

Settlement: Congestion Revenue Rights



2026_02 CRR

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

Settlement Equation

Topics in this course include:

1. CRR Auction Bids & CRR Auction Offers
2. PTP Option Award Fees
3. Pre-Assigned CRRs
4. CRR Auction Revenues
5. CRR Settlement in DAM
6. Shortfall Charges
7. CRR Balancing Account

Which Markets and Which Participants?

CRR Auction

DAM

Real-Time

Three Settlement Processes

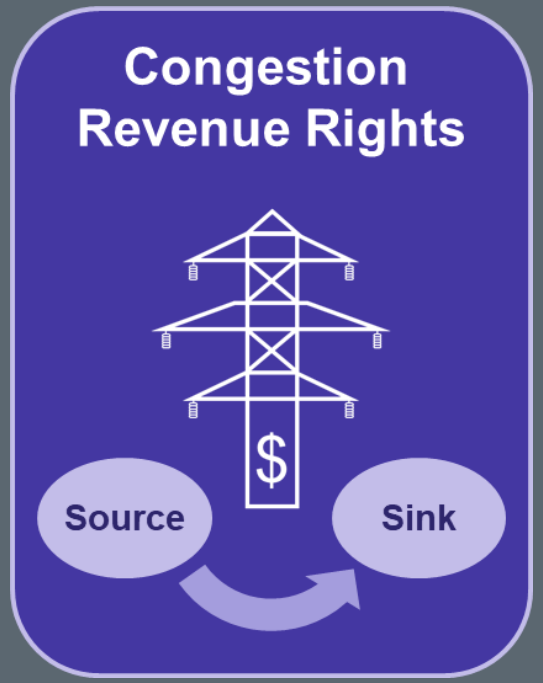
- Auctions
- DAM Settlement
- Balancing Account

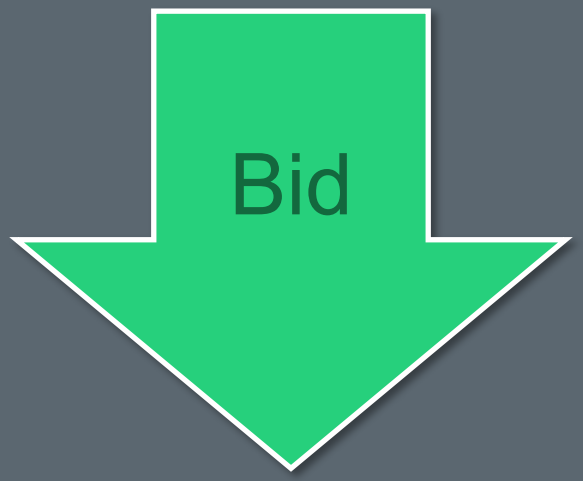
Point-to-Point Obligations (OBL)

Payment or Charge in DAM

Point-to-Point Options (OPT)

Payment only in DAM





Proposal to buy

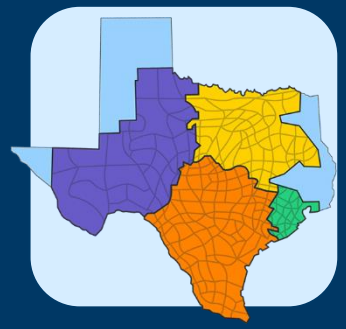
- A Product
- At a Location Pair
- For a Max Price

Proposal to Sell

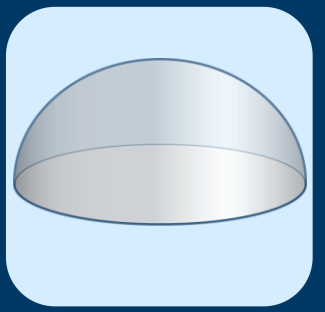
- A Product
- At a Location Pair
- For a Min Price

Resource Node (RN)

Load Zone (LZ)



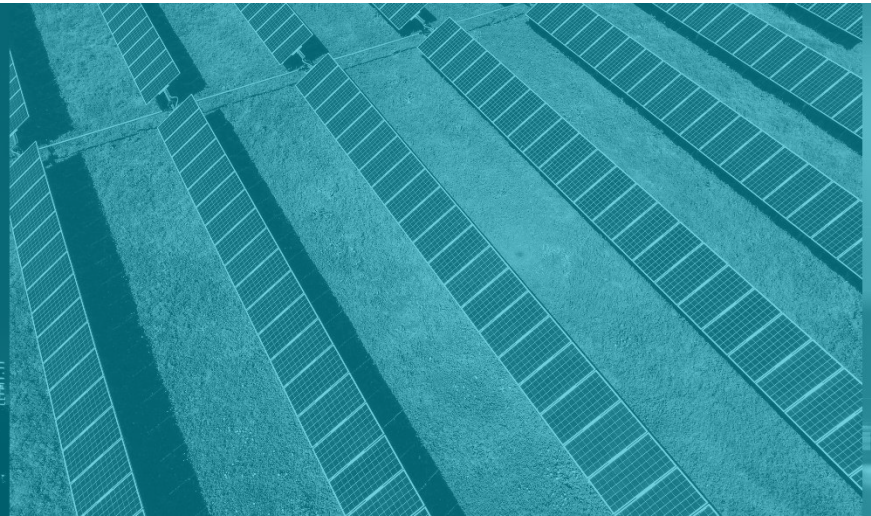
Hub (HB)

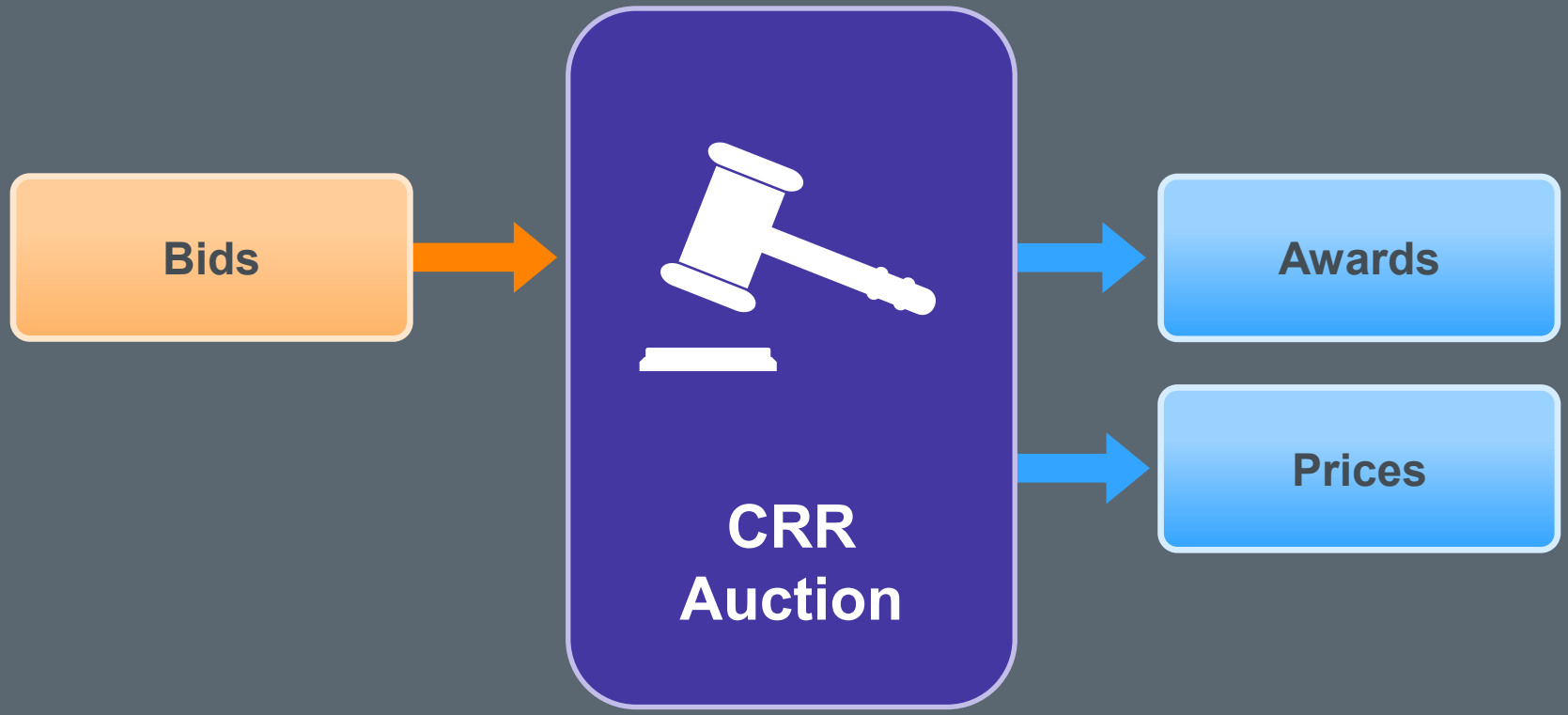


Where is the Payment (-) or the Charge (+) to the CRRAH?



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

$$OPTPAMT_{crrh,(j,k),a} = OPTPR_{(j,k),a} * OPTP_{crrh,(j,k),a}$$

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

OBLPAMT = PTP Obligation Purchase Amount

$$OBLPAMT_{crrh,(j,k),a} = OBLPR_{(j,k),a} * OBLP_{crrh,(j,k),a}$$

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

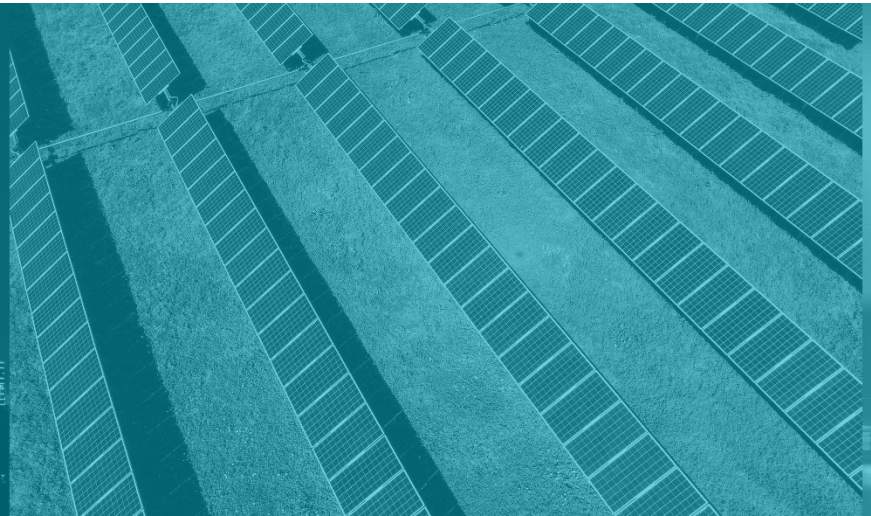
Settle Awarded PTP Obligation Bid

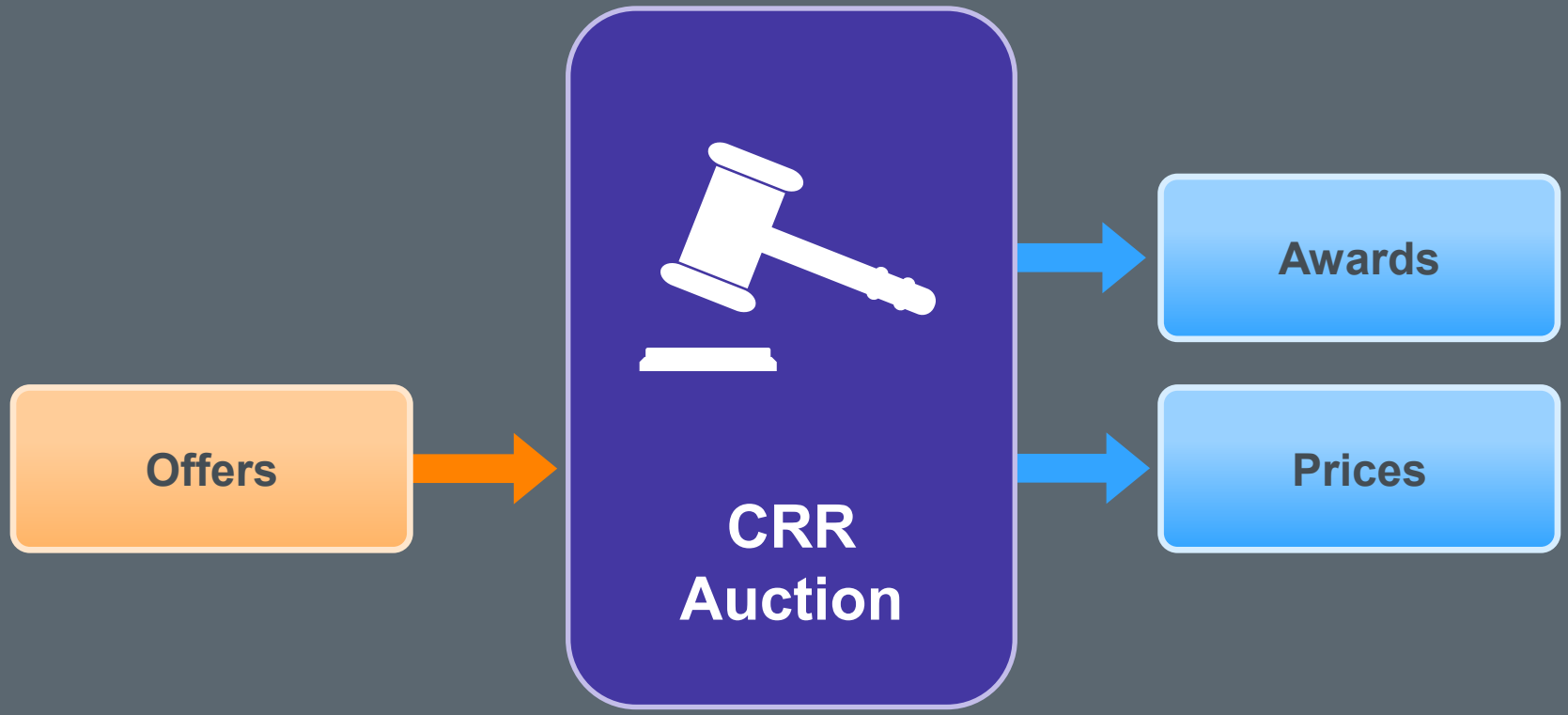
- Obligation Quantity = 14MW Peak Weekend for January 2022
- 160 Peak Weekend (2x16) hours in January 2022
- Awarded Obligation Price = $2/MW

CRR Auction



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) * Obligation Price * Obligation Quantity

Awarded PTP Obligation = (-1) * $1/MW * 5MW

-$5 for one hour of the PTP Obligation

Awarded TOU Period = Hourly Value * Total Hours

Awarded TOU Period = -$5 * 248

-$1,240 for January 2022

OBLSAMT = PTP Obligation Sale Amount

$$OBLSAMT_{crrh,(j,k),a} = (-1) * OBLPR_{(j,k),a} * OBLS_{crrh,(j,k),a}$$

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

OPTSAMT = PTP Option Sale Amount

$$OPTSAMT_{crrh,(j,k),a} = (-1) * OPTPR_{(j,k),a} * OPTS_{crrh,(j,k),a}$$

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

Example 2: CRR Auction Offer

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

CRR Auction

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

$$OPTAFAMT_{crrh,a} = \sum_{bp} \sum_{h} \sum_{(j,k)} (Max (0, OPTMBP - OPTPR_{(j,k),a,h,bp}) * OPTP_{crrh,(j,k),a,h,bp})$$

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

Example 3: PTP Option Award Fee

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

Pre-Assigned CRRs

- **Based on long-term supply contracts (prior to 9/1/1999)**
- **Allocated based on annual nominations**
- **Cost = % of Auction Price (Pricing Factor)**

PCRR Pricing Factors

Resource Type	PCRR PTP Options	PCRR PTP Obligations
Nuclear, Coal, Lignite, Combined Cycle	10%	5%
Gas Steam	15%	7.5%
Hydro, Wind, Simple, Other	20%	10%

Pre-Assigned Option for a NOIE

- PCRR Option Quantity = 15MW Peak Weekday for August 2022
- 368 Peak Weekday (5x16) hours in August 2022
- Awarded Option Price = $6/MW
- Pricing Factor = 20% for Wind

Pre-Assigned Option = Option Price * PCRR Quantity * Factor

Pre-Assigned PTP Option = $6/MW * 15MW * 20%

$18 for one hour of the Pre-Assigned Option

Pre-Assigned TOU Period = Hourly Value * Total Hours

Pre-Assigned TOU Period = $18 * 368

$6,624 for August 2022

PCRROPTAMT = PCRR PTP Option Amount

$$PCRROPTAMT_{crrh,(j,k),a,tech} = PCRROPTF_{tech} * OPTPR_{(j,k),a} * PCRROPT_{crrh,(j,k),a,tech}$$

PCRROPTF	PCRR PTP Option Pricing Factor
OPTPR	PTP Option Price
PCRROPT	PCRR PTP Option Quantity
crrh, a	CRR Account Holder, CRR Auction
j, k	Source & Sink Settlement Point
tech	Resource Technology

PCRROBLAMT = PCRR PTP Obligation Amount

$$PCRROBLAMT_{crrh,(j,k),a,tech} = PCRROBLF_{tech} * OBLPR_{(j,k),a} * PCRROBL_{crrh,(j,k),a,tech}$$

When $OBLPR_{(j,k),a} > \$0$

PCRROBLF	PCRR PTP Obligation Pricing Factor
OBLPR	PTP Obligation Price
PCRROBL	PCRR PTP Obligation Quantity
crrh, a	CRR Account Holder, CRR Auction
j, k	Source & Sink Settlement Point
tech	Resource Technology

PCRROBLAMT = PCRR PTP Obligation Amount

$$PCRROBLAMT_{crrh,(j,k),a,tech} = OBLPR_{(j,k),a} * PCRROBL_{crrh,(j,k),a,tech}$$

When $OBLPR_{(j,k),a} \leq \$0$

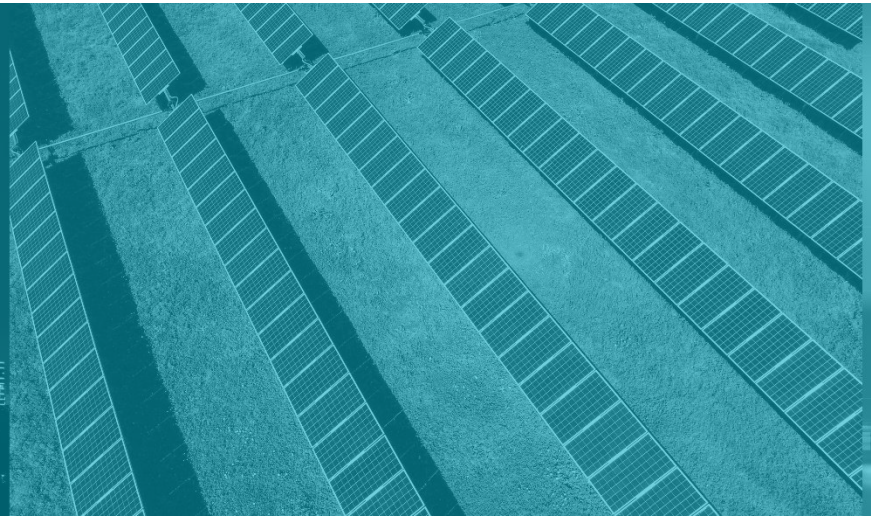
OBLPR	PTP Obligation Price
PCRROBL	PCRR PTP Obligation Quantity
crrh, a	CRR Account Holder, CRR Auction
j, k	Source & Sink Settlement Point
tech	Resource Technology

Settle a Pre-Assigned Obligation for a NOIE

- PCRR Obligation Quantity = 14MW Peak Weekend for August 2022
- 128 Peak Weekend (2x16) hours in August 2022
- Awarded Obligation Price = $5/MW
- Pricing Factor = 10% for Wind



CRR Auction Revenues


CRR Auction Revenue Distribution (CARD): Concept

Distribution occurs once each month

CARD Collection & Distribution: Concept

Zonal Load Ratio Share

Non-Zonal Load Ratio Share

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%

Zonal Revenue = (-1) * (**CRR Revenue** + **PCRR Revenue**) * **Monthly Zonal Load Ratio Share**

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

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

LACMRZAMT = Load-Allocated CRR Monthly Revenue Zonal Amount

$$LACMRZAMT_{z,q} = (-1) * \sum_a (CRRZREV_{z,a} + PCRRZREV_{z,a}) * MLRSZ_{z,q}$$

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

$$LACMRNZAMT_q = (-1) * \sum_a (CRRNZREV_a + PCRRNZREV_a) * MLRS_q$$

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

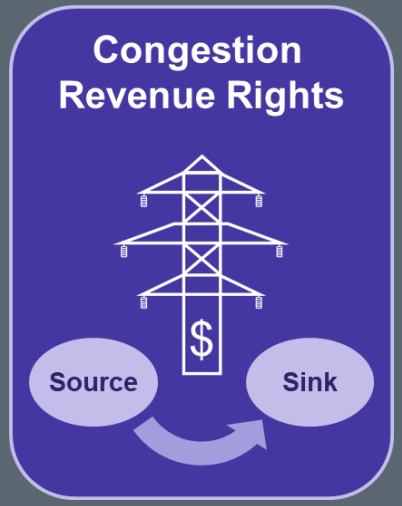
Settle Non-Zonal CRR Monthly Revenue

- 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

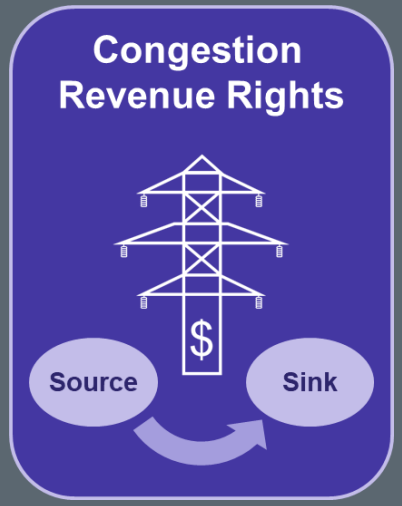
CRR Settlement in DAM may be as expected…
or CRR Payments may be derated



Expected Settlement: When CRR Sink ≠ Resource Node or Transmission Elements not oversold

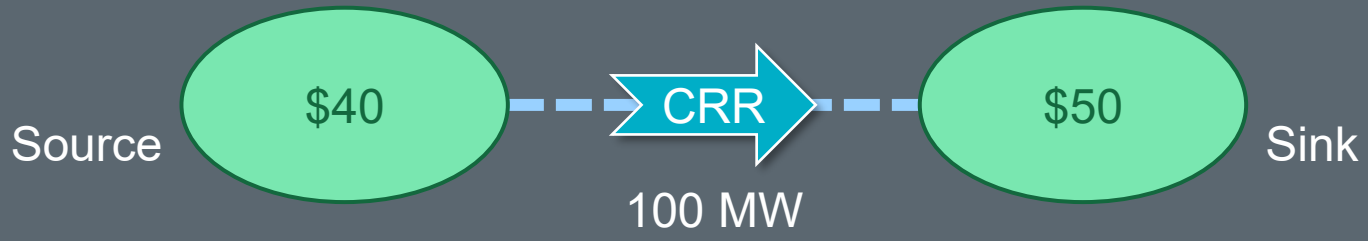
Derated Settlement of CRRs in DAM

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



Hedge Setttlement limits Derated Settlement

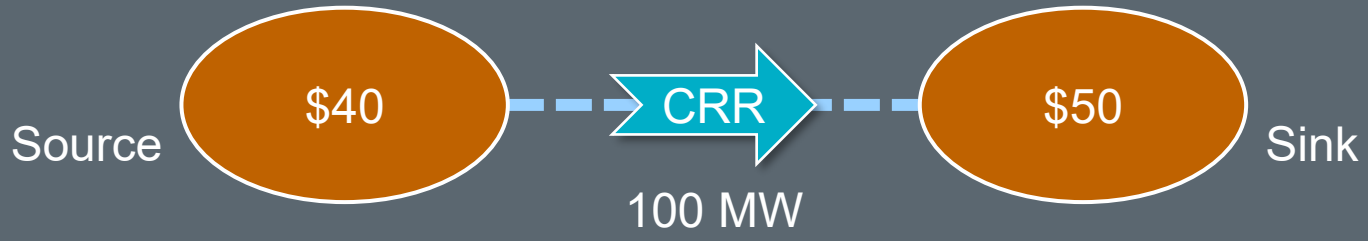
Expected Settlement



Target Payment = (Sink DASPP – Source DASPP) * Quantity

DASPP	Day-Ahead Settlement Point Price

Derated Settlement



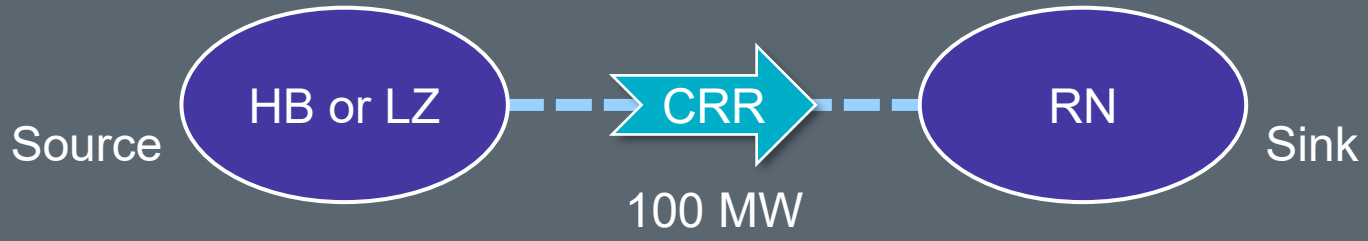
Derated Amount = $\sum_c$(Congestion Value$_c$ * Deration Factor$_c$) * Quantity

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

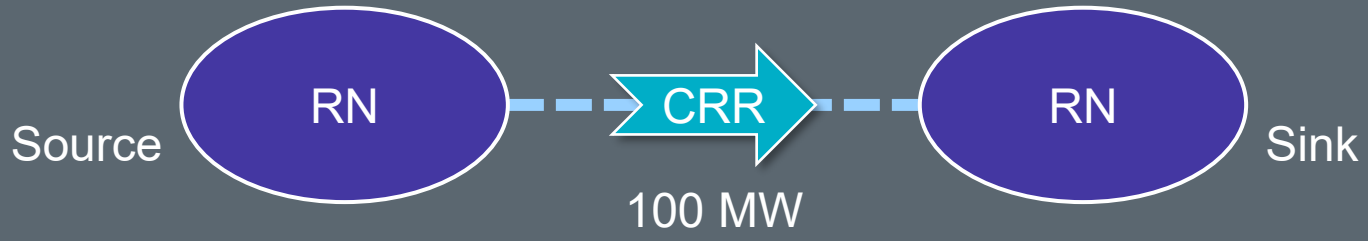
Hedge Settlement: (Hub or Load Zone) to Resource Node



Hedge Value = (MAXRESPR – Source DASPP) * Quantity

MAXRESPR	Maximum Resource Price
DASPP	Day-Ahead Settlement Point Price

Hedge Settlement: Resource Node to Resource Node



Hedge Value = (MAXRESPR – MINRESPR) * Quantity

MAXRESPR	Maximum Resource Price
MINRESPR	Minimum Resource Price

CRR Settlement is a comparison of:

Target Payment, Derated Amount and Hedge Value

If

- Target Payment
- Hedge Value

then Target Payment

Otherwise

- Target Payment
- Hedge Value

then Derated Payment or Hedge Value (whichever is greater)

CRR Settlement is a comparison of:

Target Payment, Derated Amount and Hedge Value

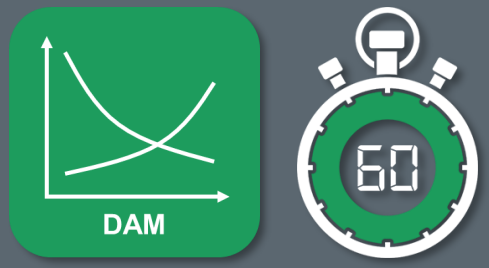
$$(-1) * \text{Max}\left(\begin{array}{c}(\text{Target Payment} - \text{Derated Amount}) \\ \text{or} \\ \text{Min}(\text{Target Payment or Hedge Value})\end{array}\right)$$

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

Obligation = (-1) * Max [(TP – DA), Min (TP, HV)]

Obligation = (-1) * Max [($100 – $10), Min ($100, $160)]

Obligation = (-1) * Max [$90, $100]

-$100 for the Obligation for the hour

DAOBLAMT = Day-Ahead Obligation Amount

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

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

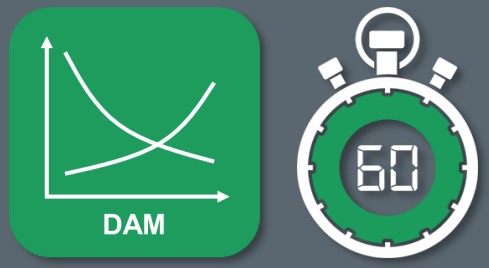
- Target Payment (TP) = $200
- Derated Amount (DA) = $25
- Hedge Value (HV) = $150
- Sink is a Resource Node

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

Option = (-1) * Max [(TP – DA), Min (TP, HV)]

Option = (-1) * Max [($300 – $250), Min ($300, $120)]

Option = (-1) * Max [$50, $120]

-$120 for the Option for the hour

DAOPTAMT = Day-Ahead Option Amount

$$DAOPTAMT_{o,(j,k)} = (-1) * Max\ [(DAOPTTP_{o,(j,k)} - DAOPTDA_{o(j,k)}),\ Min\ (DAOPTTP_{o,(j,k)},\ DAOPTHV_{o(j,k)})]$$

When Sink is a Resource Node, otherwise

$$DAOPTAMT_{o,(j,k)} = (-1) * DAOPTTP_{o,(j,k)}$$

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

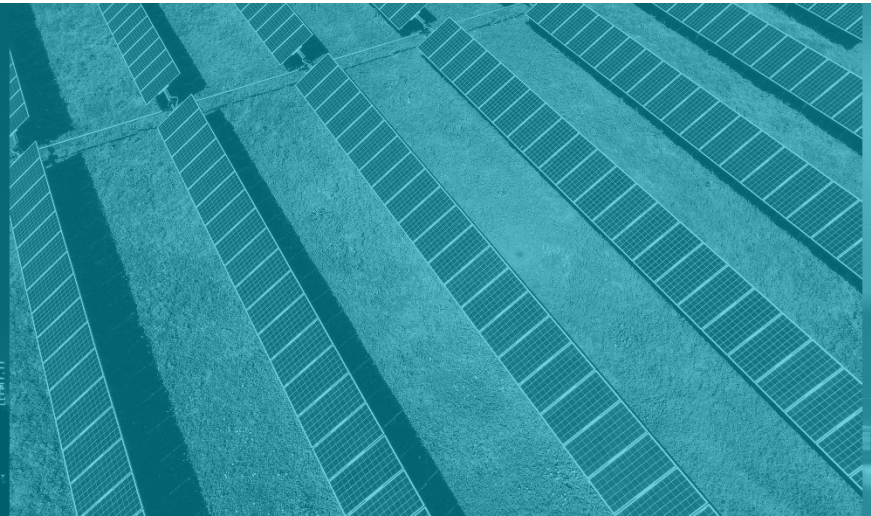
Example 7: PTP Option Settlement in DAM

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

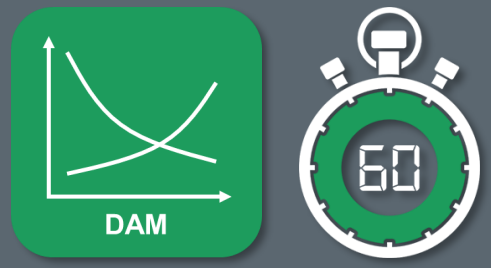
- Payments for DAM Energy Offers
- Payments for DAM PTP Obligation Bids

CRR Payment

Sometimes collected Congestion Rent is not enough!

Result is Shortfall Charge

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



Congestion Rent Shortfall for a given hour

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

Shortfall = Total CRR Shortfall * (CRRAH Payment / Total CRR Payments)

Shortfall = $150,000 * ($9,000 / $900,000)

Shortfall = $150,000 * 0.01

$1,500 Shortfall Charge for the hour

DACRRSAMT = Day-Ahead CRR Shortfall Amount

$$DACRRSAMT_o = DACRRSAMTTOT * CRRCRRSDA_o$$

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 Payment

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 Payment

CRR Settlement in DAM: Other hours have excess Congestion Rent

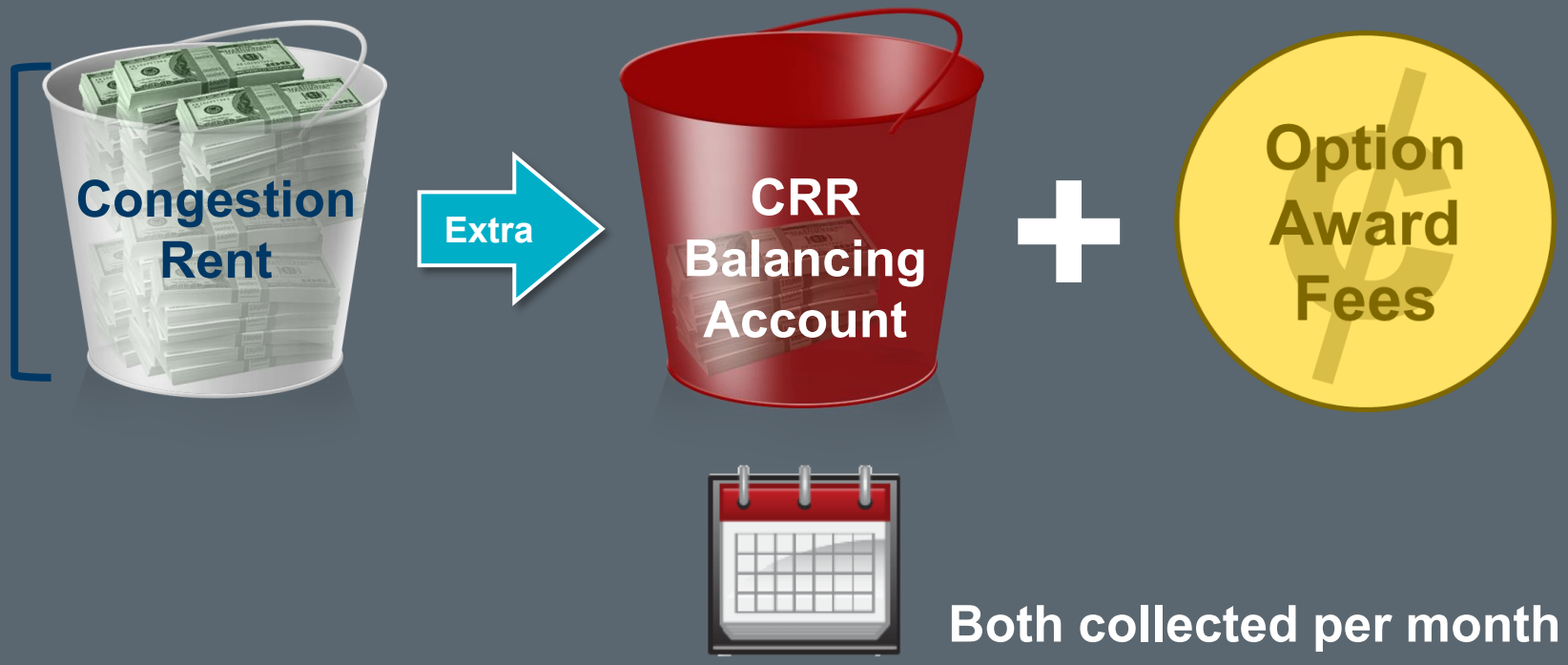
- Charges for DAM Energy Bids
- Charges for DAM PTP Obligation Bids

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

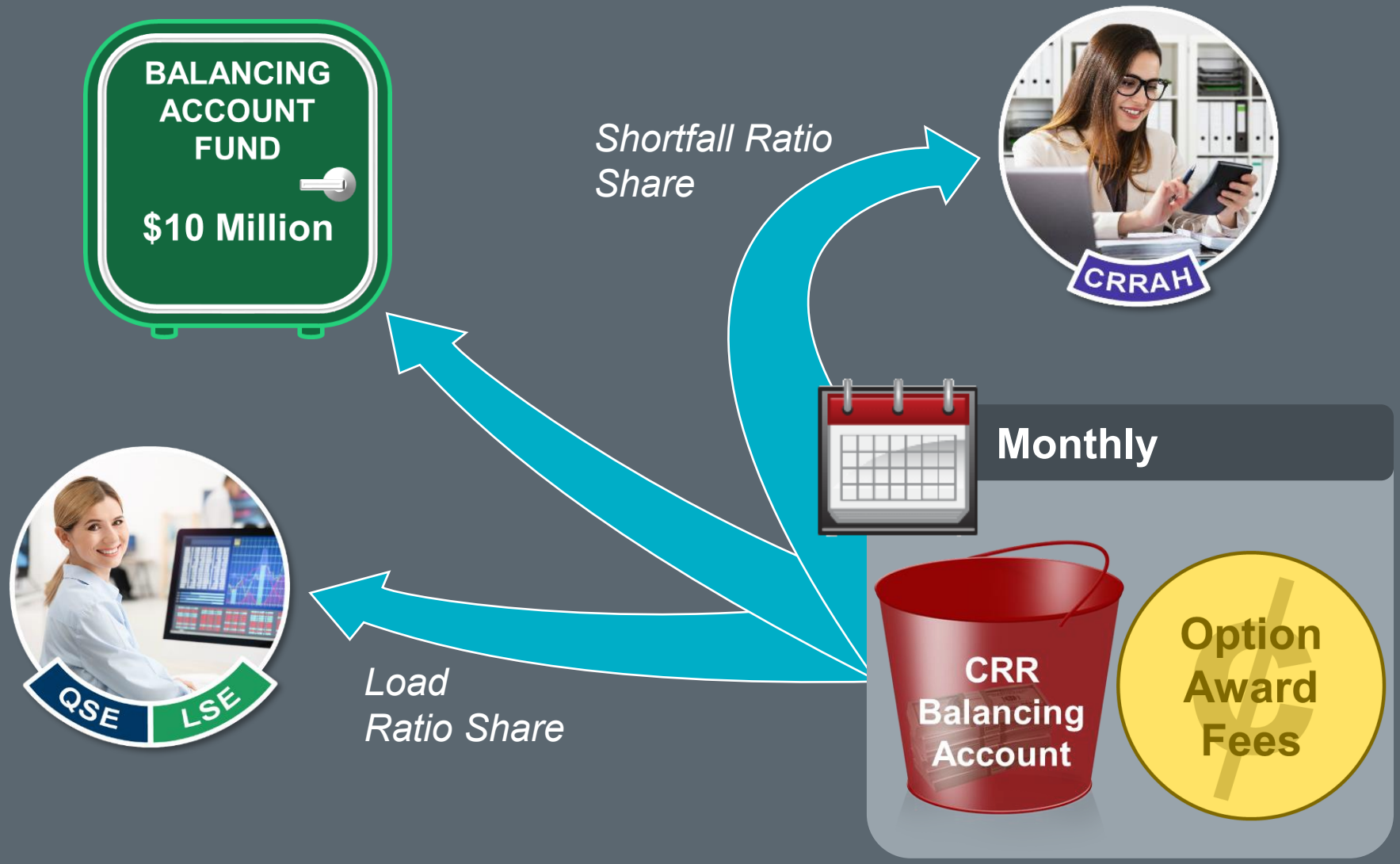
CRR Payment

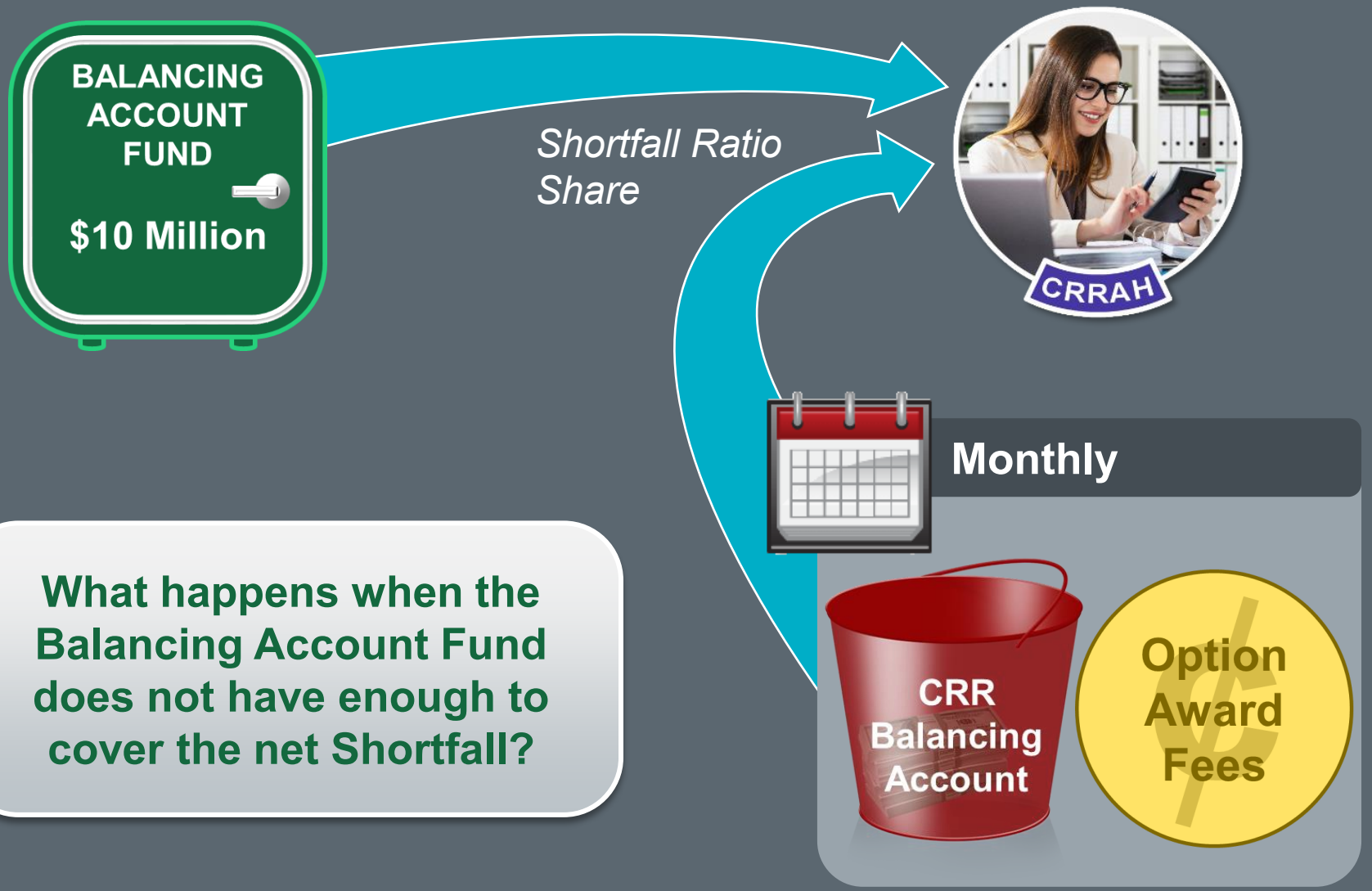
The CRR Balancing Account:

- Extra Congestion Rent
- Option Award Fees



CRR Balancing Account: Concept





What happens when the Balancing Account Fund does not have enough to cover the net Shortfall?

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) * Min (Balancing Account + Option Fees, Shortfall Charges)

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

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

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

CRRRAMT = CRR Refund Amount

$$CRRRAMT_o = (-1) * Min (CRRBACRTOT + CRRFEETOT, CRRSAMTTOT) * CRRSAMTRS_o$$

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

$$CRRRAMT_o = (-1) * Min (CRRBACRTOT + CRRFEETOT + CRRBAFA_m, CRRSAMTTOT) * CRRSAMTRS_o$$

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

Example 9: CRR Balancing Account

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 & CRR Auction Offers
2. PTP Option Award Fees
3. Pre-Assigned CRRs
4. CRR Auction Revenues
5. CRR Settlement in DAM
6. Shortfall Charges
7. CRR Balancing Account

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