Item 7.2: Board Education on Real-Time Co-optimization

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Board of Directors Meeting

ERCOT Public
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Agenda

- Framing the Timeline and Objectives of Real-Time Co-optimization (RTC)
- High-level view of RTC
- Components of the market design that are changing with the implementation of RTC
- Ongoing work at the RTC Task Force (RTCTF)

Framing the Timeline and Objectives of RTC

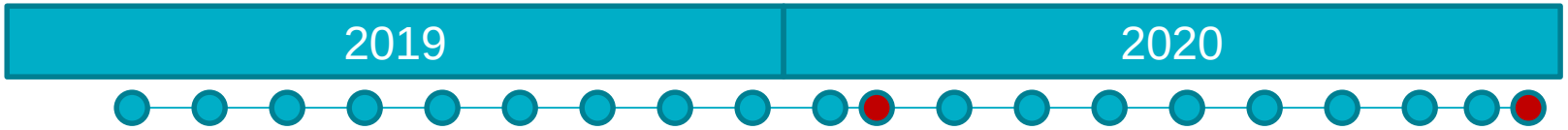
- When ERCOT implemented the Nodal Market in December 2010, RTC was not included in the scope (discussed but out of scope 2005-2006).
- In July 2013, ERCOT provided feedback in PUCT Project 40000 on RTC concept as part of development of the Operating Reserve Demand Curve (ORDC).
- In July 2017, ERCOT provided cost estimate and preliminary schedule for RTC as $40MM and 4-5 years.
- In June 2018, ERCOT and IMM provided studies of the operational improvements and benefits from RTC.
- In January 2019, PUCT gave ERCOT direction to implement RTC with funding from “favorable variances in revenue” for 2018 and 2019.

Framing the Timeline and Objectives of RTC

- Co-optimizing energy and Ancillary Services (AS) in Real-Time (every 5 minutes) will result in:
  - Reduced overall energy and AS costs (per IMM study)
  - More timely and efficient replacement of AS in Real-Time
  - Less Reliability Unit Commitments
  - Reduction in manual operator actions
  - More effective congestion management
- ERCOT's Day-Ahead Market (DAM) already co-optimizes energy and AS
- Most other Independent System Operators (ISOs) have some form of RTC

Framing the Timeline and Objectives of RTC

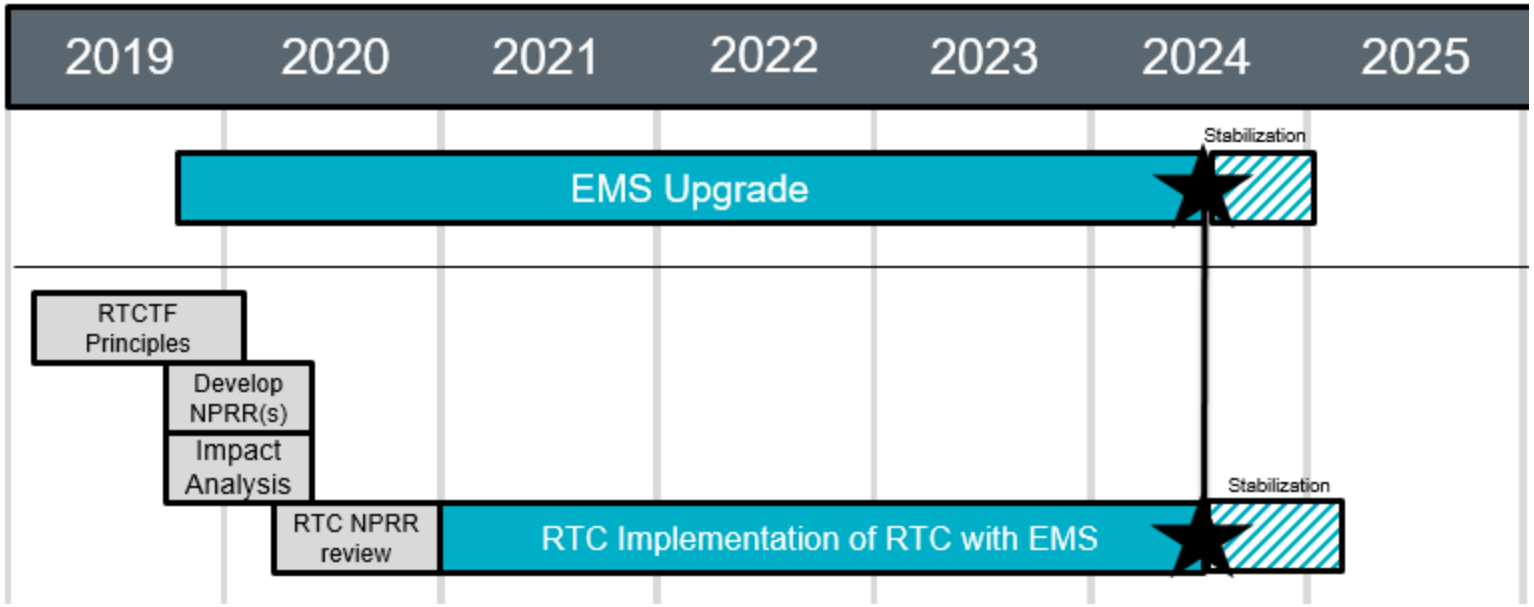
- With the direction from the PUCT in January 2019, the following activities are in-flight to align stakeholder scope by end of 2020:



- March 2019 - TAC created the RTCTF (meets every 3-4 weeks)
- April-December 2019 - ERCOT releases draft of “Key Principles” for RTC design
- July 2019 - January 2020 TAC consideration of Key Principles
- February 2020 - Board consideration of Key Principles
- April 2020 - ERCOT draft RTC NPRRs and Impact Analyses (IAs) posted for PRS review
- April-November 2020 - RTCTF consideration of any comments to RTC NPRRs
- November 2020 - PRS/TAC consideration of RTC NPRRs
- December 2020 - Board consideration/approval of NPRRs

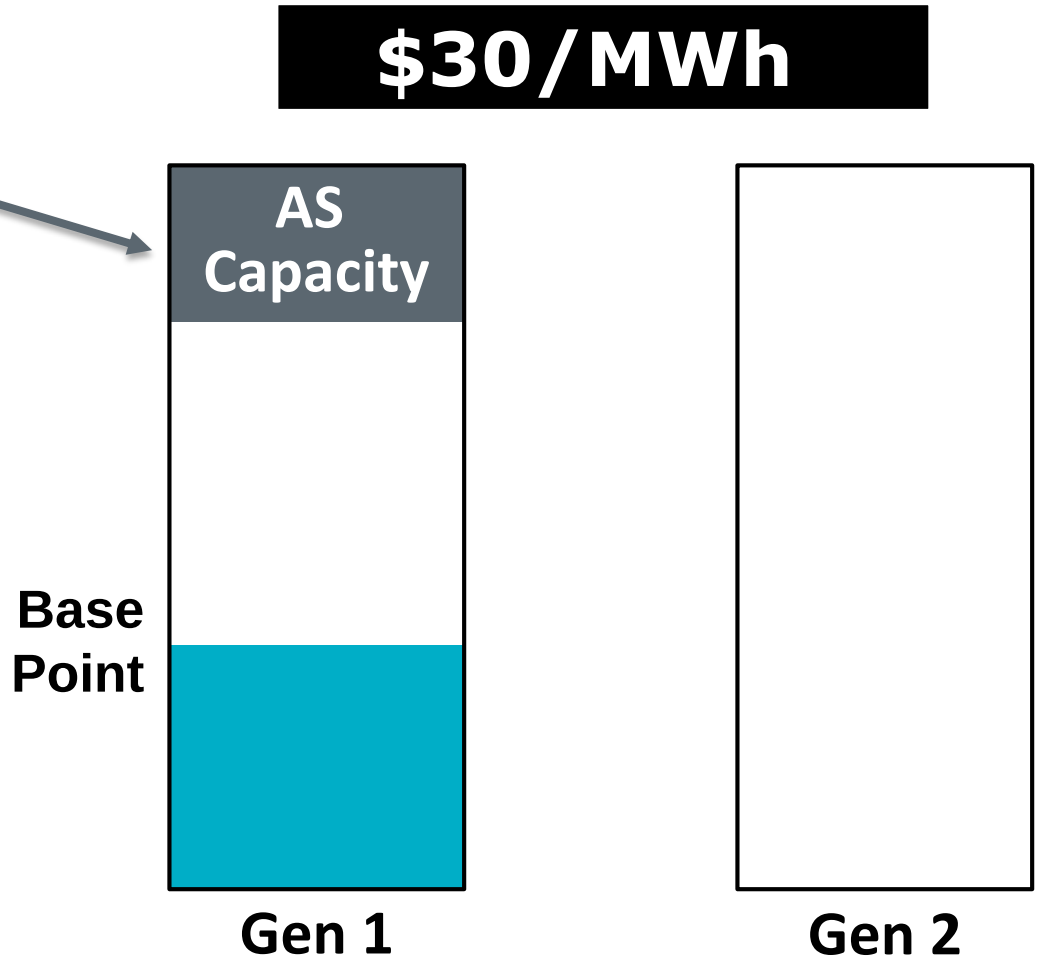
Framing the Timeline and Objectives of RTC

- Upon Board approval, ERCOT will initiate the RTC project with the current go-live target of mid-2024 with EMS upgrade.
- Current RTC 3.5 year estimate based on 2017 filing at PUCT (Project No. 41837), which included details regarding RTC development, integration, market trials, and cut-over.



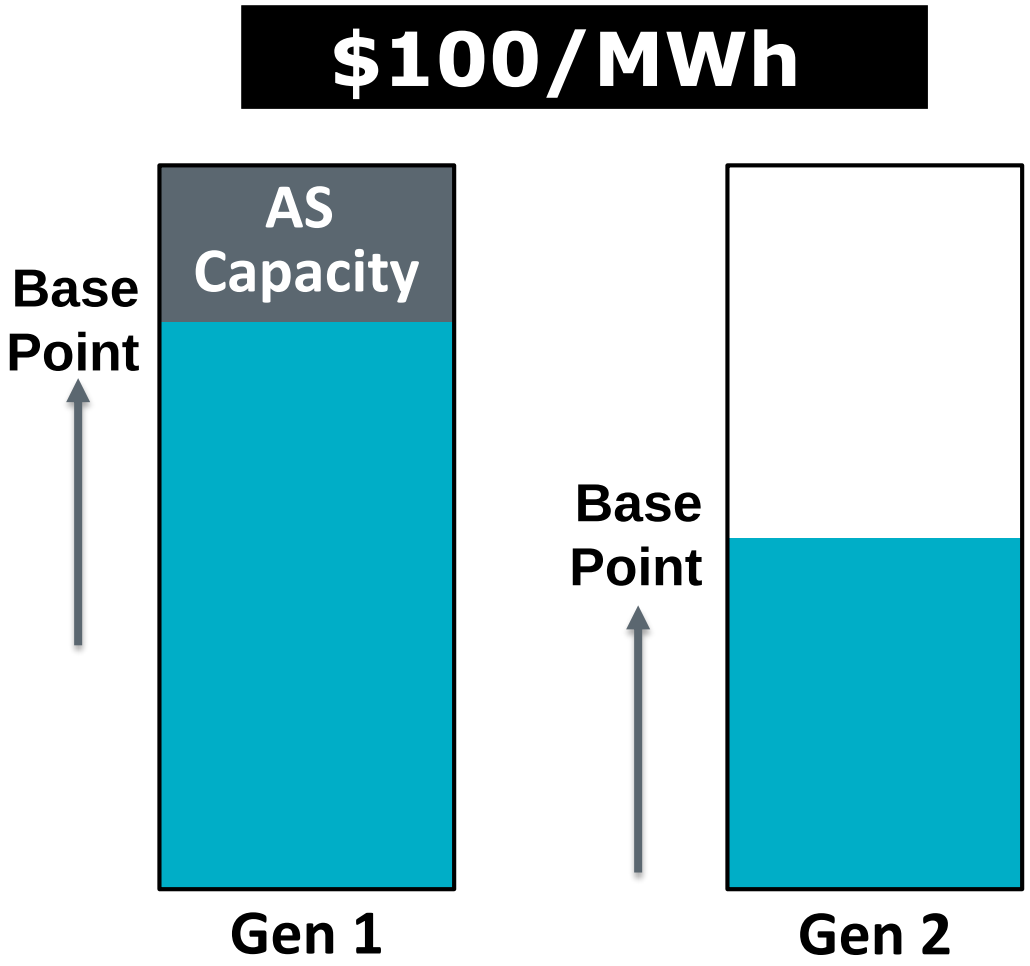
The current Real-Time Market (RTM) is only designed to find the most effective set of Resources for providing energy

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



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

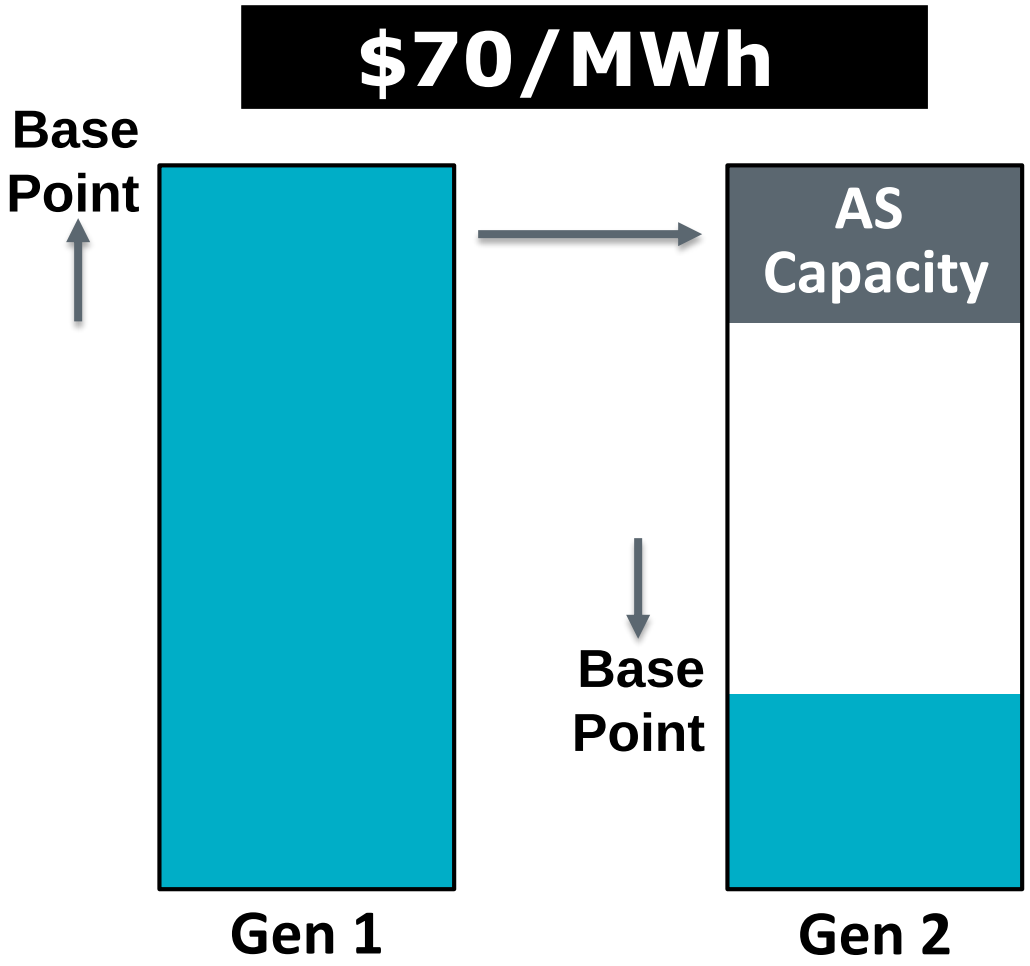
We eventually run out of less expensive, unreserved capacity, and move to more expensive alternatives



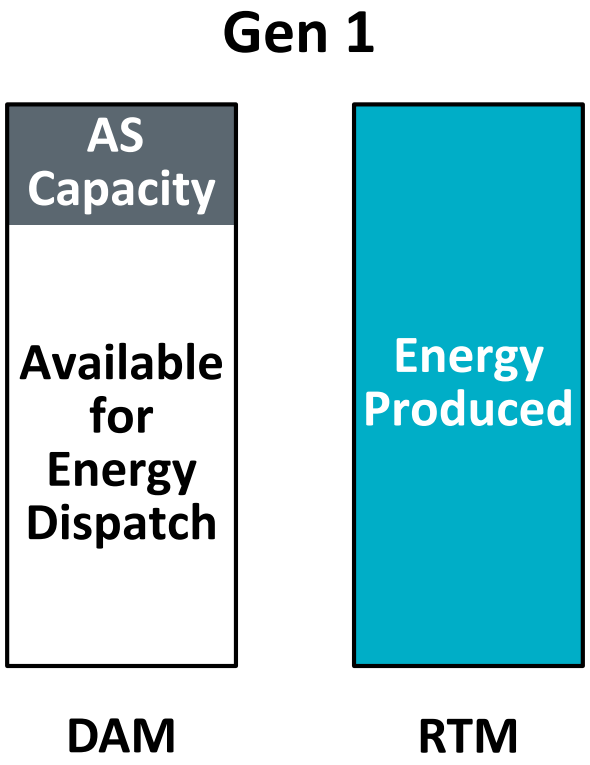
However, RTC is designed to find the most effective set of Resources for providing energy and AS

What if…

- We could keep producing energy from cheaper Resources?
- We could shift the AS to more expensive Resources?



This movement of AS is then settled out through imbalances in Real-Time



QSE Real-Time Settlement:

- Paid for energy produced in Real-Time based on the Real-Time energy price
- Charged an imbalance for the AS capacity based on a Real-Time AS price

Note: RTM Settlement does not affect DAM Settlement

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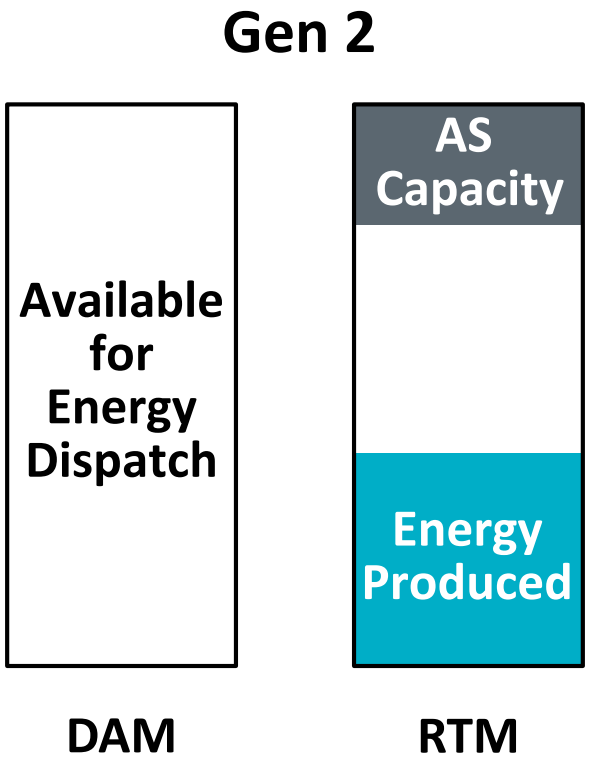

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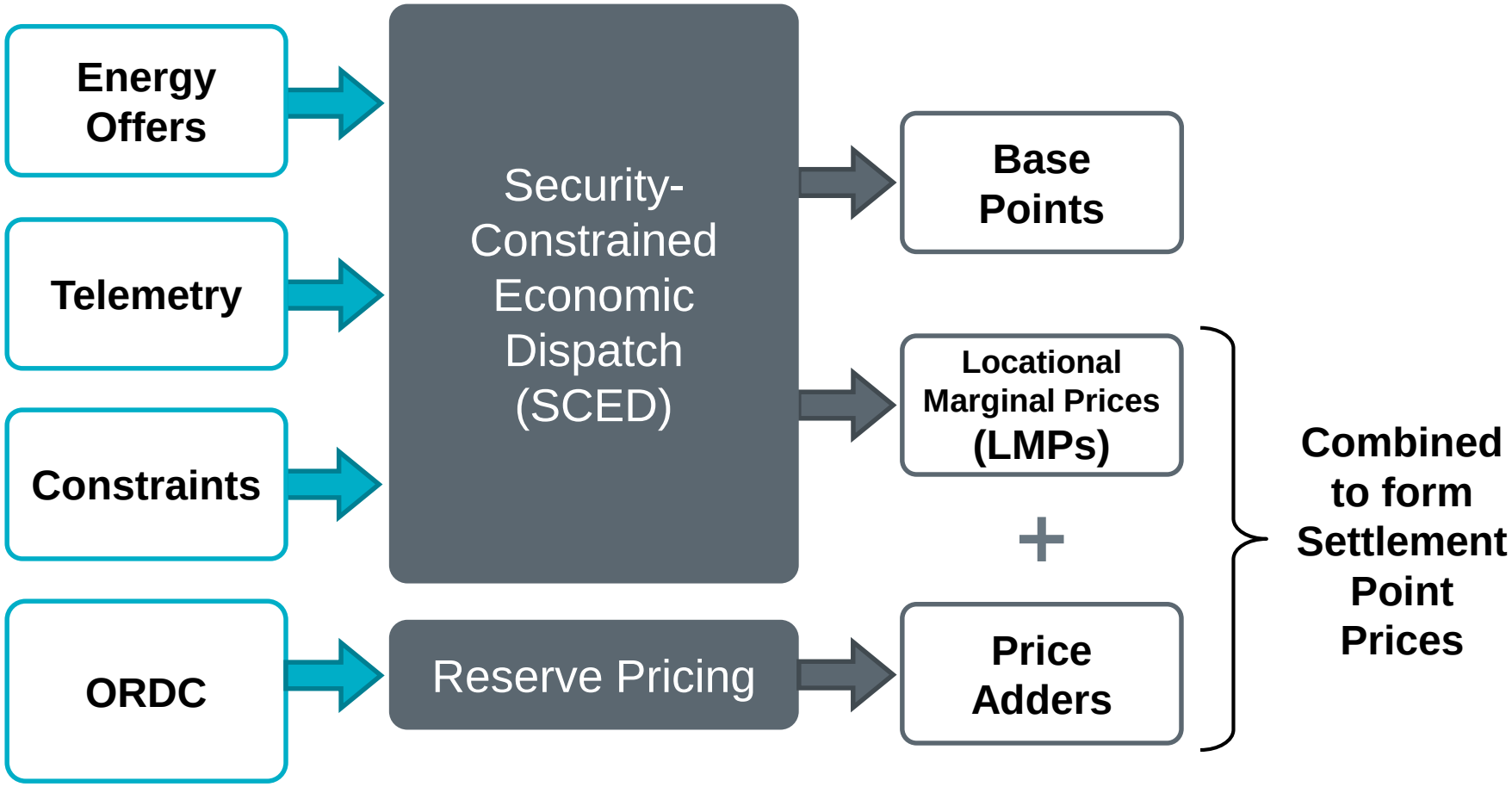
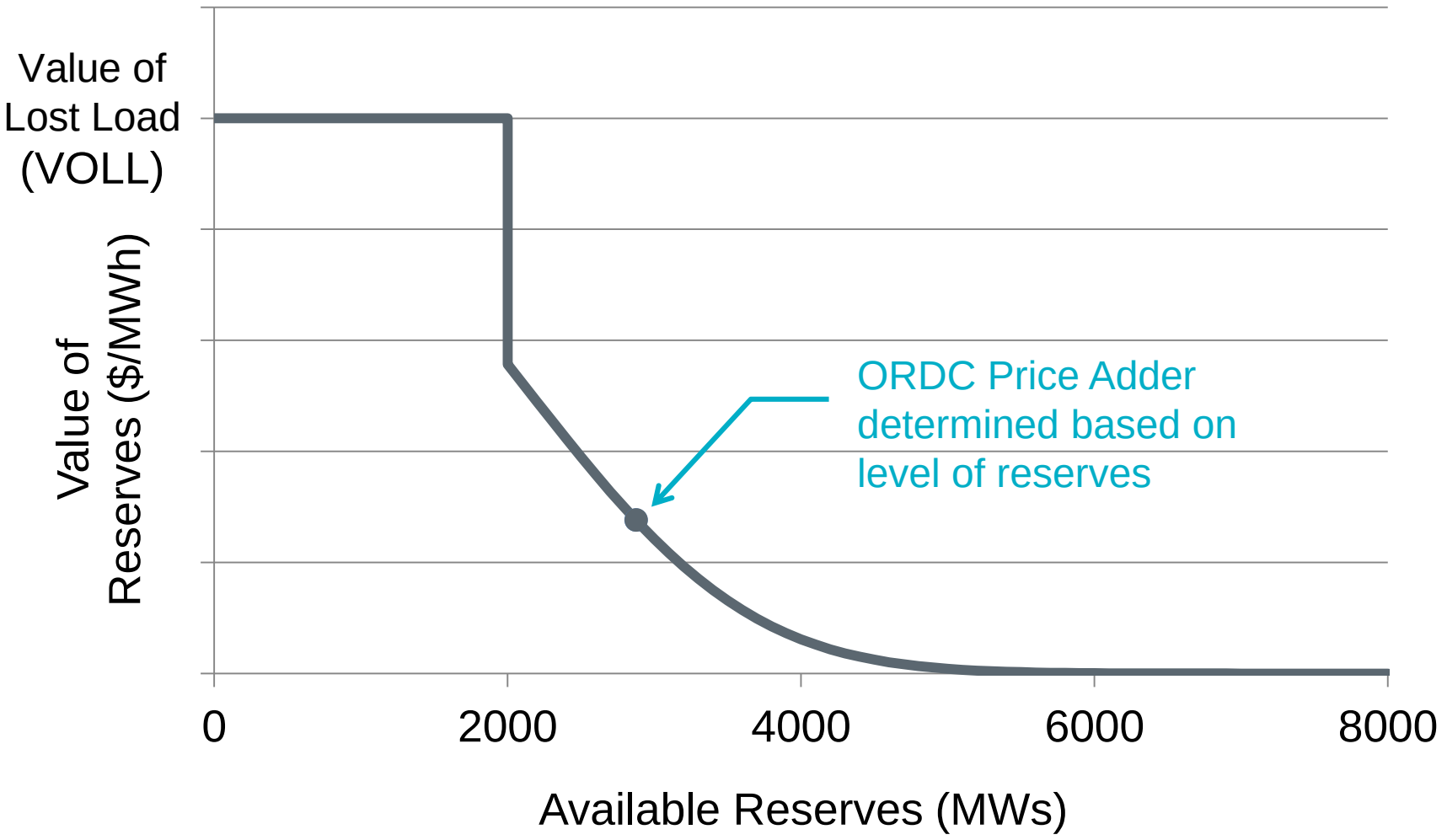
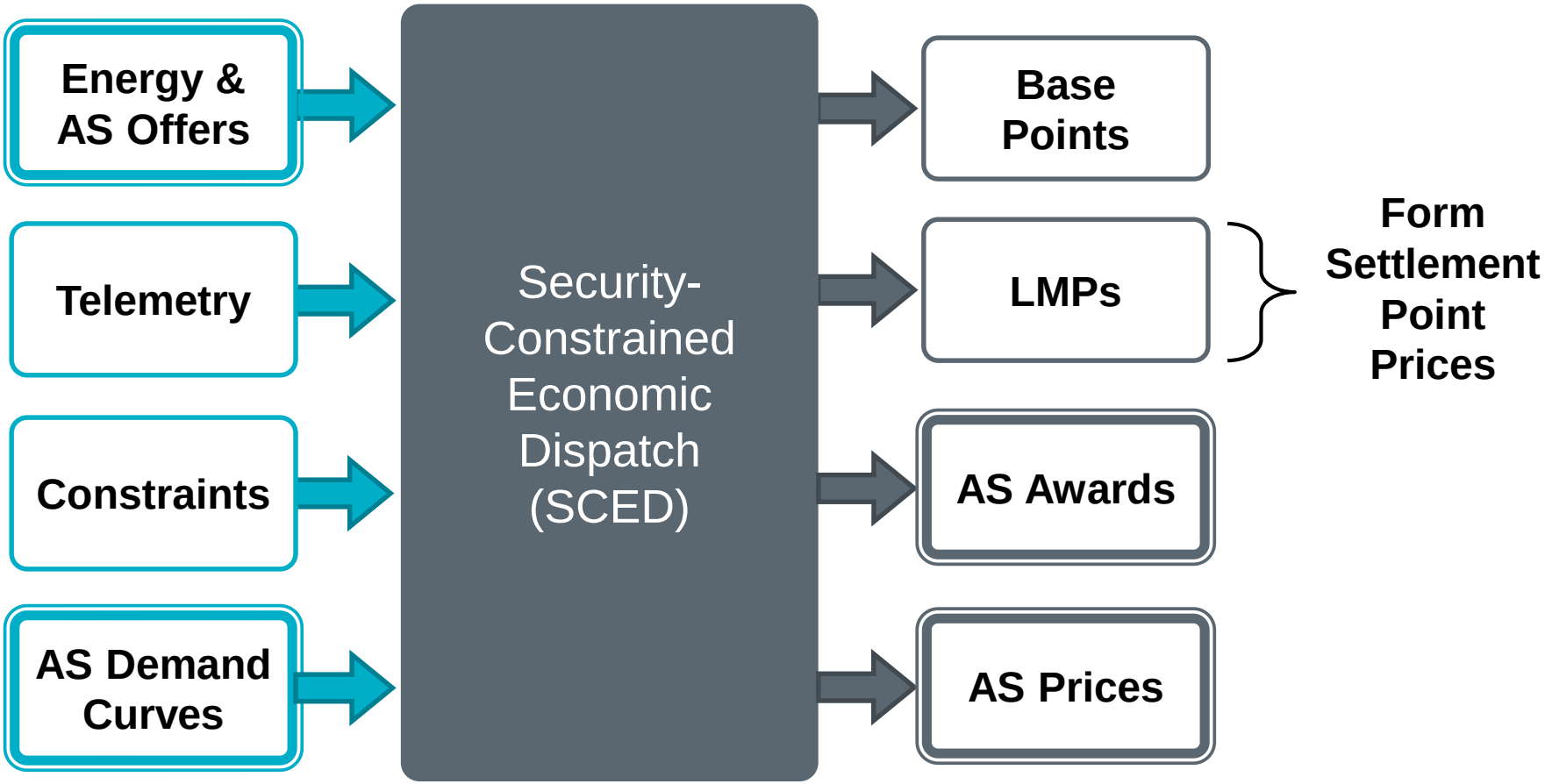
Today's market is designed to reflect scarcity through a process that is outside of the optimization



The ORDC sets the value of ERCOT System reserves



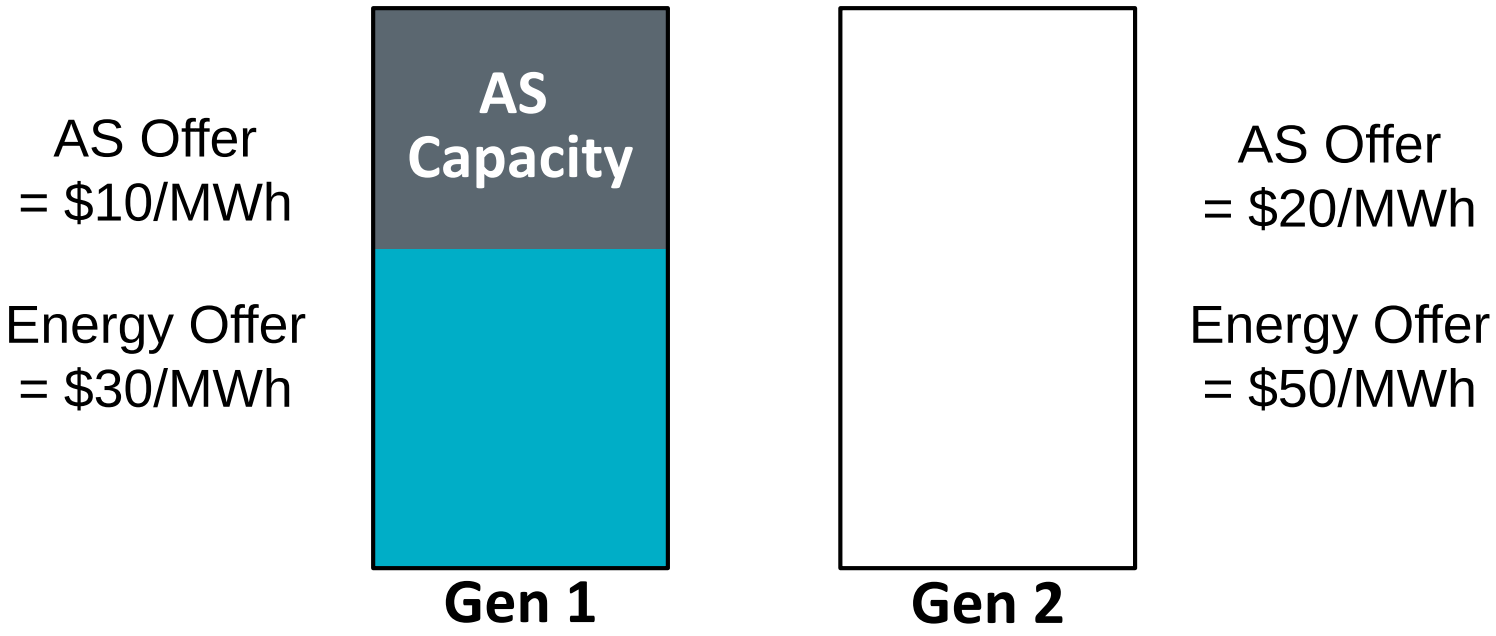
RTC is also designed to reflect scarcity, but now it occurs within the optimization



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

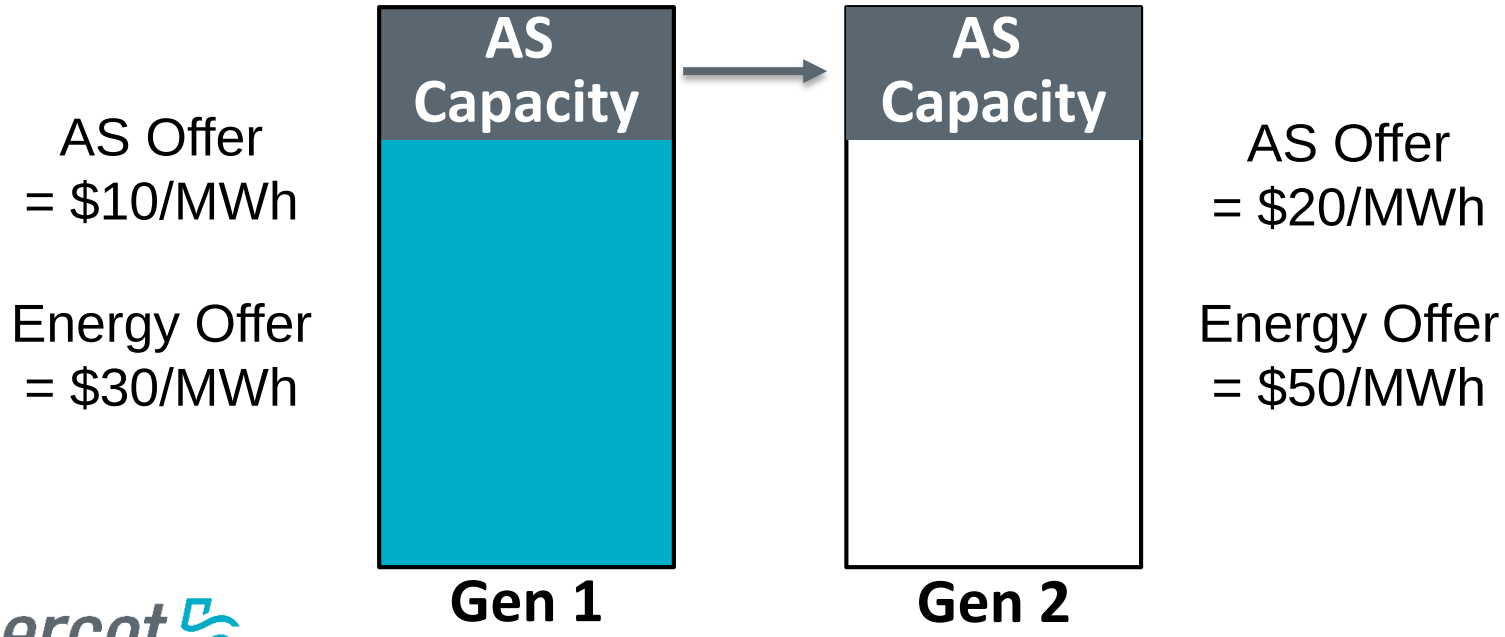
- The next MW would come from Gen 2



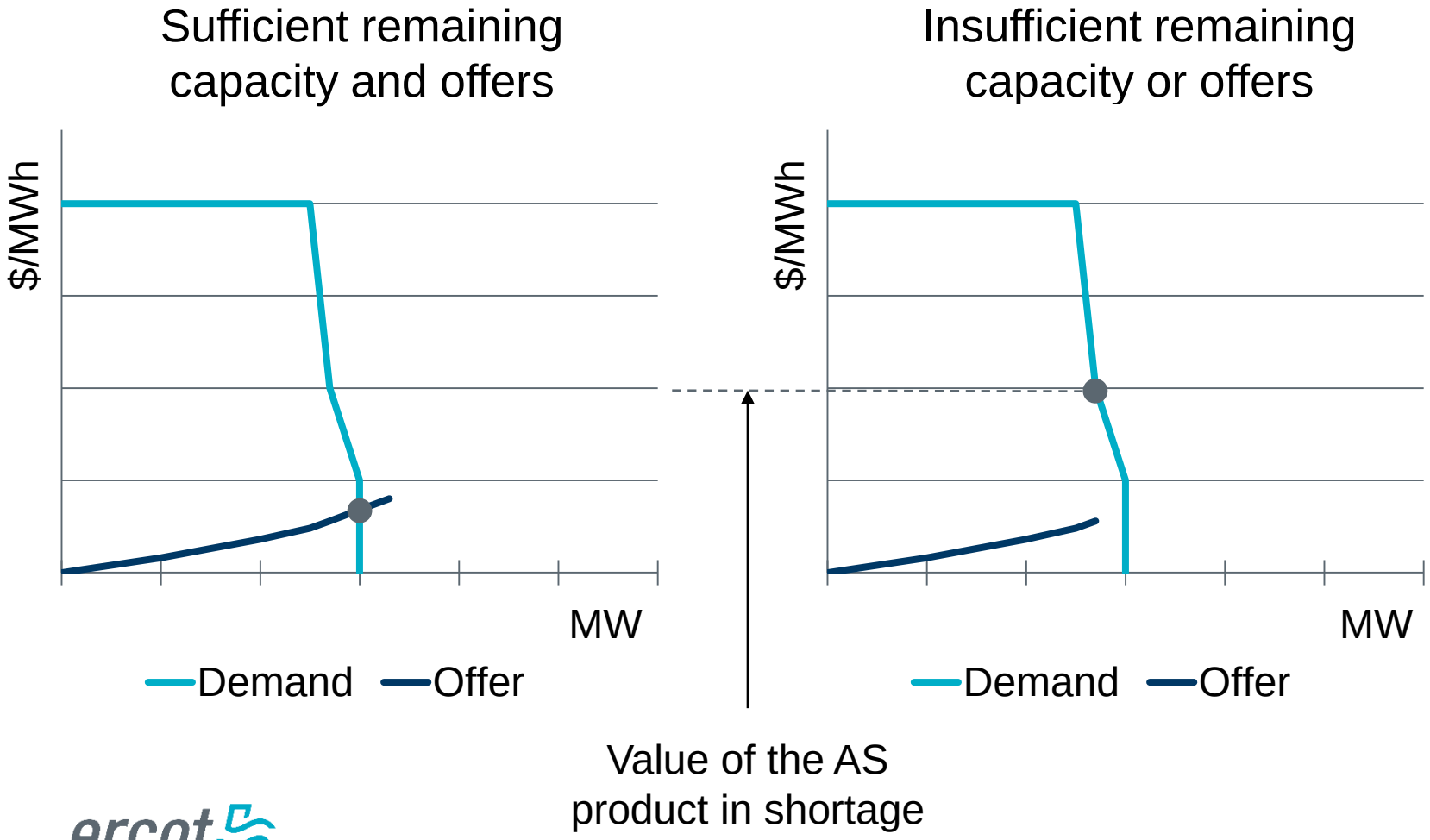
Unlike today's market, under RTC the cost of AS is factored directly into LMPs

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

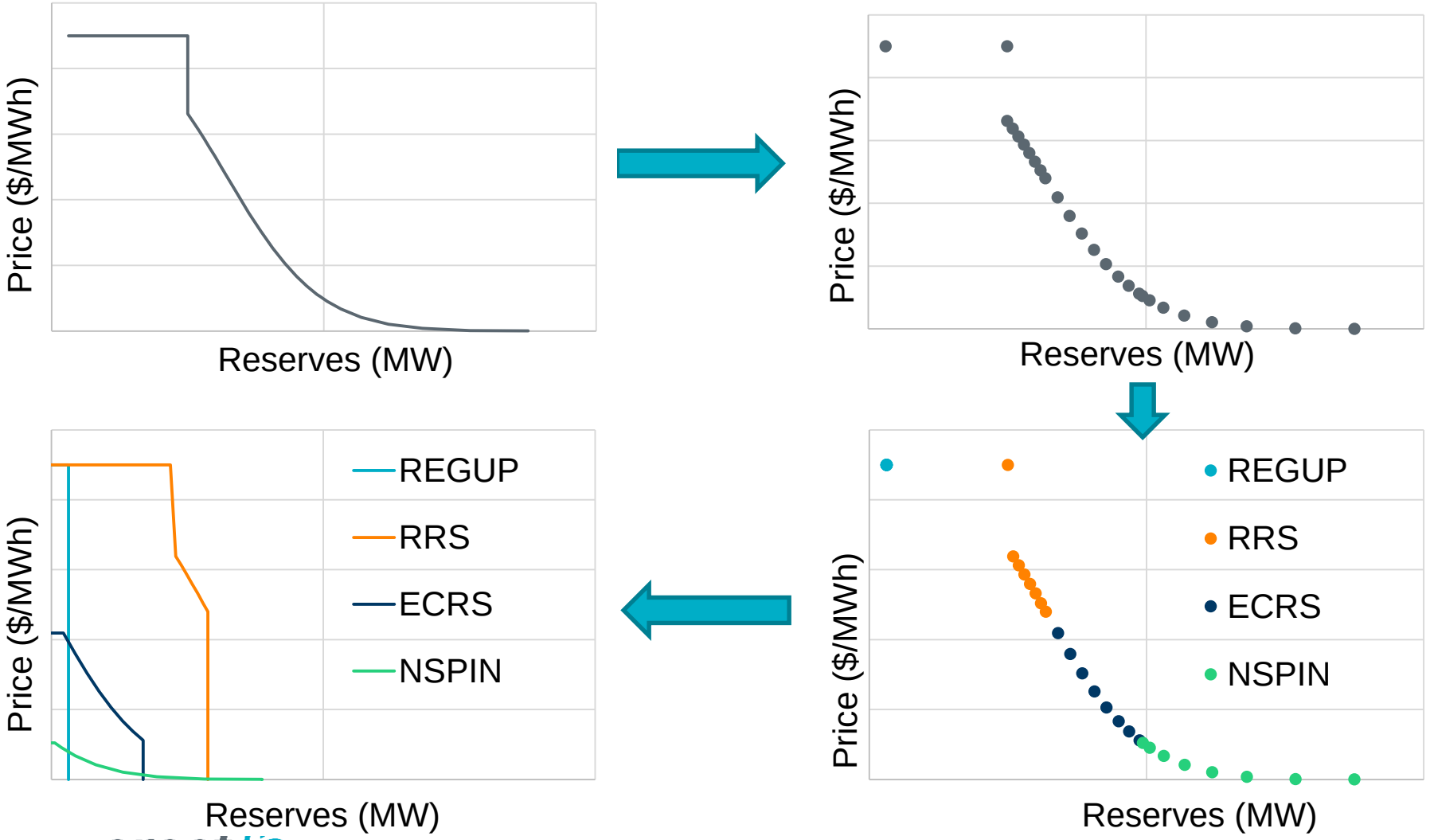
- This means the LMP goes to $40/MWh ($30/MWh for the energy from Gen 1 plus the $10/MWh of additional AS cost)
  - AS Price: $10/MWh → $20/MWh



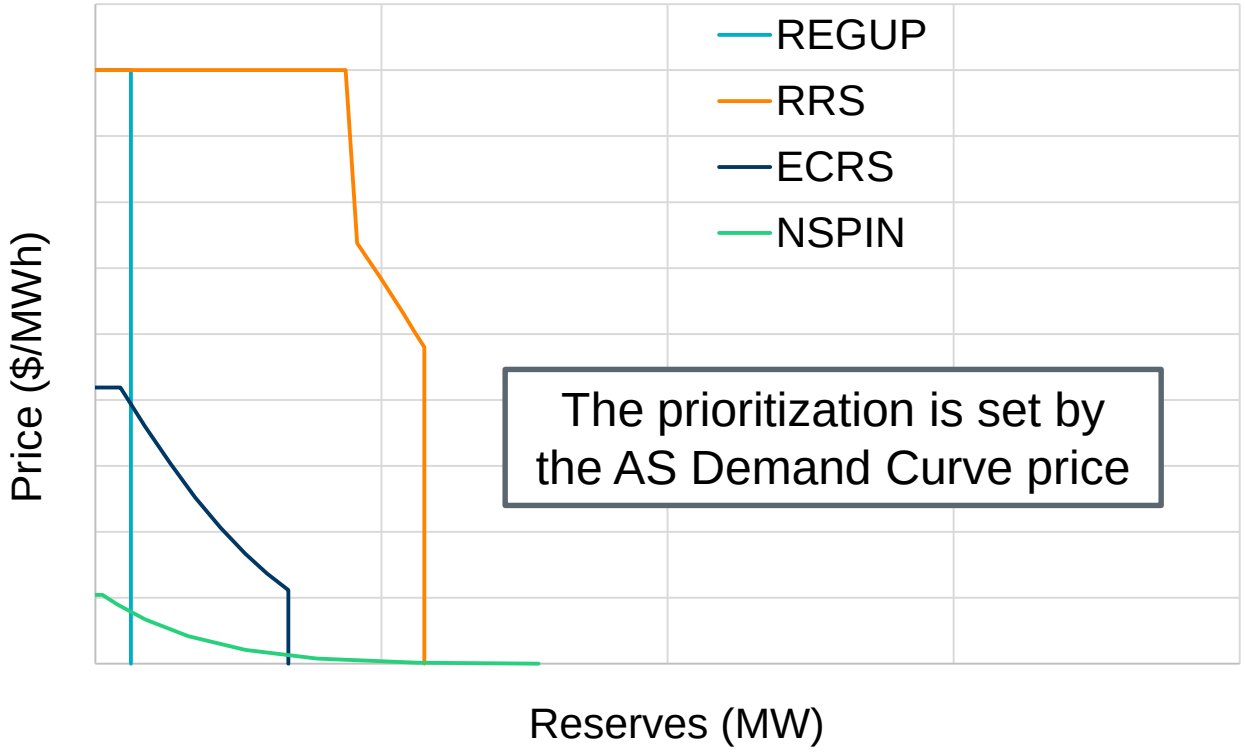
Instead of using the ORDC, under RTC, scarcity pricing and the value of reserves is set by individual AS Demand Curves (ASDCs)



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

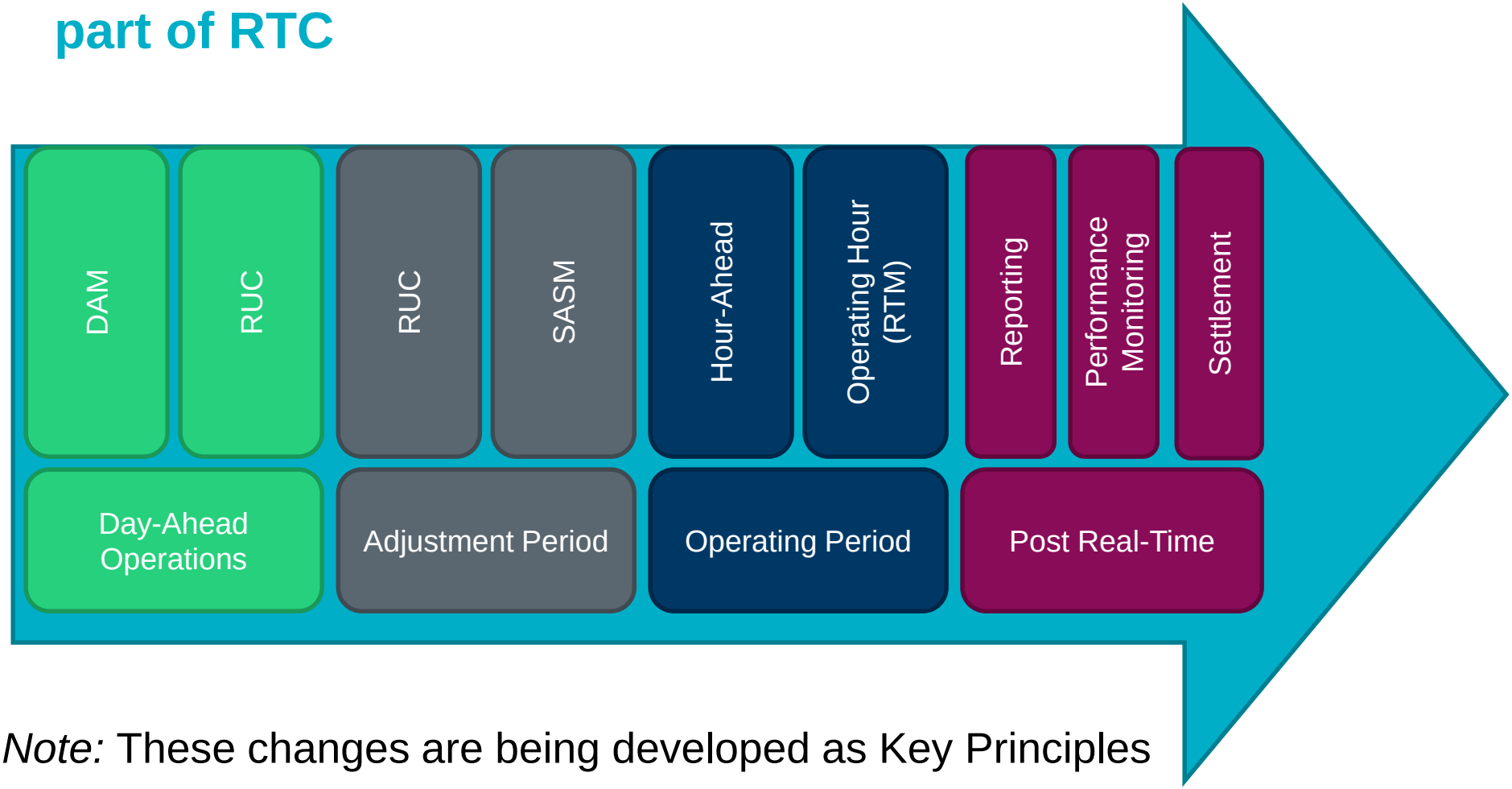


Having individual ASDCs allows RTC to better distinguish and prioritize between various AS products



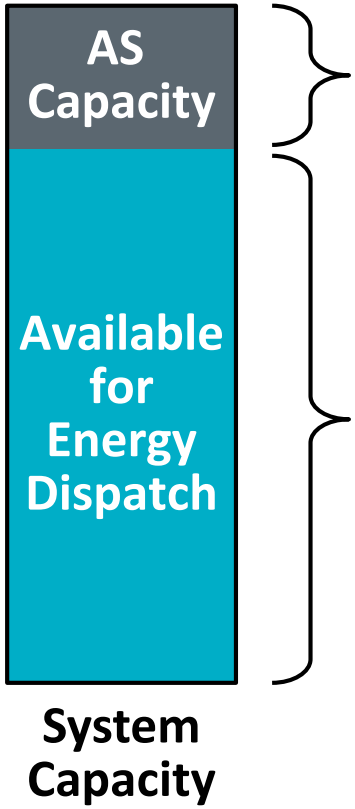
Note: Non-Spinning and ERCOT Contingency Reserve Service (NSPIN and ECRS) will be fully exhausted before Regulation Up and Responsive Reserve Service (REGUP and RRS) are fully exhausted

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



Note: These changes are being developed as Key Principles

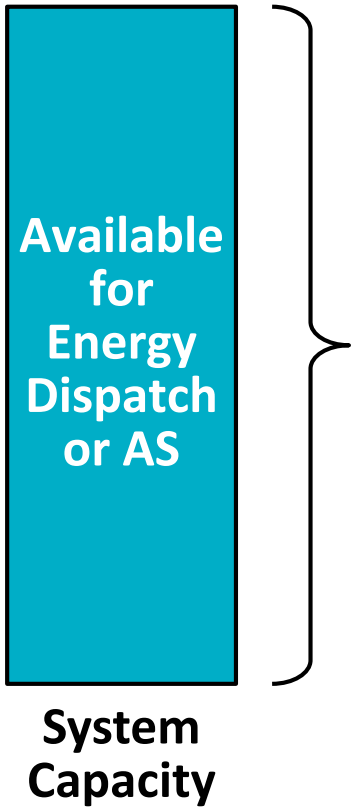
Reliability Unit Commitment (RUC), like the RTM, currently takes AS assignment to individual Resources as a known input



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

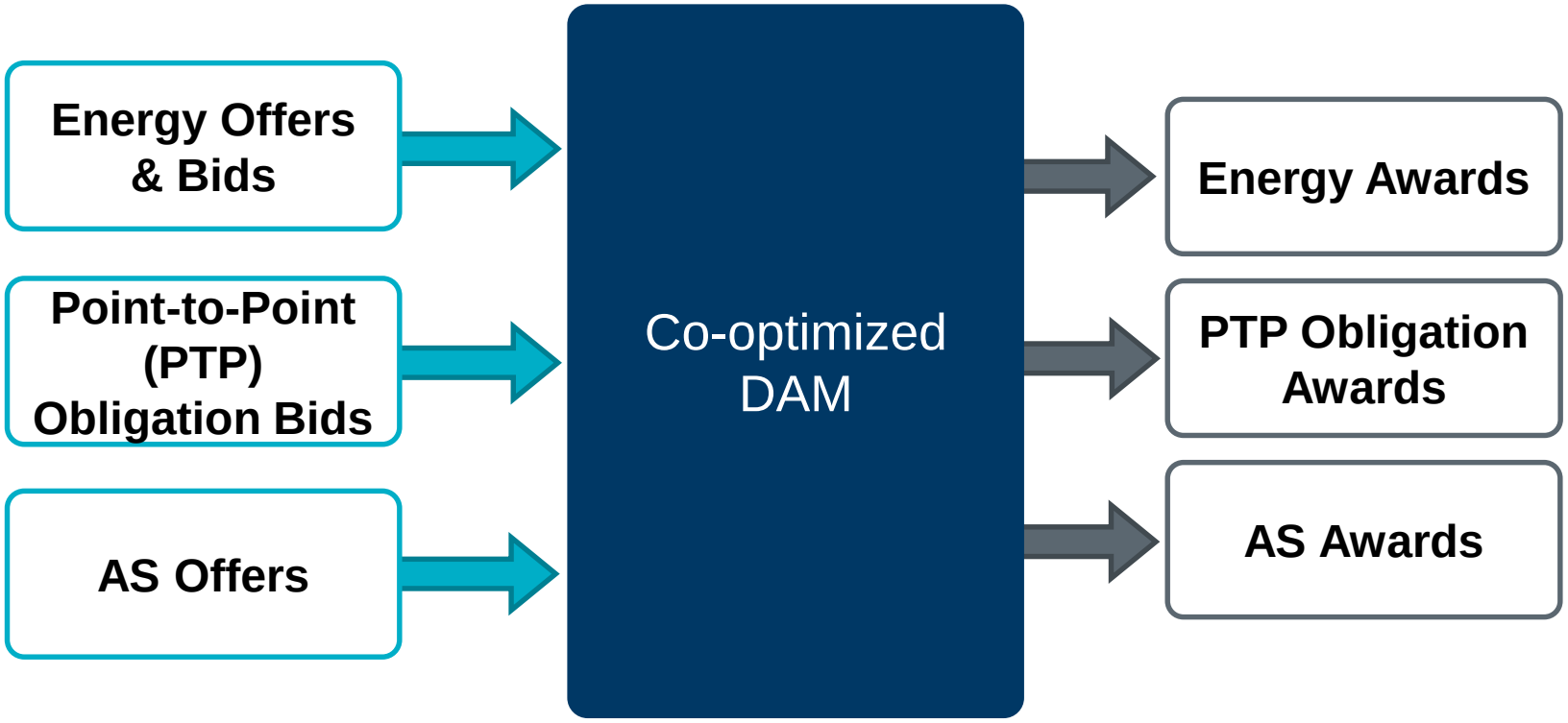
The current Supplemental Ancillary Services Market (SASM) process will be eliminated with the implementation of RTC

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

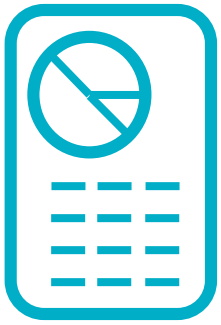


Note: Minor changes to the DAM are under discussion in RTCTF, but the objective remains the same

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

Note: Most of these items will be considered towards the end of the Key Principle development process

All of these topics will be packaged into the Key Principles under development by RTCTF

1.1 – 1.6	Changes to the RTM	5	DAM
2	Suite of AS Products	6	Market-Facing Reporting
3	RUC	7	Performance Monitoring
4	SASM	8	Out of Scope Items

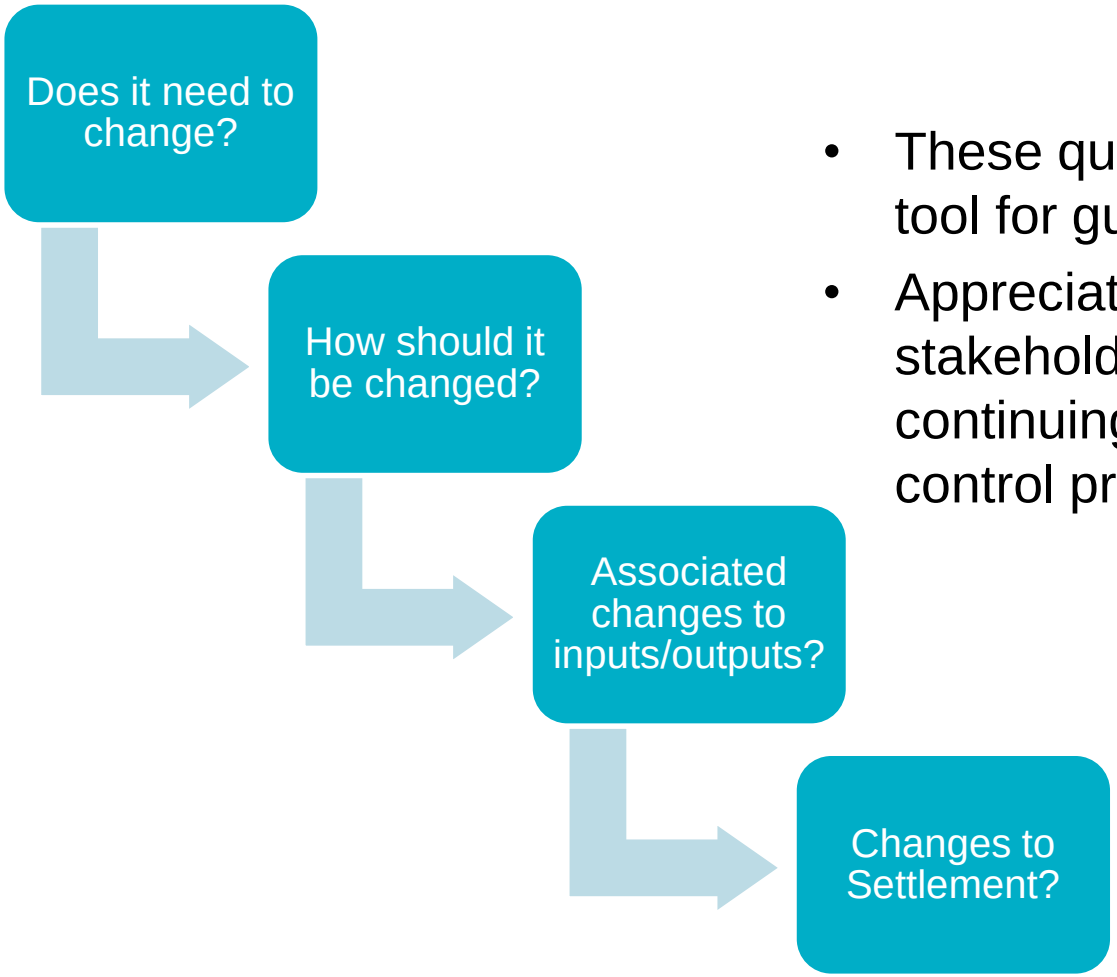
Note: Combined, these items will create the full list of topics that will be presented to the Board for consideration in February

RTCTF Status Update

- Many of the major policy and design items are well underway
  - Development of the AS Demand Curves
  - Modifications to System-Wide Offer Caps
  - Processes for deploying AS
  - Changes to the RUC design

- Continuing to identify details and downstream impacts
  - Formulation of the optimization constraints for Real-Time
  - Changes to Resource-level Real-Time telemetry being provided to ERCOT

The approach for taking items to RTCTF is designed to control scope and focus on issues necessary for implementation of RTC



- These questions provide a useful tool for guiding RTCTF discussion
- Appreciate the support from stakeholder leadership in continuing to make progress and control project scope