



# Regional Energy Markets & California's Green Goals

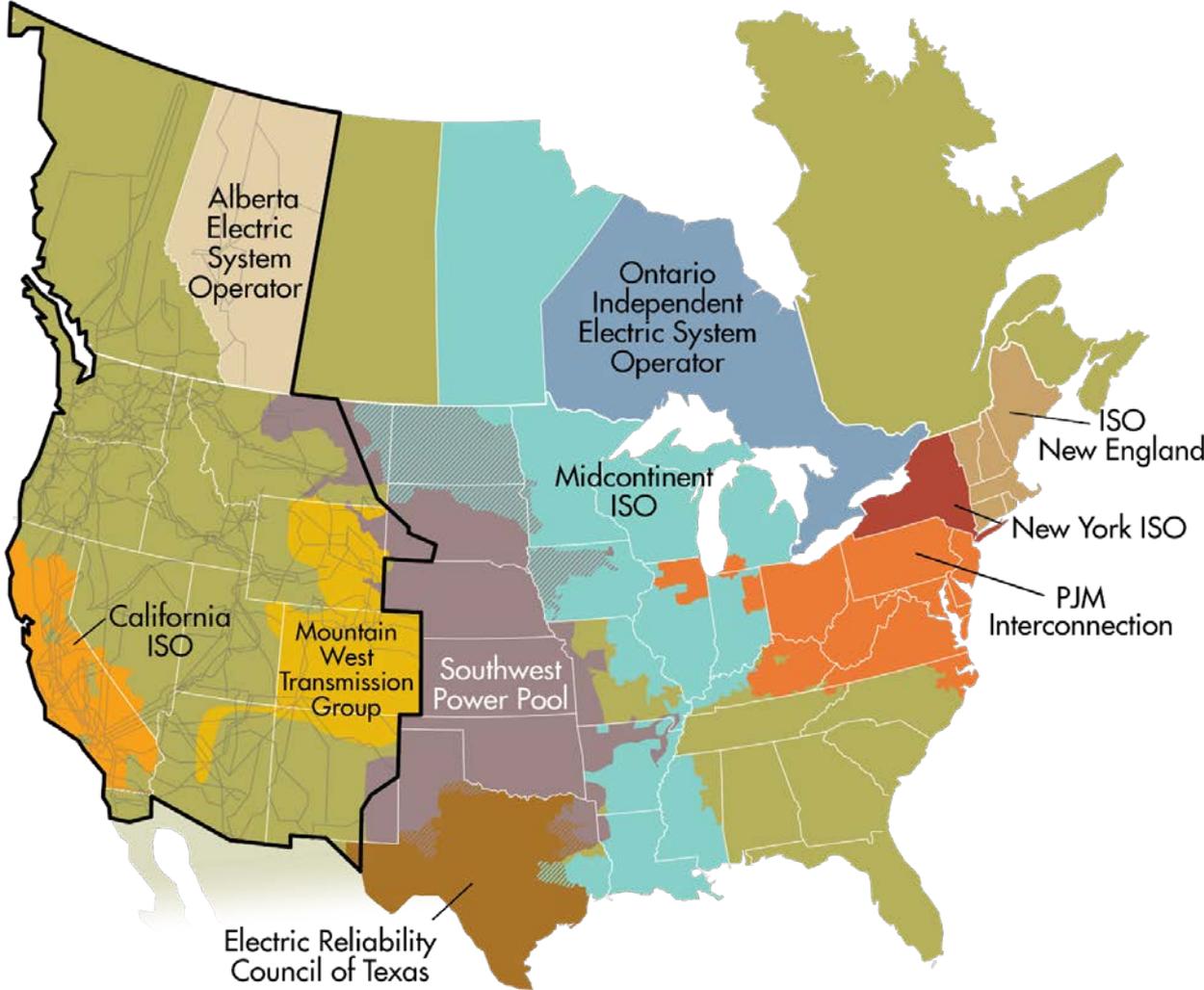
Mark Rothleder

VP for Renewable Integration and Market Quality

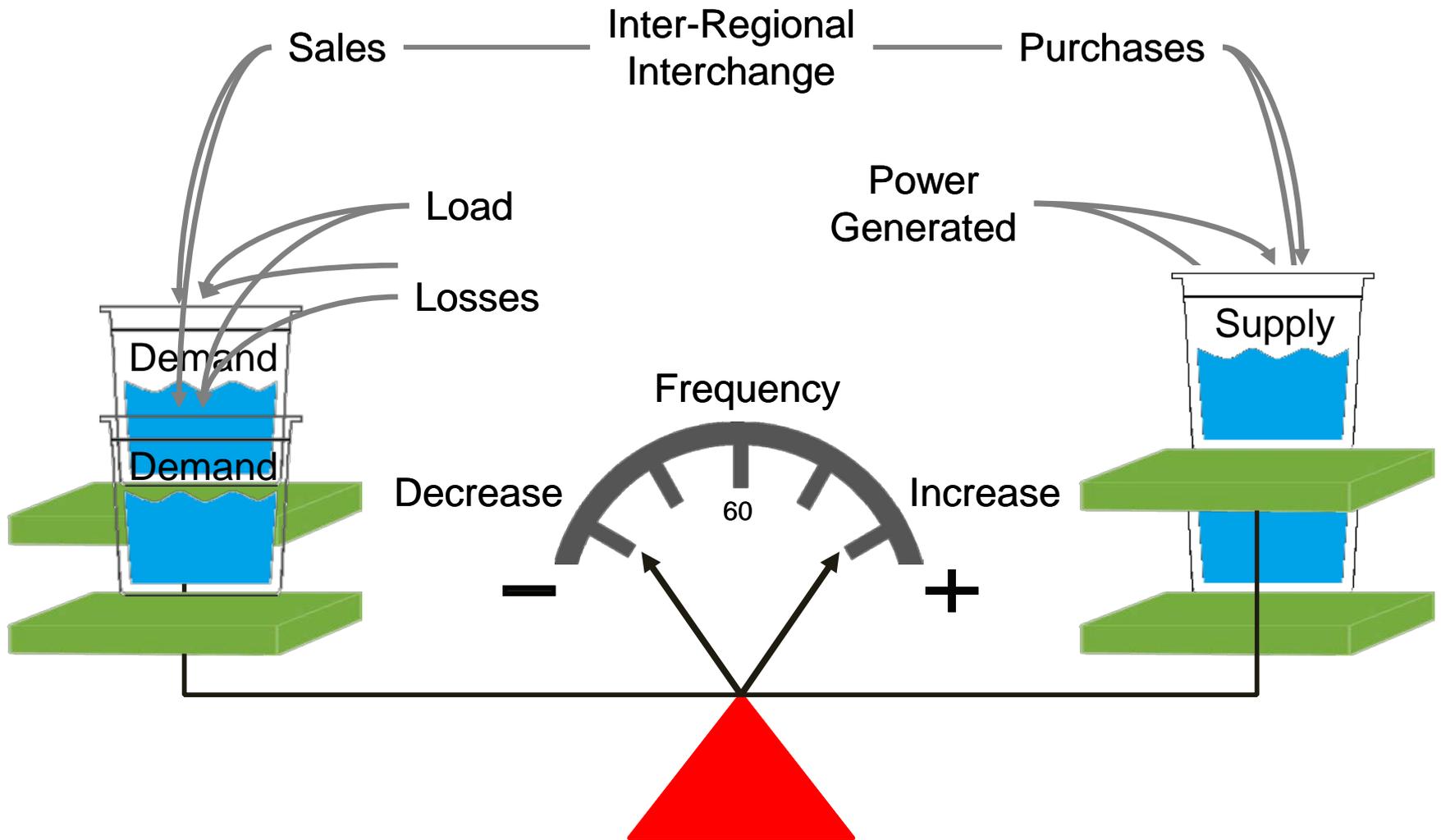
Assembly Utilities & Energy Committee Informational Hearing

March 14, 2018

# Today's Electric Grid

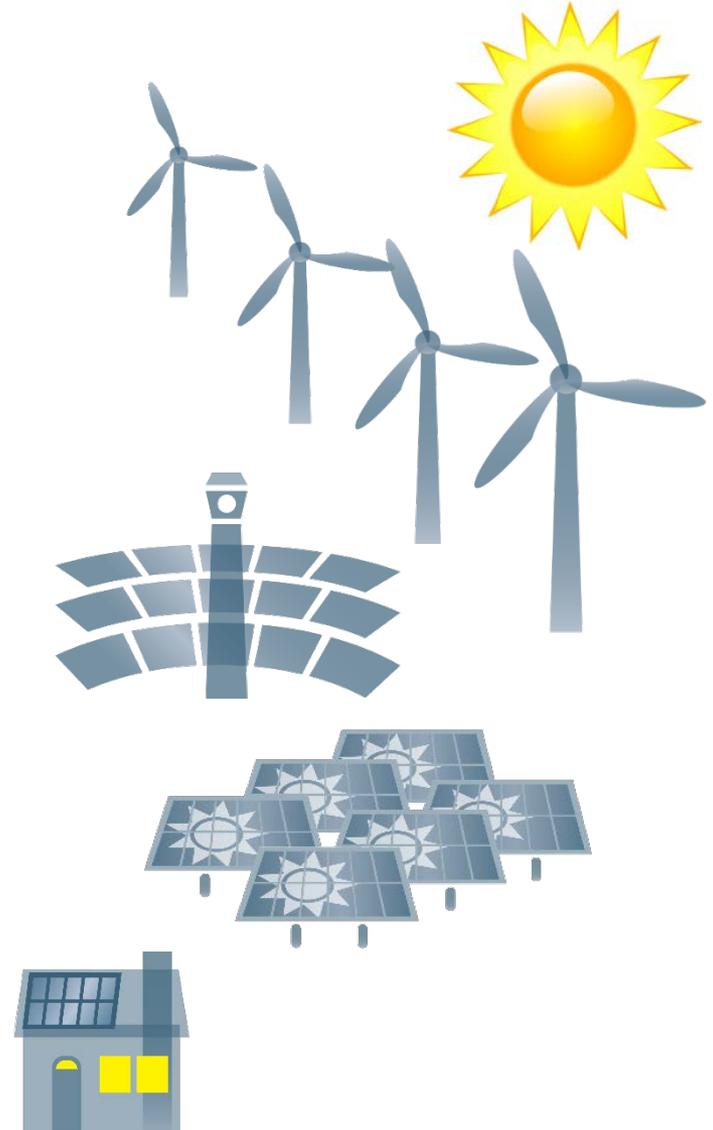


# The balancing of supply and demand



# Major progress on meeting CA's renewable goals

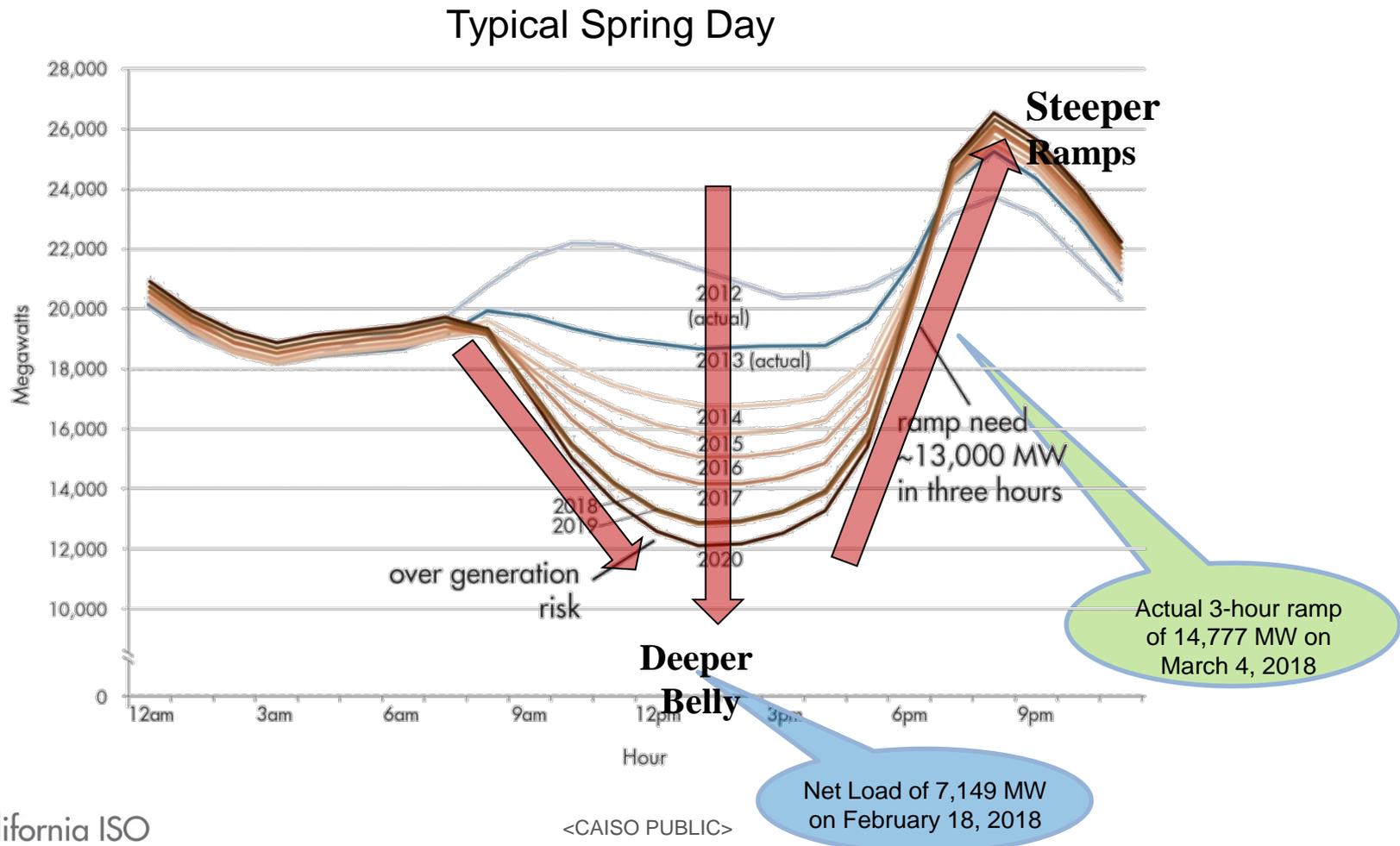
- Currently Installed:
  - 21,000 MW of large-scale renewables
  - 6,000 MW of rooftop solar
- Additional renewables:
  - 3,300 MW for 50% RPS by 2030\*
  - 11,400 MW of consumer rooftop solar by 2030\*\*



\* 2018 CPUC IRP

\*\*2017 CEC IEPR

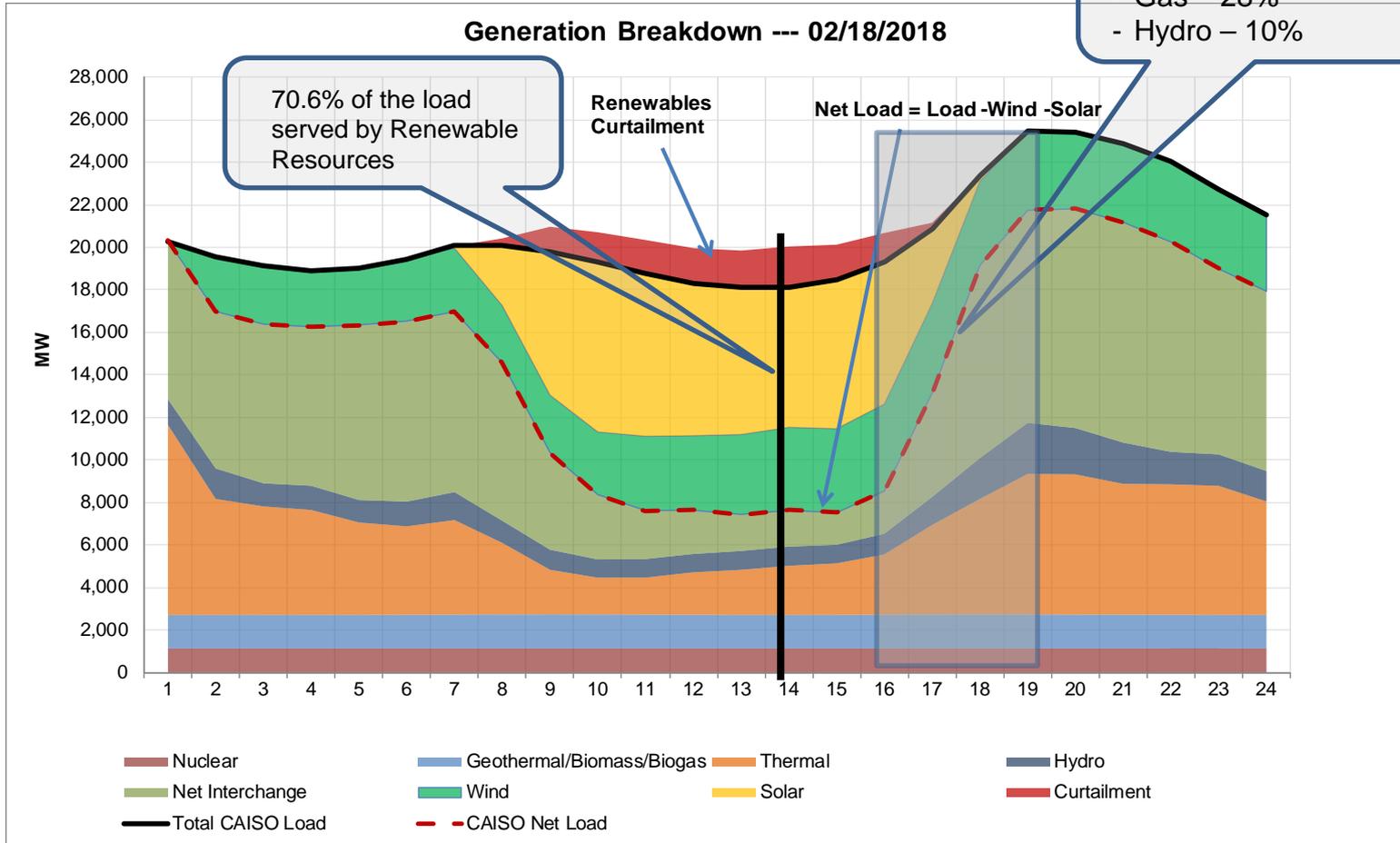
# Actual net-load and 3-hour ramps are about four years ahead of ISO's original estimate



# On Sunday, February 18, 2018 the CAISO experienced a minimum net-load of 7,149 MW @ 14:06

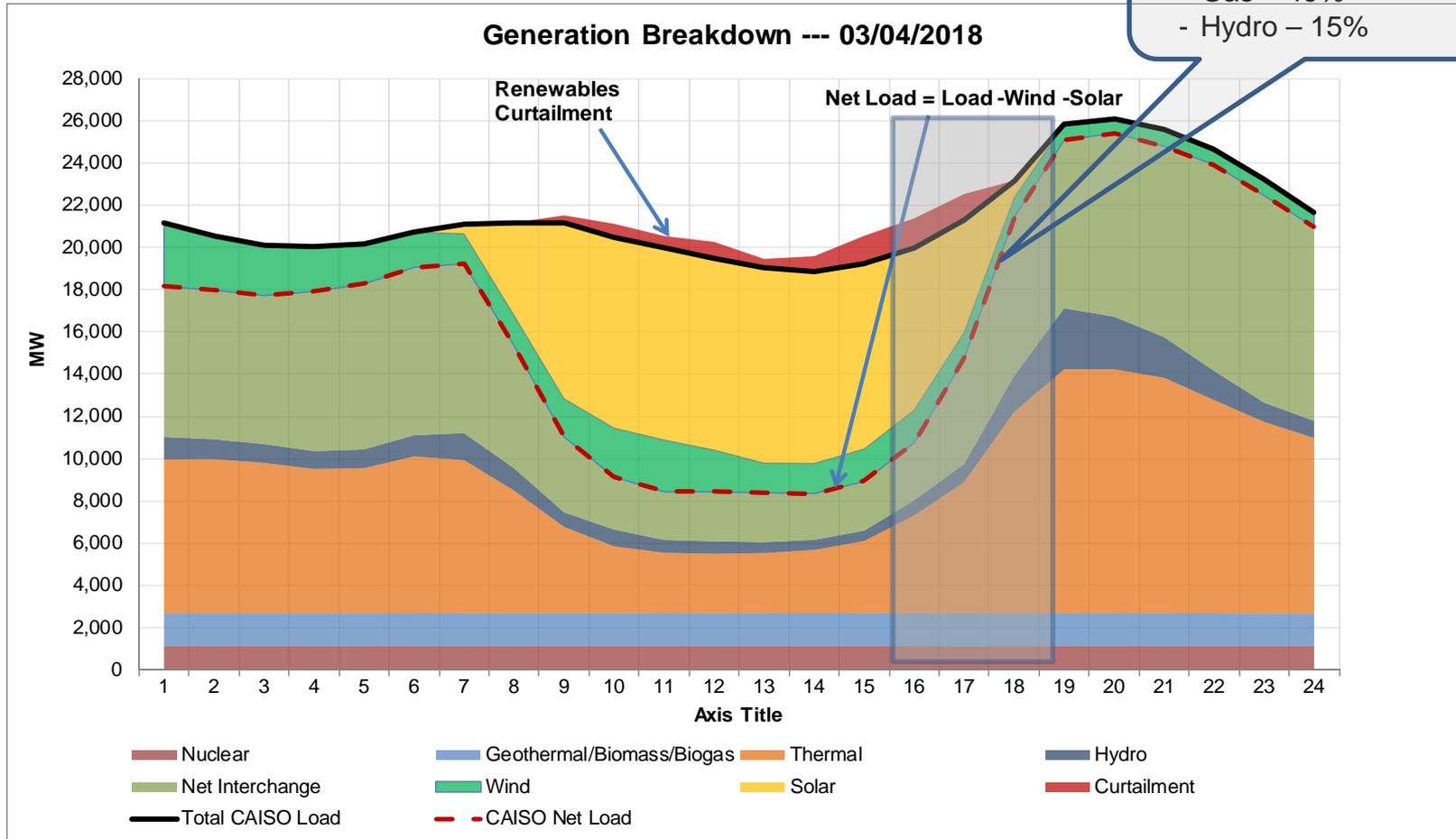
3-hr, 13,597 MW ramp met by:

- Import ~ 62%
- Gas – 28%
- Hydro – 10%



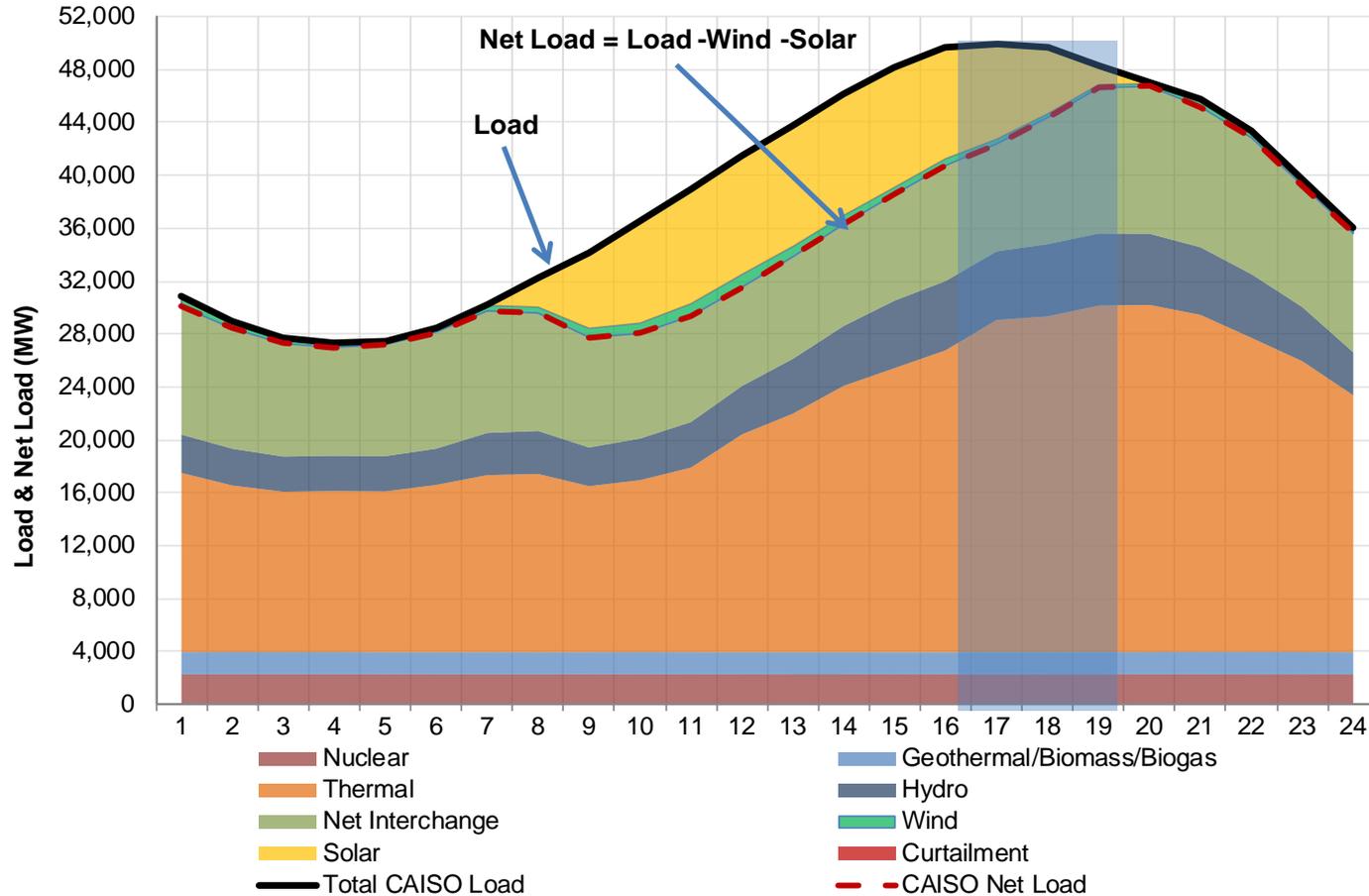
# On Sunday, March 4, 2018 the maximum 3-hour upward ramp was 14,777 MW

3-hr, 14,777MW ramp met by:  
 - Import ~ 36%  
 - Gas – 49%  
 - Hydro – 15%



# In 2017, the CAISO peak load was 50,116 MW and occurred at 15:58:24 on Friday, September 1, 2017

Generation Breakdown --- 09/01/2017



## 15:58 to 18:44

- Net Load peaked 2 hours and 46 minutes after peak demand
- Peak load decreased by 2,148 MW
- Solar production decreased by 7,199 MW
- Net Load increased by 5,258 MW

# A suite of solutions are necessary



**Storage** – increase the effective participation by energy storage resources.



**Western EIM expansion** – expand the western Energy Imbalance Market.



**Demand response** – enable adjustments in consumer demand, both up and down, when warranted by grid conditions.



**Regional coordination** – offers more diversified set of clean energy resources through a cost effective and reliable regional market.



**Time-of-use rates** – implement time-of-use rates that match consumption with efficient use of clean energy supplies.



**Electric vehicles** – incorporate electric vehicle charging systems that are responsive to changing grid conditions.



**Renewable portfolio diversity** – explore procurement strategies to achieve a more diverse renewable portfolio.



**Flexible resources** – invest in fast-responding resources that can follow sudden increases and decreases in demand.

# Questions

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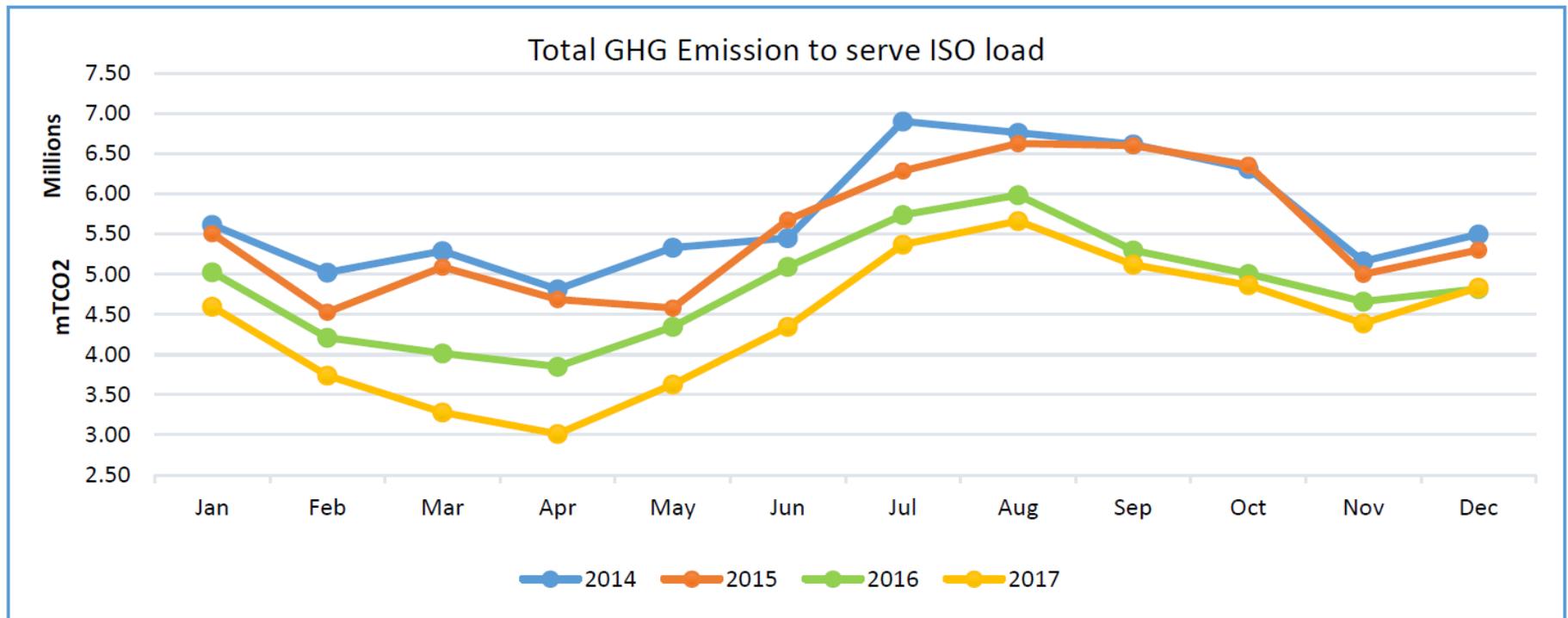


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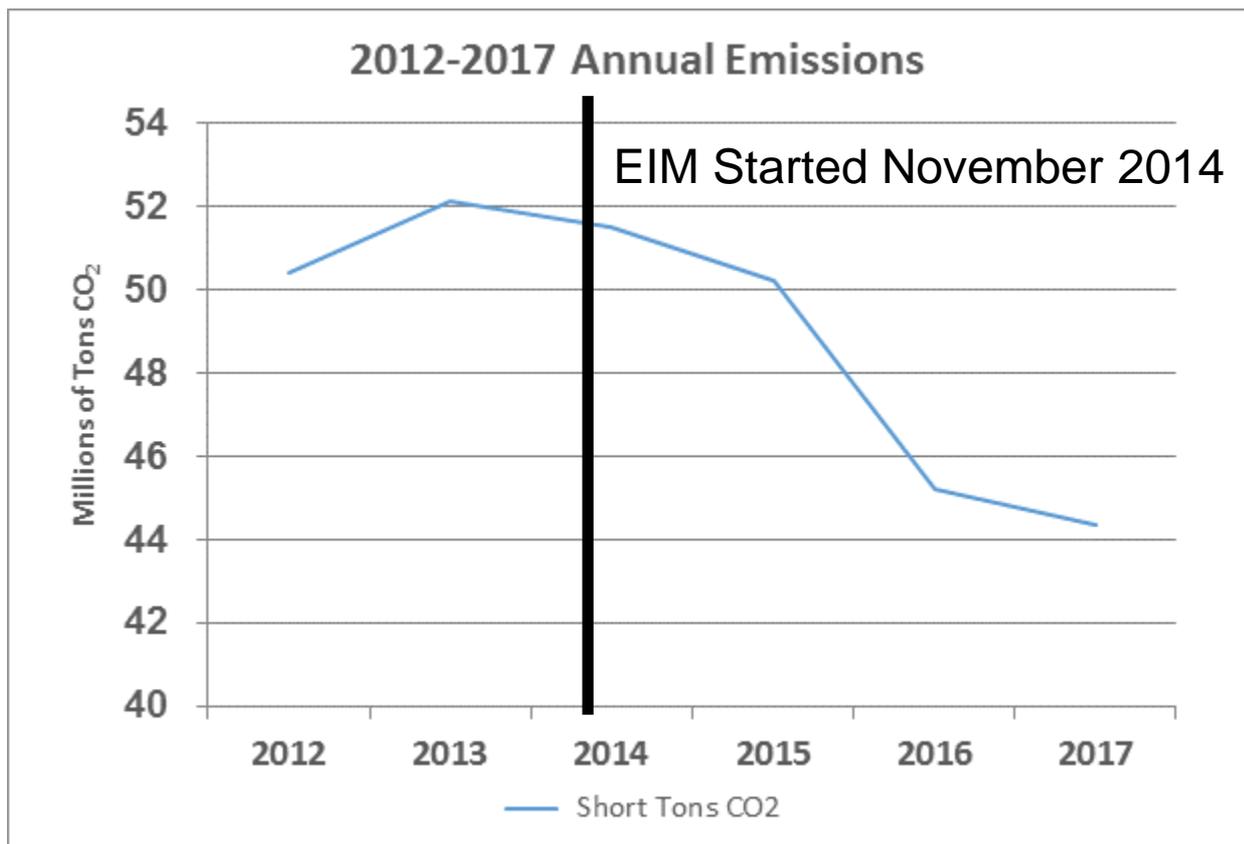
# Appendix

# CAISO GHG emissions reduced by 23% since 2014

YTD (January - December) million mTCO <sub>2</sub>	2014	2015	2016	2017
GHG Emission to serve ISO load	68.78	66.24	58.05	52.85

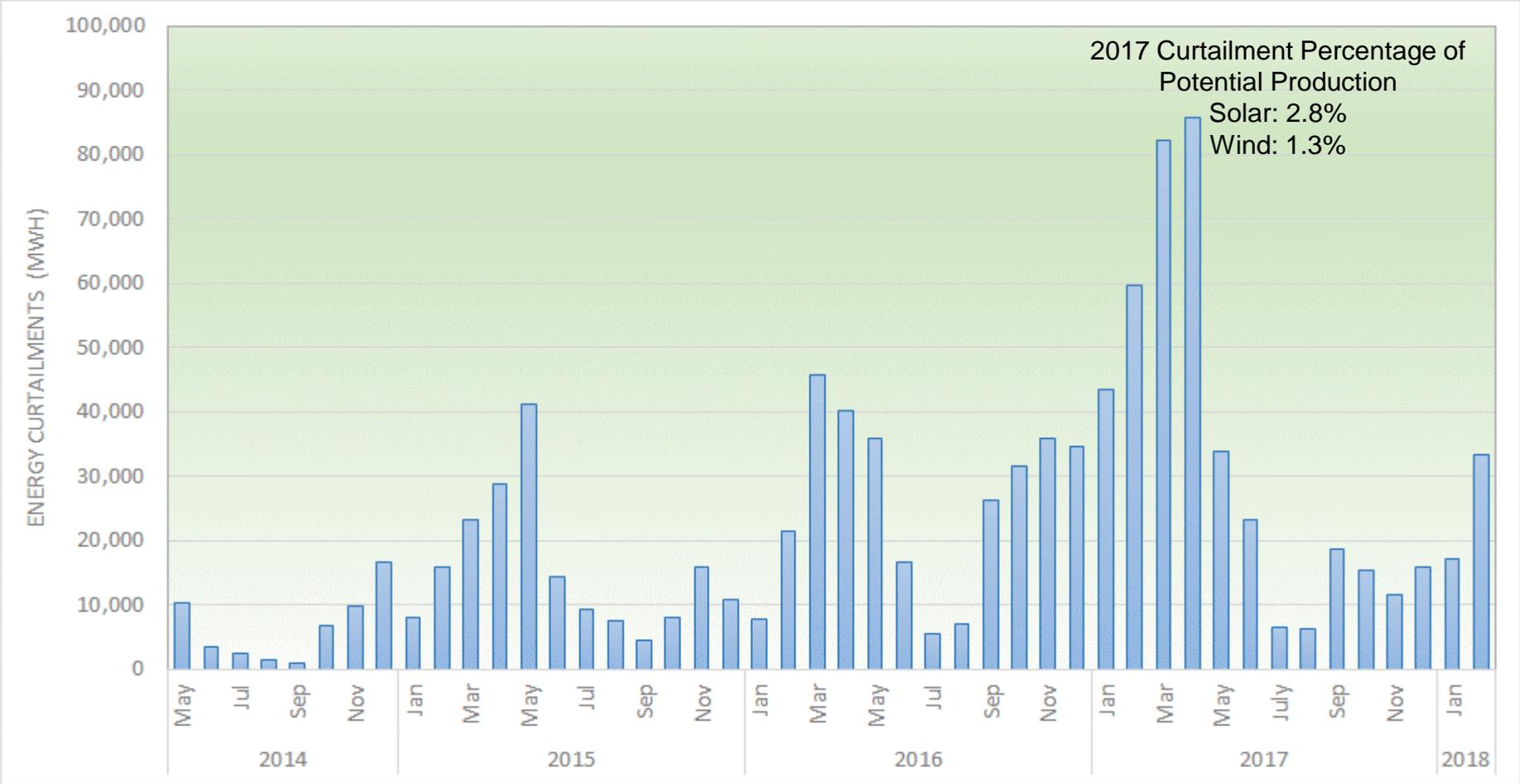


# PacifiCorp GHG emissions reduced 14% since 2014

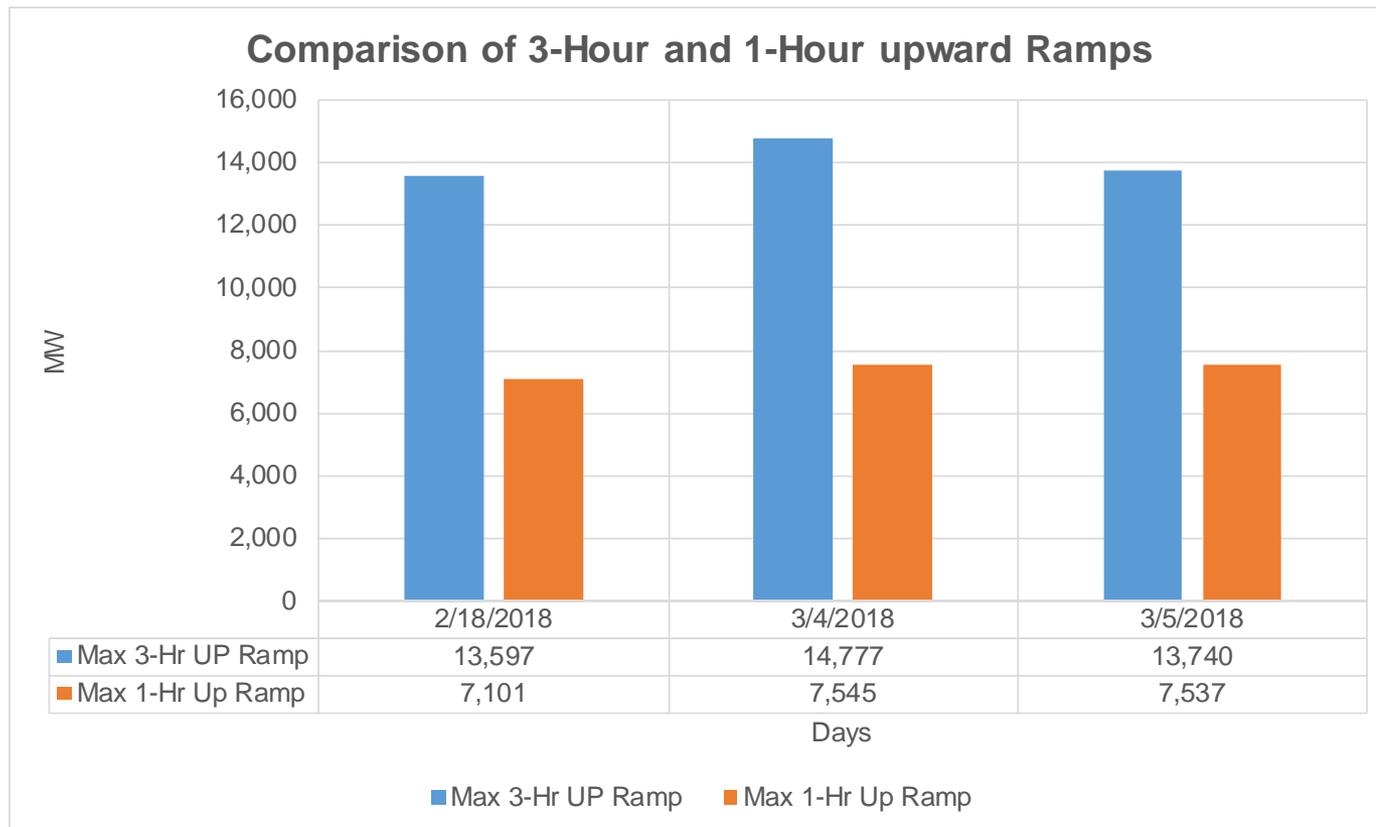


Source: PacifiCorp

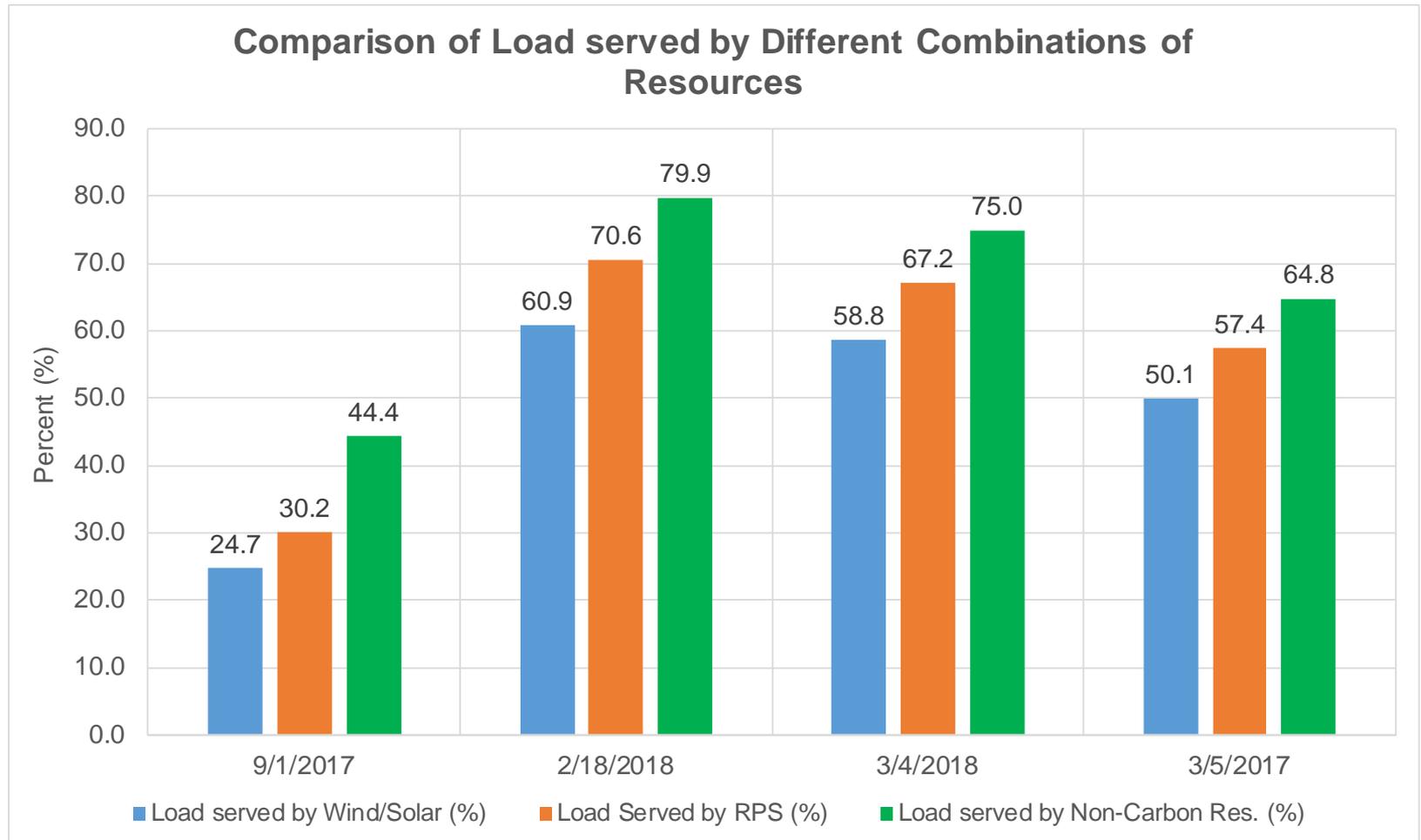
# Increasing trend of renewable curtailment varies with seasonal and hydro conditions



The 1-Hour upward ramps are more than 50% of the three hour ramps, which indicates the need for faster ramping resources



# Percentage of load served by wind/solar, total RPS and non-Carbon resources (1-minute average)



# Percentage of daily load served by wind/solar, total RPS and non-Carbon resources

