# Regional Energy Markets & California's Green Goals

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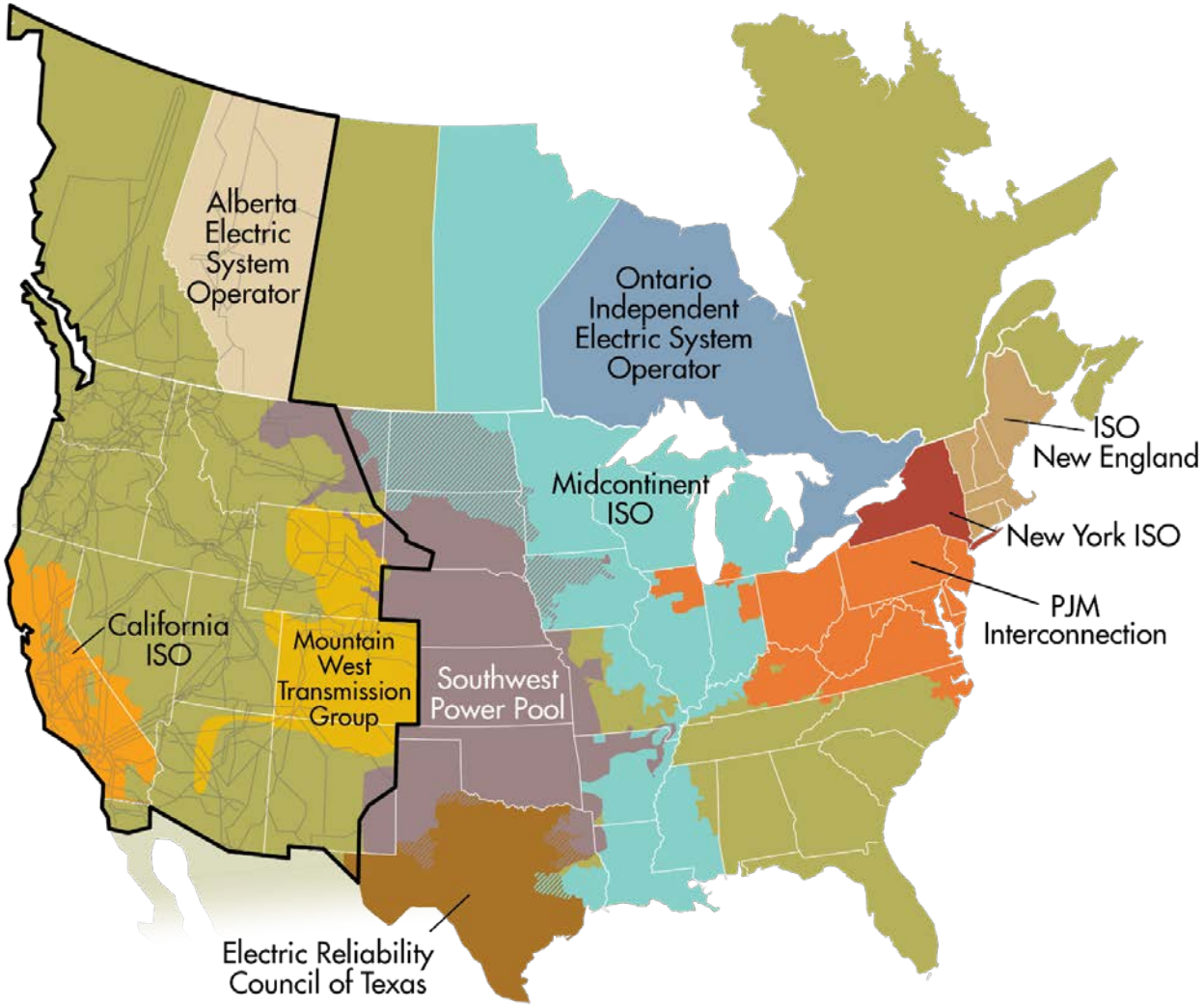
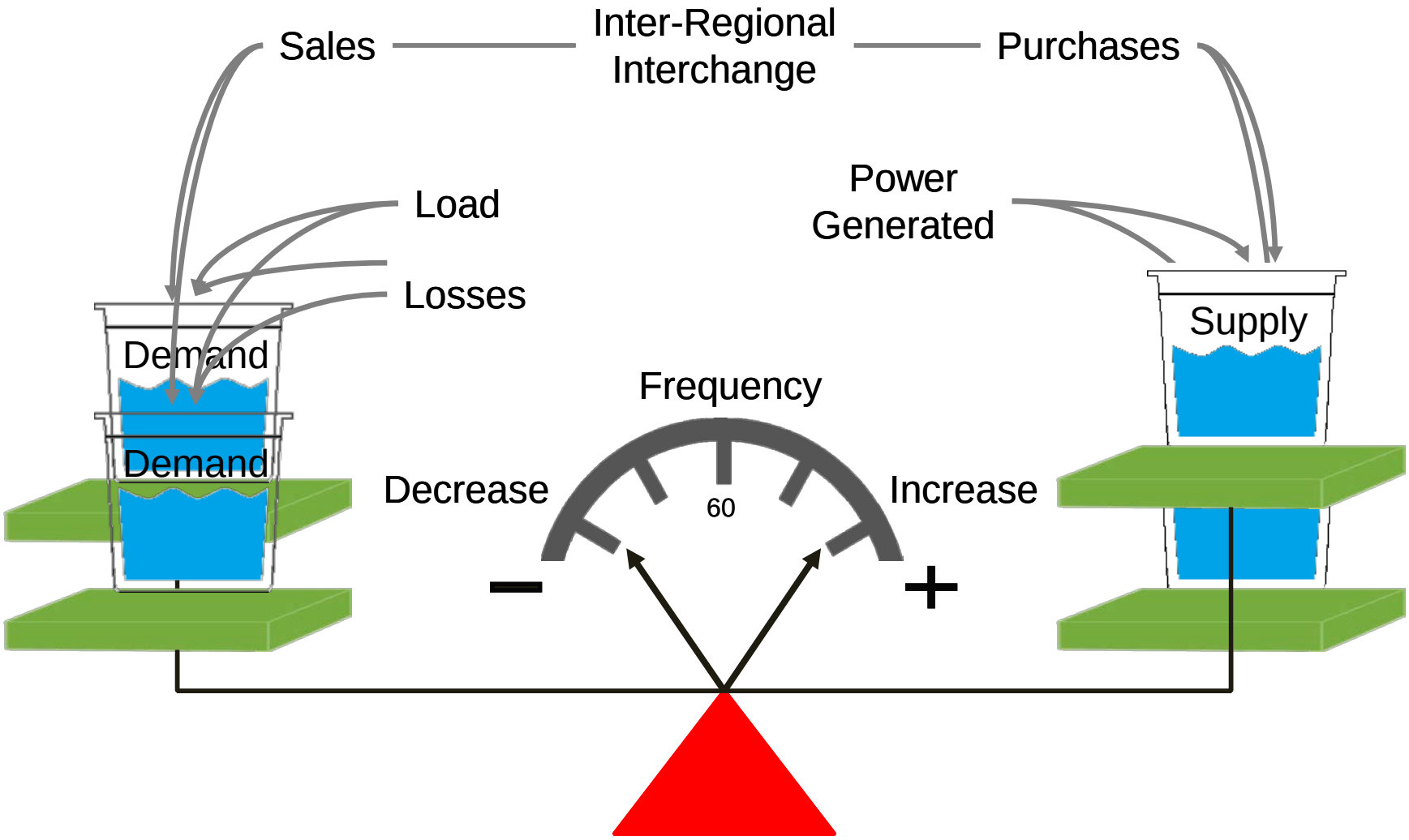
Assembly Utilities & Energy Committee Informational Hearing
March 14, 2018

# Today's Electric Grid

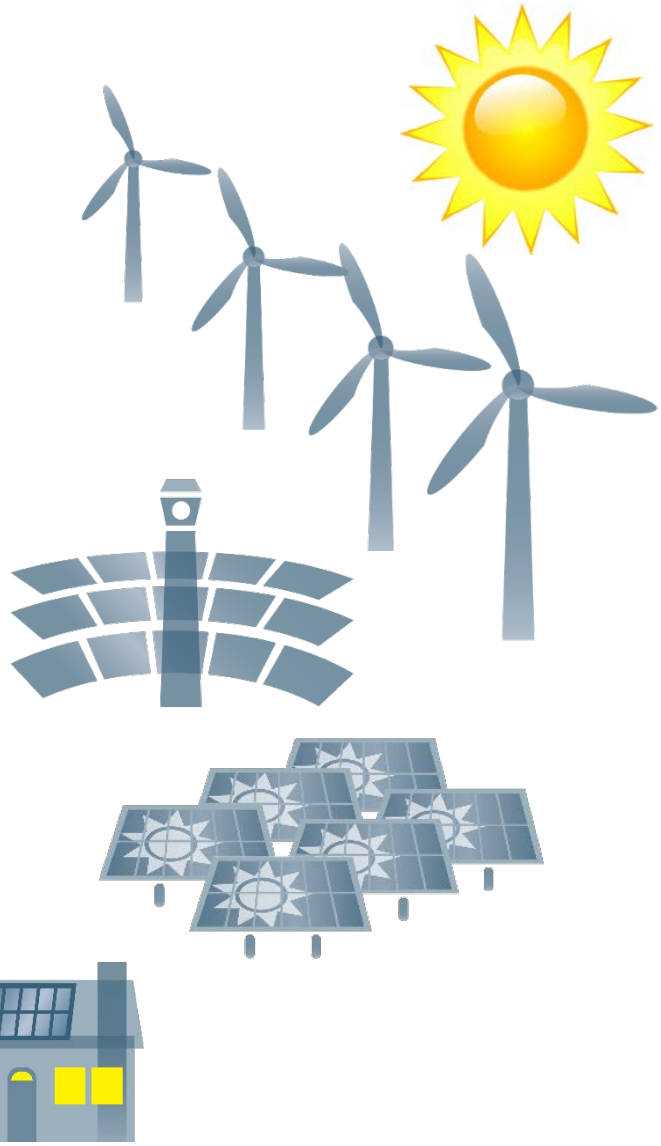


# The balancing of supply and demand



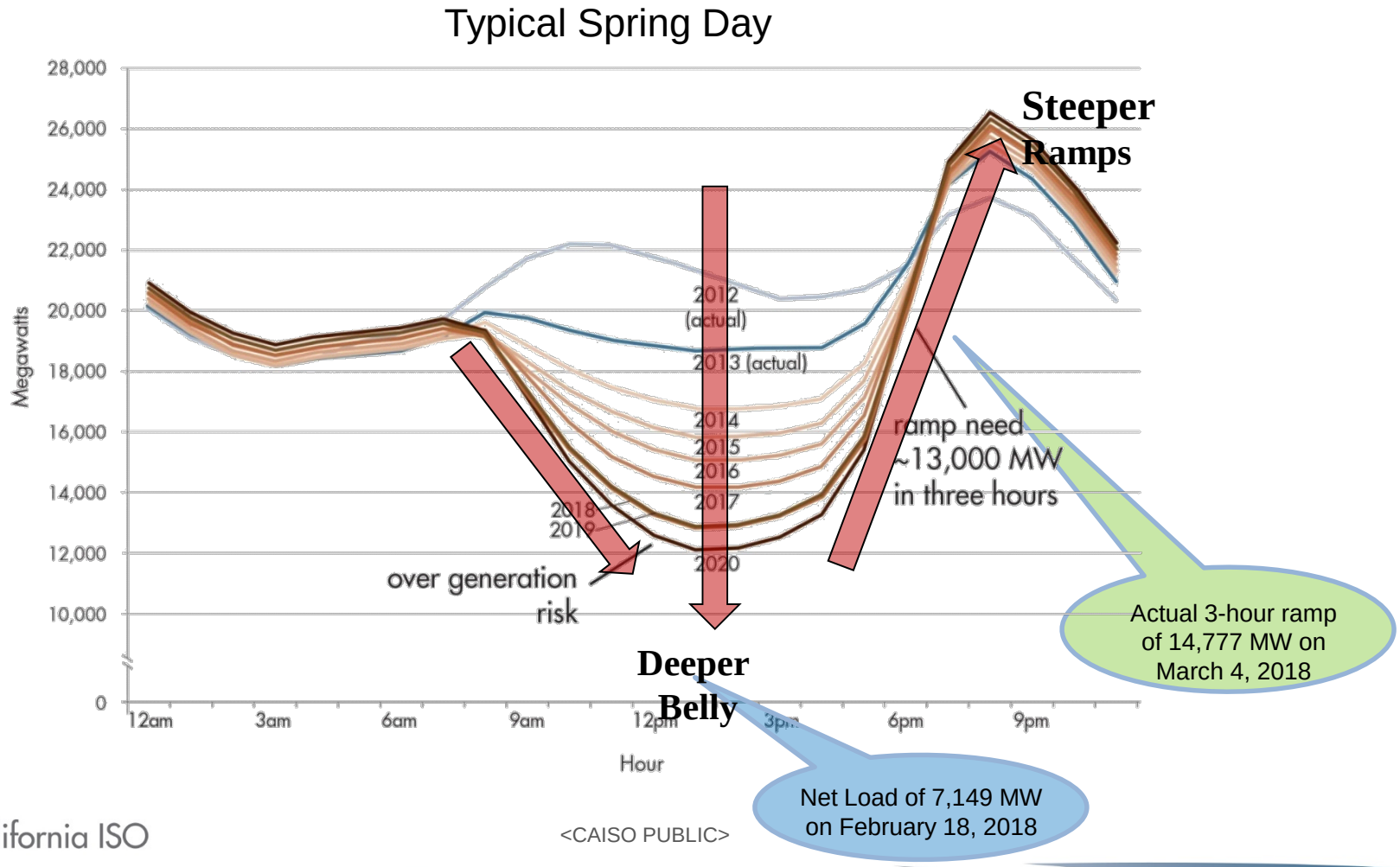
# Major progress on meeting CA's renewable goals

- 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**



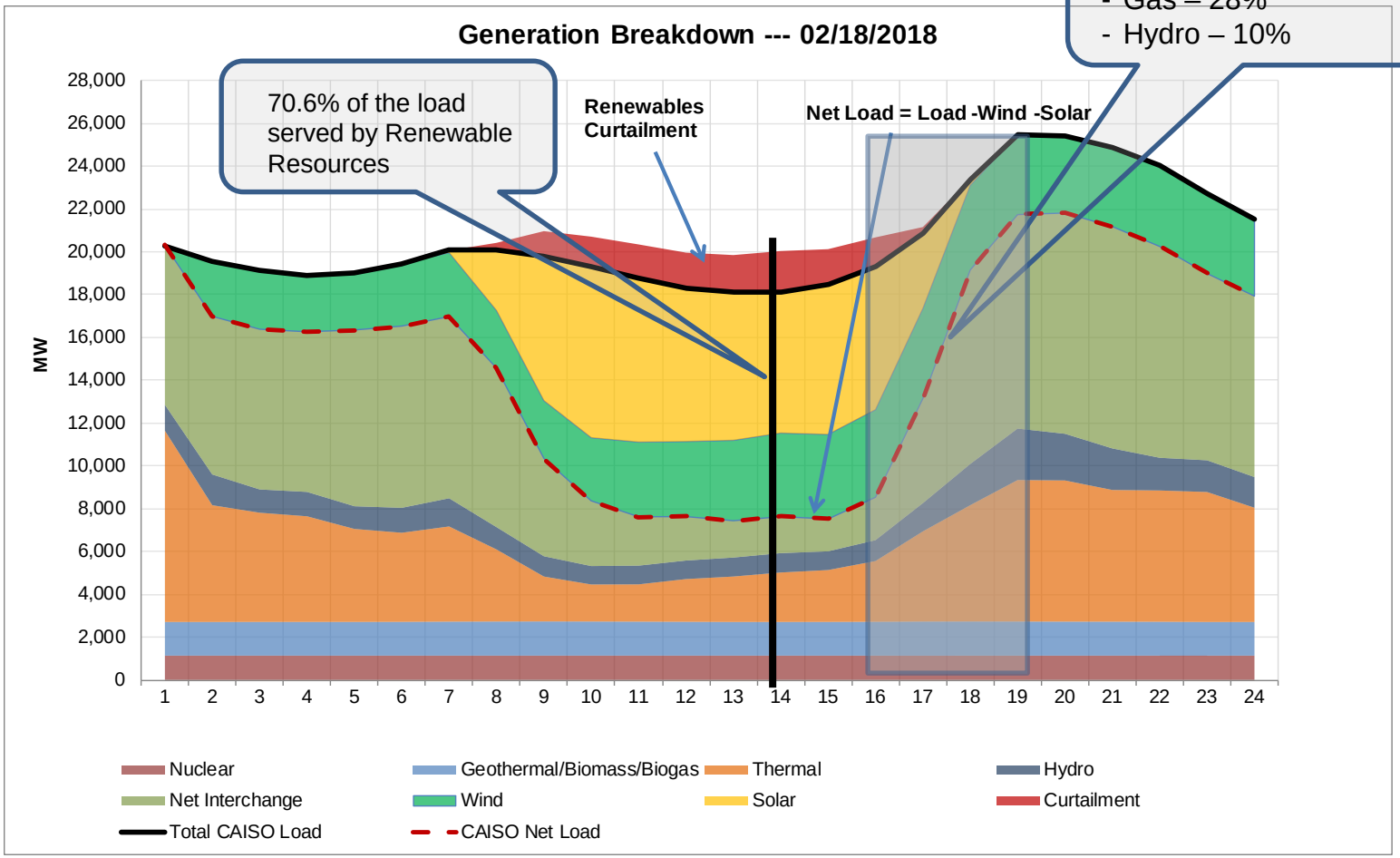
* 2018 CPUC IRP
**2017 CEC IEPR

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



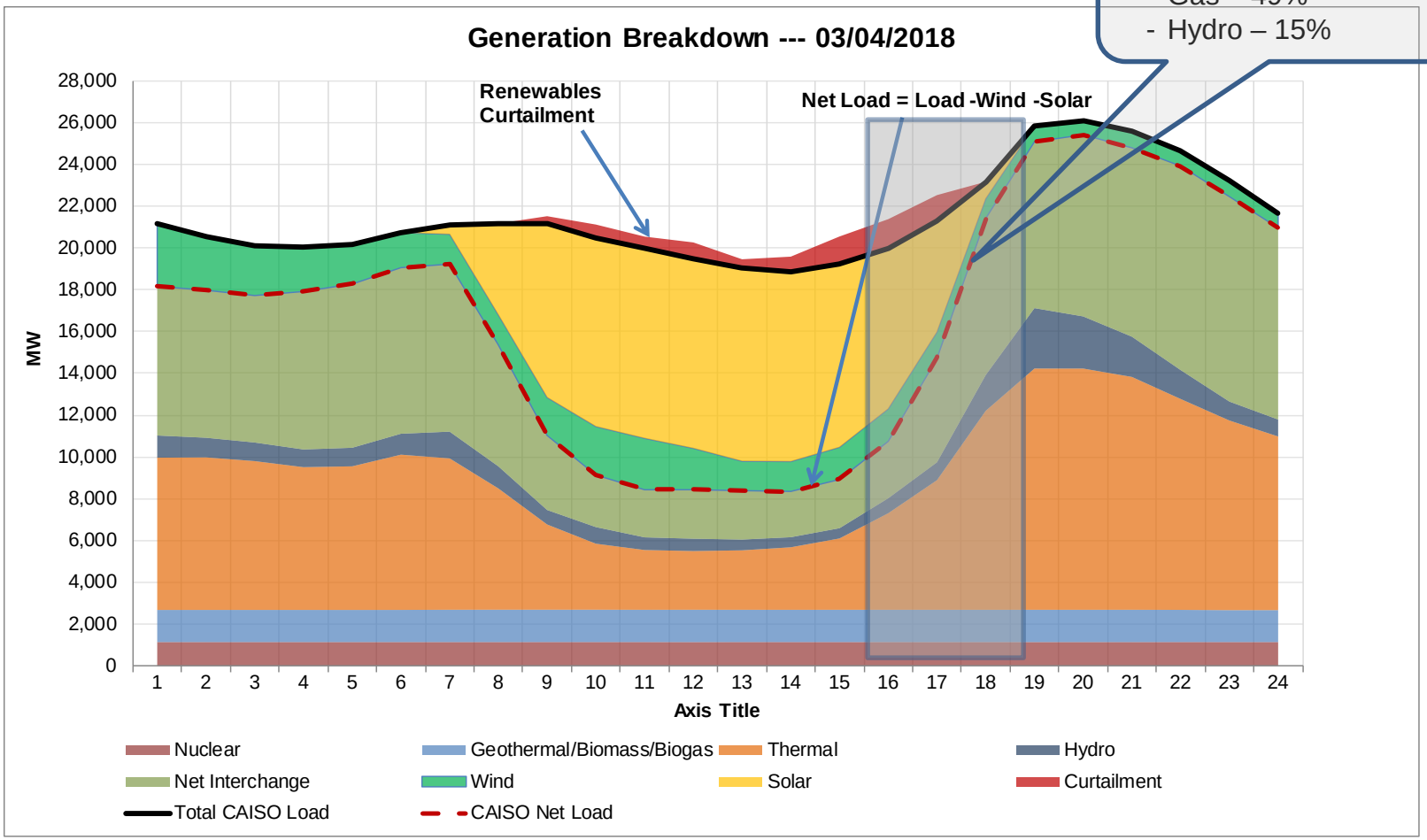
# On Sunday, February 18, 2018 the CAISO experienced a minimum net-load of 7,149 MW @ 14:06

3-hr, 13,597 MW ramp met by:
- Import ~ 62%
- Gas – 28%
- Hydro – 10%

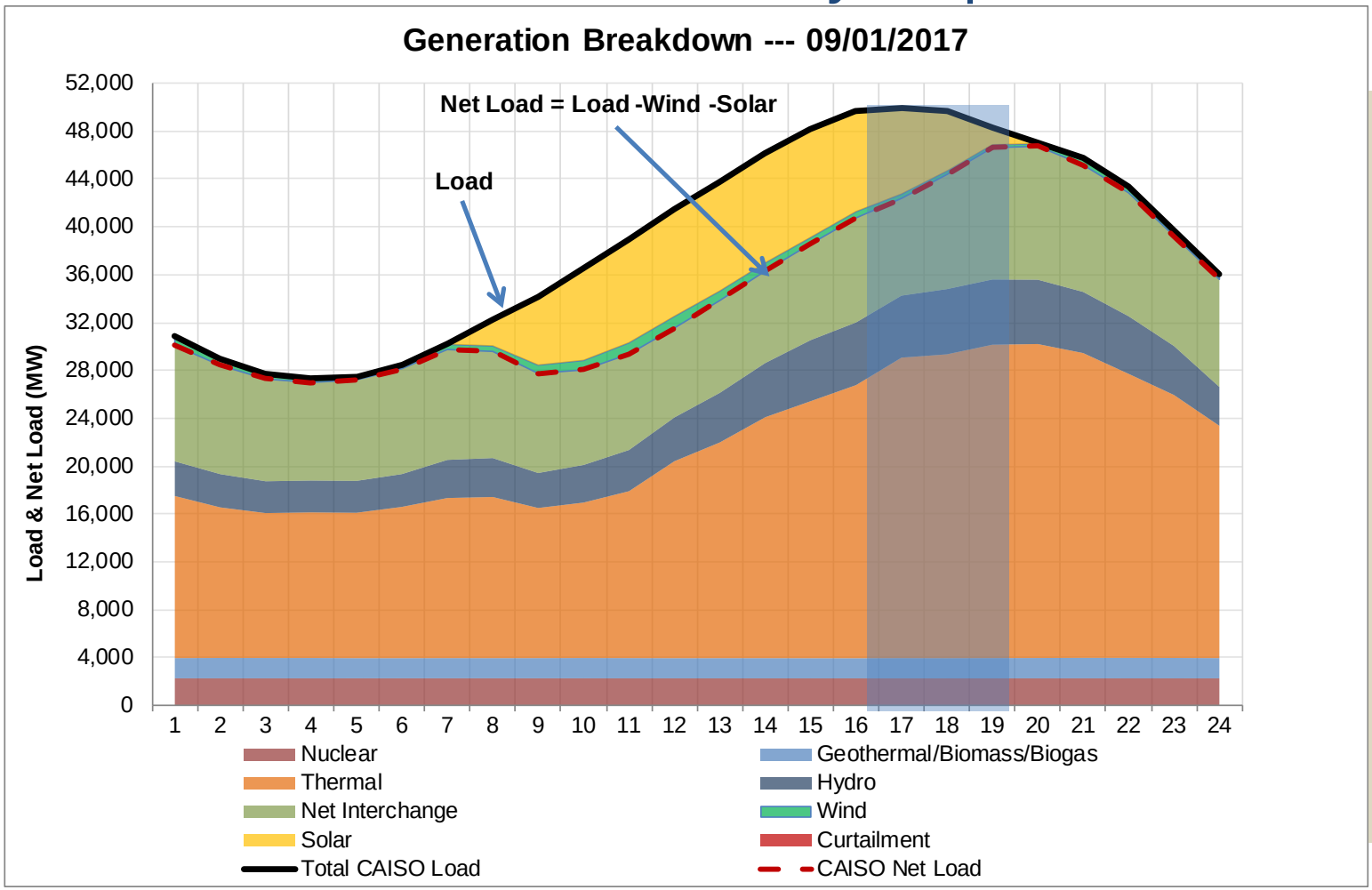


# On Sunday, March 4, 2018 the maximum 3-hour upward ramp was 14,777 MW

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




**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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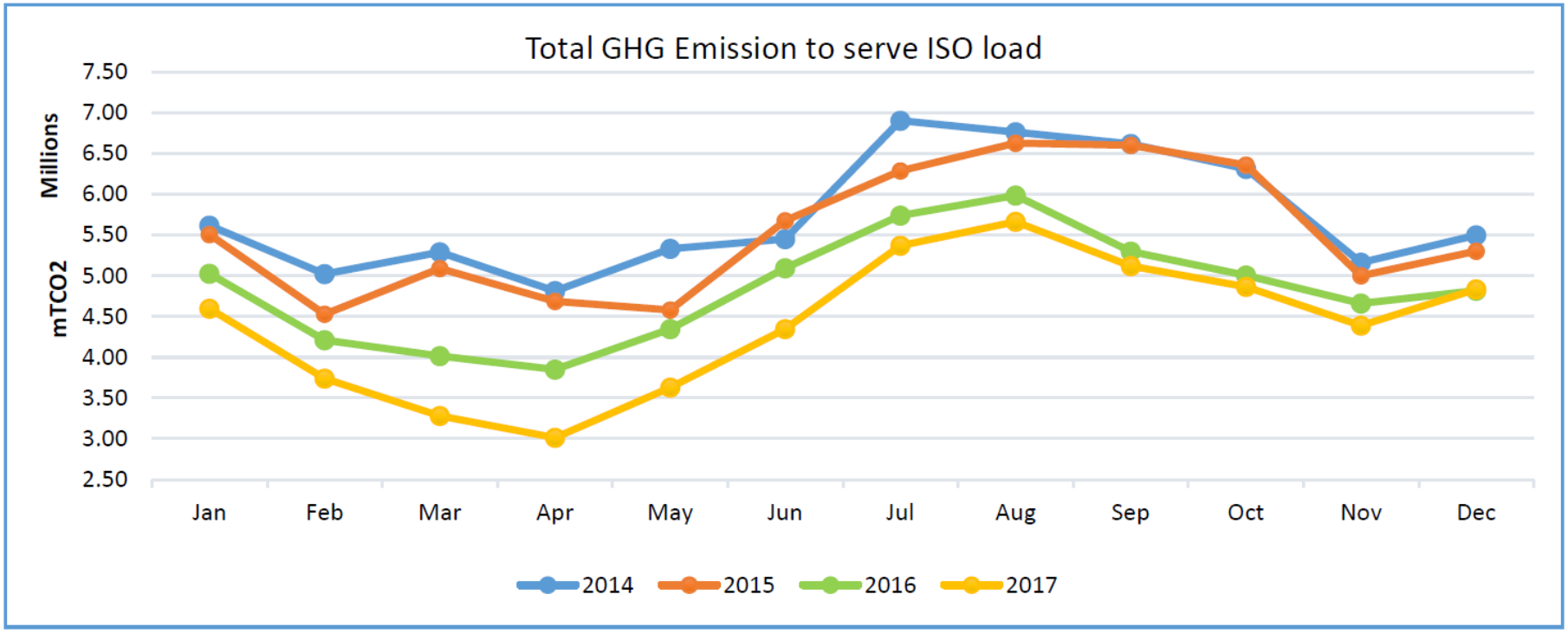
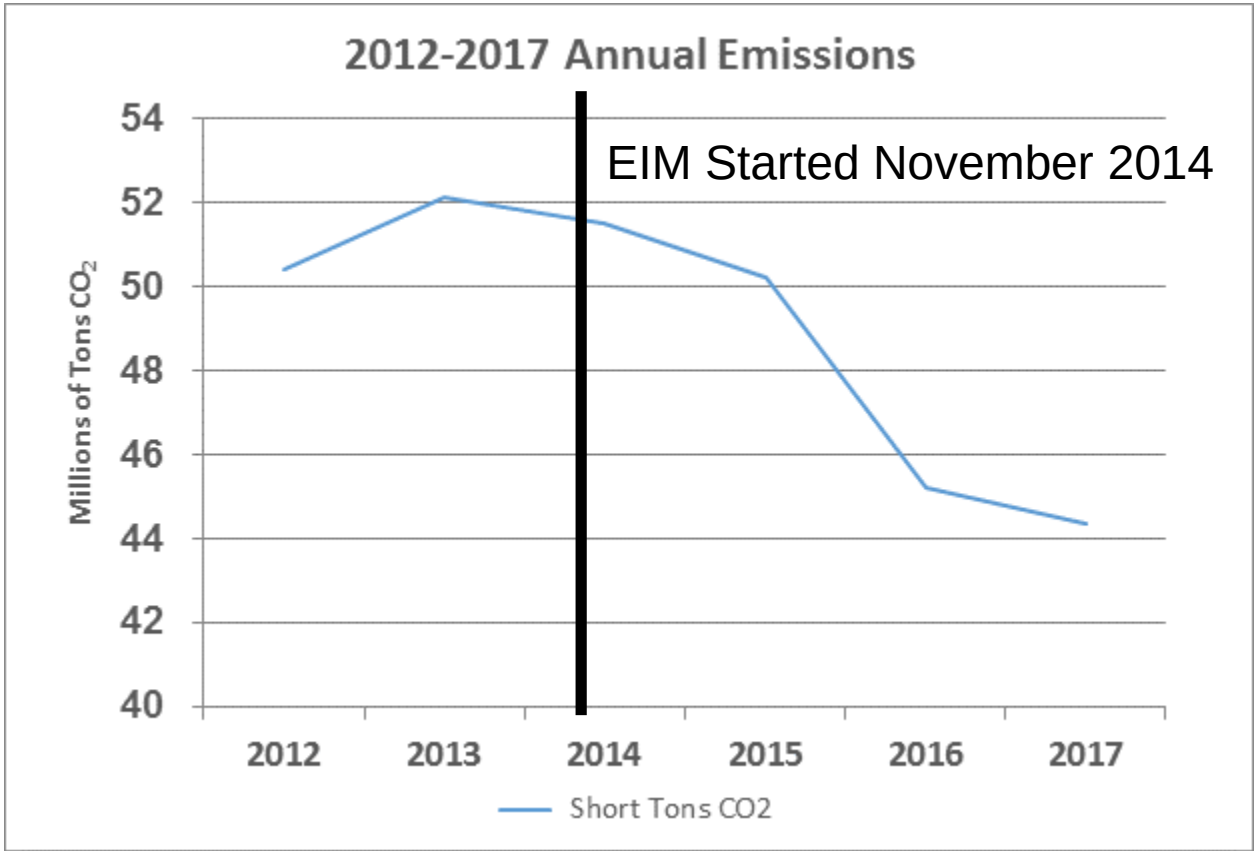
# Appendix

# CAISO GHG emissions reduced by 23% since 2014

| YTD (January - December) million mTCO2 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|
| GHG Emission to serve ISO load | 68.78 | 66.24 | 58.05 | 52.85 |

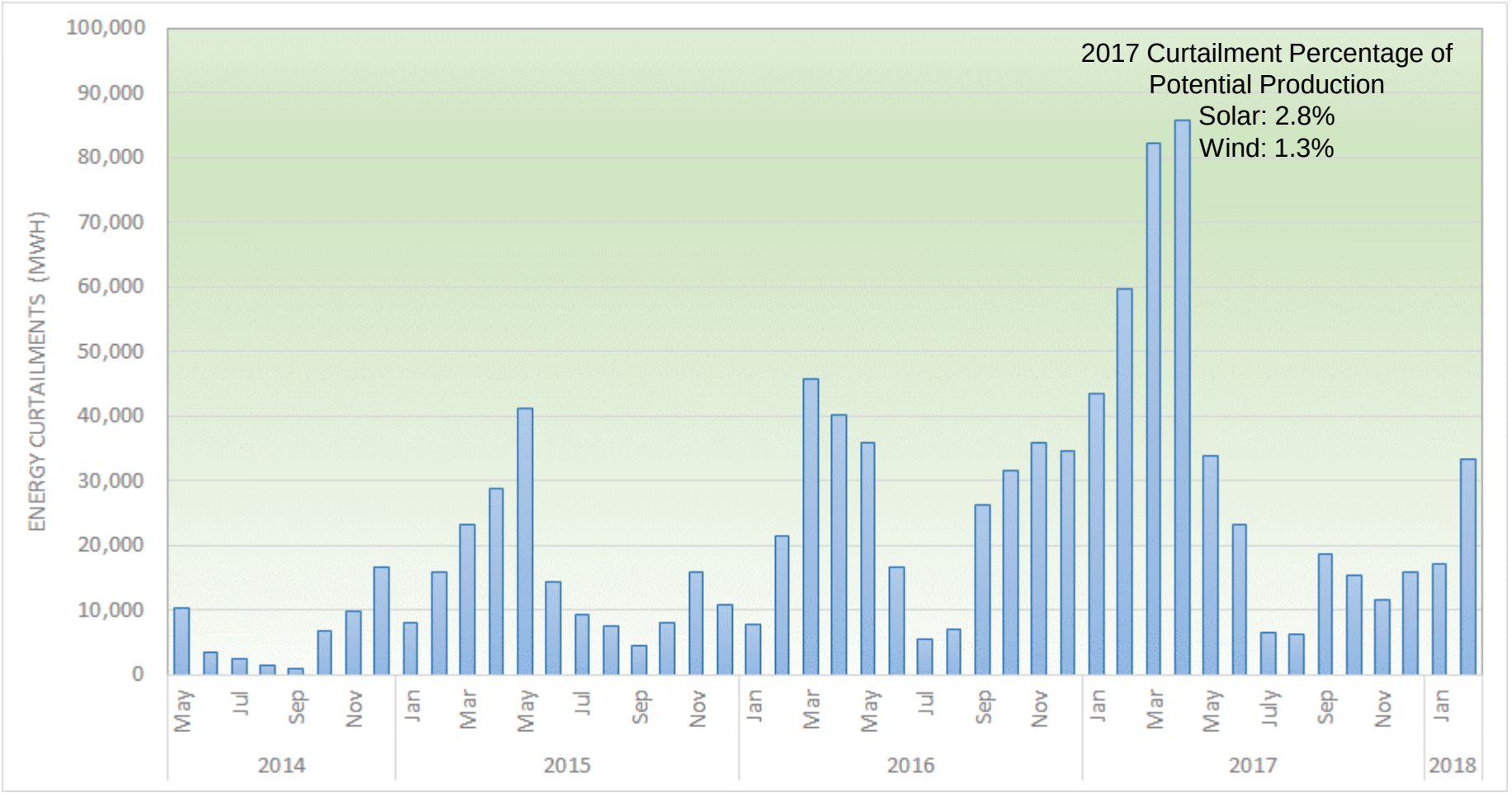


# PacifiCorp GHG emissions reduced 14% since 2014

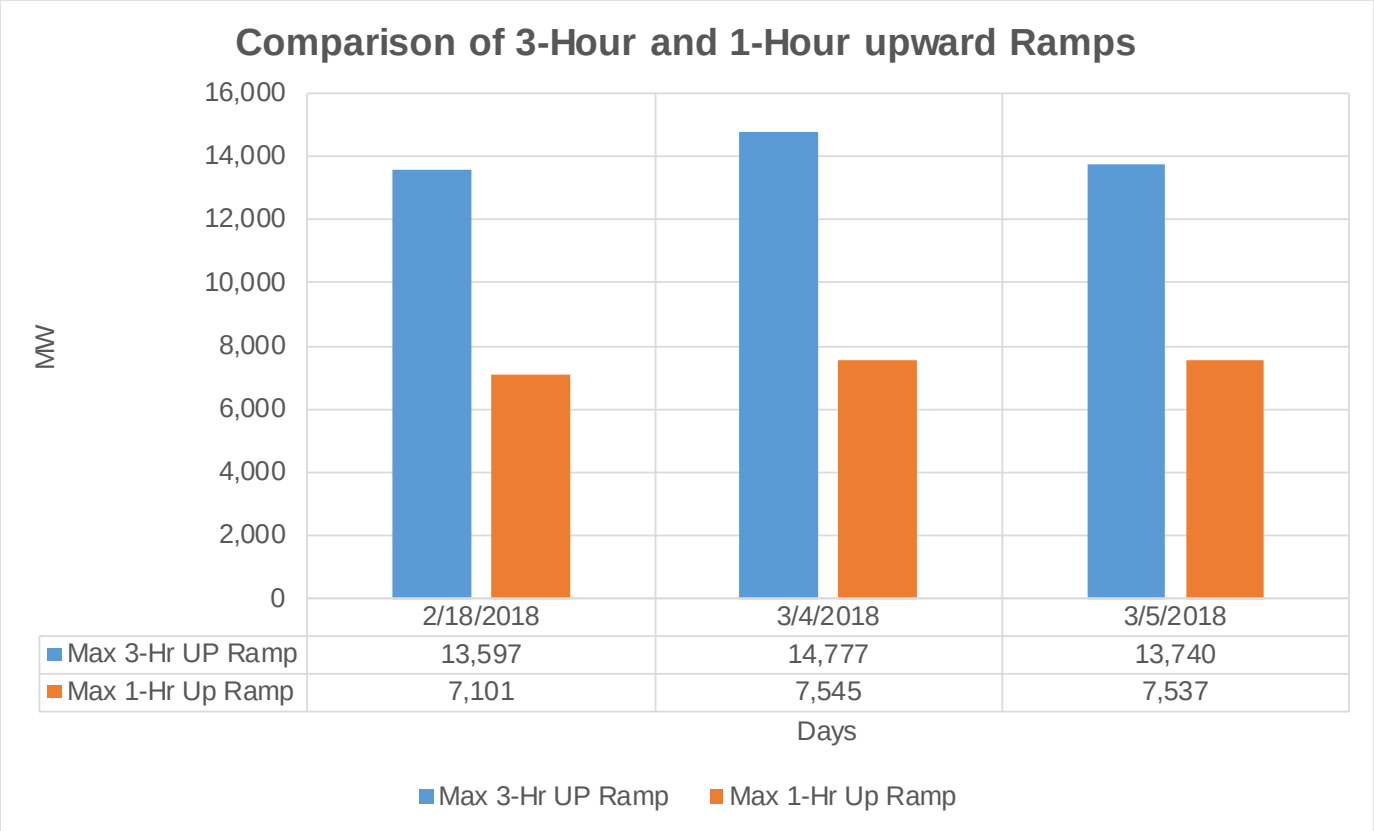



Source: PacifiCorp

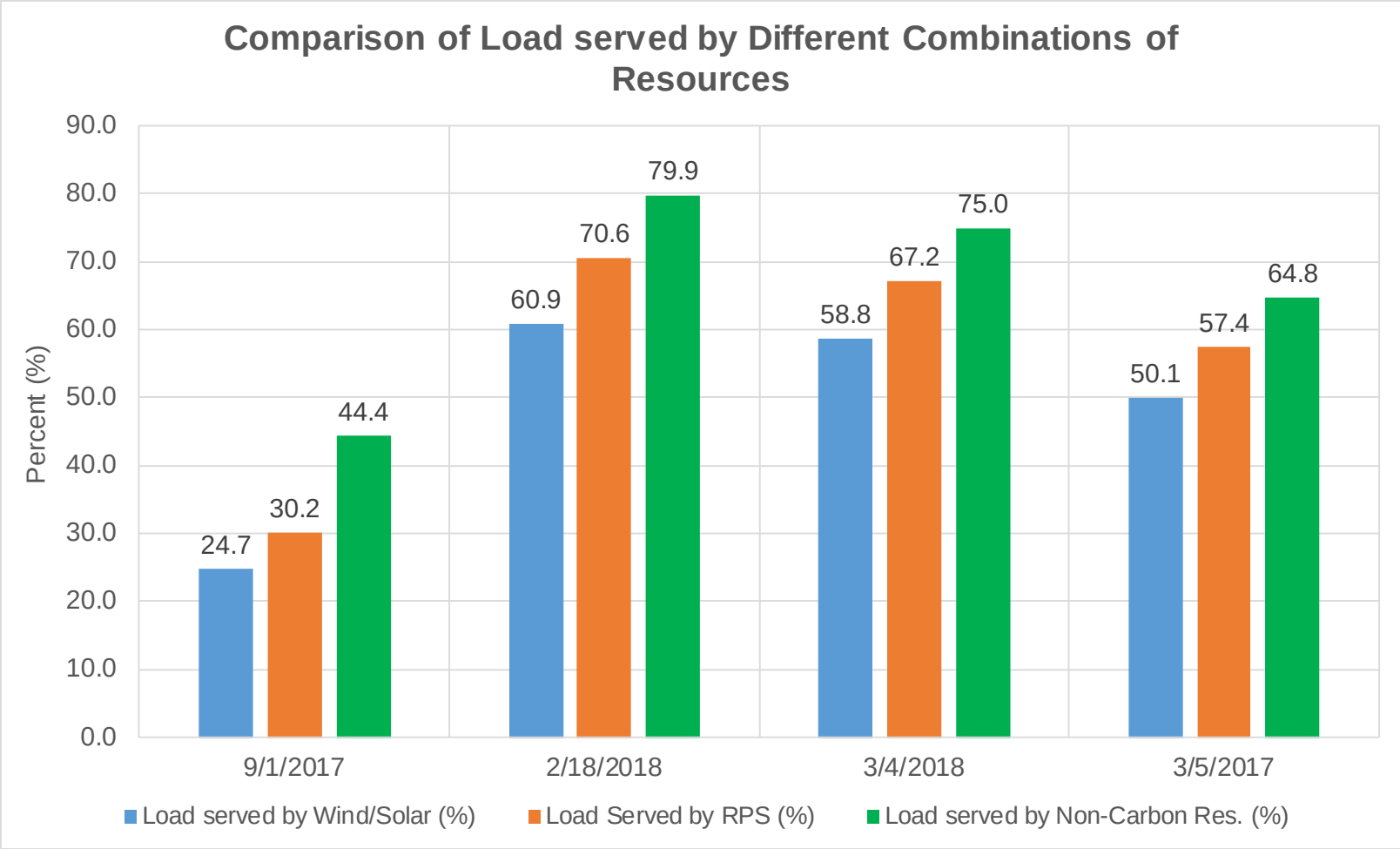
# Increasing trend of renewable curtailment varies with seasonal and hydro conditions



# 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