Item 3: Committee Education on Day-Ahead and Real-Time Market Operation

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Finance & Audit Committee Meeting

ERCOT Public
August 7, 2017

Course Overview

Topics in this presentation include:

1	ERCOT Market Relationships
2	ERCOT Market Transactions
3	Managing Congestion Costs
4	Credit Requirements
5	Market Participation
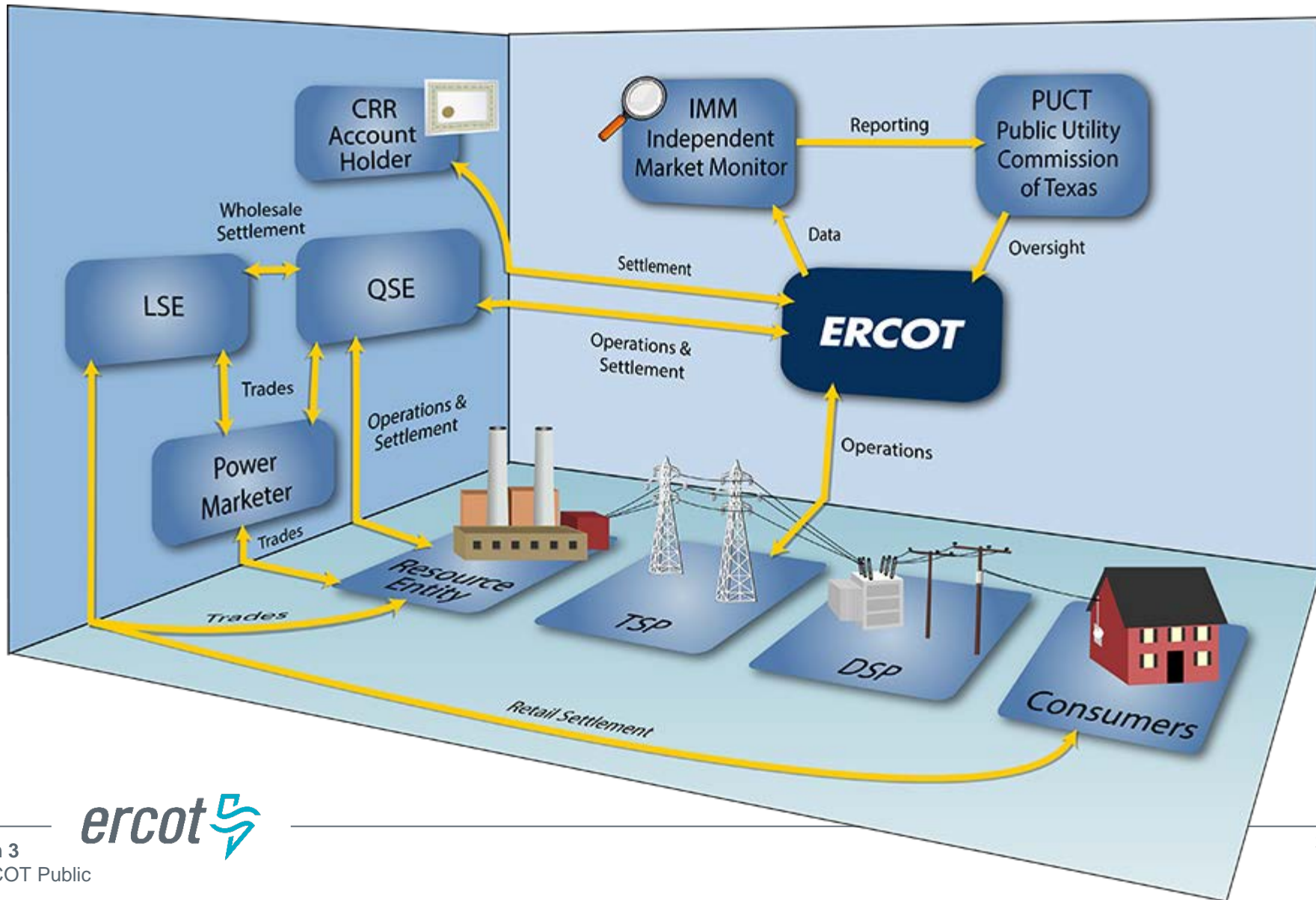
The ERCOT Market Environment

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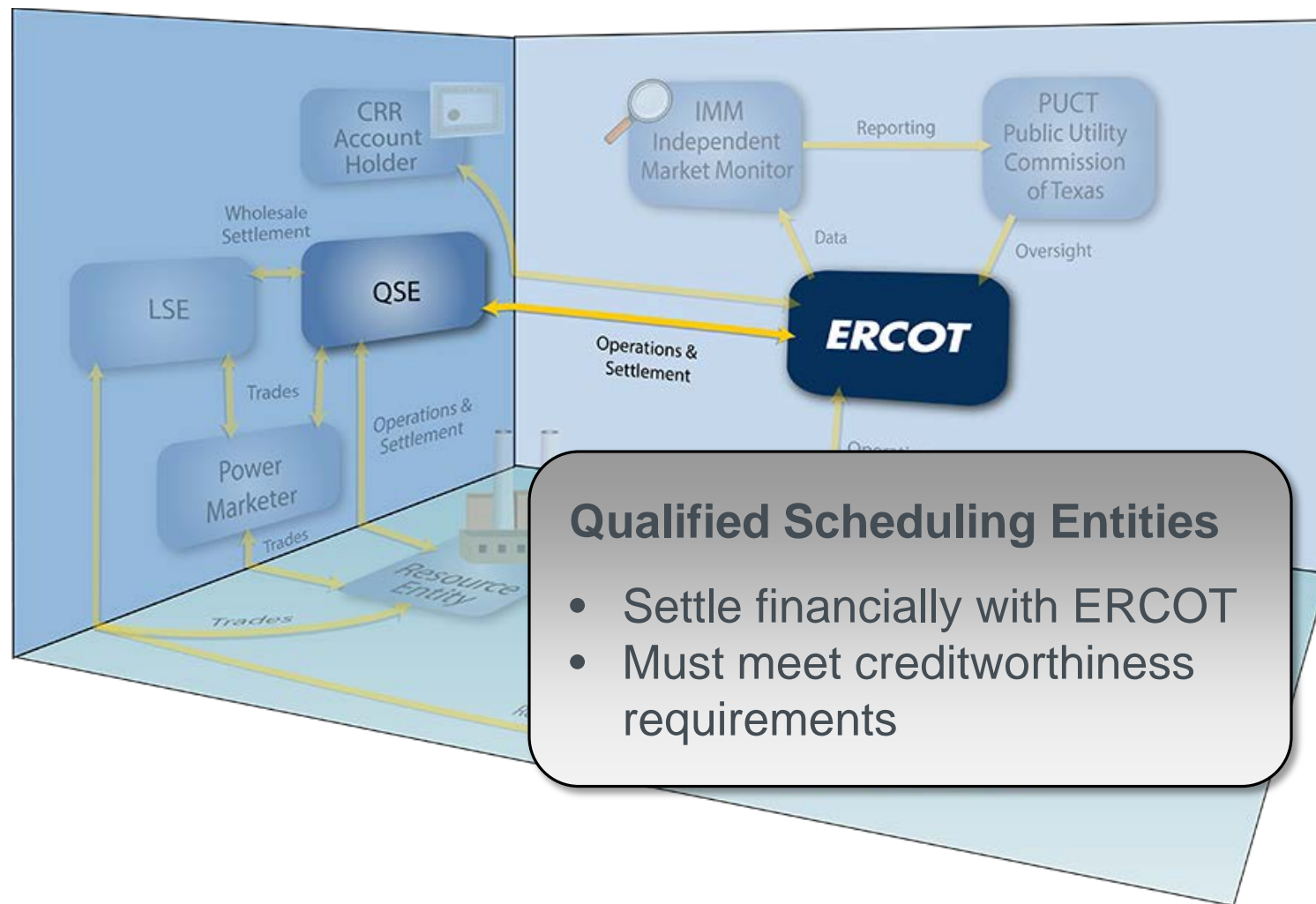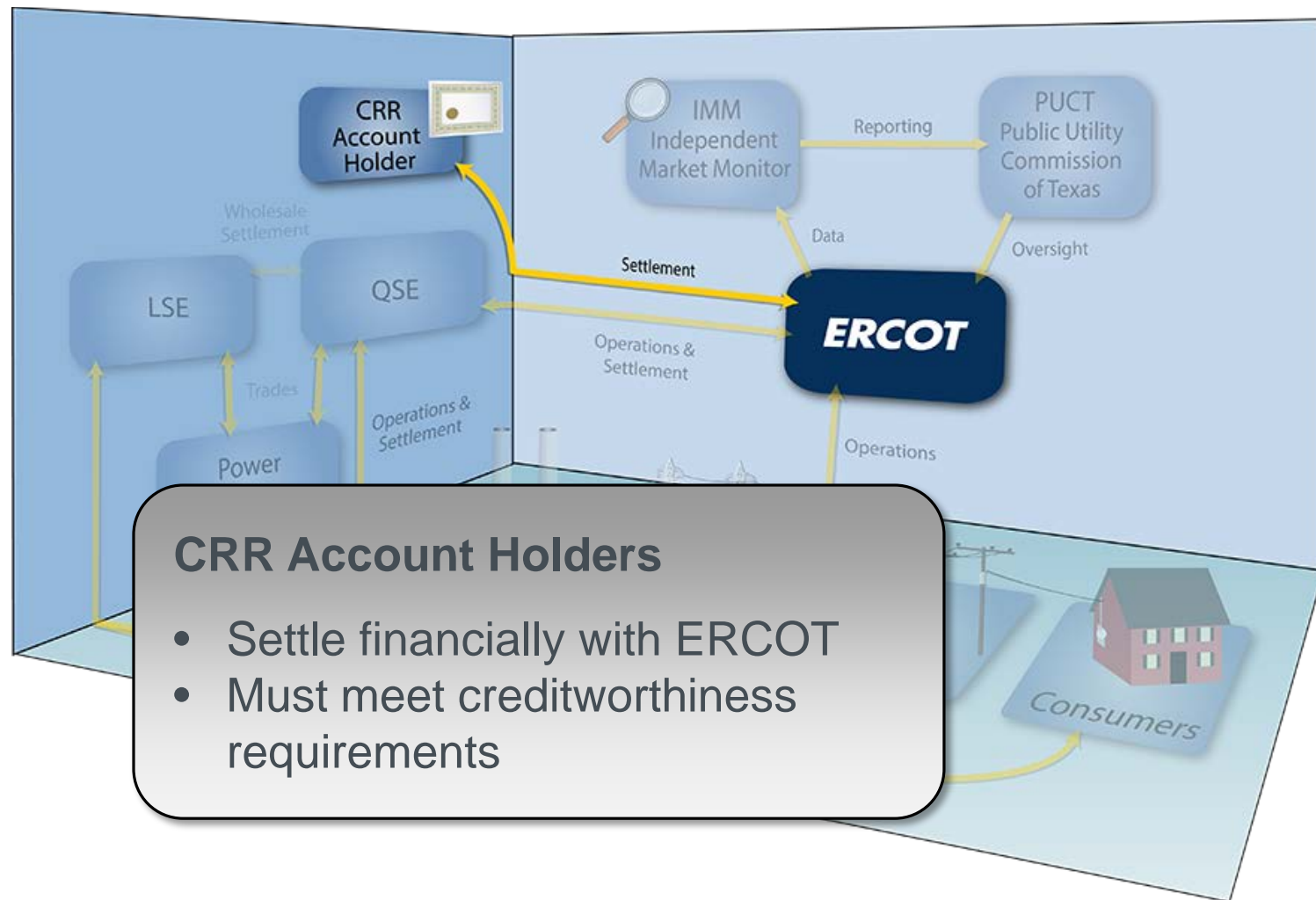
Qualified Scheduling Entities

- Settle financially with ERCOT
- Must meet creditworthiness requirements

The ERCOT Market Environment

CRR Account Holders

- Settle financially with ERCOT
- Must meet creditworthiness requirements

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Market Transactions for Energy and Ancillary Services

Bilateral Trades

Day-Ahead Market

Real-Time Market

Bilateral Trades

Arranged between QSEs

- De-centralized Forward Market
- Products
  - Energy
  - Ancillary Services
- QSEs settle with each other

Both QSEs must report trades to ERCOT to impact ERCOT Wholesale Settlements
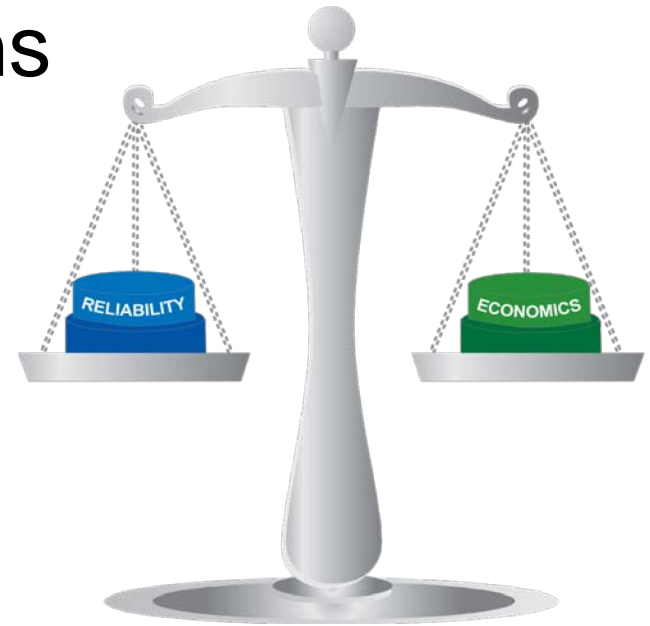
The Day-Ahead Market

ERCOT Facilitated Market

- Centralized Forward Market
- Buy and sell Energy
- Sell Ancillary Services to ERCOT
- QSEs settle with ERCOT

Real-Time Market

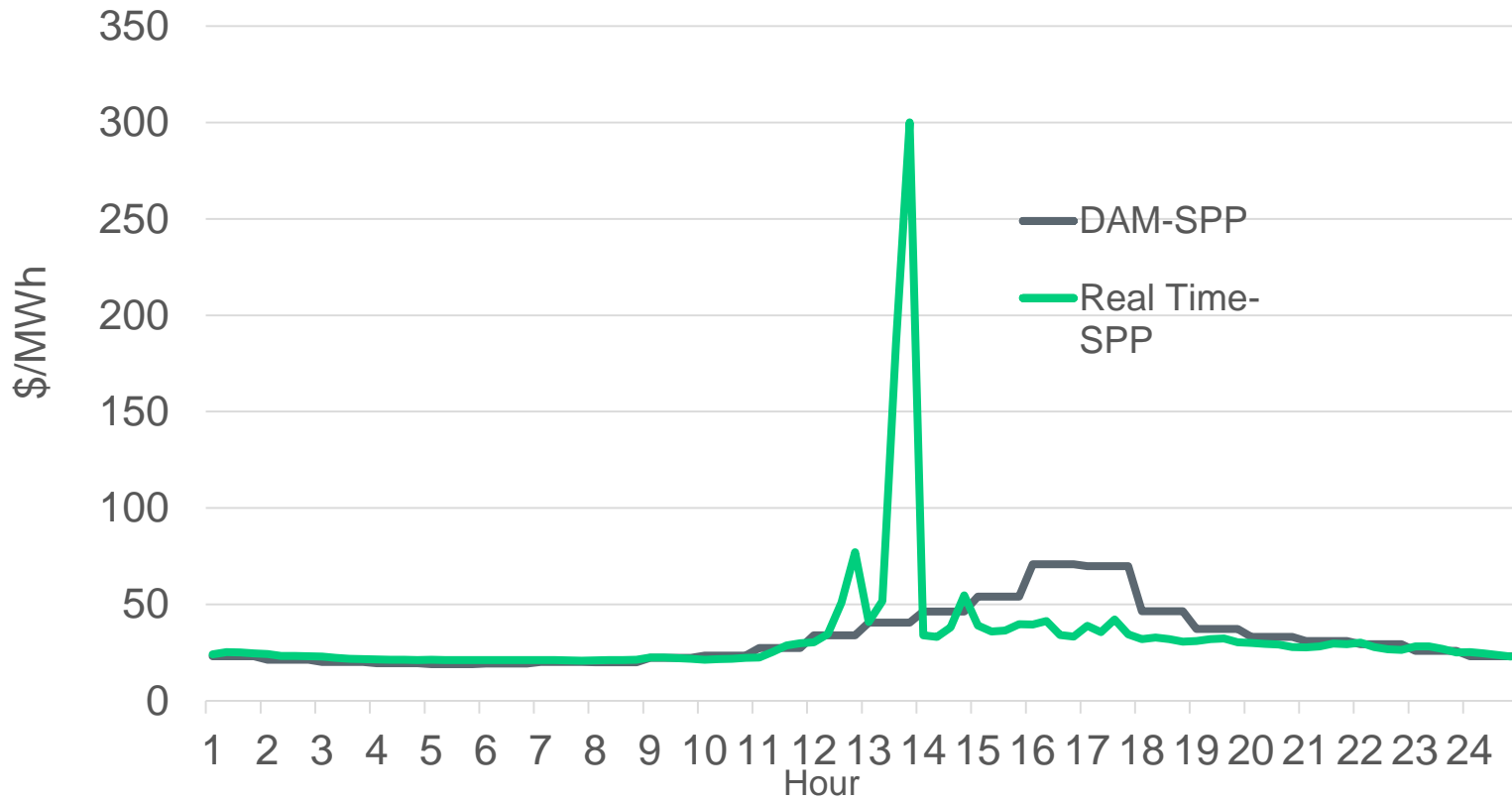## ERCOT Real-Time Operations

- Manage reliability

  - Match generation with demand

  - Operate transmission system within established limits

- Operate the system at least cost
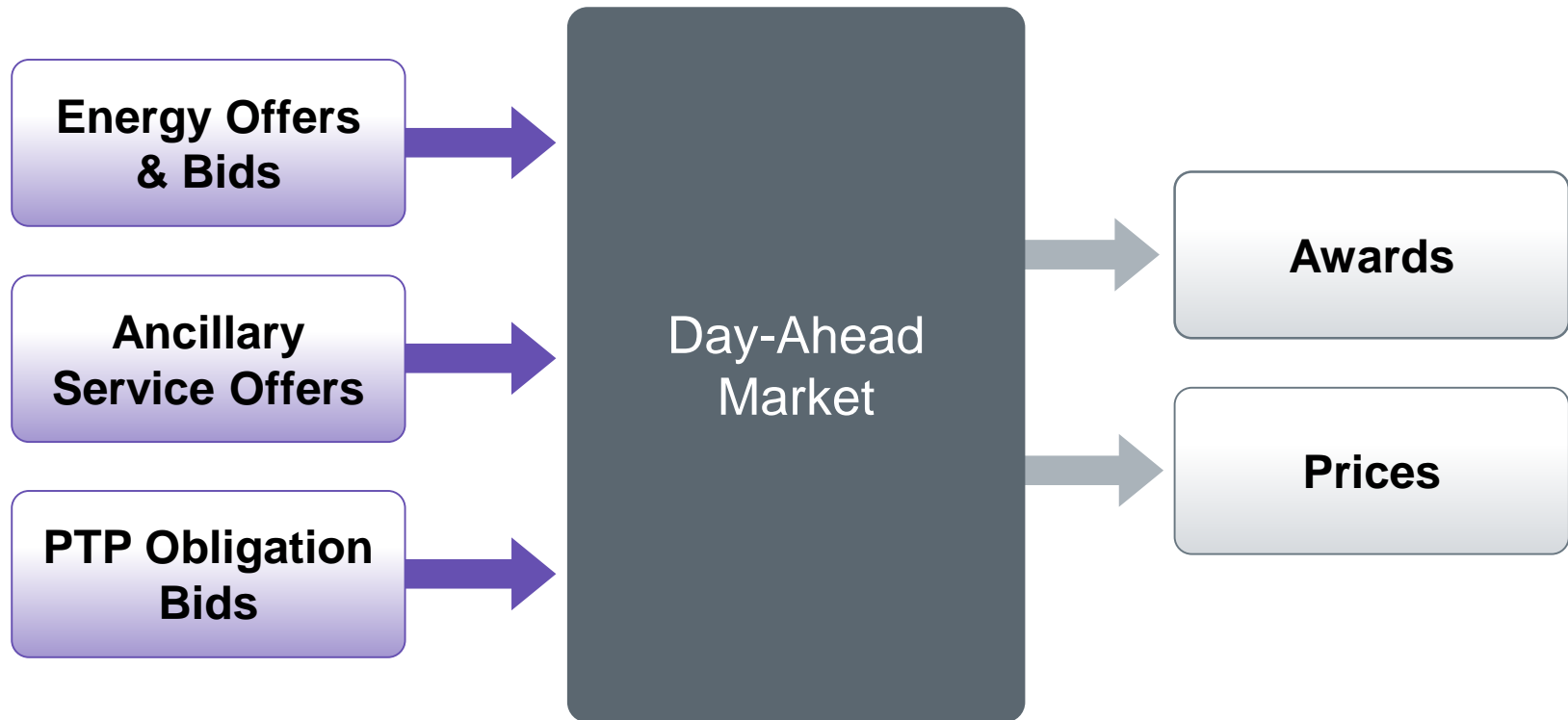
- QSEs settle with ERCOT

Why Forward Markets?

Real-Time Prices are Volatile!

Houston Load Zone 7/22/2017

Day-Ahead Market

Products bought and sold in the DAM:

```
Energy Offers & Bids  ──►

Ancillary Service Offers  ──►    Day-Ahead Market    ──►  Awards

PTP Obligation Bids  ──►                             ──►  Prices
```

ERCOT Wholesale Settlement

ERCOT Settles the Day-Ahead Market

- Buyers

  - Pay Day-Ahead Market price

  - Receive MW credit in Real-Time

- Sellers

  - Are paid Day-Ahead Market price

  - Incur MW obligation in Real-Time

Real-Time Settlements
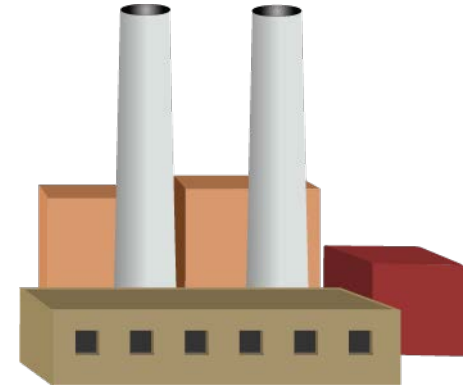
QSEs Representing Load

- Pay for energy not previously purchased through Trade or DAM

- Settle with Load Serving Entities

Real-Time Settlements

QSEs Representing Resources

- Are paid for all energy not previously sold through Trade or DAM

- Pay for any undeliverable Ancillary Services

- Settle with Resource Entities

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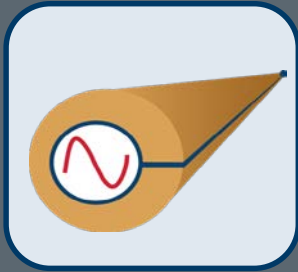| 5	Market Participation

Managing Congestion Costs

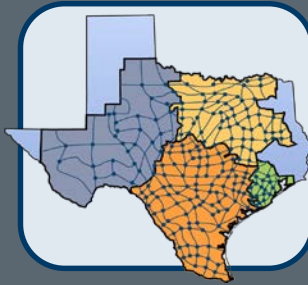
Day-Ahead Market

Real-Time Market

Settlement Points

All Energy settled at one of three types of Settlement Points:

Resource Nodes	Load Zones	Hubs
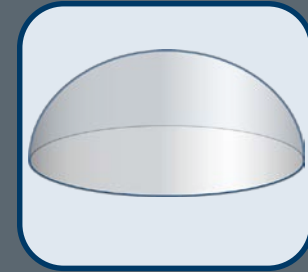
Each Settlement Point has its own Settlement Point Price

Congestion Costs

$40/MWh — Hub

$25/MWh — Resource Node

$50/MWh — Load Zone
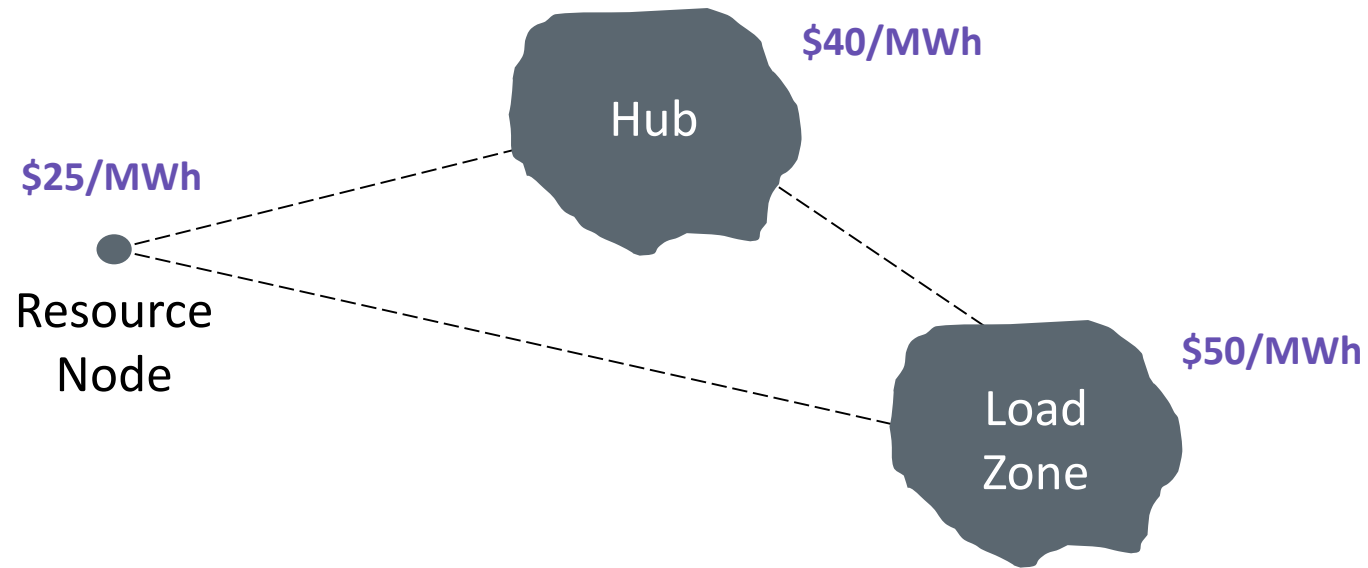
Price separation across the grid exposes buyers and sellers of energy to **Congestion Costs**

Hedging Congestion Costs in Day-Ahead Market

$40/MWh

Hub

$25/MWh

Source

$50/MWh

CRR

Sink
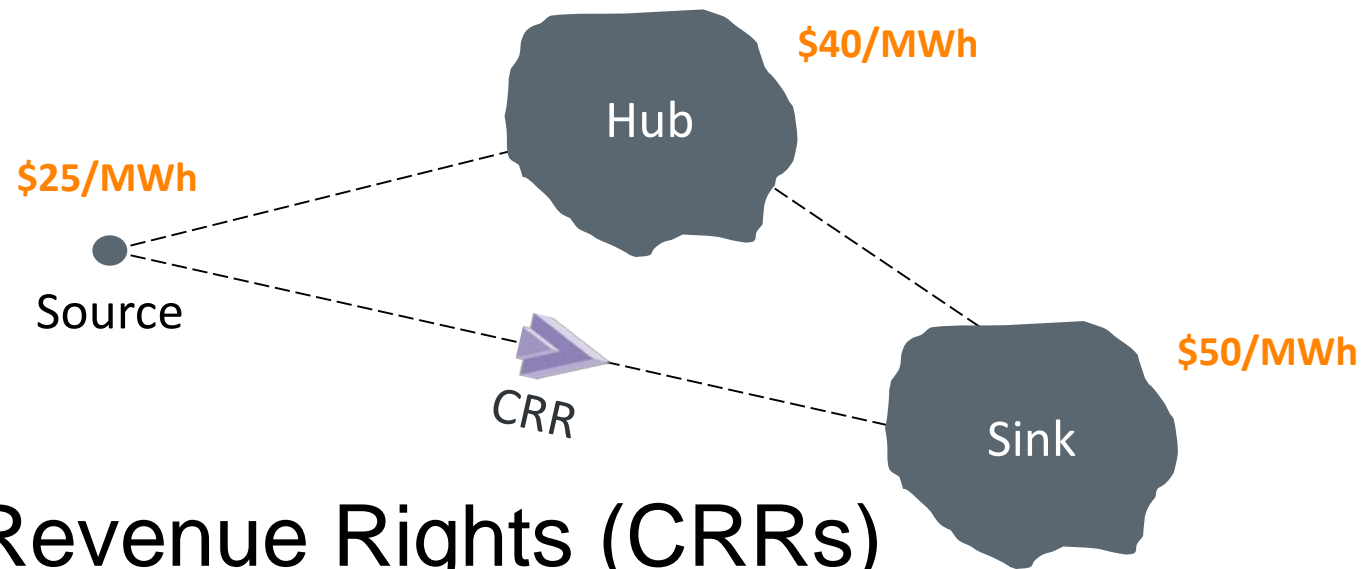
Congestion Revenue Rights (CRRs)

- Financial instruments

- Purchased at Auction Clearing Price

- Settled at Day-Ahead Market Price Spread

Hedging Congestion Costs in Real-Time

$40/MWh

Hub

$25/MWh

Source

CRR

$50/MWh

Sink
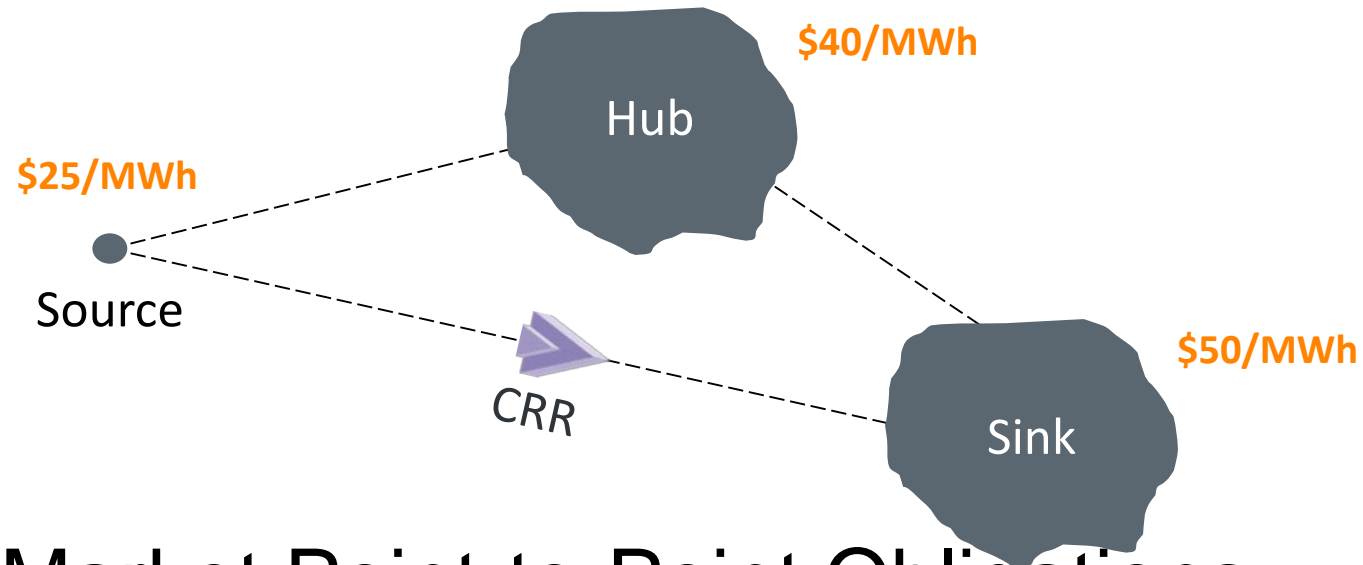
Day-Ahead Market Point-to-Point Obligations

- Financial instruments

- Purchased at Day-Ahead Market Price Spread

- Settled at Real-Time Price Spread

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Credit Relationships

Maintains Secured
Collateral with ERCOT

Available credit is shared

Day-Ahead
Market
Credit Limit

Credit Exposure

Credit Exposure comes with Market Activities

Trades →

DAM →

Real-Time →

CRRs →

Total Potential Exposure

Available Credit

Bar chart comparing two stacked columns. Left column from bottom: Unsecured Credit (teal), Secured Collateral (gray). Right column from bottom: Total Potential Exposure (green), Available Credit (purple). A dashed line connects the tops of both columns.
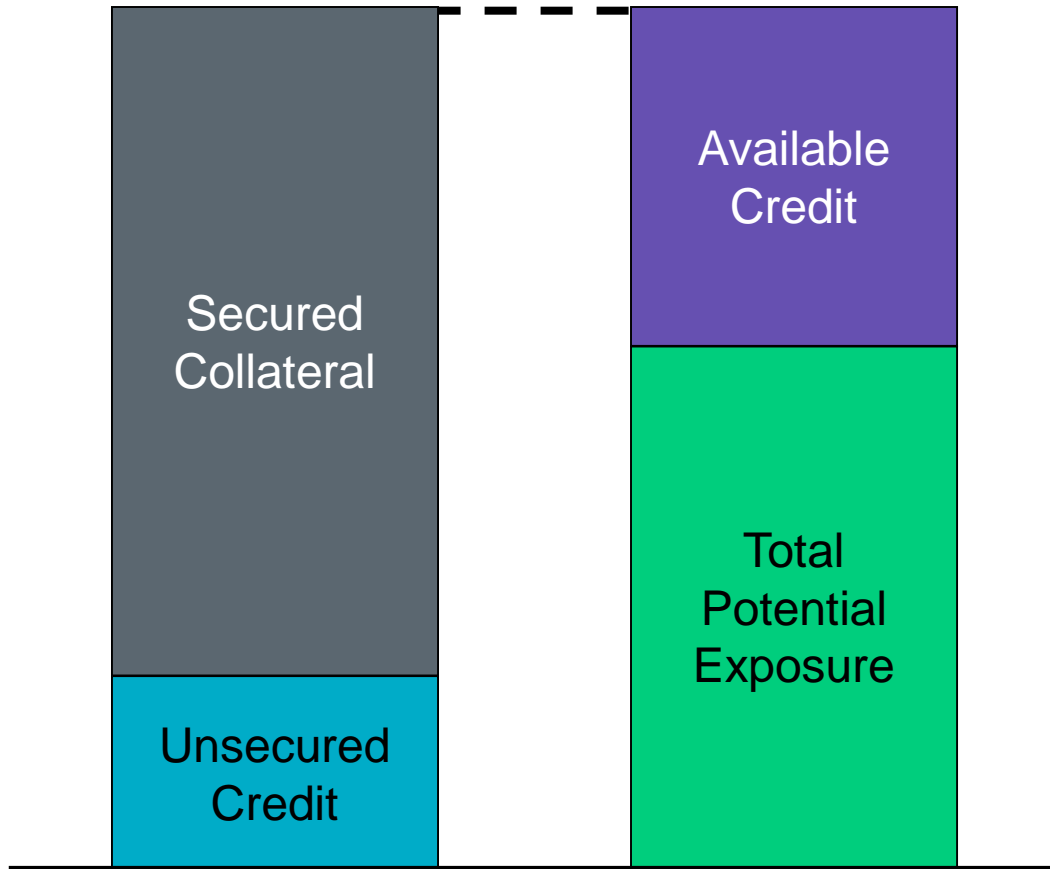
Counter-Party posts Secured Collateral to make credit available to its QSEs and CRR Account Holders

Available Credit

Secured Collateral

Unsecured Credit

Available Credit

CRR Credit Exposure

Other Credit Exposure

Credit Exposure from owning CRRs satisfied only by Secured Collateral

All other Credit Exposure satisfied by Secured and Unsecured Credit

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| 1 | ERCOT Market Relationships |

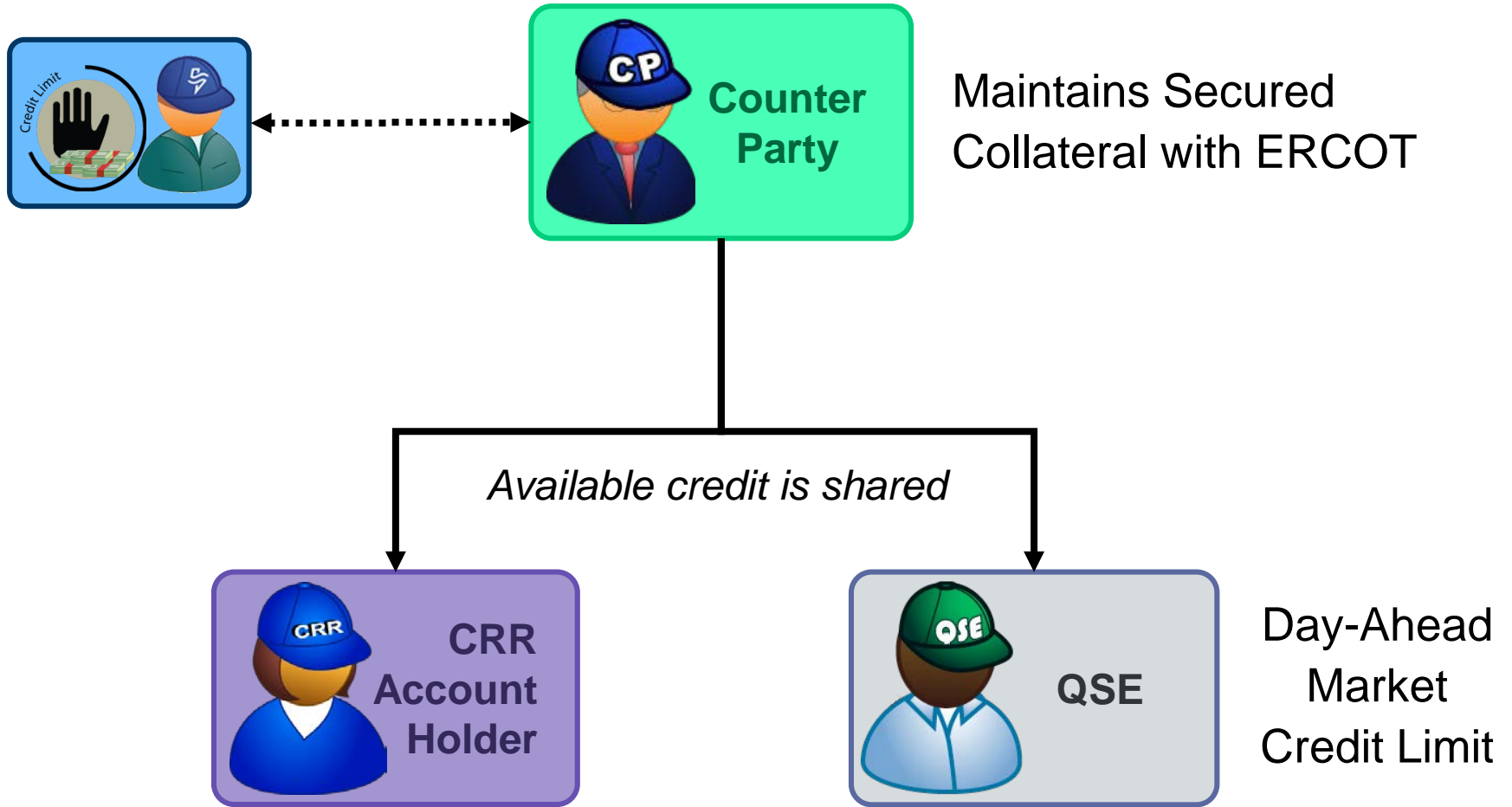| 2 | ERCOT Market Transactions |

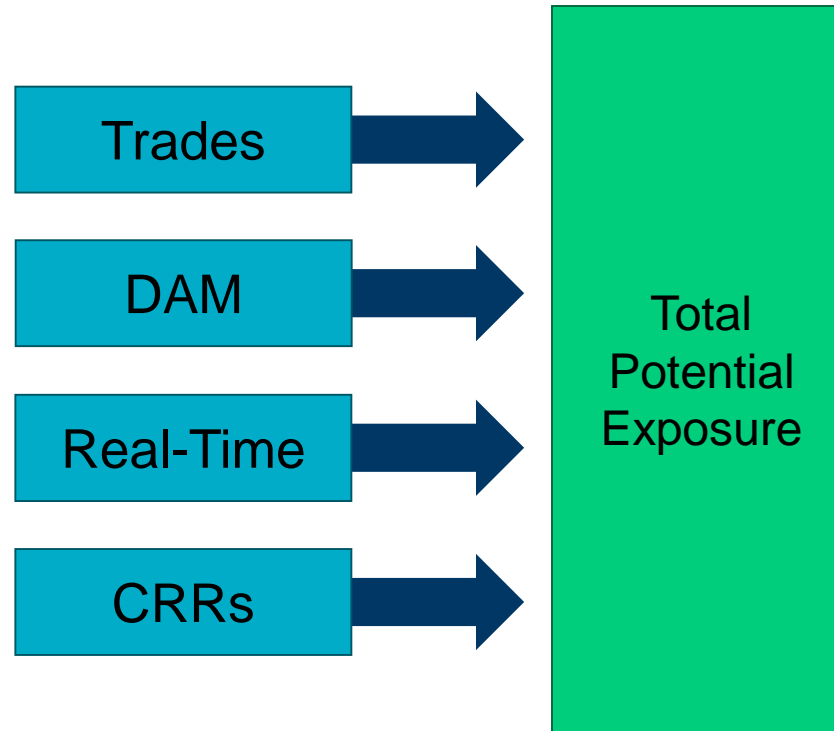| 3 | Managing Congestion Costs |

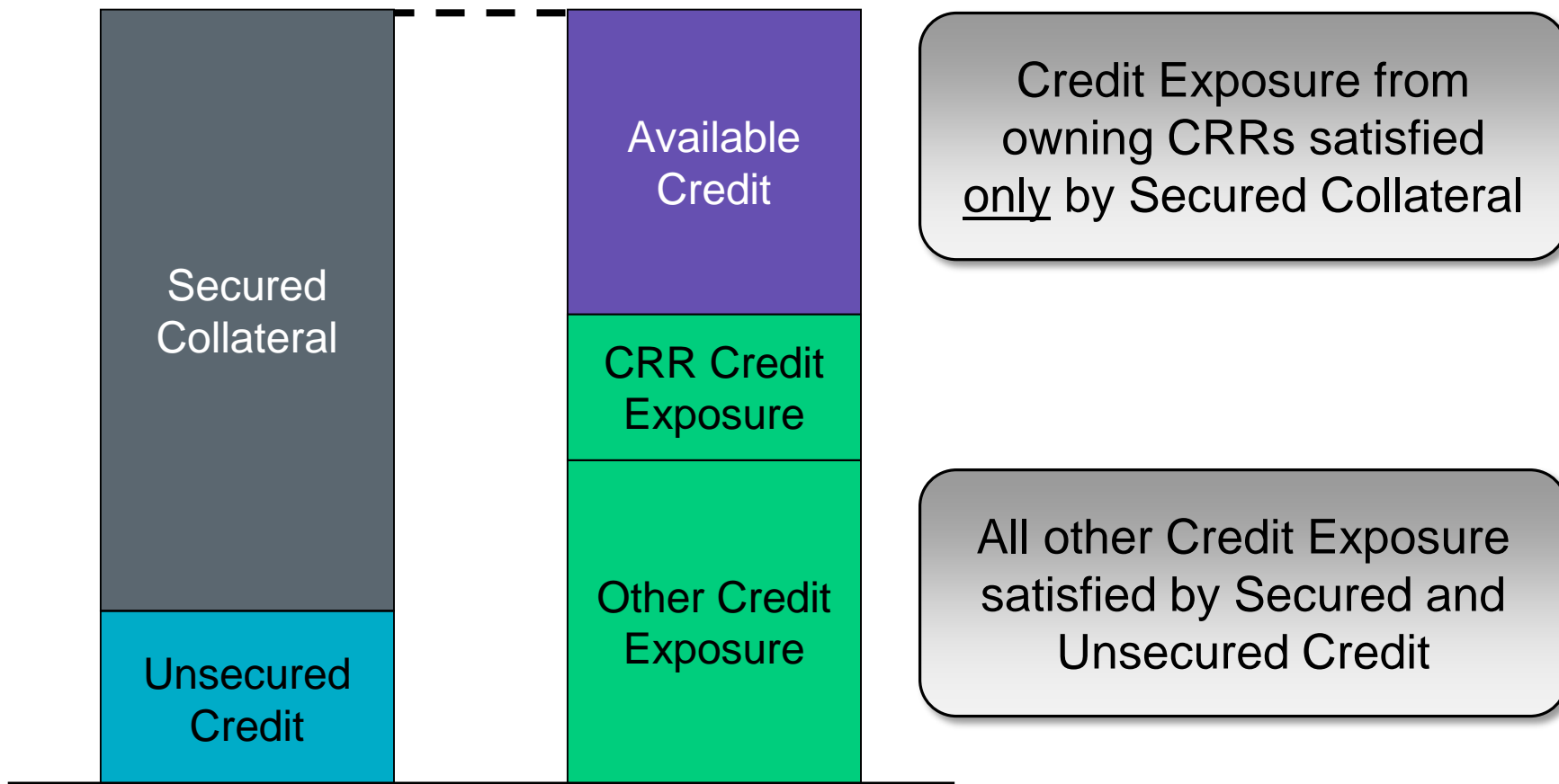| 4 | Credit Requirements |

| 5 | Market Participation |

Day-Ahead Schedule (Hourly Average) – June 2017

Liquidity and activity are normal in the Day-Ahead Market
DAM Net Flow = Combined market transmission flow of
Energy purchased/sold in Day-Ahead Market plus Point-to-Point Obligations

Legend:
- Scheduled Energy Only Offer
- Scheduled Three-part Offer
- DAM Energy Purchase
- RT System Load
- DAM Net Flow

Y-axis: MW
X-axis: Hour Ending