



Settlement: Ancillary Services





Greetings
and
Introductions

- Attendance
- Questions
- Presentation materials
- Recording for internal purposes



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/



Concept



Math



Protocols



Example

Settlement Equation

Topics in this course include:

1. Ancillary Service Obligation Procurement
2. Updated Ancillary Service Obligation
3. Ancillary Service Offer (Resource-Specific)
4. Ancillary Service Imbalance
5. Ancillary Service Only Offer & Charge
6. Ancillary Service Trade Overage Charge
7. Ancillary Service Revenue Neutrality Allocation

Which Markets and Which Participants?

CRR Auction

DAM

Real-Time





Five Ancillary Service (AS) Settlement Types:

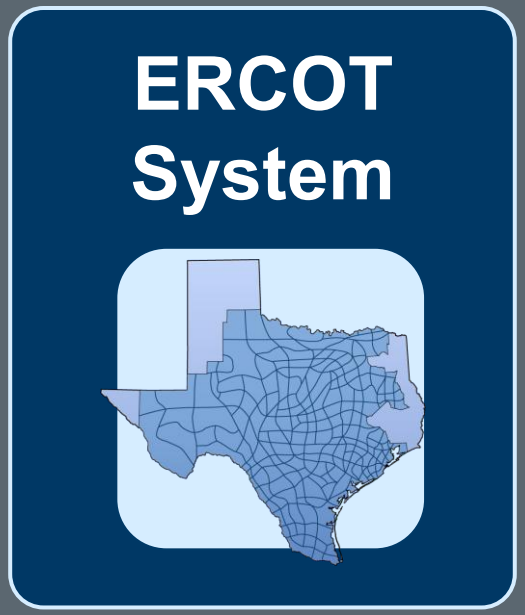
RU – Regulation Up Service

RD – Regulation Down Service

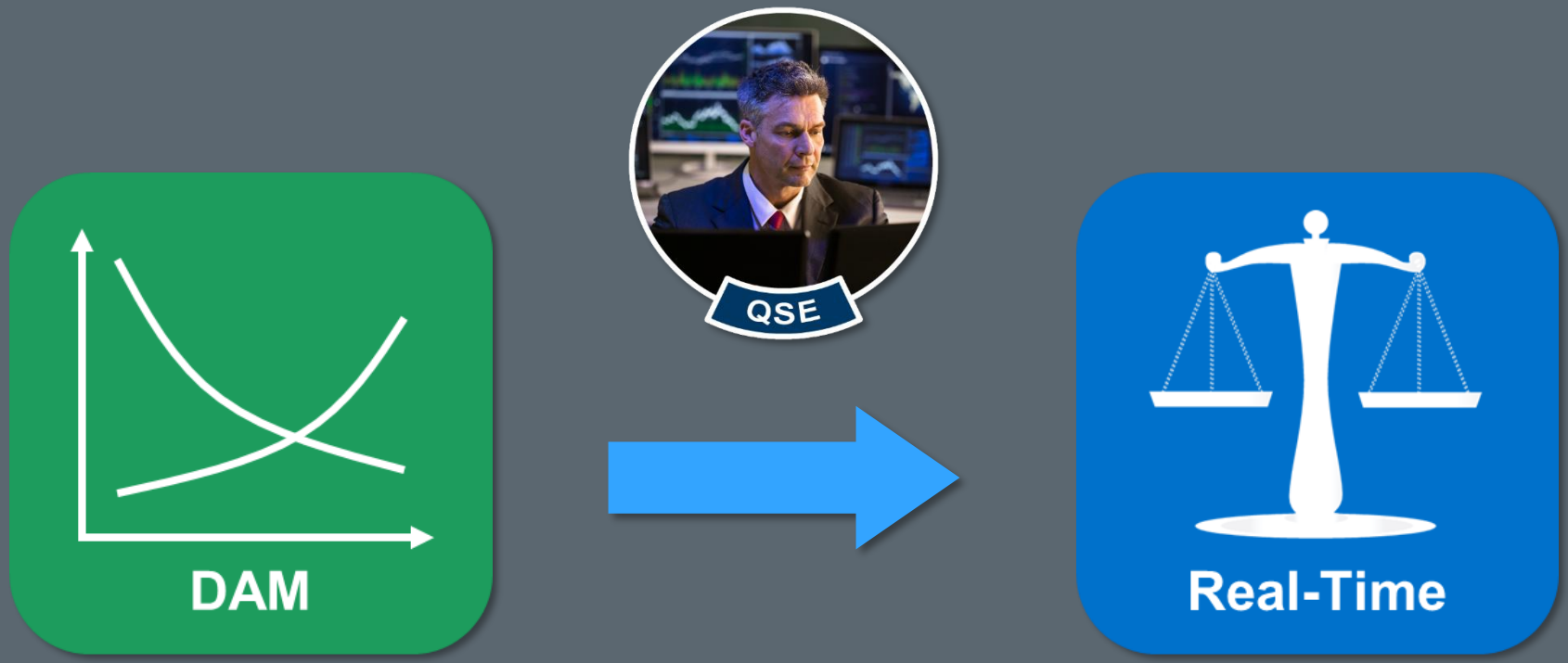
RR – Responsive Reserve Service

ECR – ERCOT Contingency Reserve Service

NS – Non-Spin Reserve Service



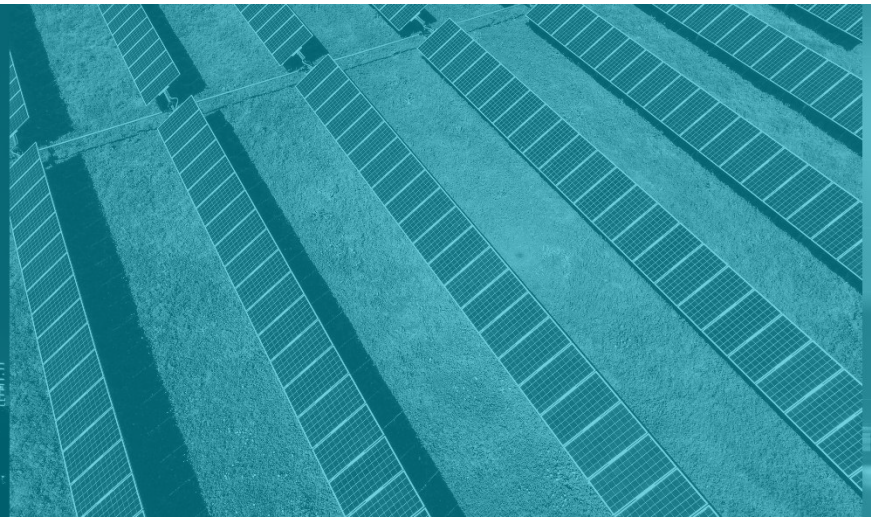
Where is the Payment (-) or the Charge (+) to the QSE?







Ancillary Service Obligation Procurement


ERCOT allocates the AS Plan as Advisory AS Obligations (by 0600)



Load Ratio Share

Load Ratio Share

Load Ratio Share



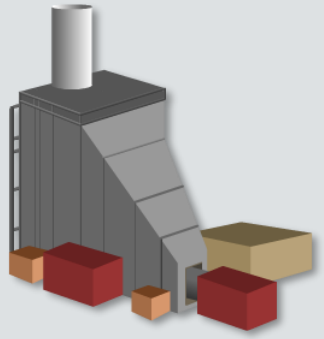






QSE chooses how to fulfill

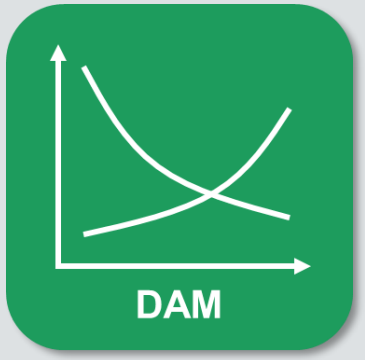
Self-Arrange





And/Or

ERCOT Procurement



Final AS Obligations are posted with DAM results

Regulation Up Procurement for a given hour

- DAM RU Obligation Quantity = 5MW
- DAM Self-Arranged RU Quantity = 2MW
- DAM RU Price = $14/MW



RU Procurement = RU Price * (RU Obligation – Self-Arranged RU)

RU Procurement = $14/MW * (5MW – 2MW)

RU Procurement = $14/MW * 3MW

$42 for Regulation Up for the hour



DARUAMT = Day-Ahead Reg-Up Amount

$$DARUAMT_q = DARUPR * DARUQ_q$$

Where: $DARUQ_q = DARUO_q - DASARUQ_q$

DARUPR	Day-Ahead Reg-Up Price
DARUQ	Day-Ahead Reg-Up Quantity
DARUO	Day-Ahead Reg-Up Obligation
DASARUQ	Day-Ahead Self-Arranged Reg-Up Quantity
q	QSE



Example 1: Ancillary Service Obligation Procurement

Settle Regulation Down Procurement for Hour 17



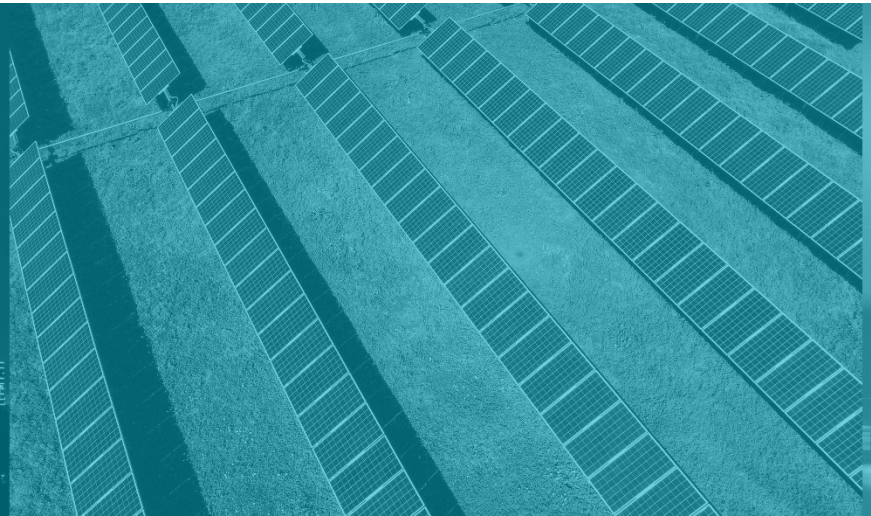
- DAM RD Obligation Quantity = 8MW
- DAM Self Arranged RD Quantity = 1.5MW
- DAM RD Price = $38/MW



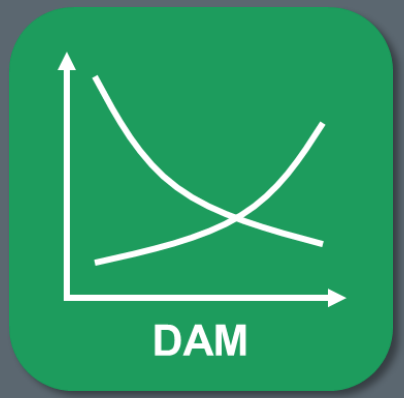




Updated Ancillary Service Obligation


Final AS Obligation is updated for Real-Time Load Ratio Share







Estimate Ratio Share

vs

Actual Ratio Share



Updated AS Obligation = RTM AS Cost – DAM AS Amount

Updated Regulation Up Obligation for a given hour

- DAM RU New Obligation Quantity = 4MW
- DAM Self-Arranged RU Quantity = 2MW
- DAM RU Price = $14/MW
- DAM RU Amount = $42



Updated RU = (RU New Obligation – Self-Arranged RU) * RU Price – RU Amt

Updated RU = (4MW – 2MW) * $14/MW – $42

Updated RU = 2MW * $14/MW – $42

Updated RU = $28 – $42

-$14 for Updated Regulation Up for the hour



DARTPCRUAMT = Day-Ahead Updated Real-Time Procured Capacity for Reg-Up Amount

$$DARTPCRUAMT_q = (DARUNOBL_q - DASARUQ_q) * DARUPR - DARUAMT_q$$

Where: $DARUNOBL_q = DAPCRUQTOT * HLRS_q$

DARUNOBL	Day-Ahead Reg-Up New Obligation
DASARUQ	Day-Ahead Self-Arranged Reg-Up Quantity
DARUPR	Day-Ahead Reg-Up Price
DARUAMT	Day-Ahead Reg-Up Amount
DAPCRUQTOT	Day-Ahead Procured Capacity Reg-Up QSE Total
HLRS	Hourly Load Ratio Share
q	QSE



Example 2: Updated Ancillary Service Obligation

Settle Updated Regulation Down Obligation for Hour 17



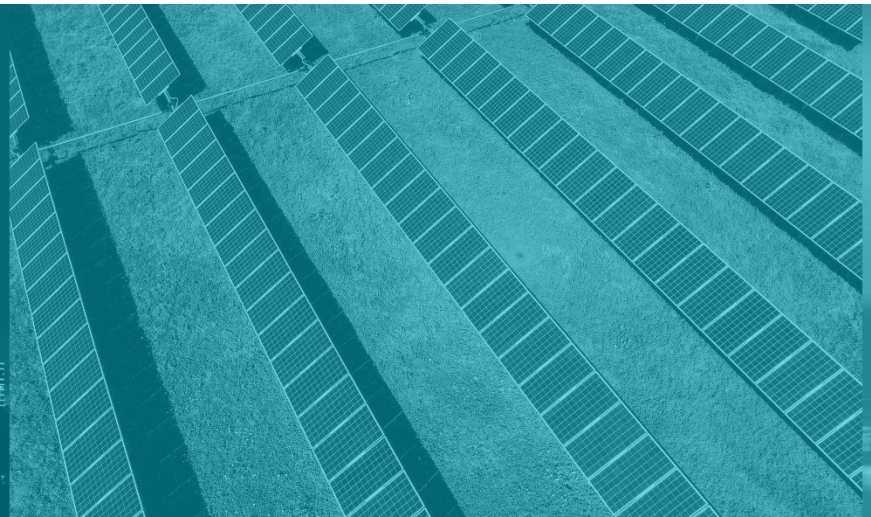
- DAM RD New Obligation Quantity = 9.5MW
- DAM Self-Arranged RD Quantity = 1.5MW
- DAM RD Price = $38/MW
- DAM RD Amount = $247





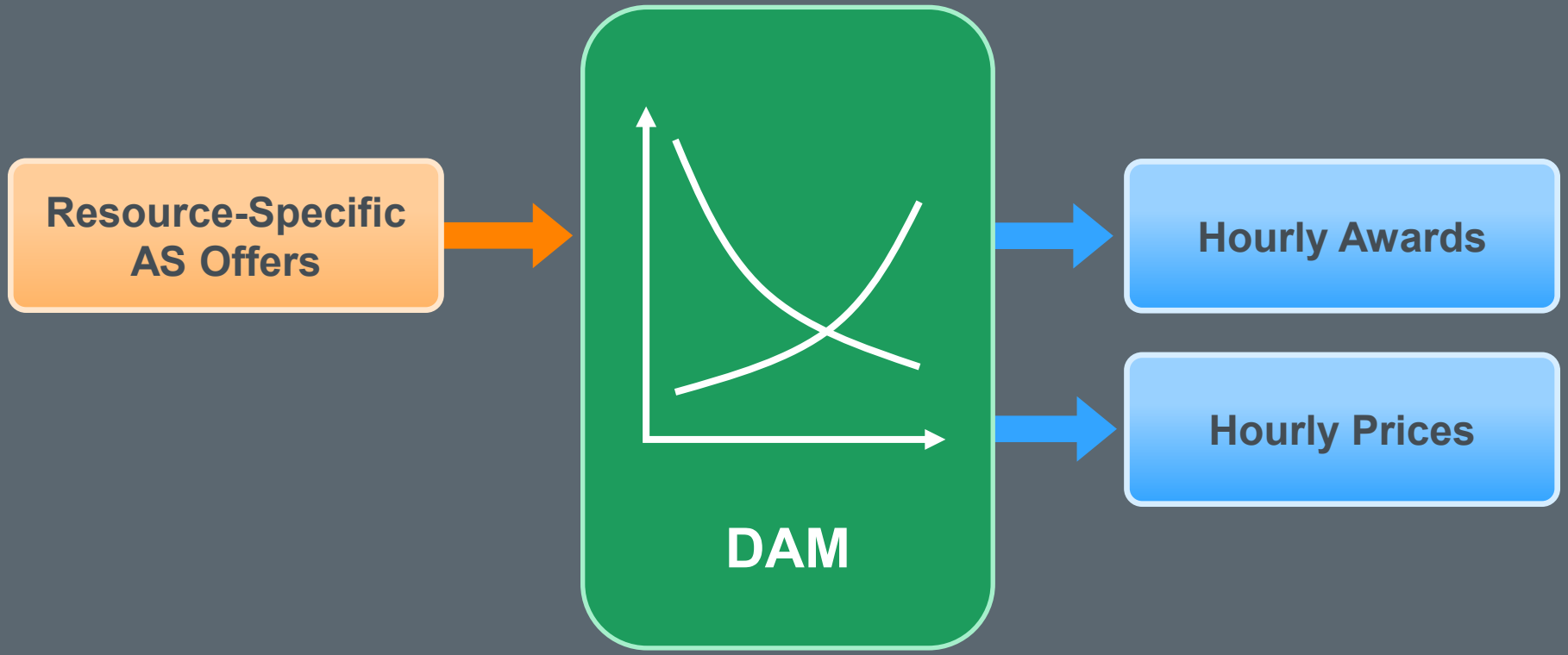


Ancillary Service Offer (Resource-Specific)


Ancillary Service Offer (Resource-Specific): Concept





Awarded Responsive Reserve Offer for a given hour

- DAM Awarded RR Quantity = 90MW
- DAM RR Price = $23/MW



RR Award = (-1) * RR Price * RR Quantity

RR Award = (-1) * $23/MW * 90MW

-$2,070 for Responsive Reserve for the hour



PCRRAMT = Procured Capacity for Responsive Reserve Amount

$$PCRRAMT_q = (-1) * MCPCRR_{DAM} * PCRR_q$$



MCPCRR	Market Clearing Price Capacity for Responsive Reserve
PCRR	Procured Capacity for Responsive Reserve
q, DAM	QSE, Day-Ahead Market

Example 3: Ancillary Service Offer (Resource-Specific)

Settle Awarded ERCOT Contingency Reserve Offer for Hour 18

- DAM Awarded ECR Quantity = 55MW
- DAM ECR Price = $77/MW





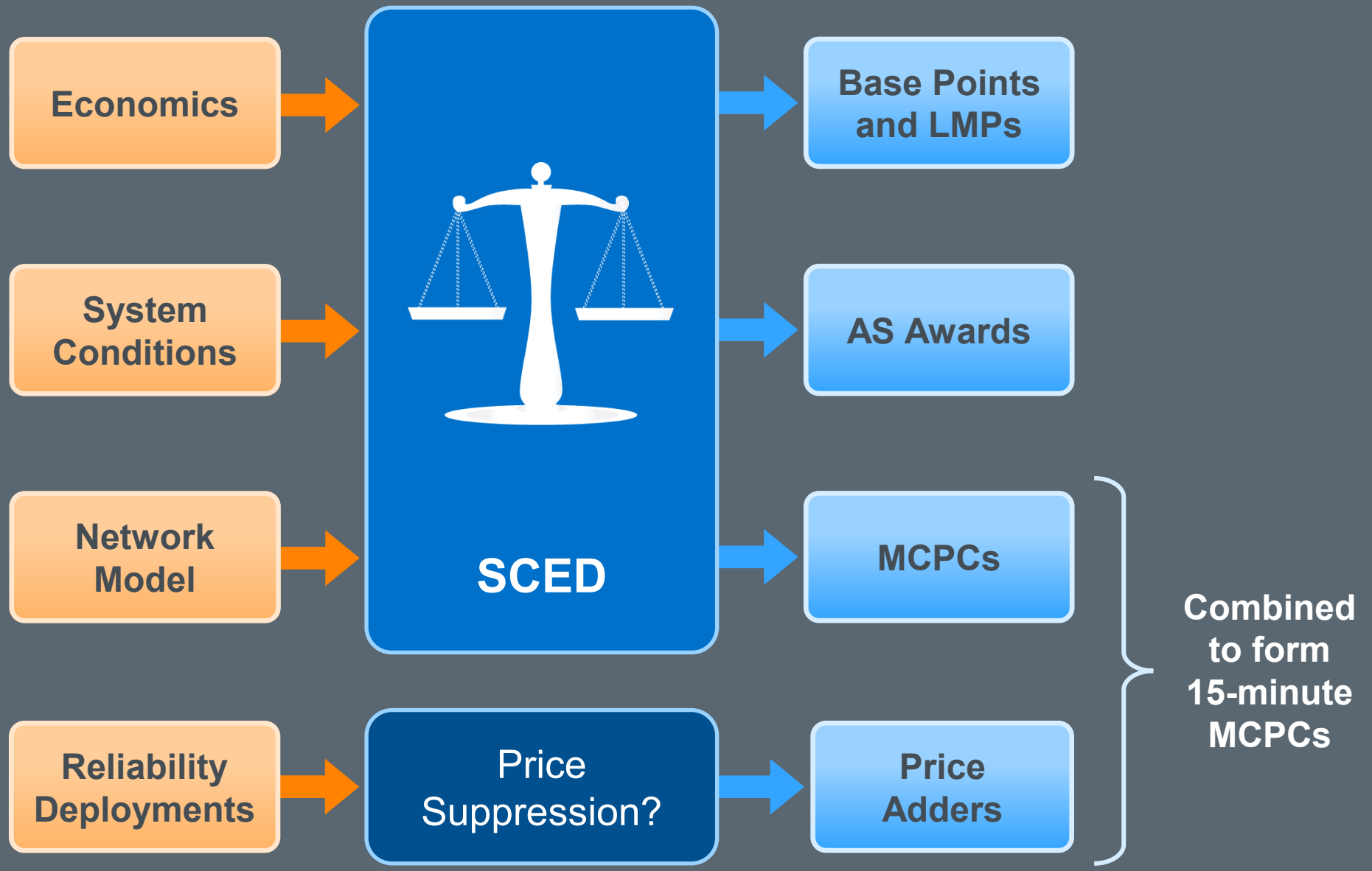


Ancillary Service Imbalance



Real-Time Market Clearing Prices for Capacity Concept

Real-Time Ancillary Service Pricing: Concept

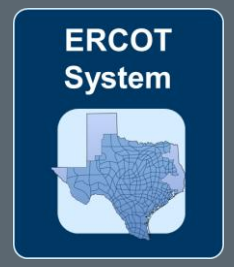


For each SCED Interval:

RTMCPCNSS = Real-Time Market Clearing Price for Capacity for Non-Spin per SCED interval

RTRDPANSS = Real-Time Reliability Deployment Price Adder for Non-Spin per SCED interval



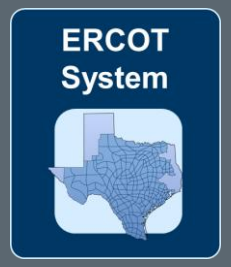


RTMCPCNS = Real-Time Market Clearing Price for Capacity for Non-Spin

Settles Financial AS Transactions

RTMCPCNS = Time-Weighted Average (RTMCPCNSS + RTRDPANSS)



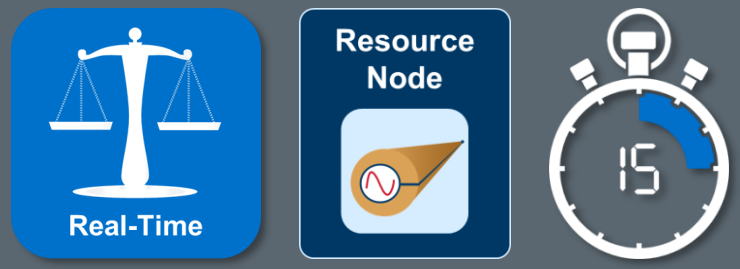




RTMCPCNSR = Real-Time Market Clearing Price for Capacity for Non-Spin per Resource

Settles Resource AS Transactions

RTMCPCNSR = (Resource Award * Time)-Weighted Average (RTMCPCNSS + RTRDPANSS)



Real-Time Ancillary Service Imbalance Concept

Real-Time Ancillary Service Imbalance: Concept

$$= (-1) \left[\left(\text{Real-Time AS Awards} + \text{Trade AS Purchases} \right) - \left(\text{DAM AS Awards} + \text{DAM Self-Arranged AS} + \text{Trade AS Sales} \right) \right] * \text{RTMCPC}$$

Supplies

Obligations



Settled ERCOT-wide per AS product

Real-Time AS Awards

- Time-weighted quantities
- 15-minute conversion (1/4 *)
- Combined with RTMCPCNSR

All other AS transactions

- Financial quantities
- 15-minute conversion (1/4 *)
- Combined with RTMCPCNS

$$= (-1) \left(\left(\text{Real-Time AS Awards} + \text{Trade AS Purchases} \right) - \left(\text{DAM AS Awards} + \text{DAM Self-Arranged AS} + \text{Trade AS Sales} \right) \right) * \text{RTMCPC}$$

Supplies — Obligations



AS Awards (RT & DAM): result from Resource-Specific AS Offers

$$= (-1) \left(\sum_{r} \left[\begin{array}{c} \text{Real-Time AS Revenue} = (1/4) * \text{RT AS Awards} * \text{RTMCPCR} \\ - \\ (1/4) * \text{DAM AS Awards} * \text{RTMCPC} \\ - \\ (1/4) * \text{DAM Self-Arranged AS} * \text{RTMCPC} \\ + \\ (1/4) * (\text{Trade AS Purchases} - \text{Trade AS Sales}) * \text{RTMCPC} \end{array} \right] \right)$$



Settled ERCOT-wide per AS product

Settle Non-Spin Imbalance of AS Awards for a given Interval

- Real-Time NS Resource Award Quantity = 10MW
- DAM NS Resource Award Quantity = 20MW
- Real-Time NS Resource Price & NS Price = $8/MW & $18/MW



NS Imbalance = (-1) * [**RT AS Revenue** – (1/4) * (**DAM NS Quantity** * **NS Price**)]

NS Imbalance = (-1) * [(1/4) * (**RT NS Quantity** * **NS Resource Price**) – (1/4) * (**DAM NS Quantity** * **NS Price**)]

NS Imbalance = (-1) * [(1/4) * (**10MW** * **$8/MW**) – (1/4) * (**20MW** * **$18/MW**)]

NS Imbalance = (-1) * [**$20** – **$90**]

$70 for Non-Spin Imbalance for the Interval



Settle Non-Spin Imbalance of Self-Arranged AS for a given Interval

- Trade NS Purchase Quantity = 40MW
- DAM Self-Arranged NS Quantity = 40MW
- Real-Time NS Price = $18/MW



NS Imbalance = (-1) * [– (1/4) * (Self-Arranged NS Quantity * NS Price) + (1/4) * (Trade NS Purchase Quantity – Trade NS Sale Quantity * NS Price)]

NS Imbalance = (-1) * [– (1/4) * (40MW * $18/MW) + (1/4) * (40MW * $18/MW)]

NS Imbalance = (-1) * [– ($180) + ($180)]

$0 for Non-Spin Imbalance for the Interval



RTNSIMBAMT = Real-Time Non-Spin Imbalance Amount

$$RTNSIMBAMT_q = (-1) * \{ \sum_r [RTNSREV_{q,r} - (1/4) * (PCNSR_{r,q,DAM} * RTMCPCNS)] - (1/4) * (DASANSQ_q * RTMCPCNS) + (1/4) * (NSTP_q - NSTS_q) * RTMCPCNS\}$$

Where: $RTNSREV = (1/4) * RTNSAWD_{q,r} * RTMCPCNSR_{q,r}$

RTNSREV	Real-Time Non-Spin Revenue
PCNSR	Procured Capacity for Non-Spin per Resource
DASANSQ	Day-Ahead Self-Arranged Non-Spin Quantity
NSTP, NSTS	Non-Spin Trade Purchase, Non-Spin Trade Sale
RTNSAWD	Real-Time Non-Spin Award
RTMCPCNS(R)	Real-Time Market Clearing Price for Capacity Non-Spin (Resource)
q, r, DAM	QSE, Resource, Day-Ahead Market



Settle Non-Spin Imbalance for Interval 2000

- Real-Time NS Revenue = $1,050 (1/4 * 56MW * $75/MW)
- Trade NS Sale Quantity = 100MW
- Real-Time NS Price = $50/MW



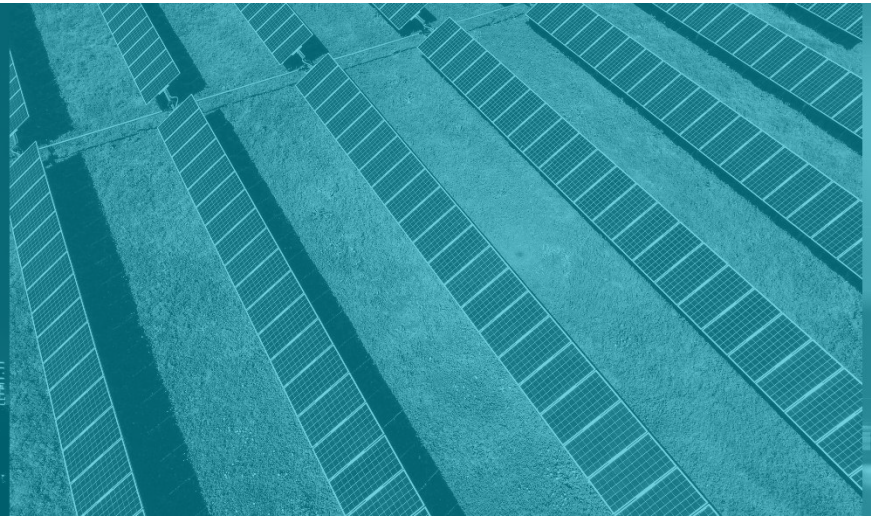






Ancillary Service Only Offer & Charge

Break until 11:20 AM CPT


Isolated Financial Transaction in each market



Awarded AS-Only Offer in DAM settles like Resource-Specific AS Offer

Awarded Regulation Down Only Offer for a given hour

- DAM Awarded RD Only Quantity = 30MW
- DAM RD Price = $27/MW



RD Only Award = (-1) * DAM RD Price * RD Only Quantity

RD Only Award = (-1) * $27/MW * 30MW

-$810 for Regulation Down Only Award for the hour



Regulation Down Only Charge for a given interval

- DAM Awarded RD Only Quantity = 30MW
- Real-Time RD Price = $18/MW



RD Only Charge = (1/4) * **RD Only Quantity** * **Real-Time RD Price**

RD Only Charge = (1/4) * **30MW** * **$18/MW**

$135 for Regulation Down Only Charge for the interval



DAPCRDOAMT = Day-Ahead Procured Capacity for Reg-Down Only Amount

$$DAPCRDOAMT_q = (-1) * MCPCRD_{DAM} * DARDOAWD_q$$



MCPCRD	Market Clearing Price Capacity for Reg-Down
DARDOAWD	Day-Ahead Reg-Down Only Award
q, DAM	QSE, Day-Ahead Market

RTRDOAMT = Real-Time Reg-Down Only Amount

$$RTRDOAMT_q = (1/4) * DARDOAWD_q * RTMCPCRD$$



DARDOAWD	Day-Ahead Reg-Down Only Award
RTMCPCRD	Real-Time Market Clearing Price Capacity for Reg-Down
q	QSE

Settle Awarded Regulation Up Only Offer for Hour 9

- DAM Awarded RU Only Quantity = 5MW
- DAM RU Price = $7/MW





Example 6: Ancillary Service Only Charge

Settle Regulation Up Only Charge for Interval 0815

- DAM Awarded RU Only Quantity = 5MW
- Real-Time RU Price = $8/MW





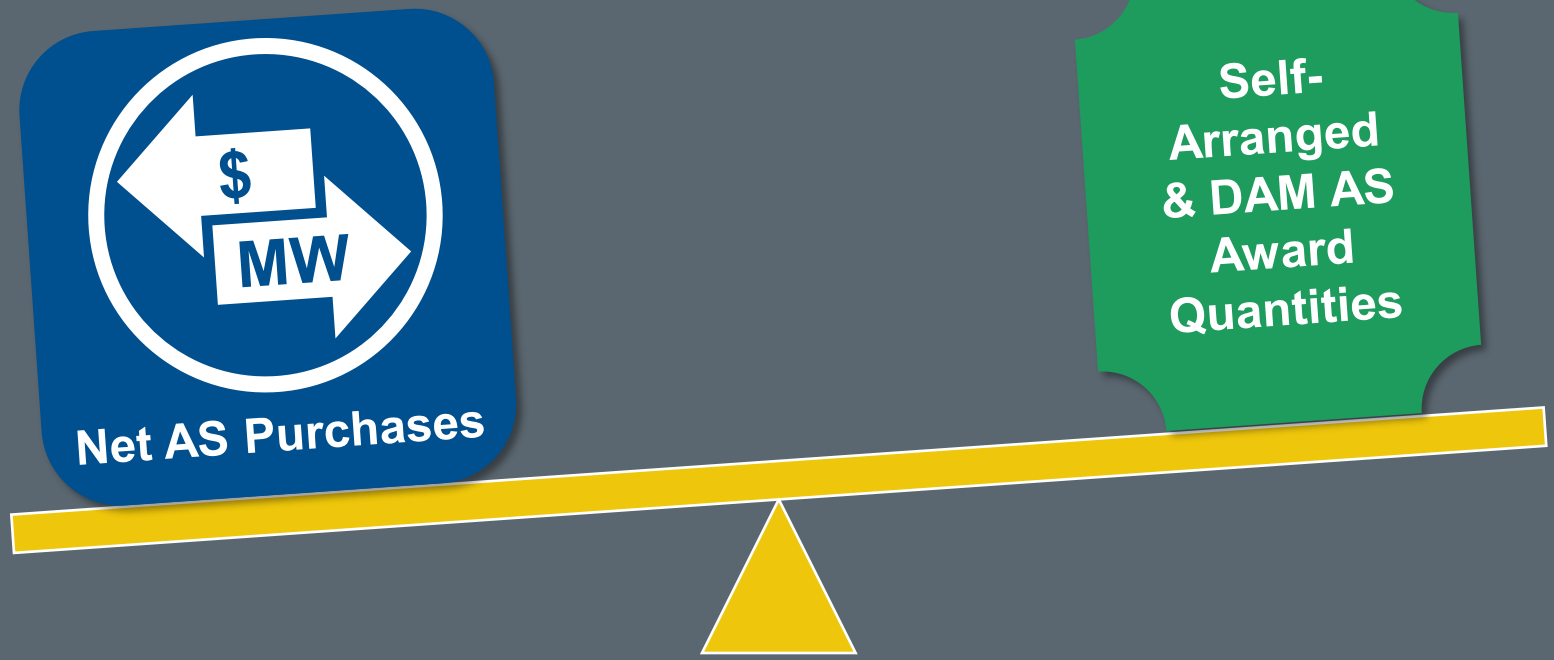


Ancillary Service Trade Overage Charge



ERCOT notifies the QSE of the Trade Overage in an hourly report, starting at 1430 Day-Ahead





Real-Time

Only applies to AS sub-types that can be self-provided

ERCOT Contingency Reserve Trade Overage for a given interval

- ECR Trade Overage Quantity = 11MW
- Real-Time ECR Price = $36/MW



ECR Trade Overage = (1/4) * **ECR Trade Overage Quantity** * **RT ECR Price**

ECR Trade Overage = (1/4) * **11MW** * **$36/MW**

$99 for ERCOT Contingency Reserve Trade Overage for the interval



RTECRTOAMT = Real-Time ERCOT Contingency Reserve Service Trade Overage Amount

$$RTECRTOAMT_q = (1/4) * RTECRTO_q * RTMCPCECR$$



RTECRTO	Real-Time ERCOT Contingency Reserve Trade Overage
RTMCPCECR	Real-Time Market Clearing Price Capacity for ERCOT Contingency Reserve
q	QSE

Example 7: Ancillary Service Trade Overage Charge

Settle Responsive Reserve Trade Overage Charge for Interval 1245

- RR Trade Overage Quantity = 17MW
- Real-Time RR Price = $52/MW



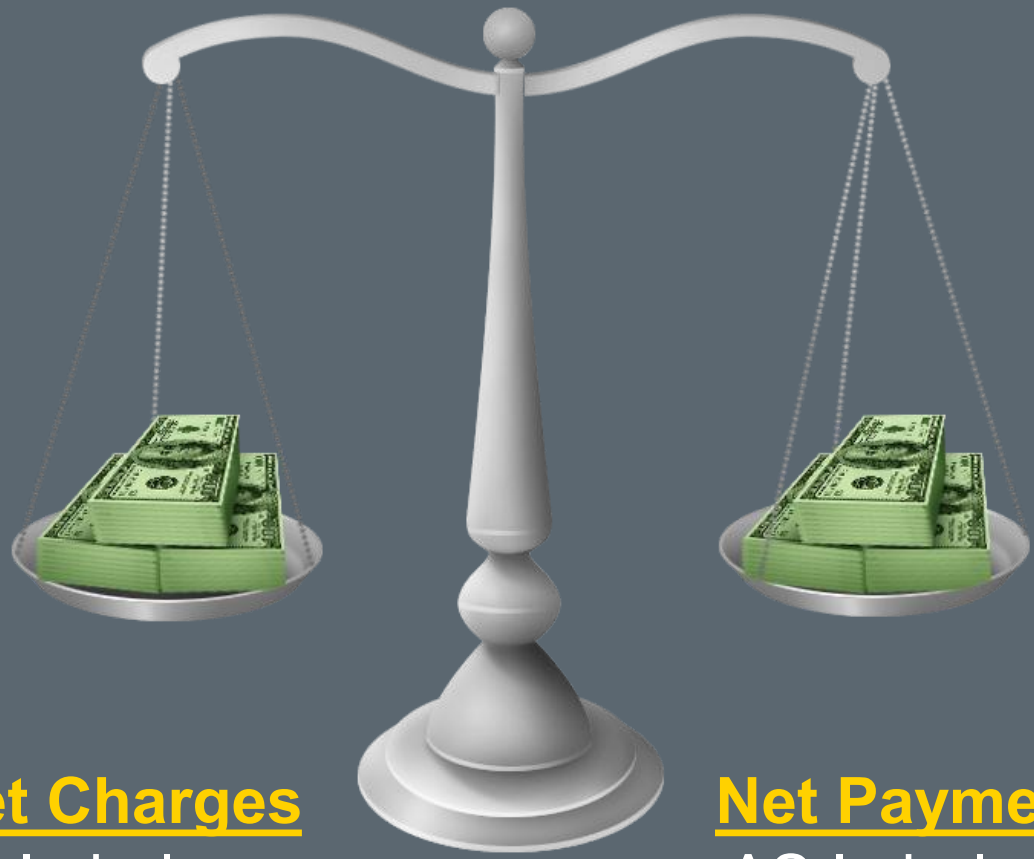
Real-Time



Ancillary Service Revenue Neutrality Allocation







Net Charges
AS Imbalance
AS Only
AS Trade Overage

Net Payments
AS Imbalance

Real-Time

ERCOT Contingency Reserve Amount for a given interval



- Real-Time ECR Imbalance Market Total Amount = $13,100
- Real-Time ECR Only Market Total Amount = $34,600
- Real-Time ECR Trade Overage Market Total Amount = $2,300
- QSE Load Ratio Share = 3%

ECR Allocation = (-1) * (Imbalance Total + Only Total + Trade Overage Total) * Load Ratio Share

ECR Allocation = (-1) * ($13,100 + $34,600 + $2,300) * 3%

ERC Allocation = (-1) * $50,000 * 3%

-$1,500 for ERCOT Contingency Reserve Allocation for the interval



LARTECRAMT = Load-Allocated Real-Time ERCOT Contingency Reserve Service Amount

$$LARTECRAMT_q = (-1) * (RTECRIMBAMTTOT + RTECROAMTTOT + RTECRTOAMTTOT) * LRS_q$$

RTECRIMBAMTTOT	Real-Time ERCOT Contingency Reserve Imbalance Total Amount
RTECROAMTTOT	Real-Time ERCOT Contingency Reserve Only Total Amount
RTECRTOAMTTOT	Real-Time ERCOT Contingency Reserve Trade Overage Total Amount
LRS	Load Ratio Share
q	QSE



Example 8: Ancillary Service Revenue Neutrality Allocation

Settle Responsive Reserve Amount for Interval 1245



- Real-Time RR Imbalance Market Total Amount = -$12,400
- Real-Time RR Only Market Total Amount = $10,300
- Real-Time RR Trade Overage Market Total Amount = $221
- QSE Load Ratio Share = 1%



Topics in this course included:

1. Ancillary Service Obligation Procurement
2. Updated Ancillary Service Obligation
3. Ancillary Service Offer (Resource-Specific)
4. Ancillary Service Imbalance
5. Ancillary Service Only Offer & Charge
6. Ancillary Service Trade Overage Charge
7. Ancillary Service Revenue Neutrality Allocation

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

Course Recommendations
https://www.ercot.com/services/training/recommendations

Market Education Contact
Training@ercot.com

ERCOT Client Services Contact
Clientservices@ercot.com

ERCOT Mailing Lists
http://lists.ercot.com/

Scan this QR code to take the course survey!

https://www.surveymonkey.com/r/ERCOTILT

