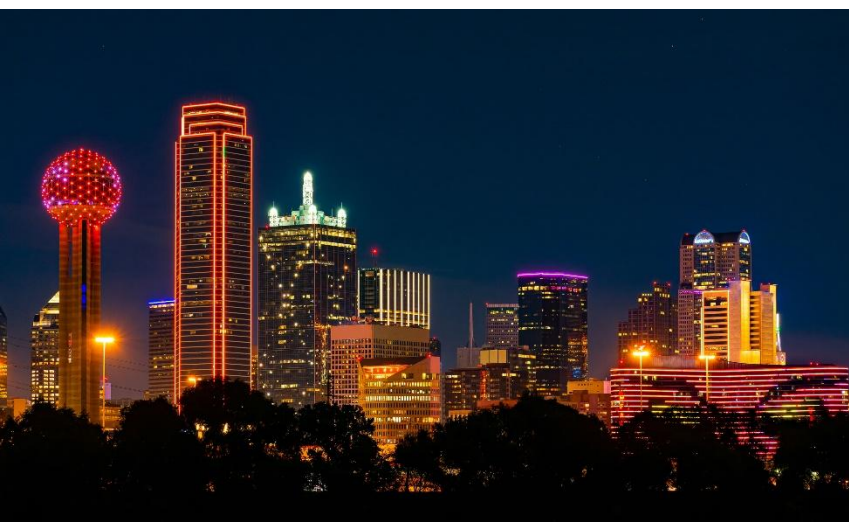




Settlement: Congestion Revenue Rights



2026_09 CRR



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

CRR Auction Bids

2

CRR Auction Offers

3

PTP Option Award Fees

4

CRR Auction Revenues

5

CRR Settlement in DAM

6

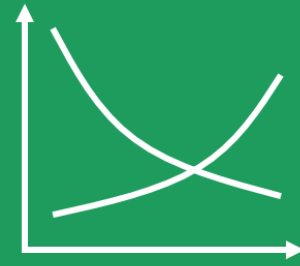
Shortfall Charges

7

CRR Balancing Account



CRR Auction



DAM



Real-Time



CRRAH



QSE

Three Settlement Processes

- Auctions
- DAM Settlement
- Balancing Account



Point-to-Point Obligations (OBL)
Payment or Charge in DAM

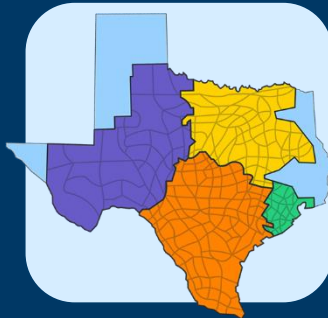
Point-to-Point Options (OPT)
Payment only in DAM



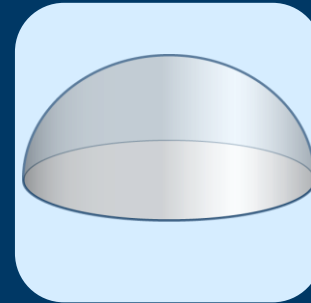
**Resource
Node (RN)**



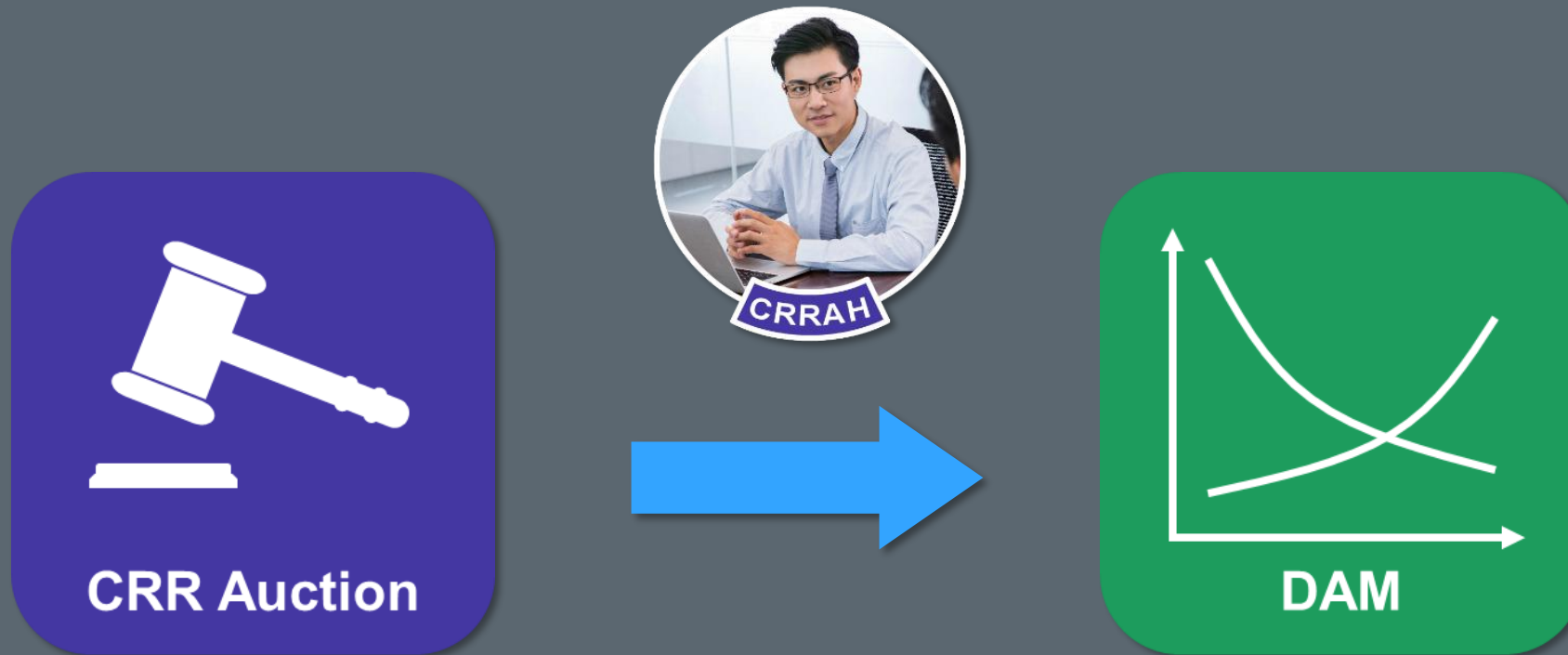
**Load
Zone (LZ)**



**Hub
(HB)**

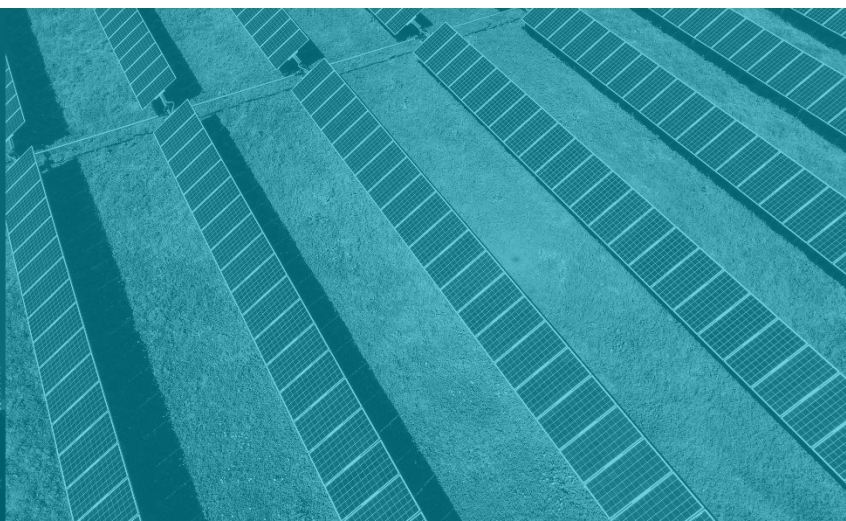


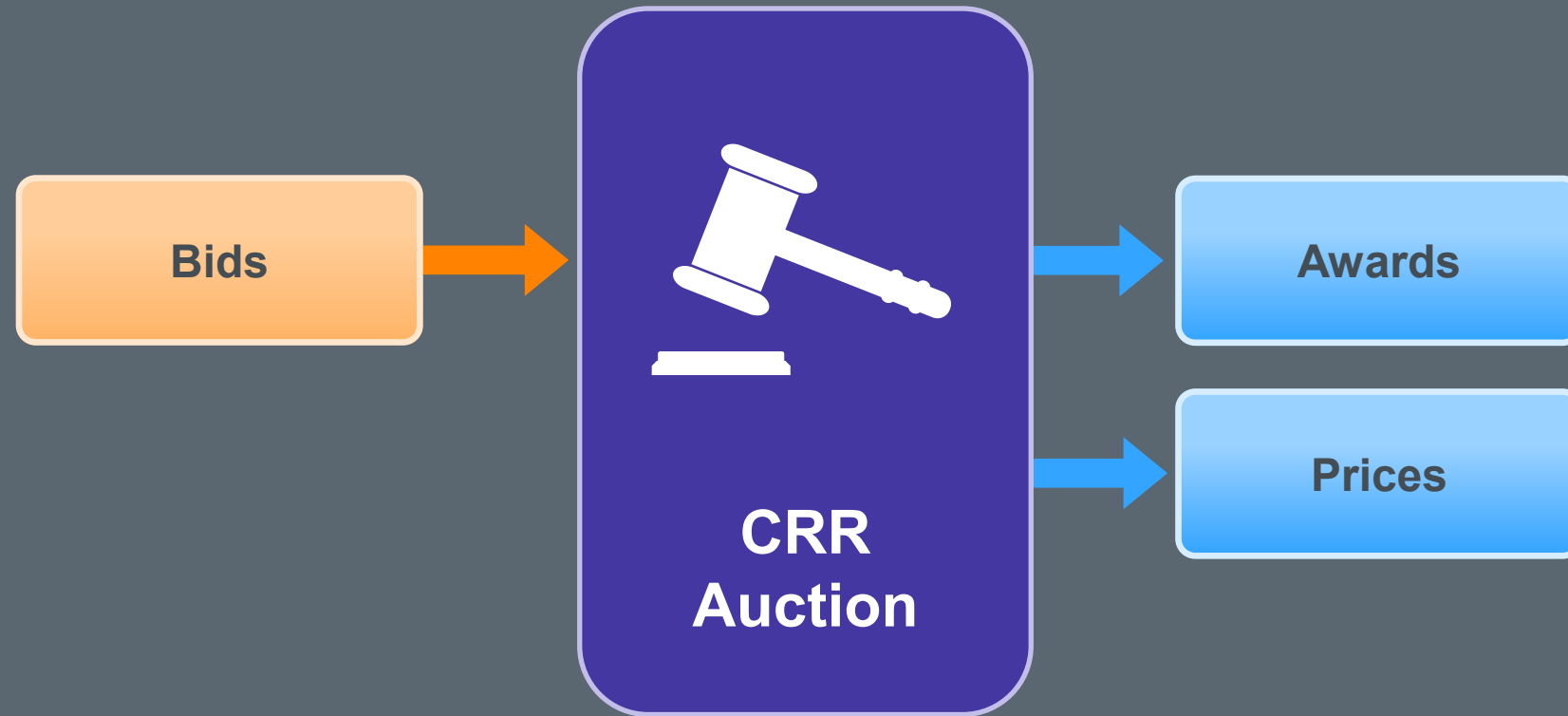
Where is the Payment (-) or the Charge (+) to the CRRAH?





CRR Auction Bids





By Time-Of-Use (TOU) Block

Awarded PTP Option Bid

- Option Quantity = 10MW Peak Weekday for January 2022
- 336 Peak Weekday (5x16) hours in January 2022
- Awarded Option Price = \$3/MW



Awarded PTP Option = Option Price * Option Quantity

Awarded PTP Option = \$3/MW * 10MW

\$30 for one hour of the PTP Option

Awarded TOU Period = Hourly Value * Total Hours

Awarded TOU Period = \$30 * 336

\$10,080 for January 2022



OPTPAMT = PTP **Option Purchase Amount**

$$\text{OPTPAMT}_{\text{crrh},(j,k),a} = \text{OPTPR}_{(j,k),a} * \text{OPTP}_{\text{crrh},(j,k),a}$$



OPTPR	PTP Option Price
OPTP	PTP Option Purchase
crrh, a	CRR Account Holder, CRR Auction
j, k	Source & Sink Settlement Point

OBLPAMT = PTP **O**bligation **P**urchase **A**mount

OBLPAMT_{crh,(j,k),a} = **OBLPR**_{(j,k),a} * **OBLP**_{crh,(j,k),a}



OBLPR	PTP O bligation P rice
OBLP	PTP O bligation P urchase
crh, a	CRR Account Holder, CRR Auction
j, k	Source & Sink Settlement Point



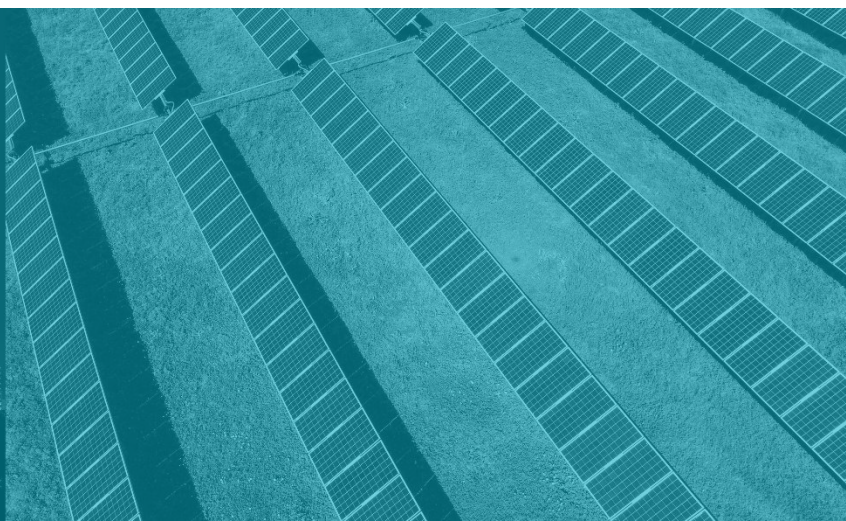
Settle Awarded PTP Obligation Bid

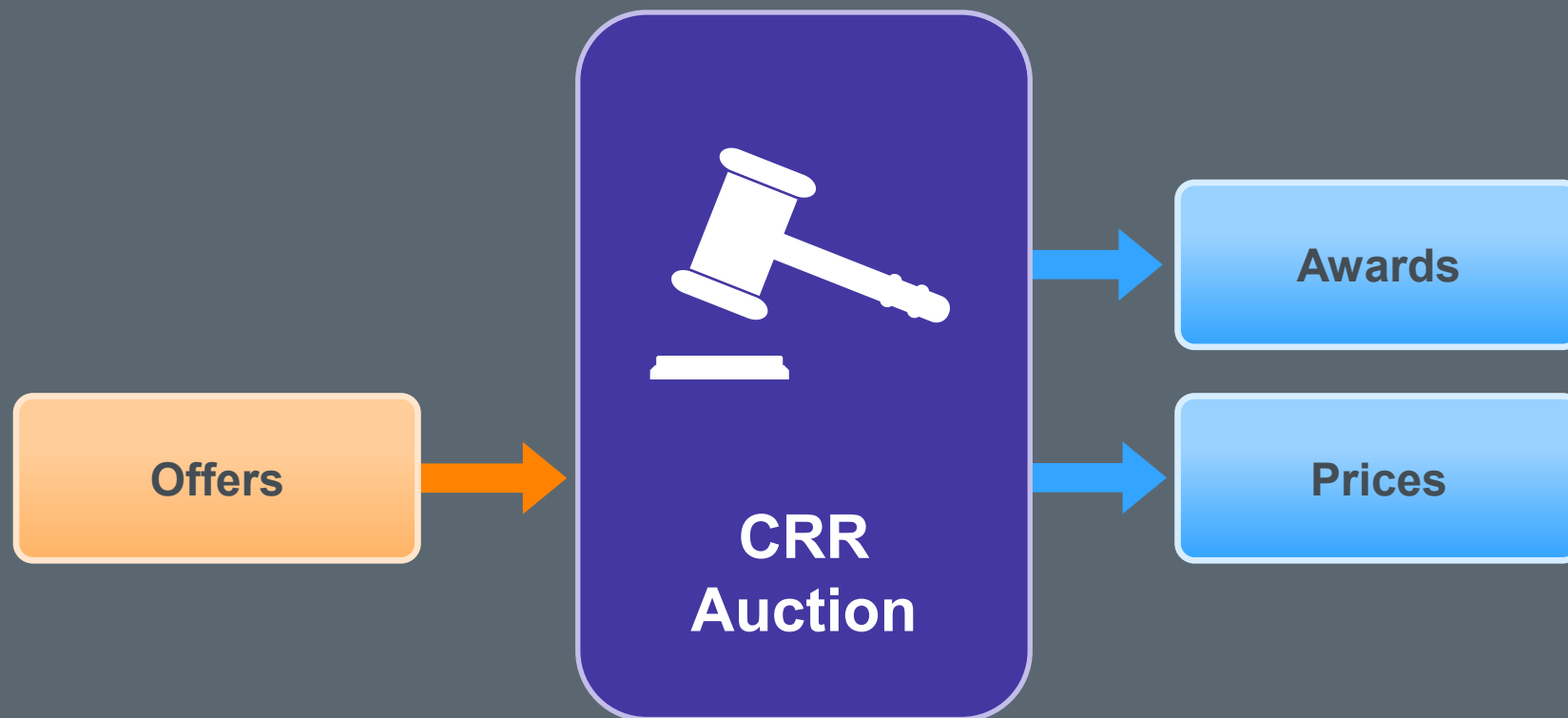
- Obligation Quantity = 14MW Peak Weekend for January 2022
- 160 Peak Weekend (2x16) hours in January 2022
- Awarded Obligation Price = \$2/MW





CRR Auction Offers





By Time-Of-Use (TOU) Block

Awarded PTP Obligation Offer

- Obligation Quantity = 5MW Off-Peak for January 2022
- 248 Off-Peak (7x8) hours in January 2022
- Awarded Obligation Price = \$1/MW



Awarded PTP Obligation = $(-1) * \text{Obligation Price} * \text{Obligation Quantity}$

Awarded PTP Obligation = $(-1) * \$1/\text{MW} * 5\text{MW}$

-\$5 for one hour of the PTP Obligation

Awarded TOU Period = $\text{Hourly Value} * \text{Total Hours}$

Awarded TOU Period = $-\$5 * 248$

-\$1,240 for January 2022



OBSAMT = PTP **O**bligation **S**ale **A**mount

$$\text{OBSAMT}_{\text{crrh},(j,k),a} = (-1) * \text{OBLPR}_{(j,k),a} * \text{OBS}_{\text{crrh},(j,k),a}$$



OBLPR	PTP Obligation Price
OBS	PTP Obligation Sale
crrh, a	CRR Account Holder, CRR Auction
j, k	Source & Sink Settlement Point

OPTSAMT = PTP **Option Sale Amount**

$$\text{OPTSAMT}_{\text{crrh},(j,k),a} = (-1) * \text{OPTPR}_{(j,k),a} * \text{OPTS}_{\text{crrh},(j,k),a}$$



OPTPR	PTP Option Price
OPTS	PTP Option Sale
crrh, a	CRR Account Holder, CRR Auction
j, k	Source & Sink Settlement Point



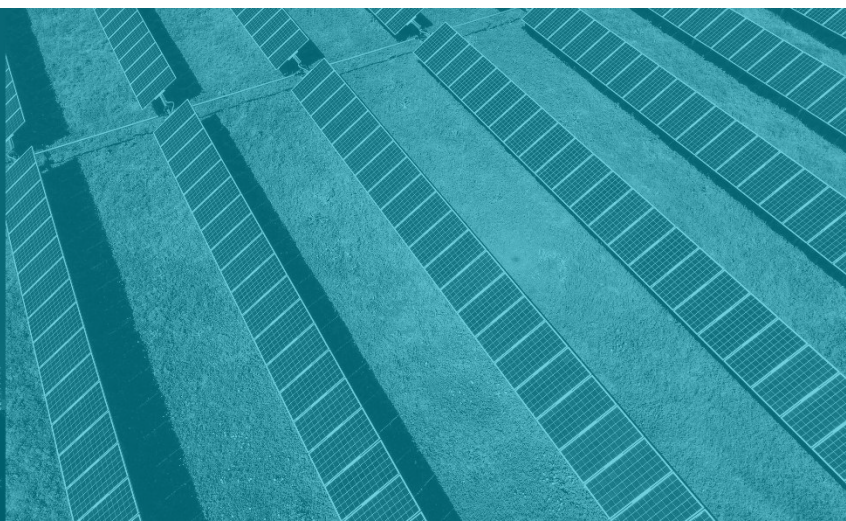
Settle Awarded PTP Option Offer

- Option Quantity = 18MW Peak Weekday for January 2022
- 336 Peak Weekday (5x16) hours in January 2022
- Awarded Option Price = \$4/MW





PTP Option Award Fees



When the Option Price < \$0.01, then
Option Award Fee = \$0.01 – Option Price



Minimum PTP Option Bid Price = \$0.01

PTP Option Award Fee

- Fee Quantity = 20MW Peak Weekday for July 2022
- 320 Peak Weekday (5x16) hours in July 2022
- Awarded Option Price = \$0.003/MW



PTP Option Award Fee = (\$0.01 – Option Price) * Fee Quantity

PTP Option Award Fee = (\$0.01 – \$0.003/MW) * 20MW

\$0.14 for one hour of the Option Award Fee

Awarded TOU Period = Hourly Value * Total Hours

Awarded TOU Period = \$0.14 * 320

\$44.80 for July 2022



OPTAFAMT = PTP Option Award Charge (Fee) Amount

$$\text{OPTAFAMT}_{\text{crrh,a}} = \sum_{\text{bp}} \sum_h \sum_{(j,k)} (\text{Max} (0, \text{OPTMBP} - \text{OPTPR}_{(j,k),a,h,\text{bp}}) * \text{OPTP}_{\text{crrh,(j,k),a,h,\text{bp}}})$$

OPTMBP	Minimum PTP Option Bid Price
OPTPR	PTP Option Price
OPTP	PTP Option Purchase
crrh, a	CRR Account Holder, CRR Auction
bp, h	CRR Bid Period, Operating Hour
j, k	Source & Sink Settlement Point





Settle a PTP Option Award Fee

- Fee Quantity = 8MW Peak Weekend for July 2022
- 176 Peak Weekend (2x16) hours in July 2022
- Awarded Option Price = \$0.005/MW



$$\text{OPTAFAMT}_{\text{crrh},a} = \sum_{bp} \sum_h \sum_{(j,k)} (\text{Max}(0, \text{OPTMBP} - \text{OPTPR}_{(j,k),h}) * \text{OPTP}_{\text{crrh},(j,k),h})$$

$$\text{OPTAFAMT}_{\text{crrh},a} = (\$0.01 - \$0.005/\text{MW}) * 8\text{MW}$$

\$0.04 for one hour of the Option Award Fee

$$\text{TOU Period} = \text{Hourly Value} * \text{Total Hours}$$

$$\text{TOU Period} = \$0.04 * 176$$

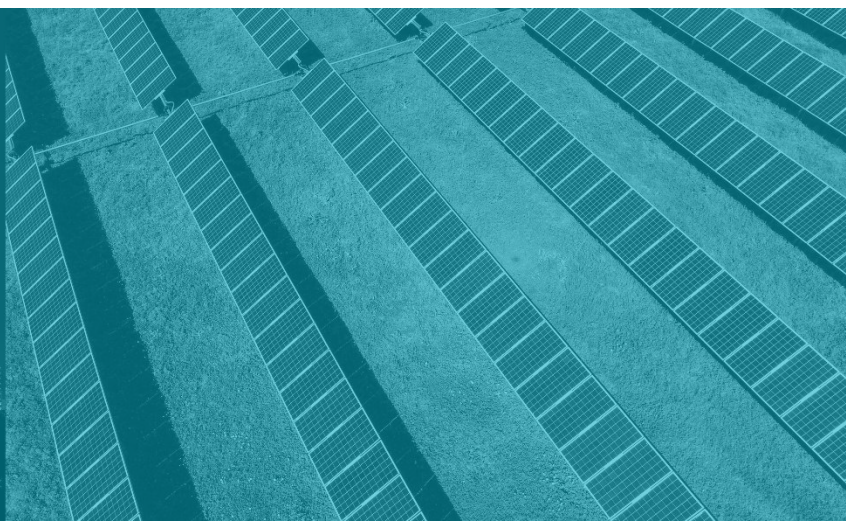
\$7.04 for July 2022

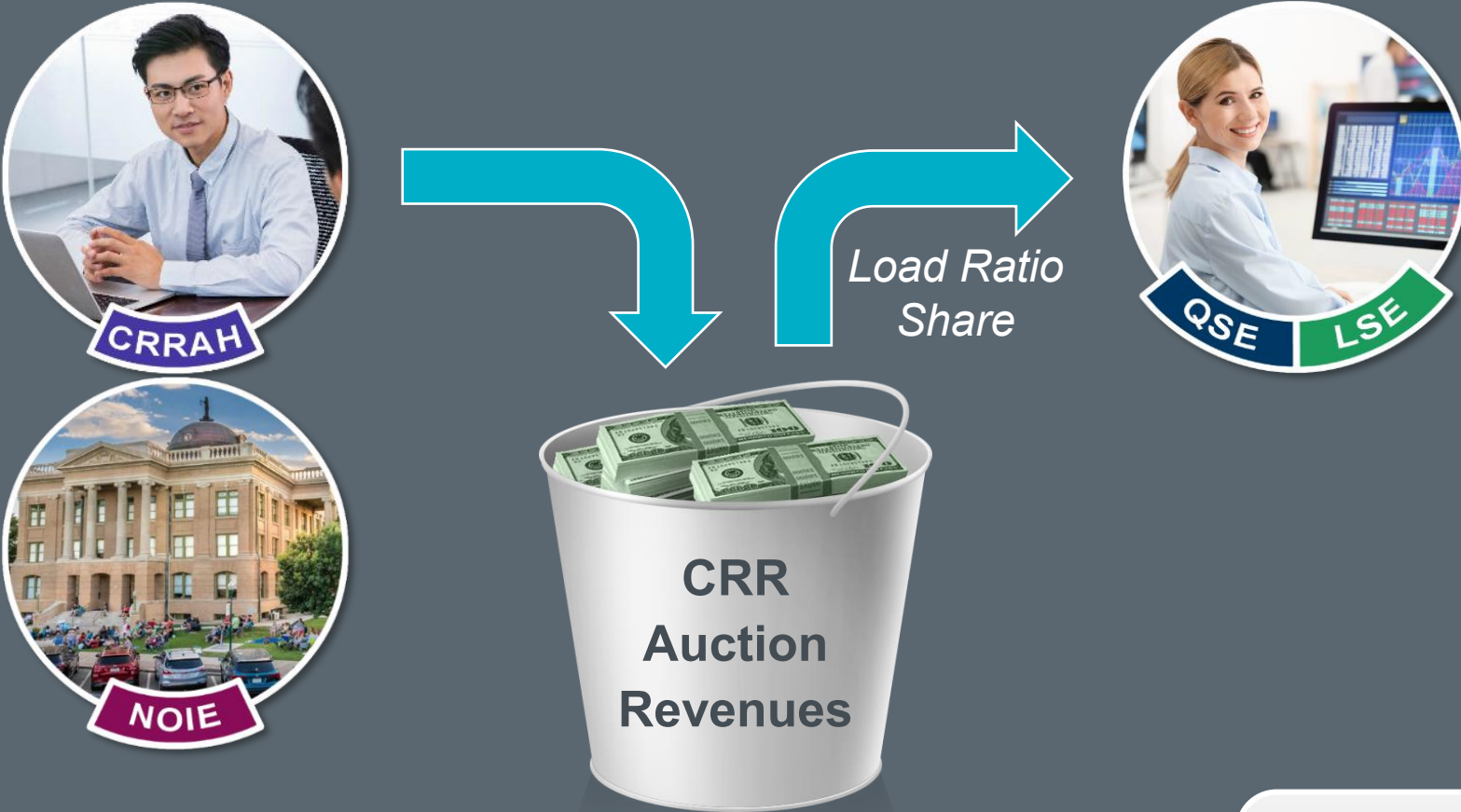


CRR Auction



CRR Auction Revenues





Distribution occurs once each month



CRR Monthly Revenue for a given Zone

- CRR Zonal Revenue = \$1,900,000 for August 2022
- PCRR Zonal Revenue = \$100,000 for August 2022
- QSE Monthly Zonal Load Ratio Share = 7%



$$\text{Zonal Revenue} = (-1) * (\text{CRR Revenue} + \text{PCRR Revenue}) * \text{Monthly Zonal Load Ratio Share}$$

$$\text{Zonal Revenue} = (-1) * (\$1,900,000 + \$100,000) * 7\%$$

-\$140,000 of CRR Zonal Revenue
for the QSE for August 2022



CRR Auction

LACMRZAMT = Load-Allocated CRR Monthly Revenue Zonal Amount

$$\text{LACMRZAMT}_{z,q} = (-1) * \sum_a (\text{CRRZREV}_{z,a} + \text{PCRRZREV}_{z,a}) * \text{MLRSZ}_{z,q}$$



CRRZREV	CRR Zonal Revenue
PCRRZREV	PCRR Zonal Revenue
MLRSZ	Monthly Load Ratio Share Zonal
a, q, z	CRR Auction, QSE, 2003 ERCOT CMZ

LACMRNZAMT = Load-Allocated **CRR** Monthly Revenue Non-Zonal Amount

$$\text{LACMRNZAMT}_q = (-1) * \sum_a (\text{CRRNZREV}_a + \text{PCRRNZREV}_a) * \text{MLRS}_q$$



CRRNZREV	CRR Non-Zonal Revenue
PCRRNZREV	PCRR Non-Zonal Revenue
MLRS	Monthly Load Ratio Share
a, q	CRR Auction, QSE,



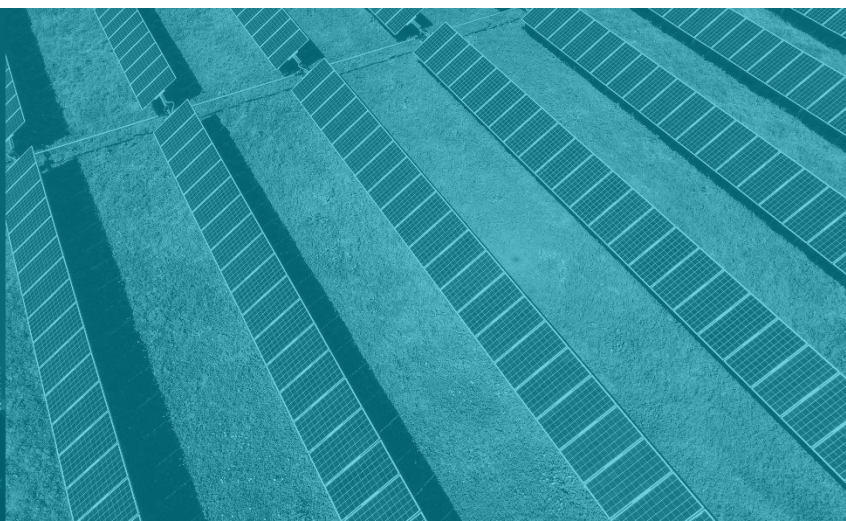
Settle Non-Zonal CRR Monthly Revenue

- CRR Non-Zonal Revenue = \$2,800,000 for August 2022
- PCRR Non-Zonal Revenue = \$200,000 for August 2022
- QSE Monthly Load Ratio Share = 12%





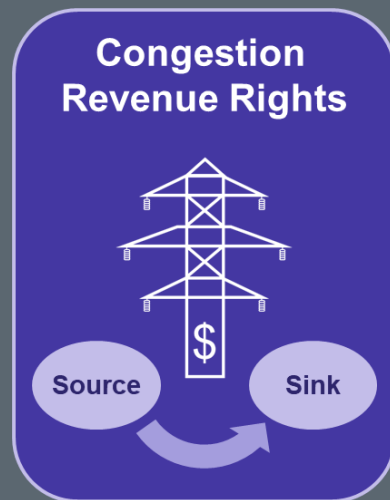
CRR Settlement in DAM



CRR Settlement in DAM

General Concepts

CRR Settlement in DAM may be as expected...
or CRR Payments may be derated



Expected Settlement: When CRR Sink $\neq$ Resource Node
or Transmission Elements not oversold

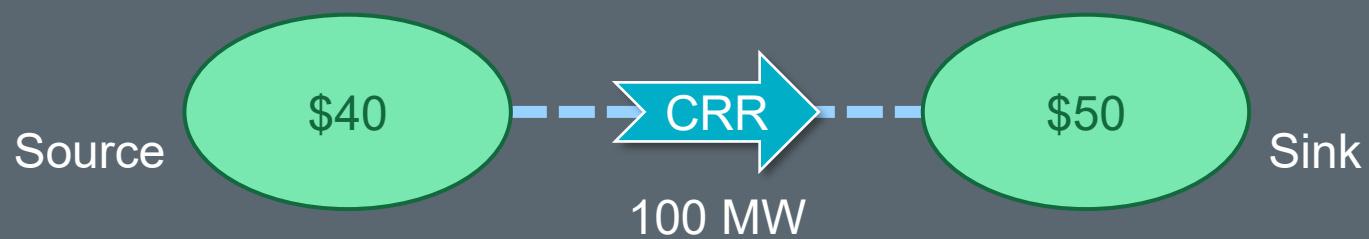
Derated Settlement of CRRs in DAM

- Transmission Elements are oversold
- CCR Sink is a Resource Node
- Expected Settlement $> \$0$



Hedge Settlement limits **Derated Settlement**

Expected Settlement

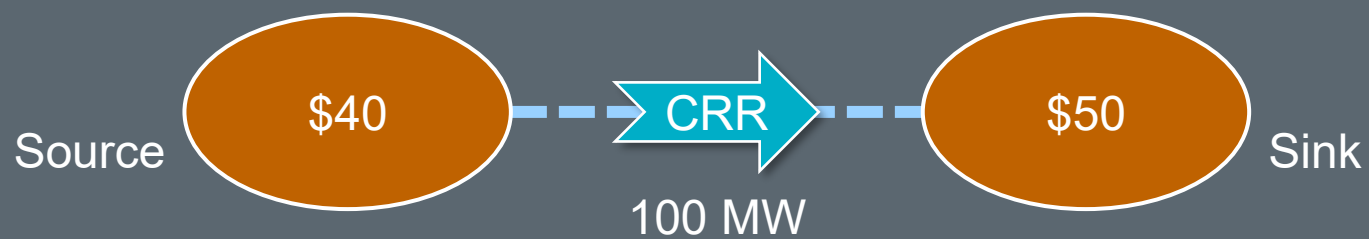


$$\text{Target Payment} = (\text{Sink DASPP} - \text{Source DASPP}) * \text{Quantity}$$



DASPP | Day-Ahead Settlement Point Price

Derated Settlement



$$\text{Derated Amount} = \sum_c (\text{Congestion Value}_c * \text{Deration Factor}_c) * \text{Quantity}$$



c

A constraint

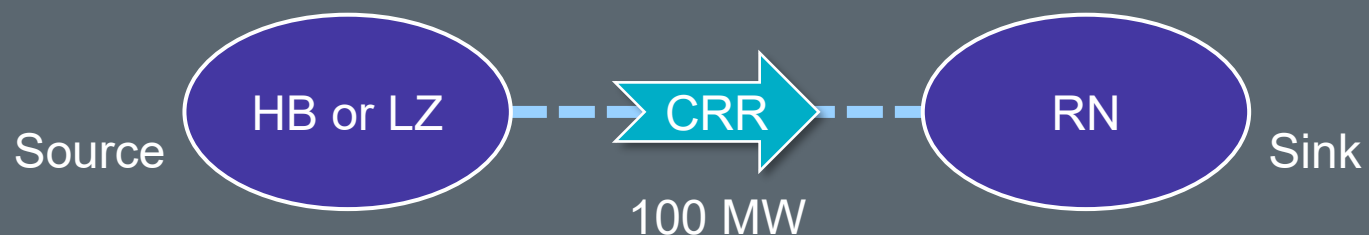
- **Derated Settlement reduces Gaming**
- **Hedge Settlement maintains some value for the CRR**
 - Minimum Resource Price (MINRESPR) as Source
 - Maximum Resource Price (MAXRESPR) at Sink



RESOURCE TYPE	MINRESPR	MAXRESPR
Nuclear	-\$20/MWh	\$15/MWh
Simple Cycle > 90MW	FIP*10	FIP*14
Combined Cycle > 90MW	FIP*5	FIP*9
Wind	-\$35/MWh	\$0
PhotoVoltaic (Solar)	-\$10/MWh	\$0



Hedge Settlement: (Hub or Load Zone) to Resource Node

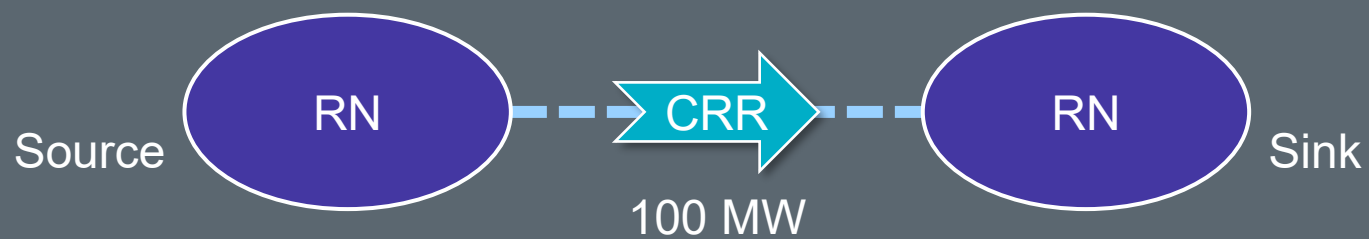


$$\text{Hedge Value} = (\text{MAXRESPR} - \text{Source DASPP}) * \text{Quantity}$$



MAXRESPR	Maximum Resource Price
DASPP	Day-Ahead Settlement Point Price

Hedge Settlement: Resource Node to Resource Node



$$\text{Hedge Value} = (\text{MAXRESPR} - \text{MINRESPR}) * \text{Quantity}$$

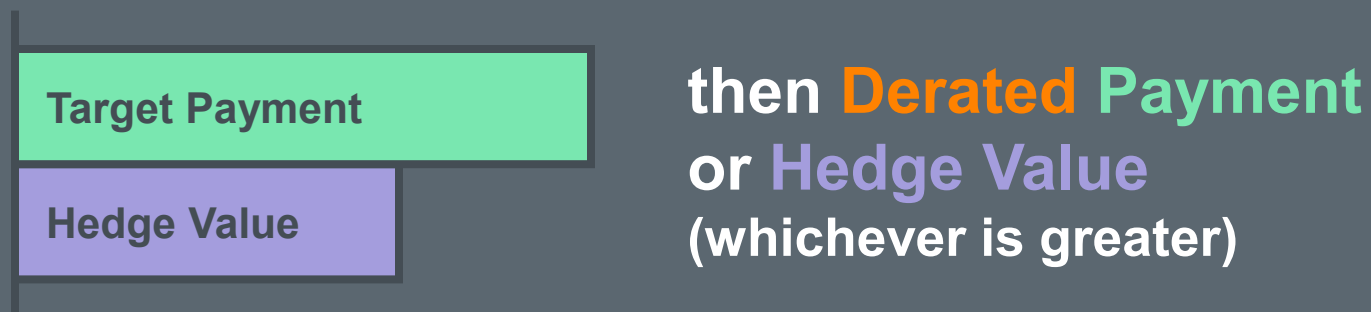


MAXRESPR	Maximum Resource Price
MINRESPR	Minimum Resource Price

CRR Settlement is a comparison of:
Target Payment, **Derated Amount** and **Hedge Value**



Otherwise



CRR Settlement is a comparison of:
Target Payment, **Derated Amount** and **Hedge Value**



$$(-1) * \text{Max} \left(\begin{array}{c} (\text{Target Payment} - \text{Derated Amount}) \\ \text{or} \\ \text{Min} (\text{Target Payment or Hedge Value}) \end{array} \right)$$



PTP Obligation Settlement in DAM

PTP Obligation Settlement compares: Target Payment, Derated Amount and Hedge Value



$$(-1) * \text{Max} \left(\begin{array}{c} (\text{Target Payment} - \text{Derated Amount}) \\ \text{or} \\ \text{Min} (\text{Target Payment or Hedge Value}) \end{array} \right)$$



PTP Obligation Settlement for a given hour

- Target Payment (TP) = \$100
- Derated Amount (DA) = \$10
- Hedge Value (HV) = \$160
- Sink is a Resource Node



$$\text{Obligation} = (-1) * \text{Max} [(\text{TP} - \text{DA}), \text{Min} (\text{TP}, \text{HV})]$$

$$\text{Obligation} = (-1) * \text{Max} [(\$100 - \$10), \text{Min} (\$100, \$160)]$$

$$\text{Obligation} = (-1) * \text{Max} [\$90, \$100]$$

-\$100 for the Obligation for the hour



DAOBLAMT = Day-Ahead Obligation Amount

$$DAOBLAMT_{o,(j,k)} = (-1) * \text{Max} [(DAOBLTP_{o,(j,k)} - DAOBLDA_{o,(j,k)}), \text{Min} (DAOBLTP_{o,(j,k)}, DAOBLHV_{o,(j,k)})]$$

When TP > 0 and Sink is a Resource Node, otherwise

$$DAOBLAMT_{o,(j,k)} = (-1) * DAOBLTP_{o,(j,k)}$$



DAOBLTP	Day-Ahead Obligation Target Payment
DAOBLDA	Day-Ahead Obligation Derated Amount
DAOBLHV	Day-Ahead Obligation Hedge Value
o, (j, k)	CRR Owner, (Source & Sink) Settlement Point

Settle a PTP Obligation for Hour 14

- Target Payment (TP) = \$200
- Derated Amount (DA) = \$25
- Hedge Value (HV) = \$150
- Sink is a Resource Node



PTP Option Settlement in DAM

PTP Option Settlement compares:
Target Payment, **Derated Amount** and **Hedge Value**



$$(-1) * \text{Max} \left(\begin{array}{c} (\text{Target Payment} - \text{Derated Amount}) \\ \text{or} \\ \text{Min} (\text{Target Payment or Hedge Value}) \end{array} \right)$$



PTP Option Settlement for a given hour

- Target Payment (TP) = \$300
- Derated Amount (DA) = \$250
- Hedge Value (HV) = \$120
- Sink is a Resource Node



$$\text{Option} = (-1) * \text{Max} [(\text{TP} - \text{DA}), \text{Min} (\text{TP}, \text{HV})]$$

$$\text{Option} = (-1) * \text{Max} [(\$300 - \$250), \text{Min} (\$300, \$120)]$$

$$\text{Option} = (-1) * \text{Max} [\$50, \$120]$$

-\$120 for the Option for the hour



DAOPTAMT = Day-Ahead Option Amount

$$\text{DAOPTAMT}_{o,(j,k)} = (-1) * \text{Max} [(\text{DAOPTTP}_{o,(j,k)} - \text{DAOPTDA}_{o,(j,k)}), \text{Min} (\text{DAOPTTP}_{o,(j,k)}, \text{DAOPTHV}_{o,(j,k)})]$$

When Sink is a Resource Node, otherwise

$$\text{DAOPTAMT}_{o,(j,k)} = (-1) * \text{DAOPTTP}_{o,(j,k)}$$



DAOPTTP	Day-Ahead Option Target Payment
DAOPTDA	Day-Ahead Option Derated Amount
DAOPTHV	Day-Ahead Option Hedge Value
o, (j, k)	CRR Owner, (Source & Sink) Settlement Point



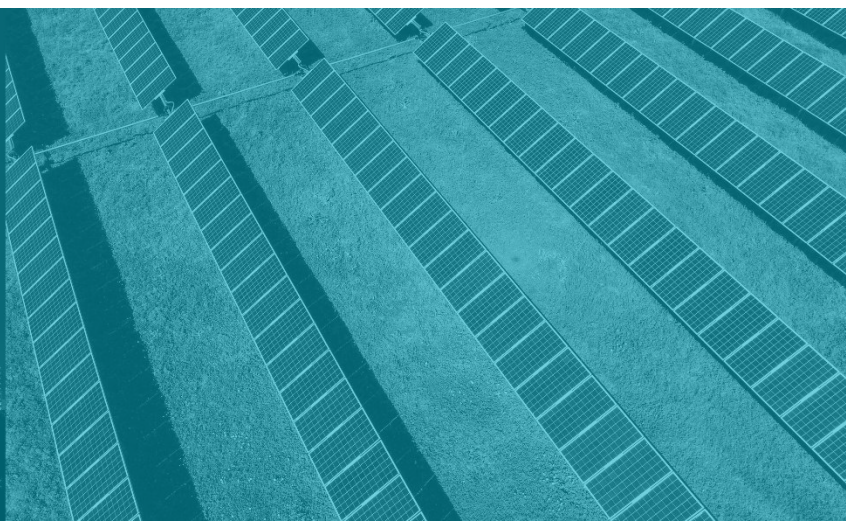
Settle a PTP Option for Hour 15

- Target Payment (TP) = \$400
- Derated Amount (DA) = \$200
- Hedge Value (HV) = \$100
- Sink is not a Resource Node





Shortfall Charges



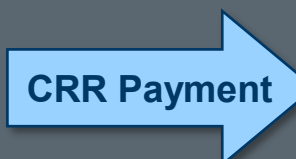
Congestion Rent is the source of CRR Payments in DAM



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

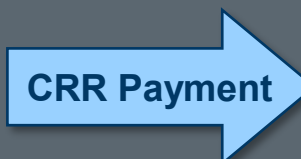


- Payments for DAM Energy Offers
- Payments for DAM PTP Obligation Bids



Sometimes collected Congestion Rent is not enough!
Result is Shortfall Charge

$$\text{Shortfall Charge} = \left(\frac{\text{Total CRR Shortfall}}{\text{Total CRR}} \right) * \left(\frac{\text{CRRAH Payment}}{\text{Total CRR Payments}} \right)$$



Congestion Rent Shortfall for a given hour

- Total CRR Shortfall = \$150,000
- CRRAH Payment = \$9,000
- Total CRR Payments = \$900,000



$$\text{Shortfall} = \text{Total CRR Shortfall} * (\text{CRRAH Payment} / \text{Total CRR Payments})$$

$$\text{Shortfall} = \$150,000 * (\$9,000 / \$900,000)$$

$$\text{Shortfall} = \$150,000 * 0.01$$

\$1,500 Shortfall Charge for the hour



DACRRSAMT = Day-Ahead **CRR** Shortfall **Amount**

$$\text{DACRRSAMT}_o = \text{DACRRSAMTTOT} * \text{CRRCRRSDA}_o$$



DACRRSAMTTOT	Day-Ahead CRR Shortfall Amount Total
CRRCRRSDA	CRR Credit Ratio Share Day-Ahead
o	CRR Owner



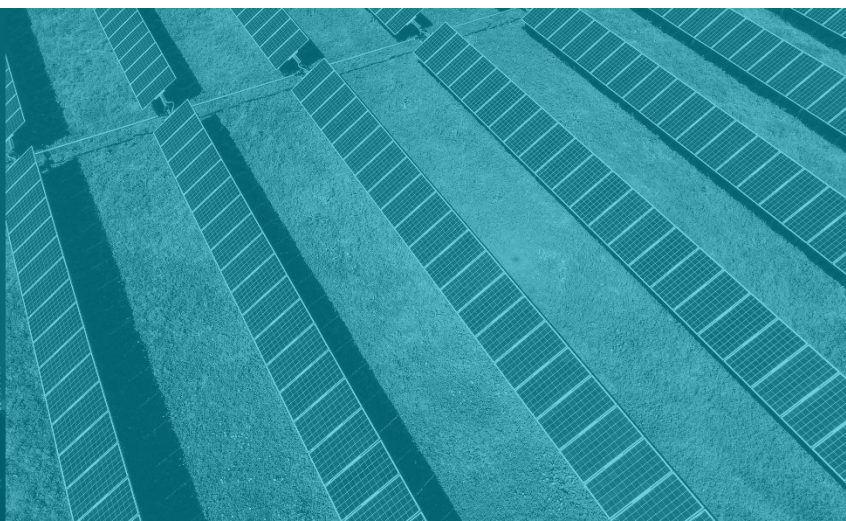
Settle the Shortfall for Hour 16

- Total CRR Shortfall = \$275,000
- CRR Credit Ratio Share = 4%





CRR Balancing Account



CRR Settlement in DAM



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



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



CRR Settlement in DAM: Some hours have a Shortfall



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



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



CRR Settlement in DAM: Other hours have excess Congestion Rent



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

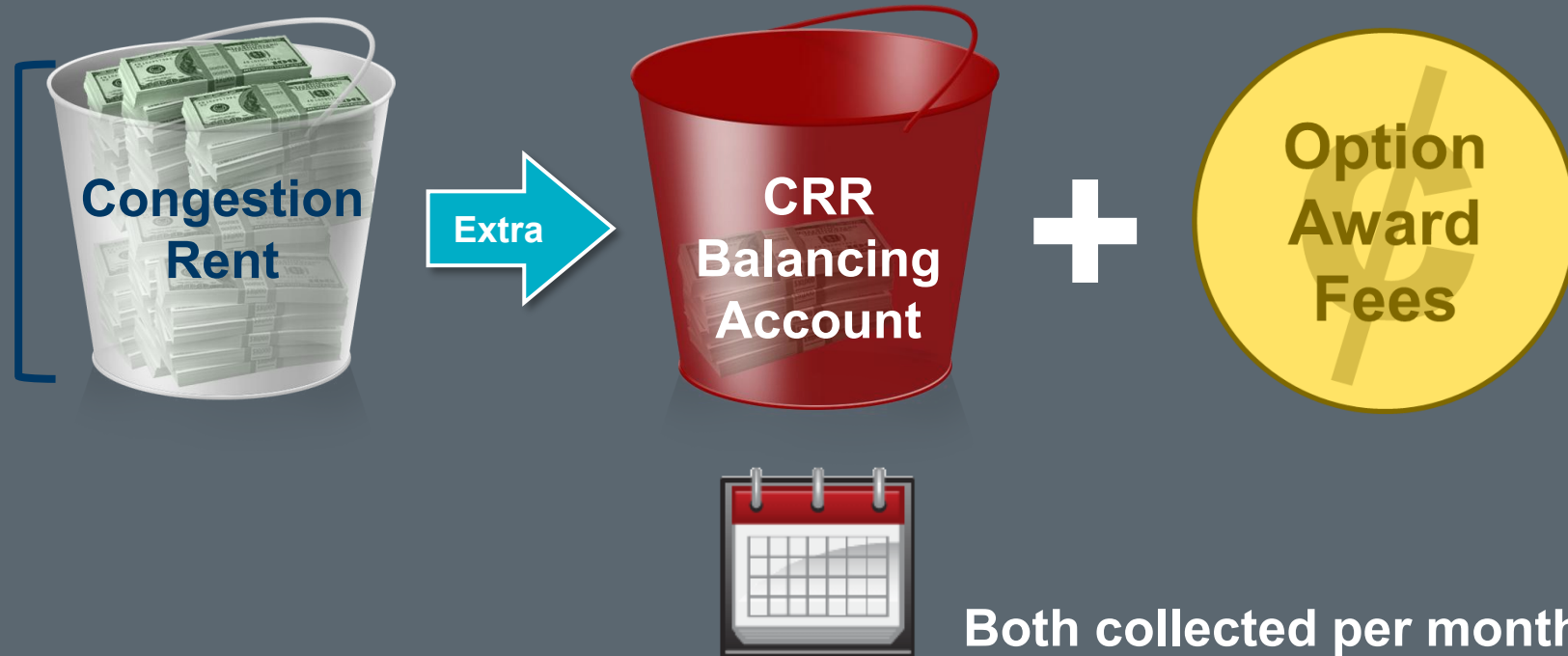


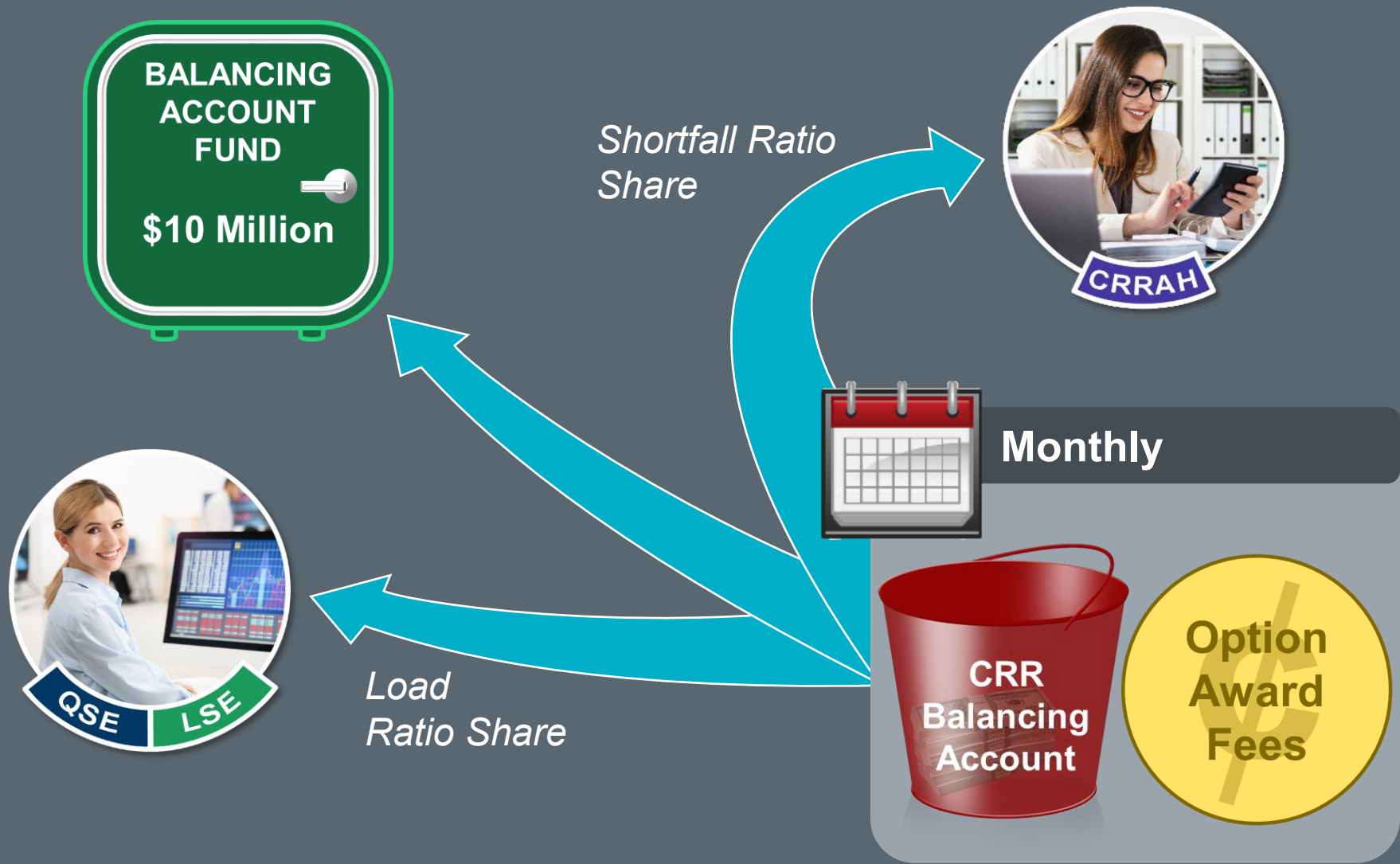
- Payments for DAM Energy Offers
- Payments for DAM PTP Obligation Bids

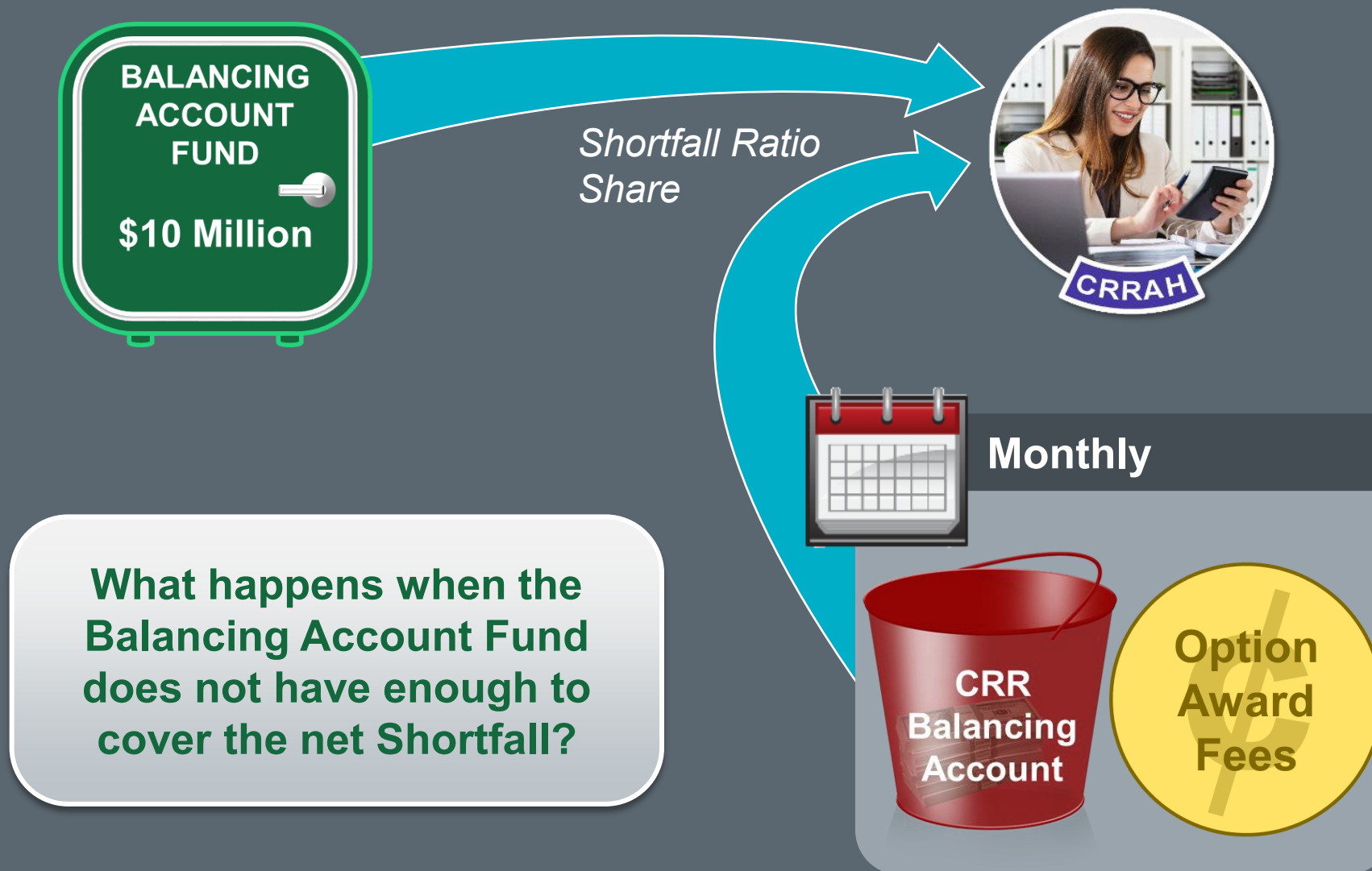


The CRR Balancing Account:

- Extra Congestion Rent
- Option Award Fees







CRR Refund total for a given month

- Balancing Account = \$15,000,000
- Option Award Fees = \$100,000
- Shortfall Charges = \$13,500,000



CRR Refund = $(-1) * \text{Min} (\text{Balancing Account} + \text{Option Fees}, \text{Shortfall Charges})$

CRR Refund = $(-1) * \text{Min} (\$15,000,000 + \$100,000, \$13,500,000)$

CRR Refund = $(-1) * \text{Min} (\$15,100,000, \$13,500,000)$

-\$13,500,000 is the CRR Refund for the month



CRRRAMT = CRR Refund Amount

$$\text{CRRRAMT}_o = (-1) * \text{Min} (\text{CRRBACRTOT} + \text{CRRFEETOT}, \text{CRRSAMTTOT}) * \text{CRRSAMTRS}_o$$

CRRBACRTOT	CRR Balancing Account Credit Total
CRRFEETOT	CRR Option Award (Fee) Total
CRRSAMTTOT	CRR Shortfall Amount Total
CRRSAMTRS	CRR Shortfall Amount Ratio Share
o	CRR Owner



CRRRAMT = CRR Refund Amount

$$\text{CRRRAMT}_o = (-1) * \text{Min} (\text{CRRBACRTOT} + \text{CRRFEETOT} + \text{CRRBAFA}_m, \text{CRRSAMTTOT}) * \text{CRRSAMTRS}_o$$

CRRBACRTOT	CRR Balancing Account Credit Total
CRRFEETOT	CRR Option Award (Fee) Total
CRRBAFA	CRR Balancing Account Fund Available
CRRSAMTTOT	CRR Shortfall Amount Total
CRRSAMTRS	CRR Shortfall Amount Ratio Share
o, m	CRR Owner, Month





Settle the CRR Refund for August 2022

- Balancing Account = \$19,800,000
- Option Award Fees = \$200,000
- Balancing Account Fund = \$5,000,000
- Shortfall Charges = \$28,500,000
- Shortfall Ratio Share = 3%



Topics in this course included:

1

CRR Auction Bids

2

CRR Auction Offers

3

PTP Option Award Fees

4

CRR Auction Revenues

5

CRR Settlement in DAM

6

Shortfall Charges

7

CRR Balancing Account

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