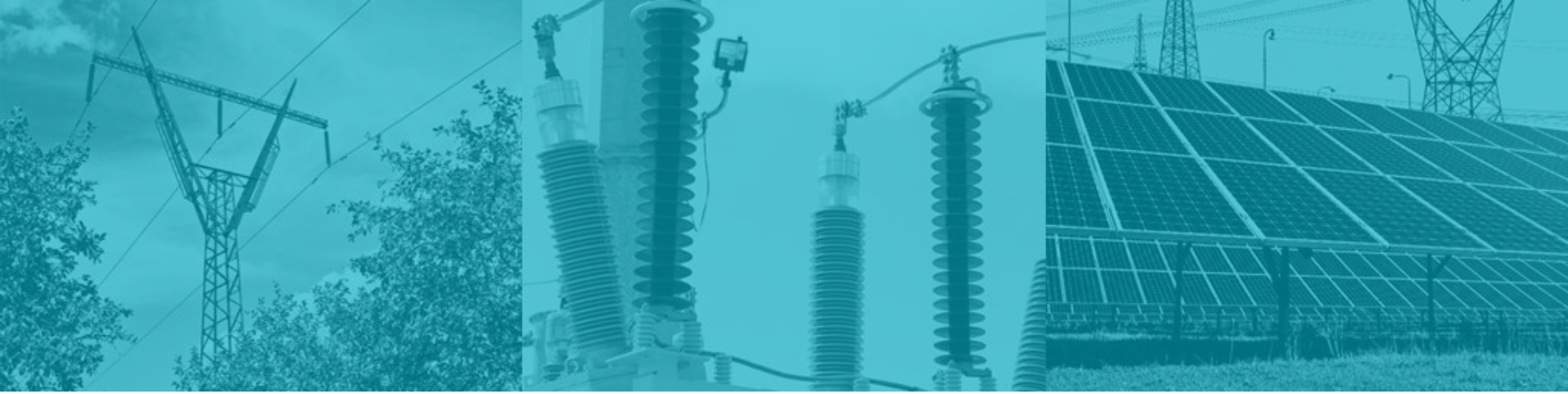


Settlement: Congestion Revenue Rights

2023_06 CRR

Greetings
and
Introductions

WebEx Tips

- Windows
- Buttons

Attendance

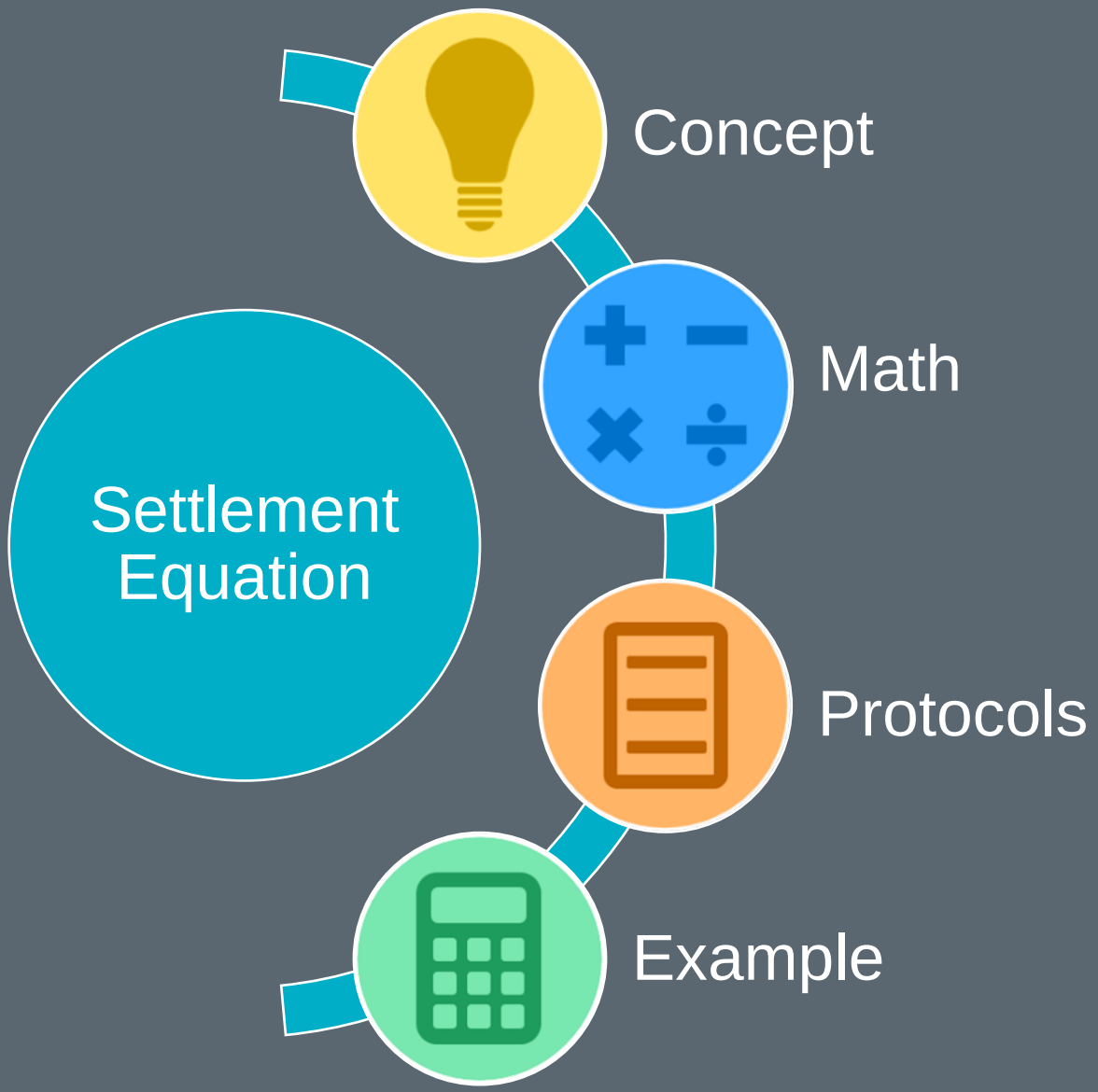
Questions / Chat

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
Settlement Equation
Protocols
Example

Topics in this course include:

1. Auction Bids
2. Auction Offers
3. Auction Revenues
4. Settlement in DAM
5. Shortfall Charges
6. Balancing Account

Which Markets & Which Participants?

CRR Auction

DAM

Real-Time

Three Settlement Processes

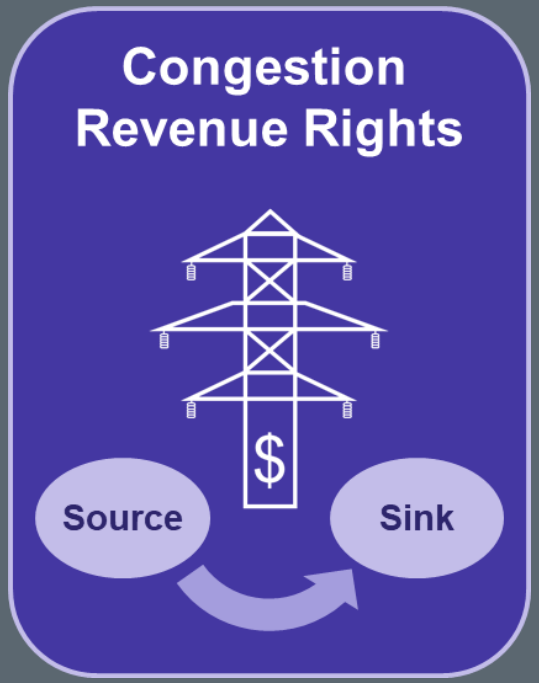
- Auctions
- Ownership (DAM)
- Balancing Account

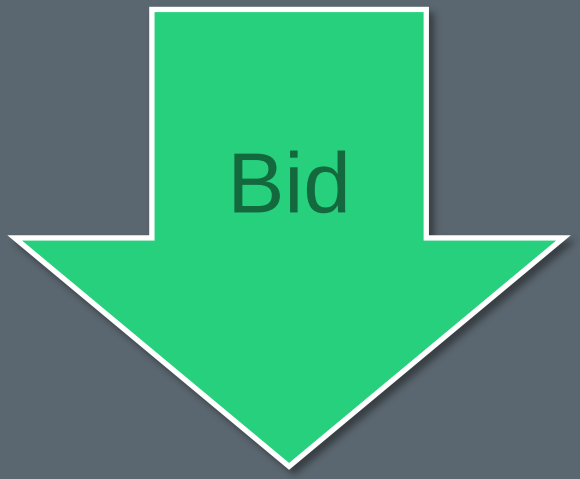
Point-to-Point Obligations (OBL)

Payment or Charge in DAM

Point-to-Point Options (OPT)

Payment only in DAM





Proposal to buy

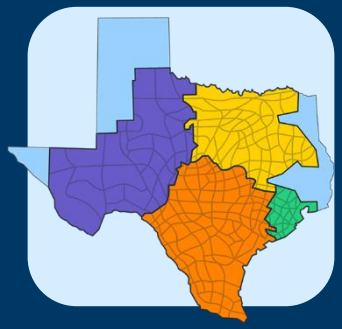
- A Product
- At a Location
- For a Max Price

Proposal to Sell

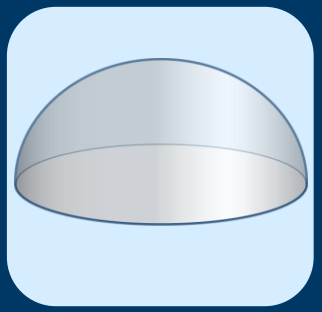
- A Product
- At a Location
- For a Min Price

Resource Node (RN)

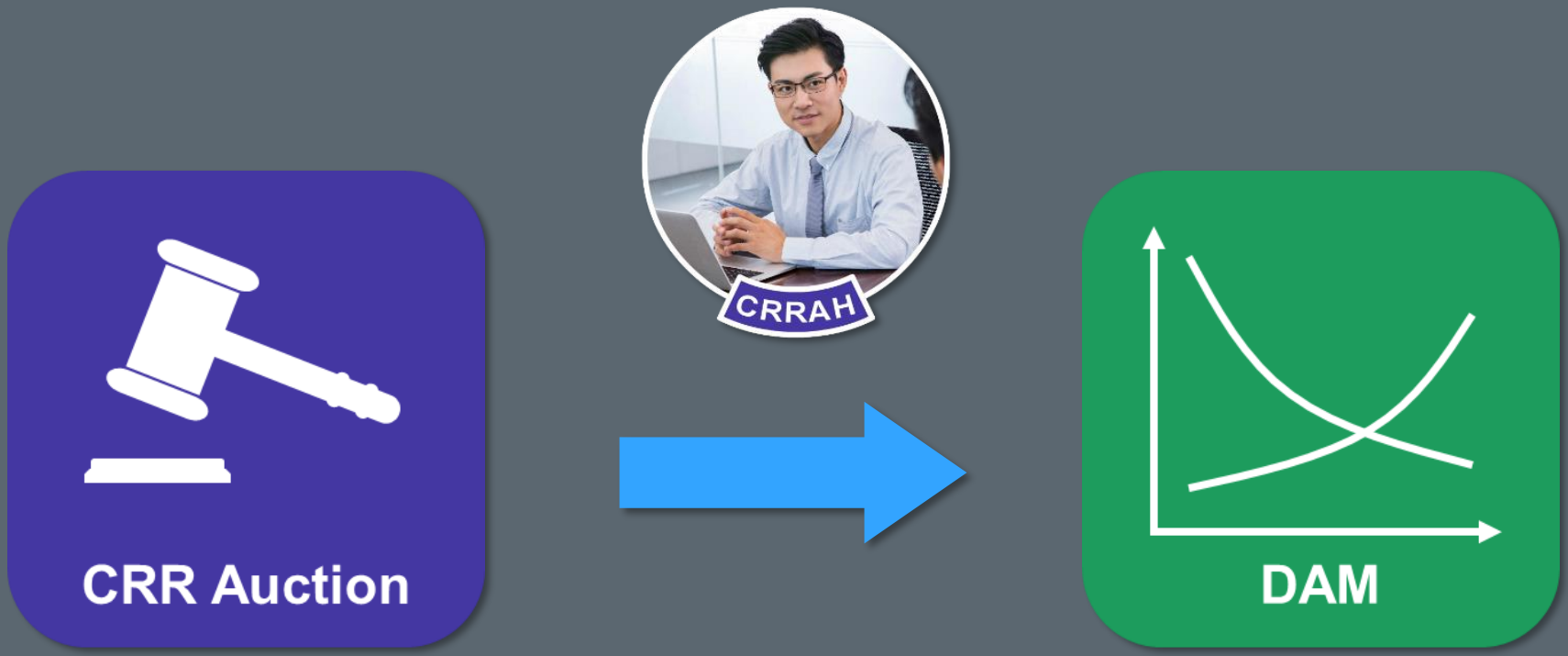
Load Zone (LZ)



Hub (HB)



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



CRR Auction Bid

Bids

CRR Auction

Awards

Prices

By Time-Of-Use (TOU) Block

Awarded PTP Option Bid

- 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 * 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

Example 1: CRR Auction Bid

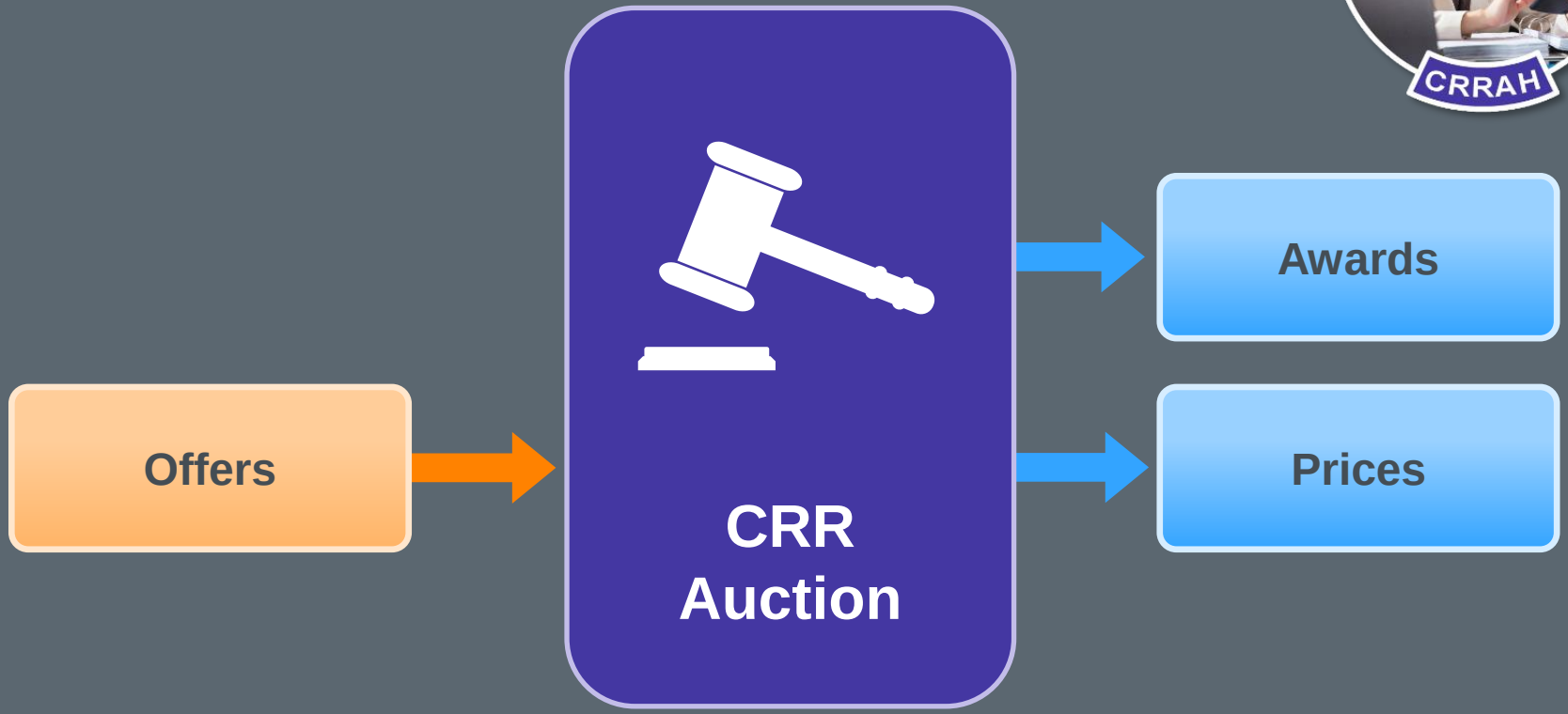
Settle Awarded PTP Obligation Bid

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

CRR Auction

CRR Auction Offer

CRR Auction Offer: Concept



By Time-Of-Use (TOU) Block

Awarded PTP Obligation Offer

- 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 * 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

- 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 Fee

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

- 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) * Quantity

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

$0.14 for one hour of 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

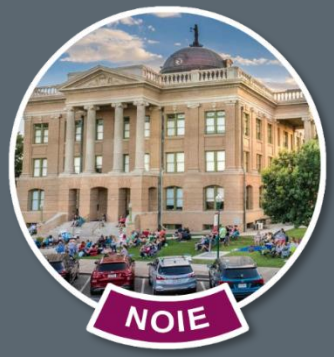
Example 3: PTP Option Award Fee

Settle a PTP Option Award Fee

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

Pre-Assigned CRRs

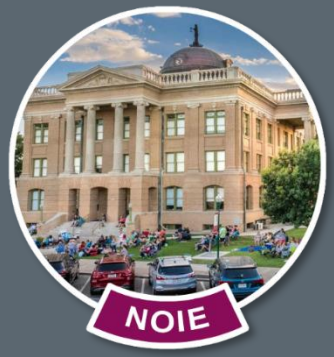
- **Based on long-term supply contracts (prior to 9/1/1999)**
- **Allocated based on annual nominations**
- **Cost = % of Auction Price (Pricing Factor)**



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 NOIE



- 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 * 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

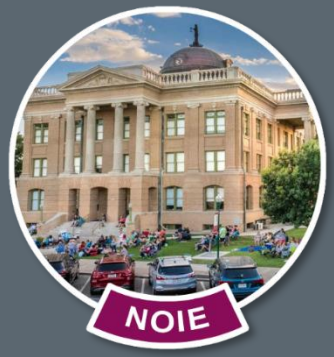
$$PCRROBLAMT_{crrh,(j,k),a,tech} = OBLPR_{(j,k),a} * PCRROBL_{crrh,(j,k),a,tech})$$

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 NOIE

- 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 Revenue Distribution Invoices

CRR Auction Revenue Distribution (CARD): Concept

Load Ratio Share

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
- PCRR Zonal Revenue = $100,000
- 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

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,

Example 5: CRR Auction Revenue Distribution (CARD)

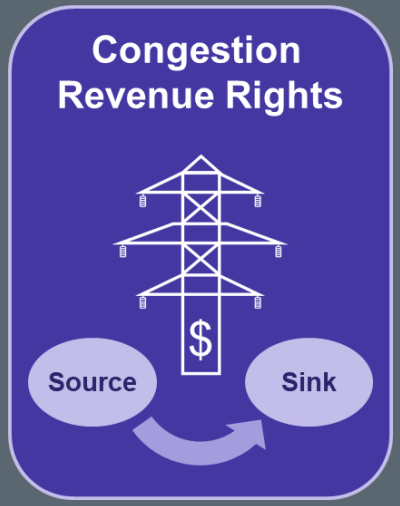
Settle Non-Zonal CRR Monthly Revenue

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

CRR Ownership Settlement in DAM (General Concepts)

CRR Settlement in DAM may be as expected…

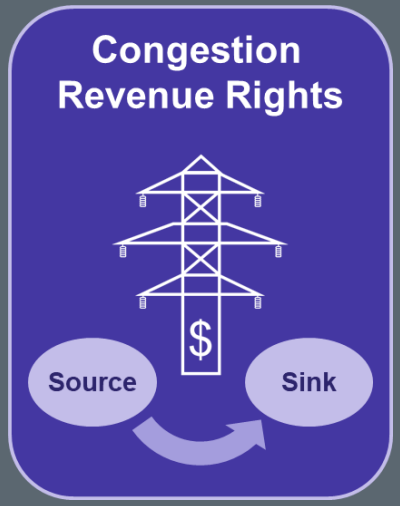
or CRR Payments may be derated



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

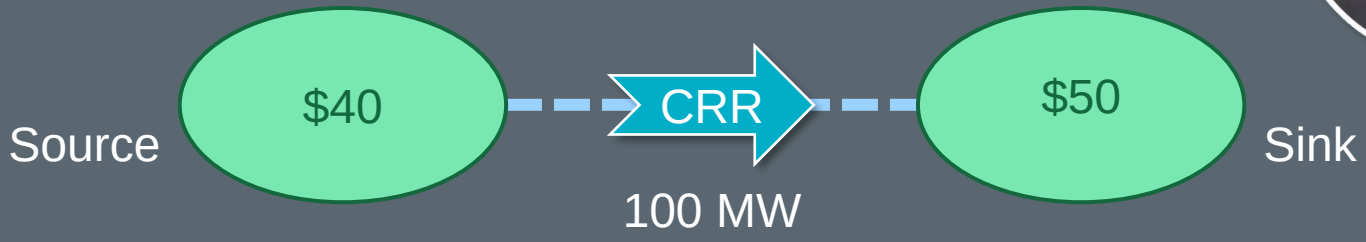
Derated Settlement of CRRs in DAM

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



Hedge Settlement limits Derated Settlement

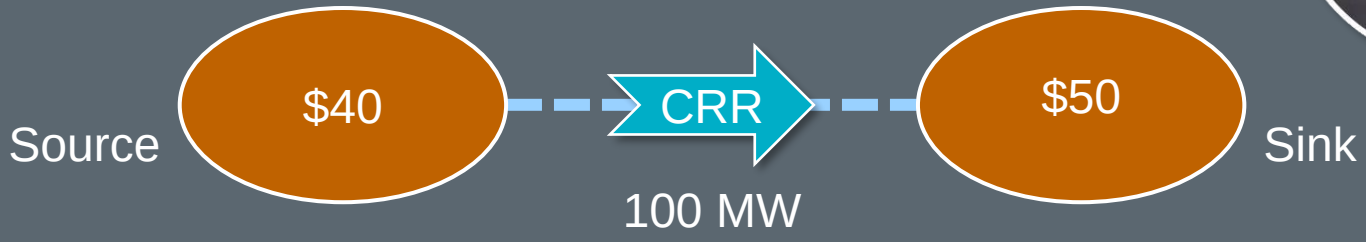
Expected Settlement



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

DASPP	Day-Ahead Settlement Point Price

Derated Settlement



Derated Amount =

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

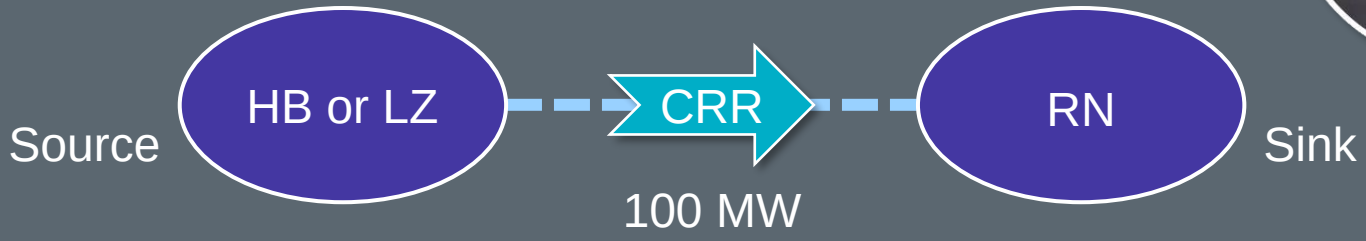
c	A constraint

- **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

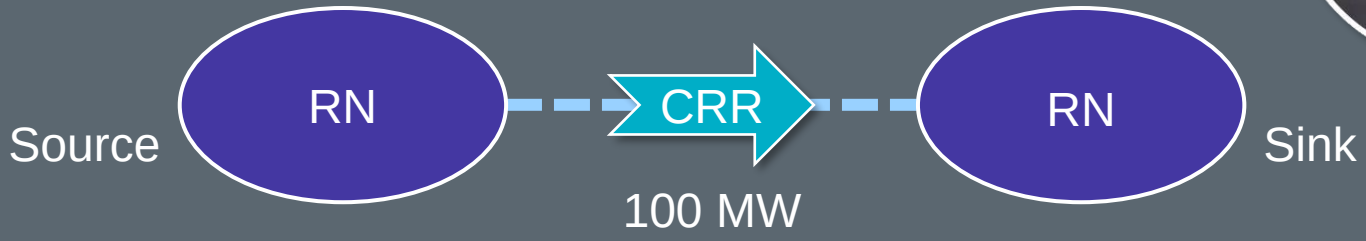


Hedge Value =
(MAXRESPR – Source DASPP) * Quantity

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

Example 6: PTP Obligation Settlement in DAM

Settle a PTP Obligation for a given hour

- 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 a given hour

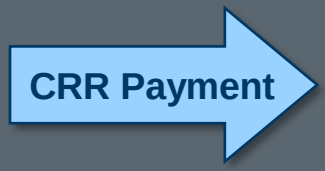
- Target Payment (TP) = $400
- Derated Amount (DA) = $200
- Hedge Value (HV) = $100
- Sink is not a Resource Node

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

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

CRR Payment

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

Example 8: Shortfall Charges

Settle the Shortfall for a given hour

- 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 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

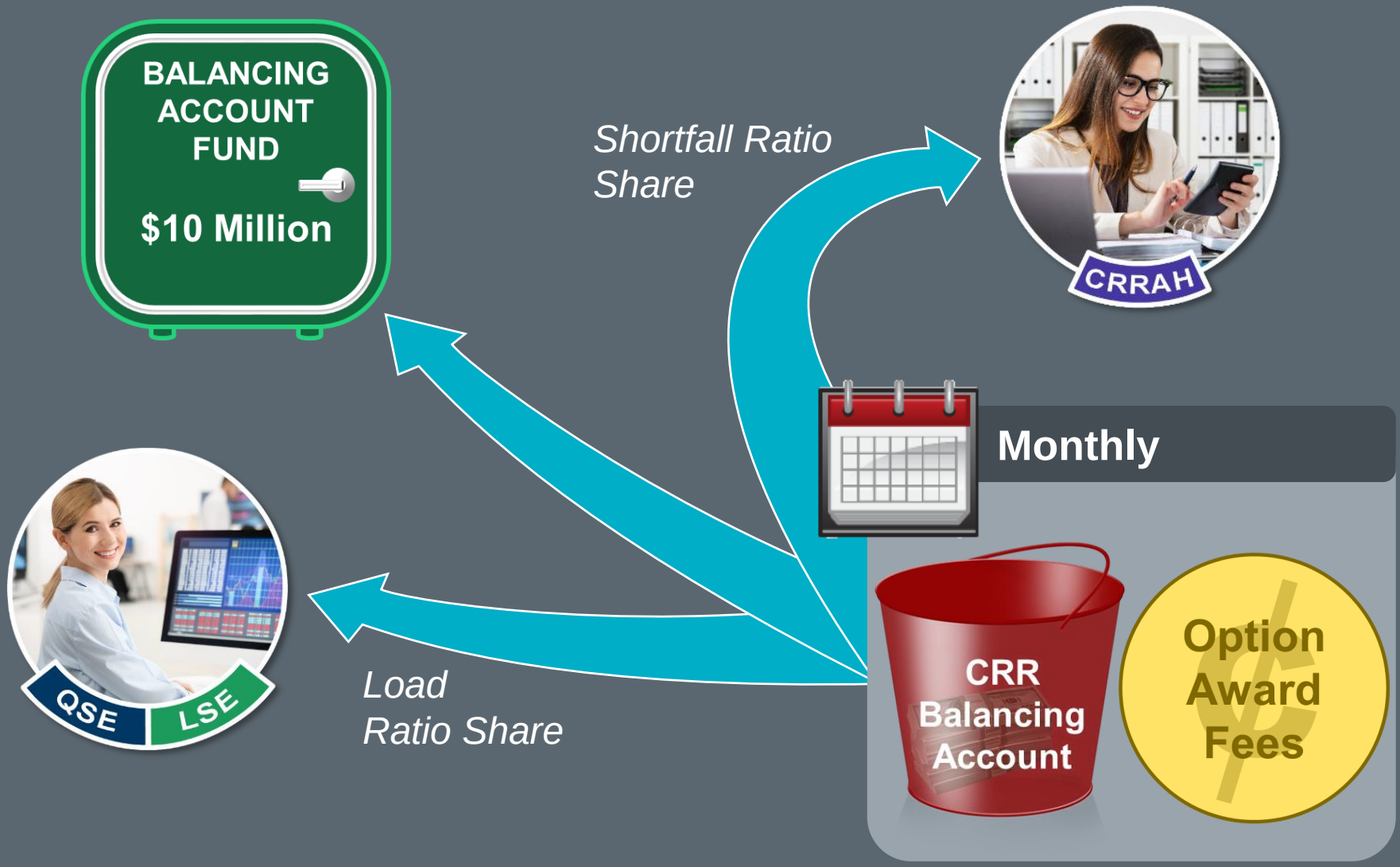
CRR Payment

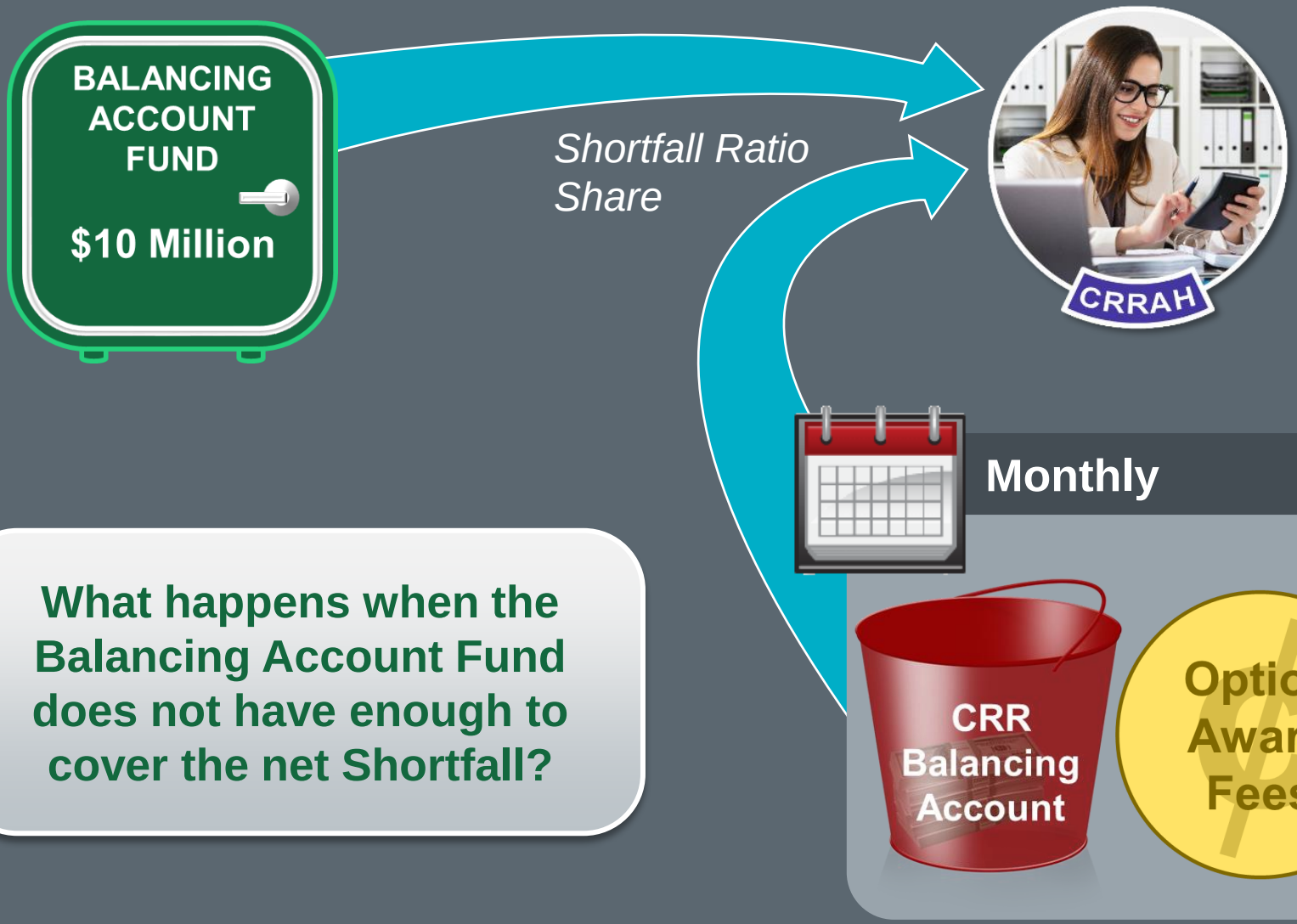
The CRR Balancing Account:

- Extra Congestion Rent
- Option Award Fees

Both collected per month

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 (BA) = $15,000,000
- Option Award Fees (Fees) = $100,000
- Shortfall Charges = $13,500,000

CRR Refund = (-1) * Min (BA + Fees, Shortfall)

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 total 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 a given month

- 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. Auction Bids
2. Auction Offers
3. Auction Revenues
4. Settlement in DAM
5. Shortfall Charges
6. Balancing Account

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