Item 6: Real-Time Co-optimization (RTC) Update

Kenan Ögelman
Vice President, Commercial Operations

Kristi Hobbs
Vice President, Corporate Strategy and PUCT Relations

Reliability and Markets Committee Meeting

ERCOT Public
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Overview

- **Purpose**
  - Provide a brief overview of the market design concept and benefits of Real-Time Co-optimization (RTC)
  - Describe the program implementation path forward

- **Voting Items / Requests**

  No action is requested of the R&M Committee or Board; for discussion only

- **Key Takeaways**
  - General understanding of the market design and operational benefits of RTC
  - Insight into the costs, timing, and risks for delivering RTC
  - Primary risk is maintaining staff availability without interruption during this 3+ year effort

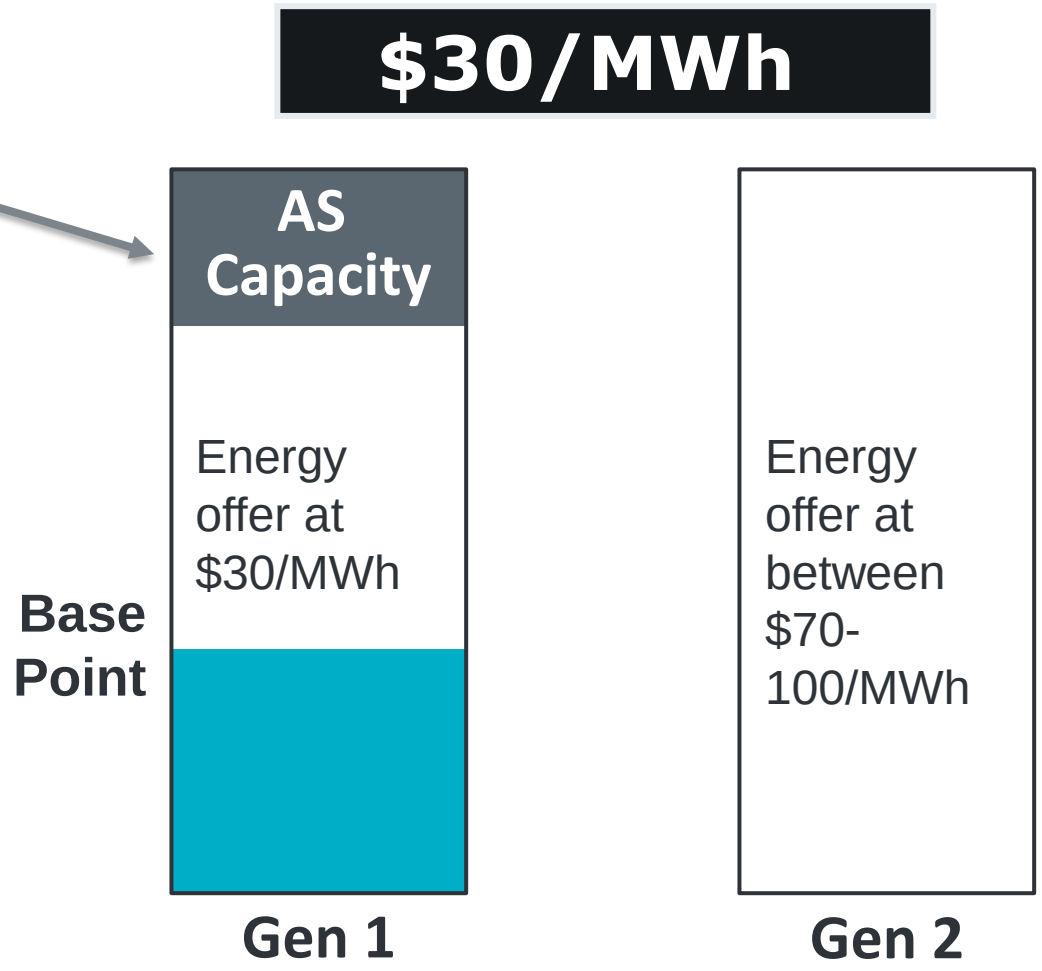
Real-Time Co-optimization

- Real-Time Co-optimization (RTC) is a key market design feature that has been in place at most other Independent System Operators (ISOs) in North America
- RTC has been on ERCOT's market design and policy radar for over 10 years
- Due to the complexity of implementation, RTC has struggled to find the timing and resources for delivery
- ERCOT is positioned to begin work on July 1, 2023

The current Real-Time Market (RTM) is only designed to find the most effective set of Resources for providing energy (but not AS)

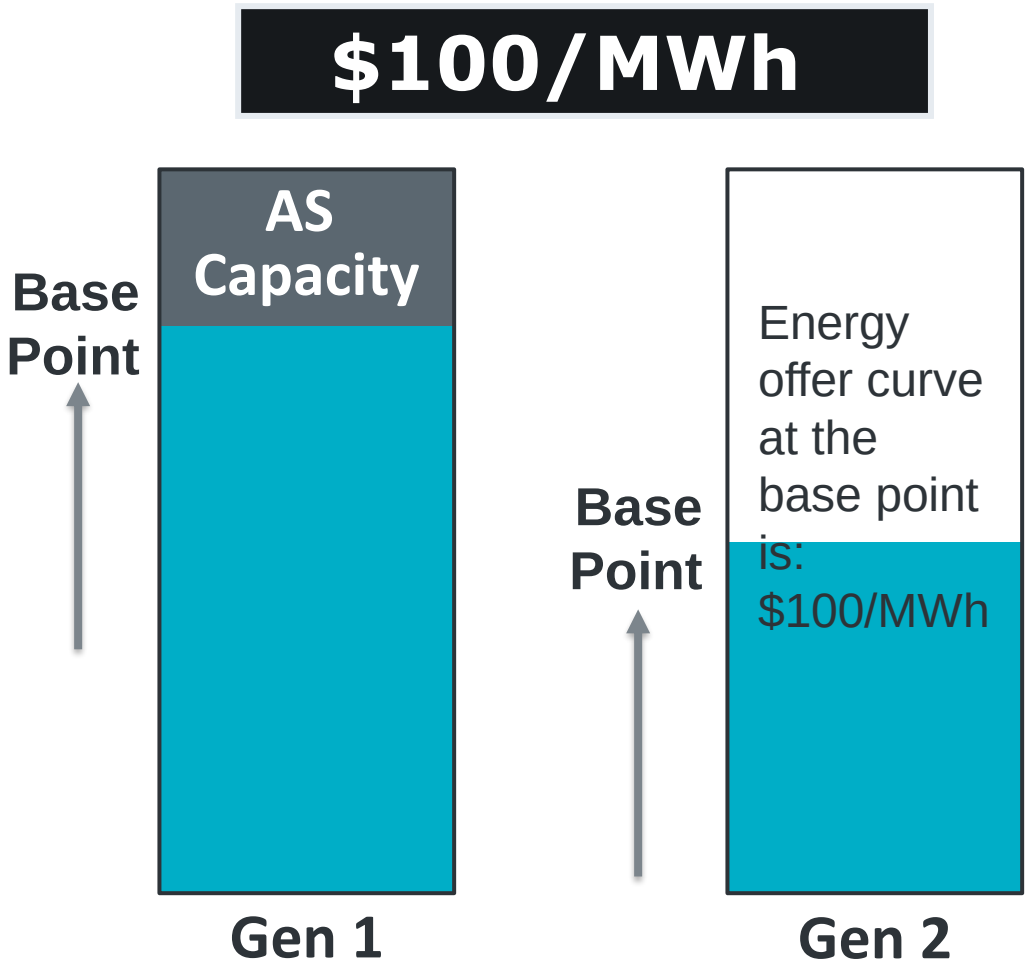
The placement of AS on Resources across the ERCOT System is assumed

- **Key Takeaway**
  - The current market design locks Ancillary Service (AS) capacity as it is awarded in the Day-Ahead



This limits the ability of the RTM to meet both energy and AS needs in the most economic way

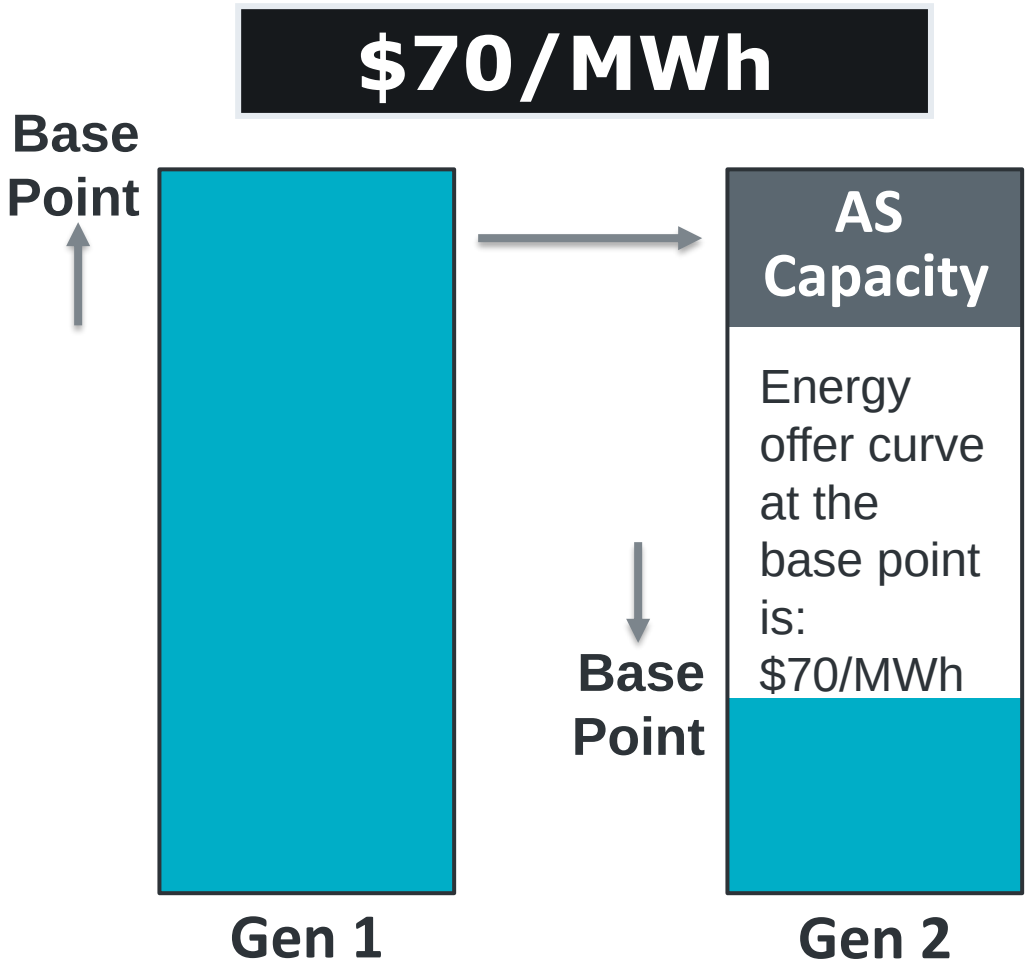
As demand increases, ERCOT eventually runs out of less expensive, unreserved capacity, and moves to more expensive alternatives



However, RTC is designed to find the most effective set of Resources for providing energy and AS

What if…We could keep producing energy from cheaper Resources and shift the AS to more expensive resources?

- **Key Takeaway**
  - Allowing ERCOT to optimize energy and ancillary services in real-time increases the efficiency of system dispatch



Real-Time Co-optimization

- Transitioning to RTC has a ripple effect into other areas of ERCOT's pricing and Operations (more details in the Appendix):

	Current	RTC
Energy procurement Energy price	Day-Ahead & Real-Time DA price & RT Price+ORDC	Day-Ahead & Real-Time DA price & RT Price includes AS scarcity
AS procurement AS price	Day-Ahead only DA AS price	Day-Ahead & Real-Time DA AS price & RT AS price
If change in AS (depletion, increase, not deliverable)	Operator initiates procurement process with 2-hour lead time	Automatic Real-Time procurement of AS every 5 mins.
Reliability Unit Commitment	Study/commit resource capacity limited by QSE managed AS	Study/commit full resource capacity
Secondary Ancillary Service Market	Utilized when sufficient AS is not procured in the DA market	Not needed. Which reduces risk to the market

DA: Day Ahead
RT: Real-Time
AS: Ancillary Services
ORDC: Operating Reserve Demand Curve (price adder)

Operational Benefits of RTC

- The reliability benefits of RTC derive from our ability to:
  - Replace and replenish Ancillary Services every 5 minutes;
  - Effectively manage Resource-specific capabilities that can change rapidly and significantly in Real-Time and the hours leading up to Real-Time;
    - This includes Energy Storage Resources (ESRs), but is applicable to all Resource types (thermal, renewable, and demand-side Resources).
  - Dynamically adjust Ancillary Service quantities all the way up to Real-Time as uncertainties on the grid change over the day;
  - Better manage and reduce transmission congestion without sacrificing on our Ancillary Service needs;
  - Prioritize Ancillary Services to preserve the most critical capacity (i.e., capacity that can respond to frequency deviations) in cases where grid conditions become scarce; and
  - Automate many process that must be managed manually by Control Room staff today.

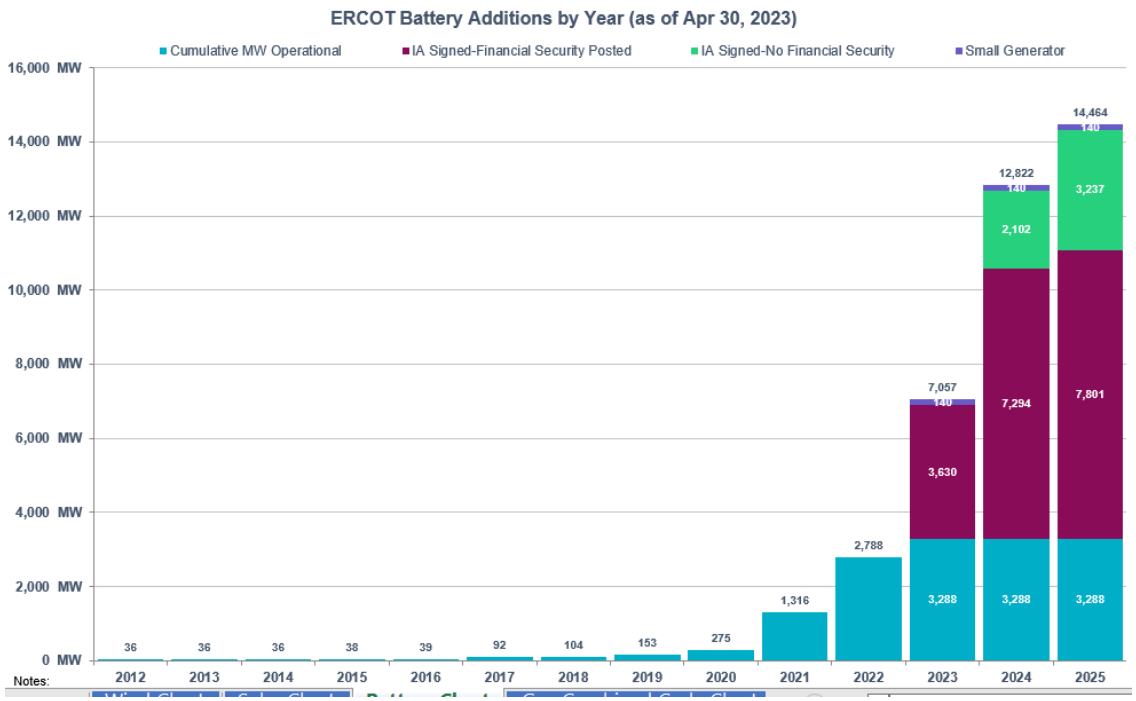
ERCOT study of operational improvements and other benefits associated with RTC

Economic Benefits of RTC

- These reliability benefits also equate to economic benefits for the end-use customer.
- The Independent Market Monitor (IMM) released a report in 2018 that included its evaluation of the impacts of RTC on the ERCOT market.
- Using 2017 as their simulated operating year, they found:
  - A **$1.6 billion** reduction in total energy costs, which equates to a ~$4/MWh reduction in price;
  - An **$11.6 million** reduction in production costs to serve load;
  - An improvement in reliability due to a reduced overloading of transmission constraints and a reduced use of the Regulation Up Ancillary Service equating to **$4.3 million**;
  - A **$257 million** reduction in congestion costs; and
  - A **$155 million** reduction in Ancillary Service costs.
- As with the reliability benefits, these cost benefits are also likely increasing over time.

Additional Scope to RTC Program

- In considering implementation of RTC in the coming years, the proliferation of batteries needs to be addressed, which is growing to over 14GW in 2025
- As RTC will touch almost every major system in ERCOT, battery functionality will be addressed and included with this effort.
- Program spans across departments and shared by many VPs with the following scope:
  - RTC (NPRR1007-1013)
  - Single Model Batteries (NPRR1014)
  - State of Charge modeling in SCED and RUC (NPRR drafted for June market discussion)



Implementation of RTC

- ERCOT has developed an Impact Analysis for a program to deliver:
  - RTC (NPRR1007-1013), Single Model Batteries (NPRR1014), State of Charge modeling in SCED and RUC
- The overall program will cost approximately $50M, with a go-live in 2026 between major releases of EMS and MMS
- Key delivery areas have been reviewed for major resource risk
  - Initial focus: July 2023-April 2024 (project planning phase)
  - Per our usual process, a revised cost estimate and timeline is produced when project planning is complete
  - Teams are very busy with other critical efforts but most of the RTC planning work can be accommodated within available capacity
  - There are areas of concern, but these over-allocations are still being worked on

- **Key Takeaway**
  - Primary risk is maintaining staff availability without interruption during this 3+ year effort

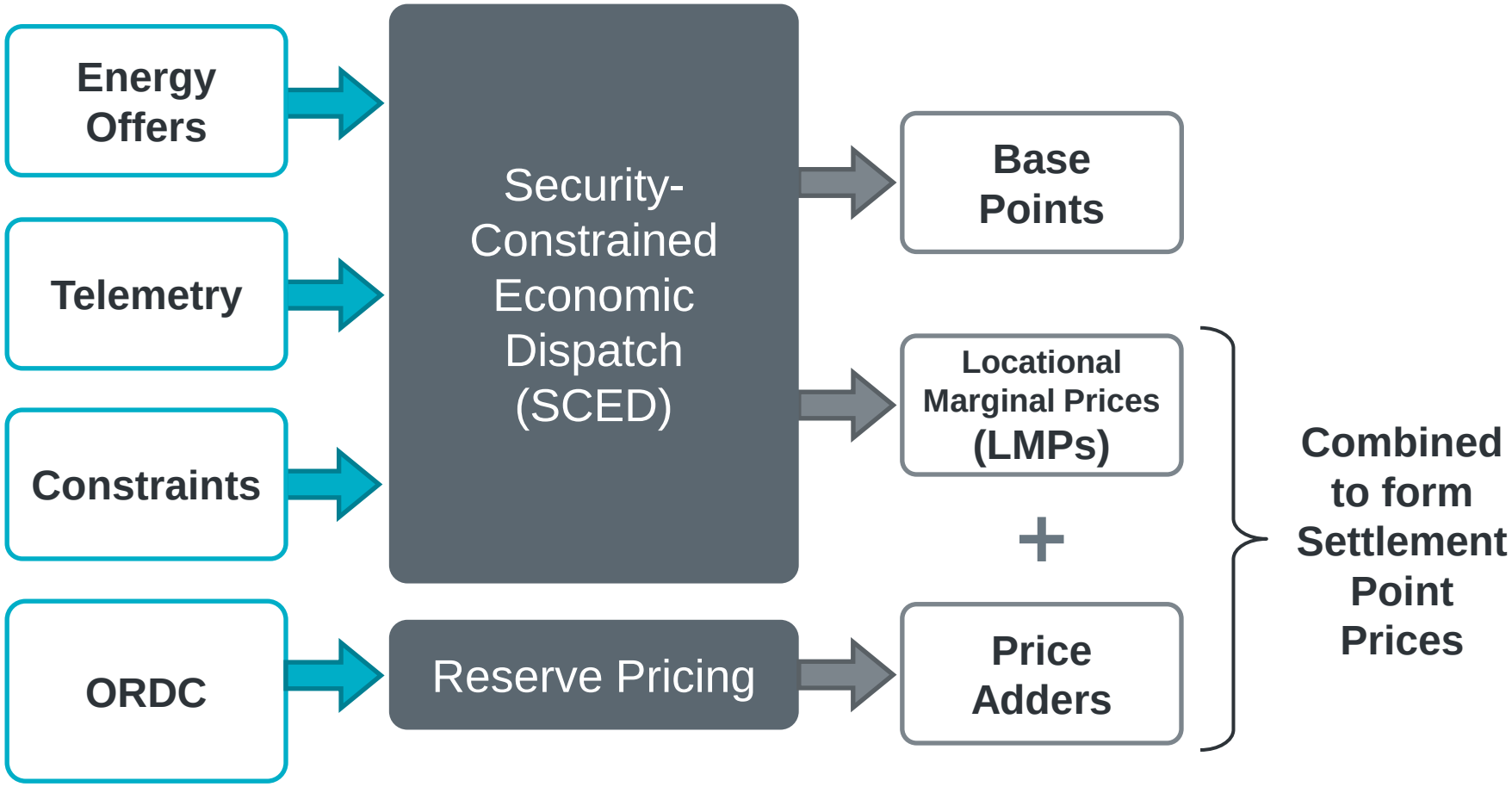
Next Steps

- ERCOT has already initiated the RTC Program Control project
- Program is re-starting with business requirements July 1, 2023
- Delivery window is targeted for 2026
- Each Board meeting will include updates on the RTC Program schedule and risk as the program progresses from initiation, to planning, and into the execution phase

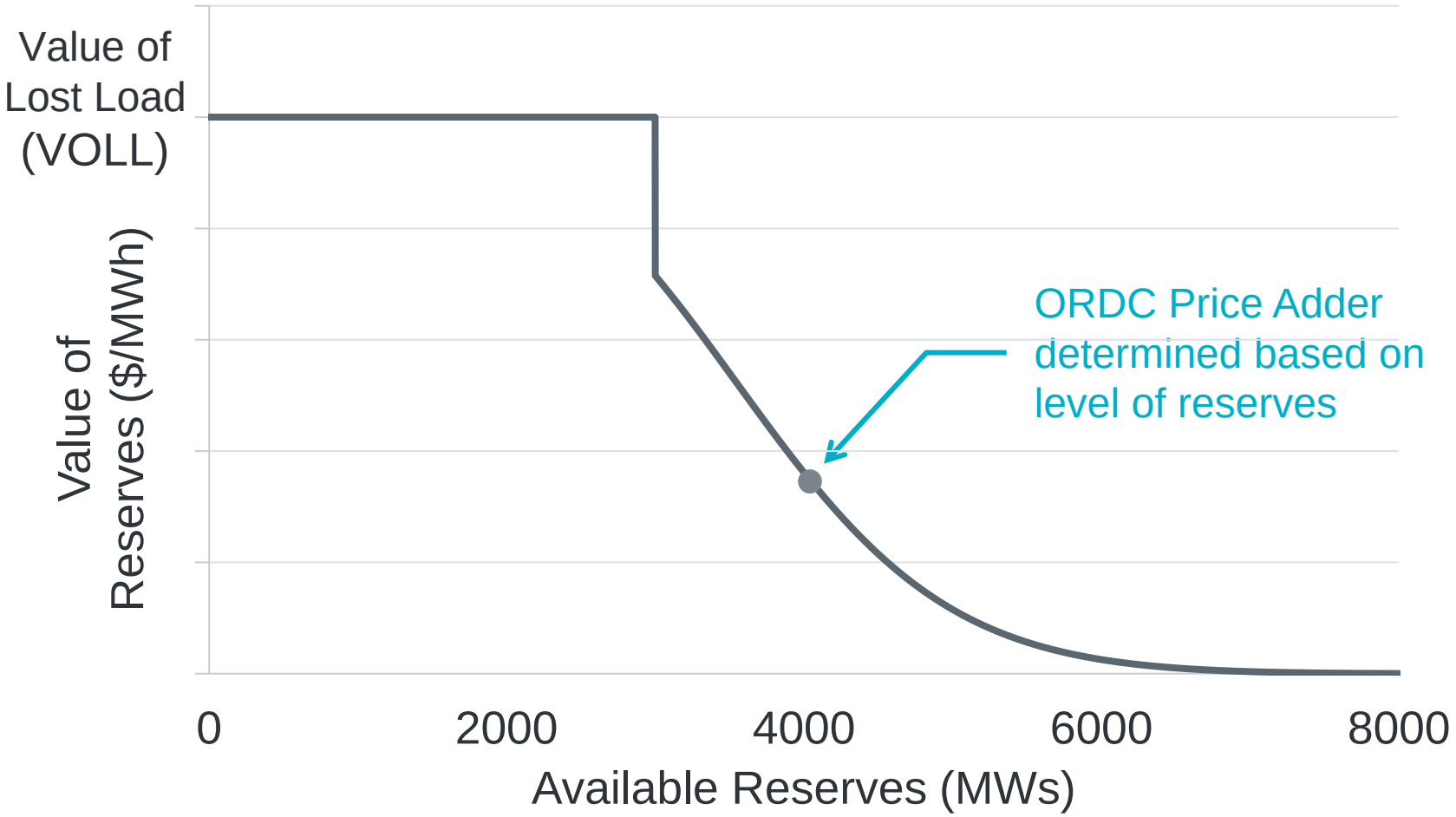
Appendix

- Educational material on the mechanics of Real-Time Co-optimization of energy and Ancillary Service in ERCOT

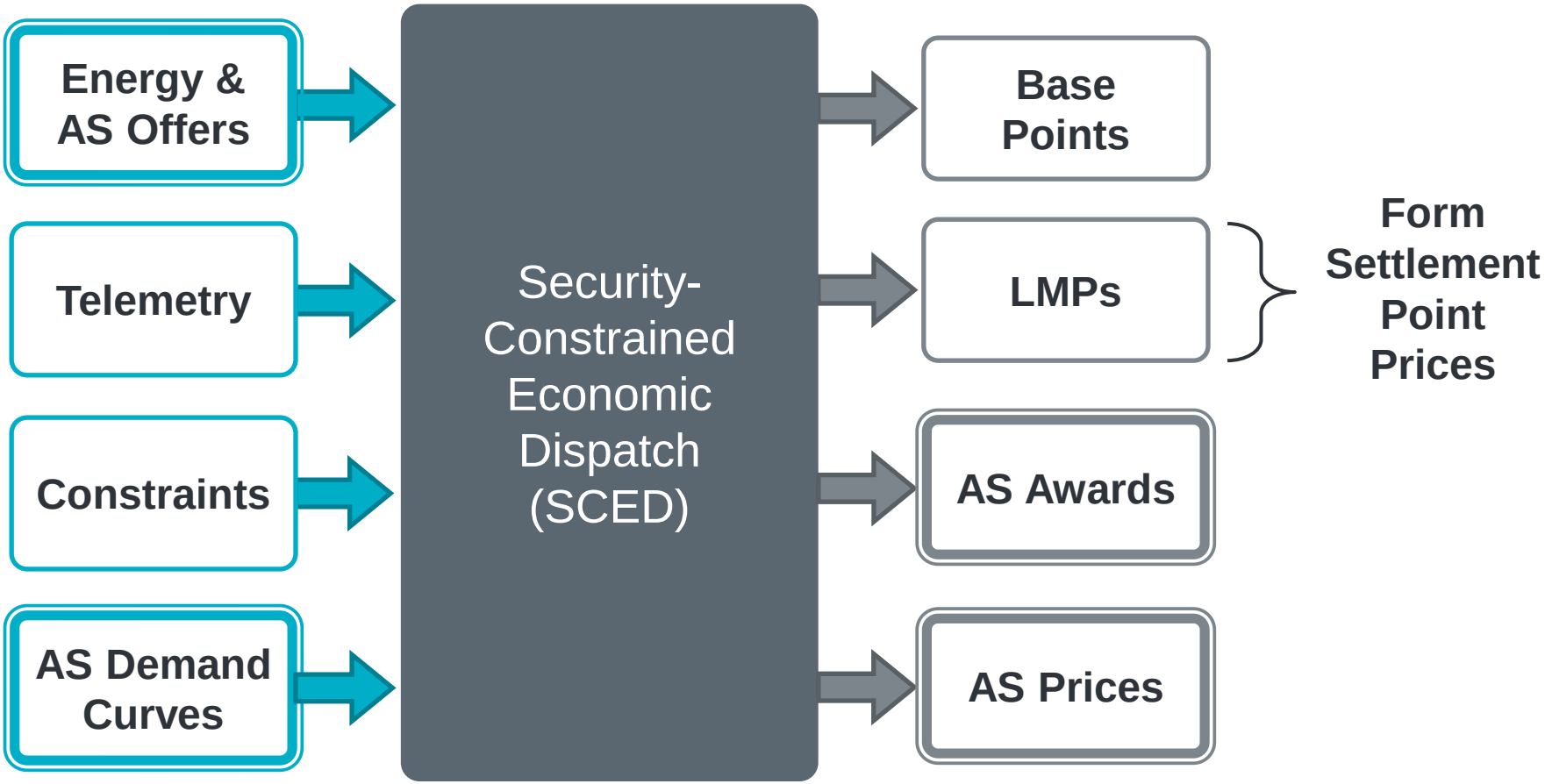
Today's market is designed to reflect scarcity through a process that is outside of the optimization



The ORDC sets the value of ERCOT System reserves



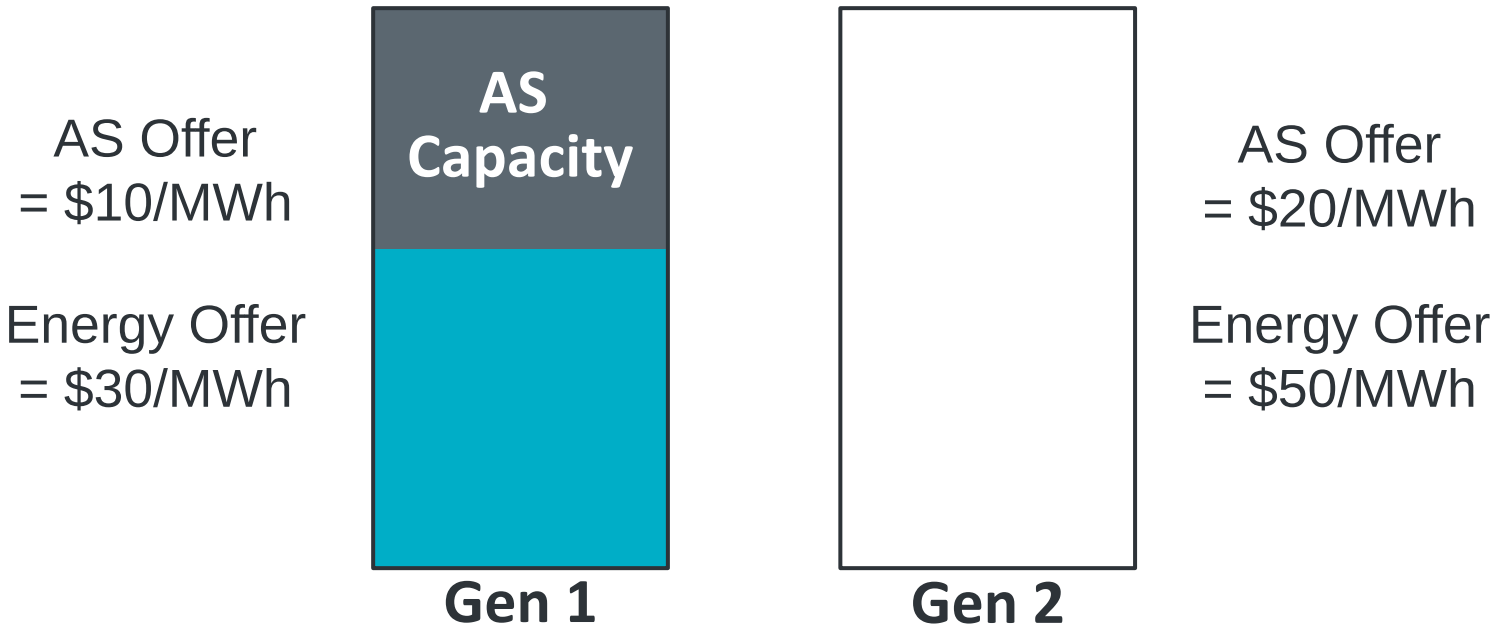
RTC is also designed to reflect scarcity, but now it occurs within the optimization



Unlike today's market, the cost of AS is factored directly into LMPs

Today, the need for an additional MWh of energy results in the price of energy (i.e., the LMP) going from $30/MWh to $50/MWh

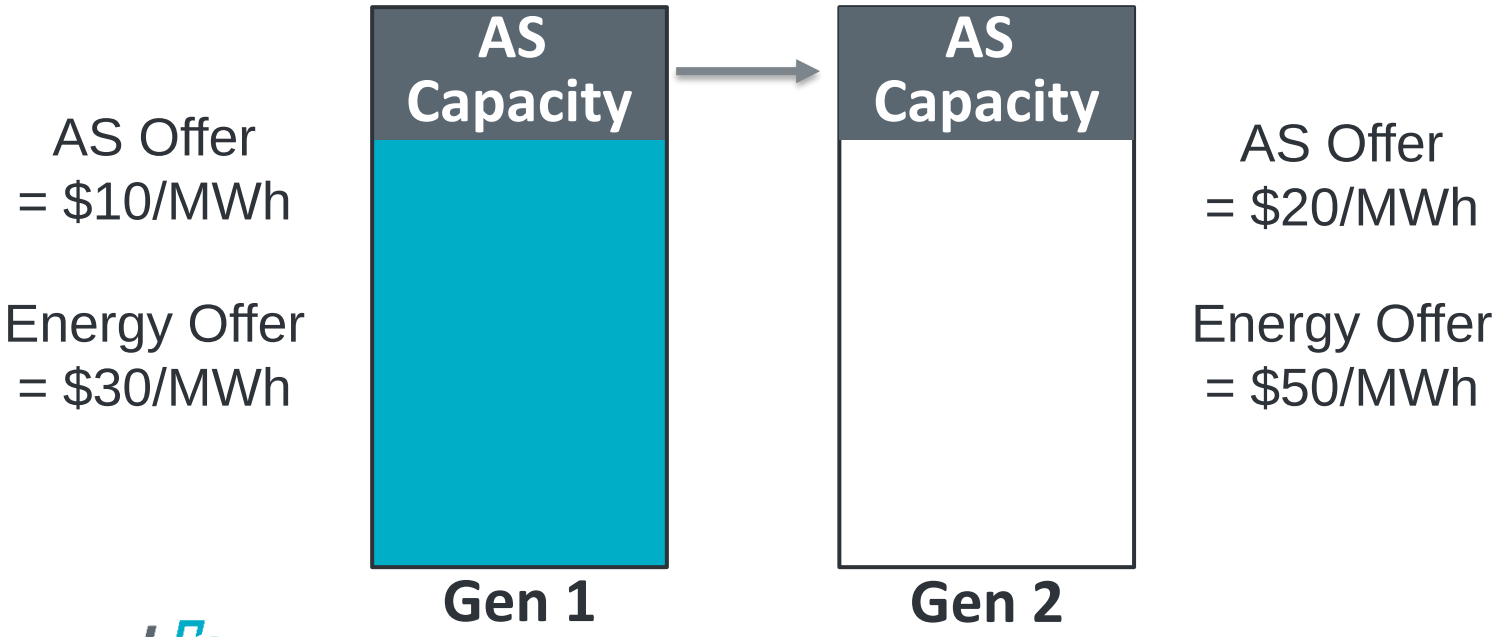
- The next MW would come from Gen 2



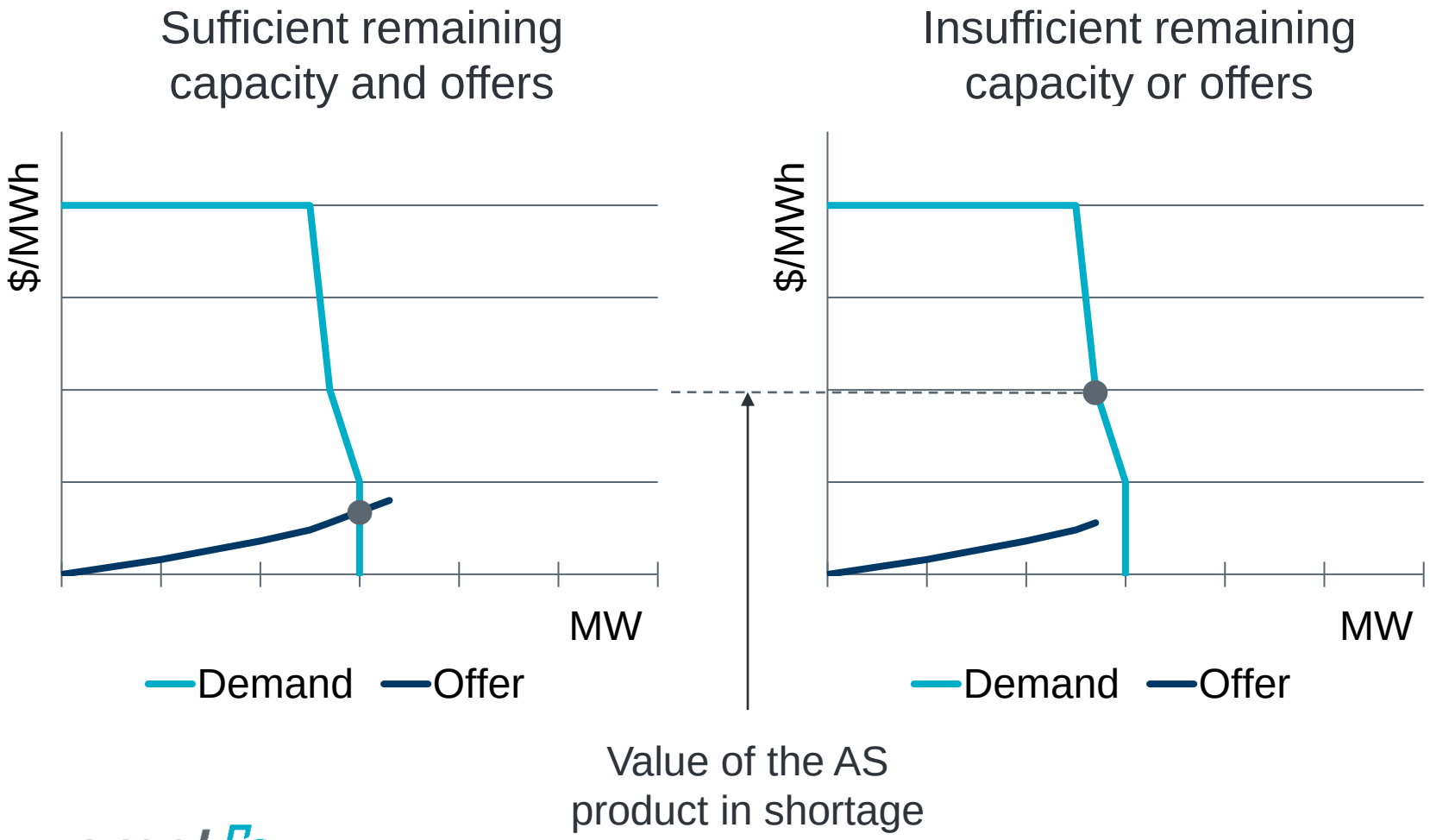
Unlike today's market, under RTC the cost of AS is factored directly into LMPs

Example: With RTC, AS can be reallocated to access cheaper energy from Gen 1. However, this has the effect of increasing AS cost.

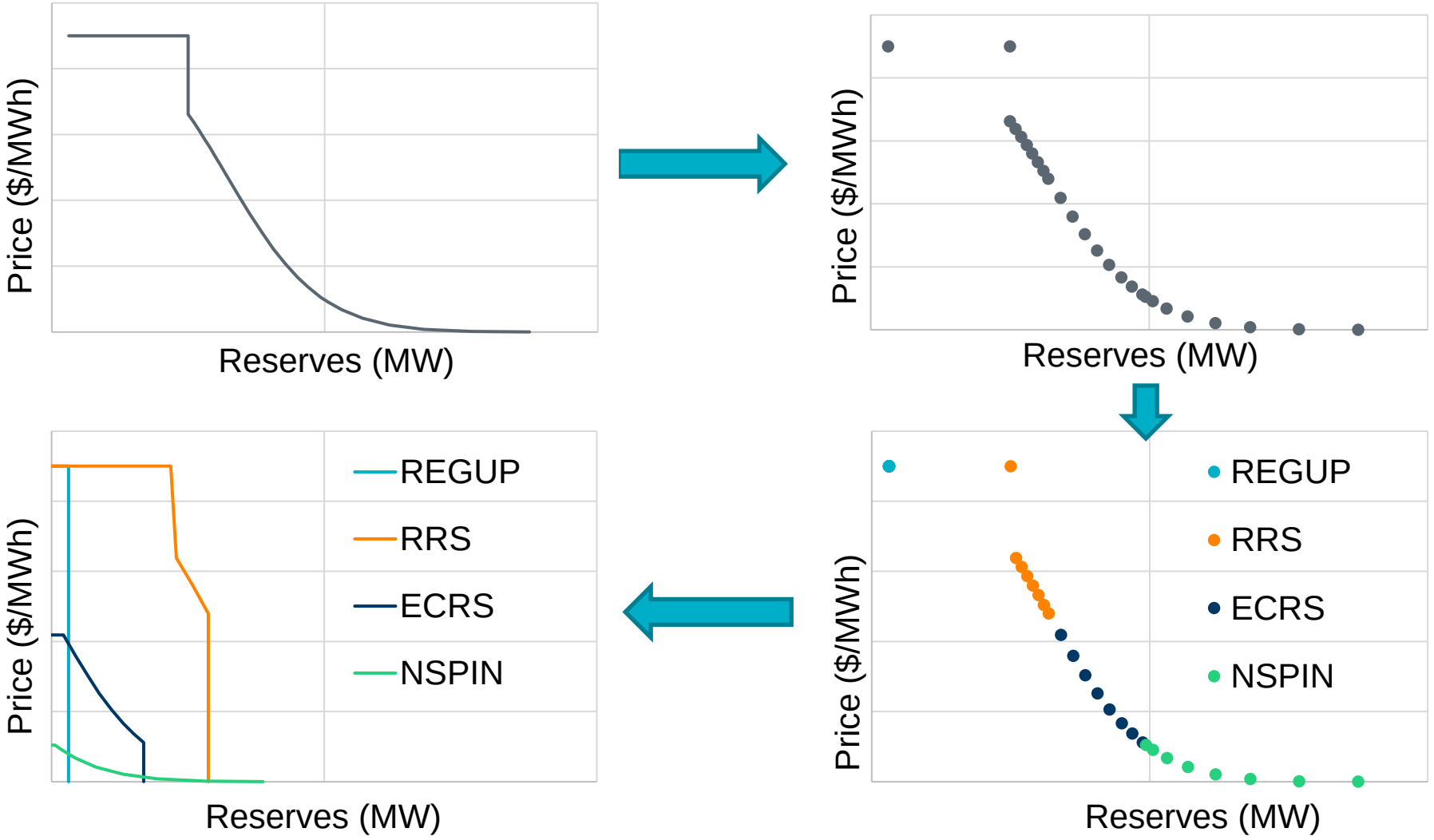
- This means the LMP goes to $40/MWh ($30/MWh for the energy from Gen 1 plus the $10/MWh of additional AS cost)
  - AS Price: $10/MWh → $20/MWh



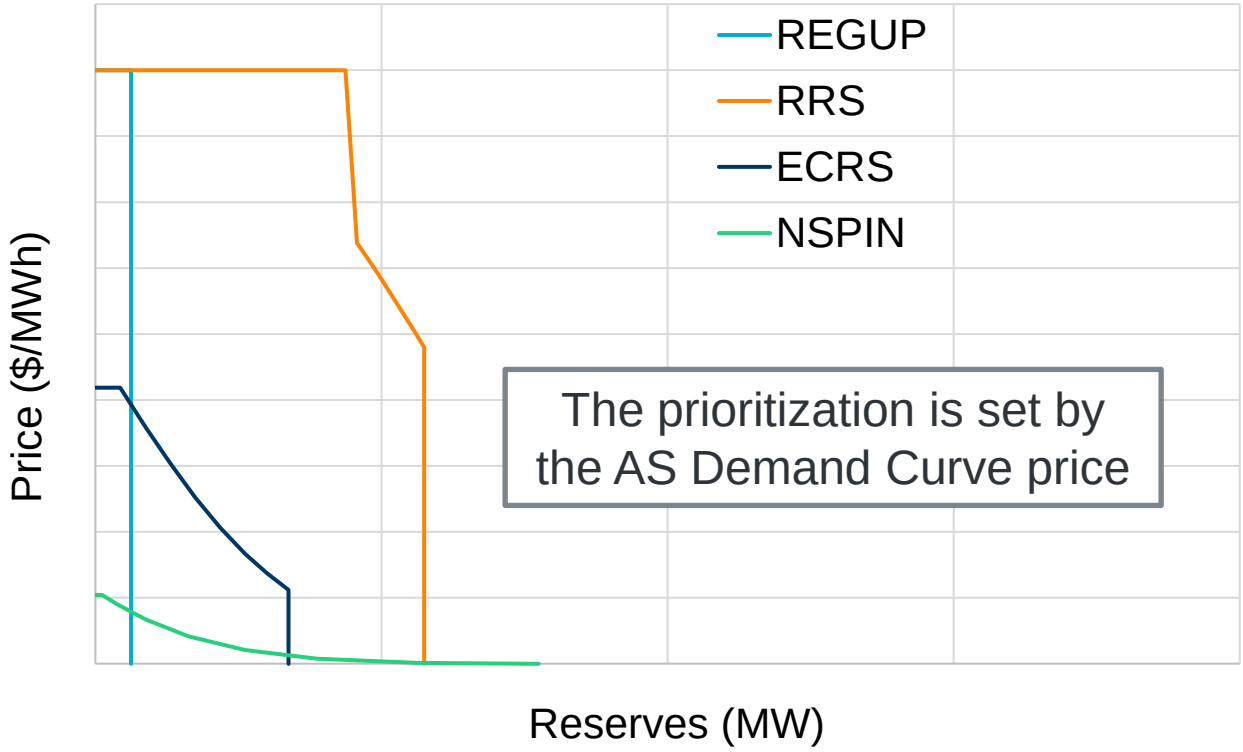
Instead of using the ORDC, under RTC, scarcity pricing and the value of reserves is set by individual AS Demand Curves (ASDCs)



ASDCs will be based on the shape and pricing outcomes of the current ORDC mechanism

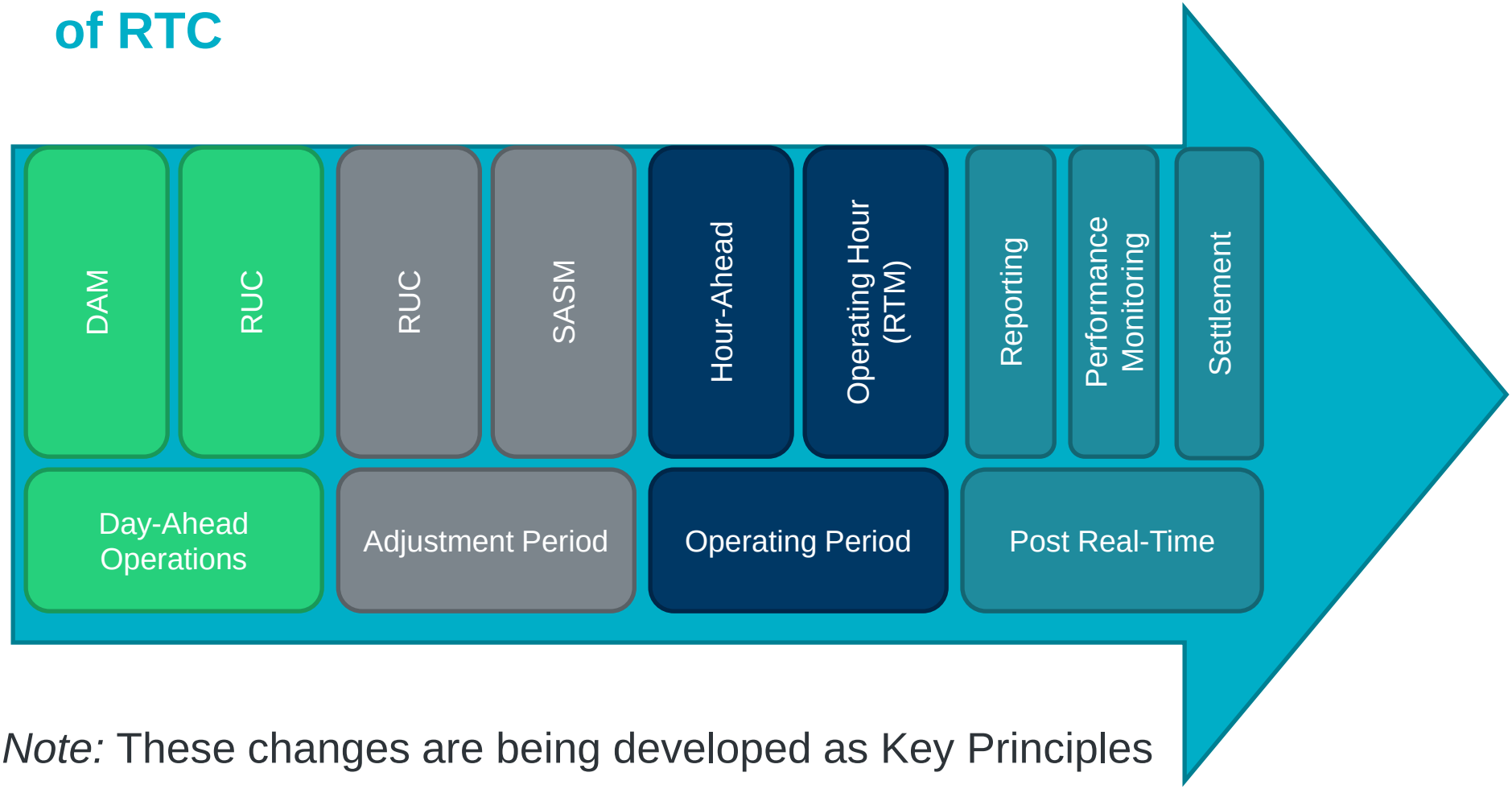


Having individual ASDCs allows RTC to better distinguish and prioritize between various AS products



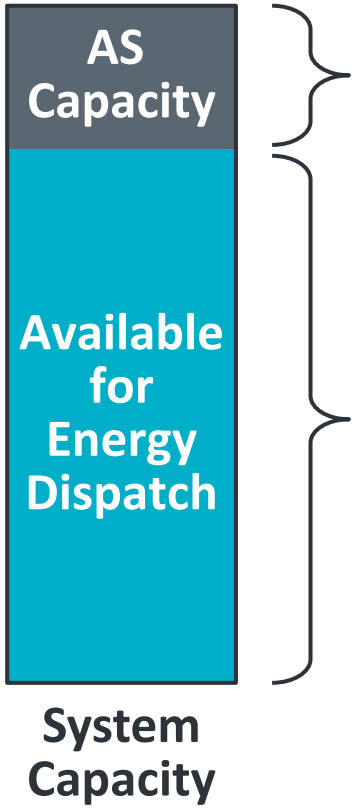
Note: Non-Spinning and ERCOT Contingency Reserve Service (NSPIN and ECRS) will be fully exhausted before Regulation Up and Responsive Reserve Service (REGUP and RRS) are fully exhausted

While the primary focus is the RTM, changes to other parts of the wholesale market must be reviewed as part of RTC



Note: These changes are being developed as Key Principles

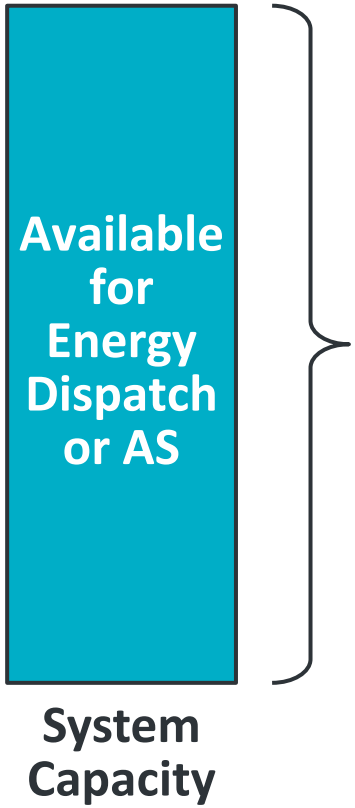
Reliability Unit Commitment (RUC), like the RTM, currently takes AS assignment to individual Resources as a known input



AS capacity is assigned to Resources by Market Participants to fulfill AS supply responsibility

RUC attempts to meet forecasted demand and solve transmission congestion with remaining capacity, not reserved for AS

To better reflect and plan for Real-Time grid conditions with RTC, RUC will also be modified to co-optimize energy and AS



RUC attempts to meet forecasted demand, solve transmission congestion, and meet system AS needs using the full capability of Resources planned to be available

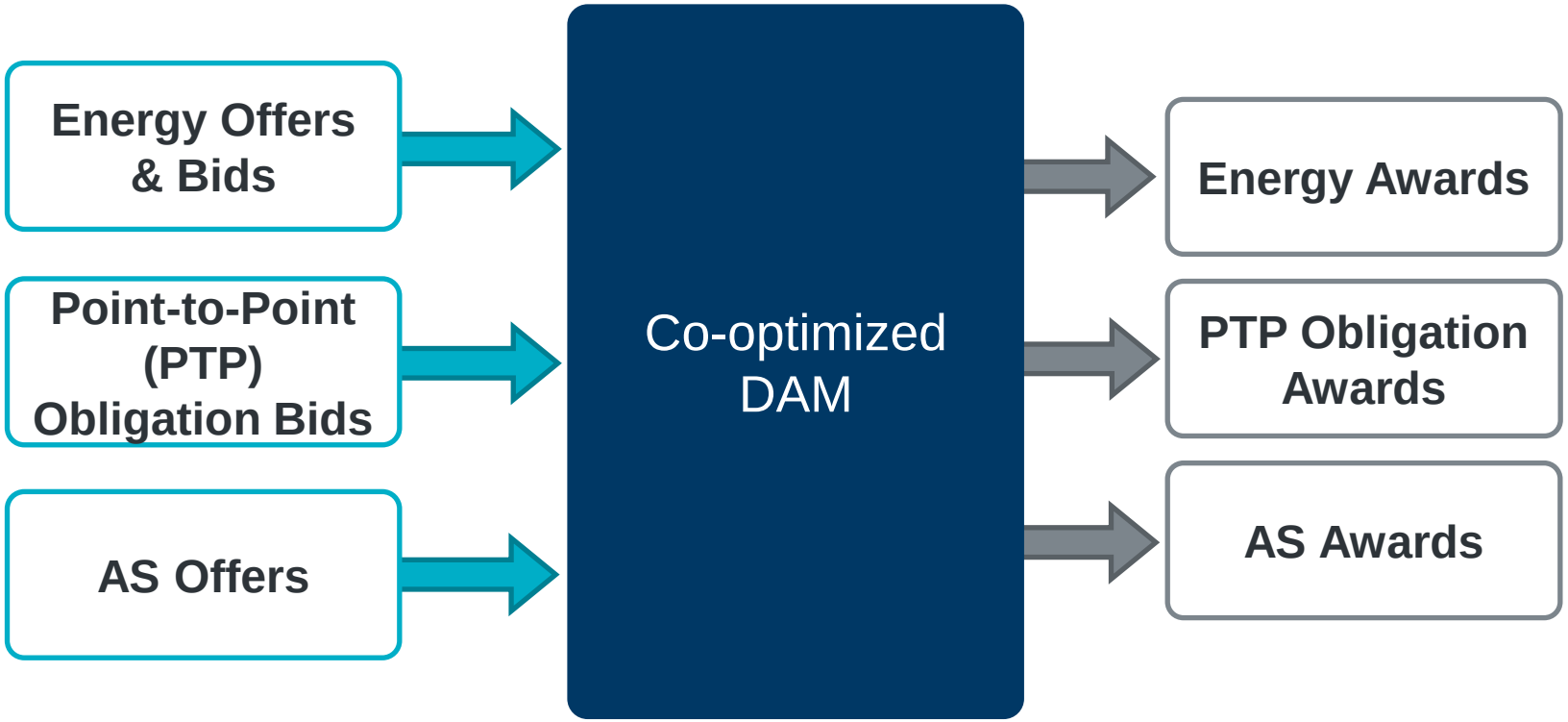
The current Supplemental Ancillary Services Market (SASM) process will be eliminated with the implementation of RTC

SASM allows ERCOT to fill AS gaps that appear after completion of the DAM

1. Failure to provide
2. Infeasible AS capacity
3. More AS capacity needed
4. Insufficient AS offers in DAM

Note: Under RTC, a co-optimized RUC and the RTM fulfill this role

The current DAM fundamentally stays the same with the implementation of RTC



Note: Minor changes to the DAM are under discussion in RTCTF, but the objective remains the same

There are additional downstream system and processes that will need to change

Settlement for all market design and process changes

Monitoring performance with AS awarded in Real-Time

Changes to external-facing reports