Flexible Resource Adequacy Criteria and Must-Offer Obligation – Phase 2

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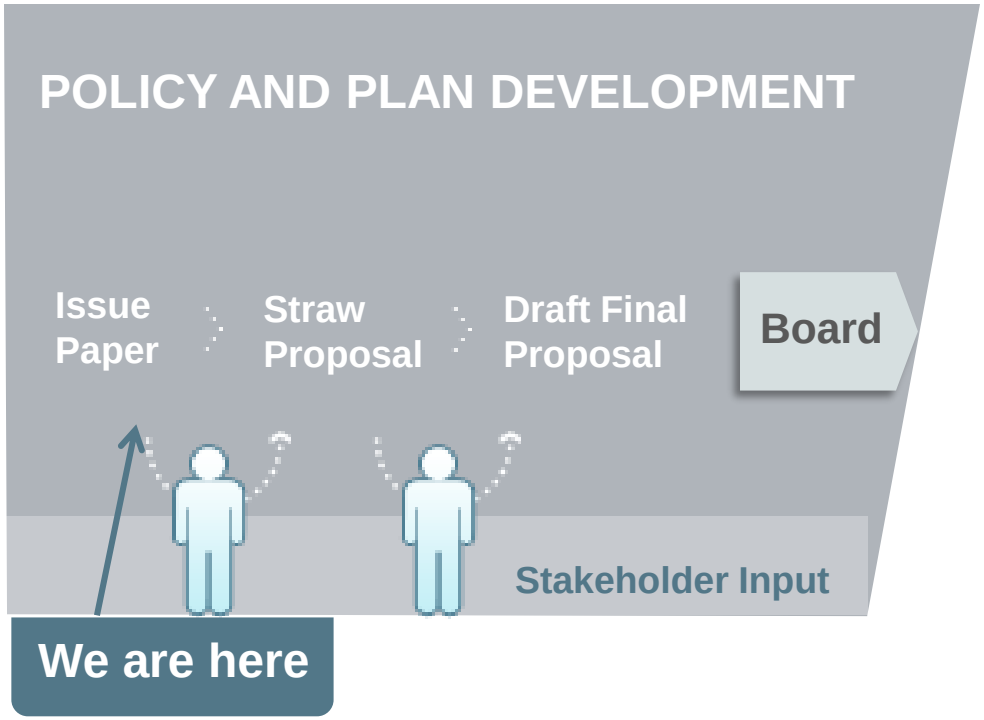
Working Group Meeting
July 22, 2015

FRACMOO 2 Working Group Meeting Agenda – 7/22/15

Time	Topic	Presenter
10:00 – 10:10	Introduction	Kim Perez
10:10 – 11:00	Overview and problem statement	Karl Meeusen
11:00 – 11:30	Upward and downward system operational constraints	
11:30 – 12:00	15-minute intertie resources and flexible RA	
12:00 – 1:00	Lunch	
1:00 – 2:00	Inflexible and flexible capacity showings	
2:00 – 2:45	Inflexible capacity RA “allowances”	
2:45 – 3:00	Break	
3:00 – 3:20	Secondary assessment of one-hour ramping capabilities	
3:20 – 3:50	Adjust market rules and/or penalty parameters for day-ahead and real-time bidding and self-scheduling	
3:50 – 4:00	Next Steps	Kim Perez

ISO Policy Initiative Stakeholder Process



FRACMOO2 scope and stakeholder process

- Scope
  - Defining the flexible capacity requirements and developing any additional flexible capacity needs
  - Provision of flexible capacity by intertie resources, including Effective Flexible Capacity calculation
  - Flexible capacity from storage resources not using the NGR model
  - Flexible capacity impacts of uncontracted/merchant VERs, for which no LSE has associated flexible capacity requirements

- Working group process
  - Three working group meetings
  - The first meeting: July 22, 2015
  - Concludes by end of September 2015
- Stakeholder process
  - Straw Proposal issued: October 2015
  - Straw Proposal will
    - Start the regular ISO stakeholder process for FRACMOO2; and
    - provide the CPUC with a proposal to consider in the RA proceeding
- Board of Governors: Q2, 2016

Defining Flexible Capacity Requirements and Developing Additional Flexible Capacity Needs

Karl Meeusen

Problem Statements

- Flexible RA requirements need to include provisions to address potential over-generation conditions
  - Primary focus – managing the PMin burden and the interplay between quantities of inflexible capacity and ramping capability provided by RA resources, particularly in non-summer months
  - Secondary focus – addressing challenges caused by large amounts of self-scheduling
- Hourly ramping needs are increasing and additional flexible RA showing validations are needed to ensure they can be addressed
- Modifications should ensure system, local, and flexible capacity needs are addressed

Objectives of FRACMOO2 Stakeholder initiative

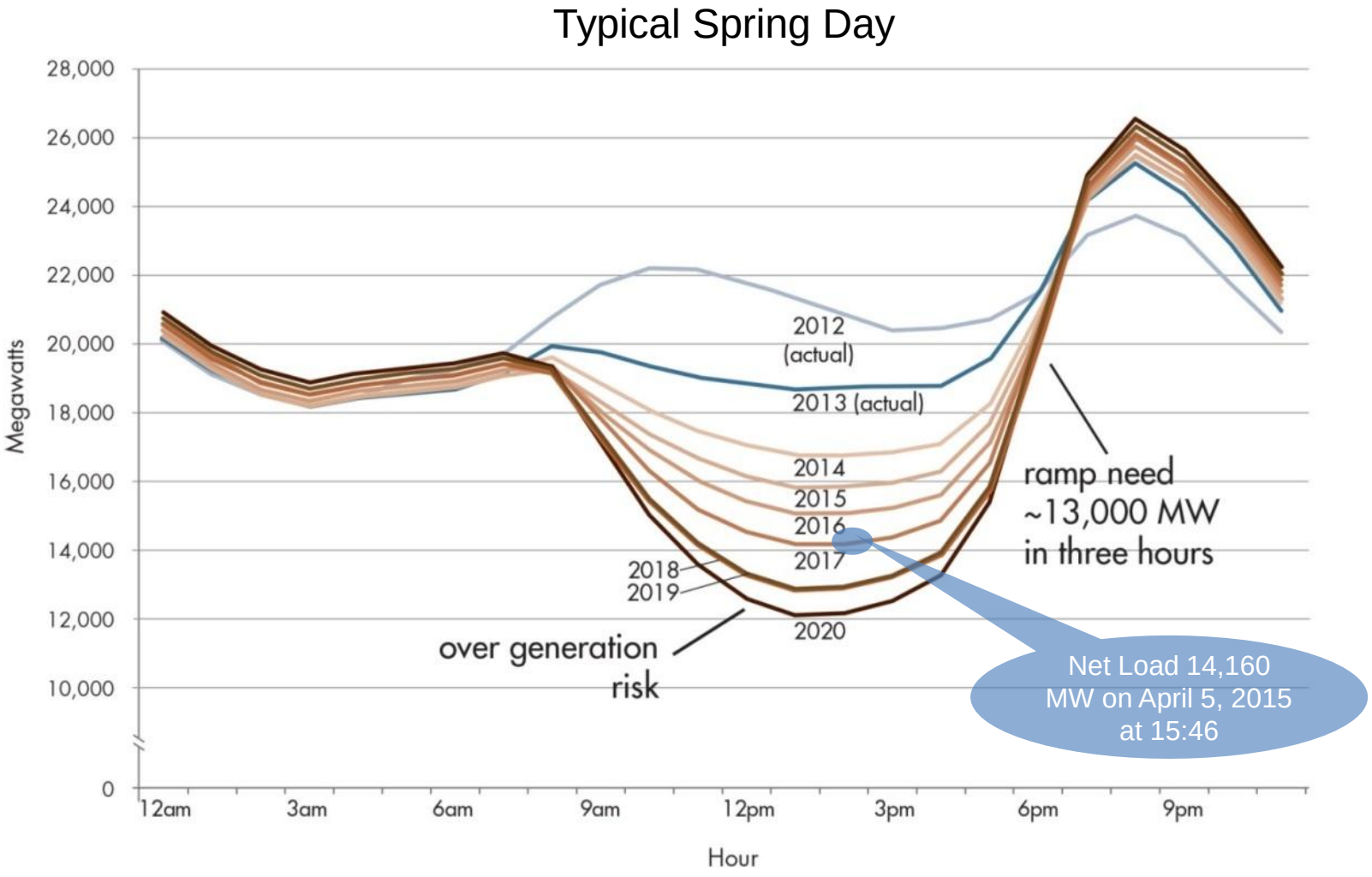
- Minimize complexity of system and flexible RA showings and requirements
- Develop RA rules to ensure the ISO is able to address
  - Gross load plus required reserves
  - Net load and ramp rates
  - Potential over-generation through responsible forward planning
- Provide LSEs and LRAs opportunity to find least cost means of addressing RA needs
- Develop a secondary test to ensure sufficient hourly ramping capability

The ISO is considering several changes to the existing RA construct to achieve the objectives of FRACMOO2

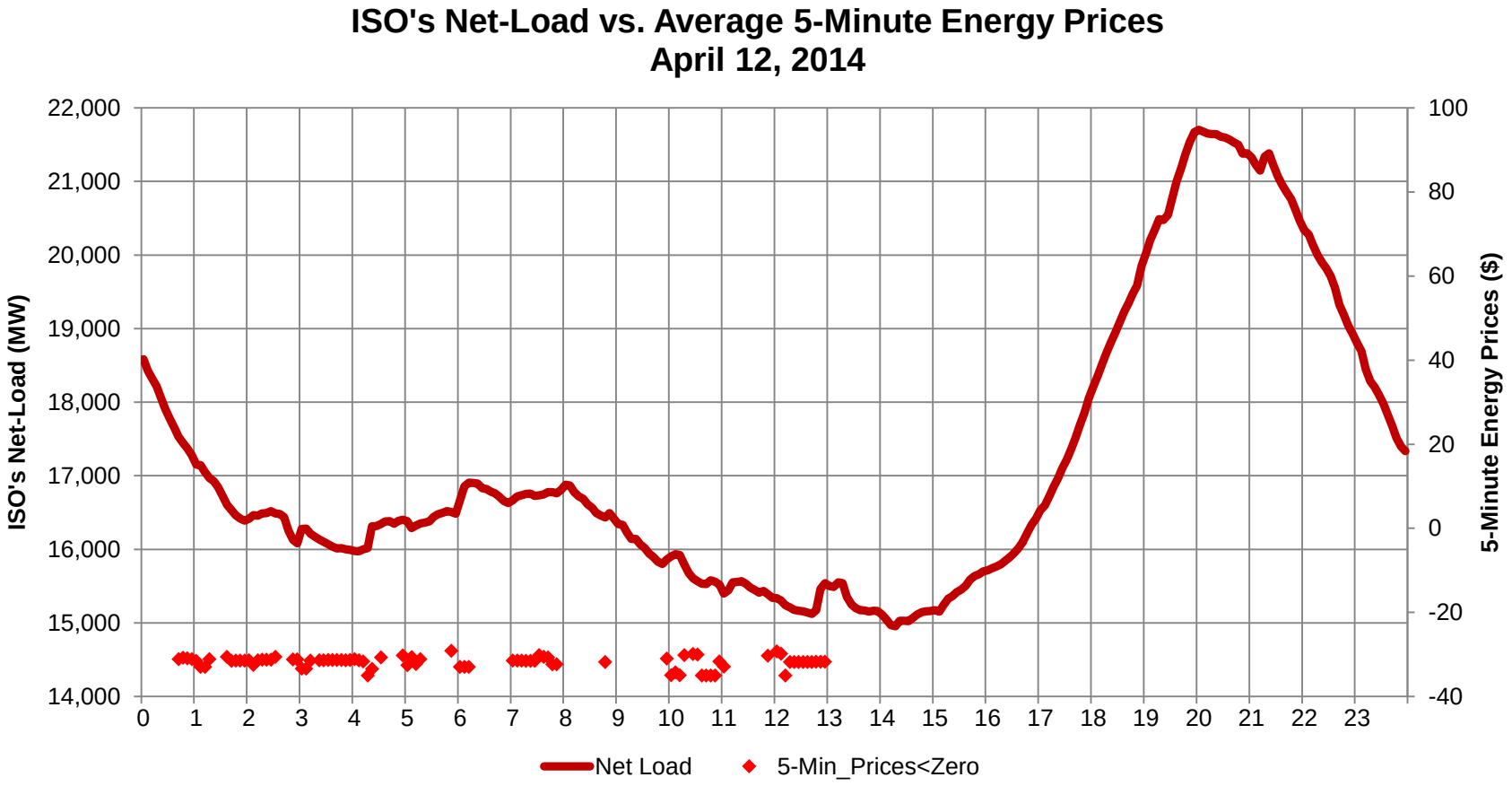
1. Account for system upward and downward operational constraints
2. Allow 15-minute intertie resources to provide flexible RA
3. Split RA showings into separate inflexible and flexible capacity showings
4. Inflexible capacity RA “allowances”
5. Conduct secondary assessment of one-hour ramping capabilities
6. Adjust market rules and/or penalty parameters for day-ahead and real-time bidding and self-scheduling

Overview of the problem statement

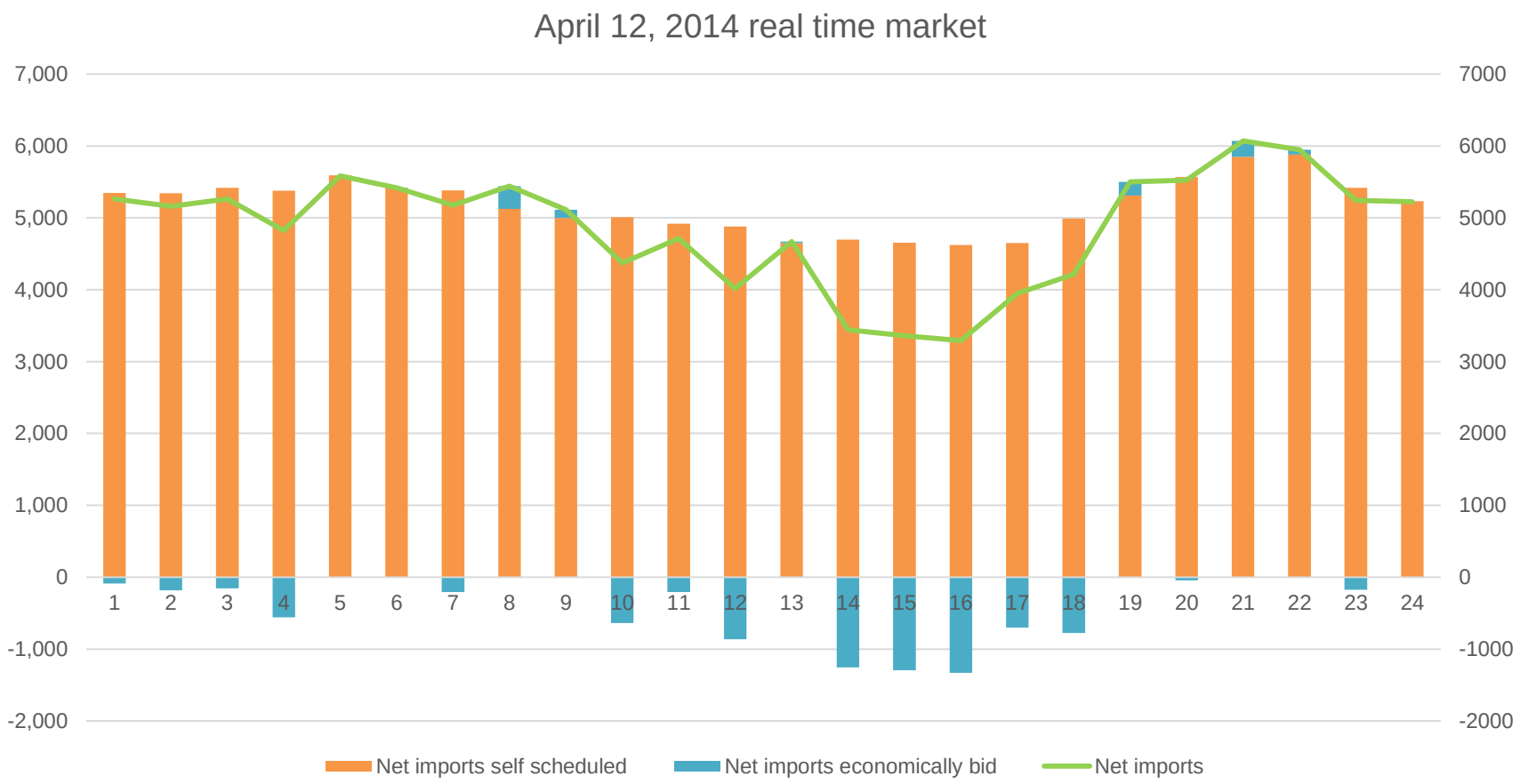
Original estimate of net-load as more renewables are integrated into the grid



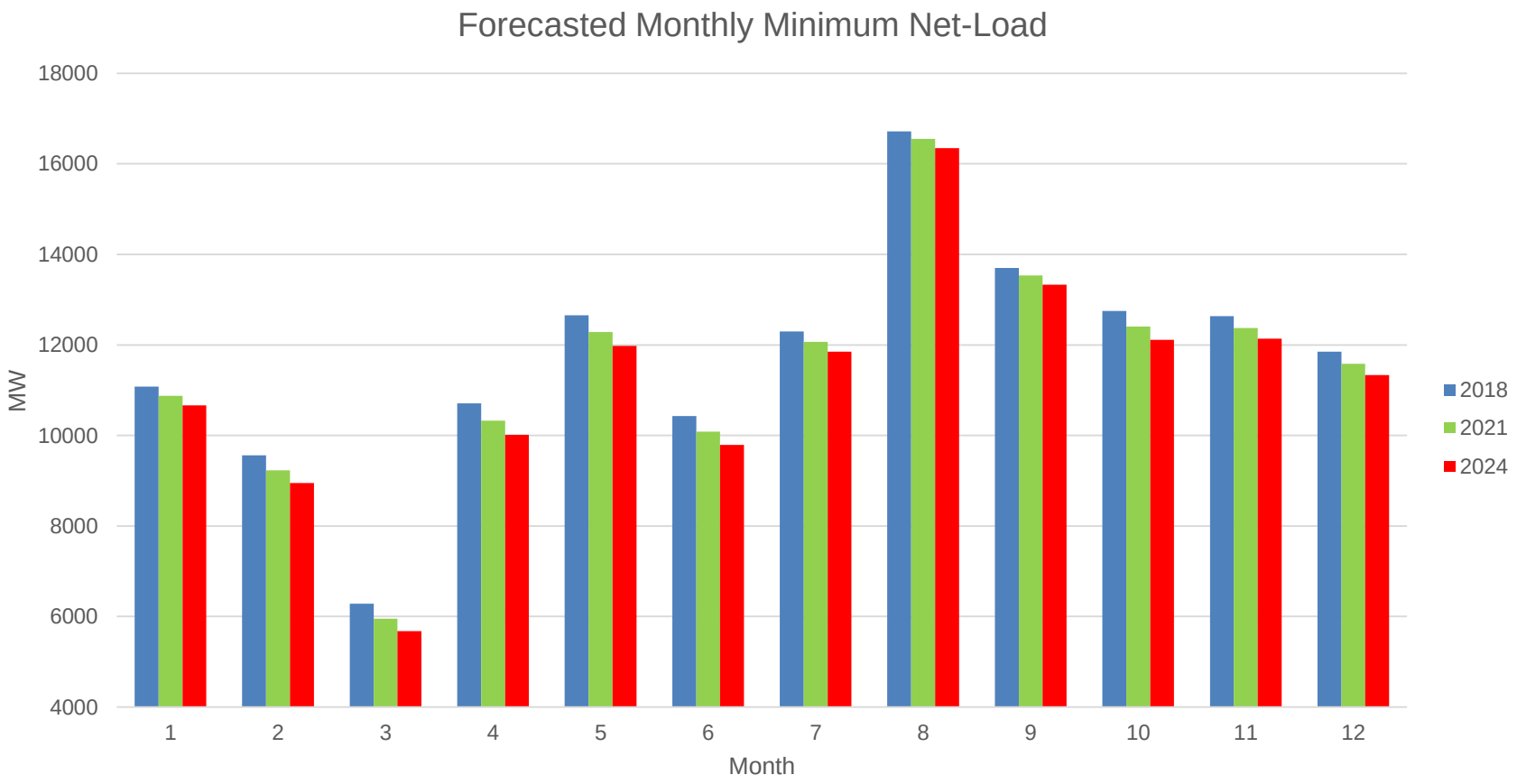
The ISO has identified a growing need for downward flexible capacity to address over-generation



Imports need to be considered as part of the over-generation solution



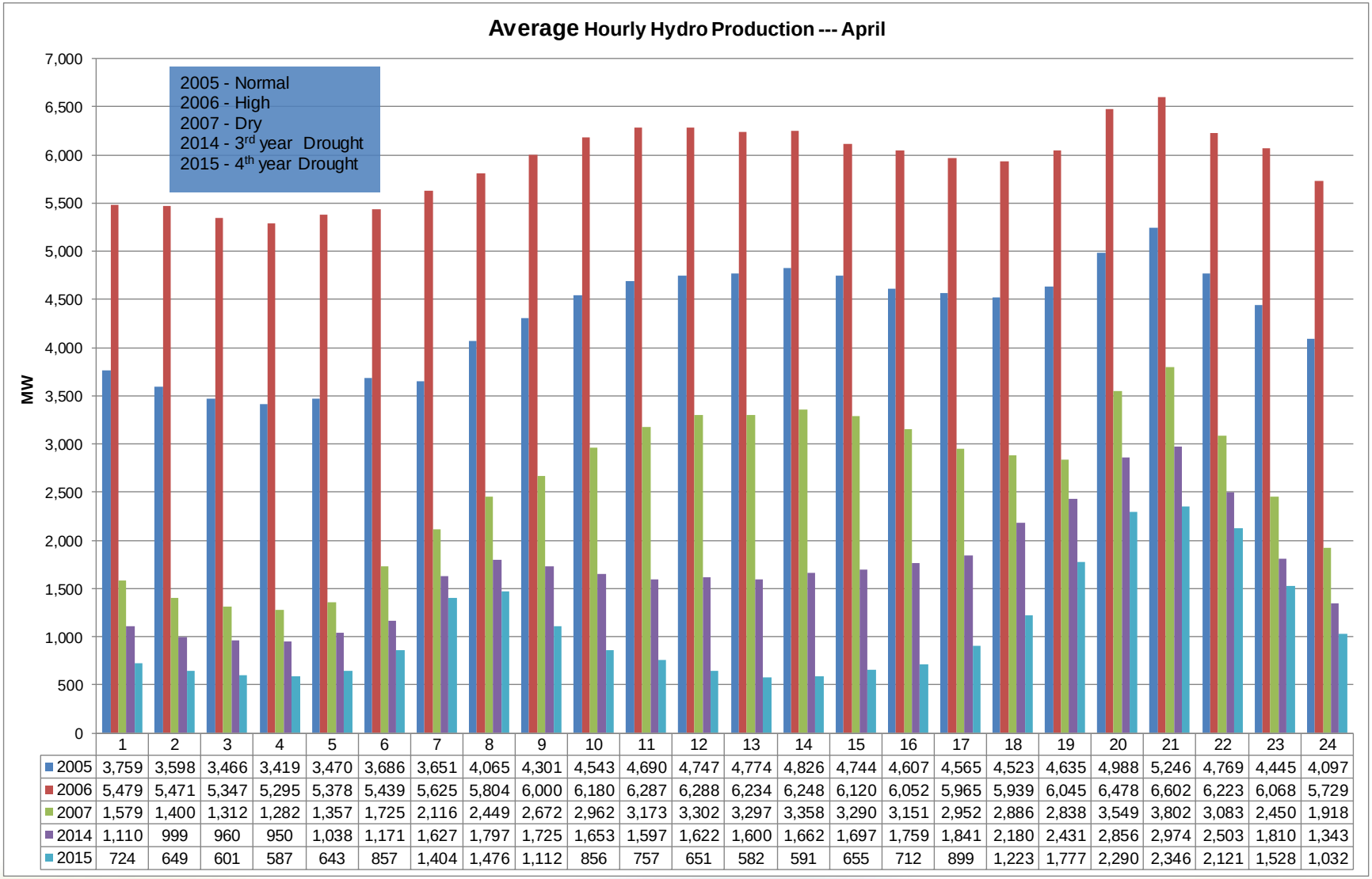
Minimum net-loads will continue to decrease over time



Over-generation is more than just an economic issue, it is also reliability issue

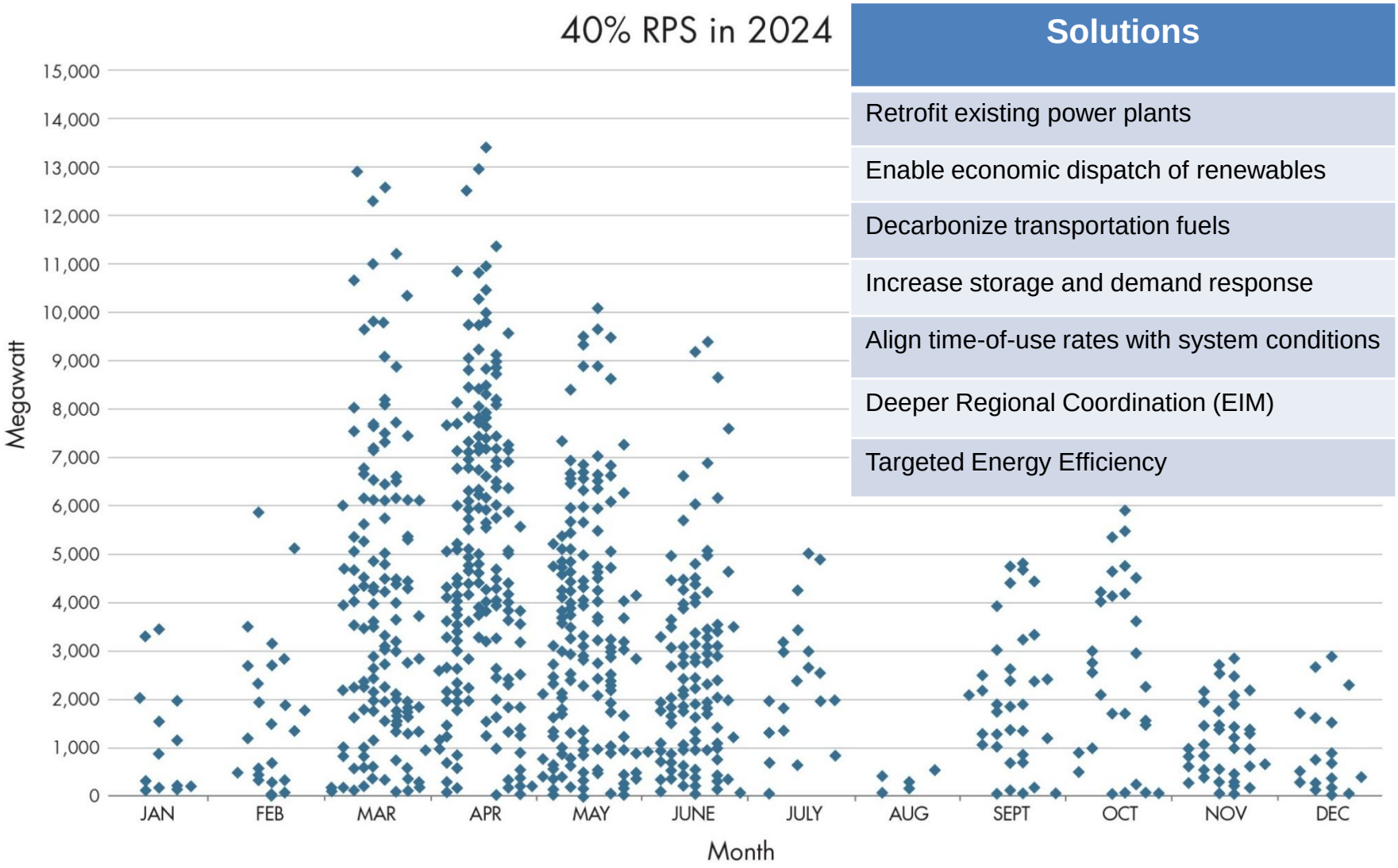
- Basic impacts
  - Impacts system frequency
  - Increases ACE
- Severe impacts
  - Lack of upward and downward dispatchability
    - Inability to commit resources in timely manner to meet evening ramps without exacerbating over generation
  - Grid facility overloads and potential generator damage
    - could result in extended periods of generating unit unavailability, including unavailability to fulfill IFM awards
  - Risk of non-compliance with NERC's Control Performance Standard 1 (CPS1) and NERC Standard BAL-001-1, ACE, DCS, and frequency response

Average hourly hydro production for high, low and average hydro years --- April



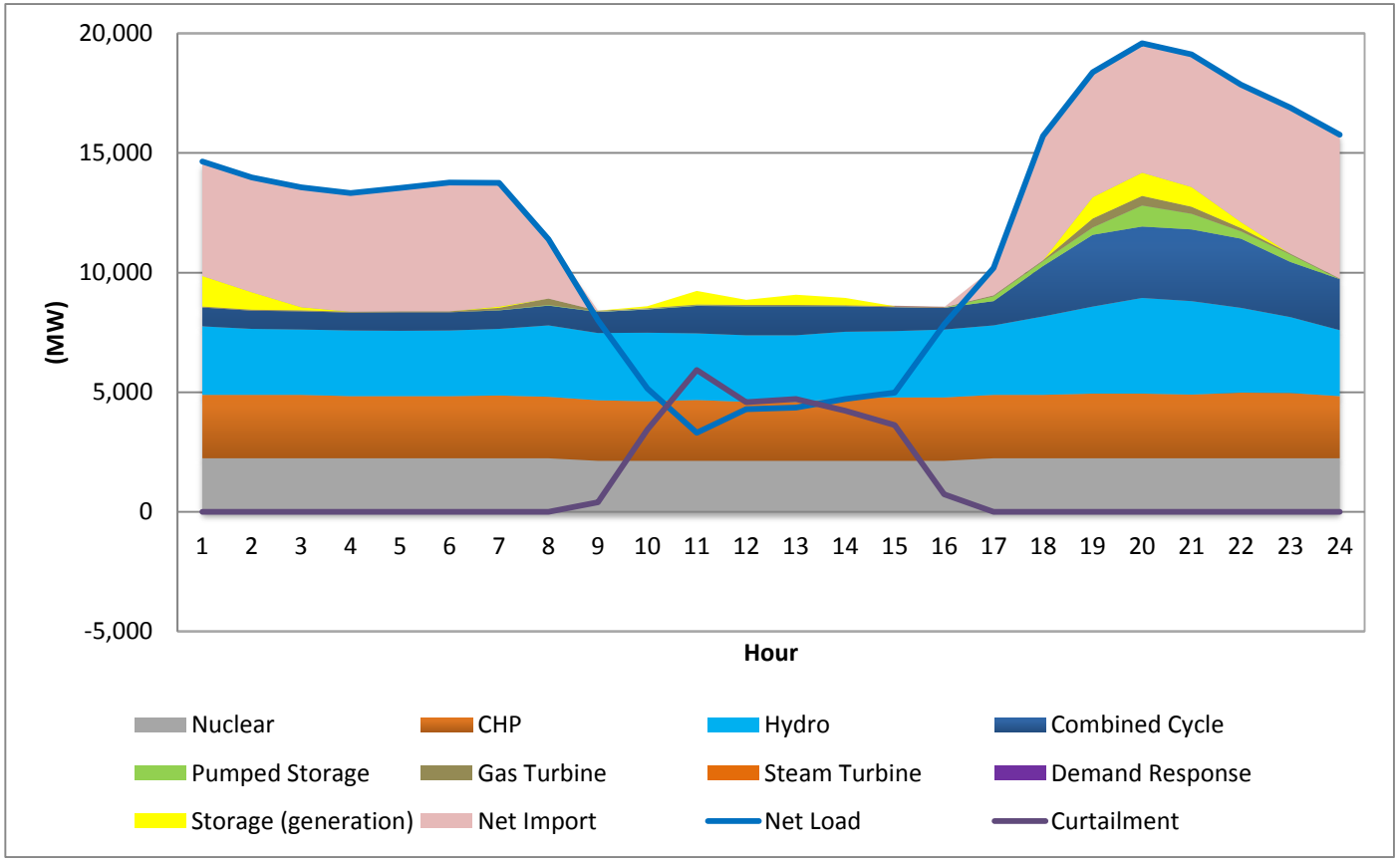
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
2005	3,759	3,598	3,466	3,419	3,470	3,686	3,651	4,065	4,301	4,543	4,690	4,747	4,774	4,826	4,744	4,607	4,565	4,523	4,635	4,988	5,246	4,769	4,445	4,097
2006	5,479	5,471	5,347	5,295	5,378	5,439	5,625	5,804	6,000	6,180	6,287	6,288	6,234	6,248	6,120	6,052	5,965	5,939	6,045	6,478	6,602	6,223	6,068	5,729
2007	1,579	1,400	1,312	1,282	1,357	1,725	2,116	2,449	2,672	2,962	3,173	3,302	3,297	3,358	3,290	3,151	2,952	2,886	2,838	3,549	3,802	3,083	2,450	1,918
2014	1,110	999	960	950	1,038	1,171	1,627	1,797	1,725	1,653	1,597	1,622	1,600	1,662	1,697	1,759	1,841	2,180	2,431	2,856	2,974	2,503	1,810	1,343
2015	724	649	601	587	643	857	1,404	1,476	1,112	856	757	651	582	591	655	712	899	1,223	1,777	2,290	2,346	2,121	1,528	1,032

RPS Curtailment in 2024 – 40% RPS Scenario

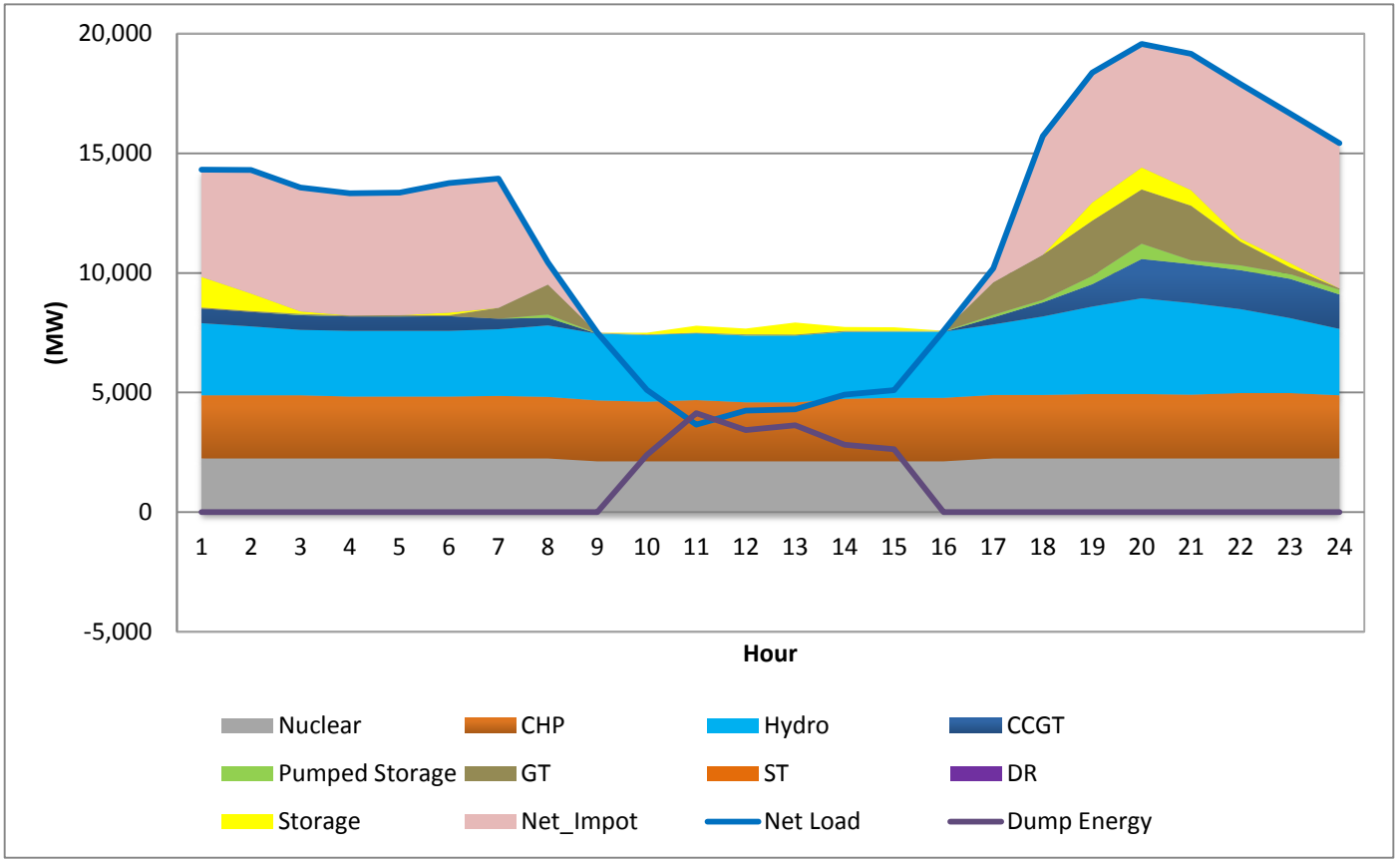


Solutions
Retrofit existing power plants
Enable economic dispatch of renewables
Decarbonize transportation fuels
Increase storage and demand response
Align time-of-use rates with system conditions
Deeper Regional Coordination (EIM)
Targeted Energy Efficiency

Ramping process of March 24, 2024 - Trajectory scenario



Ramping process of March 24, 2024 - Trajectory scenario no curtailment sensitivity case



Current tools the ISO has to address over-generation

- Tariff section 7.8 and Operating Procedure 2390
  - Identifies common causes of over-generation (i.e. Self-scheduled resources, initial and terminal conditions, IFM vs CFCD, virtual bids, test energy)
  - Includes a process starting with DAM and proceeding through RTM and recovery
  - Requires ISO operators to issue market notices, call adjacent BAAs, request decremental bids, curtail self-schedules, shut down resources if needed, turn on pumping load (if possible)

The ISO has a priority process to address over-generation

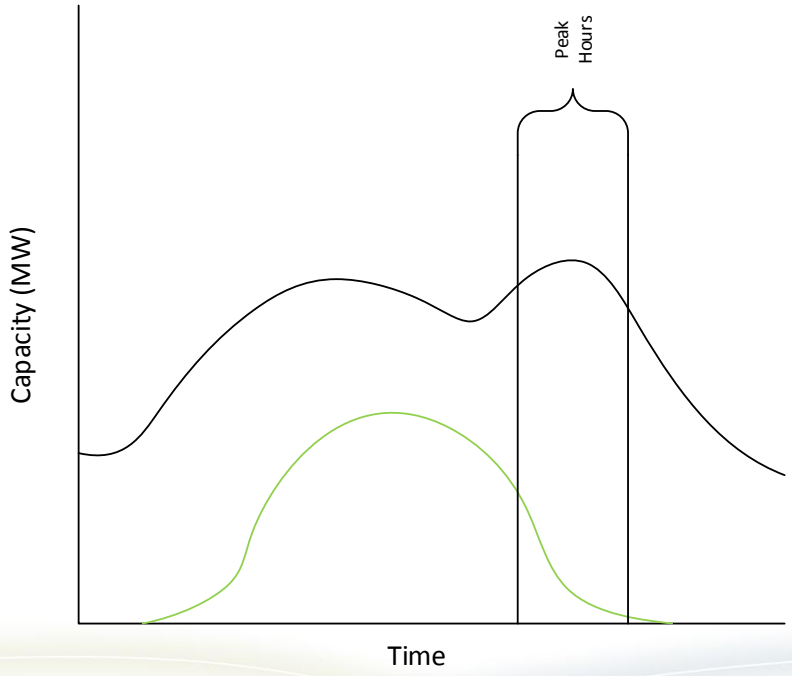
- IFM from highest priority (last to be adjusted) to lowest priority (first to be adjusted), is as follows
  a) Reliability Must Run (RMR) Generation pre-dispatch reduction;
  b) Day-Ahead TOR Self-Schedules reduction;
  c) Day-Ahead ETC and Converted Rights Self- Schedules reduction;
  d) Internal Transmission Constraint relaxation for the IFM;
  e) Other Self-Schedules of CAISO Demand reduction, exports explicitly identified in a Resource Adequacy Plan to be served by Resource Adequacy Capacity explicitly identified and linked in a Supply Plan to the exports, and Self-Schedules of exports at Scheduling Points explicitly sourced by non-Resource Adequacy Capacity;
  f) Self-Schedules of exports at Scheduling Points not explicitly sourced by non-Resource Adequacy Capacity;
  g) Day-Ahead Regulatory Must-Run Generation and Regulatory Must-Take Generation reduction;
  h) Other Self-Schedules of Supply reduction

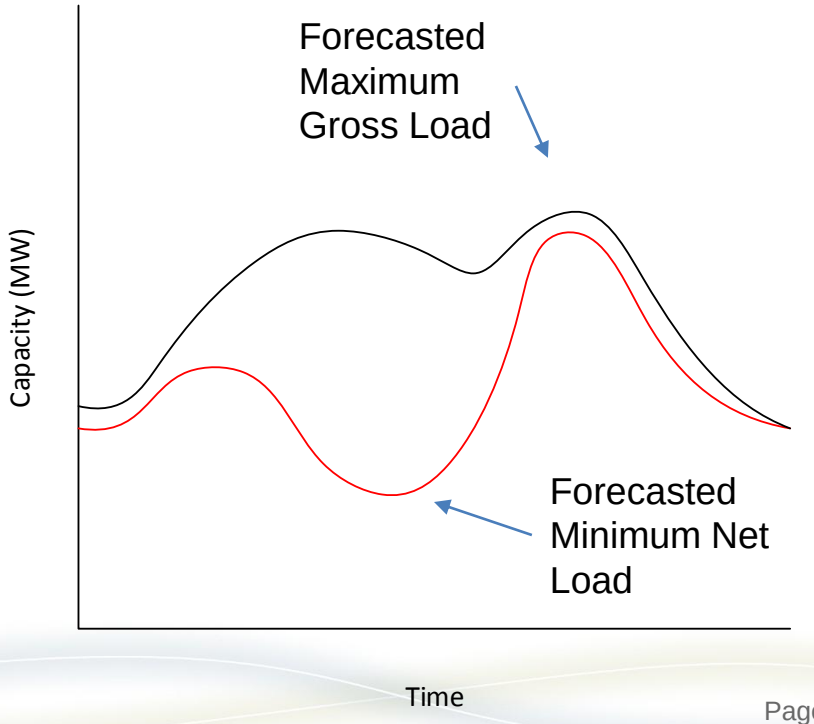
Existing tools will be insufficient to address more frequent and larger over-generation

- Does not adequately address over-generation caused by inflexibility of Pmin burden
- Frequency and magnitude of over-generation caused by Pmin burden is likely to increase
  - Mitigated in 2015 due to low hydro production
- Current tools treat self-scheduling of RA and non-RA capacity identically
  - May curtail flexible RA capacity needed for ramps
- Increase in smaller distributed resources make manual curtailment more challenging and less reliable

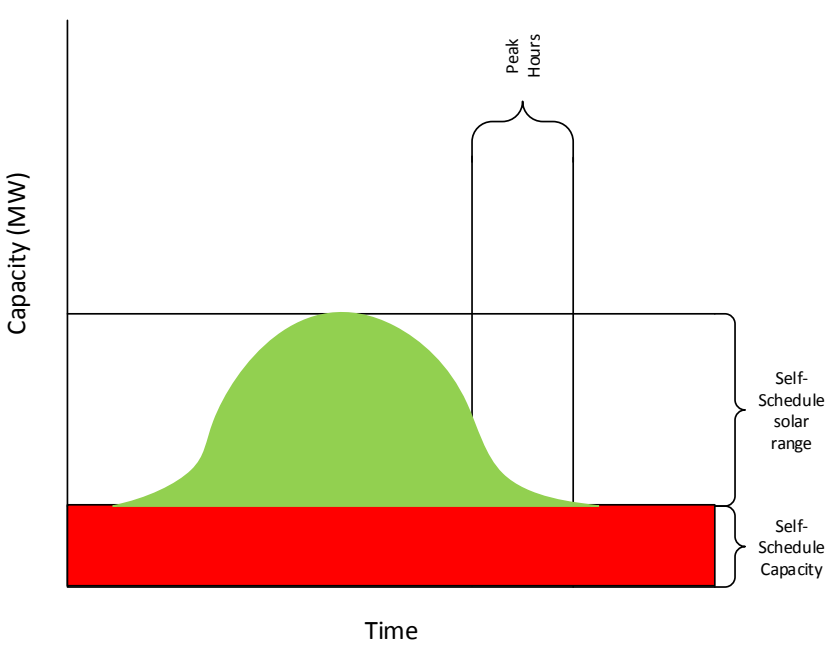
Greatest potential for over generation is not well aligned with RA requirements

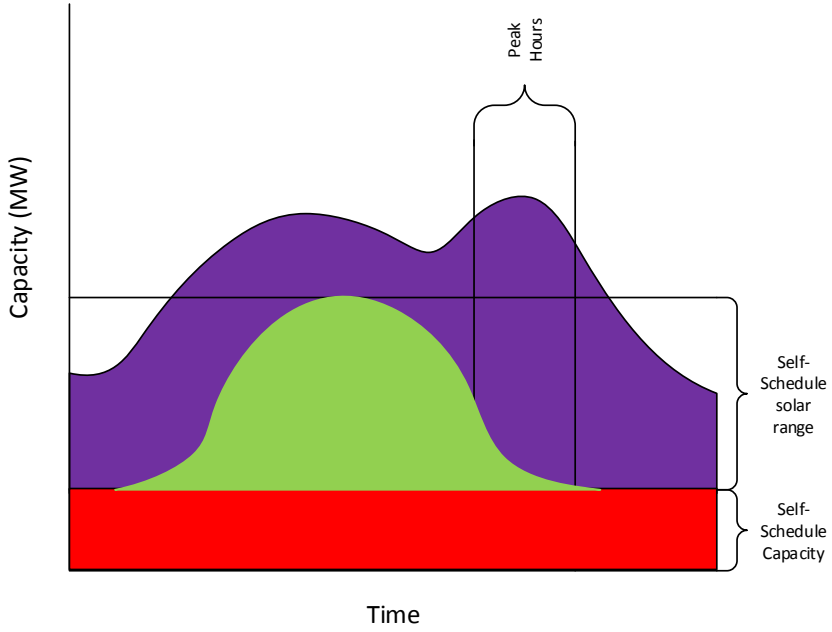
- NQC set at peak
- State environmental policy objectives encourage high levels of VER production
- Max output for many VERs occurs outside of peak
- Some amount of inflexible capacity may be beneficial



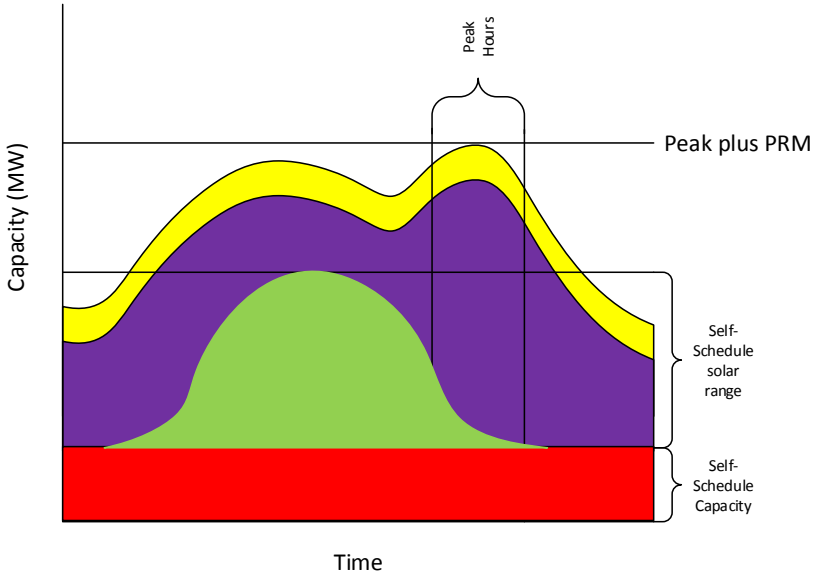


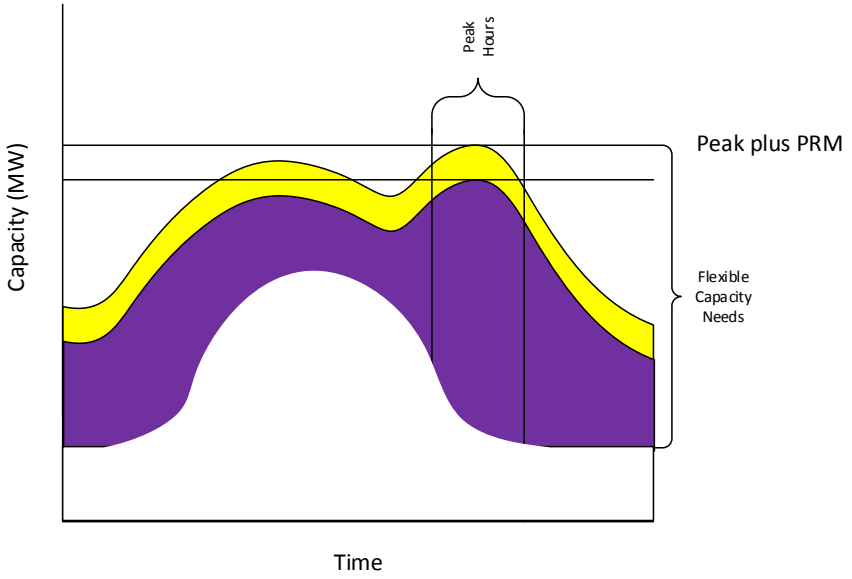
Flexibility needs must account for both operational realities and state environmental policy





Flexibility needs must account for both operational realities and state environmental policy (cont.)





It is reasonable to include downward flexible capacity needs in the RA program

- FERC and CPUC recognize RA should include operational attributes and that there is a need to value ramping capabilities in forward procurement
- The reasons for including downward flexible capacity in the RA program are similar to those for upward flexible capacity
  - Inflexible resources will not incur the full cost of their inflexibility due to bid floors
  - Without sufficient downward flexible capacity, the ISO would still experience downward ramping constraints
    - Would have to resort to out-of-market solutions to maintain reliability

Accounting for upward and downward resource operational constraints

Upward flexibility may not always equate to downward flexibility when in comes to resource PMin

- Current EFC allows Pmin to count as flexible capacity if start-up time is less than 90 minutes
- Flexible capacity for over-generation can be limited by cycle times
- EFC calculations must account operational attributes that can contribute to potential over-generation
  - Minimum operating level
  - Minimum run times
  - Minimum down times
- Due to ramping and commitment needs interplay with over generation, some portion of the flexible capacity resources may need to have start-up times between 30 and 60 minutes

EFC calculation should account for the downward inflexibility of resources' PMin

- Pmin can count as flexible if
  - Start-up time is less than 90 minutes
  - Minimum run time is less than 4 hours
  - Minimum down-time is less than 4 hours
- If Pmin of a resource fails any of these tests, it is inflexible capacity
- Number of starts per day is less than two
  - This may only limit the category of flexible capacity not the quantity

Under proposed rules EFC may be reduced for minimum run-time and min down-time: Example

Existing EFC rules

- NQC: 100 MW
- Pmin: 40 MW
- Start-up: 60 Min
- Avg Ramp Rate: 60MW/Min

- EFC = 100 MW

Proposed EFC rules

- NQC: 100 MW
- Pmin: 40 MW
- Start-up: 60 Min
- Avg Ramp Rate: 60MW/Min
- Min Run Time: 6 hours
- Min Down Time: 4 hours

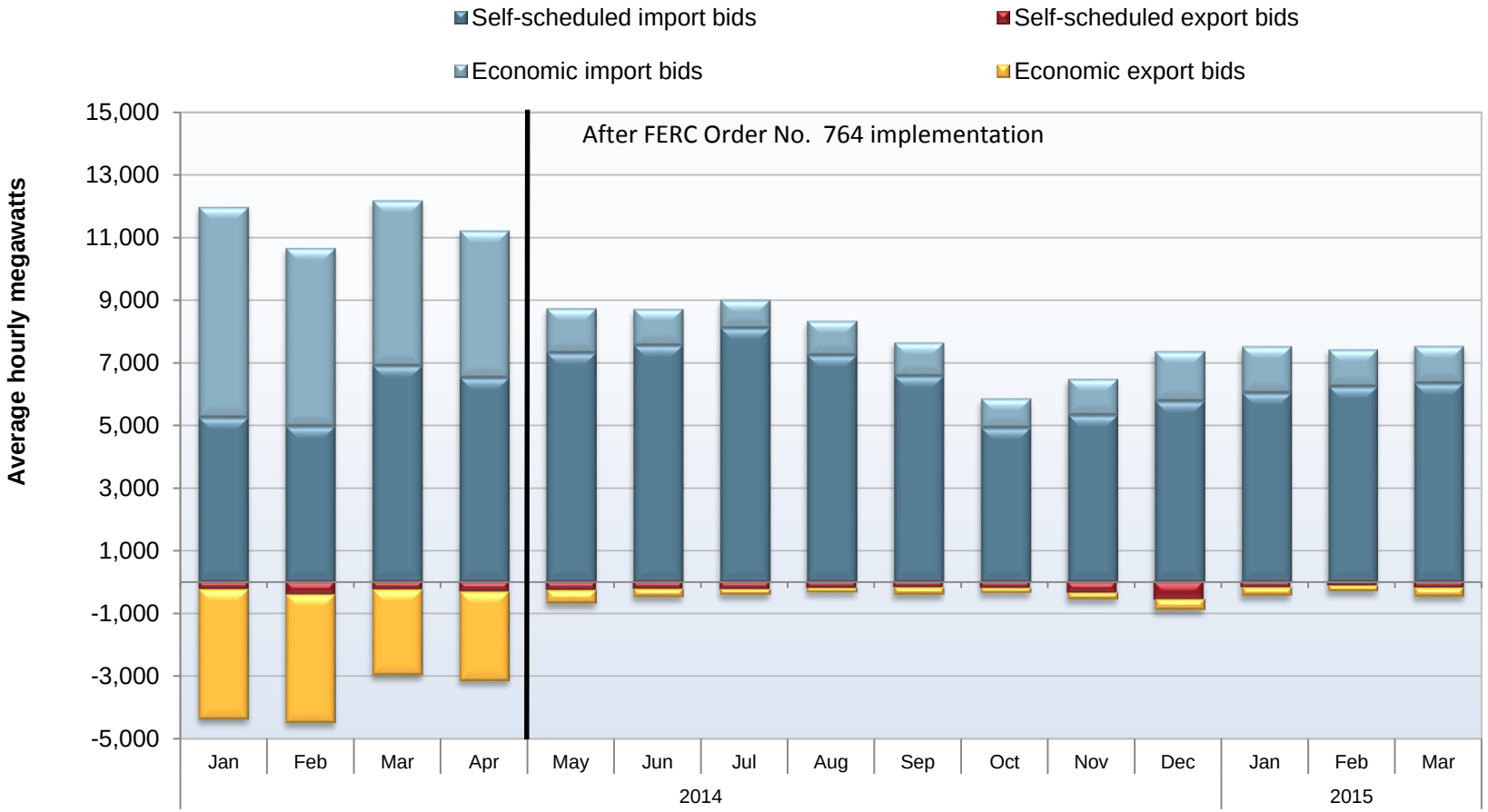
- EFC = 60 MW

15-minute intertie resources to provide Flexible RA capacity

15-minute intertie resources may provide valuable upward and downward flexible capacity

- The ISO expects greater variability over time:
  - Five minute
  - Fifteen minute
  - Hourly
  - Three hours
- 15 minute imports, if economically bid, can help address many of these needs
- Economically bidding intertie resources can help the ISO more readily address over-generation conditions

There is currently very little intertie capacity economically bidding into the real-time market



Source: Q1 2015 Report on Market Issues and Performance
Available at http://www.caiso.com/Documents/DMM_Q1_2015_Report_Final.pdf

The ISO must develop rules to allow intertie resources to provide flexible capacity

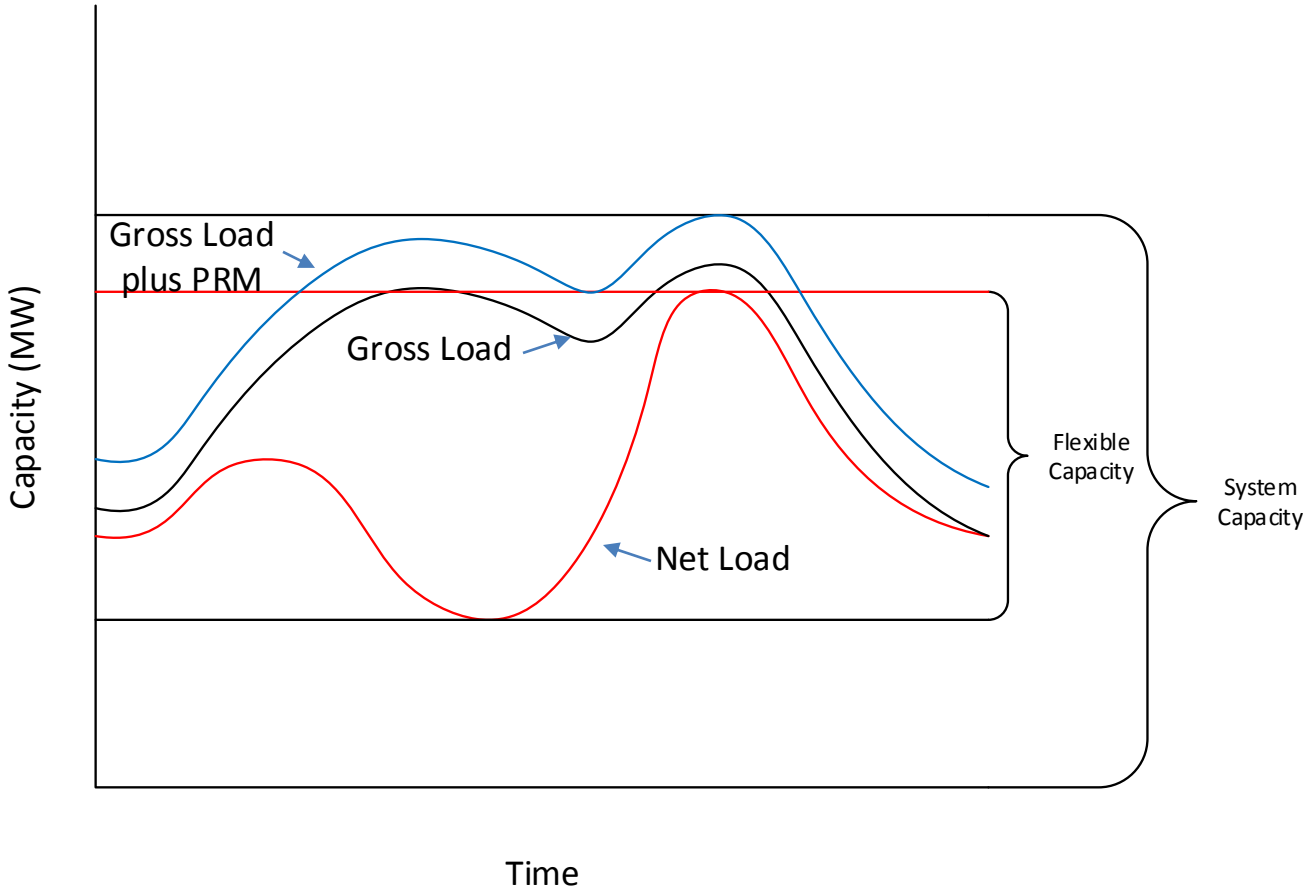
- All LSEs using intertie resources to provide flexible RA must also demonstrate sufficient import capacity
  - i.e. must reserve capacity through ISO's MIC allocation process
- All resource specific system resources will have the same EFC rules as internal resources
  - i.e. – average ramp rates, Pmin, start-up times, etc.
- ISO must develop EFC counting rules for resources that do not have all necessary parameters in Masterfile
  - i.e. Non-resource specific system

A limit on flexible capacity from 15-minute intertie resources may be needed

- Non-resource specific resources do not have PMin and minimum run time, making them well suited to provide flexible capacity
- The ISO is still assessing the magnitude of real-time flexibility that must be addressed between 15 minute and 5 minute dispatched

Determining Flexible Capacity Requirements: Inflexible vs. flexible capacity

The current flexible capacity requirements



Evaluation of the existing flexible capacity product

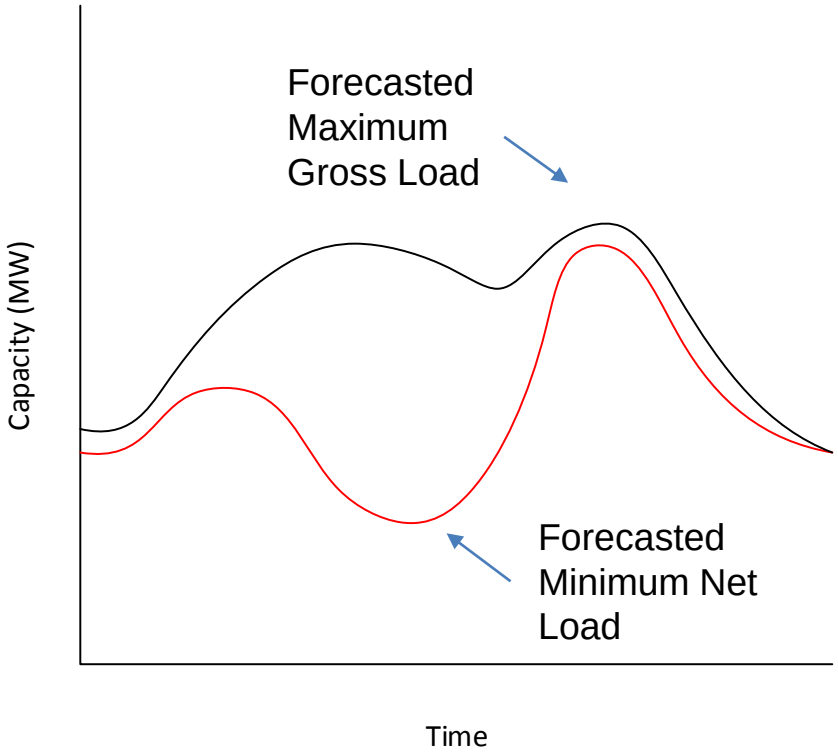
Pros

- Simple from a procurement standpoint
- Worked in the existing RA construct
- Requires economic bidding from flexible capacity resource
- Easily modified

Cons

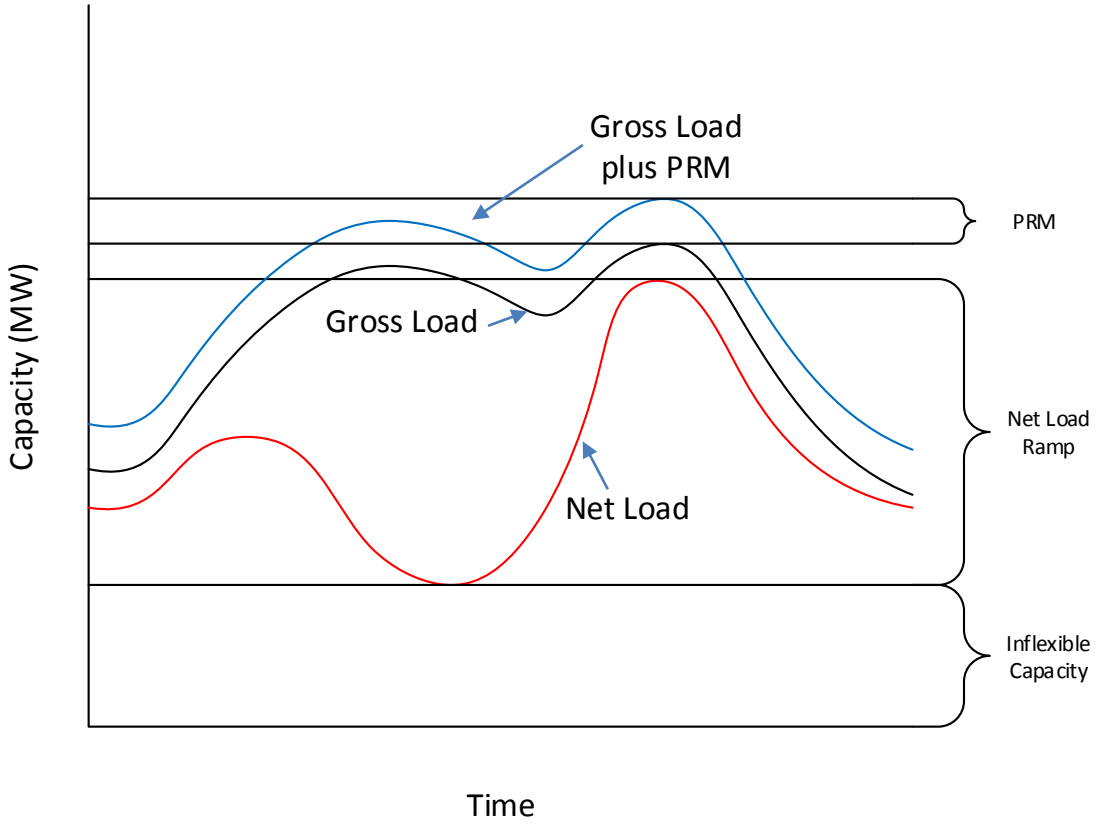
- Does not address over-generation needs caused by Pmin
- Overlap between system and flexible RA creates confusion with respect to offer obligations
- Does not consider the impact of non-RA resources

The ISO is considering a new methodology to calculate flexible and inflexible capacity needs consistent with operational and environmental objectives



- Applied only in months when over-generation is a concern
- Develop forecasted load and net load curves
- Identify minimum forecasted net load in a month
- Identify forecasted monthly maximum gross load in a month
- Determine forecasted planning reserve margins

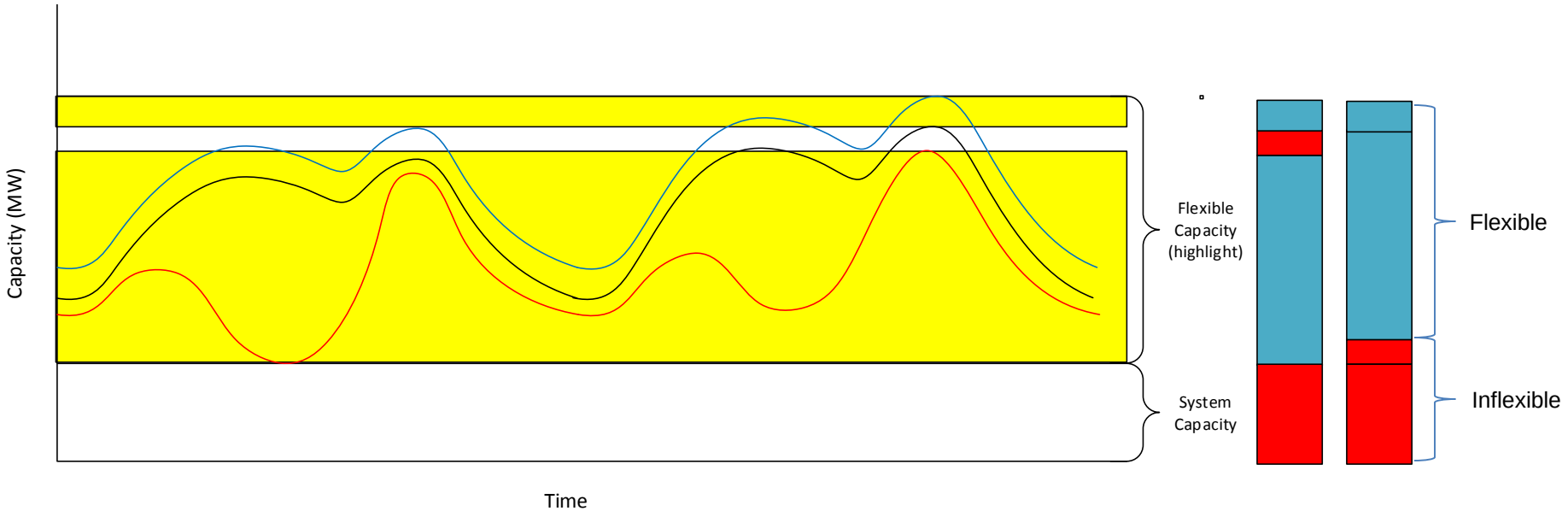
Need to establish how much inflexible capacity is operationally feasible



- Inflexible capacity set at minimum forecasted net load plus forecasted VER output at peak
- Flexible capacity requirement would be from forecasted minimum net load to forecasted maximum net load plus PRM
  - Capacity providing reserves should already be dispatchabe, by definition

An example of how inflexible and flexible capacity requirements could be determined

- Two day month



The must-offer obligations for flexible and local capacity resources need not change

- Inflexible capacity determined by minimum net load plus VER output at peak
  - Must-offer obligation = Self-schedule or economic bid
- Flexible capacity determined by maximum net load minus minimum net load plus planning reserve margin
  - Must-offer obligation = Economic bid
- Local capacity requirements remain unchanged
  - Must-offer obligation and availability requirements remain unchanged
- Balance between inflexible and flexible RA requirements can be adjusted through “inflexible capacity allowances”

Simplify RA showings and offer obligations

- Maximum inflexible requirements only apply in non-summer months
  - PMin burden is of greatest concern in non-summer months
  - System and flexible capacity split would still occur for summer months, but flexible capacity requirements calculations would not change from current rules
- System RA sufficiency could be assessed by
  - Adding NQC of system RA capacity plus EFC of flexible RA units
  - Assessing NQC only and validating flexible RA requirements separately
- Local RA assessments could continue to be done on resource NQC values
  - Applies even regardless of how flexible and inflexible adequacy are measured

Flexible RA duration requirement needs to be reassessed

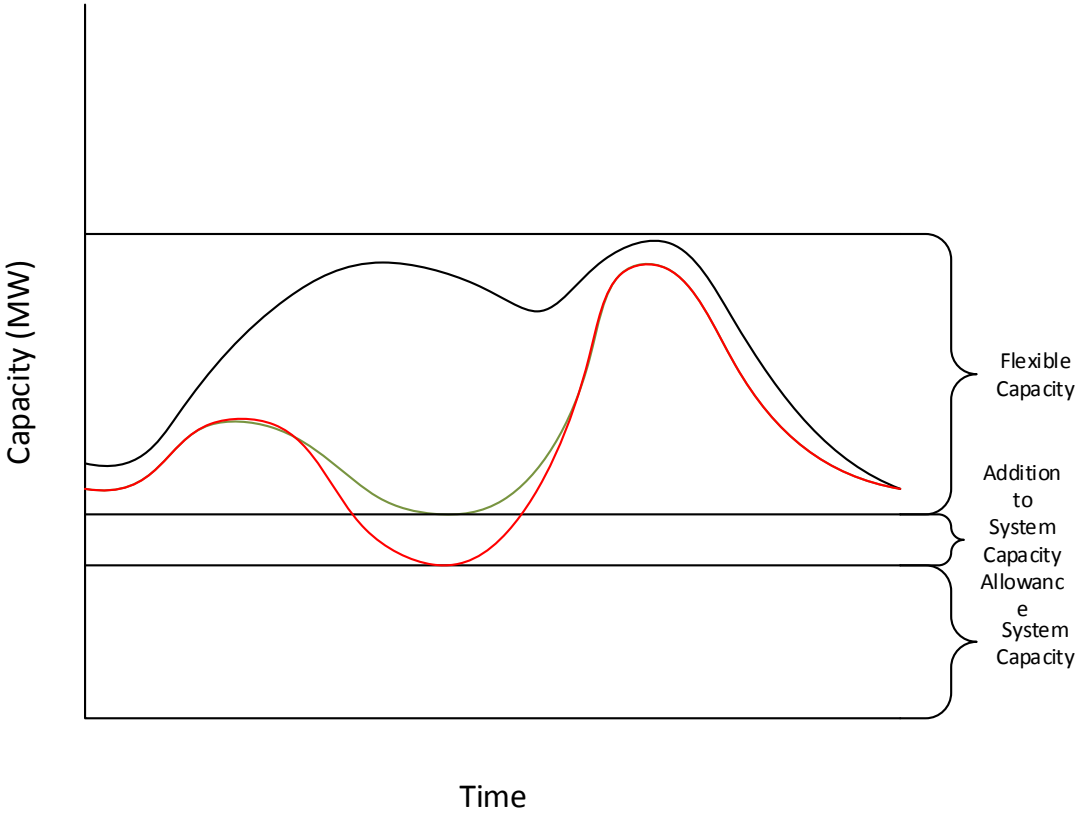
- ISO is assessing if the flexible capacity product should continue to be assessed over 3 or 4 hours
- This assessment is examining accuracy of day-peak and shape of gross load
  - 3 hours may work if
    - Day ahead peak forecast is accurate in terms of timing and quantity, and
    - Gross load is “peakier” than it was when RA was originally designed
- The ISO is not contemplating a shorter duration RA at this time

“Inflexible capacity allowances” and adjustments to inflexible capacity

Inflexible capacity allowances would allow LSEs to meet inflexible capacity constraints at least cost

- Large quantities of inflexible capacity increase the probability of over-generation
- There is currently a significant amount of inflexible capacity existing in the ISO
  - Inflexible QF
  - Nuclear
  - Run-of-river hydro
  - Self scheduled resources
- Inflexible capacity allowances are a means of increasing allowable inflexible capacity at the lowest cost
  - Allowances do to not help address gross load and are not RA capacity
  - Value should reflect incremental benefit of downward flexibility (i.e. same as incentive to lower Pmin of a resource)

Allowable inflexible capacity can be increased by providing allowances



- Allowances for inflexible capacity for:
  - Dispatchable Load
  - Dispatchable Wind and solar
  - Storage load
  - Exports
- <u>All allowances must be bid into the ISO markets</u>
  - Event based triggers will not count towards the credits
- Note for energy storage:
  - Discharge would be RA
  - Charging would be an allowance

An example of how an LSE's inflexible capacity allowance could be validated in RA showings

RA showing* (without an allowance)

- Total requirement = 1000 MW
- Max inflexible RA: 400 MW
- Min flexible RA: 600 MW
- Showing
  - Max inflexible RA: 400 MW
  - Min flexible RA: 600 MW
- Total capacity shown:1000 MW
- Outcome: Accepted, Adequate

RA showing* (with an allowance)

- Total requirement = 1000 MW
- Max inflexible RA: 400 MW
- Min flexible RA: 600 MW
- Showing
  - Inflexible RA: 450 MW
  - Flex RA: 550 MW
  - Inflexible capacity allowance: 50 MW
- Total capacity shown: 1050 MW
- Outcome: Accepted, Adequate

* Assumes the ISO validates showings of flexible and in flexible using a summation method

An example of how an LSE's inflexible capacity allowance could be validated in RA showings(cont.)

Incorrect RA showing* (without an allowance)

- Total requirement = 1000 MW
- Max inflexible RA: 400 MW
- Min flexible RA: 600 MW
- Showing
  - Max inflexible RA: 450 MW
  - Min flexible RA: 550 MW
- Total capacity shown:1000 MW
- Outcome: Rejected

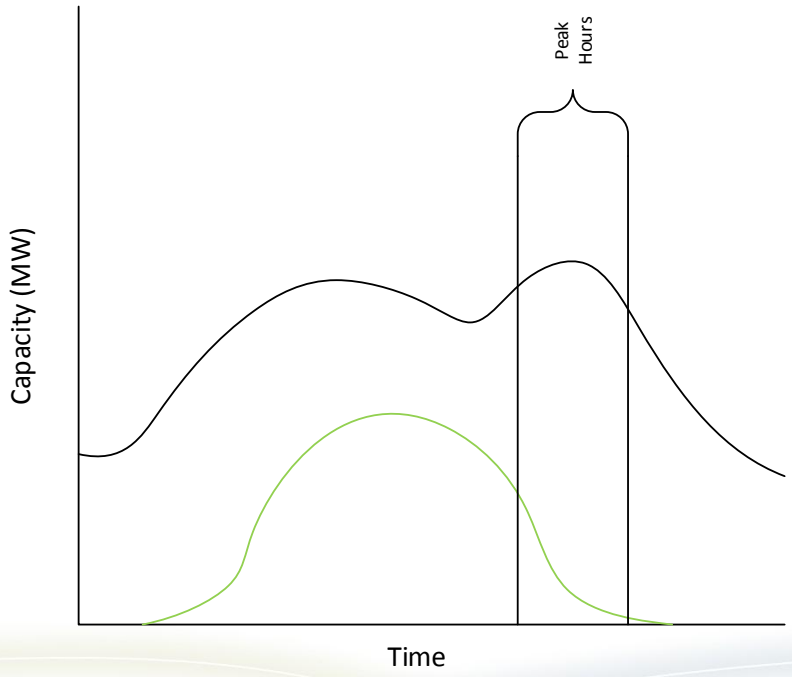
Incorrect RA showing* (with an allowance)

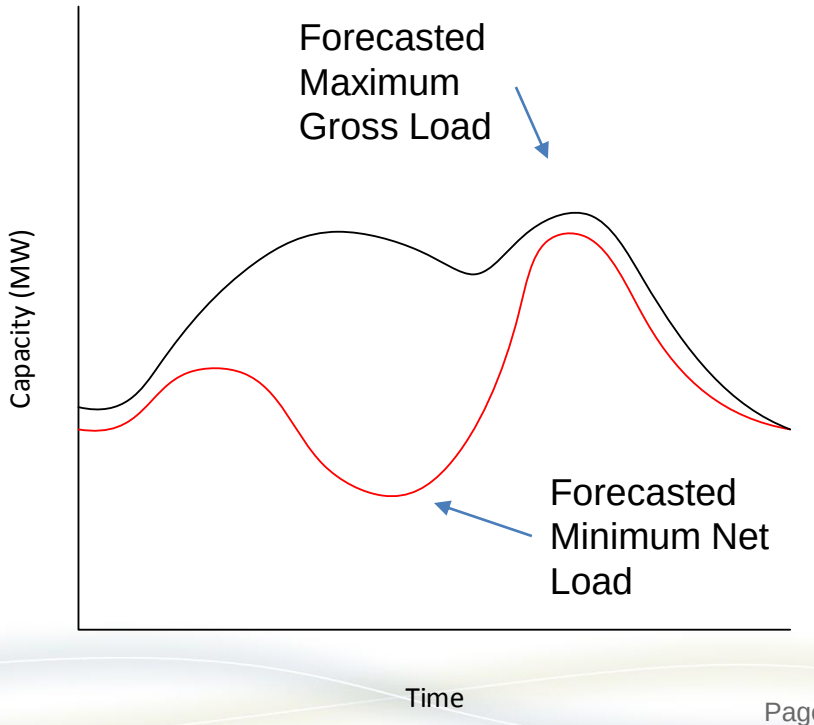
- Total requirement = 1000 MW
- Max inflexible RA: 400 MW
- Min flexible RA: 600 MW
- Showing
  - Max inflexible RA: 450 MW
  - Min flexible RA: 550 MW
- Total capacity shown:1000 MW
- Outcome: Accepted, Deficient

* Assumes the ISO validates showings of flexible and in flexible using a summation method

Allowance values for wind and solar resources must be based on output during low net load times

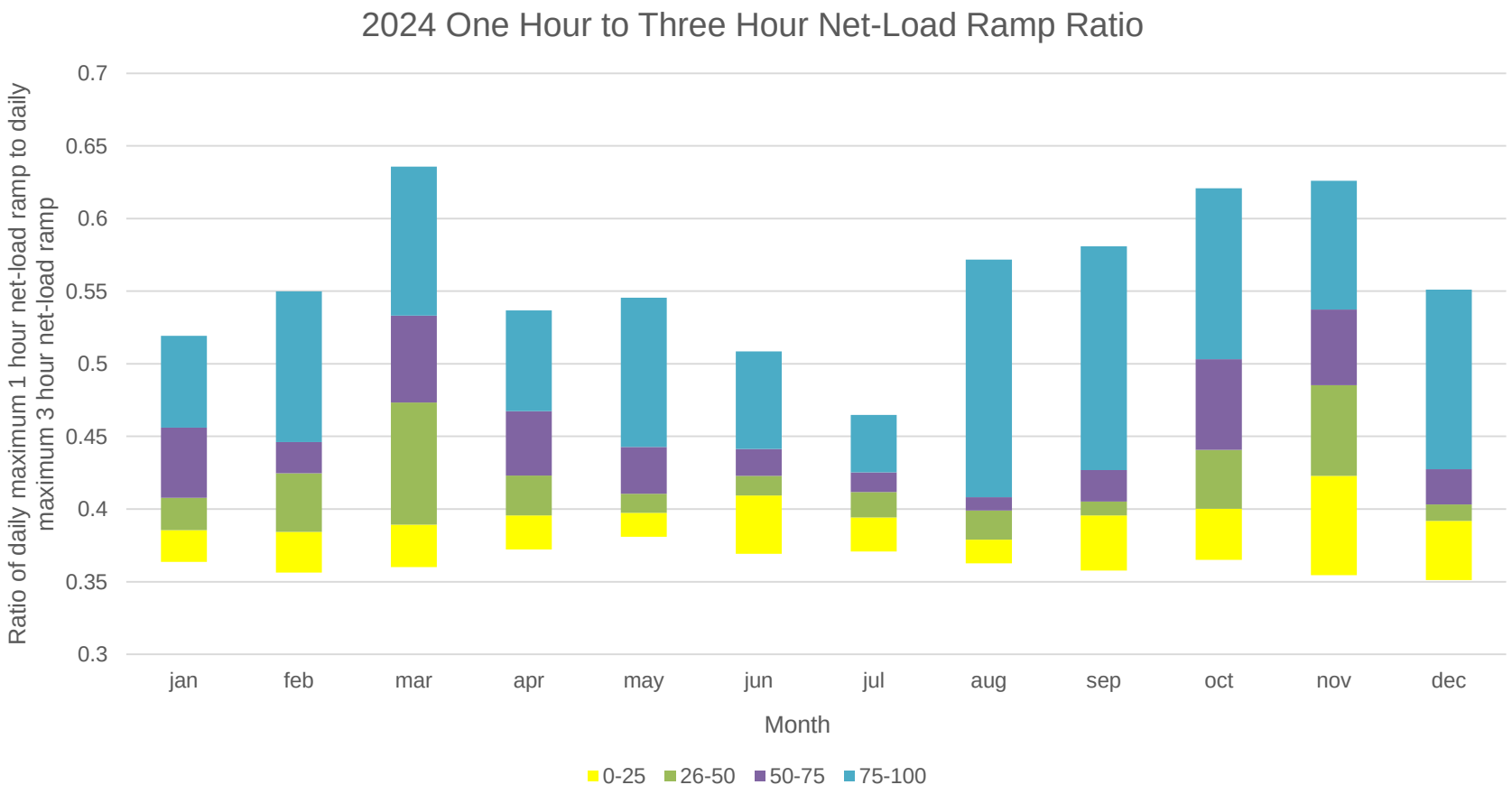
- Inflexible capacity allowances based on NQC under-value the potential benefits of flexible VERs
- ISO must assess expected output of VERs during low net load periods to determine flexible capacity credit





Assessing the ability to meet steep one hour ramps

The ISO has identified a growing need for upward ramping speed



The ramp rate of a subset of flexible capacity must have high ramp rates

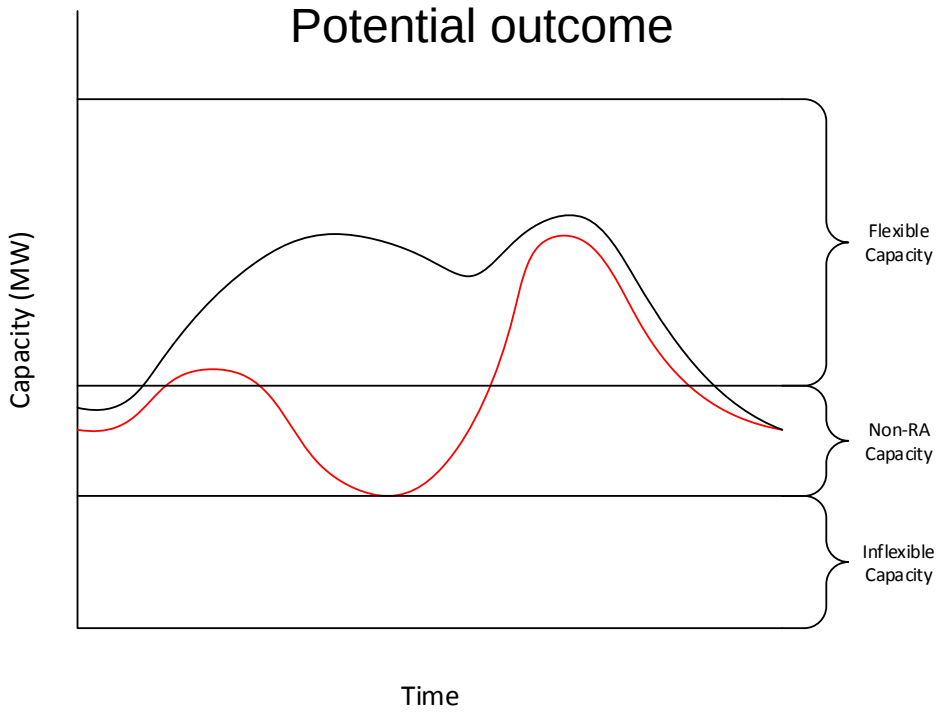
- Allows the ISO to adjust for deviations from day-ahead forecast to adjust for forecast error
  - i.e. cloud cover causes evening ramp to start earlier than expected
- Ensures adequate ramp speed during steepest hourly ramp periods
- Allows ISO to cover 5 minute variability

One hour ramps are increasing and require additional tools to assess adequacy

- Using flexible capacity showings the ISO will assess the ability to meet maximum one hour ramps
- Most balance complexity and accuracy
  - Production simulation (complex and more accurate)
  - Summing only the fastest resources (simple but not accurate
- ISO proposes to use a simple, but conservative approach
  - Assess the ramping capabilities of the mid-range ramping resources (i.e. not fastest, but not slowest)
- If deficient, the ISO could issue backstop procurement
  - Cost allocation would need to be determined

Non-RA resources and potential contributions to over-generation

Self-scheduled non-RA capacity may cause over-generation or cause flexible capacity to be uneconomic



- Non-RA resources could self schedule, limiting access to flexible RA resources

The ISO has considered several options to address self-scheduled non-RA capacity

- Option 1 – Prohibit self-scheduling non-RA resources in the day-ahead and real-time markets
- Option 2 – Day-ahead awards for non-RA capacity that do not rebid into real-time markets are automatically rebid by the ISO at:
  - Day-ahead bid,
  - DEB, or
  - Zero
- Option 3 – Non-RA capacity would have a lower penalty price parameter in scheduling rule
  - i.e. non-RA resources would be the first resources curtailed
- The final solution may apply one or more of these options

Next Steps

- Comments on working group proposal
  - Due August 5, 2015
  - Submit comments to InitiativeComments@caiso.com