

PJM Reserve Market

PJM State & Member Training Dept.

Objectives



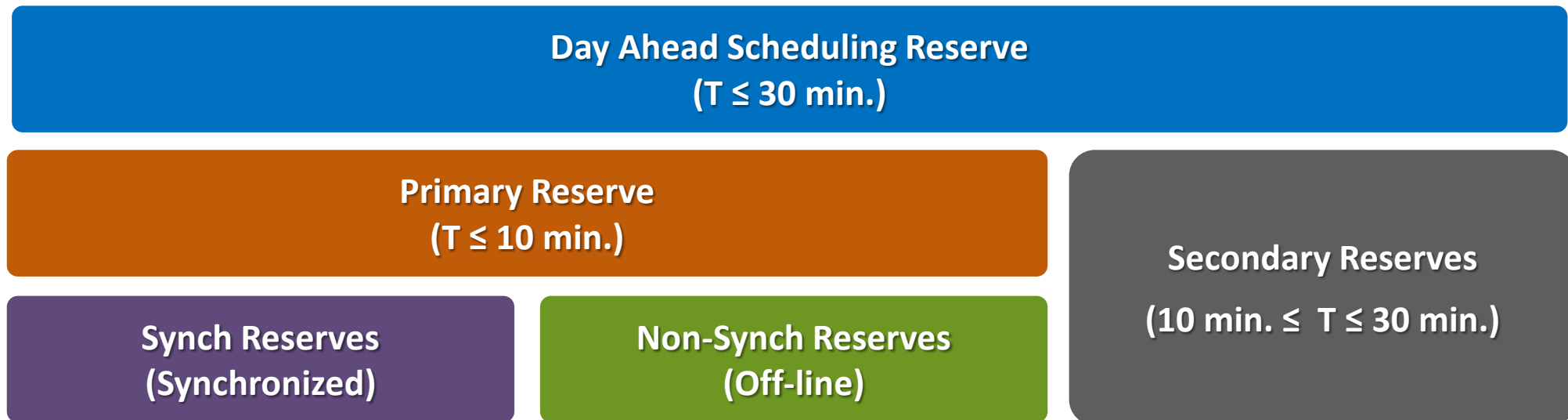
Students will be able to:

- Identify the process and procedures for participating in the Real-Time Reserve Market

Reserves Overview

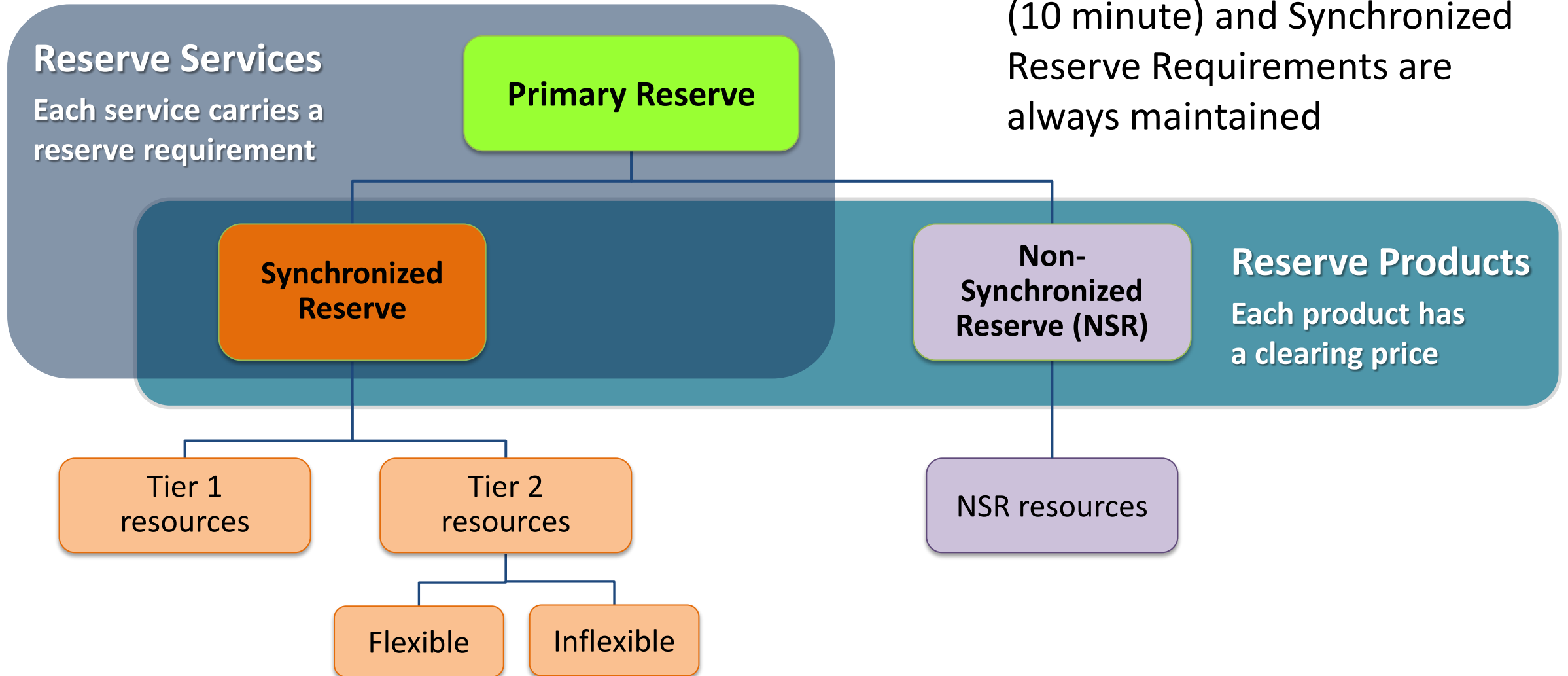
What are Reserves?

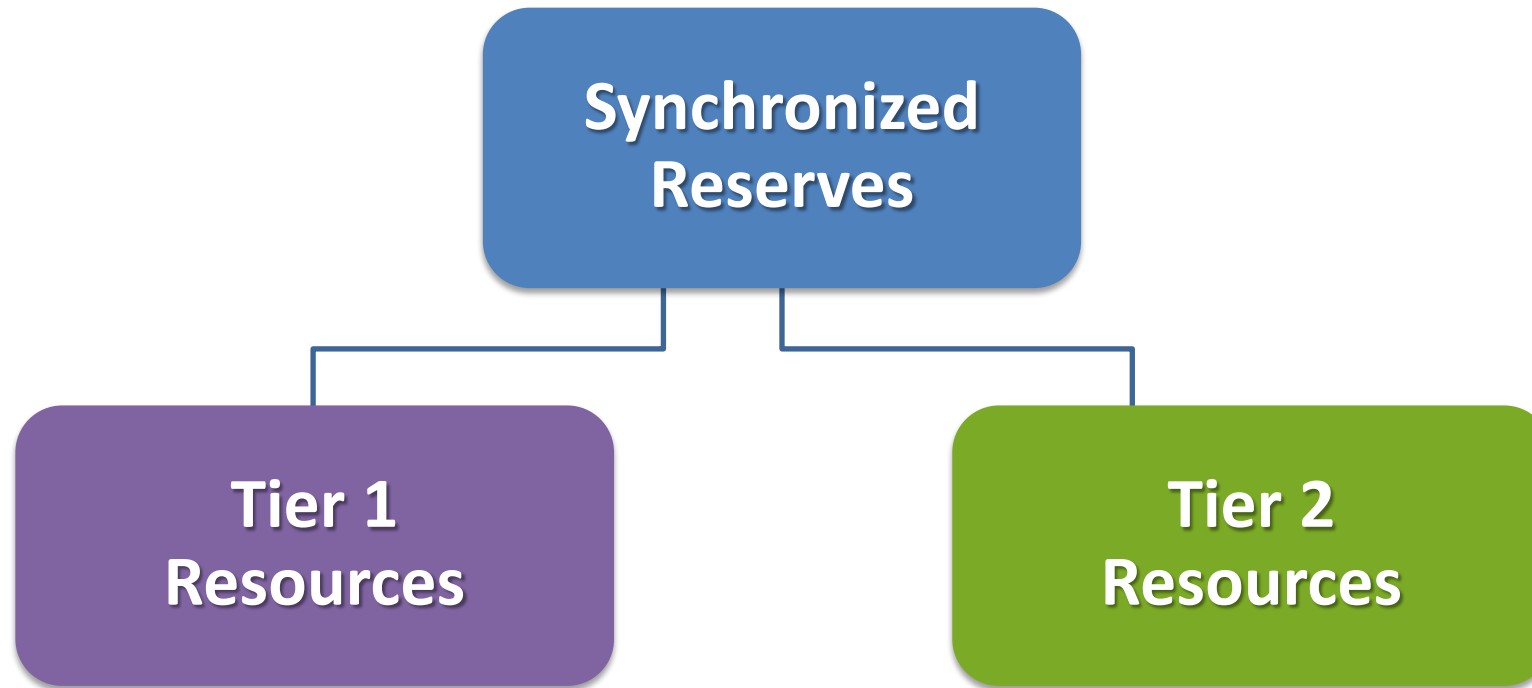
- Reserves are additional generation capacity above the expected load
 - Protects the power system against the uncertain occurrence of future operating events:
 - Loss of generation or load forecasting errors



Reserve Markets

PJM Operates in real-time to ensure Contingency/Primary (10 minute) and Synchronized Reserve Requirements are always maintained





Tier 1 (Economic)	<ul style="list-style-type: none"> • Online units that follow economic dispatch and only partially loaded <ul style="list-style-type: none"> – Able to increase output within 10 minutes following PJM dispatcher request to an event
Tier 2 (Non-economic)	<ul style="list-style-type: none"> • Resources that offered into the Synchronized Reserve Market <ul style="list-style-type: none"> – Cleared Condensers (CTs & hydro) transition to online Tier 2 condense mode • Steam reduced to provide Tier 2 CTs online at min – operating at a point that deviates from economic dispatch Demand Response that can drop load

Tier 2 Requirements

- Eligibility

- “Generation Resources and Demand Resources must be able to provide 0.1 MW of Tier 2 Synchronized Reserve Capability in order to participate in the Tier 2 Synchronized Reserve Market.” (Manual 11 – Section 4.2.1)

- Commitment

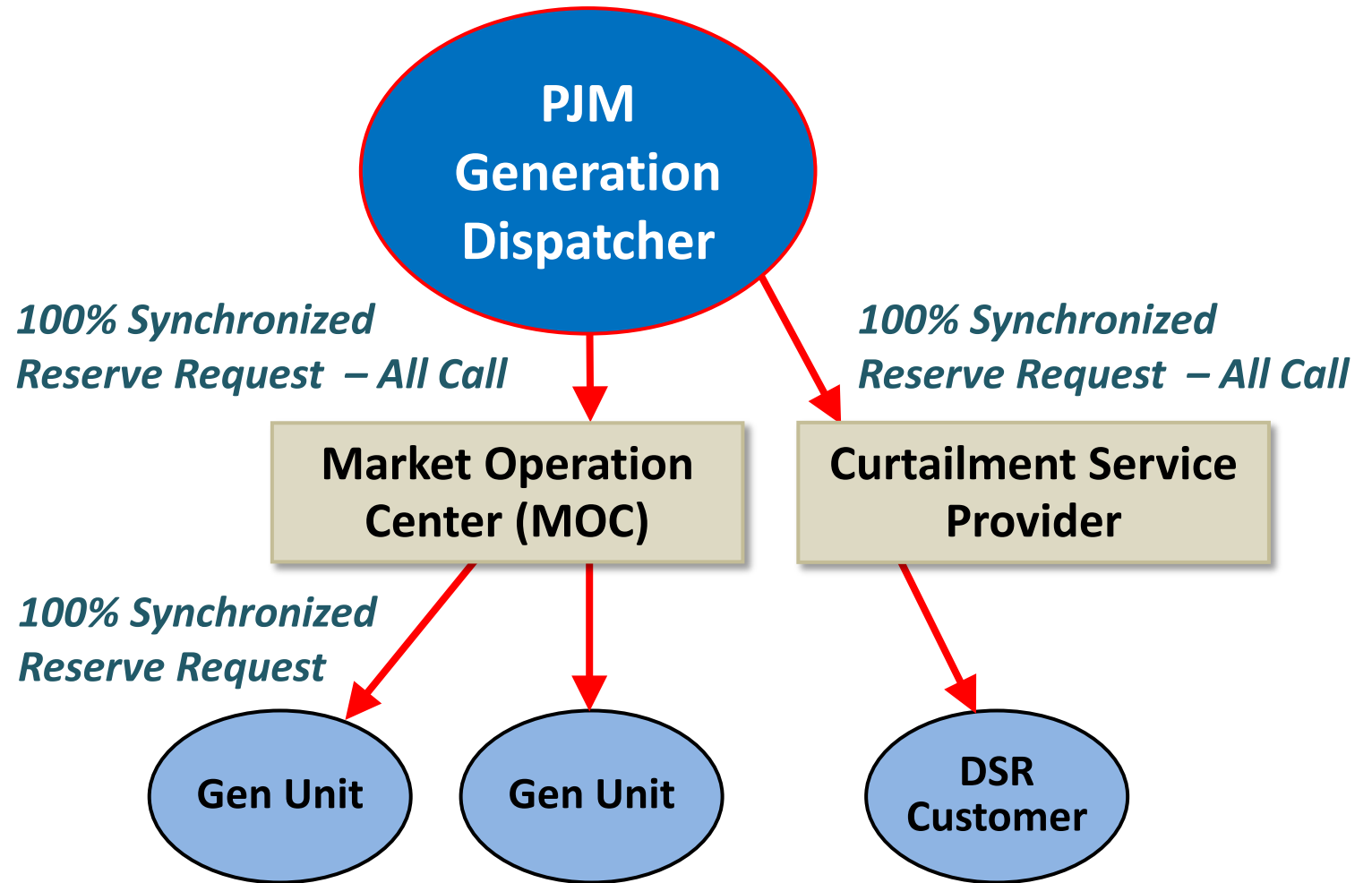
- “Any resource that is committed for Tier 2 when a synchronizes event occurs is obligated to respond for their commitment at the start of the event within 10 minutes” (Manual 11 – Section 4.2.7)

Call for Synchronized Reserve

Loading of Synchronized Reserve is a Reliability Service!

- The resource owners implement the requested percentage of Synchronized Reserve:
 - Without regard to price and as quickly as possible
- Continue to implement Synchronized Reserve until directed by PJM dispatcher to discontinue

At most, one level of operator intervention between PJM and customer reducing load



Synchronized Reserve Offers

- **Offer MW** - The amount of Synchronized Reserve MW offered for the unit
 - The Synchronized Reserve quantity is defined as the increase in output achievable by the unit in ten (10) minutes
- **Offer Price** - Must be a positive number; required if the unit is available for Synchronized Reserve
 - A Synchronized Reserve offer price may not exceed the unit's O & M cost (as determined by the Cost Development Subcommittee) plus \$7.50/MWh margin
- **Condense Energy Use** - This is the amount of energy a condensing unit consumes in an hour while operating in the condensing mode
- **Condense Startup Cost** - This is the actual cost associated with getting a unit from a completely off-line state into the condensing mode including fuel, O&M, etc.

Managing Synchronized Reserve Data

- **Condense to Gen Cost** - The cost, in dollars, of transitioning a condenser to the generating mode. The value submitted for this cost must be less than or equal to the condense Startup cost
- **Full Load Heat Rate** - The heat rate of the unit, specified in BTU/kWh, when the unit is at full load
- **Reduced Load Heat Rate** - The heat rate of the unit, specified in BTU/kWh, when the unit is at reduced load
- **VOM Rate** - The variable rate, in dollars, of operating and maintenance costs

Managing Synchronized Reserve Data

- **Spin as Condenser** - Used to identify if a combustion turbine can be committed for synchronized reserve as a condenser
- **Condenser Available Status** - Status of the resource availability for condensing
 - **Available** - Indicates if the unit is available to condense for voltage support
 - **Not Available** - Indicates if the unit is unavailable to condense for voltage support

Synchronized Reserve Market Timeline

10:30 a.m.

Due a day ahead of the operating day, by 10:30 a.m.

- Energy schedule for LOC calculation to qualified units

2:15 p.m.

Due a day ahead, by 2:15 p.m.

Tier 2 Offer Price

(capped at actual cost + \$7.50/MWh adder)

- All other SR data can be revised up to 65 minutes before the operating hour.

6:30 p.m.

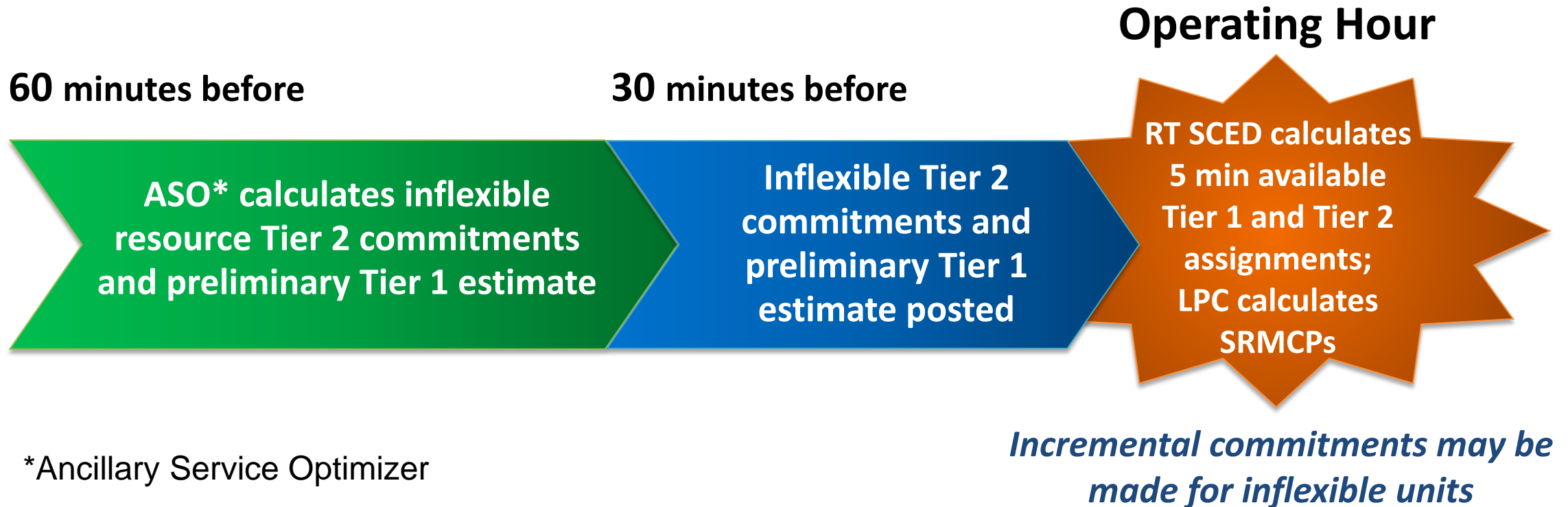
Up to 65 min prior to the operating hour

- SR status (Available, Unavailable)
 - Offer MW
 - Offer Price*
 - Self-Scheduled MW
 - Spin Max
- *subject to intraday offer rules

Data submitted to Markets Gateway

Synchronized Reserve Timing

- A forward commitment for some reserve resources and all regulation resources will be posted 30 minutes prior to the operating hour
 - Synchronous Condensers and Demand Response resources will be considered “inflexible” units and committed on a forward basis

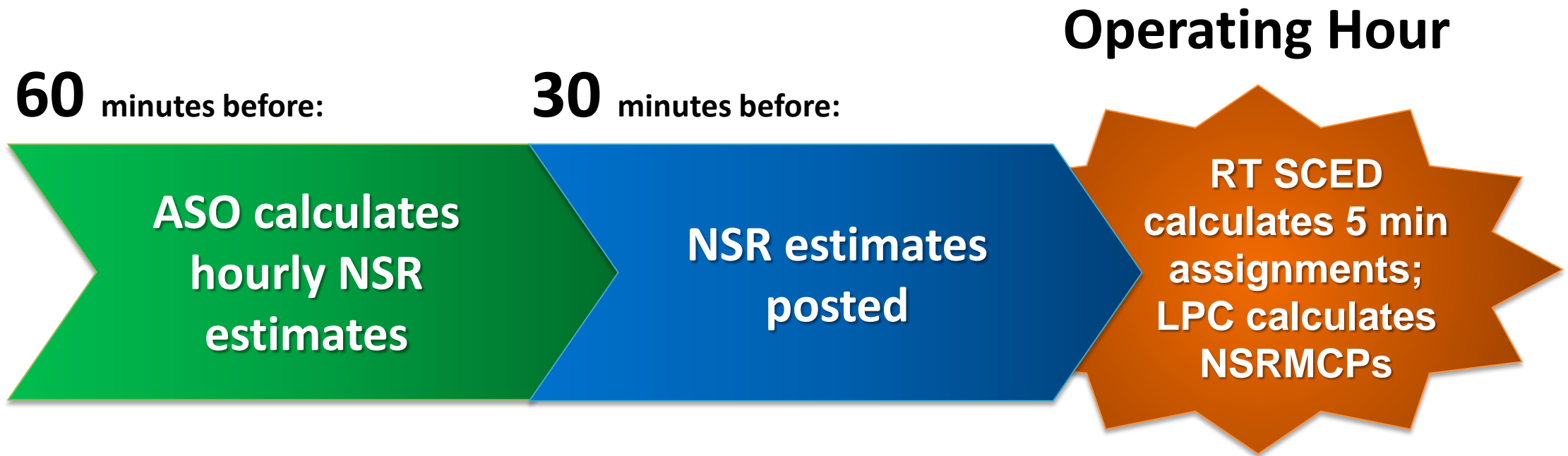


*Ancillary Service Optimizer

Synchronized Reserve Results Posting

What	Frequency	Location	When
Preliminary Tier 1 Estimate	Hourly	Markets Gateway	30 min prior to top of hour
Inflexible Tier 2 Assignment	Hourly	Markets Gateway	30 min prior to top of hour
Flexible Tier 2 Assignment	Every 5 minutes	ICCP link	Every 5 min
Clearing Price	Every 5 min	Data Viewer	Every 5 min

Non-Synchronized Reserve Timing



Non-Synchronized Reserve Results Posting

What	Frequency	Location	When
Preliminary Estimate	Hourly	Markets Gateway	30 min prior to top of hour
Assignment	Every 5 minutes	ICCP link	Every 5 min
Clearing Price	Every 5 minutes	Data Viewer	Every 5 min

Must Offer Requirement

- A must offer requirement is applied to the Synch Reserve and Non-Synchronized Reserve Markets
- Implicit must offer requirements are already built into the design of Tier 1 Synch Reserve and NSR
 - All online generation resources following PJM's dispatch and operating below eco max are automatically considered in the commitment of Tier 1 resources
 - All available offline generation capable of providing energy within 10 minutes are automatically considered in the commitment of NSR

Must Offer Requirement

- Must offer requirement for Tier 2 Synch Reserve resources
 - All non-emergency capacity resources available to provide energy and capable of providing synchronized reserves must submit offers for Tier 2 Synchronized Reserves
 - Applies only during periods for which PJM has issued a Primary Reserve Warning, Voltage Reduction Warning or Manual Load Dump Warning
 - Penalty for violating the must offer requirement is referral to the Market Monitor, similar to the day-ahead must offer requirement for capacity generation resources

Non-Synchronized Reserve Offers

- The Non-Synchronized Reserve Market is a cost-based market
- Being off-line and available within 10-minutes as a part of economic dispatch does not entail a cost, therefore:
 - No explicit offer is entered in Markets Gateway
 - All eligible resources will be considered to have an offer of \$0/MWh
 - The NSR MW available from each resource will be calculated based on:
 - Startup and Notification Time from lesser of cost schedule and price schedule
 - Economic Minimum
 - Synch Reserve Ramp Rate, or energy ramp rate in absence of a synch reserve ramp rate
- No Three Pivotal Supplier test - already a cost-based market

Managing Synchronized Reserve Data

The following Markets Gateway pages are used to manage the Synchronized Reserve Offers:

- **Unit Detail** - use this web page to enter Synchronized Reserve maximum limit for Tier 1 resources
- **Synchronized Reserve Offers** - use this web page to create Synchronized Reserve offers for Tier 2 resources and modify the status of the Synchronized Reserve offer
- **Synchronized Reserve Updates** - use this web page to modify synchronized reserve resource availability, prices and parameters on an hourly basis (up to 65 minutes before the top of the hour)
- **Synchronized Reserve Bilaterals** - use this web page to facilitate a Synchronized Reserve bilateral transaction

Questions?

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