# 2017 Annual Report

June 14, 2018

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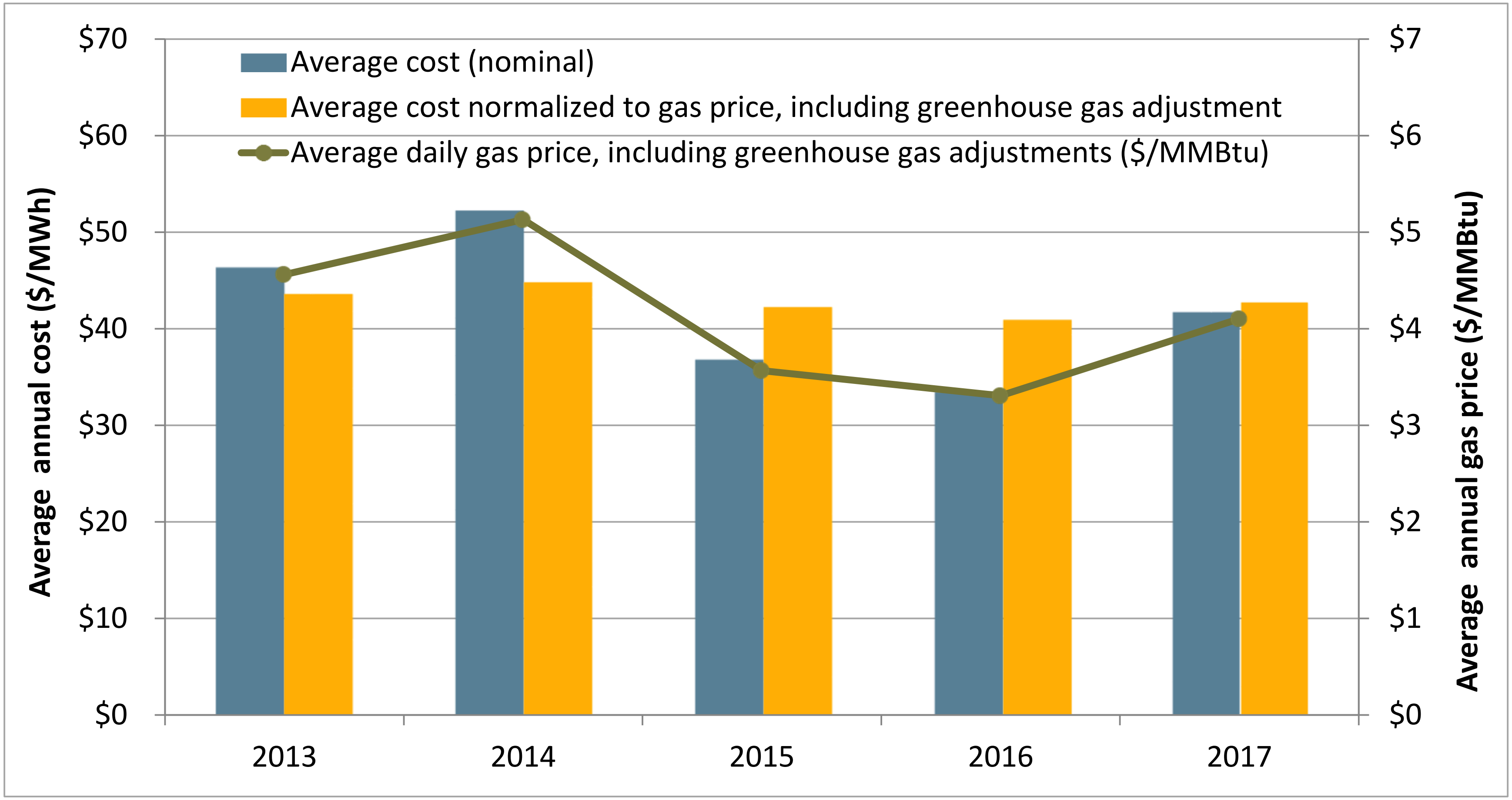
Department of Market Monitoring

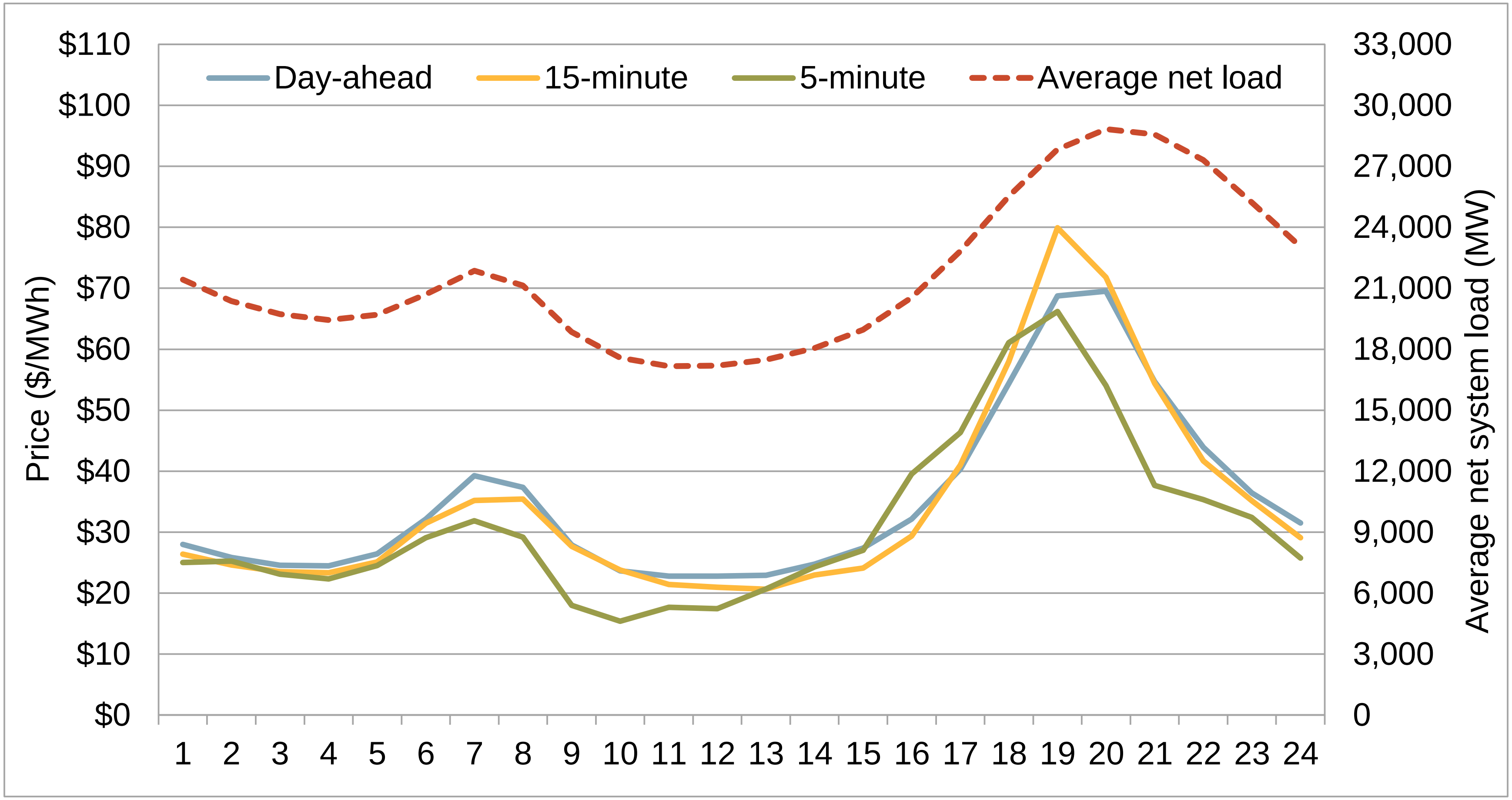
# Total wholesale costs increased 25% -- or 4% increase after accounting for 27% increase in gas cost



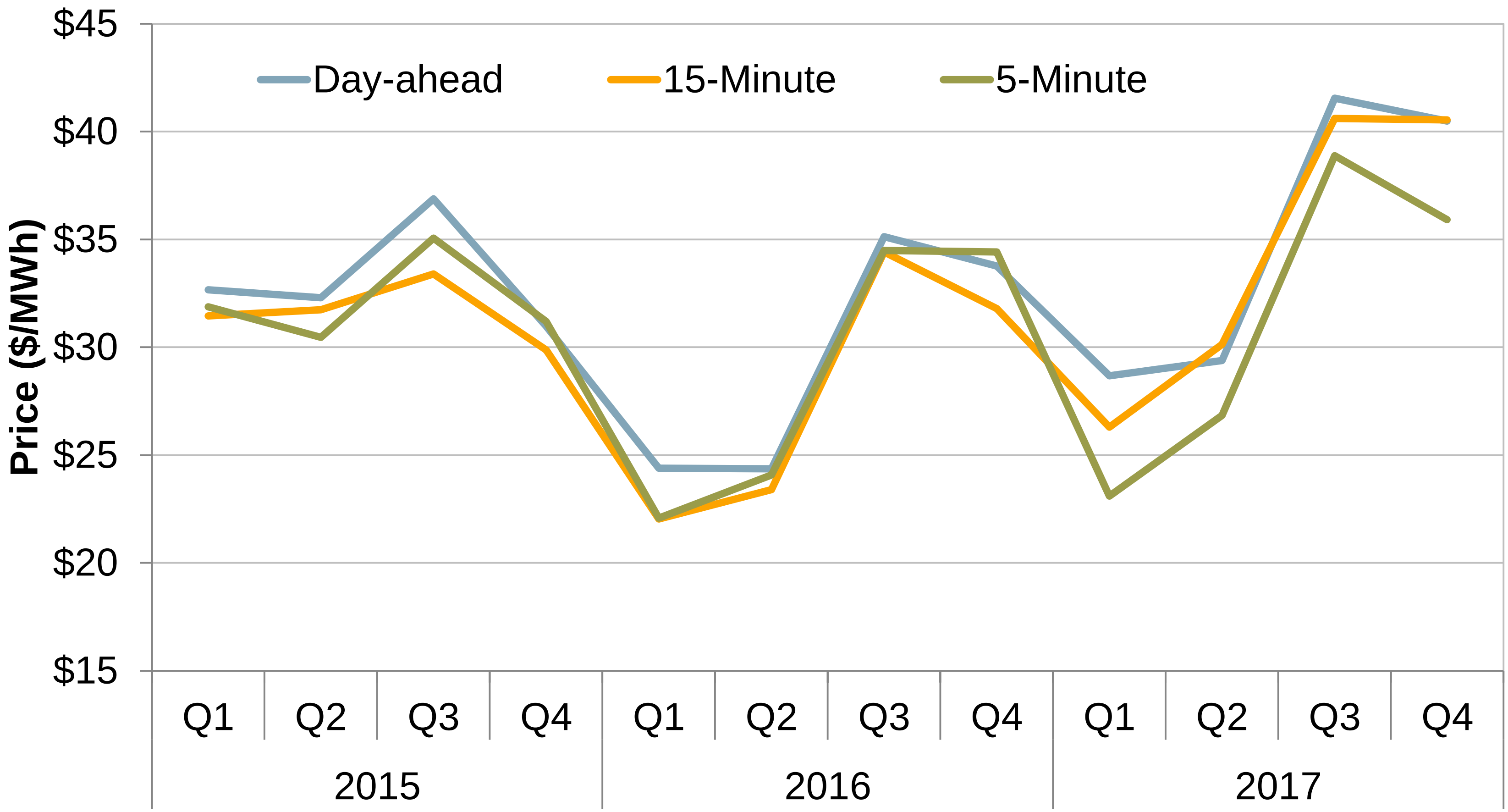
# Total wholesale costs by category – excludes costs of meeting resource adequacy requirements.

| | 2013 | 2014 | 2015 | 2016 | 2017 | Change '16-'17 |
|---|---|---|---|---|---|---|
| Day-ahead energy costs | $ 44.14 | $ 48.57 | $ 34.54 | $ 30.70 | $ 37.59 | $ 6.89 |
| Real-time energy costs (incl. flex ramp) | $ 0.57 | $ 1.98 | $ 0.69 | $ 1.03 | $ 2.01 | $ 0.98 |
| Grid management charge | $ 0.80 | $ 0.80 | $ 0.80 | $ 0.81 | $ 0.81 | $ 0.01 |
| Bid cost recovery costs | $ 0.47 | $ 0.40 | $ 0.39 | $ 0.33 | $ 0.47 | $ 0.14 |
| Reliability costs (RMR and CPM) | $ 0.10 | $ 0.14 | $ 0.12 | $ 0.11 | $ 0.10 | $ (0.01) |
| **Average total energy costs** | **$ 46.08** | **$ 51.89** | **$ 36.54** | **$ 32.98** | **$ 40.99** | **$ 8.01** |
| | | | | | | |
| Reserve costs (AS and RUC) | $ 0.26 | $ 0.30 | $ 0.27 | $ 0.54 | $ 0.77 | $ 0.24 |
| **Average total costs of energy and reserve** | **$ 46.34** | **$ 52.19** | **$ 36.81** | **$ 33.52** | **$ 41.77** | **$ 8.25** |

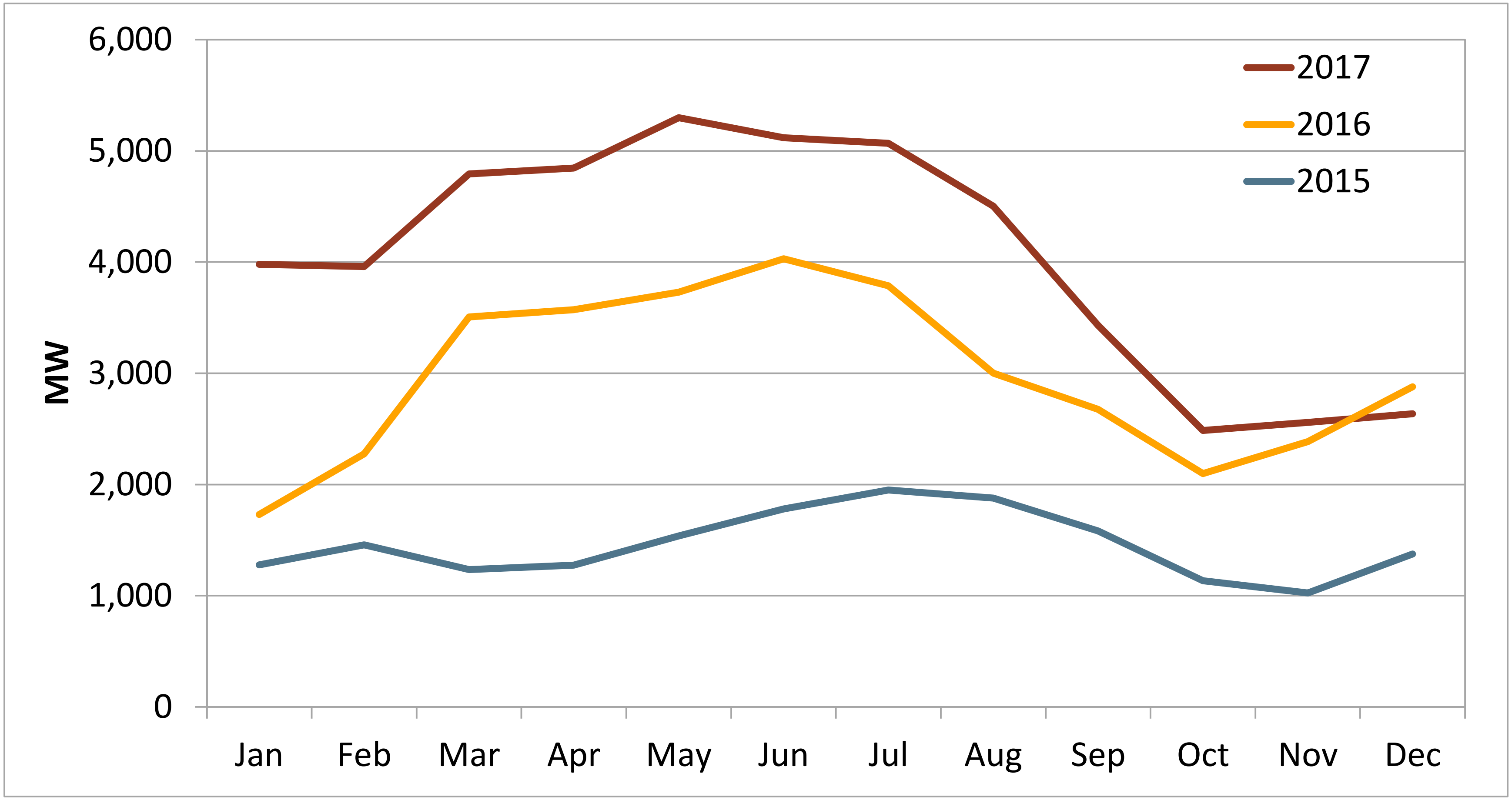
# Average hourly prices mirror net load



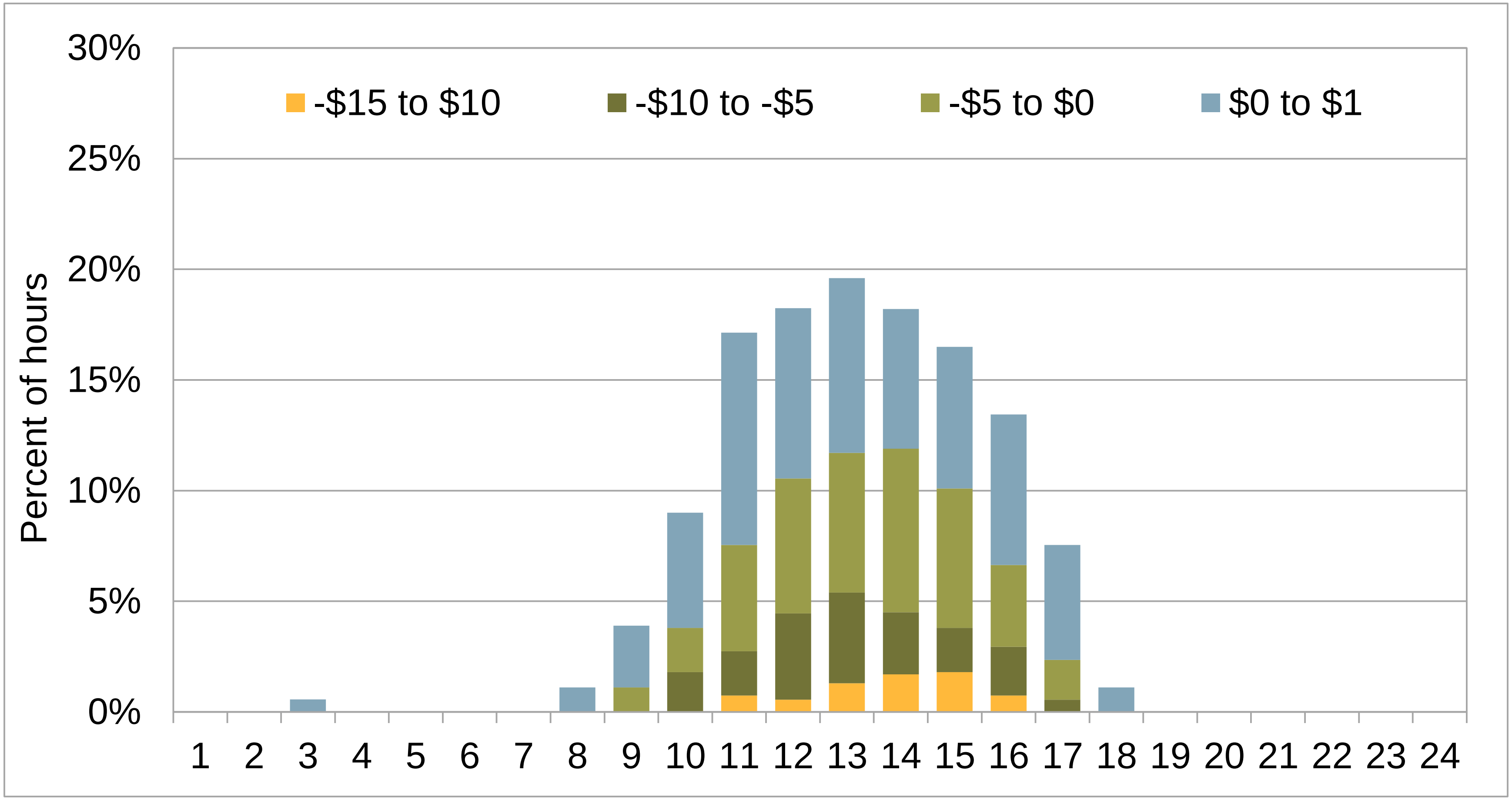
# Average quarterly system marginal energy prices increased in Q3 and Q4 due to higher gas prices and tighter supply/demand conditions.



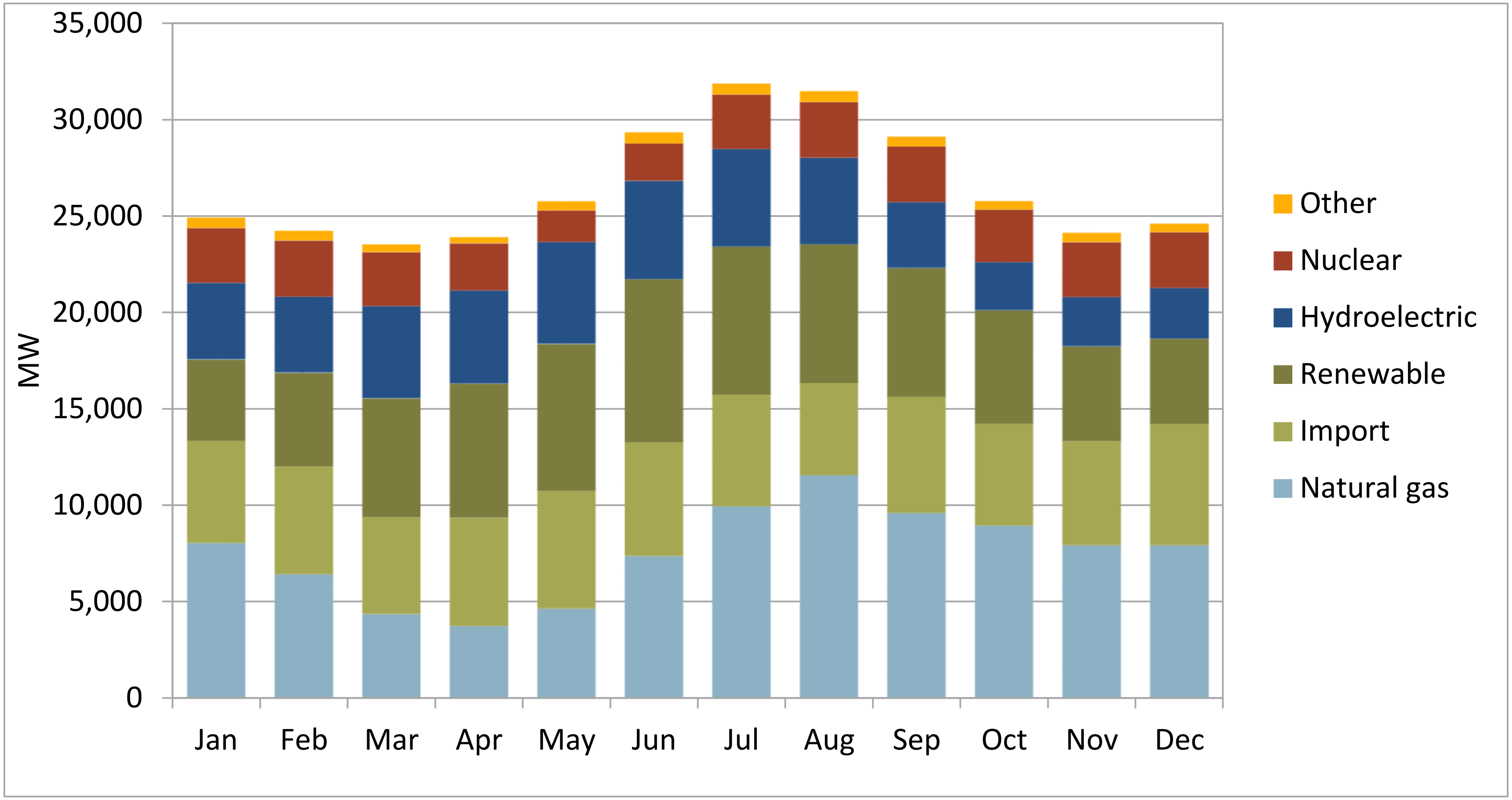
# Average hourly hydro-electric production by month (2015-2017)



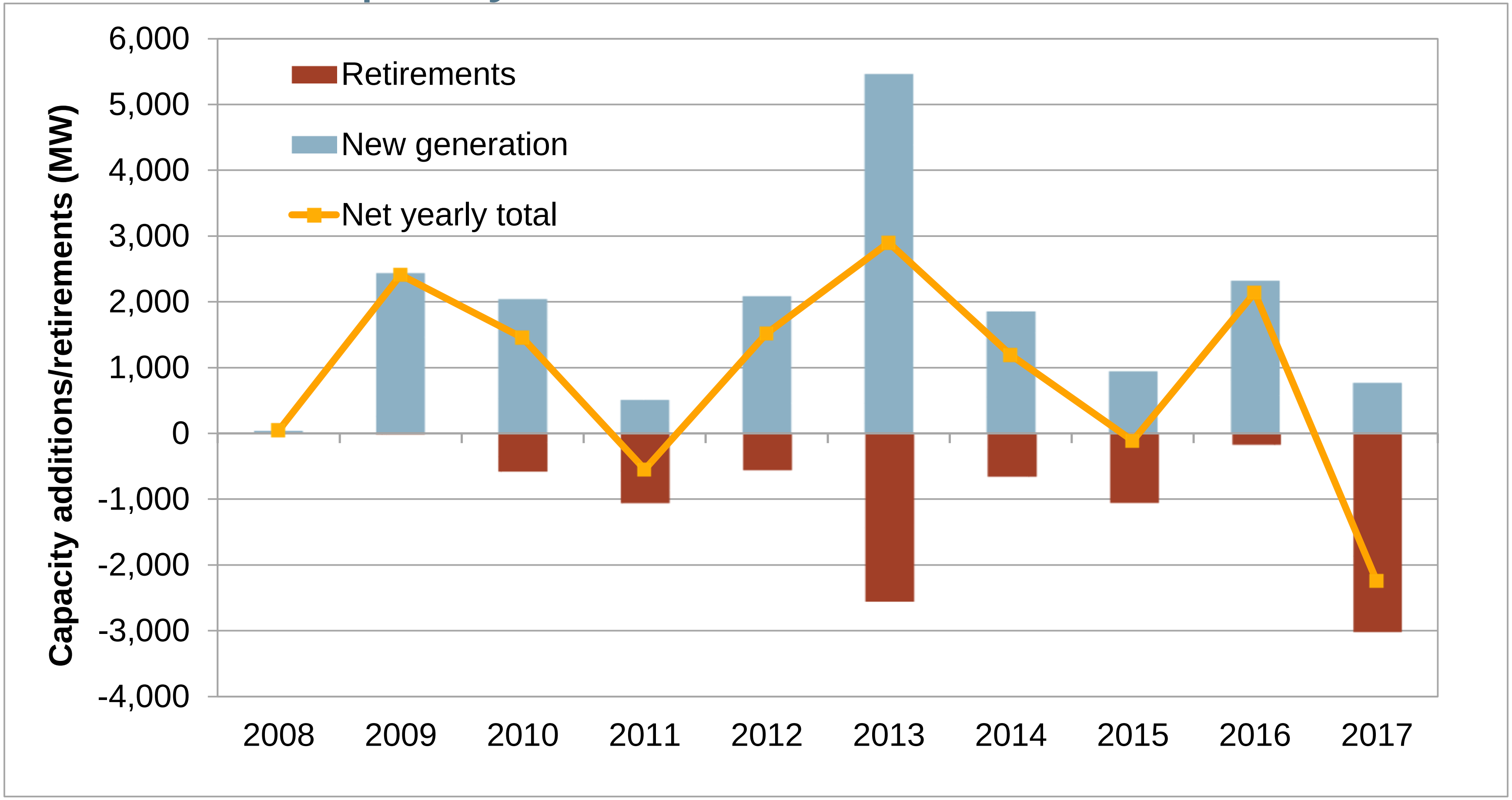
# Frequency of day-ahead prices near or below $0/MWh increased significantly in 2017 (January – June)



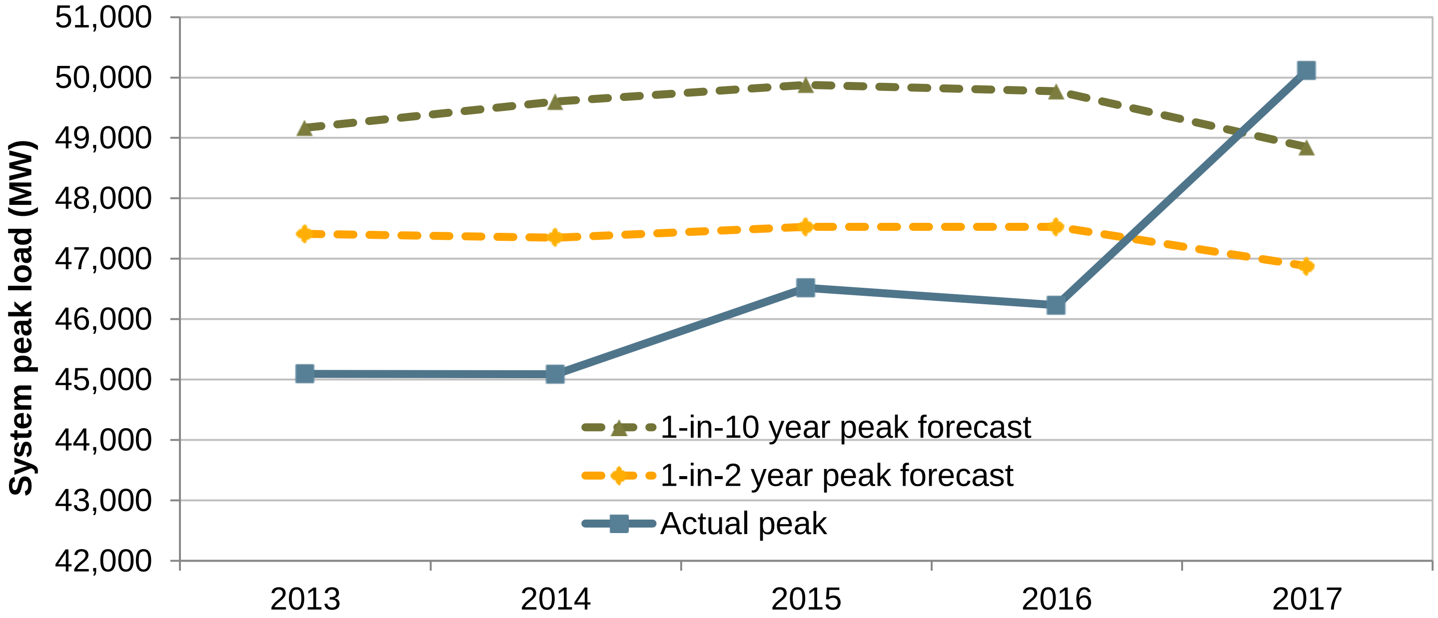
# Higher reliance on gas during months with higher loads and less hydro/renewables.



# About 3,000 MW of gas generation retirements, while most new capacity from solar.

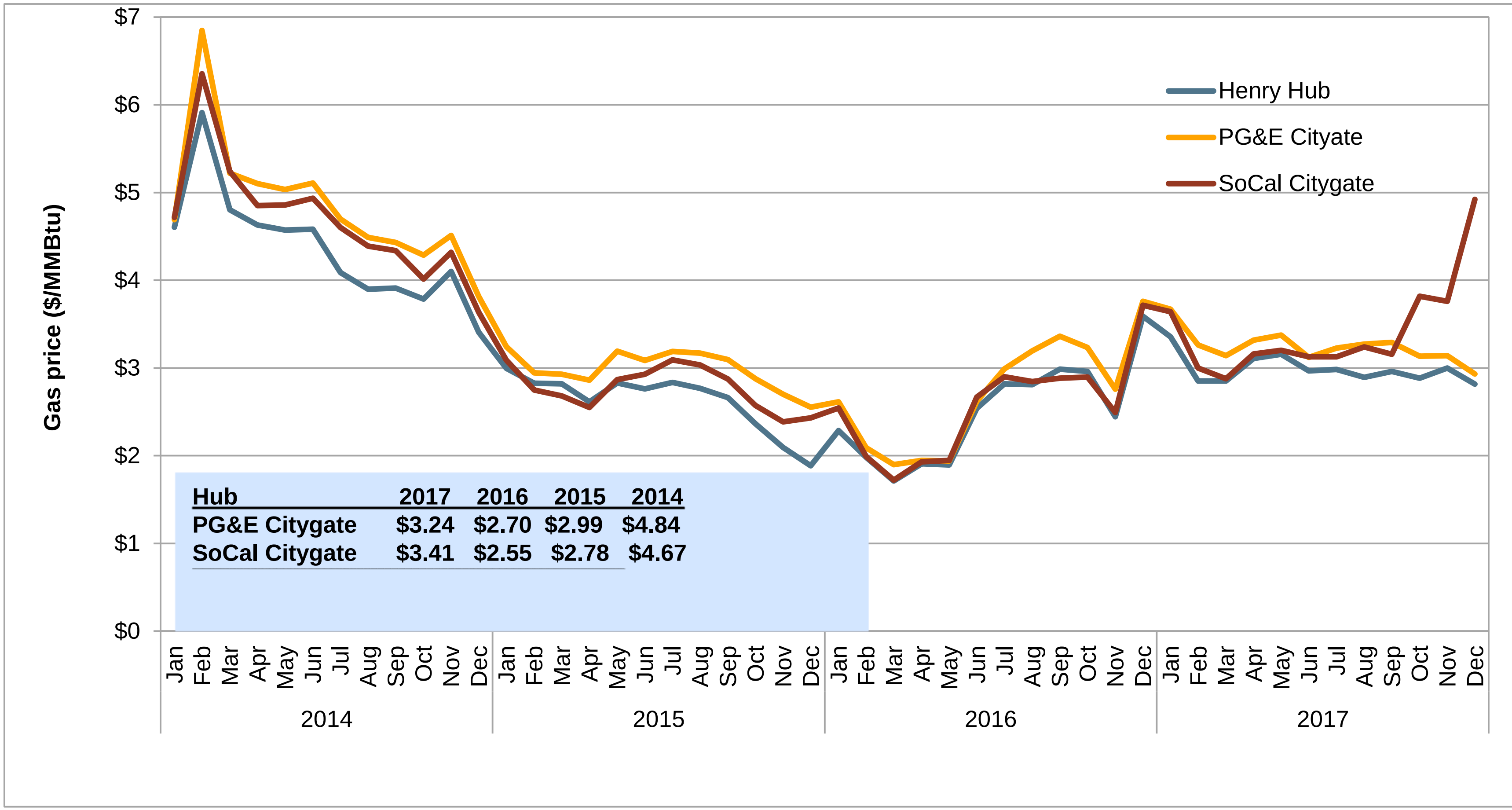


# Higher peak loads, but overall energy loads level.



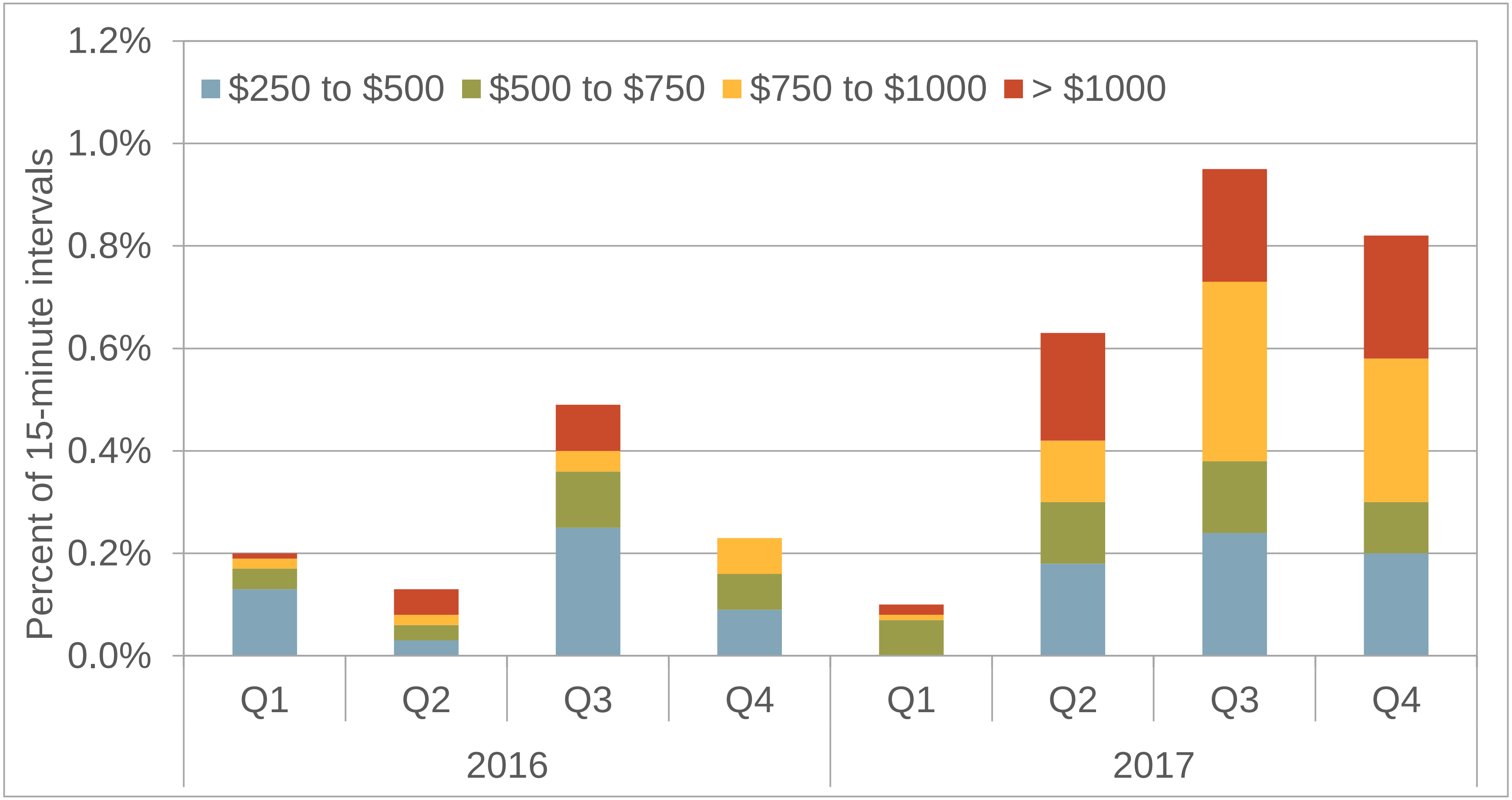

| Year | Annual total energy (GWh) | Average load (MW) | % change | Annual peak load (MW) | % change |
|---|---|---|---|---|---|
| 2013 | 231,800 | 26,461 | -1.0% | 45,097 | -3.7% |
| 2014 | 231,610 | 26,440 | -0.1% | 45,090 | 0.0% |
| 2015 | 231,495 | 26,426 | 0.0% | 46,519 | 3.2% |
| 2016 | 228,794 | 26,047 | -1.4% | 46,232 | -0.6% |
| 2017 | 228,191 | 26,049 | 0.0% | 50,116 | 8.4% |

# Gas prices are up in later months of year, especially in the south, frequent location of marginal resource

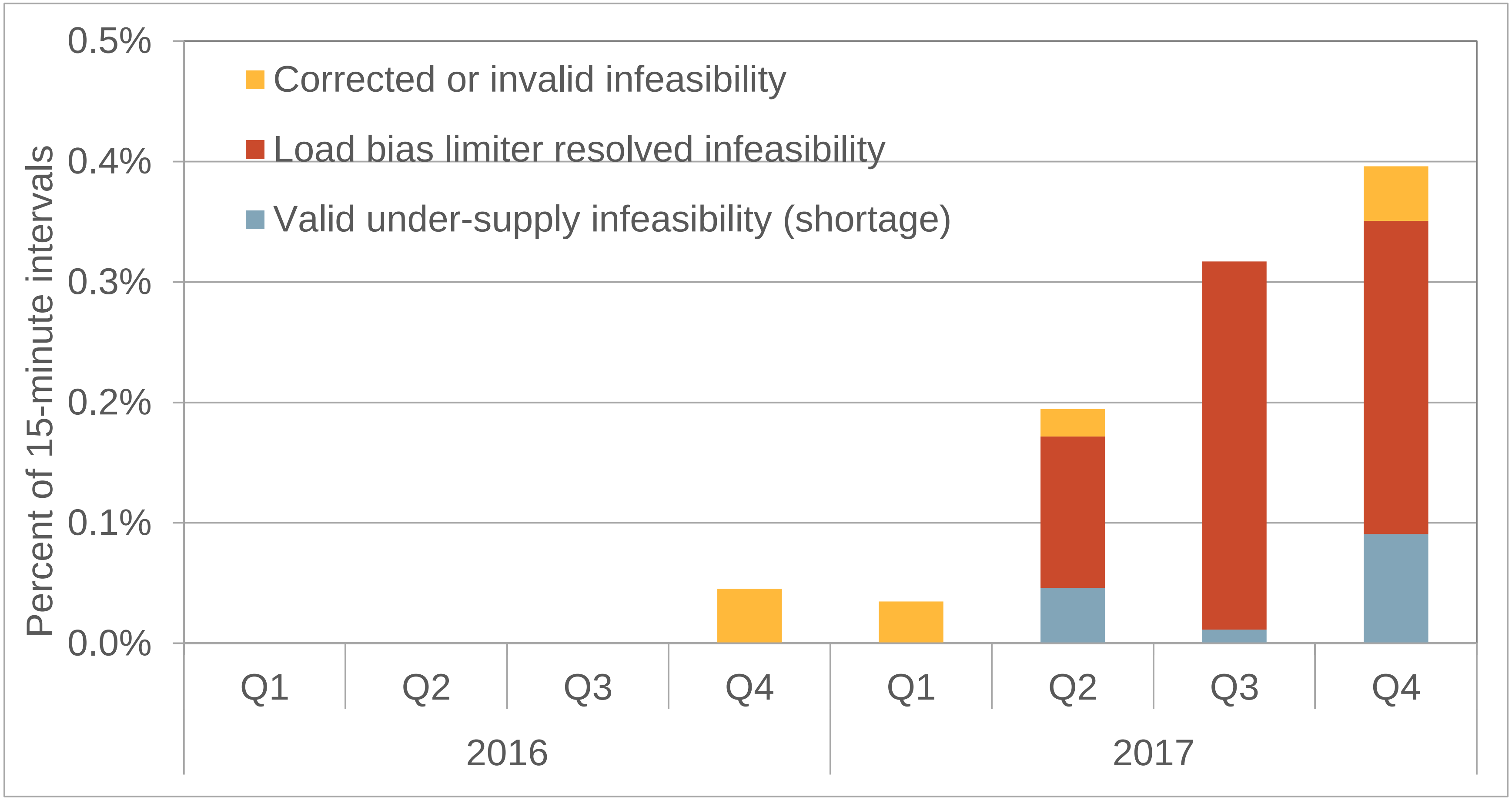



| Hub | 2017 | 2016 | 2015 | 2014 |
|---|---|---|---|---|
| PG&E Citygate | $3.24 | $2.70 | $2.99 | $4.84 |
| SoCal Citygate | $3.41 | $2.55 | $2.78 | $4.67 |

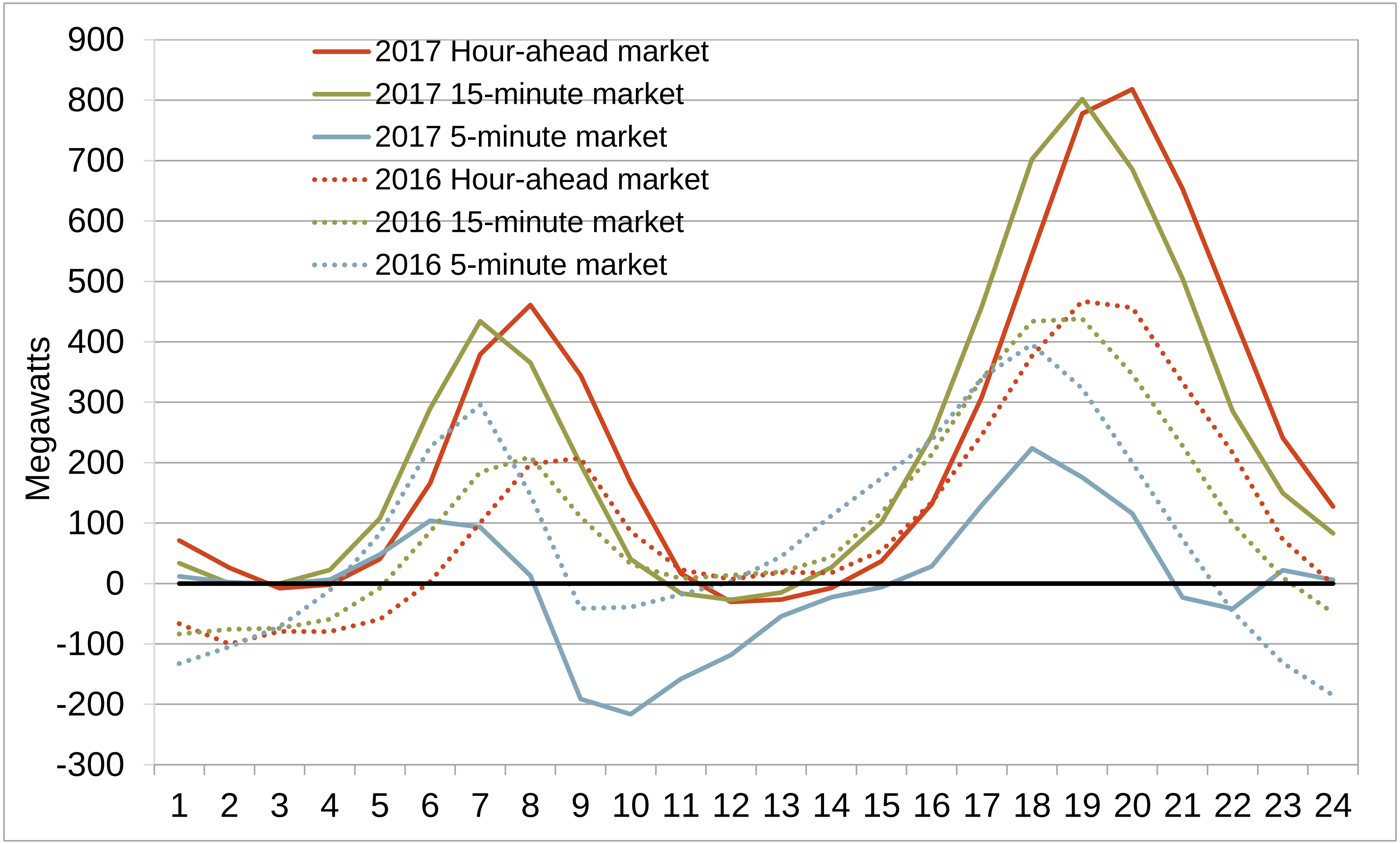
# Frequency of positive 15-minute price spikes (ISO LAP areas)



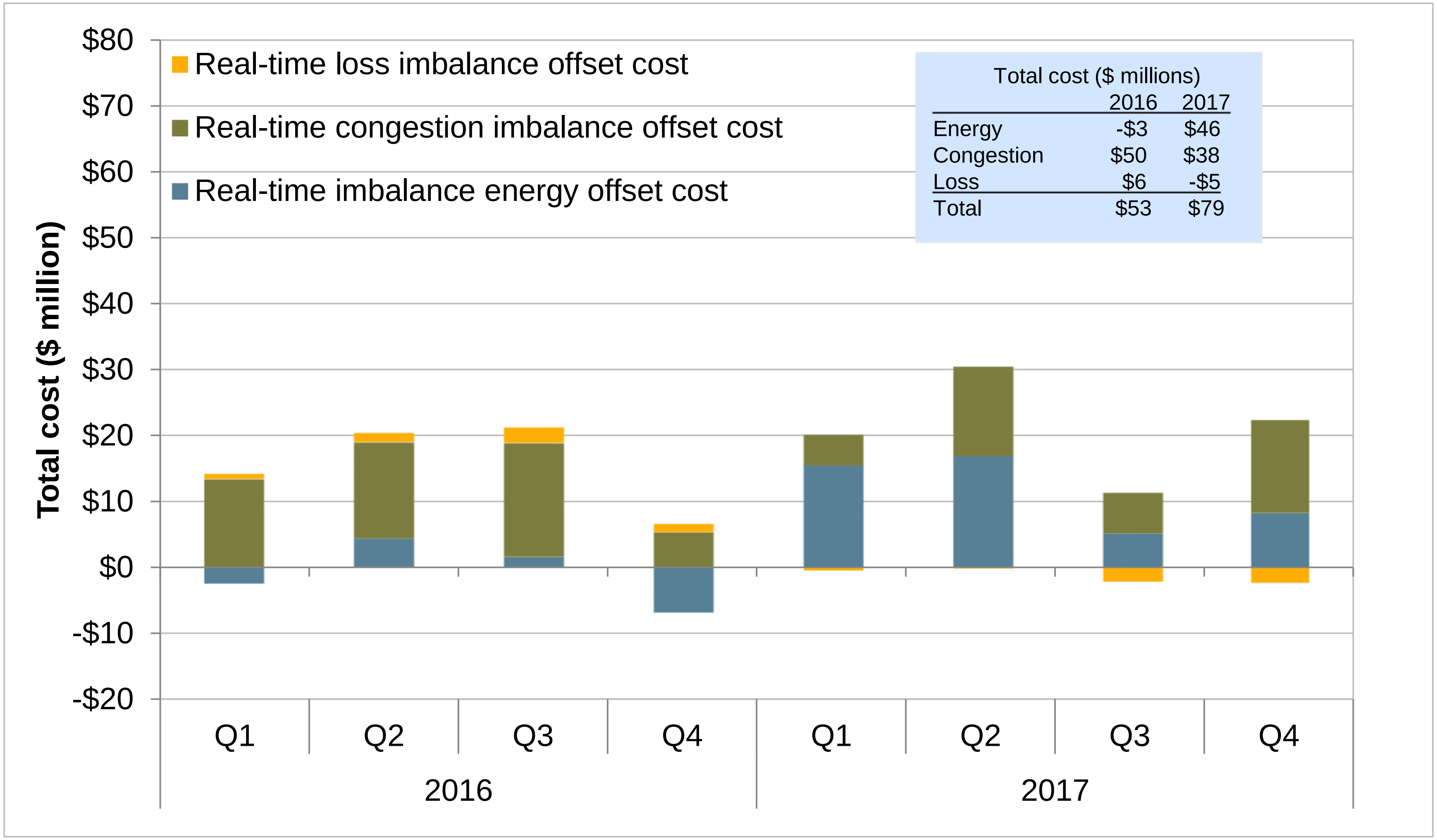
# Frequency of under-supply power balance constraint infeasibilities (15-minute market)



# Load adjustment by grid operators increased significantly.



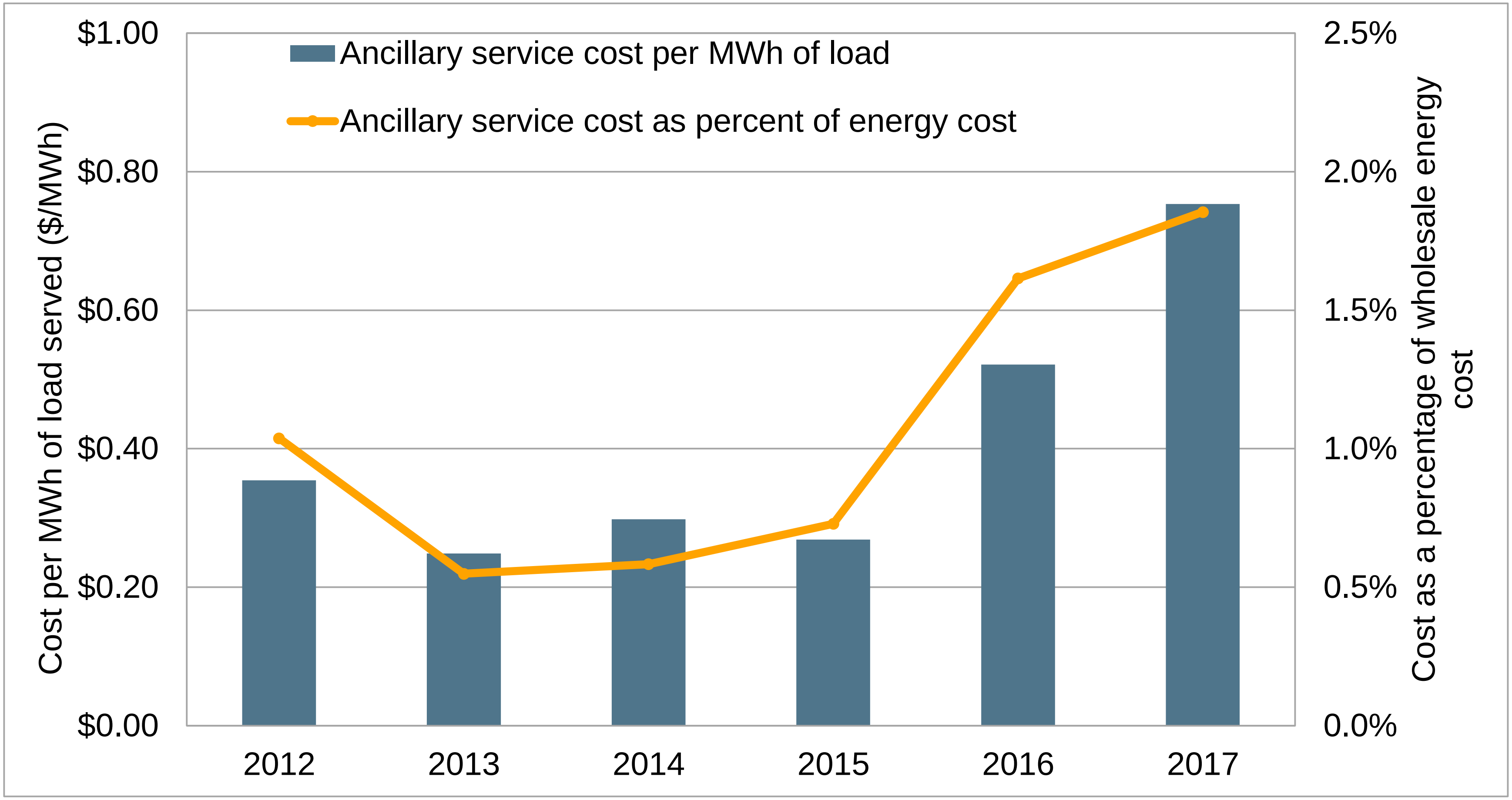
# Real-time imbalance offset costs increased ~50%.




Total cost ($ millions)

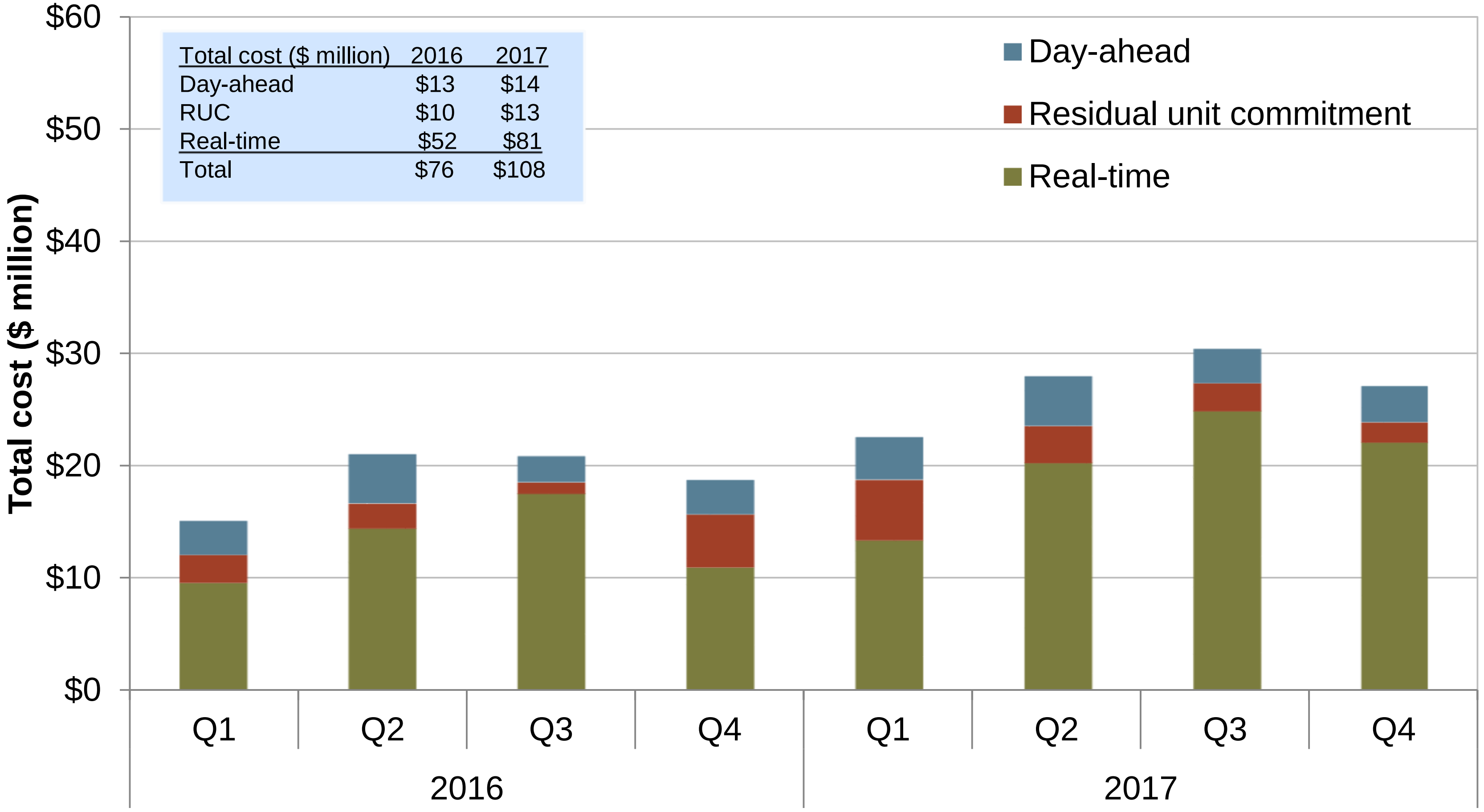
| | 2016 | 2017 |
|---|---|---|
| Energy | -$3 | $46 |
| Congestion | $50 | $38 |
| Loss | $6 | -$5 |
| Total | $53 | $79 |

# Ancillary service costs increased due to higher requirements and tight supply conditions.

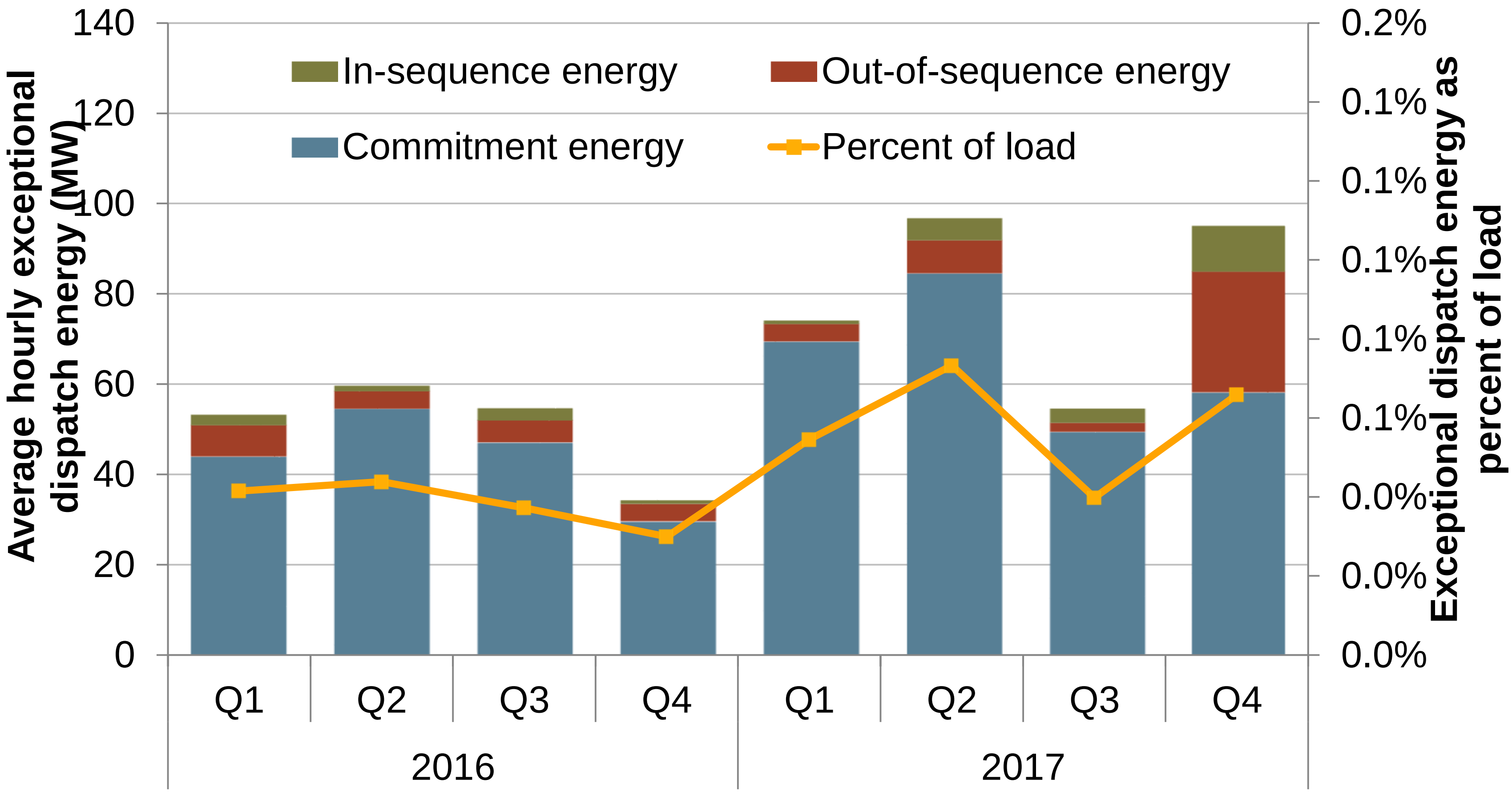


# Bid cost recovery payments increased 42% compared to 27% increase in energy cost.

| Total cost ($ million) | 2016 | 2017 |
|---|---|---|
| Day-ahead | $13 | $14 |
| RUC | $10 | $13 |
| Real-time | $52 | $81 |
| Total | $76 | $108 |



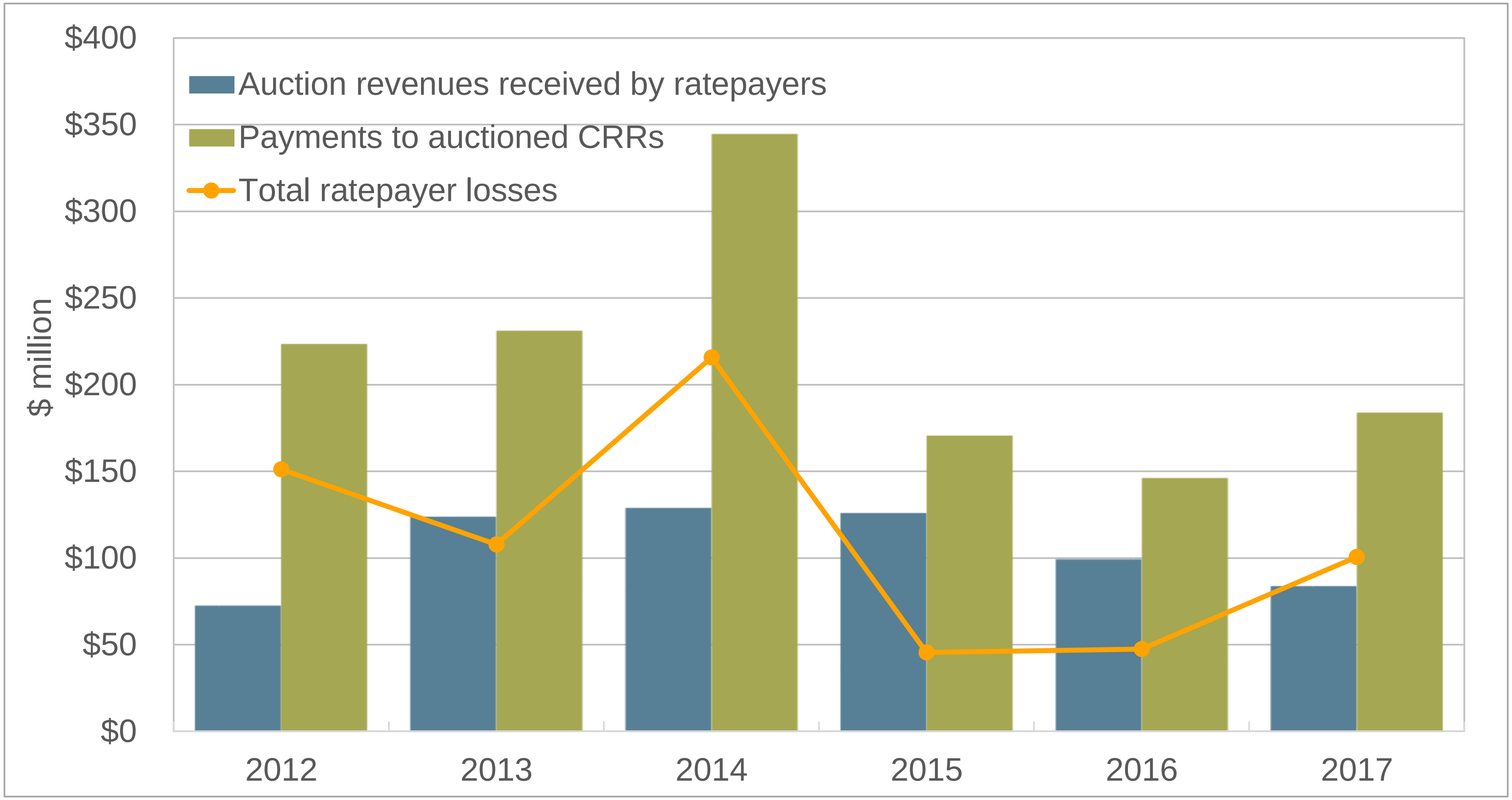
# Total above-market costs due to exceptional dispatch increased 92 percent to $20.6 million in 2017



# Congestion raised prices in southern portion of system.

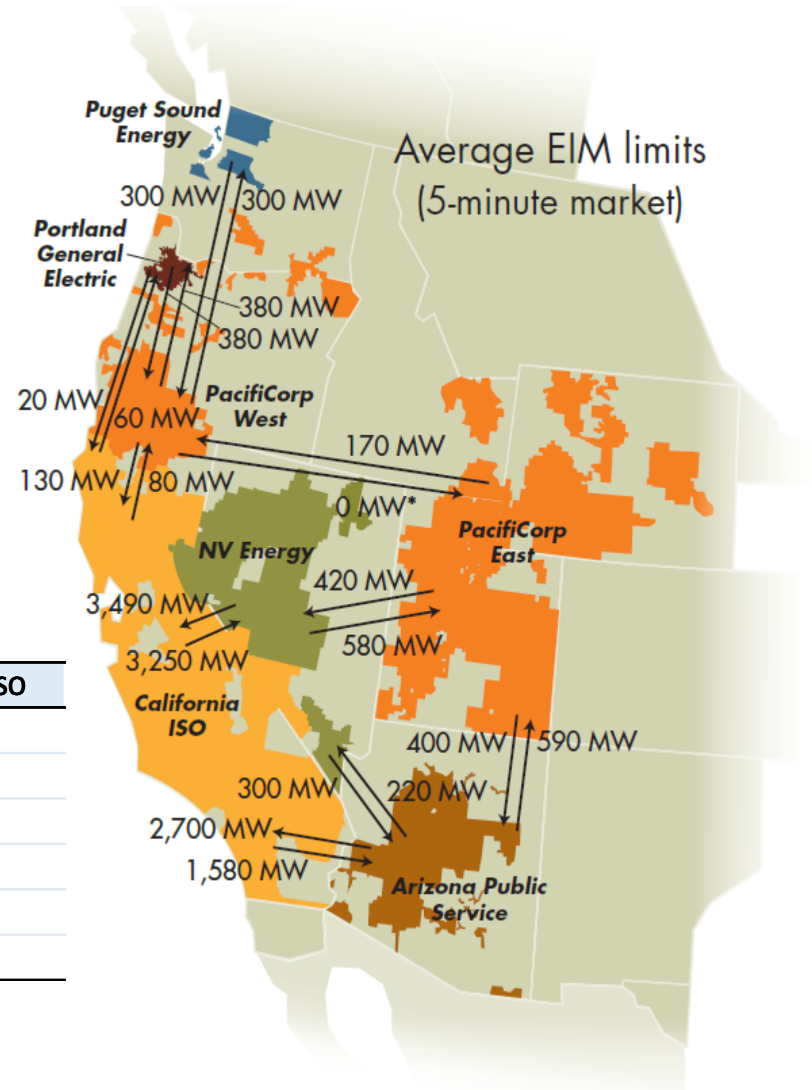
- San Diego Gas and Electric:
  - Increased day-ahead prices by $0.90/MWh (2.5%)
  - Increased real-time prices by about $1.50/MWh (4%)
- Southern California Edison:
  - Increased day-ahead prices by $0.40/MWh (1.2%)
  - Increased real-time prices by about $1.10/MWh (3%)
- Pacific Gas and Electric :
  - Decreased day-ahead prices by $0.60/MWh (2%)
  - Increased 15-minute prices by about $0.30/MWh (0.8%)
- Intertie congestion impact increased, particularly for interties connecting the ISO to the Pacific Northwest

# Transmission ratepayers lost over $100 million from auctioned CRRs in 2017 (>$730 million since 2009)

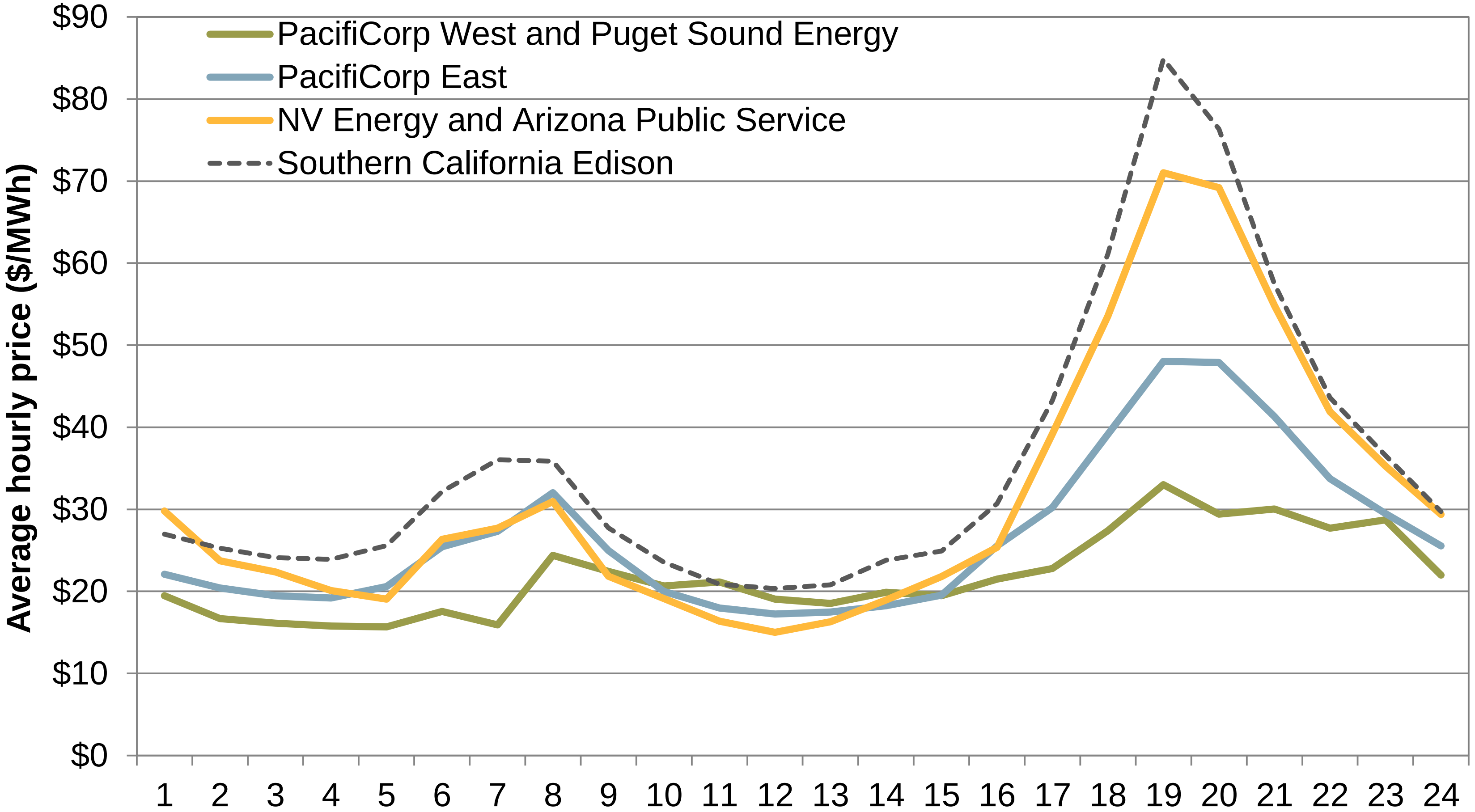


# Energy imbalance market expansion improved performance of real-time market.

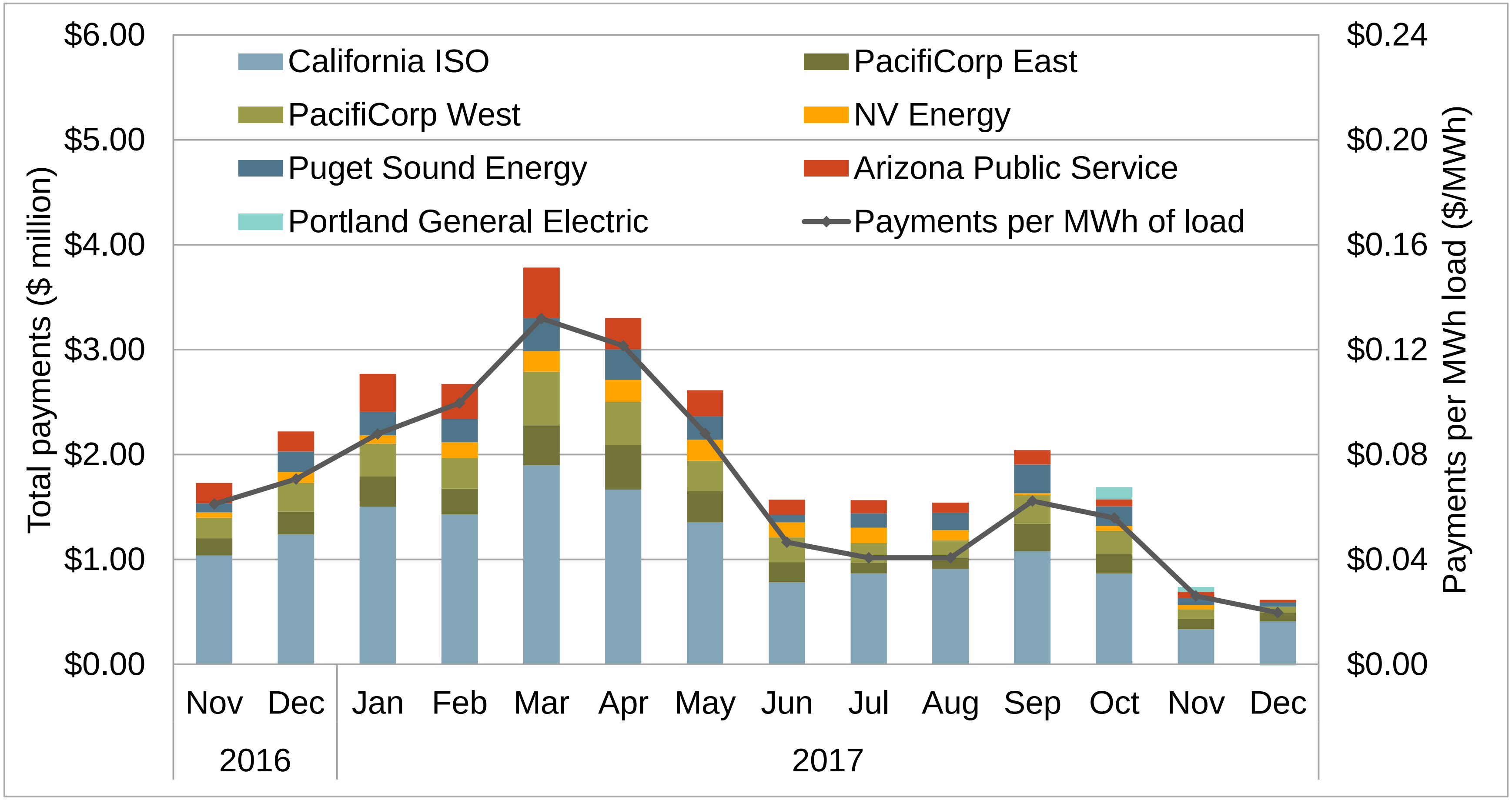
| | Congested toward ISO | Congested from ISO |
|---|---|---|
| NV Energy | 2% | 2% |
| Arizona Public Service | 5% | 2% |
| PacifiCorp East | 10% | 1% |
| PacifiCorp West | 45% | 13% |
| Puget Sound Energy | 46% | 15% |
| Portland General Electric* | 59% | 16% |



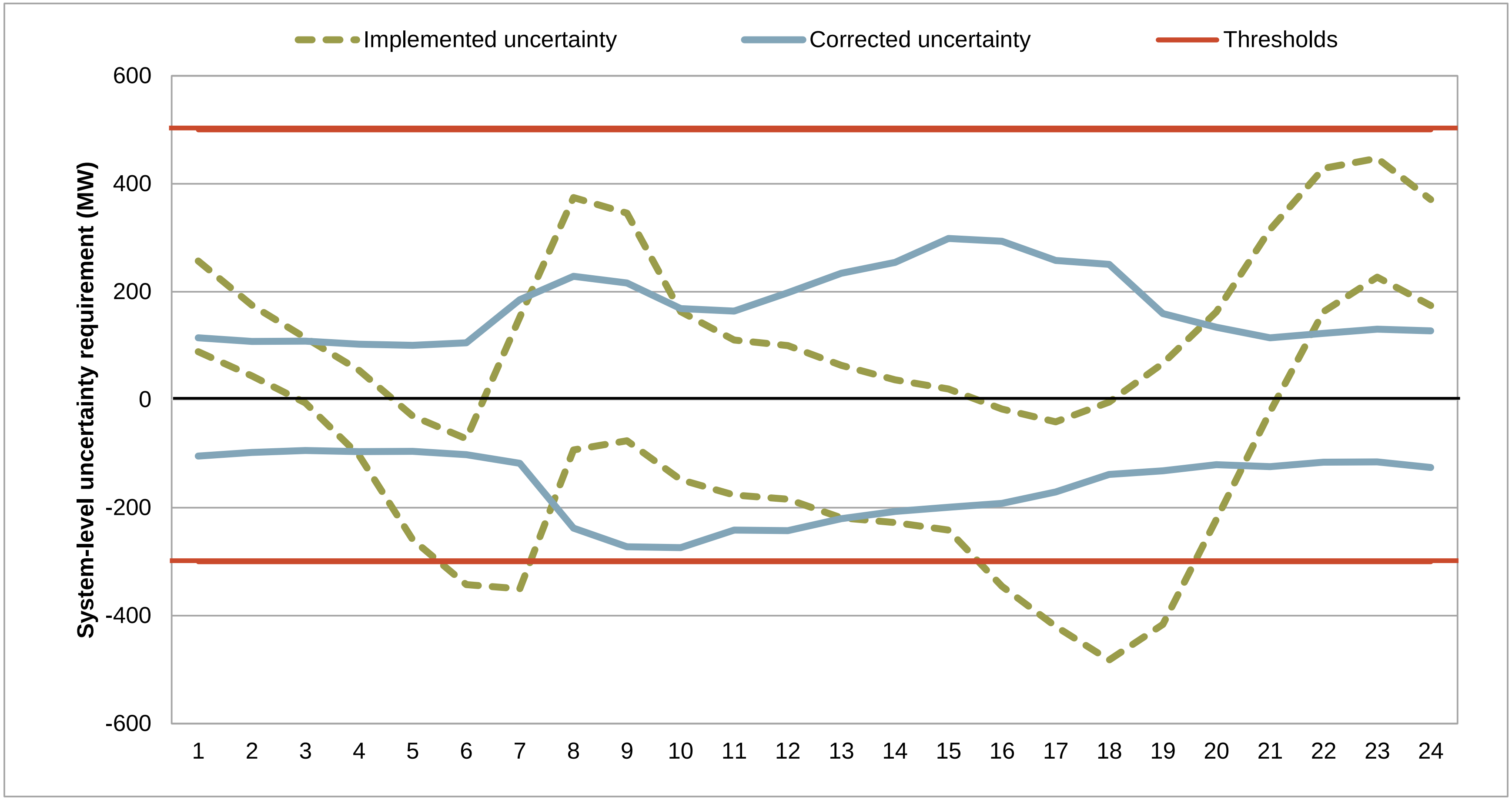
# Hourly 15-minute market prices (January – December)



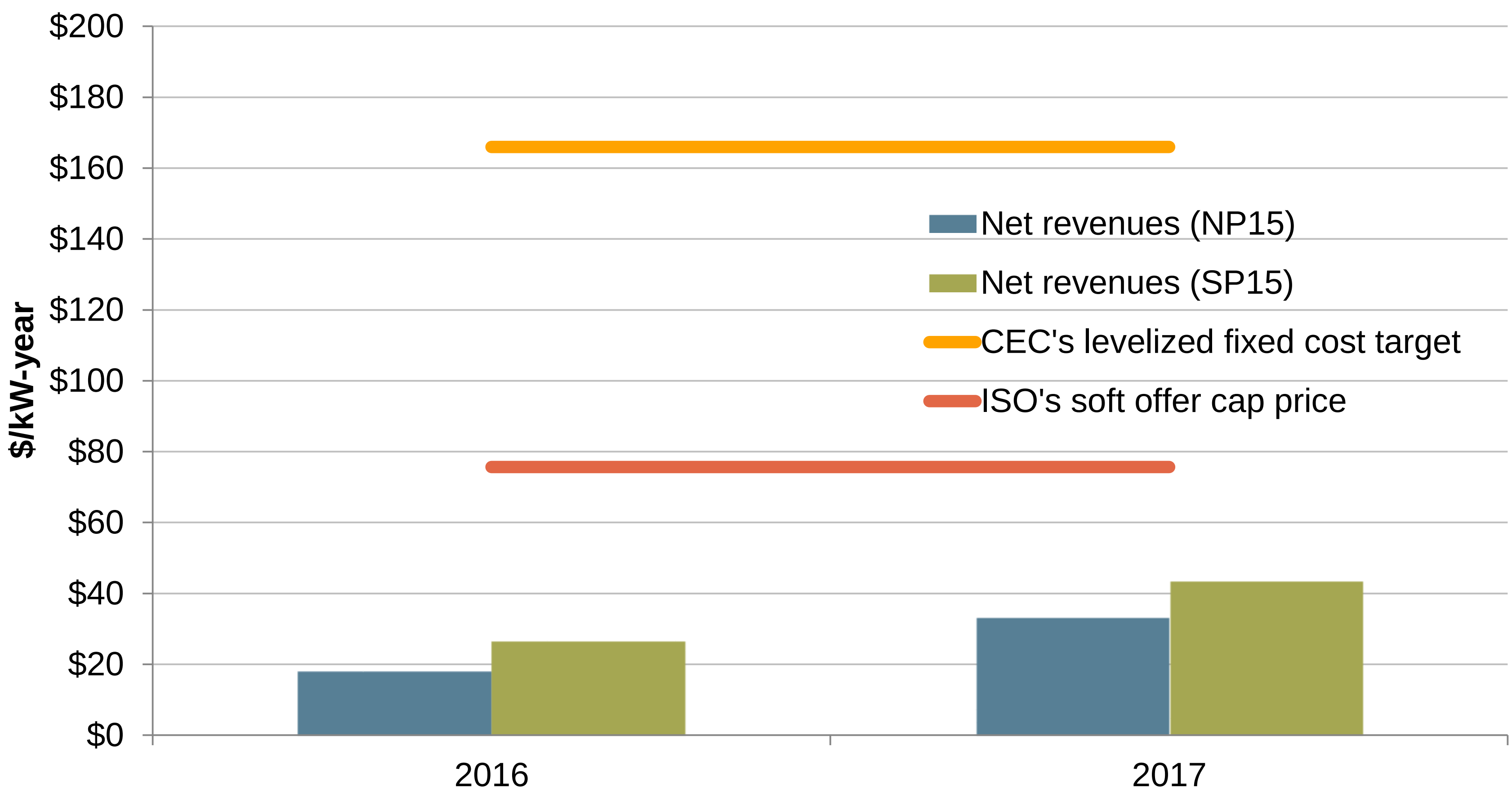
# Monthly flexible ramping payments by balancing area



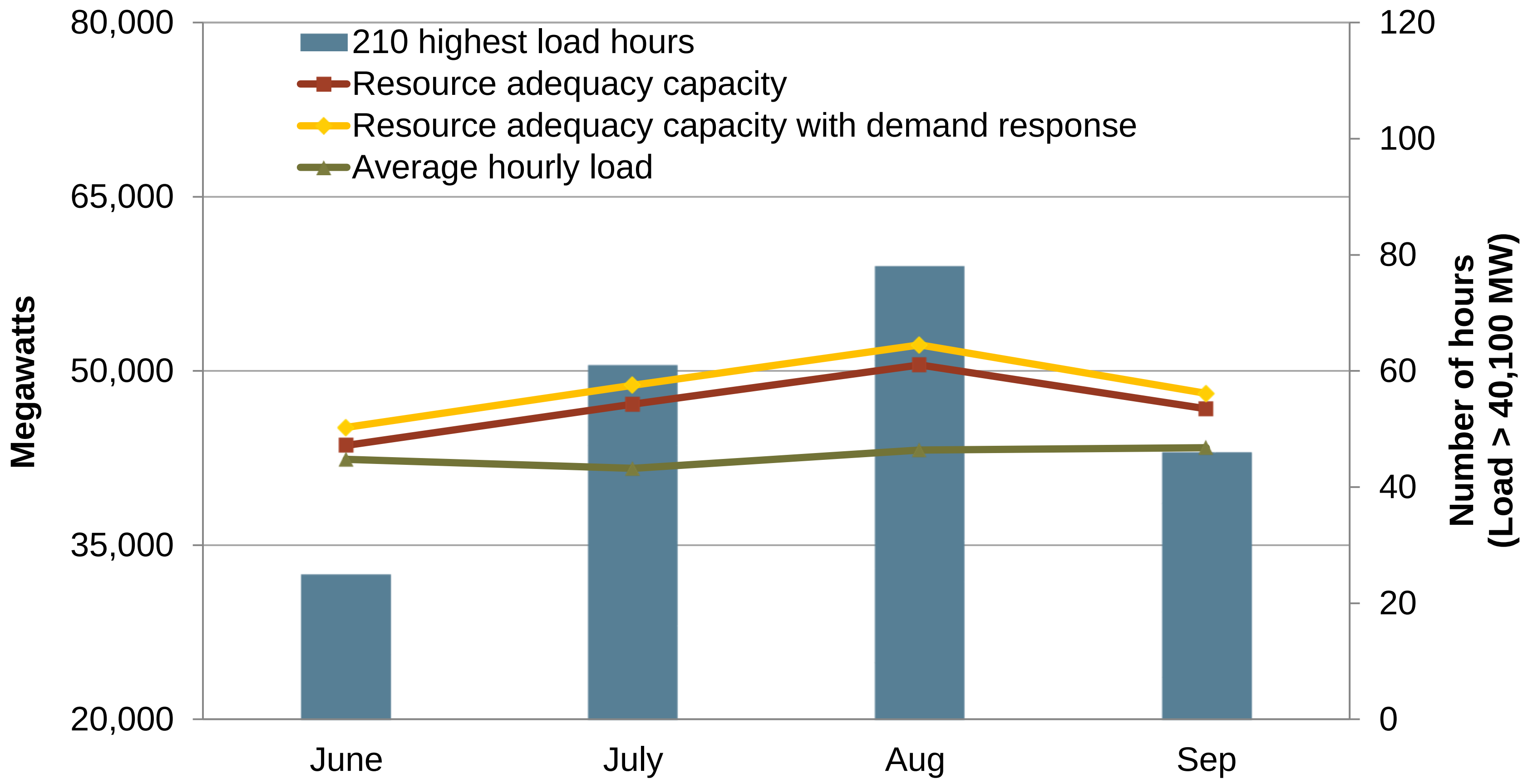
# Flexible ramping constraint requirements were miscalculated, resulting in lower procurement and lower prices in many intervals.



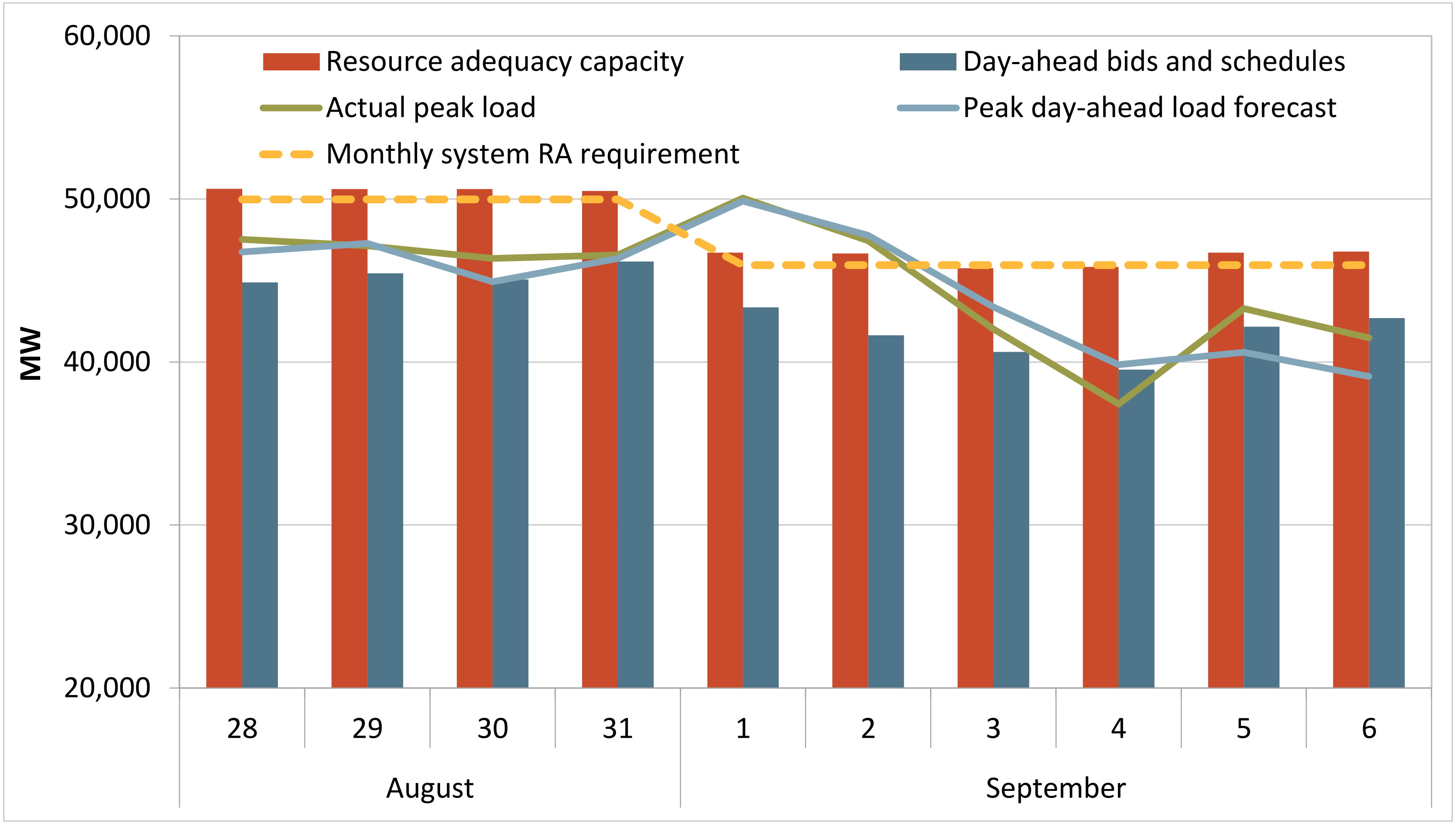
# Estimated net revenue of hypothetical combined cycle unit increased significantly.



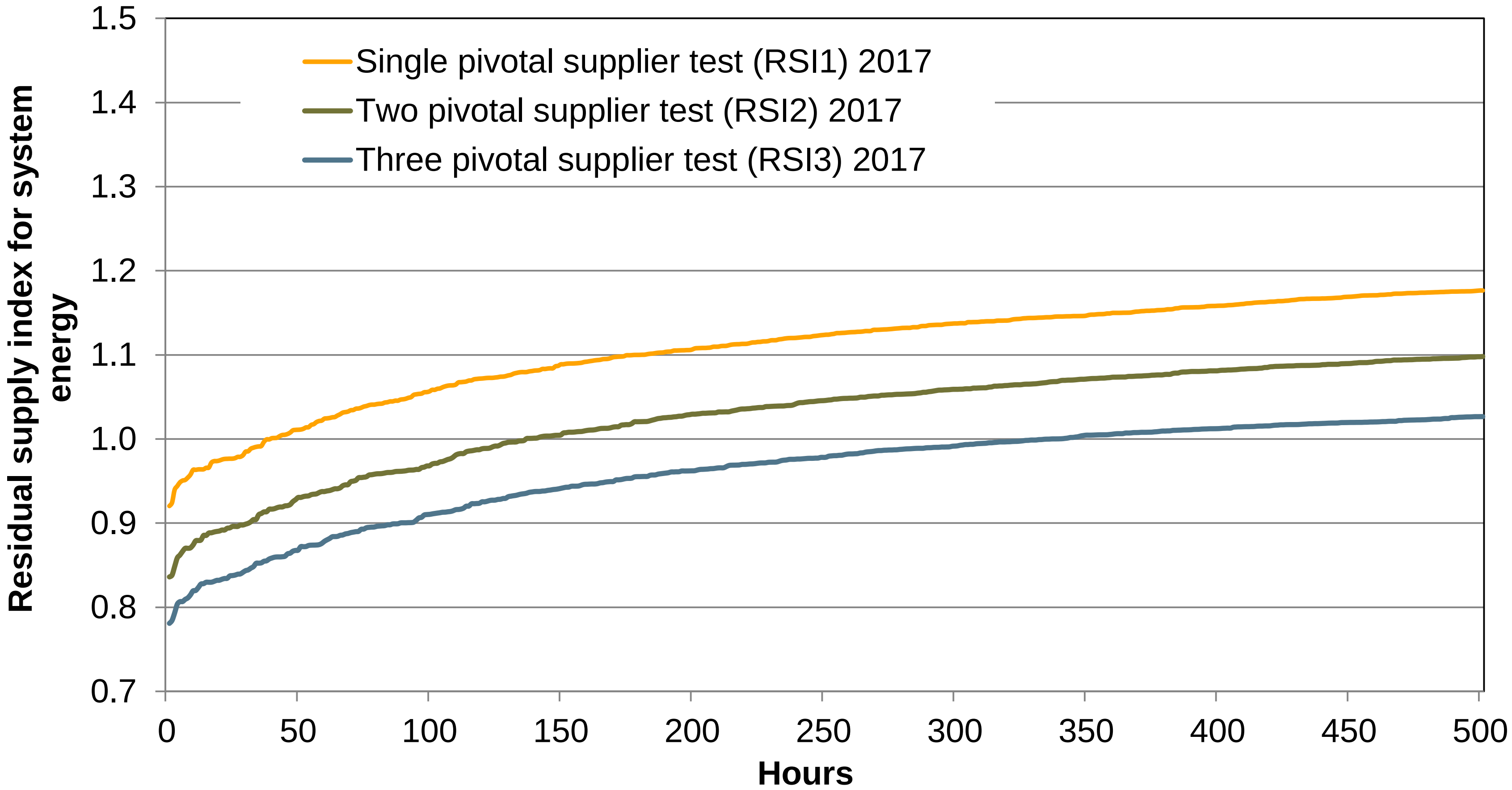
# Average hourly resource adequacy capacity and load (210 highest load hours)



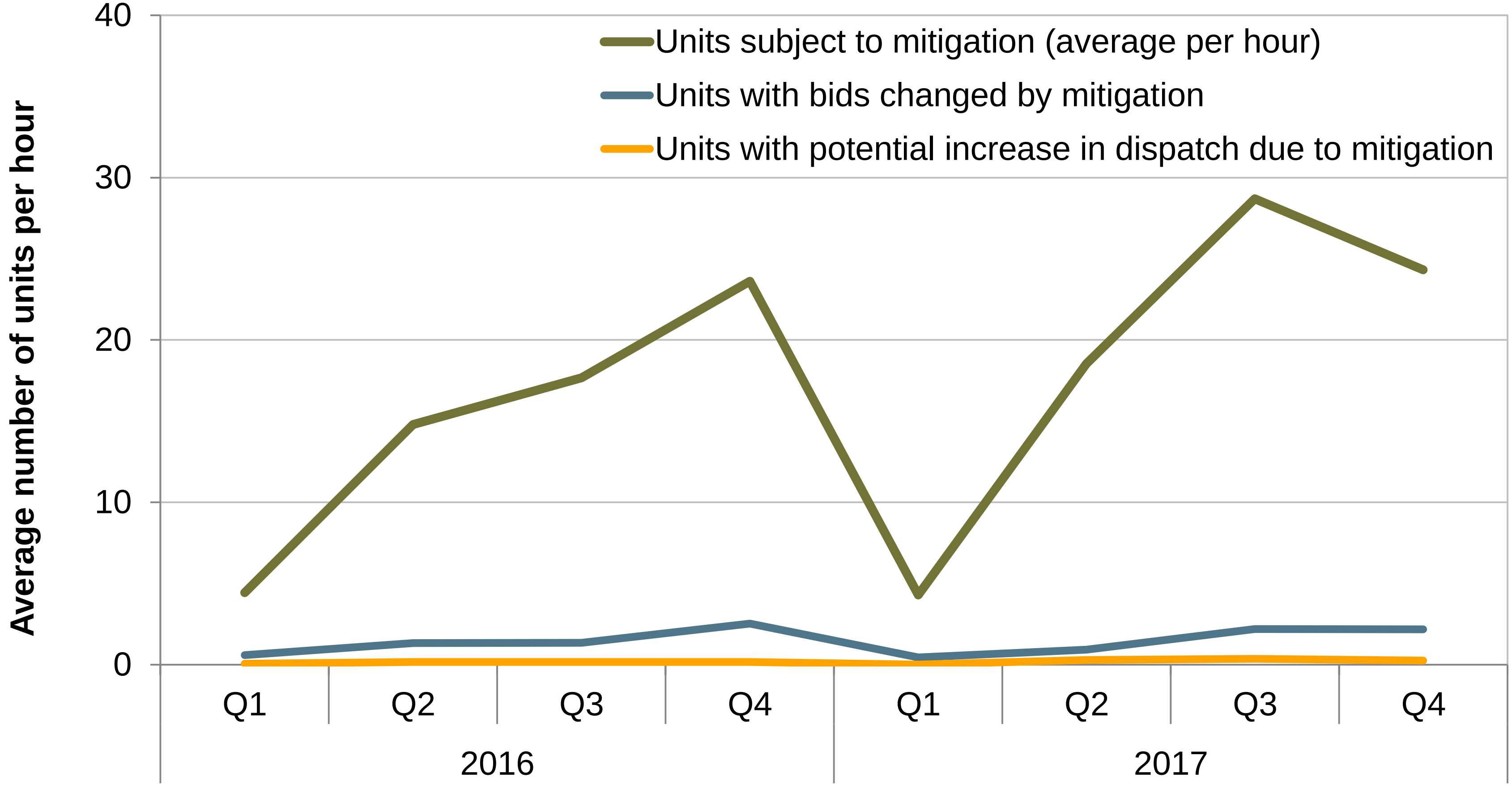
# Peak load and forecast exceed RA requirement on peak days



# System residual supply index calculation for day-ahead market (2017)



# Average number of units mitigated in day-ahead market



# Recommendations

# Congestion revenue rights (CRRs)

- Continue allocating CRRs to load-serving entities who pay for the transmission system through the transmission access charge (TAC)
- Stop auctioning off additional CRRs that are backed financially by transmission ratepayers through the congestion revenue balancing account
- Recommend that the ISO move swiftly to replace the current CRR auction with a voluntary market for financial contracts based on bids from willing buyers and sellers

# Commitment cost and default energy bid enhancements (CCDEBE)

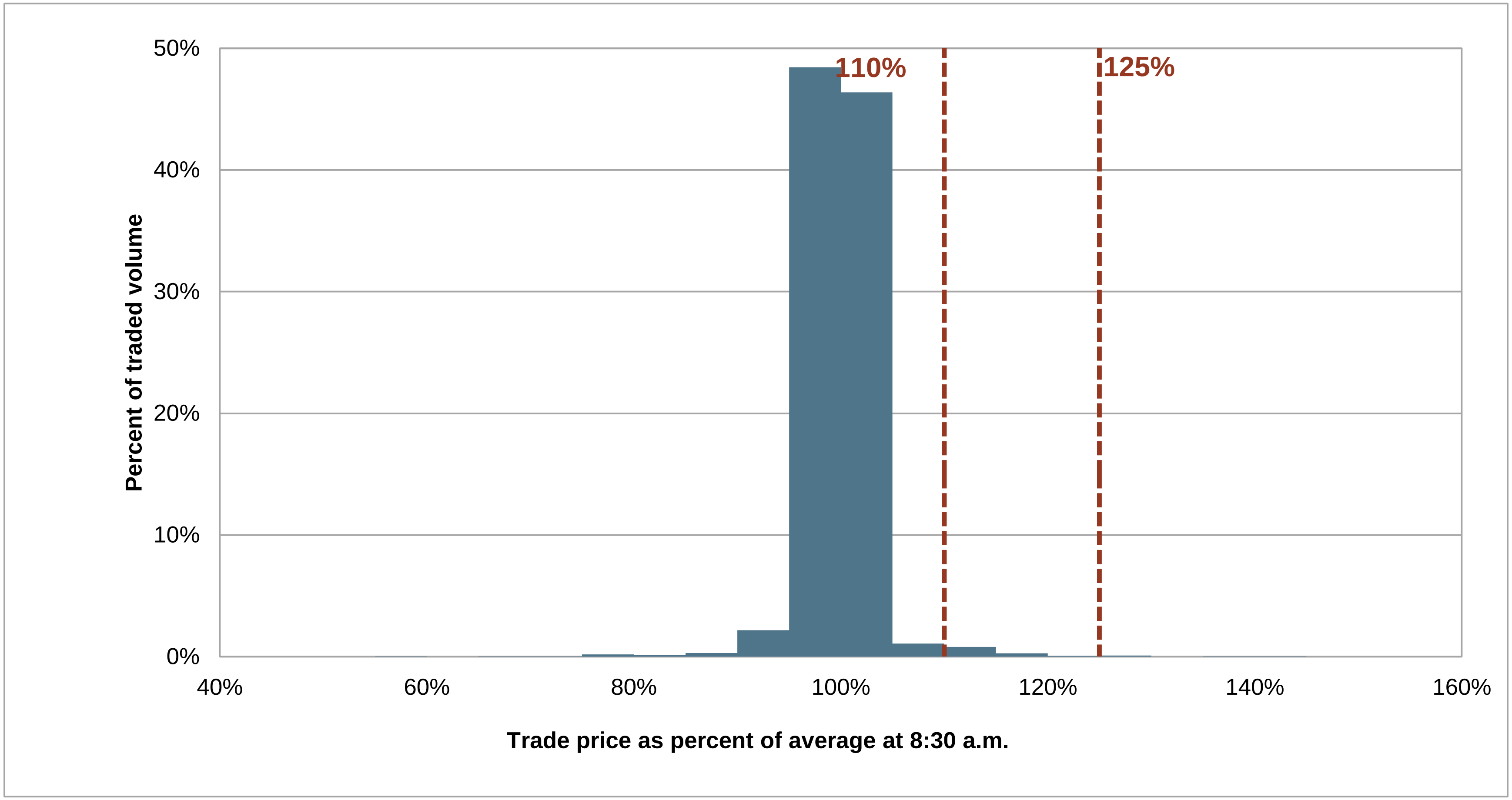
- DMM supports overall goal, but proposal has gaps:
  - Economic withholding
  - Inter-temporal constraints and gaming
  - Manual dispatch and intervention by grid operators
- Reasonableness thresholds
  - Recommend updating based on same day gas market conditions, rather than static approach based on next-day gas trading.

# Aliso Canyon gas measures

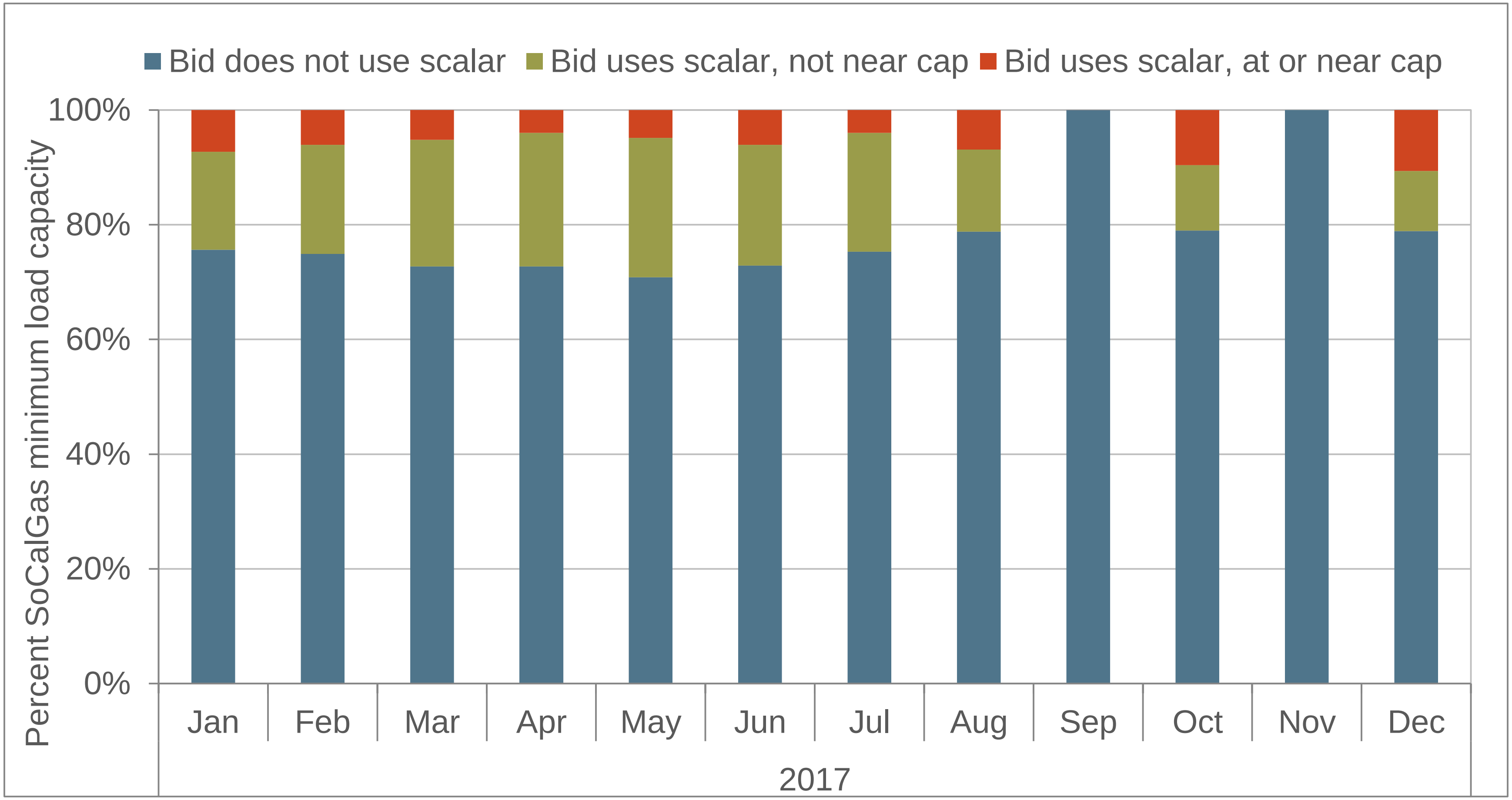
- More improvements needed in gas use nomograms
  - Day ahead?
  - Adjustment of use limits in real-time

- Gas cost scalars
  - Do not appear effective at reflecting actual gas prices and modifying merit order of units.
  - Should be replaced by ability to update gas prices during operating day based on actual gas market conditions.

# Next-day SoCal Citygate trade prices compared to updated next-day average price (Jan – Dec)



# Minimum load capacity bid level of gas resources in real-time market.



# System Market Power

*DMM has recommended that the ISO begin to consider various actions that might be taken to reduce the likelihood of conditions in which system market power may exist and to mitigate the impacts of system market power …*

2017

- Tight system conditions in real-time
- Day-ahead market showed signs of being less competitive
  - Not structurally competitive in some hours; record high prices

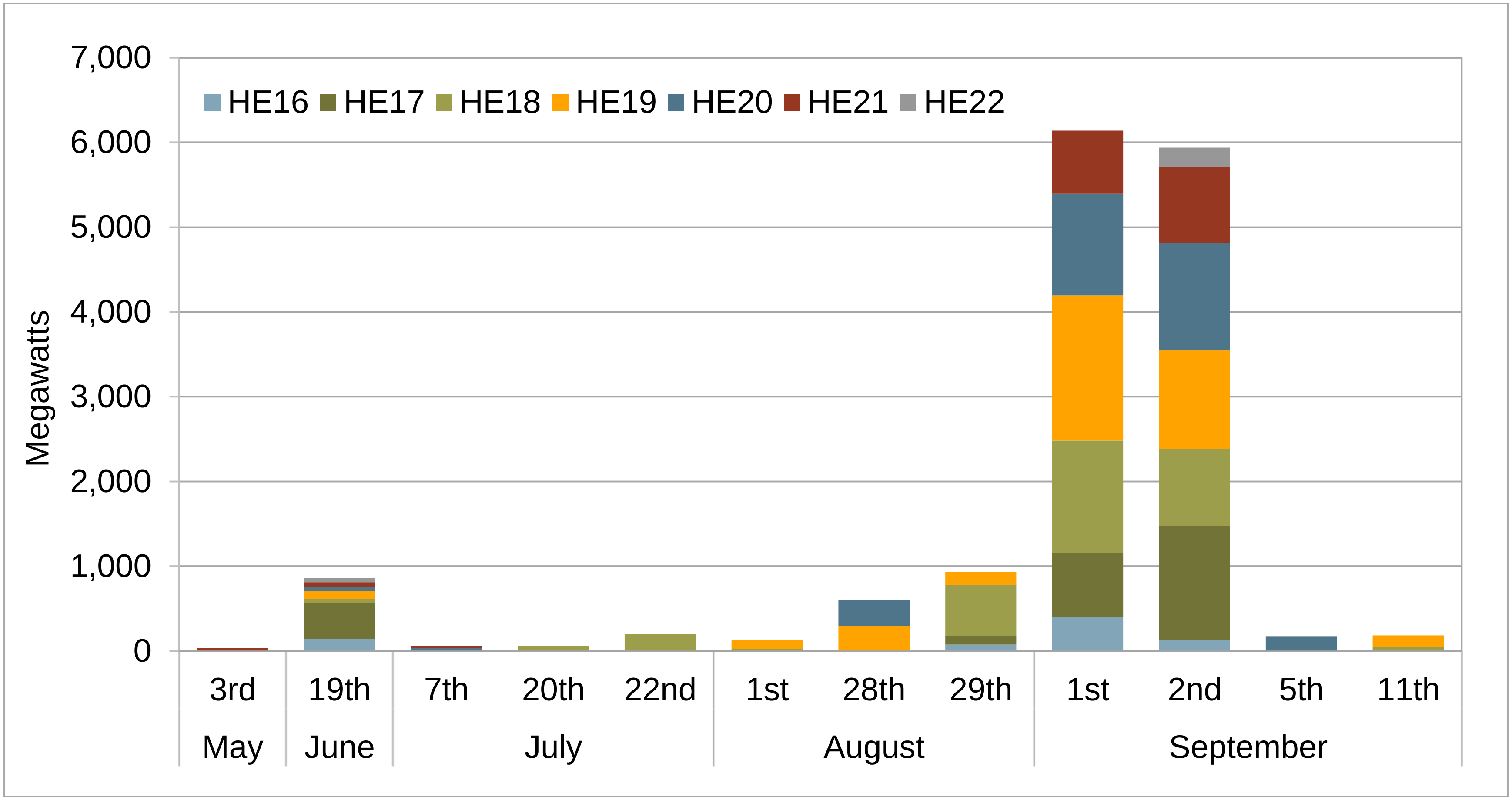
2018

- Conditions likely to allow for additional potential for system market power
  - lower hydro
  - less gas generation (~800 MW compared to summer 2017)
  - more generation controlled by net sellers (>3,750 MW)

2019

- Conditions exacerbated by FERC Order 831 compliance and ISO proposals to increase bid caps

# Manual dispatch of imports: limit use and improve logging



# Reliability must-run/capacity procurement mechanism

- Prohibition on RMR Condition 2 capacity being offered in the CAISO's energy market under most conditions must be removed
- RMR resources on Condition 1 and Condition 2 must be subject to the same must-offer requirement that units are subject to under the resource adequacy program and capacity procurement mechanism
- RMR compensation must be modified to be more consistent with CPM
- Support comprehensive effort to replace or combine backstop capacity procurement (CPM and RMR).
- Recommend resources with market power be compensated based on going forward fixed costs plus a reasonable contribution to sunk fixed costs.

# Resource adequacy

- Structural changes creating need for significant changes:
  - Intermittent resources, OTC retirements, CCAs
- Setting requirements sufficiently high to ensure both reliability and reduce likelihood of non-competitive outcomes
- Resource adequacy imports