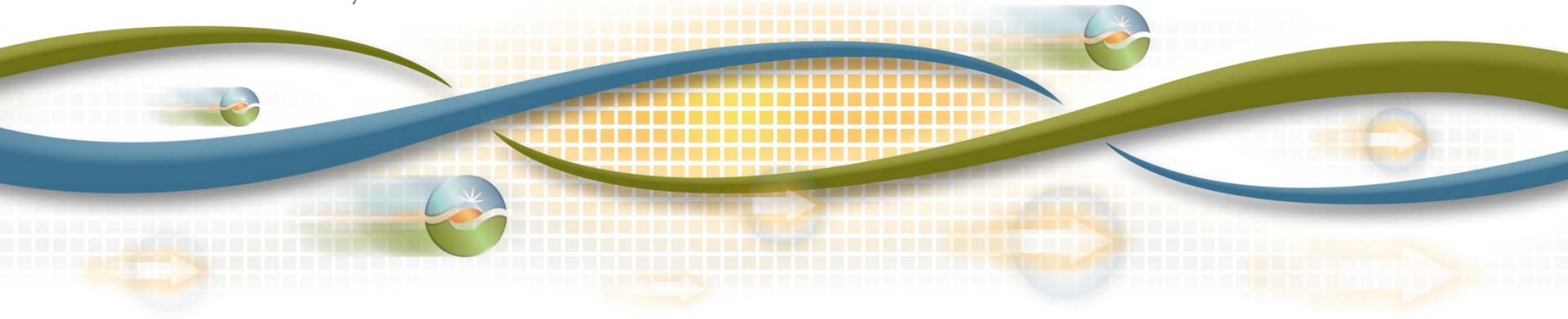




Renewable generation in California ISO markets

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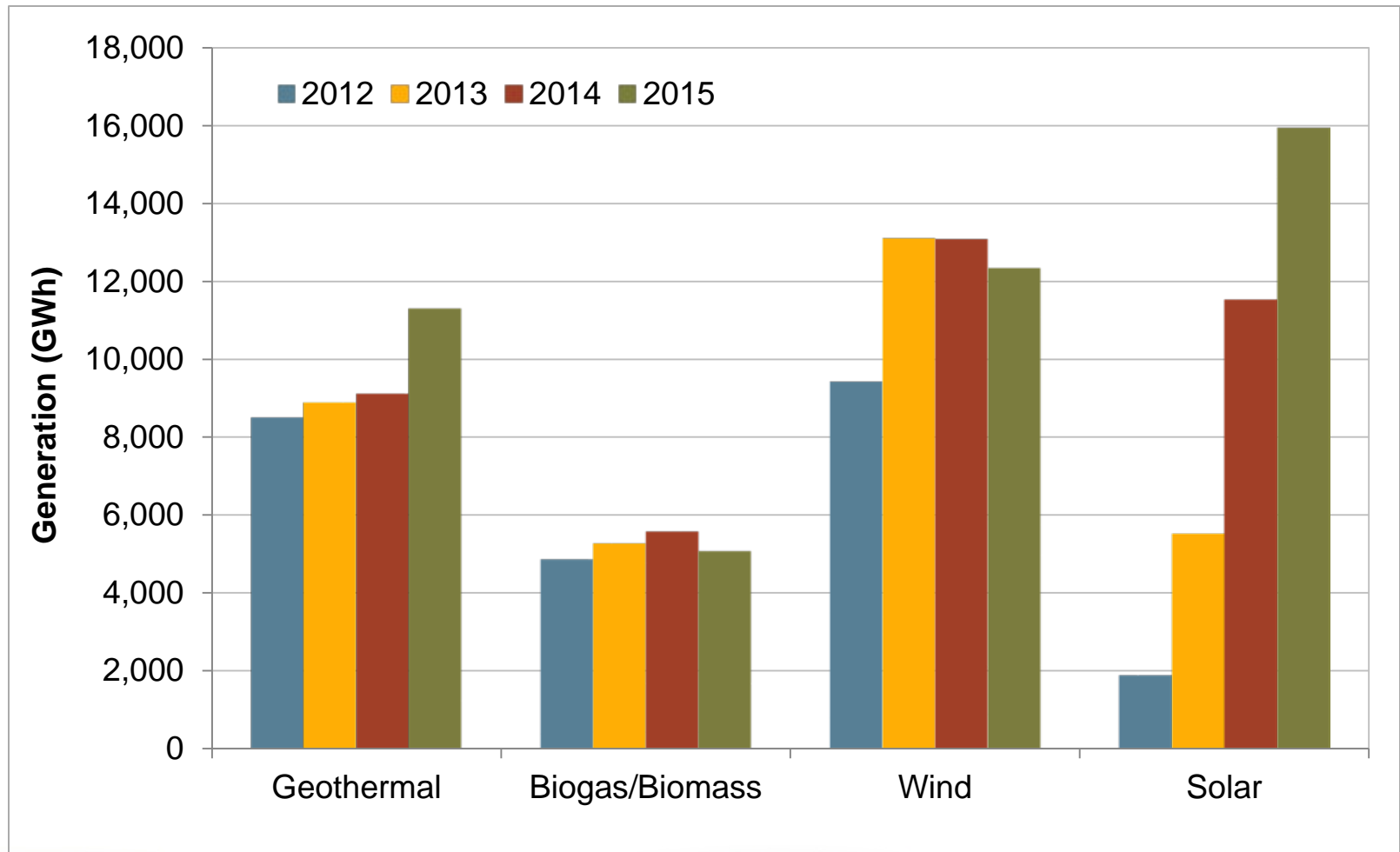
Renewable Energy Markets 2016
San Francisco, CA
October 17, 2016



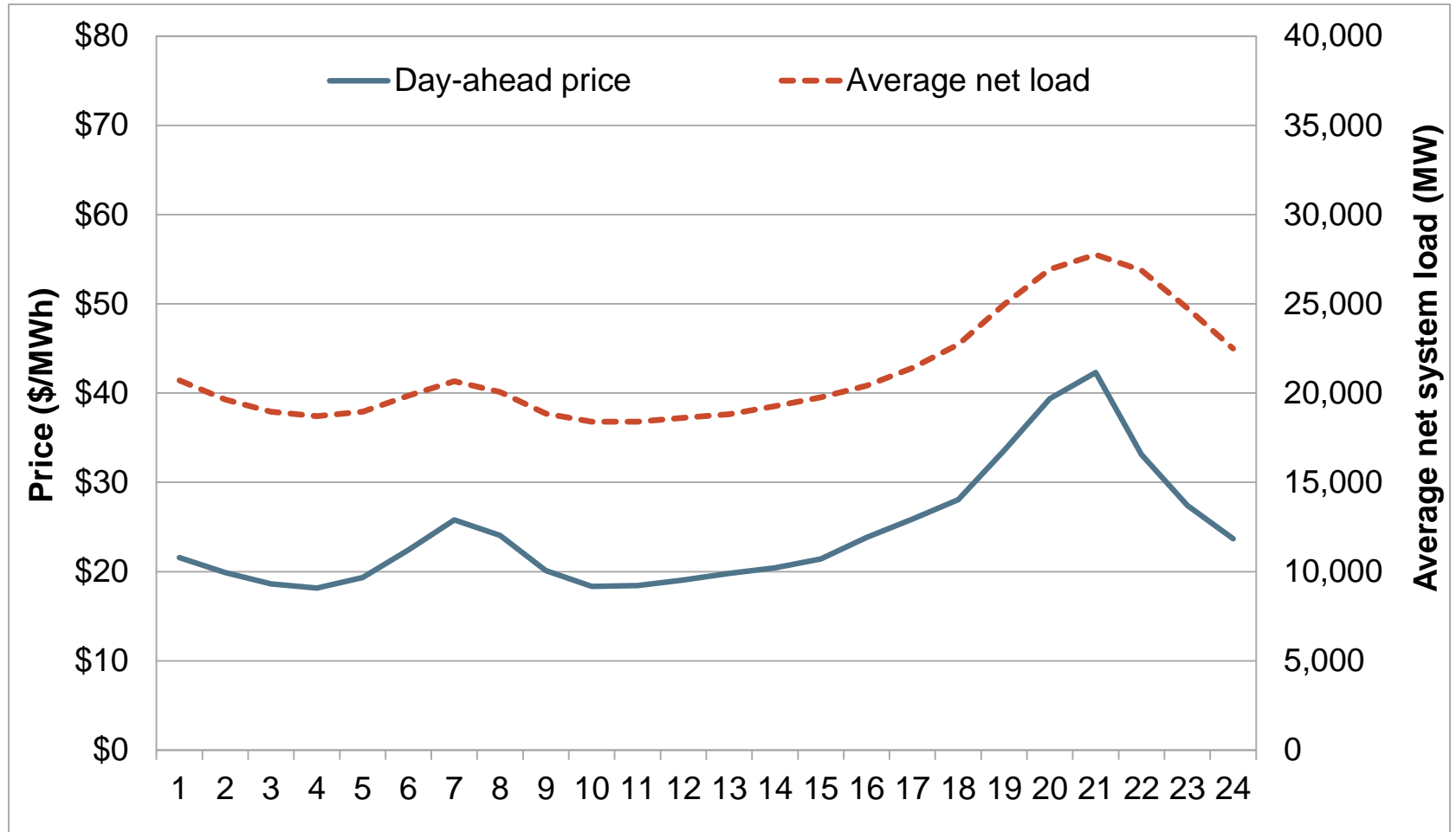
Presentation outline

- Growth of renewables
- Changes in net load and price
- Managing oversupply conditions
- Energy imbalance market transfers and renewables
- Market changes going forward

Solar generation has increased over eight fold in the California ISO balancing area since 2012

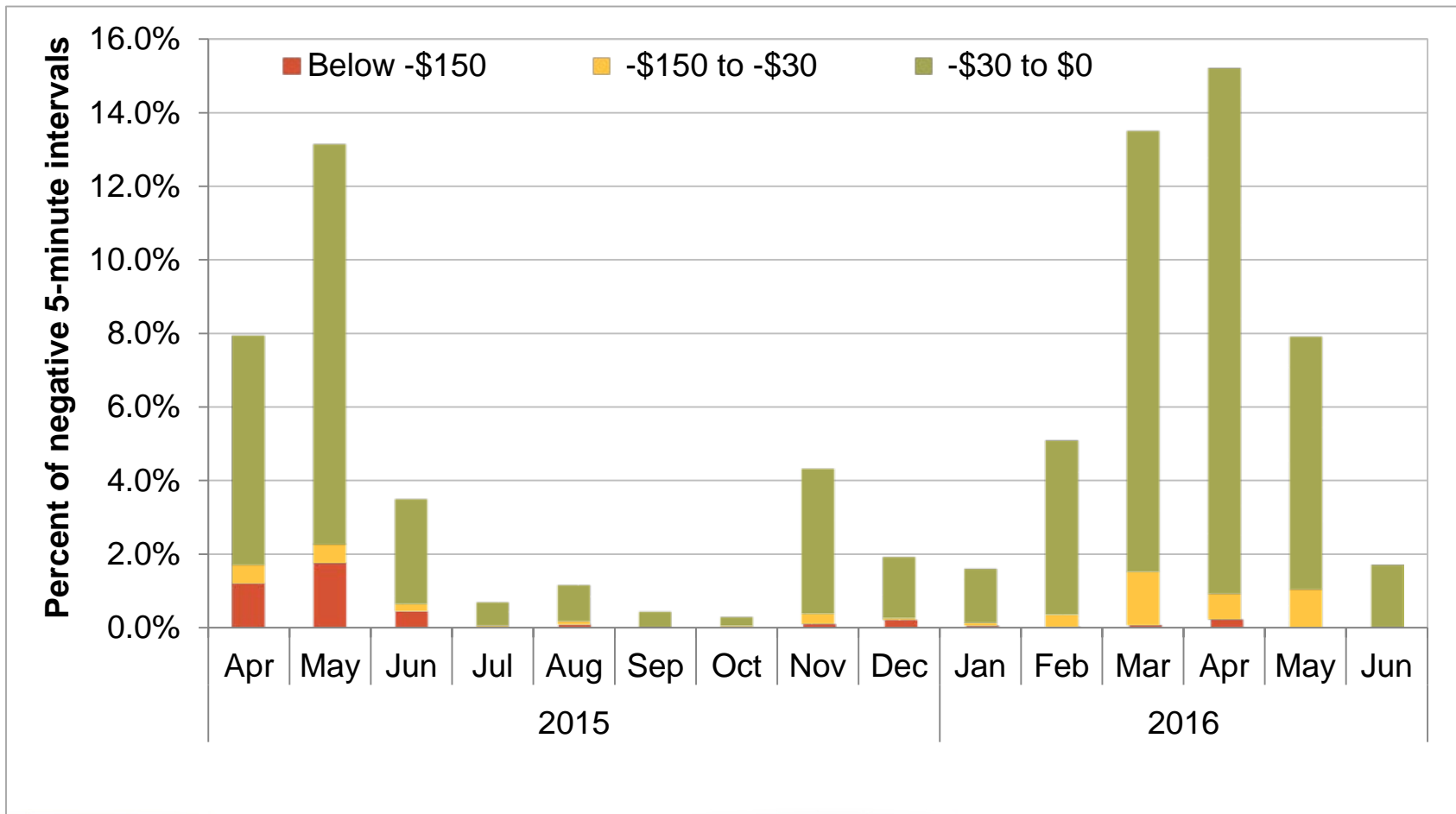


ISO prices followed the net load curve in the second quarter of 2016

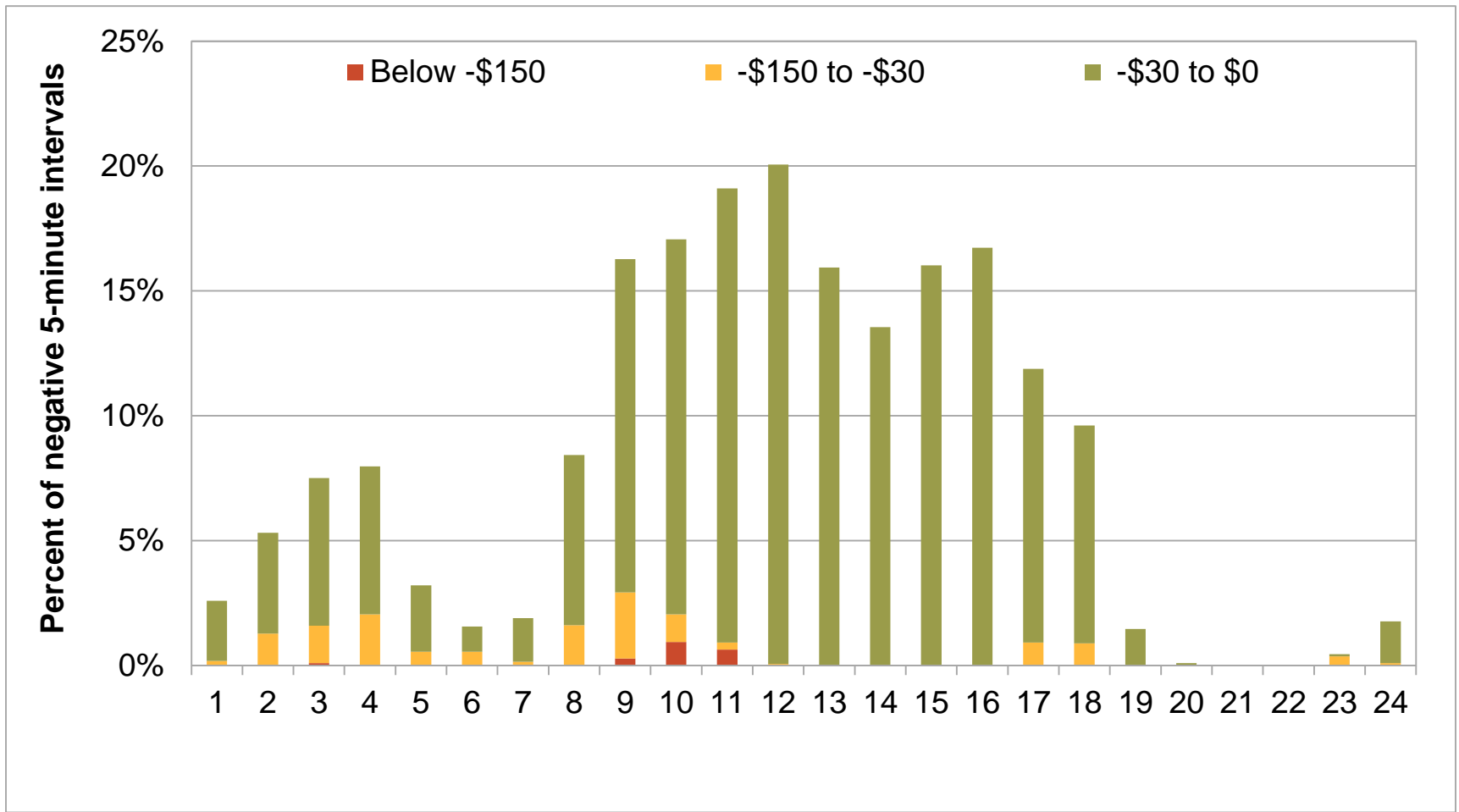


Note: Net load is calculated by subtracting wind and solar from actual load.

Real-time ISO prices were negative more frequently in March and April 2016

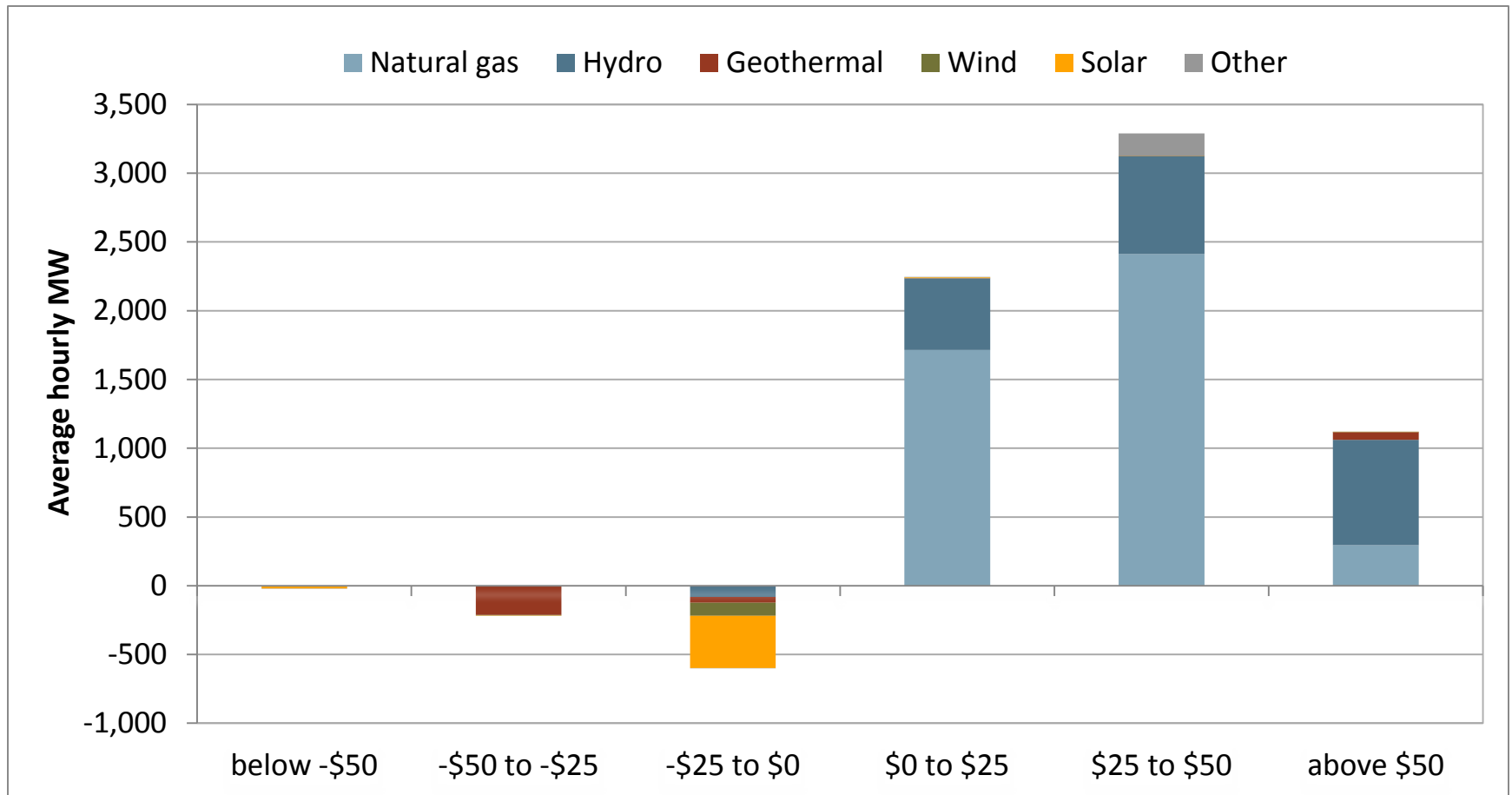


Hourly real-time ISO prices were frequently negative in high solar generation hours

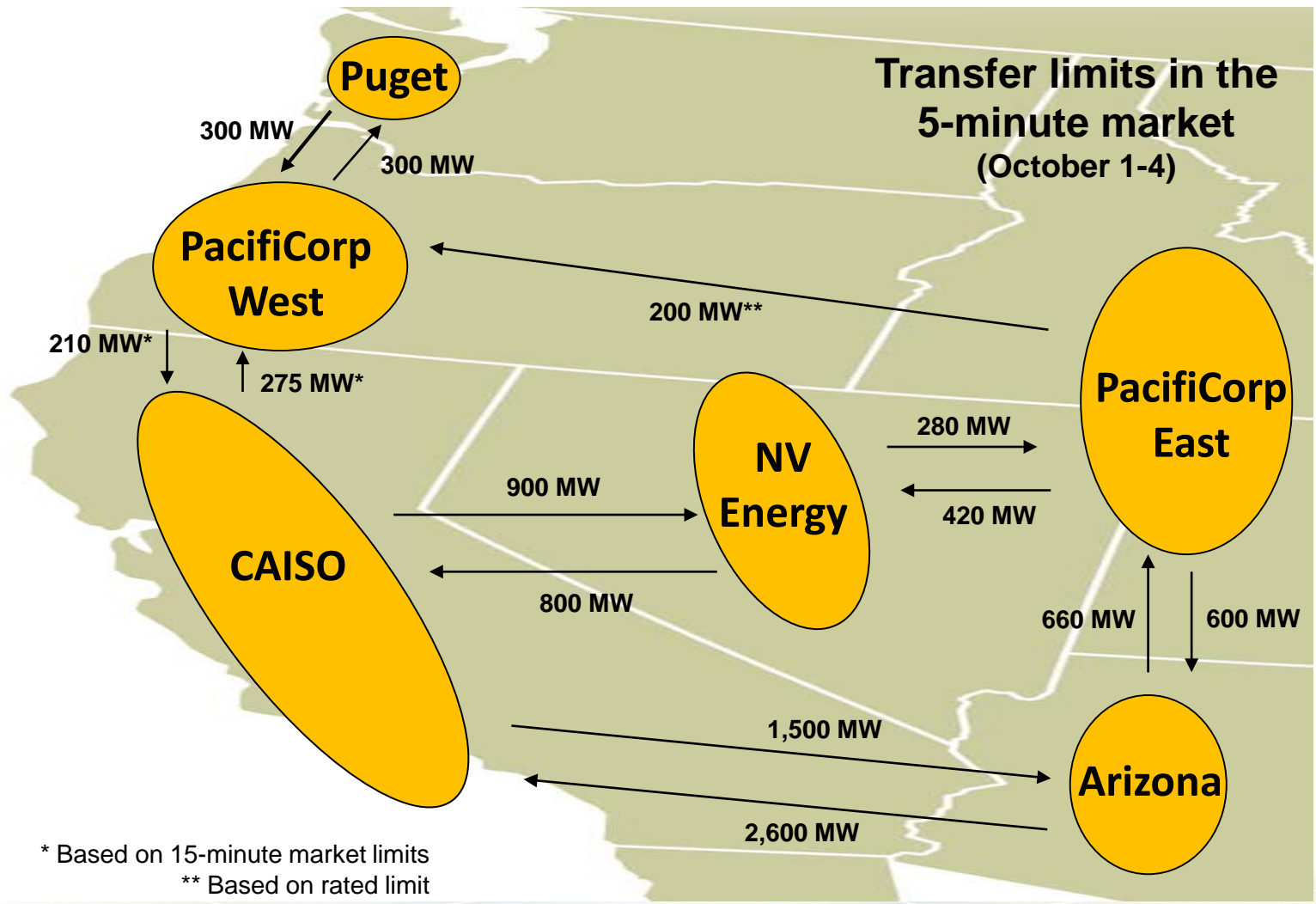


Note: The chart covers results in the second quarter of 2016.

Renewable generation bids negative, which helps manage oversupply conditions

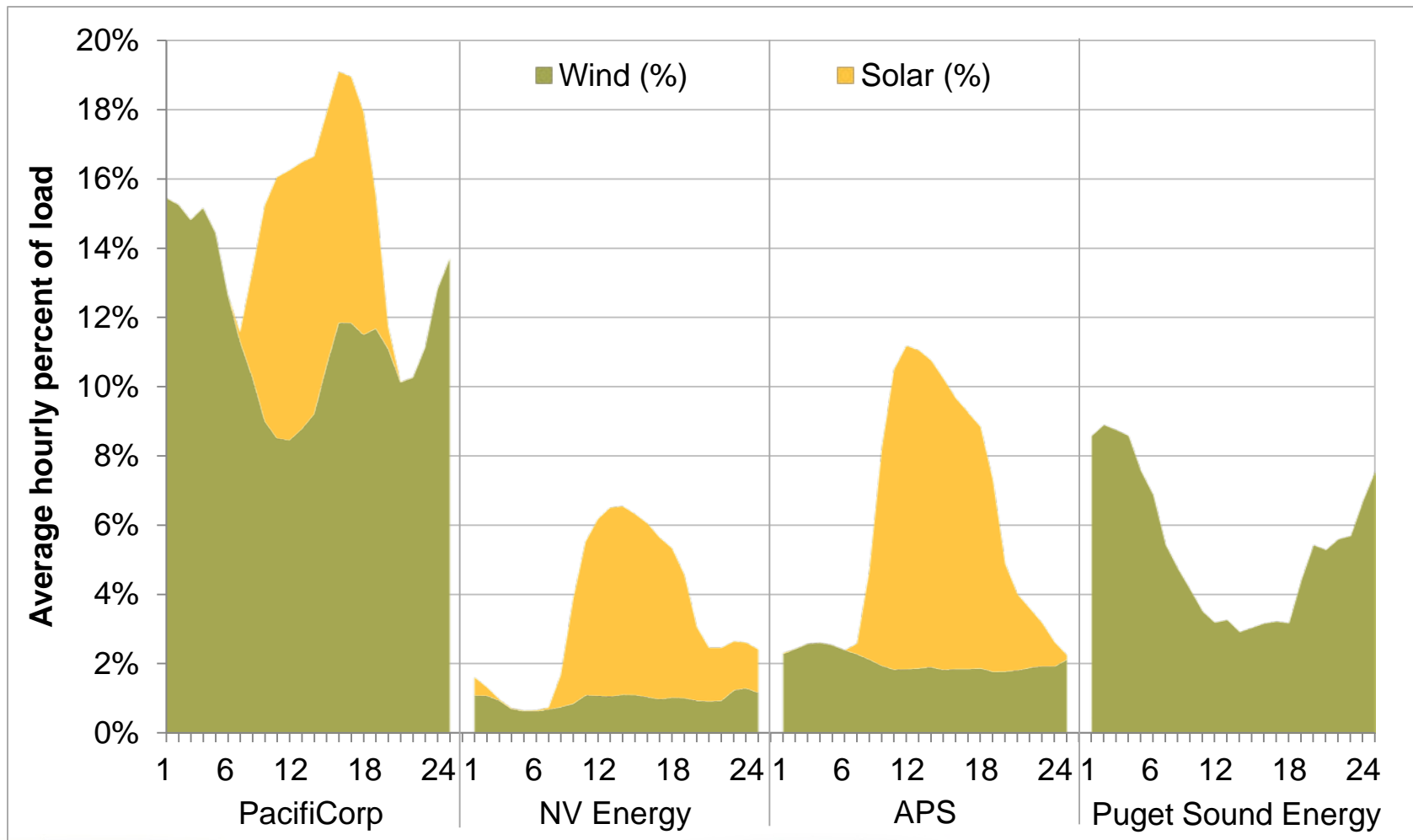


The energy imbalance market can help manage the integration of renewables in the ISO



* Based on 15-minute market limits
** Based on rated limit

The energy imbalance market helps manage renewable growth in the west



Note: Data is averaged by hour for September 1 through 26, 2016.

The ISO markets are changing as renewable generation increases

- ISO prices follow the net load curve, changing how we think of peak and off-peak periods
- ISO is managing oversupply with downward dispatch of renewables and an expanded market footprint
- The expanded footprint also assists other balancing areas in managing more renewables
- ISO is working to ensure sufficient ramping and backup capacity available to integrate renewables
- ISO is promoting further participation of energy storage

QUESTIONS?

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For more information on the ISO and renewable integration see:

<http://www.caiso.com/informed/Pages/CleanGrid/>