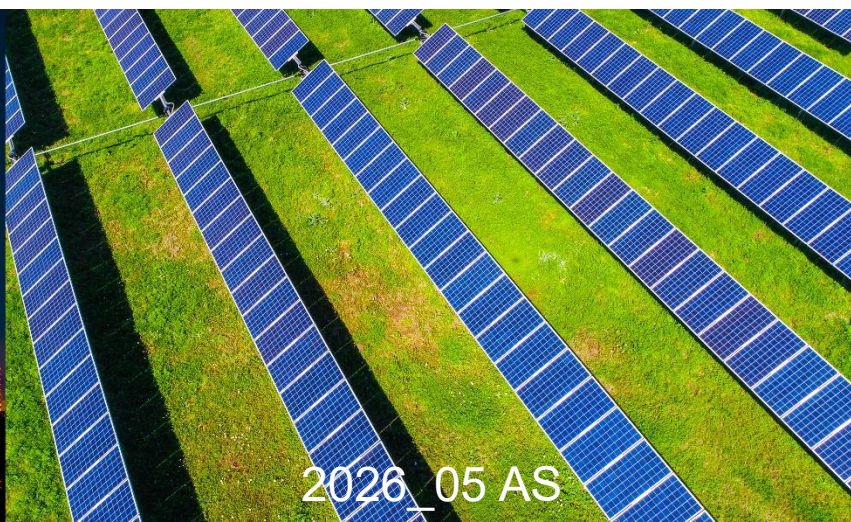
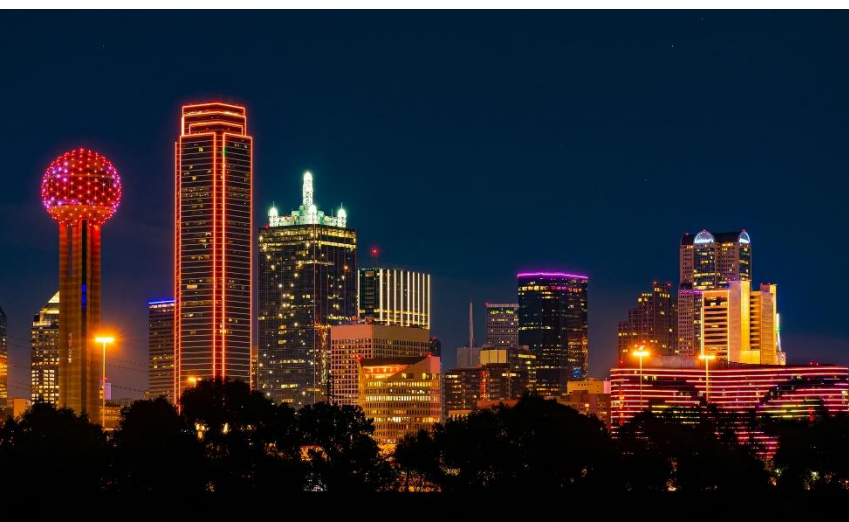




Settlement: Ancillary Services



2026_05 AS



Greetings
and
Introductions

Attendance

Questions

Presentation Materials



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



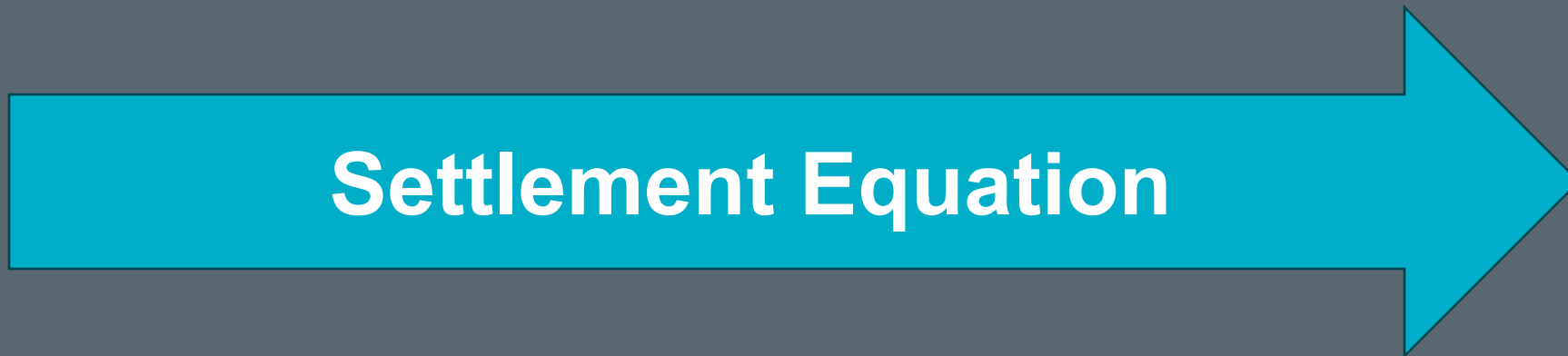
Math



Protocols



Example



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



Five Ancillary Service (AS) Settlement Types:

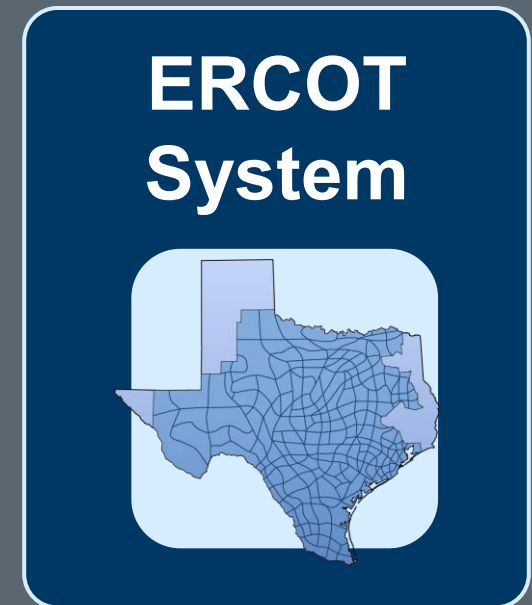
RU – Regulation Up Service

RD – Regulation Down Service

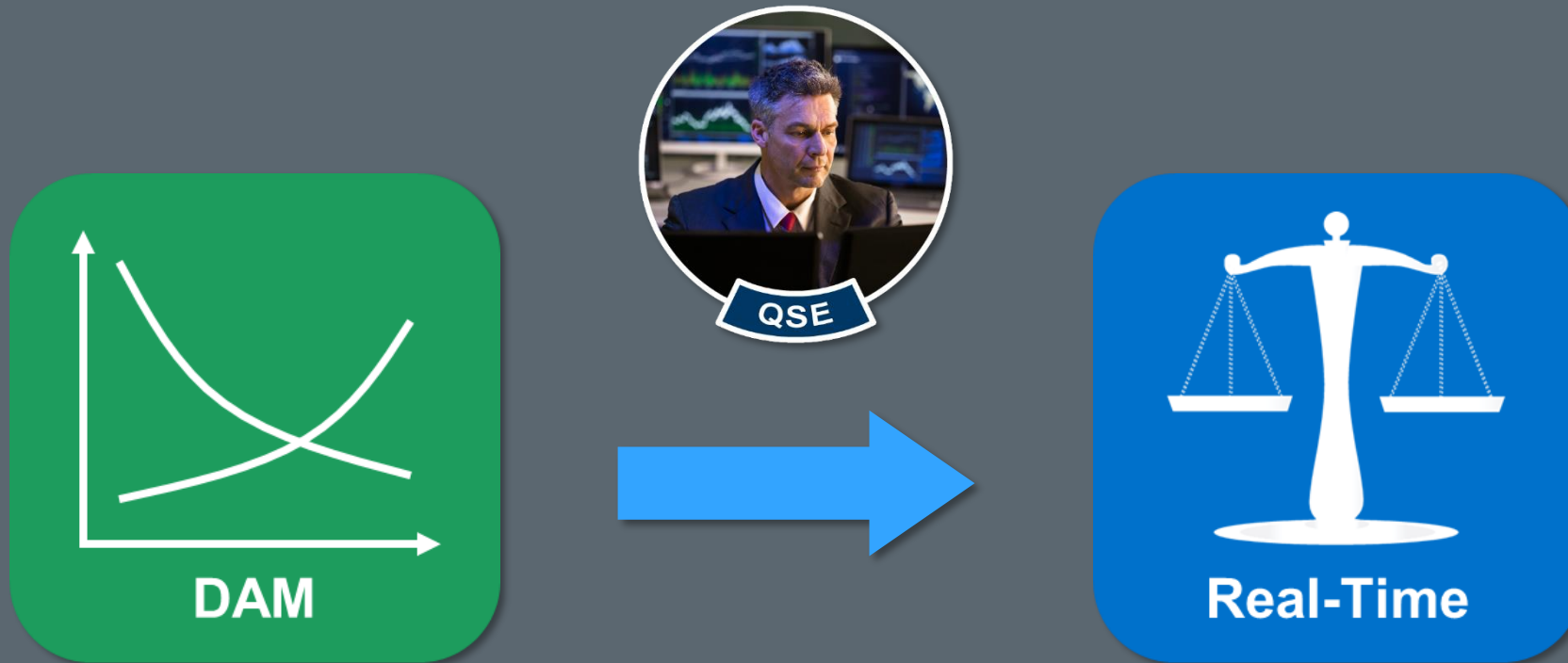
RR – Responsive Reserve Service

ECR – ERCOT Contingency Reserve Service

NS – Non-Spin Reserve Service

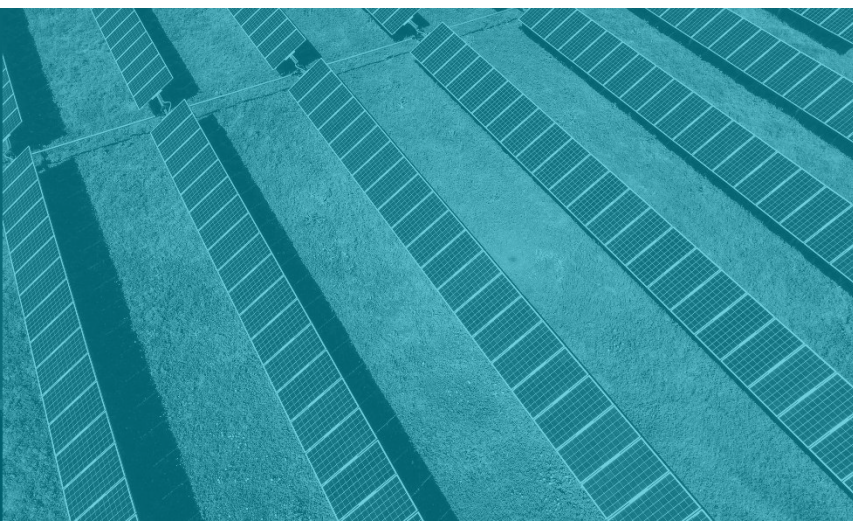


Where is the Payment (-) or the Charge (+) to the QSE?





Ancillary Service Obligation Procurement

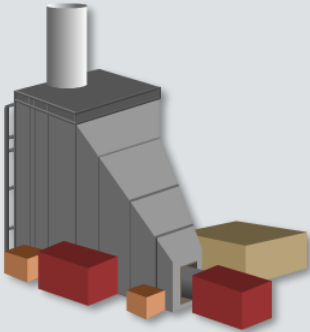


ERCOT allocates the AS Plan as Advisory AS Obligations (by 0600)



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



$$\text{RU Procurement} = \text{RU Price} * (\text{RU Obligation} - \text{Self-Arranged RU})$$

$$\text{RU Procurement} = \$14/\text{MW} * (5\text{MW} - 2\text{MW})$$

$$\text{RU Procurement} = \$14/\text{MW} * 3\text{MW}$$

\$42 for Regulation Up for the hour



DARUAMT = Day-Ahead Reg-Up Amount

$$\text{DARUAMT}_q = \text{DARUPR} * \text{DARUQ}_q$$

Where: $\text{DARUQ}_q = \text{DARUO}_q - \text{DASARUQ}_q$

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



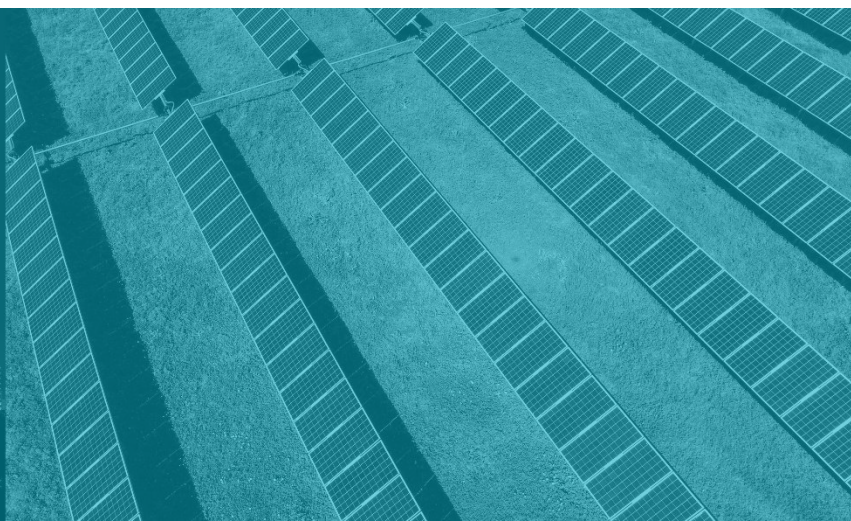
Settle Regulation Down Procurement for Hour 17

- 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



$$\text{Updated AS Obligation} = \text{RTM AS Cost} - \text{DAM AS Amount}$$

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



$$\text{Updated RU} = (\text{RU New Obligation} - \text{Self-Arranged RU}) * \text{RU Price} - \text{RU Amt}$$

$$\text{Updated RU} = (4\text{MW} - 2\text{MW}) * \$14/\text{MW} - \$42$$

$$\text{Updated RU} = 2\text{MW} * \$14/\text{MW} - \$42$$

$$\text{Updated RU} = \$28 - \$42$$

-\$14 for Updated Regulation Up for the hour



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

$$\text{DARTPCRUAMT}_q = (\text{DARUNOBL}_q - \text{DASARUQ}_q) * \text{DARUPR} - \text{DARUAMT}_q$$

Where: $\text{DARUNOBL}_q = \text{DAPCRUQTOT} * \text{HLRS}_q$

DAR <u>U</u> NOBL	Day-Ahead Reg-Up New Obligation
DASAR <u>U</u> Q	Day-Ahead Self-Arranged Reg-Up Quantity
DAR <u>U</u> PR	Day-Ahead Reg-Up Price
DAR <u>U</u> AMT	Day-Ahead Reg-Up Amount
DAPCR <u>U</u> QTOT	Day-Ahead Procured Capacity Reg-Up QSE Total
HLRS	Hourly Load Ratio Share
q	QSE





Settle Updated Regulation Down Obligation for Hour 17

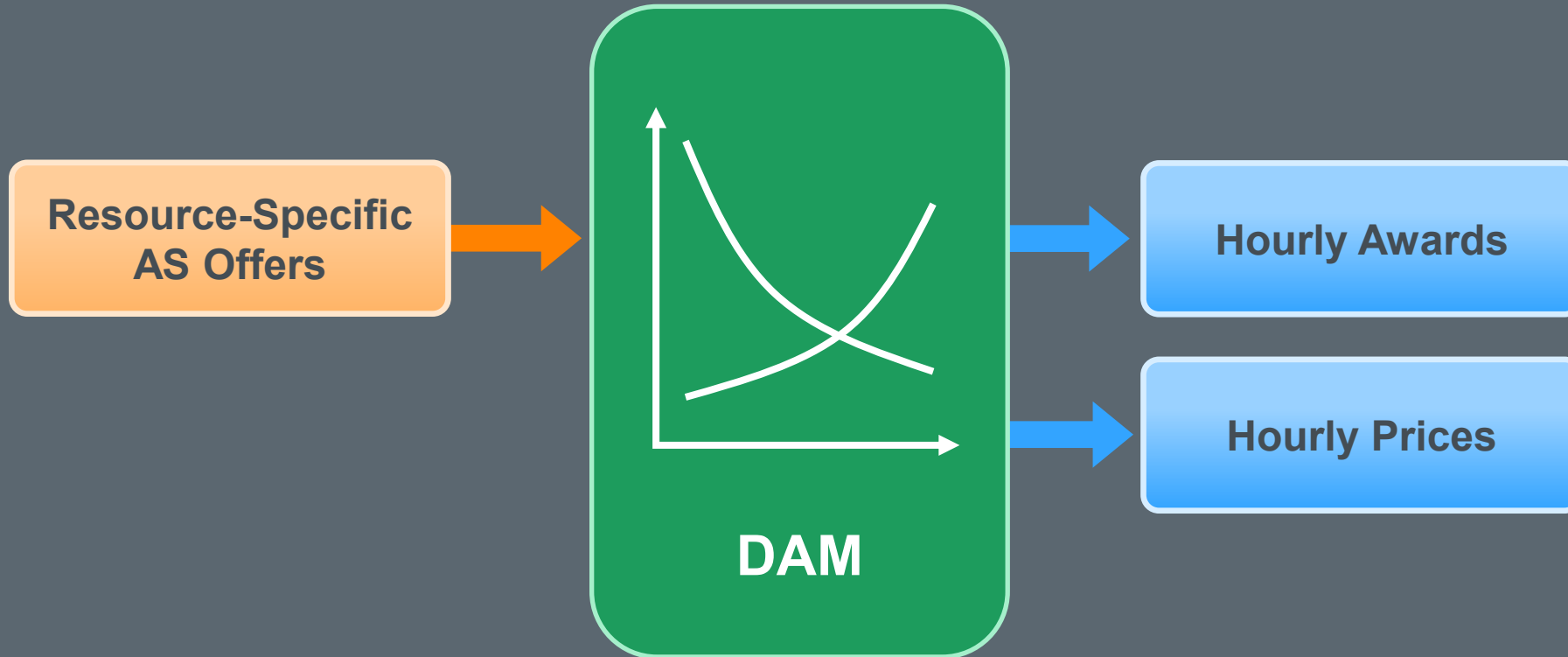
- DAM RD New Obligation Quantity = 9.5MW
- DAM Self-Arranged RD Quantity = 1.5MW
- DAM RD Price = \$38/MW
- DAM RD Amount = \$247





Ancillary Service Offer (Resource-Specific)





Awarded Responsive Reserve Offer for a given hour

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



$$\text{RR Award} = (-1) * \text{RR Price} * \text{RR Quantity}$$

$$\text{RR Award} = (-1) * \$23/\text{MW} * 90\text{MW}$$

-\$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



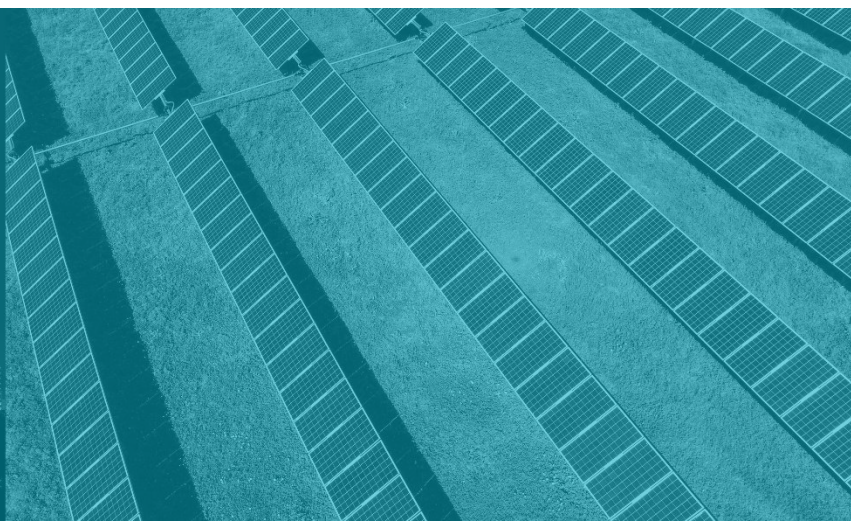
Settle Awarded ERCOT Contingency Reserve Offer for Hour 18

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

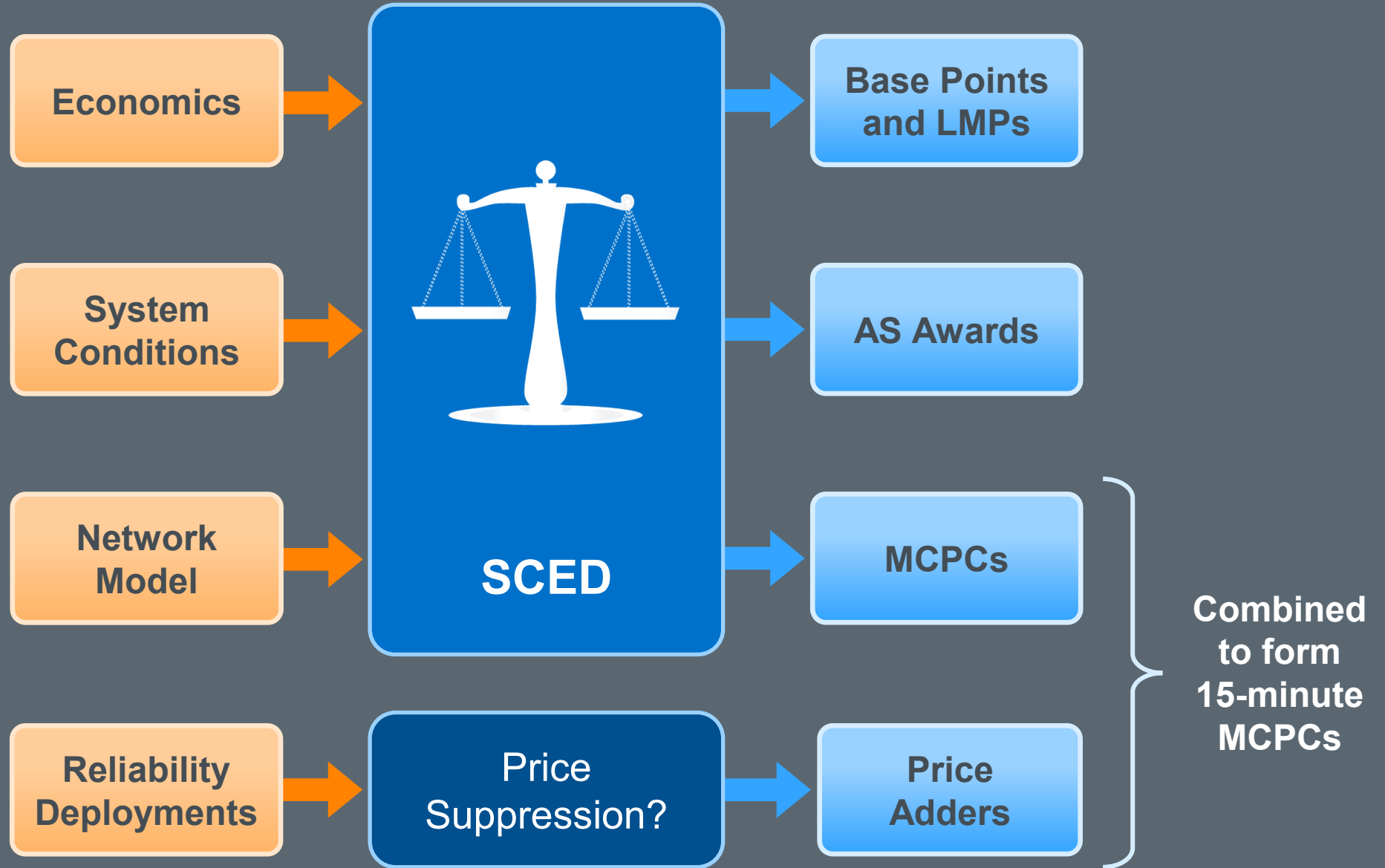




Ancillary Service Imbalance



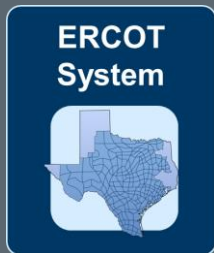
Real-Time Market Clearing Prices for Capacity Concept



For each SCED Interval:

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

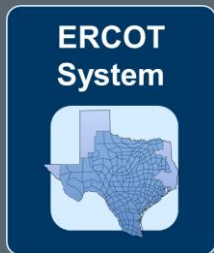
RTRDPANSS = Real-Time Reliability Deployment Price Adder
for Non-Spin per SCED interval



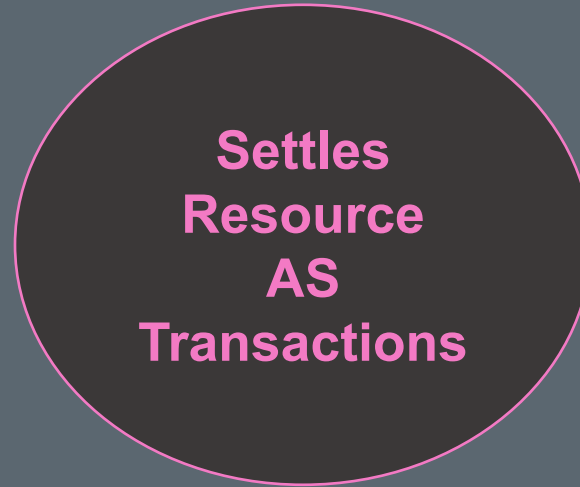
RTMCPCNS = Real-Time Market Clearing Price for Capacity for Non-Spin



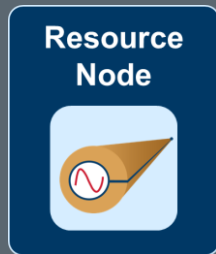
RTMCPCNS = Time-Weighted Average
(**RTMCPCNSS** + **RTRDPANSS**)



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



$$\text{RTMCPCNSR} = (\text{Resource Award} * \text{Time})\text{-Weighted Average} \\ (\text{RTMCPCNSS} + \text{RTRDPANSS})$$



Real-Time Ancillary Service Imbalance Concept

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

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**



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

Supplies Obligations

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

$$= (-1) \left(\sum_r \left(\begin{aligned} &\text{Real-Time AS Revenue} = (1/4) * \text{RT AS Awards} * \text{RTMCPCR} \\ &- \\ &(1/4) * \text{DAM AS Awards} * \text{RTMCPC} \\ &- \\ &(1/4) * \text{DAM Self-Arranged AS} * \text{RTMCPC} \\ &+ \\ &(1/4) * (\text{Trade AS Purchases} - \text{Trade AS Sales}) * \text{RTMCPC} \end{aligned} \right) \right)$$



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



$$\text{NS Imbalance} = (-1) * [\text{RT AS Revenue} - (1/4) * (\text{DAM NS Quantity} * \text{NS Price})]$$

$$\text{NS Imbalance} = (-1) * [(1/4) * (\text{RT NS Quantity} * \text{NS Resource Price}) - (1/4) * (\text{DAM NS Quantity} * \text{NS Price})]$$

$$\text{NS Imbalance} = (-1) * [(1/4) * (10\text{MW} * \$8/\text{MW}) - (1/4) * (20\text{MW} * \$18/\text{MW})]$$

$$\text{NS Imbalance} = (-1) * [\$20 - \$90]$$

\$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



$$\text{NS Imbalance} = (-1) * [- (1/4) * (\text{Self-Arranged NS Quantity} * \text{NS Price}) + (1/4) * (\text{Trade NS Purchase Quantity} - \text{Trade NS Sale Quantity} * \text{NS Price})]$$

$$\text{NS Imbalance} = (-1) * [- (1/4) * (40\text{MW} * \$18/\text{MW}) + (1/4) * (40\text{MW} * \$18/\text{MW})]$$

$$\text{NS Imbalance} = (-1) * [- (\$180) + (\$180)]$$

\$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



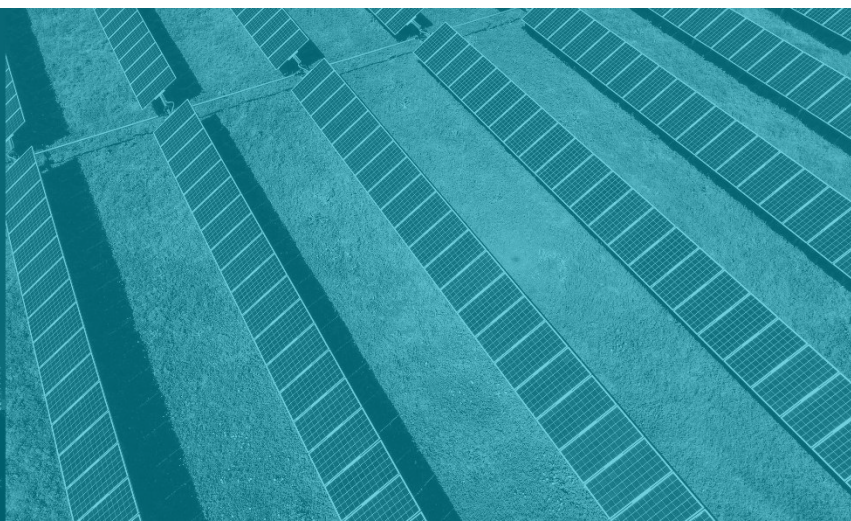
Settle Non-Spin Imbalance for Interval 2000

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

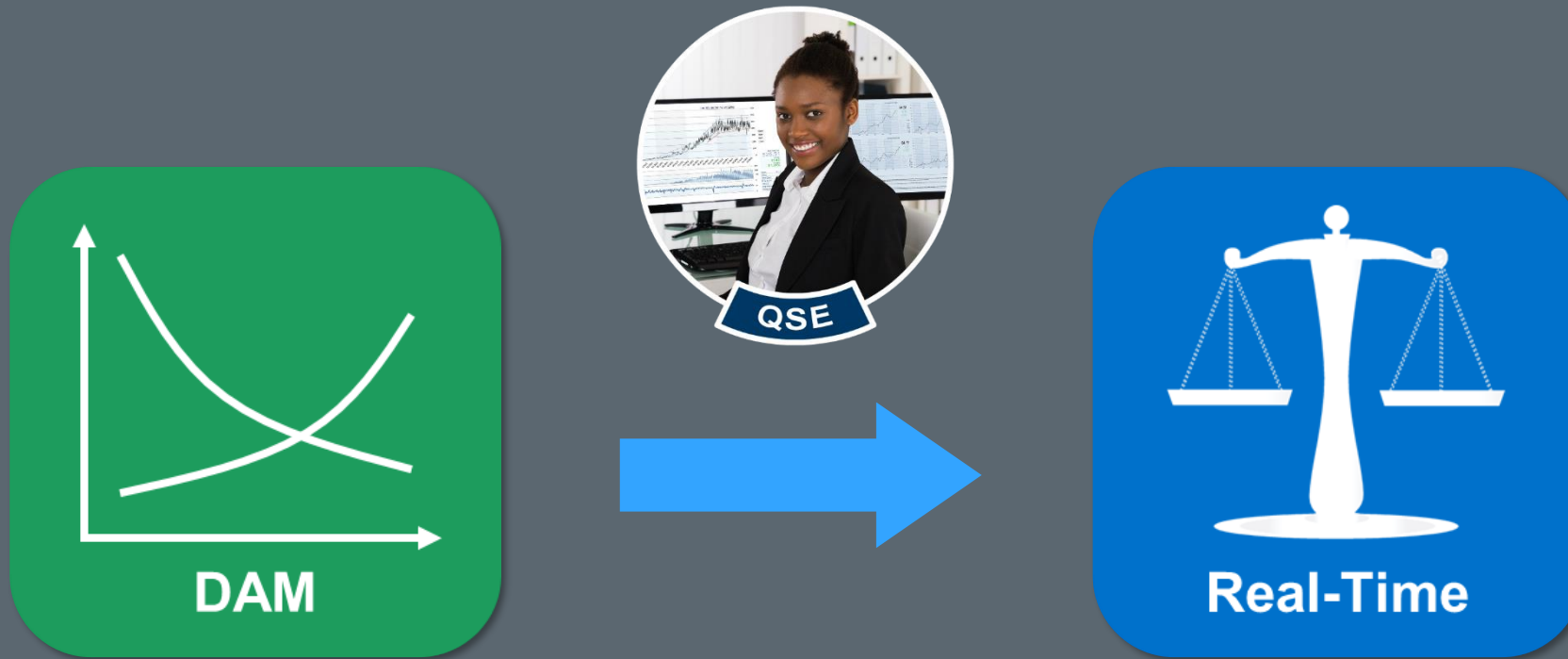




Ancillary Service Only Offer & Charge



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



$$\text{RD Only Award} = (-1) * \text{DAM RD Price} * \text{RD Only Quantity}$$

$$\text{RD Only Award} = (-1) * \$27/\text{MW} * 30\text{MW}$$

-\$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



$$\text{RD Only Charge} = (1/4) * \text{RD Only Quantity} * \text{Real-Time RD Price}$$

$$\text{RD Only Charge} = (1/4) * 30\text{MW} * \$18/\text{MW}$$

\$135 for Regulation Down Only Charge for the interval



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

$$\text{DAPCRDOAMT}_q = (-1) * \text{MCPCRD}_{\text{DAM}} * \text{DARDOAWD}_q$$



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

$$\mathbf{RTRDOAMT}_q = (1/4) * \mathbf{DARDOAWD}_q * \mathbf{RTMCPCRD}$$



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





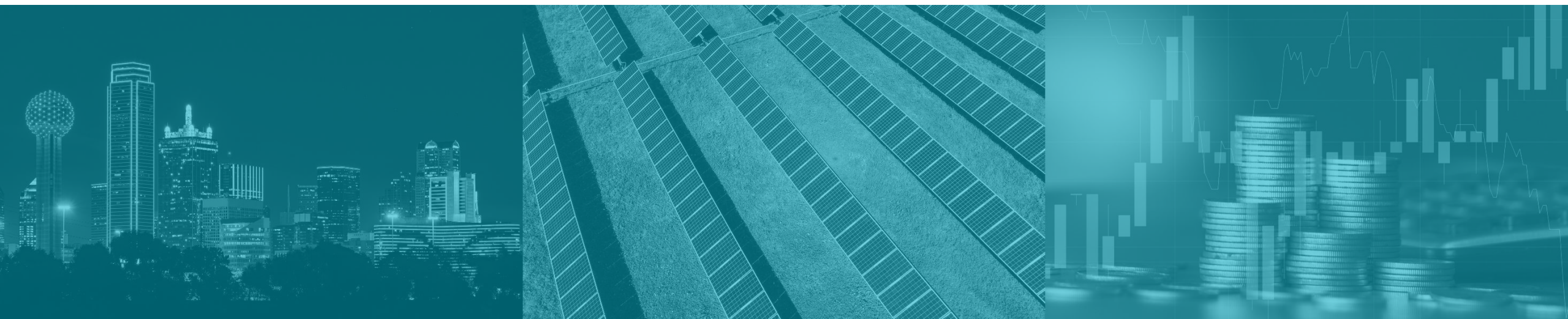
Settle Regulation Up Only Charge for Interval 0815

- 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



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



$$\text{ECR Trade Overage} = (1/4) * \text{ECR Trade Overage Quantity} * \text{RT ECR Price}$$

$$\text{ECR Trade Overage} = (1/4) * 11\text{MW} * \$36/\text{MW}$$

\$99 for ERCOT Contingency Reserve Trade Overage for the interval



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

$$\text{RTECRTOAMT}_q = (1/4) * \text{RTECRTO}_q * \text{RTMCPCECR}$$



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

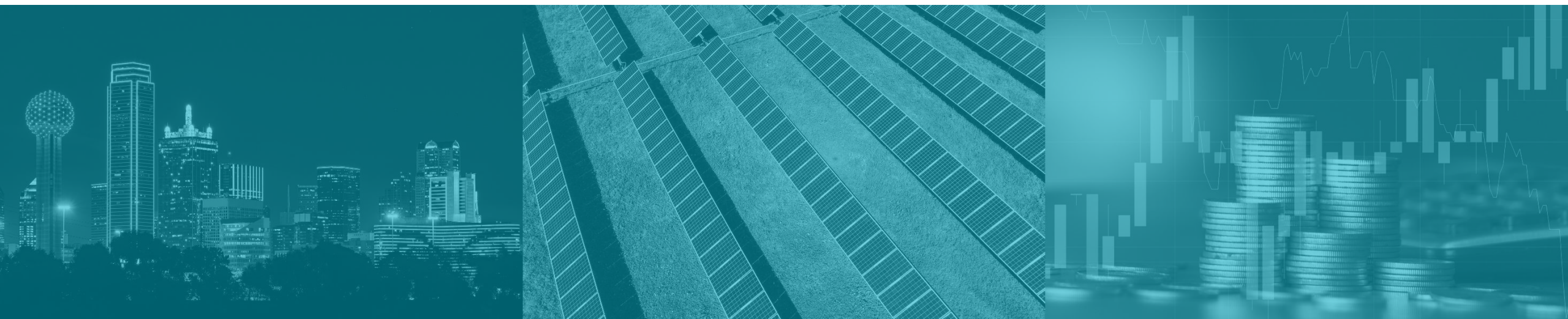
Settle Responsive Reserve Trade Overage Charge for Interval 1245

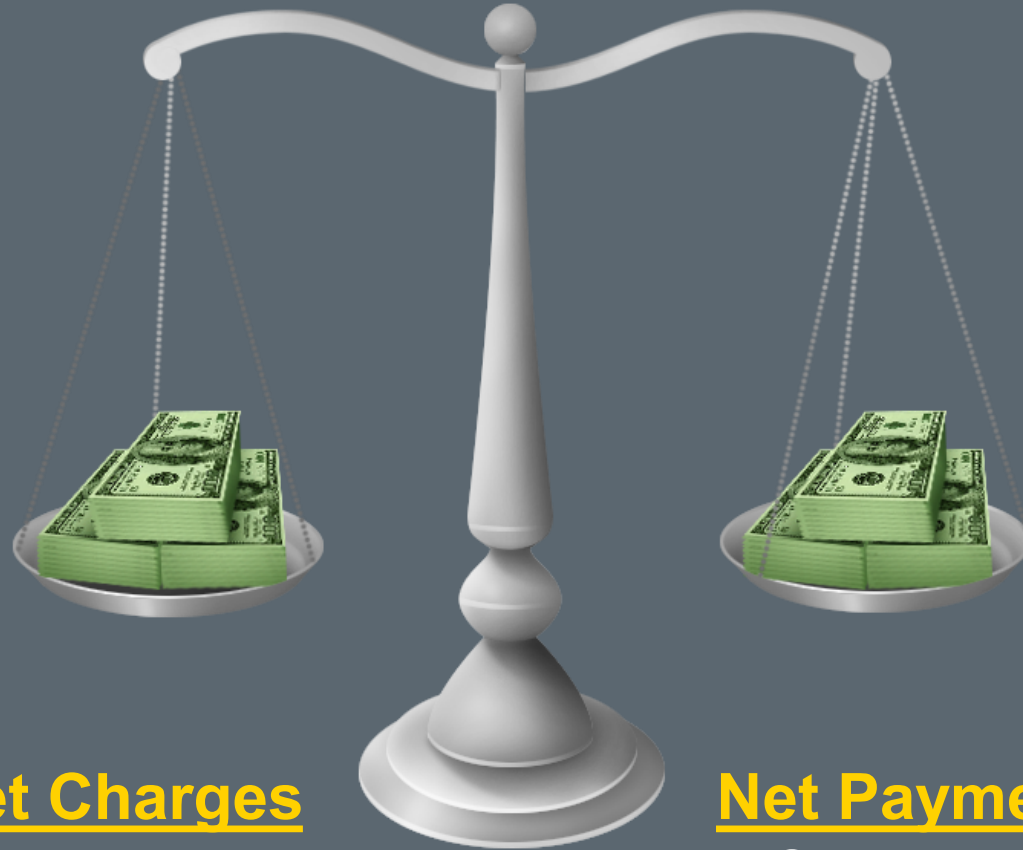
- RR Trade Overage Quantity = 17MW
- Real-Time RR Price = \$52/MW





Ancillary Service Revenue Neutrality Allocation





Net Charges

AS Imbalance

AS Only

AS Trade Overage

Net Payments

AS Imbalance



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%



$$\text{ECR Allocation} = (-1) * (\text{Imbalance Total} + \text{Only Total} + \text{Trade Overage Total}) * \text{Load Ratio Share}$$

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

$$\text{ERC Allocation} = (-1) * \$50,000 * 3\%$$

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



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

$$\text{LARTECRAMT}_q = (-1) * (\text{RTECRIMBAMTTOT} + \text{RTECROAMTTOT} + \text{RTECRTOAMTTOT}) * \text{LRS}_q$$

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





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%



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- 7 Ancillary Service Revenue Neutrality Allocation

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