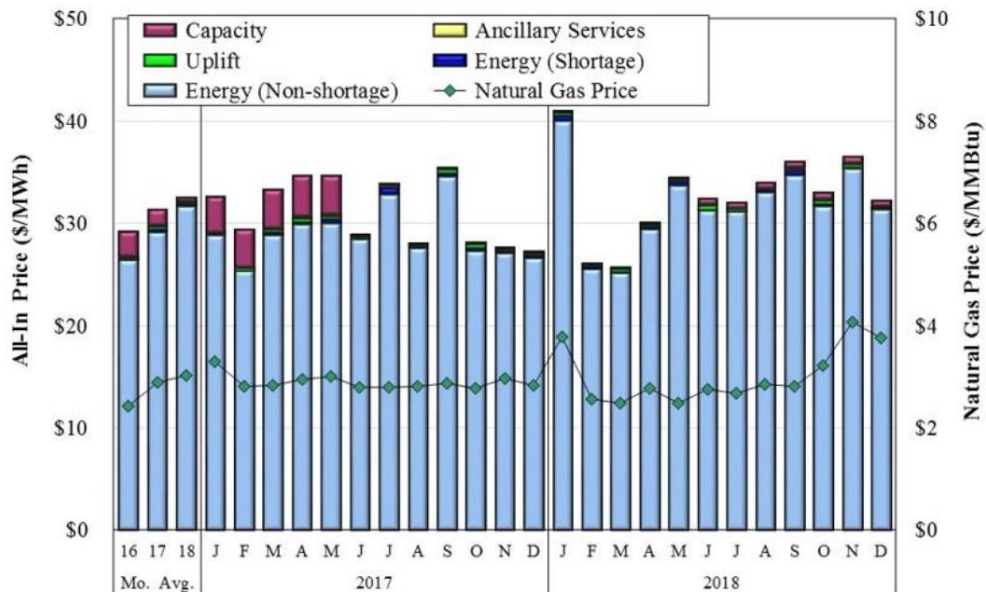


Additional questions for questionnaire only:

- Are there must offer requirement from capacity market obligation and revenue sufficiency make whole payments for DAM awards or RT ISO dispatch that deviates from DAM awards?
[MISO] Yes, there are must offer requirements for capacity resources cleared in the Planning Resource Auction. Day-Ahead Marginal Assurance Payment (DAMAP) is used to preserve the eroded Day-Ahead Margin when Real-Time dispatch deviates from Day-Ahead awards.
- Any uplift issues presented by Real-Time Co-optimization?
[MISO] No particular uplift issues presented. DAMAP as described above has already been used to address DA and RT clearing differences, and MISO tries to design DA and RT markets in a consistent way to avoid any unnecessary uplifts. A recent regulation management enhancement further reduces DAMAP when units inefficiently selected for Regulation during high load periods were capacity stranded (EconMax– RegMax) and had to buy-back DA position.
- How do you ensure adequate capacity available in real-time (RUC or other market tool)?
[MISO] Following Day-Ahead market, MISO solves Forward RAC (Reliability Assessment Commitment), Intra-day RAC and Look-Ahead Commitment. Operators also monitor capacity sufficiency and can make manual commitments if needed. During capacity shortages, MISO can schedule Emergency resources such as Load Modifying Resources in accordance to Emergency Operation Procedure.
- Split of revenue stream between capacity market, energy market and ancillary service market or just min/max/avg clearing price of different product for last year (or state of market report reference).

[MISO] 2018 State of Market Report

Figure 1: All-In Price of Electricity
2017–2018



- Has RTC had to be changed to adapt to renewables (wind, solar, battery)? Special designs for combined cycle for frequency response?
[MISO]: Yes, MISO has developed several enhancements since 2009 to adapt to renewables.
 - MISO developed Dispatchable Intermittent Resource (DIR) type to allow efficient dispatch of renewables and appropriate price signals.

- To better manage ramp challenges introduced by increasing renewable penetration, MISO introduced Ramp Capability Product.
- Following FERC Order 755 in 2011, MISO implemented Regulation Mileage to compensate the actual regulation service provide through a performance payment in addition to the regulation capacity payment. This improves the incentives for fast-ramping resources such as batteries for their regulation services.
- To further maximize the value of fast response resources such as batteries, MISO is implementing Fast Frist AGC which will better deploy fast regulation services while considering charging levels.
- MISO is also developing Short-Term Reserve to address the system-wide, regional and local flexibility and reliability needs.

MISO currently does not compensate for frequency response. For combined cycle resources, MISO recently developed the Enhanced Combined Cycle that models resource offer and constraints at the Resource-Configuration-Component level. The enhanced model better captures the operating characteristics of combined cycle resources. For example, resources can offer Transition Time during which they cannot provide reserves. Resources can specify in their offer for the Duct Burner mode if they cannot provide reserves.

- Do you have locational ancillary services?
[MISO] We do not have locational ancillary services. Nevertheless, we do enforce post zonal reserve deployment transmission constraints in the co-optimization to ensure reserve deliverability at zonal level. Such constraints could provide zonal reserve price differentiation.
- What major design changes are under evaluation now and why?
[MISO] In addition to new products such as short-term reserve as discussed earlier, MISO is holistically reviewing price formation including potential increase of Operating Reserve Demand Curves and VOLL to provide efficient scarcity pricing. MISO also continues to improve its usage of Reserve Procurement Enhancement to better manage reserve deliverability. These changes are mainly driven by the evolving generation fleet with increasing penetration of wind, solar, storage and tightening supply margin.