions made at the state level. One initial decision point that will impact both MISO and state processes will be the shift in resource adequacy from capacity to energy. That raises the key question of whether market products or capability requirements akin to the Planning Reserve Margin Requirement is the optimal way to procure these capabilities for the region, or if greater focus should be on procuring market products in Day-Ahead and Real-Time markets via short-term unit commitment and economic dispatch decisions.

**Decentralization**

Even with the increased proliferation of distributed energy resources – including small-scale solar, battery storage, electric vehicles, demand response, and so forth – it is unlikely that MISO’s market system will be asked to dispatch hundreds of thousands of individual DER assets connected at the distribution level. It is much more likely that MISO will be asked to coordinate and facilitate the dispatch of these assets with sub-regional market entities, possibly distribution utilities, to identify and communicate system needs and performance requirements, and ensure that market products are designed to accommodate DERs at the aggregate level.

As a recent report by Lawrence Berkeley National Lab and Emerging Futures on the potential benefits of EVs for the MISO grid explains\(^2\), flexible, controllable loads offer significant potential benefits, especially for the integration of variable generation resources. See the Appendix for more information on this report. However, MISO’s current lack of evaluation metrics and market participation pathways for these types of resources means key stakeholders including customers, states, and utilities are unable to even compare this approach to other options. This hampers decision making and ultimately risks increasing costs and/or reduced benefits for customers.

As DERs proliferate, MISO’s role in managing the transmission system within a hierarchy of managed systems will evolve. But MISO’s current planning and market paradigms are not equipped to deal with transformative change, but instead drive toward incremental changes, which means that MISO risks underperforming on its value proposition to its customers.

**Digitization**

The capabilities offered by the emergence of cost-effective, “smart” inverter-based resources, battery storage and flexible load control technologies offer the grid resources that can autonomously respond to setpoint instructions or grid disturbances within seconds and with accuracy and precision well beyond the capabilities of conventional generation resources. The potential benefits, such as improved efficiencies, increased reliability and resiliency, lowered production costs, are significant and worthy of aggressive pursuit on behalf of stakeholders and

customers. At the same time, as has been identified in the RIIA study, a grid with less rotating mass from large steam turbines and therefore less inertia can experience grid stability issues that, though they can be addressed with available technologies, are problematic under current market and operational constructs. In-home electronic monitoring and operation of electric devices offers opportunities for price responsive load to assist in balancing the system and reducing peaks as well. Among other things, effectively responding to these developments will require MISO to use robust, forward-looking analytics and engage more deeply with states.

2. Future risks, needs and value: For each of the trends of Demarginalization, Decentralization and Digitalization, discuss the following:

   a. How they might affect or change the risks the region faces.

   The Three D framing contemplates broad proliferation of inverter-based assets throughout the MISO footprint, many of which will be variable generation resources. From the RIIA study we know that at footprint-wide generation levels of 40% annually from renewable resources, the MISO grid as it is today is likely to experience operational complexity in the form of stranded ramping capability, voltage instability, and lower levels of primary frequency response. These are relatively new risks to address in the MISO planning processes. Fortunately, there are existing and developing solutions to these issues, including transmission solutions. Given the long lead time for transmission planning and construction, MISO should focus more on planning now so that solutions can be in place when necessary. Other trends influencing MISO are generally not well understood, such as the pace and location of electric vehicle adoption, the rate of proliferation of DERs, and the potential for new state or federal policies to incent specific generation resources or system outcomes. MISO can study these trends and integrate them into the planning framework.

   b. The services, tools and functions, e.g. markets, operations and transmission planning that you envision needing from MISO in the future. Which will be most critical?

   Market access is key. The Three D framework contemplates proliferation of many new technologies, interconnected at both the transmission and distribution levels, with many new capabilities. For any of these trends to take root, these technologies must have market access. Without proactive, long-range transmission planning and properly functioning open markets, the pace of technological change will outstrip the pace at which MISO’s planning process, state and federal regulatory approval processes, and construction of transmission lines and other infrastructure can keep pace. The result will be that the benefits of many new technologies will go uncaptured and MISO’s value to the region will diminish.

   Further, MISO’s traditional transmission infrastructure planning and cost allocation frameworks risk marginalizing the ability for digitized and decentralized transmission technologies such as storage to help MISO capture the values of these the 3-D framework. While some may say that transmission planning needs to use the most conservative assumptions given future uncertainty, there is a cost to doing nothing, and that cost can impact consumers for many years.
Beyond market access, a new resource adequacy convention beyond the 1 day in 10 year reliability rule of thumb may be warranted as pure capacity is no longer the only reliability constraint from a resource adequacy perspective. This has been demonstrated by the recent Max Gen events and detailed in the FERC/NERC January 2018 Assessment, which recommended that MISO consider planning for deliverability of reserves throughout the footprint. This reality is also highlighted by the ongoing RAN Phase 3 discussions on seasonal resource adequacy, where MISO has shown that loss of load risk can occur during non-summer months based on non-optimized generator outages and LMR availability. While MISO seems to be asking the right questions at this time, MISO’s ability to move quickly and proactively towards workable solutions remains to be seen.

Relatedly, MISO and stakeholders will also have to gain familiarity with an increased reliance on probabilistic planning and real-time (or near-real-time) market mechanisms. As more resources are based on forecasted capability, the operational practices, market participation mechanisms, and reliability requirements will need to evolve to minimize the risks inherent in forecasted vs. real-time conditions. For example, how will MISO’s markets internalize generation forecast uncertainty into operating reserve requirements to be carried, and at what time frame? How will MISO’s capacity accreditation mechanism value the added controllability and flexibility of pairing storage with variable generation resources.

Our sector also is concerned about the increasing potential for conflict between the rapid pace of change and the delays in MISO’s Market System Enhancement (MSE). While holding great promise to address many of these challenges, MSE has been delayed and stakeholders lack a clear understanding of the scope and prioritization of its implementation. MISO’s current Integrated Roadmap has 11 active market-related issues to be developed (34 if including the Parking Lot issues), many of which cannot progress until the MSE is in place. Will the MSE, which is taking so much time to roll out, be ready to address the markets and operational needs that are so rapidly changing?

c. How those items identified in b. will affect the value created for the region.

By keeping pace with the changing dynamics of the electric industry driven by policy, consumer demand, and technological advances, MISO will be able to maintain its standing as a provider of the reliable and economic delivery of electricity throughout the region, in line with the fundamental value proposition of the RTO/ISO model. To achieve these outcomes, MISO should maintain an ongoing commitment to:

1. Forward-looking, robust planning
2. Market constructs that allow and incent resources to provide necessary services
3. Dynamic and flexible operations in both normal and stressed operating conditions, and
4. Robust engagement with states and stakeholders to maximize the value of the change at hand while minimizing any risks it poses.
APPENDIX
The Values of Flexible Load in MISO

A recent study by Lawrence Berkeley National Lab (LBNL), Emerging Futures, and MISO evaluated the potential grid benefits of one-way power flow (charging only) and two-way power flow (charging and discharging) smart electric vehicles. Figure 1 illustrates the significant positive load-smoothing benefits of using a moderate projection of electric vehicles, approximately 2 million, with an energy mix consisting of 21% renewables. For the two key benefits of peak load and ramp reduction, allowing EVs to offer flexibility services -- especially “V2G” vehicles with two-way charging and discharging -- would significantly reduce the cost of balancing and maintaining energy security.

Figure 1: Evaluation of V1G and V2G with 2.16 million EV scenarios and 21% Renewable Energy Mix for 2032

Further, load-flattening benefit is even more evident under a high renewable energy penetration of ~86% and EV uptake of ~36 million vehicles as illustrated Figure 2. Flexible load is irrefutably an effective tool to mitigate both the peak exacerbation effect of large numbers of EVs, and the higher peak-valley differences (and potentially negative net loads) of high amounts of renewable generation. High levels of V1G and V2G-capable vehicles greatly reduces differences between peaks and valleys and results in a new, easily managed load shape.

1 Greenblatt, Jeffery, Zhang, Cong, and Saxena, Samveg, Quantifying the Potential of Electric Vehicles to Provide Electric Grid Benefits in the MISO Area, (2019).
Another study by LBNL compared the cost of smart charging with that of investing in fixed battery storage in California for similar peak and ramp reduction services\(^2\). The assumptions were based on the state’s 2030 EV goal of \(~1.5\) million zero emission vehicles (ZEVs), and 50\% of generation from renewable energy. It was found that the investment cost of flexible load through smart charging of V1G vehicles is approximately $150 million, or only one tenth of the cost of comparable services using fixed battery storage. Similar V2G cost savings are likely once those vehicles gain market share.

### Table 1: Comparison of EV Capacity Compared to Fixed Battery Storage Costs

<table>
<thead>
<tr>
<th>1.5 Million ZEVs in California</th>
<th>Capacity (GW)</th>
<th>Equivalent Storage Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1G</td>
<td>1 GW</td>
<td>$1.45–$1.75 billion</td>
</tr>
<tr>
<td>V2G</td>
<td>5 GW</td>
<td>$12.8–$15.4 billion</td>
</tr>
</tbody>
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