The Changing Needs of System Operations: MISO’s Perspective

ESIG Educational Session
MISO Overview

- Peak load July 20, 2011
  - Reliability Footprint: 130.9 GW
  - Market Footprint: 127.3 GW

- Wind peak March 30, 2021
  - 20.7 GW (25.7 GW installed capacity)
Wind Capacity in MISO in GW
Solar Capacity in MISO in MW

- 2016: 100 MW
- 2017: 232 MW
- 2018: 314 MW
- 2019: 330 MW
- 2020: 376 MW
- 2021: 2783 MW
MISO Renewables: Location and Growth

- Total Renewables: 26.2 GW
- Wind and Solar
As wind & solar supply a larger share of energy, forecast uncertainty and variability will grow.

Figure EAD-1: Wind forecast error for various renewable milestones
The Reliability Imperative efforts will enable those member / state goals with coordinated enhancements across multiple areas.

- **Market Redefinition**: MISO expects to rely more heavily on increased transparency in the planning horizon coupled with market prices signals in the operating horizon to incentivize needed resources.

- **Market System Enhancement**: MISO’s ability to respond to the Reliability Imperative will be enabled through continued market system enhancements and the integration of advanced technologies to process increasingly complex information.

- **Long Range Transmission Planning**: Long Range Transmission Planning is designed to assess the region’s future transmission needs holistically, in concert with utility and state plans on where to site and build new generation resources.
The ramp capability market product balances variation and uncertainty in Real-Time

- Systematic approach to pre-position resources
- Market-based approach for ramp management
- The market incurs a modest cost to obtain ramp, more than offset by reduced cost by using that ramp.

Requirements set to manage net load variations & uncertainty 10min ahead

- Single-interval RT dispatch to meet UDS target at 8:10
- Ramp requirements enforced to be capable of moving from 8:10 to 8:20 with specified uncertainty level

Net Load

Projected MW

Time

8:00  8:05  8:10  8:15  8:20  8:25  8:30  8:35
Operational characteristics of renewables

**Wind**
- Dispatchable Intermittent Resources (DIRs) were introduced in 2011
- DIRs require five minute wind forecast which becomes the economic max for the unit
- ~65% of current wind farms are DIRs

**Solar**
- ~527 MW but expected to grow to 3 GW by end 2021
- Farms can register as dispatchable or non-dispatchable
Dispatchable Intermittent Resources (DIR) first introduced in 2011

- Allow for the dispatch of wind in real-time
- 5 minute forecast becomes the economic maximum
- Over 90% of Market Participants use MISO’s forecast
- DIR forecast accuracy is integral in ensuring system reliability and market efficiency
- MISO uses regulation to balance the system for forecast errors
Forward and Real-Time commitment is highly dependent on forecasts

<table>
<thead>
<tr>
<th>Real-Time Market Commitments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Commitment Process</td>
</tr>
<tr>
<td>Process &gt; 16 hours</td>
</tr>
</tbody>
</table>

Medium Term Hourly Load and Renewable forecast

Short Term 5 minute Load and Renewable forecast
Load Forecasting is used by MISOs commitment & planning processes

>7 days + Medium Term + Short Term = Load Forecast

Daily peaks for 31 days out forecasts are shared with other RTOs, and used by outage coordination

Medium Term Load Forecast (MTLF)
- Hourly Load Forecasts updated every 15 minutes extending 7 days out
- Used for control room planning

Short Term Load Forecast (STLF)
- 5-min forecasts updated every 5 minutes extending 6 hours out
- Actual Real Time Input load submitted at a 2 second frequency
Renewable Forecasting Process Overview

Medium Term Wind Generation Forecast (MTWGF)
- Hourly Load Forecasts updated hourly rolling 168 hours out, at a farm level
- Used for control room planning

Short Term Wind Generation Forecast (ST WGF)
- 5-min forecasts updated every 5 minutes extending 6 hours out at a farm level
How do we build a renewable forecast?

- Live Dynamic Data
- Numerical Weather Predictions (NWP)
- Registered Farm Information
- Longitude/Latitude
- Operational Characteristics*

*Effort under way to update some operational information
MISO Short Term Wind Forecast changes as it updates
Wind Alerting System Monitors DIR forecast accuracy & produces reports

100 MW minute error/5 minutes
MISO Renewables: Weather Phenomena of Concern

- Turbine Icing
- High Wind Speed Cut Outs
- High/Low Temperature Turbine Cut Outs
- Low to Negative Production Periods: High Pressure with Cloudy Conditions.
- Nocturnal Low-Level Jet