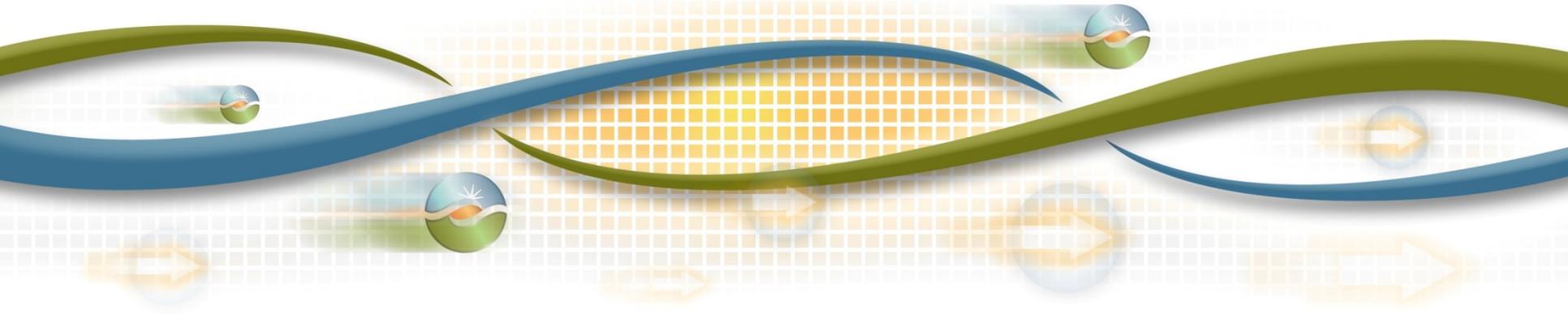


CEC Workshop Strategies to Minimize Renewable Integration Costs and Requirements and Improve Integration Technologies

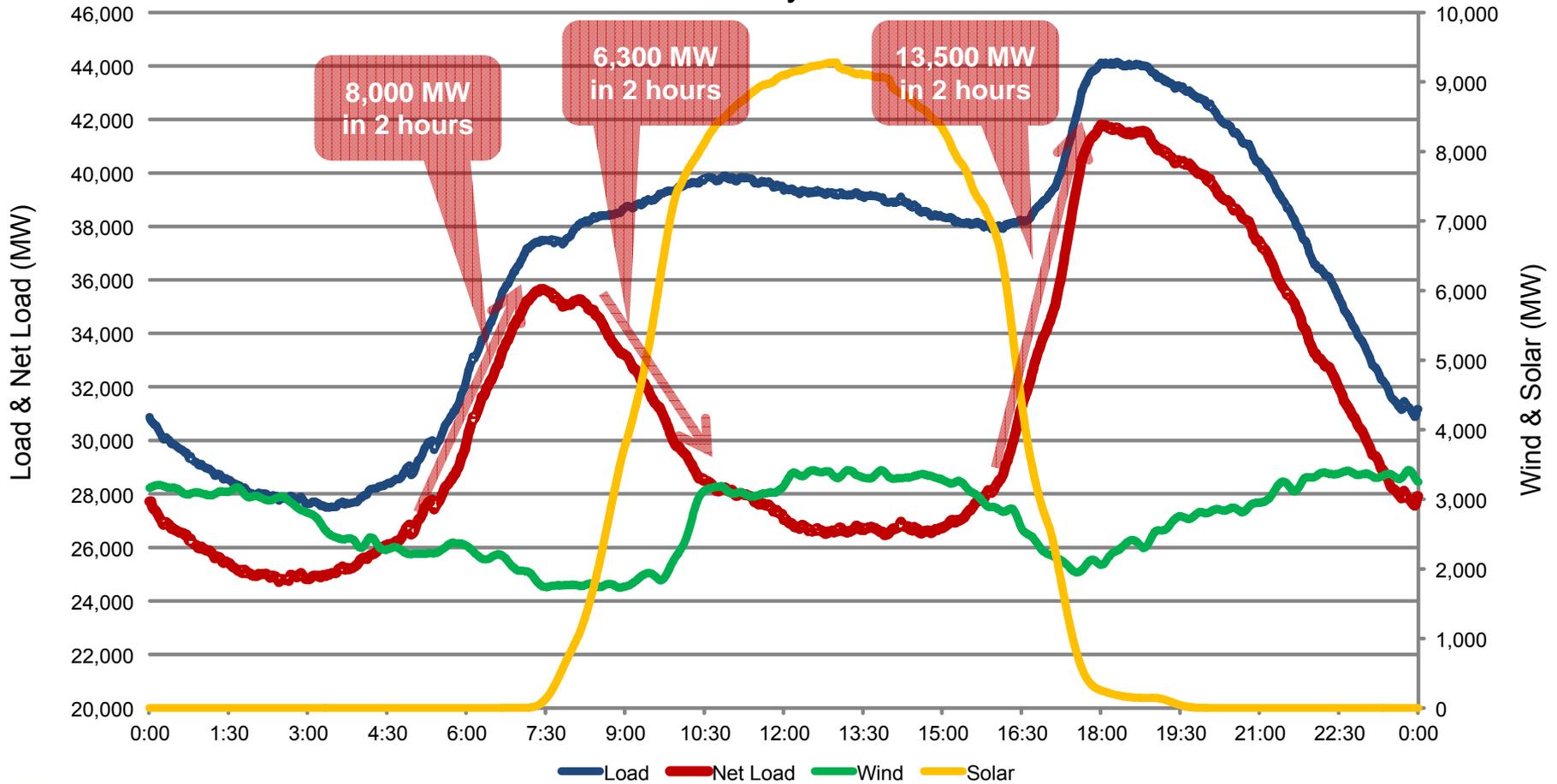
Mark Rothleder, Executive Director Market Analysis and Development

June 11, 2012



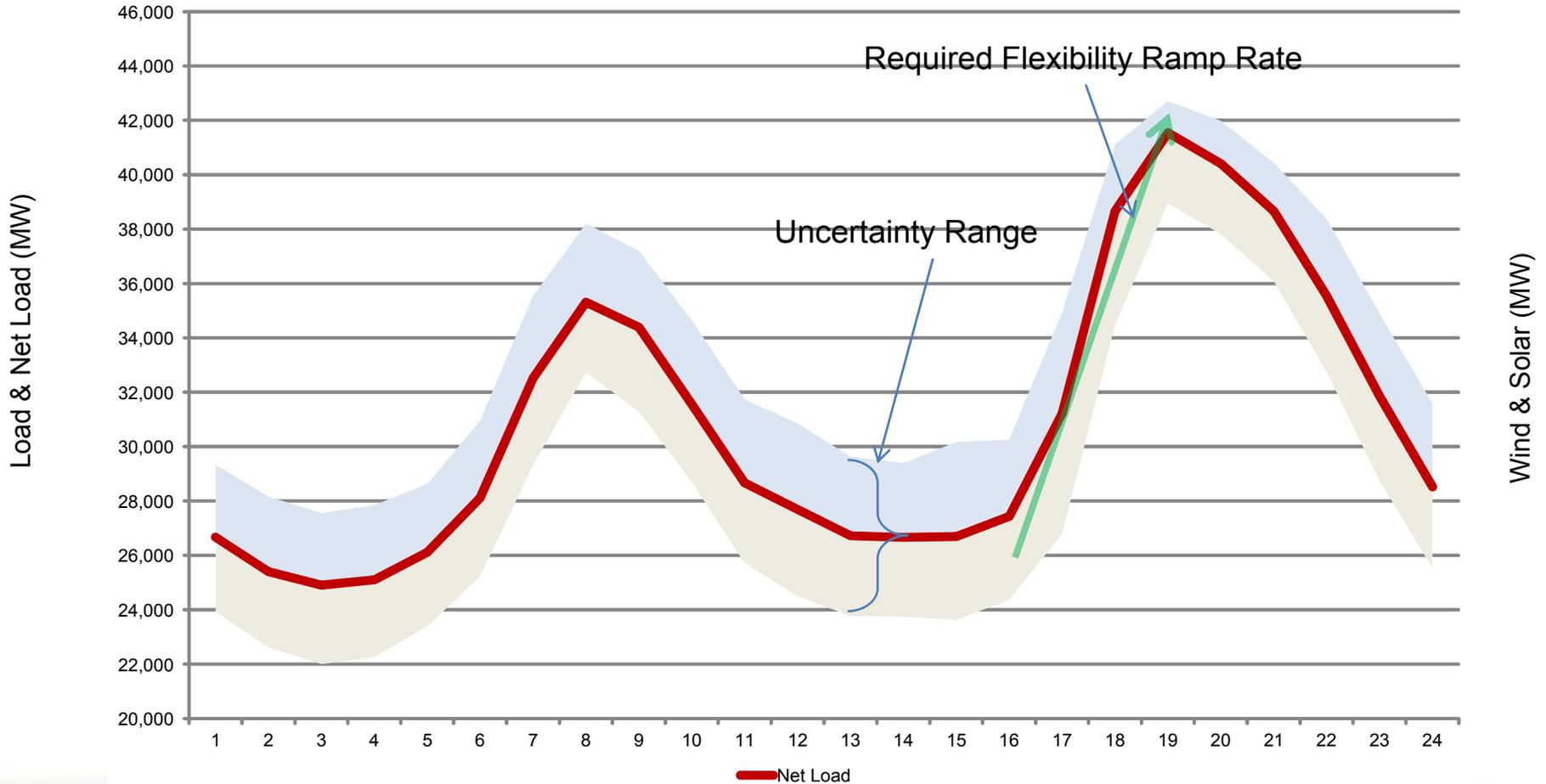
Conventional resources will be dispatched to the net load demand curve – High Load Case

Load, Wind & Solar Profiles – High Load Case
January 2020

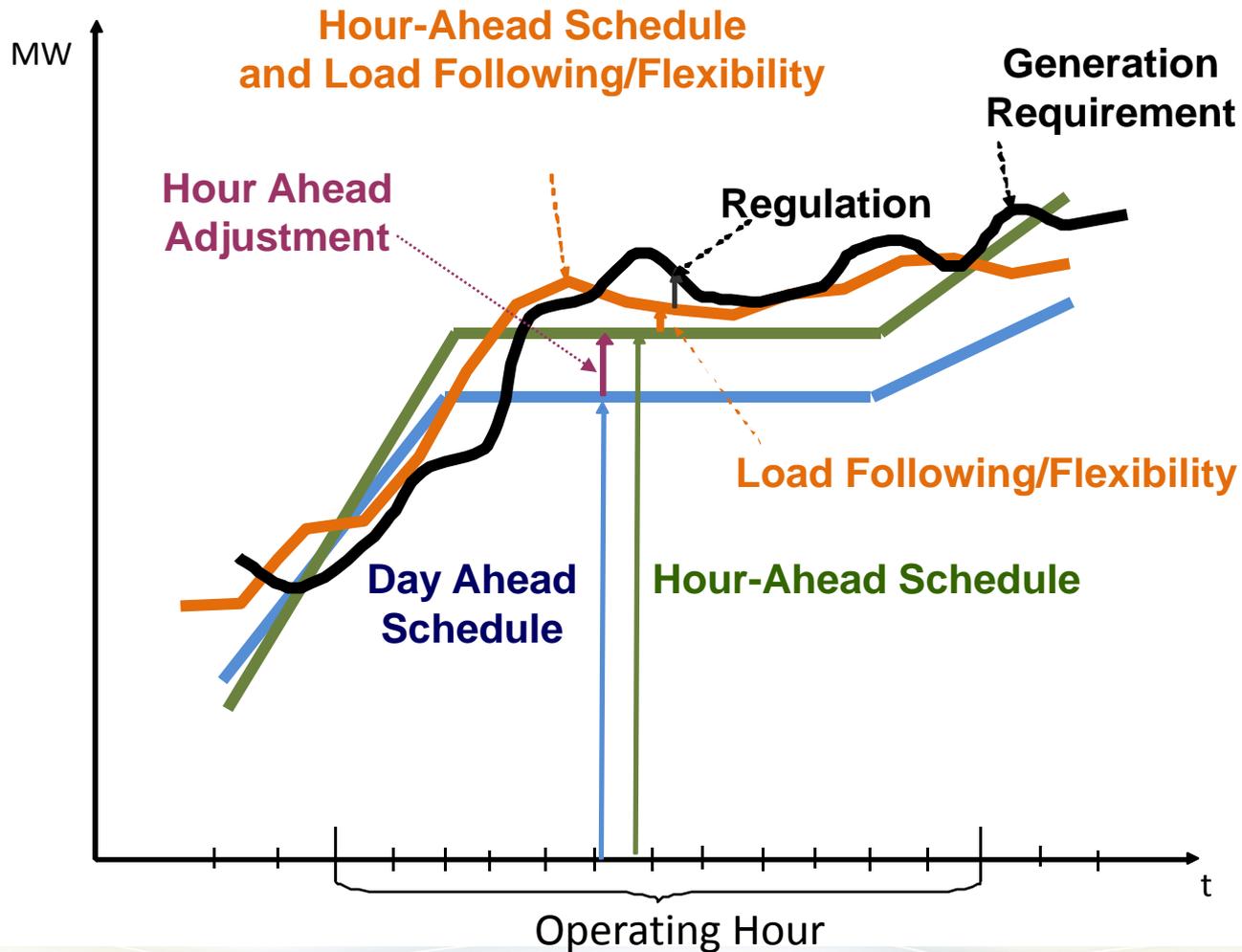


Uncertainty range around the net load demand curve – High Load Case

Load, Wind & Solar Profiles – High Load Case
January 2020



Intra hour need for flexibility and forecast uncertainty



The assessment of a balancing authority's control performance is based on three components

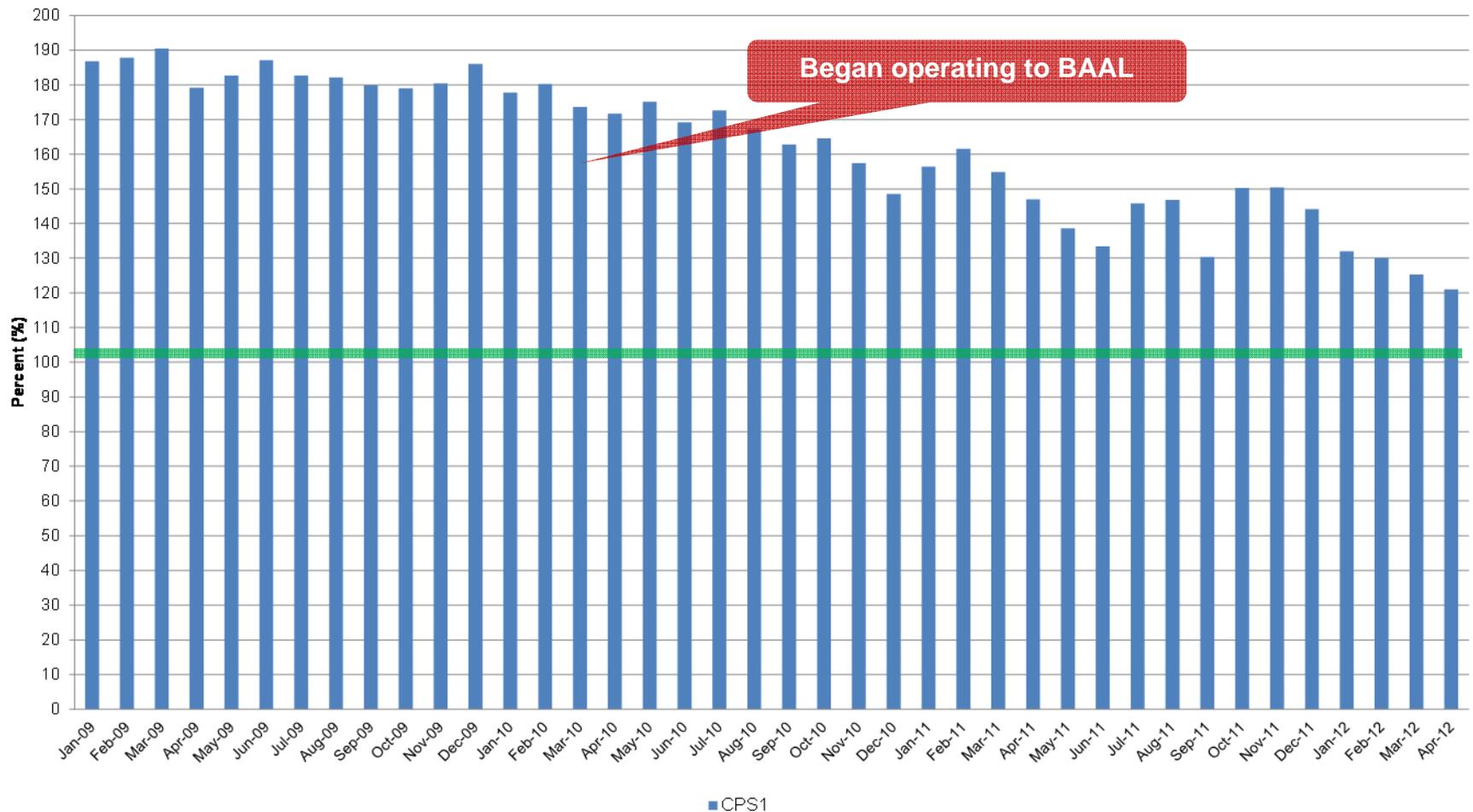
- **Control Performance Standard (CPS1)** - measures the control performance of a BA's by comparing how well its ACE performs in conjunction with the frequency error of the Interconnection
- **Balancing Authority Ace Limit (BAAL)** - is a real-time measure of Area Control Area and system frequency which cannot exceed predefined limits for more than 30-minutes
- **Disturbance Control Standard (DCS)** - is the responsibility of the BA following a disturbance to recover its ACE to zero if its ACE just prior to the disturbance was greater than zero or to its pre-disturbance level if ACE was less than zero - within 15 minutes

Control Performance Rating

Pass is when $CPS1 \geq 100\%$; $BAAL_{Limit} \leq 30$ minutes & $DCS = 100\%$

Control Performance Standard Scores (CPS1) Scores January 2009 through April 2012

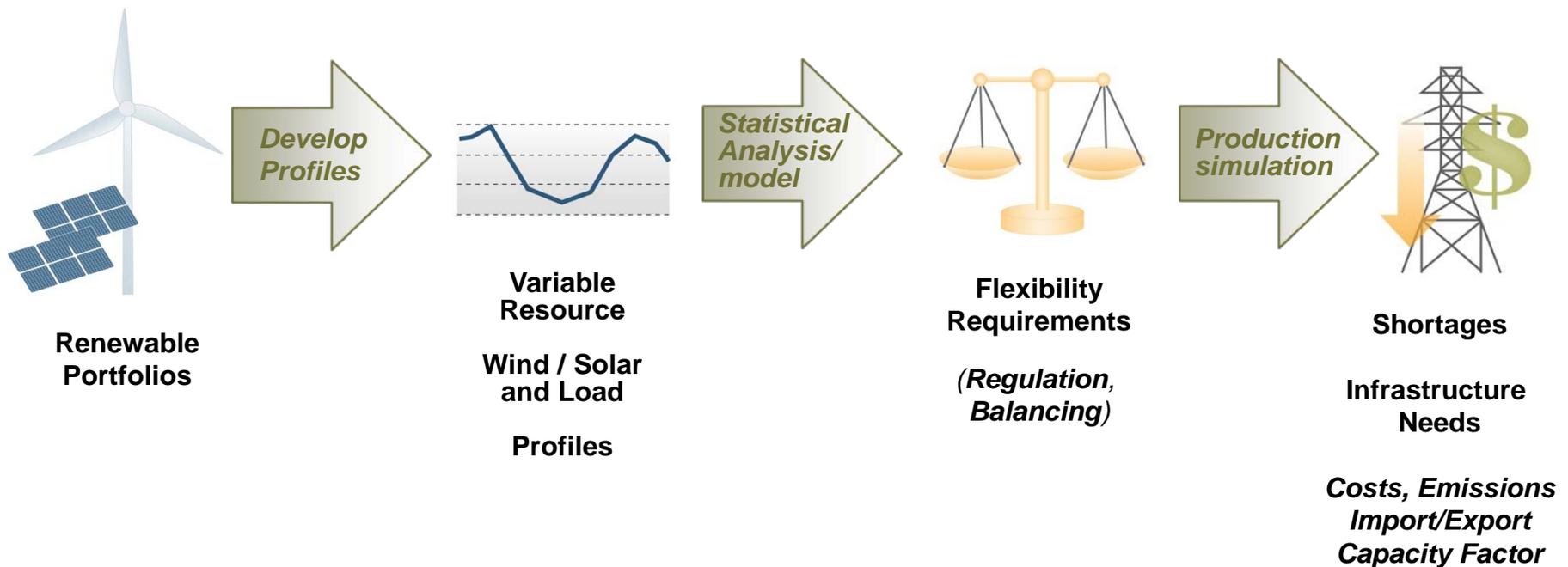
CPS 1 Scores – January 2009 through April 2012



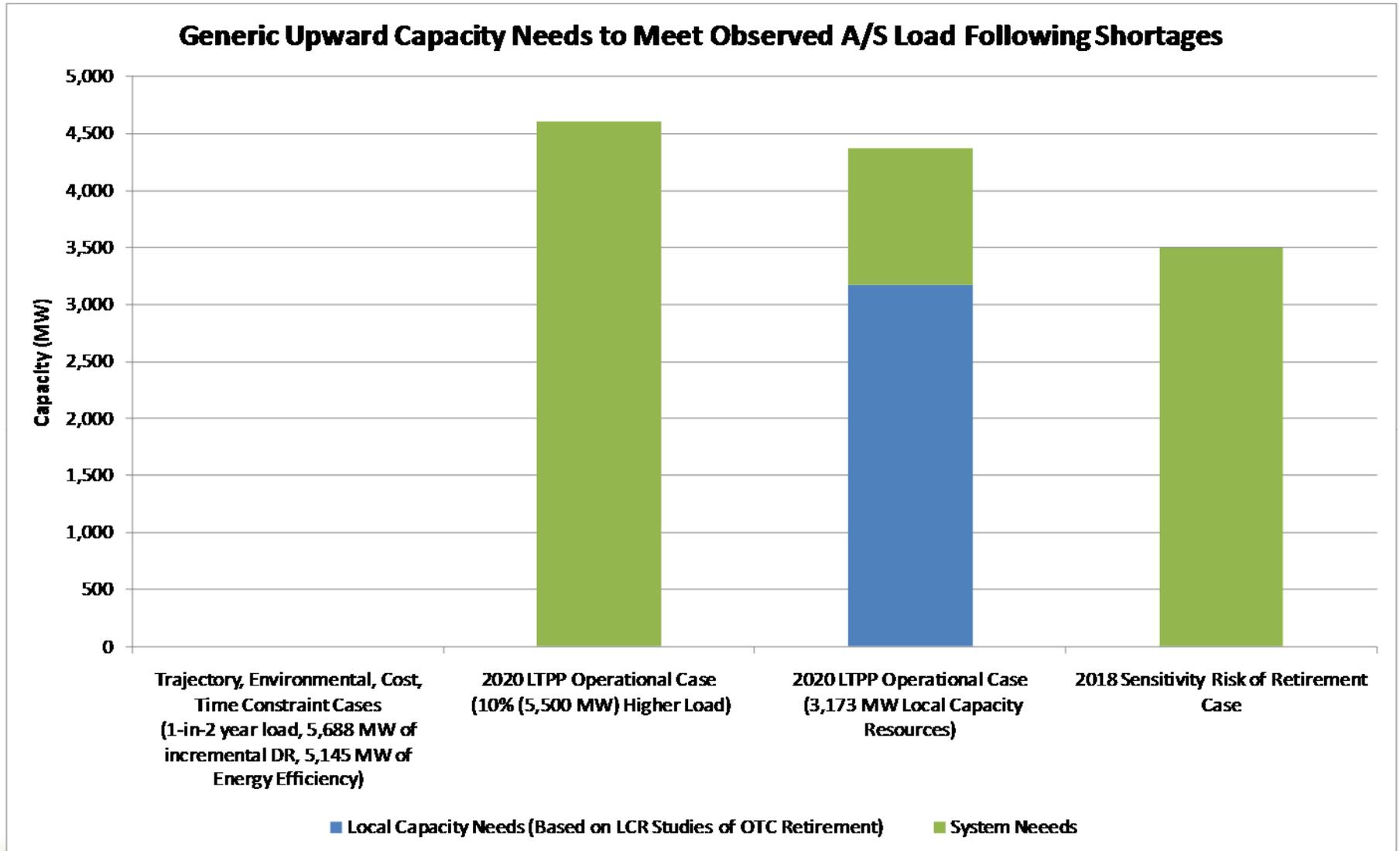
Flexibility requirements cover range of operational conditions.

| Service / Flexibility | Approximate Current Requirement (MW) | Forecast 2020 Requirements (MW) |
|--|--------------------------------------|---------------------------------|
| Maximum continuous ramp (Covers daily range of net load, 20-30 MW/min) | 18,000 | 16,000 |
| Operating Reserve (Spinning, Non-Spinning, approx. 6% of load, 10-minute) | 2,800 | 3,000 |
| Regulation (4-second automated control, 100 MW/min) | 300-600 | 600-1000 |
| Load Following (Intra-hour Load, Supply variability and Uncertainty, 50-80 MW/min) | 2,000-4,500 | 2,500-5,000 |
| Frequency response obligation / headroom (Obligation = 200MW per 0.10 Hz, Headroom = synchronized unloaded capacity) | 600-700 / 3,100 | 600-700 / 3,100 |

Study process quantifies operational requirements and evaluates fleets ability to meet operating requirements.

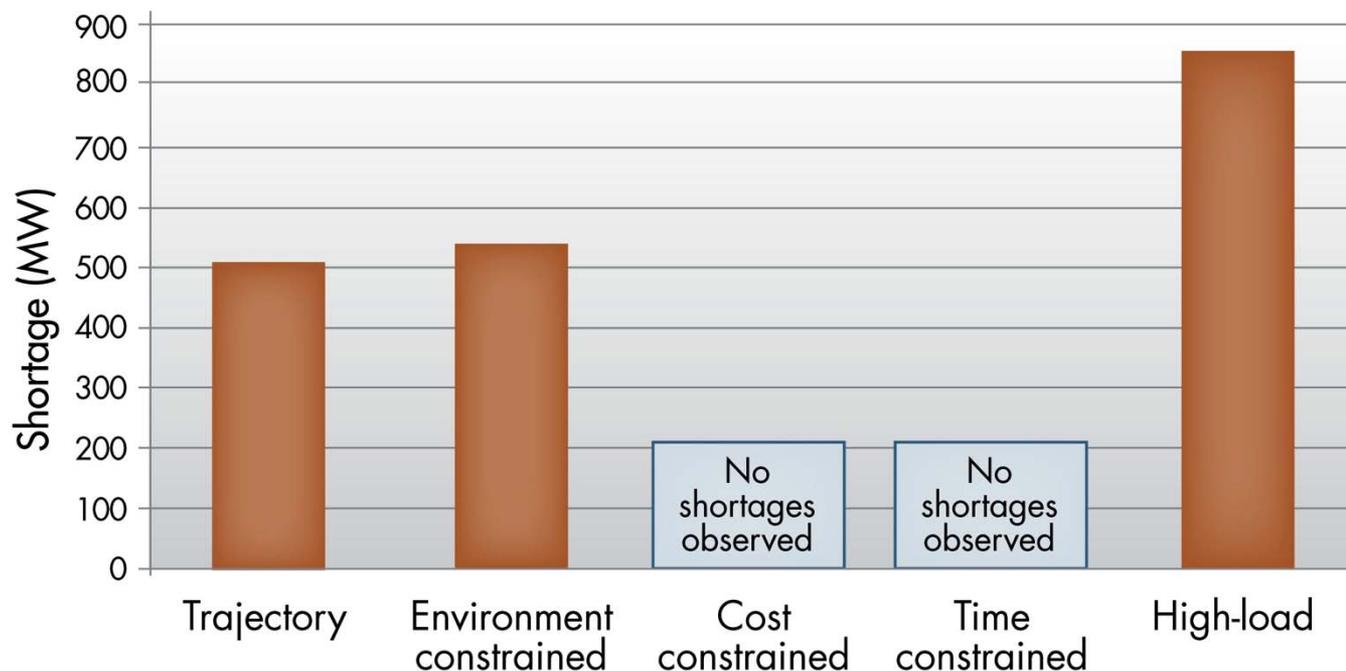


Potential need for 4,600MW of upward flexible resources observed in the high-load scenario.



Out of approximately 3,500 MW downward balancing requirements, some hours of potential shortages were observed.

Downward balancing shortage



Note: Downward balancing may be more effectively and efficiently managed using curtailment or storage rather than less economic dispatch of flexible resources to higher level to maintain downward flexibility

Next Steps

- Use stochastic analysis to determine probability of flexibility shortage
- Incorporate operational requirements into resource adequacy and long term procurement decisions
- Evolve the market to better manage variability and fleet flexibility