Flexible Resource Adequacy Criteria and Must Offer Obligation – Phase 2

Draft Framework Proposal

Karl Meeusen, Ph.D.

Stakeholder Meeting

November 29, 2017

FRACMOO 2 Stakeholder Meeting Agenda – 11/29/2017

Time	Topic	Presenter
10:00 – 10:10	Introduction	Jody Cross
10:10 – 10:25	Overview	Greg Cook
10:25 – 10:45	Flexible Capacity Framework: Outline	Karl Meeusen
10:45 – 12:00	Identifying Ramping Needs	
12:00 – 1:00	Lunch/Trivia	
1:00 – 2:25	Quantifying Flexible Resource Adequacy Needs	Karl Meeusen
2:25 – 2:35	Break	
2:35 – 3:50	Criteria for Resources to Meet the Identified Need	
3:50 – 4:00	Next Steps	Jody Cross

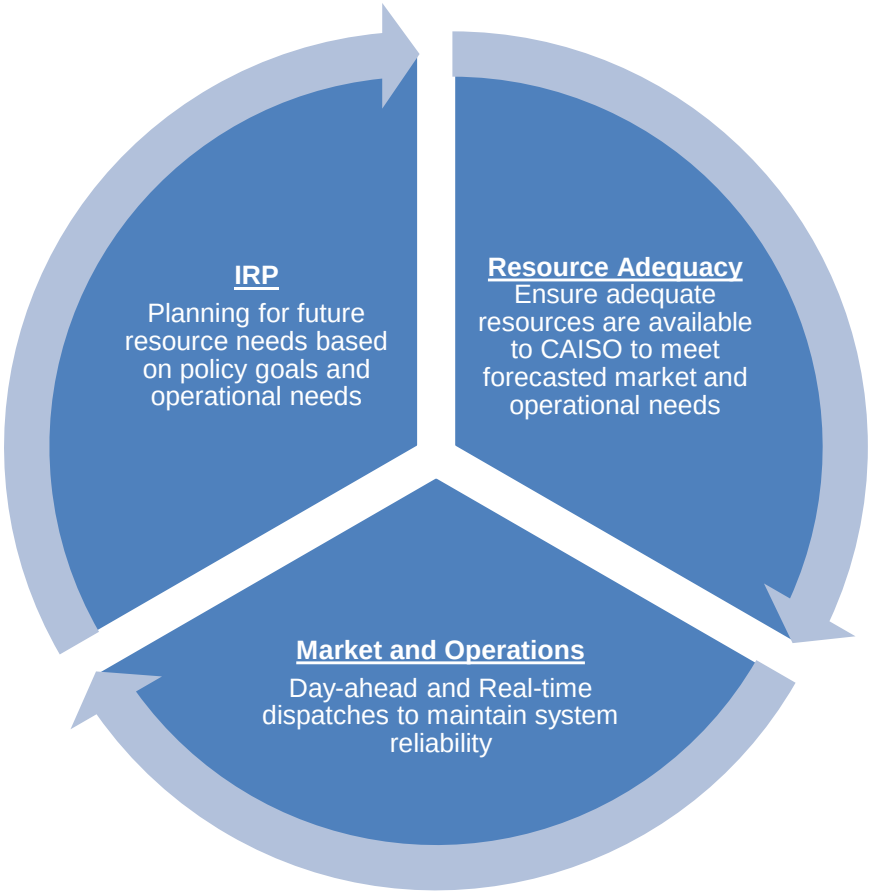
Stakeholder Engagement Plan

Milestone	Date
Revised straw proposal posted	May 1, 2017
Revised straw proposal stakeholder meeting	May 8, 2017
Stakeholder written comments due	May 22, 2017
Working group meeting	September 26, 2017
Draft Flexible Capacity Framework posted	November 17, 2017
Draft Flexible Capacity Framework stakeholder meeting	November 29, 2017
Stakeholder written comments due	December 13, 2017
Draft Final Flexible Capacity Framework posted	Late January 2018
Draft Final Flexible Capacity Framework stakeholder meeting	Early February 2018
Stakeholder written comments due	Mid February 2018
Next steps	Complete coordination with CPUC's RA proceeding prior to Board Approval of final flexible RA Framework

Overview

Greg Cook
Director – Market and Infrastructure Policy

Long term planning must prepare for new operational needs as generation fleet evolves to meet state policies



A unified vision should guide planning, procurement, and operations

Goals and objectives of RA program

Originally stated CPUC RA Objectives:

1. Provide sufficient resources to the ISO to ensure the safe and reliable operation of the grid in real time.

2. Provide appropriate incentives for the siting and construction of new resources needed for reliability in the future

Current RA programs needs going forward:

- Provide signals to help ensure the efficient retention and retirement of existing resources

- Provide a resource portfolio to the ISO that meets grid reliability needs through economic market dispatch
  - Flexible RA should ensure access to the flexibility of the fleet to ensure reliable grid operation all hours of the year

Fundamental principles of FRACMOO2

- Resource counting rules and must offer-obligations must fit operational needs
  - e.g. provide the needed ramp capability (quantity and speed) over a given time interval

- Provide opportunities for both internal and external resources to meet flexibility needs of the grid through markets without the need for out of market actions

The ISO is exploring complementary market design changes to improve control and reduce uncertainty

- Develop day-ahead load following reserve product
- 15-minute day-ahead schedules
- Integrated IFM/RUC
- Investigating the root cause of recent intertie declines and any potential market changes necessary to mitigate this as a recurring problem

Flexible Capacity Framework

Karl Meeusen, Ph.D.
Senior Advisor
Infrastructure and Regulatory Policy

Changes to flexible RA should closely align with ISO operational needs and align with ISO market runs

- The current flexible RA product fails to address fundamental gaps between ISO's market timeframes operational needs:
  - Integrated Forward Market
  - Fifteen-minute market
  - Five-minute market
- Need to meet both:
  - Anticipated ramping needs and
  - Uncertainty within the time scales of the real-time market

The ISO will develop critical linkages between RA and forward energy markets

- Ensures the ISO is able to meet grid reliability needs through its markets, accounting for uncertainty;
  - including load forecast error, VER forecast error, and outages and other resource deviations
- Provide a framework for intertie and VER resources to be part of the flexible capacity solution; and
- Provide LSEs and LRAs flexibility to meet system, local, and flexible capacity needs in ways that best align with their business and policy objectives.

Basis of a new flexible RA framework in three steps

1) Identify the ramping and uncertainty needs that flexible RA should be procured to address;
2) Quantify the capacity needed to address all identified needs; and
3) Establish criteria regarding how resources qualify for meeting these needs.

ISO seeks stakeholder feedback regarding equitable allocation methods, which the ISO will take up in the next iteration of this framework

Identifying Ramping Needs

Flexible capacity needs break down into two categories

1) Predictable: known and/or reasonably forecastable ramping needs, and

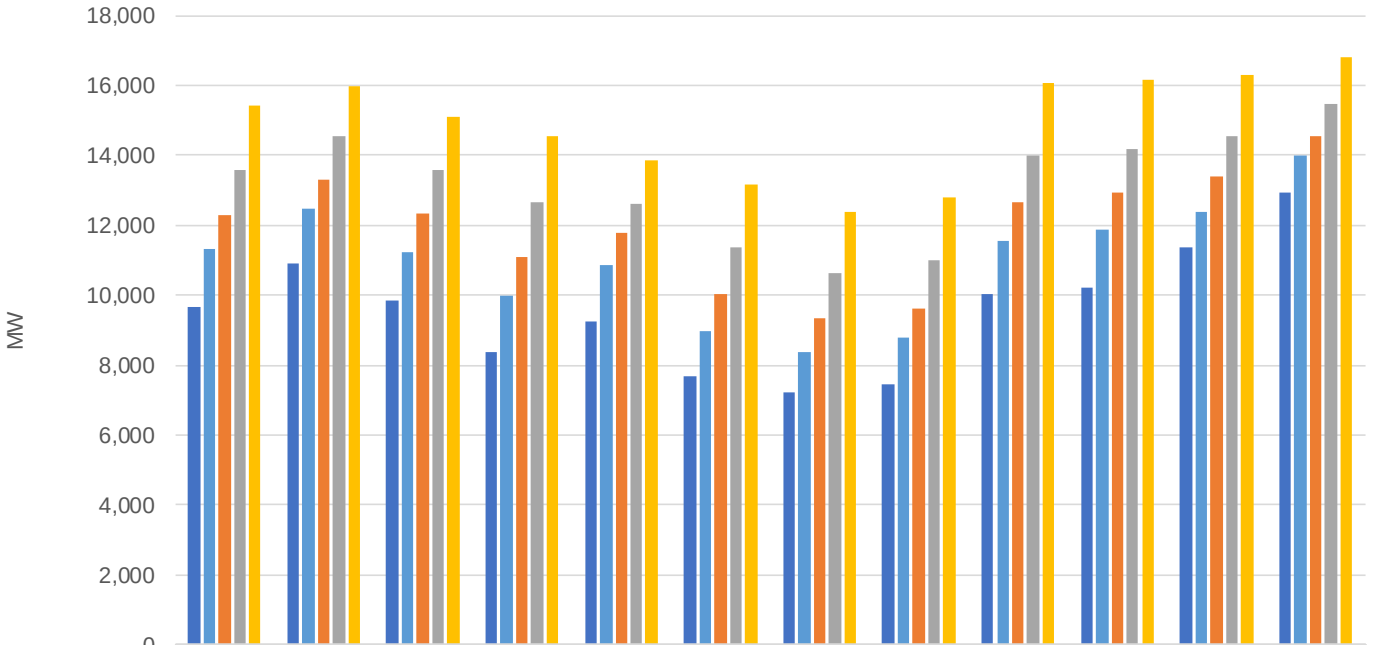
2) Unpredictable: ramping needs caused by load following and forecast error.

These two types of flexible capacity needs drive different forms of flexible capacity procurement needs

A new flexible RA framework is needed to address load and supply variability and uncertainty

- **General ramping needs**
  - IFM schedules shape and conform to forecasted loads and ramping needs
    - Sustained ramping periods and ramping speed (up and down) are increasing
    - Forecasted net load continues to drop, indicating additional trade-off between ramping vs. curtailment
- **Uncertainty**
  - Majority of ramping needs can be addressed through IFM schedules, however uncertainty after IFM can only be met with resources available in real-time

Propose to maintain the three hour net load ramp flexible capacity requirement as a day-ahead market requirement



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016 (Actual)	9,687	10,891	9,828	8,397	9,263	7,669	7,214	7,463	10,030	10,228	11,375	12,960
2017	11,342	12,465	11,253	9,973	10,878	8,996	8,379	8,768	11,575	11,900	12,391	14,004
2018	12,282	13,313	12,352	11,111	11,803	10,039	9,326	9,617	12,660	12,954	13,376	14,567
2019	13,595	14,543	13,574	12,672	12,631	11,350	10,616	10,982	13,981	14,199	14,553	15,495
2020	15,439	15,984	15,089	14,572	13,859	13,181	12,391	12,821	16,061	16,169	16,293	16,817

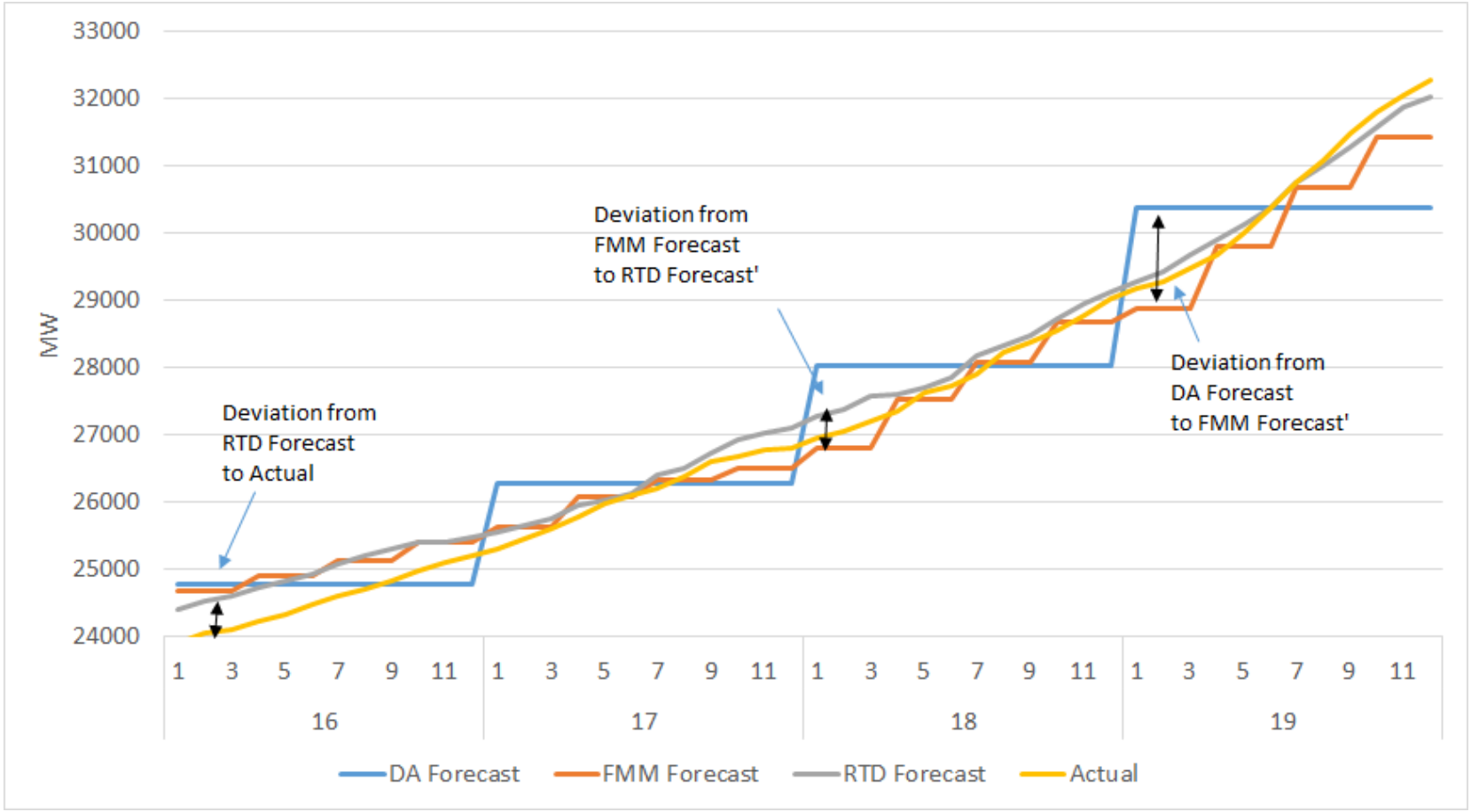
Addressing three-hour net load ramps is still an important need for continued reliable operations

- These ramps are largely forecastable on a day-to-day basis
- Setting up a fleet of resources to meet day-ahead net load ramps allows the ISO to better shape day-ahead commitments
  - Improves the efficiency of the ISO dispatch and management of renewable resources
- Increased net load ramps will lead to ramp constraints
  - Likely results in additional exceptional dispatches

Both load and generation are creating uncertainty between the day-ahead and real-time markets

- Variable energy resources and behind the meter solar photovoltaic systems continue to expand
- ISO cannot commit additional long-start units after day-ahead/RUC closes
- Uncertainty between day-ahead and real-time markets caused by both load following needs and forecast error
  - Must be addressed by resources committed in the IFM or resources that are committable during the real-time market runs

Propose to establish new requirements to address uncertainty between market runs

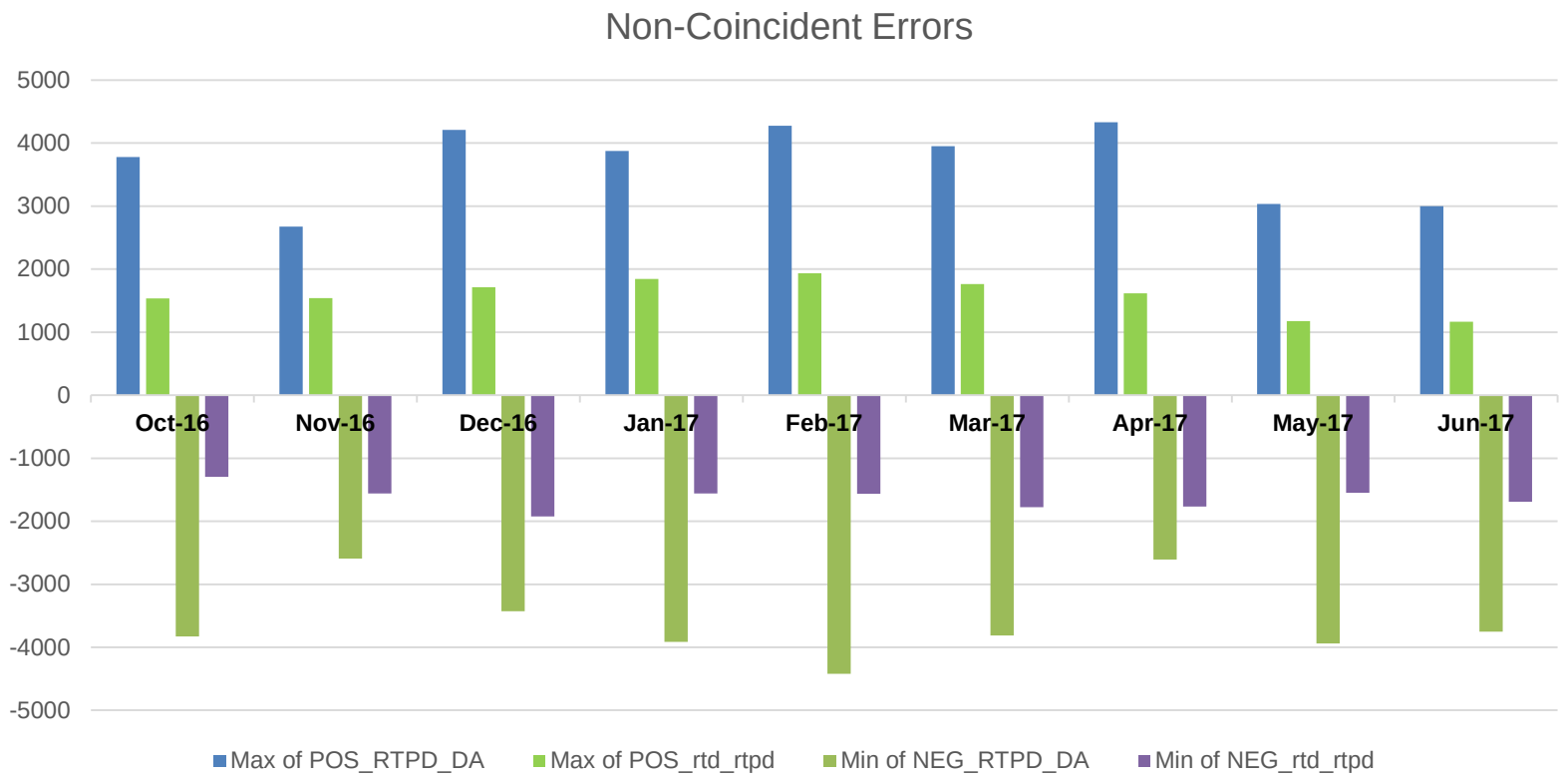


Regulation is distinct from the other types of uncertainty in three ways

1) Regulation is explicitly procured through the day ahead market
2) A resource's ability to provide regulation is based on it having Automatic Generation Control (AGC)
3) There is sufficient regulation capacity available in the system

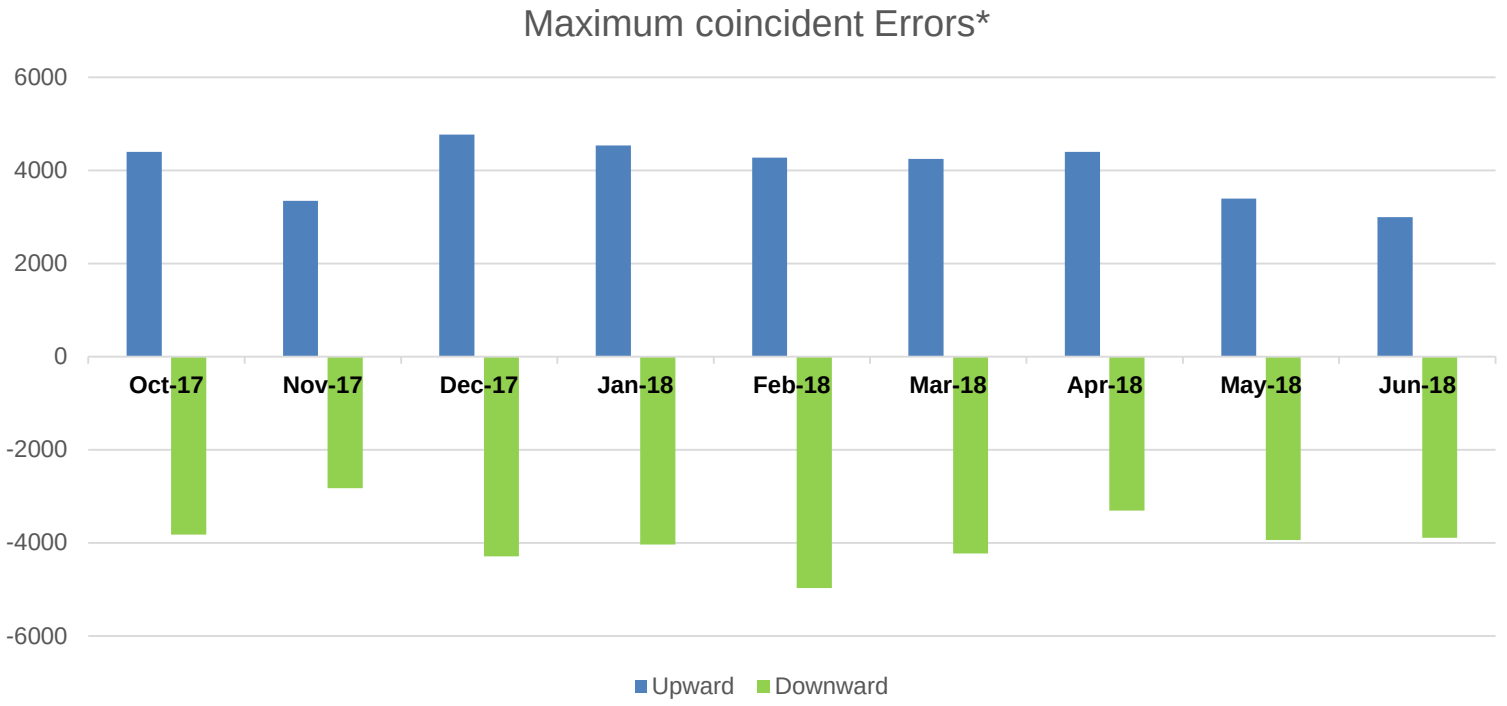
The ISO does not believe it is necessary to explicitly consider an additional flexible capacity requirement based on the deviation between RTD and actual load

Non-coincident errors provide a basis for determining how much flexible capacity might be needed and the timeframe within which that uncertainty occurs



The ISO is not seeking to address each source of error independently

It is not possible to know which direction uncertainty will occur until it happens



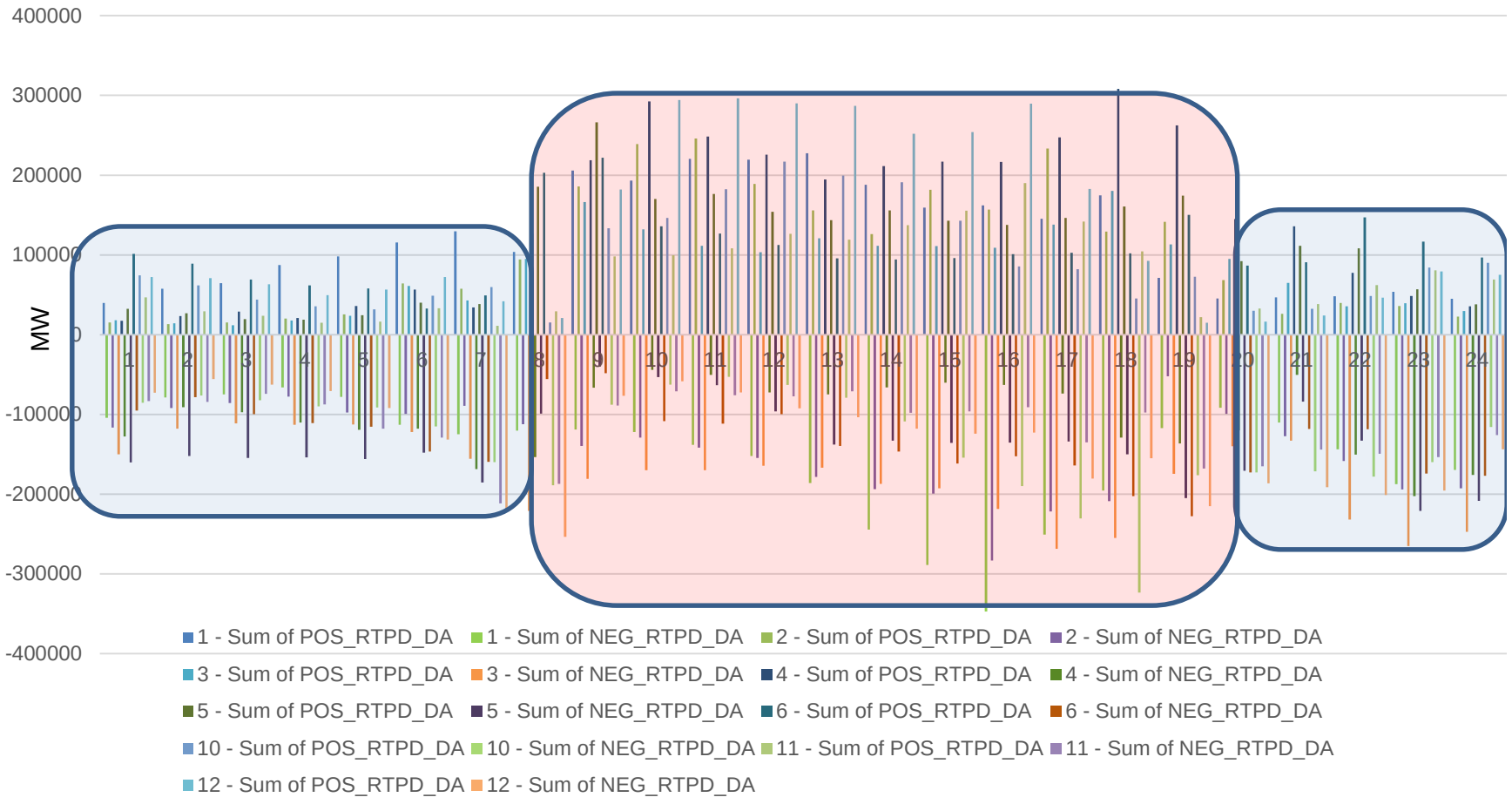
- Flexible RA needs should be procured to cover both upward and downward forecast error ranges
  - — Uncertainty will be due to under or over-forecast error

*Upward and downward ranges do not occur on the same days

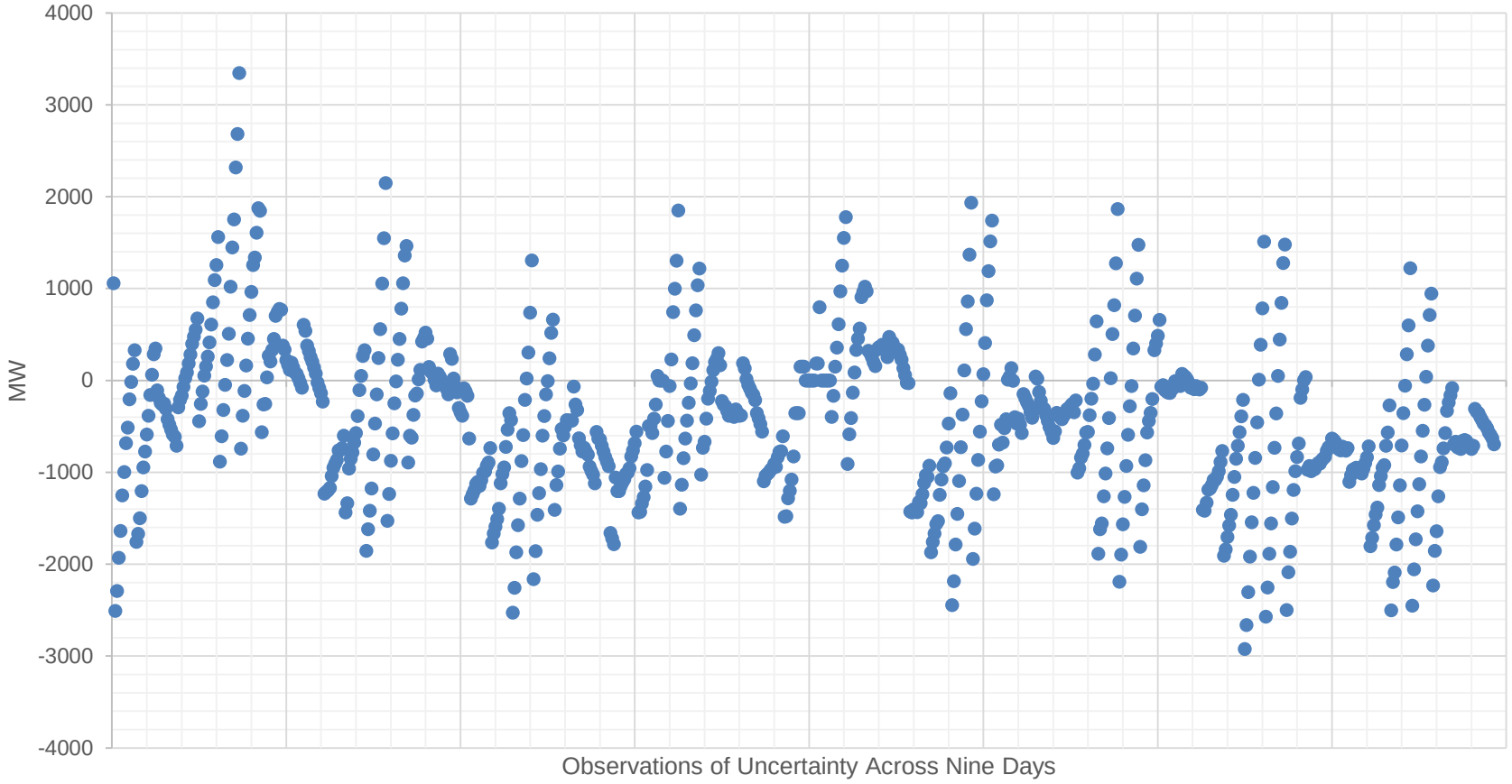
The ISO must be prepared to address the largest uncertainties that occur with the shortest notice

- Flexible RA needs should first plan for the uncertainty that occurs between FMM and RTD
  - Then extending that planning to longer notice intervals, i.e. IFM to FMM
- Resources capable of addressing FMM to RTD needs should also be capable of addressing the uncertainty between IFM and FMM
  - Additional capacity should be procured to address the uncertainty that occurs between IFM and FMM

Uncertainty occurs most often during daylight hours, including during maximum net load ramps



ISO requires additional upward ramping capabilities to address forecast error and load following needs during the steepest 3 hour net load ramps.



Quantifying Flexible Resource Adequacy Needs

The maximum forecasted three hour net load ramp plus contingency reserves should continue being the starting point for establishing Flexible RA needs

- The interplay between contingency reserves and flexible capacity identified in FRACMOO process still exists
  - ISO will modify this to be consistent with modifications to WECC Standard BAL-002-WECC-2a

- The ISO will reconstruct overall available wind and solar output into formulation of the three hour net load ramp

Uncertainty should be added to the three hour net load ramps to determine overall need

- Add a portion of the upward uncertainty measure to the overall flexible capacity need
  - Initial estimates are 50% of upward uncertainty need

<u>Overall flexible capacity need</u>

Maximum 3-Hour ramp + 3% of the monthly expected peak load + 50% of incremental real-time incremental flexible capacity need

An illustration of how flexible capacity drivers stack to establish an overall flexible RA need

Observed uncertainty between ISO market runs, maximum for both positive and negative observations

Month	Max Positive error DA-FMM	Max Negative error DA-FMM	Max Error Range DA-FMM	Max Positive error FMM-RTD	Max Negative error FMM-RTD	Max Error Range FMM-RTD
October	3781	-3826	7606	1537	-1297	2834
November	2673	-2591	5264	1542	-1557	3099
December	4210	-3428	7638	1715	-1921	3636
January	3877	-3912	7789	1842	-1559	3401
February	4276	-4421	8697	1933	-1565	3498
March	3950	-3813	7763	1761	-1779	3540
April	4331	-2610	6941	1615	-1765	3380
May	3033	-3938	6971	1178	-1548	2726
June	2996	-3753	6750	1164	-1693	2857

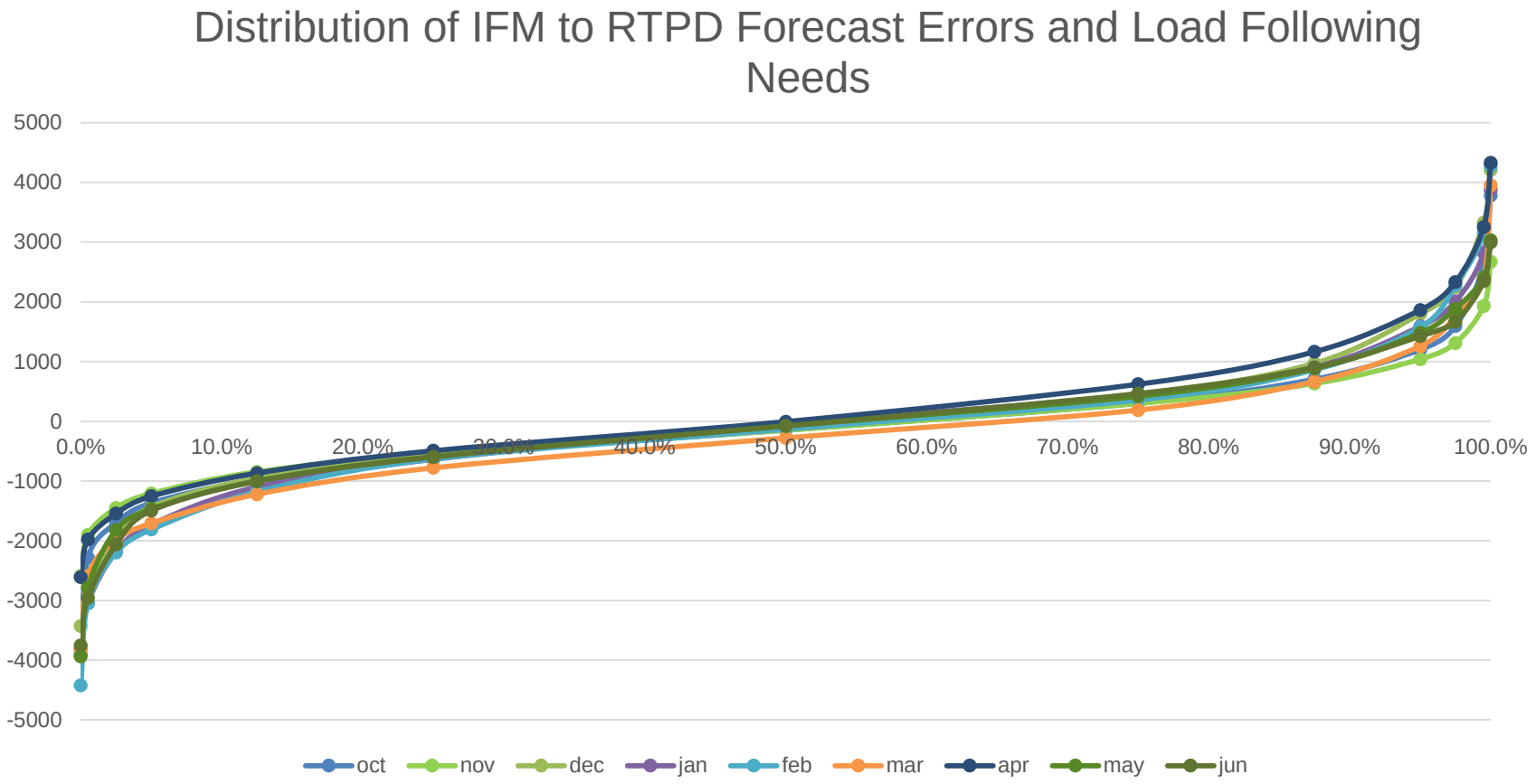
Percentile rankings for observed errors between IFM and FMM and the need for a 15 minute product

	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017
100.0%	3,781	2,673	4,210	3,877	4,276	3,950	4,331	3,033	2,996
99.5%	2,617	1,933	3,324	2,821	3,154	2,392	3,254	2,411	2,346
97.5%	1,597	1,311	2,244	2,006	2,281	1,761	2,332	1,885	1,671
95.0%	1,200	1,041	1,798	1,590	1,575	1,260	1,865	1,479	1,426
87.5%	706	634	971	906	863	666	1,164	886	901
75.0%	303	299	454	446	356	189	621	419	465
50.0%	-147	-149	-72	-49	-130	-278	-5	-79	-77
25.0%	-579	-541	-555	-636	-632	-780	-493	-591	-597
12.5%	-968	-845	-950	-1,098	-1,179	-1,222	-868	-999	-1,006
5.0%	-1,367	-1,207	-1,435	-1,728	-1,811	-1,708	-1,254	-1,467	-1,497
2.5%	-1,698	-1,449	-1,966	-2,185	-2,198	-1,980	-1,544	-1,820	-2,063
0.5%	-2,286	-1,902	-2,765	-3,046	-3,049	-2,587	-1,981	-2,789	-2,958
0.0%	-3,826	-2,591	-3,428	-3,912	-4,421	-3,813	-2,610	-3,938	-3,753

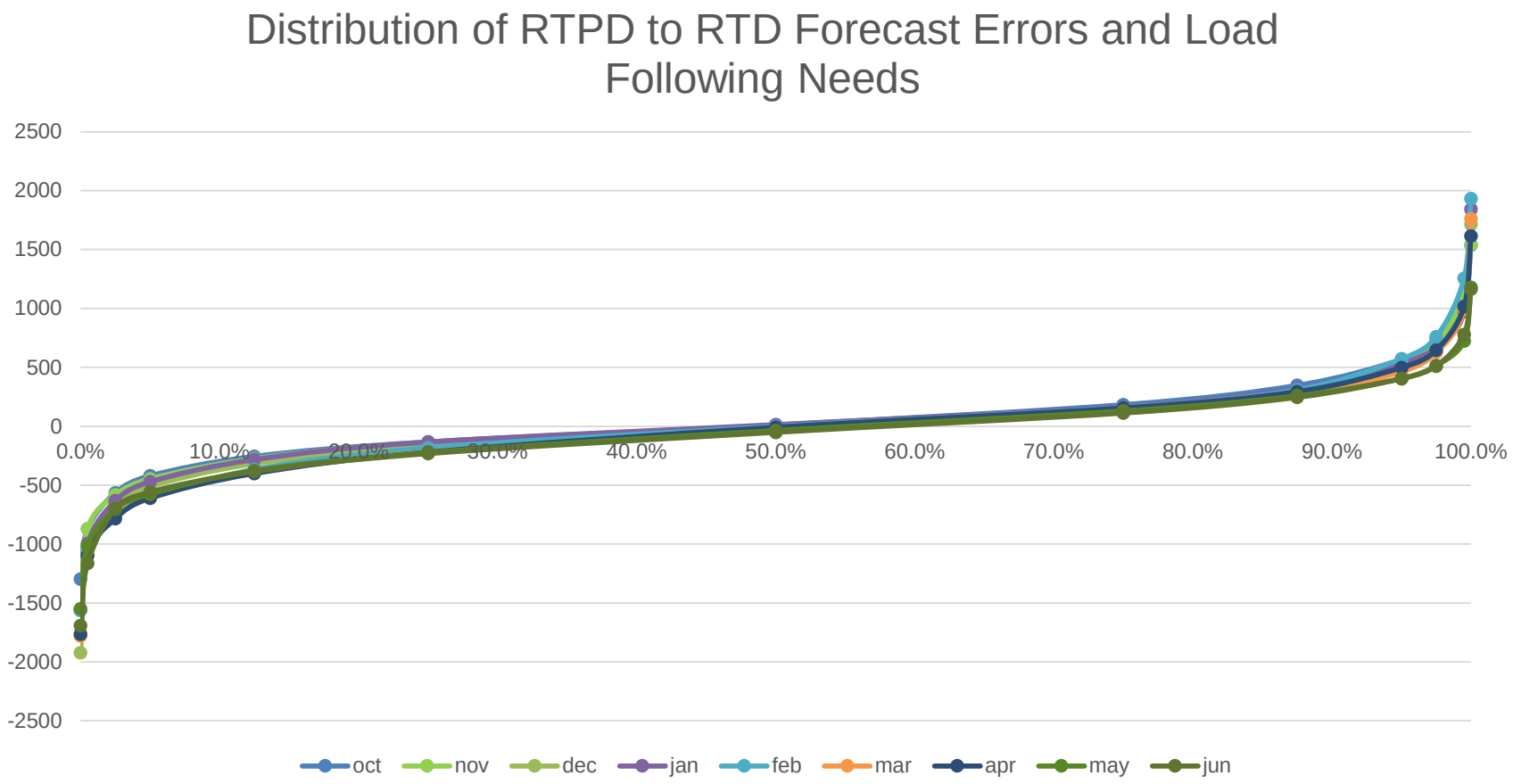
Percentile rankings for observed errors between FMM and RTD and the need for a 5 minute product

	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017
100.0%	1,537	1,542	1,715	1,842	1,933	1,761	1,615	1,178	1,164
99.5%	1,041	1,104	1,027	974	1,255	991	1,016	723	780
97.5%	734	718	668	669	760	626	646	516	511
95.0%	566	534	504	536	572	464	497	404	405
87.5%	347	290	280	321	310	263	294	258	246
75.0%	183	145	147	167	160	115	155	129	113
50.0%	10	0	-2	13	-2	-33	-9	-37	-51
25.0%	-133	-137	-161	-134	-183	-217	-220	-223	-232
12.5%	-256	-275	-317	-283	-366	-391	-401	-376	-384
5.0%	-420	-447	-509	-471	-610	-611	-609	-575	-558
2.5%	-565	-583	-650	-632	-760	-770	-783	-704	-699
0.5%	-871	-871	-1,019	-996	-1,025	-1,093	-1,096	-1,017	-1,165
0.0%	-1,297	-1,557	-1,921	-1,559	-1,565	-1,779	-1,765	-1,548	-1,693

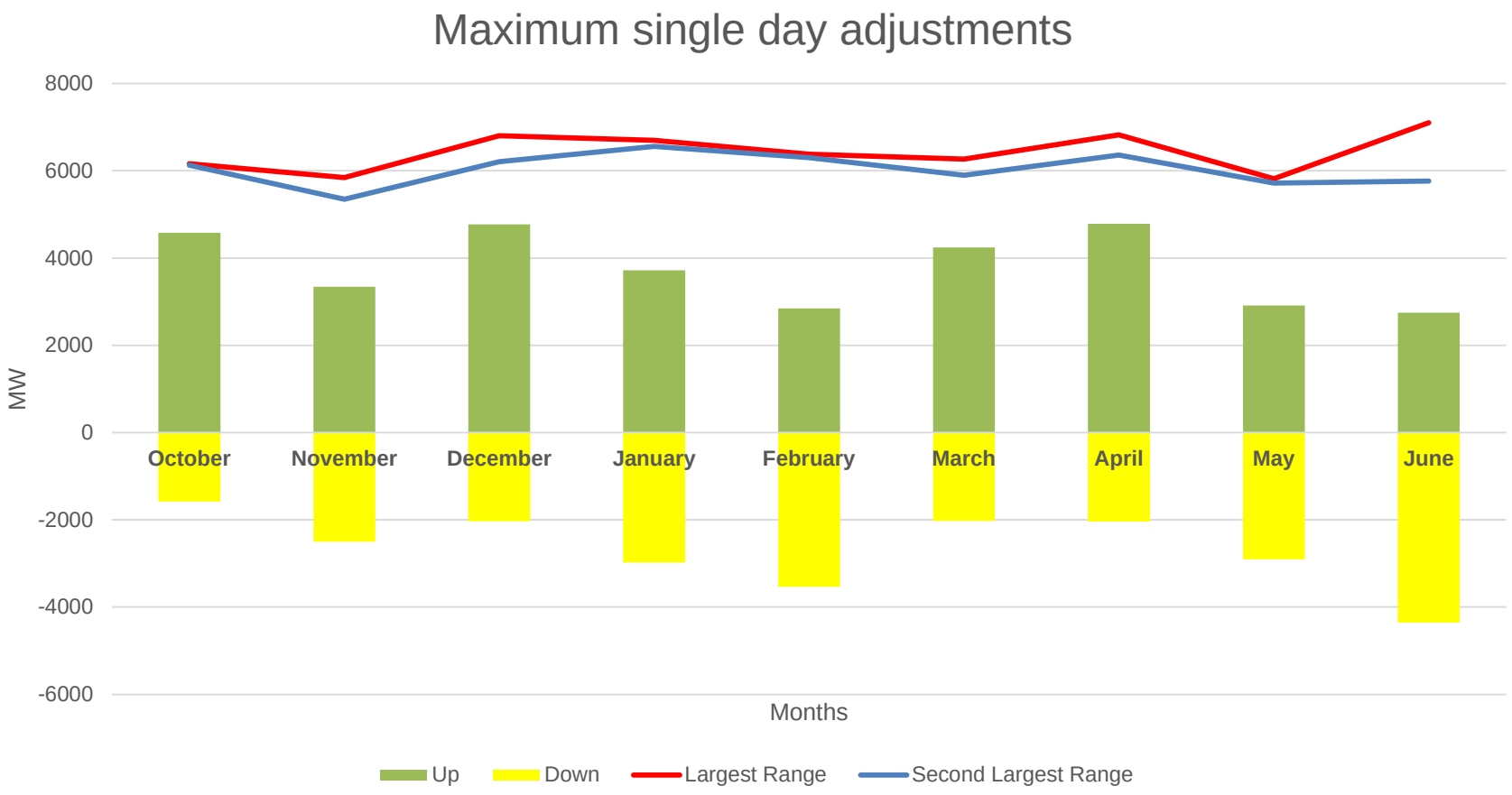
Real-time flexible RA capacity needs for 15 minute product



Real-time flexible RA capacity needs for 5 minute product



Daily uncertainty ranges over 6,000 MW occur almost every month



Criteria for Resources to Meet the Identified Need

The ISO is proposing three flexible RA products

System wide requirement for real-time product should be based on the range of historic forecast error

1) Five minute flexible RA product – Start with the magnitude of forecast error between the FMM and RTD
   – Actual requirement based on confidence interval chosen
2) Fifteen minute flexible RA product – Difference between the real-time markets uncertainty and the quantity of five minute flexible RA product
3) Day-ahead shaping product – Overall flexible capacity need minus the real-time markets uncertainty

Five minute Flexible RA product should be based on resource capabilities within five minutes

- Resource counting for this product would be based on the number of MWs the resource can ramp in 5 minutes.
  - A 100 MW resource with a 10 MW/minute ramp rate would be eligible to provide 50 MW of five-minute RA flexible capacity.
- Resource will have a must offer obligation to make its capacity available to the ISO using economic bids for a range equal to the MW of flexible capacity for the full range for which it has been shown
  - Can be fulfilled through either incremental or decremental bids

Complete eligibility criteria must be determined

- Use-limited resources would be eligible
  - Once a resource reaches its use-limitation, it would be required to provide replacement capacity or be subject to availability charges
- What other eligibility criteria must be considered?
  - Minimum and maximum ramp rates
  - Start-time
  - Cycle time
  - Capacity factor
  - Start frequency
  - Pmin
  - Pmin-Pmax ratio

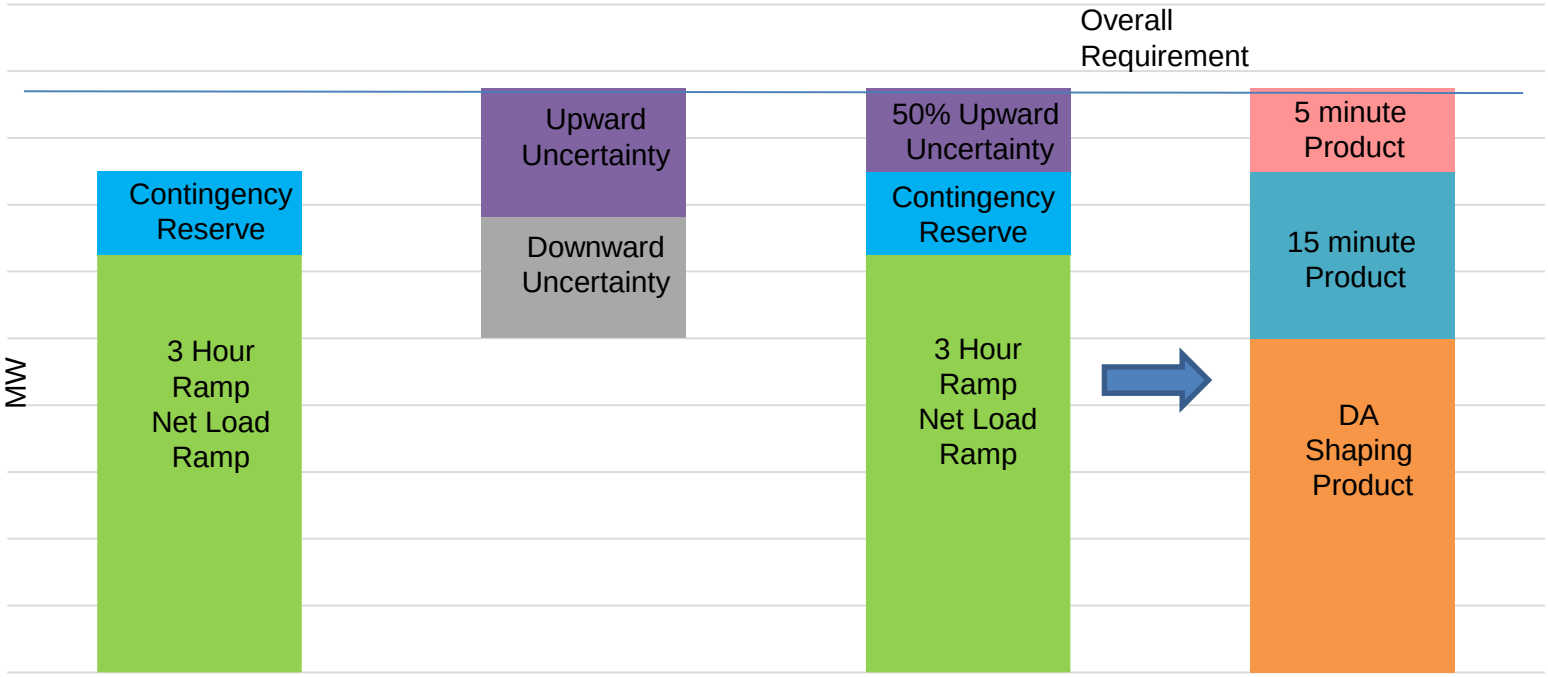
ISO must determine in what hours the resources must be available

- Uncertainty occurs during all hours
- ISO observes more uncertainty during day-light hours
  - Should all resources that provide the five-minute flexible RA product have a 24 by 7 must offer obligation, or is there an opportunity to create an additional day-time product with a shorter must offer obligation window?

Fifteen minute Flexible RA product is based on many of the same principles as the five minute products, but facilitates imports

- Counting rules based on fifteen-minute ramping capabilities of resources
- Intertie resources eligible to provide this product
  - Must be connected to specific resources
    - May be a single specific resource or electrically connected system of resources
  - Requires change to EIM ramp sufficiency tests to credit ISO with flexible capacity
  - ISO is considering changing MOO for external resources to require both the day-ahead and real-time availability

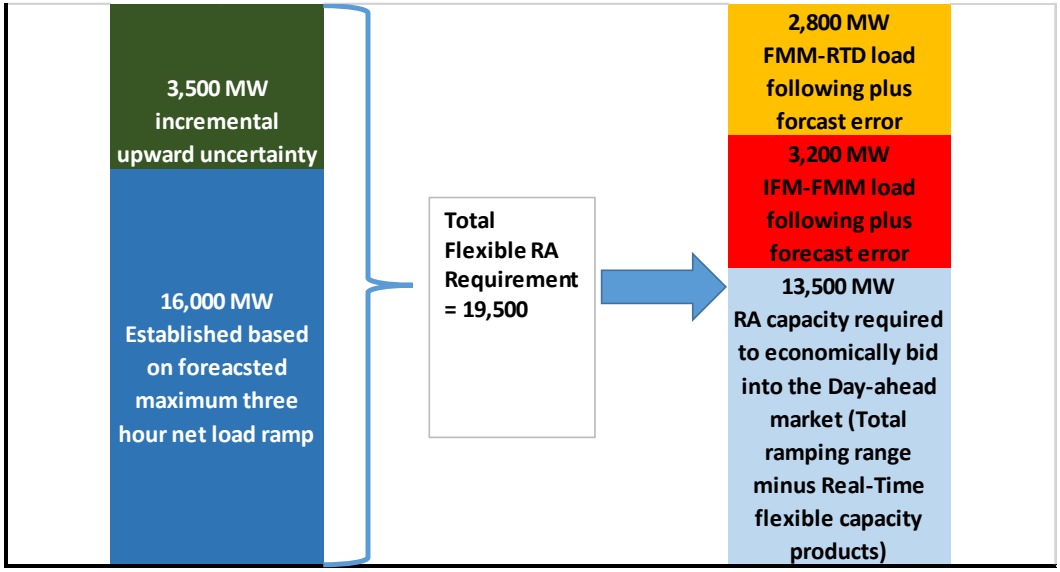
The remaining flexible capacity would be a day-ahead shaping capacity product



- The basic counting rules for the day-ahead shaping product will remain the same as those used today for the effective flexible capacity (EFC) value for most resources
- External resources would be allowed to provide this product

Products cascade from highest to lowest quality

- Flexible RA framework:
  - Relies on IFM commitments to address forecasted ramping needs while ensuring sufficient ramping range
  - Real-time dispatchable resources with faster ramp rates and shorter response times



EFC values for wind and solar most be changed

- The EFC for wind and solar resources are currently capped at the resource's NQC
  - EFC value may be is very small relative to the resource's potential output during early afternoon hours when net load is at its lowest
- VER resources that are willing to economically bid into the day ahead market
  - Help the ISO to better shape IFM commitments
  - Address the net load ramp at quantities that far exceed the NQC of the resource

Next steps

- Stakeholder comments due December 13, 2017
  - Comments template posted by COB November 30, 2017

- Draft Final Flexible Capacity Framework late January