

Real-Time 101



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:

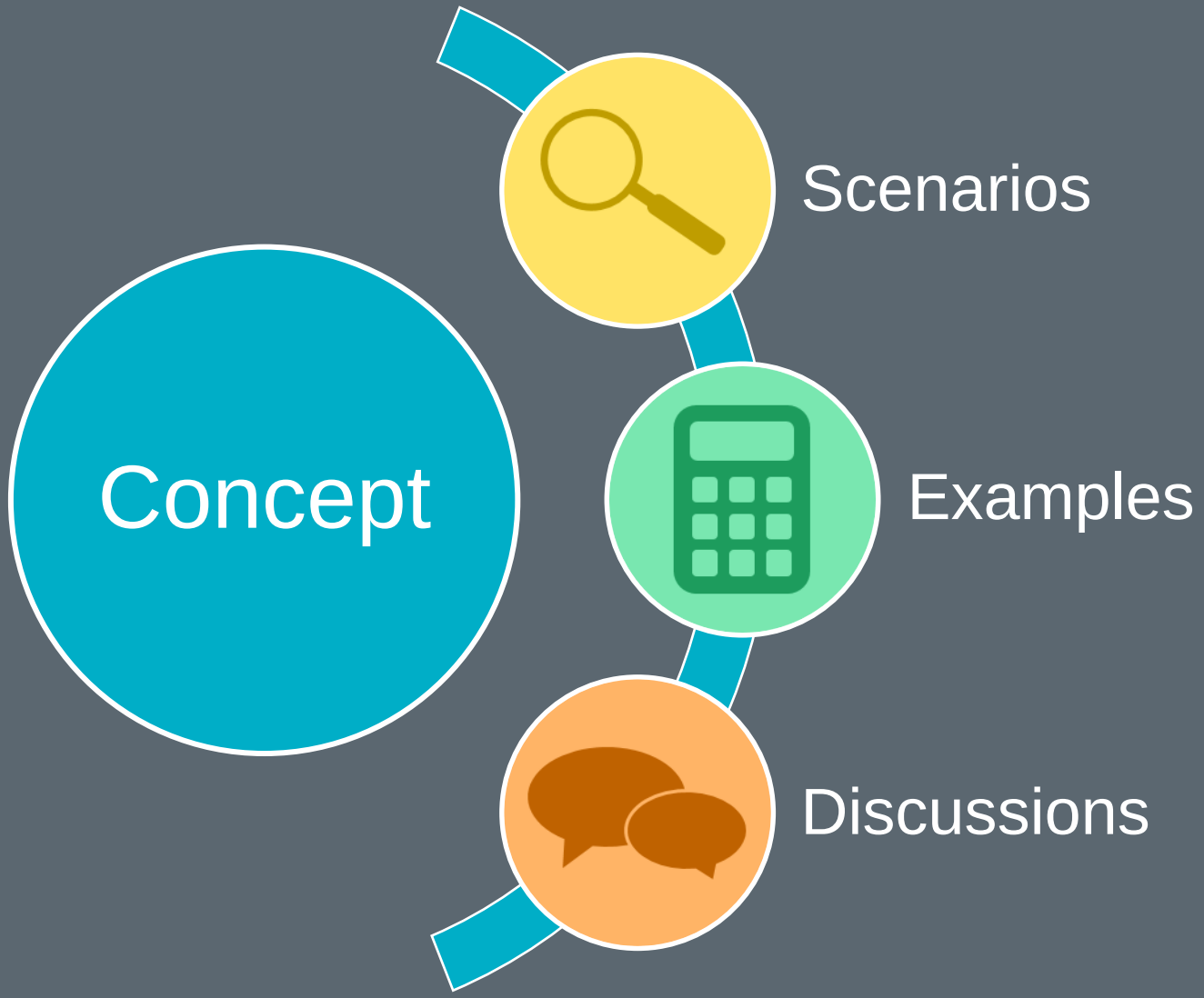
http://www.ercot.com/mktrules/nprotocols/

Applicability to RTC+B

This presentation contains material that is effective upon implementation of Real-Time Co-Optimization plus Batteries in the ERCOT Market. Portions of this course are not relevant to the ERCOT Market before RTC+B implementation.

For more information, please view grey-boxed language in:

http://www.ercot.com/mktrules/nprotocols/

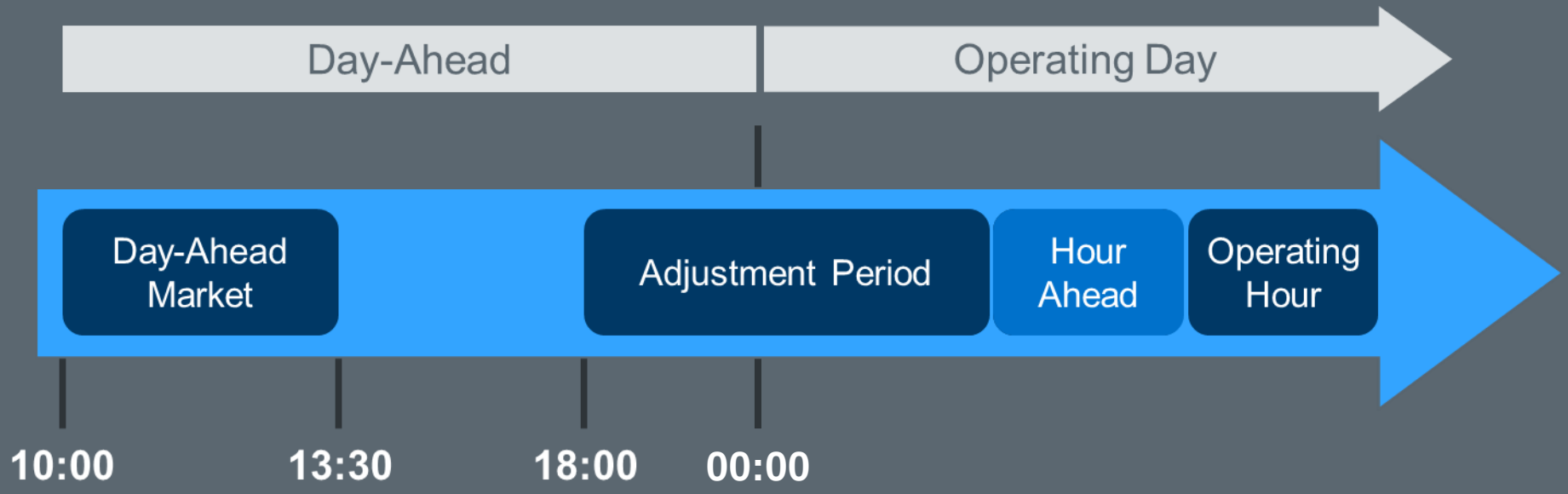

Concept
Scenarios
Examples
Discussions

Topics in this course include:

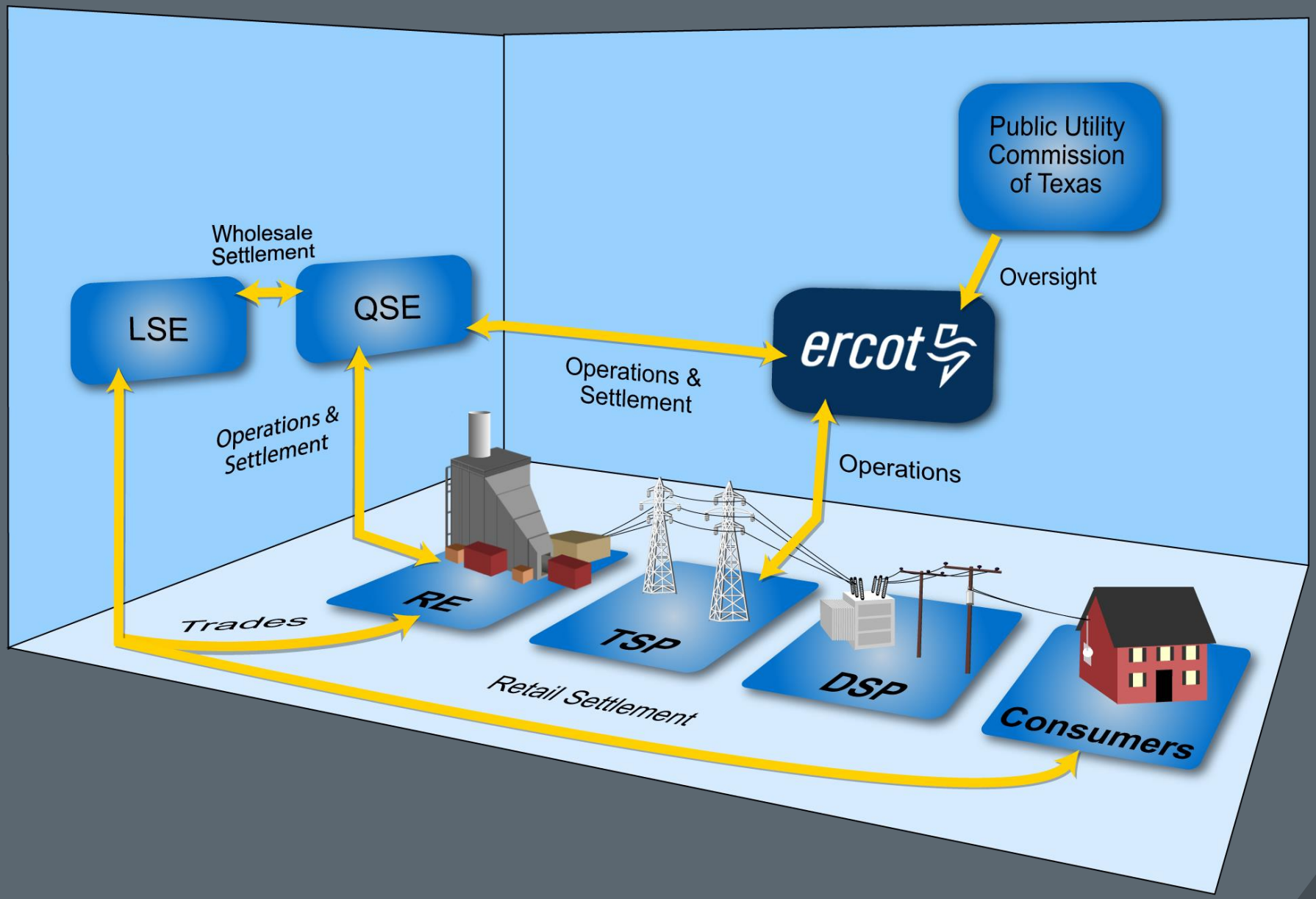
1. Introduction
2. Real-Time Dispatch and Pricing
3. Ancillary Services
4. Real-Time Co-Optimization
5. System Capacity
6. Summary and Conclusion

Introduction

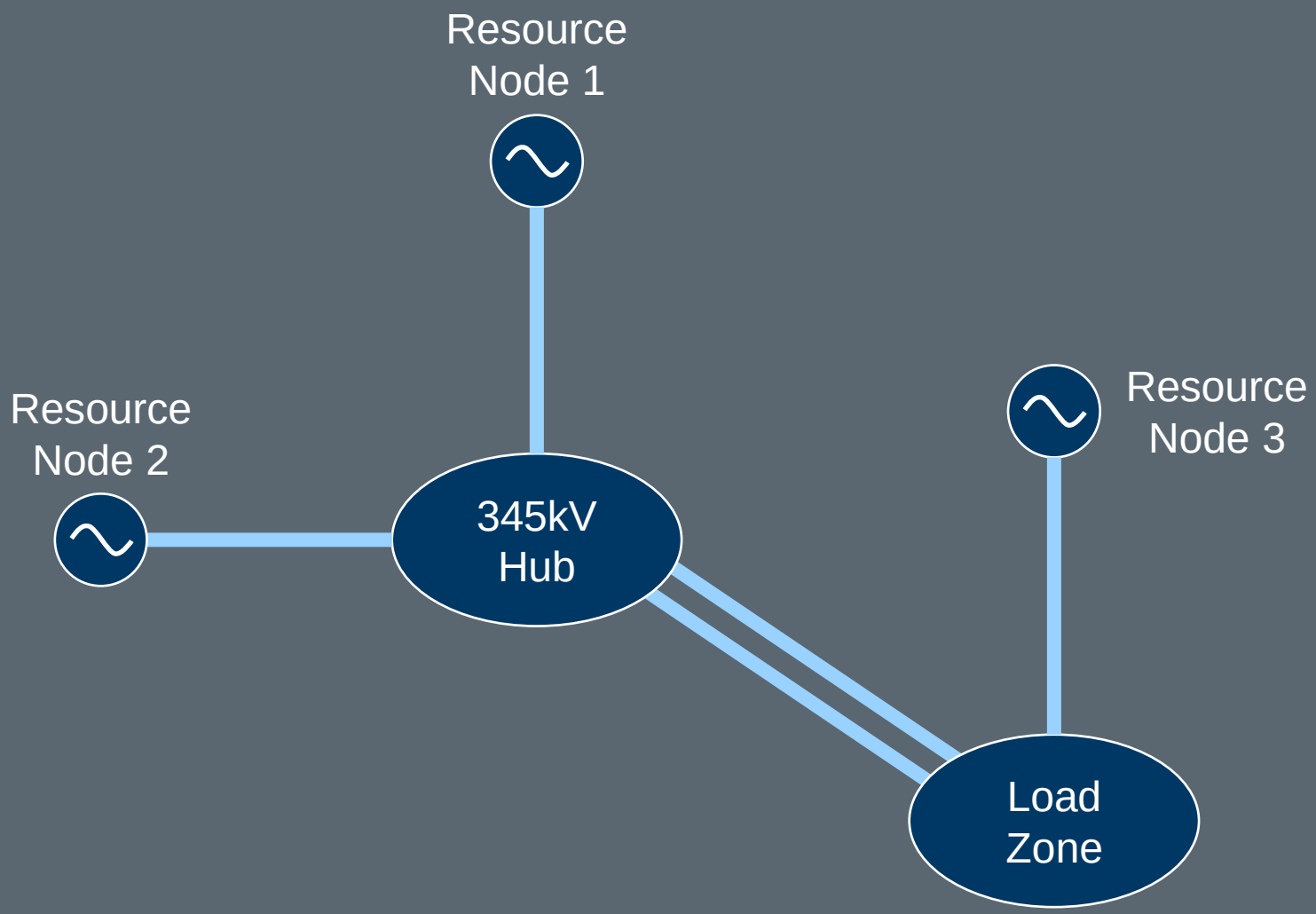
In general . . .


Day-Ahead
Operating Day
Day-Ahead Market
Adjustment Period
Hour Ahead
Operating Hour
10:00
13:30
18:00
00:00

The Central Role of QSEs

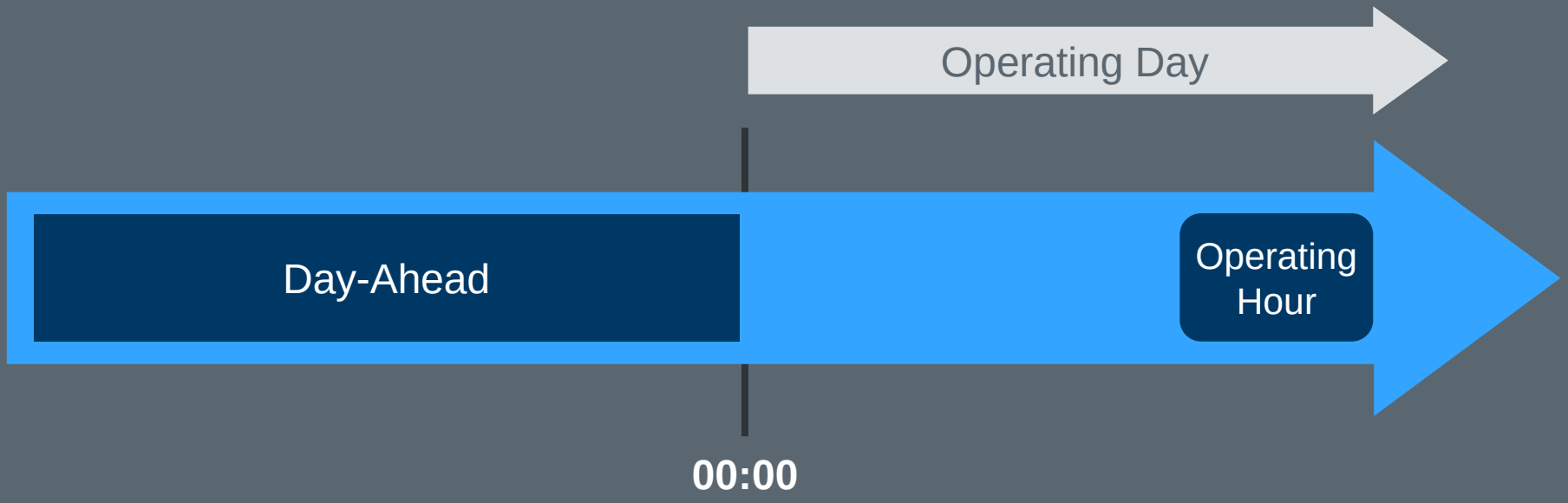


Mini-Market for Scenarios



Real-Time Dispatch and Pricing

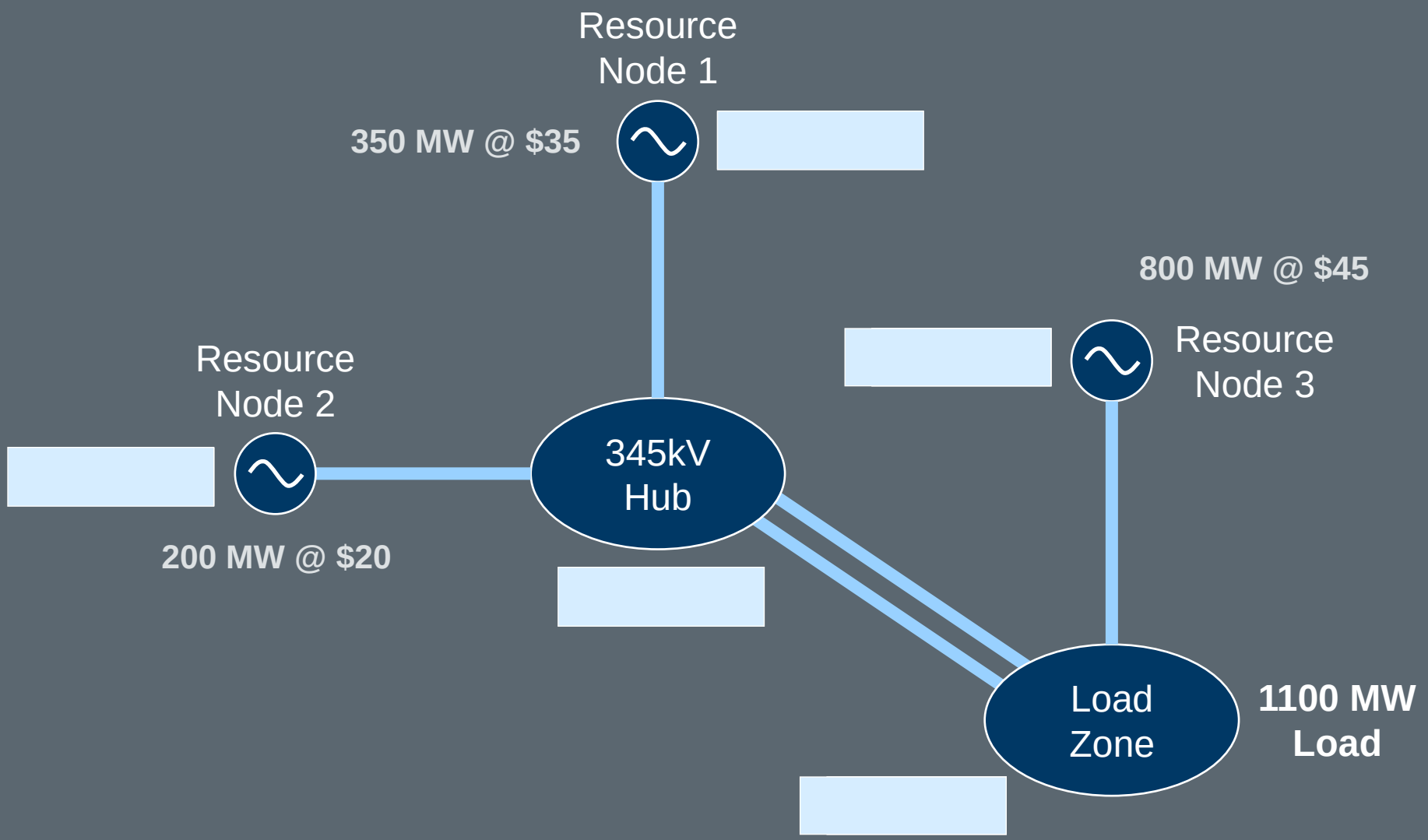
Timing



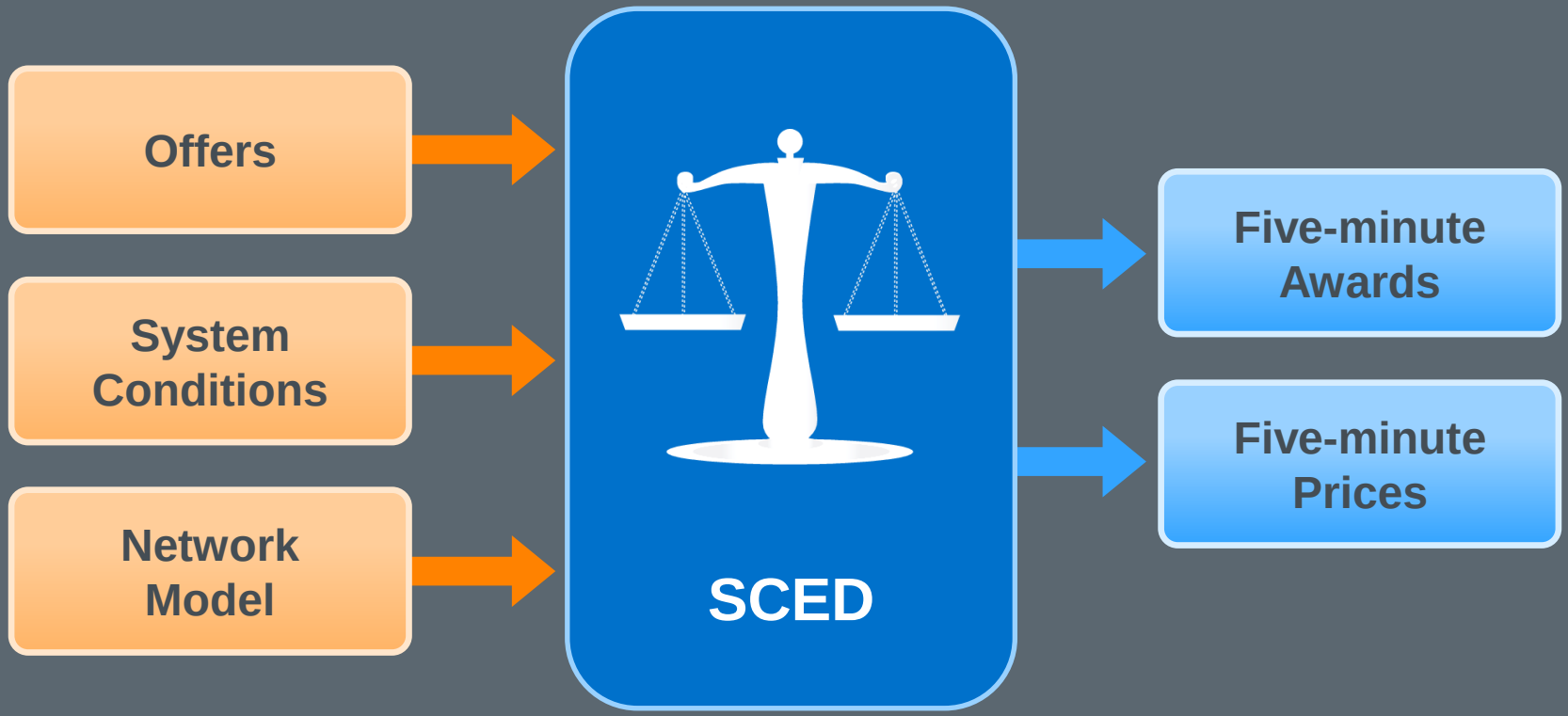
Goals

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

Scenario: Find Real-Time Dispatch Solution

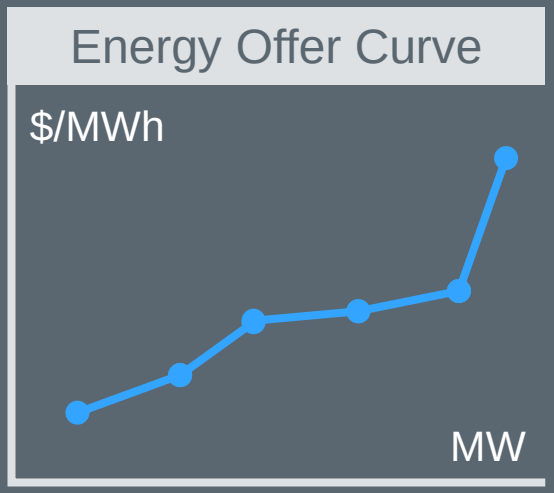


Security Constrained Economic Dispatch (SCED)



Energy Offer Curve

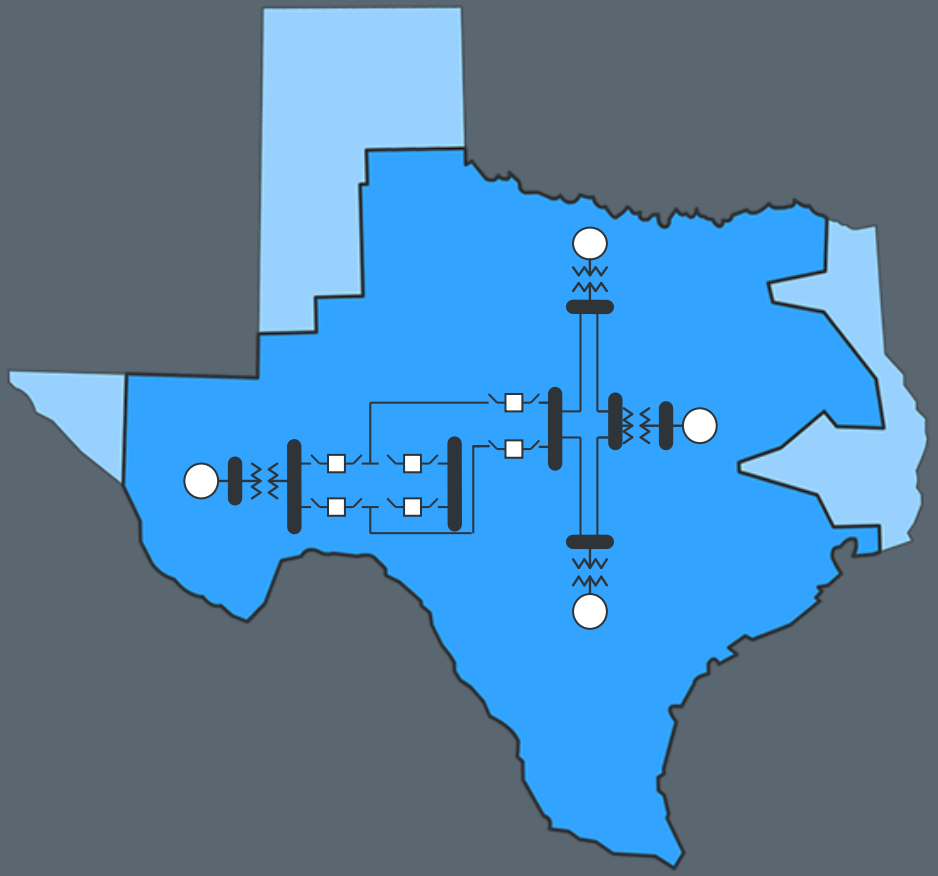
- Non-decreasing curve
- Ten price/quantity pairs max
- One MW minimum quantity
- Prices between -$250 and appropriate Offer Cap



Monitored Conditions

What do we need to know to dispatch energy?

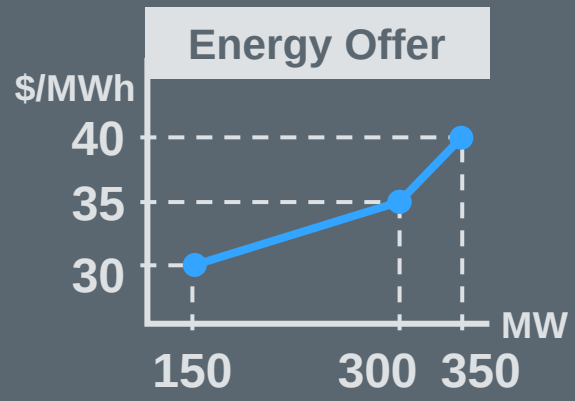
Represents physical transmission grid



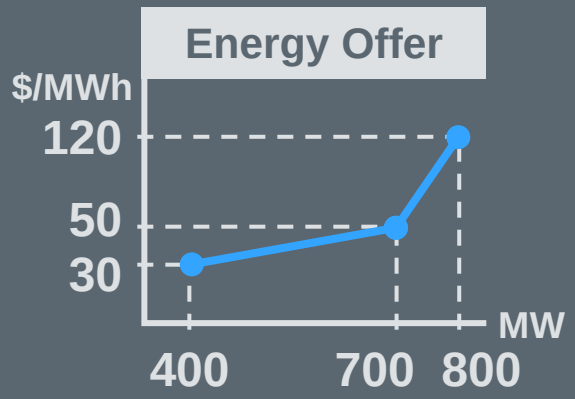
Used for:

- Reliability studies
- All Market Processes

Scenario: Find Dispatch Solution



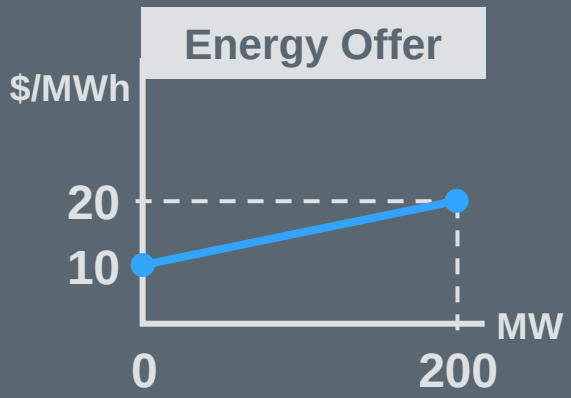
Resource Node 1



Resource Node 2

Resource Node 3

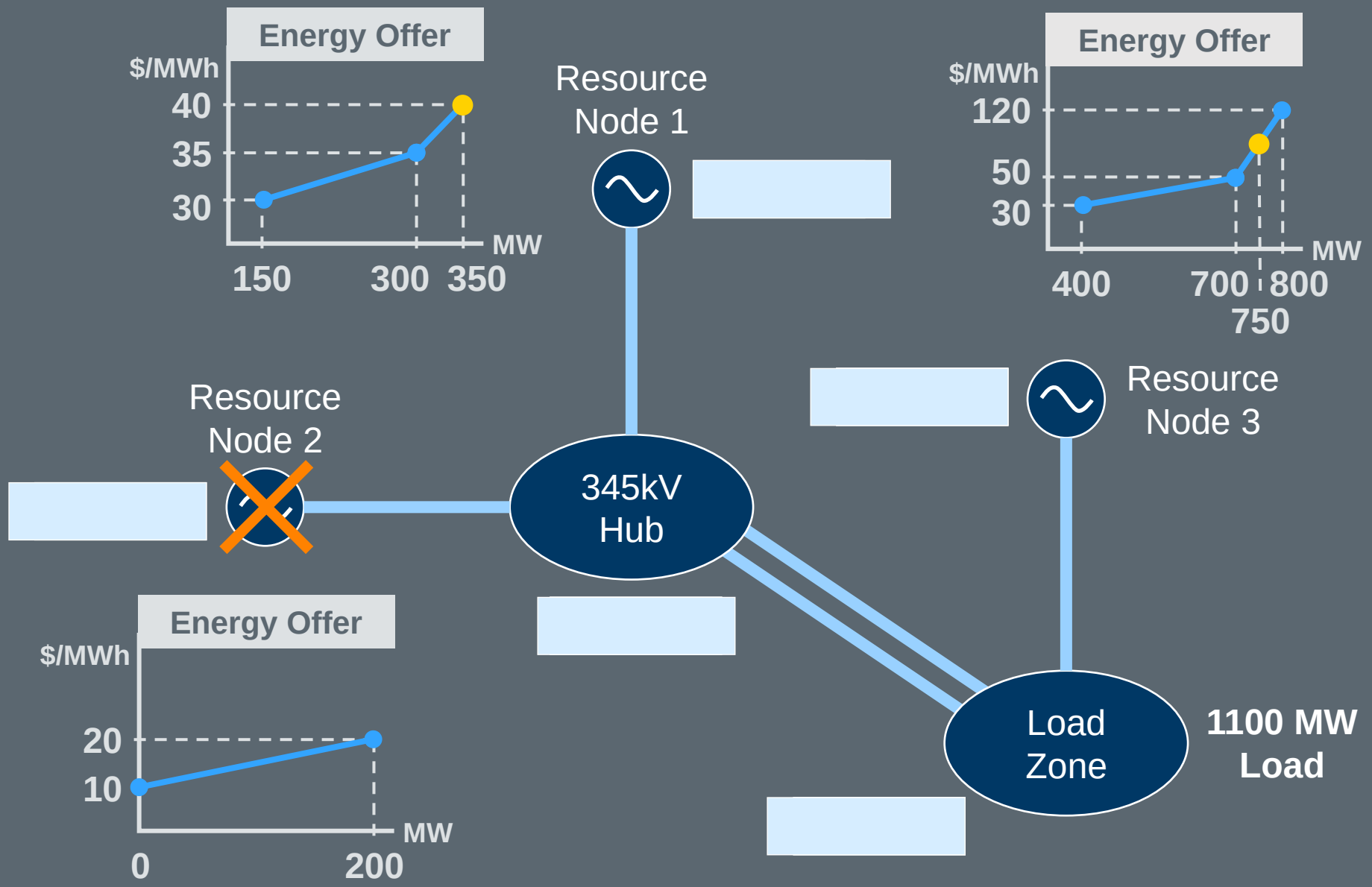
345kV Hub



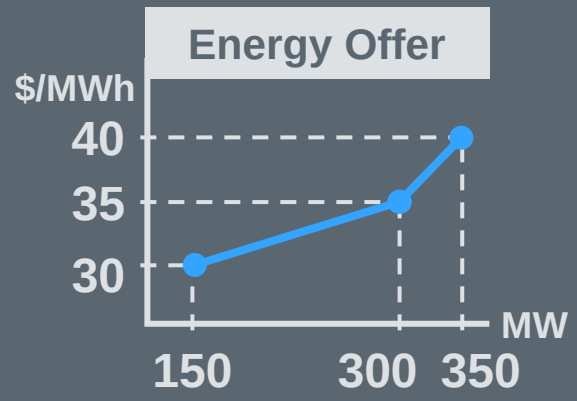
Load Zone

1100 MW Load

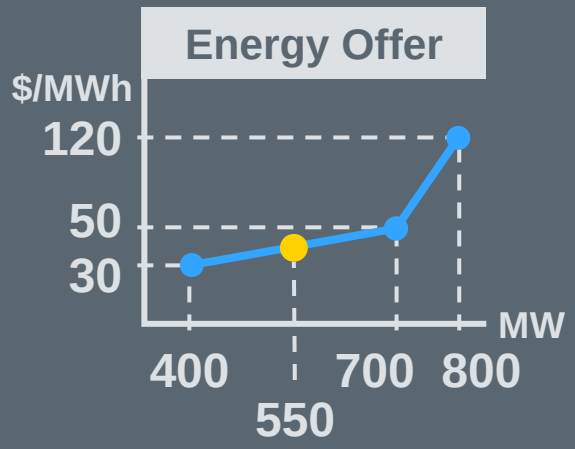
Scenario: Loss of a Resource



Scenario: Transmission Constraints



Resource Node 1



Resource Node 2

100 MW Limit

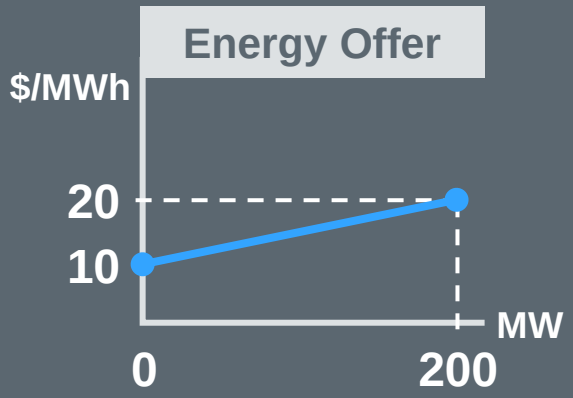
345kV Hub

Resource Node 3

400 MW Limit

Load Zone

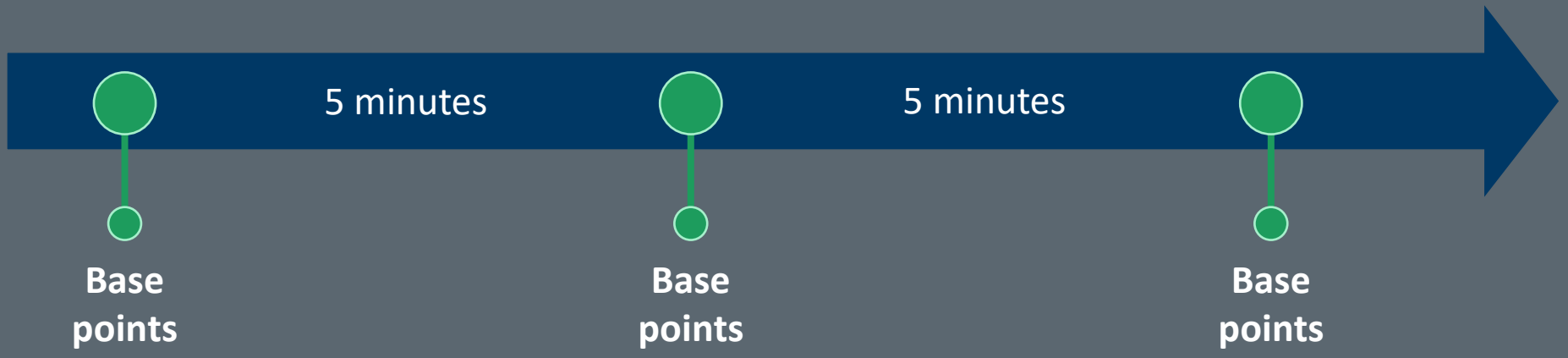
1100 MW Load



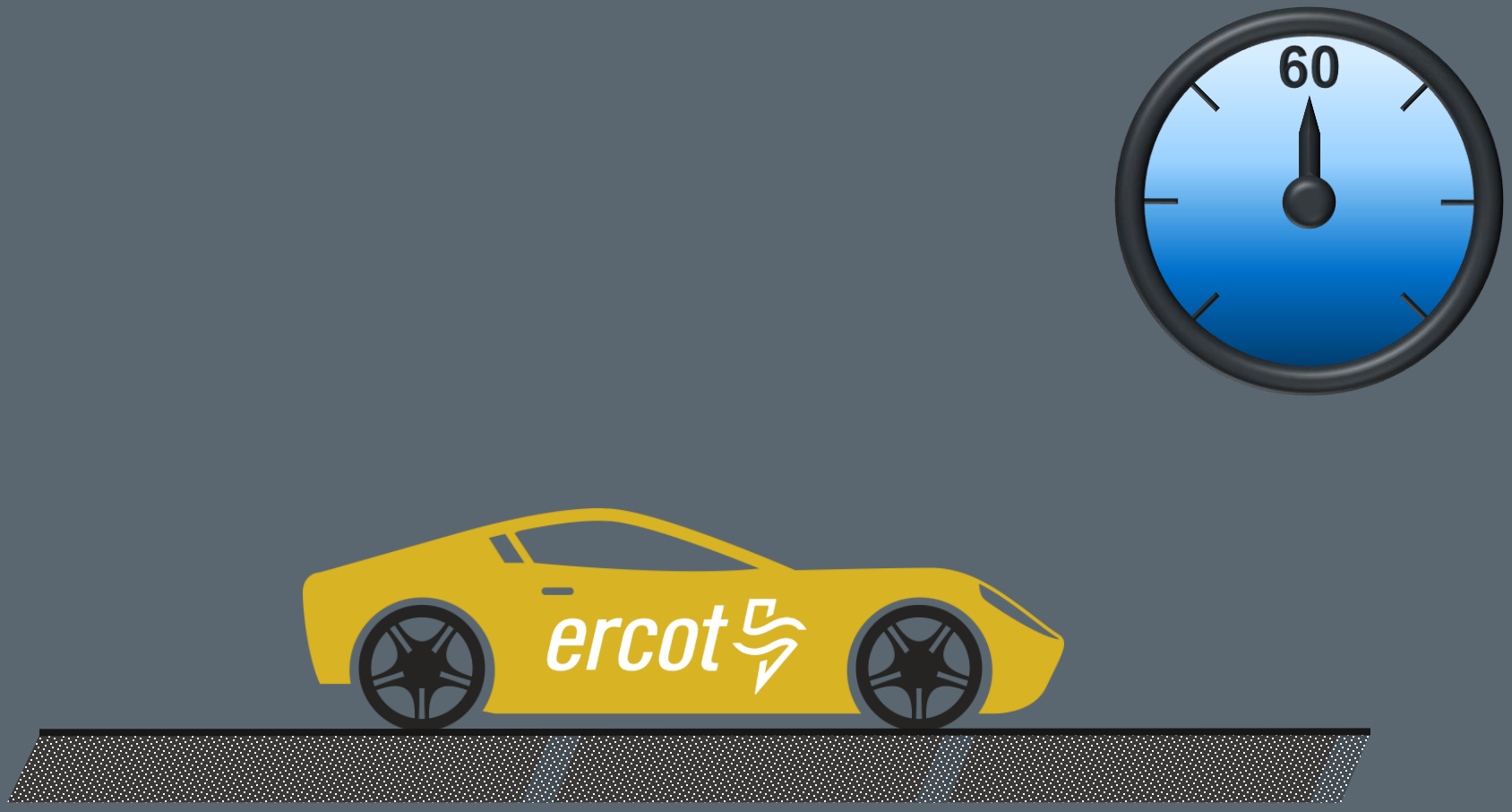
Ancillary Services

Security Constrained Economic Dispatch (SCED)

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



Discussion: Is five-minute dispatch enough?



Discussion: Is five-minute dispatch enough?

Resource Node 1

Resource Node 2

345kV Hub

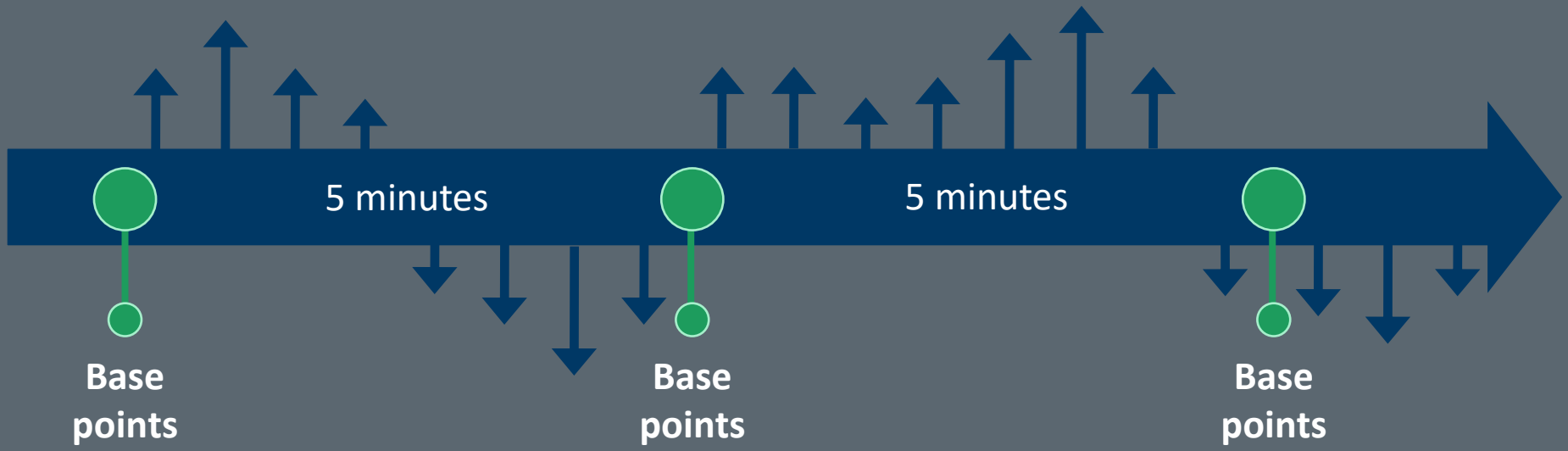
Resource Node 3

Load Zone

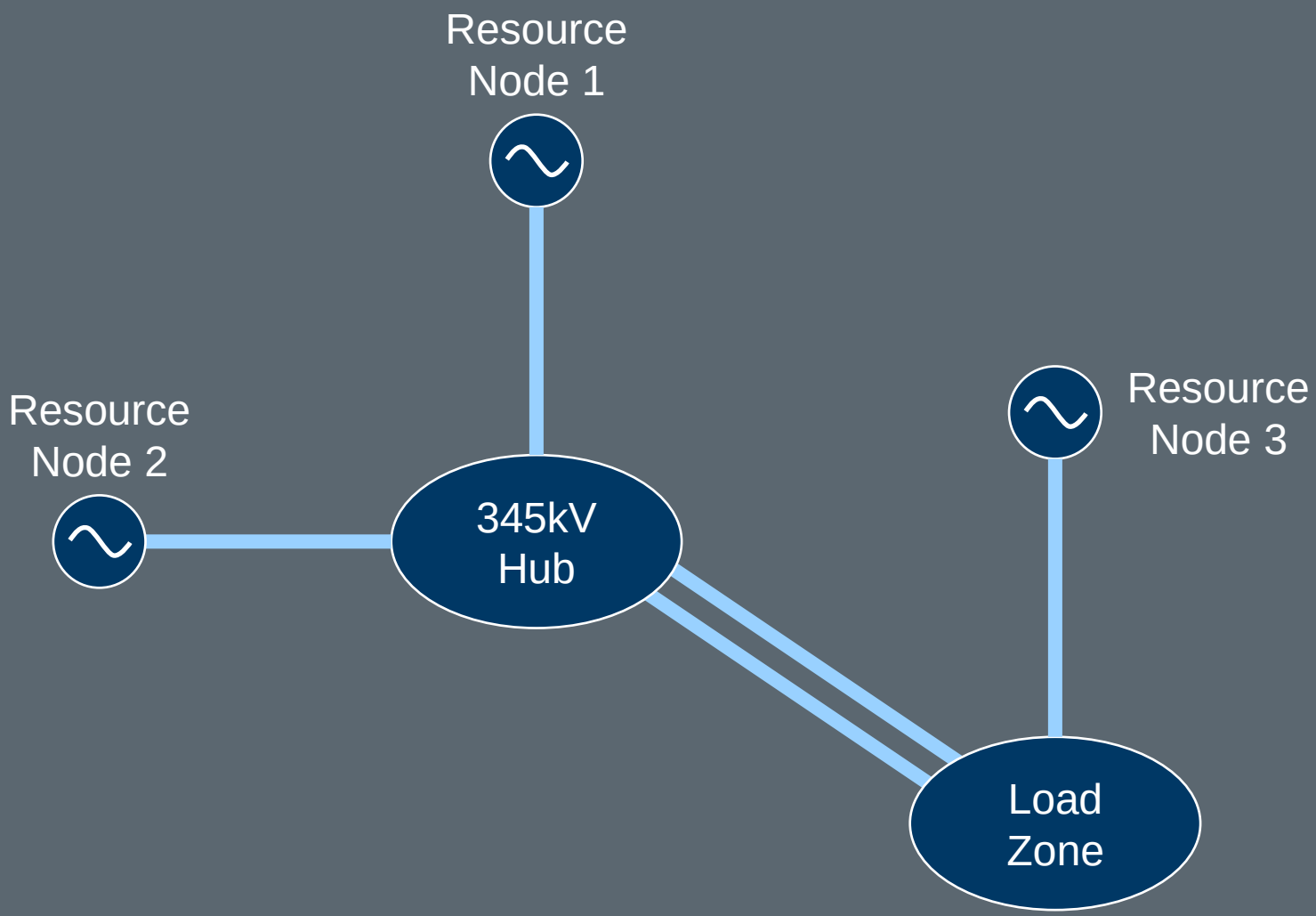
1100 MW Load

Regulation Service

- Matches generation with demand
- Responds to frequency deviations



Discussion: What else can happen in Real-Time?



Responsive Reserve Service

Possible Uses

- Loss of Generation
- Large load-ramps

Responsive Reserve is frequency responsive

RRSPF – Primary Frequency Response

- Automatic response at 59.983 Hz
- Proportional to frequency decay

RRSFF – Fast Frequency Response

- Auto-deployed at 59.85 Hz
- Full response within 15 Cycles

RRSUF – Load Resource on Under-Frequency Relay

- Auto-deployed at 59.70 Hz
- Trips within 30 cycles

ERCOT Contingency Reserve Service

Possible Uses

- Restore RRS
- Provide ramping reserves to SCED

Resources must be capable of 1-hour deployment

Non-Spinning Reserve Service

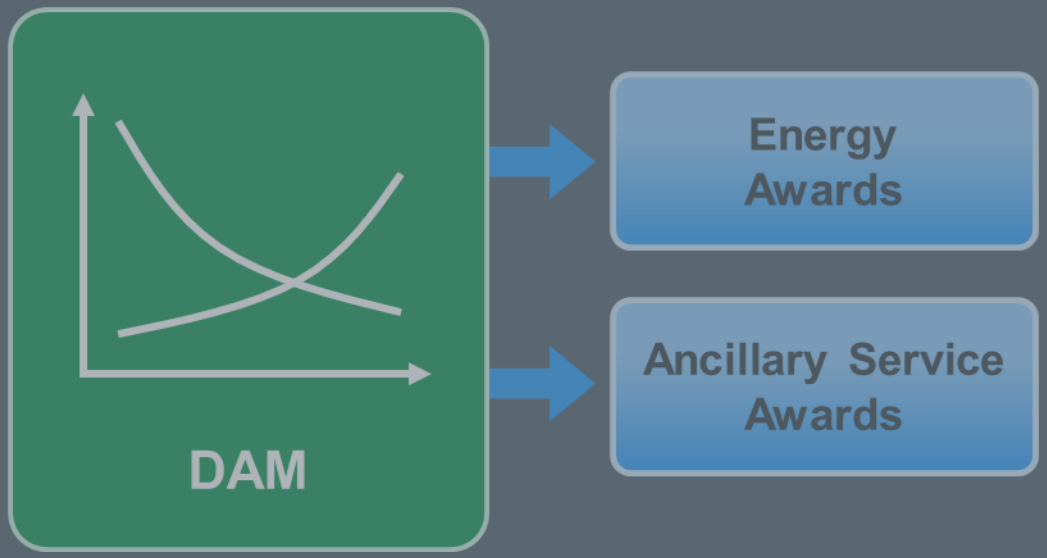
Possible Uses

- Restore RRS and ECRS
- Provide ramping reserves to SCED

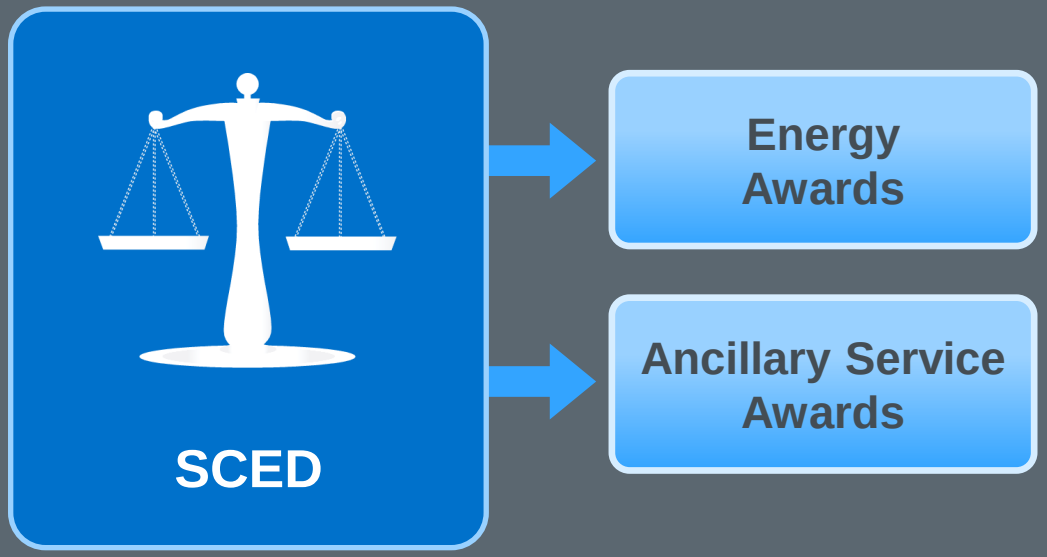
Resources must be capable of 4-hour deployment

Procurement of Ancillary Services

Day-Ahead Market

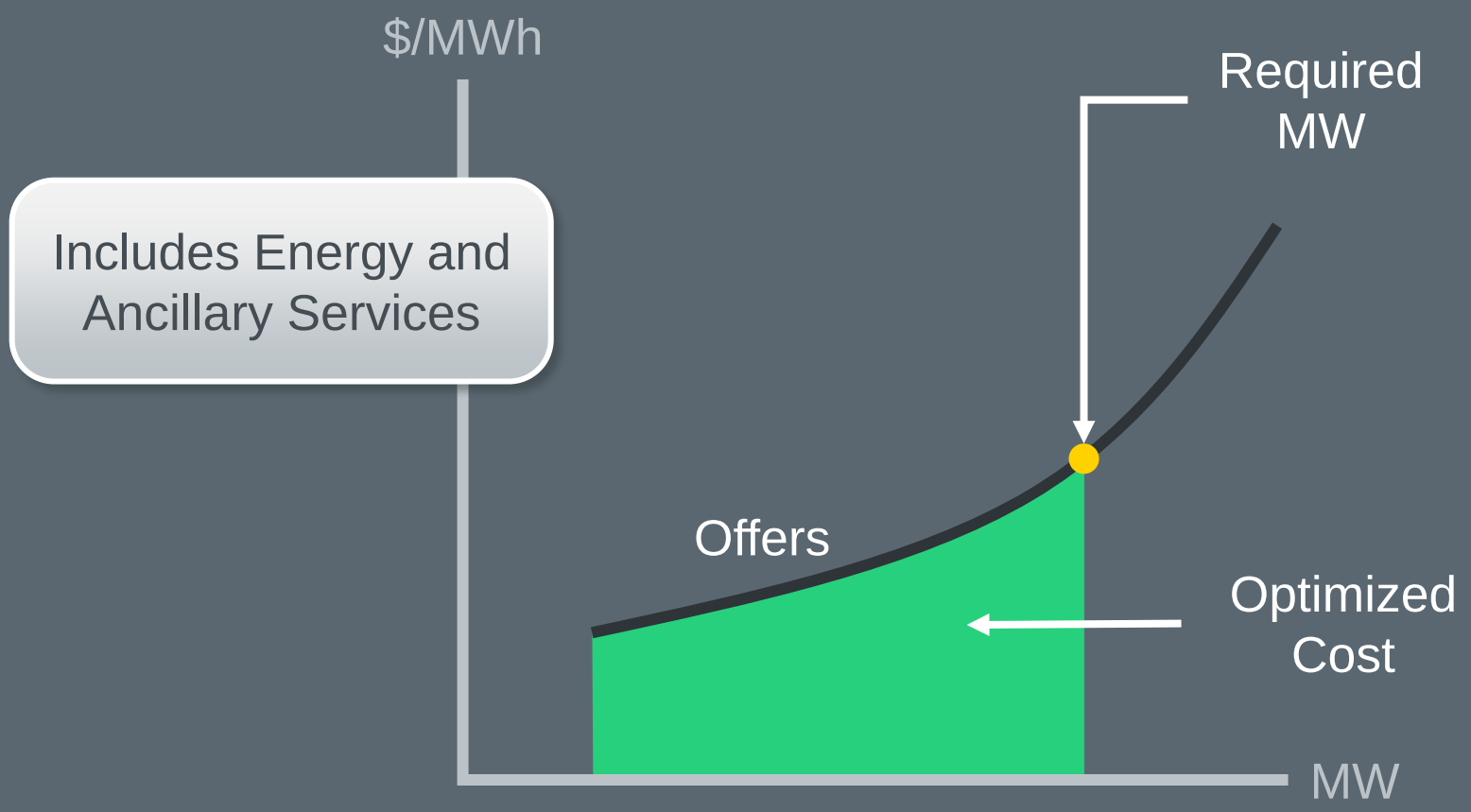


Security Constrained Economic Dispatch

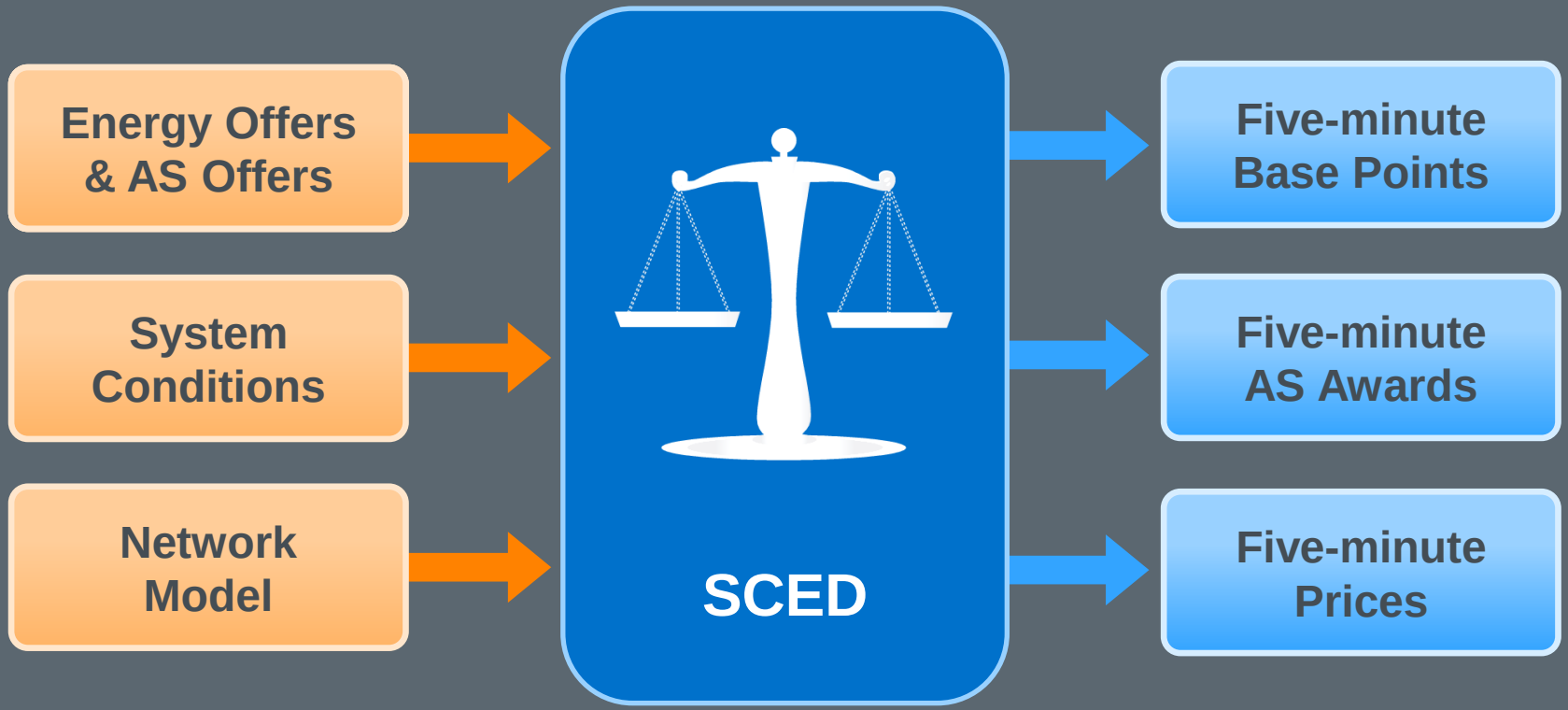


Real-Time Co-Optimization

The SCED process is optimized for cost



Security Constrained Economic Dispatch (SCED)



Resource-Specific Offers for Each Service

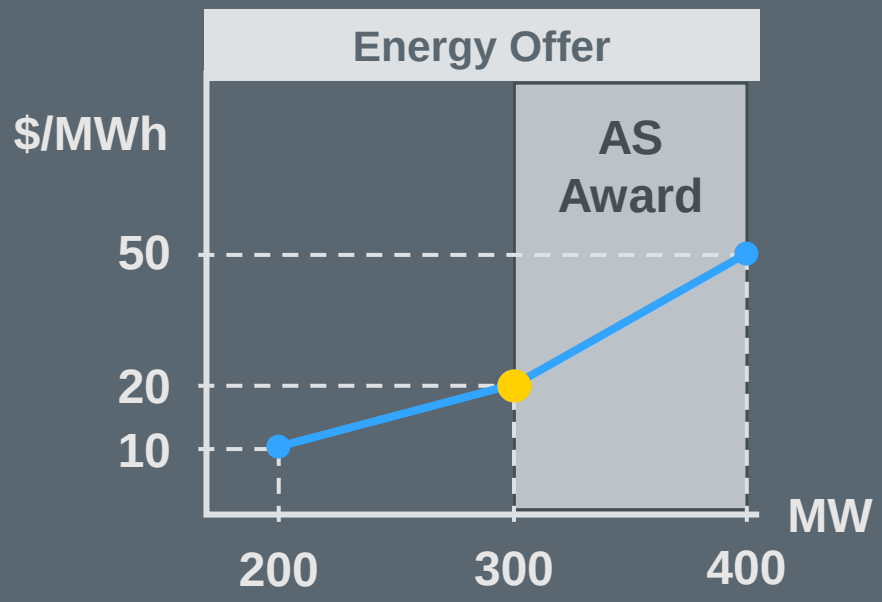
Type of Service	Offer	
Regulation Up	MW	$ / MW
Regulation Down	MW	$ / MW
Responsive Reserve	MW	$ / MW
Contingency Reserve	MW	$ / MW
Non-Spinning Reserve	MW	$ / MW

Multiple offers from single Resource:

- Multiple Ancillary Services
- Combined with Energy Offers

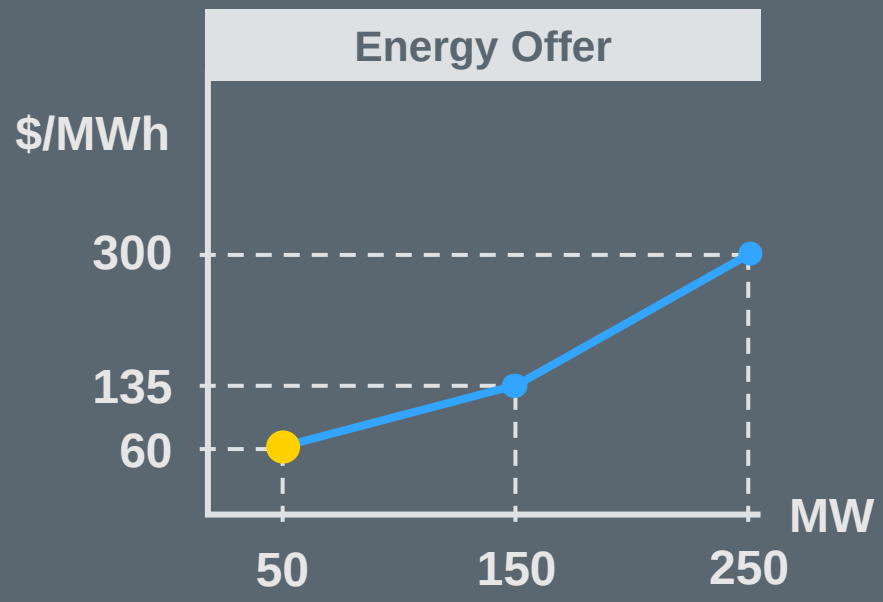
Discussion: Co-Optimized Economics

GEN 1



AS offer $10/MW

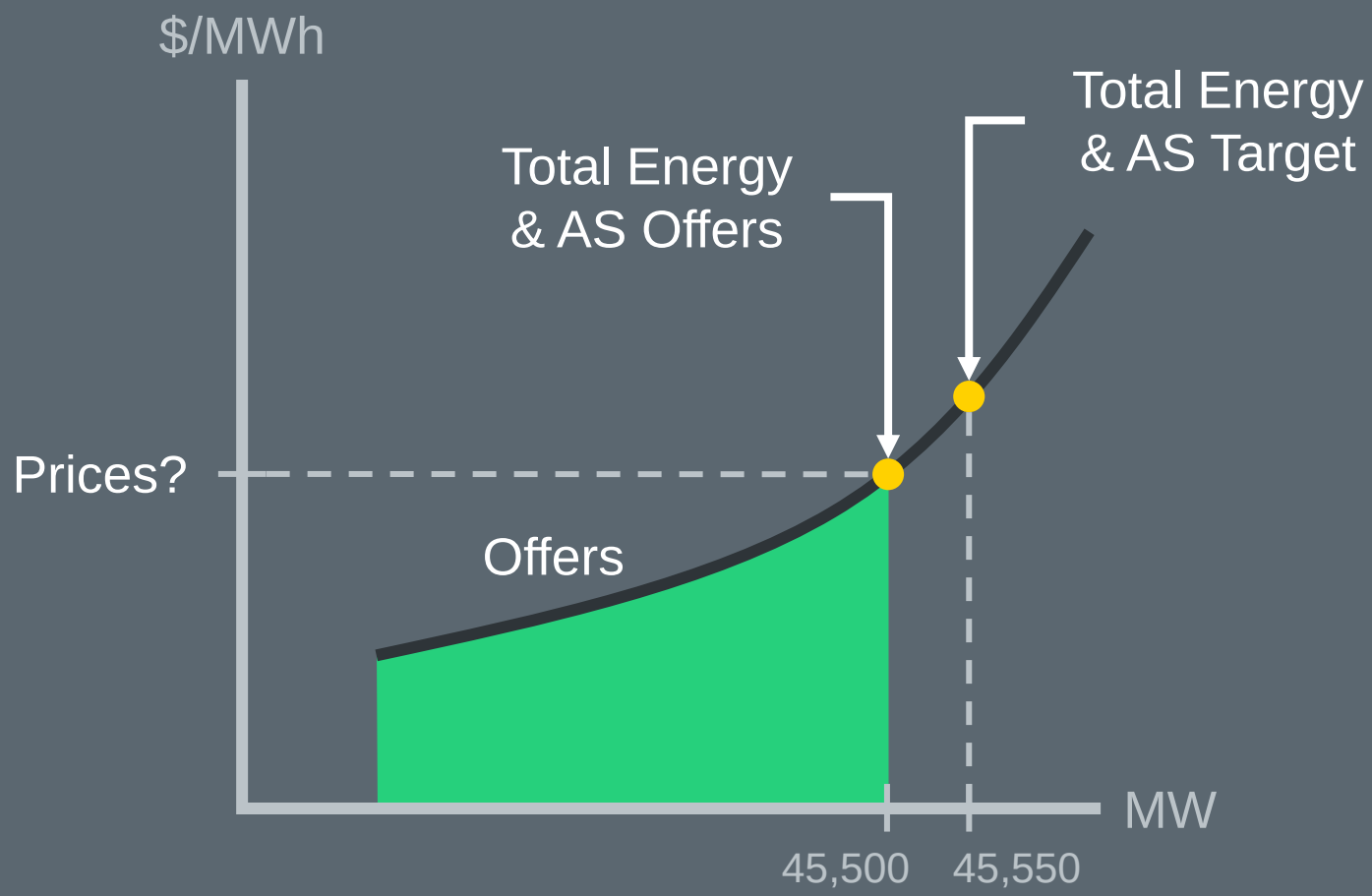
GEN 2



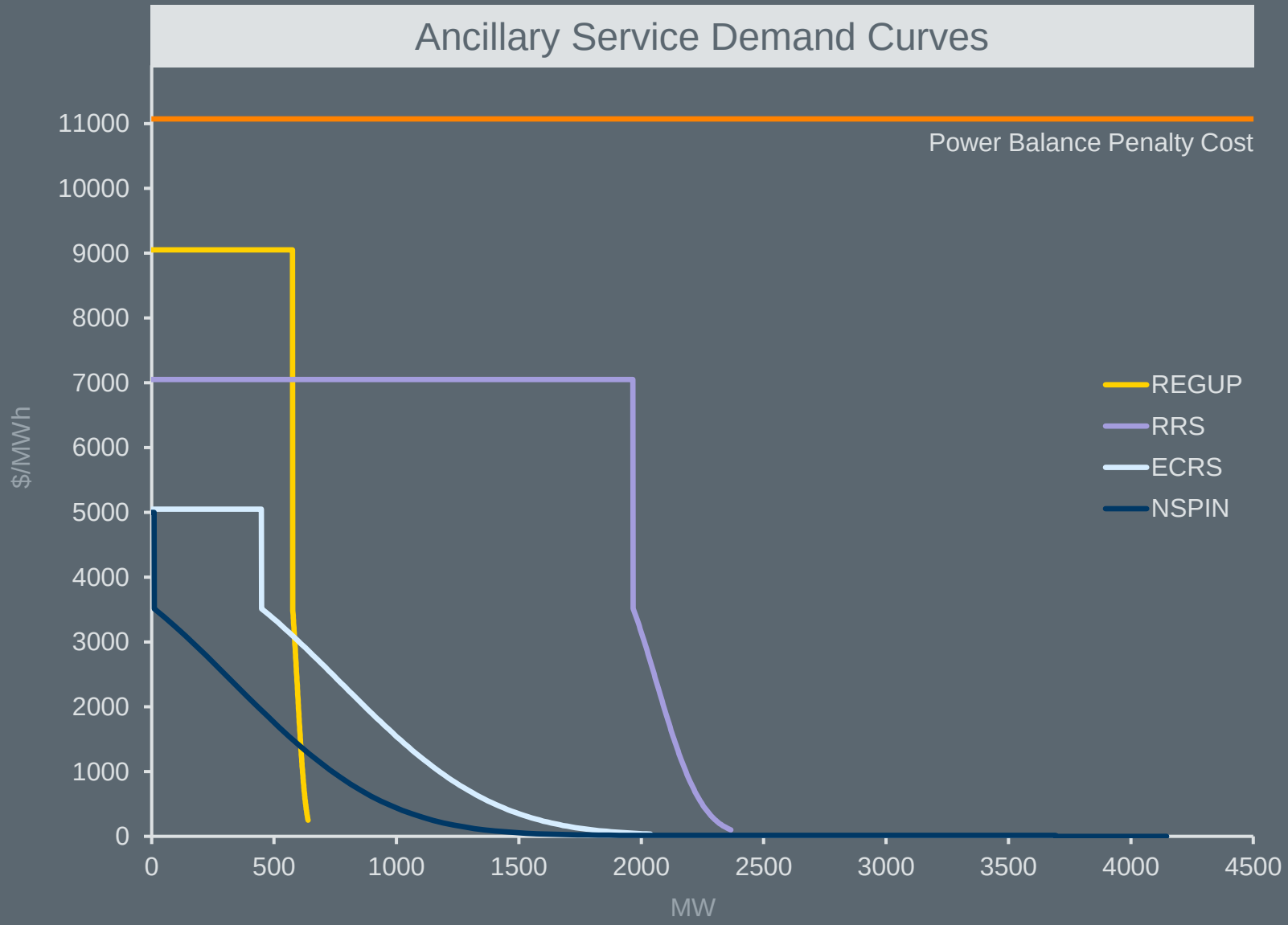
AS offer $20/MW

$20.00

What will SCED do?

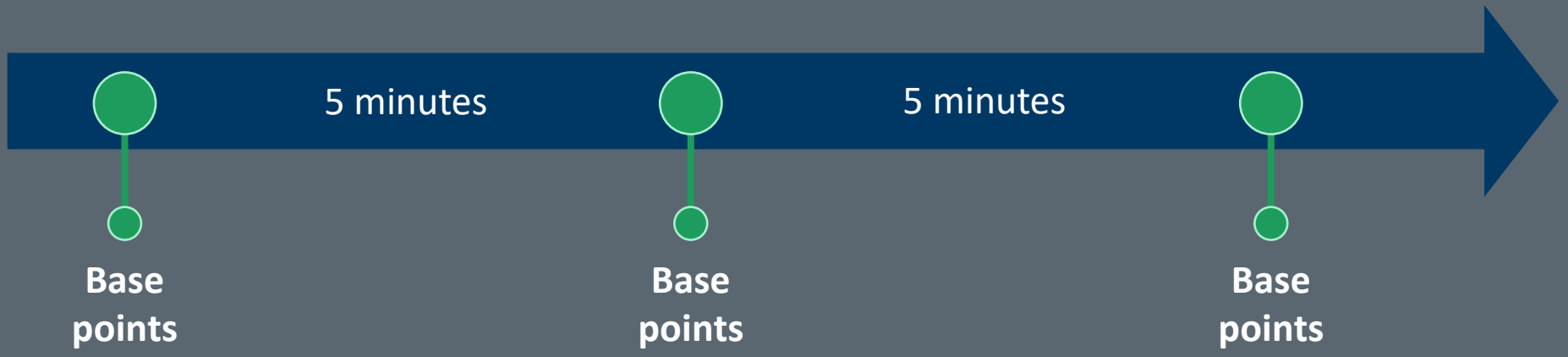


Example: AS Demand Curves and Power Balance

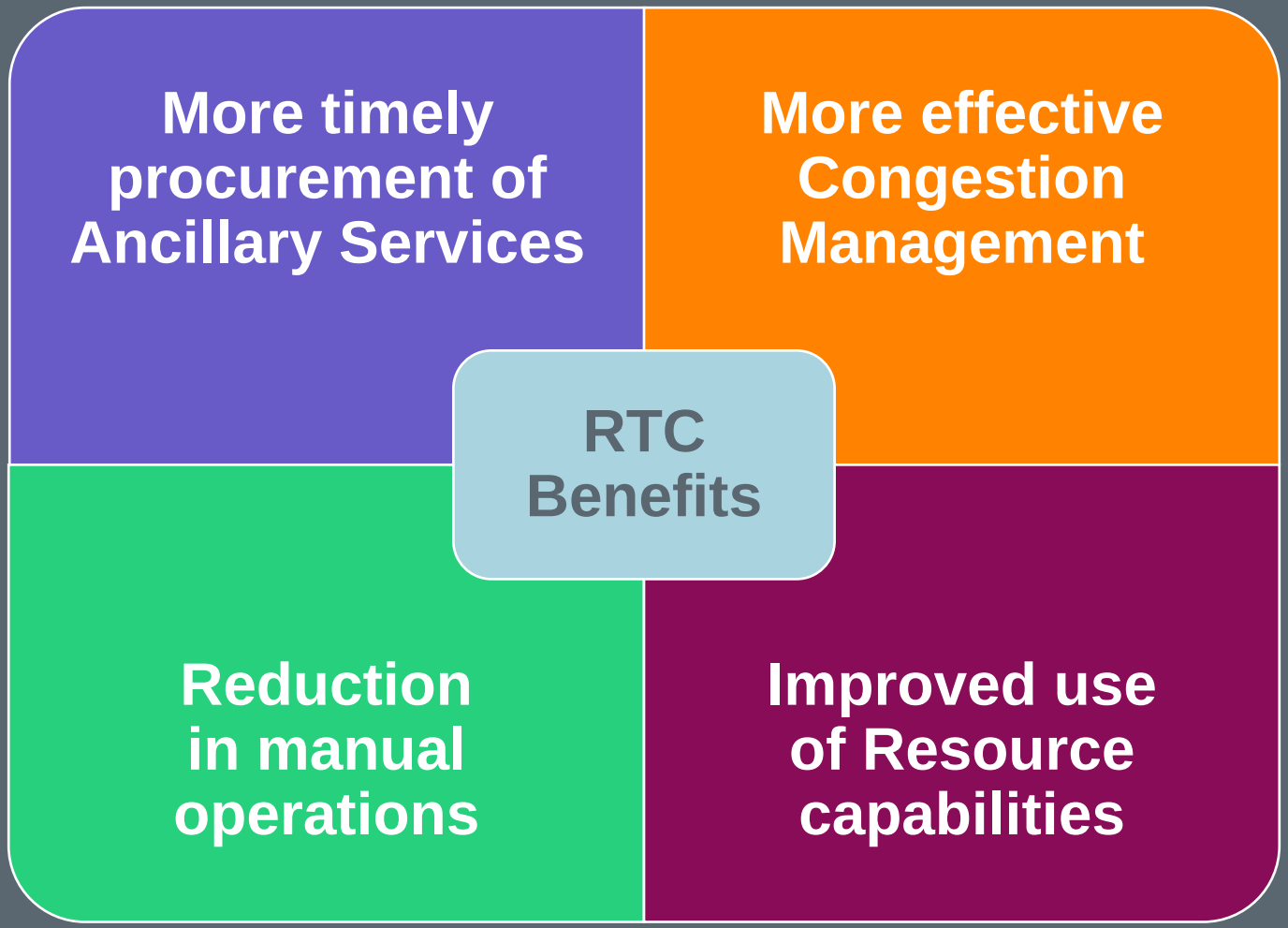


Security Constrained Economic Dispatch (SCED)

- Dispatches Energy
- Manages Congestion
- Awards Ancillary Services
- Achieves least cost solution



Benefits of Real-Time Co-Optimization





System Capacity



Co-Optimization requires sufficient capacity

Requirements:

- Serve Load
- Award Ancillary Services
- Manage Congestion

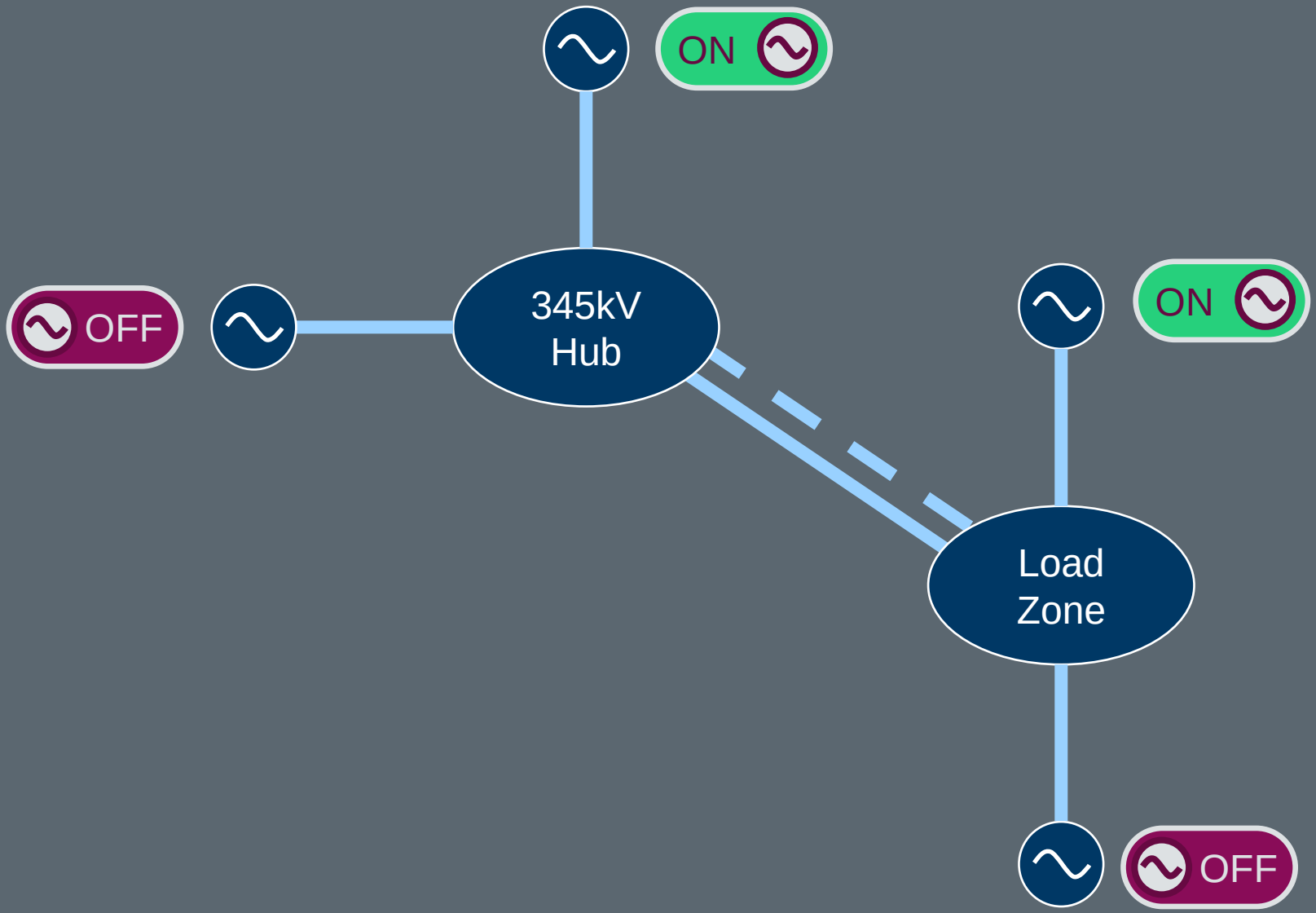
Current Operating Plan (COP)

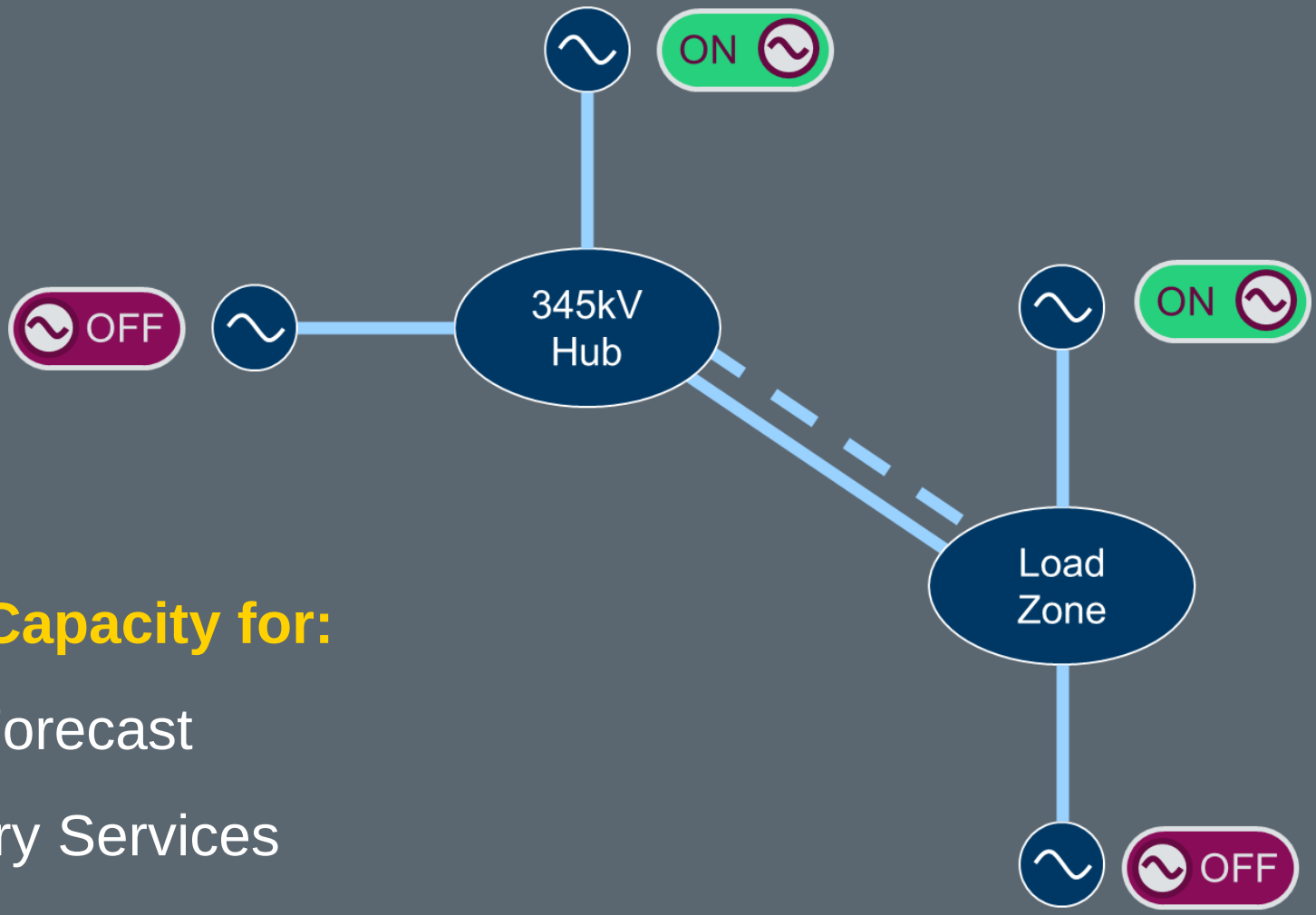
Anticipated Resource operating conditions

- Resource Status
- Resource Limits
- Ancillary Service Capabilities

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

Discussion: What if not enough generators plan to run?

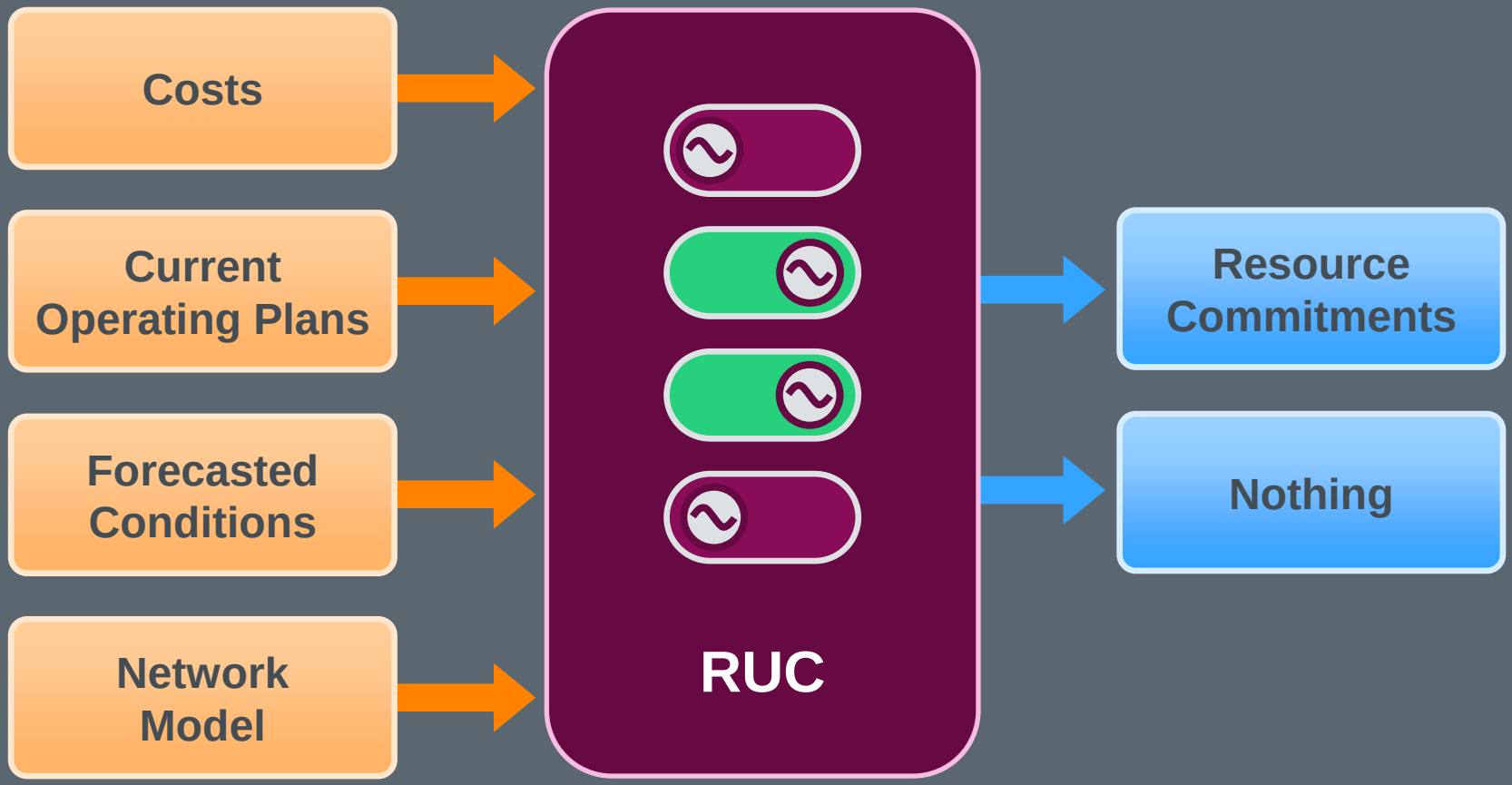




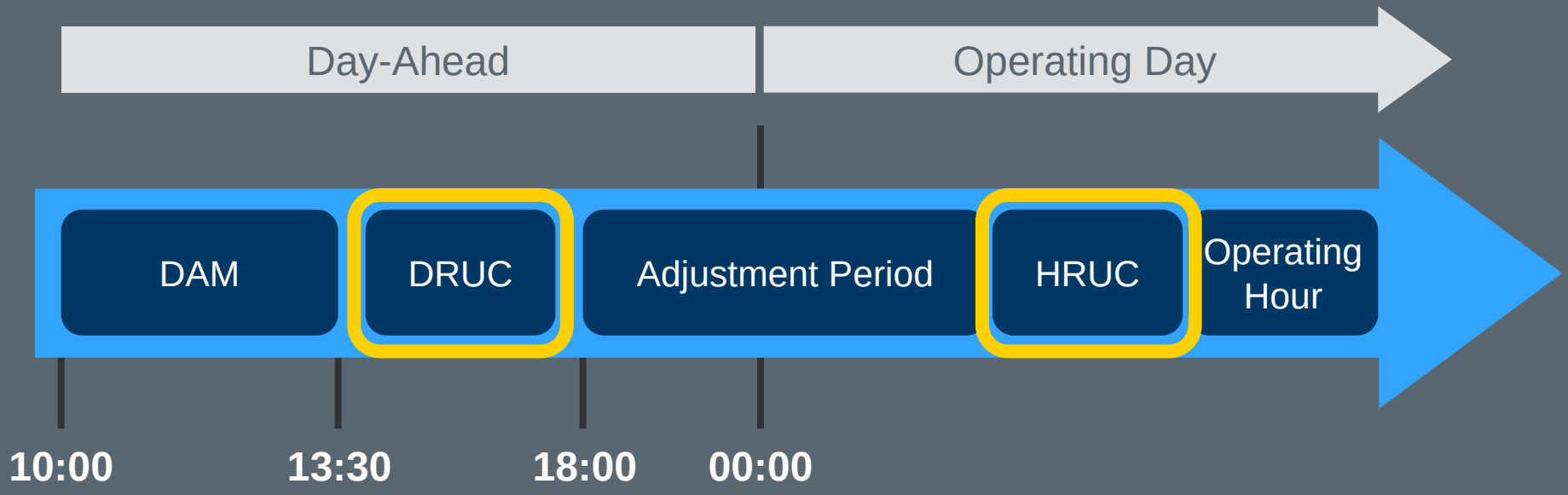
Ensures Capacity for:

- Load Forecast
- Ancillary Services
- Congestion Management

Reliability Unit Commitment (RUC)



Timing

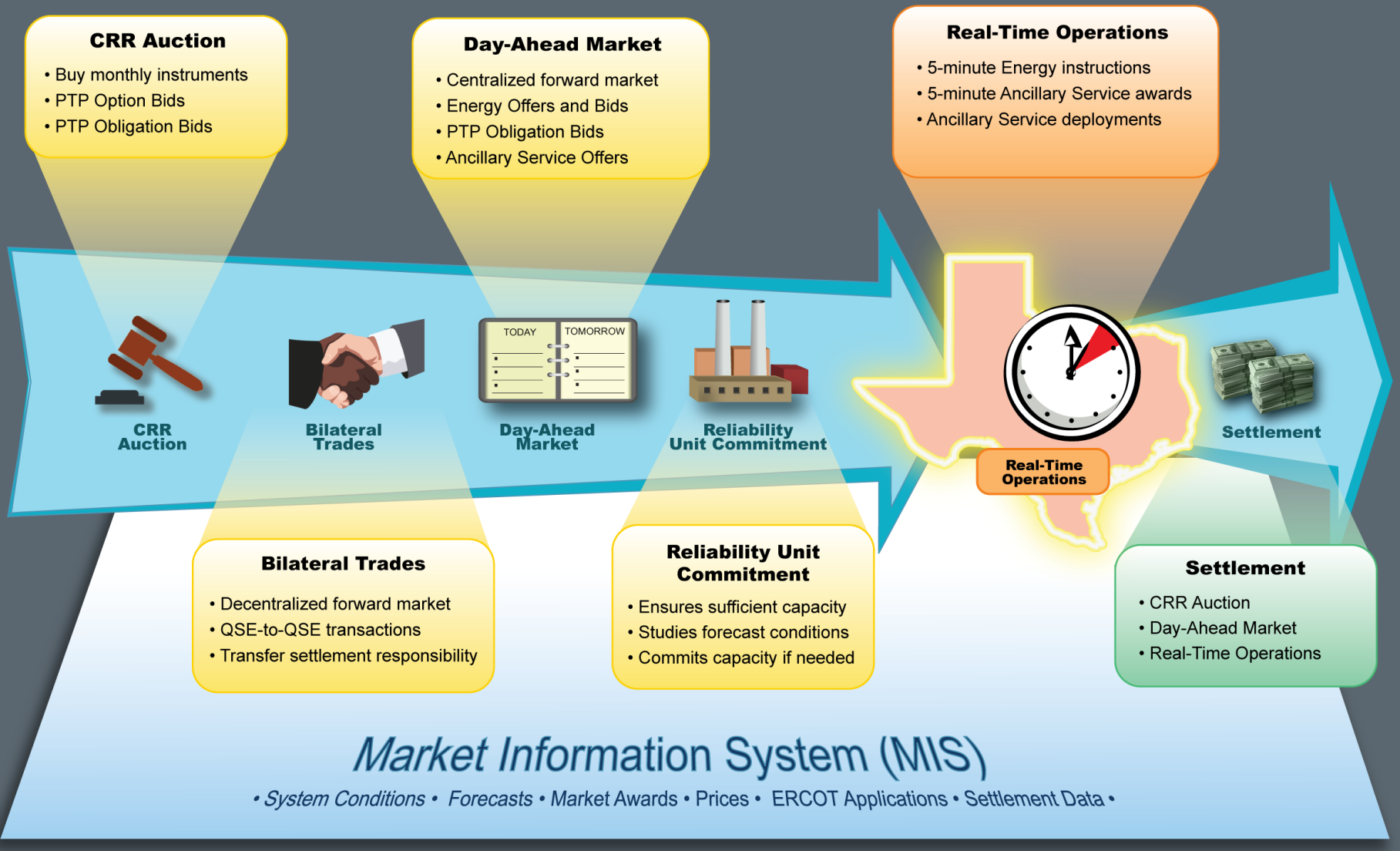


DRUC = Day-Ahead Reliability Unit Commitment

HRUC = Hourly Reliability Unit Commitment

Summary and Conclusion

Wholesale Market Summary



Market Information System Data Access

Also available on ercot.com

Available to all Market Participants

Available to specific Market Participant

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