Independent Evaluation of MISO's Auction Revenue Rights and Financial Transmission Rights

Victor Chung
Julia Frayer
Siddharth Jaswal
Max Lee
Sayad Moudachirou
Ma. Cherrylin Trinidad

London Economics International LLC

717 Atlantic Avenue, Suite 1A

Boston, MA 02111

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717 Atlantic Avenue, Suite 1A
Boston, MA 02111
www.londoneconomics.com

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List of Acronyms

ARR	Auction Revenue Rights
BPM	Business Practices Manual
BRSS	Baseload Reserved Source Set
CARR	Candidate Auction Revenue Rights
CPNodes	Commercial Pricing Nodes
DA	Day-Ahead
EPNodes	Elemental Pricing Nodes
FERC	Federal Energy Regulatory Commission
FTR	Financial Transmission Rights
GFAs	Grandfathered Agreements
GSF	Generation Shift Factor
HUFU	High Utilization Factor Unit
ILTTR	Incremental Long-Term Transmission Rights
IMM	Independent Market Monitor
IPP	Independent Power Producer
ISO	Independent System Operator
LEI	London Economics International LLC
LMP	Locational Marginal Pricing
LSE	Load Serving Entity
LTTR	Long-Term Transmission Rights
MCC	Marginal Congestion Components
MISO	Midcontinent Independent System Operator
MPMA	Multi-Period Monthly FTR Auction
MW	Megawatts
NITS	Network Integration Transmission Service
NPLF	NITS Peak Load Forecast
OATT	Open Access Transmission Tariff
PPA	Power Purchase Agreement
PTP	Point-to-Point Transmission Service
REC	Renewable Energy Credit
RSPs	Reserved Source Points
RT	Real-Time
RTO	Regional Transmission Operator
SFT	Simultaneous Feasibility Test
SPP	Southwest Power Pool
TCM	Transmission Customer Metric
TO	Transmission Owner
TSR	Transmission Service Reservation

1 Executive Summary

London Economics International LLC ("LEI") was retained by the Midcontinent Independent System Operator ("MISO") in April 2022 to provide an independent review of MISO's auction revenue rights ("ARR") mechanism and financial transmission rights ("FTR") market.

LEI is a global economic, financial, and strategic advisory professional services firm specializing in energy and infrastructure. We have advised private sector clients, market institutions, and government entities on electricity market policies, wholesale market rule design, efficient tariff and rate constructs, asset valuation, market power, and utility strategy in virtually all deregulated markets worldwide. A short description of the firm is included in Section 10.

A summary of LEI's main tasks and findings is provided below.

Task 1: assess whether the ARR/FTR market is functioning efficiently – LEI's findings

LEI finds that the current ARR and FTR mechanisms are functioning as designed. As discussed in detail in Section 5, the ARR and FTR mechanisms provide a pathway for market participants to hedge congestion costs arising in the day-ahead ("DA") nodal energy market. FTRs are not only a necessary feature of a nodal energy market design, but also support liquidity and commercial arrangements in the broader forward energy market, as discussed in Section 7.5. From the perspective of transmission customers,[1] annual ARR allocation and FTR auctions are critical to the ARR and FTR mechanisms; without a market that allows for market-based valuation of such rights, transmission customers would need to rely on a rules-based system to allocate DA congestion costs, which would not provide transmission customers with the opportunity to express their risk appetite and allocate risk accordingly. ARRs are also beneficial to transmission customers because they provide optionality in the management of congestion risk, by allowing load serving entities ("LSEs") to monetize the value of expected DA congestion costs on a forward basis, well ahead of the DA energy market.

Definition of FTRs and ARRs

FTRs are financial contracts that market participants acquire through FTR auctions or through awarded ARRs. An FTR entitles the holder to receive (or pay) the difference in congestion prices between a source and sink node on the MISO system in the day-ahead energy market.

ARRs are allocated to transmission customers based on their historical usage of the transmission network. ARR holders are entitled to receive the annual FTR auction revenues associated with the specific set of sources and sinks. ARR holders can also convert their ARRs into FTRs by self-scheduling in the annual FTR auction.

[1] We use transmission customers and load serving entities interchangeably in this report.

Task 2: evaluate the impact of financial traders on the FTR market – LEI's findings

Financial traders are crucial to a well-functioning FTR auction and provide multiple benefits to the market, as discussed in Section 7.3. Financial traders' participation in the annual FTR auction enhances the ability of LSEs – who participate in these markets on behalf of transmission customers to get paid for their ARRs on a market efficient basis. The payment on any ARRs retained by an LSE is keyed off of the annual FTR auction results, which generally reflect market efficient outcomes based on LEI's analysis of historical auction data and DA congestion. Hypothetically, if LSEs were the only participants in the annual FTR auctions, market activity would be insufficient to establish a market-based price signal for all pricing nodes. As such, the value of (some) ARRs and FTRs could be less efficient than those formed by a market with financial participants.

Efficacy vs. Efficiency

The scope of work assigned to LEI by MISO employs the term "efficiency" in several instances.

In the first instance, MISO asks whether the current ARR/FTR construct is efficient in meeting its intended purpose.

In the second instance, MISO asks about the functionality of the FTR market. In relation to the market, LEI has applied an economics perspective, which corresponds to the concept of market efficiency, and specifically whether market prices reflect all available and relevant information to ensure productive and allocative efficiency.

To avoid confusion, in Task 1 of this report, when discussing whether the ARR/FTR construct is meeting its intended purpose, LEI applies the concept of "efficacy." When referring to issues related to FTR auction performance, LEI uses the term "efficiency."

LEI was asked to examine the equity of financial traders' participation in the FTR market. LEI understands that the equity consideration around financial traders is in relation to transmission customers. For equity between LSEs and financial traders, LEI evaluated whether the risk and opportunities for different market participants are comparable, and whether there is material difference in the balance between the risk and reward for each group. As noted above, financial traders contribute positively to efficient FTR market outcomes, which in turn benefits transmission customers. LEI found that on an aggregate basis, financial traders as a group earned net profits from purchasing FTRs in MISO. But within the net profit calculus, there are many individual FTR purchases that were not profitable. LSEs also earned net profits overall, but also incurred losses on individual FTR purchases. Such findings are consistent with competitive market expectations. If financial traders chronically incurred economic losses from their participation in FTR auctions, they would eventually exit the market. The presence of economic profit opportunity attracts financial traders to the FTR auctions, which then yields a variety of benefits to LSEs, as discussed further in this report. LEI's analysis also found that the FTR market has been attractive to and has attracted new entrants. This means that the FTR market is contestable, alleviating concerns around lack of competition and associated negative consequences.

Is the TCM an effective metric?

LEI was asked to assess whether the transmission customer metric ("TCM") should be used as a metric to evaluate the efficacy of the ARR/FTR construct. LEI examined the TCM in detail and concluded that the TCM value is impacted by both the functioning of the ARR/FTR mechanism and decisions made by LSEs on whether to hold their ARRs or to self-schedule (thereby converting their ARRs to FTRs). In recognition of the impact of LSEs' decisions on the TCM, LEI recommends that MISO calculate additional metrics that would allow transmission customers to understand the range of financial benefits that they would receive if LSEs made different choices with respect to the ARRs that they hold.

In addition, because of the forward nature of the ARR/FTR construct, the TCM is also impacted by the frequency and extent of unexpected (difficult to predict) market conditions in the DA energy market, which is outside the control of any market participant. One factor contributing to the decline of the TCM value in recent years is such unexpected (difficult to predict) market events. For example, the annual FTR auctions held in May of 2020 (which covered FTRs for December 2020 to February 2021) would not have anticipated the extreme weather that occurred the week of February 9, 2021 (Winter Storm Uri), which caused record energy prices (and unprecedented amount of congestion).[2]

LEI observes that the TCM does not explicitly measure the benefits of financial traders to MISO's FTR market. Those benefits – including more efficient and liquid FTR auctions, and more liquid forward energy markets – are incremental to the direct payouts that LSEs/transmission customers receive from ARRs and FTRs. Given the decentralized nature of the forward markets, fully quantifying these incremental benefits within the TCM is not possible. However, these benefits are likely to be substantial as indicated by a material increase in activity on exchanges where energy forwards are bought and sold for MISO delivery points in the aftermath of the FTR auctions.

Task 3: identify any gaps or opportunities for improvement – LEI's findings

One of the major gaps in the current ARR design is the use of a historical year in the ARR entitlement process. LEI's analysis of trends in the changeover in entitlements versus the changes in the generation fleet suggests that the continued use of a fixed historical year for a majority of the entitlements is creating a misalignment between ARR entitlements and transmission customers' utilization of the transmission system, which would undermine the ability of the ARR/FTR construct to assist in hedging congestion risk. LEI heard from MISO stakeholders that it is very difficult to change entitlements, even when their arrangements with generators evolve (for example, because a new generation asset comes online, a power purchase agreement ("PPA") with a generator terminates, or a generator retires). The result is that some LSEs cannot acquire ARR paths that would provide them with an opportunity to hedge the DA congestion that they actually face, given the location of their load and the generation resources they are relying on for power supply. LEI recommends that MISO explore changing the basis for the ARR entitlements

[2] Potomac Economics. "IMM Quarterly Report: Winter 2021." April 15, 2021

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717 Atlantic Avenue, Suite 1A
Boston, MA 02111
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so that there is greater alignment with current network use. LEI also recommends that MISO consider expanding the combination of nodes that can be used in the entitlement and ARR process so that LSEs can hedge a variety of commercial arrangements, not just historical paths from specific generators (sources) to load (sinks).

Another identified gap relates to the TCM. The TCM provides an incomplete picture of the value of the rights that transmission customers are granted (in the form of ARR entitlements) given they pay for the transmission system. Thus, LEI recommends that MISO estimate two additional hypothetical TCM metrics, namely:

1) a ***self-scheduling strategy hypothetical TCM***, which would estimate the payment that transmission customers would have received if all ARRs were self-scheduled (e.g., converted to FTRs); and

2) an ***ARR holding strategy hypothetical TCM***, which would estimate the payment that transmission customers would have received if LSEs held on to all their ARRs.

In addition, the current TCM includes FTR funding target to transmission customers resulting from FTRs purchased by LSEs "out-of-pocket"[3] in annual FTR auctions, which can distort TCM results. If the primary purpose of the TCM is to value the efficacy of the ARR/FTR construct, payments to transmission customers from "out-of-pocket" FTR purchases should be removed from the TCM formula because including payments from "out-of-pocket" FTR purchase distorts the amount of DA congestions purely from the ARR process.

In its review of the FTR auctions, and based on discussions with stakeholders, LEI determined that there is also a potential benefit to market participants if MISO were to expand its FTR products to include more time periods per day (such as early morning, morning, afternoon, and night, instead of just peak and off-peak)[4] in the annual and monthly auctions. Given the evolution of the generation fleet and changing load profiles (due to electrification trends), LEI expects that this additional granularity in FTR products would allow LSEs and other market participants to more effectively hedge their congestion risk.

In response to questions about the overall competitiveness of the FTR market, LEI would also recommend that MISO monitor and report trends in the number of auction participants over time.

Finally, LEI acknowledges that there have been some concerns raised by the internal market monitor ("IMM") and some stakeholders about the Multi-Periods Monthly FTR Auctions ("MPMAs"). LEI observed that LSEs rarely participate in the MPMAs as compared to financial traders. The majority of transactions in the MPMAs are completed by financial traders. LEI theorizes that the reduced participation by LSEs is due (at least, in part) to the fact that LSEs do

[3] "Out-of-pocket" purchases are FTRs that LSEs purchase in annual FTR auctions. This differs from FTRs obtained by LSEs through the conversion of ARRs to FTRs.

[4] Similarly, the weekend days should also have this additional differentiation. Currently, all weekend hours are counted as part of the "off-peak" period.

not receive free ARR entitlements to use in the MPMAs. Before holding MPMAs, MISO updates its network models with new information about network availability; this causes the release of additional network capacity for purchase in the MPMAs (this results in clearing of new forward flow FTRs), as well as the need for MISO to ensure the auction result respects network capacity that is no longer available (which results in the clearing of counter-flow FTRs). Financial traders take advantage of both opportunities. In contrast, it was suggested that LSEs do not take advantage of these opportunities in the MPMAs, as they may be viewed as speculative by state regulators. One option MISO can consider is awarding additional entitlements (in the form of free month-specific FTRs) for MISO system capacity that become available in the MPMAs to LSEs that have not been able to receive ARRs up to their full peak load. The LSEs can choose to hold those FTRs (and receive the DA congestion revenues) or sell them in the MPMAs (and receive the auction proceeds). LEI theorizes that such additional entitlements can motivate more LSEs to participate in the MPMAs. In addition, this would ensure that the rights to DA congestion revenues are first offered to LSEs (and transmission customers).[5]

Another reason that causes network model changes between annual FTR auctions and MPMAs is transmission outage schedule changes. Currently, transmission owners do not have strong incentives to accurately predict transmission outage schedules before the annual FTR auctions. As outage schedules becomes clearer and as it gets closer to actual outage time periods, MISO must update the network model to accommodate this updated information, and such updates result in profit opportunities in the MPMAs (which benefits financial traders more than LSEs due to their different level of participation in the MPMAs). Therefore, LEI recommends MISO explore ways to incentivize scheduling and undertaking of transmission outages that align the ARR and FTR markets with DA energy market outcomes.

In terms of profitability from counter-flow trades,[6] LEI understands that MISO is currently in the process of addressing differences in its network models for the FTR auctions and DA energy markets, which may have implications on realized profits for counter-flow FTRs in the future. After addressing these model differences, and before making any further changes, MISO should assess whether there is continued and consistent counter-flow FTR profitability in the MPMAs.

In summary, LEI recommends the following changes to the current ARR mechanism, FTR market, and TCM:

1. consider changing the basis for ARR entitlements to better align with current network use in order to more effectively meet the original purpose of the ARR/FTR mechanisms;

[5] Holistically, if entitlements are provided to LSEs in the MPMAs, the TCM should also be changed to include the FTR funding target and ARR settlement target from these monthly entitlements. The language in MISO's Business Practices Manual describing the purpose of ARRs will also need to be updated.

[6] Counter-flow FTRs are FTRs where the expected marginal congestion component of the sink is lower than that of the source, resulting in a negative FTR value.

2. expand the combination of nodes that can be used for entitlements and nomination of ARRs in order to provide LSEs more flexibility;

3. expand annual and monthly FTR auction products to include more granular time periods (for example, four mutually exclusive time periods per day, weekday and weekend, rather than current peak and off-peak);

4. provide an entitlement FTR product to qualified LSEs, if additional MPMA network capacity is available;

5. monitor and report trends in the number of auction participants over time to ensure continued contestability of the FTR auctions;

6. explore ways to incentivize scheduling and undertaking of transmission outages that align the ARR and FTR markets with DA energy market outcomes;

7. review the effectiveness of MISO's efforts in addressing the network modeling differences between the FTR and DA energy models;

8. establish two new metrics to supplement the TCM: the self-scheduling strategy hypothetical TCM and the ARR holding strategy hypothetical TCM; and

9. remove payments from "out-of-pocket" purchases from the TCM formula.

2 Answers to questions posed in the scope of work

1) **What objectives and criteria should be used to evaluate the efficiency and equity of the FTR markets? What specific metrics should be used?** The overarching objective should be to assess whether the current ARR/FTR market is achieving the goal that was set when these markets and mechanisms were first introduced. LEI considered the following economic criteria in its review: allocative efficiency, market efficiency, equity, contestability, and transparency. *For a discussion of the stated goals of MISO's ARRs/FTRs, please see Section 5.2, and for a description of the criteria used by LEI in this report, please see Section 4.*

2) **Could MISO improve the TCM?** The TCM does not offer a complete picture of the benefits of the ARR/FTR construct to transmission customers, and some benefits may be difficult to capture as they arise outside of the MISO-administered markets. The TCM is also influenced by the fundamental nature of the FTR auctions, which occur well in advance of the DA energy market, coupled with the impact of difficult to predict factors on DA congestion. The annual FTR auction occurs up to 12 months before DA congestion costs are calculated – therefore, there is always some forecast risk that can affect outcomes, and that forecast risk varies with the decisions that LSEs make around ARRs. For that reason, LEI recommends that MISO start reporting two additional complementary metrics on the current TCM. *Section 8.6 provides a more detailed description of these two additional metrics.*

3) **How can MISO assess FTR market competitiveness?** Traditional competition analysis cannot be readily applied to FTR market given the complexity in defining the market and data availability. However, LEI was able to determine the change in the number of market participants over time, which supports the conclusion that FTR auctions are contestable: new entry provides the competitive discipline over time. As such, LEI recommends that MISO monitor and report trends in the number of market participants routinely. In addition, LEI found that annual FTR auction prices were relatively good predictors of DA congestion costs, which suggests that the annual FTR auctions are efficient and generally functioning well. *Please see Sections 6.12 and 8.7 for a discussion of these findings.*

4) **If market competition concerns exist, how can MISO identify the root causes?** LEI observed that LSEs tended to purchase only certain FTR paths and have a minimal role in the MPMAs. LEI understands that this may be the result of individual companies' risk tolerance, risk management policies and regulatory guidance. LEI recommends adding an entitlement FTR product if additional network capacity is available in the MPMAs. This may help motivate LSEs' participation in the MPMAs, without necessitating LSEs to take on any additional risk. Moreover, the additional TCM metrics that LEI recommends MISO publish may provide greater clarity on the value of the entitlements under the ARR/FTR construct which, in turn, may also result in behavioral changes by LSEs to take advantage of opportunities provided in the ARR construct. More generally, additional transparency about the network models that MISO uses may likewise help improve confidence in outcomes and attract more market participants. *Please see Sections 6.13.2, 8.2, and 8.7 for more information on this topic.*

5) **What are the benefits of financial trader participation in the FTR markets? Are they being realized?** There are several benefits to the participation of financial traders in the market. These include providing liquidity to the FTR auctions, supporting the development of market-based price signals for all FTR pricing points in the auctions, enhancing the ability of LSEs to opt for holding their awarded ARRs (and therefore get an advance payment of expected congestion costs), and reinforcing liquidity in the forward energy market (by virtue of the information on expected congestion that is released after the annual FTR auction results are published). *Please see Sections 7.3, 7.5, and 7.8.2 for a discussion of these benefits.*

6) **What is the impact of financial traders on MISO's TCM?** There are situations in which market outcomes lead to reduced revenues for LSEs. This happens when profitable FTRs are acquired by financial traders in the annual FTR auctions, although the relationship between financial traders' profit and TCM change is not 1-to-1. However, the TCM alone does not fully capture the benefit to transmission customers that financial traders bring to the FTR auctions and the broader forward energy markets. These benefits would not be realized if financial traders were constrained in their participation in the annual FTR auctions. Furthermore, the current TCM definition does not capture MPMA results. If MISO and stakeholders decided that LSEs should obtain entitlements ahead of the MPMAs, the TCM should be updated to include results from MPMAs as well. *Sections 7.4 and 8.6 provide a more detailed discussion of the implications of financial traders on the TCM and the broader market.*

7) **How can MISO assess equity in the FTR markets?** Equity, in the context of Task 2, can be analyzed by looking at whether clearing prices in the FTR market have been efficient. LEI concludes that the annual FTR auctions have been efficient. LEI also describes how transmission customers have benefited from the participation of financial traders in the FTR auctions. *Please see Sections 7.1, 7.3, and 7.5 for further information.*

8) **Are there any improvements MISO could make to increase ARR/FTR market efficiency, liquidity, and/or equity?** Yes, LEI recommends several changes to the ARR process and the FTR market to improve the efficiency of the ARR allocation process, FTR auctions, and equity of outcomes. On the ARR process, LEI suggests changing the entitlement process to focus on current network use and providing transmission customers with an expanded set of paths during the ARR nomination process. In relation to the FTR market, LEI proposes that MISO consider including additional FTR products to allow more effective hedging opportunities for energy generated from intermittent resources. In addition, LEI recommends that—to the extent that MPMAs involve the sale of additional network capacity rights—capacity should flow first to ARR holders that have not been allocated their 100% peak load as entitled FTRs. LEI also suggests that MISO publish additional metrics to help transmission customers better understand the TCM. Finally, LEI recommends that MISO track market participation in the FTR auctions to ensure that the market remains contestable and open to new entrants. *Please see Section 8 for a detailed description of these recommended changes and improvements.*

9) **Are there improvements MISO could make to improve alignment between MISO's ARR/FTR and Day-Ahead Energy and Operating Reserve markets?** LEI understands that MISO is currently in the process of addressing the differences in the network models used in the FTR auctions and DA energy markets (specifically, by harmonizing the Generation Shift Factor ("GSF") cut-off in the FTR model and the DA energy market model). LEI proposes that MISO review the effectiveness of this effort as a solution to observed levels of profitability on counter-flow FTRs. In addition, LEI recommends that MISO consider exploring ways to incentivize scheduling and undertaking of transmission outages in a manner that (1) harmonizes the ARR and FTR markets with DA energy market outcomes, and (2) maximizes the value of ARRs and FTRs to transmission customers. *Please see Section 8 for a detailed description of these recommended enhancements.*

10) **Could new products be developed?** Yes. LEI proposes that MISO create new FTR products that would allow LSEs to more effectively manage congestion risk given the generation patterns of renewable resources and evolving pattern of demand (due to electrification activities). LEI recommends that MISO create new FTR products that are more granular than the current peak/off-peak products, reflecting four time periods in each day: morning, afternoon, evening, and nighttime. LEI also recommends alternative procedures for the determination of entitlements and allocation of ARRs (including creating opportunities for the nomination of ARR paths that are not currently available) so that LSEs can maximize their opportunities to hedge the congestion they face in the DA energy market given their current resource and load obligations. *Section 8.3 provides a discussion of this recommendation.*

3 Introduction and overview of the scope of work

The ARR/FTR market was designed as a financial mechanism for LSEs and other market participants to hedge congestion charges in MISO's Day-Ahead energy and operating reserve markets. In 2005, MISO held its first FTR auction. In 2007, MISO began allocating ARRs, which entitled ARR recipients to receive revenues from FTR auctions or to convert the ARR into a FTR. This contrasts to the practice of directly allocating FTRs to qualified market participants, which was done in the first two years of FTR auctions.

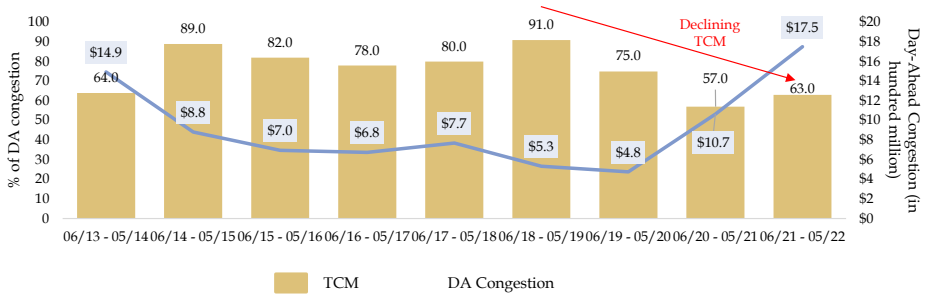
MISO initiated this engagement because stakeholders expressed concern with the decrease in the TCM over the past few years. The TCM was created to assess the value of ARRs (and FTRs) to transmission customers. The TCM formula is shown in Figure 1; the numerator consists of revenues distributed to ARR holders, while the denominator is the total DA congestion.

Figure 1. TCM formula

$$TCM = \sim \frac{\left(\text{FTR Revenue}_{\textit{Purchased in Auctions}}\right) + \left(\text{FTR Revenue}_{\textit{Converted from ARRs}}\right) + \left(\text{ARR Revenue}_{\textit{ARR Payment and Stage 2}}\right)}{\text{Total DA Congestion Revenue}}$$

As shown in Figure 2, the TCM has been declining since 2018, while DA congestion (the denominator of the TCM) has been increasing. From planning year 6/2013 to 05/2022, the TCM averaged 77%. In planning year 2020-21, the average TCM has dropped to 57%. At face value, the lower TCM suggests that transmission customers are receiving a smaller benefit from the ARR/FTR mechanism. But this is an oversimplified interpretation. Based on MISO's internal assessment conducted in late 2021, the declining TCM is driven by weather-related uncertainty in forecasting DA congestion a year in advance (which can result in lower FTR auction revenues vis-à-vis realized DA congestion) as well as hedging decisions taken by ARR holders on whether to hold ARRs or self-schedule and obtain FTRs , which is discussed further in Section 6.13.4.[7] LEI has independently analyzed the components of the TCM and concurs with the findings from MISO's internal assessment. The TCM is not an indication of any flaws in the market design or an inefficient annual FTR auction.

Figure 2. Historical TCM



Source: MISO. "ARR/FTR Transmission customer Metric." March 10, 2022.

[7] MISO. "Transmission customer Metric." October 7, 2021. p. 6.

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Boston, MA 02111
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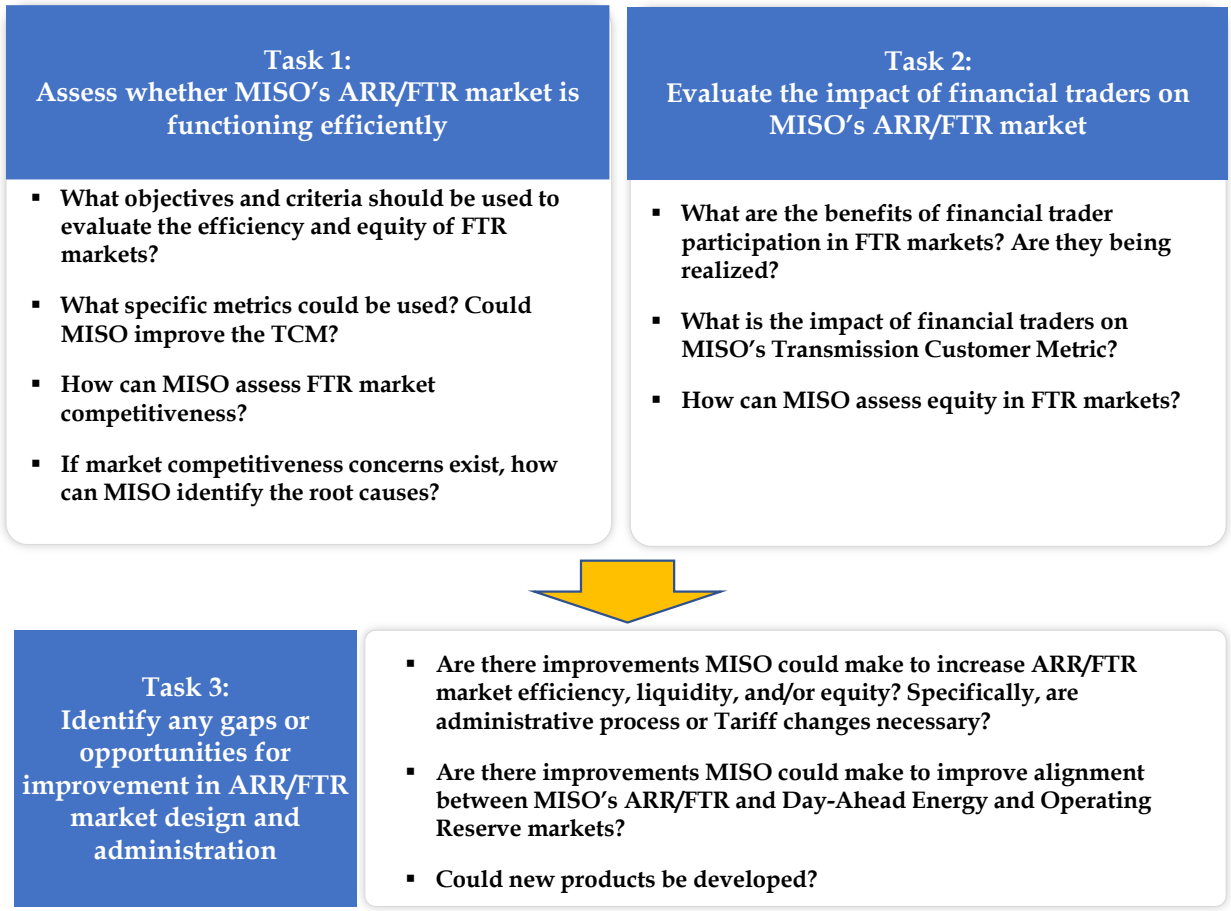
As required by this engagement, LEI analyzed the functionality and efficiency of the ARR and FTR mechanisms, identified the causes of any observed efficiency declines, and recommended enhancements to MISO's ARR/FTR design. Figure 3 lists the key questions that MISO asked LEI to address in the terms of reference. This report addresses these questions – see Section 2 for a summary of LEI's answers.

Figure 3. Key questions addressed in this engagement



In addressing these questions, LEI employed a data- and research-based approach to methodically assess the ARR mechanism and FTR market (Task 1) and consider how different market participants affect market outcomes (Task 2). It is important to recognize that Tasks 1 and 2 are highly correlated, and certain analyses that LEI performed for Task 1 also provided insight into the findings of Task 2.

As shown in Figure 4, LEI's approach consisted of quantitative and qualitative components. In addition to research and analysis, LEI hosted several public stakeholder engagement sessions in August 2022. LEI staff also solicited comments from MISO staff and the IMM, Potomac Economics.

Figure 4. LEI's approach to this engagement

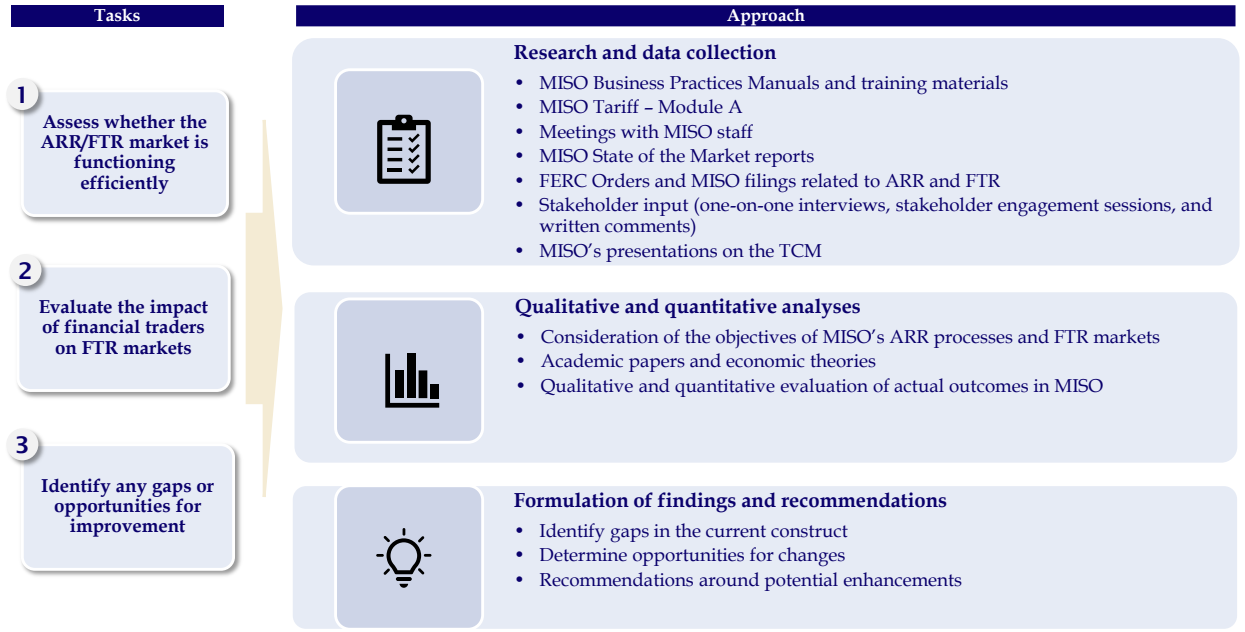
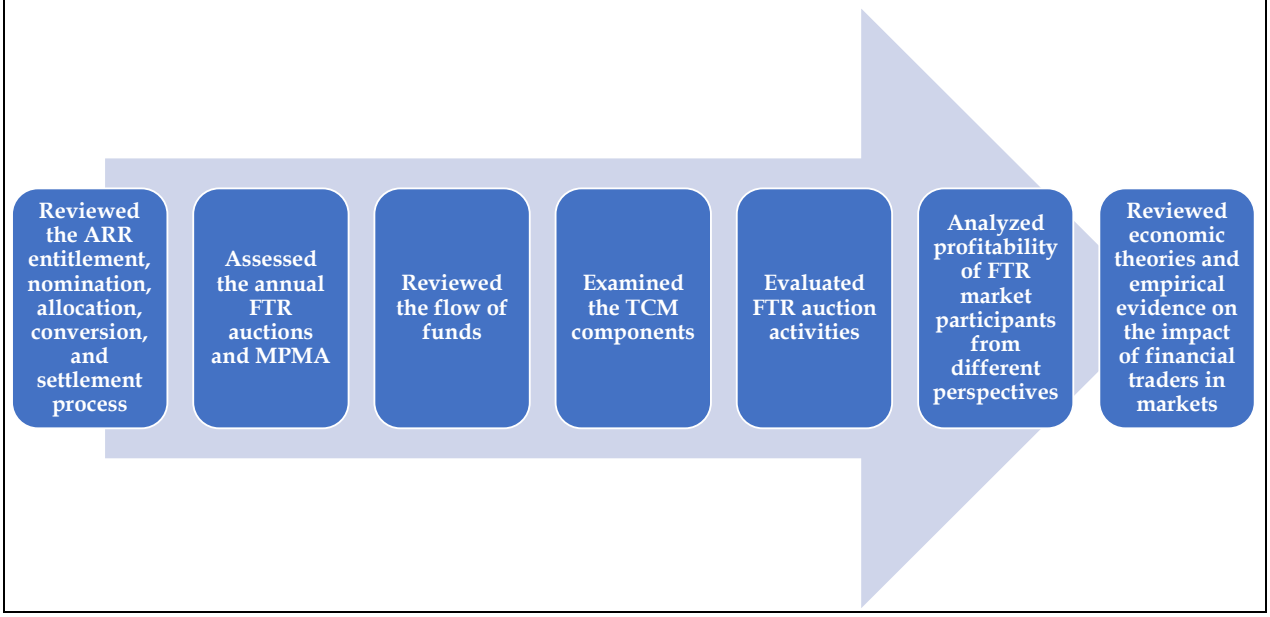


Figure 5. High level stages of LEI's analysis



LEI analyzed the various ARR, FTR, and DA market settlement processes. As shown in Figure 5, LEI began with a review of the ARR process, which includes entitlement, nomination, allocation, conversion, and payment settlement. Then, LEI reviewed the annual FTR auctions and MPMAs. LEI also assessed the flow of funds to understand who gets paid or pays up after the DA market when there is excess or shortfall funding, respectively, for ARRs and FTRs. Next, LEI evaluated in detail the components of the TCM and reviewed how each process mentioned above interacts

with the TCM. After reviewing the ARR and FTR processes, LEI used econometrics to examine activity in the FTR auctions relative to DA congestion, in order to determine whether FTR auctions have been efficient. LEI also analyzed the profitability of FTR market participants including LSEs as a class, financial traders as a class, individual financial traders, and individual FTR trades. These analyses were useful in understanding balance of risks and rewards reflected in market outcomes, and distribution of auction proceeds between financial participants and LSEs. While reviewing the profitability of financial traders in the MISO FTR market, LEI also reviewed economic theory related to financial traders and empirical evidence on how financial traders impact markets and the nature of the benefit to transmission customers within the ARR/FTR construct and more broadly. Detailed descriptions of LEI's analyses are presented in Section 6.1 for Task 1 and Section 7.1 for Task 2.

Lastly, stakeholders provided LEI with their views on the efficacy of the markets and, in some cases, offered suggestions on potential improvements to the ARR and FTR construct, which LEI considered and took into account as part of the analysis. At the stakeholder engagement sessions, LEI learned that most stakeholders support the current design and believe that ARR/FTR mechanisms are generally working as intended. In general, most stakeholders agreed that the ARR process and FTR market offer participants the opportunity to hedge congestion costs.

4 Purposes and criteria

Key takeaways

- Based on MISO's rules and its original FERC filings, the primary purpose of the ARR/FTR construct was to provide market participants with a hedging mechanism against congestion charges in the DA energy market.
- An additional purpose of the ARR/FTR construct is to expand the options for market participants and enable them to obtain a share of revenue generated in the annual FTR auction.
- LEI used two primary criteria – efficacy and equity – to evaluate whether MISO's ARR/FTR construct is achieving its intended purposes. These criteria were chosen because they are objective, quantifiable, and commonly used in regulatory economics and policy design. The first two tasks for this engagement relate to the issues of efficacy and equity and therefore are of primary importance to the evaluation.
- Transparency was also used as a supportive criterion in Task 1 that can reinforce (or hinder) the achievement of the primary criteria.
- Other criteria used under Task 2 include usefulness, which refers to whether financial traders' participation in the FTR market improves transmission customers' ability to hedge congestion risk and competition and contestability or the ability of firms to easily enter and exit the market.

4.1 The purpose of the ARR/FTR construct

For Task 1, LEI was asked to assess whether the ARR/FTR construct's efficacy in serving its intended purpose. To carry out this assessment, it is important to first identify the original purpose of establishing the ARR/FTR market, and to then create objective criteria for evaluating the functions of the ARR/FTR market against this purpose.

The original purpose of MISO's FTR construct was to provide market participants with a hedging mechanism against congestion charges. In 2003, when submitting its FTR market design proposal to the Federal Energy Regulatory Commission ("FERC"), MISO stated:

> *"FTRs will provide Market Participants[8] with a mechanism to protect themselves against fluctuations in the cost of congestion in the Transmission Provider Region. Holders of FTRs will be entitled to a stream of revenue whenever congestion occurs in the direction*

[8] The MISO Electric Tariff Third Revised Volume 1 (2003) defines Market Participant as "an entity that is qualified by the Transmission Provider to submit schedules for Self-Scheduled Resources, Bilateral Transaction Schedules, Bids, Offers, hold and sell FTRs, and settle in the Energy Markets and the FTR Auction." Source: MISO. *Initial Filling of Open Access Transmission and Energy Market Tariff* under Docket Number ER03-1118-000. July 25, 2003.

that the FTR is defined based on LMPs calculated in the Day-Ahead Energy Market. The stream of revenues associated with each FTR is derived from payments made by Market Participants for the cost of congestion (i.e., the cost of redispatch of higher cost facilities)."[9]

ARRs were introduced in 2007 when MISO replaced its direct allocation of point-to-point FTRs with the direct allocation of point-to-point ARRs. In its filing to FERC, MISO said that allocating ARRs annually will entitle "*the recipient to receive revenues from the auction of FTRs, rather than the existing procedure of directly allocating FTRs to qualified Market Participants.*"[10]

MISO's Business Practices Manual ("BPM") further helps us define the purpose of FTRs and ARRs:

> "*FTRs are financial instruments whose values are determined by the transmission congestion charges that arise in the Day-Ahead Energy and Operating Reserve Market, leading to differences in the Marginal Congestion Components (MCCs) of Ex-Post Day-Ahead Locational Marginal Prices (LMPs) at different locations. FTRs may be used to provide a financial hedge to manage the risk of congestion cost in the Day-Ahead Energy and Operating Reserve Market.*"[11]

> "*ARRs are financial instruments that entitle their holders to a share of the revenue generated in the annual FTR Auction. ARRs are initially allocated to Market Participants based on firm historical usage of the transmission network. Incremental ARRs may be allocated for Network Upgrades, and for new and replacement Network Resources.*"[12,13]

Hedging is an investment decision or strategy that attempts to reduce the impact of adverse fluctuations in the price of an asset. An entity that seeks to hedge its market position enters into a so-called offsetting position.

From a congestion risk management perspective, a transmission customer is exposed to congestion risk if locational marginal price of the source of its energy is different from that of its sink (i.e. load). The transmission customer can offset this risk if it can obtain a financial instrument that have a payout equivalent to the price difference between the source and sink nodes.

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[9] MISO. *Initial Filling of Open Access Transmission and Energy Market Tariff* under Docket Number ER03-1118-000. July 25, 2003. p. 20.

[10] MISO. *Compliance Filing of Midwest Independent Transmission System Operator, Inc*, FERC Docket No. 07-478-000. January 29, 2007. p. 5.

[11] MISO. *Business Practices Manual - Financial Transmission and Annual Revenue Requirements*. June 1, 2021. p. 27.

[12] Ibid.

[13] With respect to ARR/FTR, the MISO BPM defines Market Participant as "a valid legal entity that is qualified, pursuant to criteria and procedures established by MISO, to: submit bilateral transactions to MISO; submit bids to purchase energy and operating reserves, and/or offers to supply energy and operating reserves in the day-ahead and/or real-time energy and operating reserve markets; hold FTRs and submit bids to purchase, and/or offers to sell such rights; hold ARRs; and settle all payments and charges with MISO." A market participant therefore could be a financial trader, a generation owner, as well as an LSE.

Based on these authoritative documents, it is clear that the original purpose of the ARR/FTR construct is to provide market participants[14] with a financial hedging tool to manage the risk of congestion costs in the DA energy market. An additional purpose of the ARR/FTR construct is to enable transmission customers to obtain a share of revenue generated in the annual FTR auction.

After identifying the purposes of the ARR/FTR market, LEI identified the criteria that it would use to assess the efficiency of the market.

4.2 Criteria for Task 1

While Task 1 refers to "evaluating the overall efficiency of MISO's ARR/FTR Market," ARR by itself is not a market. When looking at ARR/FTR construct as a whole, it is more meaningful to evaluate whether the ARR/FTR construct is functioning efficiently to meet its intended purpose. For the avoidance of confusion, we refer "functional efficiency" as "efficacy" in this report, to separate from "market efficiency", which has more technical meaning from an economics perspective.[15]

This does not mean LEI did not investigate the market efficiency of FTR auctions in MISO. In fact, market efficiency of FTR auctions contributes to the efficacy of MISO's ARR/FTR construct, but it is not all of the factors that impact the efficacy. Since market efficiency involves analyzing FTR market results that are related to financial traders' participation, LEI places the discussion on market efficiency in Task 2.

In addition to the efficacy criterion, LEI also considered the **equity** aspect of the ARR/FTR construct. In this context, the equity criterion examines whether the market's current design returns congestion charges to transmission customers. Equity considerations are subjective, meaning that an outcome may be equitable from one party's perspective but inequitable or unjust from the perspective of another party. In the

Terminologies used in evaluating Task 1

Efficacy refers to how functionally efficiency is a mechanism for meeting its intended purpose.

Market efficiency measures how well current prices reflect all available, relevant information about the actual value of the underlying assets.

Equity reflects the fair treatment of affected parties. Assessing equity in competitive markets involves examining the distribution of benefits and profits from the purchase or sale of goods and services.

Transparency indicates a condition whereby every market participant has timely access to relevant information for decision-making in an auction or regulatory context.

[14] This refers to market participants. LSEs and financial traders are each a subgroup of market participants. The current BPM and the original intent of ARR/FTR do not distinguish between LSEs and financial traders.

[15] ***Market efficiency*** describes a situation where the auction clearing price reflects the market's expectations of future congestion.

context of ARRs and FTRs, subjectivity occurs when similarly sized and similarly situated LSEs receive differing congestion charges.

LEI also used **transparency** as a secondary criterion. Market participants need timely access to information to make informed decisions. Information asymmetries have long been recognized as a major obstacle in markets.[16] Transparency promotes equitable and efficient outcomes. Equity is supported because transparency allows stakeholders/market participants to recognize distortions or inequitable outcomes, if there are any. Furthermore, market transparency ensures access to relevant information, which aids in reducing risk and uncertainty and is therefore also supportive of efficiency. In this respect, transparency facilitates efficient outcomes by resolving information asymmetries that can impede competition.

Task 1 also required LEI to investigate the TCM as a metric. As described in Section 3, the TCM has a specific purpose. In its assessment, LEI considered whether the TCM results in an equitable and efficient outcome for transmission customers. LEI asked the following questions:

- Does a lower TCM reflect poor ARR/FTR performance, and is the ARR/FTR mechanism fulfilling its purpose?
- Does a higher TCM mean that the ARR/FTR mechanism is achieving its intended purpose?
- Where does the money for each component of the TCM come from, and why should transmission customers be recipients of those funds?

In order to answer these questions, LEI looked at the various components of the TCM, and considered whether the components – individually or in concert – aligned with equity, efficiency, and transparency criteria.

4.3 Criteria for Task 2

Under Task 2, LEI was asked to evaluate financial traders' participation in the FTR market, assess the impact of financial traders' participation on the TCM, consider the benefits of financial traders' participation in the FTR auctions on the broader energy markets, and determine how MISO can assess equity in the FTR market. Analyzing the effect of financial traders' participation involves equity considerations, as profits earned by financial traders are correlated to lower TCM (although not a 1-to-1 relationship). There have been concerns that financial traders' purchase of FTRs contributed to the decrease in the TCM. Therefore, in this task, LEI also revisited how financial traders impacted the TCM, and specifically the role they played in the annual FTR auction.

[16] Information asymmetry refers to a situation in which different agents in an economic transaction might have different amounts of information. It is considered a type of market failure, as it often prevents market equilibria to be Pareto optimal.

To understand the benefits associated with the participation of financial traders in the FTR market, LEI first determined if market prices in the FTR auctions are efficient. LEI used market efficiency as a criterion for this piece of the analysis. An efficient annual FTR auction price gives transmission customers the opportunity to hedge the DA congestion they face with ARRs. LEI also examined the competitiveness of the FTR market. This was done by assessing whether the market is contestable; a contestable market will have competitive discipline from new entry.

Summary of criteria relied upon for Task 2

Market efficiency, as applied to Task 2, reflects how well current prices reflect all available, relevant information about the actual value of the underlying assets.

Equity refers to the risks and opportunities for different market participants and the balance between the risk and reward for each group.

Usefulness refers to whether financial participants in FTR market improve the ability of transmission customers to hedge congestion risk through ARR/FTR.

Competition and contestability imply a market that has no barrier to entry or exit, so firms can easily enter and exit the market with minimum or no sunk costs.

Next, LEI examined the economic theory behind engaging financial traders (also known as speculators) in various types of commodities and futures markets. Economic theory argues that in most situations, financial participants increase the likelihood that prices are efficient and, therefore, enhance liquidity and stabilize futures markets. Empirical studies have shown that the participation of financial participants tends to drive the price of the target asset toward the fundamental value, thereby making the market more efficient.[17] This is the principle which energy market designers used for advocating for virtual bidding to get convergence between the day-ahead and real-time energy markets.[18] The presence of a large number of financial participants may ensure a more efficient dissemination of information into asset prices. Furthermore, multiple empirical studies and "laboratory" economic experiments have found the rate of dissemination of information in the trading process to be remarkably high.

Then, LEI assessed how the MISO FTR market specifically benefits from financial traders' participation. MISO's FTR market rules may differ from those of other FTR market, resulting in certain benefits that are unique to the MISO market. For example, participating in an FTR market with a large share of vertically integrated utilities results in benefits that differ from those of more liberalized markets in the US (such as PJM). LEI assessed the benefits brought by financial traders to the MISO market by conducting a thought experiment on a hypothetical case where financial traders do not participate in MISO FTR market. By comparing possible market outcomes with and without financial traders, as well as FTR auction mechanics and flow of funds at different stages of the MISO ARR/FTR process, one can have a clearer picture of the benefits of financial traders in the MISO FTR market.

[17] Catalyst Institute Monograph Series. "The Contribution of Speculators to Effective Financial Markets." p. 8-29.

[18] FERC. "Energy Primer – A Handbook for Energy Market Basics" April 2020. p.68

With regard to the second question on the impact of financial traders on the TCM, LEI first reviewed the TCM's components to determine the drivers of TCM trends. This included looking at the FTR revenues of ARR holders; ARR holders' FTR purchases and sales in the annual FTR auction and MPMA; annual auction revenues for Stage 1 and Stage 2 ARR allocations; and DA congestion distributed to FTRs holders. Then, LEI assessed the flow of funds for each stage of the ARR/FTR auction cycle along with the settlement process.

For equity between LSE and financial traders, LEI evaluates whether the risk and opportunities for different market participants are comparable, and whether there is material difference in the balance between the risk and reward for each group.

LEI used the results of Tasks 1 and 2 to recommend solutions to enhance the efficiency, efficacy, and equity of the MISO ARR/FTR construct.

5 Introduction to the MISO ARR and FTR institutions

Key takeaways

- MISO started trading FTRs in 2005 and added ARRs in 2007. MPMAs were added in 2013.
- The integration of MISO South in 2013 expanded MISO's market footprint.
- FTRs are financial instruments that pay to an FTR holder the accumulated DA energy market congestion costs for a specified period and a specified source-to-sink path. FTR auctions currently trade eight products (on and off-peak for four seasons). Any market participant can buy an FTR.
- Counter-flow FTRs are negatively priced FTRs that MISO uses to pay a market participant to accept an FTR obligation in the opposite direction. This helps to cancel out excess FTRs.
- ARRs are entitlements that entitle their holders to a share of the revenue generated in the annual FTR auction or the ability to convert the ARR into an FTR. Transmission customers and their agents (LSEs) are qualified to obtain ARRs.
- MISO conducts MPMAs to sell residual FTRs and facilitate the buying and selling of existing FTRs by market participants.

5.1 Overview of the MISO market

MISO was established in 1998 as an Independent System Operator ("ISO") after FERC accepted its organizational plan and initial transmission tariff. The organization initially only offered transmission services to increase grid stability. Subsequently, in response to FERC Order 2000, MISO became the nation's first Regional Transmission Operator ("RTO") (FERC docket No. R01-87-000).[19] MISO formally started its centrally organized wholesale market for energy, including its FTR market, in April 2005. In addition to day-ahead and real-time ("RT") markets, MISO operates an ancillary services market that began in 2009.[20]

Currently, MISO's membership includes 56 transmission owners ("TO") and 128 non-transmission owners, which include transmission-dependent utilities, independent power producers ("IPPs"), power marketers, and other categories of wholesale market participants.[21]

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[19] MISO Energy. *Timeline of our past 15 years*. <http://timeline.misomatters.org/>.

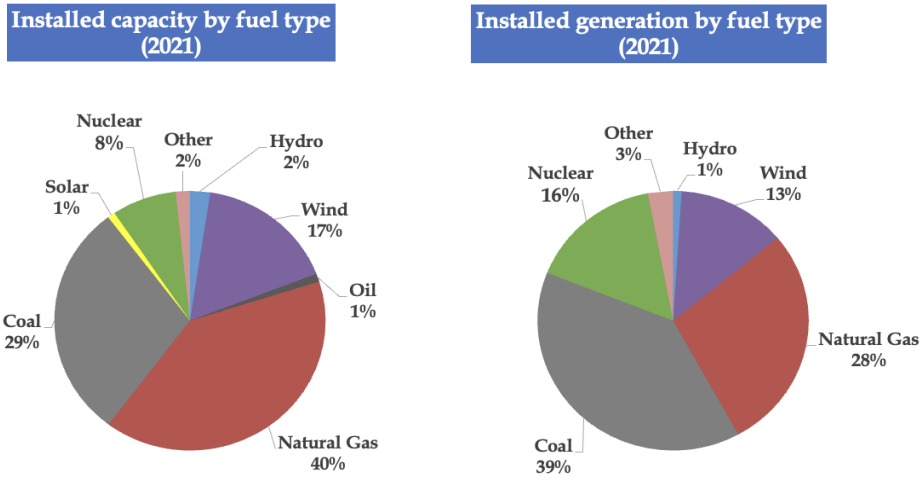
[20] Currently, MISO's energy and operating reserves market includes a day-ahead market and a real-time market. MISO also administers a Planning Resource Auction ("PRA") for capacity to ensure resource adequacy.

[21] MISO Energy. *MISO Corporate Information*. <https://www.misoenergy.org/about/media-center/corporate-fact-sheet/>.

MISO oversees a transmission system with 65,800 miles of transmission lines, and installed capacity of nearly 200,000 MW of power annually serving about 42 million people.[22]

Figure 6. Snapshot of the MISO market

Key facts (2021)	
Installed capacity	198,600 MW
Peak demand	130,900 MW (July 2011)
Transmission lines	Approximately 65,800 miles
People served	Approximately 42 million people
Area served	15 U.S. states and the Canadian province of Manitoba



Source: MISO. *Corporate Information*. December 2021.

MISO's footprint consists of load that is still primarily served by regulated and vertically integrated utilities. Therefore, most generation investment is primarily driven by traditional integrated resource plans and financed by regulated utilities. Notably, only three states[23] within MISO have retail competition, namely, Illinois, Michigan, and Texas (although MISO's footprint in Texas encompasses the service area of a vertically integrated utility).

MISO's fuel mix is dominated by coal and natural gas, each making up about 29% and 40% of the installed capacity, respectively, as shown in Figure 6. The contribution of gas-fired plants to total net generation increased from 19% in 2011 to 28% in 2021. This change can be attributed to a combination of coal retirements due to economics and more stringent environmental rules, as well as favorable fuel pricing conditions for gas-fired technologies. Over the past decade, the

[22] Ibid.

[23] MISO also only serves parts of Illinois and Texas.

penetration of wind resources in the MISO system has consistently increased as baseload coal resources gradually retire. Wind output now contributes to more than half of the real-time congestion in MISO.[24]

Coal is the dominant fuel type in MISO North, accounting for 35% of total capacity. It is followed by gas at 30% and renewable resources at 27%. MISO South, on the other hand, is dominated by gas, which accounted for 68% of total capacity in 2021. It is followed by coal at 17% and renewable resources at 5%.

5.2 ARR and FTR market history

MISO began planning an FTR market as early as 2003. In its initial filing of the Open Access Transmission Tariff ("OATT") and Energy Markets Tariff to FERC, it discussed its plans with respect to the type of FTR mechanism that it wanted to implement, uses of the FTRs by FTR holders, the type of FTR products it will offer in the future, and equitable FTR allocation methods.[25]

The FTR market in MISO was implemented in 2005 with the overarching purpose of providing market participants with a hedging mechanism against congestion charges collected in nodal energy markets, as discussed in Section 4.1.[26]

The first rendition of the MISO FTR mechanism did not have ARRs. ARRs were introduced in 2007, along with other market design changes. MISO replaced its direct allocation of point-to-point FTRs with the direct allocation of point-to-point ARRs. This was followed by the introduction of auctions for FTRs. MISO also changed its annual schedule for ARR allocation and auction of FTRs to align with the schedule used by PJM.[27] Additionally, MISO introduced long-term transmission rights ("LTTR"), which market participants could convert to equivalent point-

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[24] Potomac Economics. *2021 MISO State of the Market Report*. June 2022. p. 8.

[25] Initially, FTR allocation was a contentious issue during market design development, in part because the existing pre-OATT and OATT transmission rights in the MISO footprint did not appear to convert easily into FTRs that market participants believed would be sufficient to hedge their long-term contracts/investments. In the stakeholder process on market design, a number of different approaches were assessed. This included a MISO proposal to assign a certain percentage of FTRs based on historical use of network resources, as well as a stakeholder proposal that all FTRs be nominated voluntarily by market participants between their eligible points of injection and withdrawal. The market rules that were finally approved by FERC set out a "compromise proposal" for the annual allocation. The compromise allowed parties to voluntarily nominate FTRs between their eligible points of delivery and receipt. However, all parties remained eligible to receive a full allocation of nominated FTRs for resources used to serve load.[25]

[26] MISO. "Initial Filling of Open Access Transmission and Energy Market Tariff" under Docket Number ER03-1118-000. July 25, 2003. p. 20.

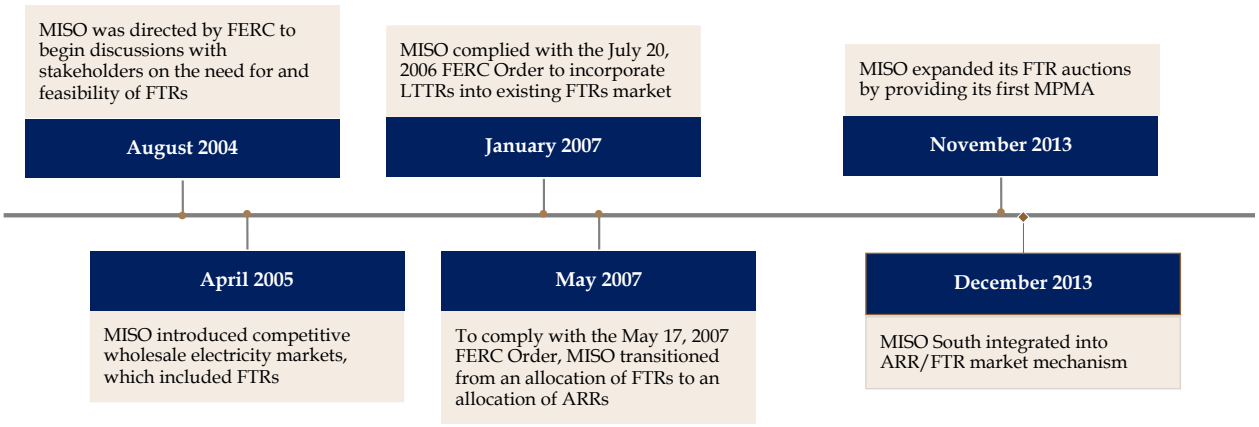
[27] FERC. "Order Accepting Long-term Transmission Rights Proposal and Revisions to Rules for Short-term Transmission Rights, Subject to Modification." May 17, 2007. (119 FERC ¶ 61,143).

to-point FTRs or use to collect FTR auction revenues. MISO's LTTRs have an annual term but can be renewed annually for up to 10 years.[28]

In December 2012, MISO proposed a monthly auction construct for FTRs, which FERC approved in August 2013. MISO held its first MPMA in November 2013.[29] MISO added the MPMAs to provide several additional trading opportunities for market participants; for example, giving FTR buyers a shorter-term monthly product (in contrast, a market participant could only buy a season-long FTR product in the annual FTR auctions). The MPMAs also gave LSEs and other market participants the ability to reconfigure FTR portfolios (i.e., buy/sell FTRs) closer to day-ahead markets. This allowed them to better manage risk, align with supply and demand expectations, and reflect updated expectations of the value of congestion costs.

In December 2013, MISO South was integrated into the MISO system, increasing the number of states completely or partially covered by MISO from 11 to 15. MISO South added approximately 40,000 MW of load and generation capacity as well as 18,000 miles of transmission to the system.[30] Figure 7 shows the key events in MISO's ARR/FTR market.

Figure 7. Key events in the ARR and FTR market



Sources: FERC. *Notice Inviting Comments on Establishing Long Term Transmission Rights in Markets with Locational Pricing*. June 27, 2005; FERC. Comments of the Organization of MISO States. Docket No. ER07-478-000. March 22, 2007; MISO. *MISO 2013 Annual Market Assessment Report*. June 2014.

[28] Ibid.

[29] FERC. "Order Accepting Tariff Amendments." August 2, 2013. (144 FERC ¶ 61,097).

[30] ACES Power. "ACES members Successfully Implemented into MISO South." December 20, 2013.

5.3 Annual ARR allocation process

ARRs are point-to-point (source-to-sink) financial instruments that entitle their holders to a share of the revenue generated in the annual FTR auction via the ARR settlement process. ARRs are restricted to generation-to-load paths in MISO. They are another type of hedging mechanism for congestion on a specific path. An ARR holder has the option to take the expected congestion costs on a specific point-to-point path a year in advance (based on the revenues generated in the annual FTR auctions) or to wait for the day-ahead energy market and receive (or pay) the actual DA congestion costs associated with the specific point-to-point path.

ARR sources are reserved source points ("RSPs"). RSPs are resources historically used by market participants to serve load in an ARR zone. RSPs include specific generators, system purchase contracts,[31] full responsibility purchases,[32] and full responsibility sales.[33] For a supply/generation resource to qualify as an RSP, the market participant must have had a capacity and energy ownership interest in, or a capacity and energy contract with, the resource that either began or ended in the reference year, which is 2004 (more specifically, the four seasons starting March 2004 and ending February 2005). The reference year for any new member is comprised of the four most recently completed seasons just before its integration into MISO. For example, for some members that joined MISO South in December 2013, the reference year for the RSP is 2013.

ARR sinks are ARR zones, or geographic areas where LSEs served load during the reference year. These locations are defined with the objective of allocating ARRs based on generation-to-load paths. Specifically, receipt points—or RSPs—are qualified generation resources historically used to serve the load located in the ARR zone during the reference year.

Zones may be one of the two following categories:

1. network integration transmission service ("NITS") reservation points of delivery are zones that correspond to Local Balancing Authorities Areas specified in the contracts existing in the reference year; and

2. ARR zones, which are requested by market participants to satisfy statutory or regulatory jurisdictional requirements.

[31] System purchase contracts are agreements for the purchase of energy that do not specify the resources that the seller shall select to supply.

[32] Full responsibility purchases are the total of all purchases coincident with the expected demand of the LSE under which the seller is contractually obligated to deliver.

[33] Full responsibility of sales refers to the total of all sales coincident with the expected demand of the LSE under which the seller is contractually obligated to deliver.

ARRs are initially allocated to transmission customers (and their representatives - LSEs) based on entitlements linked to the historical usage of the transmission network by the transmission customers or a transmission customer's responsibility to fund network upgrades. Historical usage is based on the market participant's reservation of point-to-point transmission service or the use of NITS.[34] It should be noted that using historical usage for ARR entitlements is not universal among US RTOs, as discussed in the text box below. LSEs granted ARR entitlements may then nominate ARRs and would receive ARRs subject to a Simultaneous Feasibility Test ("SFT") by MISO. The SFT assesses if the allocation of ARRs is feasible. A SFT is also used to determine whether FTRs sold through FTR auctions can be supported by MISO's transmission system.

> An SFT is a market feasibility test run by MISO that checks revenue adequacy. It ensures that MISO's transmission system can support the subscribed set of ARRs/FTRs during normal system conditions. MISO performs an SFT every time it awards new or reconfigures ARRs or FTRs in ARR allocation Stages 1A and 1B, the annual FTR auctions, and MPMAs. MISO simultaneously assesses the feasibility of the allocation of **all** ARRs and of FTRs sold through prior and current FTR auctions.
>
> Source: MISO. "FTR and ARR Business Practices Manual - BPM-004-r22." June 2021. Section 7.1. p. 157.

There are four key steps to the annual ARR allocation process, namely (i) registration, (ii) nomination, (iii) allocation, and (iv) settlement, as shown in Figure 8.

The first step of the annual ARR allocation process is the **ARR registration**. This step consists of gathering the initial data that defines the set of ARR sources and sinks,[35] and reviewing and approving historical firm transmission services that are eligible to obtain an ARR allocation through "ARR entitlements" granted in a new asset's first year. ARR entitlements are only available in the form of gen-to-load paths. Annual ARR registration for the asset in Year 2 and beyond entails only the second step, which involves reviewing and approving the ARR entitlements through the market portal.

> **Comments from stakeholders related to ARR entitlements**
>
> Some stakeholders expressed concerns over the difficulty of obtaining new entitlements in MISO and have even experienced ARR entitlement requests being rejected by MISO even though they provided relevant data. Multiple stakeholders have expressed that their experience in obtaining ARR paths for newly connected generation is smoother in Southwest Power Pool's ("SPP") entitlement process.
>
> In SPP, the entitlements are updated monthly using up-to-date information obtained from SPP's OASIS. LEI understands from MISO staff that MISO's OASIS does not have such information, and therefore if MISO is to adopt SPP's process, changes to MISO's information collection process are needed.

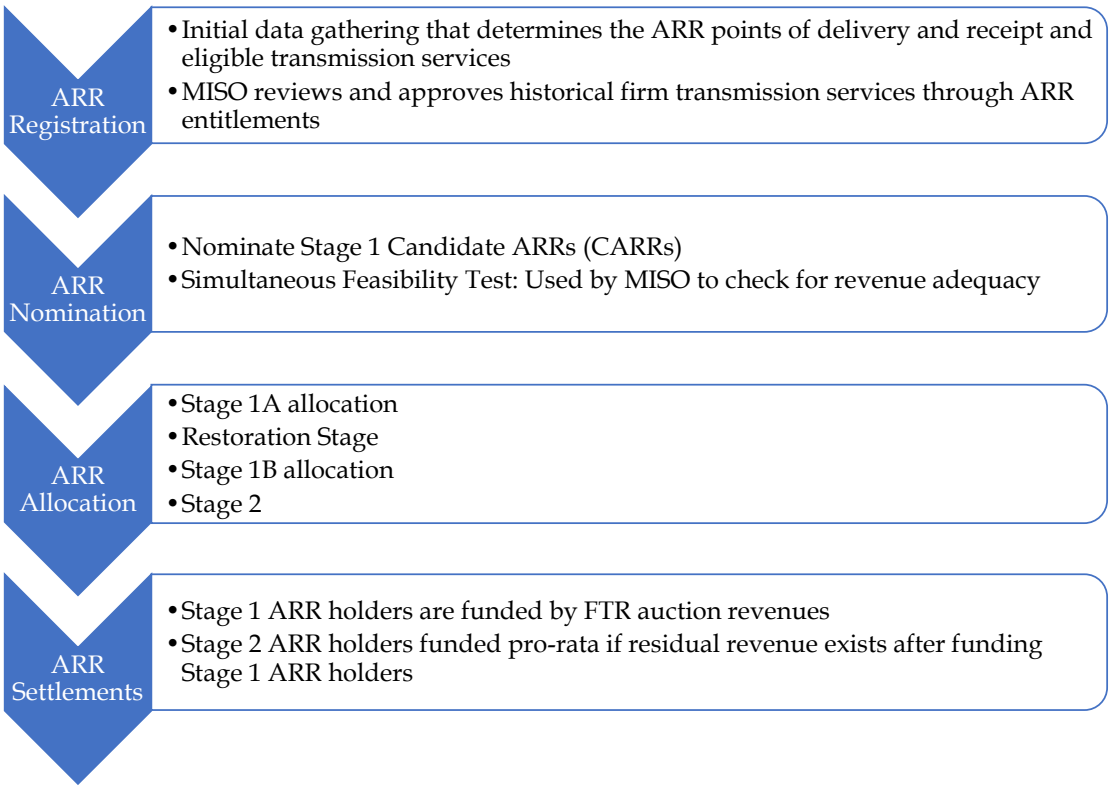
[34] MISO. "FTR and ARR Business Practices Manual - BPM-004-r22." June 2021. Section 3.8. p. 35.

[35] MISO. "FTR and ARR Business Practices Manual - BPM-004-r22." June 2021. Section 3.9. p. 41.

ARR zones (or the ARR sinks) are defined during the asset's first year and will not change over time to match changing load zone configurations. The ARR entitlements will also remain fixed after Year 1, barring any changes in the MISO footprint or the expiration of transmission service.

Once the ARR registration process is complete, MISO conducts the ARR nomination step in which LSEs decide the amount of ARR entitlements that they want to nominate – these are then referred to as Candidate ARRs (also known as "CARRs"). After the nomination step, MISO conducts the ARR allocation step of which CARRs are converted into ARR obligations subject to the SFT. This third step consists of a multi-stage process (Stage 1A, Restoration, Stage 1B, and Stage 2) that allows for not only the nomination/allocation of ARRs, but also the termination of previously assigned LTTRs and the assignment of excess FTR auction revenues to unallocated ARRs. Figure 8 depicts in detail the multi-steps process of the ARR allocation stages.

Figure 8. Annual ARR allocation steps



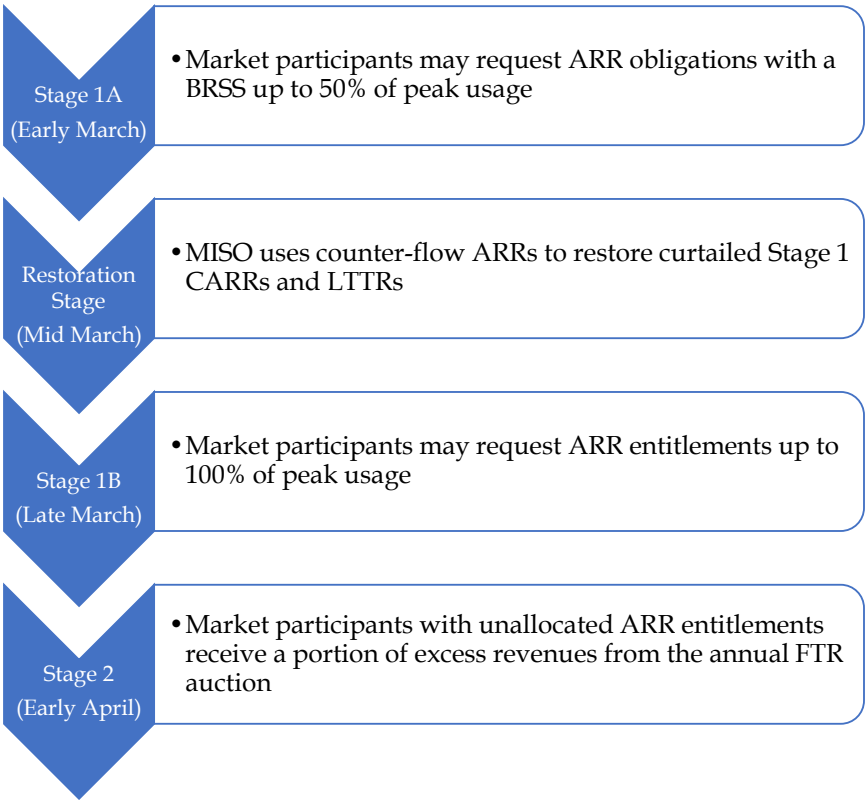
Source: MISO. "FTR and ARR Business Practices Manual - BPM-004-r22." June 2021.

Figure 9 illustrates the four stages within the ARR allocation step. Under **Stage 1A**, transmission customers may request ARR obligations with a Baseload Reserved Source Set ("BRSS")[36] of up to

[36] BRSS is the set of baseload supply resources that have met resource qualification requirements for inclusion as a reserved source point for a given ARR zone.

50% of peak usage.[37] Stage 1A includes eight independent nominations, resulting from combining four seasons (winter, spring, summer, and fall) and two periods of use (peak and off-peak). MISO assesses all CARRs by running an SFT to determine the amount of ARRs that could be awarded. ARRs granted in Stage 1A are known as LTTRs.[38]

Figure 9. Four stages in ARR allocation



Source: MISO. "FTR and ARR Business Practices Manual - BPM-004-r22." June 2021.

During the **Restoration Stage**, MISO determines whether it needs to restore all or a portion of curtailed (unallocated) Stage 1 CARRs and LTTRs using counter-flow ARRs. Counter-flow ARRs are MW quantities of Stage 1A eligible ARR entitlements that were not nominated in Stage 1A of

[37] MISO. "FTR and ARR Business Practices Manual - BPM-004-r22." June 2022. Section 3.9.2.1. p. 57.

[38] Ibid.

Year 1 annual ARR allocation.[39,40] Restoration involves putting the curtailed ARRs through the SFT and having the feasible ARRs readied for allocation in the next stage.

Like Stage 1A, **Stage 1B** has eight independent nominations (peak and off-peak for each of the four seasons). Any CARRs not allocated either during Stage 1A or the Restoration Stage are considered in Stage 1B as so-called infeasible ARRs.[41,42,43]

Unlike the earlier stages**, Stage 2** does not have an additional nomination process. MISO takes the annual FTR auction revenues from paths that were not part of the ARR entitlement process and distributes those revenues back to LSEs with unallocated ARRs entitlements (i.e., the difference between ARRs previously allocated and their nomination eligibility). So, LSEs receive a portion of the excess revenues from the annual FTR auction based on the share of their unallocated ARRs over the total unallocated ARRs.

5.4 FTR auctions

FTRs take the form of obligations, which means the holder of the FTR will receive credits (inflow) from MISO or charges (outflow) to MISO depending on relative level congestion level between the source and sink node. In other words, the buyer of an FTR could incur losses that are greater than the initial costs it paid to purchase the FTR.[44] The receipt point (source) and delivery point (sink) specified in each FTR may be any one of the following commercial pricing nodes ("CPNodes"):[45]

1. node for the generation resource;
2. ARR zone;

---

[39] MISO. "FTR and ARR Business Practices Manual - BPM-004-r22." June 2021. Section 9.1. p. 170.

[40] Available counter-flow ARRs are also a form of obligation. There are three types: (i) ARR entitlements not nominated in Stage 1A, (ii) LTTR termination requests submitted during Stage 1, and (iii) ARR entitlements defined from a high utilization factor unit RSP.

[41] If they are not allocated during Stage 1B, MISO will still allocate them as infeasible ARRs, subject to the same settlement process as other ARRs. However, they will be funded by an uplift charge paid by LTTR holders.

[42] In Stage 1B, market participants may request ARR obligations with HUFU, or any RSP in the BRSS for up to 100% of peak usage, subtracting the ARRs allocated in Stage 1A subject to the simultaneous feasibility test.

[43] In addition to Stage 1A and 1B nominations, market participants have the opportunity to request additional CARRs because of incremental load growth during the planning year. Network upgrades also present an alternative pathway to obtaining ARRs based on the capability resulting from additions and modifications, as well as consistency with previously assigned ARRs. If allocated, these ARRs will be LTTRs.

[44] This is as opposed to an option, of which the buyer will never incur losses greater that the cost it pays to purchase the option. FTR options exists in other RTOs in the US, but not in MISO.

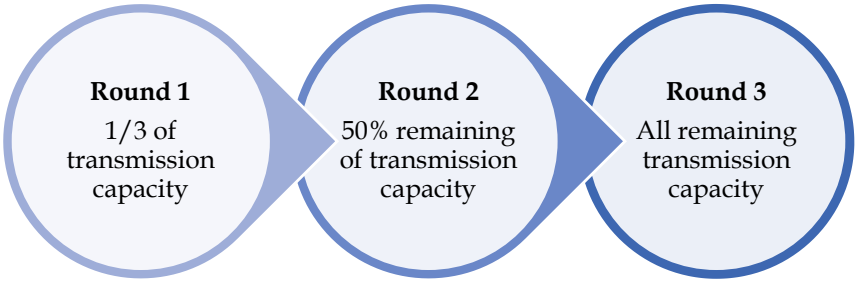
[45] MISO. *Business Practices Manual FTR & ARR.* June 1, 2021. p. 127.

3. hub;
4. load zone; and
5. interface.[46,47]

MISO conducts two types of auctions: annual and monthly. While both the annual and monthly auctions facilitate FTR transactions (i.e., buying, selling, and reconfiguration) among market participants, the annual auction also allows the conversion of ARRs into FTRs. Participation in the FTR auctions is restricted to MISO members, which include transmission and generation owners, LSEs, and other entities, such as financial traders.[48,49]

MISO's annual FTR auction is a multi-round auction performed immediately after the annual ARR allocation, in April through May of each year. The annual FTR auction consists of eight independent auctions due to the combination of two mutually exclusive time-of-use periods (peak and off-peak) and four seasons (winter, spring, summer, fall). As illustrated in Figure 10, three rounds allocate the available transmission capability as follows: one-third in the first round, half of the remaining FTRs in the second round, and all remaining FTRs in the last round.[50] MISO's ARR holders are allowed to convert their feasible ARRs into FTRs through a process known as self-scheduling during the first round of the annual FTR auction.[51]

Figure 10. Annual FTR auction overview



Source: MISO. "2022-23 Annual Financial Transmission Rights (FTR) Auction Workshop." Slide 9.

[46] Market participants may also request incremental FTRs due to network upgrades contributing to congestion relief.

[47] MISO does not allow market participants to bid on FTRs that have source and sink points within the same bus.

[48] Financial traders are required to meet MISO's credit requirements and registration process to participate in the FTR auctions (annual and MPMA). These market participants do not own physical assets.

[49] MISO. "Market Registration Business Practices Manual - BPM-001-r18." June 2021. Section 4.1. p. 24.

[50] MISO. "Level 100 –Auction Revenue Rights and Financial Transmission Rights." Slide 17.

[51] Neither infeasible ARRs nor Stage 2 allocations are allowed to self-schedule.

In addition, MISO hosts MPMAs to sell /buy back residual/unavailable FTR capability and allow FTR holders to sell their FTRs. In the MPMA, the act of buying back capability on the oversold transmission path is known as selling counter-flow FTRs (negatively priced FTRs). Through counter-flow FTRs, MISO pays a market participant to accept an FTR obligation in the opposite direction in order to cancel out excess FTRs on a constraint.[52] The schedule of the 37 FTR auctions in the MPMA within each planning period is depicted in Figure 11. Furthermore, FTRs could also be bought and sold in the secondary market, but they should maintain their initial acquisition features and should not exceed the original FTR specifications.[53]

Figure 11. MPMA schedule

MPMA products available (peak and off-peak)							
Season	**Auction In**	**Auction For**					**Periods**
Spring	May	June					1
Summer	June	July	August	*Fall*	*Winter*	*Spring*	5
	July	August	September	October	November		4
	August	September	October	November			3
Fall	September	October	November	*Winter*	*Spring*		4
	October	November	December	January	February		4
	November	December	January	February			3
Winter	December	January	February	*Spring*			3
	January	February	March	April	May		4
	February	March	April	May			3
Spring	March	April	May				2
	April	May					1

Source: MISO. "FTR and ARR Business Practices Manual - BPM-004-r22." June 2021. Section 4. p. 150.

5.5 ARR settlement mechanism

As detailed in MISO's BPM, the ARR settlement is calculated monthly using the annual FTR auction's clearing prices.[54] The settlement is performed on the first operating day in a calendar month. The total target settlement for all feasible ARRs (as determined by the SFT) allocated in the annual ARR allocation process is calculated each month for each ARR holder:

- the value of the ARR is positive when the auction clearing price of the ARR source is greater than the price of the ARR sink;
- conversely, the value of the ARR is negative when the price of the ARR source is less than that of the ARR sink.

[52] Potomac Economics. *2021 State of the Market Report.* p. 65.

[53] MISO. "FTR and ARR Business Practices Manual - BPM-004-r22." June 2021. p. 151.

[54] MISO. "FTR and ARR Business Practices Manual - BPM-004-r22." June 2021. p. 153-156.

Stage 1 ARR holders are funded by the revenue generated from the FTR auctions and may receive less if sufficient funds do not exist. If residual revenue exists after funding Stage 1, holders of Stage 2 ARRs are funded on a pro-rata basis.

5.6 FTR settlement process

The FTR settlement process has three stages: hourly, monthly, and yearly.[55] Due to the obligation nature of FTRs, settlements can be payments from FTR holders to MISO, or from MISO to FTR holders. These settlement processes are called Revenue Congestion Allocation Processes. The processes are funded by congestion charges collected in the day-ahead and operating reserve markets.

The hourly FTR settlement consists of determining the amount of day-ahead congestion dollars available in a single hour and allocating those dollars to FTR holders from that hour. If the amount of congestion dollars collected in an hour is less than what is needed to pay FTR holders' revenue allocation target,[56] then all FTR holders are paid on a pro-rata basis[57] for that hour. The difference between an FTR holder's target revenue allocation and the actual DA congestion paid is referred to as shortfall.[58]

The monthly FTR settlement consists of determining the excess congestion dollars available in the calendar month and allocating those dollars on a pro-rata basis to all FTR holders who did not receive their full FTR target revenue allocation during the hourly process for the same calendar month. This process is funded from the day-ahead hourly unallocated congestion dollars for the calendar month, the residual dollar amount from the MPMA (for that calendar month), and the annual auction. At the conclusion of monthly FTR funding, all unallocated funds roll into the yearly FTR revenue allocation process.[59]

The yearly FTR settlement determines the amount of excess congestion revenues available as of December 31, after both hourly and monthly revenue allocations have been completed for that

[55] MISO. "Market Settlements Business Practices Manual - BPM-005-r19." February 2020. Section 2.9.3. p. 73-75.

[56] The revenue allocation target is the revenue that an FTR holder is paid if there are sufficient congestion dollars available.

[57] The pro-rating is done based on the congestion revenue for that given hour, for that specific path.

[58] When a shortfall occurs, FTR holders are eligible to receive additional revenue allocations to cover their losses in their monthly and/or yearly revenue allocations.

[59] The monthly settlement only occurs when there are excess funds available for the month.

day. The congestion revenues are used to cover FTR holders (on a pro-rata basis) who have not received their full revenue allocation target during the same calendar year.[60,61]

Once all the FTRs are fully funded, the remaining excess revenues in the excess congestion charge fund[62] are distributed to all transmission customers (NITS or firm point-to-point transmission service) based on a pro-rata share of their billing determinants.[63]

[60] MISO. "FTR and ARR Business Practices Manual - BPM-004-r22." June 2021. Section 3.11. p. 74.

[61] Transmission customers receive any excess remaining at the end of the year, per MISO's tariff. Conversely, any shortfall, usually caused by discrepancies between modeling of transmission constraints and outages in the FTR auctions, is allocated to FTR holders on a pro-rata basis according to their respective target allocations.

[62] The excess congestion fund is the amount of excess congestion remaining as of December 31 after the hourly and monthly revenue allocation has been completed for that day.

[63] Excess congestion, if any, is paid to transmission customers in December of each year. For the seven calendar years from 2015 to 2021, there are four years with excess congestion payments, totaling $102 million.

6 Task 1: Is MISO's ARR/FTR market efficient in serving its purpose?

Key takeaways

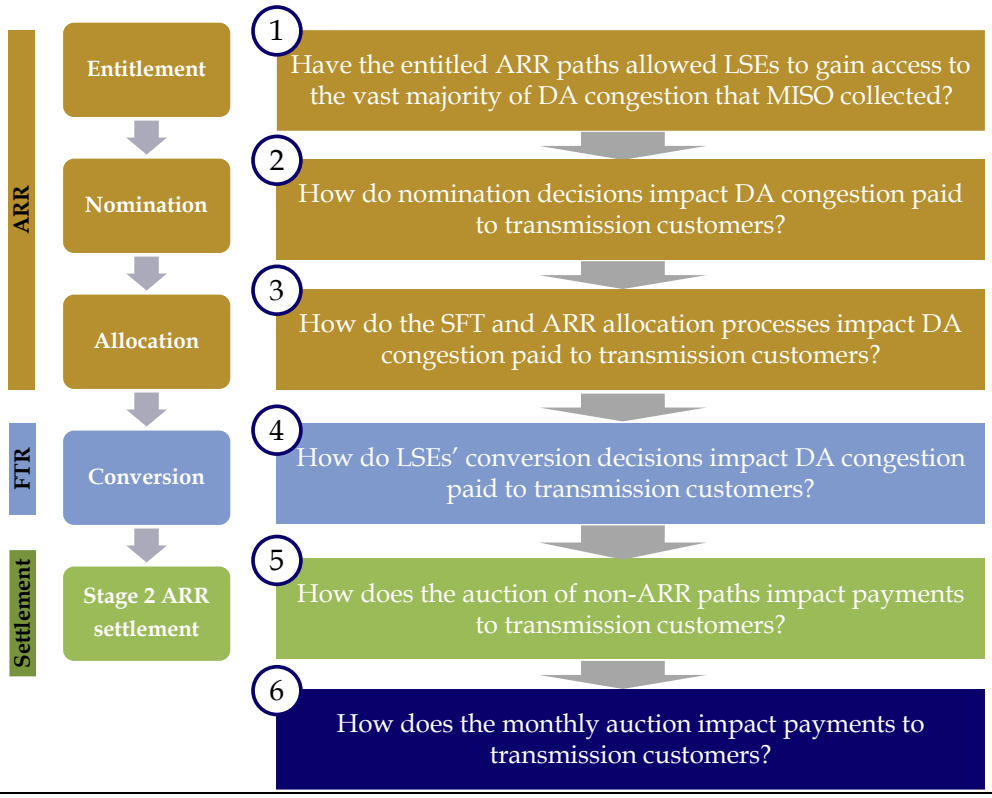
- LEI observed that the payments to LSEs from nominated and allocated ARRs have declined over time, indicating that DA congestion is occurring on non-ARR paths.
- The pace with which LSEs have been able to obtain new ARR paths is much slower than the pace of retirements and capacity additions in recent years. Analysis also suggests that the new paths allocated to LSEs in recent years appear to be insufficient in improving the LSEs' ability to hedge congestion risk.
- The current ARR entitlement and allocation processes have limitations due to the use of a historical reference year and the restricted set of pricing nodes. This may diminish the ability of transmission customers to obtain ARR paths that reflect their current commercial needs and use of the transmission system. The impact of these limitations may have become more severe in recent years. There is room for improvement in the ARR entitlement and allocation process.
- Annual FTR auctions will not perfectly predict DA congestion, but this is an inherent result of the forward market construct. Nevertheless, annual FTR clearing prices on ARR paths generally reflect DA congestion during normal system conditions. Annual FTR auction results may underestimate DA congestion during abnormal and difficult-to-predict system conditions, such as extreme weather.
- LEI observed an increased number of market participants (specifically financial traders) in the FTR market over recent years. New entry indicates a contestable market, where new entry should discipline market outcomes and support competition.
- Pursuant to updates to MISO's network model, MPMAs involve the sale of FTRs from additional network capacity (forward flow FTRs) and the purchase of network capacity that is no longer available (counter-flow FTRs). This creates economic opportunities that have attracted financial traders. LSEs rarely take advantage of these opportunities.
- Annual FTR auctions are operating efficiently. This finding is supported by a hypothetical analysis of ARR funding targets where LSEs choose to convert ARRs to FTRs. In addition, through regression analysis, LEI found that FTR auction results are robust predictors of DA congestion.
- The TCM's decline in 2020 and 2021 can be partially attributed to (1) individual decisions of LSEs to keep ARRs rather than convert them to FTRs, and (2) the inherent unpredictability of DA congestion when difficult to predict circumstances arise.

6.1 LEI's approach to Task 1

Under Task 1, LEI assessed whether MISO's ARR/FTR market is operating efficiently. As discussed in Section 4.2, to avoid confusion in terminology, we use the term "efficacy" to refer to the ability of the ARR/FTR construct to meet its intended purpose, while "efficiency" is related to the market efficiency in economic sense. To access the efficacy of the ARR/FTR construct, LEI

first identified the purpose of the ARR/FTR market and then created objective assessment criteria, which include market efficiency and equity. LEI then traced the current ARR entitlement and allocation processes and FTR auctions to understand the theoretical share of DA congestion charges that can be paid to transmission customers at the end of each step. At each stage of this analysis, LEI posed a key question to consider how congestion-related payments to transmission customers are affected. The analytical process is summarized in Figure 12 and discussed in greater detail below.

Figure 12. Key question for each step of LEI's analysis



First, LEI assessed whether the entitled ARR paths have allowed LSEs to gain access to the vast majority of the DA congestion that MISO collected. As discussed in Section 5.3, the entitlement process allows transmission customers to request ARR path entitlements, which are created pursuant to a historical reference year.

Second, LEI reviewed how LSEs' nomination decisions, whereby LSEs choose a subset of ARR paths from entitled ARR paths, impact DA congestion paid to transmission customers. LEI then

determined the funding target of the nominated ARR paths as a percentage of DA congestion to determine if all nominated ARRs were converted to FTRs.[64]

ARRs are awarded to LSEs based on their nominations but is also subject to the SFT. So as a third step, LEI assessed how the SFT in the ARR allocation process impacts DA congestion paid to transmission customers. Specifically, LEI estimated how much LSEs would get paid if all allocated ARRs were converted to FTRs.

Fourth, LEI examined how LSE conversion decisions influence DA congestion paid to transmission customers. To determine this, LEI looked at the payments LSEs received after converting their ARRs to FTRs.

As a fifth step, LEI analyzed the impact of Stage 2 ARR settlement impact payments to transmission customers. Not all nominated ARR paths are allocated in Stage 1. The MISO ARR/FTR process compensates transmission customers with unallocated ARRs through the payment of annual auction revenue that is in excess of the ARR settlement target (for non-converted ARRs). Therefore, this Stage 2 ARR settlement payment depends on the annual FTR auction clearing price and volume cleared for both ARR and non-ARR paths.

Lastly, LEI also examined how MPMAs affect payments to transmission customers. In particular, LEI looked at the total FTR funding target before and after MPMAs, trends in profitability of MPMA participants, and the implication of these factors in DA congestion paid to transmission customers.

In each step, LEI developed an assessment metric. For Steps 1 to 3, LEI utilized assessment metrics to calculate the **theoretical** payment to transmission customers if the entitled, nominated, and allocated ARR paths were all converted into FTR paths. The theoretical payment targets are based on the actual marginal congestion components in the DA energy market in MISO for all the source and sink nodes involved, and do not consider underfunding of FTRs.[65] This allows for a step-by-step analysis of the efficacy of each stage of ARR process: the entitlement, nomination, and allocation processes. For Steps 4 to 6, LEI's analyses also rely on actual FTR auction results and Stage 2 settlement payments. Overall, the assessment metrics help track how the MISO ARR/FTR mechanisms contribute to the TCM.[66] All the assessment metrics measure payments to

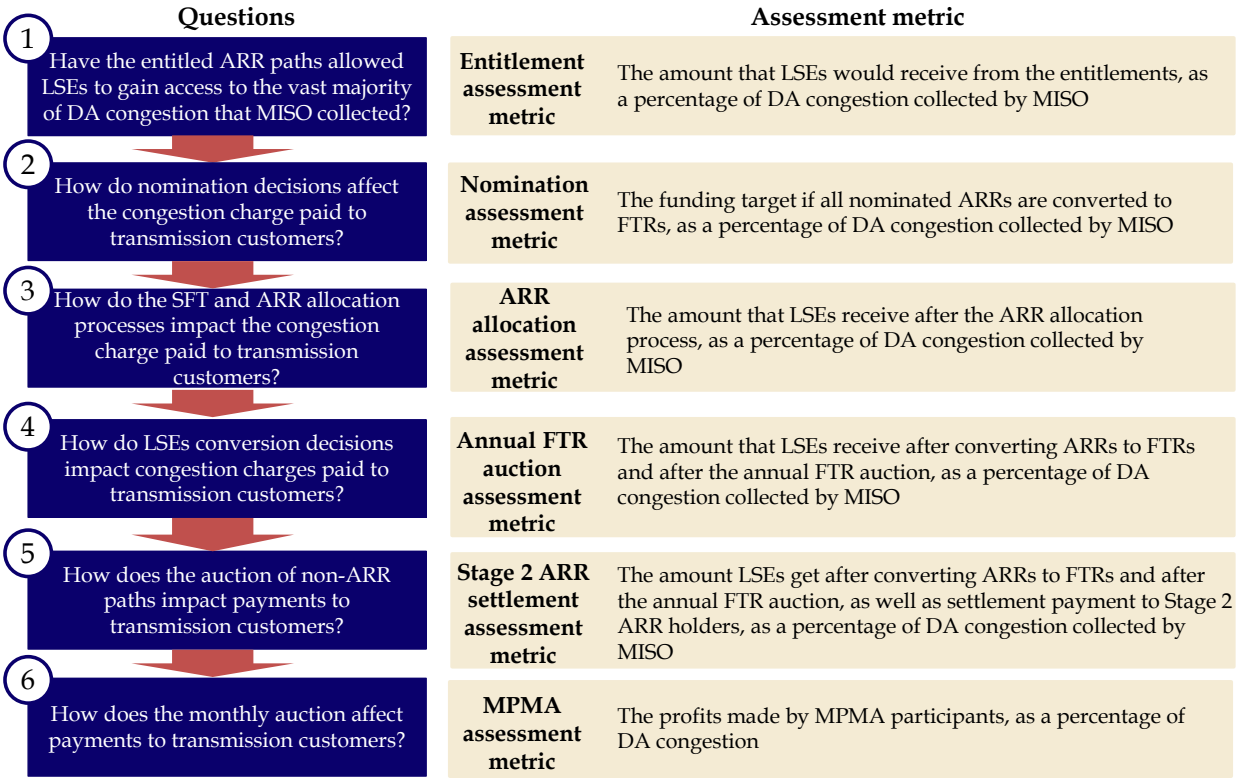
[64] Due to data availability, LEI only analyzed ARR nominations and allocations using primarily 2017-2021 data. For analysis related to FTR auction results, LEI conducted a longer time period (2014-2021) analysis due to better data availability.

[65] In recent years, FTR underfunding has been very small, if any.

[66] These assessment metrics include the concepts of a "funding target" or "settlement target." Funding target refers to what an FTR holder would be paid if there were no underfunding of FTRs. Settlement target refers to the payment an ARR holder should receive based on the clearing price of the source and sink nodes (from the FTR auction) of the ARR path.

transmission customers as a share of DA congestion. The assessment metrics are listed and described briefly in Figure 13.

Figure 13. Questions asked in each step of the evaluation of the ARR/FTR process and assessment metrics



As part of Task 1, LEI was also asked to review methods MISO might use for assessing market competition in the FTR market. Competition analysis traditionally begins with a definition of the economic market. LEI concluded that it would be difficult to use this standard approach because of the complex relationship between different FTR paths. However, LEI found that the FTR auctions are subject to market contestability. The threat of new entry can be a strong discipline on market behavior and should promote competition in the longer term. We discuss these findings further in Section 7.2.2.

6.2 Is the entitlement process meeting the goals and objectives of ARRs and FTRs?

As discussed in Section 5.3, the entitlement process allows transmission customers to request ARR entitlements on specific designated paths, and MISO validates and approves these requests. After the entitlement process, each transmission customer has a list of ARR paths that they are

Entitlement Assessment Metric: The amount that transmission customers would receive from entitlements as a percentage of DA congestion collected by MISO if all entitled paths were converted into FTRs

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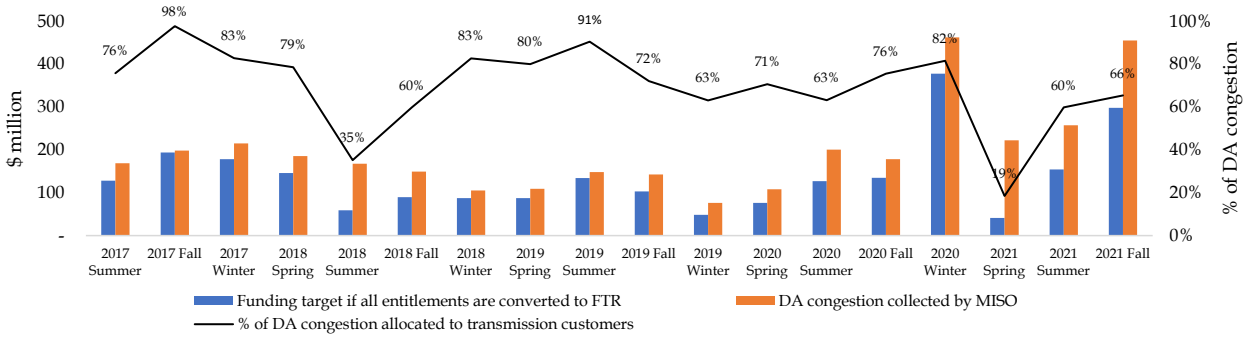
entitled to in addition to the entitled quantity (in MW) for each path.

LEI estimated the theoretical entitlement congestion revenue by first assuming that all entitled ARR paths are allocated to LSEs and converted into FTRs (e.g., self-scheduled). For each entitled ARR path, the congestion revenue is the marginal congestion components ("MCC") of its sink node minus source node, multiplied by the MW entitled ARRs. The entitlement congestion revenue is the sum of the congestion revenue of all of the entitled ARR paths. LEI then compared this entitled congestion revenue against the DA congestion collected by MISO.

The purpose of this analysis was to understand whether the entitled ARR paths that represent all transmission customers' historical use of MISO's transmission system would result in a large share of DA congestion collected by MISO. If the ratio of the entitled funding target to DA congestion is high, it means that, historically, the ARR entitlement process was able to grant transmission customers entitlements to ARR paths that represent a large share of the network congestion pattern on the MISO system.

Based on LEI's analysis, on average, 70% of the DA congestion collected by MISO between 2017 and 2021 was granted to LSEs as entitlements, as shown in Figure 14. In other words, the Entitlement Assessment Metric is 70% for 2017 to 2021. The ratio did reach nearly 100% for one season, but this occurred once in the past 18 seasons analyzed. Furthermore, LEI observed a downward trend in the past seasons, which suggests that there is an increasing gap between entitled ARR paths and where on the MISO system DA congestion is occurring, which could be due to weather patterns, changing generation mix, and mechanical issues in the ARR entitlement process (or a mix of these).

Figure 14. Entitled congestion revenue vs. day-ahead congestion collected by MISO



Note: The rationale behind the result of 35% for summer 2018 is unclear. There is no summer 2018 quarterly report available on the IMM website, and the fall 2018 report does not cover this issue.

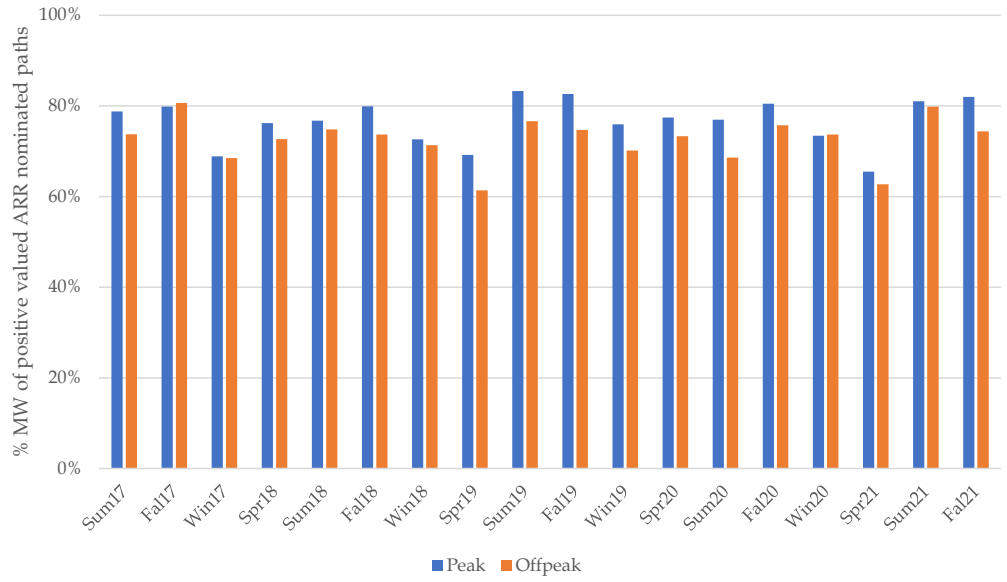
6.3 How do nomination decisions impact the amount of DA congestion paid to transmission customers associated with awarded ARRs?

Transmission customers do not always want all entitled ARR paths. First, some of the entitled ARR paths may have negative values. Second, some of the ARR paths may no longer reflect the transmission customer's expected usage of the network in the upcoming seasons. The nomination

process allows transmission customers to pick a subset of the entitled ARR paths to request from MISO.

From 2017 to 2021, LSEs, on average, nominated 60% of peak entitled paths and 57% of off-peak entitled paths (in MW terms). These nomination percentages have remained stable over the years. It is impossible to understand the full extent of LSEs' preferences and choices around entitled paths, but LEI's analysis shows that LSEs have not limited themselves to only nominating ARR paths that end up having positive congestion payments (i.e., sink node MCC > source node MCC). From 2017 to 2021, on average, 78% of peak and 73% of off-peak nominated ARR paths (in MW) ended up having positive congestion payments, as presented in Figure 15. This means that, on average, 22% and 27% of peak and off-peak nominated ARR paths, respectively, had negative funding targets if they were converted into FTRs. Such an outcome could be driven by forecasting error, or because of specific commercial arrangements (for example, some LSEs may have nominated all entitled paths for risk management purposes).

Figure 15. Percentage of positive value nominated ARR paths



If all nominated ARR paths are converted to FTRs, the process of nominating a subset of entitled paths would have resulted in an improvement in the ratio of DA congestion being paid to LSEs as compared to the ratio calculated using the Entitlement Assessment Metric examined in Section 6.2. Based on Figure 15, the 2017-2021 average Nomination Assessment Metric is 80% (as compared to the average Entitlement Assessment Metric of 70%).

Nomination Assessment Metric:

The funding target if all nominated ARRs are converted to FTRs (or self-scheduled), as a percentage of DA congestion collected by MISO

Like the Entitlement Assessment Metric, the Nomination Assessment Metric also exhibits a downward trend, as depicted in Figure 16. This is not surprising – if a material share of DA

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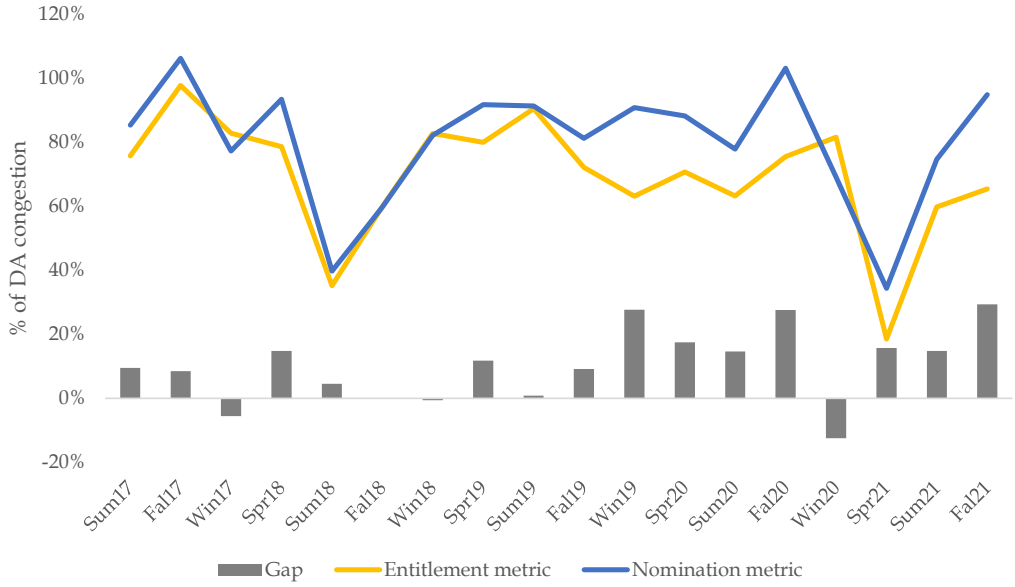
congestion occurs on non-ARR paths, then there is an implicit limit on the LSE's ability to increase the ARR funding target through the ARR path selection process.

Figure 16. Nomination Assessment Metric, Entitlement Assessment Metric, and gap



6.4 Has the amount of ARRs awarded to LSEs as a ratio of nominated ARRs been trending downwards?

Not all entitled ARR paths nominated by transmission customers are awarded. This is the nature of a system characterized by finite network capacity, where network users compete for such capacity. To allocate the ARRs to different transmission customers based on their nomination (i.e., preference), MISO runs the SFT model with the objective function of maximizing the MWs of ARRs awarded.

LEI compared the MWs allocated versus the MWs nominated over the past six nomination processes. Based on the data available, the years 2017 and 2022 had the highest allocation percentage in MW terms, where 83% of peak and off-peak nominated ARR MWs were allocated. The years 2019 and 2021 had the lowest allocation percentages, with only 78% (2019) and 79% (2021) for peak, and 75% (2019) and 76% (2021) for off-peak, as shown in Figure 17.

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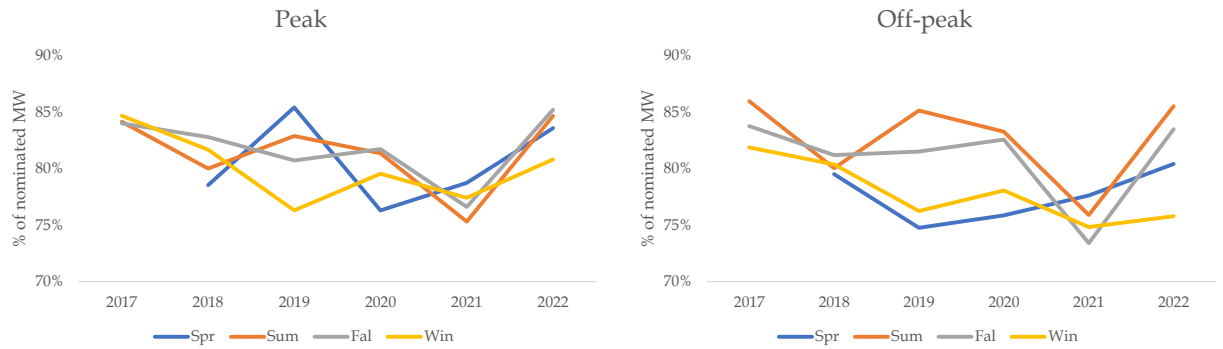
Figure 17. Allocated ARR paths as percent of nominated ARR paths



6.5 Does the ARR allocation process affect the amount of congestion charge paid to transmission customers?

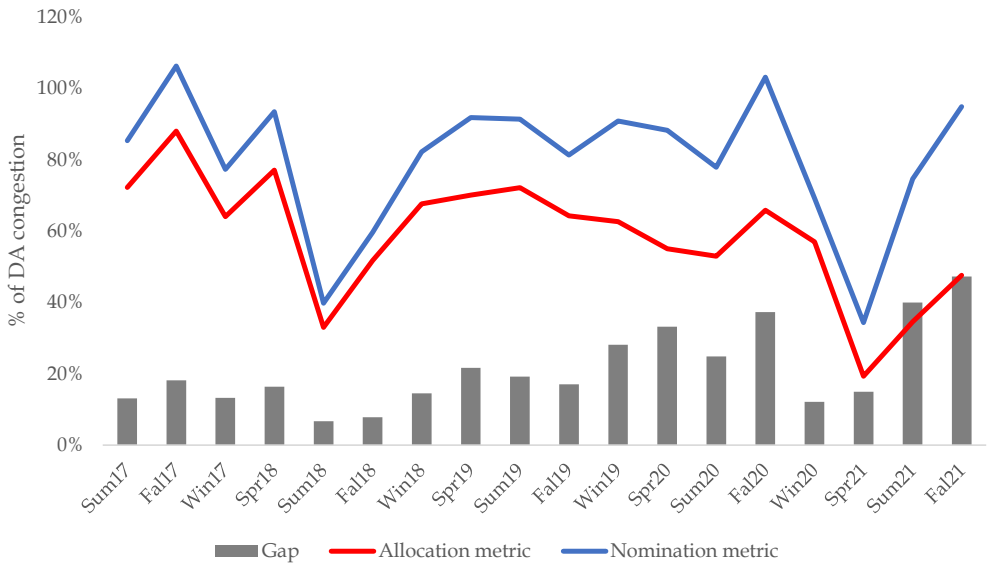
ARR Allocation Assessment Metric: The amount that transmission customers would receive after the ARR allocation process, as a percentage of DA congestion collected by MISO, if all allocated ARRs were converted into FTRs

From 2017 to 2021, if all allocated ARRs are converted to FTRs, an average of 59% of the DA congestion would have been paid to LSEs. This metric would average 65% if we look at a longer time frame of 2014 to 2021. These results are presented in Figure 18. This means that the ARR Allocation Assessment Metric, or payment as a percentage of DA congestion, has, on average, been reduced by 21 percentage points between the nomination and allocation stages (the Nomination Assessment Metric averaged 80%).

Furthermore, the gap between the Entitlement Assessment Metric and Allocation Assessment Metric has grown from 15% in 2017 to 29% in 2021 (the grey bars in Figure 18). This increase in the gap indicates a rising level of scarcity for paths where DA congestion occurs. It is essential to keep in mind that LSEs are effectively competing (but not on a price basis) against one another to obtain those paths through the ARR process.

Based on the analysis of the Entitlement Assessment Metric (Section 6.2), Nomination Assessment Metric (Section 6.3), and ARR Allocation Assessment Metric (Section 6.5), LEI concludes that the current ARR entitlement and allocation processes have some limitations that may negatively affect the efficacy of the ARR/FTR construct. This has resulted in transmission customers obtaining a declining share of DA congestion collected by MISO over the past years unless they make "out-of-pocket" purchases in the FTR auctions.

Figure 18. Nomination Assessment Metric vs. Allocation Assessment Metric in MISO



6.6 What are the implications of using a historical transmission usage snapshot to determine ARR entitlements? And is the historical reference point still relevant for satisfying the hedging objectives of market participants?

LEI's analysis shows that the use of a fixed, historical transmission usage snapshot results in annual changes in ARR paths that cannot catch up with new entries and retirements.

LEI compared the source and sink nodes of each allocated ARR path in each year's allocation as compared to Planning Year 2014-2015 allocated ARRs.[67] The analysis shows that 72% of the MWs of ARR paths allocated in 2022-2023, for example, are the same ARR paths that were allocated in 2014-2015. This indicates that 28% of the MWs of ARR paths in 2022-2023 are new. Using this analysis for the past eight allocation processes, LEI calculated that, on average, only 2,975 MW of ARR paths differ from the previous year.[68] In comparison, on average, there were 5,800 MW of new entry per year (over 50% of these new additions are wind power plants) and 4,000 MW of retirements per year in MISO from 2015 to 2022. Figure 19 shows the cumulative trend in ARR allocations, new entry, and retirements. This graph illustrates that the pace of ARR path change year-over-year is not reflective of the change in MISO's generation fleet. Notably, this MW gap between ARR path changes and new entry started in 2020-2021 and has persisted since.

[67] Planning Year 2014-2015 was chosen as the base year for this analysis because this was the first year of the ARR/FTR process after MISO South joined the RTO; many new paths were allocated in that year.

[68] Average year-over-year change for the entirety of ARR allocation in this period is 23,802 MW, but this is divided by four seasons and peak/off-peak usage. This means a difference from the previous year of 2,975 MW (23,802 MW / 8), on average.

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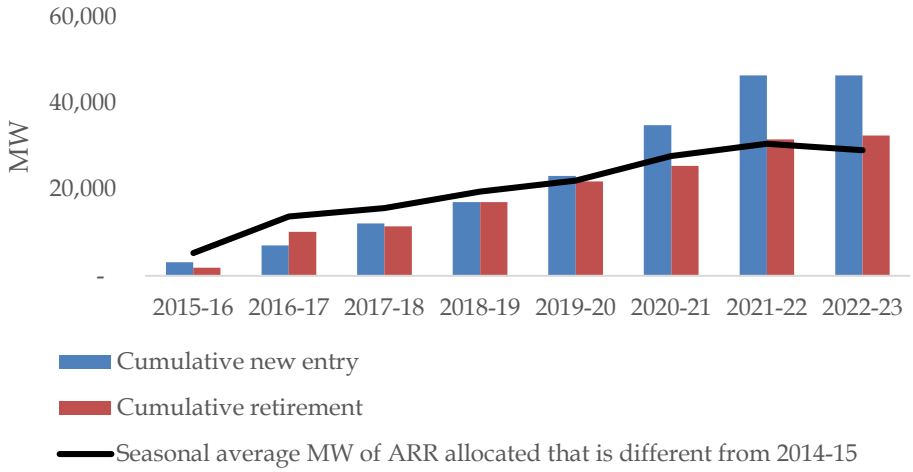
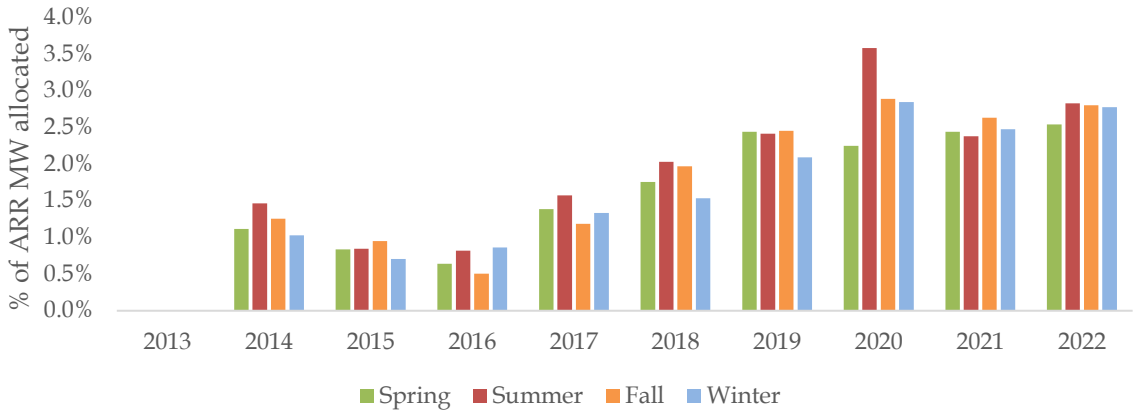
Figure 19. Cumulative new entry and retirement vs. change in ARR paths



Further evidence of a disconnect between allocated ARR paths and the changes in MISO's generation fleet is demonstrated by calculating the share of ARR paths that have a source node from a retired generation node; this share has increased over time.[69] LEI found that the share of ARR MWs sourced from retired generator nodes has been increasing, from about 1% of the peak ARR MWs allocated in PY 2014-2015 to about 2.8% in PY 2022-2023, as presented in Figure 20. This indicates that the RSP process and/or the ARR allocation process may have become less effective in allocating ARRs that reflect actual use of the transmission network.

Figure 20. Percentage of peak ARR MWs linked to a retired generation unit



[69] For nodes associated with a retired generation unit, MISO assigns the node a ".ARR" in its name. LEI calculated the number of ARR paths associated with retired generation units based on this MISO naming convention.

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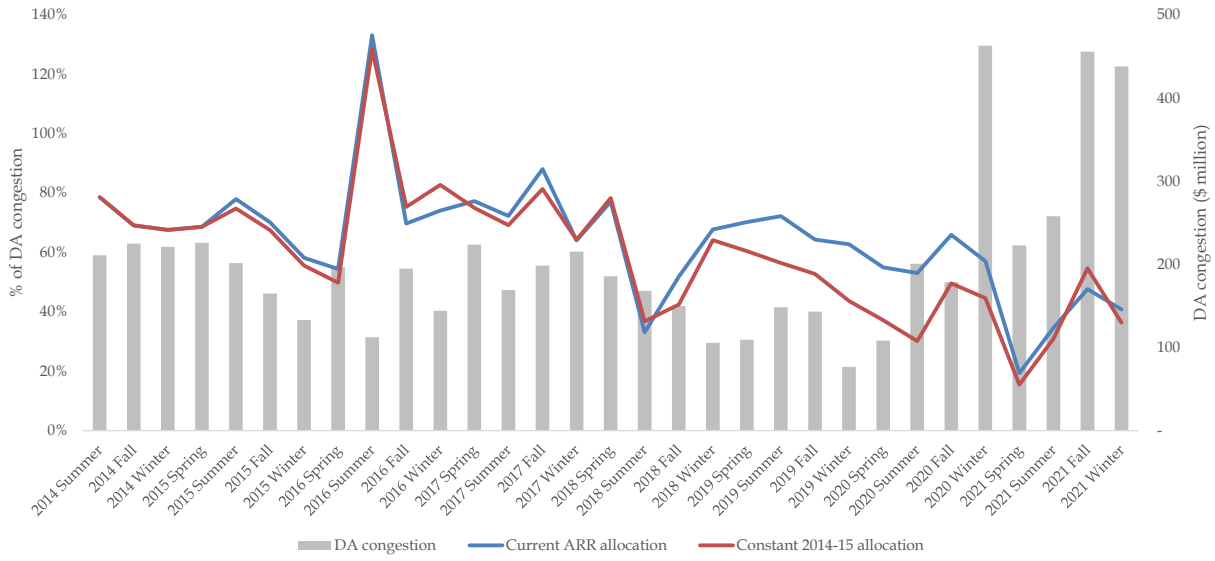
When the ARR paths allocated to LSEs do not reflect actual use of the transmission network, the efficacy of the ARR/FTR construct—providing LSEs with the ability to hedge against congestion risk—decreases. The diminution in usefulness can also be analyzed by a counterfactual comparison of what LSEs would have been paid in DA congestion if they had stayed on 2014-2015 allocated ARR paths (or the "historical ARR paths") as compared to actual allocated ARR paths (or "new ARR paths"). This allows us to understand whether changing the ARR paths has helped LSEs to hedge their congestion risk better. The results are mixed. As presented in Figure 21, when the level of DA congestion is low (for example, between winter 2018 and summer 2020), the new ARR paths were useful to LSEs in hedging congestion risk. But when the level of DA congestion is high (such as in winter 2020, fall 2021, and winter 2021), using the new ARR paths are no better (in terms of returning more congestion to LSEs) than the historical ARR paths. This shows that the newly allocated ARR paths have limited usefulness to LSEs in hedging congestion risks during high DA congestion levels.

Figure 21. Ability of ARR paths to hedge DA congestion using historical vs. current ARR allocation



6.7 Do annual FTR auction results accurately reflect DA congestion, given the forward nature of the auctions?

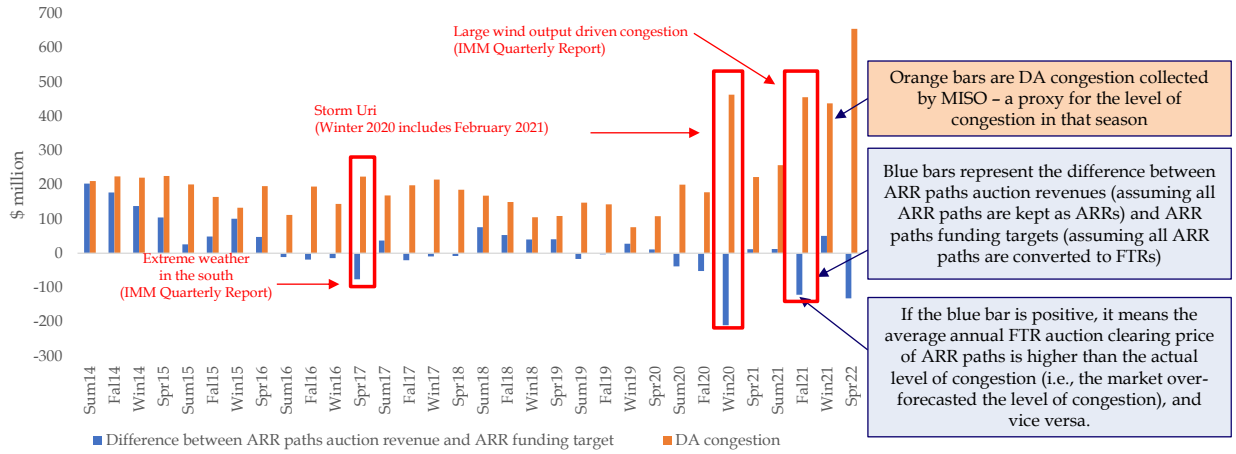
Annual FTR auction clearing prices reflect the market's expectation of the level of DA congestion over the next four seasons. This means that the annual FTR auction is an auction of forward products – the buyer of an FTR pays (or receives, if the clearing price is negative) a fixed price (e.g., the FTR auction price) and would be paid (or pays) a variable payment depending on future outcomes (level of market participation and DA congestion levels). As the future level of DA congestion is driven by exogenous factors such as weather conditions, actual electricity usage patterns, fuel prices, and generation or transmission outages, it is the nature of the annual FTR auction to have clearing prices that are not exactly the same as the realized DA congestion on a given FTR path or set of paths.

To evaluate whether FTR auction results have been reflective of DA congestion, it is more important to focus on whether, over the long term, FTR clearing prices (i.e., FTR auction revenues) are close to the FTR funding target (i.e., level of DA congestion on the auctioned FTR paths).

Based on historical data, during seasons with unexpectedly high congestion (due to, for example, unanticipated extreme weather conditions), FTR auction prices cleared lower than the funding targets. In contrast, over the long term, FTR clearing prices closely follow FTR funding targets. From Summer 2014 through Spring 2022, FTR clearing prices on all ARR paths were, on average, 12% higher than FTR funding targets. However, in some seasons with unpredictable/extreme weather, DA congestion exceeded FTR prices, and FTR buyers made large profits, as shown in Figure 22 below.

LEI views this outcome as reasonable – in seasons with normal weather conditions, FTR buyers as a whole are not very profitable, and overall losses are also not excessive. But in seasons with extreme weather events or other exogenous and unpredictable factors that led to higher-than-expected levels of DA congestion, FTR buyers as a whole were very profitable - essentially because the level of DA congestion they collected exceeded market expectations.

Figure 22. Breakdown of ARR/FTR payments as % of DA congestion collected by MISO

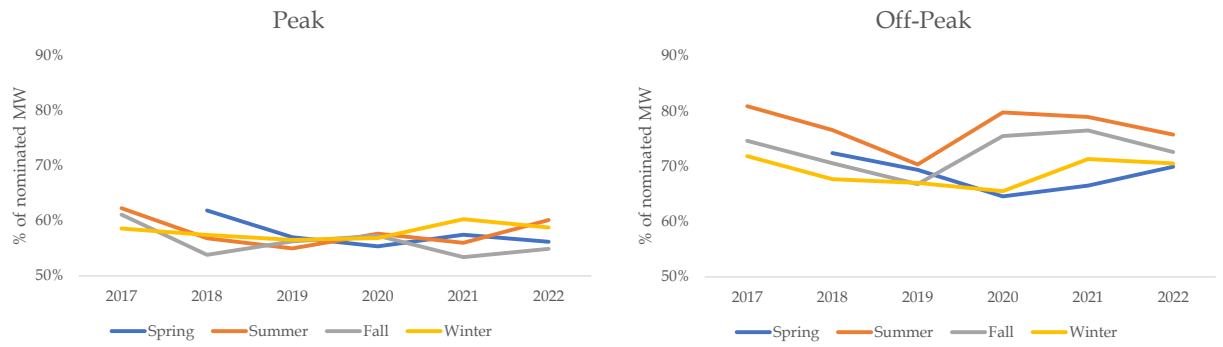


6.8 What were LSE preferences for holding ARRs versus converting them to FTRs, and how did this affect the TCM?

As FTR market results cannot perfectly predict the level of future congestion, there is a trade-off involved when LSEs decide whether to hold their ARRs (and secure a payment of funds related to annual FTR auction proceeds) or convert their ARRs into FTRs (and receive the DA congestion revenue (or pay the congestion costs) on the specified path associated with the FTR). Historically, LSEs have been more inclined to convert their ARRs into FTRs rather than hold their ARRs. From 2017 through 2022, LSEs (on average) converted approximately two-thirds of their allocated ARRs into FTRs, and this ratio has remained stable for the past six years. ARR MWs converted into FTRs are steady at around 57% for peak and 72% for off-peak, as illustrated in Figure 23.

There appears to be no apparent correlation between the conversion of ARRs into FTRs and DA congestion, suggesting that LSEs do not have superior capability in predicting future unexpected congestion.[70]

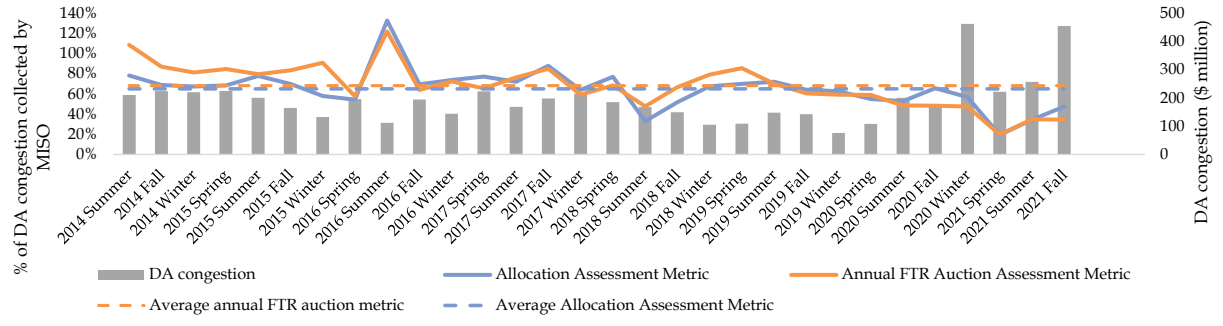
Figure 23. Self-scheduled ARR paths as percent of allocated ARR paths



LEI calculated the Annual FTR Auction Assessment Metric based on two components. For ARRs converted into FTRs, LEI calculated the FTR funding target using actual DA congestion. For ARRs not converted, payments to the ARR holder were based on actual FTR auction clearing prices for those ARR paths. The sum of these two components, as a percentage of DA congestion collected by MISO, is the Annual FTR Auction Assessment Metric, presented in Figure 24. In the graph, the orange line above the blue line represents higher revenues to LSEs resulting from their decision to hold (and not convert) their ARRs.

Annual FTR Auction Assessment Metric: The amount that LSEs received after converting part of their ARRs to FTRs (and holding the rest as ARRs, and as a result receiving the ARR settlement target), as a percentage of DA congestion collected by MISO

Figure 24. Annual FTR Auction Assessment Metric vs. Allocation Assessment Metric



[70] If LSEs had the capability to predict unexpected congestion in the future, we would see a higher level of conversion in years with high levels of DA congestion, and vice versa.

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From 2014 through 2021, the Annual FTR Auction Assessment Metric averages 68%. This is higher than the Allocation Assessment Metric, which averages 65% over the same period (as per Section 6.5).

The Annual FTR Auction Assessment Metric was higher than the Allocation Assessment Metric from 2014 to spring 2016, part of 2018, and 2019, but was also lower in some seasons in 2016, 2017, 2020, and 2021. Over the time period assessed, the decision of LSEs to hold approximately one-third of their ARRs has, on average, led to an increase in the TCM. This is in line with the observation made in Section 6.7, where the average clearing price of annual FTR auctions is higher than the FTR funding target. If future annual FTR auction clearing prices are instead lower, on average, than the FTR funding target, this situation may change.

6.9 How do the annual FTR auction results on non-ARR paths impact payments to transmission customers?

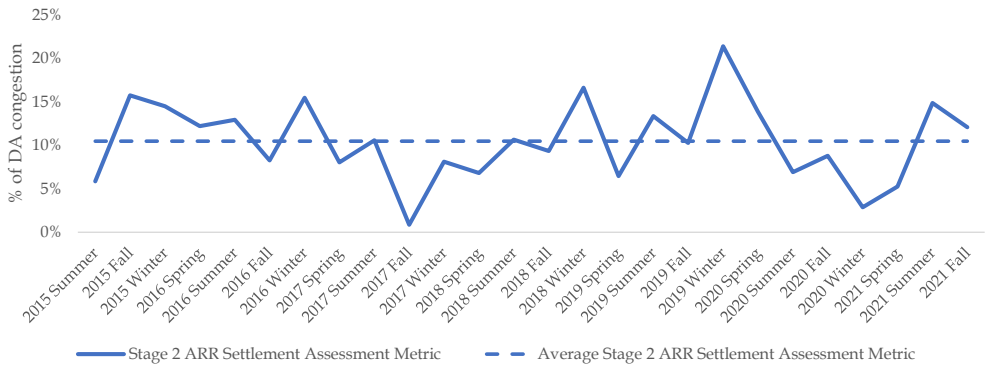
Stage 2 ARR Settlement Assessment Metric: The amount LSEs get after converting ARRs to FTRs after the annual FTR auction, as well as settlement payments to Stage 2 ARR holders, as a percentage of DA congestion collected by MISO

Stage 2 ARR settlements are monetary payments to transmission customers from the portion of annual FTR auction revenue that exceeds the annual ARR settlement target. This excess is allocated to transmission customers that have residual entitlements that are not allocated as ARRs. Since the annual FTR auction sells both ARR and non-ARR paths, the amount of Stage 2 ARR settlement (and therefore the TCM) depends on the following: (i) how many ARR paths were sold to financial traders (and how many LSEs bought ARR paths out-of-pocket), and (ii) the auction revenue raised from non-ARR paths. Holding other factors constant, the higher the non-ARR auction revenue, the larger the Stage 2 ARR settlement payments and, thus, the higher the TCM.[71]

From 2015-2021, the size of Stage 2 ARR settlement averaged 10.5% of the DA congestion collected by MISO, as illustrated in Figure **25**. In other words, the Stage 2 ARR settlement process resulted in an increase in the TCM by 10.5 percentage points, which partially offsets the difference between the Nomination Assessment Metric and the Allocation Assessment Metric presented in Section 6.5.

[71] Note that if there is no Stage 2 settlement, any DA congestion not paid out to FTR holders will eventually flow back to LSEs but through a different mechanism that is not captured in the TCM. Also, the allocation of that DA congestion among LSEs would be different from the Stage 2 settlement logic, which would change the equity relationship among LSEs.

Figure 25. Stage 2 ARR settlement dollar amount as a percent of the DA congestion collected by MISO



6.10 How do the monthly auction results impact the payments to transmission customers?

In the context of analyzing the impact of auctions on the TCM, the main difference between MISO's annual and monthly FTR auctions is that transmission customers are not granted any ARRs prior to monthly auctions. Hence, transmission customers do not have direct access to monthly auction revenues.

In the annual FTR auctions, auction revenues are used to fund ARR settlement targets (including Stage 2 ARR settlement). In contrast, auction revenues from the MISO monthly auctions are first used to offset underfunding of FTRs, and any surplus is then allocated to transmission customers. Meanwhile, payments to FTR holders (for paths bought both in annual and monthly auctions) come from DA congestion collected by MISO.

Since 2013, on an aggregate basis, market participants in the monthly FTR auctions have earned DA congestion that exceeded the MPMA clearing prices on a calendar year basis. In other words, FTR clearing prices (in aggregate) in the MPMAs have been consistently low relative to their funding target[72,73]

MPMA Assessment Metric: The profits made by MPMA participants as a percentage of DA congestion

[72] As previously discussed, we can break down monthly auctioned FTRs into two types: forward flow and counter-flow paths. Forward flow paths are FTR paths with positive clearing prices. Counter-flow paths are FTR paths with negative clearing prices. LEI's analysis on FTR auction results and realized DA congestion shows that, in aggregate, counter-flow FTRs have been profitable every year on a calendar year basis since 2013.

[73] The MISO IMM has also observed a trend in profitability in the monthly auctions and has discussed this in its annual *State of the Market* reports.

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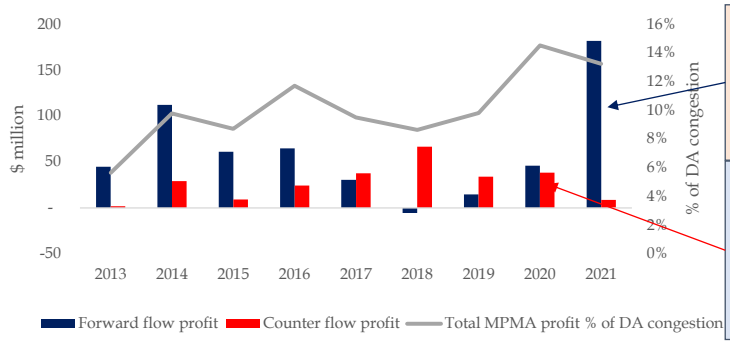
Figure 26. Historical MPMA profits



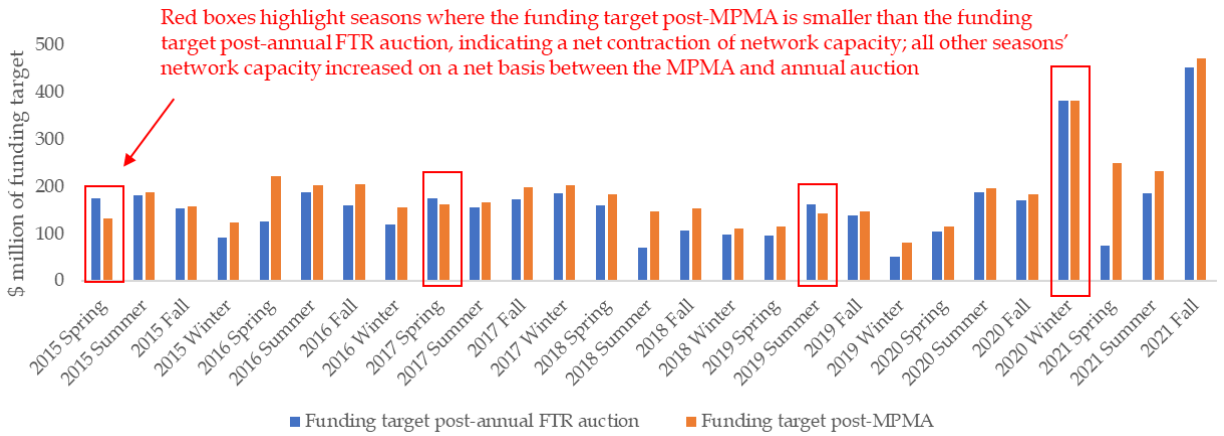
- **Blue bars are the profits for forward flow FTRs**, i.e., FTR paths with positive clearing prices in MPMAs
- These paths are profitable when DA congestion is larger than the clearing price in MPMA
- The profits are affected by weather; there are years where aggregate realized profits have been negative on a calendar year basis (i.e., 2018)

- **Red bars are the profits for counterflow FTRs**, i.e., FTR paths with negative clearing prices in MPMAs (i.e., the buyer gets paid upfront)
- These paths are profitable when DA congestion is less negative than the MPMA clearing price (buyers pay less than they get paid upfront)
- These FTRs in the aggregate have been profitable every year, on a calendar year basis, since 2013

LEI's research and analyses show that these profits can be attributed to the changes/updates in network modeling parameters between the annual and MPMA auctions (such as outage schedules and rating capacity on certain lines), as well as differences in network modeling assumptions in the DA energy market. For example, new information (such as outages) may result in MISO changing the capacity of specific paths in its network models between auctions. When trying to satisfy these new constraints in the model, the auction clearing engine creates price pressure as part of its solution, which increases profitability for FTR buyers in MPMAs.

To analyze how the network model changes between annual FTR auctions and MPMA auctions impacted congestion payments to FTR holders, LEI compared the funding target of all FTR paths cleared right after the annual FTR auction against the funding target of all outstanding FTR paths after the MPMAs. These two funding targets represents the implied network capacity sold in the auctions. LEI's analysis found that for 23 out of 27 seasons since 2015, the implied network capacity auctioned in MPMAs exceeded the network capacity sold in annual FTR auctions on a net basis, as illustrated in Figure 27. This means that in the vast majority of time, the implied network capacity expanded on a ***net*** basis from the annual FTR auction to the MPMAs. Note that the increase in implied network capacity only represents a net change because individual constraints could have their transmission capacity decreased while the overall network capacity has expanded.

Figure 27. Funding target post-annual FTR auction vs. post-MPMA



Based on LEI's analysis, the difference between the funding target post-MPMA and the funding target post-annual FTR auction amounts to $700 million from Spring 2015 to Fall 2021, as compared to total funding target post-MPMA of $5 billion over the same period of time. This implies that over the 7 years, approximately 14% of DA congestion is not auctioned during the annual FTR auctions. LEI is concerned that the prevalence and the scale of implied network capacity expansion from annual FTR auctions to MPMAs lowers the efficacy of the ARR/FTR construct. The reason is that there are no entitlements for network capacity sold in MPMAs. In other words, some of the network capacity released by MISO in the MPMAs is associated with ARR paths that should first be allocated to ARR holders, especially those that have not been fully allocated to 100% of their peak load. This gap, addressed further in Section 8.2, may indirectly contribute to a decreased TCM.

Regarding the issue of consistent profitability of counter-flow trades, LEI learned that it is partially caused by the difference in parameters used in the network model in the FTR auctions and the DA energy market;[74] MISO is currently addressing this issue, so counter-flow FTR profitability in the future may decline from historical levels.[75]

[74] The modeling difference is related to a parameter called Generation Shift Factor Cut-off. More specifically, historically the Generation Shift-factor cut-off parameter between the DA energy market model and the FTR model was different, leading to profit opportunities in counterflow FTR trades. MISO has started to reduce this in the DA energy market to align with the assumption used in the network models employed in the FTR auctions. This should realign network model results between the MPMAs and the DA energy market.

[75] In its Spring 2021 quarterly report, MISO's IMM estimated that lowering the GSF cut-off to 0.5% would (1) reduce FTR shortfalls by $44 million and (2) provide $53 million in congestion value in 2021. However, it did not discuss the impact on counter-flow FTR profitability. Potomac Economics "IMM Quarterly Report: Spring 2021". July 8, 2021. Slide 24.

6.11 Do market participants have the information and data they need to make informed decisions in the FTR auctions?

As discussed in Section 4, transparency facilitates equitable outcomes by allowing market participants to recognize potential inequities in outcomes. Moreover, a well-functioning market makes available relevant information that allows all market participants to understand a product's value and associated risks. The stakeholder engagement sessions and the submitted written comments from MISO stakeholders have informed LEI's views on this issue.

Many stakeholders believe that MISO needs to provide more information to facilitate informed decision-making, such as:

for the ARR process:

- the amount of MWs of unterminated LTTRs that are needed for restoration; and
- the available MWs for nomination and sink caps in the Stage 1B candidate file.

for the FTR auctions:

- actual models used in clearing the FTR market;
- a list of changes made to the model that was posted before the bidding window, as compared to the actual model after the auction;
- all bids in the market (to help stakeholders determine why prices are settled at a certain threshold);
- the weighting of each elemental pricing node ("EPNode") in each aggregate node; and
- participation factors for hub, load zone, and interface pricing nodes used in the FTR auctions and DA/RT energy markets.

According to MISO staff, some of these requests for additional information have, in fact, been resolved.[76] For example, the actual models used to clear the FTR auctions are already posted in response to stakeholder requests. The posted models can be used to identify changes made relative to prior model versions released. Also, data on the available MWs for nomination and sink caps is available, though not included directly in the Stage 1B candidate file. Moreover, MISO staff confirmed that, pursuant to its tariff, all bids and offers are posted 90 days after each auction with anonymized information about the submitters.[77]

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[76] Based on information provided to LEI by MISO staff

[77] These are posted on the MISO website: https://www.misoenergy.org/markets-and-operations/real-time--market-data/market-reports/#nt=%2FMarketReportType%3ABids&t=10&p=0&s=MarketReportPublished&sd=desc

6.12 How can MISO assess FTR market competitiveness?

A "classic" competition analysis is not easily applicable to the FTR market for two main reasons. First, defining the market for FTR auctions is difficult because of interdependencies in product, geography, and time. More specifically, to assess the extent of competition, one must first define the economic market along four dimensions: geography, time, product, and function. There are issues with three out of these four dimensions, as listed in Figure 28. The primary function of the FTR market can be specified generally as hedging congestion, however each participating market entity may have its own underlying business objectives. Moreover, FTR product paths are jointly related; each FTR path's clearing price is not based solely on the bids and offers on that particular path, but also on the bids and offers of other paths. Even if a specific path has few to no bids or offers, one cannot simply conclude that there is insufficient competition on that path when other related paths have competitive outcomes. Furthermore, there are three rounds to MISO's FTR auction as well as multiple auctions (annual and MPMAs) over time.

Secondly, certain data for competition analysis is not readily available. Data on whether an entity is converting ARRs to FTRs or purchasing an FTR in the FTR auction is not publicly available. Moreover, data that segregates market participants into financial participants versus non-financial participants in bid/offer data sets is not readily available.

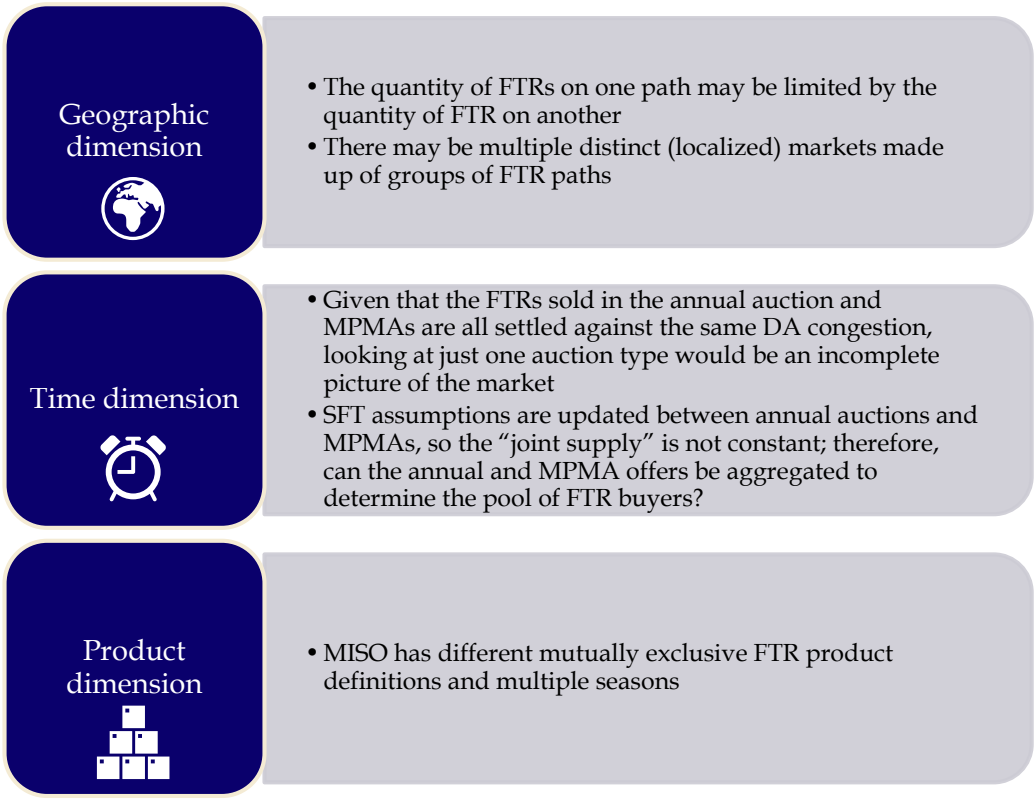
As such, LEI did not perform a "classic" competition analysis. LEI turned to the Likelihood of New Entry, a concept in competition analysis that can be used to consider the competitive nature of FTR auctions over time. This concept relates to market contestability. A market is contestable when there is free entry and exit into the market.[78] In classic competition theory, a market with perfect competition would have many participating firms. In contrast, a contestable market can have fewer firms, but those firms face the threat of new firms entering the market. This threat of entry imposes competitive behavior and competitive outcomes.

MISO can assess FTR market competitiveness by analyzing the number of new market participants entering the auctions over time and how the market share of bids, offers, and cleared FTR volumes changes over time. LEI believes that such assessment metrics can be helpful in identifying the presence of competition. Section 7.2.2 presents LEI's findings – that new market participants have entered both the MISO annual and monthly FTR auctions over time.

Another measure of FTR market competitiveness is the proximity of FTR clearing prices to efficient levels. According to economic theory, excess (or abnormal) profits are not sustainable in an efficient market. Excess profits are usually defined as profits that are above the market participant's opportunity cost. With respect to financial traders, opportunity costs could include their cost of funds (e.g., the capital they put at risk), the cost of posting collateral, and forgone profits trading in other markets with a similar level of risk, among others. Sections 7.1 and 9.1 present LEI's analysis of these measures.

[78] Glossary of Industrial Organisation Economics and Competition Law, compiled by R. S. Khemani and D. M. Shapiro, commissioned by the Directorate for Financial, Fiscal and Enterprise Affairs, OECD, 1993.

Figure 28. Issues in defining the market for FTR auctions



6.13 Summary of Task 1 findings

To assess whether MISO's ARR/FTR construct's efficacy in delivering its original purpose, LEI analyzed multiple aspects of the ARR/FTR construct. LEI's findings indicate that, at a high level, the ARR and FTR are working as intended, and FTR auction prices have been efficient. Moreover, LEI found evidence of new entry, which suggests that there are no artificial barriers to FTR auction entry. However, the current ARR entitlement process does not reflect the current use of the network. This is mainly due to the linkage of ARR entitlements to certain pricing node combinations and a dated historical snapshot of network use by transmission customers. LEI also found that the low TCM values that have been observed in recent years are related to unpredictable drivers of DA energy market outcomes, as well as (to a smaller degree) the risk preferences of LSEs, including (but not limited to) whether to hold or convert their ARRs.

6.13.1 Annual FTR auctions are operating consistently with their original purpose

LEI finds that MISO's annual FTR auctions are effective in achieving their intended purpose, namely, to allow market participants to hedge congestion risk in the DA energy market. However, certain practical factors may limit the ability of transmission customers to realize a perfect hedge for all of their energy needs. For example, a transmission customer may not get allocated ARRs on all the path it has nominated (i.e., due to transmission system conditions and SFT limitations). A transmission customer may also face a changing resource mix and load profile

after the annual ARR nomination and allocation processes, and that may also impact the feasibility of a perfect hedge. Notably, these practical factors are not unique to MISO – the complexities around orchestrating a perfect hedge are endemic to nodal markets implementing FTR constructs.

LEI did not find any artificial barriers to FTR auction participation. In fact, market data indicates that the number of entities involved in both annual and monthly FTR auctions has grown over the years. In addition to the use of ARRs, LEI found that some LSEs also actively purchase additional FTRs on paths for which they were not awarded ARRs, as presented later in Section 7.5.

Moreover, FTR auctions are relatively efficient in providing LSEs with hedging opportunities on the paths for which they receive ARRs, as indicated by LEI's analysis of the Allocation and Annual FTR Auction Assessment Metrics. Unusual weather or other challenges to predicting congestion can, in retrospect, make an LSE's decision to keep its ARRs appear economically inferior compared to self-scheduling in specific years. Large forecast errors should not be unexpected given the long time gap between the auction and actual realized congestion value, as well as the high level of uncertainty pertaining to underlying factors that drive congestion. This issue is further discussed in the Appendix (Section 9.1).

6.13.2 ARRs are an additional hedging mechanism for transmission customers

ARRs provide transmission customers with two hedging options. First, ARR holders have the ability to sell off their FTRs a year in advance, and as a result, securitize DA congestion risk into a fixed dollar payment. Second, ARRs can be converted to FTRs, in which case the transmission customer simply gets the realized DA congestion after the DA market results are made available. The ARR mechanism caters to different risk appetites and commercial needs of transmission customers. As mentioned above, based on an analysis of historical auctions and realized DA congestion values, annual FTR auction revenues have generally tracked DA congestion fairly well for periods where congestion was not heavily influenced by difficult-to-predict drivers, like extreme weather and geopolitical conflict in Ukraine (which has impacted global fuel markets).

LSEs, on behalf of transmission customers, are ultimately responsible for making the decision to either cash in their ARRs (and receive payment pursuant to the annual FTR auction results) or self-schedule in the annual FTR auctions (e.g., convert the ARR into an FTR). LEI recognizes that an LSE's risk appetite influences this decision. Nevertheless, historical data suggests that two-thirds of ARRs were self-scheduled, with a relatively stable trend over the past five annual auctions. Therefore, one can conclude that transmission customers appreciate and are actively taking advantage of the optionality afforded by ARRs with respect to how to hedge their DA energy market congestion risk.

6.13.3 The ARR entitlement process does not reflect the current use of the network

Transmission customers' entitlement to ARR paths is limited to certain buses and a dated historical snapshot of network use. Consequently, transmission customers are unable to receive congestion payments that are fully reflective of their current usage of the transmission network. Although some transmission customers do get annual FTR auction proceeds from the sale of FTRs

that are not associated with ARR paths (as part of the Stage 2 ARR settlement process), they are not given the option to self-schedule those paths as FTRs. In periods where annual auctions underestimate realized DA congestion, the shortcomings of the Stage 2 ARR settlement become apparent. LEI recommends changing the entitlement process to focus on current network use and providing transmission customers with an expanded set of paths for nomination.

In addition, when additional network capacity becomes available closer to real-time (for example, because of physical network changes or network model changes), the additional capacity is released in the monthly FTR auctions and may be purchased by any market participant. To account for changes in network capacity between the annual auction and MPMAs, the MISO auction clearing engine seeks to clear counter-flow trades. DA congestion may exceed congestion expectations in the MPMA auction due to differences between the FTR network model and the DA energy market network model. LEI understands that the DA energy market model is being adjusted to be more in-sync with the assumptions of the FTR auction model.

From LEI's perspective, the more important issue is that transmission customers are not granted any entitlements to additional network capacity that becomes available in the MPMAs. It appears that many LSEs forego participating in the monthly auctions; therefore, the competitive pool of bidders is composed primarily of financial traders. Indeed, the IMM has commented on this situation and characterized this as a potential barrier to entry. LEI suggests that MISO consider whether some of the additional network capacity should flow first to ARR holders as entitled FTRs. Please see Section 8.4 for additional details.

6.13.4 Low TCM values that have been observed in recent years are primarily related to abnormal weather conditions that led to high levels of DA congestion not predicted in the annual FTR auctions

The amount of DA congestion received by transmission customers has been relatively low in recent years primarily because of (a) inherent forecasting risk, and (b) LSEs' ex-ante decisions to receive payments tied to annual FTR auction results rather than convert their ARRs to FTRs. If these two factors are considered, the observed low TCM values are not suggestive of an inefficient market or a market design failure, but rather demonstrative of inherent limitations of a forward market construct and the reality of decision-making by LSEs in the face of uncertainty.

However, the TCM value is also influenced by other technical factors, which LEI believes can be improved to increase the TCM value.[79] As discussed above, transmission customers are currently constrained by the entitlements available for nomination. If awarded ARRs do not reflect the actual use of the transmission network, then it is unreasonable to assume that the value transmission customers receive is equal to the total DA congestion collected across the entire MISO footprint. Such potential changes are discussed in Sections 8.2 and 8.3.

[79] Although there is no explicit goal to increase the TCM, if the TCM is unnecessarily reduced for technical reasons, it would make sense to address these technical issues so that transmission customers get their share of DA congestion. This is ultimately the purpose of the ARR/FTR process.

Another observation is that, historically, the implied network capacity auctioned in the MPMA is larger than that of the annual FTR auctions. This results in a reduction of the TCM because (1) there are no entitlements granting ARRs or auction revenue of the MPMA to transmission customers, and (2) the TCM does not measure impact from MPMAs. If MISO changes the ARR/FTR construct such that entitlements are granted to transmission customers in each MPMA, the TCM should also include the values of such entitlements and the TCM would likely increase.

7 Task 2: What are the impacts of financial traders' participation in the FTR markets?

Key takeaways

- Annual FTR auctions have been efficient, and the FTR market has shown evidence of contestability.
- Financial traders play an essential role in the FTR auctions, as level of participation from transmission customers alone does not provide sufficient price signals for the annual FTR auction to clear on the basis of market offers. Financial traders, as explained by economics theory, contribute to the market efficiency of the annual FTR auctions.
- The participation of financial traders in the MISO FTR market enables one of the key functions of the MISO ARR/FTR construct – to allow LSEs to choose between holding onto the ARR (and receiving auction proceeds from the annual FTR auction that are using all available market information about expected DA congestion) or converting to an FTR (and thereby taking on the obligation associated with holding the FTR).
- Transmission customers have a genuine commercial need to participate in the FTR market, therefore an efficient FTR market benefits transmission customers.
- An efficient FTR market also supports forward energy market liquidity since FTR auctions provide valuable information to market participants, including transmission customers, about future congestion. Data from forward market activity demonstrates the value provided to market participants by the release of FTR auction outcomes.

7.1 LEI's approach to Task 2: assessing equity between transmission customers and financial traders in the FTR markets

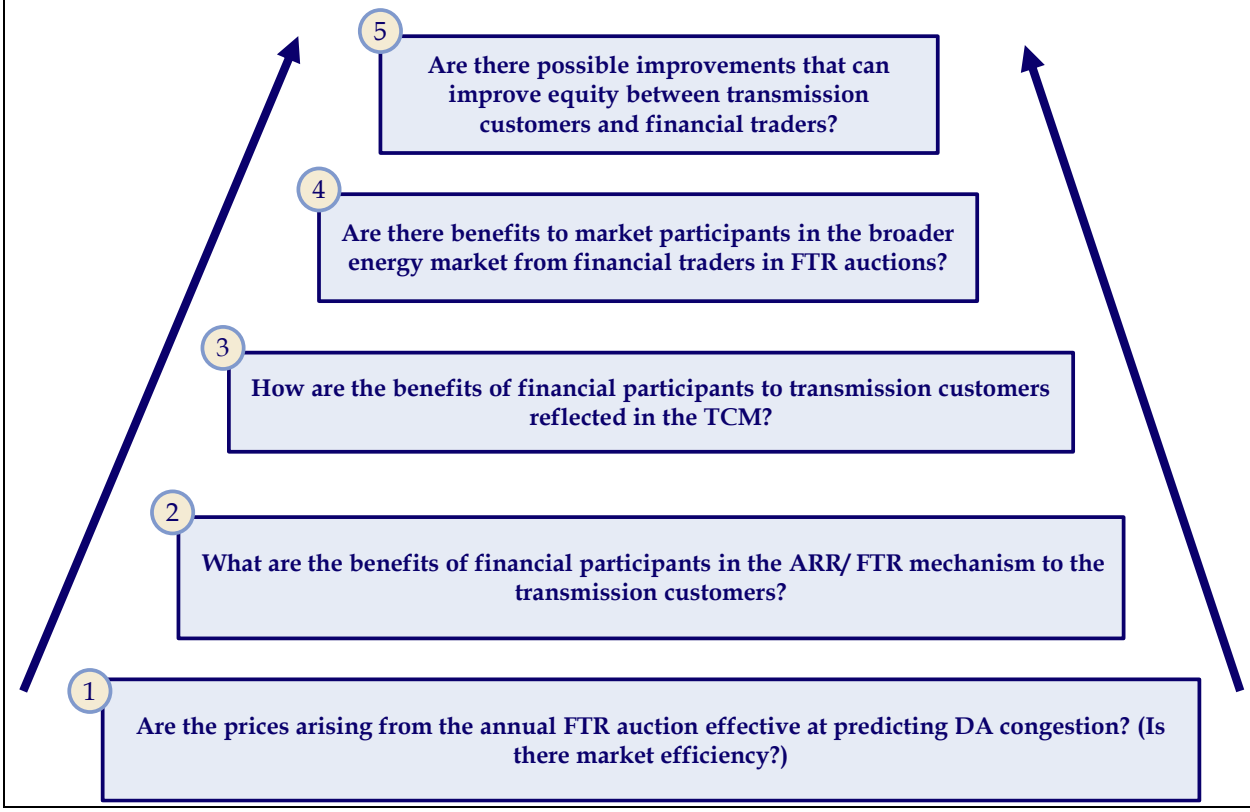
Assessing equity, in the context of Task 2, requires reviewing the risks taken and profits earned by different market participants in the FTR market and distribution of DA congestion between LSEs and financial traders. DA congestion collected by MISO is paid out to FTR holders, some of whom are LSEs and others are financial traders.

Some stakeholders have expressed a concern that financial traders have earned, through their willingness to purchased FTRs, a large amount of the DA congestion. A parallel concern is that the distribution of some of the DA congestion to financial traders may have caused the TCM to decrease. Some view this outcome as a potential equity issue between LSEs and financial traders, as discussed in Section 3. However, it is important to keep in mind that the TCM is not an equity metric between LSEs and financial traders. The TCM does not measure market efficiency. Instead, the TCM is evaluating the value of payments received by LSEs through the ARR/FTR construct, and a high TCM value in a single year does not necessarily mean the FTR market result is efficient.

As stated in Section 4.1, FTRs provide market participants with a financial hedge to manage the risk of congestion costs in the DA energy and operating reserve markets, while ARRs also enable

transmission customers the right to obtain a share of the overall auction revenues generated in the annual FTR auction. There is no mention in the official FERC filings or MISO's BPM that the purpose of ARRs (and FTRs) is to ensure that transmission customers should get 100% of DA congestion. Therefore, it would be inaccurate to presume that the TCM should be equal to 100% when the ARR/FTR market is efficient. LEI therefore approached the analysis without a specific TCM target value. Instead, LEI considered whether the participation of financial traders in the FTR market helps the ARR/FTR construct meet the original objectives and whether the presence of financial traders benefits transmission customers. This specifically means analyzing whether the involvement of financial traders improves the ability of transmission customers to (1) obtain financial hedges to manage congestion risk (the original purpose of FTRs), and (2) get a share of revenue in the annual FTR auction (the original purpose of ARRs).

Figure 29. Building blocks approach to analyzing the impact of financial participants on the FTR market



To this end, LEI used a building blocks approach to address Task 2 questions, as shown in Figure 29. LEI performed the following quantitative and qualitative analyses:

- An efficient market is the cornerstone of valuable price signals. The many benefits of having financial traders participate in the MISO FTR market are conditional on the presence of an efficient FTR market. Therefore, LEI began its analysis by answering the question: **are market prices from the annual FTR auction efficient, and are the FTR auctions competitive?** As discussed in Section 6.12, LEI argues that MISO could use two

measures to understand the competitiveness of the FTR market: market contestability and the extent (or level) of competitive pricing. In a competitive market, profits earned by financial traders as a class would remain at a reasonable level over the long term. This section focuses on these aforementioned measures of competitiveness and efficiency.

- **What are the benefits of financial traders' participation in the FTR markets?** The benefits brought on by financial traders can be analyzed through a hypothetical case where financial traders do not participate in MISO FTR market at all. By comparing possible market outcomes with and without financial traders, including FTR auction mechanics and flow of funds at different stages of the MISO ARR/FTR process, one can have a clearer picture of these benefits.

- **What is the impact of financial participants on the TCM?** On the surface, this question can be answered empirically by calculating the amount of profit financial traders have earned in the MISO FTR market over the years; any profits earned by financial traders as a class would mean that LSEs' share of DA congestion would be lower (and therefore lead to a lower TCM value). However, other impacts of financial traders on the TCM are harder to quantify. These other impacts include financial traders' offers that facilitated a market-based solution for all pricing nodes in the annual FTR auctions (which, in turn, affected the ARR settlement target and hence the TCM). Financial traders' participation in the annual FTR auctions also influenced the value of the Stage 2 ARR settlement that transmission customers receive (which is also a component of the TCM).

- **How does an efficient FTR market benefit transmission customers?** While prior questions relate to market efficiency of FTR auctions and how financial traders contribute to market efficiency, they have not covered the benefits of an efficient FTR market to transmission customers. This Section discusses how an efficient FTR market benefits transmission customers within the ARR/FTR construct and in the broader energy markets.

- **Can we improve equity between transmission customers and financial traders?** Finally, based on the analyses conducted in this Section and under Task 1, LEI identified areas for the improvement of the ARR/FTR construct that would allow the market and its participants to better realize the benefits of the participation of financial traders.

7.2 Are market prices from the annual FTR auction efficient?

An efficient FTR auction price provides transmission customers the opportunity to hedge their exposure to DA congestion. Therefore, it is important to first evaluate whether FTR auction prices have been competitive and whether there has been adequate competition to ensure efficient market operations.

7.2.1 Are FTR auction prices efficient?

As discussed in Section 6.7, LEI found that the annual FTR auctions are efficient. Auction prices reflect DA congestion in normal conditions, or conditions where there was no extreme weather or other unpredictable drivers.

The analysis presented in Section 6.7 focuses mainly on whether annual FTR clearing prices track overall DA congestion on all auctioned paths in aggregate. To understand whether individual annual FTR auction path clearing results have predictive power of DA congestion, LEI designed a set of econometric analyses using annual auction data from 2013 to 2022. In these analyses, DA congestion charges served as the dependent (explained) variable, and the annual FTR auction results (shadow prices) were the independent (explanatory) variable.

LEI's econometric analyses found that all seasons, years, and peak/off-peak periods are statistically significant, indicating that there is more than 95% statistical confidence level that the annual FTR auction results have predictive power on DA congestion.[80] This indicates that annual FTR auctions are market efficient. The detailed analysis and results are presented in the Appendix (Section 9.1).

LEI conducted an additional analysis to understand the profitability of market participants. In an efficient market where risk changes hands, there should be no single (or a specific group of) market participant that is consistently profitable (or unprofitable) for a prolonged period. In general, if there are consistent profits for a specific market participant, this indicates anomalies in the market structure that warrants further investigation. In the Appendix (Section 9.2), LEI presents its analysis of the ratio of profitable trades and the ratio of profitable financial participants. The findings in this analysis indicate that even in past seasons where financial traders, in aggregate, were profitable, a large percentage of trades were unprofitable. Therefore, LEI found no evidence that there are issues in MISO's annual FTR market related to financial traders that warrant further investigation.

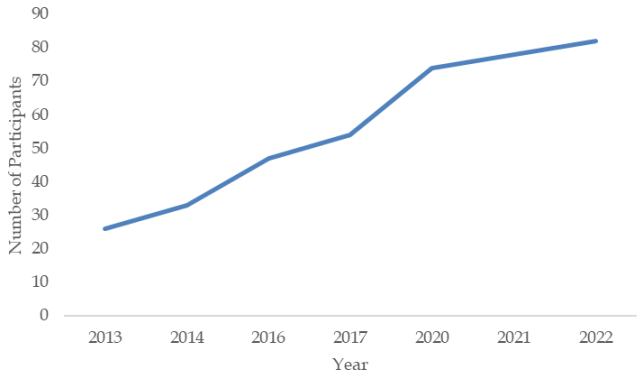
In Section 6.10, LEI came to the conclusion that monthly FTR auction outcomes in the past have been unusually profitable, despite presence of new entrants over time. As discussed in Section 6.10, LEI found that the unusual profitability are due to two reasons: prevalence and the scale of implied network capacity expansion from annual FTR auctions to MPMAs, and network modeling differences between the DA energy market and FTR market. LEI understands that MISO is already pursuing fixes to technical network model factors that contributed to the profitability of those products in the MPMAs. These issues are further addressed in Section 8.4.

7.2.2 Do we have adequate competition in the FTR auctions?

As discussed in Section 6.12, one way to understand the competitiveness of a market is by observing whether the market is contestable. The number of financial participants in the annual FTR auctions has been steadily rising since 2013, suggesting an increasingly competitive market over time, as shown in Figure 30.

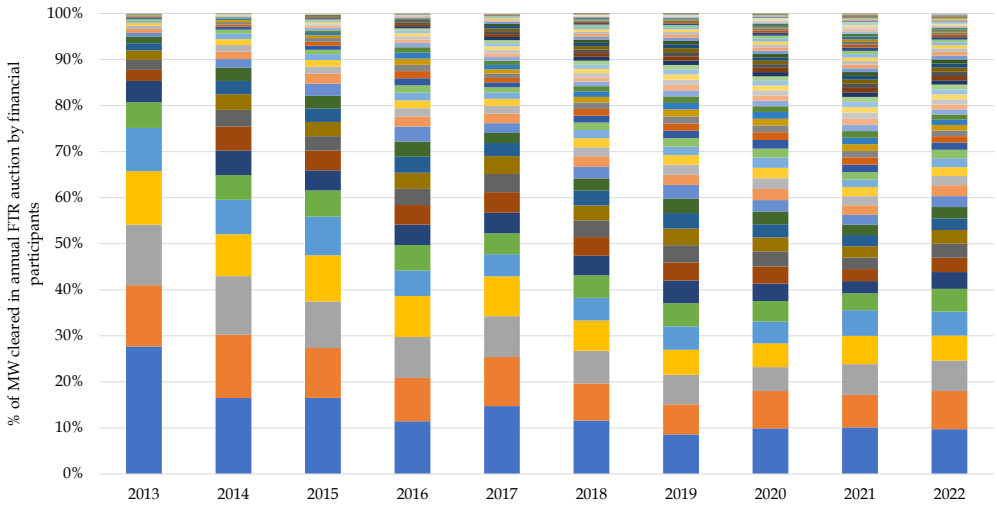
[80] It should be noted that the predictive power of FTR auctions is not perfect and that there are variations in the predictive power of the auction depending on the time period and season. LEI found that the FTR auction results for off-peak periods have higher predictive power than peak periods, likely because of the reduced uncertainty around other factors that affect congestion (and overall lower congestion). Furthermore, FTR auction results for winter seasons have reduced predictive power as there is a higher probability of unexpected events that drive congestion.

Figure 30. Number of financial participants in annual FTR auctions



Furthermore, financial participants are clearing a greater percentage of MWs in the market. At the same time, the MWs cleared are becoming more fragmented, in that the largest players cleared a smaller percentage of trades, as depicted in Figure 31. Such fragmentation is evidence of a contestable market.

Figure 31. Percentage of MWs cleared in annual FTR auctions by financial participant



Note: While this graphic shows data related to annual FTR auctions, the results are similar to the MPMAs.

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7.3 What are the benefits of financial traders' participation in the FTR markets?

Economic theory suggests that financial traders (also referred to as "speculators" in literature) are vital to efficient market outcomes.[81] Based on empirical studies, speculators enhance liquidity[82] and stabilize market outcomes by trading away arbitrage opportunities. Electricity market design generally acknowledges these benefits of speculative trading – this is why market rules allow market actors other than LSEs or generation owners to participate. Specific to the power sector, virtual transactions offer potential benefits like improving the efficiency of electricity markets, mitigating market power, enhancing price formation, hedging real-time market risks, and pricing risk-hedging benefits.[83] From 2019-2021, virtual bidding accounted for approximately 11% of demand in MISO; virtual trading is generally more active in MISO than in other RTOs, even after adjusting for the much larger size of MISO.[84] In the FTR market, financial participants perform a large share of total market transactions, thereby contributing to market liquidity (by disseminating, through their participation in the market, information about expected congestion) and auction clearing. Financial participants also put significant capital at risk to participate in this market.

MISO's FTR market can be evaluated through a hypothetical assessment of FTR auctions in which bids and offers are only submitted by transmission customers (i.e., without financial traders). Based on an analysis of the number of unique paths (i.e., a unique combination of source and sink nodes) actively traded by transmission customers in historical annual FTR auctions,[85] LEI observes that the level of participation of transmission customers alone would have been far from sufficient in providing ample price signals. This means the annual FTR auction would likely not result in market price-based solutions for the majority of pricing nodes.

To illustrate this concept, LEI considered a simple mathematical exercise. Based on historical data, there were on average 10,719 unique paths traded by transmission customers in annual FTR auctions from 2013 to 2021. In comparison, there are over 150 top-level pricing nodes in MISO FTR auctions,[86] which means that the total number of unique paths between top-level nodes

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[81] The New Palgrave Dictionary of Economics. "Futures Markets, Hedging and Speculation." p. 4984-4991.

[82] Liquidity refers to the ability of buyers and sellers of securities to transact efficiently. It is measured by the speed with which large purchases and sales can be executed and the transaction costs incurred in doing so.

[83] Hogan, William. "Virtual Bidding and Electricity Market Design". *The Electricity Journal* 29. June 5, 2016: 33-47. Print.

[84] Potomac Economics. *2021 State of the Market Report.* p. 39.

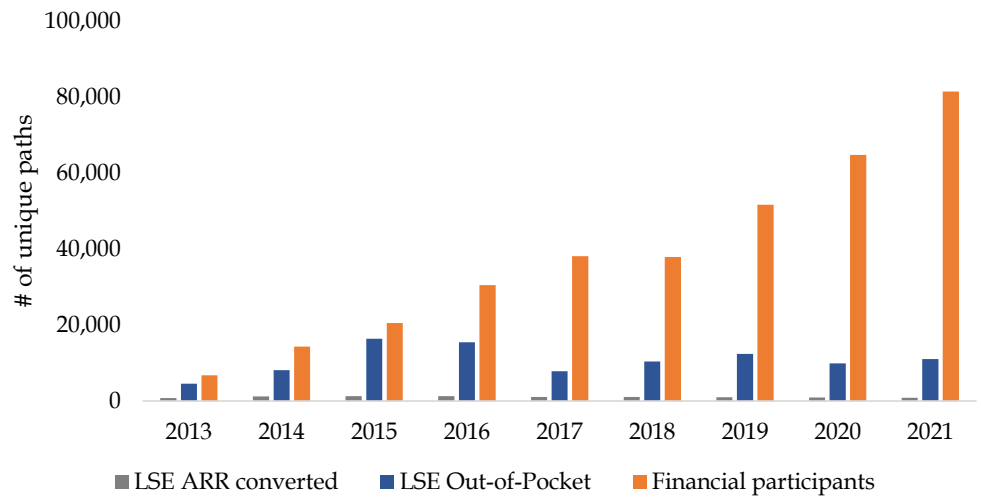
[85] These are FTRs bought or sold "out-of-pocket" by transmission customers and exclude conversion of ARRs to FTRs. ARR to FTR conversions are excluded because a conversion in the MISO FTR market is automatically set as a price-taking trade across three rounds of the annual FTR auction. Such trades do not provide price-based information to the FTR market.

[86] Typically, MISO trading nodes are named with multiple components, for example, "AECI.APM_1.AZ," "AECI.CWLD," "EAI.WMULD_1.AZ," or "EAI.H_SPR1_CT2." LEI refers to the "AECI" or "EAI" node

exceed 11,000 combinations.[87] This difference shows that the level of participation in the annual FTR auction market of transmission customers alone is insufficient in providing price signals for all the major pricing nodes in the MISO annual FTR auction.

Figure 32 presents the number of unique paths cleared "out-of-pocket" by transmission customers, the number of unique paths from the ARR-to-FTR conversion, and the number of unique paths traded by financial participants. There were a significantly lower number of unique paths traded by transmission customers as compared to those traded by financial participants, and this gap has been widening over the past several years. Without the participation of financial traders, the clearing prices of many pricing nodes would have to be derived using MISO's auction clearing algorithm and not based on market participants' offers and expectations of future congestion. In other words, the participation of financial traders allows the FTR auction to have market-based clearing prices for a greater number of pricing nodes, which better reflects market-based predictions of DA congestion. This is evidence that financial traders play an essential role in MISO's FTR auctions.

Figure 32. Number of unique paths traded, by type of market participant



designations as top-level nodes, as they refer to where nodes that are located at a major level electrically (but not necessarily geographically). There are over 2,000 pricing nodes in the MISO FTR auction.

[87] This is based on the "n-choose-r" ("nCr") formula that calculates the number of possible configurations of certain elements (here, unique paths among top-level pricing nodes), where the order of elements is irrelevant. In the formula, "n" is the number of elements and "r" is the number of samples from which to choose "n." To calculate the number of unique paths for two out of 150 points, n = 150 and r = 2, which results in 11,175 combinations.

7.4 What is the impact of financial traders on the TCM?

Directionally, profits to financial traders are correlated with a reduction in the TCM (but this relationship is not one-to-one). Therefore, on the surface, the impact of financial trader participation in the MISO FTR market can generally be quantified by calculating the total profits made as a class in each FTR auction.

Based on LEI's review of historical annual FTR auction clearing results and actual DA congestion from 2013 to 2021, financial traders earned an average of $24 million in profits per season.[88] While the average profitability is positive, there were periods where financial traders, in aggregate, incurred losses – for example, net losses of $20 million in the summer of 2014. Meanwhile, there were some seasons with relatively high profits of up to $197 million (for example, in winter 2020 due to Storm Uri, and in fall 2021 due to high gas prices and high wind output). In a hypothetical scenario where (1) the FTR clearing price can perfectly predict actual DA congestion and (2) all financial traders make neither profits nor losses, more accurate FTR clearing prices would result in an increase in the ARR settlement target, and the TCM would increase directionally.

It is important to note that the financial traders' activities are driven by profit opportunities. For LSEs and other grid users to be able to reap the benefits of having financial traders participate in the FTR market, the FTR market must present profit opportunities for these traders. Therefore, it is economically reasonable and rational to see profits earned by financial traders. If financial traders consistently make losses or their ability to make profits is unnecessarily impeded, they will exit the market.

Importantly, the impacts of financial traders on the TCM are not only tied to the division of DA congestion revenues between LSEs and financial traders. There are other dimensions where financial traders' activities benefits transmission customers and supports the TCM - although such benefits are difficult to quantify, as discussed below.

Net purchases made by financial traders in the annual FTR auction are a source of funding for the ARR settlement target and Stage 2 ARR settlement. From 2013 to 2021, the net FTR auction revenue contributed by financial traders amounted to $1.3 billion, or an average of $39 million per season. In comparison, auction revenue contributed by transmission customers from their "out-of-pocket" FTR purchases amounted to $814 million over the same period, or an average of $24 million per season. These revenues are first used to fund ARR settlement (i.e., transmission customers holding ARRs), and any remaining auction revenue is used to fund Stage 2 ARR settlement.

[88] Profits are defined as the FTR funding target (i.e., payment to FTR holders) minus FTR auction revenue (i.e., FTR clearing price). LEI identified the buyers of FTR paths in each annual FTR auction and calculated the net profits for all FTR paths owned by financial traders. LEI only considered the net position of financial traders after Round 3 since market participants can buy a path in Round 1 of the annual FTR auction and sell it in subsequent rounds. Note that a net profit to financial traders on the aggregate does not mean that all financial traders earned a profit or that all FTRs sold were profitable.

From 2013 to 2021, the ARR settlement target totaled $1.6 billion, averaging $46 million per season. This suggests that if all else is held constant, historically, auction revenue contributed by transmission customers from their "out-of-pocket" FTR purchases would not have been sufficient to fund the ARR settlement targets.

At the same time, it would be unfair to conclude that, without financial traders, the ARR settlement target would have been underfunded by $721 million over the past nine years.[89] If financial traders were not present in prior annual FTR auctions, the clearing prices of FTR paths would have differed, and ARR settlement targets would have changed, as well. The actual direction of the ARR settlement target change is difficult to estimate,[90] and therefore the actual percentage point impact on the TCM, in the absence of financial traders, is hard to quantify. But it is expected that without financial traders, the TCM would decrease. In the event that the TCM would increase, such increase would come from additional "out-of-pocket" purchases made by transmission customers and, therefore, not result in a real improvement in the total payments made to transmission customers as a whole.

7.5 How does an efficient FTR market benefit transmission customers?

Earlier sections of this report concluded that the annual FTR auctions have generally been efficient. An efficient FTR market should benefit LSEs, as they rely on the annual FTR auctions for their ARR proceeds and Stage 2 allocation. The benefits to LSEs extend beyond the ARR settlement. Those benefits should be considered when evaluating the equity of the distribution of the DA congestion and the reasonableness of the TCM. This section of the report presents evidence that transmission customers do benefit from an efficient FTR market in multiple ways. First, LEI presents that transmission customers have a genuine commercial need to participate in the MISO FTR market, and therefore an efficient FTR market provides a valuable price signal to support the commercial decisions of LSEs. Second, LEI shows that an efficient FTR market helps transmission customers that face curtailment in the ARR allocation process.

7.5.1 Transmission customers have a genuine commercial need to participate in the MISO FTR market

LEI found that transmission customers have a genuine commercial need to participate in the MISO FTR market. Analysis of historical ARR nomination and allocation data shows that transmission customers have had difficulty allocating cross-regional ARR paths.[91] We found that, historically, it is more likely that a nominated local path will get allocated (82% allocation ratio)

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[89] This is the difference between the ARR settlement target and auction revenue contributed by transmission customers from their "out-of-pocket" FTR purchases.

[90] To estimate this impact, one would have to remove all bids and offers placed by financial traders and recalculate the annual FTR auctions clearing results. Without the specific software MISO uses to clear the FTR auctions and the precise set of offers and bids from financial traders, LEI is unable to perform such analysis.

[91] Cross-regional paths are paths with different top-level source and sink nodes, while local paths are paths with the same top-level source and sink nodes.

than a cross-regional path (72%), as shown in Figure 33. Consequently, transmission customers are motivated to increase their "out-of-pocket" expenditure on cross-regional paths.

The steady increase in "out-of-pocket" cross-regional path purchases (see blue line in Figure 34) indicates that transmission customers are actively buying FTRs and are not solely dependent on ARRs to hedge their commercial risks.

Figure 33. Allocation ratio of nominated paths (local vs. cross-regional)

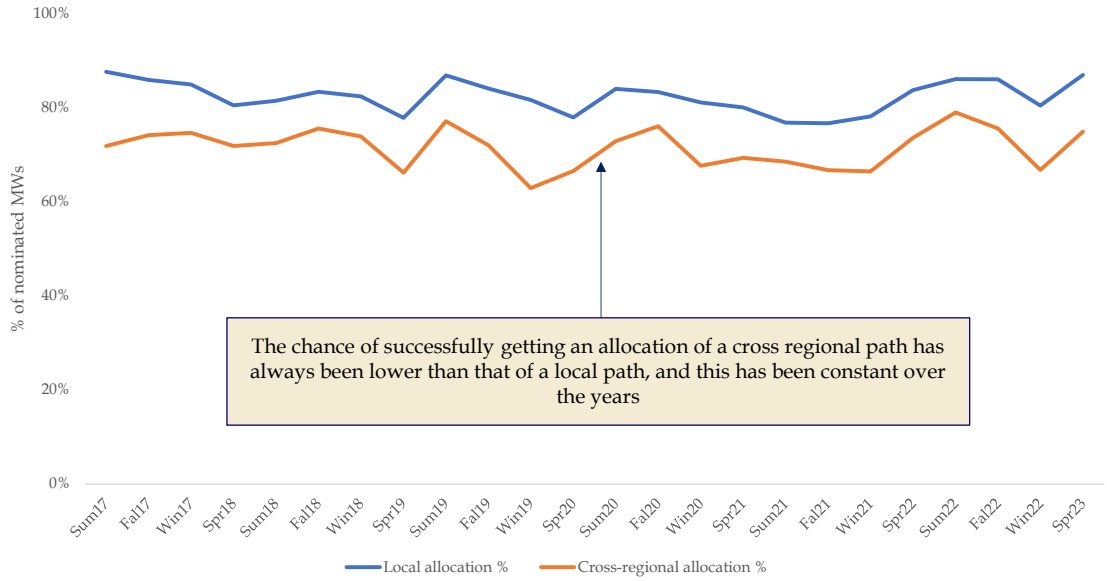
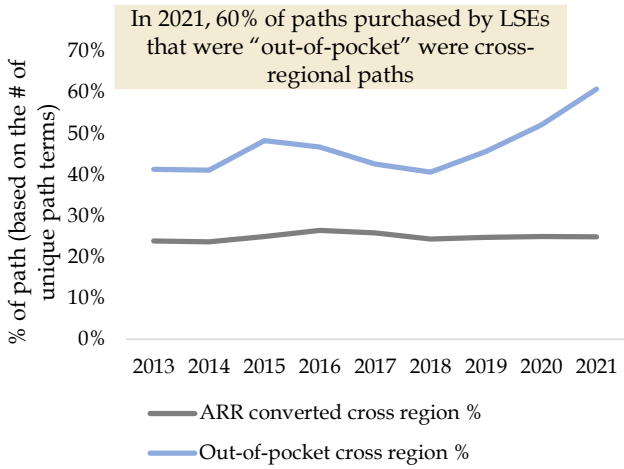


Figure 34. Percentage of cross-regional paths purchased by LSEs



As identified in Task 1, the current ARR entitlement and allocation processes are not able to allocate paths that reflect actual use of the transmission system. This could be a problem of the entitlement process, which does not provide new path entitlements that could be used by

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transmission customers; this could also be related to the SFT process, where paths are curtailed by multiple competing potential FTR buyers. According to Coase Theorem,[92] markets would reach efficient outcomes if markets were efficient and competitive. In the context of the ARR/FTR construct, the problems of the ARR entitlement and allocation process can be seen as an initial allocation of property rights. An efficient FTR market facilitates transmission customers to sell the paths that are not representative of their actual congestion needs and then use the proceeds to purchase the paths they do require to hedge their realized congestion. This, in turn, improves the allocative efficacy of FTRs and enhances the efficacy of the ARR/FTR construct.

7.5.2 An efficient FTR market helps the Stage 2 ARR settlement process

The value of financial trader participation in the annual FTR auction manifests as benefits to transmission customers in the Stage 2 ARR settlement process. As previously discussed, Stage 2 ARR settlements are monetary payments to transmission customers from the portion of annual FTR auction revenue that exceeds the annual ARR settlement target. This excess that is not allocated as ARRs is instead allocated to transmission customers that have residual entitlements.

The trading activities of financial participants in the annual FTR auction, especially with respect to non-ARR paths (as described in Section 6.9), are essential to the price formation process for Stage 2 ARR settlement. If the annual FTR market is inefficient, and if annual FTR auction clearing for non-ARR paths is consistently underpriced, then the Stage 2 ARR settlement amounts would decrease. This decrease hurts transmission customers that have a large share of curtailed ARRs. Historically, non-ARR paths that cleared in annual FTR auctions (in aggregate for both LSEs and financial participants) have historically been unprofitable, except in 2020 and 2021. This implies that the pricing of non-ARR paths has, on average, provided a reasonable level of payments (relative to the DA congestion collected by buyers of non-ARR paths) to LSEs through Stage 2 ARR settlement.

7.6 Are there benefits to broader energy market participants from the engagement of financial traders in the FTR auctions?

An efficient FTR market not only benefits transmission customers by allowing them to acquire essential market services but also allows them to make better-informed risk management decisions thanks to market signals on future DA congestion levels. For example, the market information that financial traders bring to the auctions can help LSEs refine their expectations about future DA congestion across auction rounds.

The forward energy market also relies on price signals from FTR auctions. LEI reviewed transaction data on MISO basis-related futures contracts from the past two years from Nodal Exchange, an electric power futures and options exchange in the US. There is a strong increase in

[92] According to the Coase Theorem, the trading of property rights (with minimal transaction costs) can ensure an efficient equilibrium, regardless of the initial allocation of property rights. Transaction costs and barriers to trading can obstruct efficient outcomes. See: Robson, Alex. S. Skaperdas. "Costly enforcement of property rights and the Coase Theorem." Economic Theory, July 2008, Vol. 36, No. 1. p. 109-128.

traded volumes after the release of FTR auction results (this applies to all types of FTR auctions). As shown in Figure 35, there was an average increase in trades of 234% following the posting of annual auction results. This is evidence of the price discovery attributes that FTR auctions provide, which support the functionality of the forward market. Given that auction results predict DA congestion relatively well, it is reasonable to assume that the information from FTR auctions is helpful to forward markets and to other commercial strategies that market participants across the board, including LSEs, pursue.

Figure 35. Percentage change in average daily trading volumes of Nodal Exchange MISO energy futures after FTR auction results posting

Trading Year	% Increase following Annual Auction	% Increase following Monthly MPMA Auction
2020	31%	53%
2021	438%	94%

Note: This figure is based on MISO peak, off-peak, and 24-hour locational spread trading on Nodal Exchange from January 1, 2018, to December 31, 2021. "Monthly" volume is used to evaluate the impact of monthly MPMA auctions and includes trades that are fully in the current planning year. "Annual" volume is used to evaluate the impact of annual auctions and includes trades on strips of 12 months or longer outside of the current planning year. The week (i.e., five business days) after each auction includes the auction date through four calendar days after the auction; the daily average overall volume is calculated for the remaining trading days of the week.

Source: Nodal Exchange

7.7 Can we improve equity between transmission customers and financial traders?

In addressing the questions for Task 2, LEI has shown that the annual FTR auction construct has been efficient and that the participation of financial traders in the MISO FTR market is beneficial. Furthermore, transmission customers have benefitted from increased market efficiency. However, while performing these analyses, LEI has also identified potential areas of improvement, or areas where transmission customers could benefit more from the participation of financial traders.

A key issue identified is that market efficiency only benefits transmission customers if the products offered fit their needs. Based on feedback received during the stakeholder engagement sessions, LEI learned that the current set of products offered in the FTR market is too narrow and does not suit the needs of stakeholders. For example, each season only has one peak and one off-peak product, where the off-peak product covers all weekday off-peak hours as well as all hours during weekends and select public holidays. The contracts held by transmission customers and generators do not align well with this arrangement. In Section 8.3, LEI presents potential new FTR products that may better suit this need of FTR market participants.

With these changes, transmission customers may realize greater benefits from the participation of financial traders in the MISO FTR market. As a consequence, these changes may also improve the equity relationship between transmission customers and financial traders.

7.8 Summary of Task 2 findings

In summary, aggregate historical profits and the observed increase in the number of financial participants in the annual FTR auctions attest to the attractiveness of MISO's FTR auction. Financial participants are key to producing efficient outcomes from MISO's FTR auctions. The impact that financial traders have on the FTR auctions is useful for LSEs and their hedging activities as well as in the context of their broader commercial activities in the forward energy market.

7.8.1 Annual FTR auction prices have been efficient

LEI analyzed whether FTR auction prices have been competitive and if there is adequate competition to ensure that the market is operating efficiently. The results of econometric analyses show that for all seasons, years, and peak/off-peak periods, annual FTR auction prices reflect DA congestion charges well.

LEI's analyses of the share of profitable versus unprofitable trades and number of participating individual financial traders indicate that annual FTR auction results have been reasonable. However, consistent profitability in monthly FTR auctions indicates that there are anomalies in the MPMAs.

In terms of competitiveness, LEI's analysis shows that the number of financial participants in the annual FTR auctions has been steadily rising since 2013. This suggests that the annual FTR auctions are contestable. LEI also presented evidence that the annual FTR market is becoming more fragmented for financial traders, indicating that the FTR auctions are contestable.

7.8.2 Financial traders play an essential role in FTR auctions, and their participation enhances the ability of LSEs to opt for fixed payments under the ARR/FTR construct

Through a counterfactual (or hypothetical) thought experiment, LEI found that financial traders are vital to FTR auctions as the level of participation from transmission customers alone would not provide sufficient market-based price signals for the FTR market to clear efficiently.

The MISO ARR/FTR construct allows LSEs to choose whether to collect a fixed payment (by holding their ARRs) or receive a variable payment based on realized DA congestion (by self-scheduling their ARRs to FTRs). If all else is held constant, historically, auction revenue contributed by transmission customers from their "out-of-pocket" FTR purchases have not been sufficient to fund ARR settlement targets. This means that the participation of financial traders in the MISO FTR market enables one of the key functions of the MISO ARR/FTR construct – to allow LSEs to choose between a fixed or variable payment.

7.8.3 Transmission customers benefit from an efficient FTR market

LEI found that transmission customers have a genuine commercial need to participate in the MISO FTR market. This is evidenced by historical data showing that transmission customers purchase paths in the FTR auction when ARR nomination requests are not fulfilled. Therefore, an efficient price signal in the FTR market helps transmission customers make trading decisions for the purpose of hedging congestion risks.

Furthermore, LEI observed that financial participants' trading activities in the annual FTR auctions were essential to the price formation process for Stage 2 ARR settlement. This settlement process helped support equitable outcomes amongst transmission customers themselves.

Finally, LEI found evidence that the forward energy market relied on price signals from MISO's FTR auctions. It is reasonable to assume that the information from FTR auctions is helpful to forward markets and other commercial strategies that MISO market participants pursue.

8 Gaps and recommendations for improving the current ARR/FTR design (Task 3)

Key takeaways

The gaps in the current ARR/FTR design include the following:

- The current entitlement and ARR allocation processes do not reflect actual usage of the transmission network. They also do not provide sufficient flexibility to LSEs to choose pricing nodes that can help them better hedge their congestion.
- The generation patterns of new resources like wind (and solar) are not aligned with the conventional definitions of peak and off-peak.
- Prevalence of implied network capacity expansion between annual FTR auctions and MPMAs, as well as differences between DA energy market model and FTR model, resulted in consistent profits earned by MPMA participants.
- Transmission customers are not given any entitlements to monthly network capacity.
- The TCM has several deficiencies as a metric. First, "out-of-pocket" purchases of FTRs by transmission customers should not be included in the TCM formula. Second, the TCM's usefulness in assessing the ARR/FTR construct is limited by its design that comingles the result of the ARR/FTR construct with the impact of transmission customers' decisions with respect to their ARRs (e.g., hold or self-schedule).

To address these gaps, the following enhancements should be considered:

- Change the basis of the reference year for ARR entitlements and allow LSEs to nominate more than just the current gen-to-load paths.
- Introduce new FTR products by subdividing existing products into more granular ones that better match the generation patterns of new types of resources (e.g., wind).
- Give to LSEs (that did not receive allocations of up to 100% of peak load) the additional capacity associated with the ARR paths that are released in the MPMAs. These paths result from network model adjustments made before the MPMAs.
- Review the effectiveness of MISO's efforts in fixing the modeling differences between the FTR network model and DA energy market model in minimizing unintended profitability of counter-flow FTRs.
- Investigate ways to incentivize transmission and outage scheduling to harmonize ARR and FTR outcomes with the DA energy market
- Monitor whether the FTR market is contestable by developing new metrics that track (i) the trend in the number of FTR auction participants, and (ii) the efficiency of MISO's FTR market in predicting DA energy congestion.
- Supplement the TCM with two metrics, namely, (i) the self-scheduling strategy hypothetical TCM, and (ii) the ARR holding strategy hypothetical TCM. Remove "out-of-pocket" purchases from the TCM formula.
- Publish a metric that measures the amount of congestion revenue lost by transmission customers due to ARR allocation curtailments and compare this with the Stage 2 settlement payment.

LEI's list of recommended enhancements to MISO's ARR/FTR construct are based on three main gaps identified:

- The current ARR entitlement and allocation processes do not reflect actual usage of the transmission network. Recommended enhancements in Sections 8.1, 8.2, and 8.3 focus on addressing this gap;

- Prevalence of implied network capacity expansion between annual FTR auctions and MPMAs, as well as differences between DA energy market model and FTR model, resulted in consistent profits earned by MPMA participants. Recommended enhancements discussed in Sections 8.4 and 8.5 focus on addressing this gap;

- Deficiencies in the TCM as a metric to measure the efficacy of the ARR/FTR construct. Recommended enhancements in Sections 8.7, 8.6, and 8.4 focus on addressing this gap.

LEI recognizes that these recommended enhancements may come with costs, either due to efforts required to implement these changes, or due to frictions from stakeholders as there are winners and losers driven by the enhancements. Analyzing the cost of implementing the recommended enhancements requires additional study by MISO staff and potentially external vendors that provide MISO with the tools to administer its FTR market and is therefore out of the scope of this Study.

As multiple recommended enhancements are trying to address the same identified gap, there may be overlapping effects from the enhancements, and it may be more sensible to implement one enhancement at a time. LEI, therefore, recommends MISO and its stakeholders to prioritize the implementation of enhancements based on the result of further cost-benefit studies of the proposed enhancements.

8.1 Revise the basis for ARR from the historical reference year to actual usage of the transmission network

As discussed in Section 6.6, new paths allocated to LSEs as ARRs appear to provide an insufficient hedge against congestion risks and do not reflect actual use of the transmission network. To resolve these gaps in the current market framework, MISO could consider aligning ARR allocation with the current resource mix through the RSP replacement process. For instance, in the Southwest Power Pool ("SPP"), whenever the resource mix changes (e.g., due to new entry or retirements), entitlements are updated to accommodate these changes. This mechanism keeps SPP's entitlements (and in turn, ARRs) updated and aligned with current transmission network usage. [93]

[93] SPP. *Education Workshop on Congestion Hedging*. June 29, 2020. Slides 19, 21, 31, and 60.

Unlike MISO, which only has a one-time registration process for new assets, SPP implements an annual verification process where transmission service reservations ("TSRs")—which are converted to ARRs—are verified. Moreover, SPP also undertakes annual and monthly studies on the needs of ARRs based on TSR nominations. Thus, the allocation of the ARRs in SPP is tied to numerous updates of the TSRs. In contrast, MISO takes a more passive role in updating entitlements as compared to SPP, and changes to ARR entitlements are more incremental in nature.

LEI understands that SPP relies on its Open Access Same-time Information System ("OASIS") to identify the contractual market flow within its network, and such function is not available in MISO's OASIS. Therefore, if MISO is to implement an annual or even monthly study on transmission customer network usage, MISO will have to require transmission customers to submit relevant information on a timely basis, and such submission may not be as accurate or timely as those that SPP relies upon.

LEI also acknowledges that moving away from the historical reference year to better track actual usage of the transmission network will require some changes in the current SFT and network model. This would likewise require additional step(s) in the current RSP process to determine actual usage.

8.2 Allow transmission customers to nominate a greater number of path types during the ARR nomination process

Currently, transmission customers can only nominate ARR paths that are part of their entitlement paths. Based on LEI's analysis of entitled paths, with some rare exceptions, all ARR paths have a generation node as the source node and a load zone as the sink node (i.e., gen-to-load paths).

LEI's analysis also found that a good deal of DA congestion occurs on non-ARR paths. Although auction revenue for non-ARR paths from the annual FTR auction is allocated to transmission customers through Stage 2 ARR settlement, there are two disadvantages to such an allocation method.

First, Stage 2 ARR settlement happens after the annual FTR auction, and it is a pure monetary payment to transmission customers. Transmission customers do not have the option to obtain the FTRs of non-ARR paths by self-scheduling. Even if the transmission customer wanted to purchase an FTR path in an auction, it would have to find funding to make such purchase because Stage 2 ARR settlement happens after the annual FTR auction.

Second, Stage 2 ARR settlement is a rules-based allocation process and not a market mechanism. Compared to rules-based allocation, market mechanisms are more dynamic and adaptable to changes in market conditions. The results of market-based allocation (i.e., FTR auctions) are more likely to generate efficient price signals as compared to a rules-based allocation.

LEI suggests that MISO consider allowing transmission customers to nominate non-gen-to-load paths during the ARR nomination process. One way to facilitate such modification to the market framework would be to add a Stage 1C allocation process following Stage 1A and Stage 1B. During Stage 1C, transmission customers could nominate any paths up to the amount of MWs of

their unallocated entitlements.[94] Alternatively, during the RSP process, transmission customers could be allowed to request non-gen-to-load paths if the total MWs they requested do not exceed their peak load. This may help transmission customers better align their ARR paths with their actual transmission network use.

These two recommendations give LSEs a greater number of options for hedging their congestion risks than are currently available through the ARR process. Nevertheless, the introduction of an additional stage in the allocation process may extend/prolong the ARR/FTR process. In addition, LSEs may need more analytical capabilities to assess the risk/return of acquiring these new types of paths.

8.3 Introduce new FTR products to reflect the profile of newer generation assets

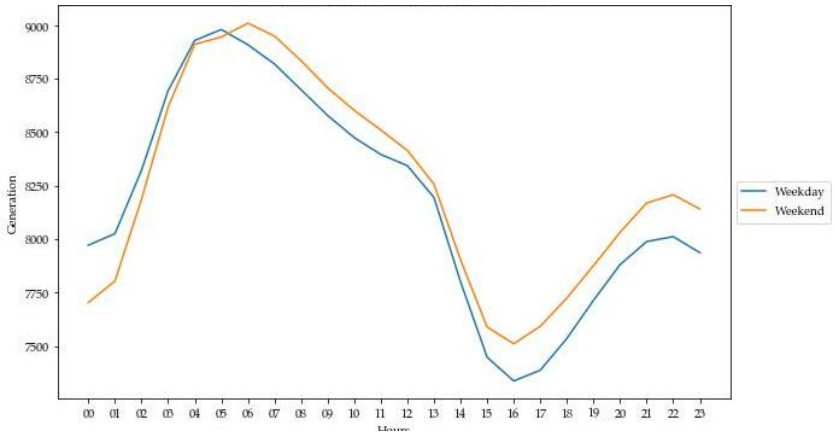
As suggested by MISO stakeholders, a potential way to improve FTR product offerings is to create new products that better reflect the output profile of generation assets. After conducting its analysis, LEI suggests that MISO create more granular time block FTR products for both weekday and weekend.

The current FTR peak and off-peak products follow MISO's peak and off-peak definitions for the energy market, which follow historical conventions for trading power. Peak hours are defined as hour ending 0700 to hour ending 2200 on all weekdays (Monday to Friday) except certain public holidays. All other hours are defined as off-peak. These definitions do not necessarily align with intermittent resource production and therefore do not reflect the need to hedge the congestion risk that arises. For example, a wind generator's level of output has no relationship with whether it is a weekday, a weekend, or a public holiday.

Figure 36 presents the average hourly wind generation in MISO. Wind generation is concentrated between 3 AM and 12 PM, which does not coincide with the peak/off-peak definitions used in the MISO FTR construct. There is little difference in wind generation between weekdays and weekends. Likewise, solar generates between 6 AM and 5 PM, which also does not align with MISO's FTR peak/off-peak definitions, as shown in Figure 37.

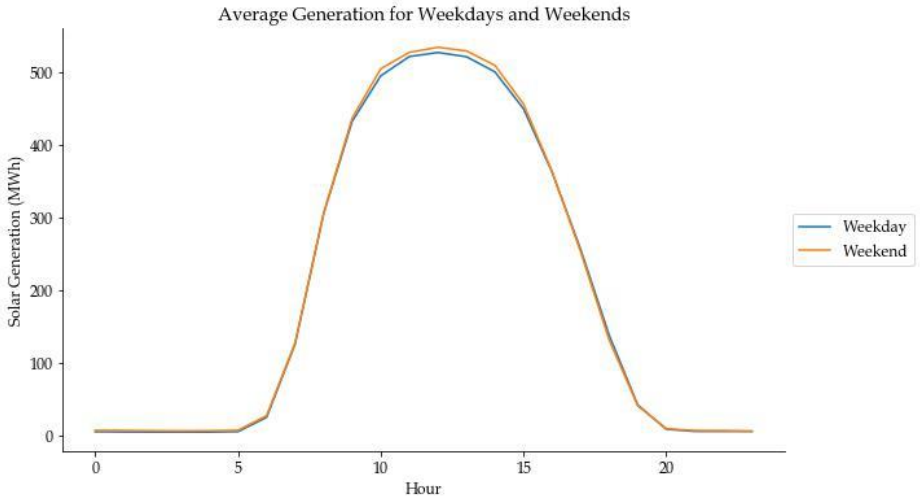
[94] This recommendation is also in line with LEI's recommendation to PJM, which was accepted by FERC in ER22-797.

Figure 36. Average wind output in MISO (2018-2022)



Source: Data from Energy information Administration ("EIA") processed by LEI

Figure 37. Average solar output in MISO (2018-2022)



Source: Data from EIA processed by LEI

For comparison, Figure 38 presents average demand in MISO during weekdays and weekends in the four seasons. The load patterns follow the peak/off-peak definitions in MISO, and the difference between weekdays and weekends is significant.

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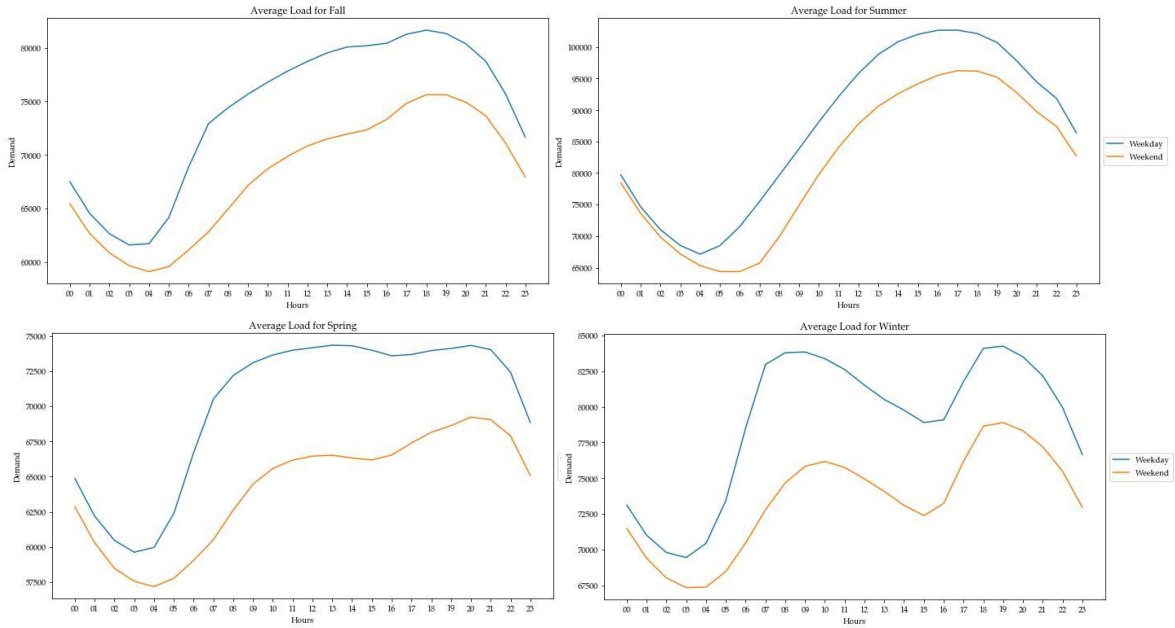
Figure 38. Average weekday vs. weekend load profile in MISO, by season



Source: Data from EIA processed by LEI

For wind and solar generation or for an LSE that enters into a PPA with a wind or solar generator, the current available FTR products do not offer a good solution to hedge congestion risk – neither the peak nor the off-peak product is able to match the average generation pattern of a wind unit. MISO has over 55 GW of wind and solar resources, which are expected to constitute the majority of the new resource mix. As presented in Section 5.1, wind comprised 17% of installed capacity and 13% of energy generation in MISO in 2021, which is anticipated to grow further. Therefore, the FTR market design needs to be able to accommodate the needs of wind generators and load that entered into PPAs with wind generators.

One potential solution is to divide peak/off-peak FTR products further. For example, each day could be divided into four time periods, such as morning (6 AM – 12 PM), afternoon (12 PM – 7 PM), night (7 PM - 10 PM), and nighttime (10 pm – 6 AM).[95] This granular segmentation could better match the potential diurnal energy consumption patterns of some transmission customers and the generation pattern of wind generators.[96] Furthermore, each of these four time period products could be further differentiated between weekday and weekend products, meaning that there will be eight products per season instead of the existing two products per season.

[95] These time periods should be further fine-tuned based on more detailed analyses of generation, demand, and congestion patterns.

[96] MISO can also consider creating time periods that better match solar's generation profile. However, this is of lower priority as compared to wind, seeing as solar only constituted 1% of installed capacity in MISO as of 2021.

Offering these new FTR products would provide market participants with contracts with intermittent resources with additional access to congestion hedging instruments. For example, with more granular FTR products, LSEs could hypothetically purchase more wind-to-load paths during hours with more generation, and more thermal-to-load paths during the afternoon with low wind generation, to better match their needs in hedging congestion. Furthermore, MISO's fleet of renewables is expected to grow, increasing the relevance of these new products.

The introduction of these FTR products, however, would increase the complexity of the auction clearing process, as both the SFT and auction process would need to be modified. One potential method to quantify the benefit of introducing more granular FTR products is to conduct an analysis on a hypothetical transmission customer. MISO could identify a typical LSE located in a load center, and assume its load is served by generation that is reflective of MISO's average capacity mix. The location of wind units is assumed to be where most wind farms are located in the MISO system (the same logic applies to an equivalent analysis of solar resources). Using historical congestion patterns, MISO would analyze whether the congestion revenue paid to the LSE in this scenario is closer to actual DA congestion as compared to the revenues obtained when ARR/FTR paths are only obtained from current on/off-peak products. This would allow MISO to ascertain the benefits of a portfolio of ARRs that are based on more granular ARR/FTR product definitions.

8.4 Developing an ARR-like mechanism for monthly auctions

As explained in Section 6.10, the main difference between MISO's monthly and annual FTR auctions is that transmission customers are not granted ARRs before the monthly auctions. Hence, transmission customers do not have direct access to monthly auction revenues.

At the same time, LEI identified that in 23 out of 27 seasons since 2015, the implied network capacity auctioned in MPMAs exceeded the network capacity sold in annual FTR auctions on a net basis, as presented in Figure 27.

Furthermore, LEI's analysis of historical MPMA results shows that transmission customers have historically not been active participants in these auctions. Figure 39 presents the number of MWs of FTR cleared in monthly auctions by entity type.[97] It is clear that the level of participation by financial traders has increased over time, while the participation by LSEs (who represent transmission customers) has declined since 2016.[98]

The combination of these factors raises the concern that network capacity expansion between annual and monthly auctions is being sold to financial traders without transmission customers

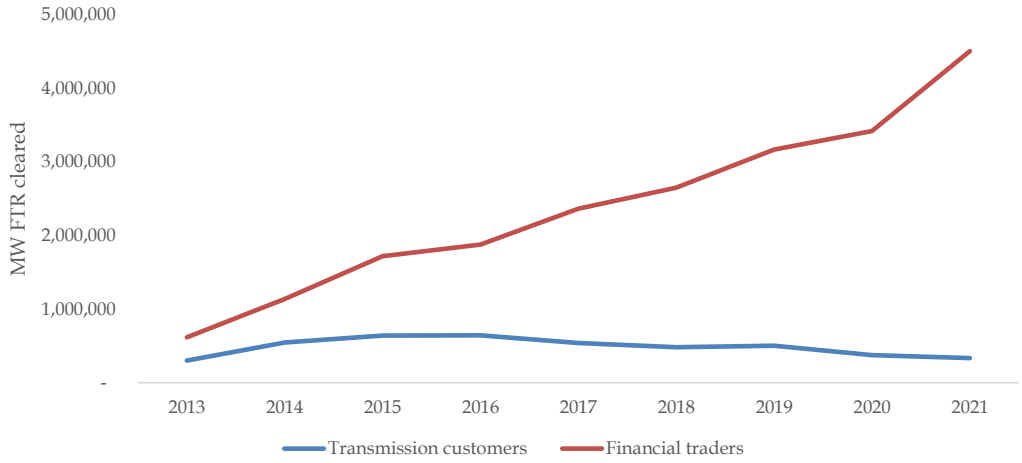
[97] There could be bids and offers from transmission customers and financial traders that do not clear the auction, as well. However, LEI is unable to separate the two based on the data provided by MISO. Moreover, the quantity of such bids and offers are expected to be a small portion of the MWs cleared.

[98] It is unclear why transmission customers are not active in the monthly auctions. LEI was not able to identify any additional requirements to participate in the monthly auctions as compared to the annual auctions.

(who have not been allocated ARRs that cover 100% of their peak load) getting a chance to access this capacity.

While it would be possible to put into effect the ARR process before each monthly auction, this may be too administratively complex. Additionally, LEI understands that MISO had a monthly ARR process over a decade ago, but this was canceled as it was deemed ineffective.

Figure 39. MWs of FTR cleared in monthly auctions, LSEs vs. financial traders



One potential avenue through which to emulate an ARR-like mechanism in the monthly auctions would be to treat each transmission customer's annual ARR nomination as a "standing order." In other words, if there are unallocated ARRs resulting from the annual ARR allocation process, these ARR nominations would automatically carry over into the MPMAs.[99] If the network model upgrade makes it feasible to carry over ARR nominations, then transmission customers would be directly granted the FTRs for such paths. There are three options to implement this framework modification.

The first option is the introduction of a full monthly ARR nomination, allocation, and conversion process. Under this option, MISO's monthly ARR nomination process would be similar to the annual process. Then, MISO would allocate monthly and multi-month ARRs and allow ARR holders to convert their monthly and multi-month ARRs into FTRs. The advantage of this option is that it provides LSEs with direct access to the additional capacity identified in the monthly auctions. Another advantage is that it gives them the option to either keep their ARRs or convert them to FTRs. This option has the disadvantage of requiring complex calculations, and may also

[99] Changes to the Stage 2 ARR settlement process may be required for this "standing order" ARR-like mechanism to work. The current Stage 2 ARR settlement process already compensates transmission customers with curtailed ARR nominations. For example, Stage 2 ARR settlement may have to be phased over the year, depending on whether additional capacity has been identified during monthly auctions. Alternatively, Stage 2 settlement payment would be withheld until the end of the year.

delay Stage 2 settlement payments. A mechanism may also be required to buy back over-allocated capacity.

The second option is to allocate FTRs to LSEs based on unallocated ARRs. Through this mechanism, LSEs would be able to access additional capacity directly through the monthly auction. Similar to the first option, the drawbacks to this second option include complexity in the process (albeit less complexity as compared to the first option), delayed Stage 2 settlement payments, and the need to develop a buyback mechanism for over-allocated capacity.

A third option is to allocate MPMA auction revenues to the LSEs. Some allocation methods include allocating MPMA auction revenue based on (i) the amount of transmission tariff paid by transmission customers (similar to how the Excess Congestion Fund is allocated) or (ii) the unallocated ARRs (similar to Stage 2 ARR settlement). This option is easy to implement and helps increase the TCM.[100] However, MISO would first need to develop an allocation method that is acceptable to all LSEs.

8.5 Investigate ways to incentivize transmission and outage scheduling to harmonize ARR and FTR outcomes with the DA energy market

As discussed in Section 6.10, changes in the transmission outage schedule (as well as the GSF cut-off difference between the FTR network model and the DA energy model) is the root cause of the issues that exhibited its effect in MPMA results. Therefore, LEI suggests that MISO consider formulating a mechanism for incorporation in the FTR auctions that incentivizes transmission owners to submit timely and accurate outage reporting. For instance, PJM introduced reforms that incentivize transmission owners to submit timely and accurately outage schedules as far in advance as possible. The purpose of these reforms was to ensure that FTR auctions better reflected actual market conditions. As a result, transmission owners in PJM are now required to submit all outage requests in excess of five calendar days in duration before the first of the month, six months in advance of the start of the outage.[101] All outage requests less than or equal to five calendar days in duration must be submitted by the first of the month before the month of the requested outage start date. Outages submitted late may be denied as they could jeopardize system reliability or cause congestion that requires off-cost operations. Alternatively, for PJM to accept the outage, transmission owners may elect to pay for off-cost operations associated with the late outage notification. The New York ISO has a similar scheme in place.

LEI recommends MISO to implement changes to incentivize transmission owners to communicate to MISO all known planned transmission outages ahead of the annual ARR/FTR processes, as these outages could impact ARR allocations and FTR auction results.

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[100] The TCM currently only considers results from the annual ARR/FTR process. If MISO implements a monthly ARR-like process, the TCM would also have to be adjusted to reflect the payments to transmission customers arising from this monthly ARR-like process.

[101] PJM. *PJM Manual 03: Transmission Operations Revision: 62.* June 1, 2022. p. 63.

Incentivizing submission of accurate transmission outage schedules harmonizes ARR and FTR outcomes with the DA energy market and better reflects the market conditions of the MPMA auctions. It also reduces the discrepancy between modeled transmission outages in the FTR auctions, actual planned transmission outages, and actual transmission outages affecting the DA energy market. Nevertheless, this solution requires designing an incentive mechanism that will be acceptable to market participants and transmission owners. Lastly, MISO should continue its efforts to fix the GSF to align the FTR network model and the DA energy model.

8.6 Complement the TCM by adding new metrics that measure potential congestion paid to transmission customers at various stages of the ARR/FTR process

LEI reviewed the composition of the current TCM and identified several shortcomings. First, the TCM includes payments to transmission customers from FTRs that they purchased "out-of-pocket" in annual FTR auctions. These payments are driven by activities that are not directly related to the entitlements that LSEs receive under the ARR/FTR mechanism. Instead, those payments from "out-of-pocket" purchases are driven solely by the trading decisions made by the LSEs. Including these payments in the TCM distorts the meaning of the TCM as a measure of the efficiency of the ARR/FTR construct in achieving its stated purposes for transmission customers. Therefore, LEI recommends the removal of "out-of-pocket" purchases from the TCM formula. This minimizes the distortion in TCM results.[102,103] Even MISO decided not to remove "out-of-pocket" FTR payments from the TCM, MISO should make sure such payments are net of the costs LSEs paid to acquire these FTRs in the auctions, such that gross and net cash flow are not mixed when calculating the TCM.

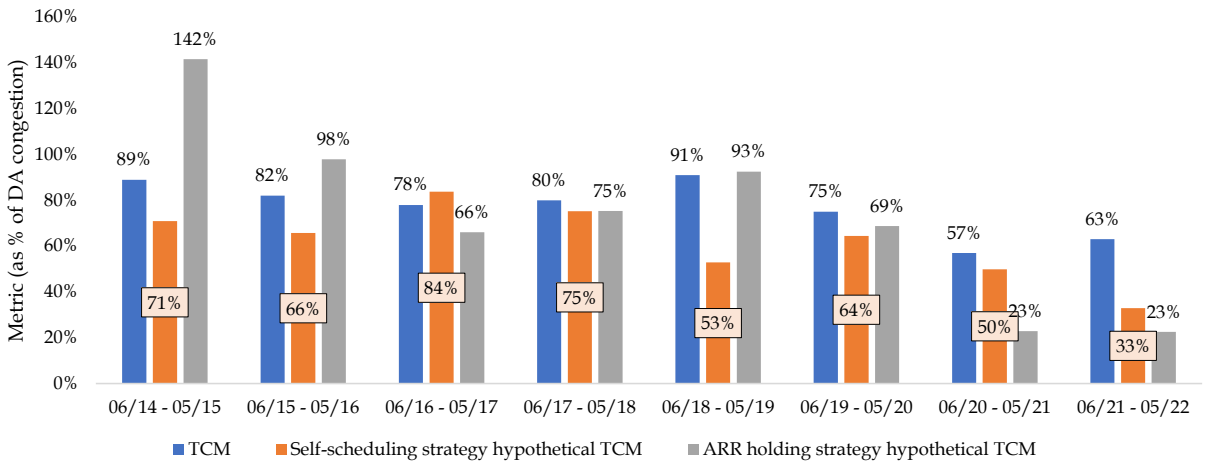
Second, as discussed in prior sections, the TCM value is impacted when transmission customers decide whether to hold their ARRs or convert them to FTRs. This decision may result in a high TCM in one year but a low TCM in another, depending on which ARR paths are converted to FTRs and whether the annual auction clearing price of a specific ARR path is higher or lower than the realized DA congestion. A good metric would support stakeholders' understanding of ARR/FTR market efficiency and focus on ARR/FTR outcomes as opposed to the impact of individual transmission customer decisions. Therefore, LEI suggests that MISO publish two additional metrics to address this issue. They are (i) the self-scheduling strategy hypothetical TCM, and (ii) the ARR holding strategy hypothetical TCM. The former is the payment transmission customers would receive if all ARRs were converted to FTRs. The latter is the payment transmission customers would receive if all ARRs remained as ARRs. These two metrics can serve as "bookend" values that help stakeholders understand the theoretical congestion payments that transmission customers could have received under the ARR/FTR construct if they

[102] The removal of "out-of-pocket' purchases will also reduce the TCM, which will require recalculation of prior years' TCM numbers to be comparable.

[103] It is possible that MISO current does not separately track FTRs held by LSEs from ARR-to-FTR conversion or bought from annual FTR auctions. If MISO removes payments from FTRs bought by LSEs "out-of-pocket" from the TCM, MISO will have to start tracking how the LSEs obtained their FTRs.

had made different decisions.[104] Figure 40 shows these two additional metrics based on historical data and the existing TCM.

Figure 40. TCM, self-scheduling strategy hypothetical TCM, and ARR holding strategy hypothetical TCM



Note: The TCM includes revenues from FTR paths that LSEs purchased "out-of-pocket" in annual FTR auctions. The two other metrics do not include these revenues. Therefore, it is expected that the TCM is generally higher than the other two proposed metrics. The low values of the self-scheduling and ARR holding strategy TMC metrics in recent years are likely a result of allocated ARR paths that are not reflective of where congestion happened in the system. Another explanation is that a material share of congestion happens on paths that are not auctioned at all during the annual FTR auction but rather during the MPMA.

Third, through analysis of the MISO ARR/FTR market, LEI also found that part of the reason for the decline in the TCM is the decrease in ARR paths allocated as a share of ARR paths nominated by transmission customers. In theory, losses in congestion revenue paid to transmission customers due to this curtailment are partially offset by Stage 2 ARR settlement payments. As a solution, MISO could begin publishing a metric that measures the amount of congestion revenue lost by transmission customers as a result of ARR allocation curtailments. This metric could then be compared against Stage 2 settlement payments for the same annual auction. This would allow stakeholders to understand whether the Stage 2 ARR settlement payment can compensate for the impact of ARR curtailment on the TCM. MISO will have to collect and process data to develop this new metric.

Finally, as discussed in Section 8.4, if changes are made in MPMAs, such as granting ARRs/FTRs to LSEs before MPMA, the TCM should be updated to reflect payments to LSEs arising from these new monthly ARR/FTRs entitlements.

[104] Calculating these metrics do not necessarily require recalculating the clearing prices of the auctions – the intent is to understand how much of the TCM is impacted by the LSE decisions assuming clearing prices are the same, without worrying about issues such as funding adequacy or competition.

8.7 Monitor trends in the number of FTR auction participants and efficiency of the FTR market in predicting DA energy congestion

While analyzing the value of financial traders participating in MISO's FTR market (as discussed in Section 6.12), LEI found that measuring the level of competition in MISO's FTR market using traditional techniques implemented in other markets may not be practical. However, it is important for MISO or MISO's IMM to periodically report on the trend in the number of market participants across the FTR auctions as well as on the efficiency of MISO's FTR market in predicting DA energy congestion. Such metrics would reassure stakeholders that market signals are efficient and subject to competitive discipline. Monitoring these metrics will also increase data transparency. This will require that MISO collect and process additional data to be able to evaluate trends.

9 Appendix 1: Supporting analysis

9.1 Do FTR auctions provide predictive power for day-ahead congestion?

If annual FTR auction results have predictive power over realized day-ahead congestion, then market participants can reliably use this information to make operating plans and investment decisions. To test this hypothesis, LEI ran regression analyses on annual auction data and actual DA congestion from 2013-2021. A model was then developed. The day-ahead congestion charges were the dependent (explained) variable, and the annual FTR auction results (shadow prices) were the independent (explanatory) variable. Regressions were run individually for each year, season, and peak/off-peak periods. FTR auction results are represented by the calculated shadow prices (average over three rounds).

Figure 41 and Figure 42 present the F-statistic ("F-Stat") values for various years and seasons segmented by peak and off-peak. The overall explanatory power of the model is reflected in the F-statistic. In general, the F-statistic is a ratio of two quantities that are expected to be roughly equal under the null hypothesis (i.e., when the model explains none of the variations in the dependent variable). In that case, the calculation produces an F-statistic of approximately one. The further away from one, the more the model explains the relationship. The F-statistic for all seasons, years, and peak/off-peak periods is statistically significant, indicating that LEI can be more than 95% confident that the model explains day-ahead congestion charges well.

Figure 41. F-Stat for peak regressions

Season/Year	2013	2014	2015	2016	2017	2018	2019	2020	2021
Summer	6711.78	3596.57	1377.26	1514.59	2540.36	2737.93	755.79	8942.16	2140.08
Fall	1909.44	347.67	6348.59	2425.65	8398.64	2845.61	5618.49	2972.66	3396.89
Winter	1556.79	1409.85	791.92	1963.96	2016.85	804.14	4278.72	151.76	417.31
Spring	-	2561.08	2931.78	4014.82	2400.98	2680.80	1682.03	5907.47	3151.82

Figure 42. F-Stat for off-peak regressions

Season/Year	2013	2014	2015	2016	2017	2018	2019	2020	2021
Summer	562.08	1151.09	81.83	1124.87	1810.83	1561.37	519.62	3127.27	1599.72
Fall	679.77	442.28	1219.50	952.81	2449.42	1818.69	2903.70	3426.45	3682.92
Winter	856.53	163.01	182.23	434.13	333.15	251.08	4137.45	18.07	319.39
Spring	-	1593.96	1033.29	1123.42	965.82	1363.21	3002.24	3513.22	2348.46

A key takeaway from this analysis is that FTR auction results for off-peak periods have higher predictive power than on-peak periods, likely because of the reduced uncertainty around other factors affecting congestion (and overall lower congestion). Furthermore, FTR auction results for winter seasons have poor predictive power over DA congestion as there is a higher probability of unexpected events driving congestion.

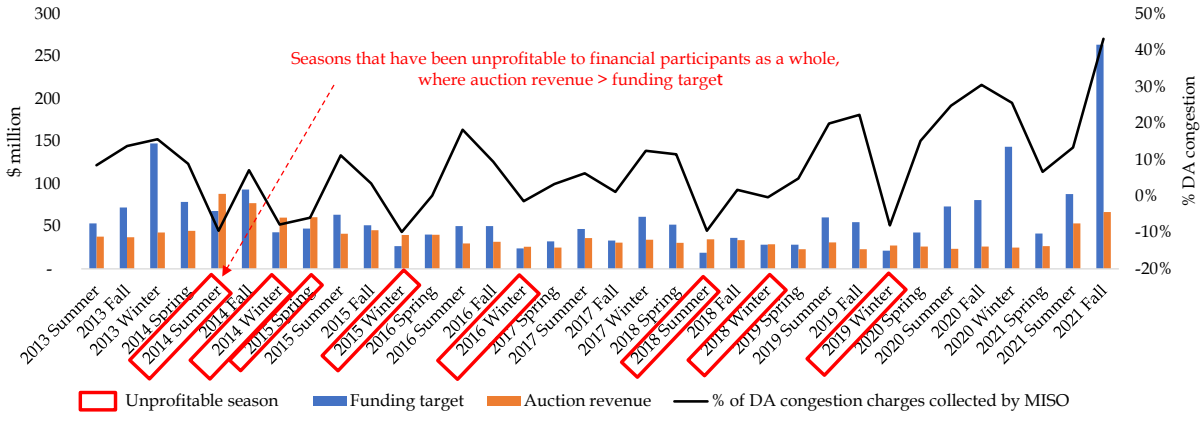
Another observation is that the predictive power of FTR auction results is generally higher in fall than in spring. One possible explanation is that, time-wise, spring (March to May) is much further away from the auction (May) than fall (September to November). The further away actual energy market operations are, the harder it is to predict fuel price, weather, and transmission network conditions.

9.2 Have profits earned by financial traders been reasonable?

The MISO FTR market would only be attractive to financial traders if they provided an opportunity for them to earn a reasonable level of profit. On average, financial traders have been profitable in annual FTR auctions. However, one needs to consider that these financial traders have also put significant capital at risk, and the perceived market opportunities have also led to losses on some FTR paths in some periods. Financial traders experienced negative returns (where auction revenue was higher than the funding target) in 8 out of 34 seasons, as illustrated in Figure 43. Financial traders have earned high profits from FTR purchases when there have been higher-than-expected levels of DA congestion (in 6 out of the 34 seasons, aggregate funding target of FTRs held by financial traders is more than double of auction revenues paid by financial traders); many drivers for this congestion are challenging to predict, such as extreme weather conditions. For example, Storm Uri had a pronounced effect on DA congestion in the winter of 2020, and exceptional levels of wind-related congestion which amplified the DA congestion realized in the fall of 2021. It is also notable that if LSEs had converted their ARRs into FTRs in the annual auctions, they would have also received significant payouts.

In addition, it is important to remember that financial traders put $1.3 billion of aggregate capital at risk (excluding credit costs) in these 34 seasons.

Figure 43. Profitability of financial participants in the annual FTR auctions



Secondly, financial participants take risks, which can result in losses. Even in past seasons where financial traders in aggregate were profitable, a large percentage of trades ended up unprofitable. LEI graphed all FTR trades cleared by financial traders from the least profitable (in terms of percent of profit) to the most profitable. Samples of such graphs for seasons where financial traders as a whole are profitable and unprofitable are presented in Figure 44. In this set of figures, the x-axes represent the count of trades, sorted from least profitable to most profitable, while the y-axes represent the percent of profitability of the trades. When a path is unprofitable, it is graphed below the horizontal line, at zero percent. The vertical black line represents the breakpoint between profitable and unprofitable trades. If the black line is towards the right of the graph, then there are more unprofitable than profitable trades. We can observe that even in seasons where financial traders as a whole are profitable, there is a large share of FTR trades that

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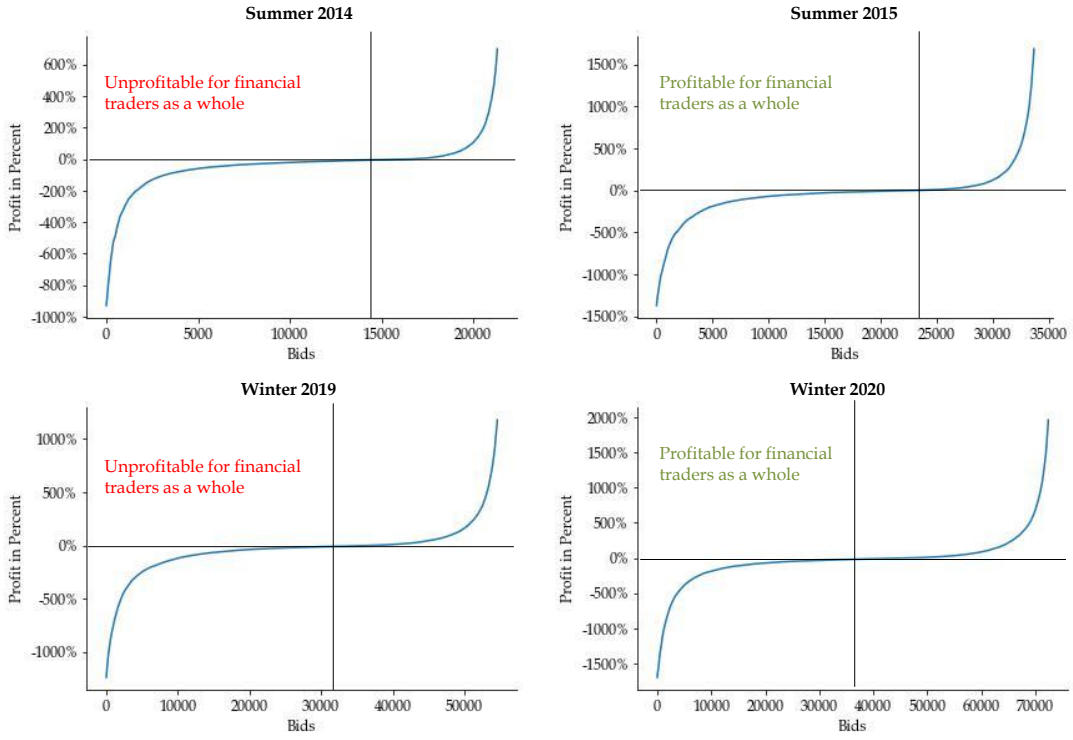
are unprofitable. This shows that financial traders are taking significant risks when participating in the MISO FTR market.

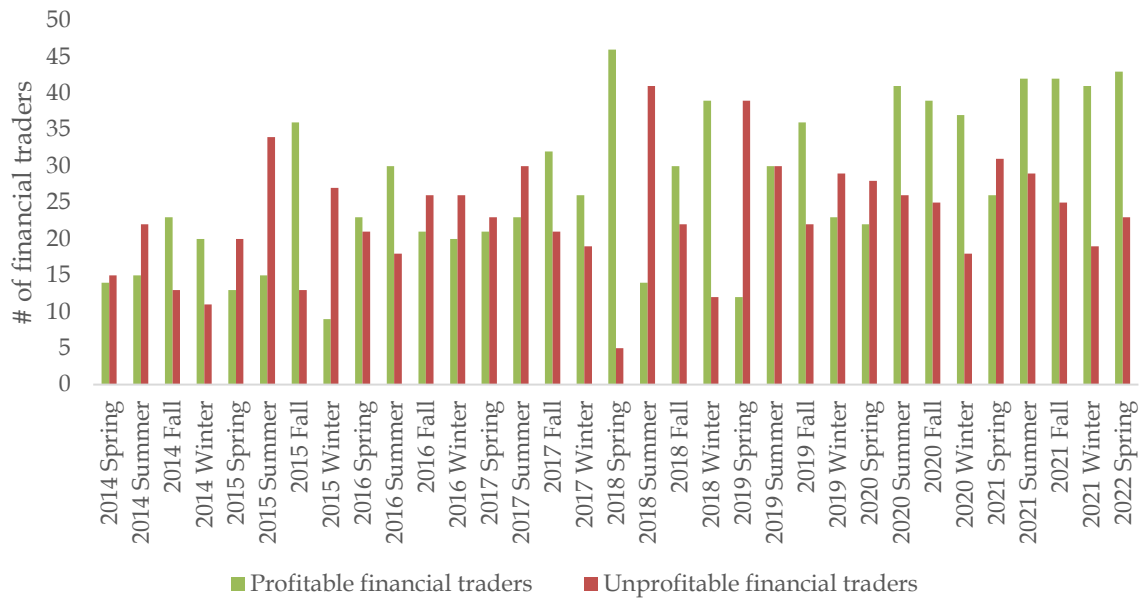
Figure 44. Profitability of financial trader paths in select seasons



Note: For better visualization, the top 1.25% and bottom 1.25% of trades are not displayed in the graphs. Bids are the count of trades.

In addition, LEI analyzed the profitability of financial traders. LEI evaluated the profitability of individual financial traders using their annual FTR cleared positions and realized DA congestion. The results are shown in Figure 45. LEI found that even in seasons where financial traders as a whole are profitable, there was a significant number of financial traders that were unprofitable. In all seasons reviewed, regardless of the overall profitability of financial traders, there were always individual financial traders that were not profitable. This again shows that financial traders are taking risks when participating in the MISO FTR market. In well-functioning markets, risks require compensation, so it is natural to observe that financial traders earn a profit on the aggregate.

Figure 45. Number of profitable and unprofitable financial traders in annual FTR auctions



In conclusion, LEI finds that while in recent seasons financial traders have made sizable profits in the MISO annual FTR auctions, over the long term, the profit level has been commensurable with the risks being taken.

London Economics International LLC
717 Atlantic Avenue, Suite 1A
Boston, MA 02111
www.londoneconomics.com

10 Appendix 2: About London Economics International LLC

LONDON ECONOMICS INTERNATIONAL LLC

LEI is a global economic, financial, and strategic advisory professional services firm specializing in energy, water, and infrastructure. The firm combines detailed understanding of specific network and commodity industries, such as electricity generation and distribution, with sophisticated analysis and a suite of proprietary quantitative models to produce reliable and comprehensible results.

The firm also has in-depth expertise in economic and financial issues related to the electricity, gas, and water sectors, such as asset valuation, procurement, regulatory economics, and market design and analysis. LEI has worked extensively in North America, Europe, Asia, Latin America, Africa, and the Middle East, and has a comprehensive understanding of the issues faced by the utilities and regulators alike.

The following attributes make LEI unique:

- *clear, readable deliverables* grounded in substantial topical and quantitative evidence;
- *internally developed proprietary models* for electricity price forecasting incorporating game theory, real options valuation, Monte Carlo simulation, and sophisticated statistical techniques;
- *balance of private sector and governmental clients* enables LEI to effectively advise both regarding the impact of regulatory initiatives on private investment and the extent of possible regulatory responses to individual firm actions;
- *ability to estimate relative efficiency levels* and efficiency frontiers provides expertise to advise on network tariffs and design rates under performance-based ratemaking; and
- *worldwide experience* backed by multilingual and multicultural staff.

LEI has significant experience in several areas, including:

ELECTRICITY: London Economics International LLC has participated in the birth and development of competitive electricity markets worldwide. Our strategy practice has helped traditional IOUs in the creation of competitive gencos, assessment of the establishment of independent transcos, and valuation of synergies with associated businesses. Market design achievements include use of game theoretic techniques to assess bidding strategy and creation of sophisticated contracting structures to mitigate market power.

WATER: LEI's water and wastewater, and collection system sector services include advising on water utility management, tariff rate-setting and regulatory frameworks, PBR, water demand management programs, and freshwater supply, treatment and distribution systems. LEI has advised water and wastewater industry clients ranging from power and water utilities to government regulators and financial institutions in Europe, Africa and the Middle East.

NATURAL GAS: LEI's natural gas related activities include assessment of the synergies between the natural gas and electric power industries, examination of performance-based ratemaking and total factor productivity for natural gas distribution companies, and developing screening methodologies for potential investments in the natural gas industry.

RENEWABLES: LEI provides a range of services associated with the renewable energy industry. This includes working with developers to value potential revenue streams from renewable energy credits (RECs) and/or emissions offsets, advising private equity funds to craft investment plans targeted at "green" technologies, and counseling governments and regulators on creating policies which efficiently incentivize investment in renewable energy.

TRANSPORTATION: London Economics is at the forefront of analyzing key issues related to pricing and privatization of key transportation infrastructure. This includes analysis of the implications of road pricing, regulation and development of privatized ports, and lessons from the UK rail privatization process.

LE

LONDON ECONOMICS

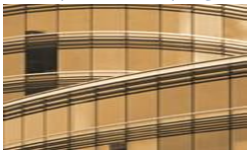
ASSET VALUATION, PRICE FORECASTING & MARKET ANALYSIS

REGULATORY ECONOMICS, PBR & MARKET DESIGN

EXPERT TESTIMONY & LITIGATION CONSULTING

TRANSMISSION

RENEWABLE ENERGY



PROCUREMENT

London Economics International LLC
717 Atlantic Avenue, Suite 1A
Boston, MA 02111
www.londoneconomics.com