



Energy Storage Resources



2026_07 Energy Storage Resources



Greetings and Introductions

Attendance

Questions

Presentation materials

Recording for internal purposes



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.

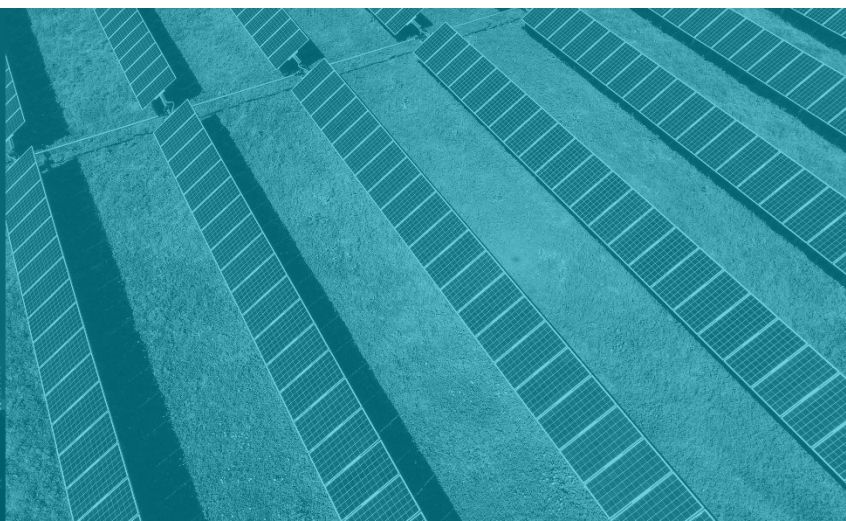
For more information, please visit:

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

Purpose	Format	Title
Pre-requisite	WBT	✓ Resources in ERCOT
		✓ Resource Responsibilities in ERCOT
Core Courses	ILT	✓ Resources in ERCOT Market Operations
		^ Energy Storage Resources
		Operational Requirements >
		ESRs in the ERCOT Markets >
		Financial Considerations >
		✓ Intermittent Renewable Resources
		✓ Combined Cycle Generation Resources
Post-requisite	WBT	✓ IRR Forecasting
		✓ Quick Start Generation Resources



Operational Requirements



Topics in this module include:

1

Basic ESR Capabilities

2

Current Operating Plan

3

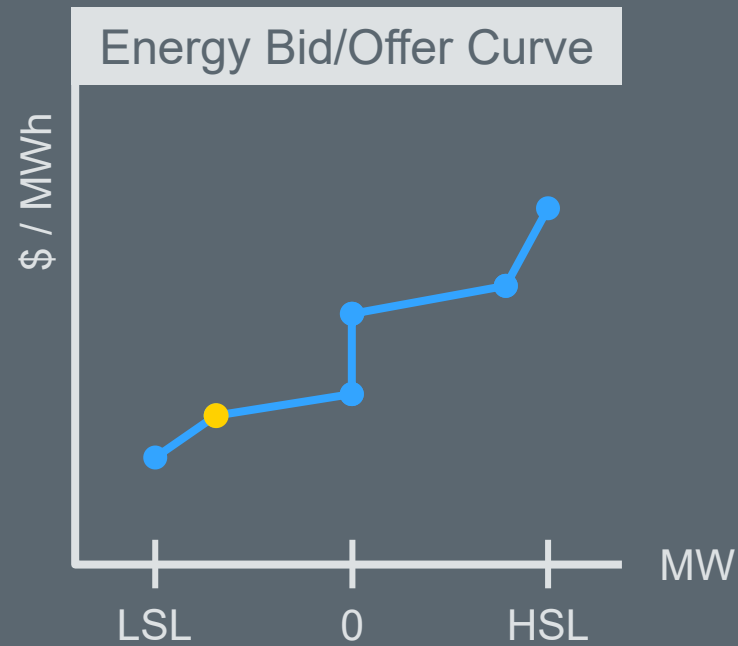
Telemetry Requirements



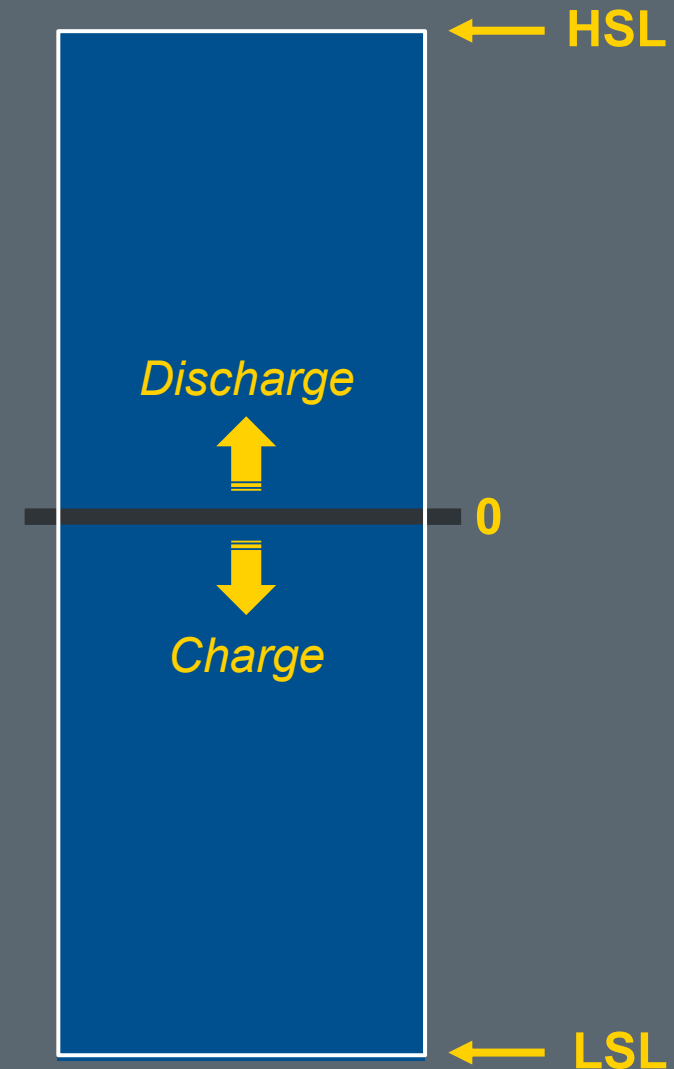
Energy Storage System

- Store energy when plentiful
- Release energy when scarce
- May provide Ancillary Services

Dispatched by ERCOT whether charging or discharging

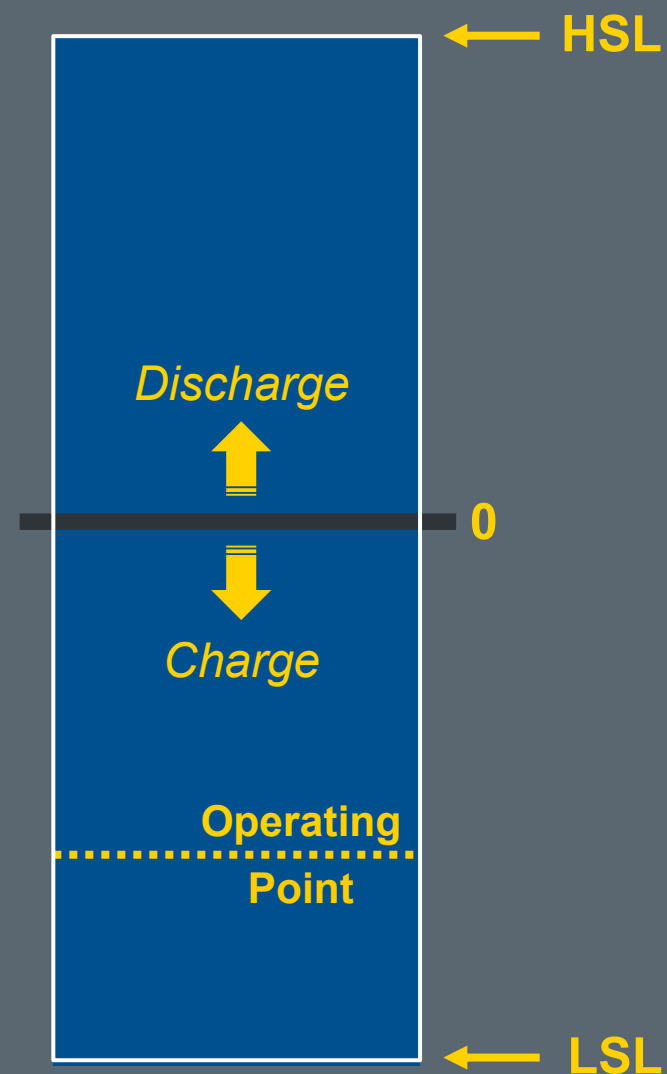


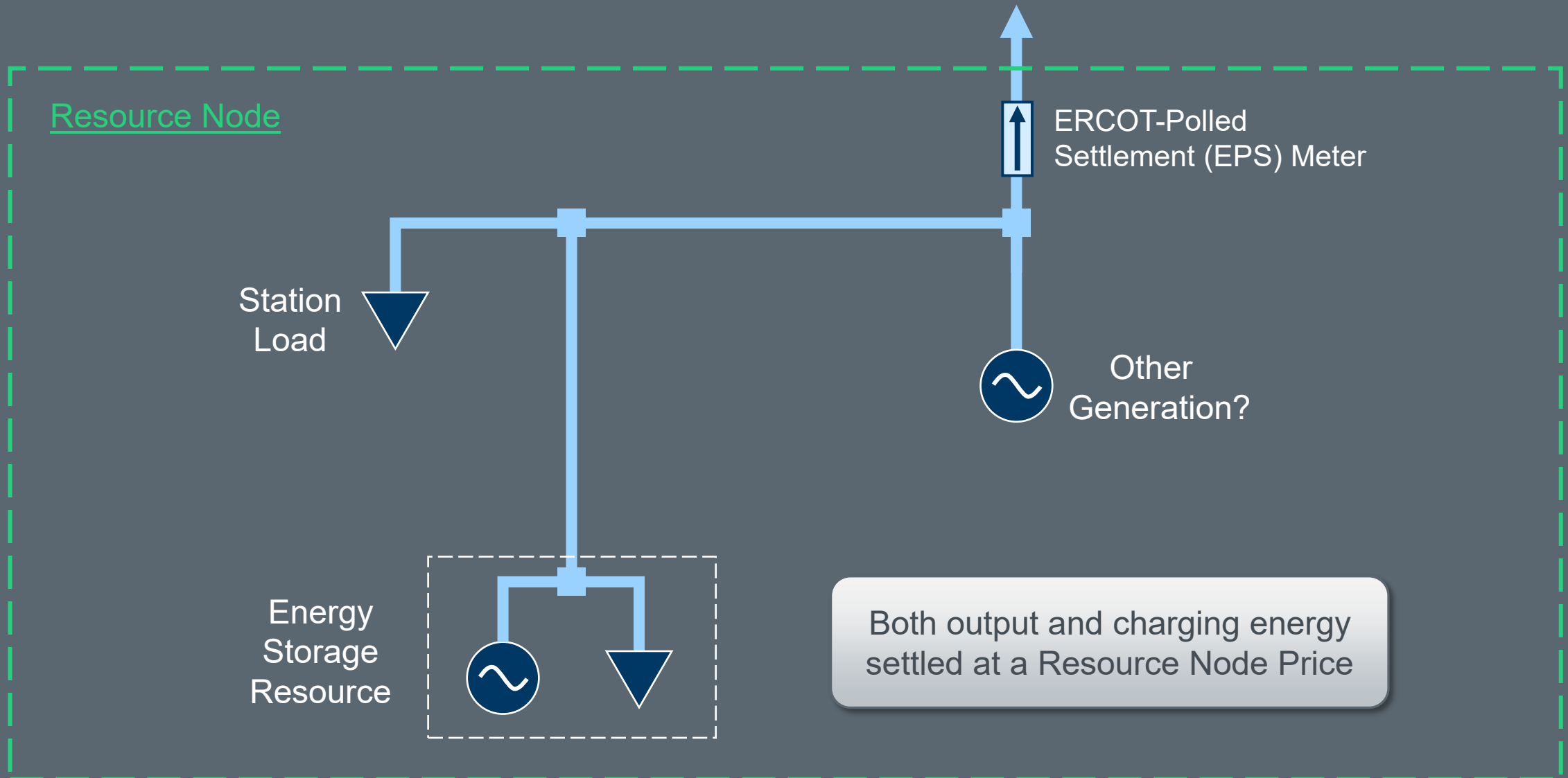
HSL = High Sustained Limit
LSL = Low Sustained Limit

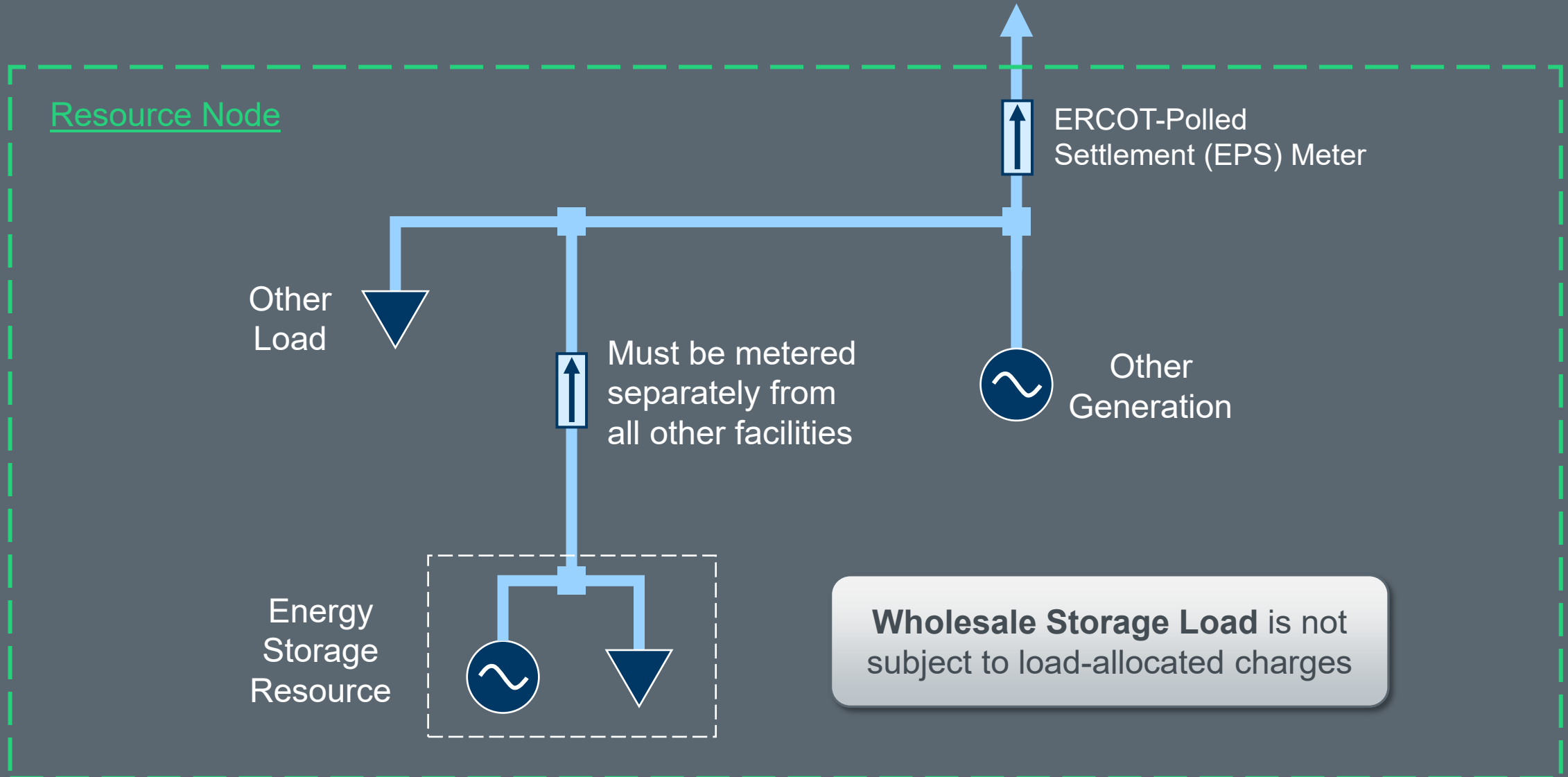




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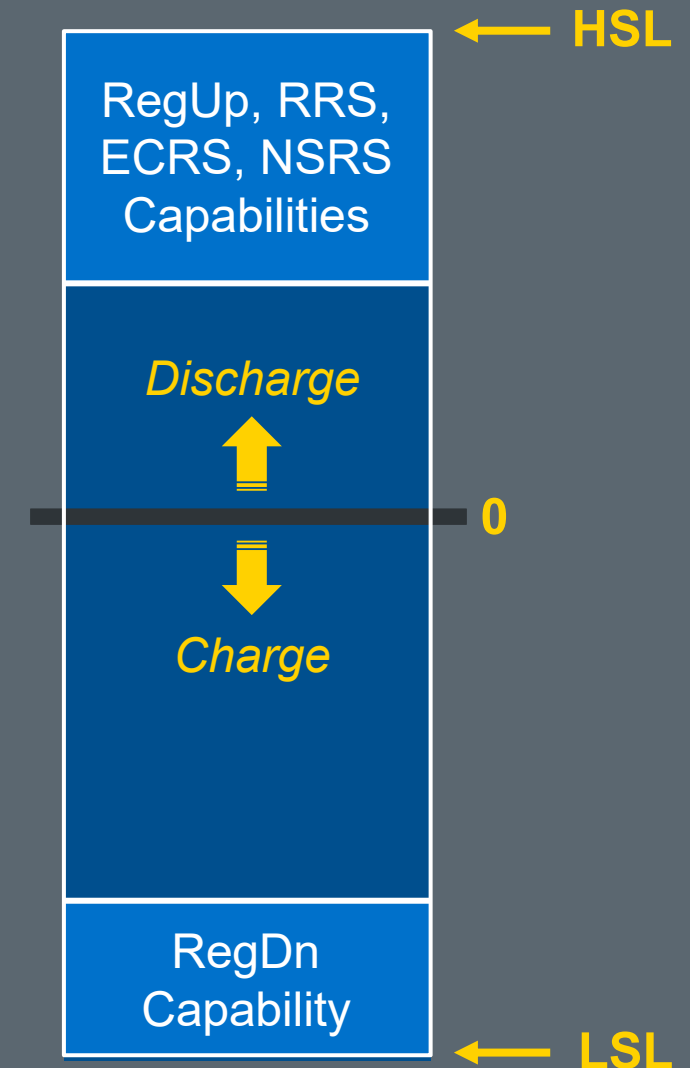






Ancillary Service		Ramping Requirement	Duration Requirement
RegUp		5 minutes	30 minutes
RegDn		5 minutes	30 minutes
RRS	RRSPF	N/A*	30 minutes
	RRSFF	15 cycles	15 minutes
ECRS		10 minutes	1 hour
Non-Spin		30 minutes	4 hours

*RRSPF for ESRs limited to 20% of (HSL-LSL)



Topics in this module include:

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Telemetry Requirements

Current Operating Plan													
Hour	Resource Name	Resource Status	Resource Limits		ESR SOC Limits			Ancillary Service Capabilities					
			HSL	LSL	Min	Max	Hour Beginning	Reg-Up	Reg-Dn	RRSPF	RRSFF	ECRS	NSRS
15	ESR1	ON	40	-40	0	40	30	0	0	0	30	30	0
16	ESR1	ON	40	-40	0	40	40	0	0	0	20	20	0
17	ESR1	ON	40	-40	0	40	20	0	0	0	10	10	0
18	ESR1	ON	40	-40	0	40	10	0	0	0	10	10	0
19	ESR1	OUT	0	0	0	40	0	0	0	0	0	0	0



Topics in this module include:

1

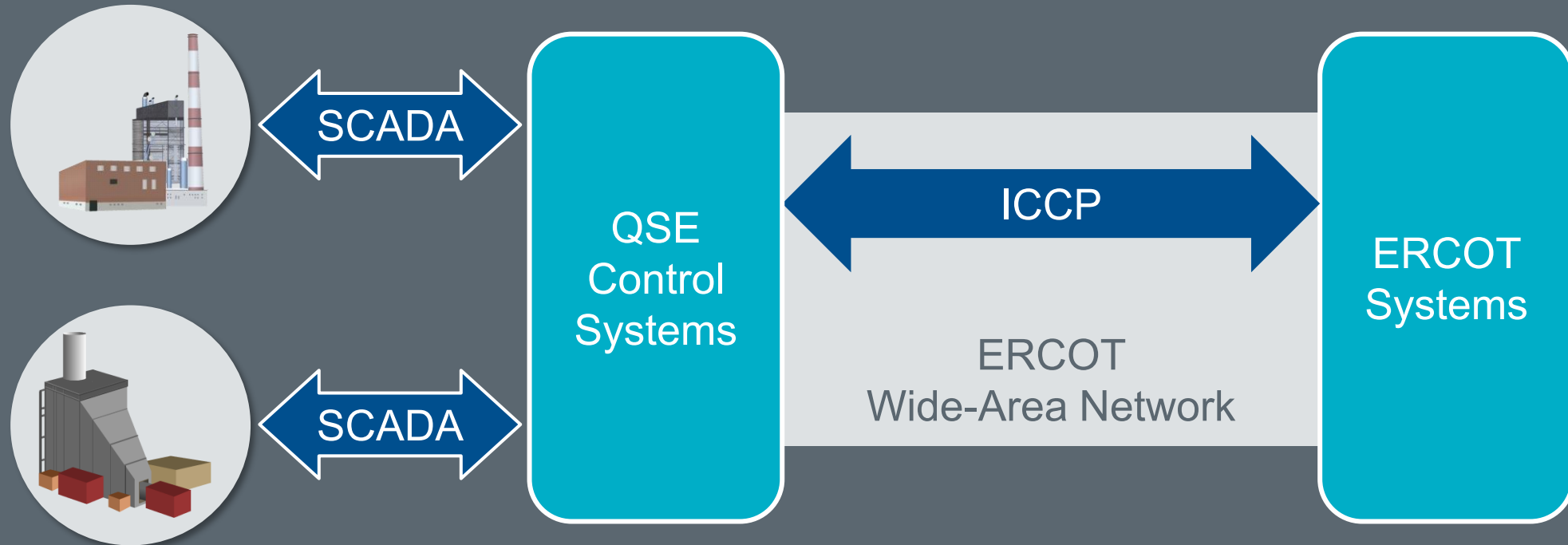
Basic ESR Capabilities

2

Current Operating Plan

3

Telemetry Requirements



Communicates Real-Time Resource Capabilities:

- Operational Status and Limits
- Ramp Rates
- AS Capabilities
- Self-Provided Ancillary Services
- SOC data for ESRs



ICCP Resource Telemetry								
Name	Operational Status and Limits					State of Charge		
	Power Output/Consumption (MW)	Max Discharge Power Limit (MW)	HSL (MW)	LSL (MW)	Max Charge Power Limit (MW)	Min (MWh)	Max (MWh)	Current (MWh)
ESR1	0	40	40	-40	(-)40	0	40	20
ESR2	-10	40	0	-40	(-)40	0	40	0
ESR3	0	40	40	0	(-)40	0	40	40
ESR4	35	40	40	-24	(-)40	0	40	38

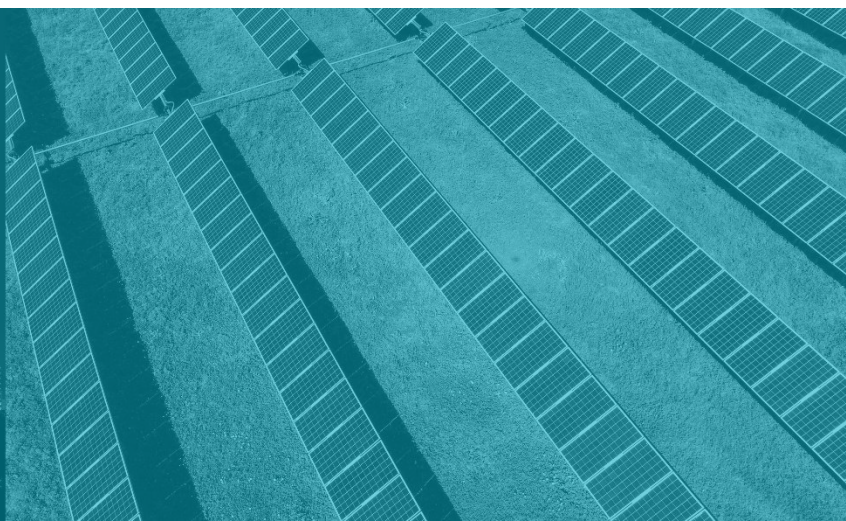
What's the difference?

What's the difference?

Must be updated every 2 seconds



ESRs in the ERCOT Markets



Topics in this module include:

1

Participation across Market Processes

2

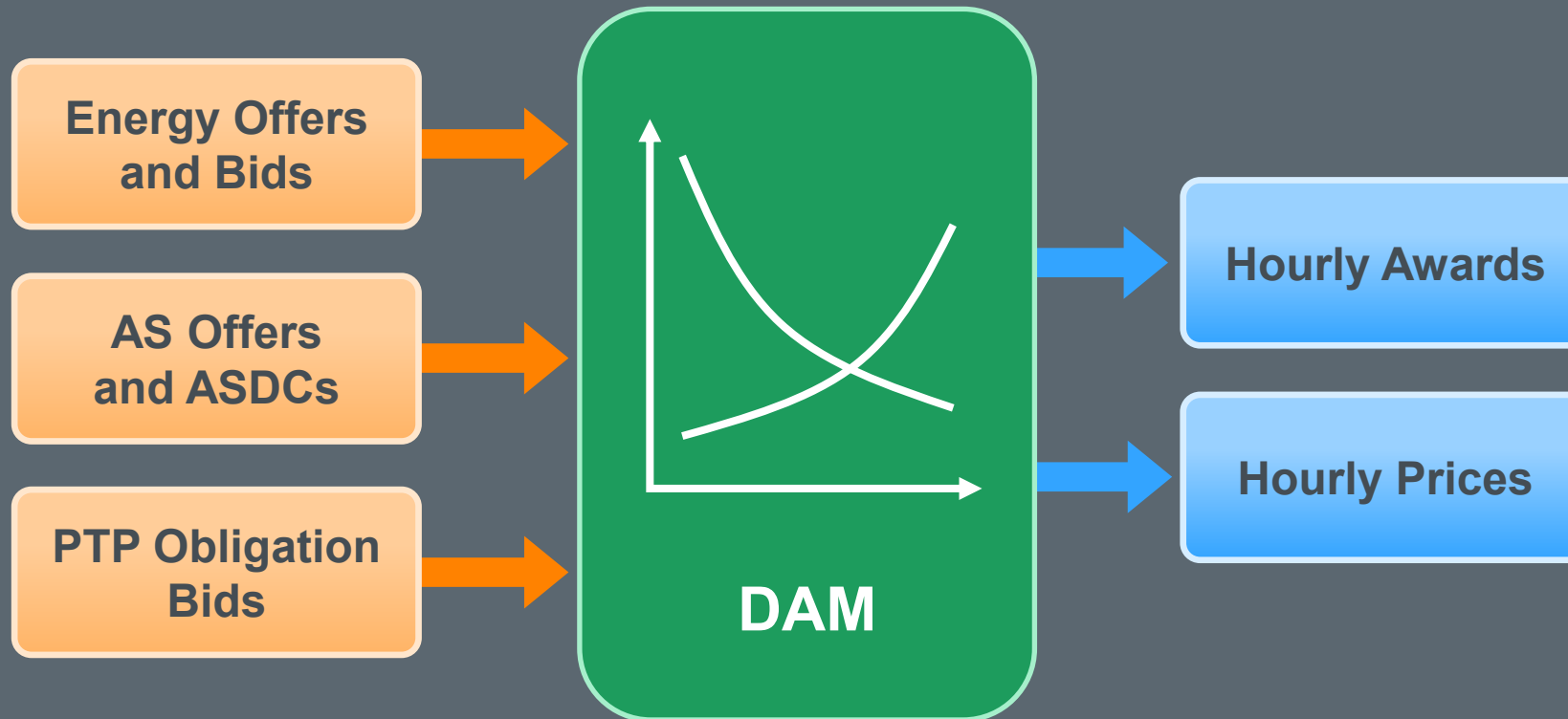
Energy Dispatch and Real-Time AS Awards

3

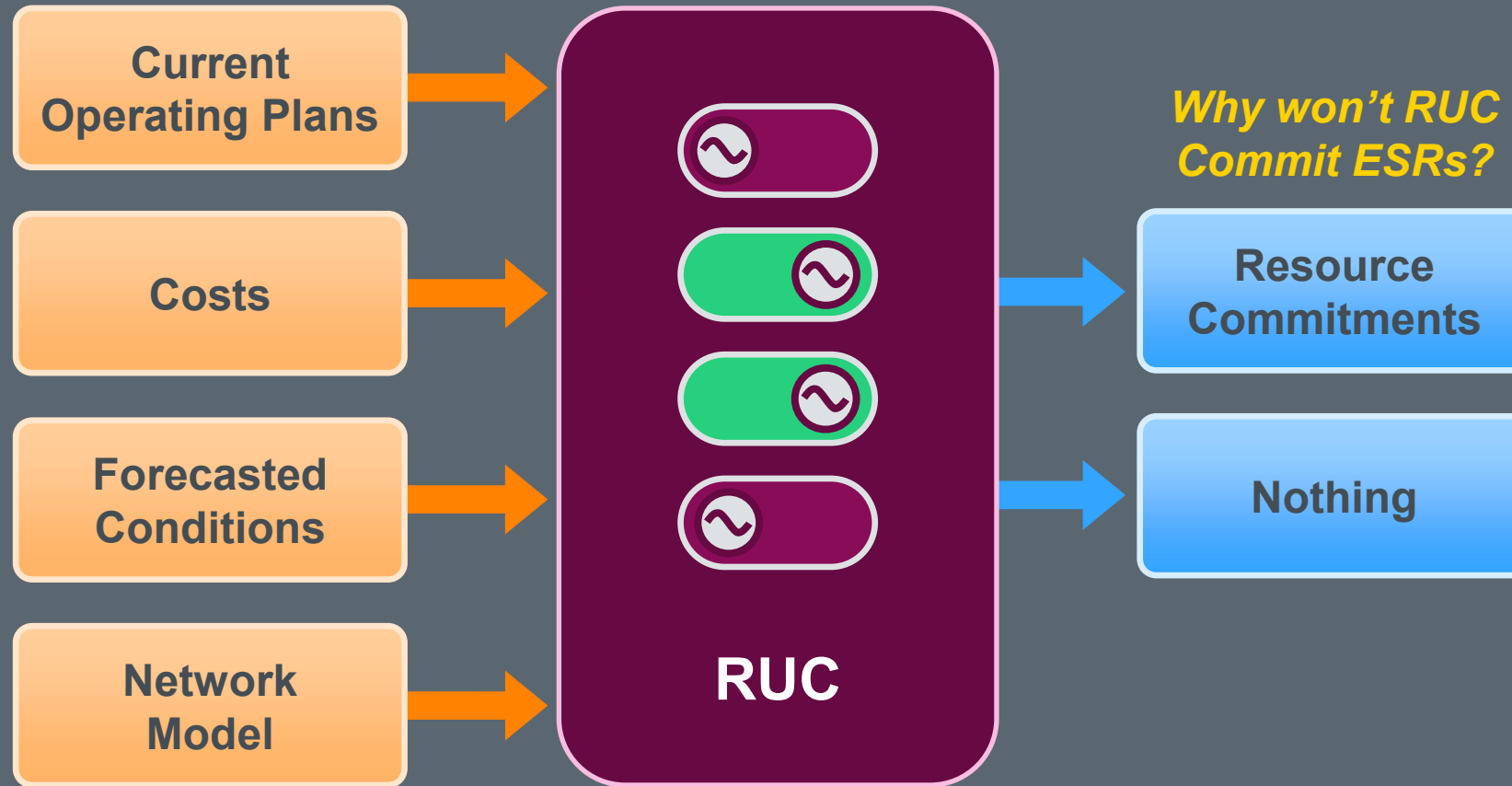
AS Deployment



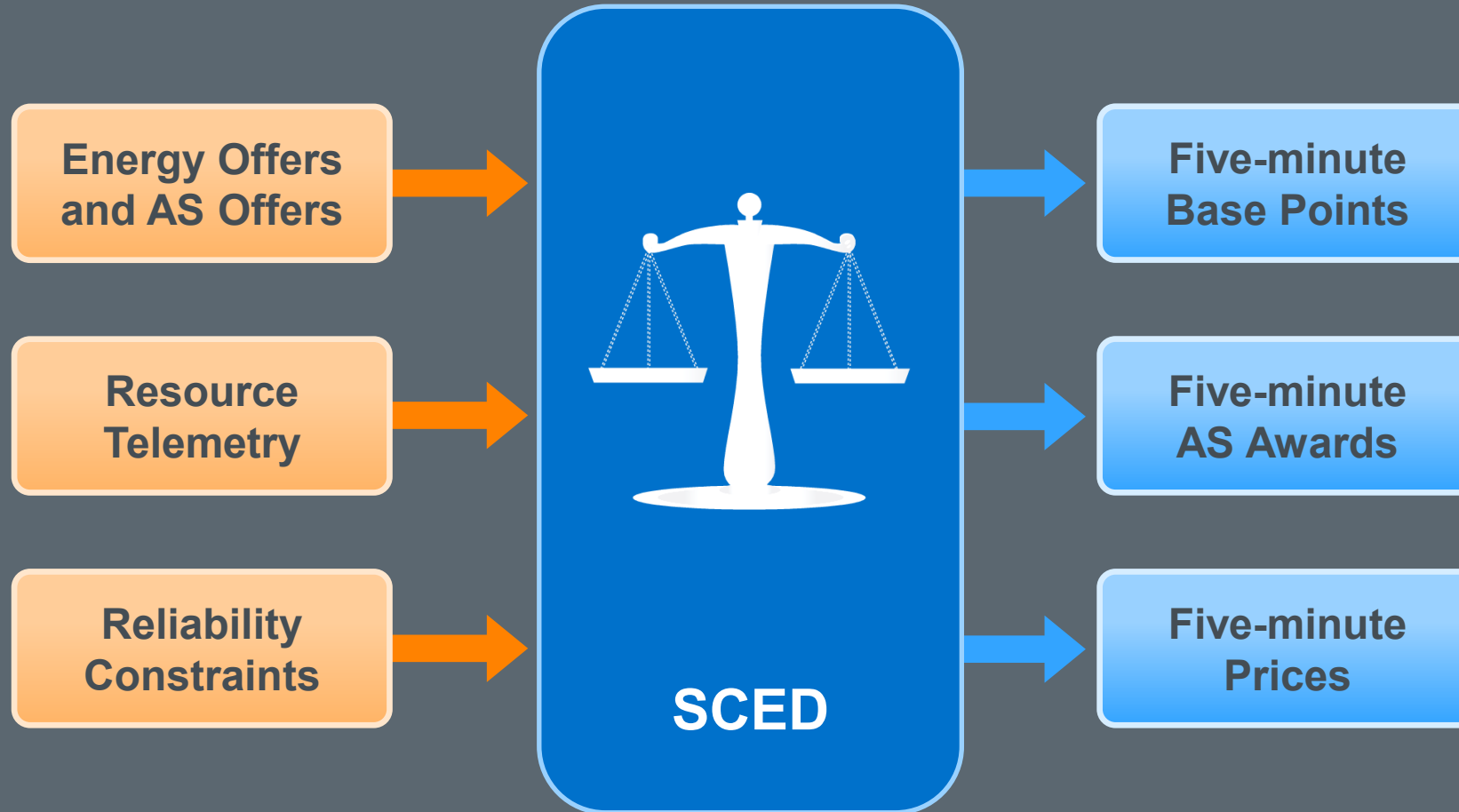
What can Energy Storage Resources do in DAM?

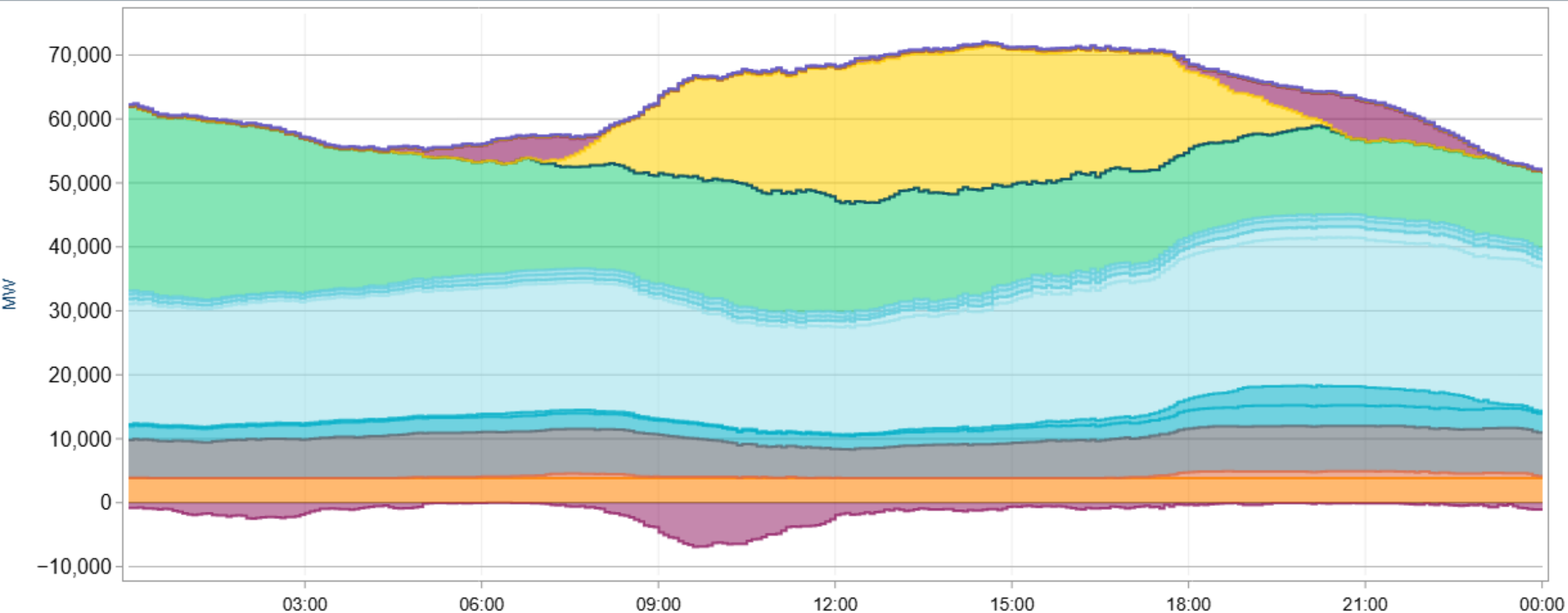


Considers Energy Storage Resource Impact



ESRs play an increasing role in Energy Dispatch and Ancillary Services







Topics in this module include:

1

Participation across Market Processes

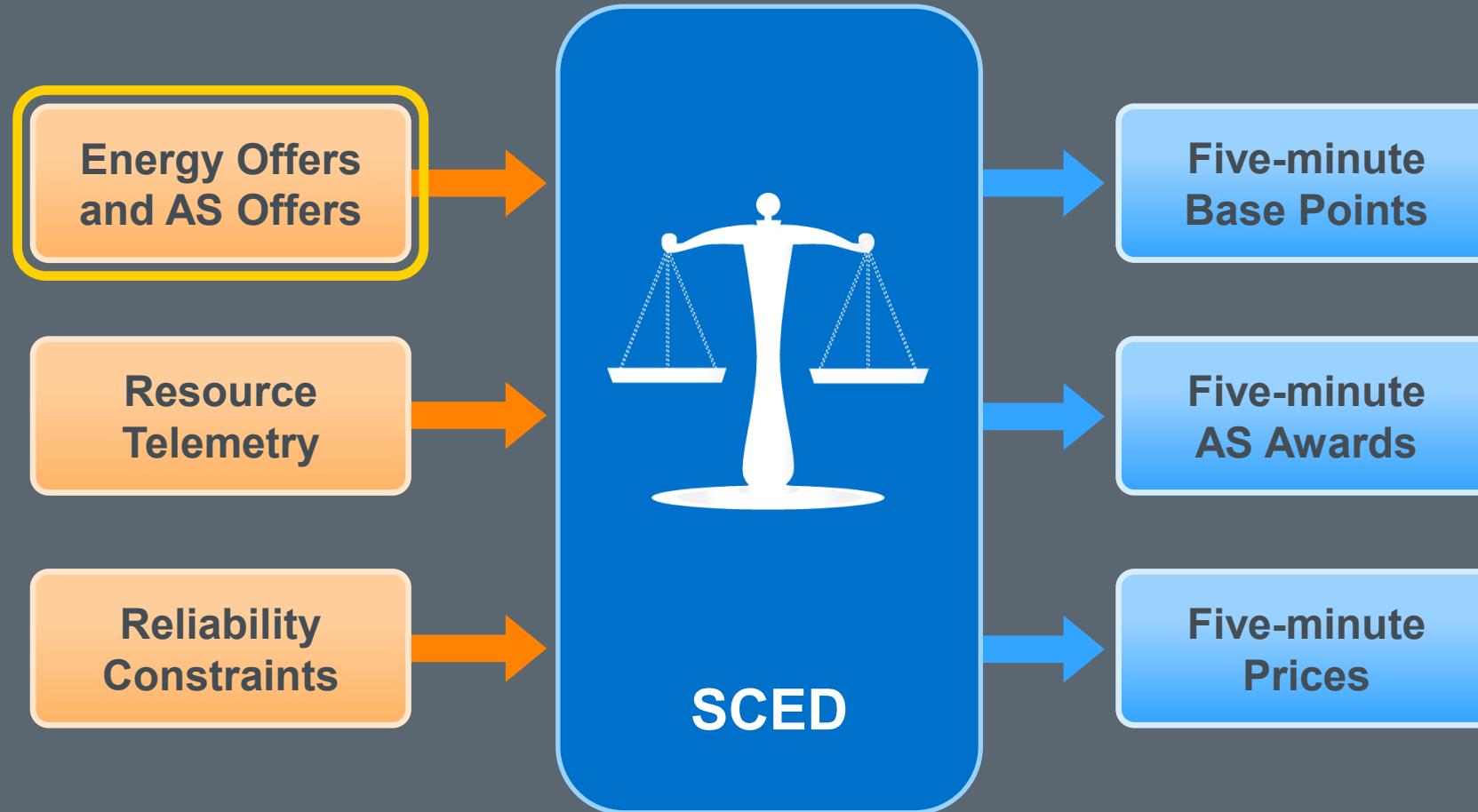
2

Energy Dispatch and Real-Time AS Awards

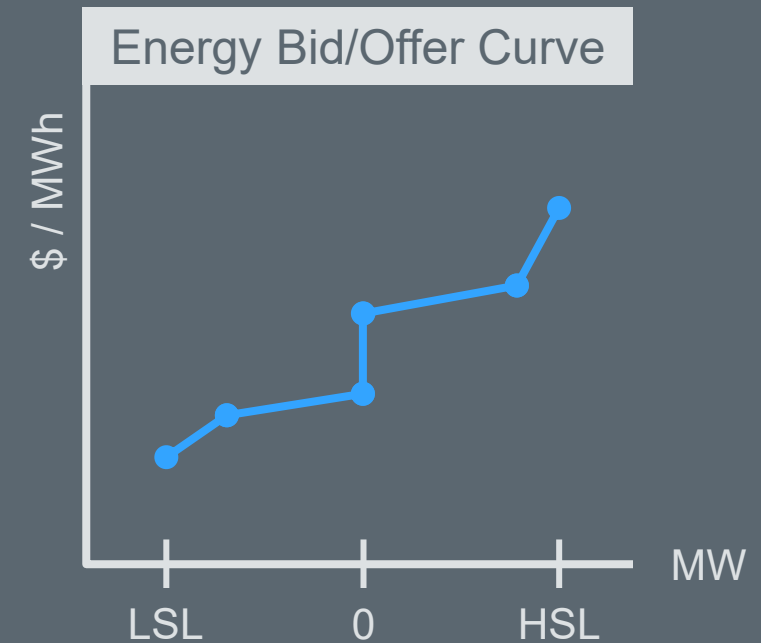
3

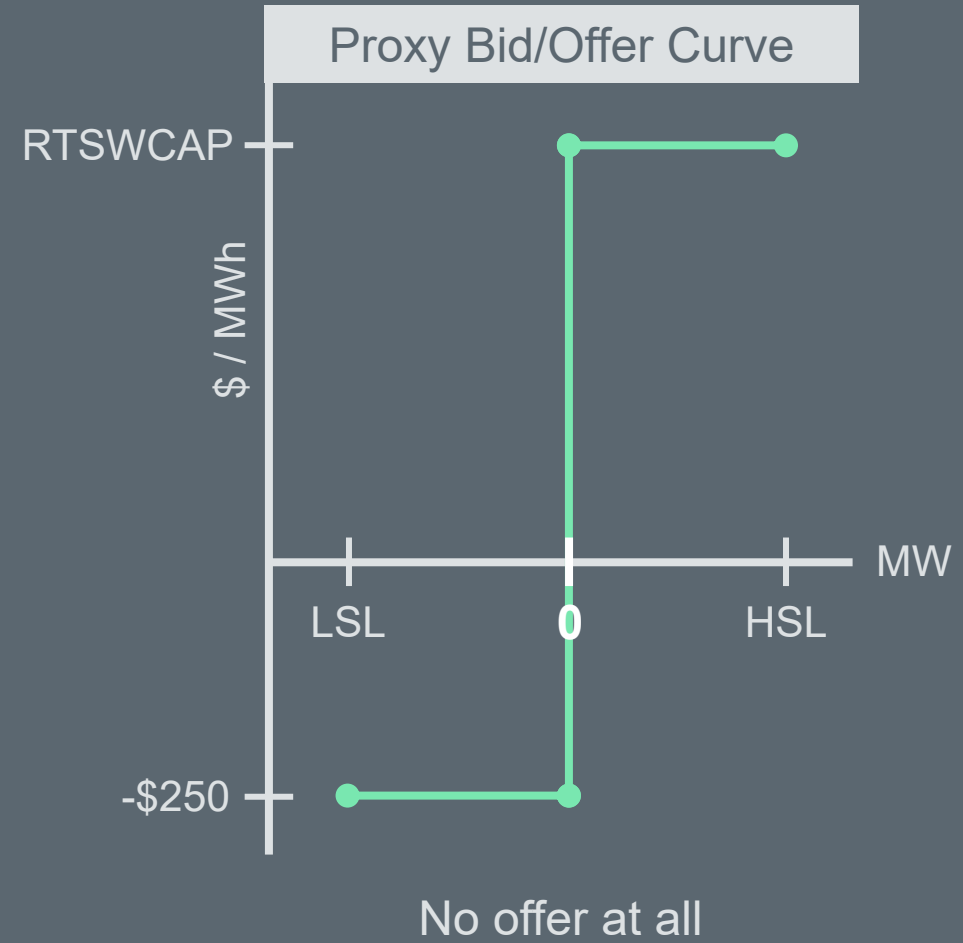
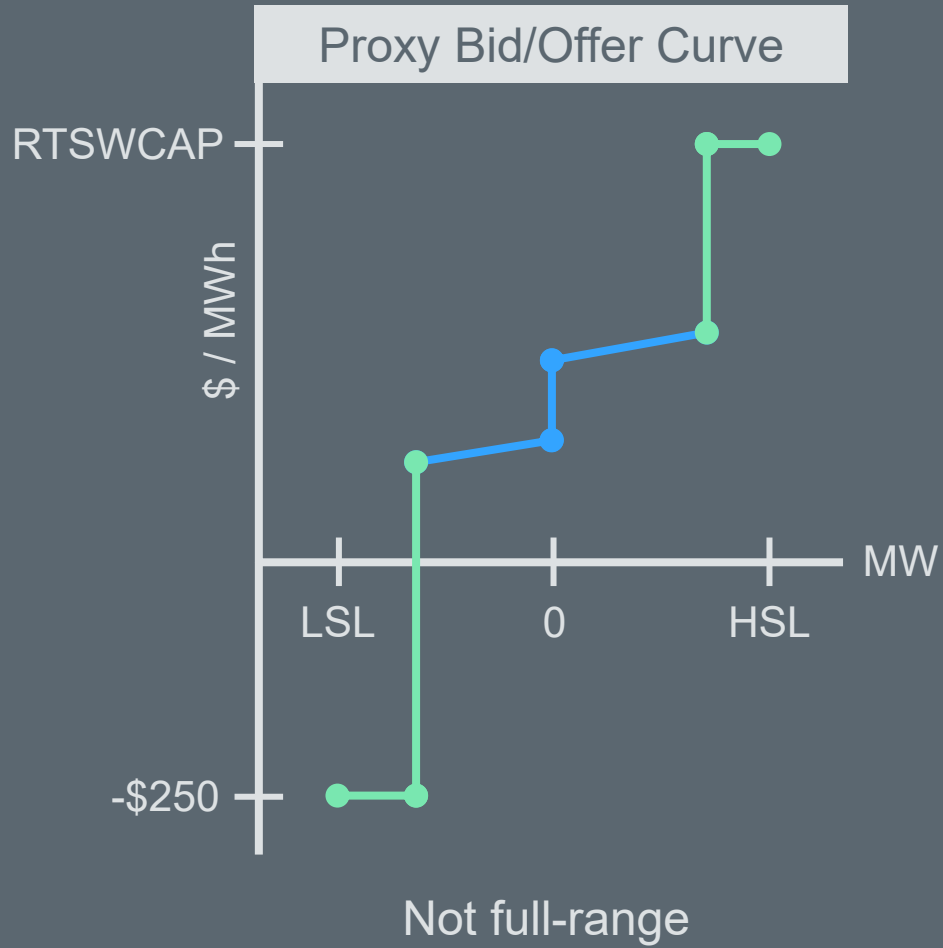
AS Deployment

Manages Reliability at Least Cost

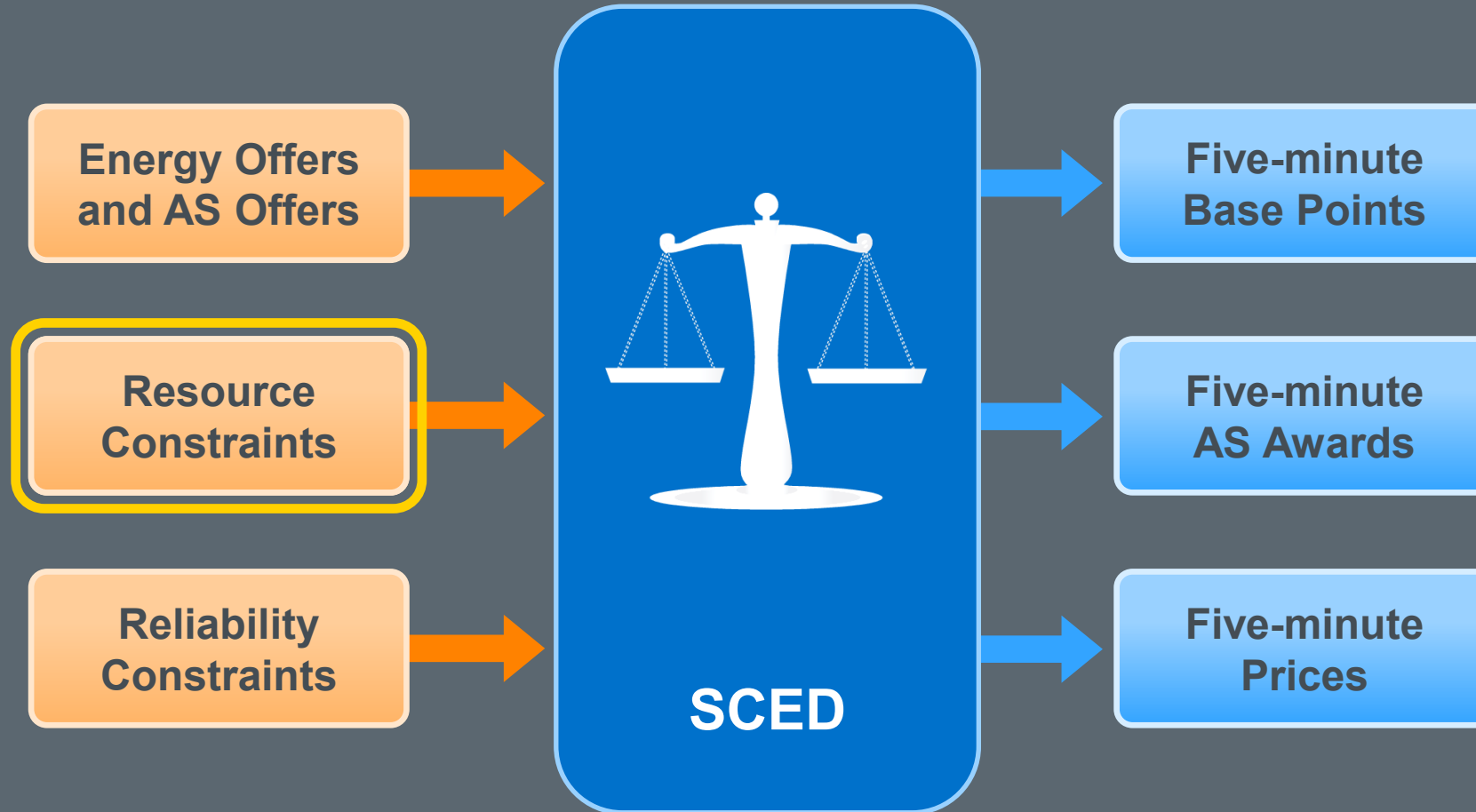


May be updated any time before SCED





Manages Reliability at Least Cost

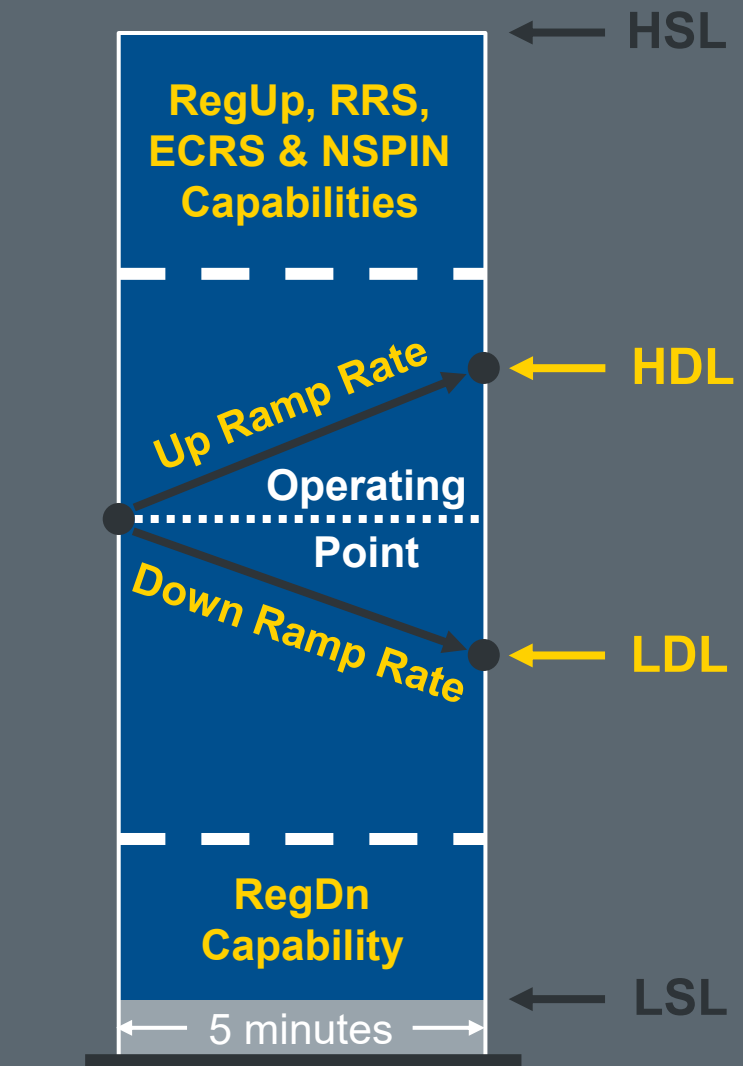


High Dispatch Limit

$$\text{Base Point} + (5/7) \text{ RegUp Award} \leq \text{HDL}$$

$$\text{Base Point} - (5/7) \text{ RegDn Award} \geq \text{LDL}$$

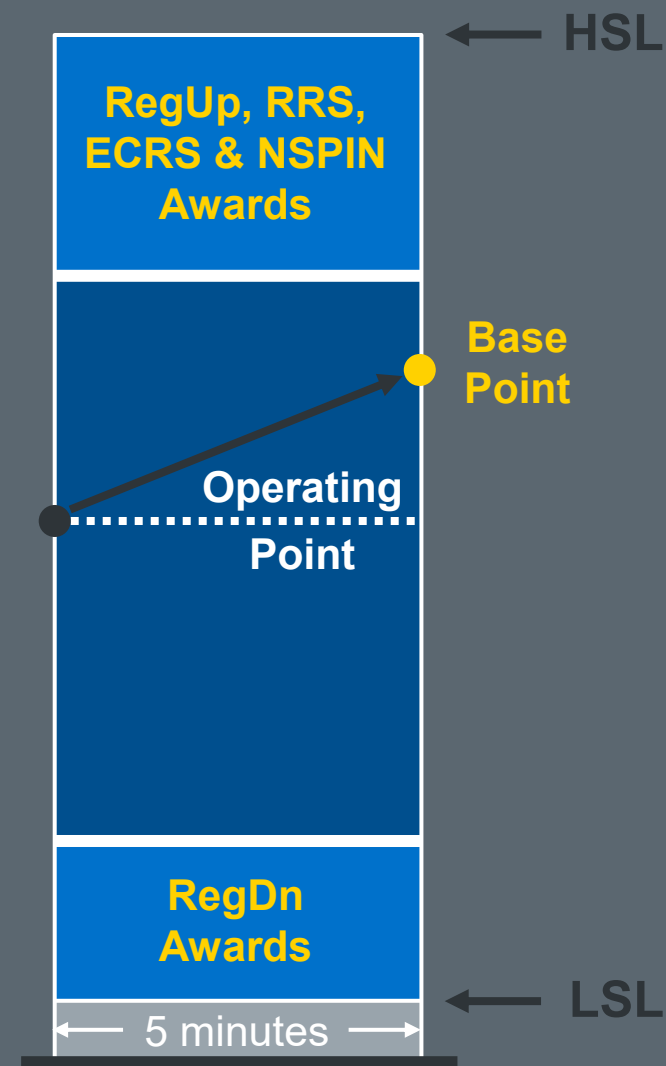
Low Dispatch Limit



Resource Limit Calculator

Base Points and AS Awards must be feasible based on

- **State-of-Charge (SOC)**
- **Min/Max SOC limits**
- **Duration requirements**





Used in RUC and SCED Optimizations

- ESR consumes more than it can return
- Charging Base Point allows for losses

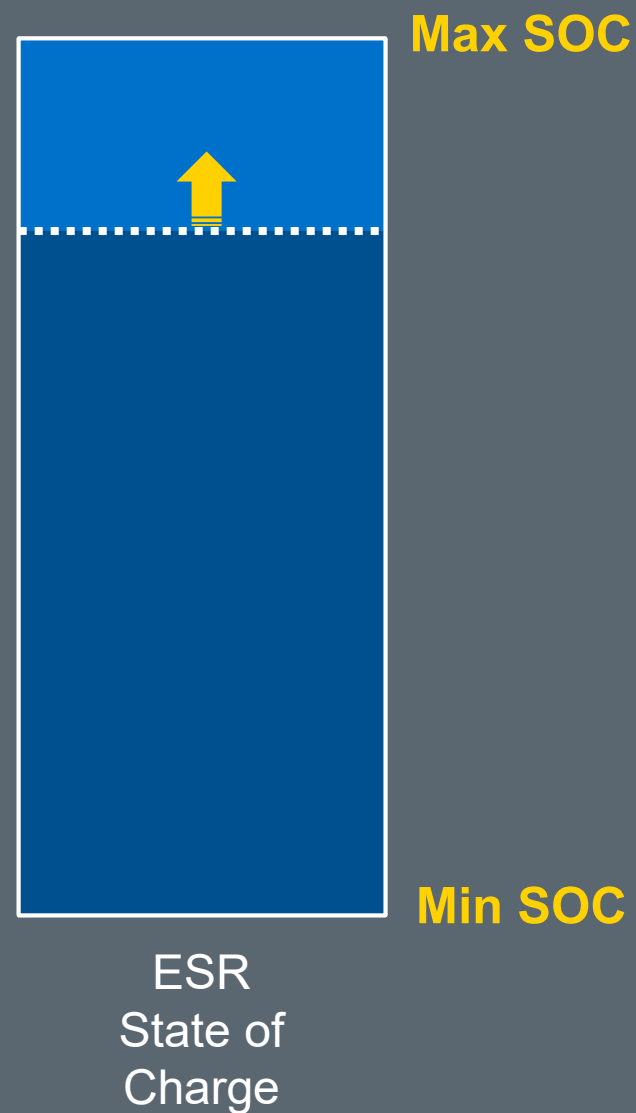


RE

Resource
Parameters



QSE



Topics in this module include:

1

Participation across Market Processes

2

Energy Dispatch and Real-Time AS Awards

3

AS Deployment

AS Type	Deployment Methodology
ERCOT Contingency Reserve Service	SCED
On-line Non-Spin	SCED
Off-line Non-Spin	Operator Dispatch Instruction
Regulation Up and Regulation Down	Load Frequency Control
Responsive Reserve Service	Frequency Trigger



RRSPF – Primary Frequency Response

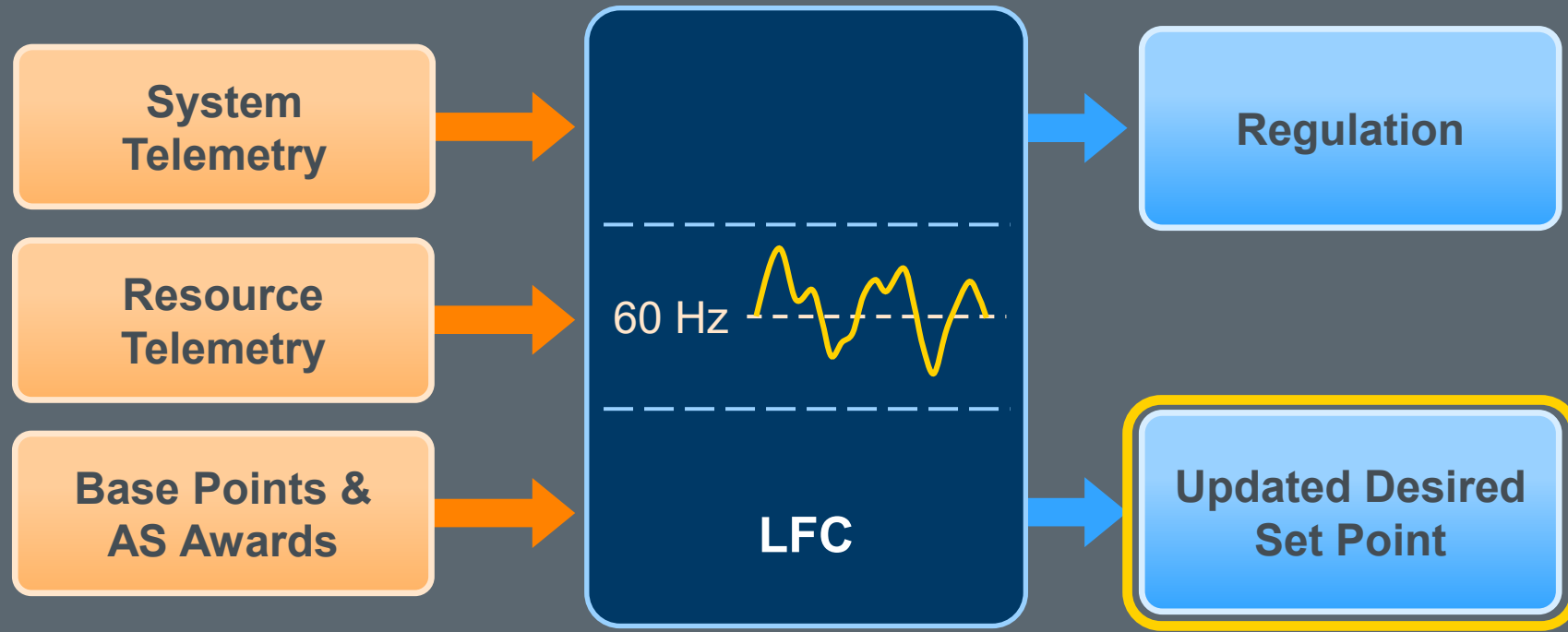
- Automatic Response at 59.983 Hz
- Proportional to frequency decay

RRSFF – Fast Frequency Response

- Auto-deployed at 59.85 Hz
- Responds within 15 Cycles
- Recalled at 59.95 Hz

RRSUF – Load Resource on Under-Frequency Relay

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



ICCP signals updated every 4 seconds



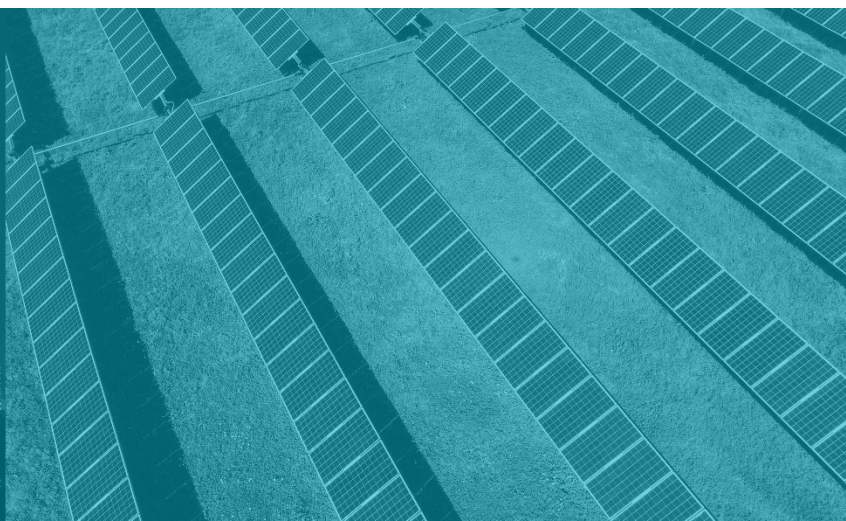
Instructed output level of Resource to meet:

- SCED Base Point Ramping
- Regulation deployments
- Expected RRSFF deployments

ERCOT also sends FFR Active Flag (FFAC) via ICCP



Financial Considerations



Topics in this module include:

1

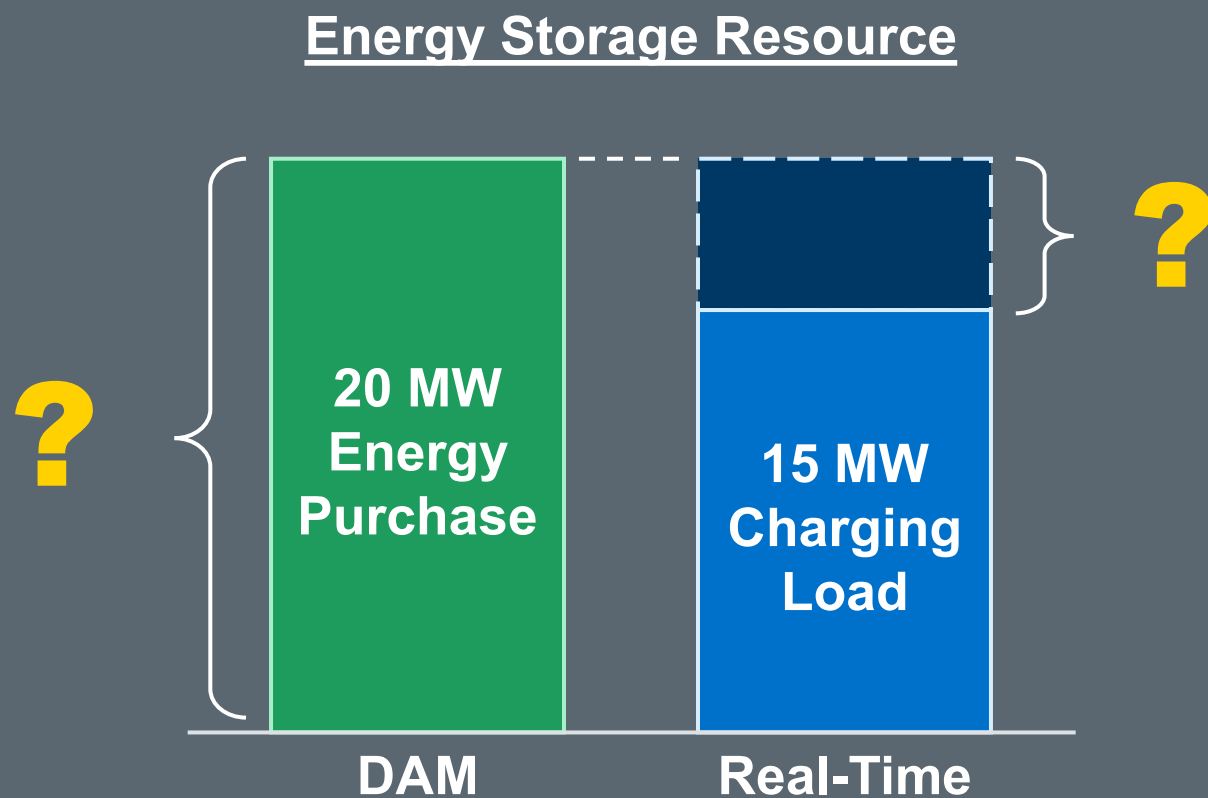
Energy and Ancillary Services

2

RUC Capacity Short Charge

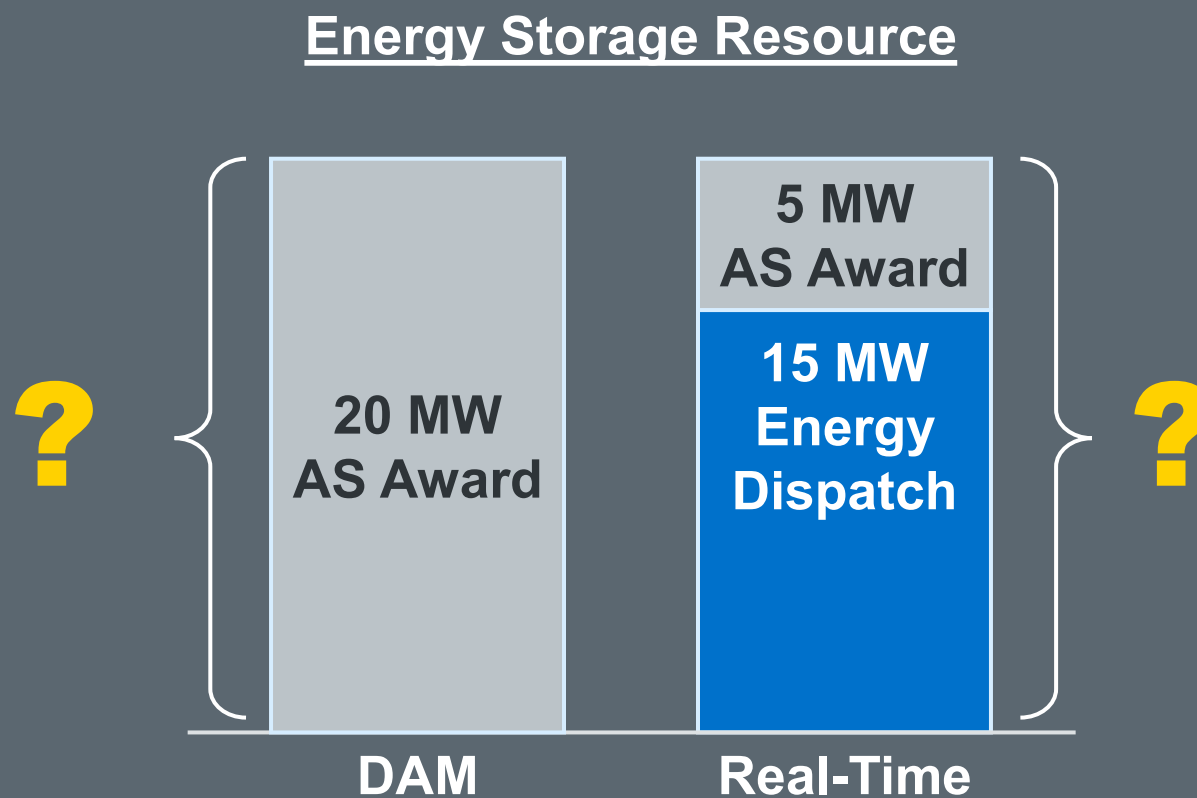


QSE has transactions for their Resource





QSE has transactions for their Resource



Topics in this module include:

1

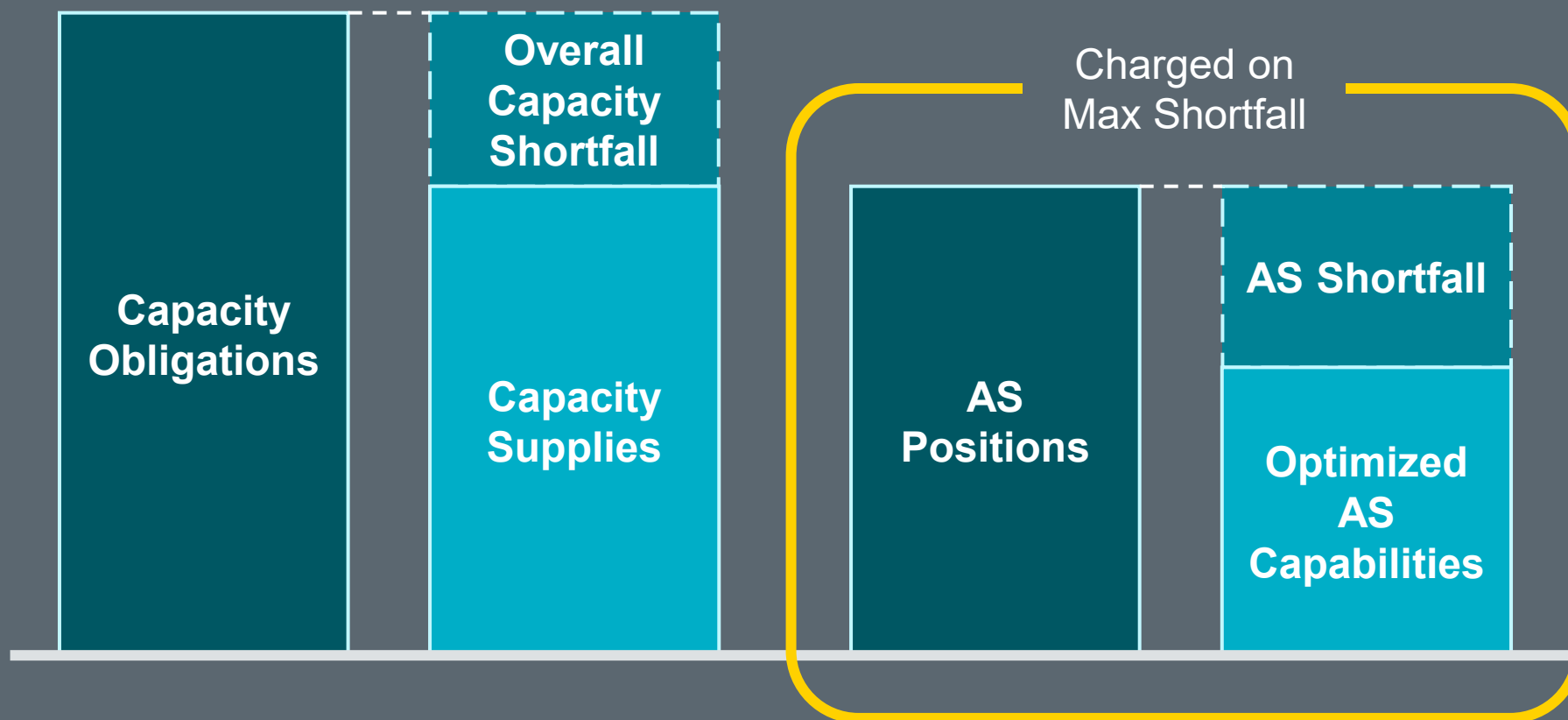
Energy and Ancillary Services

2

RUC Capacity Short Charge



Two Ways for QSE to be Capacity Short



Potential Capacity Obligations for QSE



**Capacity
Obligations**

Load

Energy Sales (DAM and Trades)

On-Line AS Sales (DAM and Trades)

Self-Arranged AS from DAM

Planned ESR charging

Potential Capacity Supplies for QSE



Committed Resource Capacity

Energy Purchases (DAM and Trades)

On-Line AS Purchases (DAM and Trades)

AS from Load Resources

Planned ESR discharging & ESR upward AS

Capacity
Supplies

Ancillary Service Financial Obligations for QSE



**Ancillary
Service
Positions**

DAM Self-Arranged AS

+

DAM AS Awards

+

AS Trade Sales

–

AS Trade Purchases

Ancillary Service Supply for QSE



Capabilities prioritized for AS

Constraints:

- Resource Limits
- SOC (ESRs)
- Duration Requirement (ESRs)
- Deployment Factors (ESRs)

Optimized
Ancillary
Service
Capabilities



RUC Information for Hour 15

- QSE sold 40 MW ECRS through Trade
- QSE has no DAM Transactions
- ECRS Deployment Factor = 0



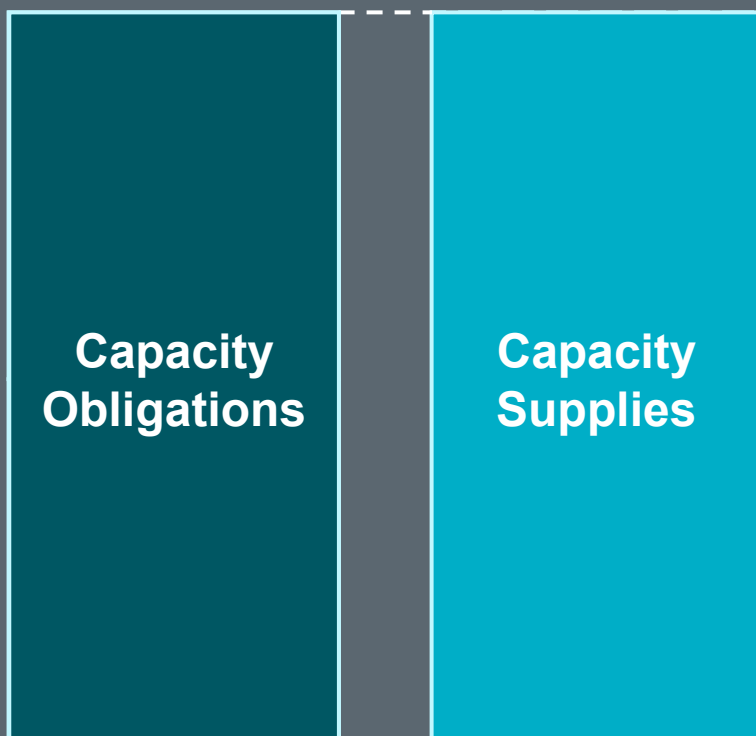
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Hour	Resource Name	Resource Limits		ESR SOC Limits			Ancillary Service Capabilities				
		HSL	LSL	Min	Max	Hour Beginning	Reg-Up	Reg-Dn	Responsive	ECRS	NSRS
15	ESR3	40	-40	0	40	0	0	0	0	40	0
16	ESR3	40	-40	0	40	40	0	0	0	40	0



Two Ways for QSE to be Capacity Short



Overall Capacity Shortfall?



Ancillary Service Shortfall?





RUC Information for Hour 15

- QSE sold 40 MW ECRS through Trade
- QSE buys 40 MW of Energy in DAM
- ECRS Deployment Factor = 0



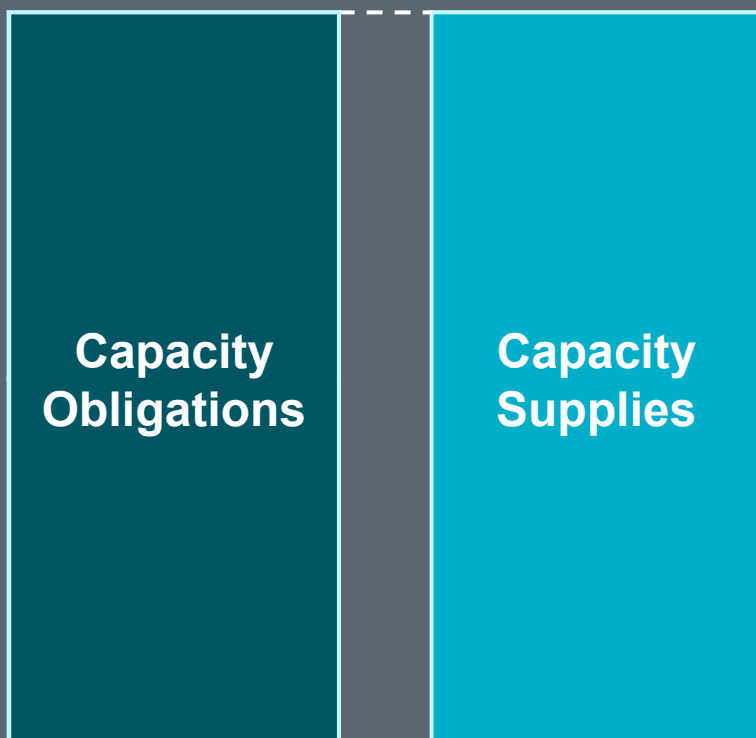
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16	ESR3	40	-40	0	40	40	0	0	0	40	0



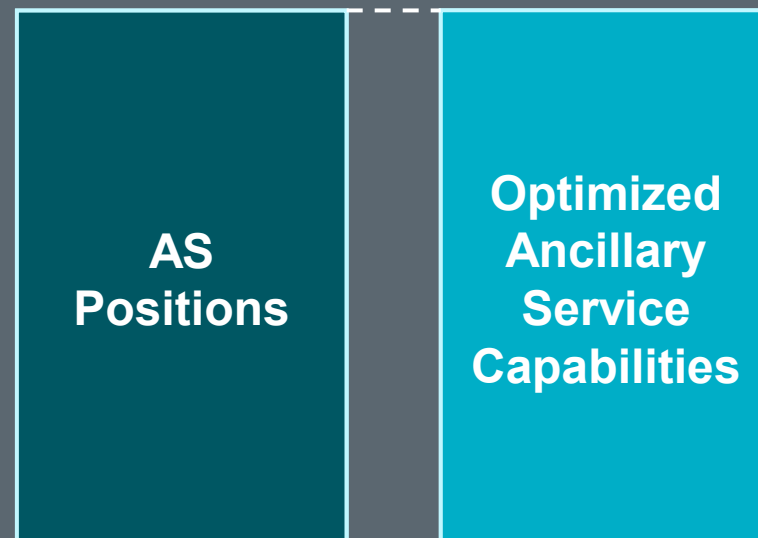
Two Ways for QSE to be Capacity Short



Overall Capacity Shortfall?



Ancillary Service Shortfall?





RUC Information for Hour 15

- QSE sold 40 MW ECRS through Trade
- QSE has no DAM Transactions
- ECRS Deployment Factor = 1



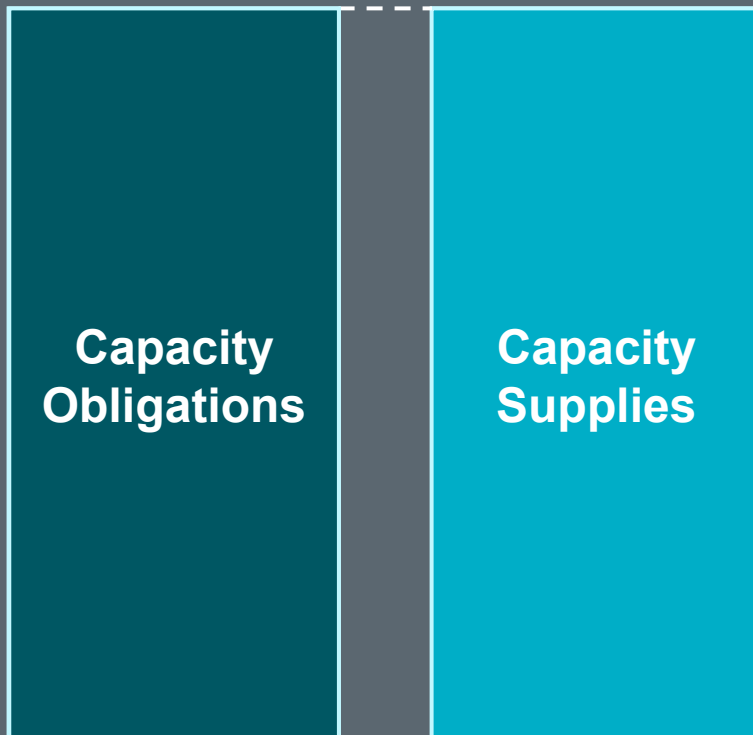
Current Operating Plan											
Hour	Resource Name	Resource Limits		ESR SOC Limits			Ancillary Service Capabilities				
		HSL	LSL	Min	Max	Hour Beginning	Reg-Up	Reg-Dn	Responsive	ECRS	NSRS
15	ESR3	40	-40	0	40	40	0	0	0	40	0
16	ESR3	40	-40	0	40	0	0	0	0	40	0



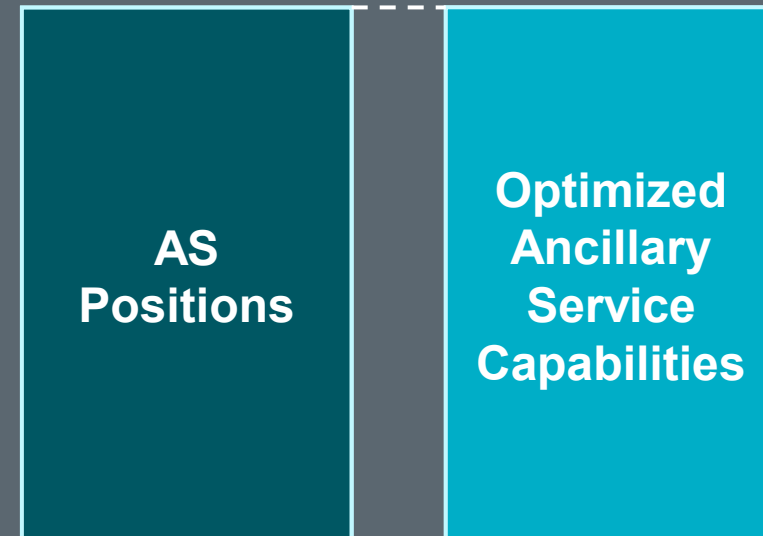
Two Ways for QSE to be Capacity Short



Overall Capacity Shortfall?



Ancillary Service Shortfall?





RUC Information for Hour 15

- QSE sold 40 MW ECRS through Trade
- QSE has no DAM Transactions
- ECRS Deployment Factor = 0.5



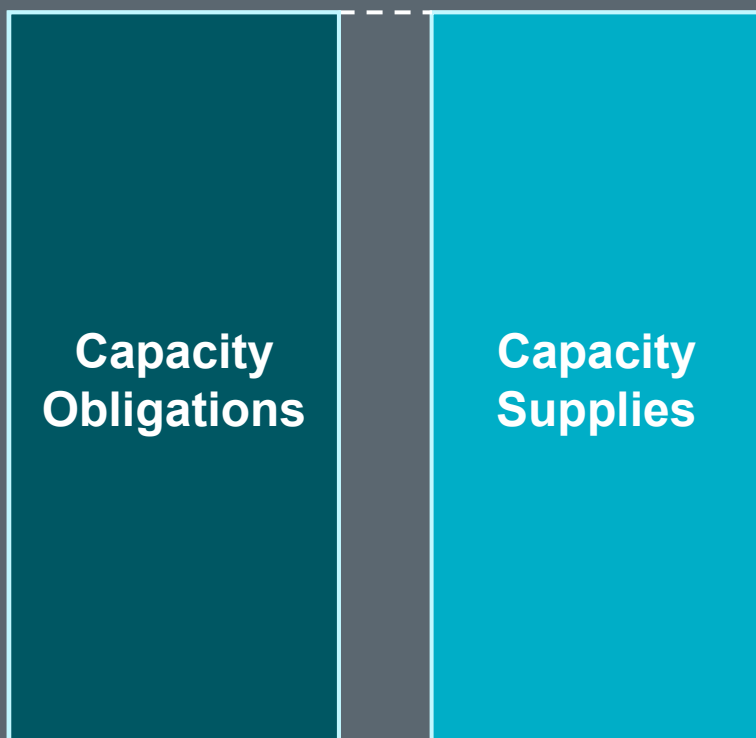
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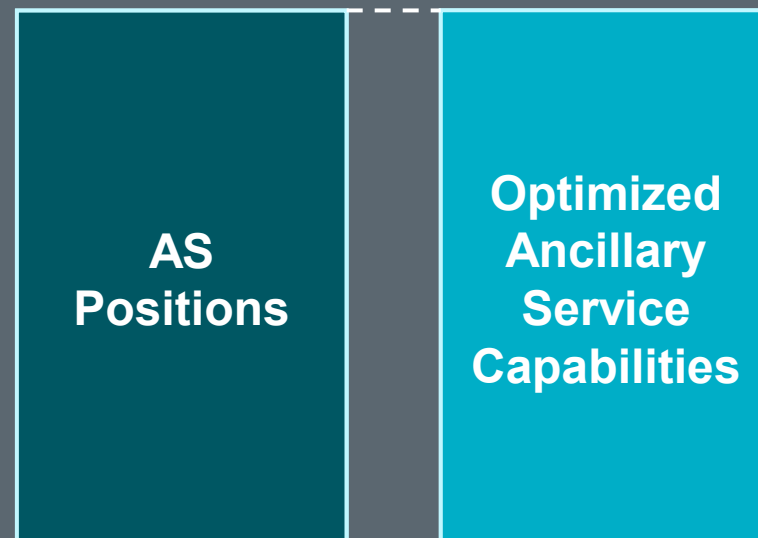
Two Ways for QSE to be Capacity Short



Overall Capacity Shortfall?



Ancillary Service Shortfall?





RUC Information for Hour 15

- QSE sold 40 MW ECRS through Trade
- QSE has no DAM Transactions
- ECRS Deployment Factor = 0.5



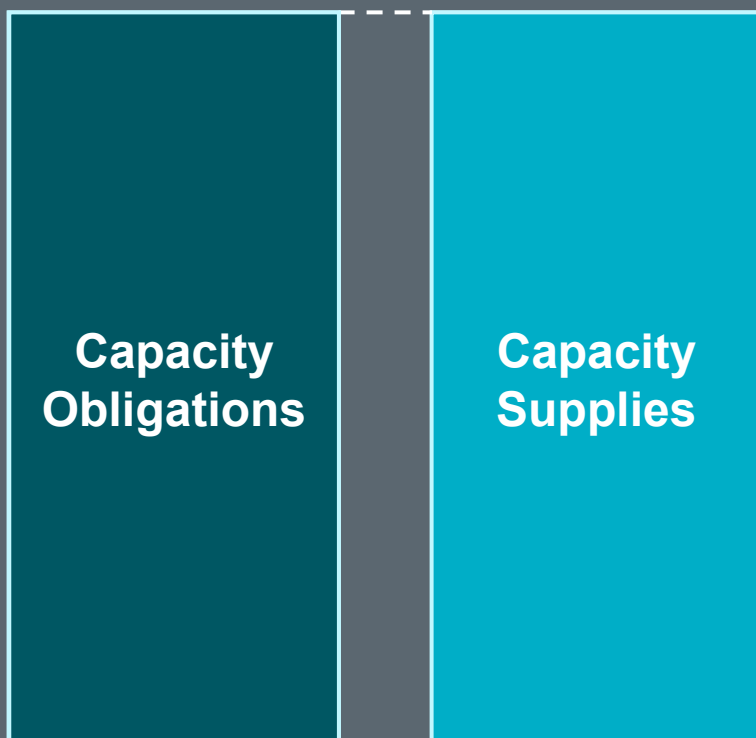
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15	ESR3	40	-40	0	40	40	0	0	0	40	0
16	ESR3	40	-40	0	40	10	0	0	0	30	0



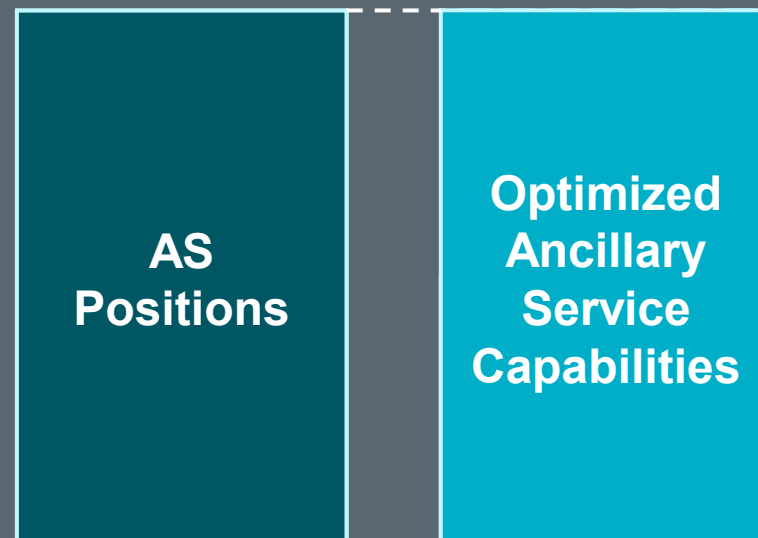
Two Ways for QSE to be Capacity Short



Overall Capacity Shortfall?



Ancillary Service Shortfall?



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Course Recommendations

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ERCOT Client Services Contact

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