Development of the Next MTEP Futures

MTEP Futures Workshop
August 15, 2019
Why Resource Forecasting?

- For transmission planning 20+ years into the future, new generation resources are likely needed for adequate reserves.
- Generator interconnection queues are generally limited to 5 years out for new capacity additions (can contain speculative generation).
- Integrated Resource Plans don’t typically have sufficient timeline or detail for new capacity additions.
- For adequate reserves, a mechanism is needed to determine type, size, and timing of new generation and demand-side management resources.
Why do we use Futures?

- It’s very difficult to accurately predict the future, so we create scenarios to hedge uncertainty and “bookend” a range of economic, political, and technological possibilities.
- Goal: define a set of broad Futures to hedge against future uncertainties and help ensure that any new recommended transmission provides benefits and value, regardless of specific future developments.
What are MTEP Futures?

- Scenarios that look 20+ years ahead into the energy landscape
- Intend to capture wide array of potential fleet changes and conditions for long-term transmission planning
- Not a prediction of ‘the’ future—rather a range of potential futures to set reasonable bookends
- Used to model economic generation capacity expansion

Example of what the futures could be – from MTEP19
Why retool the Futures process?

- Respond to stakeholders
  - Substantial interest and feedback submitted during MTEP20 Futures development, indicating various reasons to reshape the Futures process
- Stay ahead of real-world developments
  - Encompass scope of potential changes before they happen
  - “Bookend” the range of possibilities to manage risk & uncertainty
- Become more efficient, agile, and valuable
  - Apply to multiple annual cycles (at least three years)
  - Incorporate members’ Integrated Resource Plans/commitments & state policies/preferences more directly
MISO’s Resource Mix is Rapidly Evolving

The current generator interconnection active queue consists of 640 projects totaling 100.1 GW.
Industry projections are already outpacing the MTEP Futures

*The ‘30 + Policy ring represents 2030 with the addition of proposed but not enacted state initiatives

Accelerated Fleet Change
Renewables and demand side technologies added at a rate above historical trends. Fleet changes result in a 20% CO₂ emission reduction.

Distributed & Emerging Tech
New renewable additions largely distributed and storage resources added across the region.

Limited Fleet Change
Stalled generation fleet changes. Limited renewables additions driven primarily by existing RPS under limited demand growth.

Continued Fleet Change
Continuation of the renewable addition and coal retirement trends of the past decade.
Wind, solar, & gas bookends need to be broadened.
IRPs have caught up to the Future bookends

MTEP19 Wind & Solar vs. IRP (%energy served)

MTEP18 Wind & Solar vs. IRP (%energy served)

MTEP19 vs. IRP Coal Retirements (MW)

MTEP18 vs. IRP Coal Retirements (MW)
The time and effort to develop the Futures, resource expansion, and siting has increased over the past 5 years.

9,728 hours of MISO staff time spent on MTEP17 & MTEP18

These two MTEP cycles the Futures were relatively the same with the major change being the addition of the DET Future.
Goals of MTEP Process Retooling

• Continue to utilize Futures to bookend uncertainty across multiple planning cycles while building in flexibility and ensuring availability
• Ensure futures/siting processes produce meaningful & representative outcomes
• Incorporate members’ IRPs/commitments & state policies/preferences more directly
• Incorporate MISO’s need for availability, flexibility, & visibility (3Ds)
• Focus on parts of the process that provide more value
• Align to OMS’ principles on Long-Range Transmission Planning
Scope of Futures Process Retooling

- Only includes the MTEP Futures, resource forecasting, and resource siting processes
- Business practice manual changes will be made if necessary
- Intended only to discuss MISO’s regional MTEP process and not any interregional processes
- Use of the EGEAS tool will continue
Feedback Request

• In preparation for the September MTEP Futures Workshop, MISO is requesting each stakeholder sector to provide feedback on the particular global changes/improvements they would like to see with respect to MTEP Futures development, corresponding resource forecasting, and associated siting.
  • This request is focused on broader, more conceptual/philosophical parts of the Futures processes and is not intended to solicit feedback on particular MTEP21 variables or assumptions (those discussions will occur after the broader improvements are nearly finalized).

• Feedback due Friday, August 30, 2019
• All feedback requests are posted to the Stakeholder Feedback Page and stakeholder comments are submitted through the feedback tool: https://www.misoenergy.org/stakeholder-engagement/stakeholder-feedback
Futures Development
Background
What is the “MTEP Futures Process”?

Essentially Steps 1-2 of MISO’s 7-Step Planning Process

- **STEP 1**: Multi-Future Regional Resource Forecasting
- **STEP 2**: Site-Generation and Place in Powerflow Model
- **STEP 3**: Design Conceptual Transmission Overlays by Future IF Necessary
- **STEP 4**: Test Conceptual Transmission for Robustness
- **STEP 5**: Consolidate & Sequence Transmission Plans
- **STEP 6**: Evaluate Conceptual Transmission for Reliability
- **STEP 7**: Cost Allocation Analysis

![Diagram of the MTEP Futures Process](image)
Futures to serve multiple MTEP cycles

- Intent is to use Futures for up to three consecutive MTEP cycles
- Barring significant changes in policy and economic drivers, Futures definitions will continue to be used for multiple MTEP cycles.
- Uncertainty variables within MTEP Futures definitions will be evaluated and may be updated annually for relevant changes to policy and economic drivers (e.g. updating the mid-level Henry Hub natural gas price forecast).
Typical MTEP Futures Schedule?

- The Futures development cycle typically begins in January of the year prior the start of the targeted MTEP cycle (e.g. the development of MTEP17 Futures would begin in January 2016).
- Barring significant changes in policy and economic drivers, Futures definitions will continue to be used for multiple MTEP cycles (up to three consecutive cycles).
- Uncertainty variables within MTEP Futures definitions will be evaluated and may be updated annually for relevant changes to policy and economic drivers.
Regional Resource Forecasting

- Process developed to economically identify the least-cost portfolio of new supply-side and demand-side resources.
- Utilizes the Electric Power Research Institute’s (EPRI) Electric Generation Expansion Analysis System (EGEAS).
  - Simulates resource expansion for 20 years out into the future
  - Includes a 40 year extension period in order to ensure that the selection of resources in the last few years of the forecast period is based on the costs of the resource over the total tax/book life of the resource.
  - EGEAS is a transmission-less model
- Produces a list of particular Regional Resource Forecast (RRF) units corresponding to type, size, and installation date.
EGEAS Inputs and Outputs

**Optimization Constraints**
- Planning Reserve Margin
- CO\textsubscript{2} emission constraint (mass-based)
- Resource availability

**Input Data Assumptions**
- Demand and energy forecast
- Fuel forecast
- Generation Retirements
- CO\textsubscript{2} constraint
- RPS requirements

**Existing Resource Data**
- Unit capacity
- Heat rate
- Outage rate
- Emissions rate
- Fuel and O&M cost

**New Resources Data**
- Capital cost
- Construction cash flow
- Fixed charge data
- Fuel and O&M cost
- Years of availability

**Optimized Resource Plan**
- 20-year resource expansion forecast
- Amount, type, and timing of the new resources
- Total system Net Present Value (NPV) of cost
- Annual production costs for system
- Annual fixed charges for new units
- Annual tonnage for each emissions type
- Annual energy generated by fuel type
- Annual system capacity reserves and generation system reliability

Total System Costs = Sum of Production Costs + Fixed O&M Cost + Capital Carrying Costs
Resource Forecasting Study Areas

- MISO futures assumptions and resource forecasting is applied to the following areas:
  - Midcontinent Independent System Operator (MISO);
  - New York Independent System Operator (NYISO);
  - PJM Interconnection (PJM);
  - Southeast Reliability Corporation (SERC);
  - Southwest Power Pool (SPP); and
  - Tennessee Valley Authority (TVA).
- Resource expansions are performed for each of these areas so as not to produce generation biases from one region to another which would in turn skew transmission flows.
Retirement Methodology

- Thermal unit age-related retirements occur in the year the useful life is reached unless planned retirement is sooner
  - Oil & gas units retire at 55 years of age in all futures
  - Coal retires at 65 years of age in the Limited Fleet Change future
  - In the Continued Fleet Change, Accelerated Fleet Change and Distributed and Emerging Technologies futures, coal retires at 60 years of age reflecting historical trends
  - The Accelerated Fleet Change future had units cycle seasonally to better meet CO2 reduction targets without steeper retirement levels
- Nuclear units assumed to have license renewals granted and remain online, except in the Distributed and Emerging Technology future - unless significant upgrade or maintenance (>500M)
- Publically announced retirements supported by approved attachment Y or officially committed retirements (e.g. IRP) that are submitted to MISO included
Coal age-based retirement assumptions need updating

In MTEP17, 18 and 19, MISO modeled coal retirement at age of 65 years LFC future and 60 years in other future.

Between 2010 and first quarter of 2019, 102 GW of Coal plants are retired with anticipated 17 GW by 2025. Average retirement age in 2018 dropped to 45 year *

*More U.S. coal-fired powerplants are decommissioning as retirements continue: [https://www.eia.gov/todayinenergy/detail.php?id=40212](https://www.eia.gov/todayinenergy/detail.php?id=40212)
General financial assumptions

- Variables associated with the financing of new generation projects are listed below.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Stock</td>
<td>50.64</td>
</tr>
<tr>
<td>Preferred Stock</td>
<td>0.17</td>
</tr>
<tr>
<td>Debt</td>
<td>48.94</td>
</tr>
<tr>
<td>ROR Common Stock</td>
<td>10.91</td>
</tr>
<tr>
<td>ROR Preferred Stock</td>
<td>1.60</td>
</tr>
<tr>
<td>ROR Debt</td>
<td>4.65</td>
</tr>
<tr>
<td>Property Tax</td>
<td>1.50</td>
</tr>
<tr>
<td>Income Tax</td>
<td>39.09</td>
</tr>
<tr>
<td>Customer Discount</td>
<td>8.20</td>
</tr>
<tr>
<td>AFUDC(^*) Rate</td>
<td>7.00</td>
</tr>
</tbody>
</table>

- These are average values across the footprint and are largely sourced annually from MISO transmission owners through updated Attachment O values of the MISO Tariff.
Supply-Side Resources Offered

- Combustion Turbine
  Combined Cycle
  CCS
- Coal
  IGCC
  IGCCS
- Solar - PV
- Wind
- Nuclear
- Storage - Battery
  Biomass
- Hydro
Why do we have a siting process?

- Futures development and regional resource forecasting (steps 1 & 2 of the MISO 7-step planning process) produces a list of future resources corresponding to type, size, and installation date; however, it does not specify where these units are needed.
- Projected future demand and unit retirements drive the need for future generation.
- Siting needed for transmission planning purposes.
General Siting Methodology

- Site with consideration of Zonal Resource Adequacy Requirements, except for wind and solar.
- Site at DPP queue sites of the same RRF type and similar size, to the nearest 100 MW.
- Avoid greenfield sites for gas units (CT and CC) if possible; prefer to use brownfield sites.
  - “Brownfield” applies to coal and gas, either replacement of retired capacity or expansion of existing.
  - Replacement capacity prioritizes assumed retirements over known, unless known has some documented plan for replacement with gas CC or CT.
- Site baseload CC units in 600-900 MW increments, CT units in 300 MW increments, and nuclear in 1,200 MW increments.
- Limit the total amount of expansion at an existing site to no more than an additional 2,400 MW but prefer 1,200 MW.
- Restrict greenfield sites to a total size of 2,400 MW.
- Limit using queue generation in multiple Futures, unless resource is highly certain.
- Use high-voltage (230kV or higher) buses unless new unit replaces existing at a low-voltage bus.
Generation Unit Sizes for Siting

• When possible, forecast units will match size of existing site or queued capacity
  • For simplicity, MISO will round up to nearest 100 MW
• Restrict total site capacity to 1,200 MW, unless justified

<table>
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<tr>
<th>Unit Type</th>
<th>Size*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC</td>
<td>600 MW/Matched to Site</td>
</tr>
<tr>
<td>CT</td>
<td>300 MW/Matched to Site</td>
</tr>
<tr>
<td>Solar</td>
<td>Matched to Site</td>
</tr>
<tr>
<td>Nuclear</td>
<td>1,200 MW</td>
</tr>
<tr>
<td>Wind</td>
<td>Matched to Site</td>
</tr>
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</table>

*Sizes based on typical size in GI Queue as well as stakeholder feedback
Thermal Siting Methodology

- Diversity in siting across futures encourages robust solution development
- Stakeholder review was used to identify if a site is not a feasible location

Priority 1:
Active DPP Phase 1,2,3 Generator Interconnection Queue

Priority 2:
Brownfield – Existing and Retired Sites

Priority 3.1:
SPA or Canceled / Postponed GI Queue

Priority 3.2:
Greenfield Siting Criteria
MTEP Wind Siting

- Siting tiers are created based on combination of Vibrant Clean Energy (VCE) study results and MISO’s Interconnection Queue data
- Capacity is sited in tiers based on priority
- Sites filled evenly within tier until total tier capacity filled

<table>
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<tr>
<th>Tier 1**</th>
<th>Tier 2</th>
<th>Tier 3</th>
<th>Tier 4</th>
<th>Tier 5*</th>
<th>Tiers 6+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remaining MVP-enabled capacity in RGOS Zones</td>
<td>VCE Zones 30% / Phase 3 and Phase 2 Queue Sites</td>
<td>VCE Zones 30% / Phase 1 Queue Sites</td>
<td>VCE Zones 30% / Pre-Queue and Withdrawn Queue Sites</td>
<td>VCE Zones 50%</td>
<td>VCE Zones 90%</td>
</tr>
</tbody>
</table>

Existing Zones | Planned/likely areas for wind expansion | Potential areas for future wind expansion

* “50% VCE” refers to results from the 50% penetration case
** Multi-Value Project (MVP)-Enabled capacity, see https://www.misoenergy.org/Planning/TransmissionExpansionPlanning/Pages/MVPAnalysis.aspx
### MTEP Utility-Scale Solar Siting

- Siting tiers are created based on combination of Vibrant Clean Energy (VCE) study results and MISO’s Interconnection Queue data
- Capacity is sited in tiers based on priority
- Sites filled evenly within tier until total tier capacity filled

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## Alternative Technologies Siting

<table>
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<tr>
<th>MTEP 2019 Future</th>
<th>Limited Fleet Change</th>
<th>Distributed &amp; Emerging Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Continued Fleet Change</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accelerated Fleet Change</td>
<td></td>
</tr>
<tr>
<td><strong>Distributed Solar(^1)</strong></td>
<td>1/3 of Solar Capacity Expansion: Distributed (Top 20 Load Buses per county identified by dGen)</td>
<td>2/3 of Solar Capacity Expansion: Distributed (Top 20 Load Buses per county identified by dGen)</td>
</tr>
<tr>
<td><strong>Demand Response(^1)</strong></td>
<td>Residential: Top 10 Non-Industrial Load Buses per LBA</td>
<td>Commercial &amp; Industrial: Top 10 Industrial Load Buses per LBA</td>
</tr>
<tr>
<td><strong>Battery Storage(^2)</strong></td>
<td>Top load bus per LBA</td>
<td></td>
</tr>
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</table>

1. Bus level siting (magnitude and location) reviewed through MTEP19 process; sites commented as infeasible were replaced
2. 2 GW of battery storage by 2033 included in the Distributed & Emerging Technologies future; storage offered as a resource option in all futures
MTEP20 Futures Update

Futures to be used in MTEP20

Development of a specific set of MTEP20 Futures ceased in June to focus efforts on retooling the MTEP Futures processes.

The MTEP19 Futures will be used in MTEP20 and applied to the models created for MTEP20.

Next MTEP Futures development path

- Futures education
- Process improvements
- MTEP21 specific assumptions

Currently have monthly workshops scheduled beginning Aug 15, 2019.
Contact Information

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Questions?