Module 2: Day-Ahead Operations
Module Objectives

Upon completion of this module, you will be able to:

• Identify the components of Day-Ahead Operations
• Explain the timeline and purpose of Day-Ahead Operations
  – Day-Ahead Market (DAM)
  – Day-Ahead Reliability unit Commitment (DRUC)
• Describe the inputs and outputs of DAM / DRUC
• Describe the functions within DRUC
  – Transmission Security Analysis (TSA)
  – Reliability Unit Commitment (RUC)
• Identify impacts of Day-Ahead Operations on Real-Time
Module Overview

Course Modules:

Module 1: Nodal Market Overview
Module 2: Day-Ahead Operations
Module 3: Adjustment Period
Module 4: Operating Period
Module 5: Emergency Operation Conditions
Module 6: Performance Monitoring
Day-Ahead Operations

Day 1

Day 2

Day-Ahead Operations

DAM

DRUC

Adjustment Period

Hour-Ahead

Operating Hour

Operating Period

0600
Day-Ahead Begins
1800
Day-Ahead Complete
00:00
Midnight
60 minutes prior to Operating Hour
Day-Ahead Market (DAM)

- **Day 1**
  - Day-Ahead Operations
  - DRUC
  - Adjustment Period
- **Day 2**
  - Hour-Ahead
  - Operating Hour
  - Operating Period

Key Dates:
- **0600**: Day-Ahead Begins
- **1800**: Day-Ahead Complete
- **00:00 Midnight**: 60 minutes prior to Operating Hour
Day-Ahead Reliability Unit Commitment (DRUC)
Day-Ahead Market Overview

1. Day-Ahead Market Basics

2. Pre-Market Activities

3. DAM Clearing & Post-Market Activities
Day-Ahead Market Overview

1. Day-Ahead Market Basics

2. Pre-Market Activities

3. DAM Clearing & Post-Market Activities
Day-Ahead Market Timeline

- DAM is executed between 1000 and 1330 hrs.
- Information relevant to DAM must be posted by 0600 hrs.
Day-Ahead Market Features

**Participation in Day-Ahead is:**

- Voluntary

**RMR Units may be required to participate**

- Financially Binding

**Ancillary Services also carry physical commitment**
What Occurs in the Day-Ahead Market?

- Energy Bids & Offers
- Ancillary Service Offers
- PTP Obligation Bids
- Energy Awards
- Ancillary Service Awards
- PTP Obligation Awards
- Co-Optimization Engine
What Occurs in the Day-Ahead Market?

- Energy Bids & Offers
- Ancillary Service Offers
- PTP Obligation Bids
- Energy Awards
- Ancillary Service Awards
- PTP Obligation Awards

Co-Optimization Engine
Options for Day-Ahead Energy Bids and Offers:

- Energy Bids
- Energy-Only Offers
- Three-Part Supply Offers
The Energy Bid

Bid to buy energy at a DAM Settlement Point
- Available to all QSEs
- Helps lock in price certainty
The Energy-Only Offer

Offer to sell energy at a DAM Settlement Point
- Virtual transaction
- Available to all QSEs
- Helps lock in price certainty
The Three-Part Supply Offer

Offer to sell energy at a DAM Settlement Point

- Linked to a specific resource
- Available only from QSEs with Generation
- QSE participation in Day-Ahead helps ERCOT plan Real-Time commitments
Submission Options

DAM

DRUC

QSE

0600 1000 1330 1430

Three-Part Supply Offer

OR

Energy Offer Curve
What Occurs in the Day-Ahead Market?

- Energy Bids & Offers
- Ancillary Service Offers
- PTP Obligation Bids
- Energy Awards
- Ancillary Service Awards
- PTP Obligation Awards
- Co-Optimization Engine
The Ancillary Service Plan identifies obligations for each hour of the next Operating Day, assigned to each QSE with load on a load-ratio share basis.
Ancillary Service Obligation

DAM

0600  1000

DRUC

1330  1430

Self-Arranged Quantity

AND/OR

Purchase From ERCOT

Ancillary Service Obligation

QSE

0600  1000
Self-Arranged Ancillary Services

DAM

0600 1000

DRUC

1330 1430

Self-Supply

AND/OR

Bilateral Purchases

Self-Arranged Quantity
What Occurs in the Day-Ahead Market?

- Energy Bids & Offers
- Ancillary Service Offers
- PTP Obligation Bids
- Co-Optimization Engine
- Energy Awards
- Ancillary Service Awards
- PTP Obligation Awards
An LMP is the offer-based, marginal cost of serving the next increment of Load at an electrical bus.
LMPs may reflect impact of congestion caused by:

- Supply & Demand
  - Offers and Bids
- Transmission Constraints
- Outages
  - Transmission
  - Resources
LMPs are used to calculate Settlement Point Prices

- Settlement Points may be:
  - Resource Nodes
  - Load Zones
  - Hubs
Resource Node

- An electrical bus where a Generation Resource’s measured output is settled.
- Settlement Point Prices - Based on the LMP at the Resource Node.
Load Zone

Three types of Load Zones:
- Competitive
- NOIE
- DC Tie

Settlement Point Prices - Load-weighted average of the LMPs at all the load buses in the zone.
Trading Hub

Hub

- Settlement Point Prices at Hubs are calculated using the simple average of LMPs for all hub-buses in the defined hub.
LMPs are generated in both Day-Ahead and Real-time
• Calculated separately
• Typically different
• Creates financial impact on QSEs
Pre-Market Activities

1. Day-Ahead Market Basics

2. Pre-Market Activities

3. DAM Clearing & Post-Market Activities
QSEs with RMR Agreements must submit their updated Current Operating Plans.
ERCOT must publish:

- Operations model topology
- Weather assumptions
- Load forecasts & distribution factors
- Settlement Point lists and maps
- Transmission constraints
1. Day-Ahead Market Basics

2. Pre-Market Activities

3. DAM Clearing & Post-Market Activities
DAM Clearing

- Energy Bids & Offers
- Ancillary Service Offers
- PTP Obligation Bids

Co-Optimization Engine

- Energy Awards
- Ancillary Service Awards
- PTP Obligation Awards
### ERCOT must publish:

- Awarded Ancillary Service Offers
- Awarded Energy Bids & Offers
- Awarded PTP Obligation Bids
- DAM LMPS and Shadow Prices
- DAM Settlement Point Prices
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**COP**

- Resource Status
- High Sustained Limit
- Low Sustained Limit
- Ancillary Service Resource Responsibility
QSE is responsible for updating COP due to:

- Changes in Market conditions
- DAM awards
- RUC
- SASMs
- Outages*
- Deratings*

* Must also update Outage Scheduler – to be covered later

The COP may be updated any time before end of Adjustment Period
The COP reflects anticipated operating conditions, including:

- Expected Status, by hour
- Capacity
- Ancillary Service commitments

Each QSE has one and only one COP of each Resource
ERCOT monitors COPs for validity

- If invalid, QSE must update ASAP within applicable timeframes
By 1430 COPs must be updated to reflect:

- Assignment of AS Resource Responsibility
- Commitments due to award of resource-specific offers.
- Self-Commitments in response to DAM results.
COP ceases to be in effect at Real-Time.
DAM Awards

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- **3PSO**
- **Update COP**
- **Awarded**
- **Not Awarded**
- **Self-Commit**

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Ancillary Service Supply Responsibility

**AS Supply Responsibility** is the total amount of each Ancillary Service commitment expected to be delivered in Real-Time

- Per QSE
- For each Ancillary Service

\[
\text{AS Supply Responsibility} = \text{Self-Arranged Quantity} + \text{Ancillary Service Trades} + \text{Ancillary Service Awards}
\]
Ancillary Service Resource Responsibility

DAM

DRUC

0600 1000 1330 1430

AS Resource Responsibility

AS Supply Responsibility

AS Resource Responsibility

AS Resource Responsibility
QSEs may wish to make Bilateral Trades based upon the results of the Day-Ahead Market.

- QSE-to-QSE trades:
  - Energy
  - Capacity
  - Ancillary Service

Trades and corresponding COP updates should be reported to ERCOT by 1430 to be recognized in the DRUC process.
Transfers responsibility to supply *energy* at Real-Time.
Transfers responsibility to supply capacity at Real-Time
Transfers responsibility to supply *Ancillary Services* at Real-Time
DC Ties connect the ERCOT transmission grid to outside transmission elements

- QSEs may leverage to buy / sell energy
- Transactions subject to NERC and ERCOT scheduling restrictions

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</table>
ERCOT considers DC Tie transactions when examining grid reliability:

- Energy entering the grid is treated as a Resource
- Energy leaving the grid is treated as a Load

These transactions can impact the QSE during RUC
DAM Results may prompt a QSE to submit a DC Tie Schedule.
1. DRUC Basics

2. Transmission Security Analysis

3. Reliability Unit Commitment
This module covers Day-Ahead **Reliability Unit Commitment**
Why DRUC?

Why look at reliability at the end of the DAM?

Because The Day-Ahead Market allows the marketplace to:

- Buy / Sell energy
- Meet Ancillary Service obligations
- Commit enough Resources
Errors and uncertainty may occur in:

- Weather forecasts
- Demand forecasts
- Time of day forecasts are taken
- Resource shortages
DRUC Comprised of 2 Sub-Processes:

- Transmission Security Analysis (TSA)
- Reliability Unit Commitment (RUC)
1 DRUC Basics

2 Transmission Security Analysis

3 Reliability Unit Commitment
TSA Inputs

- Forecast potential problems on grid
- Screen contingencies
- Generate inputs for RUC
- Make adjustments in Load and weather data
TSA Summary

DRUC TSA Sub-Process

**Inputs**
- Base Case Network Model
- Normal Breaker & Switch Status
- Load Forecast
- Load Distribution Factors
- Weather Forecast

**Processes**
- Updated Network Model
- Network Security Analysis
- ERCOT Operator Review
- Screened Contingency List

**Outputs**
- Valid Network Model
- Known Contingency List
- Self Committed Resource Set
- Violations to resolve

Generic Constraints
Contingency List
## TSA Summary

### DRUC TSA Sub-Process

<table>
<thead>
<tr>
<th>Inputs</th>
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</thead>
<tbody>
<tr>
<td>Unplanned Transmission Outages</td>
<td>Updated Network Model</td>
<td>Valid Network Model</td>
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<tr>
<td>Equipment Ratings</td>
<td>Network Security Analysis</td>
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TSA Summary

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<td>Other COP Input</td>
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## Contingency List

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Contingency List
## Network Security Analysis

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**ERCOT Review**

**DRUC TSA Sub-Process**

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Reliability Unit Commitment

1. DRUC Basics

2. Transmission Security Analysis

3. Reliability Unit Commitment
RUC’s goal is to maintain grid reliability while observing transmission constraints and minimizing costs.
## RUC Overview

### Day-Ahead RUC Sub-Process

<table>
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<tr>
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<td>Resource Standing Data</td>
<td>RUC Function</td>
<td>RUC Time Stamp</td>
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<tr>
<td>Resource Cost and Fuel Data</td>
<td>RUC Iteration Results</td>
<td>Cleared Commitments</td>
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<td>Self-Arranged AS &amp; Previous RUCs</td>
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<td>Mitigated Offer-Cap Curve</td>
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<td>Procured AS capacity for DAM insufficiency</td>
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<td>RMR 3-Part Supply Offers</td>
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<td>Previous DRUC, SASM, &amp; HRUC Results</td>
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<tr>
<td>Hourly TSA Results</td>
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<td>DC Tie Schedules</td>
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Iterations
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RUC Inputs - TSA

Day-Ahead RUC Sub-Process

**Inputs**

- Previous DRUC, SASM, & HRUC Results
- Hourly TSA Results

**Processes**

- RUC Function
- RUC Iteration Results
- ERCOT Operator Review
- Iterations

**Outputs**

- RUC Time Stamp
- Cleared Commitments
- Cleared Decommitments
- Procured AS capacity for DAM insufficiency
- Infeasible Resource AS Capacity

Previous DRUC, SASM, & HRUC Results
Hourly TSA Results
## RUC Inputs - QSE

### Day-Ahead RUC Sub-Process

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- Current Operating Plan
- 3-Part Supply Offers
- DC Tie Schedules
- RUC Time Stamp
- Cleared Commitments
- Cleared De-commitments
- Procured AS capacity for DAM insufficiency
- Infeasible Resource AS Capacity
### RUC Outputs

**Day-Ahead RUC Sub-Process**

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**Outputs**
- RUC Time Stamp
- Cleared Commitments
- Cleared De-commitments
- Procured AS capacity for DAM insufficiency
- Infeasible Resource AS Capacity
You’ve learned about…

• Components of Day-Ahead Operations
• Purpose of Day-Ahead Operations
  – Day-Ahead Market (DAM)
  – Day-Ahead Reliability unit Commitment (DRUC)
• Inputs and outputs of DAM / DRUC
• Functions within DRUC
  – Transmission Security Analysis (TSA)
  – Reliability Unit Commitment (RUC)
• Impacts of Day-Ahead Operations on Real-Time
Module Conclusion