Reliability-Based Demand Curve(s)

Resource Adequacy Subcommittee

RASC-2019-8

April 18-19, 2023

- Changes are made on slide 12
- Updated footnote on slides 15 and 19

Purpose & Key Takeaways

Purpose: Continue the discussion on the design of reliability-based demand curves

Key Takeaways:

- MISO's RBDC proposal better aligns its RA construct with the MISO Market guiding principles
    - Incremental capacity above the PRMR has a reliability value to MISO and stakeholders, and it should be reflected in the PRA construct
- MISO received significant feedback on RBDC design. Thank you!!
    - Detail response to feedback is provided
- Detail analysis shows the impact of the prior three planning years using RBDC indicating that RBDC provides better price signal and shrinking reliability margin information to stakeholders

MISO's Resource adequacy construct (PRA) currently fails on at least three of MISO Market guiding principles*

PRA clearing **prices fail to properly value** incremental capacity

- As a result, understating capacity prices when supply is a bit in excess leads to MP's uneconomic retirements

As per MISO IMM, current PRA **does not facilitate the investment and retirement decisions necessary** to maintain the resources to meet system reliability

The MISO PRA is **highly inefficient** on pricing capacity accurately. Residual nature of PRA makes it **highly volatile**.

*MISO Market Guiding Principles

PREVIOUSLY PRESENTED

Creation of a Reliability Based Demand Curve in the MISO's Resource Adequacy construct will go a long way in addressing misalignment with three design principles

- PRA clearing prices will more properly value incremental capacity, recognizing that additional capacity above the 0.1 LOLE standard has additional reliability value
- The capacity prices will better support MP's retirement and replacement decisions
- The MISO PRA should clear at more economically efficient outcomes reflecting appropriate price of capacity

PREVIOUSLY PRESENTED

MISO's proposed RBDC construct is based on three fundamental tenets:

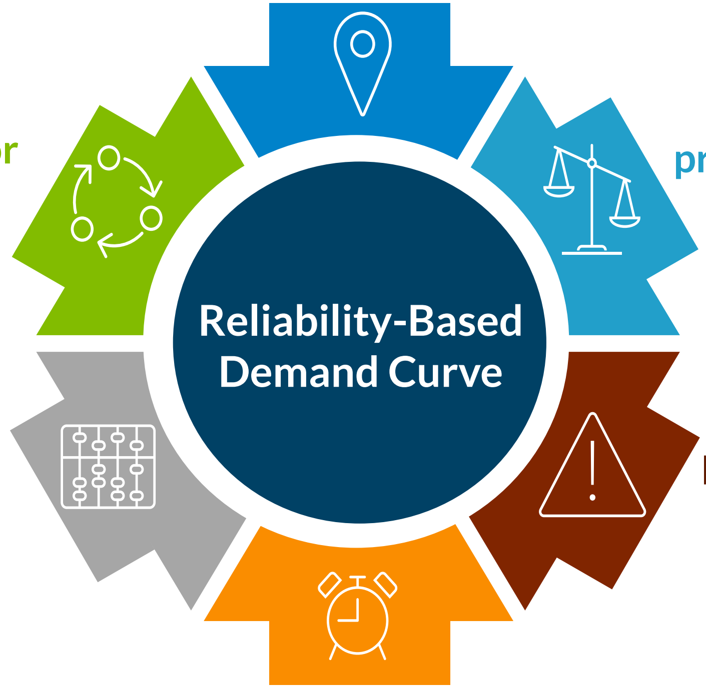
Reliability principle:	Establish a RBDC to meet the reliability targets
Long run sustainability principle	Construct should create outcome that, over time, a MP participating in the PRA has the opportunity to recover costs to build and operate an asset in excess of rents achieved from energy & operating reserve market participation
Cost–effective principle	Create reliability-based demand curves that do not overbuild, nor produce insufficient capacity

PREVIOUSLY PRESENTED

Key Decision Points on the Design of a Reliability-Based Demand Curve

Consider reliability-based demand curves for each location and seasons

Identify the process and steps necessary for creation of such curves for both seasons and regions



Consider FRAP-type provisions to respect states' rights toward resource adequacy

Develop the methodology to derive the Marginal Reliability Impact and to build the curve

Timing of implementation in PRA

Address the need for PRA algorithm modifications

In addition, consider co-optimization across seasons

Address the method for estimating Net CONE

Net CONE = CONE – inframarginal rents

Highlights of Stakeholder Feedback*

Net-CONE: A few stakeholders seek rationale to use Net-CONE. Some stakeholders also asked for clarification on how Net-CONE will be calculated, and it will be used to develop RBDC

- MISO has incorporated feedback in materials for today's meeting

RBDC, annual Participation Model, seasonal co-optimization, MRI Curves: stakeholders generally ask for more clarification and education on each of these design elements

- MISO has included additional clarification in materials for today's meeting

AFRAP: Most stakeholders expressed concerns with respect to requirements in MISO's AFRAP proposal with some stakeholders indicating their support.

- MISO is still evaluating all feedback on AFRAP and having conversations with the OMS. MISO will continue AFRAP design discussion at the next meeting.

*Note: MISO response to stakeholder feedback will be posted on the MISO website prior to the 18 April RASC meeting.

MISO's clarifications & rationale on key design elements

MISO considered various options while designing an approach to calculate Net-CONE and confirms that the proposed approach is the best option for current implementation plan

Forward looking Net-CONE approach does not align with MISO's prompt year PRA construct

- Forward looking data accuracy and data availability challenges
- Forward looking Net-CONE approach better suit for eastern markets because capacity procurements are 3 years in advance
- MISO is going to use a scaling parameter to adjust historic actual energy and ancillary services revenues for the prompt year based on expected LMPs and forward looking gas prices

Reference technology is not changing to ensure timely implementation of RBDC

- MISO is open to consider changes to reference technology in the future after RBDC implementation

Anchoring RBDCs around perspective Net-CONE is the most logical option

- Anchoring RBDC around Net-CONE provides an opportunity to recover going forward costs for existing and new resources
- All other options are more administrative and can result in inefficient prices and clearing volumes

These options and approach were chosen based on the market design guiding principles

RBDC is one of the critical steps to ensure short-term resource adequacy across the MISO footprint

- RBDC alone is not sufficient to ensure reliability in the MISO footprint, but it is one of the critical steps
- Other RA changes also contributes to insuring reliability in MISO footprint

MISO RBDCs are reflective of reliability needs in the footprint

- MISO PRA is a prompt market – therefore the amount of uncertainties that need to be accounted for is relatively low compared to other eastern markets (which are 3-year forward markets)
- Steepness of RBDC is not only from the MRI curves but also from the level of load participation in the market. If most of the load in the PRA opt-outs from the market the resultant RBDC is going to look like vertical demand.
- Steepness of the demand curve is going to add pricing volatility in the market, but it is not going to be more than the status quo (vertical demand curve)

MISO is proposing the use of Expected Unserved Energy (EUE) metric to design RBDC

- EUE is not a new concept, it is an outcome of exiting LOLE process.
- For RBDC design, MISO is expanding this matrix to reflect true reliability needs
- EUE will not add any additional variability in the market which does not exist today in the LOLE model

The annual participation model and seasonal co-optimization provides a better pricing design and improves market efficiency

The annual participation model gives an additional option for resource owners to participate in the PRA

- More participation options => improved market participation and market efficiency

Initially, for implementation simplicity, MISO only considers a “block model” for annually participating resources

- MISO is already considering expanding the annual participation model for resources looking for shorter commitment than a PY (but more than a season) in the near future after RBDC implementation
- Provides avenues for future market enhancements.

The annual participation model is not designed for a specific fuel type resource

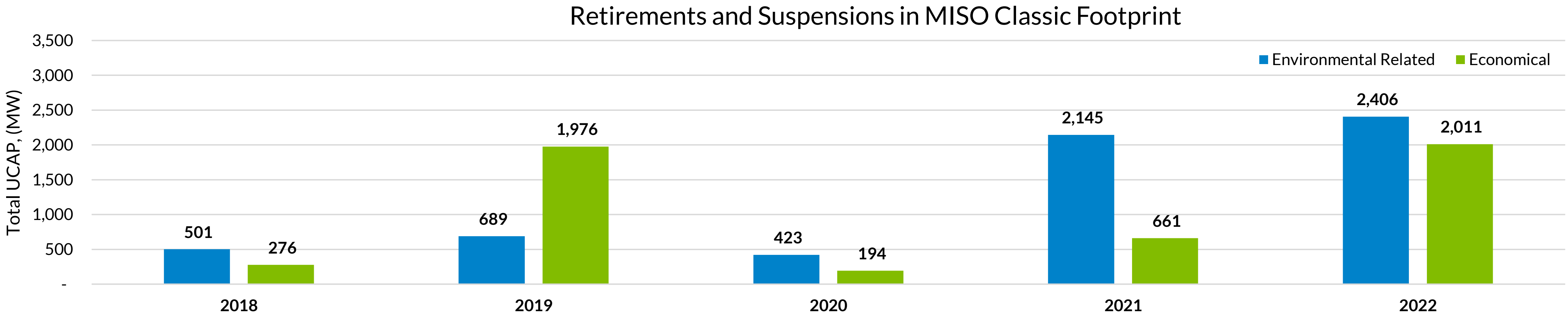
- Fuel agnostic

MISO expects uplift situations to less frequent under the annual participation model than otherwise.

- Needed to make the resource whole. For details see additional examples posted w/ the Feb. RASC meeting material

Historic Data on Resource Suspensions/Retirements*

- In the 2018-22 timeframe, in the MISO classic footprint,
  - 6.2 GW of capacity is retired/suspended due to environmental reasons
    - This trend has been accelerated from 2021
  - 5.1 GW of capacity is retired/suspended due to economical reasons
- Some of the retirements/suspensions due to economical reasons could have been avoided w/ RBDC and better capacity price signals



* Data source MISO IMM

Note: Public resource retirement information is available here on the MISO OASIS. It does not include resource retirement information that is considered confidential under the Tariff (Attachment Y).

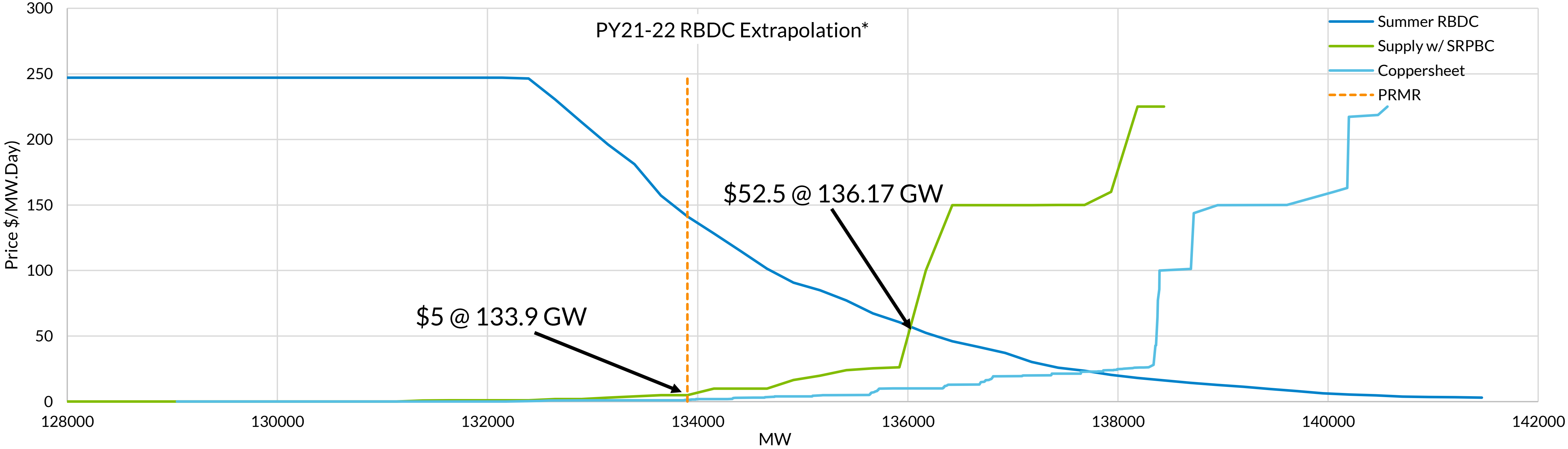
Impact of RBDC: Prior PRA

Study Assumptions

- No AFRAP (100% PRA participation)
- No changes to the supply curve
- No seasonal PRA changes
- No LRZ-specific constraints are enforced (no LCR, CIL, and CEL constraints)
- No change in price and offer cap
- SRPBC is enforced

PY21-22: RBDC Comparison+

- Systemwide RBDC clearing is at $52.5/MW.Day @ 136.17 GW
  - PY21-22 PRA cleared at $5/MW.Day
  - No impact on South price: SRPBC is binding, and the South price will be $0.1 (same as PRA)
- w/ RBDC PRA would clear 1.7% above the PRMR



* To show RBDC details the curve is zoomed in on x axis.
+ Study assumptions are included on slide #14

Financial Impact of RBDC

LSE Capacity w.r.t. PRA Obligation*	Cost of Purchasing Excess in the Market		Revenue from Selling Excess in the Market	
	w/ RBDC ($52.5/MW.Day)	w/o RBDC ($5/MW.Day)	w/ RBDC ($52.5/MW.Day)	w/o RBDC ($5/MW.Day)
80% (20% PRMR+1.7% purchase above PRMR)	52.5*21.7 **$1,139.3/Day**	20*5 **$100/Day**	-	-
100% (100% supply & load match @ PRMR)	52.5*1.7 **$89.3/Day**	-	-	-
101.7% (1.7% excess over PRMR)	-	-	-	5*1.7 **$8.5/Day**
105% (5% excess over PRMR)	-	-	52.5*3.3 **$173.3/Day**	5*5 **$25/Day**

* Assuming 100MW PRMR obligation. RBDC clears at 1.7% above PRMR (101.7MW)

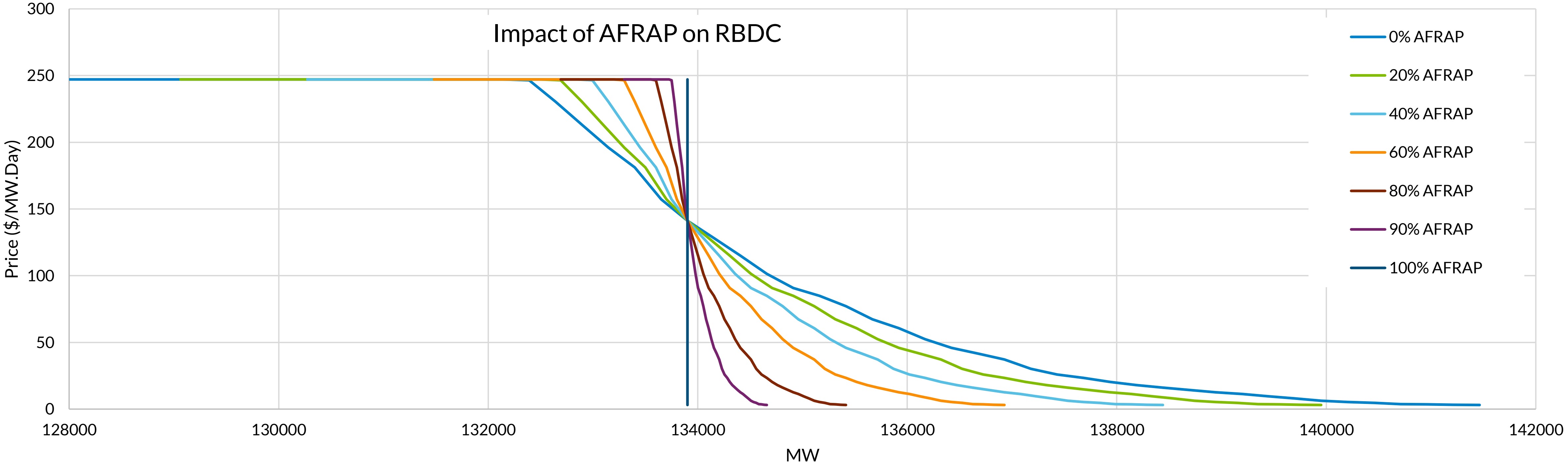
Financial Impact of RBDC* (cont.)

- LSE relies more on PRA to meet most of the obligation
  - w/ RBDC capacity price is going to increase if PRA clears above PRMR
  - w/ RBDC capacity price is going to decrease if PRA clears below PRMR (smooth shortage pricing)
- LSE relies less on PRA to meet most of the obligation
  - No significant impact of RBDC on LSE
- LSE has excess capacity beyond the obligation
  - Beneficial pricing outcome.
    - w/ RBDC capacity price is going increase if PRA clears above PRMR
  - Financially beneficial to participate in the PRA.
    - w/ RBDC excess capacity price in the PRA could be better than selling outside (bilateral market)
  - More stable pricing outcome could be achieved w/ higher PRA participation

* Comparison is w.r.t. status quo (vertical demand)

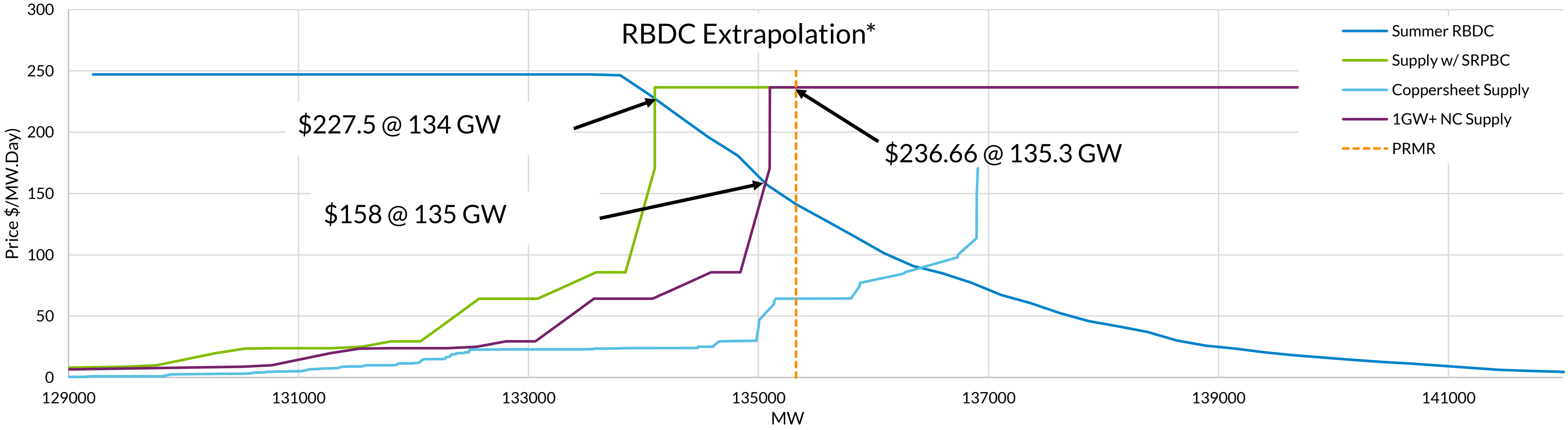
Impact of AFRAP at 1 in 10

- In general, AFRAP degrades the effectiveness of RBDC
  - Higher AFRAP participation could nullify the benefits of RBDC
- MISO proposed AFRAP considers prior PRA clearing without degrading the integrity of PRA significantly



PY22-23: RBDC Comparison w/ SRPBC Binding

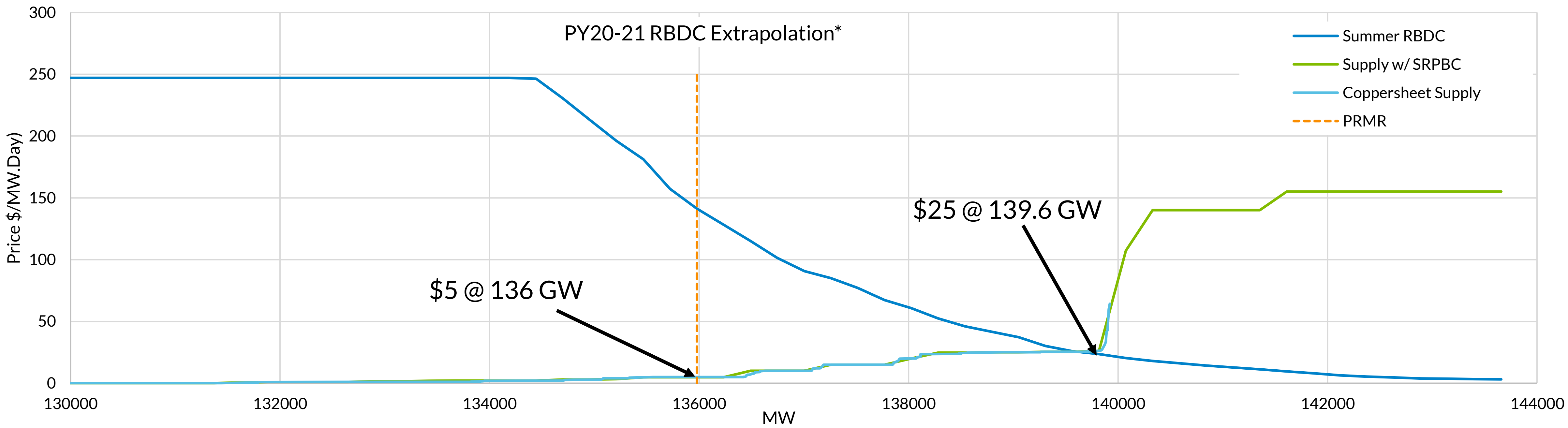
- Systemwide RBDC clearing is at $227.5/MW.Day @ 134 GW
  - w/ SRPBC is binding, and the south price will be $1.9/MW.Day
- PY22-23 PRA cleared at $236.66/MW.Day for MISO classic (shortage of 1,230MW) and $2.88/MW.Day MISO South
- w/ RBDC and 1GW of perfect capacity in MISO classic footprint, market clearing is at $158/MW.Day @ 135GW (still less than PRMR)
  - w/ RBDC MISO could have given a better price in the footprint



* To show RBDC details the curve is zoomed in on x-axis. 1GW of perfect capacity is added to MISO classic footprint to highlight the impact of SRPBC and additional capacity.

PY20-21: RBDC Comparison

- Systemwide RBDC clearing is at $25/MW.Day @ 139.6 GW
  - SRPBC is binding, and the south price will be $24.4
- w/ RBDC PRA would clear 2.7% above the PRMR
- PY20-21 PRA cleared at $5/MW.Day (MISO Classic) and $4.75/MW.Day (MISO South)



* To show RBDC details the curve is zoomed in on x axis

Systemwide RBDC Comparison

- W/ RBDC MISO could have given a better price signal from PY20-21 to PY22-23 reflecting system conditions
  - In MISO classic, systematic price increase from PY20-21 to PY22-23 indicates decreasing system margins
  - No significant pricing impact in MISO south: prices would have stayed below 10% daily CONE w/ RBDC

PY	RBDC Clearing above PRM	Prices w/ RBDC		Prices w/ vertical DC	
		MISO Classic	MISO South	MISO Classic	MISO South
PY22-23	-0.9% (shortage)	$227.5/MW.Day	$1.9/MW.Day	$236.66/MW.Day	$2.88/MW.Day
PY21-22	1.7%	$52.5/MW.Day	$0.1/MW.Day	$5/MW.Day	$0.1/MW.Day
PY20-21	2.7%	$25/MW.Day	$24.4/MW.Day	$5/MW.Day	$4.75/MW.Day
Total capacity payments over 3 years		**$305/MW.Day**	**$26.4/MW.Day**	**$246.66/MW.Day**	**$7.73/MW.Day**

Next Steps

MISO plans to push out the filing schedule to later this year to allow for additional design detail discussion and simulations following the 23/24 seasonal PRA. The earliest implementation of RBDC will now be 25/26 PRA.

We are here

FRAME / EVALUATE | **CONCEPT DESIGN** | **2023-25 FILE/BUILD/ IMPLEMENT**

RASC (October)

- Initiate the framing and evaluation stages
- Identify primary goals and core principles

RASC (November)

- Identify step-by-step approach
- Assess feasibility of chosen approach
- Initiate Conceptual design evaluation

Q3-Q4, 2023

- Present and discuss in detail the final conceptual design recommendation
- Assess implementation with seasonal/ locational aspects

Q3-Q4, 2023

- Present and discuss final design recommendation
- Tariff filing at FERC in 2023
- Implementation 25/26 PRA

Stakeholder Feedback Request

- MISO is requesting feedback on the reliability-based demand curve proposal and design elements by May 5, 2023

- MISO Dashboard ID#: *RASC-2019-8*

- Feedback requests and responses are managed through the Feedback Tool on the MISO website: misoenergy.org/stakeholder-engagement/stakeholder-feedback/

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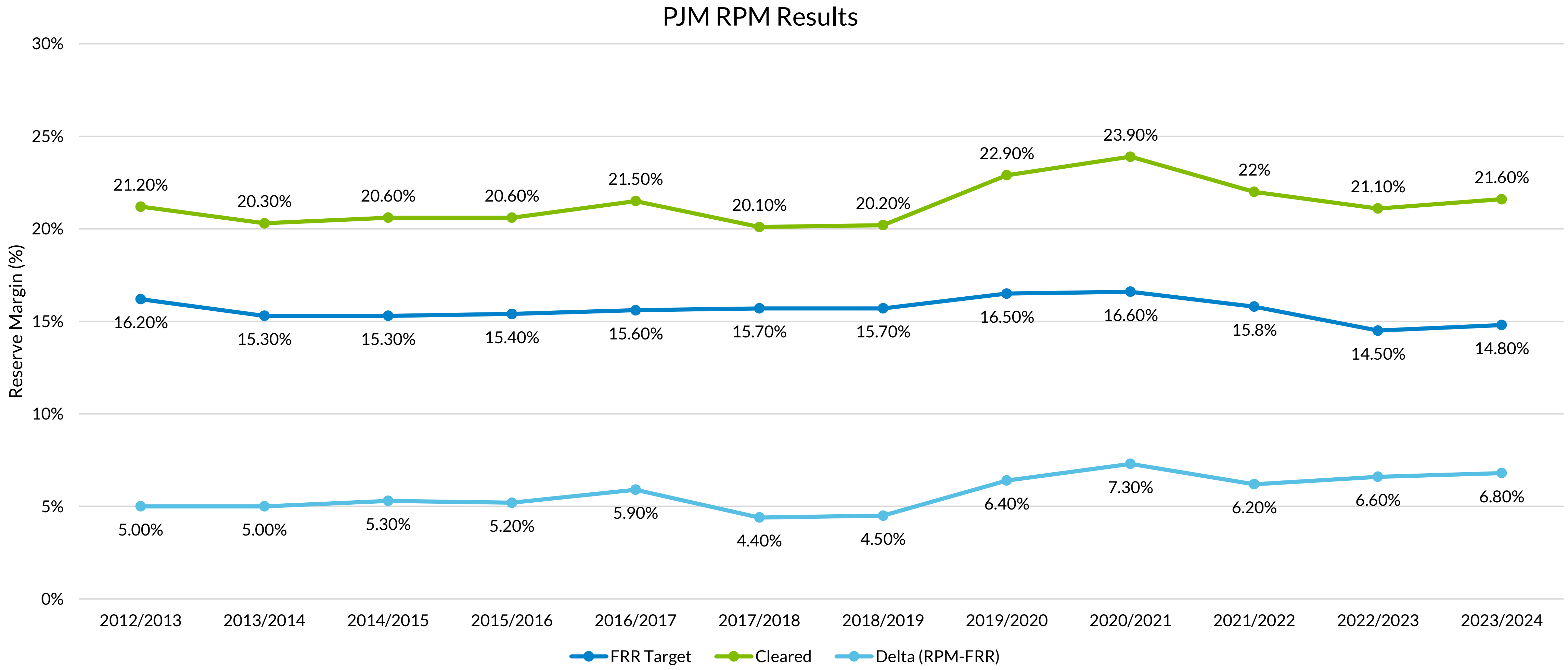
Appendix

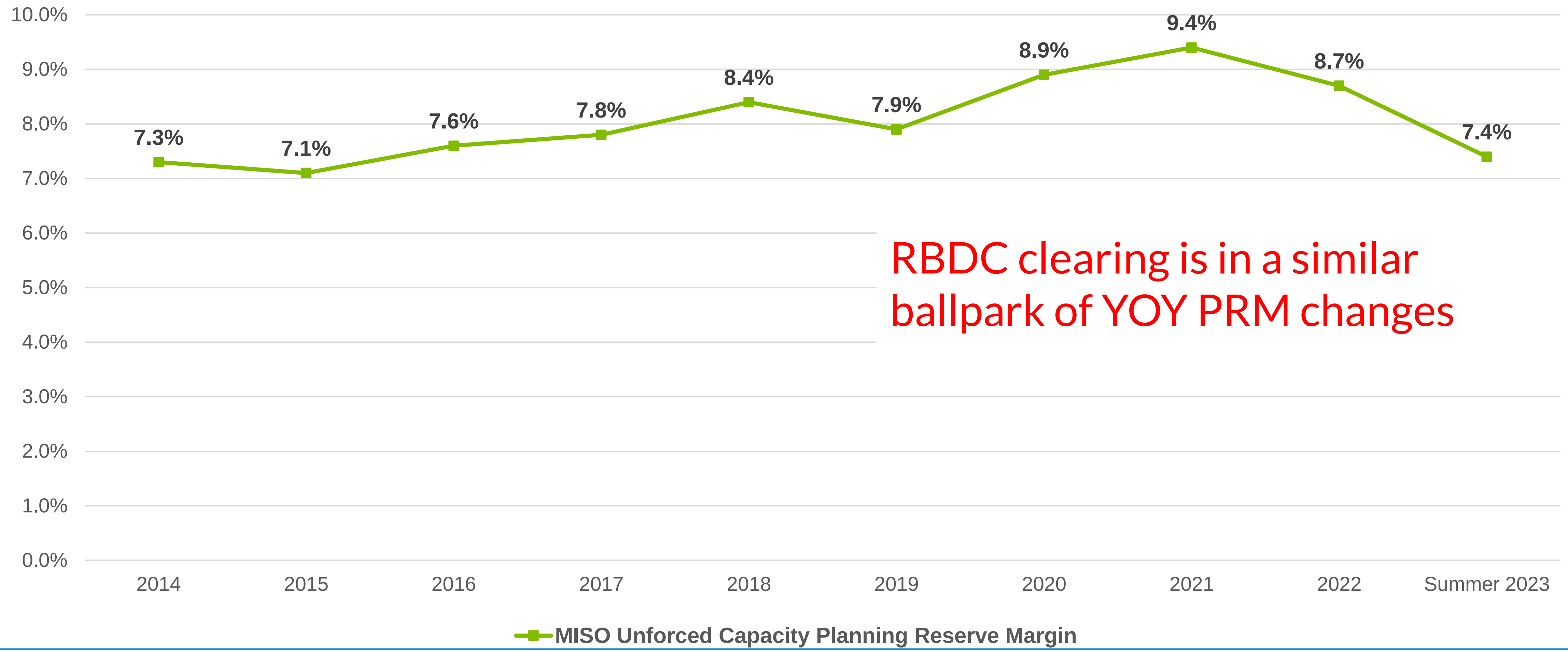
Acronyms

AFRAP	advanced fixed resource adequacy plan	**MRI**	marginal reliability impact
CDC	capacity deficiency charge	**Net CONE**	= (CONE – inframarginal rents in A/S markets)
CEL	capacity export limit	**PRA**	planning resource auction
CIL	capacity import limit	**PRM**	planning reserve margin
CONE	cost of new entry	**PRMR**	planning reserve margin requirement
EUE	expected unserved energy	**PY**	planning year
FRAP	fixed resource adequacy plan	**RBDC**	reliability-based demand curve
IRP	integrated resource planning	**RERRA**	relevant electric retail regulatory authority
LCR	local clearing requirement	**SAC**	seasonal accredited capacity
LOLE	loss of load expectation	**SFT**	simultaneous feasibility test
LOLH	loss of load hours	**UCAP**	unforced capacity
LOLP	loss of load probability	**VOLL**	value of lost load
LSE	load serving entity	**WTA/WTP**	willingness to accept/pay
LRZ	local resource zone	**ZDC**	zonal delivery charge

Impact of FRR on PJM's RPM



Year to Year PRM Variability



RBDC clearing is in a similar ballpark of YOY PRM changes