ENO 2018 IRP
Technical Meeting #1

January 22, 2018
Goals and Agenda of Technical Meeting #1

Goals
• As described in the Initiating Resolution (R-17-430), the main purpose of this meeting is for ENO, the Advisors, and Intervenors to discuss Planning Scenarios and Strategies with a view towards reaching consensus on the Scenarios and Strategies to be used in developing the 2018 IRP.
  – As such, per the Initiating Resolution, the meeting shall be treated as a settlement negotiation and subject to all applicable procedural and evidentiary protections.
• ENO will present its reference and alternative Planning Scenarios and its least-cost/reference Planning Strategy.
• Prior to the meeting, Intervenors should have discussed among themselves their priorities regarding Planning Scenarios and Strategies.
• Should the parties not agree that the proposed Scenarios and/or Strategies, or any Scenarios and/or Strategies developed during Technical Meeting #1, will adequately capture the Intervenors’ point of view, the Intervenors shall prepare and submit, with the Advisors’ assistance as needed, their proposed Planning Scenario and/or Strategy before Technical Meeting #2.

Agenda
1. 2018 IRP Objectives
2. Analytical Framework
3. Inputs and Assumptions
4. Resource Options
   a. Supply-Side Resources
   b. DSM Potential Study (Navigant)
5. Timeline
Section 1
2018 IRP Objectives
ENO’s planning process seeks to accomplish three key objectives:

- **Reliability**: Serve customers’ needs reliably.
- **Cost**: Serve customers’ needs at the lowest reasonable cost.
- **Risk Mitigation**: Mitigate exposure to risks that may affect customer cost or reliability.

Achieve these objectives while considering known utility regulatory policy goals of the Council.
In the 2018 IRP, ENO will consider the ongoing evolution of the utility industry.

The Changing Utility Industry

**Customer Preferences**
ENO’s planning processes seek to address changing customer needs. Planning processes and tools will continue to evolve to help identify customer needs and wants.

**Resource Alternatives**
Ever advancing technology provides new opportunities to meet future customer needs reliably and affordably. Planning processes strive to understand these technological changes in order to enable us to design optimal portfolios of resources and services.

**Grid Modernization**
ENO’s distribution planning process will need to accommodate the integration of distributed energy resources safely and securely so they can be interoperable with the grid.
Section 2
Analytical Framework
Analytic Process to Create and Value Portfolios

Development of Planning Scenarios and Strategies

Market Modeling
- Projection of MISO market outside of ENO for each Scenario

Portfolio Development
- Construction of resource portfolios for each Scenario/Strategy combination

Total Relevant Supply Cost
- Production costs and fixed costs are determined for each portfolio under each Scenario/Strategy combination

Action Plan
- Identify action plan that balances reliability, cost, and risk

Development of assumptions and inputs for Scenarios and Strategies
## ENO Planning Scenarios--Assumptions

<table>
<thead>
<tr>
<th></th>
<th>Scenario 1 (Reference)</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
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<tbody>
<tr>
<td>Peak Load &amp; Energy Growth</td>
<td>Reference</td>
<td>Low</td>
<td>High</td>
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<tr>
<td>Natural Gas Prices</td>
<td>Reference</td>
<td>Low</td>
<td>High</td>
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<tr>
<td>Market Coal &amp; Legacy Gas Deactivations</td>
<td>Reference (60 years)</td>
<td>Accelerated (50 years)</td>
<td>Accelerated (55 years)</td>
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<tr>
<td>Magnitude of Coal &amp; Legacy Gas Deactivations</td>
<td>12% by 2028, 54% by 2038</td>
<td>54% by 2028, 91% by 2038</td>
<td>31% by 2028, 88% by 2038</td>
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<tr>
<td>MISO Market Additions Renewables / Gas Mix</td>
<td>34% / 66%</td>
<td>50% / 50%</td>
<td>50% / 50%</td>
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<tr>
<td>CO2 Price Forecast</td>
<td>Reference</td>
<td>High</td>
<td>Reference</td>
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If necessary, a fourth Stakeholder Scenario will be modeled.
## ENO Planning Strategies--Assumptions

<table>
<thead>
<tr>
<th>Objective</th>
<th>Strategy 1 (Reference)</th>
<th>Strategy 2</th>
<th>Strategy 3</th>
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</thead>
<tbody>
<tr>
<td>Least Cost Planning</td>
<td>0.2/2% DSM Goal</td>
<td>TBD</td>
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<tr>
<td>Meet 12% long-term Planning Reserve Margin (PRM) target using least-cost resource portfolio of supply and DSM resources</td>
<td>Include a portfolio of DSM programs that meet the Council’s stated 2% goal and determine remaining needs</td>
<td></td>
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<tr>
<td>Assess demand- and supply-side alternatives to meet projected capacity needs with a focus on total relevant supply costs</td>
<td>Design a portfolio that includes a set of potential DSM programs intended to meet the Council’s stated 2% goal and considers additional supply-side alternatives</td>
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</table>

If necessary, an Stakeholder Planning Strategy will be modeled.
MISO Market Modeling and Total Relevant Supply Cost Calculation

1. **Market Model Set-Up**
   - Develop projection of MISO market outside ENO for each Scenario
     - 16% reserve margin target (based on MISO summer peak load and Resource Adequacy process)
     - Build out MISO resource pool to achieve target fuel mix per Scenario

2. **Initial Production Cost Simulation**
   - Using AURORA production cost model, simulate MISO market to generate market price curve (i.e., LMPs) for each Scenario

3. **Development of Portfolios using either AURORA or Manual Process**
   - Use AURORA capacity expansion model to select demand- and supply-side alternatives to create ENO portfolios for each Scenario/Strategy combination
     - 12% long term reserve margin (based on ENO long term planning assumption)
     - Portfolio addition decisions based on maximizing market value of supply additions
   - If the capacity expansion model is unable to select resources required by a particular Strategy consistent with identified resource needs, develop manual portfolios using defined constraints and professional judgment

4. **Final Production Cost Simulations and Total Relevant Supply Cost Calculations**
   - Compute variable supply costs for each portfolio in each of the Scenarios/Strategies using detailed MISO Zonal Model in AURORA
   - Calculate Total Relevant Supply Cost for each portfolio
     - Includes: variable supply costs, cost of DSM programs, incremental non-fuel fixed costs, and capacity purchases
Assessment of Portfolio Performance Across Scenarios

- Portfolios developed for each Scenario/Strategy combination will be tested across all other Scenarios to assess performance in a range of possible outcomes.
- The total relevant supply cost of each of the Scenario/Portfolio combinations represents the present value of fixed and variable costs to customers in 2018$.

*ILLUSTRATIVE ONLY—Actual number of Scenario/Portfolio combinations TBD*

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<tr>
<th>Portfolios</th>
<th>Stragiety 1 (Reference)</th>
<th>Strategy 2 (2% DSM Goal)</th>
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<td>R_{13}</td>
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<td>R_{42}</td>
<td>R_{43}</td>
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Note: “R” = resulting total relevant supply cost
Section 3
Inputs and Assumptions
### 2018 IRP Inputs and Assumptions

<table>
<thead>
<tr>
<th>Input/Assumption</th>
<th>Present at Technical Meeting</th>
<th>MISO Market Modeling</th>
<th>Portfolio Development</th>
<th>Total Relevant Supply Costs</th>
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<td>Input Sensitivities</td>
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<td>DSM Potential Study Results</td>
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Gas Forecast

Nominal $/mmbtu

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<tr>
<th>Case</th>
<th>2018</th>
<th>2025</th>
<th>2030</th>
<th>2037</th>
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<tr>
<td>Low</td>
<td>$2.67</td>
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<td>$3.08</td>
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<td>$3.55</td>
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CO₂ Forecast

Nominal
$/Short Ton

$0
$10
$20
$30
$40
$50
$60
$70
$80

2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037

High  Ref  Low

$27
$38
$70

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ENO Capacity Value

Levelized Cost of a New-Build CT

$/kW-Yr

2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037

$70 $90 $110 $130

$85 $123

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Section 4a
Supply-Side Resource Options
Technology Assessment Process and Purpose

• Generation technology cost and performance are a necessary input to resource planning and portfolio development.

• The process to evaluate generation technologies has two main steps – an initial screening level analysis and a more detailed economic analysis.

• The technology assessment includes technologically mature alternatives that are expected to be operational in or around the Entergy regulated service territory.

• In an effort to minimize operational and economic risk, ENO prefers technologies that are proven on a commercial scale. Some technologies identified lack the commercial track record to demonstrate their technical and operational feasibility.

• The technology screening analysis identifies generation technology alternatives which are expected to reasonably meet primary planning objectives of reliability, cost, and risk mitigation. Economic modeling parameters are developed for the identified technologies.

• Technologies that are eliminated as a result of the initial screen will continue to be monitored and changes in technology assessments will be incorporated in future IRPs, when appropriate.
Identified Supply-Side Resource Alternatives

Technology Deployment Over Time

Conventional Gas Fired
- Microturbines

Solid Fuel
- Generation IV Nuclear
- Small Modular Reactor (SMR)
- MSW Plasma Torch
- Ocean and Tidal Power

Renewable
- Underground Pumped Hydro
- Solar Thermal
- Geothermal
- Solar PV

Energy Storage
- Battery
- Flywheel
- Pumped Storage Hydro

Established
- Frame CT and CCGT
- Internal Combustion Engine
- Aeroderivative CT
- Supercritical Coal
- Biomass - CFB
- Generation II Nuclear
- Biomass - Stoker Boiler
- Onshore Wind

Retained for further evaluation
Section 4b
DSM Potential Study
(Navigant Presentation)
Section 5
Timeline
## Current Timeline

<table>
<thead>
<tr>
<th>Description</th>
<th>Target Date</th>
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<tr>
<td>Public Meeting #1 - Process Overview</td>
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<td>Technical Meeting #1 Material Due</td>
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<td><strong>IRP Inputs Finalized</strong></td>
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<td>Optimized Portfolio Results Due</td>
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<td>Technical Meeting #4</td>
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<td>File IRP Report</td>
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<td>Public Meeting #2 Material Due</td>
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<tr>
<td>Public Meeting #2 - Present IRP Results</td>
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<td>Intervenors and Advisors Questions &amp; Comments Due</td>
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<td>ENO Response to Questions and Comments Due</td>
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<td>Public Meeting #3 Material Due</td>
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<tr>
<td>Advisors File Report</td>
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