Pacific Northwest
NATIONAL LABORATORY

Grid and Flexibility Services: An Overview of California ISO

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Sohom Datta (PNNL)

Abhishek Somani (PNNL)

Audun Botterud (ANL)

U.S. DEPARTMENT OF ENERGY BATTELLE

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Overview

- Overview of California ISO (CAISO) market products
- Market size for different grid services

Different Timescales of Power System Flexibility

Flexibility type	Short-term			Medium term	Long-term	
Time scale	**Sub-seconds to seconds**	**Seconds to minutes**	**Minutes to hours**	**Hours to days**	**Days to months**	**Months to years**
Issue	Ensure system stability	Short term frequency control	More fluctuations in the supply / demand balance	Determining operation schedule in hour- and day-ahead	Longer periods of VRE surplus or deficit	Seasonal and inter-annual availability of VRE
Relevance for system operation and planning	Dynamic stability: inertia response, voltage and frequency	Primary and secondary frequency response	Balancing real time market (power)	Day ahead and intraday balancing of supply and demand (energy)	Scheduling adequacy (energy over longer durations)	Hydro-thermal coordination, adequacy, (energy over very long durations)
Availability in California ISO (CAISO)						
Defined products or mechanisms	**Limited**	**Partly**	**Yes**		**Yes**	
Compensation	**Partly**	**Partly**	**Yes**		**Yes**	
Hydro contribution	**Yes**	**Yes**	**Yes**		**Yes**	

Time Scales: Sub-Seconds to Seconds

Flexibility type	Short-term
Time scale	**Sub-seconds to seconds**
Issue	Ensure system stability
Relevance for system operation and planning	Dynamic stability: inertia response, voltage support

Grid Services / Products	Mechanisms
Dynamic Stability: • No specific market for services like *inertia* • Reliance on existing resources generating energy or providing spinning reserves	• Long term contracts such as Reliability Must-Run (RMR) contracts* • Transmission tariff based on transmission upgrades**

Notes:
*reliability coordination services are used to identify reliability must-run resources to ensure system stability;
**Transmission and Operations planning based on NERC planning standards.
http://www.caiso.com/Documents/Final2018-2019StudyPlan.pdf

Time Scales: Seconds to Minutes

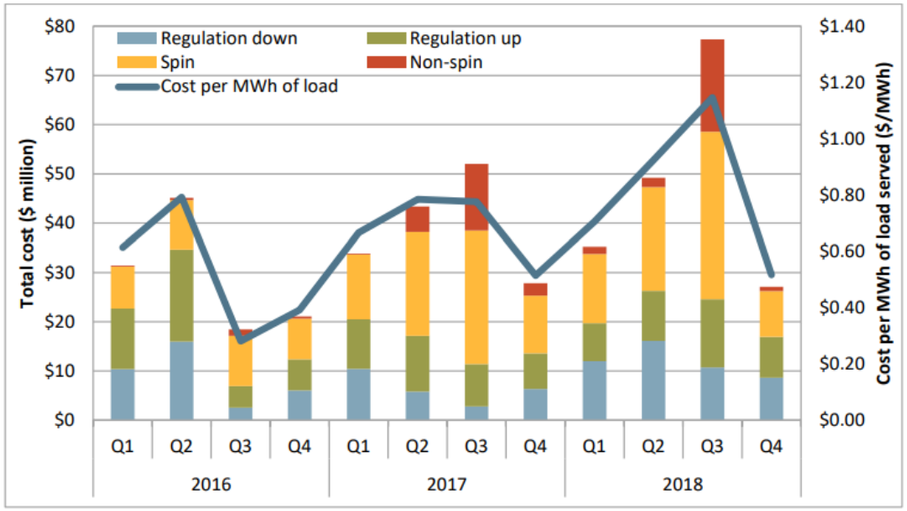
Short-term

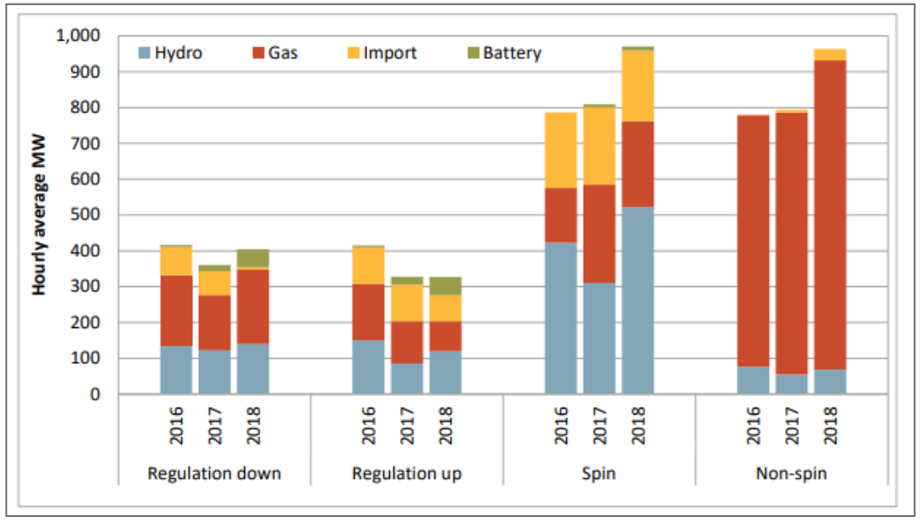
Seconds to minutes

Short term frequency control and energy balance

Primary and secondary frequency response

Figure 6.2 Total ancillary service cost by quarter and type





Grid Services/Products	Mechanisms

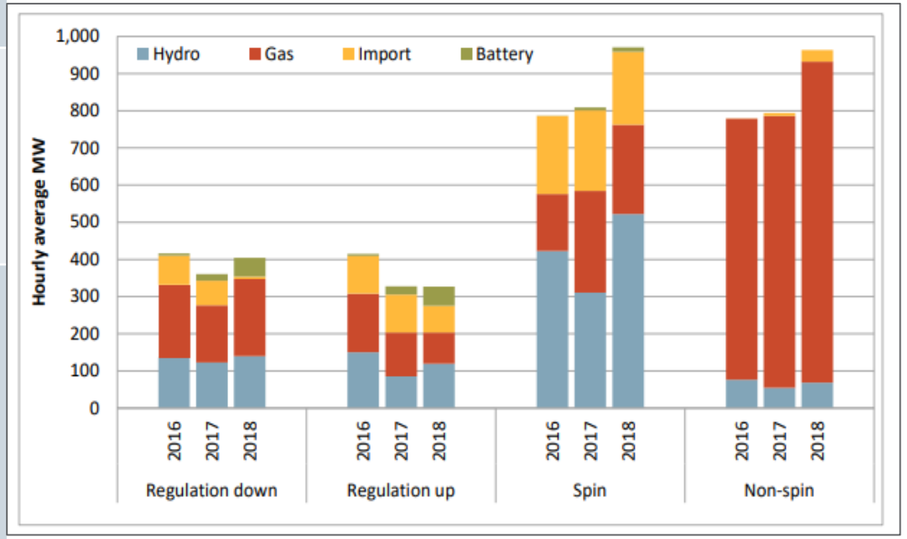
• Primary Frequency Response
  • No specific market product
  • Reliance on existing resources generating energy or providing spinning reserves
	In 2016, CAISO contracted with two entities for primary frequency response:
	
	• Seattle City Light: $1.22 M or $81/kW-year
	• Bonneville Power Administration: $2.22 M or $44.40 / kW-year

• Secondary Frequency Response/ Automatic Generation Control • Regulation Up and Down	• Day-ahead and real-time ancillary services market

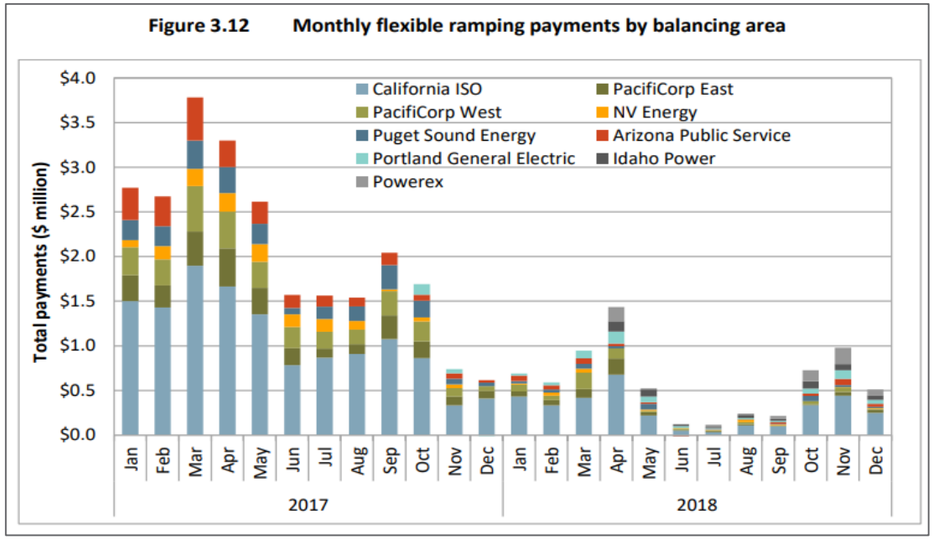
Source: CAISO

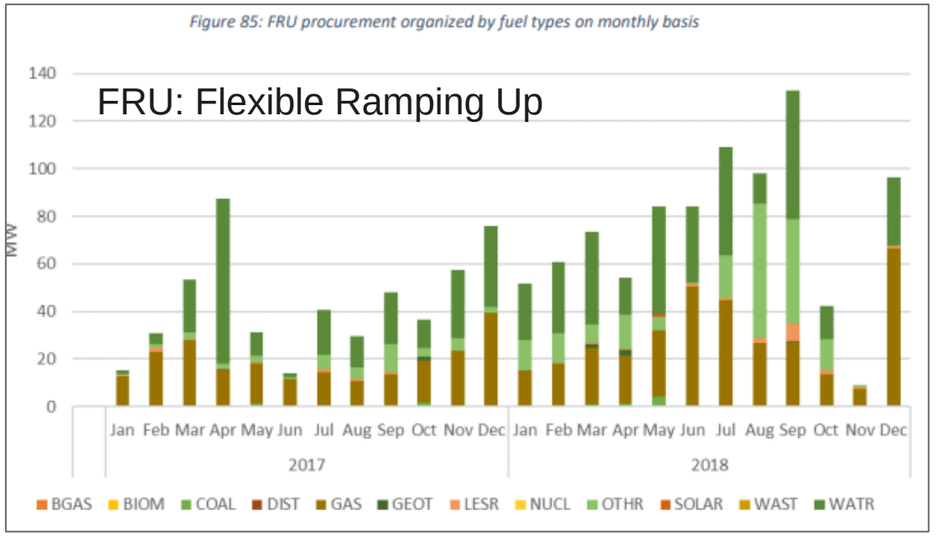
Time Scales: Minutes to Days

Short-term	Medium term
Minutes to hours	**Hours to days**
Fluctuations in the supply/ demand balance	Determining operation schedule in hour- and day-ahead
Balancing real time market (power)	Day ahead and intraday balancing of supply and demand (energy)



Grid Services / Products	Mechanisms
Minutes to hours: • Energy, Flexible Ramping Product, Ancillary Services	• Intra-day spot markets like Hour Ahead Scheduling Process (HASP), Fifteen Minute Market (FMM), Real-time Market (RTM), Energy Imbalance Market
Hours to days: • Energy, Ancillary Service (Contingency Reserves – Spin and Non-spin, Regulation Reserves)	• Day-Ahead Market • Reliability Unit Commitment



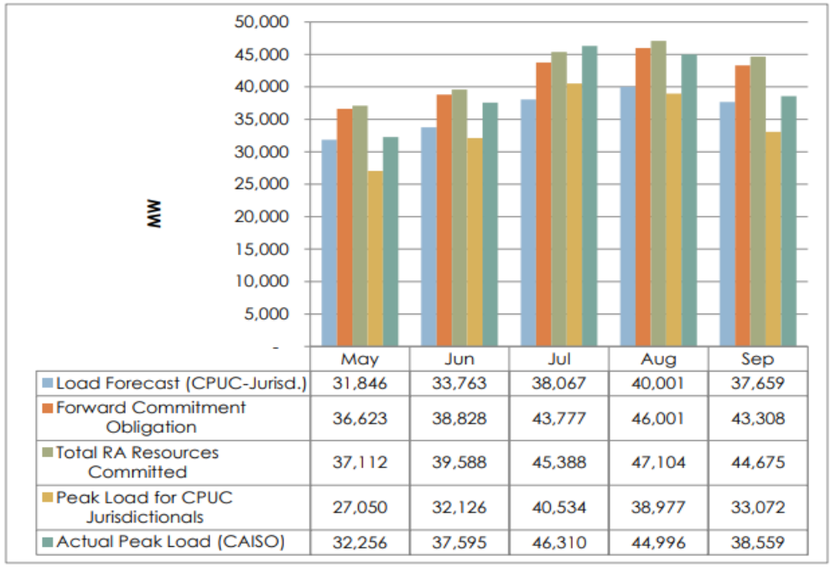


Source: CAISO

Time Scales: Days to Years

Long-term	
Days to months	**Months to years**
Planned outages; longer periods of VRE surplus or deficit	Seasonal and inter-annual availability of generation capacity
Resource adequacy (energy over long durations)	Resource adequacy (energy over very long durations)

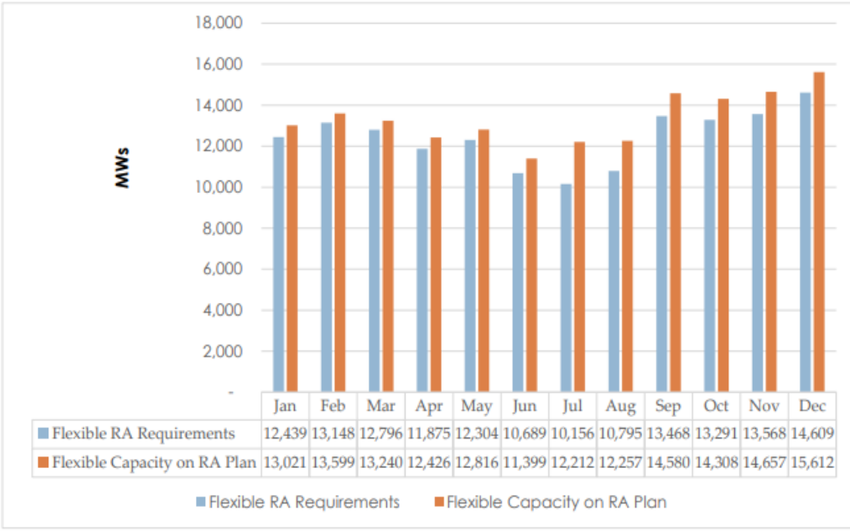
Figure 3. 2018 CPUC Load Forecast, RA Requirements, Total RA Committed Resources, and Actual Peak Load For Summer Months



	May	Jun	Jul	Aug	Sep
Load Forecast (CPUC-Jurisd.)	31,846	33,763	38,067	40,001	37,659
Forward Commitment Obligation	36,623	38,828	43,777	46,001	43,308
Total RA Resources Committed	37,112	39,588	45,388	47,104	44,675
Peak Load for CPUC Jurisdictionals	27,050	32,126	40,534	38,977	33,072
Actual Peak Load (CAISO)	32,256	37,595	46,310	44,996	38,559

Source: CPUC RA Filings, CEC load forecasts, and CAISO EMS data.

Figure 4. Flexible RA Procurement in 2018, CPUC-Jurisdictional LSEs

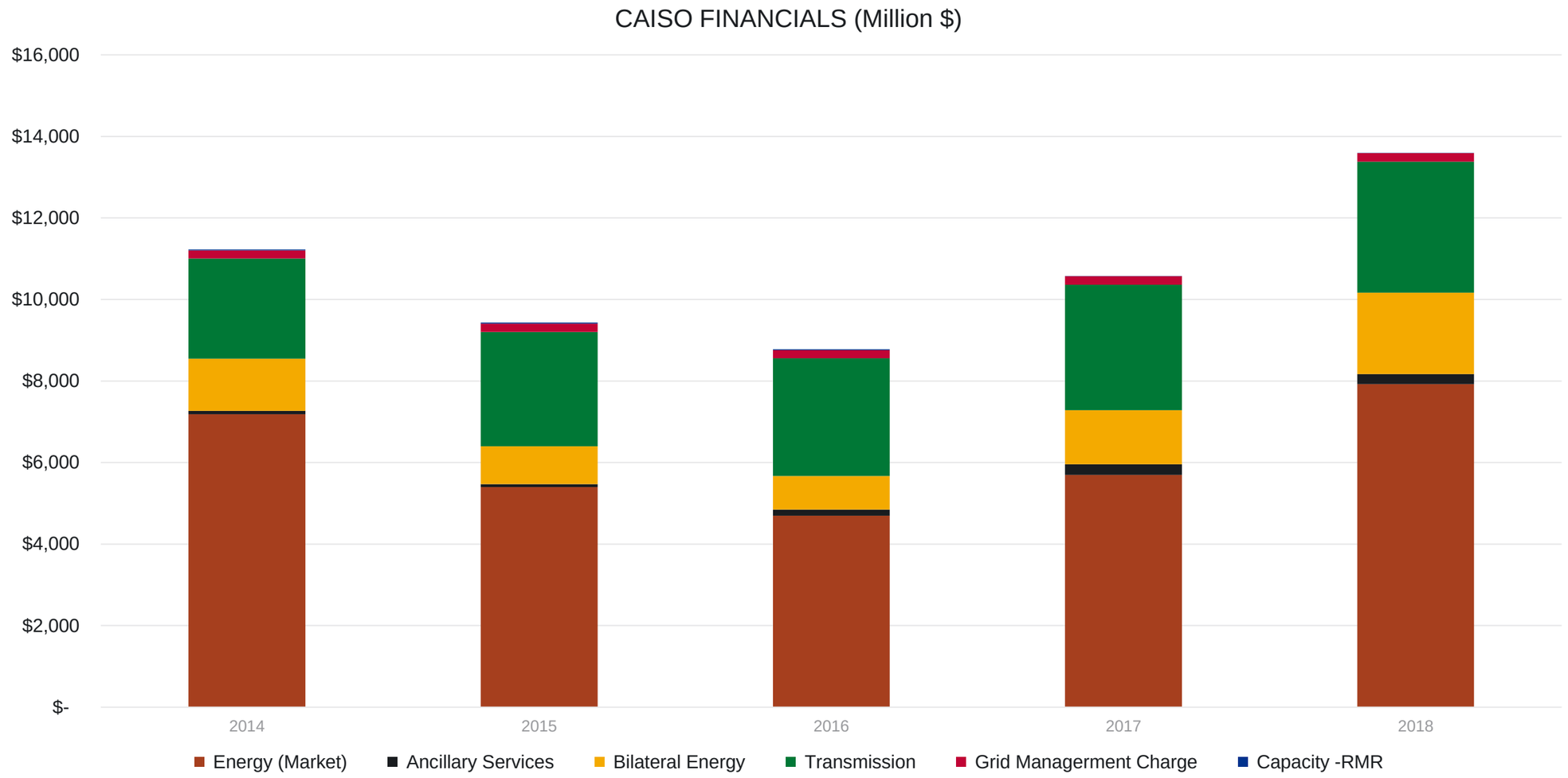


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flexible RA Requirements	12,439	13,148	12,796	11,875	12,304	10,689	10,156	10,795	13,468	13,291	13,568	14,609
Flexible Capacity on RA Plan	13,021	13,599	13,240	12,426	12,816	11,399	12,212	12,257	14,580	14,308	14,657	15,612

Source: 2018 RA filings.

Grid Services / Products	Mechanisms
• Long-term generation adequacy	• CPUC/CAISO: Resource Adequacy, Local Resource Adequacy, and Flexible Resource Adequacy • No capacity market • CAISO: Capacity Procurement Mechanism

Overview of Financial Transactions by CAISO



http://www.caiso.com/Documents/CAISO2018_5yearsummaryfinal.pdf

Note: Does not include mechanisms managed outside the ISO (e.g. resource adequacy)

Summary for California ISO

- A number of different products and mechanisms that provide system flexibility do exist across the time scales
- Products and mechanisms are less well defined for very short-term grid issues
- Some mechanisms contribute to flexibility across the time scales
  - E.g. day-ahead and real-time energy markets
- California has a unique centralized capacity planning mechanism that largely relies on bilateral contracts (no centralized capacity market)
- Flexible ramping product (up and down) added in November 2016
  - Provides additional ramping flexibility to account for uncertainty in demand and renewable energy