Products bought and sold in the DAM:

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

Day-Ahead Market

- Energy Awards
- Ancillary Service Awards
- PTP Obligation Awards
Day-Ahead Market Settlements

DAM

Participation in DAM
- Energy
- Ancillary Services
- PTP Obligations

DAM Commitment
- Make-Whole

Settlement of CRRs in the DAM
Participation in the DAM: Outcomes

Energy Offers & Bids

Charge to QSE for Awarded Energy Bid in DAM

Payment to QSE for Awarded Energy Offer in DAM
QSE5 submits an Energy Bid in the Day-Ahead Market

DAM Energy Bid is a QSE’s willingness to buy energy:

- Maximum price
- Up to a certain quantity
- At a specific Settlement Point in the DAM
Trigger
#1

QSE5 submits an Energy Bid in the Day-Ahead Market
- Bid Price = $45/MWh
- Quantity = 68MW for one hour
- At Load Zone 2

ERCOT executes the DAM Clearing Process

DAM prices Load Zone 2 at $40 / MWh
DAM Settlements: Charge for an Awarded Energy Bid

- QSE5 purchased:
  - 68 MW of Energy for one hour
  - At Load Zone 2
  - Price of $40/MWh

- Settled hourly
- Settlement calculation is:

\[
\text{Day-Ahead Settlement Point Price} \times \text{Quantity} = \text{Settlement Amount}
\]

\[
($40/MWh) \times (68 \text{ MW}) = $2720
\]
Day-Ahead Energy Purchase Amount

\[ DAEPAMT_{q, p} = DASPP_{p} \times DAEP_{q, p} \]

Determinants

- Day-Ahead Energy Purchase Amount
- Day-Ahead Settlement Point Price
- Day-Ahead Energy Purchase
- Day-Ahead Energy Purchase Amount QSE Total

\[ DAEPAMTQSETOT_{q} = \sum_{p} DAEPAMT_{q, p} \]

\[ p = \text{A Settlement Point} \]

\[ q = \text{QSE} \]
Participation in the DAM: Outcomes

Energy Offers & Bids

DAM
- Participation in DAM
  - Energy
  - AS
  - PTP Obligations

Outcome #1
Charge to QSE for Awarded Energy Bid in DAM

Outcome #2
Payment to QSE for Awarded Energy Offer in DAM
• QSE1 submits an Energy Offer in the Day-Ahead Market

• Three-Part Supply Offer
  – Startup Offer
  – Minimum Energy Offer
  – Energy Offer Curve

• DAM Energy-Only Offer

Two types of Energy Offers in Nodal Market
DAM Settlements: Payment of an Awarded Energy Offer

QSE1 submits an DAM Energy-Only Offer in the Day-Ahead Market

- Offer Price = $16/MWh
- Quantity = 40 MW for one hour
- At Resource Node 4

ERCOT executes the DAM Clearing Process

DAM prices Resource Node 4 at $16/MWh
• QSE1 sold:
  - 40 MW of Energy for one hour
  - At Resource Node 4
  - Price of $16/MWh

• Settled hourly
• Settlement calculation is:

\[
(-1) \times (\text{Day-Ahead Settlement Point Price}) \times (\text{Quantity})
\]

\[
(-1) \times ($16/\text{MWh}) \times (40 \text{ MW}) = -$640
\]
Day-Ahead Energy Settlements - Payments

Day-Ahead Energy Sale Amount

\[ \text{DAESAMT}_{q,p} = (-1) \times \text{DASPP}_p \times \text{DAES}_{q,p} \]

Day-Ahead Energy Sale Amount QSE Total

\[ \text{DAESAMTQSETOT}_q = \sum_p \text{DAESAMT}_{q,p} \]

\( p = \text{A Settlement Point} \)
\( q = \text{QSE} \)

Determinants

- Day-Ahead Energy Sale Amount
- Day-Ahead Settlement Point Price
- Day-Ahead Energy Sale
- Day-Ahead Energy Sale Amount QSE Total

Participation in DAM
- Energy
- AS
- PTP Obligations
Combined Cycle Train (CCT)

• A group of Combustion Turbines (CT) and Steam Turbines (ST)

• Operate in one or more configurations

Combined Cycle Generation Resource (CCGR)

• A registered configuration of a Combined Cycle Train

• Offered as a single Resource

Any or all CCGRs from a Combined Cycle Train may be offered in the Day-Ahead Market.
Day-Ahead Energy Settlements - Combined Cycle Resources

Combined Cycle Plant

Train 1

ST₁  CT₁  CT₂  CT₃

CCGR 1

Train 2

ST₂  CT₄  CT₅  CT₆

CCGR 2

DAM may start any offered CCGR and transition from one offered CCGR to another
## Settlement Point Locations in DAM

<table>
<thead>
<tr>
<th>Settlement Point</th>
<th>3PSO</th>
<th>CCGR 3PSO</th>
<th>DAM Energy Only Offer</th>
<th>DAM Energy Bid</th>
<th>PTP Obligation Bids</th>
<th>QSE to QSE Trades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Node</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>CCP Logical Resource Node</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>CCU Resource Node</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Load Zone</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hub</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

1. CCP = Combined Cycle Plant
2. CCU = Combined Cycle Unit
3. 3PSO = Three Part Supply Offer
4. CCGR = Combined Cycle Generation Resource
Day-Ahead Market Settlements

DAM

Participation in DAM
- Energy
- Ancillary Services
- PTP Obligations

DAM Commitment
- Make-Whole

Settlement of CRRs in the DAM
Ancillary Service (AS) Plan

The required quantity in MW of each Ancillary Service for each hour of the Operating Day ERCOT-wide

- Developed by ERCOT
- Posted to MIS Public Area by 0600

Types of Ancillary Services
- Regulation Up (Reg-Up)
- Regulation Down (Reg-Down)
- Responsive Reserve
- Non-Spin
By 0600 Day-Ahead, ERCOT posts each QSE’s AS Obligation to the MIS Certified Area.

- Per QSE
- Per type of Ancillary Service (AS)
- Per hour
In the Day-Ahead Market:

QSE may Self-arrange by 1000:

• Self Supply its AS Obligation
• Trade to cover AS Obligation

QSE may Offer AS by 1000:

• Offer available capacities by AS Type
• Offers include MW and Price

ERCOT procures:

• Ancillary Services not self-arranged
Ancillary Services in the Day-Ahead Market

Outcome #1: Payment to QSE for Awarded AS Offer in DAM

Outcome #2: Charge to QSE for ERCOT procuring AS on its behalf
• QSE4 offers to sell AS in the Day-Ahead Market

• Resource
• Quantity (tenths of MWs)
• Price
• Ancillary Service type
• Range of hours offered
• Expiration date and time of offer
DAM Settlements: Payment of an Awarded AS Offer

- QSE4 submits an Offer to sell Ancillary Service capacity
  - Regulation Up (Reg-Up)
  - 100 MW for at least $4/MW
- ERCOT executes the DAM Clearing Process
- DAM sets Day-Ahead Market Clearing Price for Capacity (Reg-up) at $4/MW and awards QSE4’s Offer
• QSE4 sold:
  • 60 MW of Regulation Up (Reg-Up)
  • Day-Ahead Market Clearing Price for Capacity of $4/MW

• Settled hourly
• Settlement calculation is:

\[ (-1) \times (\text{Price}) \times (\text{Quantity}) \]

\[ (-1) \times ($4/MW) \times (60 \text{ MW}) = -$240 \]
Regulation Up Service Payment

\[
PCRUAMT_q = (-1) \times MCPCRU_{DAM} \times PCRU_{q, DAM}
\]

\[
-240_{QSE4} = (-1) \times \frac{4}{MW}_{DAM} \times 60MW_{QSE4}
\]

**Determinants**

- Procured Capacity Reg-Up Amount
- Procured Capacity Reg-Down Amount
- Procured Capacity Responsive Reserve Amount
- Procured Capacity Non-Spin Amount
- Market Clearing Price Capacity Reg-Up
- Market Clearing Price Capacity Reg-Down
- Market Clearing Price Capacity Resp. Reserve
- Market Clearing Price Capacity Non-Spin
- Procured Capacity Reg-Up
- Procured Capacity Reg-Down
- Procured Capacity Responsive Reserve
- Procured Capacity Non-Spin

\(DAM = \text{Day-Ahead Market}\)

\(q = QSE\)
Day-Ahead Market Ancillary Services Payments

**Regulation Up Service Payment**

\[
\text{PCRUAMT}_q = (-1) \times \text{MCPCRU}_{\text{DAM}} \times \text{PCRU}_{q, \text{DAM}}
\]

**Regulation Down Service Payment**

\[
\text{PCRDAMT}_q = (-1) \times \text{MCPCRD}_{\text{DAM}} \times \text{PCRD}_{q, \text{DAM}}
\]

**Responsive Reserve Service Payment**

\[
\text{PCRRAMT}_q = (-1) \times \text{MCPCRR}_{\text{DAM}} \times \text{PCRR}_{q, \text{DAM}}
\]

**Non-Spinning Reserve Service Payment**

\[
\text{PCNSAMT}_q = (-1) \times \text{MCPCNS}_{\text{DAM}} \times \text{PCNS}_{q, \text{DAM}}
\]

---

**Determinants**

- Procured Capacity Reg-Up Amount
- Procured Capacity Reg-Down Amount
- Procured Capacity Responsive Reserve Amount
- Procured Capacity Non-Spin Amount
- Market Clearing Price Capacity Reg-Up
- Market Clearing Price Capacity Reg-Down
- Market Clearing Price Capacity Resp. Reserve
- Market Clearing Price Capacity Non-Spin
- Procured Capacity Reg-Up
- Procured Capacity Reg-Down
- Procured Capacity Responsive Reserve
- Procured Capacity Non-Spin
Participation in the DAM: Outcomes

Ancillary Services in the Day-Ahead Market

DAM Participation in DAM
- Energy
- AS
- PTP Obligations

Outcome #1
Payment to QSE for Awarded AS Offer in DAM

Outcome #2
Charge to QSE for ERCOT procuring AS on its behalf
If a QSE does not self-arrange all of its AS Obligation:

- ERCOT will procure the remaining portion in DAM
- ERCOT procures AS from available AS Offers
A QSE may submit negative Self-Arranged AS Quantities:

- Limited to -500 MW for each Ancillary Service
- Limited in magnitude to net AS Trades (compliance only)
A QSE may submit negative Self-Arranged AS Quantities:

- Limited to -500 MW for each Ancillary Service
- Limited in magnitude to net AS Trades (compliance only)

Impact:
ERCOT will charge the QSE for their share of the Ancillary Service Capacities procured in DAM.
QSE3, QSE4, & QSE5 did not Self-Arrange entire AS Obligation for Responsive Reserve Service (RRS)

- QSE3 AS Obligation (14 MW): 14 MW Procured
- QSE4 AS Obligation (52 MW): 36 MW Procured, 16 MW Self-Arranged
- QSE5 AS Obligation (84 MW): 66 MW Procured, 18 MW Self-Arranged
DAM Settlements: Charge for ERCOT Procurement of AS

- ERCOT needs to procure total of 116 MW of RRS
- ERCOT executes the DAM Clearing Process and procures additional AS from AS Offers

**Total RRS:**
- **Total Quantity Needed** = 116MW
- **Total Quantity Procured** = 128MW
- **Total Cost** = $512
• ERCOT needs to procure total of 116 MW of RRS

• ERCOT executes the DAM Clearing Process and procures 128 MW RRS from AS Offers

• Charged per QSE

• Settlement calculation:

\[
(Price) \times (Quantity) = (-1) \times \left( \frac{Total \ Cost \ of \ RRS}{Total \ RRS \ Needed} \right) \times \left( \frac{QSE \ obligation \ not \ Self-Arranged}{not \ Self-Arranged} \right)
\]
### DAM Settlements: Charge for ERCOT Procurement of AS

**Outcome #2**

\[ (-1) \times \left( \frac{\text{Total Cost of RRS}}{\text{Total RRS Needed}} \right) \times (\text{QSE obligation not Self-Arranged}) \]

<table>
<thead>
<tr>
<th>QSE</th>
<th>Price</th>
<th>Quantity Procured on behalf of QSE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>QSE3</td>
<td>$4.41 / MW</td>
<td>14 MW</td>
<td>$61.74</td>
</tr>
<tr>
<td>QSE4</td>
<td>$4.41 / MW</td>
<td>36 MW</td>
<td>$158.76</td>
</tr>
<tr>
<td>QSE5</td>
<td>$4.41 / MW</td>
<td>66 MW</td>
<td>$291.06</td>
</tr>
<tr>
<td></td>
<td>$512 / 116 MW</td>
<td></td>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>
Responsive Reserve Quantity

\[ \text{DARRQ}_q = \text{DARRO}_q - \text{DASARRQ}_q \]

**QSE3**

\[ 14\text{MW} = 14\text{MW} - 0\text{MW} \]

**QSE4**

\[ 36\text{MW} = 52\text{MW} - 16\text{MW} \]

**QSE5**

\[ 66\text{MW} = 84\text{MW} - 18\text{MW} \]

**DAM Participation in DAM**

- Energy
- AS
- PTP Obligations

**Determinants**

<table>
<thead>
<tr>
<th>Day-Ahead</th>
<th>Reg-Up Quantity</th>
<th>Reg-Up Obligation</th>
<th>Self-Arranged Reg-Up Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day-Ahead</td>
<td>Non-Spin Quantity</td>
<td>Non-Spin Obligation</td>
<td>Self-Arranged Non-Spin Quantity</td>
</tr>
</tbody>
</table>
Day-Ahead Market Ancillary Services Charges – Quantity (continued)

Responsive Reserve Quantity

\[ \text{DARRQ}_q = \text{DARRO}_q - \text{DASARRQ}_q \]

Regulation Down Quantity

\[ \text{DARDQ}_q = \text{DARDO}_q - \text{DASARDQ}_q \]

Regulation Up Quantity

\[ \text{DARUQ}_q = \text{DARUO}_q - \text{DASARUQ}_q \]

Non-Spinning Reserve Quantity

\[ \text{DANSQ}_q = \text{DANSO}_q - \text{DASANSQ}_q \]

\[ q = QSE \]

DAM

Participation in DAM
- Energy
- AS
- PTP Obligations

Determinants

| Day-Ahead Resp Reserve Quantity |
| Day-Ahead Resp Reserve Obligation |
| Day-Ahead Self-Arranged Resp Reserve Quantity |
| Day-Ahead Reg-Down Quantity |
| Day-Ahead Reg-Down Obligation |
| Day-Ahead Self-Arranged Reg-Down Quantity |
| Day-Ahead Reg-Up Quantity |
| Day-Ahead Reg-Up Obligation |
| Day-Ahead Self-Arranged Reg-Up Quantity |
| Day-Ahead Non-Spin Quantity |
| Day-Ahead Non-Spin Obligation |
| Day-Ahead Self-Arranged Non-Spin Quantity |
Responsive Reserve Price

\[
DARRPR = (-1) \times \frac{PCRRAMTTOT}{DARRQTOT}
\]

\[
$4.41/MW = (-1) \times \frac{-512}{116 \text{ MW}}
\]
Responsive Reserve Price

DARRPR  
= \((-1) \times \frac{PCRRAMTTOT}{DARRQTOT}\)

Regulation Down Price

DARDPR  
= \((-1) \times \frac{PCRDAMTTOT}{DARDQTOT}\)

Regulation Up Price

DARUPR  
= \((-1) \times \frac{PCRUAMTTOT}{DARUQTOT}\)

Non-Spinning Reserve Price

DANSPR  
= \((-1) \times \frac{PCNSAMTTOT}{DANSQTOT}\)

DAM Participation in DAM
- Energy
- AS
- PTP Obligations

Determinants

<table>
<thead>
<tr>
<th>Day-Ahead</th>
<th>Responsive Reserve Price</th>
<th>Procured Capacity for Responsive Reserve Quantity Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day-Ahead</td>
<td>Reg-Down Price</td>
<td>Procured Capacity for Reg-Down Quantity Total</td>
</tr>
<tr>
<td>Day-Ahead</td>
<td>Reg-Up Price</td>
<td>Procured Capacity for Non-Spin Quantity Total</td>
</tr>
<tr>
<td>Day-Ahead</td>
<td>Non-Spin Price</td>
<td>Procured Capacity for Non-Spin Amount Total</td>
</tr>
</tbody>
</table>
DAM Settlements: Charge for ERCOT Procurement of AS

Responsive Reserve Service Charge

\[ DARRAMT_q = DARRPR \times DARRQ_q \]

\[ $61.74_{QSE3} = $4.41/MW \times 14MW_{QSE3} \]

Determinants

<table>
<thead>
<tr>
<th>Day-Ahead</th>
<th>Responsive Reserve Amount</th>
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<th>Day-Ahead</th>
<th>Reg Down Amount</th>
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<tr>
<th>Day-Ahead</th>
<th>Reg Down Quantity</th>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day-Ahead</th>
<th>Reg Up Amount</th>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Day-Ahead</th>
<th>Reg Up Price</th>
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</table>

<table>
<thead>
<tr>
<th>Day-Ahead</th>
<th>Reg Up Quantity</th>
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</table>

<table>
<thead>
<tr>
<th>Day-Ahead</th>
<th>Non-Spinning Reserve Amount</th>
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</table>

<table>
<thead>
<tr>
<th>Day-Ahead</th>
<th>Non-Spinning Reserve Price</th>
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</table>

<table>
<thead>
<tr>
<th>Day-Ahead</th>
<th>Non-Spinning Reserve Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ q = QSE \]
DAM Settlements: Charge for ERCOT Procurement of AS

Responsive Reserve Service Charge

\[ DARRAMT_q = DARRPR \times DARRQ_q \]

Regulation Down Service Charge

\[ DARDAMT_q = DARDPR \times DARDQ_q \]

Regulation Up Service Charge

\[ DARUAMT_q = DARUPR \times DARUQ_q \]

Non-Spinning Reserve Service Charge

\[ DANSAMT_q = DANSPR \times DANSQ_q \]

\[ q = QSE \]
Day-Ahead Market Settlements

DAM

Participation in DAM
- Energy
- Ancillary Services
- PTP Obligations

DAM Commitment
- Make-Whole

Settlement of CRRs in the DAM
Participation in the DAM: Outcomes

PTP Obligations Acquired in the Day-Ahead Market

Outcome #1  Charge to QSE for Awarded PTP Obligation Bid in DAM

DAM Participation in DAM
• Energy
• AS
• PTP Obligations
Day-Ahead Market PTP Obligations

- Hedge against congestion costs in Real-Time
- Charge or payment when Grid is congested in Real-Time
## PTP Obligations – The bigger picture

<table>
<thead>
<tr>
<th></th>
<th>PTP Obligation (CRR)</th>
<th>DAM PTP Obligation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How acquired:</strong></td>
<td>Auction / Allocation</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 (Sink – Source)</td>
<td>Real-Time SPPs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Sink – Source)</td>
</tr>
</tbody>
</table>

* Other DAM charges may apply
• QSE3 Bids to buy a PTP Obligation in the DAM

• Source and Sink of PTP Obligation
• Not-to-Exceed Price ($ / MW / hr)
• Quantity (MW)
• Range of hours
• QSE3 Bids to buy a PTP Obligation in the DAM
  • Not-to-Exceed Price = $26/MWh
  • Quantity = 10 MW
  • Source Resource Node 4 (RN4)
  • Sink Load Zone 2 (LZ2)
• ERCOT executes the DAM Clearing Process
DAM Settlements: Charge for Purchased PTP Obligation

• QSE3 Bids to buy a PTP Obligation in the DAM
  • Not-to-Exceed Price = $26/MWh
  • Quantity = 10 MW
  • Source is Resource Node 4 (RN4)
  • Sink is Load Zone 2 (LZ2)

• ERCOT executes the DAM Clearing Process

DAM Prices:

- RN4: $16/MWh
- LZ2: $40/MWh

PTP Obligation Price is $24/MWh
ERCOT awards QSE3 its PTP Obligation Bid
QSE3 purchased:

- 10 MW of PTP Obligation
- Source Resource Node 4 (RN4)
- Sink Load Zone 2 (LZ2)
- Price of $24/MWh

- Settled hourly
- Settlement calculation is:

\[
(\text{Price}) \times (\text{Quantity})
\]

\[
(\text{SPP at Sink} - \text{SPP at Source}) \times (\text{Quantity})
\]

\[
($24/\text{MWh}) \times (10 \text{ MW}) = $240
\]
Settlement for PTP Obligations Acquired in the DAM

DARTOBLAMT\(_{q, (j, k)}\) = DAOBLPR\(_{(j, k)}\) \* RTOBL\(_{q, (j, k)}\)

DAOBLPR\(_{(j, k)}\) = DASPP\(_k\) - DASPP\(_j\)

Determinants

<table>
<thead>
<tr>
<th>Day-Ahead Real-Time Obligation Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day-Ahead Obligation Price</td>
</tr>
<tr>
<td>Real-Time Obligation</td>
</tr>
<tr>
<td>Day-Ahead Settlement Point Price</td>
</tr>
</tbody>
</table>

\(q = QSE\)
\(j = \text{Source Settlement Point}\)
\(k = \text{Sink Settlement Point}\)
Special Product for NOIEs

• A NOIE (or their QSE) can buy PTP Obligations linked to PTP Options they own.
• Cash out PTP Options in DAM
• Buy like quantity of DAM PTP Obligations
• No charge in Real-time if price spread is negative
Settlement for DAM PTP Obligations with Links to Options

\[ \text{DARTOBLLOAMT}_{q, (j, k)} = \max (0, \text{DAOBLPR}_{(j, k)}) \times \text{RTOBLLO}_{q, (j, k)} \]

\[ \text{DAOBLPR}_{(j, k)} = \text{DASPP}_k - \text{DASPP}_j \]

Determinants

- **Day-Ahead Real-Time Obligation with Links to an Option Amount**
- **Day-Ahead Obligation Price**
- **Real-Time Obligation with Links to an Option**
- **Day-Ahead Settlement Point Price**

\( q = \text{QSE} \)
\( j = \text{Source Settlement Point} \)
\( k = \text{Sink Settlement Point} \)
Day-Ahead Market Settlements

DAM

Participation in DAM
- Energy
- Ancillary Services
- PTP Obligations

DAM Commitment
- Make-Whole

Settlement of CRRs in the DAM
Make-Whole Payment to DAM-Committed QSE with a Three-Part Supply Offer

**Outcome #1**

**What:** A payment to ensure generation costs are met when Resource is DAM-committed

**Why:** Guarantees that a DAM-committed Resource with a Three-Part Supply Offer recovers its allowable cost to Start-Up and its operating energy costs
Calculating the Day-Ahead Make-Whole Payment

- Incremental Energy Costs
- Minimum Energy Costs
- Start-up Costs
Calculating the Day-Ahead Make-Whole Payment

- Day-Ahead Market Sales
- Revenues Received

- Incremental Energy Costs
- Minimum Energy Costs
- Start-up Costs

- Costs Incurred
Calculating the Day-Ahead Make-Whole Payment

\[
\text{Day-Ahead Market Sales} = \text{DAM Energy Sales} \times \text{SPP} + \text{AS Sales} \times \text{MCPC}
\]
What if revenues are less than costs?

Revenue Shortage

Day-Ahead Market Sales

Revenues Received

Costs Incurred

Incremental Energy Costs
Minimum Energy Costs
Start-up Costs
What if revenues are less than costs?

Day-Ahead Make-Whole Payment

Difference = Make-Whole Payment

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</tbody>
</table>

Day-Ahead Market Sales

Make-Whole Payment

Revenues Received

Costs Incurred

- Incremental Energy Costs
- Minimum Energy Costs
- Start-up Costs
What if revenues are less than costs?
A QSE will receive a Make-Whole Payment if its revenues from the DAM are less than the Startup, Minimum Energy, and Operating costs.
Day-Ahead Make-Whole Payment

Trigger #1

( DAM Revenues ) < ( DAM Guaranteed Amount )

QSE To Do

- Submit Three-Part Supply Offer in DAM
- QSE is DAM-Committed
- Runs DAM-Committed Resource in Real-Time

ERCOT To Do

- Calculate DAM Guaranteed Costs
  - Use appropriate values for start up and minimum energy
  - Calculate Day-Ahead AIEC
- Calculate DAM Revenues
  - Calculate Revenues from Energy
  - Calculate Revenues from AS
Calculate DAM Guaranteed Costs

DAM Guaranteed Costs =

- Startup costs
- Minimum energy costs
- Incremental Energy Costs

Startup Offer
Minimum-Energy Offer
Energy Offer Curve

$/MWh at LSL
$/MWh Above LSL
Calculate DAM Guaranteed Costs

DAM Guaranteed Costs = (Startup costs + Minimum energy costs + Incremental Energy Costs)

- Minimum Energy Offer (MEO)
- Low Sustained Limit (LSL)
Startup and Minimum Energy costs subject to caps

If ERCOT has Verifiable Costs

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Startup Cap</strong></td>
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<tr>
<td></td>
<td><strong>Verifiable Startup</strong></td>
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<tr>
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<td><strong>Costs</strong></td>
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<td><strong>Minimum Energy Cap</strong></td>
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<td><strong>Minimum-Energy</strong></td>
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<td><strong>Costs</strong></td>
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Otherwise

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<td></td>
<td><strong>Startup Offer</strong></td>
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<td></td>
<td><strong>Generic Cap</strong></td>
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<tr>
<td><strong>Minimum Energy Cap</strong></td>
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<td><strong>Minimum Energy</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Generic Cap</strong></td>
</tr>
</tbody>
</table>
Day-Ahead Make-Whole Payment

ERCOT To Do

☐ Calculate DAM Guaranteed Costs
  ☑ Use appropriate values for start up and minimum energy

☐ Calculate Day-Ahead AIEC

☐ Calculate DAM Revenues
  ☐ Calculate Revenues from Energy
  ☐ Calculate Revenues from AS
Calculate DAM Guaranteed Costs

DAM Guaranteed Costs = (Startup costs + Minimum energy costs + Incremental Energy Costs)

• Day-Ahead Average Incremental Energy Cost (DAAIEC)
Calculate DAM Guaranteed Costs

Calculate Average Incremental Energy Cost (AIEC)

Calculates the additional cost for a Generation Resource to produce energy above its LSL.
Average Incremental Energy Cost (AIEC)

- LSL is the minimum sustained energy production
- DAESR is amount of energy that was cleared in the DAM

<table>
<thead>
<tr>
<th>Determinants</th>
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<tbody>
<tr>
<td>Low Sustained Limit</td>
</tr>
<tr>
<td>Day-Ahead Energy Sale from Resource</td>
</tr>
</tbody>
</table>
Average Incremental Energy Cost (AIEC)

The area under the curve divided by the energy cleared above LSL gives the average cost per MWh for that energy.
For calculating Make-Whole, the curve is capped by the Day-Ahead Energy Offer Curve Price Cap (DAEOCPRCAP)

The cap is defined in the Protocols by technology type.
Average Incremental Energy Cost (AIEC)

$$\text{AIEC} = \text{Area under curve} \over \text{(DAESR-LSL)}$$

Average cost for supplying energy from the LSL to the DAESR for the hour
Average Incremental Energy Cost (AIEC)

**ERCOT To Do**

- Calculate DAM Guaranteed Costs
  - Use appropriate values for start up and minimum energy
  - Calculate Day-Ahead AIEC

- Calculate DAM Revenues
  - Calculate Revenues from Energy
  - Calculate Revenues from AS

**Determinants**

- Low Sustained Limit
- Day-Ahead Energy Sale from Resource
- Day-Ahead Energy Sale Clearing Price
- Day-Ahead Energy Offer Curve Price Cap
- Day-Ahead Energy Offer Curve Quantity Cap
QSE1’s Resource is committed for 4 hours

- Awarded 50 MW per hour
- Low Sustained Limit is 10MW
- From Three-Part Supply Offer
  - Startup Offer = $5000
  - Minimum Energy Offer = $10/MWh
  - AIEC = $20/MWh
- Startup Cap = $4,400
- Minimum Energy Cap = $12/MWh
**Day-Ahead Make-Whole Payment**

**Trigger #1**

\[
\text{DAMG\text{COST}}_{q, p, r} = \text{Min}(\text{DAS\text{UO}}_{q, p, r}, \text{DAS\text{UCAP}}_{q, p, r})
+ \sum(\text{Min}(\text{DAME\text{O}}_{q, p, r, h}, \text{DAME\text{CAP}}_{q, p, r, h}) * \text{DAL\text{SL}}_{q, p, r, h})
+ \sum(\text{DA\text{AIEC}}_{q, p, r, h} * (\text{DA\text{ESR}}_{q, p, r, h} - \text{DAL\text{SL}}_{q, p, r, h}))
\]

**Startup Offer (DASUO) and Cap (DASUCAP)**

**Minimum Energy Offer (DAMEO) and Cap (DAMECAP)**

**Low Sustained Limit (DALSL)**

**Day-Ahead AIEC (DAAIEC)**

**Day-Ahead Energy Sales (DAESR)**
Day-Ahead Make-Whole Payment

\[
\text{DAMGCOST} = \min\left( \text{DASUO}, \text{DASUCAP} \right)
\]
\[
+ \sum\left( \min\left( \text{DAMEO}, \text{DAMECAP} \right) \times \text{DALSL} \right)
\]
\[
+ \sum\left( \text{DAAIEC} \times \left( \text{DAESR} - \text{DALSL} \right) \right)
\]

\[
\text{DAMGCOST} = \min\left( \$5000, \$4400 \right)
\]
\[
+ \left( \min\left( \$10/\text{MWh}, \$12/\text{MWh} \right) \times 10\text{MW} \right) \times 4\text{h}
\]
\[
+ \left( \$20/\text{MWh} \times (50\text{MW} - 10\text{MW}) \right) \times 4\text{h}
\]

\[
= \$4400 + \$400 + \$3200
\]
\[
= \$8000
\]
**Day-Ahead Make-Whole Payment**

**ERCOT To Do**

- **Calculate DAM Guaranteed Costs**
  - Use appropriate values for start-up and minimum energy
  - Calculate Day-Ahead AIEC

- **Calculate DAM Revenues**
  - Calculate Revenues from Energy
  - Calculate Revenues from AS

**DAMGCOST**

\[ \text{DAMGCOST}_{q, p, r} = \min(\text{DAMSUO}_{q, p, r}, \text{DASUCAP}_{q, p, r}) \]

\[ + \sum \left( \min(\text{DAMEO}_{q, p, r, h}, \text{DAMECAP}_{q, p, r, h}) \times \text{DALSL}_{q, p, r, h} \right) \]

\[ + \sum \left( \text{DAAIEC}_{q, p, r, h} \times \left( \text{DAESR}_{q, p, r, h} - \text{DALSL}_{q, p, r, h} \right) \right) \]
DAM Revenues < $8000

Revenues from Energy + Revenues from Ancillary Services

Trigger #1
Day-Ahead Make-Whole Payment

Energy Revenues for Hour 1

Revenues = (-1) * (Price) * (Quantity)

DAEREV = (-1) * DASPP * DAESR
= (-1) * $30/MWh * 50 MW
= -$1500

Trigger #1

$8000
Day-Ahead Make-Whole Payment

Revenues = (-1) * (Price) * (Quantity)

\[
\text{DAASREV}_{q, r, h} = (-1) \times \text{MCPCRU}_{\text{DAM}, h} \times \text{PCRUR}_{r, q, \text{DAM}, h} + (-1) \times \text{MCPCRD}_{\text{DAM}, h} \times \text{PCRDR}_{r, q, \text{DAM}, h} + (-1) \times \text{MCPCRR}_{\text{DAM}, h} \times \text{PCRRR}_{r, q, \text{DAM}, h} + (-1) \times \text{MCPCNS}_{\text{DAM}, h} \times \text{PCNSR}_{r, q, \text{DAM}, h}
\]

\[
-\$180_{q, r, h} = ((-1) \times \$5/\text{MW} \times 10 \text{ MW}) + ((-1) \times \$5/\text{MW} \times 10 \text{ MW}) + ((-1) \times \$10/\text{MW} \times 5 \text{ MW}) + ((-1) \times \$15/\text{MW} \times 2 \text{ MW})
\]
Day-Ahead Make-Whole Payment

DAM Revenues = DAEREV + DAASREV

<table>
<thead>
<tr>
<th></th>
<th>DAEREV</th>
<th>DAASREV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hour 1</td>
<td>-$1500</td>
<td>-$180</td>
</tr>
<tr>
<td>Hour 2</td>
<td>-$1500</td>
<td>-$220</td>
</tr>
<tr>
<td>Hour 3</td>
<td>-$1500</td>
<td>-$250</td>
</tr>
<tr>
<td>Hour 4</td>
<td>-$1500</td>
<td>-$350</td>
</tr>
<tr>
<td>Total for Commitment</td>
<td>-$6000</td>
<td>-$1000</td>
</tr>
</tbody>
</table>

\[
\left( \$7000 \right) < \left( \$8000 \right)
\]
Day-Ahead Make-Whole Payment

**ERCOT To Do**

- **Calculate DAM Guaranteed Costs**
  - Use appropriate values for start up and minimum energy
  - Calculate Day-Ahead AIEC

- **Calculate DAM Revenues**
  - Calculate Revenues from Energy
  - Calculate Revenues from AS

<table>
<thead>
<tr>
<th>Hour</th>
<th>DAEREV</th>
<th>DAASREV</th>
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<td>$350</td>
</tr>
<tr>
<td>Total for Commitment</td>
<td>-$6000</td>
<td>$8000</td>
</tr>
</tbody>
</table>
Day-Ahead Make-Whole Payment

- DAM Revenues are less than DAM Guaranteed Costs for QSE1 unit 5
- QSE1 eligible for DAM Make-Whole Payment
DAMWAMT_{q, p, r, h} =

(-1) * \text{Max} \left( 0, \text{DAMGCOST}_{q, p, r} + \sum \text{DAEREV}_{q, p, r, h} + \sum \text{DAASREV}_{q, r, h} \right)

* \left( \frac{\text{DAESR}_{q, p, r, h}}{\sum \text{DAESR}_{q, p, r, h}} \right)
DAM Make-Whole Payment for each hour

DAMWAMT = (-1) * Max (0, $8000 + $-6000 + $-1000) * 50 MW / (200 MW)

= (-1) * Max (0, $1000) * 0.25 = -$250
What if the DAM-committed Resource is part of a Combined Cycle Plant?

- Make-Whole is paid at the Train level
- DAM Guaranteed Amount
  - Start-up Costs
  - Minimum and Incremental Energy Costs
  - May include Transition Costs

DAM may start any offered CCGR and transition from one offered CCGR to another
Combined Cycle Plant

Train 1

\[ \text{CT}_1 \rightarrow \text{CT}_2 \rightarrow \text{CT}_3 \]

CCGR 1

Train 2

\[ \text{CT}_4 \rightarrow \text{CT}_5 \rightarrow \text{CT}_6 \]

CCGR 2

DAM Guaranteed Amount may include Transition Cost from CCGR1 to CCGR2
Day-Ahead Make Whole - Combined Cycle Resources

\[ \text{DAMGCOST}_{q, p, r} = \text{Min}(\text{DASUO}_{q, p, r}, \text{DASUCAP}_{q, p, r}) + \text{Transition Cost} + \sum(\text{Min}(\text{DAMEO}_{q, p, r, h}, \text{DAMECAP}_{q, p, r, h}) \times \text{DALSL}_{q, p, r, h}) + \sum(\text{DAAIEC}_{q, p, r, h} \times (\text{DAESR}_{q, p, r, h} - \text{DALSL}_{q, p, r, h})) \]

**Startup Offer** (DASUO) and **Cap** (DASUCAP)

**Minimum Energy Offer** (DAMEO) and **Cap** (DAMECAP)

**Low Sustained Limit** (DALSL)

**Day-Ahead AIEC** (DAAIEC)

**Day-Ahead Energy Sales** (DAESR)
Transition Cost = \( \max(0, \min(D\text{ASUO}_{\text{afterCCGR}}, D\text{ASUCAP}_{\text{afterCCGR}}) - \min(D\text{ASUO}_{\text{beforeCCGR}}, D\text{ASUCAP}_{\text{beforeCCGR}})) \)

**afterCCGR:** The CCGR to which a Combined Cycle Train transitions

**beforeCCGR:** The CCGR from which a Combined Cycle Train transitions
Activity: Now it’s your turn!

Refer to your Settlements Workbook

In a small group, respond to the questions that relate to Scenario #DAM1.

You have 5 – 10 minutes to complete your questions.

If you cannot complete all questions, don’t worry – all questions will be reviewed as a class.
Day-Ahead Market Settlements

**DAM**

**Participation in DAM**
- Energy
- Ancillary Services
- PTP Obligations

**DAM Commitment**
- Make-Whole

**Settlement of CRRs in the DAM**
**Outcome #1**

*Make-Whole Charge to a QSE with one or more cleared DAM Energy Bids and/or PTP Obligation Bids*

<table>
<thead>
<tr>
<th>What:</th>
<th>Charge to collect all funds needed for the Make-Whole Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why:</td>
<td>Keep ERCOT revenue neutral</td>
</tr>
</tbody>
</table>
Day-Ahead Make-Whole Charge

Total DAM Make-Whole Payments ERCOT-Wide \( \times \) DAM Energy Purchase Ratio Share

Where...

DAM Energy Purchase Ratio Share

\[ \frac{\text{A QSE’s DAM Energy Purchase}}{\text{Total DAM Energy Purchases ERCOT - Wide}} \]
• QSE3 has a cleared Energy Bid from DAM
  • Purchased 50 MW in the DAM
• ERCOT-Wide total energy purchases in the DAM:
  • 500 MW

Make-Whole Charge = \((-1) \times \left( \frac{\text{Total DAM Make-Whole Payments}}{\text{Total DAM Energy Purchases}} \right) \times \left( \frac{\text{QSE’s DAM Energy Purchase}}{\text{Total DAM Energy Purchases}} \right)\)
• QSE3 has a cleared Energy Bid from DAM
• Purchased 50 MW in the DAM
• ERCOT-Wide total energy purchases in the DAM:
  • 500 MW

\[
\text{Make-Whole Charge} = (-1) \times (-250) \times \frac{50\text{MW}}{500\text{MW}} = (-1) \times (-250) \times 0.10 = \$25
\]
**Day-Ahead Make-Whole Charge**

\[
\text{Make-Whole Charge} = (-1) \times \left( \frac{\text{Total DAM Make-Whole Payments}}{\text{Total DAM Energy Purchases}} \right) \times \left( \frac{\text{QSE’s DAM Energy Purchase}}{\text{Total DAM Energy Purchases}} \right)
\]

\[
\text{LADAMWAMT}_q = (-1) \times \text{DAMWAMTTOT} \times \text{DAERS}_q
\]

**Determinants**

- **Load Allocated Day-Ahead Make-Whole Amount**
- **Day-Ahead Make-Whole Amount Total**
- **Day-Ahead Energy Purchase Ratio Share**

\[ q = \text{QSE} \]
Day-Ahead Market Settlements

CRR Auction
- Charges and Payments for CRRs
- Revenue Distribution

DAM
- Participation in DAM
  - Energy
  - Ancillary Services
  - PTP Obligations
- DAM Commitment
  - Make-Whole
- Settlement of CRRs in the DAM
CRR owners may be paid according to their “target” payment.

Or their payments may be reduced:

- Derations
- CRR Shortfall Charges
Target Payment

CRRs will be settled at the Target Payment when not derated

Target Payment = Price * Quantity
Deration of CRRs

Due to oversold transmission elements, a CRR payment may be derated:

• If sink is a Resource Node
• If the Target Payment is a positive value.
Settling CRRs in the DAM

Deration of CRRs

Deration is based on impact of Resource Node on constraints

- Minimal impact
  - Minimal deration

- Significant impact
  - Significant deration
Deration of CRRs

- Developed daily
- Reflects forecasted transmission system for the next day
- Updated with scheduled outages and forecasted system conditions
Deration of CRRs

During Day-Ahead Market

- Executed daily
- Verifies feasibility of CRRs sold in Auction
Settling CRRs in the DAM

Deration of CRRs

During Day-Ahead Market

Day-Ahead Network Operations Model
- Developed from the Network Model

Transmission elements not oversold
- Account Holders receive Target Payment

Transmission elements oversold
- Account Holders receive reduced payment
Derated Payment

\[ (-1) \times \text{Max} \left( \begin{array}{c} \text{Target Payment - Derated Amount} \\ \text{or} \\ \text{Min} \left( \text{Target Payment or Hedge Value} \right) \end{array} \right) \]
Derating CRRs Reduces Gaming Opportunity

Hedge Value maintains value of CRR as Hedge

- Maximum Resource Price when Resource Node is Sink
- Minimum Resource Price when Resource Node is Source
**Hedge Value Price**

\[
HV \text{ PRICE}_{(j, k)} = \max(0, \text{MAXRESPR}_k - \text{DASPP}_j)
\]

<table>
<thead>
<tr>
<th>RESOURCE TYPE</th>
<th>MAXRESPR&lt;sub&gt;k&lt;/sub&gt;</th>
<th>MINRESPR&lt;sub&gt;j&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>$15/MWh</td>
<td>-$20/MWh</td>
</tr>
<tr>
<td>Simple Cycle &gt; 90MW</td>
<td>FIP*14</td>
<td>FIP*10</td>
</tr>
<tr>
<td>Combined Cycle &gt; 90MW</td>
<td>FIP*9</td>
<td>FIP*5</td>
</tr>
<tr>
<td>Wind</td>
<td>$0</td>
<td>-$35/MWh</td>
</tr>
<tr>
<td>PhotoVoltaic (Solar)</td>
<td>$0</td>
<td>-$10/MWh</td>
</tr>
</tbody>
</table>
Hedge Value

Hedge Value Price

\[
HV\ PRICE\ (j, k) = \text{Max} (0, \text{MAXRESPR}_k - \text{MINRESPR}_j)
\]

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Settlement of Congestion Revenue Rights

CRRs Settled in the DAM

**Outcome #1**
Payment or Charge to CRRAHs for PTP Obligations settled in the DAM

**Outcome #2**
Payment to CRRAHs for PTP Options settled in the DAM
CRRAH5 owns a PTP Obligation that settles in the Day-Ahead Market
Target Payment for PTP Obligations

\[
\text{DAOBLTP}_{o, (j, k)} = \text{DAOBLPR}_{(j, k)} \times \text{DAOBL}_{o, (j, k)}
\]

\[
\text{DAOBLPR}_{(j, k)} = \text{DASPP}_k - \text{DASPP}_j
\]

- \( j = \text{Source Settlement Point} \)
- \( k = \text{Sink Settlement Point} \)
- \( o = \text{CRR Owner} \)

Determinants

- Day-Ahead Obligation Price
- Day-Ahead Obligation Quantity
- Day-Ahead Settlement Point Price
Target Payment

When either
• Sink is not a Resource Node, or
• Target Payment is less than zero

\[ \text{DAOBLAMT}_{o, (j, k)} = (-1) \times \text{DAOBLTP}_{o, (j, k)} \]
- CRRAH5 owns a PTP Obligation that settles in the Day-Ahead Market
  - Quantity: 10 MW
  - Source: Hub 2
    - $20/MWh
  - Sink: Resource Node 4
    - $30/MWh
  - Price: $10/MWh

**Target Payment = Price \times Quantity**

Target Payment = $10/MWh \times 10 \text{ MW} = $100 \text{ per hour}
When Sink is a Resource Node & Target Payment is greater than zero

Settlement of PTP Obligations

PTP Obligation Settlement

- Target Payment
- Derated Payment
- Derated Amount
- Hedge Value

\[
(-1) \times \text{Max}\left(\text{Target Payment} - \text{Derated Amount}\right) \\text{or} \\\text{Min}\left(\text{Target Payment or Hedge Value}\right)
\]
Derated Amount of PTP Obligations

\[
\text{DAOBLDA}_{o, (j, k)} = \text{OBLDRPR}_{(j, k)} \text{ (Price)} \times \text{DAOBL}_{o, (j, k)} \text{ (Quantity)}
\]

\[
\text{OBLDRPR}_{(j, k)} = \sum_c \left( \text{Max} \left( 0, \text{DAWASF}_{j, c} - \text{DAWASF}_{k, c} \right) \times \text{DASP}_c \times \text{DRF}_c \right)
\]

Determinants

- **Day-Ahead Obligation Derated Amount**
- **Obligation Deration Price**
- **Day-Ahead Obligation Quantity**
- **Day-Ahead Weighted Average Shift Factor**
- **Day-Ahead Shadow Price**
- **Deration Factor**

\( j = \text{Source Settlement Point} \)
\( k = \text{Sink Settlement Point} \)
\( o = \text{CRR Owner} \)
\( c = \text{A constraint} \)
Derated Amount of PTP Obligations

\[
\text{DAOBLDA}_{o, (j, k)} = \text{OBLDRPR}_{(j, k)} (\text{Price}) \times \text{DAOBL}_{o, (j, k)} (\text{Quantity})
\]

OBLDRPR = $0.75/MW per hour

DAOBLDA = OBLDRPR * DAOBL

= $0.75/MW * 10 MW

= $7.50

Determinants

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Day-Ahead Obligation Deration Amount</td>
</tr>
<tr>
<td>Obligation Deration Price</td>
</tr>
<tr>
<td>Day-Ahead Obligation Quantity</td>
</tr>
<tr>
<td>Day-Ahead Weighted Average Shift Factor</td>
</tr>
<tr>
<td>Day-Ahead Shadow Price Deration Factor</td>
</tr>
</tbody>
</table>
**Hedge Value for PTP Obligations**

\[
DAOBLHV_{o, (j, k)} = DAOBLHVPR_{(j, k)} \text{(Price)} \times DAOBL_{o, (j, k)} \text{(Quantity)}
\]

\[
DAOBLHVPR_{(j, k)} = \text{Max} (0, \text{MAXRESPR}_k - \text{DASPP}_j)
\]

<table>
<thead>
<tr>
<th>Determinants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day-Ahead Obligation Hedge Value</td>
</tr>
<tr>
<td>Day-Ahead Obligation Hedge Value Price</td>
</tr>
<tr>
<td>Day-Ahead Obligation Quantity</td>
</tr>
<tr>
<td>Maximum Resource Price</td>
</tr>
<tr>
<td>Day-Ahead Settlement Point Price</td>
</tr>
</tbody>
</table>
Hedge Value for PTP Obligations

**DAOBLHV**\_o, (j, k) = **DAOBLHVPR**\_(j, k) (Price) * **DAOBL**\_o, (j, k) (Quantity)

**DAOBLHVPR** = Max (0, $36 – $20)

= $16/MWh

**Resource is Combined Cycle > 90MW**

**FIP** = $4
**Hedge Value for PTP Obligations**

\[
\text{DAOBLHV}_{o, (j, k)} = \text{DAOBLHVPR}_{(j, k)} \text{ (Price)} \times \text{DAOBL}_{o, (j, k)} \text{ (Quantity)}
\]

**Determinants**

<table>
<thead>
<tr>
<th>Determinants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day-Ahead Obligation Price</strong></td>
</tr>
<tr>
<td><strong>Hedge Value</strong></td>
</tr>
<tr>
<td><strong>Day-Ahead Obligation Quantity</strong></td>
</tr>
<tr>
<td><strong>Day-Ahead Settlement Point Price</strong></td>
</tr>
<tr>
<td><strong>Minimum Resource Price</strong></td>
</tr>
</tbody>
</table>

\[
\text{DAOBLHV} = \text{DAOBLHVPR} \times \text{DAOBL}
\]

\[
= \$16/\text{MWh} \times 10 \text{ MW}
\]

\[
= \$160 \text{ per hour}
\]
Settlement of PTP Obligations

\[ \text{DAOBLAMT} = (-1) \times \max \left( \text{Target Payment} - \text{Derated Amount} \right) \]

or

\[ \min (\text{Target Payment} \text{ or } \text{Hedge Value}) \]
Settlement of PTP Obligations

**Outcome #1**

\[
DAOBLAMT = (-1) \times \max \left( (DAOBLTP_{o, (j, k)} - DAOBLDA_{o, (j, k)}) \right) \quad \text{or} \quad \min \left( (DAOBLTP_{o, (j, k)} \text{ or } DAOBLHV_{o, (j, k)}) \right)
\]

- Target Payment
- Hedge Value
- Target Payment
- Derated Amount
Settlement of PTP Obligations

Outcome #1

\[ \text{DAOBLAMT} = (-1) \times \max \left( \frac{100 - 7.50}{100 - 160}, \frac{100}{100} \right) = -100 \]
CRRs Settled in the DAM

Outcome #1
Payment or Charge to CRRAHs for PTP Obligations settled in the DAM

Outcome #2
Payment to CRRAHs for PTP Options settled in the DAM
CRRAH5 also owns a PTP Option that settles in the Day-Ahead Market
Settlement of PTP Options

Target Payment

Determinants

Day-Ahead Option Amount
Day-Ahead Option Target Payment

When sink is not a Resource Node

\[ \text{DAOPTAMT}_{o, (j, k)} = (-1) \times \text{DAOPTTP}_{o, (j, k)} \]

\( j = \text{Source Settlement Point} \)

\( k = \text{Sink Settlement Point} \)

\( o = \text{CRR Owner} \)
CRRAH5 owns a PTP Option that settles in the Day-Ahead Market

- Quantity: 10 MW
- Source: Resource Node 1
  - $10/MWh
- Sink: Resource Node 3
  - $30/MWh
- Price: $20/MWh

Target Payment = Price \times Quantity

Target Payment = $20/MWh \times 10 \text{ MW}

= $200 \text{ per hour}
Settlement of PTP Options

When Sink is a Resource Node & Target Payment is not zero

\[ (-1) \times \text{Max} \left( \frac{\text{Target Payment} - \text{Derated Amount}}{\text{Hedge Value}} \right) \]

or

\[ \text{Min} \left( \frac{\text{Target Payment}}{\text{Target Payment} \text{ or Hedge Value}} \right) \]
Settlement of PTP Options

**Outcome #2**

| DAOPTTP<sub>o, (j, k)</sub> | $200 |
| DAOPTDA<sub>o, (j, k)</sub> | $25 |
| DAOPTHV<sub>o, (j, k)</sub> | $150 |

**Determinants**

<table>
<thead>
<tr>
<th>Determinant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day-Ahead Option Target Payment</strong></td>
</tr>
<tr>
<td><strong>Day-Ahead Option Derated Amount</strong></td>
</tr>
<tr>
<td><strong>Day-Ahead Option Hedge Value</strong></td>
</tr>
</tbody>
</table>

**DAOPTAMT**

\[
DAOPTAMT = (-1) \times \max \left( \frac{(\text{Target Payment} - \text{Derated Amount})}{\min (\text{Target Payment} or \text{Hedge Value})} \right)
\]
Settlement of PTP Options

Outcome #2

\[
DAOPTAMT = (-1) \times \max \left( \max (DAOPTTP_{o, (j, k)} - DAOPTDA_{o, (j, k)}), \min (DAOPTTP_{o, (j, k)} \text{ or } DAOPTHV_{o, (j, k)}) \right)
\]
Settlement of PTP Options

Outcome #2

\[ \text{DAOPTAMT} = (-1) \times \max \left( \left( \frac{\text{Target Payment} - \text{Derated Amount}}{\text{Hedge Value}} \right) \right) = -$175 \]
In a small group, respond to the questions that relate to Scenario #DAM2.

You have 5 – 10 minutes to complete your questions.

If you cannot complete all questions, don’t worry – all questions will be reviewed as a class.
PCRRs Settled in the DAM

**Outcome #1**  
Payment or Charge to CRRAHs for settled PTP Obligations with Refund

**Outcome #2**  
Payment to CRRAHs for settled PTP Options with Refund
## Settlement of PCRRs with Refund

The Quantity depends on the Resource output in Real-Time

<table>
<thead>
<tr>
<th>Price</th>
<th>Quantity (Lesser of)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAM PCRR Price between Source and Sink</td>
<td>PCRR Quantity Held by the NOIE</td>
</tr>
<tr>
<td></td>
<td>Output Schedule of the Resource</td>
</tr>
</tbody>
</table>

ERCOT uses time-weighted generation, if there is not an Output Schedule.
For Example

### Settlement of PCRRs with Refund

<table>
<thead>
<tr>
<th>Price</th>
<th>Obligation Quantity (Lesser of)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$50/MWh</td>
<td>100 MW</td>
</tr>
<tr>
<td></td>
<td>PTP Obligation Quantity Held by the NOIE</td>
</tr>
<tr>
<td></td>
<td>90 MW</td>
</tr>
<tr>
<td></td>
<td>Resource Real-Time Output based on its Output Schedules</td>
</tr>
</tbody>
</table>

**PTP Obligation w/Refund Payment**

\[
\text{Price} \times \text{Quantity} = \text{Settlement Amount} \\
$50/MWh \times 90\text{MW} = $4500/h \]
Target Payment for PTP Obligations with Refund

\[ \text{DAOBLRAMT}_{o, (j, k)} = (-1) \times \text{DAOBLPR}_{(j, k)} \times \min(\text{DAOBLR}_{o, (j, k)}, \text{OBLRACT}_{o, (j, k)}) \]

Quantity = Lesser of

(Obligations held or Actual Obligations used)

Determinants

- Day-Ahead Obligation with Refund Amount
- Day-Ahead Obligation Price
- Day-Ahead Obligation with Refund Quantity
- Obligation with Refund Actual Usage

\[ j = \text{Source Settlement Point} \]
\[ k = \text{Sink Settlement Point} \]
\[ o = \text{CRR Owner} \]
Target Payment for PTP Options with Refund

\[ DAOPTRAMT_{o, (j, k)} = (-1) \times DAOPTPR_{(j, k)} \times \min (OPTR_{o, (j, k)}, OPTRACT_{o, (j, k)}) \]

Quantity = Lesser of
(Options held or Actual Options used)

Determinants

<table>
<thead>
<tr>
<th>Determinants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day-Ahead Option with Refund Amount</td>
</tr>
<tr>
<td>Day-Ahead Option Price</td>
</tr>
<tr>
<td>Option with Refund Quantity</td>
</tr>
<tr>
<td>Option with Refund Actual Usage</td>
</tr>
</tbody>
</table>

\( j = \) Source Settlement Point

\( k = \) Sink Settlement Point

\( o = \) CRR Owner
Charge to CRR AHs when there are insufficient funds to settle CRRs in the DAM

**Outcome #1**

**What:** Charge to CRR Account Holders based on a Credit Share Ratio

**Why:** Congestion Rent collected in the DAM may not be adequate to pay the amount due to CRR Owners in the DAM
Target Payment of CRRs Settled in the Day-Ahead

Occurs hourly

- 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
• Insufficient funds collected to pay CRR Account Holders

\[
\text{Day-Ahead Shortfall Charge} = \left( \frac{\text{Total CRR Shortfall}}{\text{Total CRR Target Payments for hour}} \right) \times \left( \frac{\text{CRR Owner Target Payment}}{} \right)
\]
Shortfall Charge for CRRs Settled in Day-Ahead - Activity

Day-Ahead Shortfall Charge = \( \frac{\text{Total CRR Shortfall}}{\text{CRR Owner Target Payment} / \text{Total CRR Target Payments for hour}} \)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</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>
</tr>
<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 Credit Ratio Share</td>
<td>?</td>
</tr>
<tr>
<td>CRR Owner’s Shortfall Charge</td>
<td>?</td>
</tr>
</tbody>
</table>
Day-Ahead CRR Shortfall Amount

\[ DACRRSAMT_o = DACRRSAMTTOT \times CRRCRRSDA_o \]

\[ DACRRSAMTTOT = (-1) \times \min(0, (DACONGRENT + DACRRCRTOT + DACRRCHTOT)) \]

Payment due to CRR Account Holders (Target Payment)

<table>
<thead>
<tr>
<th>Determinants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day-Ahead CRR Short Amount</td>
</tr>
<tr>
<td>Day-Ahead CRR Short Amount Total</td>
</tr>
<tr>
<td>CRR Credit Ratio Share</td>
</tr>
</tbody>
</table>

\( o = CRR Owner \)
Day-Ahead Congestion Rent

\[ DACONGRENT = DAESAMTTOT + DAEPAMTTOT + DARTOBLAMTTOT + DARTOBLLOAMTTOT \]

<table>
<thead>
<tr>
<th>DACONGRENT</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAESAMTTOT</td>
<td>Day-Ahead Energy Sale Amount Total</td>
</tr>
<tr>
<td>DAEPAMTTOT</td>
<td>Day-Ahead Energy Purchase Amount Total</td>
</tr>
<tr>
<td>DARTOBLAMTTOT</td>
<td>Day-Ahead Real-Time Obligation Amount Total</td>
</tr>
<tr>
<td>DARTOBLLOAMTTOT</td>
<td>Day-Ahead Real-Time Obligation with Links to an Option Amount Total</td>
</tr>
</tbody>
</table>
Payment due to CRR Account Holders (Target Payment)

Charges + Payments

DACRRCHTOT + DACRRCRTOT

<table>
<thead>
<tr>
<th>DACRRCHTOT</th>
<th>DACRRCRTOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAOBLCHTOT</td>
<td>Day-Ahead Obligation Credit Total</td>
</tr>
<tr>
<td>DAOBLRCRHTOT</td>
<td>Day-Ahead Obligation with Refund Credit Total</td>
</tr>
<tr>
<td>DAOBLRCRTOT</td>
<td>Day-Ahead Obligation with Refund Charge Total</td>
</tr>
<tr>
<td>DAOPTRAMTTOT</td>
<td>Day-Ahead Option Amount Total</td>
</tr>
<tr>
<td>DAOPTRAMTTOT</td>
<td>Day-Ahead Option with Refund Amount Total</td>
</tr>
</tbody>
</table>
Day-Ahead CRR Shortfall Amount

\[ \text{DACRRSAMT}_o = \text{DACRRSAMTTOT} \times \text{CRRCRRSDA}_o \]

\[ \text{CRRCRRSDA}_o = \left( \frac{\text{Target Payment per CRR Owner}}{\text{Total CRR Payments for hour}} \right) \]

Determinants:
- Day-Ahead CRR Short Amount
- Day-Ahead CRR Short Amount Total
- CRR Credit Ratio Share

\( o = \text{CRR Owner} \)
CRR Credit Ratio Share (Day-Ahead)

\[ \text{CRRCRRSDA}_o = \frac{(\text{Target Payment per CRR Owner})}{(\text{Total CRR Payments for hour})} \]

<table>
<thead>
<tr>
<th>Target Payment per CRR Owner</th>
<th>Total CRR Payments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAOBLCROTOT</strong></td>
<td>Day-Ahead Obligation Credit Total</td>
</tr>
<tr>
<td><strong>DAOBLRRCROTOT</strong></td>
<td>Day-Ahead Obligation with Refund Credit Total</td>
</tr>
<tr>
<td><strong>DAOPTAMTOTOT</strong></td>
<td>Day-Ahead Option Amount Total</td>
</tr>
<tr>
<td><strong>DAOPTRAMTOTOT</strong></td>
<td>Day-Ahead Option with Refund Amount Total</td>
</tr>
<tr>
<td><strong>DACRRCRTOTOT</strong></td>
<td>Day-Ahead CRR Credit Total</td>
</tr>
</tbody>
</table>
Module Conclusion

CRR Auction
- Charges & Payments for CRRs
- Revenue Distribution

CRR Balancing Account
- Reconcile CRR Short payments

DAM
- Participation in DAM
  - Energy
  - AS
  - PTP Obligations
- DAM Commitment
  - Make-Whole
- Settlement of CRRs purchased in the Auction

RUC
- Commitment
  - Make-Whole
  - Clawback
- Decommitment

Real-Time
- Real-Time Activities
  - Imbalances
  - Base Point Deviations
  - Other odds & ends
- Settlement of PTP Obligations purchased in the DAM
- Real Time Ancillary Service Settlements
- Revenue Neutrality