

California's Evolving Energy Market

Harvard Electricity Policy Group – Seventy-First Plenary Session Calgary, Canada Where do we go from here?

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California Market - Today



CAISO Market – FERC Jurisdictional

- Day-Ahead and Real-time Spot Market
- Energy & Ancillary Services



Significant Generation Investment over Past Decade





CAISO Market Revenues – Missing Money or Right Signal?

\$200 \$180 \$160 \$140 Net revenues (NP15) k§120 /k%/\$100 Net revenues (SP15) Levelized fixed cost target \$80 \$60 \$40 \$20 \$O 2009 2010 2011 2012

Estimated CAISO Market Revenues for Hypothetical Combined Cycle Unit

Source: 2012 Annual Report on Market Issues and Performance CAISO Department of Market Monitoring



California Energy and Environmental Policy Drivers

- Greenhouse gas reductions to 1990 levels by 2020
- > 33% of load served by renewable generation by 2020
- ➤ 12,000 MW of distributed generation by 2020
- > Ban on use of once-through cooling in coastal power plants
- Limits on availability of air emission credits for replacement generation



Roughly 11,000 MW of Gas-Fired Generation Subject to Meeting Compliance under OTC Regulations

Generating Units Compliance with California Statewide Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling				
Plant (Unit)	Owner	Final Compliance Date	Capacity (MW)	PTO Area
Compliance Plan Yet to be imp	lemented (Na	atural Gas Fired)		
🗄 Segundo Units 4	NRG	12/31/2015	335	SCE
Morro Bay Units 3 and 4	Dynegy	12/31/2015	650	PG&E
Encina Power Station Units 1-5	NRG	12/31/2017	946	SDG&E
Pittsburg Units 5 and 6	NRG	12/31/2017	629	PG&E
Moss Landing Units 1 and 2	Dynegy	12/31/2017	1,020	PG&E
Moss Landing Units 6 and 7	Dynegy	12/31/2017	1,500	PG&E
Huntington Beach Units 1-2	AES	12/31/2020	452	SCE
Redondo Beach Units 5-8	AES	12/31/2020	1,343	SCE
Alamitos Units 1-6	AES	12/31/2020	2,011	SCE
Mandalay Units 1 and 2	NRG	12/31/2020	430	SCE
Ormond Beach Units 1 and 2	NRG	12/31/2020	1,516	SCE
		Total NW	10,832	
In Compliance	DCOE	Cast 2040	400	DCAE
Detrom Link 2	ConOn	36pt. 2010	200	DOME
Policio uni 3 Conth Davi	Deserv	2/20/2011	200	COCOE
		42070842	102	SUGGE
Huntington Eleach Units 3-4*	AES	12///2012 Total MM	452	SLE
			1,465	
Expected to be in Compliance	by end of 20	13		
El Segundo Units 3	NRG	12/31/2015	335	SCE
Contra Costa Units 6 and 7	NRG	12/31/2017	674	PG&E
		Total MW	1,009	
Compliance pending study by	Water Board	Review Committee 1	for Nuclear Plan	İs
San Onofre	SCE	12/31/2022	2,246	SCE
Diablo Canyon	PG&E	12/31/2024	2,240	PG&E
		Total MW	4,486	
	Total of all OTC Units		17,792	

¹ Hundington Beach generating units 3-4 are refired and are being converted to synchronous condensers. A portion (i.e., about 25%) of the plant cooling system is required only when synchronous condensers are operating. When synchronous condensers are not operating, no ocean water cooling is required.





System flexibility will be significantly reduced as OTC resources retire.





Resource Mix Changing Dramatically



Flexibility Requirements

Changes in the fleet capacity results in potential need of 4,600 MW of flexible capacity by 2020 which represents about 38% of the OTC retired capacity.



Interaction of Wind & Solar on Net-Load Profile (1)



Interaction of Wind & Solar on Net-Load Profile (2)



Sample winter day in 2020

Growing need for flexibility starting in 2015







Our Challenge

- System needs (ramping, load following, etc) changing dramatically over this decade.
- Resource mix changing dramatically
 - Increasing levels of wind & solar
 - Decreasing levels of flexible/dispatchable resources due to:
 - OTC Retirements
 - Potential retirements due to current market conditions

Challenges -

How to ensure we identify and secure the resource capabilities needed in future years.

How to ensure we optimally utilize and price resource capabilities in the ISO markets.





Should the CAISO pursue a Multi-year Ahead Capabilities Market?





Should we instead focus on evolving the state regulatory procurement framework?





CAISO market design is evolving to meet changing needs of the system.

- LMP Market Design (April 2009)
 - Security constrained unit commitment and economic dispatch
 - Day-ahead and Real-time
 - Co-optimize energy and ancillary services (Regulation, Spin, Non-Spin)
- Key Enhancements (2011 2013)
 - Flexible Ramping Constraint
 - Regulation Energy Management
 - Multi-Stage Generation Modeling
- Proposed Enhancements (2014)
 - FERC Order 764 (15-minute inter-tie scheduling, 15-minute market)
 - Flexible Ramping Product
 - Energy Imbalance Market CAISO/PacifiCorp Agreement



Flexible Ramping Constraint

- Implemented December 2011
- Secure additional upward ramping capability based on projected variability in real-time imbalance forecast.
- Compensation based on an administrative price capped between \$0 and \$800/MWh.
- Flexible ramping payments totaled \$20M in 2012, compared to \$35M for spinning reserve.

Flexible Ramping Product under consideration

- Bid-based capacity product similar to ancillary services
- Upward and downward flexibility requirements



Improvements to Regulation Market

- Regulation Energy Management
 - Implemented Spring 2012
 - Allows resources that can produce energy for only short durations (less than 60-min) to provide hourly regulation service.
- Pay for Performance Regulation (FERC Order 755)
 - Implemented June 1, 2013
 - Two-Part Payment for regulation service
 - Capacity Payment
 - Payment for response to regulation signal (mileage & accuracy)
 - Mileage Resource movement between 4 sec intervals
 - Accuracy Regulation signal to actual telemetry



FERC Order 764

- FERC Order 764 requires:
 - Transmission providers to offer an option to schedule energy in 15-minute increments, and
 - Variable energy resources to provide meteorological and forced outage data
- Compliance created opportunity to revamp ISO real-time market design.
 - Proposing a full three settlement market
 - Day-Ahead, 15-Minute Market, 5-minute market
 - Real-time <u>fixed</u> hourly-intertie transactions settled as price takers
 - Convergence bids settled between Day-Ahead and 15-minute market.
 - Improved forecasting and market settlements for VERs.
- Implementation planned for Spring 2014



CAISO Energy Imbalance Market (EIM)

- CAISO developing EIM to optimize realtime balancing across multiple balancing areas.
- PacifiCorp and ISO have entered into an EIM implementation agreement.
- Implementation planned for Fall 2014.
- Stakeholder process on design is underway. Some key issues:
 - Day-ahead scheduling and system modeling.
 - Allocation of uplift costs.
 - GHG emissions and CA Cap & Trade





California's Evolving Energy Market

CAISO Spot Market Design

- Increasingly sophisticated
- Defining & pricing needed resource capabilities

ISO Capabilities

Hybrid?

Market?

- Removing barriers to broader participation
 - Regionally & Clean/smart technologies

Multi-Year Procurement Framework

Optimally utilize and price resource capabilities in the ISO markets

Identify and secure the resource capabilities needed in future years.

from here?

Where do we go

Regulated

procurement?

- State regulated
- Procurement requirements evolving
 - Local, System, Flexibility
- Promoting clean technologies

California ISO Shaping a Renewed Future