Legal Disclaimers and Admonitions

Protocol Disclaimer
This presentation provides a general overview of the Texas Nodal Market and is not intended to be a substitute for the ERCOT Protocols, as amended from time to time. If any conflict exists between this presentation and the ERCOT Protocols, the ERCOT Protocols shall control in all respects.

For more information, please visit:

http://www.ercot.com/mktrules/nprotocols/
Antitrust Admonition

ERCOT strictly prohibits market participants and their employees who are participating in ERCOT activities from using their participation in ERCOT activities as a forum for engaging in practices or communications that violate antitrust laws. The ERCOT Board has approved guidelines for Members of ERCOT Committees, subcommittees and working groups to be reviewed and followed by each market participant attending ERCOT meetings.
Housekeeping

- Restrooms
- Refreshments
- Attendance sheet
- Exam
- Questions

Please turn off cell phones & other electronics
Course Introduction
Course Audience

Anyone considering:

• Participation in the CRR Markets
• Purchasing PTP Obligations in the Day-Ahead Market.

This may include:

• Participants in CRR Auctions
• Qualified Scheduling Entities (QSEs) purchasing Point-to-Point Obligations in the Day-Ahead Market (DAM)
• Non-Opt In Entities (NOIEs) eligible for Pre-Assigned CRRs
Course Objectives

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

• Identify the requirements to participate in the CRR market
• Explain various CRR market processes
• Describe possible financial outcomes of CRRs in the ERCOT markets
Course Modules

Modules in this course include:

1. Fundamentals of Congestion Revenue Rights
2. CRR Allocation & Auction Processes
3. Trading of CRRs
4. Day-Ahead Market Point-to-Point Obligations
5. Managing Creditworthiness
6. CRR Settlements
Module 1: Fundamentals of Congestion
Revenue Rights
Upon completion of this module, learners will be able to:

• Describe the basics of Locational Marginal Prices
• Explain the nature of congestion cost exposure
• Describe the types of Congestion Revenue Rights available to hedge congestion exposure
Settlement Points

All Energy in the ERCOT Market is settled at one of three types of Settlement Points:

- **Resource Nodes**
- **Load Zones**
- **Hubs**

Each Settlement Point has its own Settlement Point Price.
Settlement Point Prices are calculated from Locational Marginal Prices:

- **Resource Node**: LMP at Resource Node

- **Load Zone**: Load-weighted average of LMPs at Load Buses within the Load Zone

- **Hub**: Simple Average of LMPs at defined Hub Buses within the Hub
What is Locational Marginal Pricing (LMP)?

Pricing: Cost
Marginal: to serve the next increment of Load
Locational: at an Electrical Bus

Buses can be:
- Load Buses
- Generation Resource Buses
- Hub Buses
- Other Buses
Locational Marginal Pricing

LMP components

- Energy
- Congestion

In some markets, LMPs have a component for losses.

The ERCOT Market does **NOT** include losses in LMPs.
Locational Marginal Pricing

EXAMPLE

Introducing the players...

Gen 1

Gen 2

Gen 3

345kV Hub Bus

69kV Load Bus

Load
Locational Marginal Pricing

EXAMPLE

Let’s solve for LMPs at each Bus

- **Gen 1**: 20 MW @ $20
- **Gen 2**: 20 MW @ $10
- **Gen 3**: 40 MW @ $30

**345kV Hub Bus**
- LMP?
- 10 MW Limit

**69kV Load Bus**
- LMP?

LMP? (5 MW Limit)

LMP? (20 MW Limit)
Since we have *congestion*. . .

### Payments to Sellers

<table>
<thead>
<tr>
<th></th>
<th>LMP</th>
<th>MW</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen 1</td>
<td>$20</td>
<td>5</td>
<td>$100</td>
</tr>
<tr>
<td>Gen 2</td>
<td>$10</td>
<td>5</td>
<td>$50</td>
</tr>
<tr>
<td>Gen 3</td>
<td>$30</td>
<td>10</td>
<td>$300</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$450</td>
</tr>
</tbody>
</table>

### Charges to Buyers

<table>
<thead>
<tr>
<th></th>
<th>LMP</th>
<th>MW</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$30</td>
<td>20</td>
<td>$600</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$600</td>
</tr>
</tbody>
</table>
Locational Marginal Pricing

- Charges to Buyers: $600
- Payments to Sellers: $450
- Congestion Rent: $150

Day-Ahead Market Congestion Rent funds Congestion Revenue Rights (CRRs)
Congestion Costs

Congestion Cost exposure

Resource Node A

Hub

Load Zone

$30/MWh

$40/MWh

$50/MWh

Congestion costs are built in to the Settlement Point prices.
Congestion Revenue Rights:

- Financial instruments
- Payment or charge to owner when Transmission Grid is congested in Day-Ahead Market

A CRR is not a right to deliver physical energy
Congestion Revenue Rights

CRRs may be used as:

- Financial Hedge
- Financial Investment
Congestion Revenue Rights

As a Financial Hedge for…

- Price certainty - Locking in the price of congestion at the cost of purchasing the CRR

*Price Separation between two Settlement Points*
As a Financial Investment...

CRRs may be purchased as a financial tool to speculate:

Congestion Rent $\geq$ Purchase Price
Types of Congestion Revenue Rights

- Designated point of injection (source) and point of withdrawal (sink)
- Settlement based on difference between sink and source Settlement Point Prices
- Two Instruments:
  - Point-to-Point Options
  - Point-to-Point Obligations
Point-to-Point Options

Provide a hedge that can only result in a payment to the CRR Account Holder

Option \( \text{AB} \) Payment = $5.00

Option \( \text{CB} \) Payment = $0.00
Point-to-Point Obligations

Provide a hedge that may result in a payment or a charge to CRR Account Holder

Obligation $_{AB}$ Payment = $5.00

Obligation $_{CB}$ Charge = $5.00
Congestion Revenue Rights

Three ways of acquiring CRRs:

• CRR Auction
• Allocation (Special Cases)
• Bilateral Trades
CRR Account Holder

Registration and qualification:

• Standard Form Agreement and CRR Account Holder Application
• Demonstrate the capability to perform the functions of an Account Holder
• Satisfy ERCOT’s creditworthiness requirements
• Provide bank account information
• Financially responsible for payment of settlement charges
Hedging Congestion Costs

Day-Ahead Congestion Hedging

- 5MW DAM Energy Purchase at Load Zone
- 5MW PTP Option from Resource Node A to Load Zone
### Day-Ahead Congestion Hedging

**Example**

<table>
<thead>
<tr>
<th>Energy Purchase</th>
<th>PTP Option Payment</th>
<th>Net Day-Ahead Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

- **Resource Node A (source)**
- **Load Zone (sink)**
- **Resource Node B**

**Costs:**
- $20/MWh

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**Table:**

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Node A</td>
<td>$20/MWh</td>
</tr>
<tr>
<td>Resource Node B</td>
<td>$20/MWh</td>
</tr>
<tr>
<td>Load Zone (sink)</td>
<td>$20/MWh</td>
</tr>
</tbody>
</table>
Hedging Congestion Costs

**EXAMPLE**

**Day-Ahead Congestion Hedging**

<table>
<thead>
<tr>
<th>Energy Purchase</th>
<th>PTP Option Payment</th>
<th>Net Day-Ahead Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>$20/MWh</td>
<td>$25/MWh</td>
<td>$100</td>
</tr>
<tr>
<td>Resource Node A (source)</td>
<td>Load Zone (sink)</td>
<td>Resource Node B</td>
</tr>
<tr>
<td>$25/MWh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$30/MWh</td>
<td></td>
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</tr>
</tbody>
</table>
Hedging Congestion Costs

Day-Ahead Congestion Hedging

**EXAMPLE**

Don’t forget – there was a cost to buy the PTP Option in the CRR Auction.

<table>
<thead>
<tr>
<th>Energy Purchase</th>
<th>PTP Option Payment</th>
<th>Net Day-Ahead Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Resource Node A (source)

Resource Node B

$20/MWh

$25/MWh

$30/MWh
Hedging Congestion Costs

Real-Time Congestion Hedging

EXAMPLE

- 5MW Trade Energy Purchase at Resource Node A
- 5MW Load at Load Zone
Hedging Congestion Costs

Real-Time Congestion Hedging

EXAMPLE

<table>
<thead>
<tr>
<th>Payment at Resource Node A</th>
<th>Charge at Load Zone</th>
<th>Real-time Congestion Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

$30/MWh

Resource Node A

Load Zone

$30/MWh

Resource Node B

$30/MWh
Hedging Congestion Costs

Real-Time Congestion Hedging

EXAMPLE

<table>
<thead>
<tr>
<th>Resource Node A</th>
<th>Load Zone</th>
<th>Resource Node B</th>
</tr>
</thead>
<tbody>
<tr>
<td>$30/MWh</td>
<td>$40/MWh</td>
<td>$45/MWh</td>
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</table>

<table>
<thead>
<tr>
<th>Payment at Resource Node A</th>
<th>Charge at Load Zone</th>
<th>Real-time Congestion Exposure</th>
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Day Ahead Market PTP Obligations:

- Financial instruments
- Payment or charge to owner when Transmission Grid is congested in Real-Time
DAM PTP Obligations may be used as:

- Financial Hedge
- Financial Investment
Day Ahead Market PTP Obligations

As a Financial Hedge for...

- Price certainty - Locking in the costs of Real-time congestion at Day-Ahead Market prices

*Price Separation between two Settlement Points*
As a Financial Investment…

DAM PTP Obligations may also be purchased as a financial tool to speculate:

Real-time value $\geq$ Purchase Price
Day Ahead Market PTP Obligations

Day-Ahead Market PTP Obligations

- Purchased at DAM price spread
- Settled at Real-Time price spread

Only QSEs may participate in the Day-Ahead Market
Qualified Scheduling Entity

Registered and qualified with ERCOT:

• May trade power
• May represent Resources and/or Load
• Satisfy ERCOT’s creditworthiness requirements
• Meet communications requirements
• Financially responsible for payment of settlement charges
Day Ahead Market PTP Obligations

EXAMPLE

5 MW PTP Obligation

DAM Prices:
- Source Node A: $20/MWh
- Load Zone: $25/MWh

Real-Time Prices:
- Resource: $30/MWh
- Sink: $40/MWh

QSE charge in Day Ahead Market = ?

QSE payment in Real Time = ?
Hedging Congestion Costs

Real-Time Congestion Hedging

EXAMPLE

- 5MW Trade Energy Purchase at Resource Node A
- 5MW Load at Load Zone
- 5MW DAM PTP Obligation Resource Node A to Load Zone
Hedging Congestion Costs

Real-Time Congestion Hedging

EXAMPLE

<table>
<thead>
<tr>
<th>Payment at Resource Node A</th>
<th>Charge at Load Zone</th>
<th>Payment for PTP Obligation</th>
<th>Real-time Net Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>$150</td>
<td>$200</td>
<td></td>
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</tr>
</tbody>
</table>
In module, you’ve learned about:

• The basics of LMPs
• Congestion cost exposure in the ERCOT markets
• Hedging congestion costs in the ERCOT markets
Module 2: CRR Auction & Allocation Process
Module Objectives

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

• Describe the role of the CRR Network Model in the CRR Auction
• Explain the impact of Pre-Assigned CRRs on the CRR Auction
• Identify the inputs of the CRR Auction Process
• Describe the CRR Auction Process
• Identify the outputs of the CRR Auctions
Congestion Revenue Rights Life Cycle

Allocation
- PCRRs to NOIEs
- Prior to the CRR Auction

CRR Auction
- Bids to Buy
- Offers to Sell

Day-Ahead Market
- Daily Settlement of CRRs

Auctions held monthly and semi-annually.
Timing of Auctions:

- Monthly
- Long Term Auction Sequence
  - Semi-annual
  - Four successive auctions

1\textsuperscript{st} Six months

2\textsuperscript{nd} Six months

3\textsuperscript{rd} Six months

4\textsuperscript{th} Six months
Available Capacity

• 90% in Monthly Auction
• Less in Long-Term Auction
  • 60% for first six months
  • 45% for second six months
  • 30% for third six months
  • 15% for fourth six months
Modeling for Congestion Revenue Rights

ERCOT’s System Capacity is determined from the Network Operations Model

Reflects characteristics of ERCOT Transmission System

- Topology
- Equipment Ratings
- Other Operational Limits
CRR Network Model

- Derived from Network Operations Model
- Representative of the transmission capacity for each month
CRR Network Model will reflect:

- Transmission facilities expected to be in-service for the specified month
- Significant outages
- Dynamic Ratings
- Monitored Elements
- Contingencies
- Settlement Points
Modeling for Congestion Revenue Rights

ERCOT uses the CRR Model in:

- CRR Auction Process
- CRR Allocation to NOIEs

ERCOT posts CRR Model on MIS:

- 10 business days before Monthly Auction
- 20 business days before Long-Term Auction Sequence
CRR Allocation

Pre-Assigned CRRs (PCRRs)

- Allocated to Non-Opt-In Entities (NOIEs)
  - Monthly
  - Annually
- Based on long-term supply contracts
- Cost based on Auction clearing price
Simultaneous Feasibility Test

Goal:
• Confirms that the transmission system can support an awarded set of CRRs during anticipated system conditions

Process
• DC power-flow model
• Used during Allocation
• Used prior to Day-Ahead Market
CRR Allocation

Possible Transmission Capacity Available for *Allocation*

Possible Transmission Capacity Available *Prior to the Auction*
CRR Auction Process

- Bids
- Offers
- CRR Model
  - Allocated CRRs
  - Previously Awarded CRRs
  - Credit Limits

CRR Auction Engine

Data Transmitted Daily
- Credit
- Settlements

Auction Results
- Postings
- Settlements
Inputs

Bids – willingness to buy CRRs

Indicate:

• Not-to-Exceed Price
• Maximum MWs of CRRs
## Bids

<table>
<thead>
<tr>
<th>Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Price</th>
<th>Time Of Use</th>
<th>Buy or Sell</th>
<th>Hedge Type</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRRAH1</td>
<td>RN1</td>
<td>LZ4</td>
<td>10</td>
<td>10</td>
<td>Peak WD</td>
<td>Buy</td>
<td>OBL</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
</tr>
<tr>
<td>CRRAH1</td>
<td>RN2</td>
<td>LZ4</td>
<td>10</td>
<td>10</td>
<td>Peak WD</td>
<td>Buy</td>
<td>OBL</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
</tr>
<tr>
<td>CRRAH1</td>
<td>LZ5</td>
<td>RN3</td>
<td>10</td>
<td>10</td>
<td>Peak WD</td>
<td>Buy</td>
<td>OBL</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
</tr>
<tr>
<td>CRRAH1</td>
<td>Hub1</td>
<td>LZ2</td>
<td>10</td>
<td>10</td>
<td>Peak WD</td>
<td>Buy</td>
<td>OBL</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
</tr>
</tbody>
</table>
CRRs are allocated or auctioned in:

- One month strips
- Time-of-Use Blocks

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<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Off-Peak (0100 – 0600)</strong></td>
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<td></td>
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<td><strong>Peak Weekend (0700-2200)</strong></td>
<td></td>
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<tr>
<td><strong>Peak Weekday (0700 – 2200)</strong></td>
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<td><strong>Off-Peak (2300 – 2400)</strong></td>
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</tr>
</tbody>
</table>
24-Hour Bids in *Monthly* Auctions

Treated as single bid across all three Time-of-Use blocks

<table>
<thead>
<tr>
<th>If…</th>
<th>Then…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bid Price $\geq$</td>
<td>Weighted average (by hour) of all three time-of-use clearing prices</td>
</tr>
<tr>
<td>Weighted average (by hour)</td>
<td></td>
</tr>
<tr>
<td>of all three time-of-use</td>
<td></td>
</tr>
<tr>
<td>clearing prices</td>
<td></td>
</tr>
</tbody>
</table>

| Bid Price $<$              | Weighted average (by hour) of all three time-of-use clearing prices | 24-Hour CRR bid *not awarded* |
| Weighted average (by hour)|                                           |                            |
CRR Auction

24-Hour Bids in *Monthly* Auctions
Treated as single bid across all three Time-of-Use blocks

<table>
<thead>
<tr>
<th>If…</th>
<th>24-Hour Bids are not accepted in the Long-Term Auction Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bid Price $\geq$ 24-Hour CRR bid awarded</td>
<td>Weighted average (by hour) of all three time-of-use clearing prices</td>
</tr>
<tr>
<td>Bid Price $&lt;$ 24-Hour CRR bid <em>not awarded</em></td>
<td>Weighted average (by hour) of all three time-of-use clearing prices</td>
</tr>
</tbody>
</table>

24-Hour Bids are not accepted in the Long-Term Auction Sequence
CRR Account Holder enters 24-hr bid for CRR from Source A to Sink B

- Month of February 2015 has total of 672 hours, including
  - 224 Off Peak hours
  - 128 Peak Weekend hours
  - 320 Peak Weekday hours
The three time-of-use Clearing Prices for CRR A-B are:
- $2 Off Peak
- $3 Peak Weekend
- $8 Peak Weekday

Weighted average price for the 3 time-of-use periods is
\[
\frac{(224 \times 2 + 128 \times 3 + 320 \times 8)}{672} = \$5.048/\text{MWh}
\]

To be awarded, the 24-hour bid must be $5.05 or greater
Minimum Bid Price and Auction Fees

• Minimum Bid Price for PTP Options
  • Currently $0.01
  • Reviewed by TAC Annually

• Auction Fee for PTP Options that clear below Minimum Bid Price
  • Difference between award price and minimum price
  • Works out to $0.01/MW/hour
CRR Auction

Inputs

Bids

Offers

Offers - willingness to sell CRRs

Indicate:

• Minimum Reservation Price
• Quantity (equal to or less than value) in MW

Only the Owner of Record can offer a CRR
## CRR Auction

### Offers

<table>
<thead>
<tr>
<th>CRR ID</th>
<th>Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Price</th>
<th>Time Of Use</th>
<th>Buy or Sell</th>
<th>Hedge Type</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>12345</td>
<td>CRRAH1</td>
<td>RN1</td>
<td>LZ4</td>
<td>10</td>
<td>10</td>
<td>Peak WD</td>
<td>Sell</td>
<td>OBL</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
</tr>
<tr>
<td>67890</td>
<td>CRRAH1</td>
<td>RN2</td>
<td>LZ4</td>
<td>20</td>
<td>50</td>
<td>Peak WD</td>
<td>Sell</td>
<td>OPT</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
</tr>
<tr>
<td>23456</td>
<td>CRRAH1</td>
<td>LZ5</td>
<td>RN3</td>
<td>50</td>
<td>25</td>
<td>Peak WD</td>
<td>Sell</td>
<td>OBL</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
</tr>
<tr>
<td>78901</td>
<td>CRRAH1</td>
<td>Hub1</td>
<td>LZ2</td>
<td>15</td>
<td>10</td>
<td>Peak WD</td>
<td>Sell</td>
<td>OBL</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
</tr>
</tbody>
</table>
CRR Auction

Inputs

- Bids
- Offers

Constraints submitted by ERCOT

- Total Transmission Capacity
- Transmission Capacity already “owned”
- Credit limit acts as budget constraint

CRR Model
Allocated CRRs
Previously Awarded CRRs
Credit Limits
CRR Auction

Clearing Process

- Bids
- Offers
- CRR Model
  - Allocated CRRs
  - Previously Awarded CRRs
  - Credit Limits

CRR Auction Engine

Data Transmitted Daily
- Credit
- Settlements

Auction Results
- Postings
- Settlements
Clearing Process

• Single-round, simultaneous auction

• Objective
  – Maximize net auction revenue
  – Subject to applicable constraints
    ◦ Transmission System limits
    ◦ Credit limits
CRR Auction Objective:

Maximize \[ \text{Bid-based Value} - \text{Offer-based Cost} \]

Bid-based Value: \[ \text{Sum} \left[ \text{Bid Price} \times \text{Cleared Bid Quantity} \right] \]

Offer-based Cost: \[ \text{Sum} \left[ \text{Offer Price} \times \text{Cleared Offer Quantity} \right] \]

In this step, Auction uses bid prices and offer prices, not clearing prices.
EXAMPLE

Introducing a simple model . . .

A = Settlement Point
MW = Transmission Capacity

CRR Clearing Process

A

B

C

D

E

F

200 MW

200 MW

100 MW

200 MW

200 MW
## Case 1: Bids only

### CRR Clearing Process

<table>
<thead>
<tr>
<th>Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Price</th>
<th>Buy or Sell</th>
<th>Hedge Type</th>
<th>Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRRAH 1</td>
<td>A</td>
<td>B</td>
<td>150</td>
<td>$20</td>
<td>Buy</td>
<td>OPT</td>
<td></td>
</tr>
<tr>
<td>CRRAH 2</td>
<td>C</td>
<td>D</td>
<td>20</td>
<td>$10</td>
<td>Buy</td>
<td>OPT</td>
<td></td>
</tr>
</tbody>
</table>

### Bid-based Value

\[
\text{Bid-based Value} = (100\text{MW} \times \$20) + (0\text{MW} \times \$10) - \$0 = \$2000
\]

\[
(80\text{MW} \times \$20) + (20\text{MW} \times \$10) - \$0 = \$1800
\]

### Offer-based Cost

### Prices

\[
P_{AB} \quad P_{CD} \quad P_{EF}
\]
And now, introducing . . .

**THE SHADOW PRICE**

The marginal cost to make an additional increment of a commodity available

Commodity: Transmission Capacity
Cost: Depends on Bids and Offers
### CASE 2: BIDS ONLY

<table>
<thead>
<tr>
<th>Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Price</th>
<th>Buy or Sell</th>
<th>Hedge Type</th>
<th>Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRRAH 1</td>
<td>A</td>
<td>B</td>
<td>150</td>
<td>$10</td>
<td>Buy</td>
<td>OPT</td>
<td></td>
</tr>
<tr>
<td>CRRAH 2</td>
<td>C</td>
<td>D</td>
<td>20</td>
<td>$20</td>
<td>Buy</td>
<td>OPT</td>
<td></td>
</tr>
</tbody>
</table>

**Bid-based Value**

\[
(20 \text{MW} \times \$20) + (80 \text{MW} \times \$10) = \$1200
\]

**Offer-based Cost**

\[
(0 \text{MW} \times \$20) + (100 \text{MW} \times \$10) = \$1000
\]

### PRICES

\[
\begin{align*}
P_{AB} & \quad P_{CD} & \quad P_{EF}
\end{align*}
\]
Case 3: Bids and Offer

<table>
<thead>
<tr>
<th>Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Price</th>
<th>Buy or Sell</th>
<th>Hedge Type</th>
<th>Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRRAH 1</td>
<td>A</td>
<td>B</td>
<td>150</td>
<td>$10</td>
<td>Buy</td>
<td>OPT</td>
<td></td>
</tr>
<tr>
<td>CRRAH 2</td>
<td>C</td>
<td>D</td>
<td>20</td>
<td>$20</td>
<td>Buy</td>
<td>OPT</td>
<td></td>
</tr>
<tr>
<td>CRRAH 3</td>
<td>E</td>
<td>F</td>
<td>30</td>
<td>$15</td>
<td>Sell</td>
<td>OPT</td>
<td></td>
</tr>
</tbody>
</table>

Bid-based Value: \(-20 \text{MW} \times $20 + 70 \text{MW} \times $10\) = $800
Price: \(-20 \text{MW} \times $20 + 50 \text{MW} \times $10\) = $900

Prices

\[ P_{AB} \quad P_{CD} \quad P_{EF} \]
### Case 4: Bids and Offer

#### CRR Clearing Process

<table>
<thead>
<tr>
<th>Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Price</th>
<th>Buy or Sell</th>
<th>Hedge Type</th>
<th>Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRRAH 1</td>
<td>A</td>
<td>B</td>
<td>150</td>
<td>$10</td>
<td>Buy</td>
<td>OPT</td>
<td></td>
</tr>
<tr>
<td>CRRAH 2</td>
<td>C</td>
<td>D</td>
<td>20</td>
<td>$20</td>
<td>Buy</td>
<td>OPT</td>
<td></td>
</tr>
<tr>
<td>CRRAH 3</td>
<td>E</td>
<td>F</td>
<td>90</td>
<td>$15</td>
<td>Sell</td>
<td>OPT</td>
<td></td>
</tr>
</tbody>
</table>

**Bid-based Value**

- (20MW × $20) + (10MW × $10) = $200

**Offer-based Cost**

- (20MW × $20) + (0MW × $10) – (10MW × $15) = $250

**Prices**

- $P_{AB}$
- $P_{CD}$
- $P_{EF}$
Outputs

- Bids
- Offers
- CRR Model
  - Allocated CRRs
  - Previously Awarded CRRs
  - Credit Limits

CRR Auction Engine

Data Transmitted Daily
- Credit
- Settlements

Auction Results
- Postings
- Settlements
## Outputs

<table>
<thead>
<tr>
<th>Credit</th>
<th>Clearing prices and quantities of CRRs – offers and bids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit System</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Settlements</th>
<th>Clearing prices and quantities of awarded CRRs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settlements System</td>
<td></td>
</tr>
</tbody>
</table>
MIS Postings

- **Awarded CRRs**
  - CRR Account Holders
  - TOU, Number, Clearing Prices, Effective Dates

- **All auction bids and offers**
  - Without identifying CRR Account Holders

- **Specific CRR Account Holder Information**
  - Awarded Bids and Offers
  - Unique ID, Source-Sink, Number of CRRs, Type of CRR, Clearing Price, Effective dates & TOU
CRR Auction – Transmission Capacity

Possible Transmission Capacity Available *Prior to Auction*

Possible Transmission Capacity Available *After the Auction*
Module Summary

In module, you’ve learned about:

• How Allocation & Auction processes use the CRR Network Model
• Inputs to the CRR Auction Process
• CRR Auction Process
• Outputs of the CRR Auction
Module 3: Trading of Congestion Revenue Rights
Module Objectives

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

• Identify which CRRs are tradable
• Describe the process of registering CRR trades with ERCOT
• Describe the ERCOT requirements to trade CRRs
Congestion Revenue Rights Life Cycle

**Allocation**
- PCRRs to NOIEs
- Prior to the CRR Auction

**CRR Auction**
- Bids to Buy
- Offers to Sell

**CRR Trades**
- Bilateral Transaction
- CRR Account Holders

**Day-Ahead Market**
- Daily Settlement of CRRs
## Tradable Congestion Revenue Rights

<table>
<thead>
<tr>
<th>Type of CRR</th>
<th>Tradable</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTP Options</td>
<td>✔️</td>
</tr>
<tr>
<td>PTP Obligations</td>
<td>✔️</td>
</tr>
<tr>
<td>PTP Options w/ Refund</td>
<td></td>
</tr>
<tr>
<td>PTP Obligations w/ Refund</td>
<td></td>
</tr>
</tbody>
</table>
CRR Account Holder Jane wants to trade a CRR:

<table>
<thead>
<tr>
<th>CRR ID</th>
<th>Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Start Date</th>
<th>End Date</th>
<th>Time Of Use</th>
<th>Hedge Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>12345</td>
<td>Jane</td>
<td>RN1</td>
<td>LZ4</td>
<td>10</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
<td>Peak WE</td>
<td>OBL</td>
</tr>
</tbody>
</table>
### Parameters for Trading Congestion Revenue Rights

**What fields may be modified?**

**Example**

<table>
<thead>
<tr>
<th>CRR ID</th>
<th>Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Start Date</th>
<th>End Date</th>
<th>Time Of Use</th>
<th>Hedge Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>12345</td>
<td>Jane</td>
<td>RN1</td>
<td>LZ4</td>
<td>10</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
<td>Peak WE</td>
<td>OBL</td>
</tr>
</tbody>
</table>

**CRR Account Holder Jane cannot modify:**
- Source
- Sink
- Time-of-Use Block

**CRR Account Holder Jane can modify:**
- Number of CRRs
- Effective Days of CRR
### EXAMPLE

Jane may offer the CRR for trade in two different ways:

<table>
<thead>
<tr>
<th>CRR ID</th>
<th>Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Start Date</th>
<th>End Date</th>
<th>Time Of Use</th>
<th>Hedge Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>12345</td>
<td>Jane</td>
<td>RN1</td>
<td>LZ4</td>
<td>3</td>
<td>07/12/2014</td>
<td>07/13/2014</td>
<td>Peak WE</td>
<td>OBL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12345</td>
<td>Jane</td>
<td>RN1</td>
<td>LZ4</td>
<td>2</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
<td>Peak WE</td>
<td>OBL</td>
</tr>
</tbody>
</table>
CRR Account Holders may indicate willingness to:

- Sell a CRR in a trade
- Buy a CRR in a trade

### CRRs for Sale

<table>
<thead>
<tr>
<th>CRR ID</th>
<th>Initiating Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Start Date</th>
<th>End Date</th>
<th>Time Of Use</th>
<th>Hedge Type</th>
<th>Contact Info</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>12345</td>
<td>Jane</td>
<td>RN1</td>
<td>LZ4</td>
<td>2</td>
<td>07/01/2014</td>
<td>07/31/2014</td>
<td>Peak WE</td>
<td>OBL</td>
<td>Seller</td>
<td>Open</td>
</tr>
</tbody>
</table>

### Want to Buy

<table>
<thead>
<tr>
<th>Initiating Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Start Date</th>
<th>End Date</th>
<th>Time Of Use</th>
<th>Hedge Type</th>
<th>Contact Info</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davis</td>
<td>RN1</td>
<td>LZ4</td>
<td>15</td>
<td>08/01/2014</td>
<td>08/31/2014</td>
<td>Peak WE</td>
<td>OPT</td>
<td>Buyer 1</td>
<td></td>
</tr>
<tr>
<td>Jill</td>
<td>LZ5</td>
<td>Hub1</td>
<td>22.5</td>
<td>06/01/2014</td>
<td>06/30/2014</td>
<td>Peak WE</td>
<td>OBL</td>
<td>Buyer 2</td>
<td></td>
</tr>
</tbody>
</table>
**Trading of Congestion Revenue Rights**

**EXAMPLE**

CRR Account Holder Jill
- Sees Jane’s offers
- Contacts Jane to trade for Offer #1

<table>
<thead>
<tr>
<th>CRR ID</th>
<th>Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Start Date</th>
<th>End Date</th>
<th>Time Of Use</th>
<th>Hedge Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>12345</td>
<td>Jane</td>
<td>RN1</td>
<td>LZ4</td>
<td>3</td>
<td>07/12/2014</td>
<td>07/13/2014</td>
<td>Peak WE</td>
<td>OBL</td>
</tr>
</tbody>
</table>
Trading of Congestion Revenue Rights

CRR Account Holders:

- Selling party reports the trade to ERCOT
- Buying party confirms the trade through ERCOT
ERCOT

- Checks Account Holders’ Available Credit Limits
- Financially settles with new CRR owner
Settlements of Traded Congestion Revenue Rights

EXAMPLE

Traded CRR reflects:

• New Account Holder
• New ID Number

<table>
<thead>
<tr>
<th>CRR ID</th>
<th>Account Holder</th>
<th>Source</th>
<th>Sink</th>
<th>MW</th>
<th>Start Date</th>
<th>End Date</th>
<th>Time Of Use</th>
<th>Hedge Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>6789</td>
<td>Jill</td>
<td>RN1</td>
<td>LZ4</td>
<td>3</td>
<td>07/12/2014</td>
<td>07/13/2014</td>
<td>Peak WE</td>
<td>OBL</td>
</tr>
</tbody>
</table>
Module Summary

In module, you’ve learned about:

• Tradable CRRs
• Where to find CRRs that are being offered to trade
• How to trade CRRs so that they are registered with ERCOT
• How traded & registered CRRs are settled with ERCOT
Module 4: Day-Ahead Market Point-to-Point Obligations
Module Objectives

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

• Identify how to acquire PTP Obligations in the DAM
• Explain the differences between DAM PTP Obligations and CRRs acquired in the Auction
Congestion Revenue Rights Life Cycle

Allocation
- PCRRs to NOIEs
- Prior to the CRR Auction

CRR Auction
- Bids to Buy
- Offers to Sell

CRR Trades
- Bilateral Transaction
- CRR Account Holders

Day-Ahead Market
- Daily Settlement of CRRs
- Buy DAM PTP Obligations

Real-Time Operations
- Settlement of DAM PTP Obligations
Transmission Capacity in Day-Ahead

Possible Transmission Capacity Available After the Auction
Transmission Capacity in Day-Ahead

Possible Transmission Capacity Available for Day-Ahead Market

Day-Ahead Market:

- CRRs purchased in Auction are settled in DAM
- Settlement of CRRs “frees up” available network capacity for the DAM
## PTP Obligations in the Day-Ahead Market

<table>
<thead>
<tr>
<th></th>
<th>PTP Obligations (CRRs)</th>
<th>DAM PTP Obligation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How acquired:</strong></td>
<td>Allocation / Auction</td>
<td>DAM</td>
</tr>
<tr>
<td><strong>Who Purchases:</strong></td>
<td>CRR Account Holder</td>
<td>QSE</td>
</tr>
<tr>
<td>** Tradable:**</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>How Purchased:</strong></td>
<td>TOU Blocks</td>
<td>Hourly</td>
</tr>
<tr>
<td><strong>Initial Investment:</strong></td>
<td>Auction clearing price</td>
<td>Day-Ahead SPPs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Sink – Source)*</td>
</tr>
<tr>
<td><strong>Target Payout:</strong></td>
<td>Day-Ahead SPPs</td>
<td>Real-Time SPPs</td>
</tr>
<tr>
<td></td>
<td>(Sink – Source)</td>
<td>(Sink – Source)</td>
</tr>
</tbody>
</table>

*Other DAM charges may apply*
DAM PTP Obligations

CRR Auction

Acquired in CRR Auction

Settled using DAM Prices

Day-Ahead Market

Acquired in Day-Ahead Market

Real-Time

Settled using Real-Time Prices
PTP Obligations in the Day-Ahead Market

Inputs for Award of PTP Obligations

- PTP Obligation Bids
- Energy Bids and Offers
- Day-Ahead Network Model

Day-Ahead Market
DAM PTP Obligation Bid

- Submitted for any two Settlement Points
- Includes:
  - MW Quantity
  - \((\text{Sink} - \text{Source})\) price buyer is willing to pay
PTP Obligations in the Day-Ahead Market

Day-Ahead Market

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

Co-Optimization Engine
In module, you’ve learned about:

- How to acquire PTP Obligations in the Day-Ahead Market
- How PTP Obligations in the Day-Ahead are different from and similar to CRRs acquired in the Auction
Module 5: Managing Creditworthiness
Upon completion of this module, learners will be able to:

- Describe how ERCOT monitors creditworthiness in the ERCOT Market
- Identify how creditworthiness impacts participation in the ERCOT Market
Counter-Party Role

Counter-Party

- A QSE and/or CRR Account-Holder which is part of the same legal entity as the QSEs and Account Holders they financially support
- Registered Market Participants must indicate their Counter-Party at Registration
- CRR Account Holders cannot participate in the CRR Markets without a Counter-Party
Counter-Party Role

Maintains Available Credit Limits with ERCOT

Available Credit Limit for CRR Auction (ACLC)

Available Credit Limit for DAM (ACLD)
ACL establishes the financial limit to participate in:

- Congestion Revenue Rights Markets (CRR Auction, CRR Trades)
- Day-Ahead Market

ACL posted on MIS Certified Area

- Twice Daily
Available Credit Limit

Available Credit Limit for CRR Auction

- Secured Collateral
- Available Credit Limit (ACLC)
- Credit Exposure

Secured Collateral includes cash, letters of credit, and surety bonds.
Available Credit Limit

Available Credit Limit for Day Ahead Market

- Secured Collateral
- Available Credit Limit (ACLD)
- Unsecured Credit Limit
  - Credit Exposure

Unsecured Credit Limit is based on ERCOT’s evaluation of Counter-Party financial reports.
Credit Exposure comes in two flavors

- **Total Potential Exposure Secured**
  - Must be backed by Secured Collateral

- **Total Potential Exposure Any**
  - May be backed by Secured Collateral or Unsecured Credit
Credit Exposure comes in two flavors

Total Potential Exposure Secured (TPES)

TPES is based on the Future Credit Exposure of Congestion Revenue Rights owned by a CRR Account Holder
Future Credit Exposure for Congestion Revenue Rights

- Exposure based on Mark to Market valuation
- Further exposure based on Deferred Invoicing for Long-Term Auction Sequence

\[
FCE = FCEOPT + FCEOBL + DIEOPT + DIEOBL
\]

Deferred Invoicing is not currently implemented
Future Credit Exposure for PTP Options (FCEOPT)

- Based on historical average prices
- Each path has its own value

\[ \text{Value} = \text{NAOPTMW} \times A \]

Where

\[ \text{NAOPTMW} = \text{Net Awarded PTP Options for source-to-sink path} \]

\[ A = \text{Path-Specific DAM-Based Adder (price)} \]
Credit Exposure

Path-Specific DAM-Based Adder

\[ A_{\text{ci99}} \]

- Calculated for each source/sink pair
- Three-year look-back

\[ \text{ci99} = 99^{\text{th}} \text{ percentile} \]

Confidence Interval

Average Price per Monthly TOU Block

Occurrences
Future Credit Exposure for PTP Options (FCEOPT)

\[ \text{FCEOPT} = - \sum [\text{NAOPTMW} \times \text{Max}(0, \text{Aci}_{99})] \]

Summed over:
- All source/sink pairs
- Remaining TOU hours of current month
- TOU hours of next month (Prompt Month)
Future Credit Exposure for PTP Obligations (FCEOBL)

Portfolio Weighted Adder (PWA)
- Not path specific
- Based on historical values

- OR -

Portfolio Weighted Auction Clearing Price (PWACP)
- Not path specific
- Most recent Auction
Portfolio Weighted Adder (PWA)

- Weighted by volume
- Three-year look-back

\[ \text{ci}_{100} = 100^{\text{th}} \text{ percentile} \]

Confidence Interval

Average Price per Monthly TOU Block
Future Credit Exposure for PTP Options (FCEOPT)

\[
FCEOBL = - \sum \left[ NAOBLMW \times \min(0, PWAc_{100}, PWACP) \right]
\]

Summed over
- TOU hours of current month
- TOU hours of next month (Prompt Month)
- TOU hours of Forward Months
Putting it all together,

\[ FCE = FCEOPT + FCEOBL + DIEOPT + DIEOBL \]

Credit for PTP Options offsets the exposure of PTP Obligations
Total Potential Exposure Secured

\[ \text{TPES} = \text{Max} \left(0, \text{FCE}\right) \]
Total Potential Exposure Secured

**TPES** may also have an Independent Amount necessary to fulfill capitalization requirements of the Counter-Party.
Credit Exposure comes in two flavors

- **Total Potential Exposure Any (TPEA)**

- **TPEA** is based on credit exposure from Market Activities
Total Potential Exposure Any (TPEA)

Counterparty’s estimated forward liability based on market activity of its QSEs and/or CRR Account Holders

- Real-Time and Adjustment Period Activities
- Day-Ahead Market Activities
- Unbilled Real-Time Amounts
- Outstanding Unpaid Transactions
- Potential Uplifts
Credit Exposure

Total Potential Exposure Any (TPEA)

Counterparty’s estimated liability based on market activity of its QSEs and/or CRR Account Holders:

- Real-Time Activities
- Day-Ahead Market Activities
- Unbilled Real-Time Amounts
- Outstanding Unpaid Transactions
- Potential Uplifts

**TPEA** is subject to a Minimum Current Exposure based on recent market activities
Available Credit Limit

Available Credit Limit for CRR Auction (ACLC)

Available Credit Limit for DAM (ACLD)

Maintenance Available Credit Limits with ERCOT
Available Credit for CRR Auction (ACLC)

- **Secured Collateral**
- **Available Credit Limit**
  - **TPES**
  - **TPEA**
    - **UCL**
    - **GA**

ERCOT assigns Counter-Party Credit Limit to 90% of ACLC

Secured Collateral consumed by other Market Activities
Available Credit for Day Ahead Market (ACLD)

- Secured Collateral (Remainder)
- Available Credit Limit
  - Locked for Auction
  - TPEA

ERCOT assigns Counter-Party Credit Limit to 90% of ACLD
Managing Available Credit

Credit Limit for CRR Auction Participation

- ERCOT assigns 90% of ACLC to Counter-Party
- Counter-Party assigns Credit Limit for each CRR Auction
Managing Available Credit

Credit Limit for CRR Auction Participation

- ERCOT assigns 90% of ACLC to Counter-Party
- Counter-Party assigns Credit Limit for each CRR Auction
- CRR Account Holder may assign self-imposed Credit Limit

The CP credit limit determines how much credit is locked for the auction.
Managing Available Credit

Credit Constraint in CRR Auction

Credit is consumed as follows:

- **PTP Options Bids**: Volume * Bid price
- **PTP Obligation Offers**: Volume * Min (0, Offer price)
- **PTP Obligation Bids**: Volume * (Bid price + Path-Specific Adders)

90% CP Credit Limit

Auction Limit

CRR AH Self-Imposed
Managing Available Credit

Path-Specific DAM-Based Adder for PTP Obligation Bids

\[ ci_{99} = 99^{th} \text{ percentile Confidence Interval} \]

- Calculated for each source/sink pair
- Three-year look-back

\[ A_{ci_{99}} \]

Average Price per Monthly TOU Block

Occurrences
Managing Available Credit

Auction PTP Obligation Credit Requirement (AOBLCR)

\[ \text{AOBLCR} = \text{BOBLMW} \times \max(0, \text{BPOBL} - \min(0, \text{Aci}_{99}, \text{ACP})) \]

Where

- \text{BOBLMW} = (Potentially) Awarded PTP Obligation
- \text{BPOBL} = Bid Price for PTP Obligation
- \text{ACP} = Auction Clearing Price (Most recent)
Credit Pre-Screening for CRR Auction

- Like credit constraint except calculated with Bid Volumes rather than Awarded Volumes
- If exposure < CP Credit Limit, then Limit is ignored
- If exposure < Self-Imposed Credit Limit, then Limit is ignored
CRR Account Holder sets a self-imposed credit limit of $100,000 and submits bids for a CRR Auction

- 200 MW PTP Options from A to B
- $1000 Bid Price

Auction awards them 100MW @ $20

What happened?
In module, you’ve learned about:

• How ERCOT monitors Creditworthiness
• How Creditworthiness impacts participating in ERCOT Markets
• How participation in ERCOT Markets impacts Creditworthiness
Module 6: CRR Settlements
Upon completion of this module, learners will be able to:

- Identify the settlements associated with buying, owning and selling CRRs
- Describe the flow of money in the CRR Auction and for settlements of CRRs in the Day-Ahead Market
- Explain how ERCOT uses the CRR Balancing Account
- Identify the settlements associated with buying PTP Obligations in the DAM.
- Describe the flow of money for DAM PTP Obligations
CRR Settlements

Three Settlement Processes

- CRR Auction Settlement
- Day-Ahead Market
  - Settlement of CRRs
  - Shortfall Charges
- CRR Balancing Account
CRR Auction Settlements Timeline

- **Auction Completed**
- **Day 1***: Auction Results
- **Day 2**: Auction Invoice
- **Day 3**: Payments Due to ERCOT
- **Day 4**: Payments Due to CRR Account Holders
- **Day 5**:

* Business Day
** Bank Business Day
*** Business Day and Bank Business Day
CRR Auction Settlements

Charges and Payments for CRR Auction

Charge for awarded CRR Bid

\[ = (\text{Price}) \times (\text{CRRs}) \times (\text{TOU Hours}) \]

Payment for awarded CRR Offer

\[ = (-1) \times (\text{Price}) \times (\text{CRRs}) \times (\text{TOU Hours}) \]
CRR Auction Settlements

CRRAH1 is awarded on a PTP Option bid:
- 20 MWs
- Peak WD (5x16)
- Price of $5/MW
- 320 hr in February 2015

- For one hour:
  \[
  \text{(Price) } \times \text{ (CRRs)} = \frac{\text{($5/MW)} \times (20 \text{ MW})}{\text{($5/MW)} \times (20 \text{ MW})} = $100
  \]

- For entire TOU block:
  \[
  $100 \times 320 = $32,000
  \]
Auction Revenue Money Flow

Collection & Distribution of Auction Revenues

- PCRR Revenues
- Charges for Awarded CRR Bids

- Payments for Awarded CRR Offers
- Payments for Awarded CRR Bids
Distribution of Auction Revenues

- Revenue from CRRs within the same 2003 Congestion Zone are distributed on a Zonal LRS

- Revenue from CRRs between 2003 Congestion Zones are distributed on an ERCOT-wide LRS

Distribution occurs once a month.
Day-Ahead Settlement of CRRs – Money Flow

CRRs Settled in the Day-Ahead

Occurs hourly

Payment due to CRR Account Holders (Target Payment)

- Charges for Cleared DAM Energy Bids
- Charges for Cleared DAM PTP Obligation Bids
- Payments for Cleared DAM Energy Offers
- Payments for Cleared DAM PTP Obligation Bids
Payment for CRRs Settled in Day-Ahead

Target Payment

\[
\text{Price} \times \text{Quantity} \text{ Per hour}
\]

Price: \( \text{DASPP}_{\text{sink}} - \text{DASPP}_{\text{source}} \)

Quantity: MW of CRRs owned on path
Payment for CRRs Settled in Day-Ahead

• Only results in a payment
• If price is negative, there is no charge
Payment for CRRs Settled in Day-Ahead

CRR Account Holder owns 2 MWs of PTP Options between Source A and Sink B.

Target Payment

\[
\text{Price} \times \text{Quantity} \text{ Per hour} = ?
\]

PTP Options

A \hspace{1cm} $12 / \text{MWh}$ \hspace{1cm} B \hspace{1cm} $20 / \text{MWh}$
Payment for CRRs Settled in Day-Ahead

Target Payment

\[
\text{Price} \times \text{Quantity} \quad \text{Per hour}
\]

PTP Obligations

- Results in a payment or charge
Reduced CRR Payments

CRR payments may be derated if:

- Transmission elements are oversold
- The Target Payment is a positive value
- CRR source or sink is a Resource Node
Payment for CRRs Settled in Day-Ahead

Deration of CRRs

- Developed daily
- Reflects forecasted transmission system for the next day
- Updated with scheduled outages and forecasted system conditions
Payment for CRRs Settled in Day-Ahead

Deration of CRRs

Prior to Day-Ahead Market

- Executed daily
- Verifies feasibility of CRRs sold in Auction

Day-Ahead Network Operations Model

Day-Ahead Simultaneous Feasibility Test
Payment for CRRs Settled in Day-Ahead

Deration of CRRs

Prior to Day-Ahead Market

- Transmission elements not oversold
  - CRRs receive Target Payment
- Transmission elements oversold
  - CRRs receive reduced payment
Deration of CRRs is based on impact of Resource Node on constraints

- Minimal impact
  - Minimal deration
- Significant impact
  - Significant deration
Payment for CRRs Settled in Day-Ahead

Derating CRRs Reduces Gaming Opportunity

Hedge Value maintains value of CRR as Hedge

- Minimum Resource Price at source
- Maximum Resource Price at sink

<table>
<thead>
<tr>
<th>RESOURCE TYPE</th>
<th>MINRESPR$_J$</th>
<th>MAXRESPR$_K$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>-$20/MWh</td>
<td>$15/MWh</td>
</tr>
<tr>
<td>Coal</td>
<td>0</td>
<td>$18/MWh</td>
</tr>
<tr>
<td>Simple Cycle &gt; 90MW</td>
<td>FIP*10</td>
<td>FIP*14</td>
</tr>
<tr>
<td>Combined Cycle &gt; 90MW</td>
<td>FIP*5</td>
<td>FIP*9</td>
</tr>
<tr>
<td>Wind</td>
<td>-$35/MWh</td>
<td>0</td>
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</tbody>
</table>
Hedge Value Price

$$HV\ PRICE = \max(0, \text{DASPP}_{\text{sink}} - \text{MINRESPR}_{\text{source}})$$

$$HV\ PRICE = \max(0, \text{MAXRESPR}_{\text{sink}} - \text{DASPP}_{\text{source}})$$

$$HV\ PRICE = \max(0, \text{MAXRESPR}_{\text{sink}} - \text{MINRESPR}_{\text{source}})$$
Payment for CRRs Settled in Day-Ahead

Target Payment < Hedge Value
CRR Owner receives Target Payment

Hedge Value < Target Payment
CRR Owner receives Hedge Value or derated amount, whichever is greater
Day-Ahead Settlement of CRRs – Money Flow

Day-Ahead Market Congestion Rent

- Charges for Cleared DAM Energy Bids
- Charges for Cleared DAM PTP Obligation Bids
- Payments for Cleared DAM Energy Offers
- Payments for Cleared DAM PTP Obligation Bids

Payment due to CRR Account Holders (Target Payment)
Day-Ahead Market Congestion Rent

Some hours there is more Congestion Rent collected than needed to pay CRR Owners

- Charges for Cleared DAM Energy Bids
- Charges for Cleared DAM PTP Obligation Bids
- Payments for Cleared DAM Energy Offers
- Payments for Cleared DAM PTP Obligation Bids
Day-Ahead Settlement of CRRs – Money Flow

Day-Ahead Market Congestion Rent

- Charges for Cleared DAM Energy Bids
- Charges for Cleared DAM PTP Obligation Bids

Payment due to CRR Account Holders (Target Payment)

- Payments for Cleared DAM Energy Offers
- Payments for Cleared DAM PTP Obligation Bids

CRR Balancing Account
Day-Ahead Settlement of CRRs – Money Flow

Day-Ahead Market Congestion Rent

- Charges for Cleared DAM Energy Bids
- Charges for Cleared DAM PTP Obligation Bids
- Payments for Cleared DAM Energy Offers
- Payments for Cleared DAM PTP Obligation Bids

Some hours there is not enough Congestion Rent to pay CRR Owners

Payment due to CRR Account Holders (Target Payment)
Shortfall Charge for CRRs Settled in Day-Ahead - Activity

\[
\text{Shortfall Charge} = \left( \frac{\text{Total CRR Shortfall}}{} \right) \times \left( \frac{\text{CRR Owner Target Payment}}{\text{Total CRR Target Payments for hour}} \right)
\]

<table>
<thead>
<tr>
<th>Hour Ending 1300</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CRR Target Payment</td>
<td>$20 Million</td>
</tr>
<tr>
<td>Congestion Rent Collected</td>
<td>$19 Million</td>
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<tr>
<td>CRR Shortfall for the hour</td>
<td></td>
</tr>
<tr>
<td>CRR Owner’s Target Payment</td>
<td>$2 Million</td>
</tr>
<tr>
<td>CRR Owner’s Share of Total Payment</td>
<td></td>
</tr>
<tr>
<td>CRR Owner’s Shortfall Charge</td>
<td></td>
</tr>
</tbody>
</table>
Congestion Revenue Rights Balancing Account

CRR Balancing Account Distribution

- Pay to short paid CRR Acct. Holders
- Pay to QSEs representing Load

Distribution occurs once a month.
Charge for DAM PTP Obligation Bids

\[
\left( \text{Price} \right) \times \left( \text{Quantity} \right) \text{ Per hour}
\]

Price: \( \text{DASPP}_{\text{sink}} - \text{DASPP}_{\text{source}} \)

Quantity: MW of PTP Obligations awarded on path
Cleared PTP Obligation Bids in the Day-Ahead Market

CRRs Settled in the Day-Ahead Market

- Charges for Cleared DAM Energy Bids
- Charges for Cleared DAM PTP Obligation Bids
- Payments for Cleared DAM Energy Offers
- Payments for Cleared DAM PTP Obligation Bids

Payment due to CRR Account Holders (Target Payment)
Payment for DAM PTP Obligations

\[
\left( \text{Price} \right) \times \left( \text{Quantity} \right) \text{ Per hour}
\]

Price:
\[
\sum_{i=1}^{4} \left( \text{RTSPP}_{\text{sink}} - \text{RTSPP}_{\text{source}} \right) / 4
\]

Quantity: MW of DAM PTP Obligations owned on path
In module, you’ve learned about:

- Settlements associated with CRRs
- The flow of money related to CRRs in the ERCOT Markets
- Settlements associated with DAM PTP Obligations
Course Conclusion
In this course, you’ve learned about:

- Requirements to participate in the CRR market
- CRR Market processes
- Possible financial outcomes of CRRs in the ERCOT markets
Accessing additional information

ERCOT Protocols
http://www.ercot.com/mktrules/nprotocols/

ERCOT Training
http://www.ercot.com/services/training/

ERCOT Market Education Contact
Training@ercot.com
ALSO AVAILABLE ON THE ERCOT LEARNING MANAGEMENT SYSTEM

(https://www.ercottraining.com)

Working With Auction Portfolios

PCRR Nominations

CRR Messages

Downloading CRR Files

Managing Credit (Assigning Credit Limits)

Bilateral Market Trades