Balancing Operating Reserve (BOR) Credit Reform (Energy Uplift):
Tracking Ramp Limited Desired MW Calculation

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Market Settlements Subcommittee
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Main Elements of the Solution

The following elements were included in the approved package in support of the Balancing Operating Reserve Credit Reform topic

1	Use of a new Tracking Ramp Limited Desired (TRLD) MW metric to measure how well a unit follows dispatch across consecutive intervals.
2	Structural changes to the Energy Uplift Credit calculation
3	Adjustments to the periods for which resources will be eligible to receive Energy Uplift Credits
4	Conforming changes to the calculation of generator deviations

FERC approved the proposal on December 5, 2025. Docket ER26-59-000

Determining Following Dispatch

The weakness of the existing Desired MW metrics is their lack of ability to determine if the unit is actually following dispatch consecutive intervals

Dispatch Signal and Ramp Limited Desired rely on actual generation as a baseline, therefore they do not capture where the unit should have been when it deviates from dispatch.

- This may result in overcompensation, making units whole for more MW than PJM intended.

LMP Desired can also be overly punitive, as it ignores ramp limits and does not reflect achievable output based on ramping capability.

Tracking Ramp Limited Desired Metric

As part of the approved reforms, the Tracking Ramp Limit Desired (TRLD) MW metric was introduced

- TRLD more accurately measures how closely a resource is following dispatch over a period of time than the Status Quo metrics
- TRLD uses the previous dispatch instruction as the starting point of the calculation instead of Actual Generation like the current Ramp-limited desired values
- TRLD considers ramping limitations unlike the current LMP Desired MW value that is currently used when resources are significantly deviating
- This value would replace **all three** of the existing desired MW values in the calculation of BOR credits and deviation charges

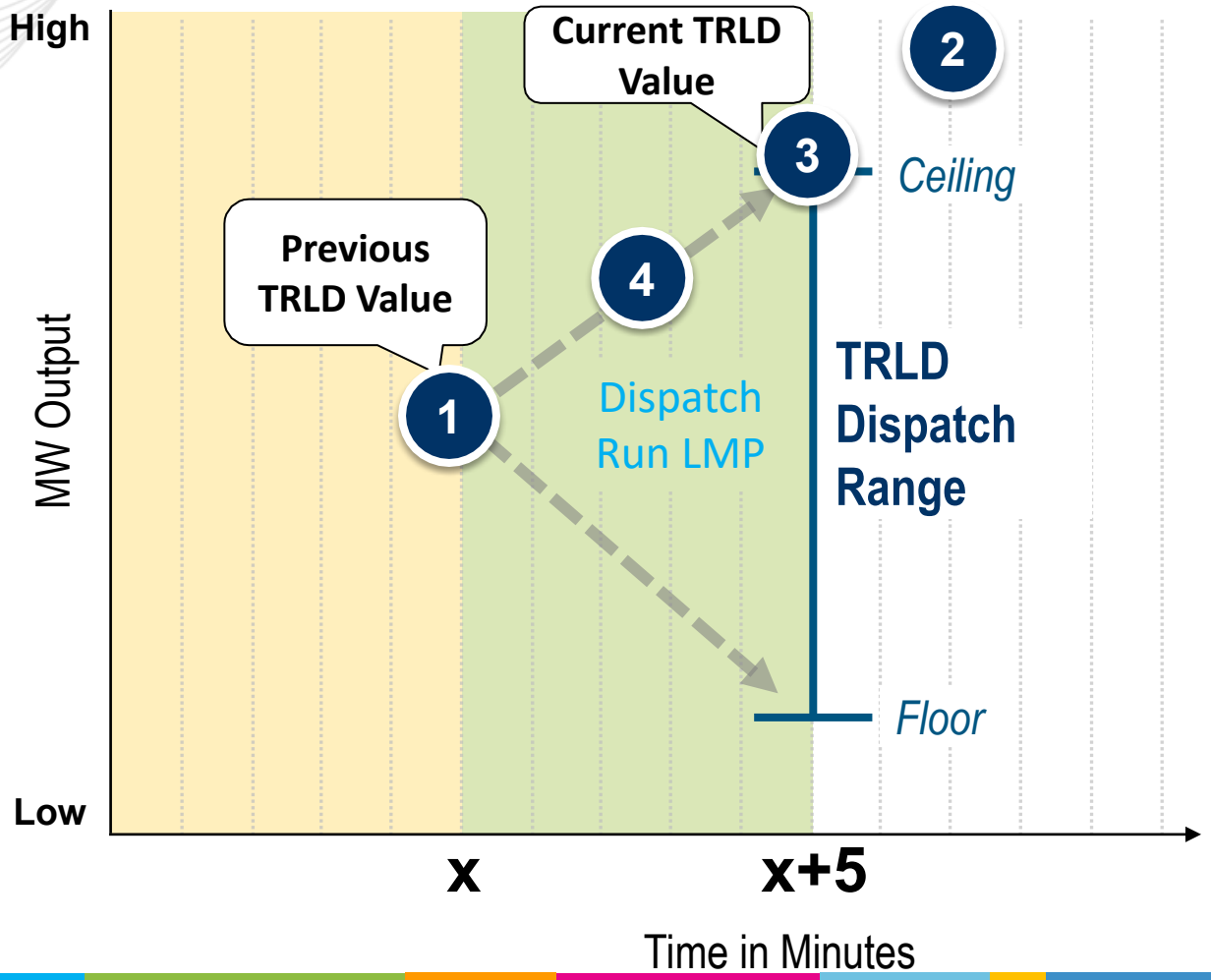
Implementation Approach

In response to stakeholders' feedback, a phased implementation approach is in progress to provide experience with the TRLD metric prior to its use in calculating Energy Uplift credits and charges.

TRLD soft launch in May 2026 – TRLD will be calculated and published via MSRS reports, but not yet used in settlements calculations – Allows time for participant training / learning and parallel operations	Implementation of the entire package of changes, including usage of TRLD in settlements, in 2027.

TRLD Calculation Overview

Step 1	Determine/Obtain Previous Interval Power TRLD Value
Step 2	Determine increase/decrease in output based on non ramp limited Dispatch LMP Desired MW
Step 3	Utilizing bid in ramp rate to determine Current Interval Power TRLD Value (Step 1 + Step 2)
Step 4	Determine Current Interval TRLD Energy Value = Integrated (Step 1 + Step 3)



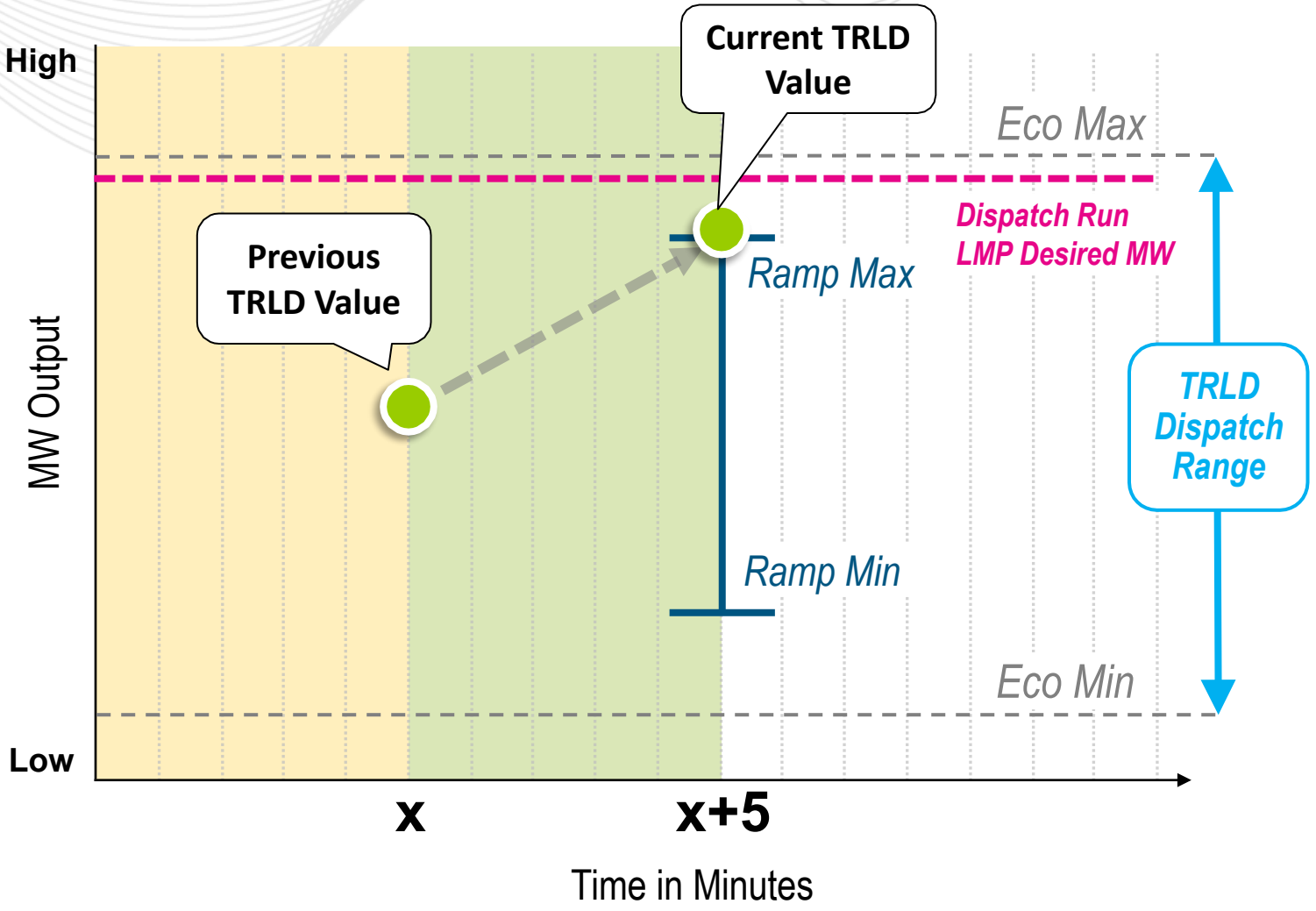
TRLD Calculation Overview

When:

Dispatch LMP Desired MW is *greater than* ***Previous TRLD***

Current TRLD =
Previous TRLD + Ramp MW

Ramp MW > 0



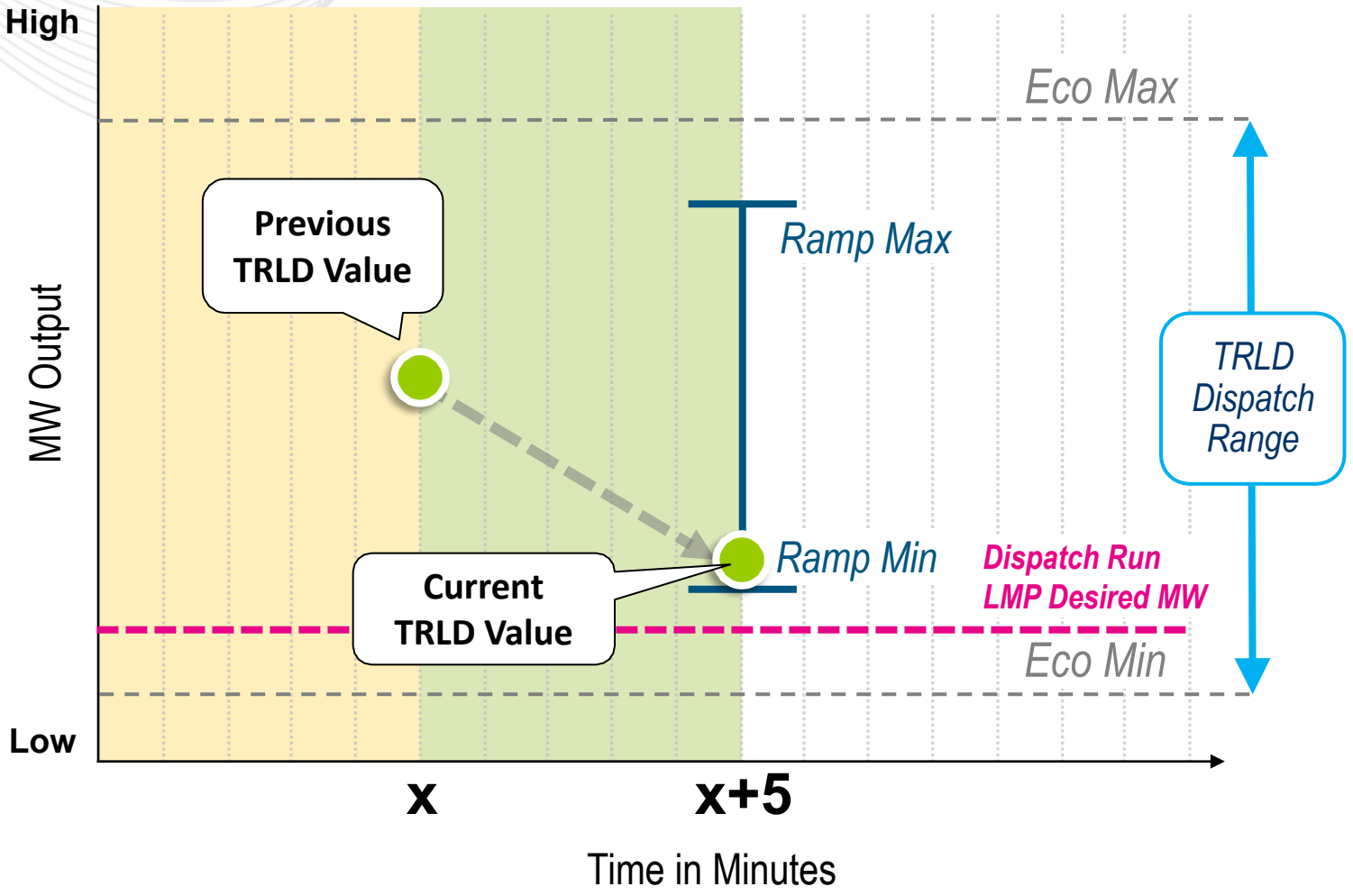
TRLD Calculation Overview

When:

Dispatch LMP Desired MW is *less than* ***Previous TRLD***

Current TRLD =
Previous TRLD + Ramp MW

Ramp MW < 0



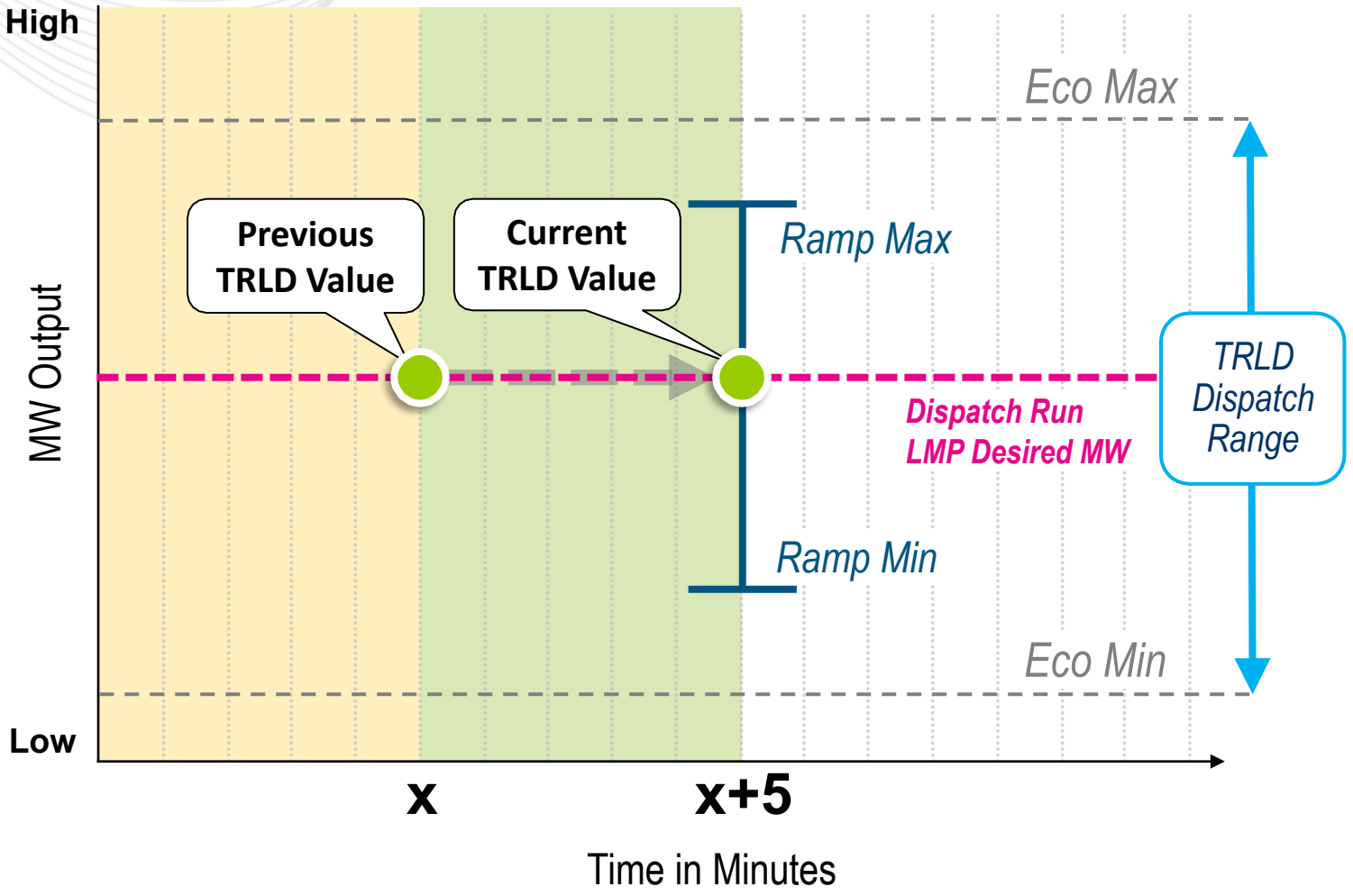
TRLD Calculation Overview

When:

Dispatch LMP Desired MW = ***Previous TRLD***

Current TRLD =
Previous TRLD

Ramp MW = 0



Power Vs. Energy

- PJM's energy market settles in energy (MWh).
- Generators provide hourly or five-minute metered energy data via Power Meter which represents the amount of power produced over the defined time (e.g. an hour or five minutes).
- "Power TRLD MW" is calculated first to represent the desired output at a specific point in time
- "Energy TRLD MW" is calculated as the average of the previous Power TRLD MW and current Power TRLD MW and represents the desired amount of power produced over five minutes.

Starting Interval of Tracking Calculation

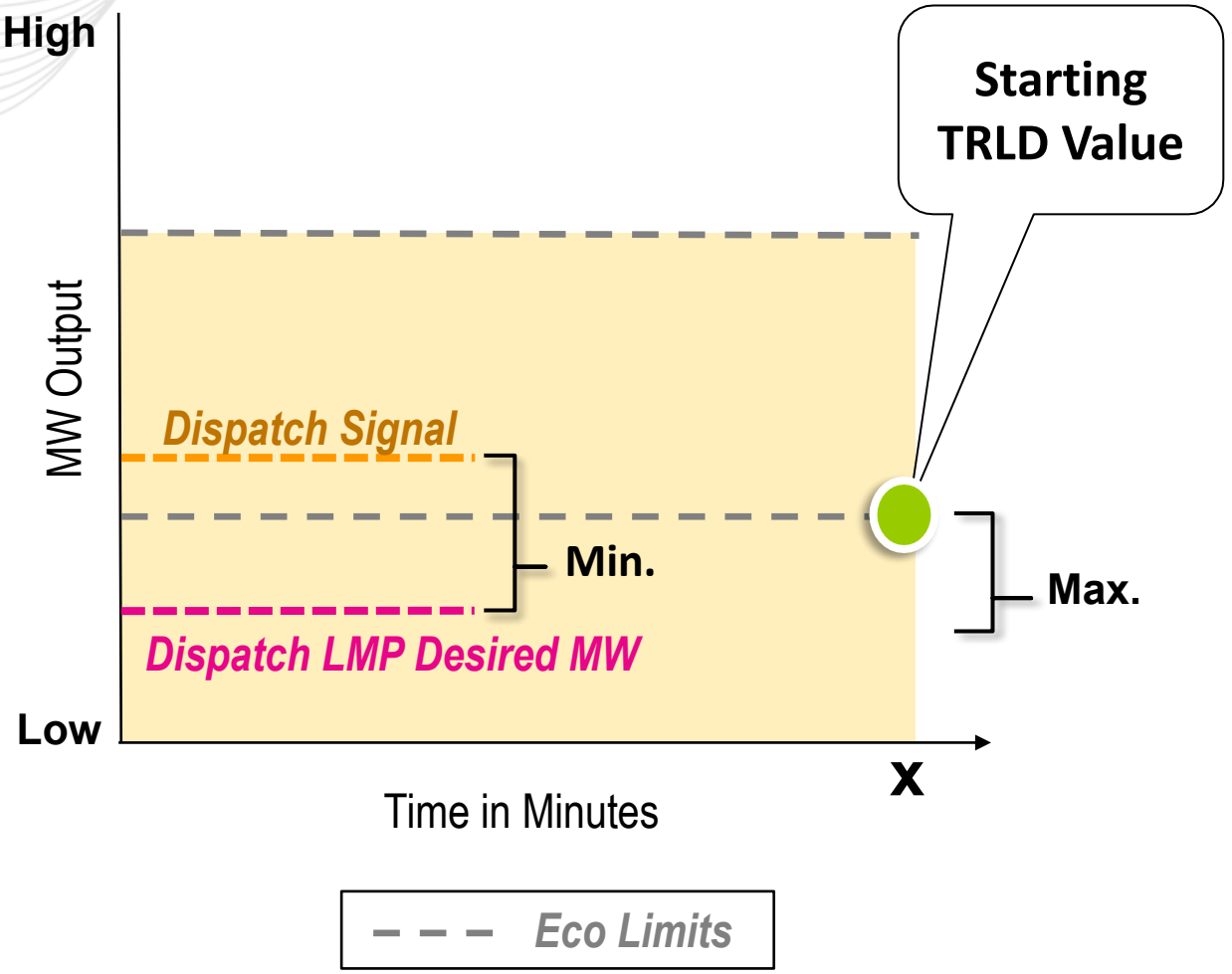
The starting interval (T_0) for a dispatchable unit depends on both the reason (DA/RT) for the unit coming online and its expected online time

- **For units committed in the future (e.g. DA Resources):** TRLD will start at first hour of Future Unit Commitment time
- **For units called in real-time:** TRLD will start at the earlier of the PJM Dispatch log time + Time to Start (Notification + Startup) or Unit Online
- **If a unit trips or fails to start:** TRLD calculation will continue to be calculated for all applicable intervals until the DA/MIN Run ends

TRLD Starting MW

For the starting interval, T_0, the unit's previous TRLD is calculated as:

- MAX (MIN (Dispatch LMP Desired MW, Dispatch Signal MW), RT Eco Min MW)
- Enforces that the unit should at least be online at the RT Eco Min MW
- Incorporating both Dispatch LMP Desired MW and Dispatch Signal MW, we can better reflect when a unit ramps up in advance of its expected schedule.



Step 1: Previous Interval Power TRLD MW

SCENARIO:

PJM schedules the unit in DA	**Eco Min =** 10 MW	**Eco Max =** 50 MW	**Ramp Rate =** 2 MW/min	**Ramp Interval =** 5 Min

Values:

Dispatch LMP Desired MW: 10

Determines Direction of TRLD (increase or decrease output)

Dispatch Signal MW: 15

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RT Min MW: 12

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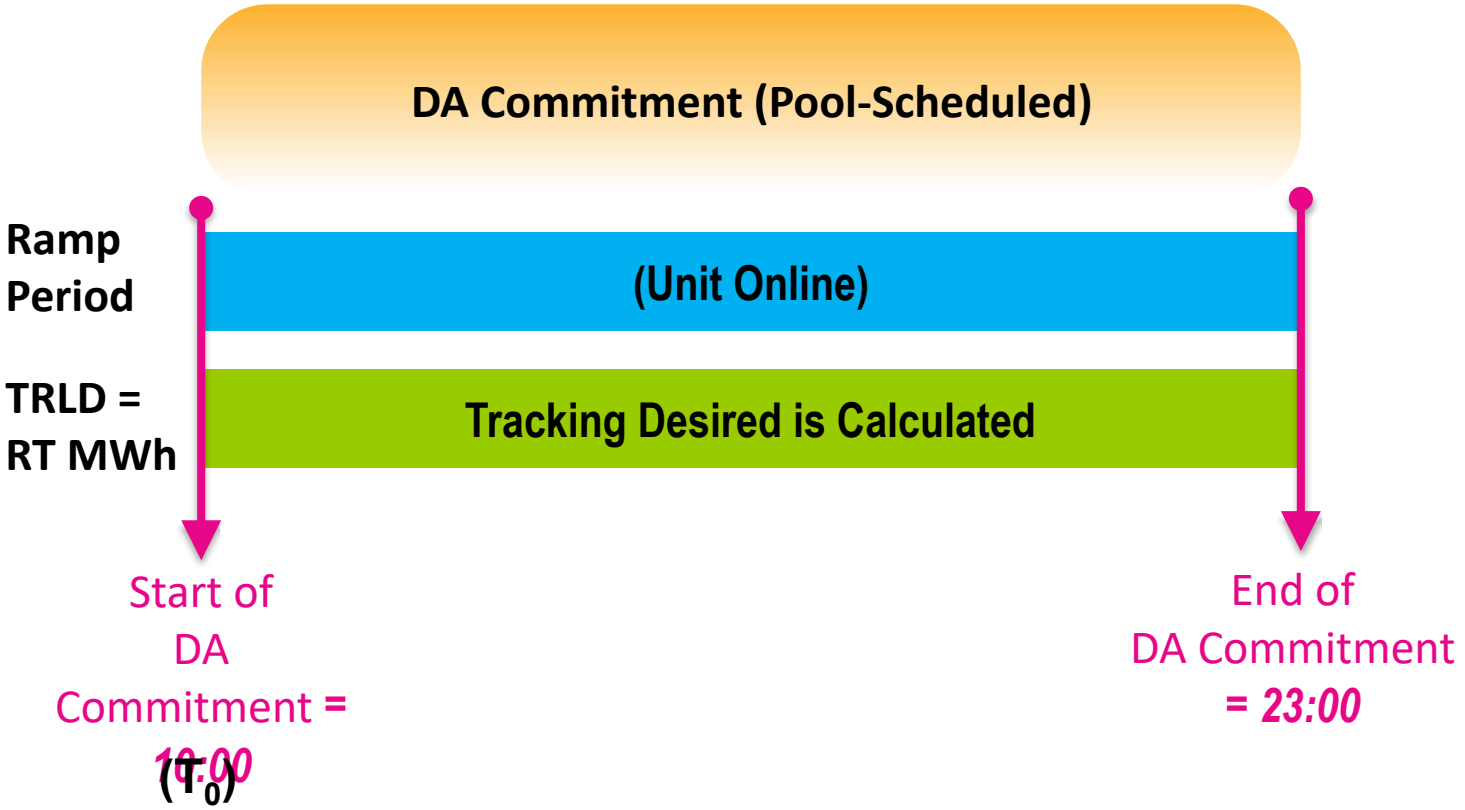
Previous Power TRLD MW: 12

(Starting Point)



Step 2: Ramp Direction Calculation

SCENARIO:

PJM schedules the unit in DA	**Eco Min =** 10 MW	**Eco Max =** 50 MW	**Ramp Rate =** 2 MW/min	**Ramp Interval =** 5 Min

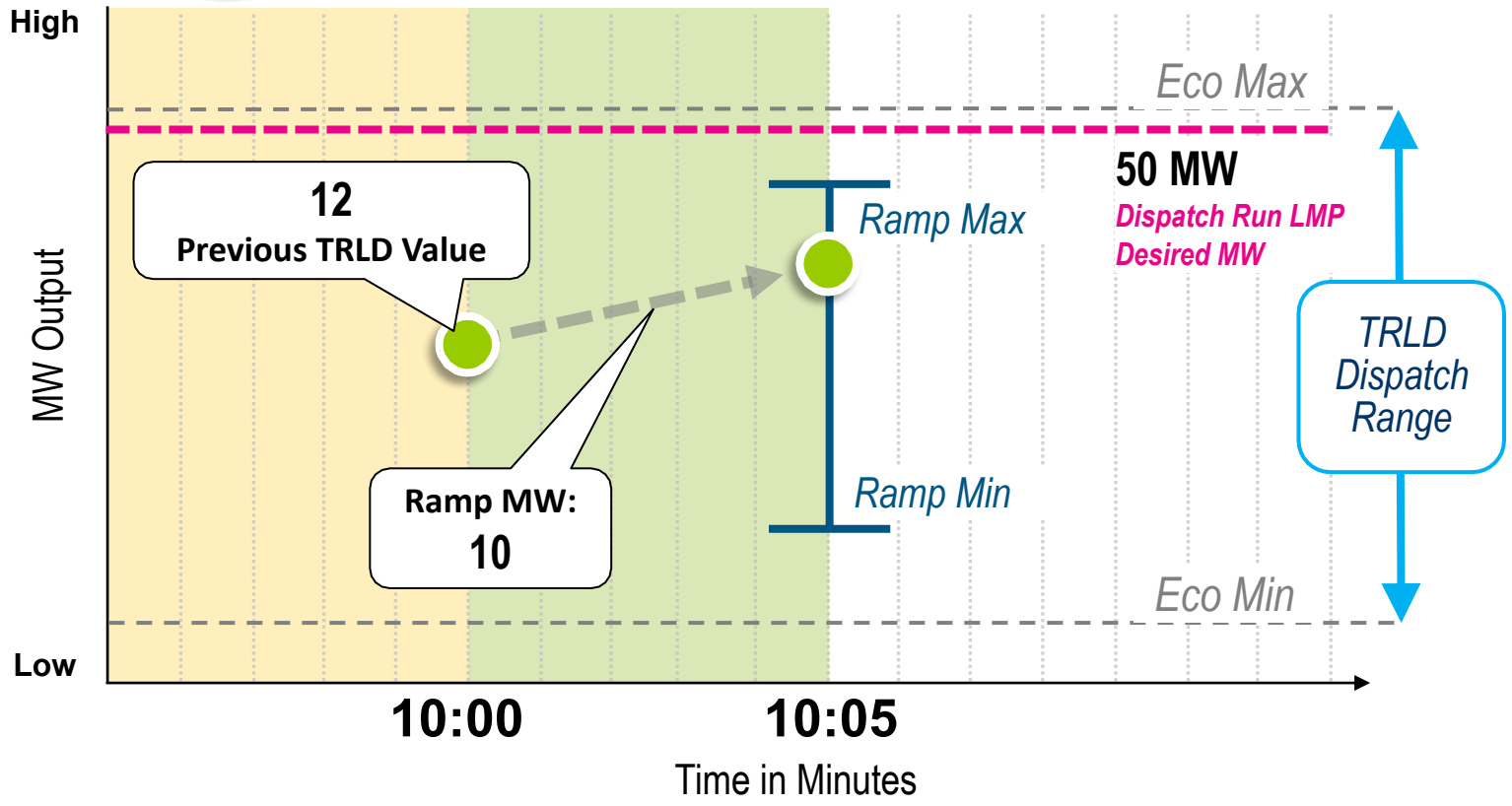
Values:

Previous TRLD: 12

Starting Point of Calculation

Dispatch LMP Desired MW: 50

Determines Direction of TRLD (increase or decrease output)



**During SCED outages utilize Zonal Dispatch Rates in lieu of Dispatch LMP

Step 3: Current Interval Power TRLD MW

SCENARIO:

PJM schedules the unit in DA	**Eco Min =** 10 MW	**Eco Max =** 50 MW	**Ramp Rate =** 2 MW/min	**Ramp Interval =** 5 Min

Values:

Dispatch LMP Desired MW: 50

Determines Direction of TRLD (increase or decrease output)

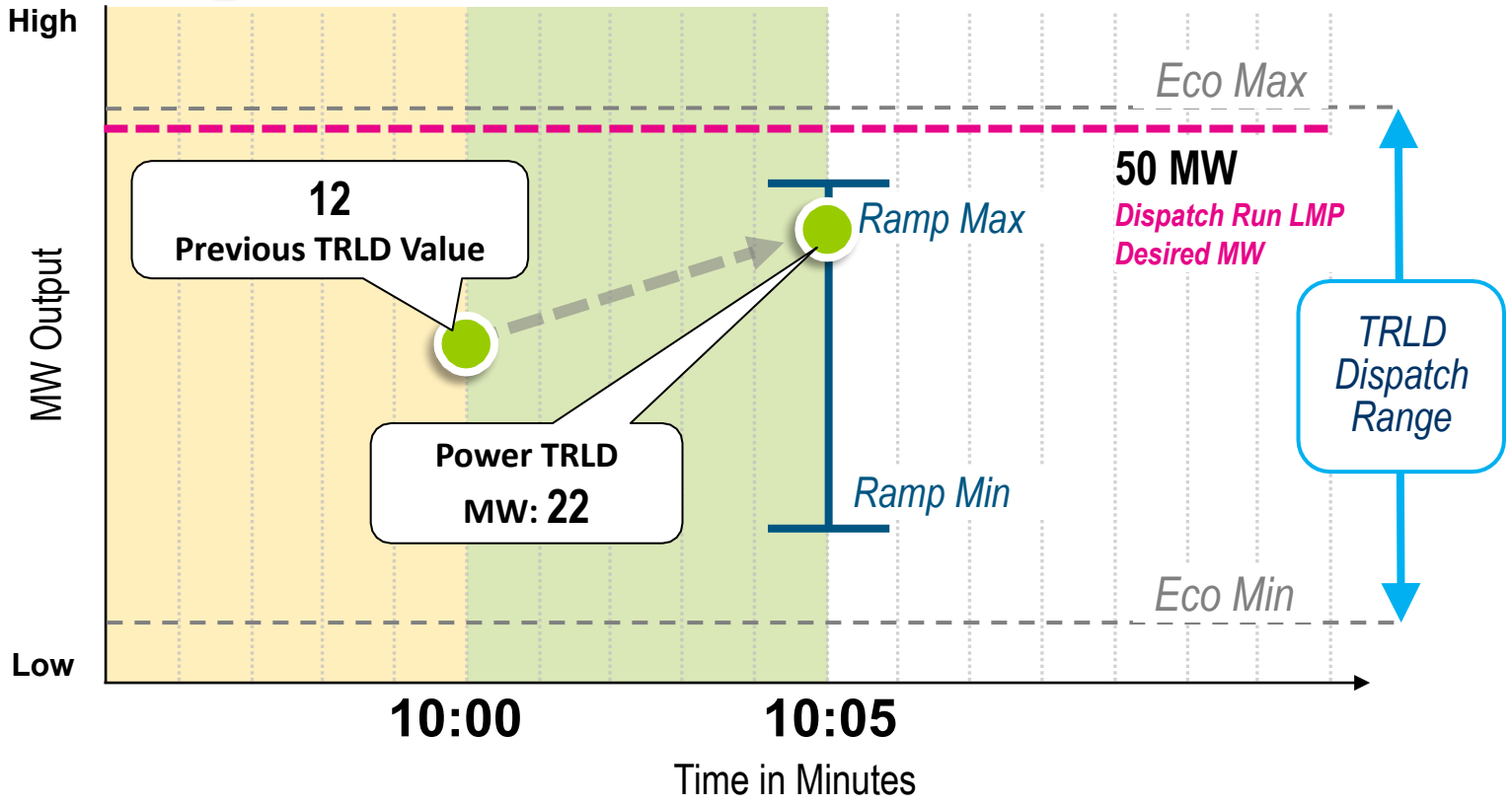
Ramp MW: 10

Ramp Rate & Ramp Interval

Calculation respects segmented ramp rates

Power TRLD MW: 22

Starting Point & Ramp MW



Step 4: Current Interval Energy TRLD MW

SCENARIO:

PJM schedules the unit in DA	**Eco Min =** 10 MW	**Eco Max =** 50 MW	**Ramp Rate =** 2 MW/min	**Ramp Interval =** 5 Min

Values:

Dispatch LMP Desired MW: 50

Determines Direction of TRLD (increase or decrease output)

Ramp MW: 10

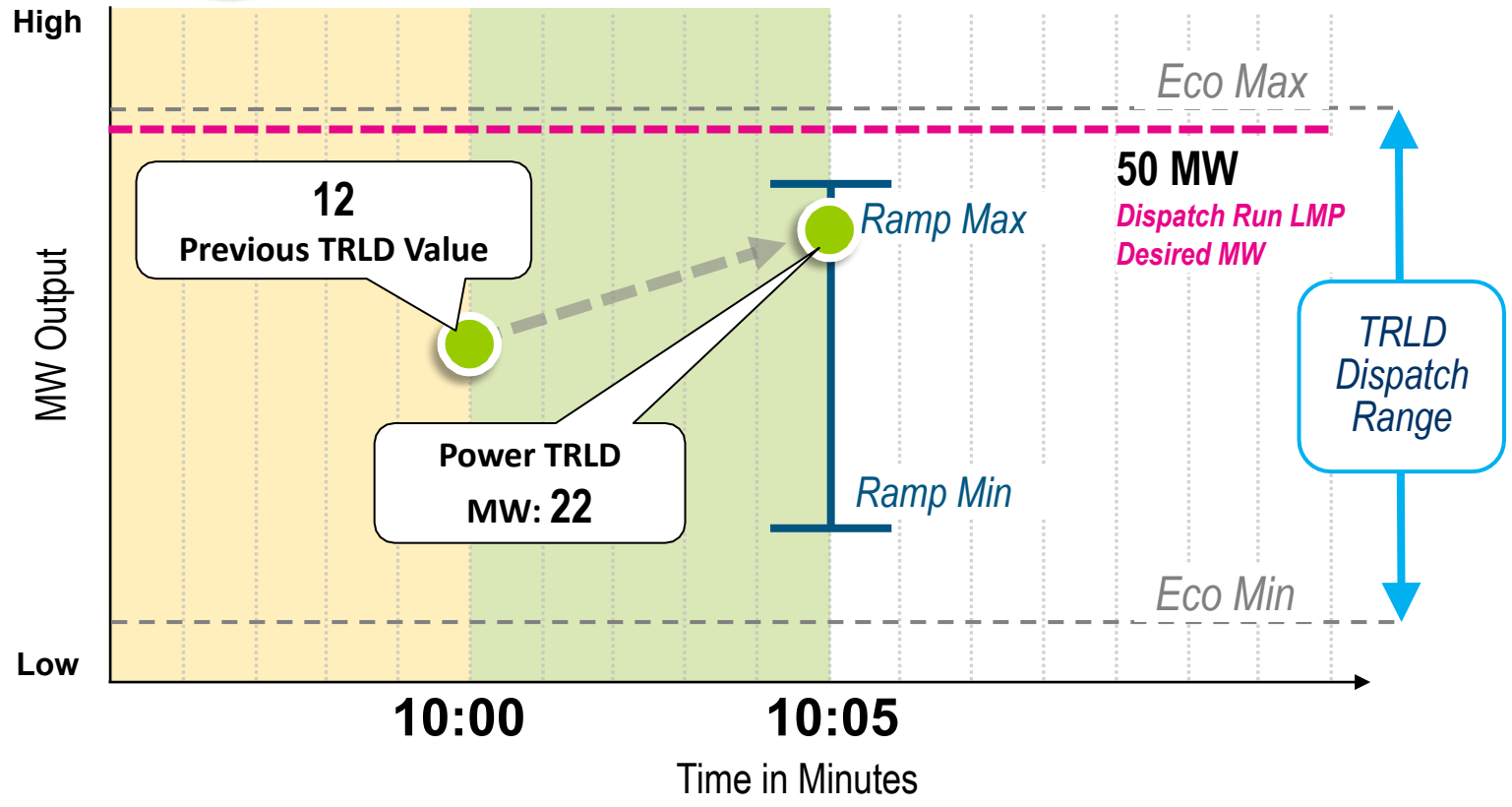
Ramp Rate & Ramp Interval

Power TRLD MW: 22

Starting Point & Ramp MW

Energy TRLD: 17

*Integrated between **Previous Power TRLD** and **Power TRLD** values*



TRLD calculation will continue until:

- **Unit is released:** TRLD calculation will continue to ramp down the unit until reaches EcoMin
- **Unit trips or fails to start:** TRLD calculation will continue to be calculated for all applicable intervals until the DA/MIN Run ends
- **If unit continues to remain online**, it shall be re-logged and TRLD calculation will continue

Stopping the TRLD Calculation

SCENARIO:

PJM schedules the unit in DA	**Eco Min =** 10 MW	**Eco Max =** 50 MW	**Ramp Rate =** 2 MW/min	**Ramp Interval =** 5 Min

Values:

Dispatch LMP Desired MW: 10

Determines Direction of TRLD (increase or decrease output)

Ramp MW: -10

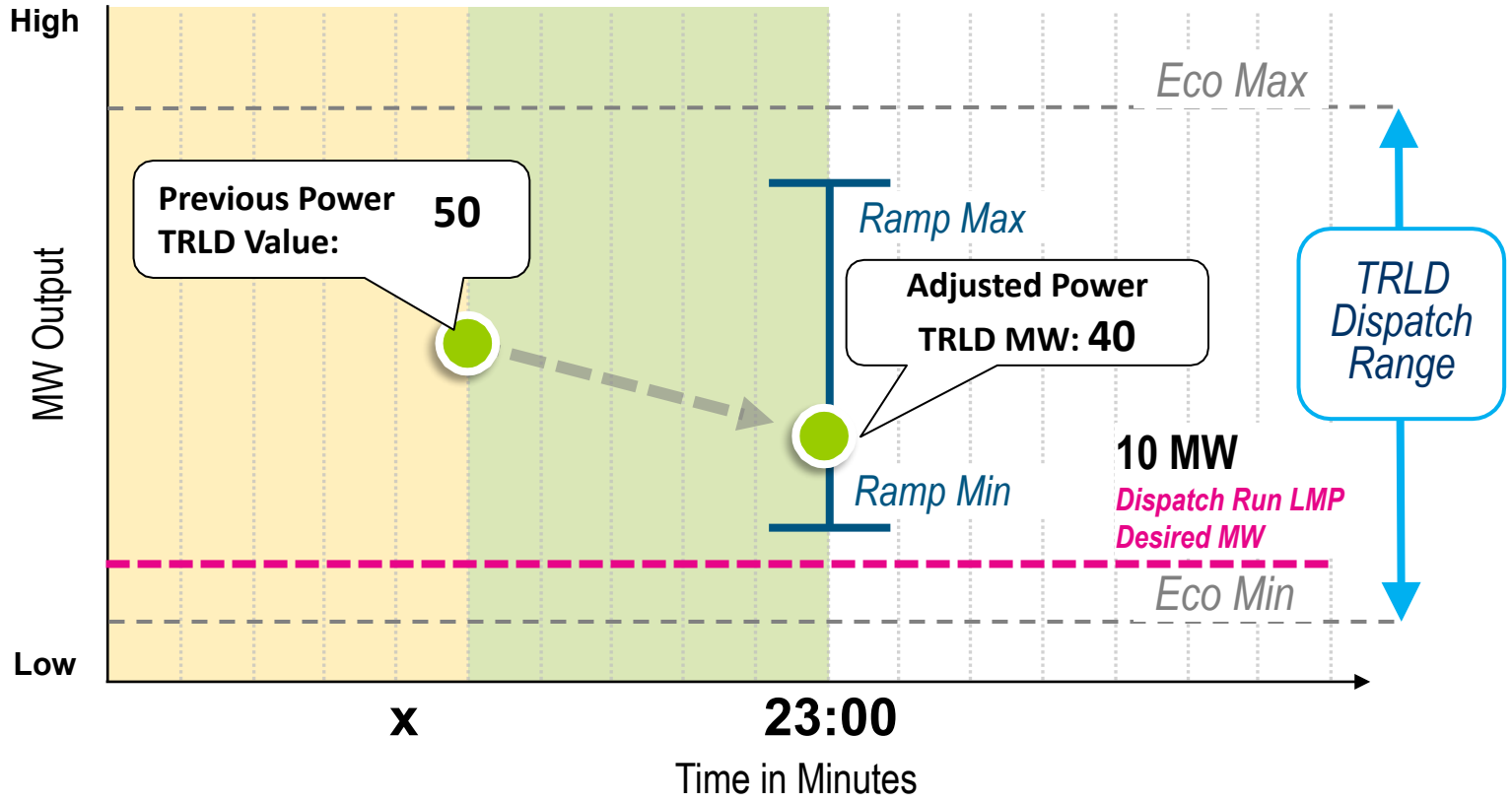
Ramp Rate & Ramp Interval

Adjusted Power TRLD MW: 40

Starting Point & Ramp MW

Adjusted Energy TRLD: 45

*Integrated average between **Previous Power TRLD** and **Power TRLD** values*



Current Interval Energy TRLD MW

SCENARIO:

PJM schedules the unit in DA	**Eco Min =** 10 MW	**Eco Max =** 50 MW	**Ramp Rate =** 2 MW/min	**Ramp Interval =** 5 Min

Interval Ending	Previous Power TRLD MW	Dispatch LMP Desired MW	Ramp MW	Power TRLD MW	Energy TRLD MWh
	Starting Point of Calculation	*Determines direction of TRLD*	*Ramp Rate & Ramp Interval*	*Previous Power TRLD MW ⇨ Ramp MW*	*Integrated average between Previous and TRLD values*
10:00(T_0)	12				
10:05	12	50	10	22	17
10:15	22	60	10	32	27
10:20	32	20	-10	22	27
10:25	22	22	0	22	22
23:00	22	0	-10	12	17

Business Rules Summary

Event Type	Start Tracking	Description
Start Tracking	Early Prior to DA Commitment	TRLD = RTMW
Start Tracking	Begins at Future Unit Commitment	Time of future Commitment otherwise, If no Future commitment, TRLD begins at → TTS (Notification + Startup, Unit online) The time of Commitment
Stop Tracking	Release	TRLD Ramps down to EcoMin then TRLD= RTMW
Stop Tracking	Trip/FTS	Continues until Min(DA commitment, MIN Run)
Start Tracking	Early Prior to DA Commitment	TRLD = RTMW

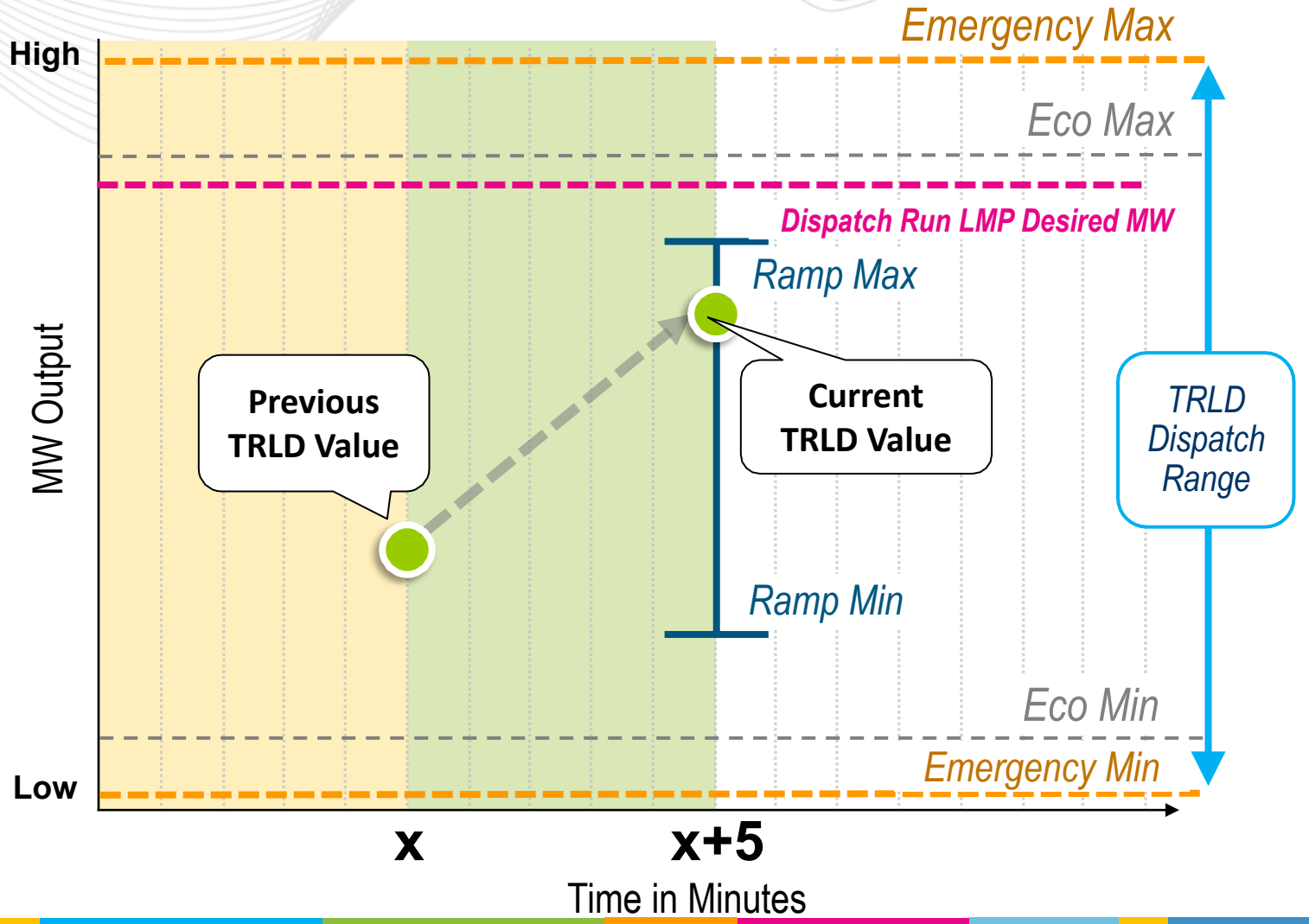
Adjustments to TRLD

Exception	Description
SCED Outage (Zonal Drate > 0)	TRLD will use the Zonal Dispatch rates sent from the PJM EMS instead of Dispatch LMP value.
Emergency Event	TRLD will use the Emergency Limits Reflected in TRLD Min/Max MW
Stability Limit (Y)	TRLD will limit the economic MAX used to the Stability Limit value

TRLD – Emergency Limits

Current TRLD values are limited by the Emergency Limits

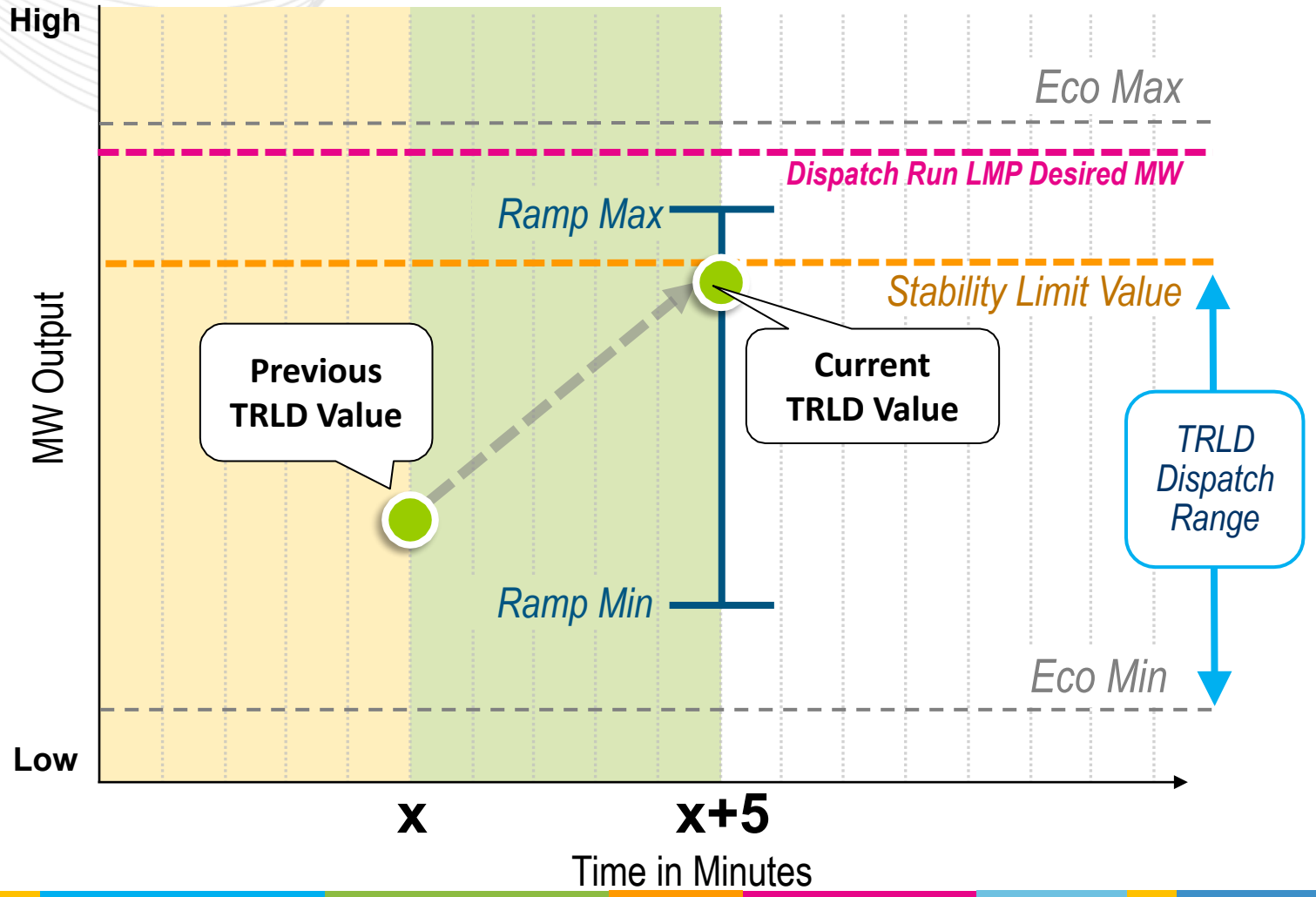
During applicable Emergency Events



TRLD – Stability Limits

Current TRLD values are limited by the Stability Limit Value

When Stability Limit is effective for specific resources or groups of resources



TRLD Vs. Adjusted TRLD

- TRLD is calculated to simulate a unit following PJM dispatch instructions in each interval for energy purposes.
- It cannot be used to reflect where PJM would have wanted a unit absent Ancillary Service Assignments or Manual Dispatch instructions for Lost Opportunity Cost purposes.
- As a result, an Adjusted TRLD value is also calculated for Lost Opportunity Cost (LOC) purposes to reflect where a resource would been dispatched for energy absent ancillary service commitments or manual dispatch instructions.

Adjusted TRLD Special Logic

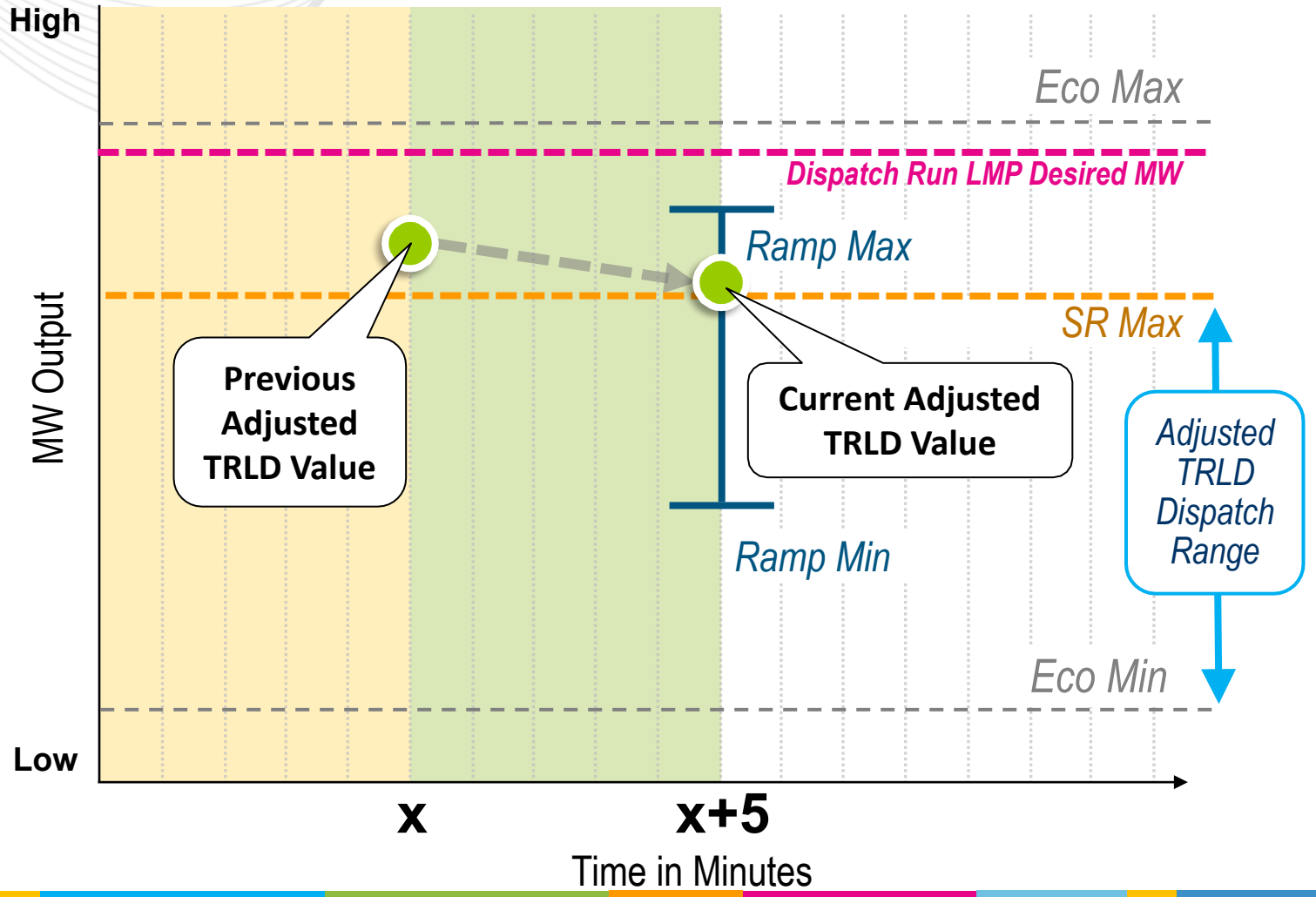
Exception	Description
Ancillary Service Assignments > 0	Adjusted TRLD will reduce the output of the resource to honor the ancillary service assignment
Regulation Ramp Share > 0	Adjusted TRLD limits the ramp MW capability of resource
Manual Dispatch (Y)	Adjusted TRLD will use the override economic limits reflected in Adjusted TRLD Min/Max MW

***The adjustments to TRLD described on slide 21 also apply to Adjusted TRLD value*

Adjusted TRLD – Reserve Assignments

Unit did not have a reserve assignment in the previous interval

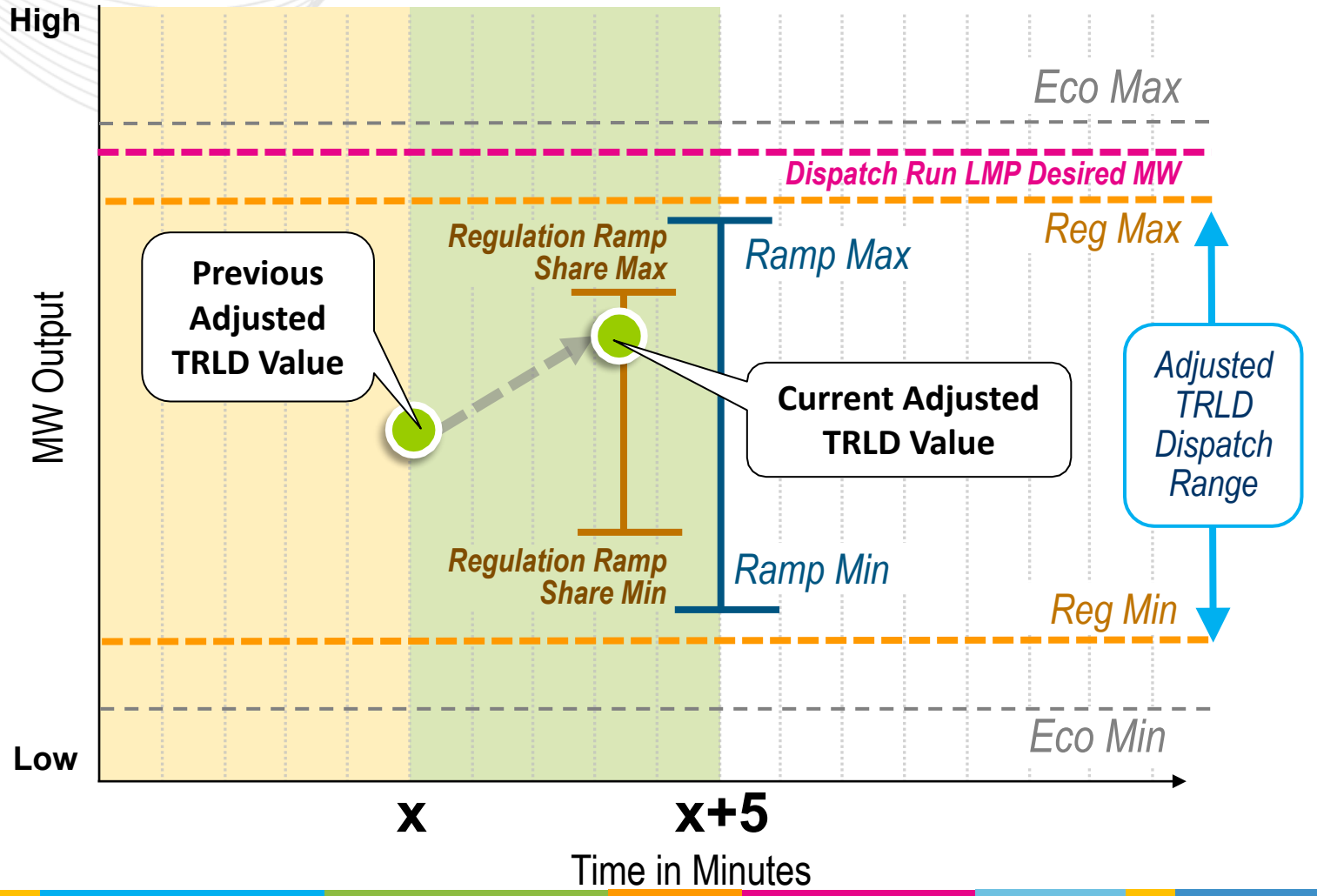
Current Adjusted TRLD value is limited by the Reserve MAX MW



Adjusted TRLD – Regulation Assignment

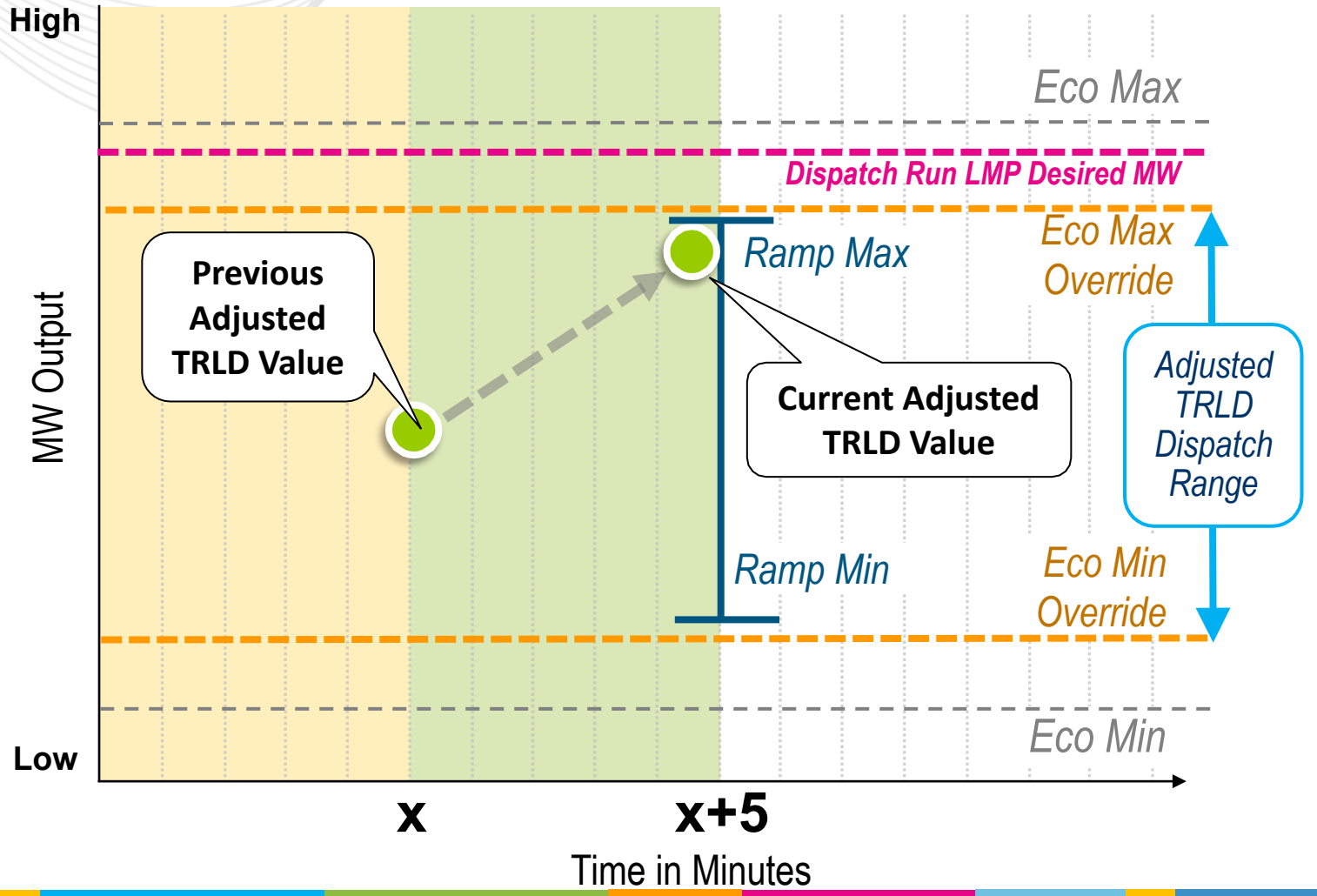
Regulation ramp share may reduce unit's adjusted ramp MW.

Current Adjusted TRLD value is limited by the Regulation Limits



Adjusted TRLD – Manual Dispatch

Current Adjusted TRLD Max or Min value is limited, if applicable, by Manual Dispatch Override Limits



MSRS – TRLD New Reports

MSRS Report	Report Information
Energy Uplift Generator Tracking Ramp Limited Desired	Detailed breakdown of generator data used in TRLD calculation
Unit Tracking Ramp Details	Supporting details for ramp MW segments used in the TRLD calculation

MSRS Report Documentation for new reports has been posted on pjm.com.
Report documentation (Description, CSV, and XML) is also posted with May MSS materials.

Future Work and Next Steps

Upcoming Enhancements

- Define appropriate eco-limits for RT-only commitments
- Regulation Ramp Share
- Incorporate Emergency Min usage
- After the fact Offer verification updates

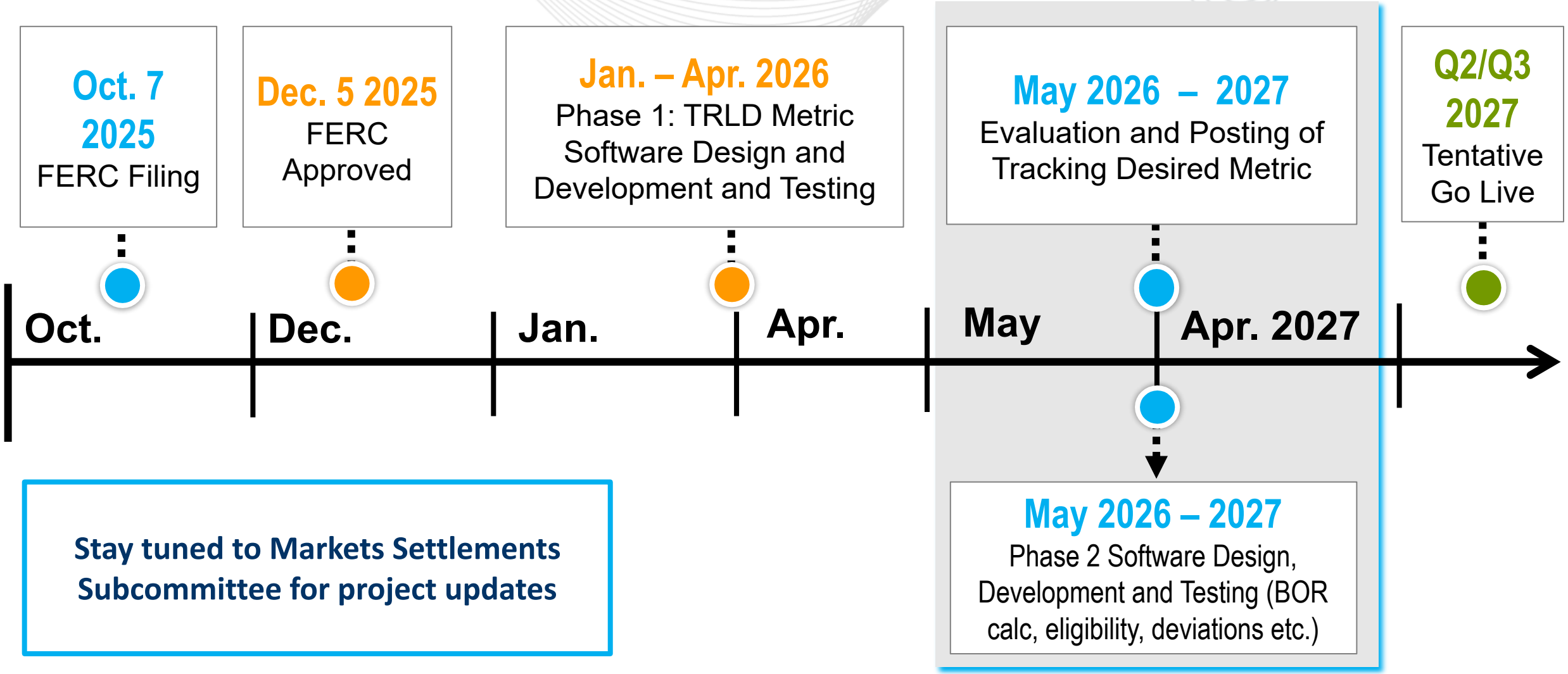
Parallel evaluation period: ~1 year

Ongoing evaluation, defect fixes, and enhancements | Additional updates to calculations and reports

Project updates, when available, will be sent to MSS

MSS meetings planned in 2027 for Phase 2 Energy Uplift Make Whole implementation

Timeline



Stay tuned to Markets Settlements Subcommittee for project updates

Key Takeaways

1

- Phase 1 TRLD calculations deployed to production to support parallel evaluation
- Report availability follows normal settlements processing dates

2

- MSRS Reports available in Sandbox
- MSRS Reports available in Production beginning with May 2026 Billing Month
- Any TRLD related questions during parallel evaluation can be sent to mrkt_settlement_ops@pjm.com

3

- New Report Documentation posted to MSRS webpage on pjm.com
- Additional communications will be sent to MSS distribution list containing details on future enhancements, sandbox/training availability and documentation updates.

Contact

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BOR Credit Reform: Tracking Ramp Limit Desired MW Calculation

Member Hotline

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Appendix – Reference Materials

Additional Information

- Issue Tracking
- MIC Special Session Detailed Proposal Overview
- Consolidated BOR Credit Proposal Examples
- CBIR Matrix

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