# ATCO SITE VISIT



Day Ahead and FRAC Process - EOR Market Overview

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# Discussion Topics

- MISO Organizational Structure
- Ancillary Service Market Products
- Resource Types and Requirements
- Resource Offer Guidelines
- Day–Ahead and FRAC Market Clearing

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# MISO - Maintaining Independence

**Four checkpoints**

- Board of Directors (direction)
- Stakeholders (guidance)
- FERC (regulatory landscape)
- NERC (compliance)

**Overseeing Entities**

- FERC
  - Changes or additions to Midwest ISO Tariff subject to FERC approval
- NERC
  - Develops and enforces reliability standards as part of its responsibility as a FERC-certified Electric Reliability Organization (ERO). Designated as an ERO in 2006
- Regional Entities
  - Region-specific reliability rules
  - MRO, RFC, and SERC in Midwest ISO region

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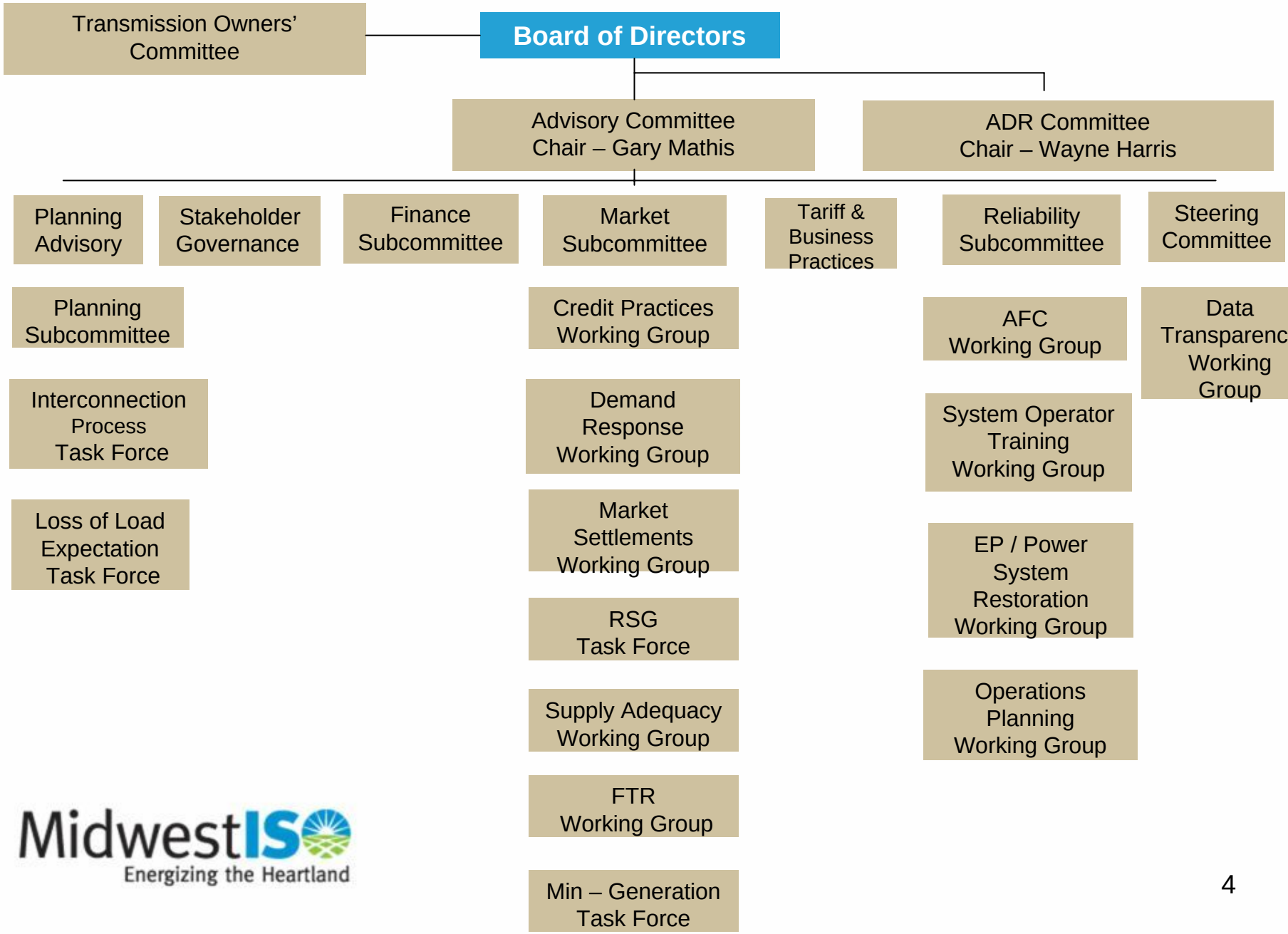
# MISO Committee Structure

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# Advisory Committee Representation

- Transmission Owners* - 3
- Power marketers/brokers - 3
- Coordination Member - 1
- Eligible end-use customers - 3
- Muni/coops/other TDUs - 3
- Environmental/other - 2
- IPPs/EWGs - 3
- Public consumer group - 2
- State regulatory authorities - 3

**Consists of 23 representatives from stakeholder groups**

One of three groups reporting to the Board of Directors ---Other two groups are Transmission Owners' Committee and Alternate Dispute Resolution Committee

***** Two members of Vertically Integrated Transmission Owners (VITOs), one member of Midwest Stand-Alone Transmission Company (MSATs)

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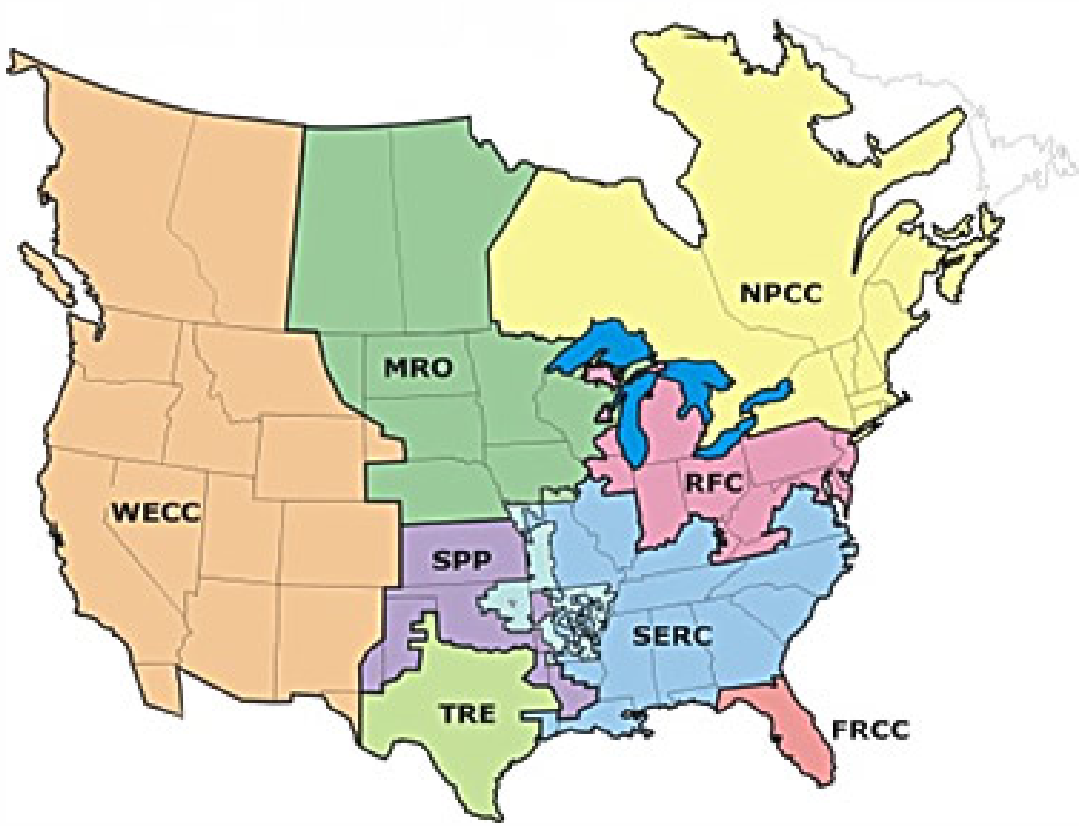
# Regional Entities

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# Ancillary Services Market Products

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# Reserve Hierarchy

- Operating Reserve
  - Regulating Reserve
  - Contingency Reserve
    - Spinning Reserve
    - Supplemental Reserve

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# Actual Products

- Energy – Priced by Commercial Pricing Node
- Regulation – Priced by Resource Type and Reserve Zone
- Spinning Reserve – Priced by Reserve Zone
- Supplemental Reserve – Priced by Reserve Zone

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# Demand Curves

- Demand curve prices will be used as the shadow price of reserve requirement constraints in an event of Regulating Reserve and/or Operating Reserve product shortage.
- The Regulating demand curve price will be calculated on a monthly basis. The regulating demand curve will be based on the average of natural gas spot price and an annual proxy heat rate. The average of the spot gas price index will be calculated as the average over the first three weeks of the month prior to the month for which the Regulating Reserve Demand Curve price is being calculated will be calculated.
- The annual proxy heat rate will be calculated once a year as the average single hour offer prices of generating units defined as peakers offered in the Midwest ISO's Day Ahead Energy and Real Time
- The calculated Operating reserve and regulating reserve demand curves will be published and posted seven calendar days prior to the month for which the Demand Curve price is being calculated.

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# Ancillary Services Market
# Resource Types and Requirements

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# Regulation Qualified Resources

- **Day-ahead market**
  - Committed internal market generation resources that are available and qualified to provide regulation
  - Committed external market generation resources that are:
    - Available and qualified to provide regulation
    - Registered in the Midwest ISO market
    - Pseudo-tied into the Midwest ISO balancing authority
  - Committed type 2 demand response resources that are available and qualified to provide regulation
- **Real-time market**
  - On-line internal market generation resources that are available and qualified to provide regulation
  - On-line external market generation resources that are:
    - Available and qualified to provide regulation
    - Registered in the Midwest ISO market
    - Pseudo-tied into the Midwest ISO balancing authority.
  - Type 2 demand response resources that are available and qualified to provide regulation

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# Spin Qualified Resources

- **Day-ahead market**
  - Committed internal market generation resources
  - Committed external market generation resources that are:
    - Registered in the Midwest ISO market
    - Pseudo-tied into the Midwest ISO balancing authority
  - Available internal type 1 demand response resources qualified to supply spinning reserve
  - Committed type 2 demand response resources
  - External asynchronous resources
- **Real-time market**
  - On-line internal market generation resources
  - On-line external market generation resources that are:
    - Registered in the Midwest ISO market
    - Pseudo-tied into the Midwest ISO balancing authority.
  - Available internal type 1 demand response resources qualified to supply spinning reserve
  - On-line type 2 demand response resources
  - External asynchronous resources

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# Supplemental Qualified Resources
## Day-Ahead Market

- Committed internal market generation resources
- Available Uncommitted internal quick-start market generation resources
- Committed external market generation resources that are:
  - Registered in the Midwest ISO market
  - Pseudo-tied into the Midwest ISO balancing authority
- Available Uncommitted external quick-start market generation resources that are:
  - Registered in the Midwest ISO market
  - Pseudo-tied into the Midwest ISO balancing authority
- Available type 1 demand response resources qualified to supply spinning reserve or supplemental reserve
- Committed type 2 demand response resources
- Uncommitted quick-start type 2 demand response resources
- External asynchronous resources

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# Demand Response Resources Classifications

- **Type 1 Demand Response Resources.** Demand Response Resources representing behind-the-meter interruptible load.

- **Type 2 Demand Response Resources.** Demand Response Resources representing behind-the-meter generation and/or controllable load.

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# Type 1 Demand Response Resources

- Type 1 Demand Response Resources may supply the following products:
  - Economic Energy
  - Emergency Energy
  - Contingency Reserve if Supplemental Qualified Resource
- If no minimum frequency response ERO standard exists, then Type 1 Demand Response Resources may also supply:
  - Spinning Reserve if a Spin Qualified Resource
- Load Serving Entities may offer Type 1 Demand Response Resources at Aggregate Commercial Pricing Nodes to model the following economic or emergency demand response programs:
  - Interruptible Contracts
  - Demand Side Management Programs
  - Voltage Reduction

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# Type 1 Demand Response Resources

- Type 1 Demand Response Resources offers include the following data:
  - Targeted Demand Reduction Level
  - Minimum Interruption Time
  - Maximum Interruption Time
  - Minimum No-Interruption Time
  - Shut-Down Times
  - Notification Times
  - Supplemental Reserve Availability Offer
  - Shut-Down Offers
  - Hourly Curtailment Offer
- Type 1 Demand Response Resources can be committed but not dispatched. They are analogous to a self-scheduled generation resource with an economic commitment status.

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# Type 2 Demand Response Resources

- Type 2 Demand Response Resources may supply the following products:
  - Energy
  - Supplemental Reserve if a Supplemental Qualified Resource
  - Spinning Reserve if a Spin Qualified Resource
  - Regulation if a Regulation Qualified Resource

- A Type 2 Demand Response Resource that is not a Regulation Qualified Resource must provide telemetered output data every ten seconds.
- A Type 2 Demand Response Resource that is a Regulation Qualified Resource must be able to respond to AGC control signals every four seconds and must provide telemetered output data every two seconds.

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# External Asynchronous Resources

- External asynchronous resources represent asynchronous ties (DC ties) between the Eastern Interconnection and an asynchronous island.
- External asynchronous resources are located where the asynchronous tie terminates in the Eastern Interconnection.
- External asynchronous resources must be located within a balancing authority that participates in the same contingency reserve sharing group in which the Midwest ISO participates.
- External asynchronous resources can provide energy, regulation and contingency reserve.
- Firm transmission capacity will be required to the Midwest ISO border in an amount equal to the emergency maximum limit of the asynchronous resource.
- Asynchronous resources are not be eligible for a revenue sufficiency guarantee.

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# Ancillary Services Market Resource Offer Guidelines

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# Resource Offer Templates

- Independent day-ahead and real-time resource offer templates facilitate energy and reserve availability offers in the energy and ancillary service markets.

- Resource offer templates include the following key components:
  - Emergency Limits
  - Economic Limits
  - Regulation Limits
  - Dispatch Band Model
  - Dispatch Band Limits
  - Ramp Rates
  - Resource Status Data
  - Energy Offer Structure
  - Availability Offer Structure

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# ASM Resource Offer Structure

| Old Parameter | New Parameter | DA Market | RAC Only | RT Market Only | RAC and RT Market |
|---|---|---|---|---|---|
| Emergency Limits | | √ | | | √ |
| Economic Limits | | √ | | | √ |
| | Regulation Limits | √ | | | √ |
| Ramp Rates | | √ | √ | | |
| | Dispatch Band Model | | | √ | |
| | Dispatch Band Limits | | | √ | |
| | Dispatch Band Ramp Rates | | | √ | |
| | Commitment Status | √ | √ | | |
| | Dispatch Status | √ | | | √ |
| | Control Status | √ | √ | √ | |

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# Overall Resource Limit Definitions

Overall resource limit definitions are as follows:

- **Emergency Maximum Limit.** The maximum resource output under emergency conditions.
- **Economic Maximum Limit.** The maximum resource output under non-emergency conditions.
- **Regulation High Limit.** The maximum output for which the resource can immediately respond to automatic control signals.
- **Regulation Low Limit.** The minimum output for which the resource can immediately respond to automatic control signals.
- **Economic Minimum Limit.** The minimum resource output under non-emergency conditions.
- **Emergency Minimum Limit.** The minimum resource output under emergency conditions.

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# Day-ahead Market Offers

A six-part day-ahead offer is utilized including:

- Start-up offer
- No-load offer
- Energy offer curve
- Regulation availability offer
- Spinning reserve availability offer
- Supplemental reserve availability offer

– Regulation availability offers can only be submitted for resources that are qualified and available to provide regulation.

– Quick-start resources can submit both spinning reserve and supplemental reserve availability offers. All other resources submit one or the other.

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# Day-ahead Market Reserve Availability Offers

- A day-ahead regulation availability offer is utilized each hour for each resource available and qualified to provide regulation.

- A day-ahead spinning reserve availability offer is utilized each hour for each of the following resource types:
  - Committed internal generation resources
  - Committed external generation resources (registered and pseudo-tied)
  - Committed type 2 demand response resources
  - Available type 1 demand response resources qualified to supply spinning reserve
  - External asynchronous resources
- A day-ahead supplemental reserve availability offer is utilized each hour for each of the following resource types:
  - Uncommitted available internal quick-start generation resources
  - Uncommitted available external quick-start generation resources (registered and pseudo-tied)
  - Uncommitted available type 2 demand response resources
  - Available type 1 demand response resources qualified to supply supplemental reserve only

- Available internal and external quick-start resources are allowed to submit both spinning and supplemental reserve availability offers in the day-ahead market.

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# RAC Reserve Availability Offers

- A real-time regulation availability offer is utilized each hour for each resource available and qualified to provide regulation.

- A real-time spinning reserve availability offer is utilized each hour for each of the following resource types:
  - Committed internal generation resources
  - Committed external generation resources (registered and pseudo-tied)
  - Committed type 2 demand response resources
  - Available type 1 demand response resources qualified to supply spinning reserve
  - External asynchronous resources

- A real-time supplemental reserve availability offer is utilized each hour for each of the following resource types:
  - Uncommitted available internal quick-start generation resources
  - Uncommitted available external quick-start generation resources (registered and pseudo-tied)
  - Uncommitted available quick-start type 2 demand response resource
  - Available type 1 demand response resources qualified to supply supplemental reserve only

- Available internal and external quick-start resources are allowed to submit both spinning and supplemental reserve availability offers in the RAC process.

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# Self-Scheduling Provisions

- Participants may elect to self-schedule energy, regulation and/or contingency reserve on a specific resource as long as the self-schedules comply with appropriate limits, ramp rates and resource qualifications.

- Participants that elect to self-schedule one or more products are price takers for the products that are self-scheduled.

- Independent self-scheduled amounts can apply to each of the following products:
  - Energy
  - Regulation
  - Spinning Reserve or Supplemental Reserve
- The market will allow one product on a specific resource during a specific time interval to be self-scheduled while another product is dispatchable (e.g., energy and contingency reserves are dispatchable while regulation is self-scheduled).

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# Ancillary Services Market
# Day–Ahead and FRAC
# Market Clearing

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# Day-ahead Market Process

- **Day-ahead Market Components**
  - **Simultaneously co-optimized security-constrained unit commitment**
  - **Simultaneously co-optimized security-constrained economic dispatch**
- **Day-ahead Market Costs to be Minimized**
  - **Startup**
  - **No-load**
  - **Energy**
  - **Reserve availability**
  - **Reserve scarcity**
- **Day-ahead Constraints to be Enforced**
  - **Power balance**
  - **Reserve balance**
  - **Other reserve**
  - **Resource limit**
  - **Resource ramping**
  - **Resource startup**
  - **Resource minimum run / minimum down times**
  - **Transmission and generic constraints**

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# Day-ahead Market Results

- Hourly LMPs
- Hourly resource commitment schedule
- Hourly resource control status schedule
- Hourly resource energy schedule
- Hourly resource regulating reserve schedule
- Hourly resource spinning reserve schedule
- Hourly resource supplemental reserve schedule
- Hourly regulation market clearing prices
- Hourly spinning reserve market clearing prices
- Hourly  supplemental reserve market clearing prices

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# Reliability Assessment and Commitment Process

- **Reliability Assessment Commitment Components**
  - **Simultaneously co-optimized security-constrained unit commitment**
- **Reliability Assessment Commitment Costs to be Minimized**
  - **Startup**
  - **No-load**
  - **Minimum Energy**
  - **Reserve availability**
  - **Reserve scarcity**
- **Reliability Assessment Commitment Constraints to be Enforced**
  - **Power balance**
  - **Reserve balance**
  - **Other reserve**
  - **Resource limit**
  - **Resource ramping**
  - **Resource startup**
  - **Resource minimum run / minimum down times**
  - **Selected transmission and generic constraints**

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# Reliability Assessment and Commitment Results

- Hourly resource commitment schedule
- Hourly resource control status schedule

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