



California ISO
Shaping a Renewed Future

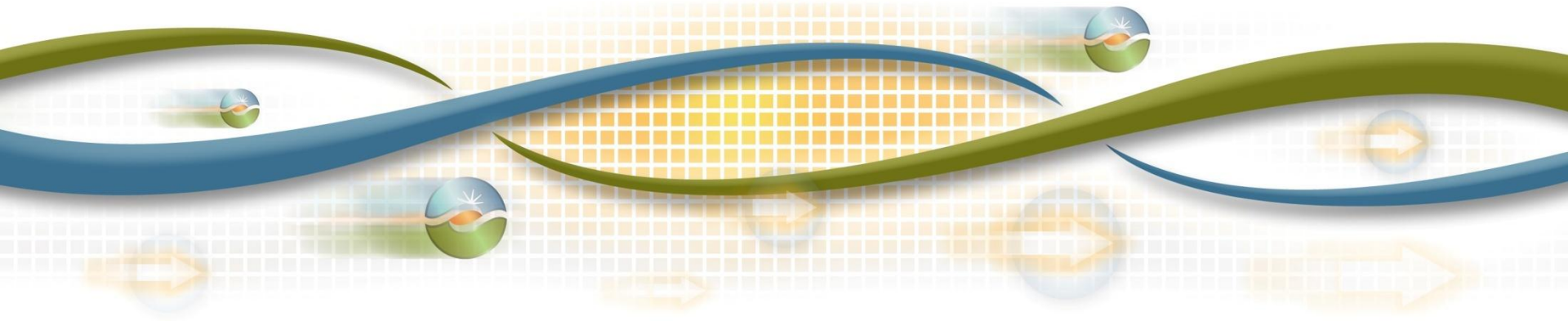
Multi-Stage Generation: Modeling Enhancements

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March 1, 2012



Agenda

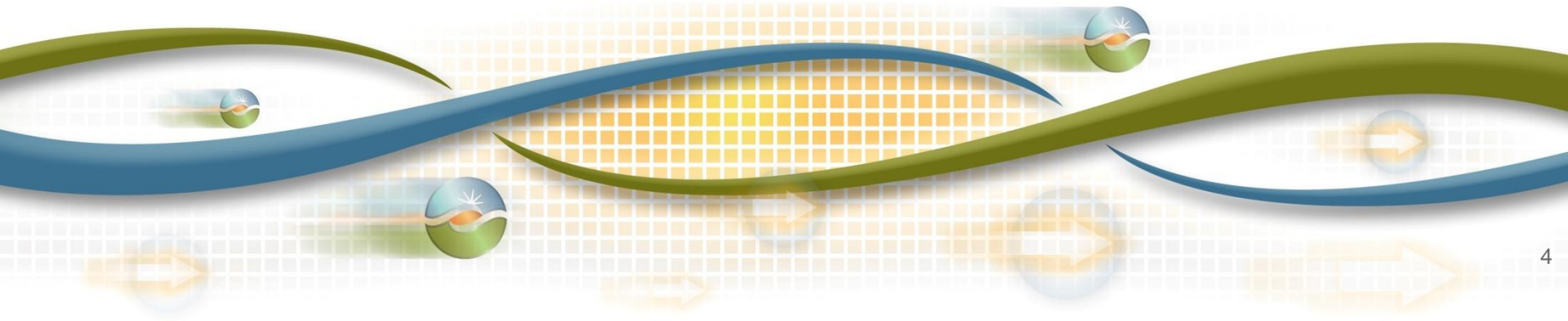
- Background
- Summary of refinements
- Biddable configurations and path limits
- Bidding requirements
- Ramp rates
- Real-time self scheduling flexibility
- Minimum load cost accounting

Course objectives

The goal of this session is to enable participants to:

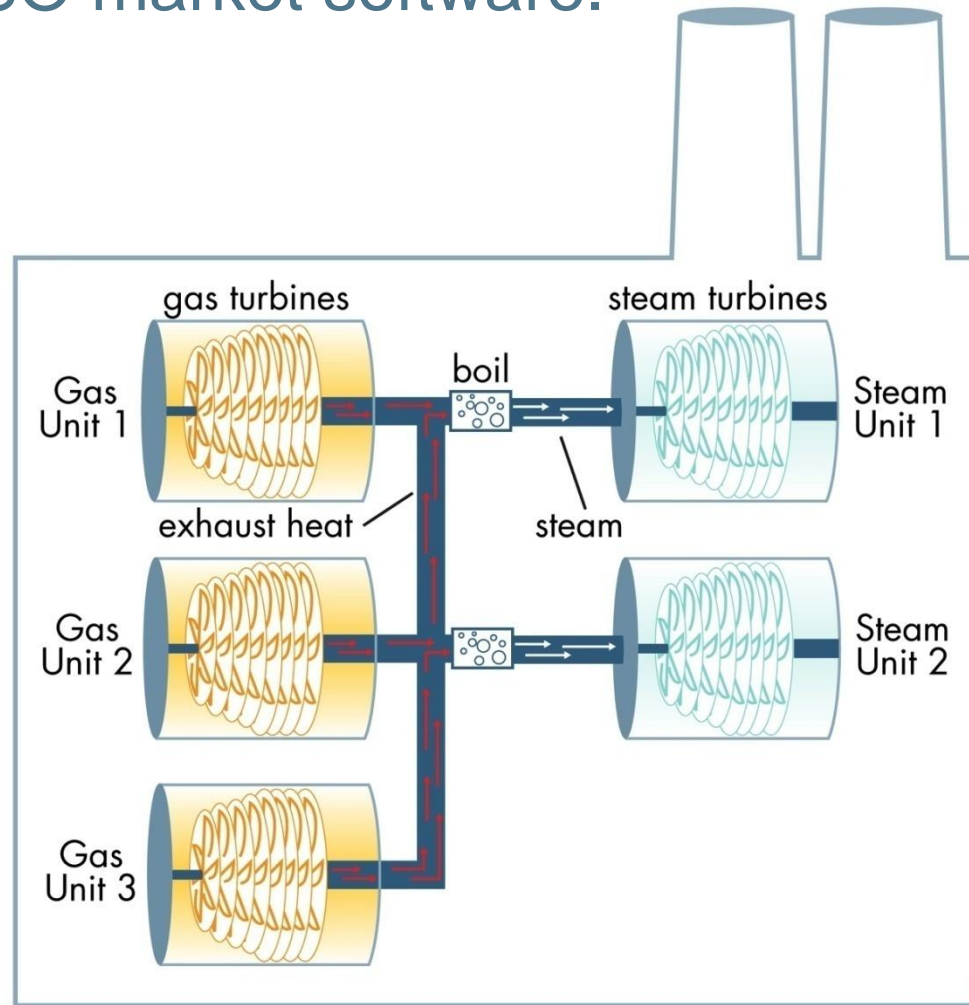
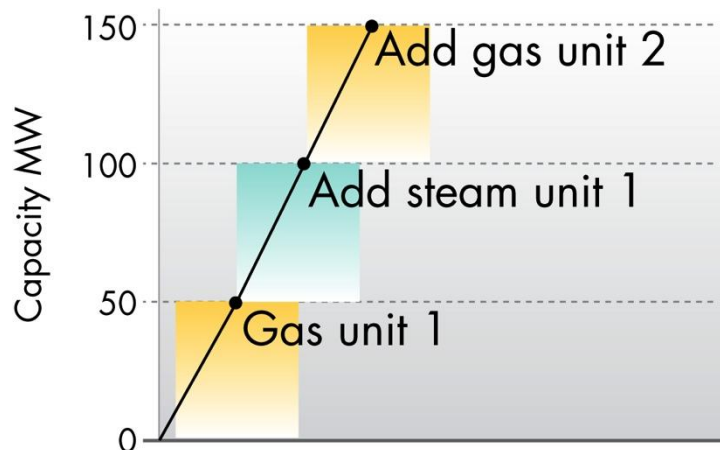
- Identify the planned enhancements for multi-stage generating units
- Evaluate how these changes will impact their current business processes with the ISO

Background



Multi-stage generating resources are flexible but complex to model in the ISO market software.

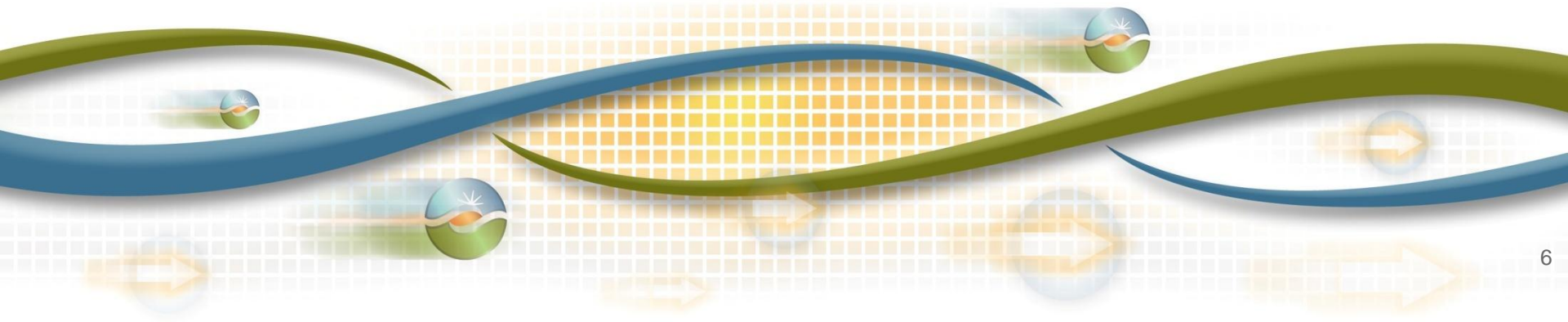
- *Multi-stage generating unit modeling enables economic dispatch based on bids and operating constraints of each configuration*





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Summary of refinements

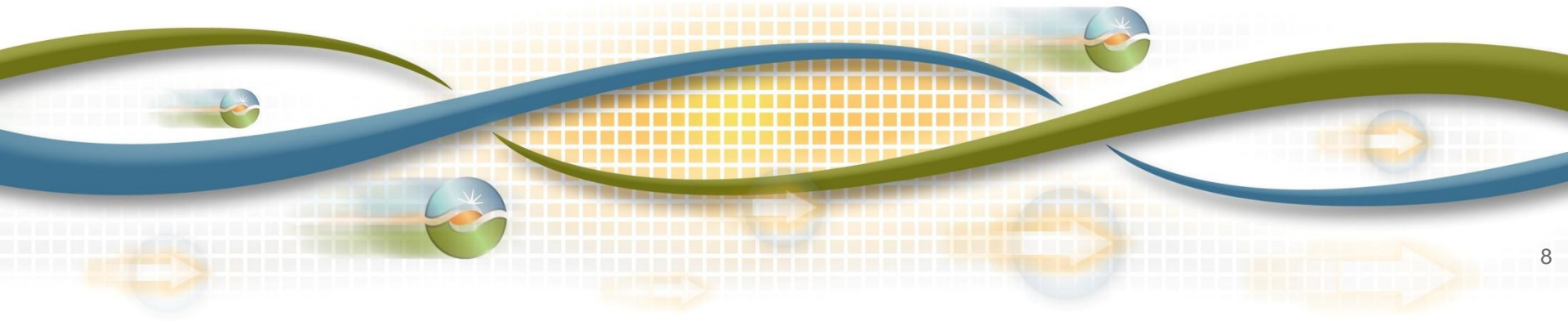


Experience has enabled the identification of several enhancements for more efficient real-time dispatch.

Current	New*
3 configurations in the real-time market	6 configurations in the real-time market
No bids required below RA capacity	Bids required down to minimum operating level
Maintain same configuration for day-ahead and real-time self-schedules	Different configurations allowed for day-ahead and real-time self-schedules
1 ramp-rate for each configuration	2 ramp-rates for each configuration
No minimum load cost recovery if unit does not reach dispatched configuration	Allow minimum load costs of configuration reached

* These proposed enhancements are pending FERC approval (FERC Docket No. ER12-992-000)

Change 1 - Biddable configurations



Number of biddable configurations in real-time

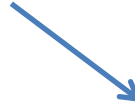
- Current limit is 3 configurations + 1 for RA, + 1 for RUC
- Concern about performance of optimization
- New
 - Increase the number of biddable configurations in real-time to 6 +1 for RA, +1 for RUC
 - If RA capacity is not bid-in as required, generated bids will be inserted on their behalf
 - No change to number of registered configurations (10)

Limit the number of paths between configurations

- Currently there is no limit on number of paths
- No MSG resources have specified more than **3** paths
- Many transition paths → significant problem for the MSG algorithm
- New
 - Units with 2-6 registered configurations, no limit on registered paths
 - Units with 7-10 registered configurations, limit to 2 registered paths

Example

More permutations



MSG Resource A

- Configuration 1
 - Transition A
- Configuration 2
 - Transition A
- Configuration 3
 - Transition A
- Configuration 4
 - Transition A

MSG Resource B

- Configuration 1
 - Transition A
 - Transition B
 - Transition C
- Configuration 2
 - Transition A
 - Transition B
 - Transition C
- Configuration 3
 - Transition A
 - Transition B
 - Transition C

Resources with 6 registered configurations – upward transitions

From C-1	From C-2	From C-3	From C-4	From C-5
1 to 2				
1 to 3	2 to 3			
1 to 4	2 to 4	3 to 4		
1 to 5	2 to 5	3 to 5	4 to 5	
1 to 6	2 to 6	3 to 6	4 to 6	5 to 6

Resources with 6 registered configurations – downward transitions

From C-2	From C-3	From C-4	From C-5	From C-6
				6 to 5
			5 to 4	6 to 4
		4 to 3	5 to 3	6 to 3
	3 to 2	4 to 2	5 to 2	6 to 2
2 to 1	3 to 1	4 to 1	5 to 1	6 to 1

Resources with 10 registered configurations – upward transitions

From C-1	From C-2	From C-3	From C-4	From C-5	From C-6	From C-7	From C-8	From C-9
1 to 2								
1 to 3	2 to 3							
1 to 4	2 to 4	3 to 4						
1 to 5	2 to 5	3 to 5	4 to 5					
1 to 6	2 to 6	3 to 6	4 to 6	5 to 6				
1 to 7	2 to 7	3 to 7	4 to 7	5 to 7	6 to 7			
1 to 8	2 to 8	3 to 8	4 to 8	5 to 8	6 to 8	7 to 8		
1 to 9	2 to 9	3 to 9	4 to 9	5 to 9	6 to 9	7 to 9	8 to 9	
1 to 10	2 to 10	3 to 10	4 to 10	5 to 10	6 to 10	7 to 10	8 to 10	9 to 10

Limit to 2 from each of these columns

Resources with 10 registered configurations – downward transitions

From C-2	From C-3	From C-4	From C-5	From C-6	From C-7	From C-8	From C-9	From C-10
								10 to 9
							9 to 8	10 to 8
						8 to 7	9 to 7	10 to 7
					7 to 6	8 to 6	9 to 6	10 to 6
				6 to 5	7 to 5	8 to 5	9 to 5	10 to 5
			5 to 4	6 to 4	7 to 4	8 to 4	9 to 4	10 to 4
		4 to 3	5 to 3	6 to 3	7 to 3	8 to 3	9 to 3	10 to 3
	3 to 2	4 to 2	5 to 2	6 to 2	7 to 2	8 to 2	9 to 2	10 to 2
2 to 1	3 to 1	4 to 1	5 to 1	6 to 1	7 to 1	8 to 1	9 to 1	10 to 1



Limit to 2 from each of these columns

MSG Reference Data Template

MSGReferenceDataTemplate [Read-Only] [Compatibility Mode] - Microsoft Excel

Home Insert Page Layout Formulas Data Review View

Clipboard Font Alignment Number Styles Cells Editing

Security Warning Data connections have been disabled Options...

G13

	A	B	C	D	E	F	G
1	Resource ID	Configuration ID_From	Configuration ID_To	Transition Cost	Max Transition Cost	Transition Ramp Time	Notification Time
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							

For a resource with 7 to 10 registered configurations, each configuration can only appear in the "Configuration ID_From" field twice

Transition tab

FORBIDDEN OPR REGION REGULATION REG RAMP OP RES RAMP MSG CONFIG TRANSITION CONFIG RAMP CONFIG HEAT

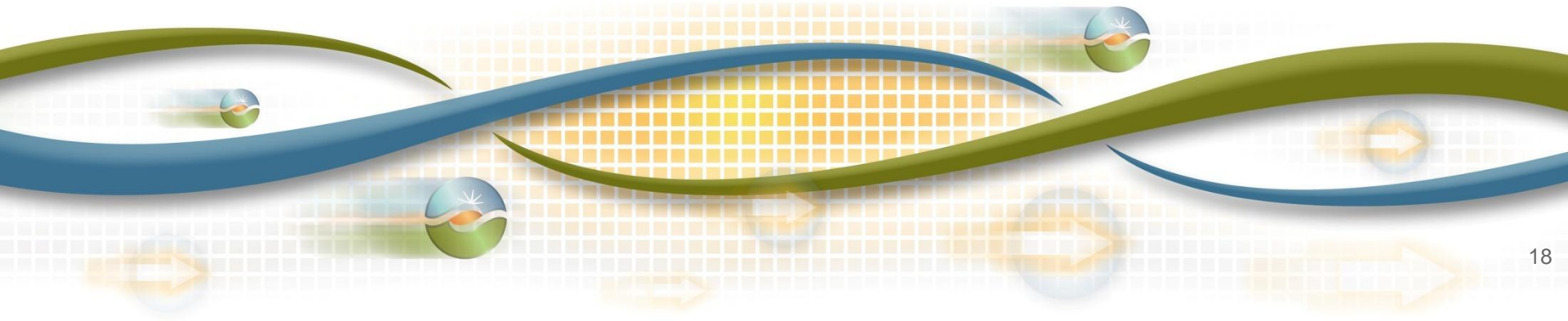
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The MSG Reference Data Template is on the ISO website

- Caiso.com>Market & Operations>Network and Resource Modeling
- <http://www.caiso.com/Documents/MSG%20Registration>

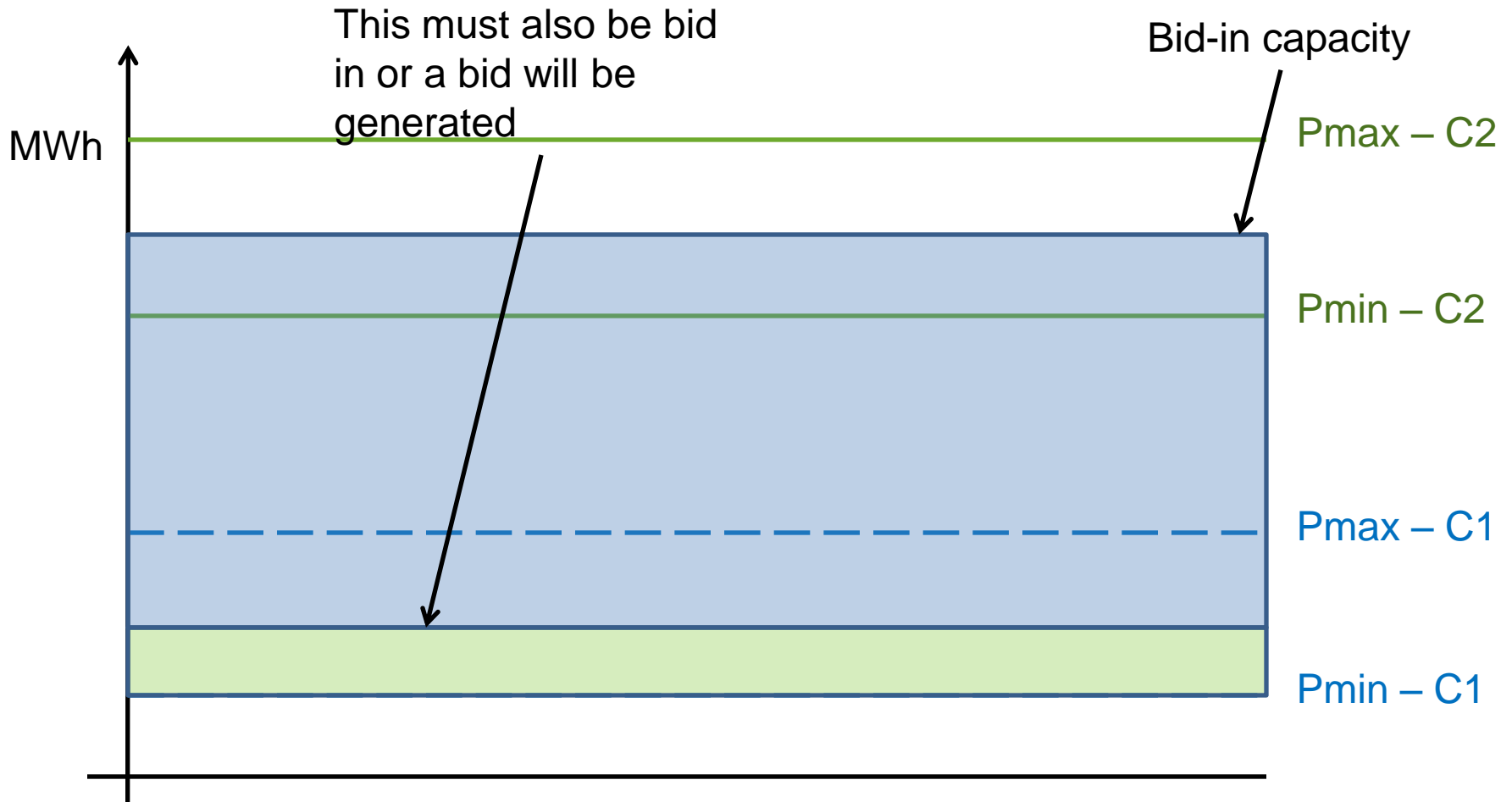
Change 2 – Bidding requirements



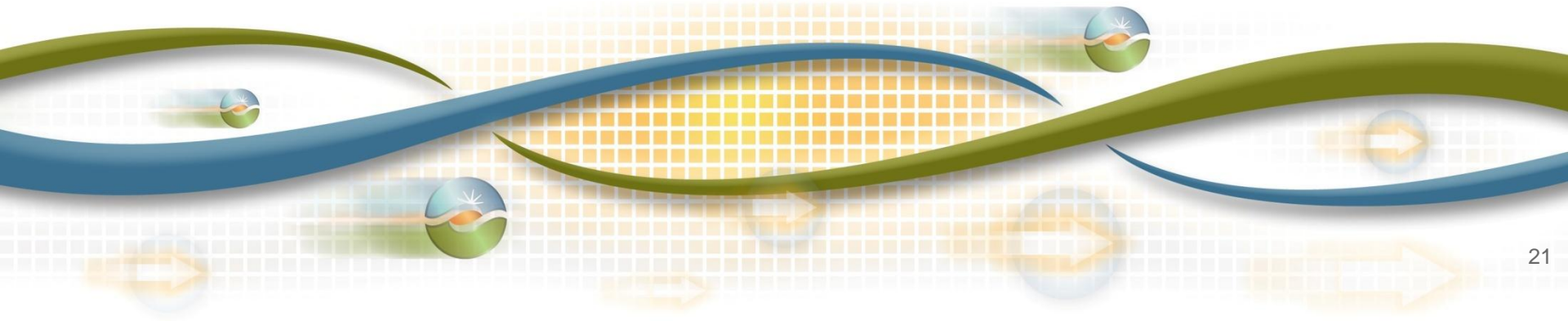
Add bidding requirements on lower configurations

- Requires that MSG resources bid in configurations as necessary to provide capacity from the maximum of the resource P_{min} (or the self-schedule) to the higher of
 - Their contracted RA capacity, or
 - Their maximum bid-in capacity
- This is consistent with the requirements for non-MSG resources
- Having additional biddable configurations in real-time will make this requirement less onerous

New bidding requirements



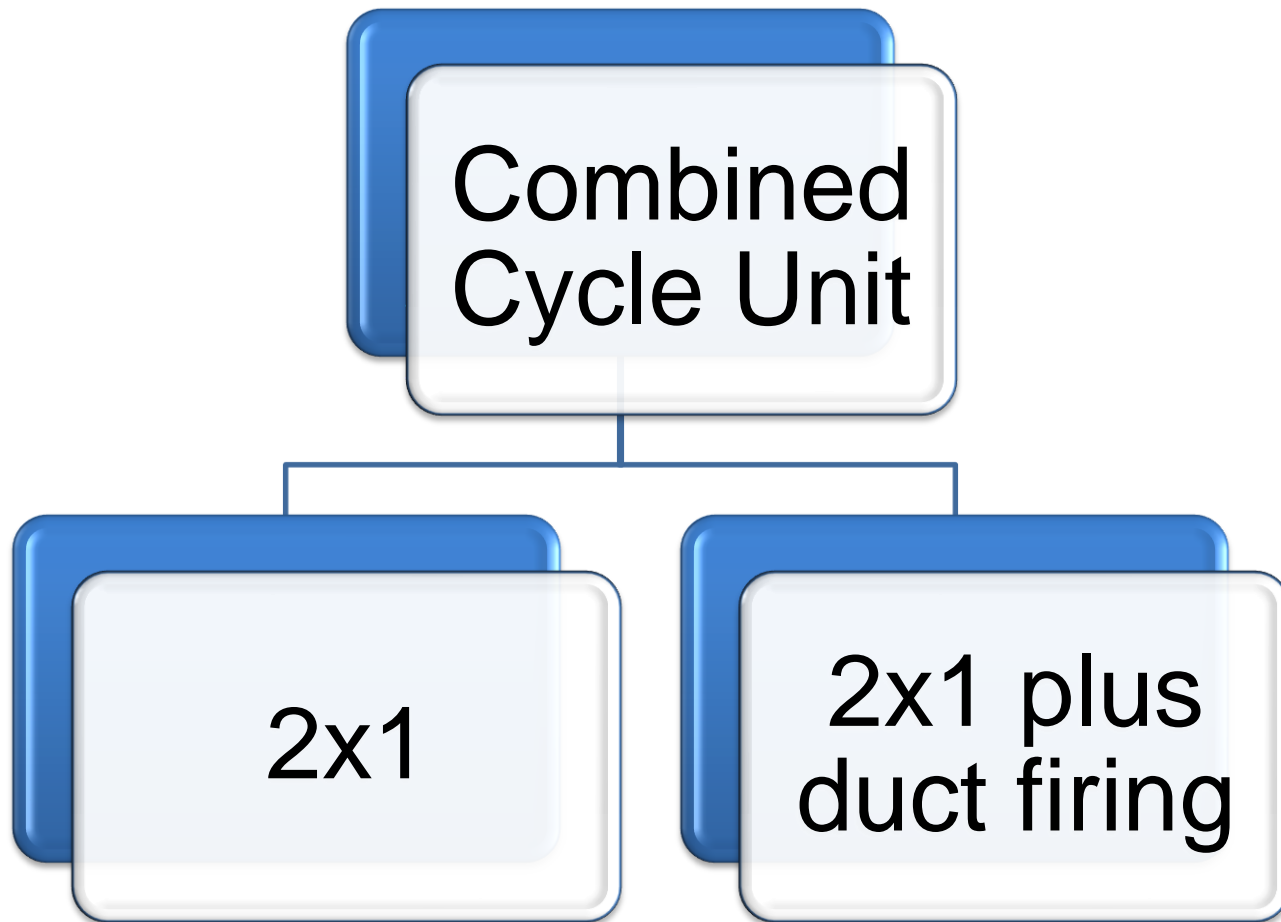
Change 3 – Ramp rates



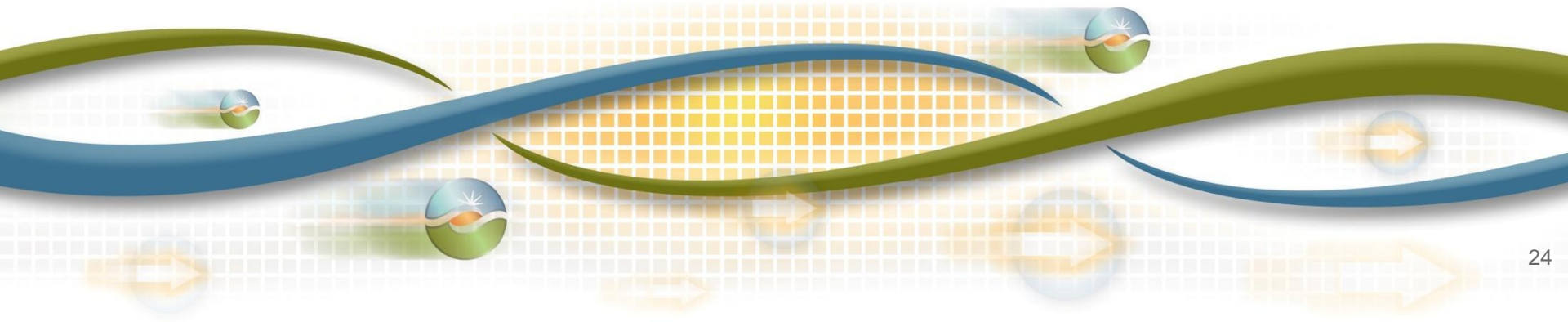
Allow two ramp rates per configuration

- The current MSG functionality allows only one ramp-rate to be defined and bid-in per configuration
- This limit was put in place out of concern that more ramp rates per configuration might slow optimization
- A unit may have largely different ramp rates within one configuration

Example: A combined cycle unit that can operate in two modes



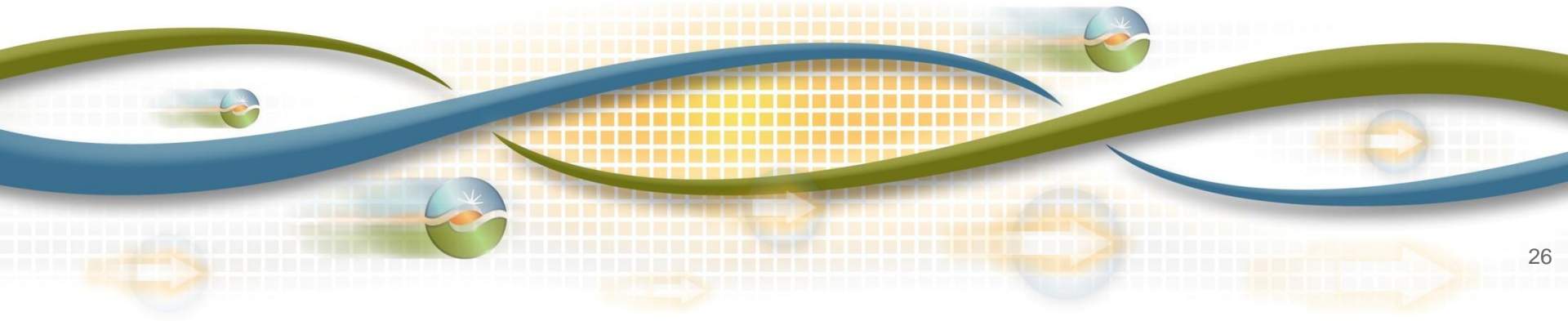
Change 4 – Real-time self scheduling flexibility



Self-scheduling flexibility between day-ahead and real-time

- Currently, if an MSG has a day-ahead self-schedule or ancillary service award then it can submit a real-time self-schedule only into that same configuration
- New
 - Real-time self-scheduled configuration can be different if it can support the day-ahead ancillary service and RUC awards

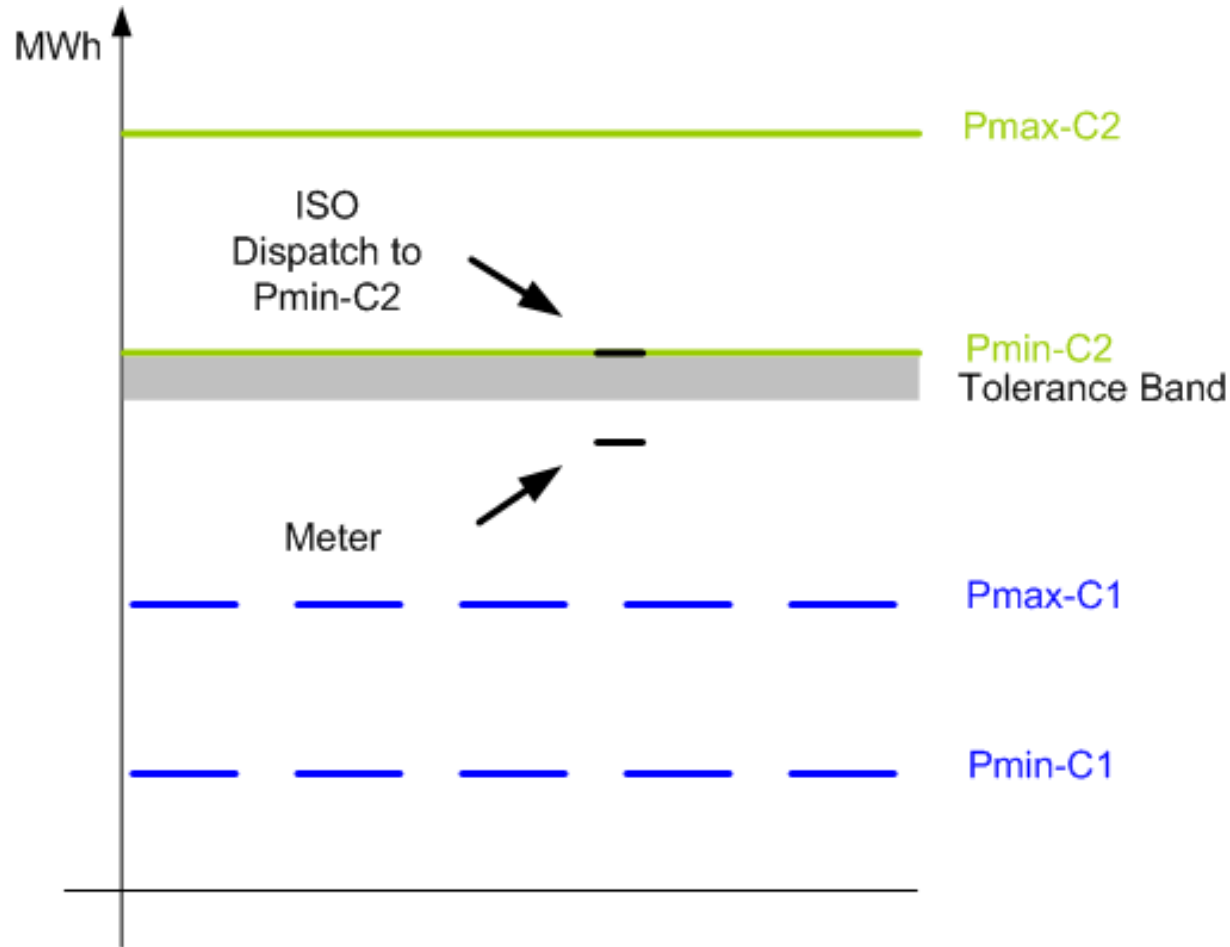
Change 5 – Minimum load cost accounting



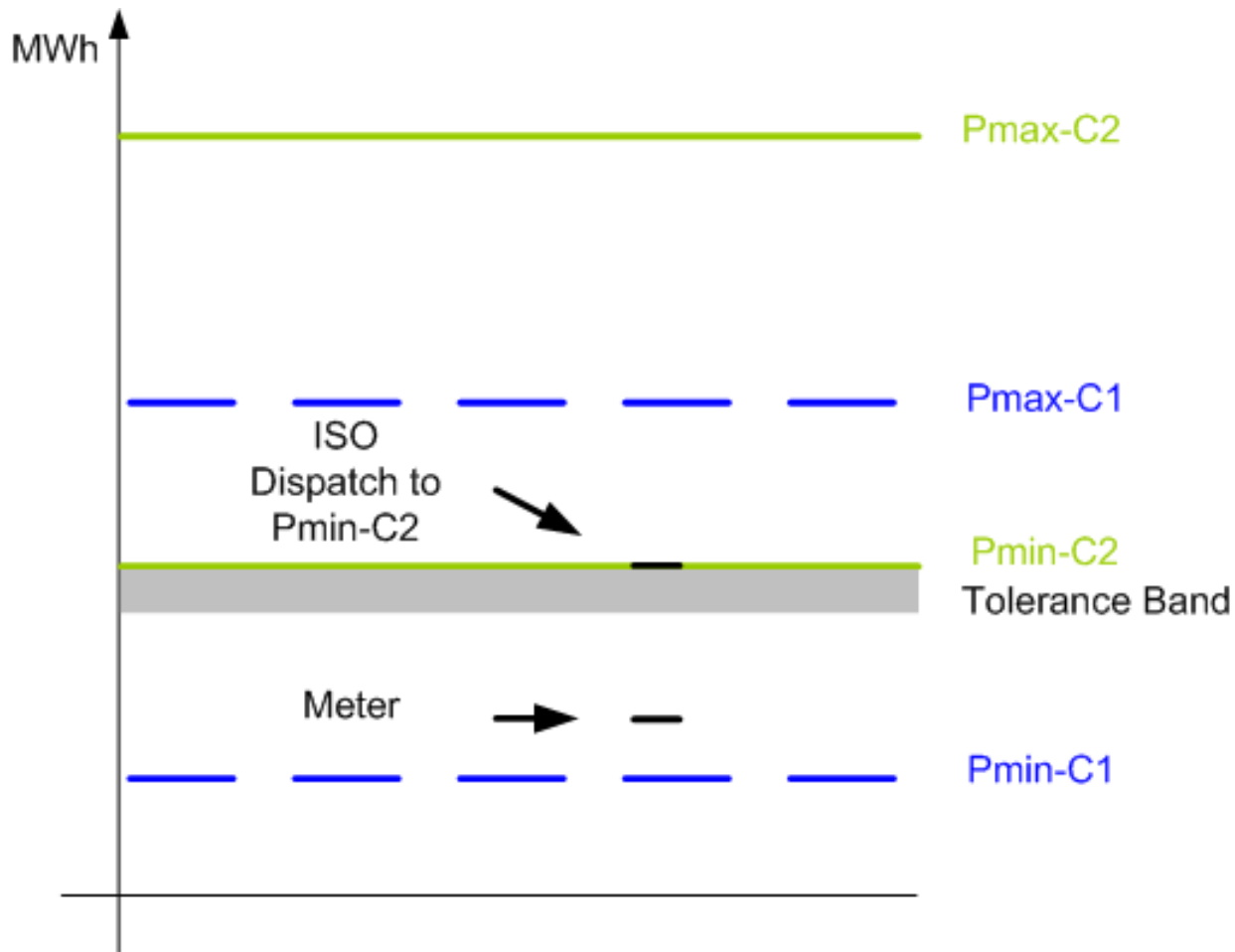
Change minimum load cost accounting

- Today, if an MSG resource in an upward transition doesn't come within the 3% tolerance band of the target configuration it is not eligible for any MLC for that interval
- New
 - When an MSG unit's metered configuration is different from the committed configuration, MLC will be based on the lower of the MLC cost of the metered configuration and the committed configuration

Example – non-overlapping configurations

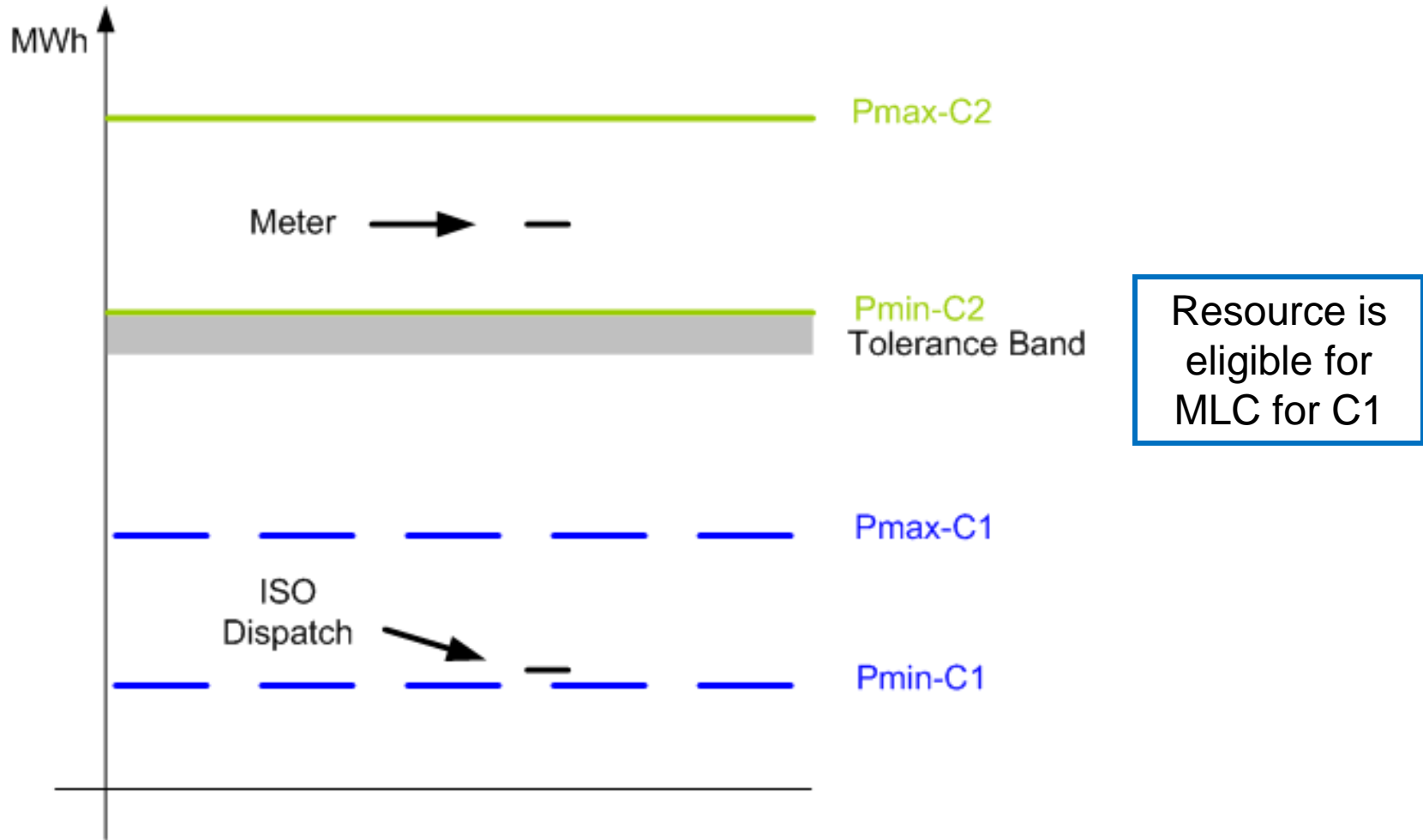


Example – overlapping configurations

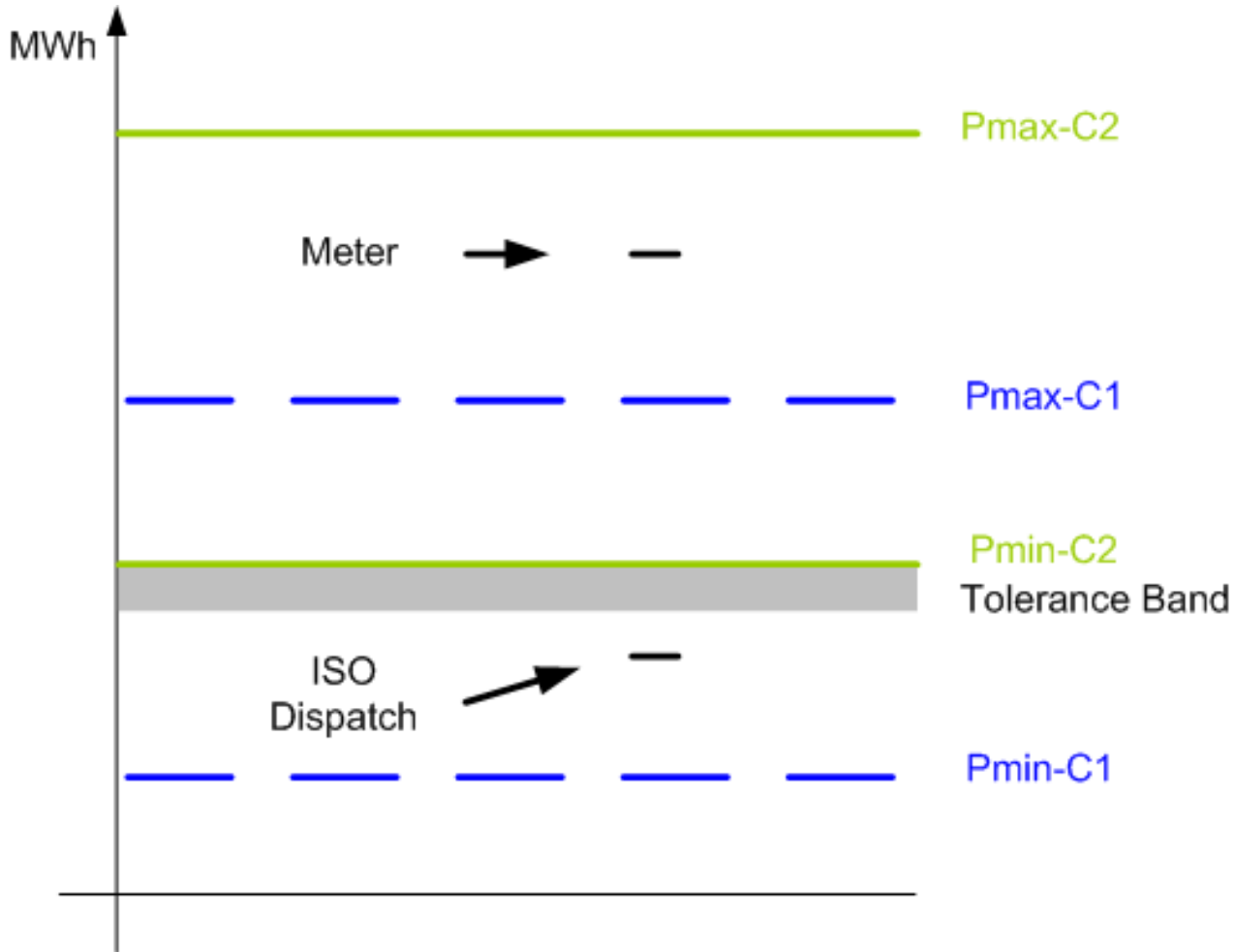


Resource is eligible for MLC for C1

Example – decremental dispatch, non-overlapping

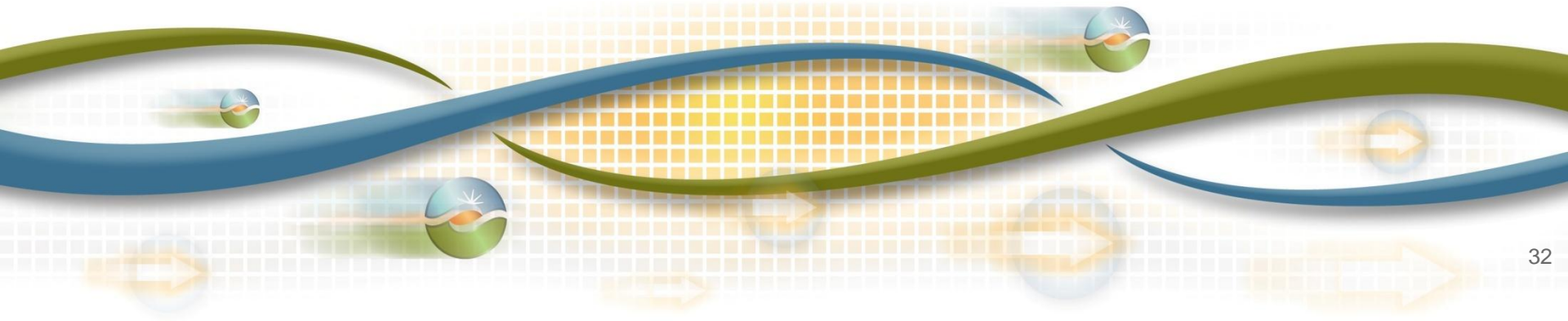


Example – decremental dispatch, overlapping



Resource is eligible for MLC for C1

Questions?



Thank You for Attending!!

Please send additional questions to:

MarketTraining@caiso.com