



Wholesale Markets 101



Greetings
and
Introductions

WebEx Tips

- Windows
- Buttons

Attendance

Questions / Chat

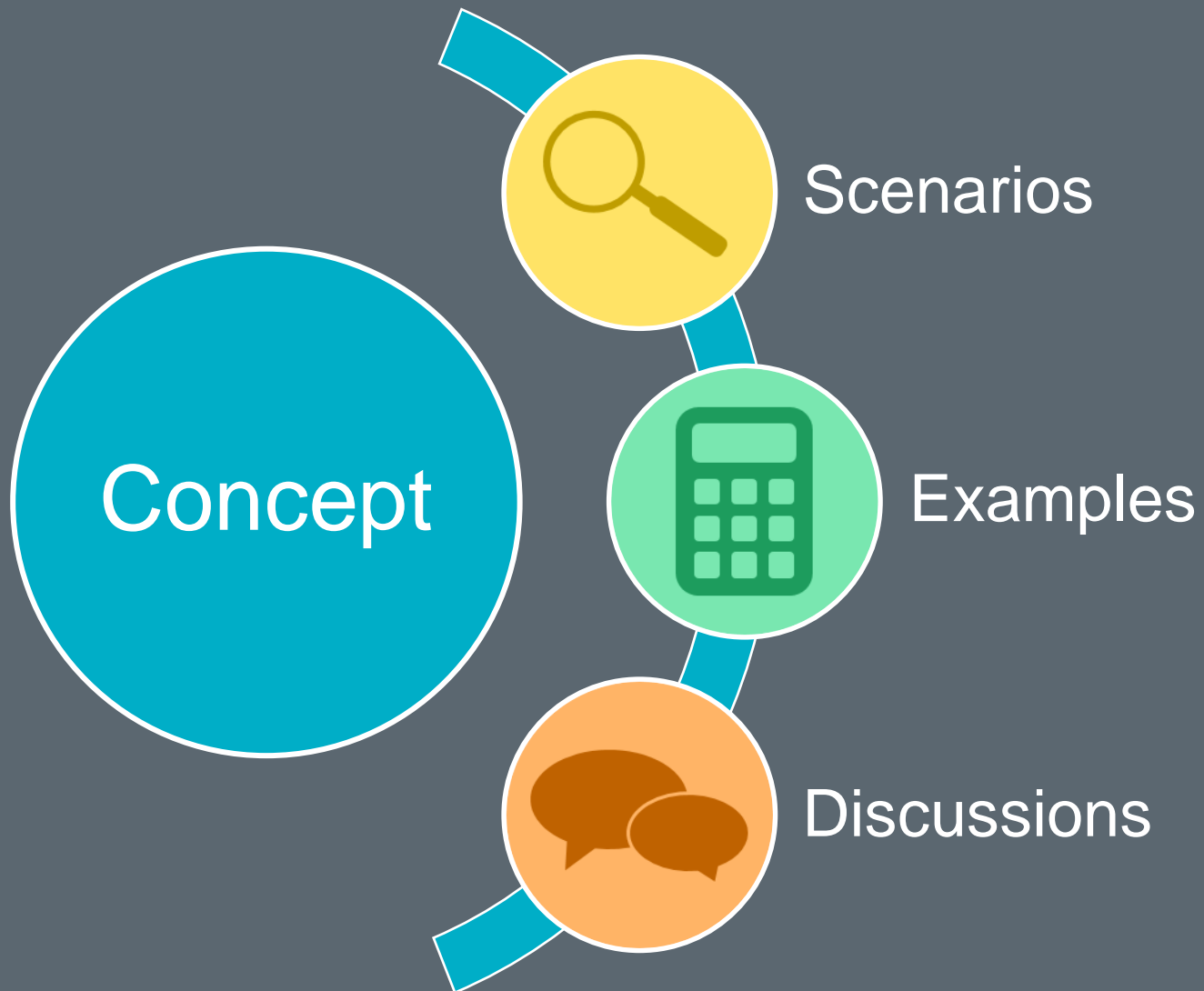


PROTOCOL DISCLAIMER

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/>



Topics in this course include:

1

Introduction

2

Real-Time Dispatch and Pricing

3

Forward Markets

4

Energy Settlements

5

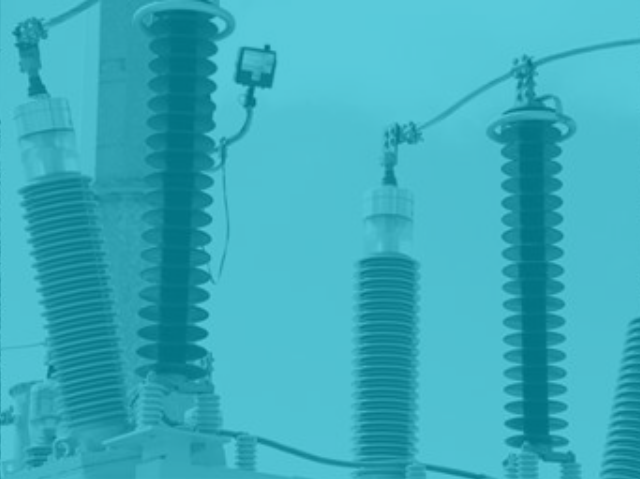
Congestion

6

Ancillary Services

7

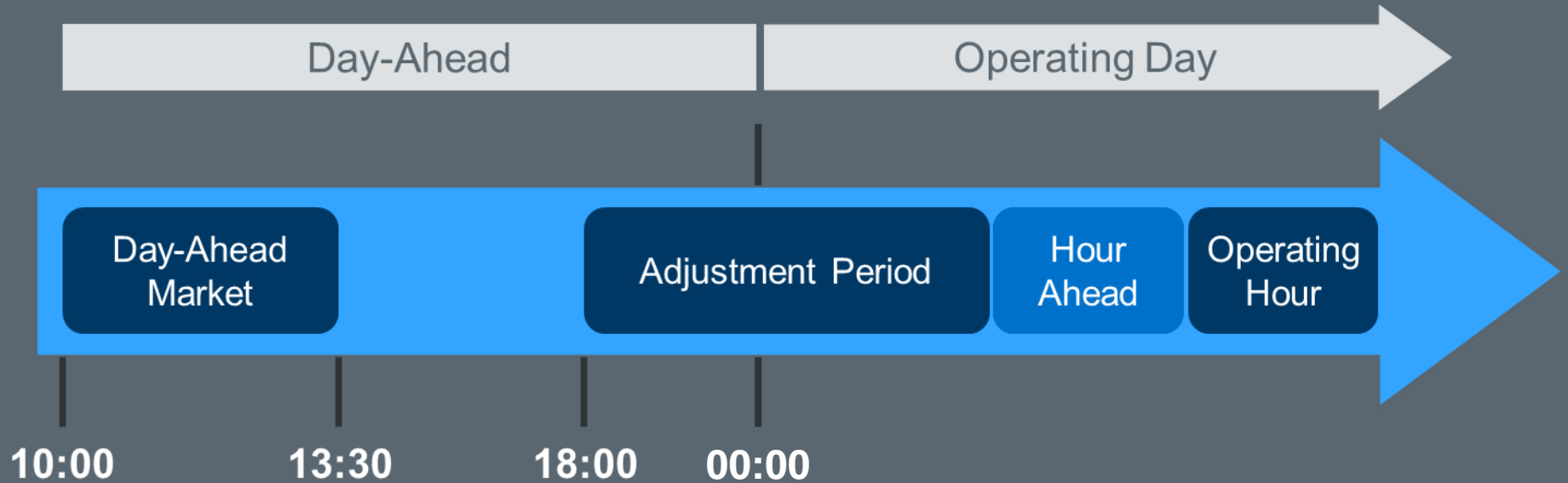
System Capacity

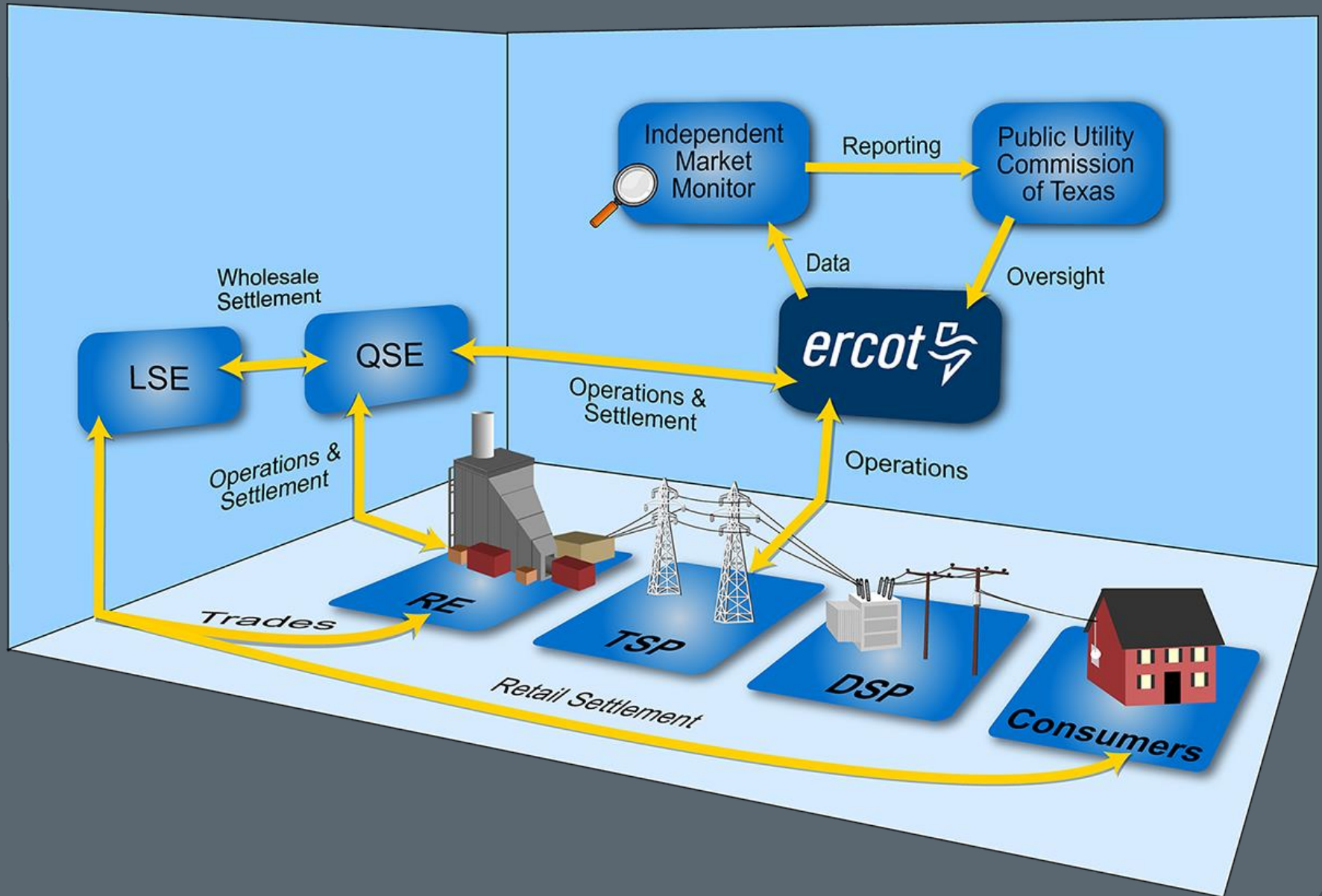


Introduction

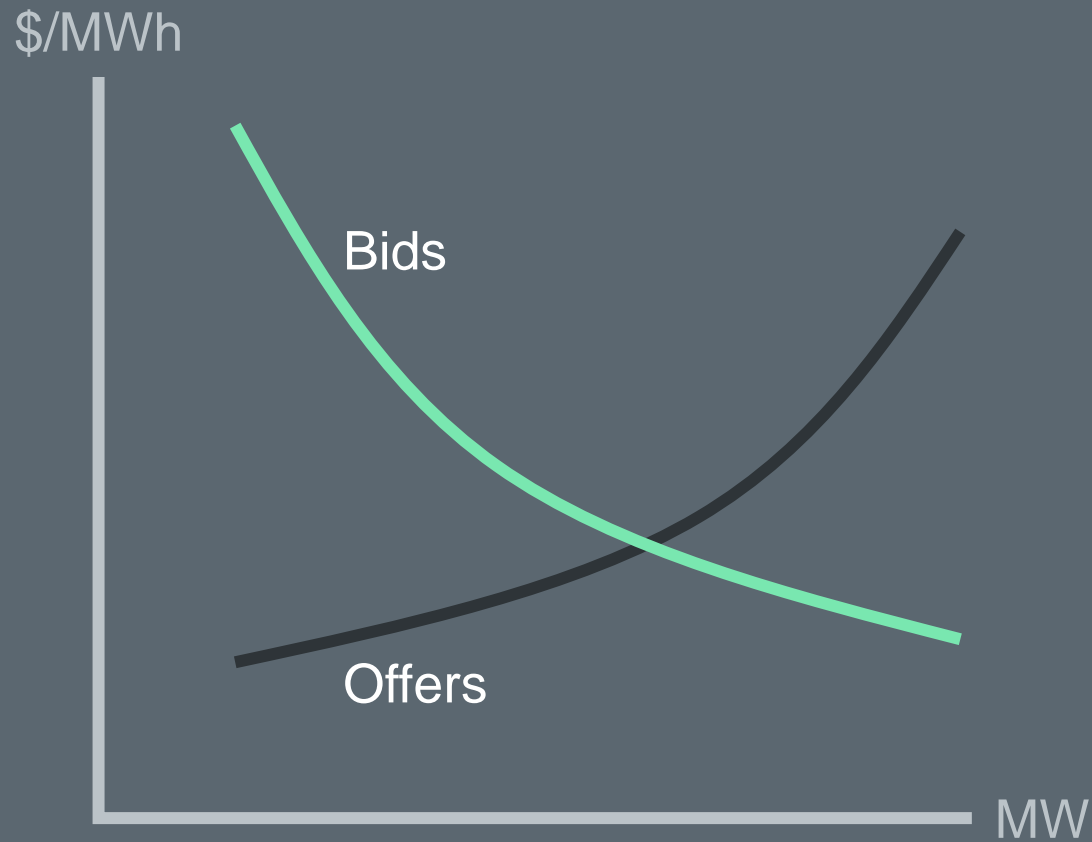


In general . . .





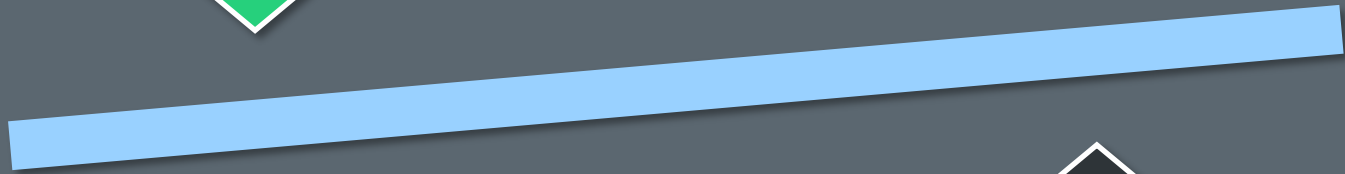
Supply and demand curves





Proposal to buy

- A Product
- At a Location
- For a Price

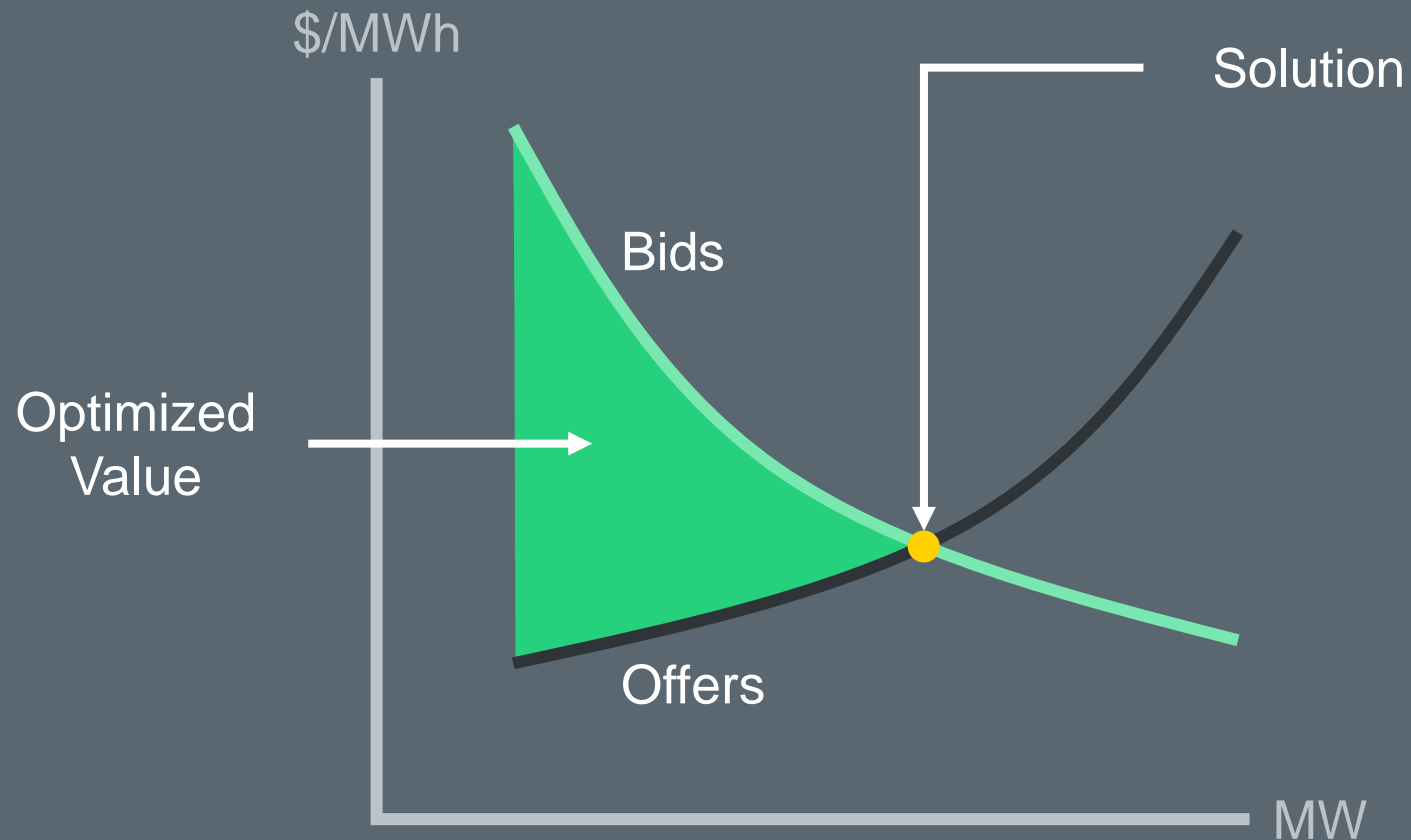


Proposal to Sell

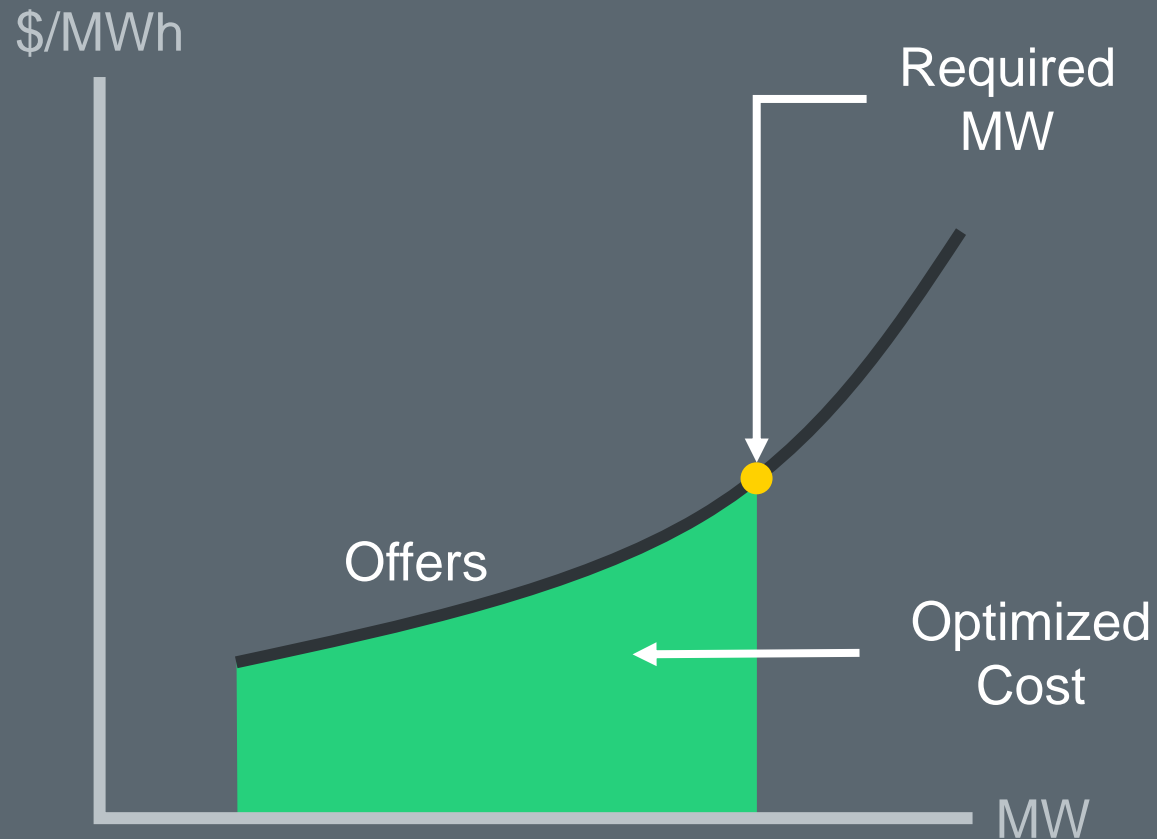
- A Product
- At a Location
- For a Price

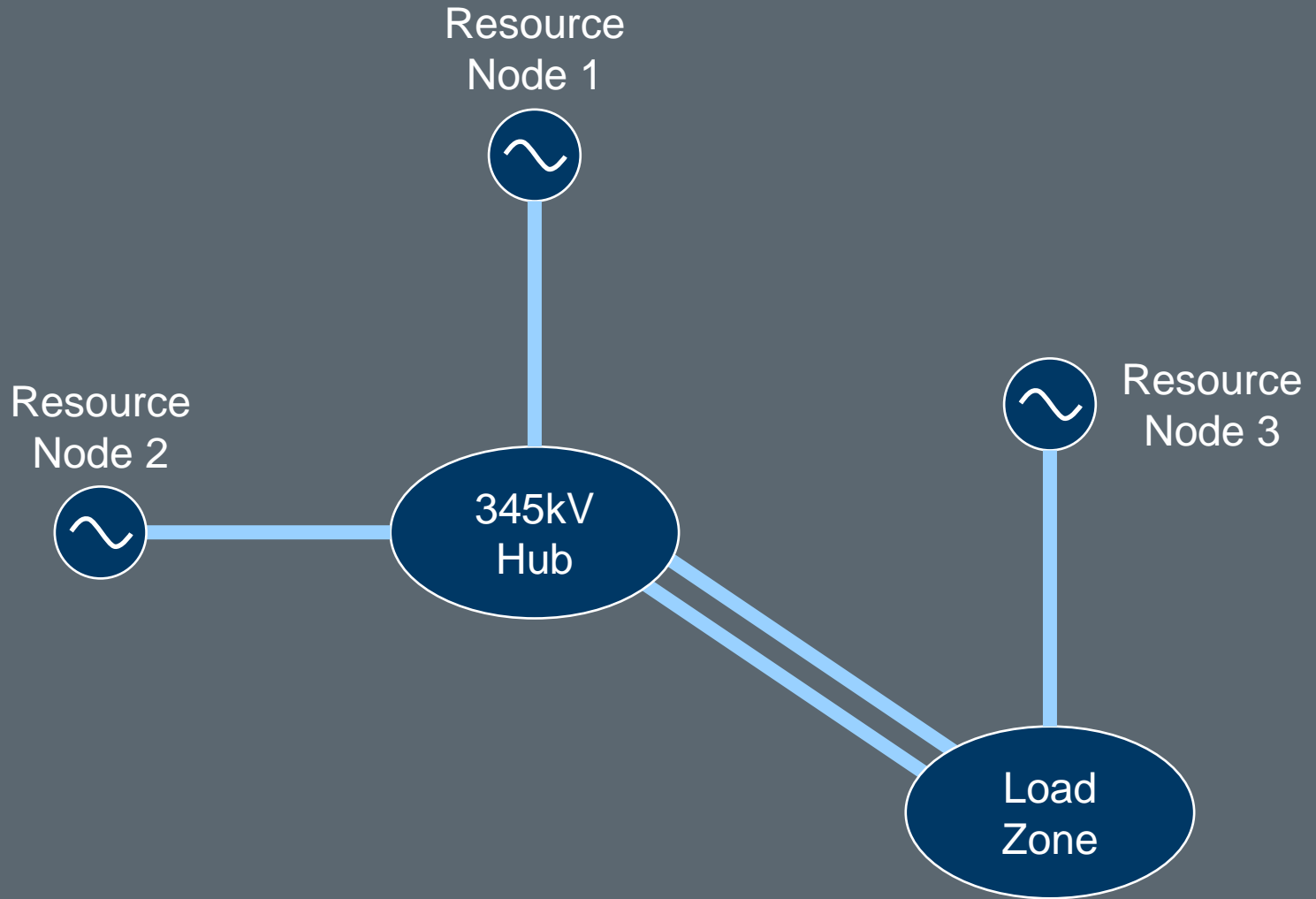


Some ERCOT processes are optimized for value



Other ERCOT processes are optimized for cost



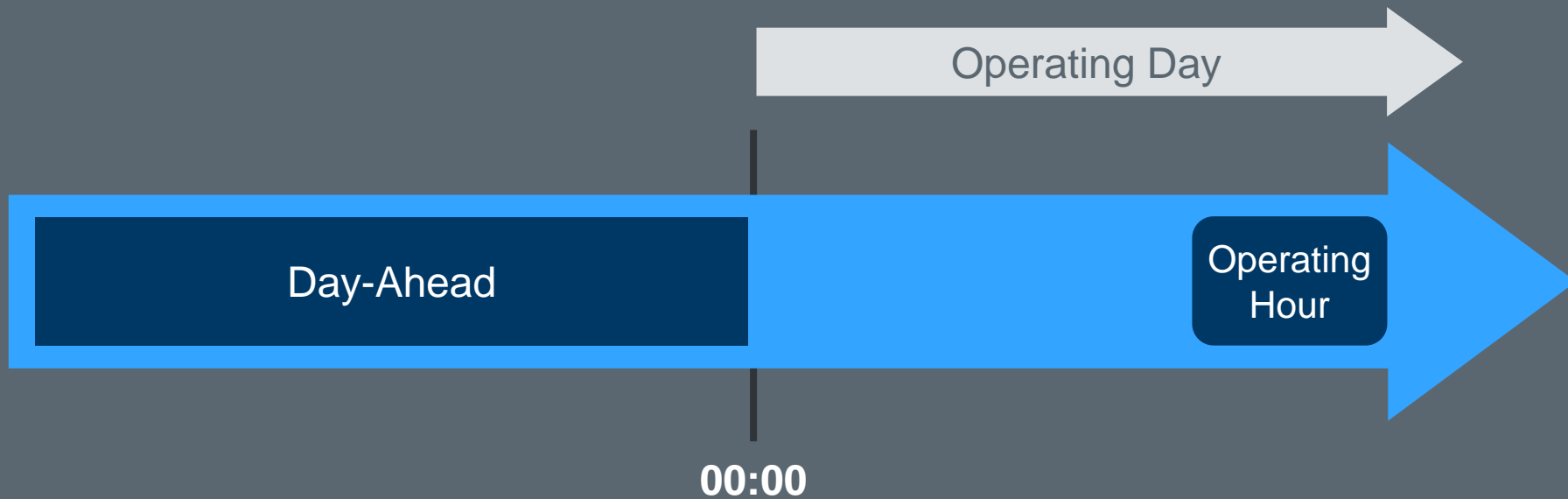




Real-Time Dispatch and Pricing



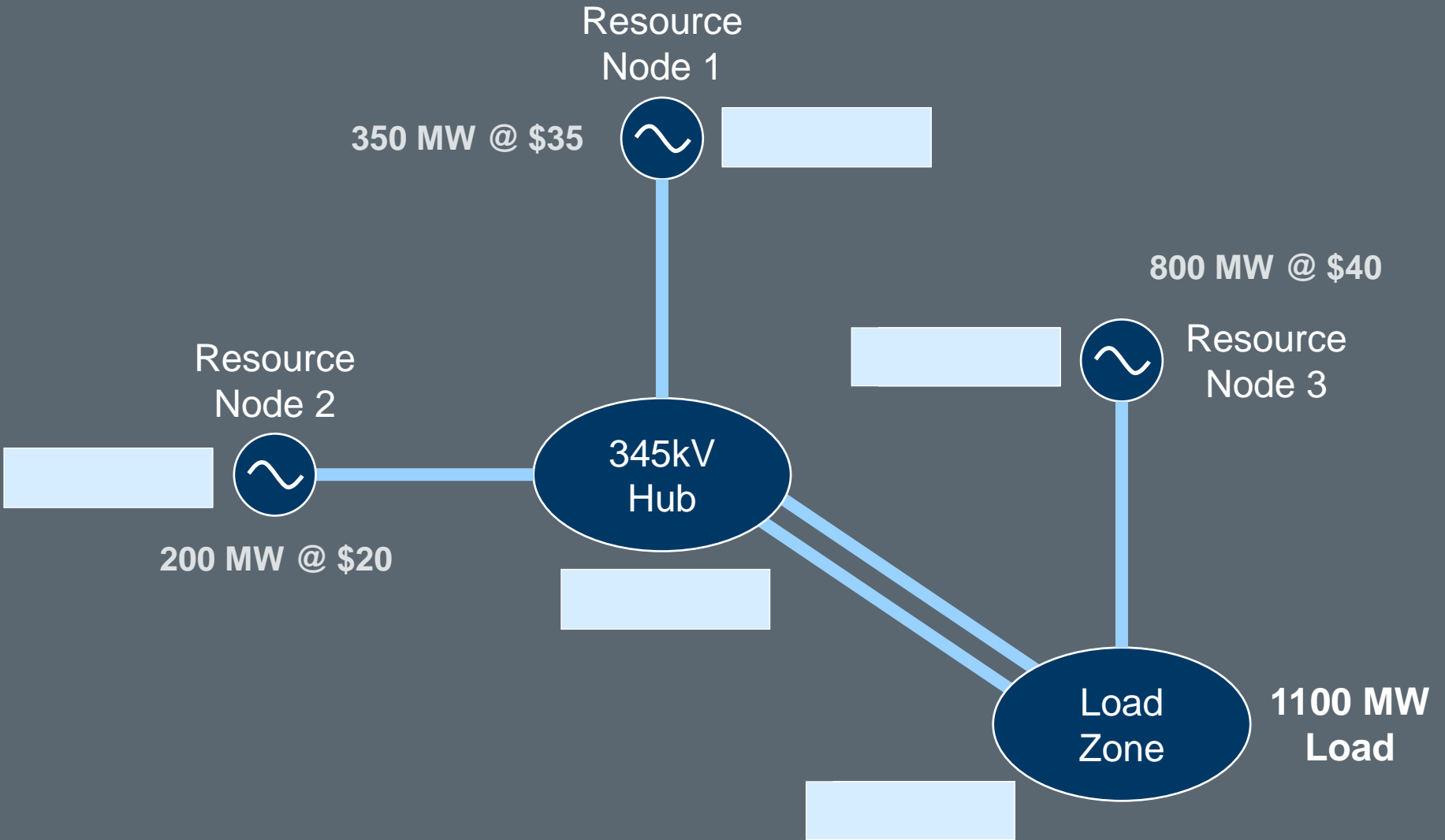
Timing

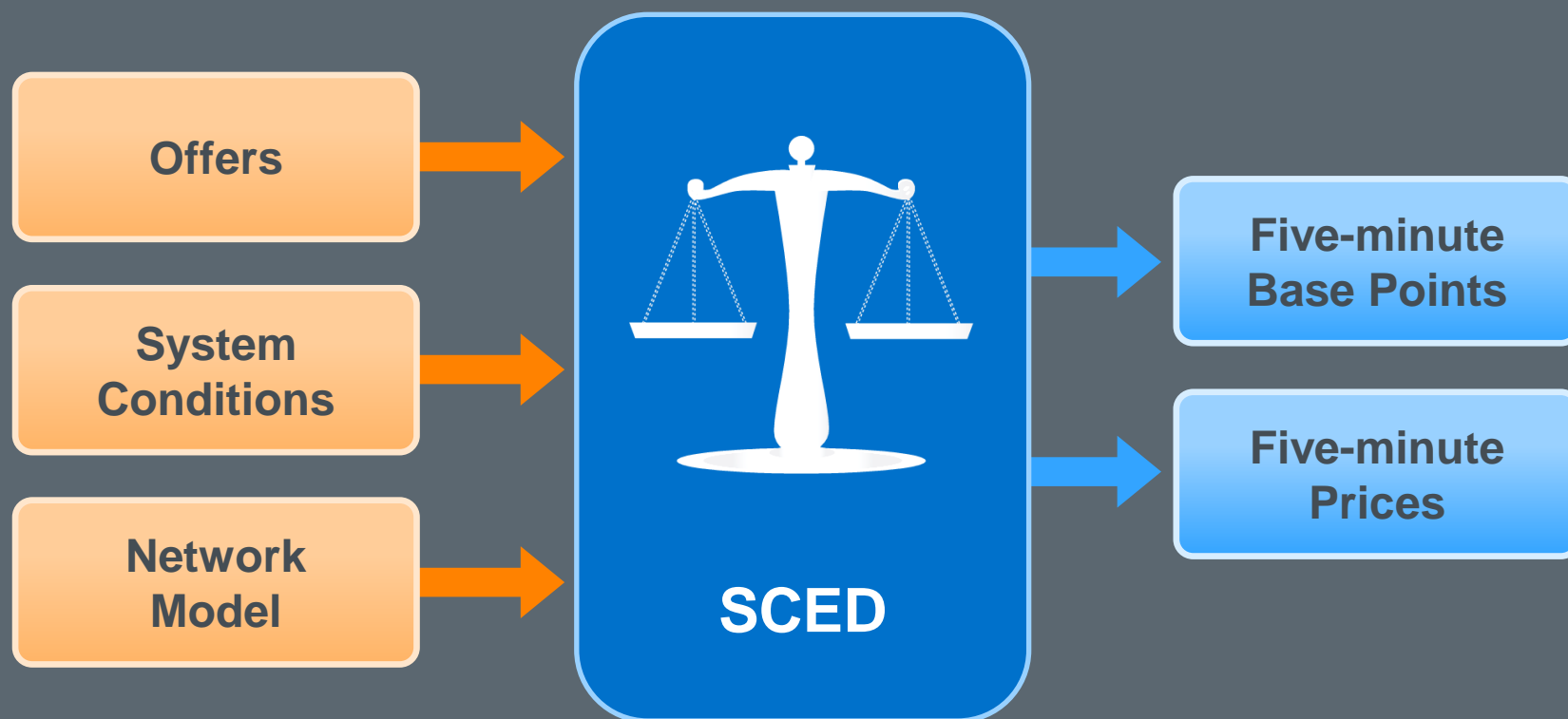


Goals

- Manage reliability
 - Match generation with demand
 - Keep transmission flows within limits
- Operate the system at least cost

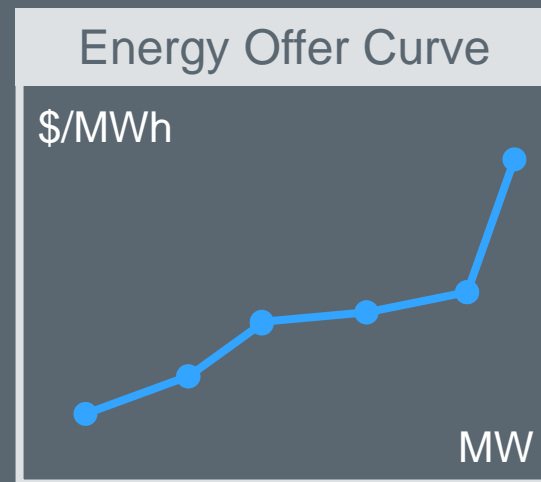






Energy Offer Curve

- Monotonically increasing curve
- Ten price/quantity pairs max
- One MW minimum quantity
- Prices between $-\$250$ and SWCAP



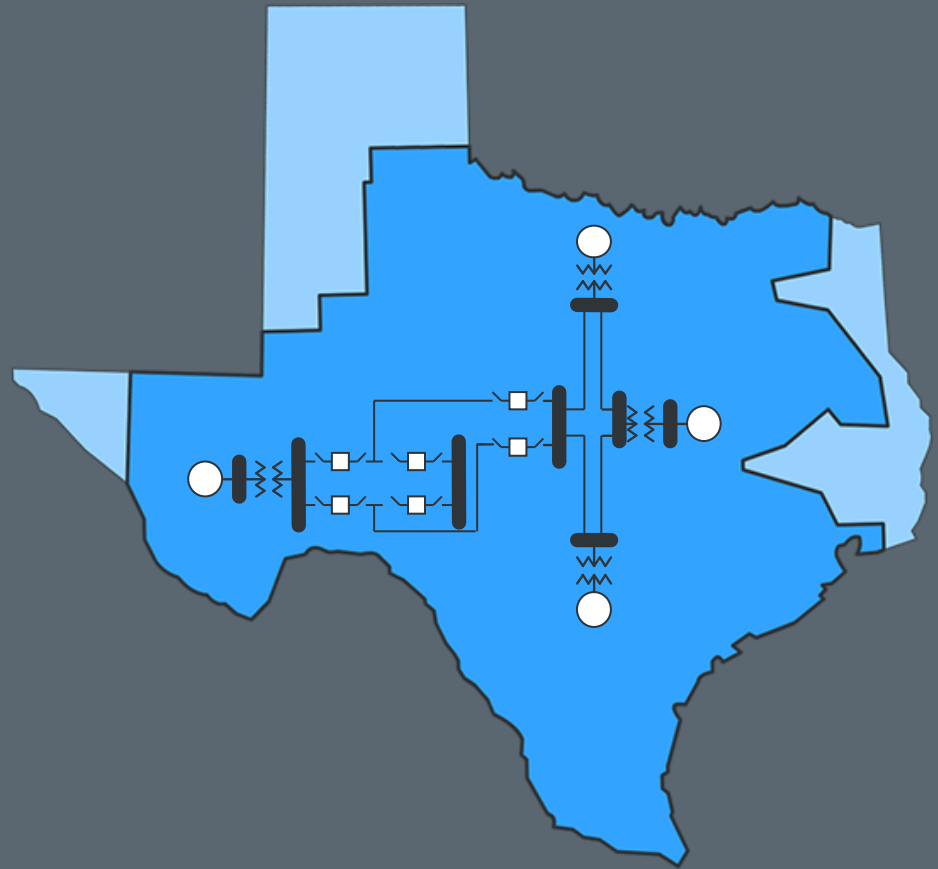


Monitored Conditions

What does SCED need to know?



Represents physical transmission grid

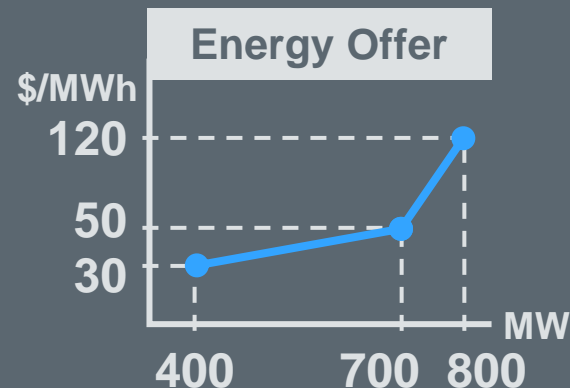
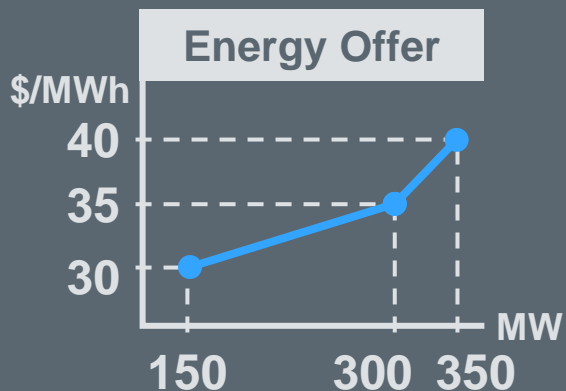


Used for:

- Reliability studies
- All Market Processes



Scenario: Find Dispatch Solution



Resource Node 1

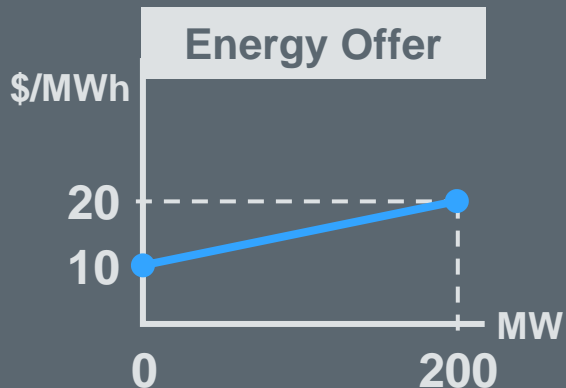
Resource Node 3

Resource Node 2

345kV Hub

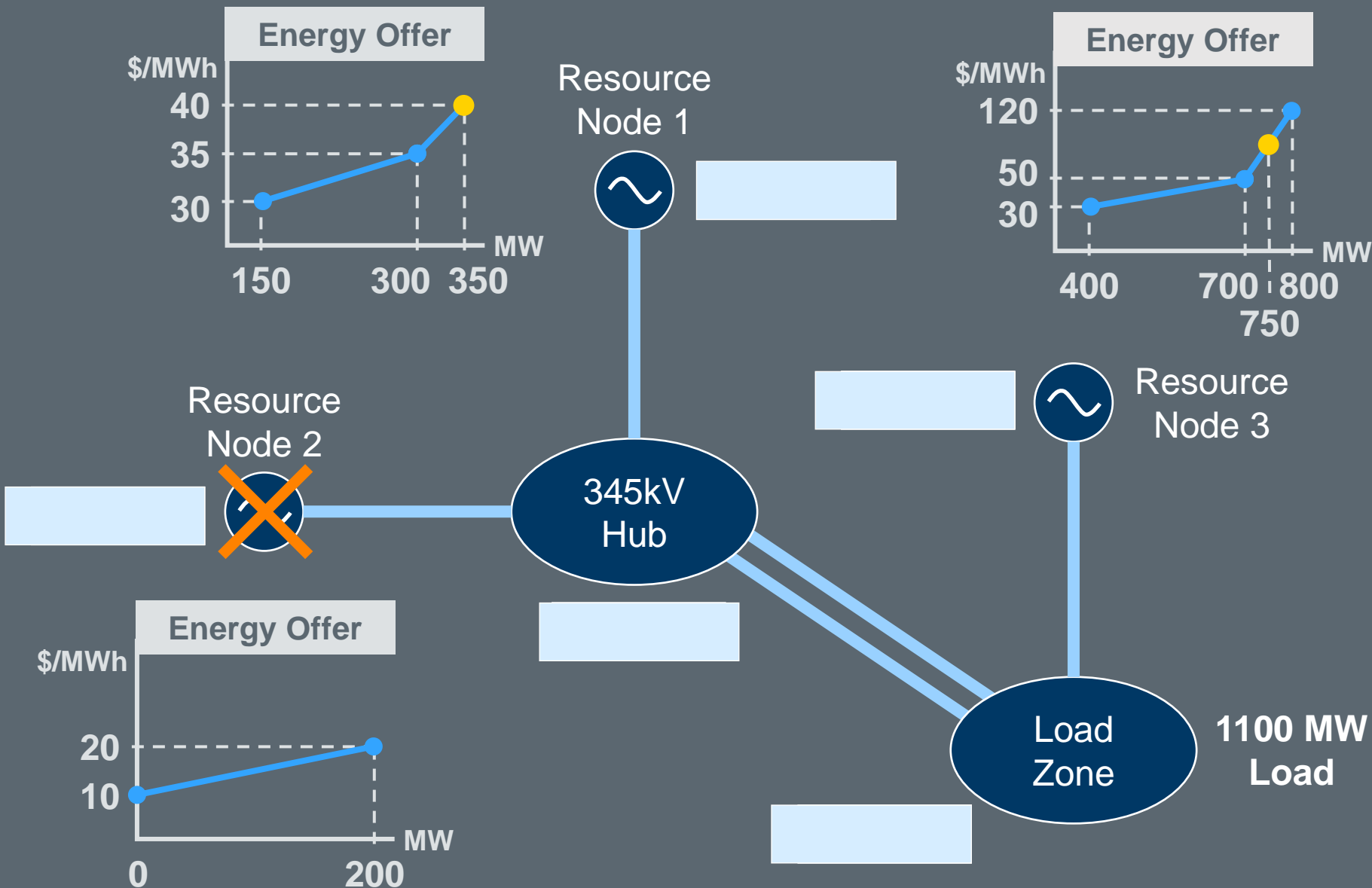
Load Zone

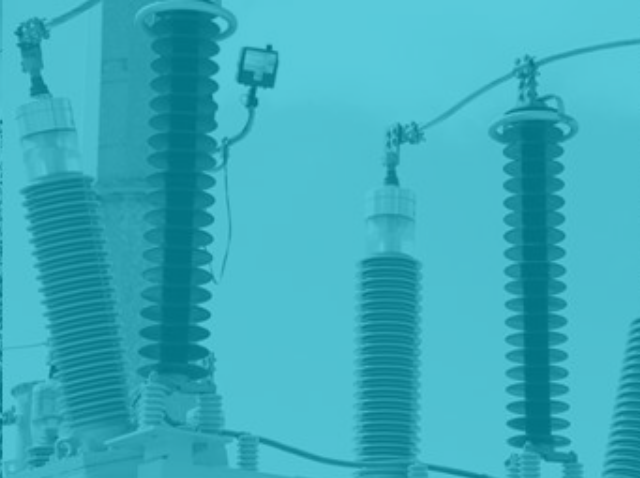
1100 MW Load





Scenario: Find Dispatch Solution





Forward Markets



Hedging is transacting at a known price now ...



... to protect from having to transact at an unknown price later.



Break into teams:

Load Teams

- Given Load Forecast
- Determine Bid MWs and Bid Price

Generation Teams

- Given MWs to offer
- Determine Offer MWs and Offer Price

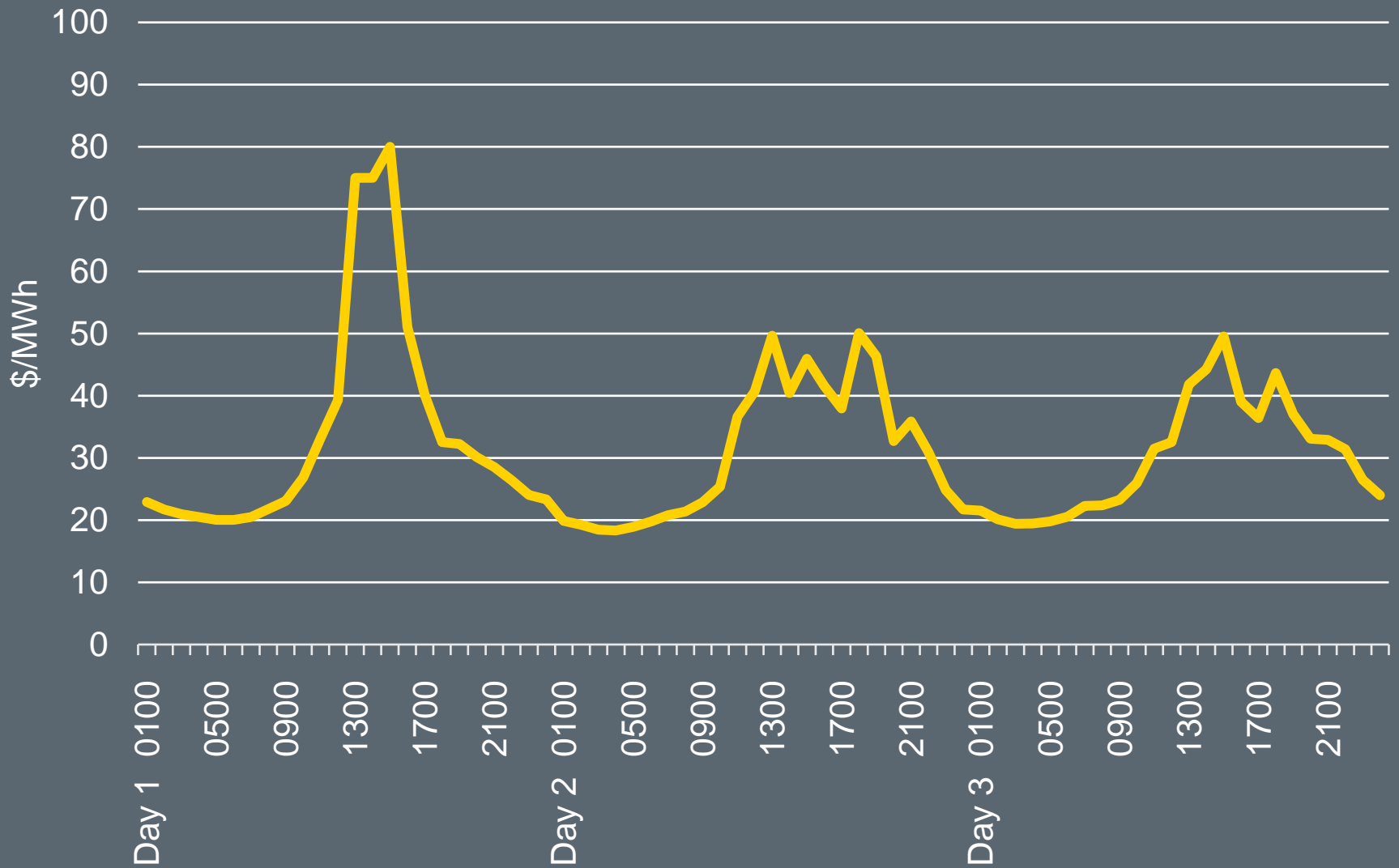


Instructor will clear the market

*Class will evaluate hedging
“Success”*



Scenario: Historical Data



Day-Ahead Market



Bilateral Trades

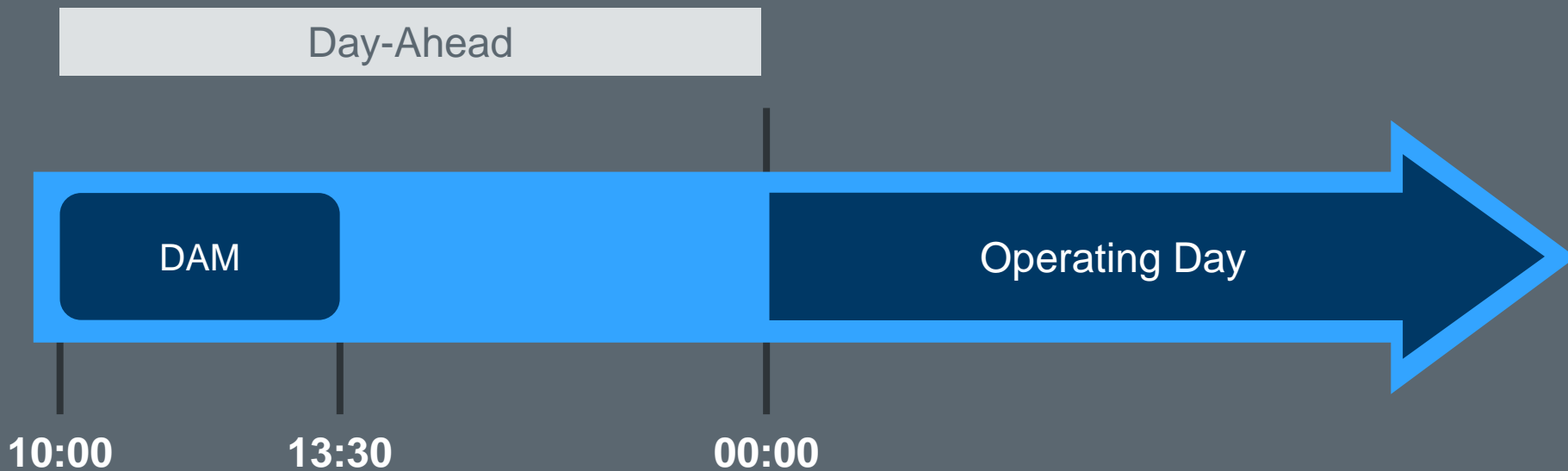


Centralized Forward Market

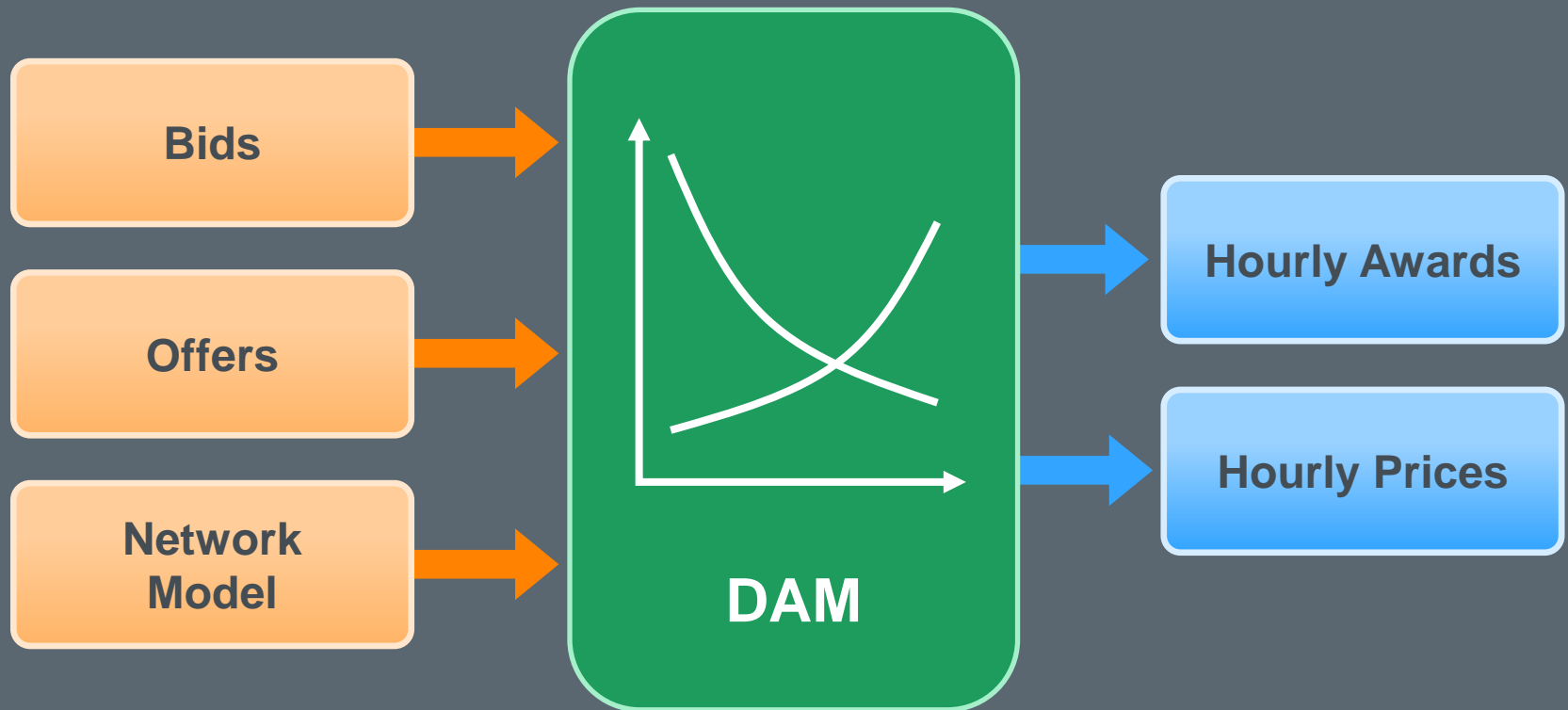
- Conducted daily
- Facilitated by ERCOT



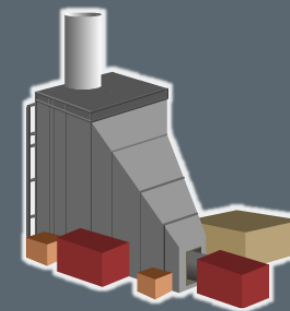
Timing



Transactions



Three-Part Supply Offer



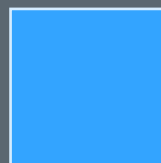
Startup Offer

\$/Start



Minimum Energy Offer

\$/MWh



Energy Offer Curve

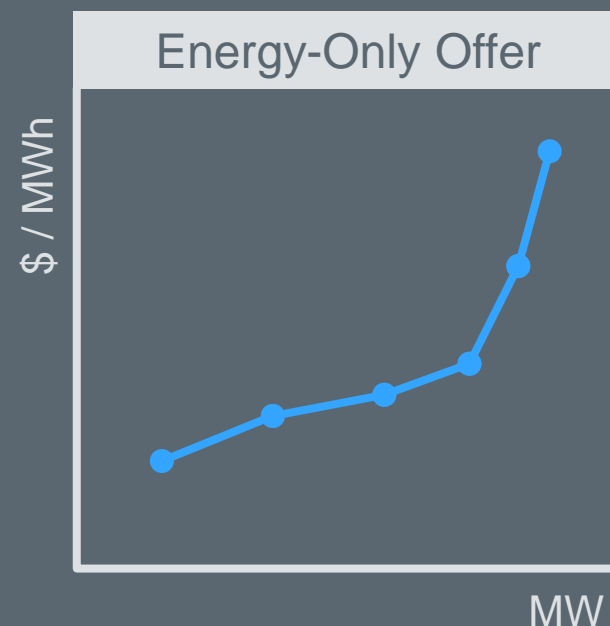
\$/MWh

MW



Day-Ahead Market Energy-Only Offer

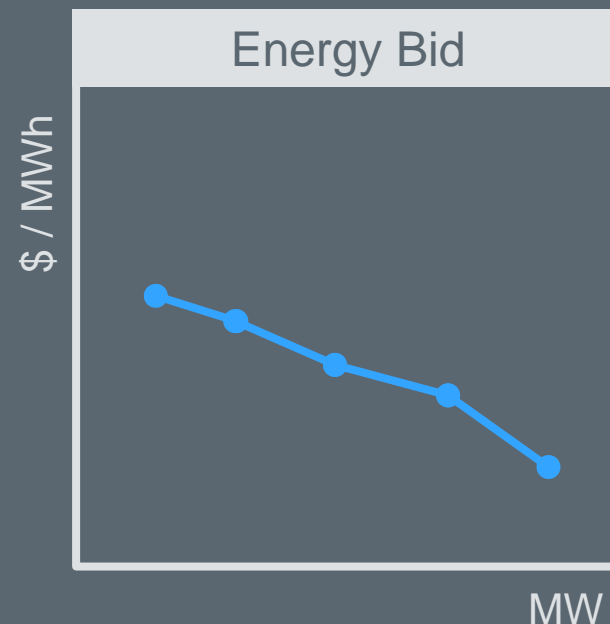
- Proposal to sell energy in DAM
- Offered at any Settlement Point



Financial obligation in Real-Time

Day-Ahead Market Energy Bid

- Proposal to buy energy in DAM
- Submitted at any Settlement Point



Financial credit in Real-Time

Day-Ahead Market



Bilateral Trades



Decentralized Forward Market

- QSE-to-QSE transactions
- Transfers settlement responsibility



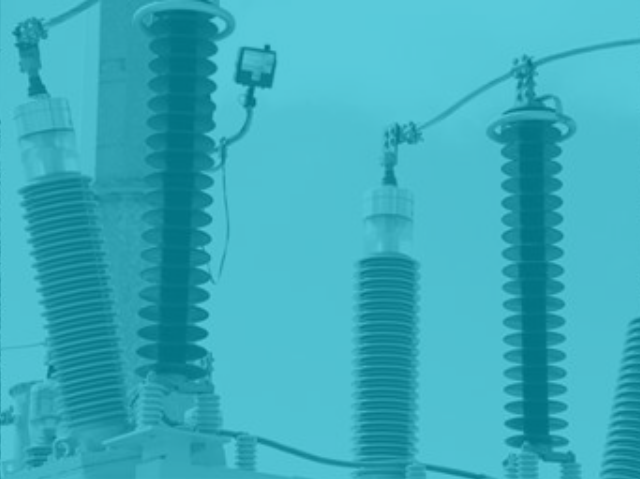
Buyer and Seller QSE must confirm Trades

One QSE reports



Other QSE confirms





Energy Settlement





QSEs settle their transactions



ERCOT settles



ERCOT settles

Charge for awarded Energy Bid

$$= \text{Awarded MWs} * \text{DASPP}$$

Payment for awarded Energy Offer

$$= (-1) * \text{Awarded MWs} * \text{DASPP}$$

DASPP = Day-Ahead Settlement Point Price

Real-Time Energy Imbalance

$$= (-1) \left(\left(\text{SUPPLIES} \right) - \left(\text{OBLIGATIONS} \right) \right) * \text{RTSPP}$$

RTSPP = Real-Time Settlement Point Price

Real-Time Energy Imbalance Components

$$= (-1) \left(\begin{array}{c} \text{Metered Generation} \\ + \\ \text{DAM Energy Purchases} \\ + \\ \text{Trade Energy Purchases} \end{array} \right) - \left(\begin{array}{c} \text{DAM Energy Sales} \\ + \\ \text{Trade Energy Sales} \\ + \\ \text{Metered Load} \end{array} \right) * \text{RTSPP}$$

Each Settlement Point
settled separately

DAM Awards & Trades in Real-Time Energy Settlements

- DAM awards and settles hourly MWs
- Energy Trades reported as hourly MWs
- Real-Time settles 15-minute MWs

Hour 0800	Hour 0900
<u>0715</u>	<u>0815</u>
<u>0730</u>	<u>0830</u>
<u>0745</u>	<u>0845</u>
<u>0800</u>	<u>0900</u>

*Multiply DAM
awards and Trades
by $\frac{1}{4}$ hour*



DAM Awarded Energy Offer at Resource Node

Hour	MW	DASPP
0800	200	\$25 / MWh

Real-Time Metered Generation

Interval	MWh	RTSPP
0715	45	\$20 / MWh



Real-Time Energy Imbalance for Interval 0715

$$= (-1) \left(\left(\begin{array}{c} \text{Metered Generation} \\ + \\ \text{DAM Energy Purchases} \\ + \\ \text{Trade Energy Purchases} \end{array} \right) - \left(\begin{array}{c} \text{DAM Energy Sales} \\ + \\ \text{Trade Energy Sales} \\ + \\ \text{Metered Load} \end{array} \right) \right) * \text{RTSPP}$$

$$= (-1) \left(\left(45\text{MWh} \right) - \left(200\text{MW} * \frac{1}{4} \text{ h} \right) \right) * \$20/\text{MWh}$$

$$= \$100$$



Break into teams: Determine how team's energy settles

Load Teams

- Awarded Energy Bid in DAM
- Adjusted Metered Load in Real-Time

Generation Teams

- Awarded Energy Offer in DAM
- Metered Generation in Real-Time



*DAM and Real-Time Results
on Next Slide*



DAM Awarded Energy Bid at Load Zone		
Hour	MW	DASPP
1400	100	\$35 / MWh
Real-Time Adjusted Metered Load		
Interval	MWh	RTSPP
1315	24	\$30 / MWh
1330	25	\$31 / MWh
1345	26	\$75 / MWh
1400	25	\$70 / MWh

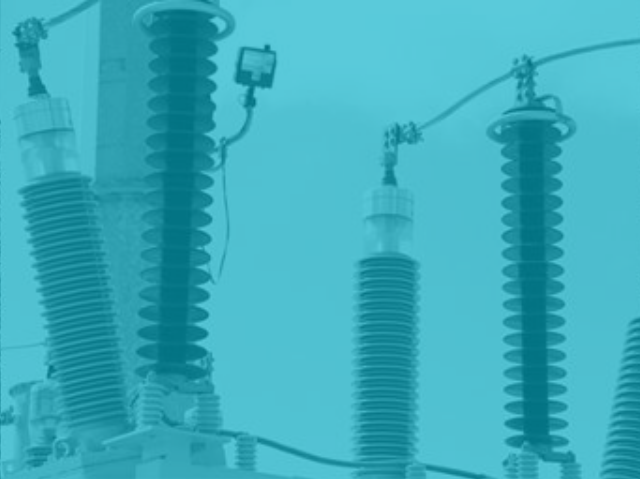
DAM Awarded Energy Offer at Resource Node		
Hour	MW	DASPP
1400	300	\$35 / MWh
Real-Time Metered Generation		
Interval	MWh	RTSPP
1315	70	\$30 / MWh
1330	72	\$31 / MWh
1345	85	\$75 / MWh
1400	85	\$70 / MWh



DAM Award	Real-Time Energy Imbalance		Net
	1315		
	1330		
	1345		
	1400		

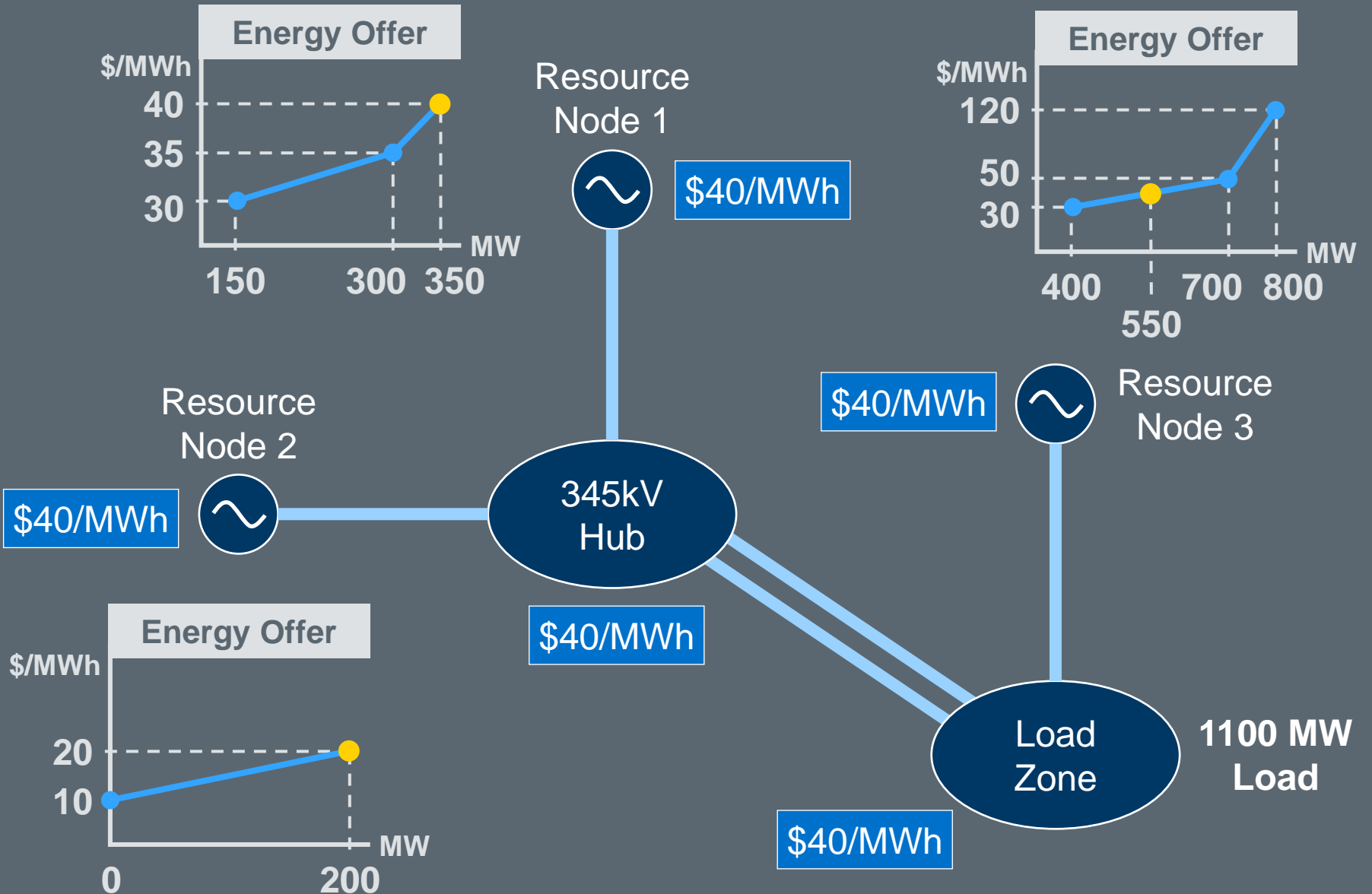


DAM Award	Real-Time Energy Imbalance		Net
	1315		
	1330		
	1345		
	1400		



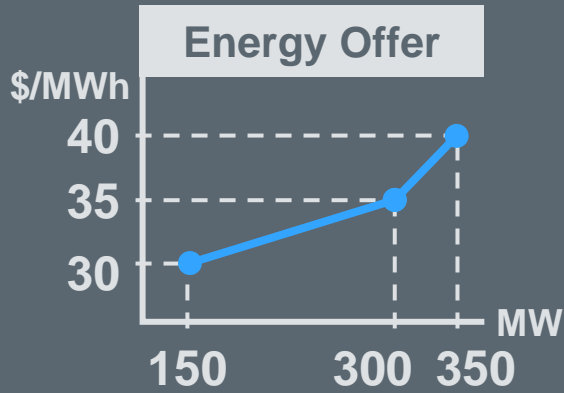
Congestion



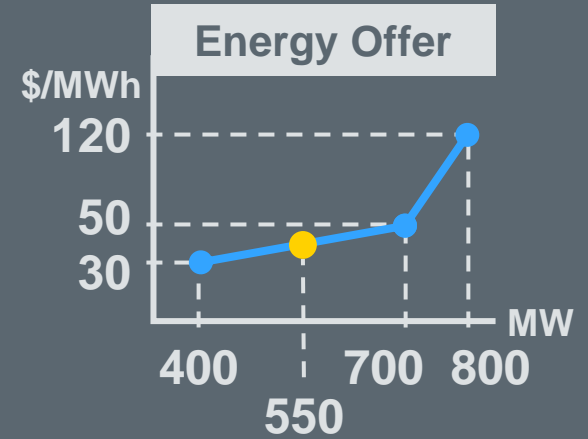




Scenario: Clearing with Transmission Constraints



Resource Node 1



Resource Node 3

Resource Node 2

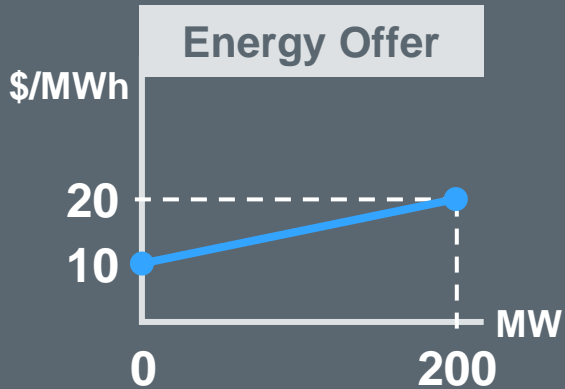
100 MW
Limit

345kV
Hub

400 MW
Limit

Load
Zone

1100 MW
Load





100 MW
Trade
Purchase



100 MW
Load

DAM Prices:

\$38

\$42

RT Prices:

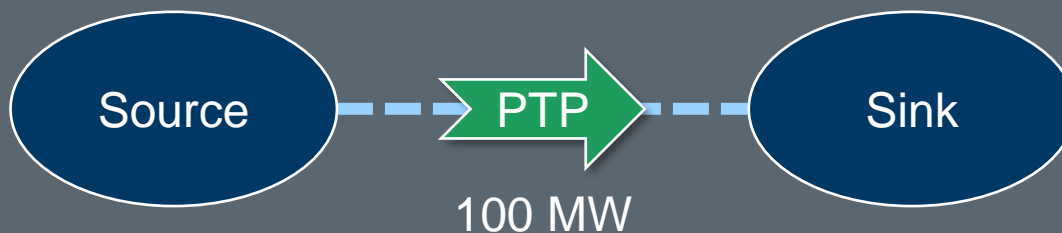
\$35

\$50

Settlement	Payment at Hub	Charge at Load Zone	Net Amount



Introducing DAM Point-to-Point Obligations



DAM Prices:

\$38

\$42

RT Prices:

\$35

\$50

Settlement	Sink minus Source Price	PTP Obligation Amount
DAM		
RT		



Example: Hedging Real-Time Congestion Costs



100 MW
Trade
Purchase



100 MW



100 MW
Load

DAM Prices:

\$38

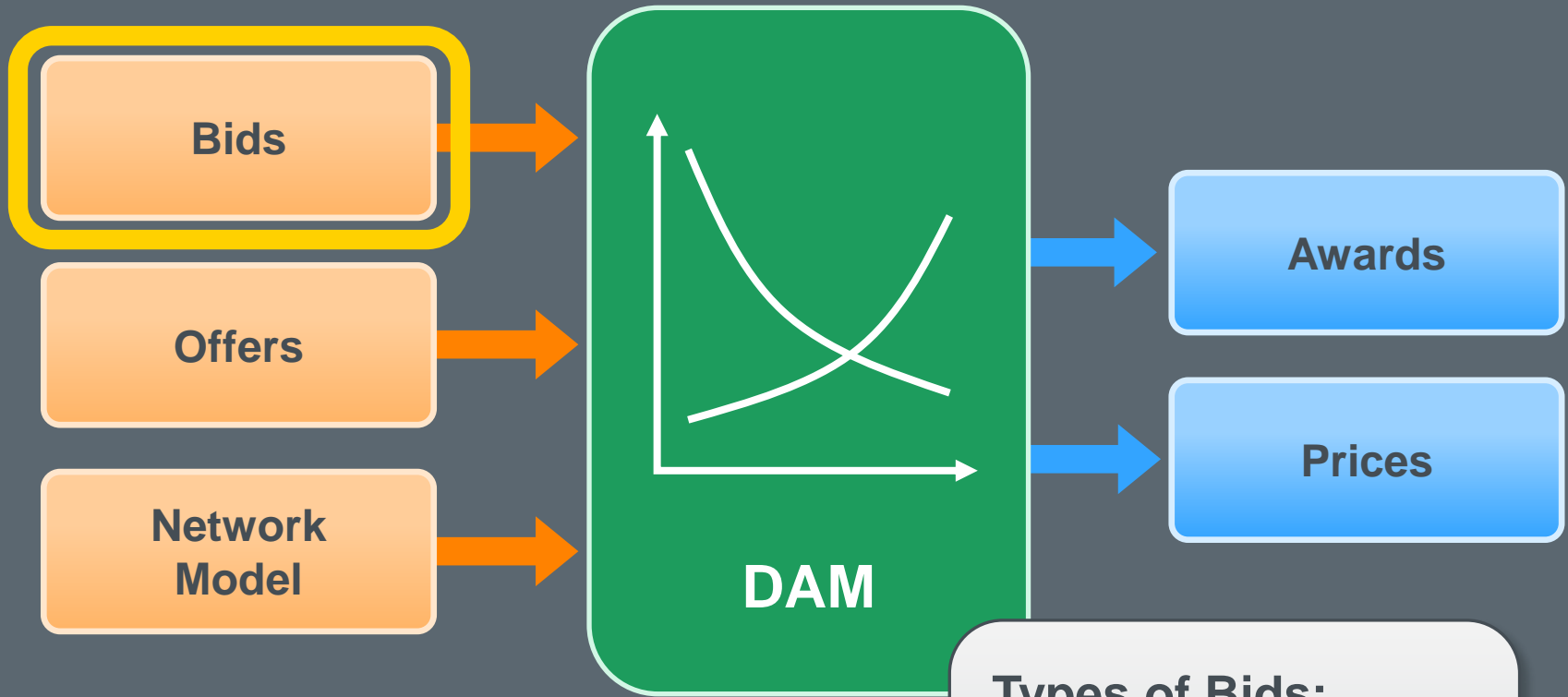
\$42

RT Prices:

\$35

\$50

Settlement Type		Amount
DAM	PTP Obligation	
RT	Energy Imbalance	
	PTP Obligation	
Total		



Types of Bids:

- Energy Bid
- PTP Obligation Bid

Submitted between any two Settlement Points

Source	Sink	Bid	
345kV Hub	Load Zone	MW	\$ / MW
Resource Node 1	Load Zone	MW	\$ / MW
Resource Node 2	Resource Node 3	MW	\$ / MW
Resource Node 1	345kV Hub	MW	\$ / MW

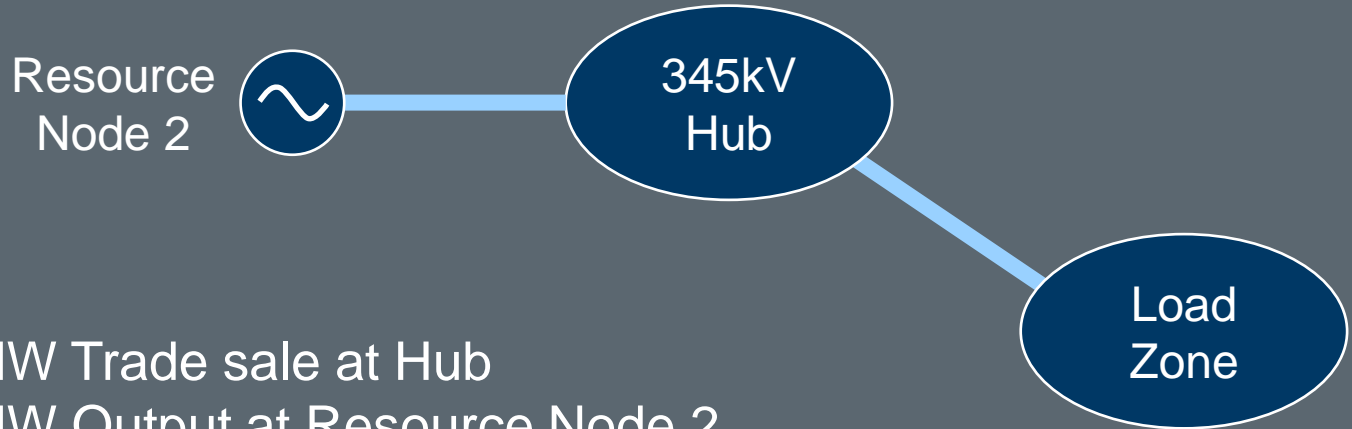


Payment or charge in Real-Time!



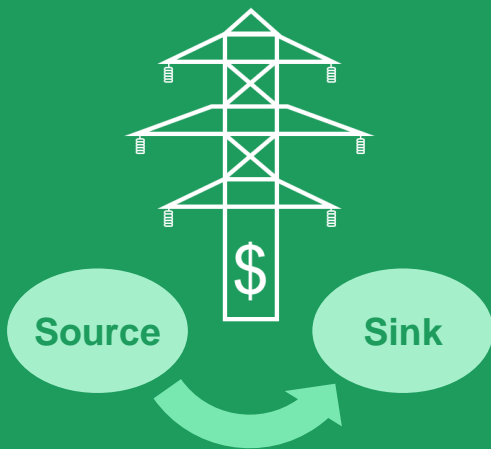
Break into teams: Optimize QSE's Revenues using DAM PTP Obligations

	Resource Node 2	345kV Hub	Load Zone
DAM SPP	\$36/MWh	\$38/MWh	\$40/MWh
Average RT SPP	\$15/MWh	\$35/MWh	\$42/MWh



100 MW Trade sale at Hub
 100 MW Output at Resource Node 2

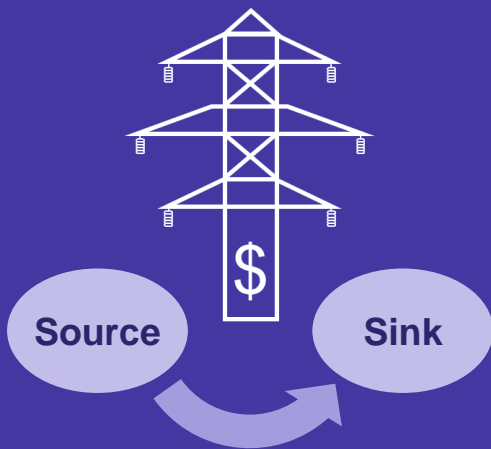
Point-to-Point Obligations



Hourly Financial instruments

- Purchased at DAM price spread
- Settled at Real-Time price spread

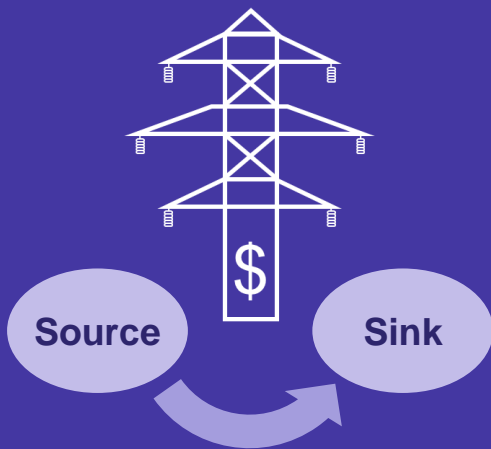
Congestion Revenue Rights



Monthly Financial instruments

- Purchased at Auction Price
- Settled at DAM price spread

Congestion Revenue Rights



Two types of instruments

Point-to-Point Obligation

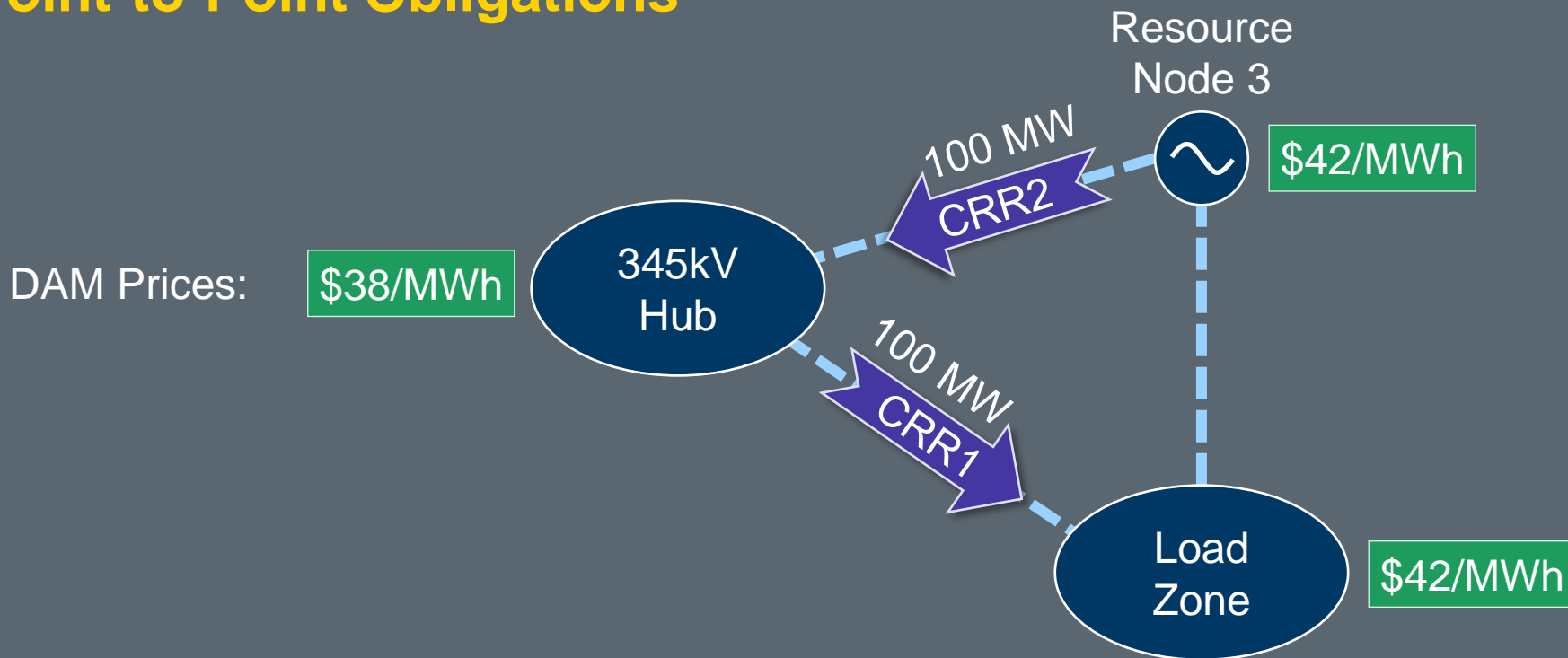
Payment or Charge in DAM

Point-to-Point Option

Payment only in DAM



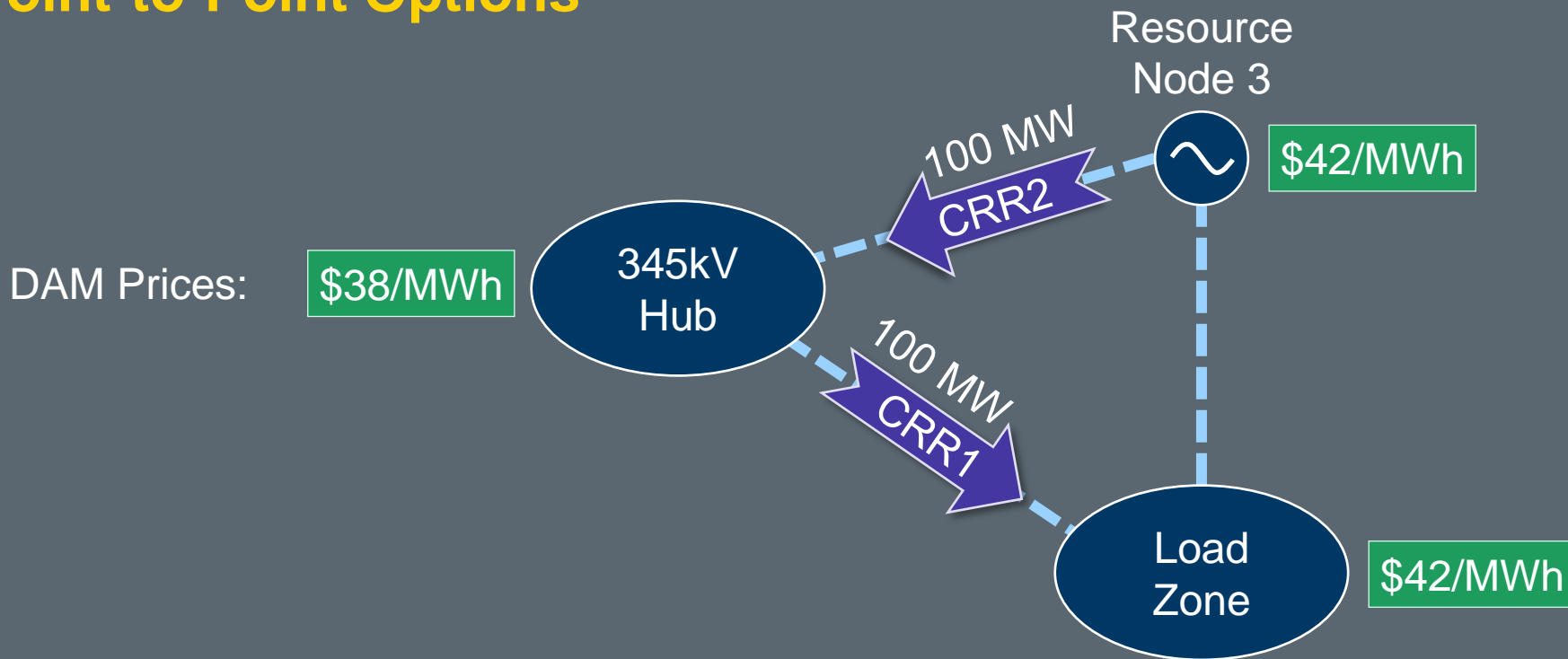
Point-to-Point Obligations



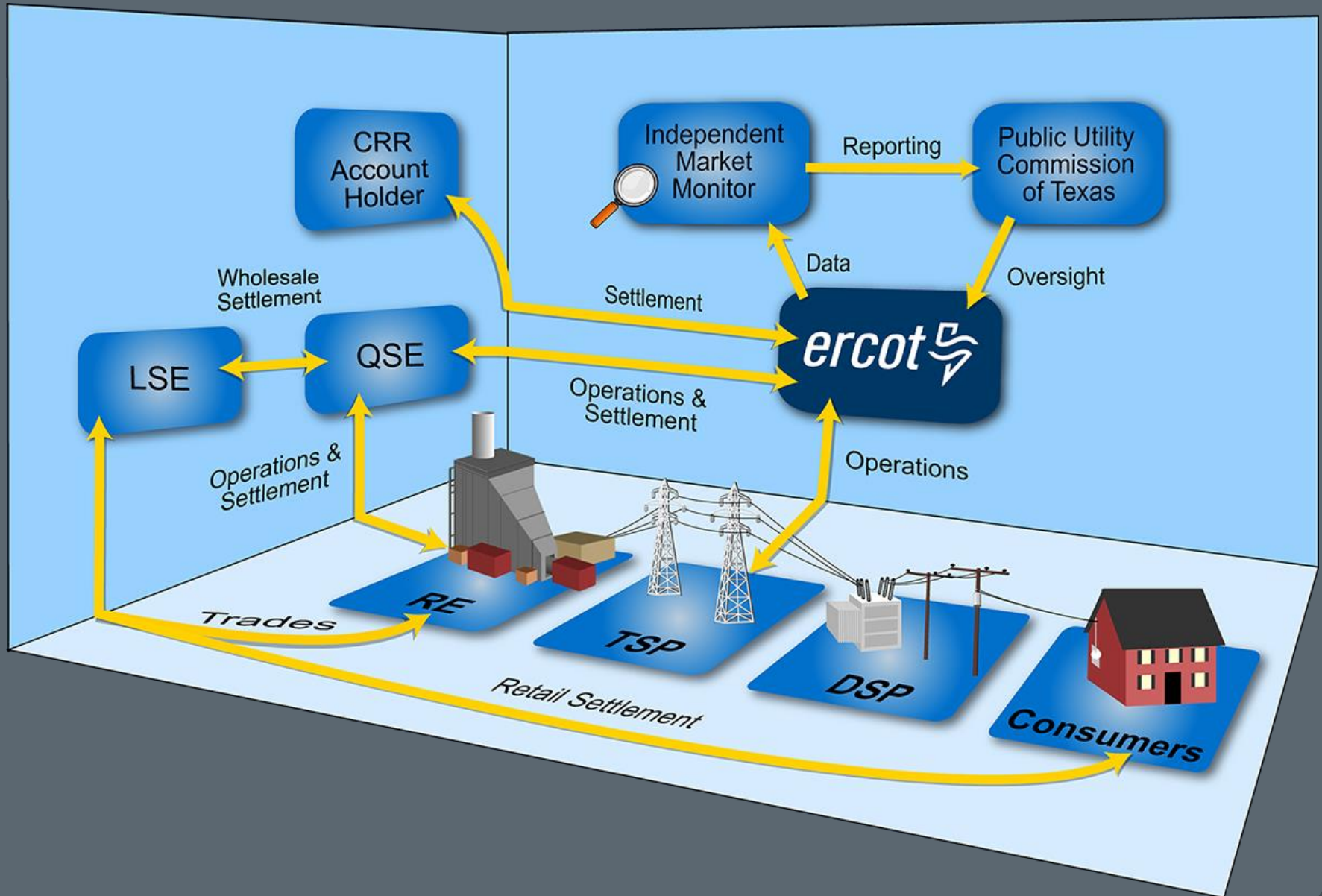
Settlement	Sink minus Source Price	CRR Amount
CRR1		
CRR2		



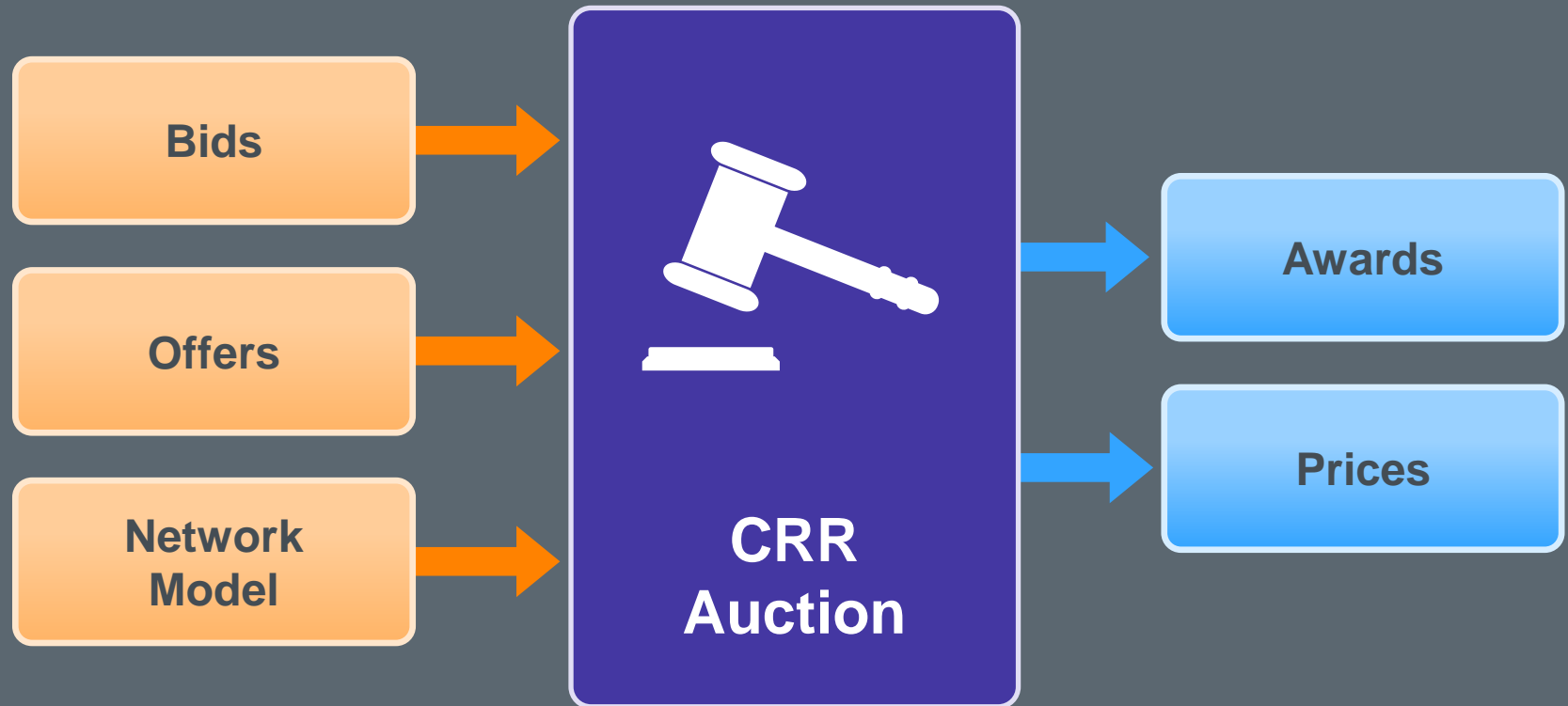
Point-to-Point Options



Settlement	Sink minus Source Price	CRR Amount
CRR1		
CRR2		



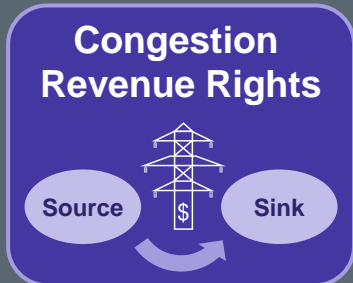
CRR Auction Transactions



CRRs are auctioned by:

- Time-of-Use Blocks
- One-month strips

Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Off-Peak (0100 – 0600)						
Peak Weekday (0700 – 2200)					Peak Weekend (0700 – 2200)	
Off-Peak (2300 – 0000)						



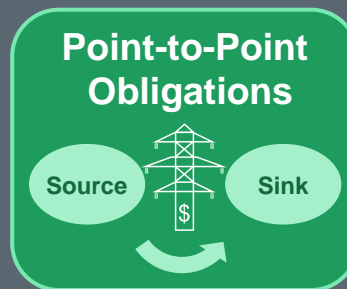
CRR Auction

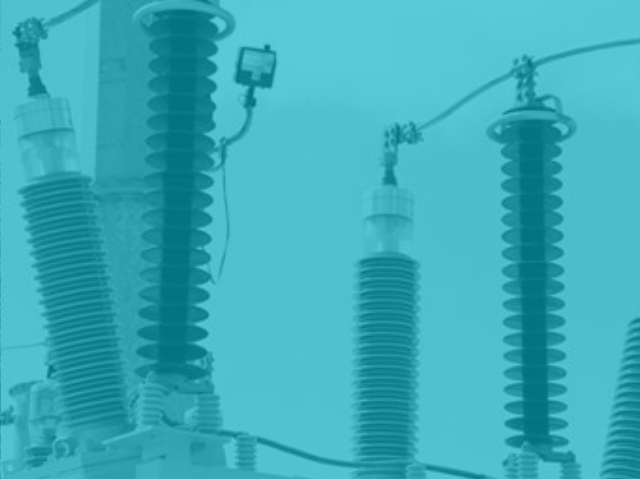


Day-Ahead Market



Real-Time



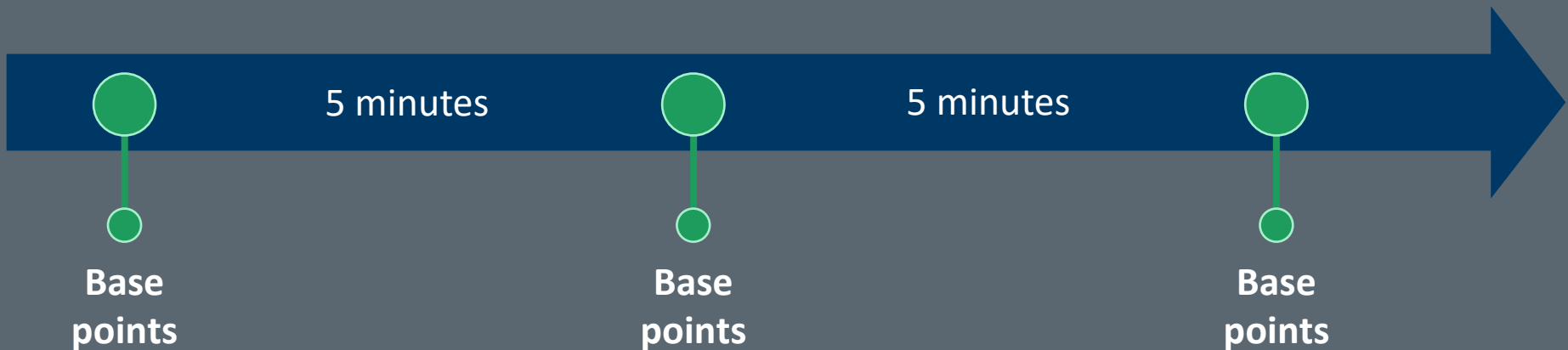


Ancillary Services

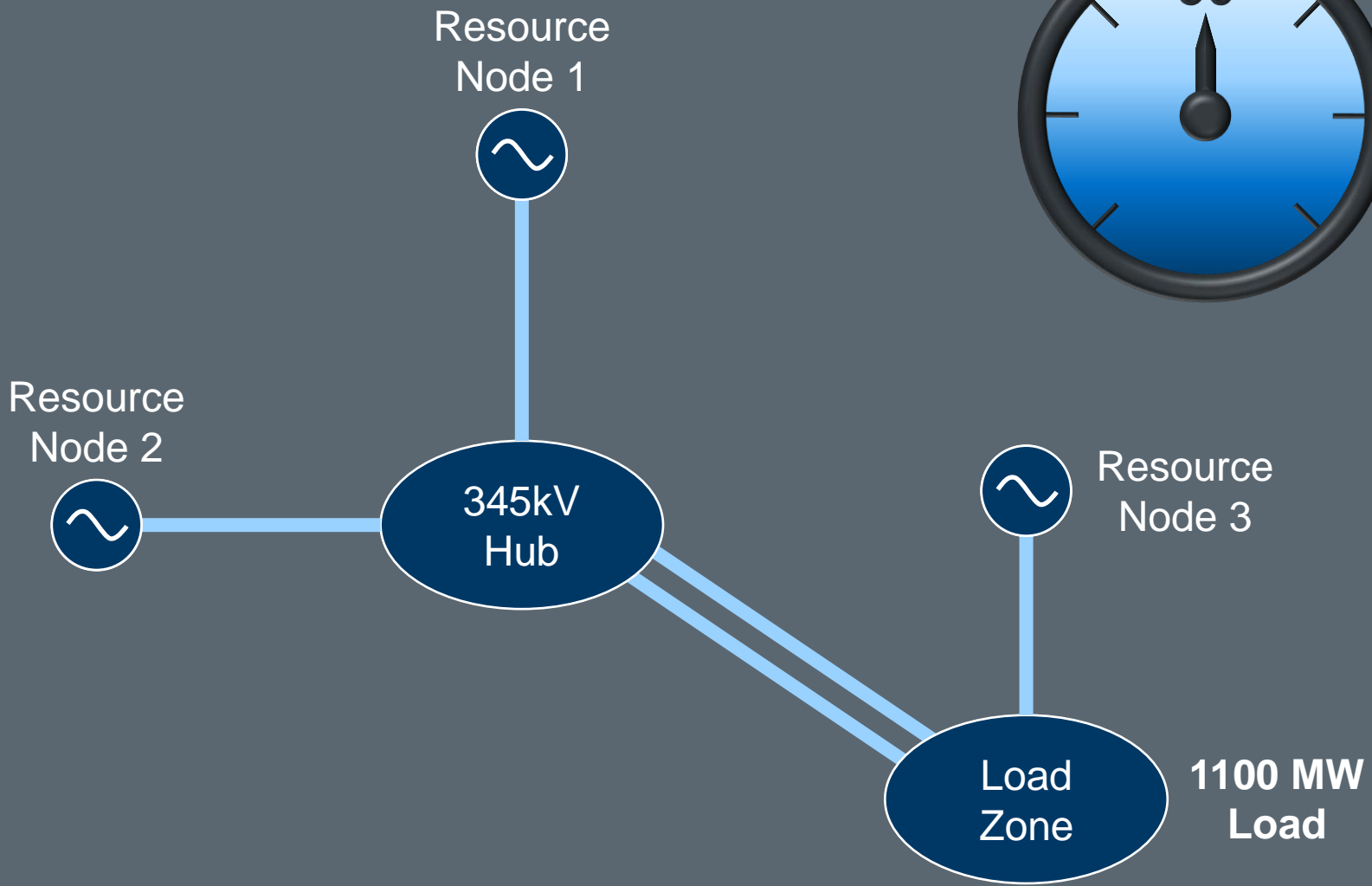


Security Constrained Economic Dispatch (SCED)

- Matches generation with demand
- Manages congestion
- Achieves least cost dispatch

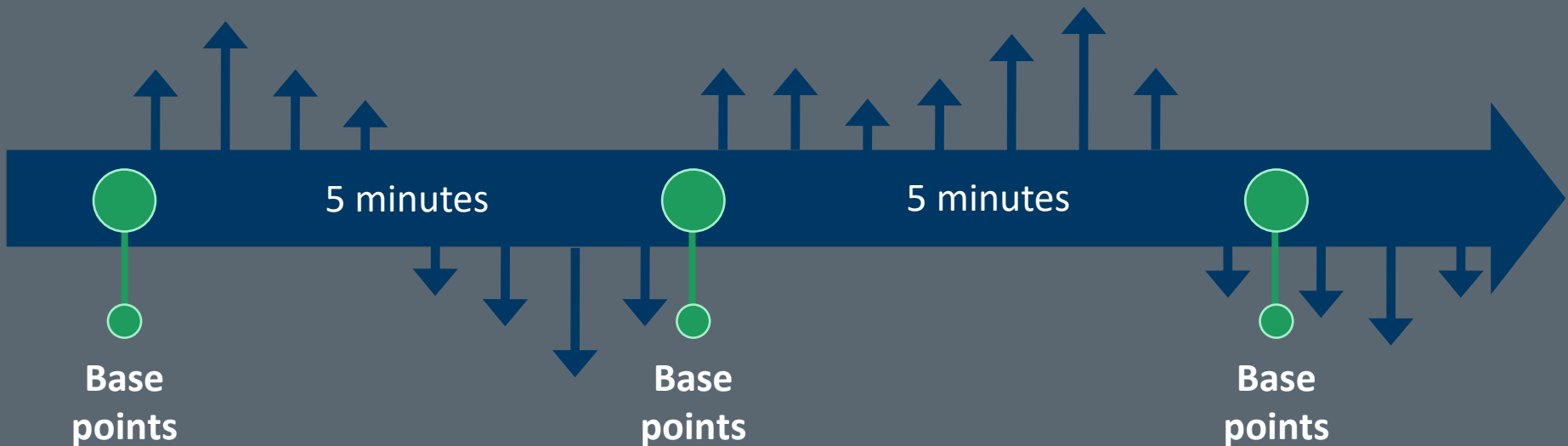


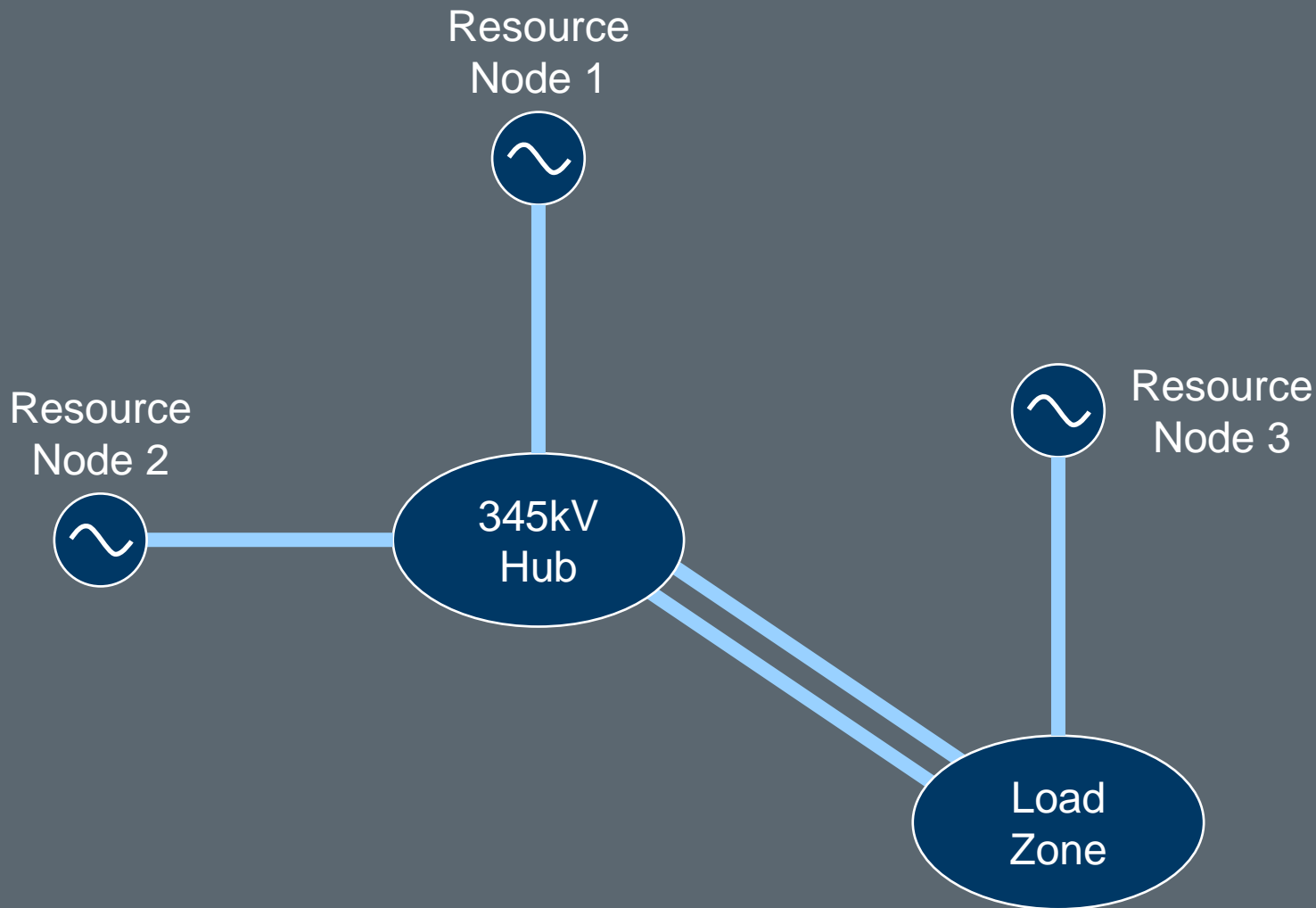




Regulation Service

- Matches generation with demand
- Responds to frequency deviations





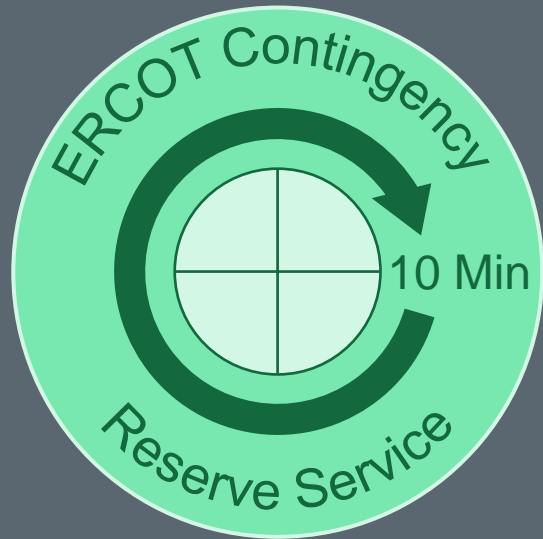
Responsive Reserve Service



Possible Uses

- Loss of Generation
- Large load-ramps

ERCOT Contingency Reserve Service



Possible Uses

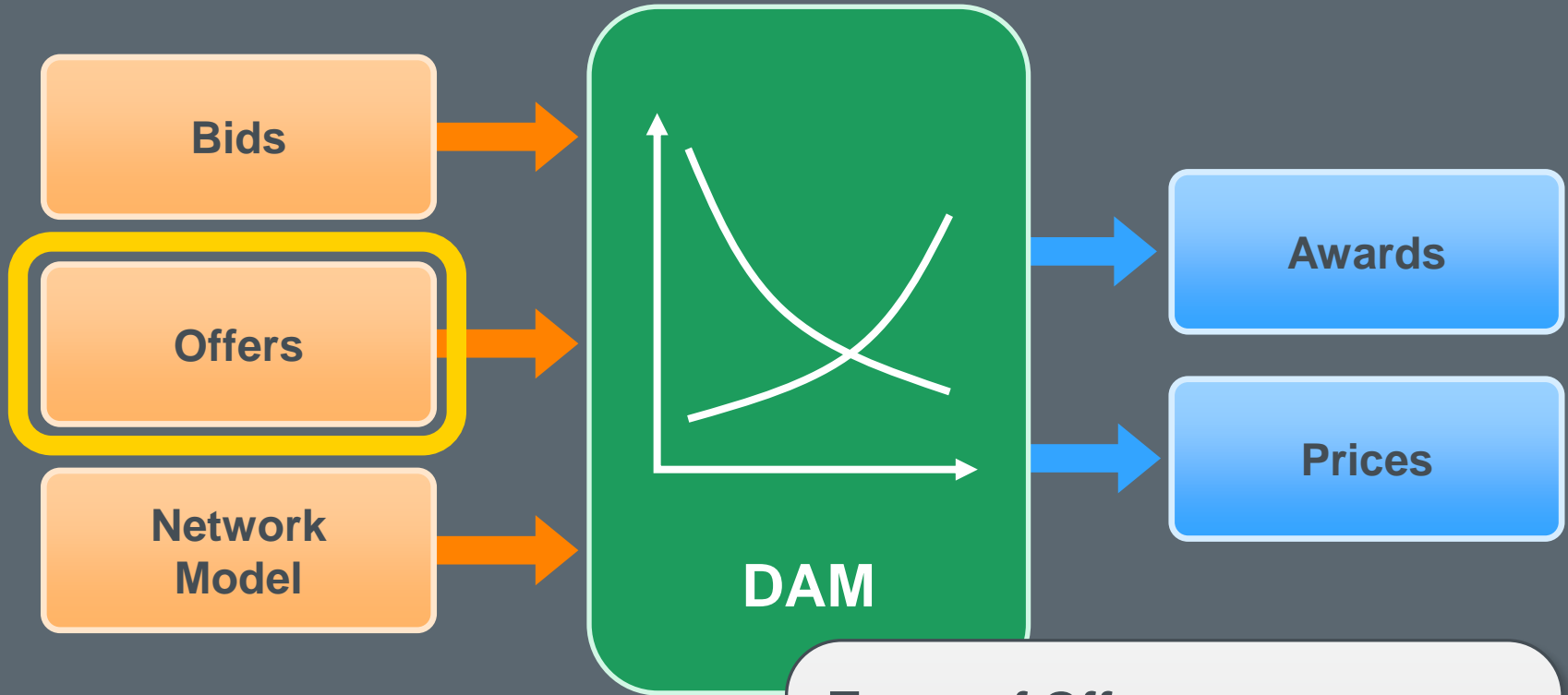
- Restoring Responsive Reserve
- Large renewable ramps

Non-Spinning Reserve Service



Possible Uses

- Larger load than expected
- Local transmission issues



Types of Offers:

- Three-Part Supply Offer
- DAM Energy-Only Offer
- Ancillary Service (AS) Offer

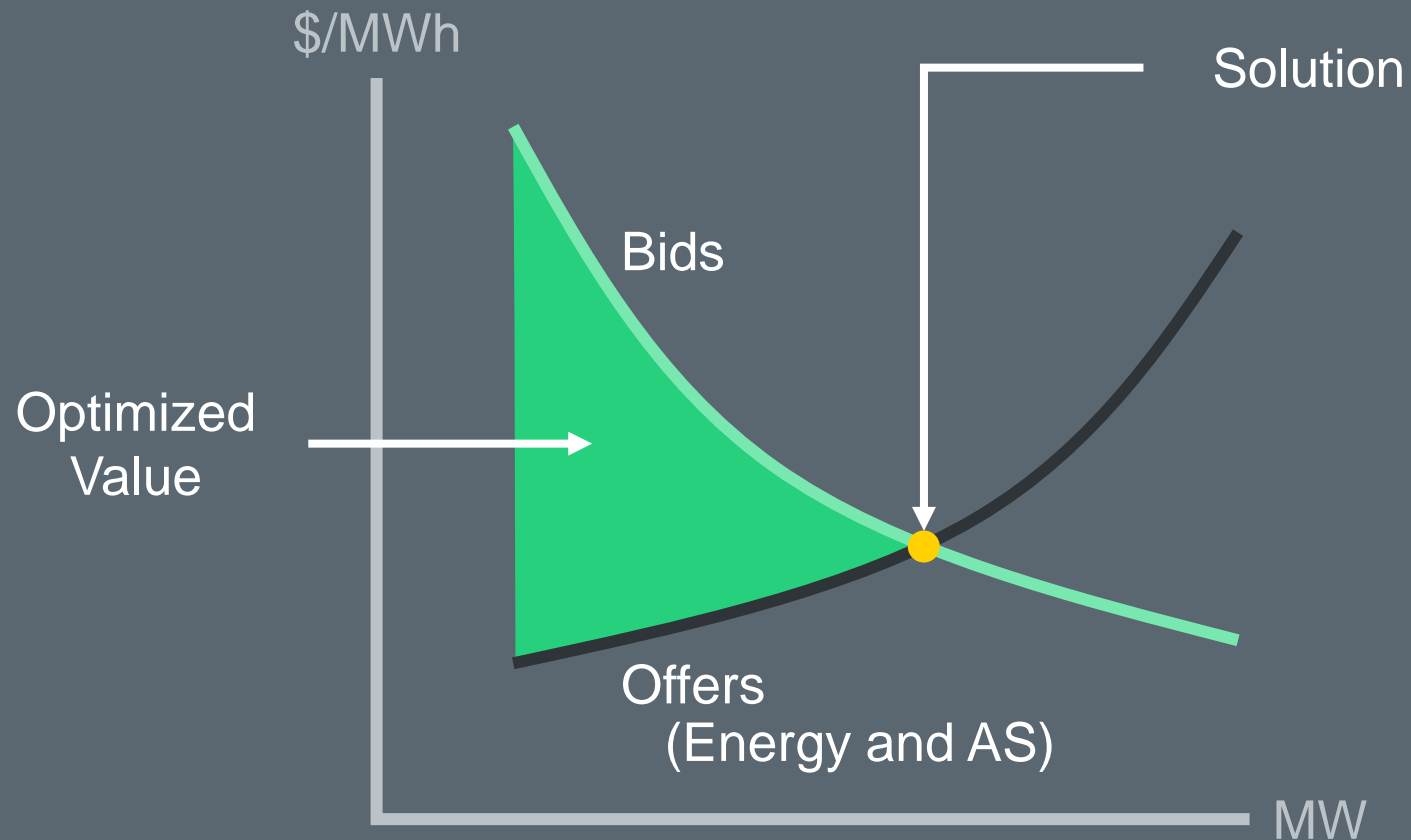
Resource-Specific Offers for Each Service

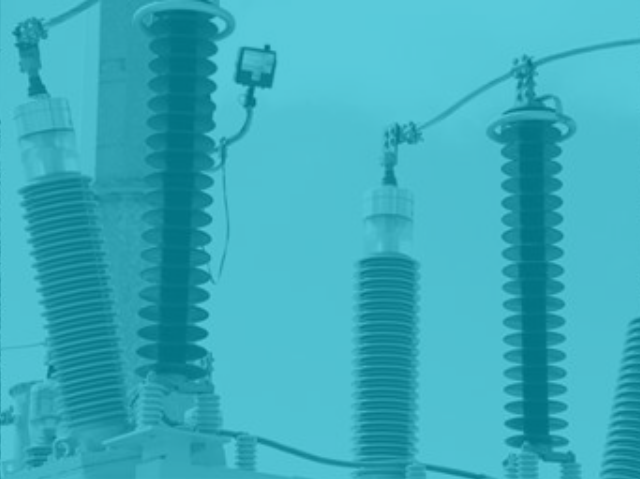
Type of Service	Offer	
Regulation Up	MW	\$ / MW
Regulation Down	MW	\$ / MW
Responsive Reserve	MW	\$ / MW
Contingency Reserve	MW	\$ / MW
Non-Spinning Reserve	MW	\$ / MW

Multiple offers from single Resource:

- Multiple Ancillary Services
- May be combined with Energy Offers

Energy and Ancillary Services are co-optimized

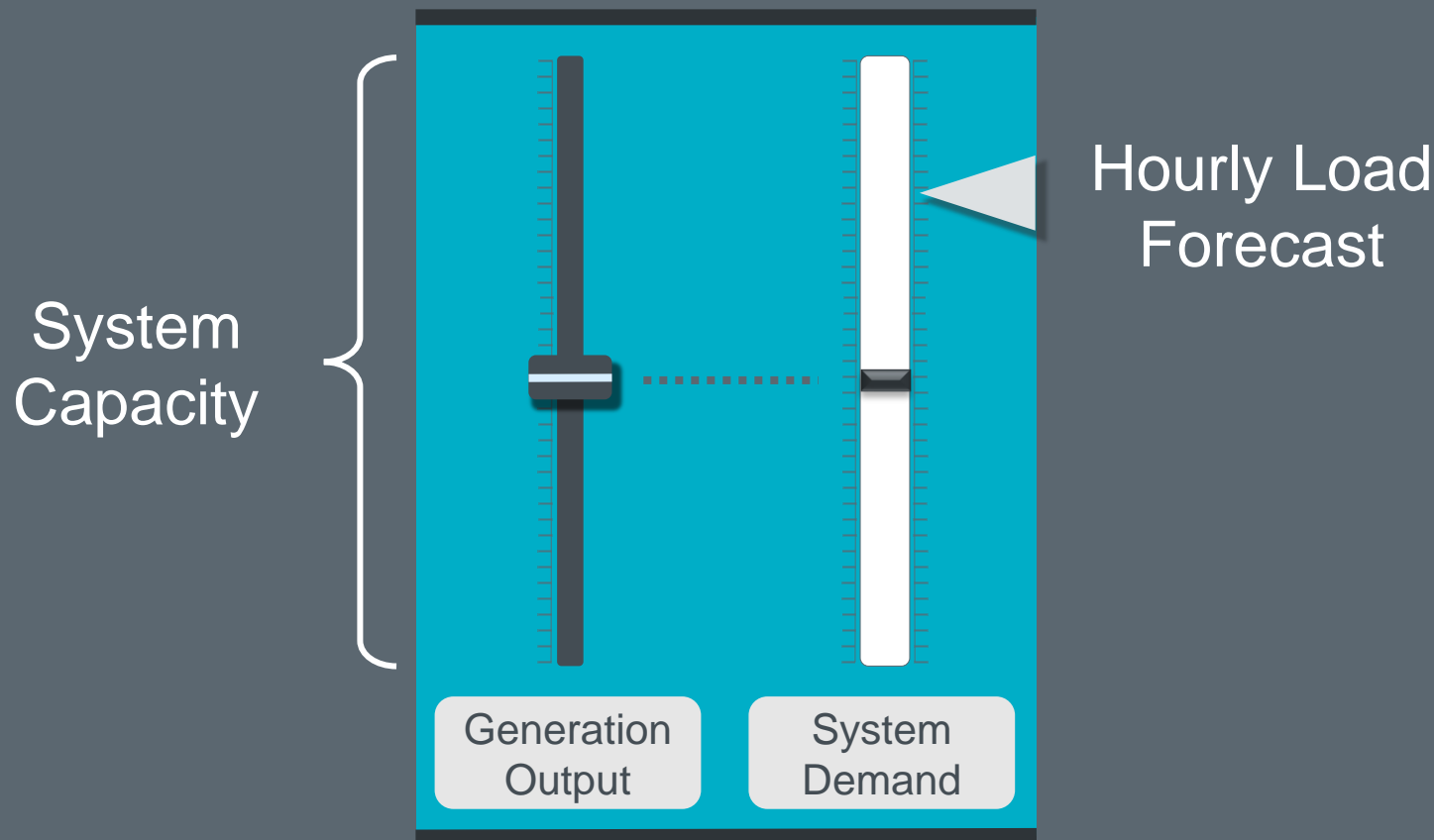




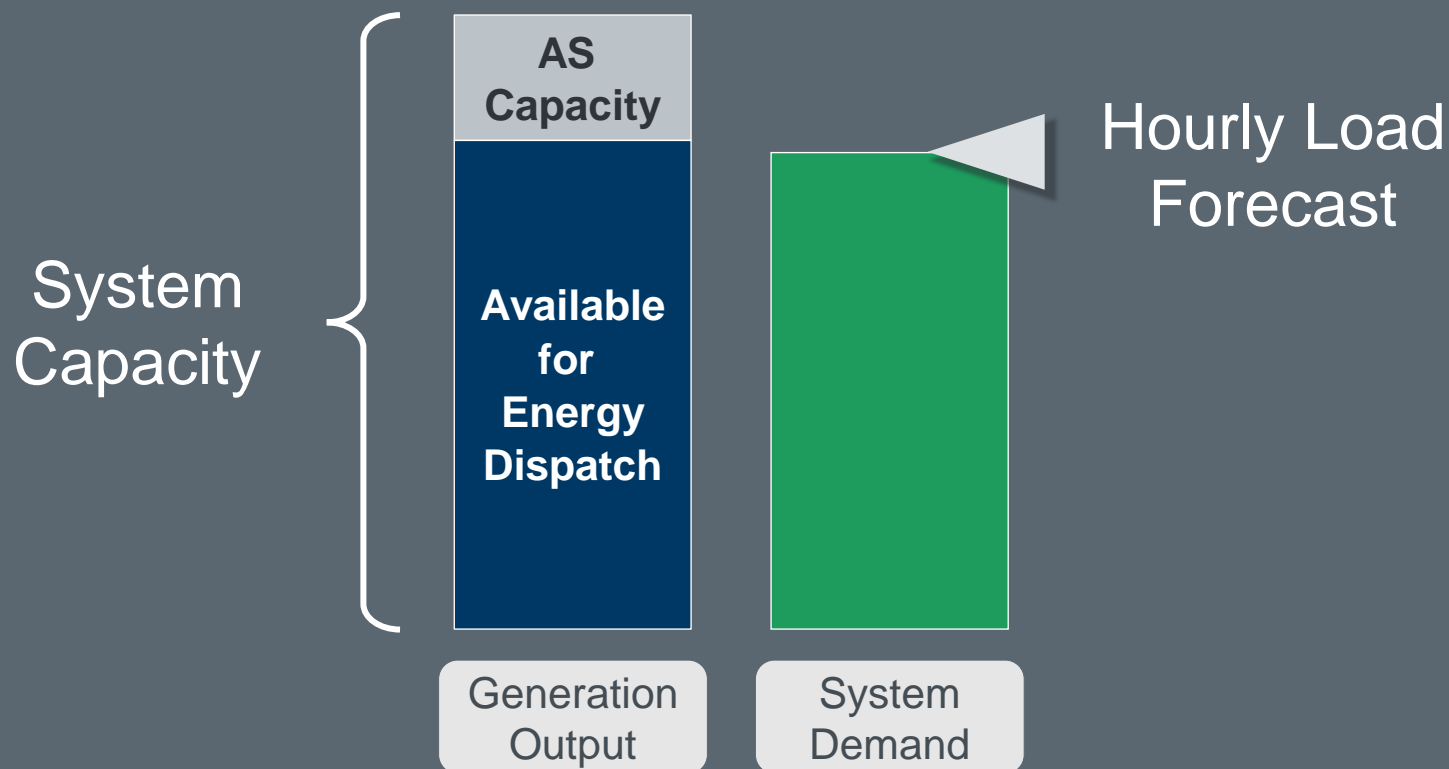
System Capacity



ERCOT dispatches Generation to follow Demand



Two needs for Capacity



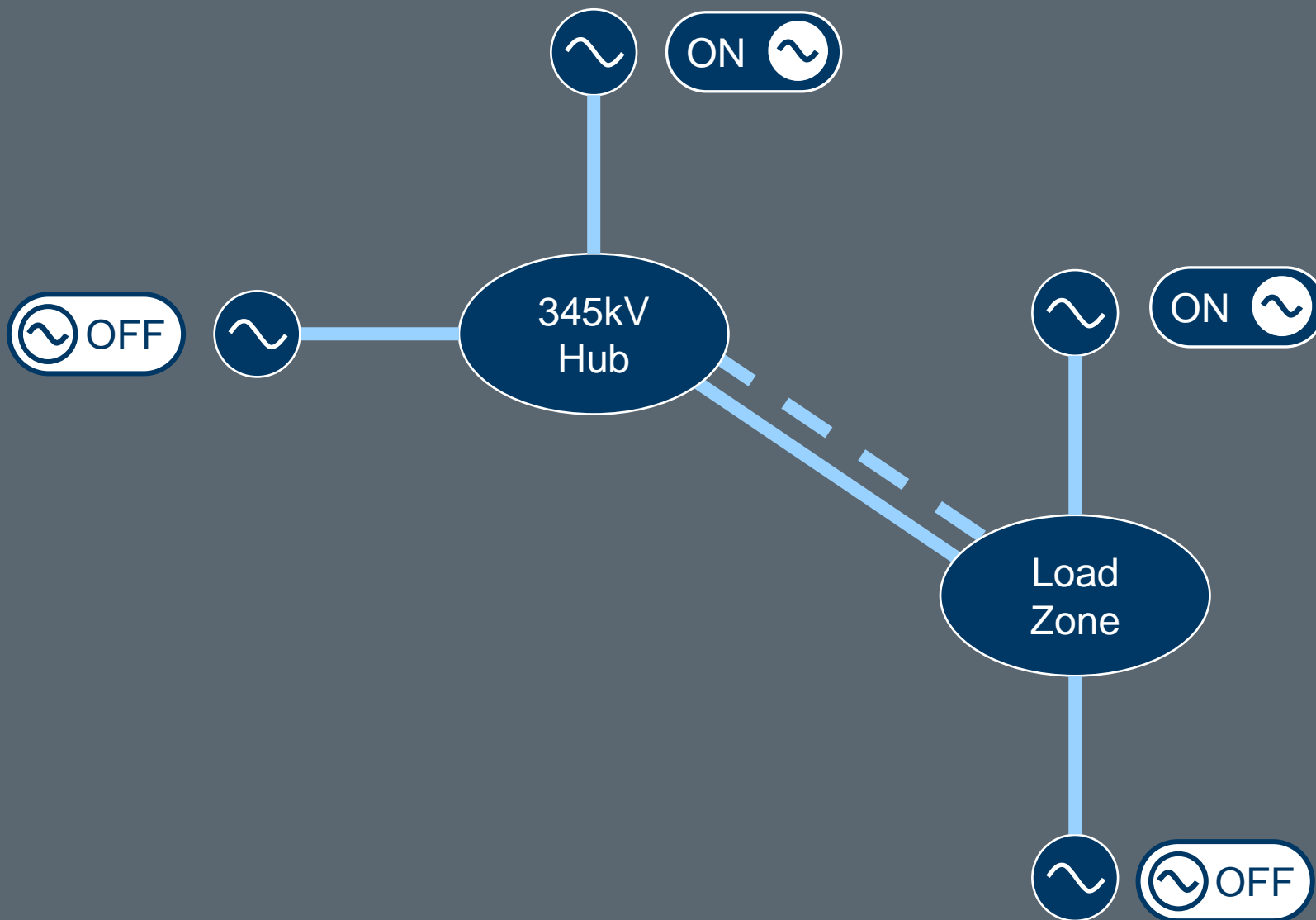
Current Operating Plan (COP)

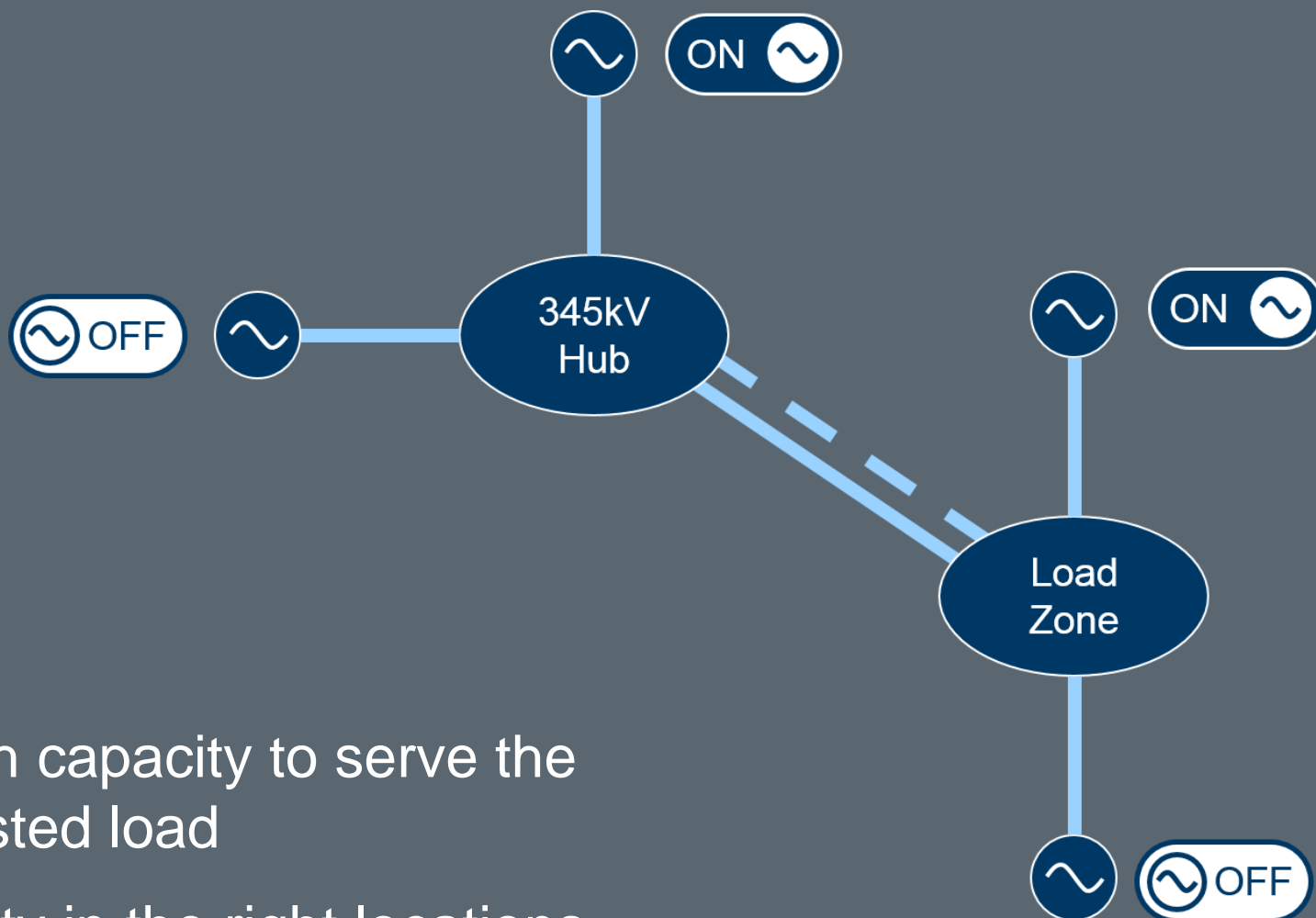
Anticipated Resource operating conditions

- Resource Status
- Resource Limits
- Ancillary Service Commitments



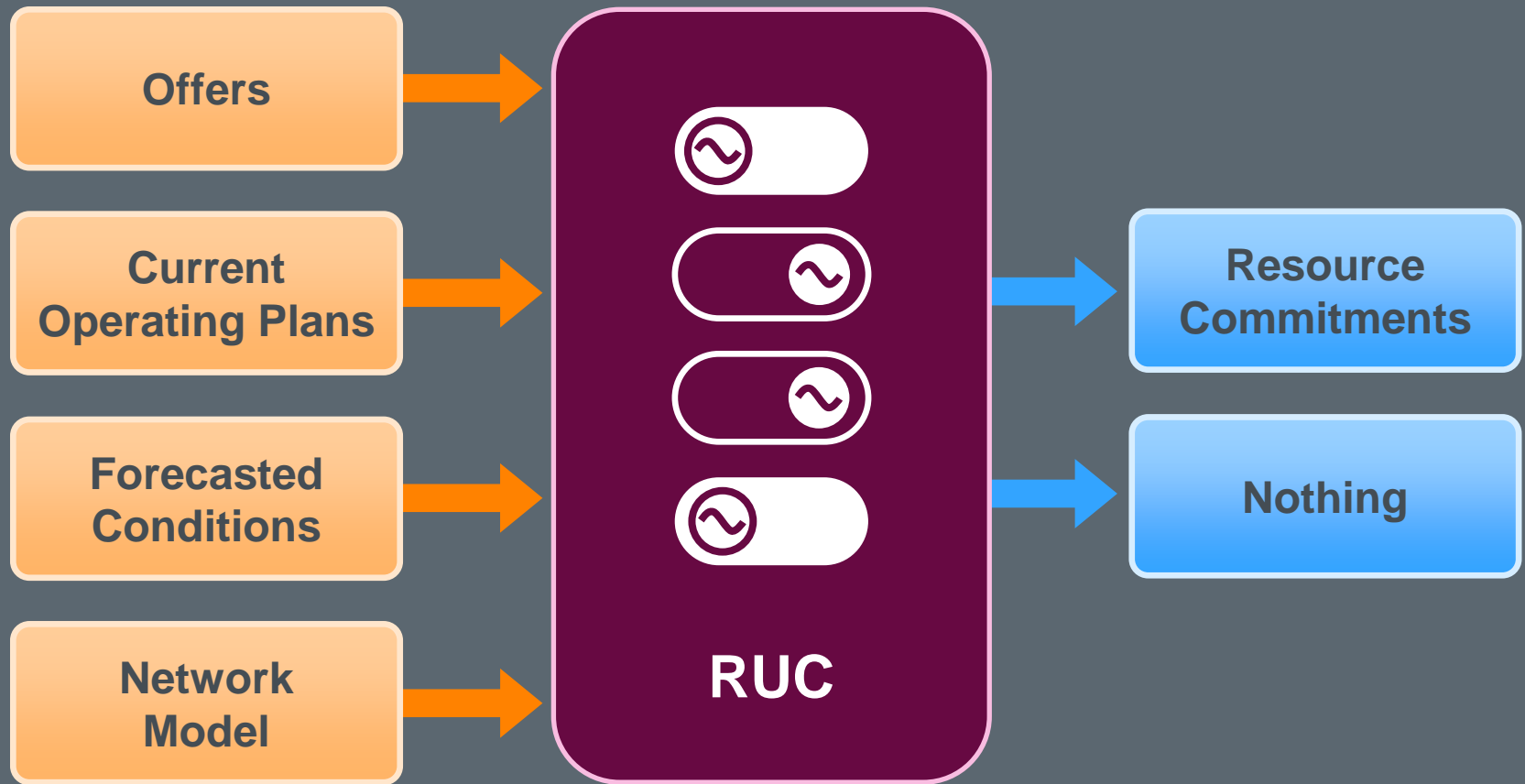
Resource QSEs must maintain a COP for each hour of the next 7 days



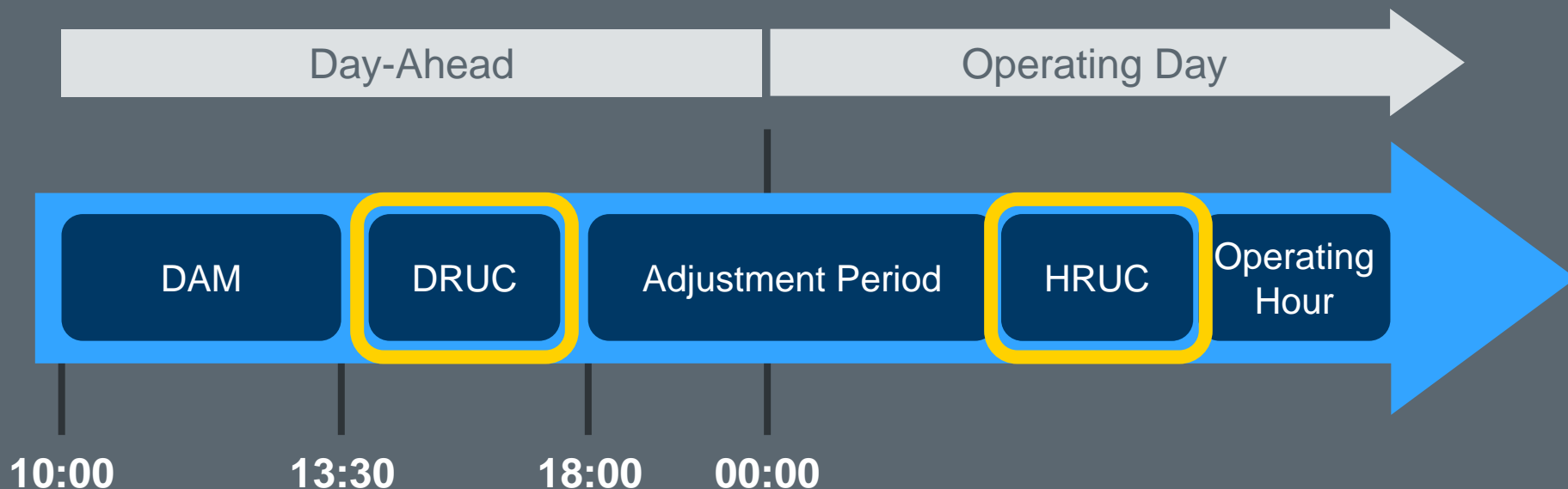


Ensures:

- Enough capacity to serve the forecasted load
- Capacity in the right locations



Timing



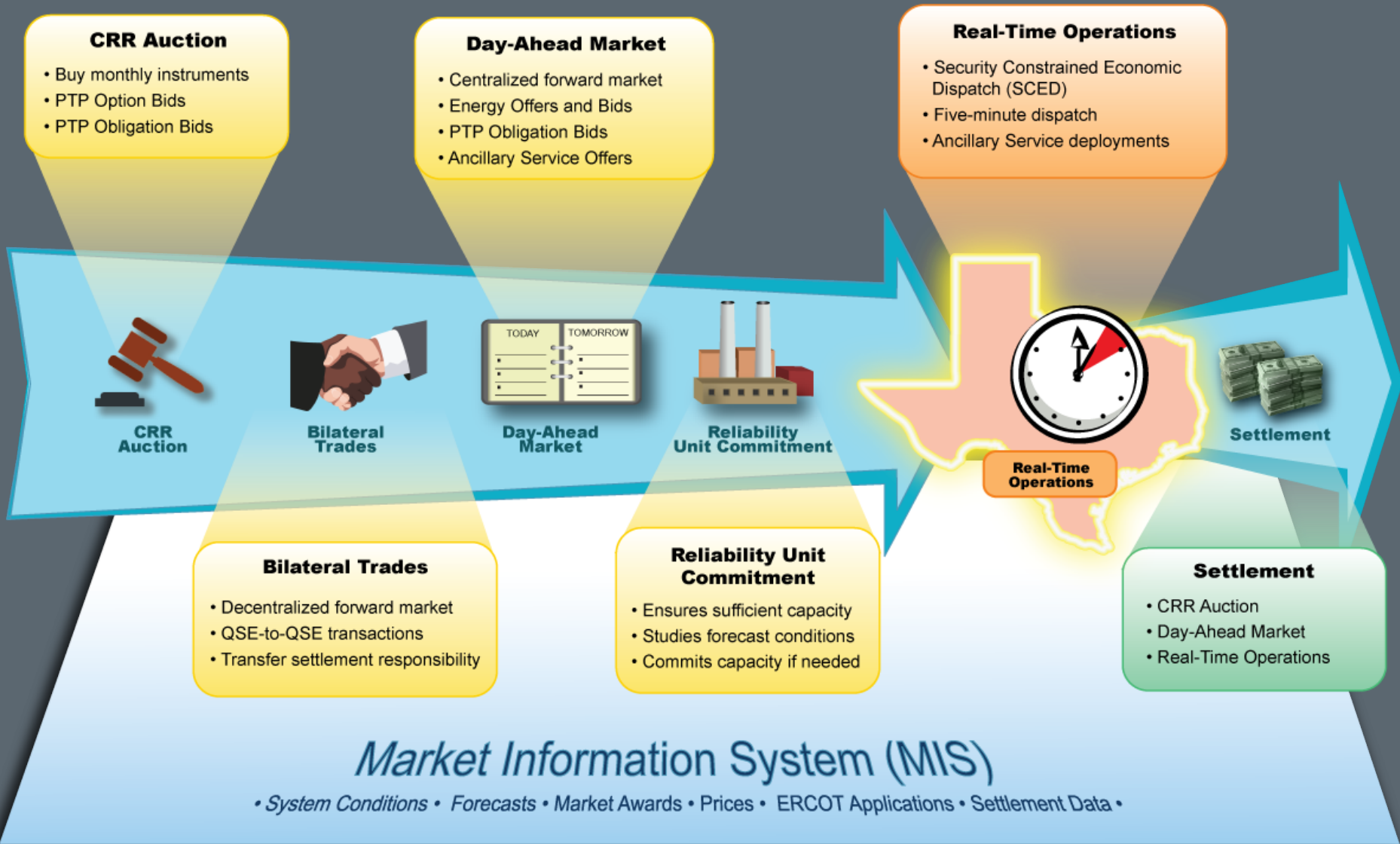
DRUC = Day-Ahead Reliability Unit Commitment

HRUC = Hourly Reliability Unit Commitment



Summary and Conclusion







Also available
on ercot.com



Available to
all Market
Participants



Available to
specific Market
Participant

ercot 

JEOPARDY!



JEEPARDY!

GET
REAL

FORWARD
THINKING

LET'S GET
THIS
SETTLED

GET THE
POINT?

ANTS ON
LARRY?

ENOUGH
ALREADY!

\$50

\$50

\$50

\$50

\$50

\$50

\$100

\$100

\$100

\$100

\$100

\$100

\$150

\$150

\$150

\$150

\$150

\$150

Home > Services > Training > Course Recommendations

Course Recommendations

+ Foundational Market Courses

- Wholesale Market Courses

	QSE	QSE-L	QSE-R	RE	CR	NOIE	CRR	TDSP
Load Serving Entities 201 ILT WBT		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Wholesale Markets 201 WBT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>					
Wholesale Market Operations: Day-Ahead ILT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>					
Wholesale Market Operations: Real-Time ILT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>					
Congestion Revenue Rights ILT WBT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>	

+ Retail Market Courses

+ Resource Courses

+ Settlement and Financial Courses

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