Demand Response Providing Ancillary Services:

A Comparison of Opportunities and Challenges in US Wholesale Markets

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February 14th, 2012

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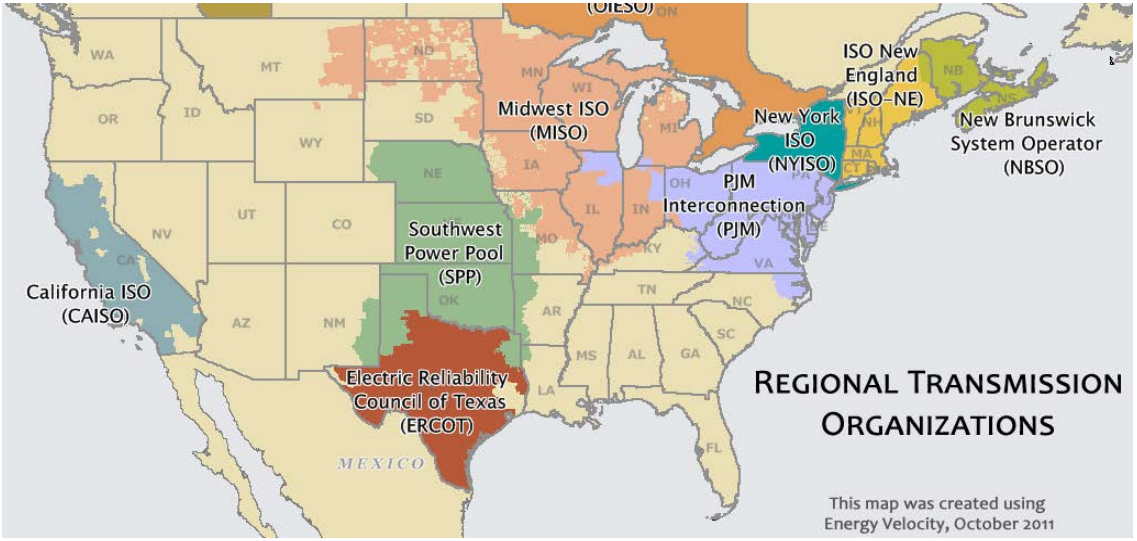
Ancillary Services in US ISO/RTOs

- ISO/RTOs are balancing authorities that run open wholesale markets for both energy and Ancillary Services (AS)
- AS maintain reliable functioning of the bulk power system
- AS in ISO/RTO markets include:
  - Frequency Regulation
  - Spinning Reserve
  - Non-Spinning Reserve
  - Supplemental Reserve
- AS traded in markets are capacity reserve products



Source: FERC.gov

- Expressed in units of MW-h, one MW held in reserve for one hour

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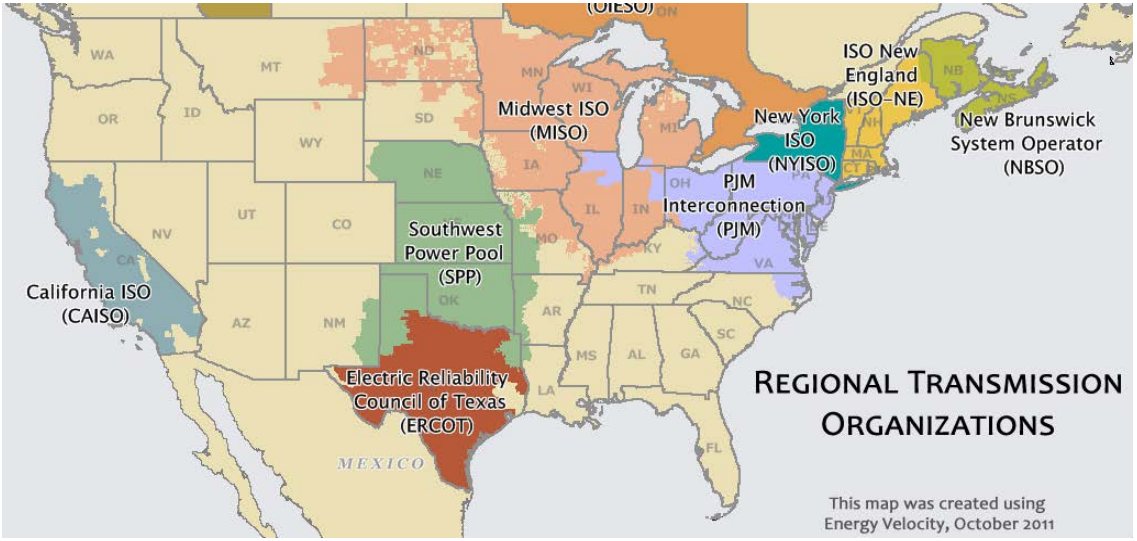

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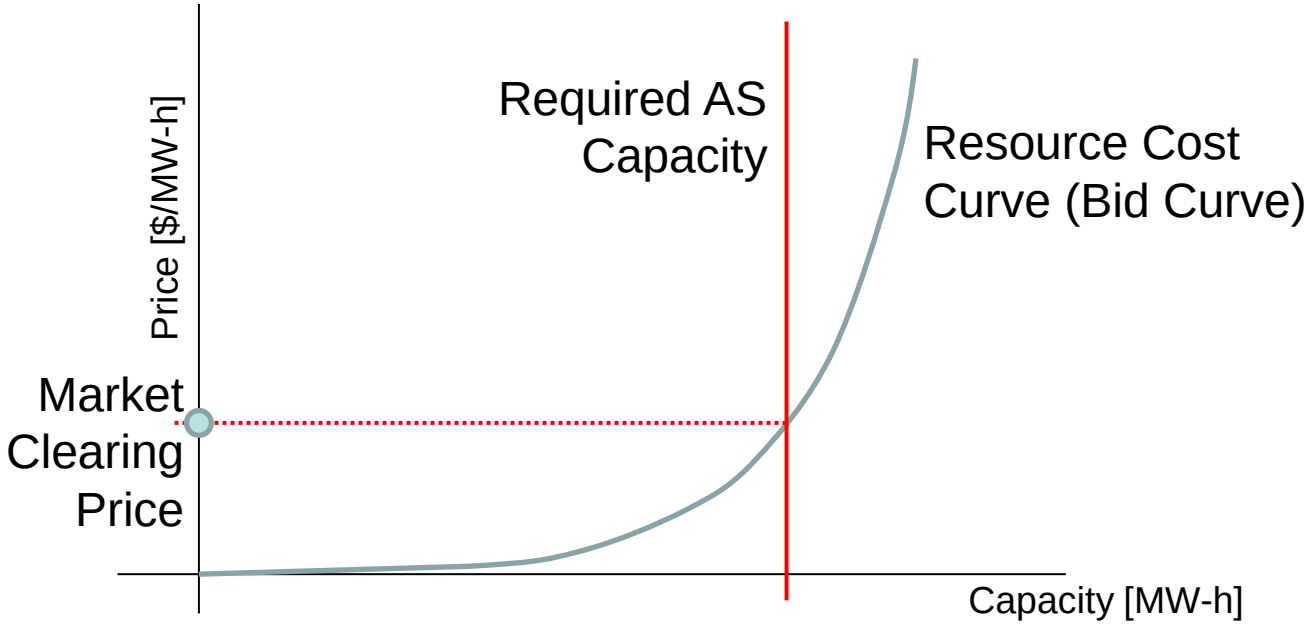
Why DR for AS?

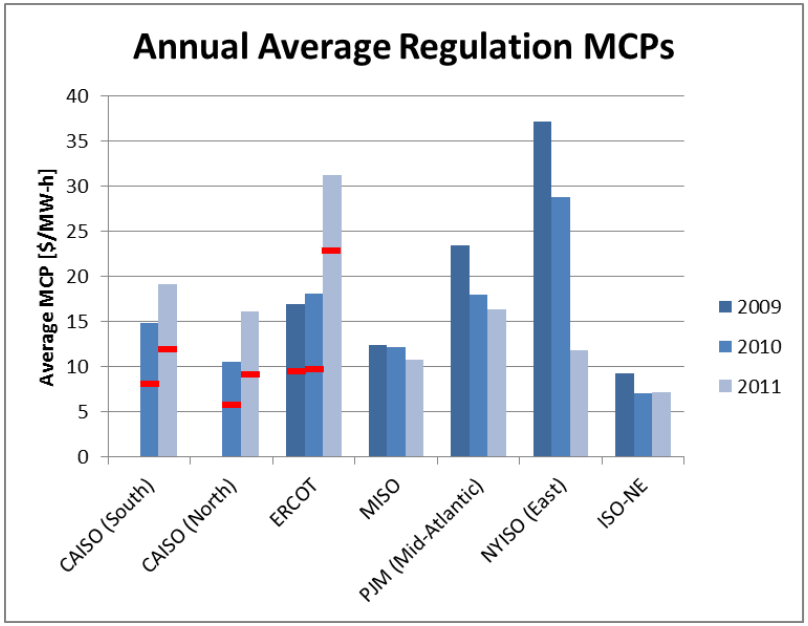
- Qualities of DR resources may provide some benefits to the system:
  - Very fast (extremely high ramp rates)
  - Cheap to operate (likely price takers)
  - Statistical reliability (property of large aggregations of small resources)
  - Fast to market (very few siting/permitting issues)
  - Controllable, distributed resource near load served

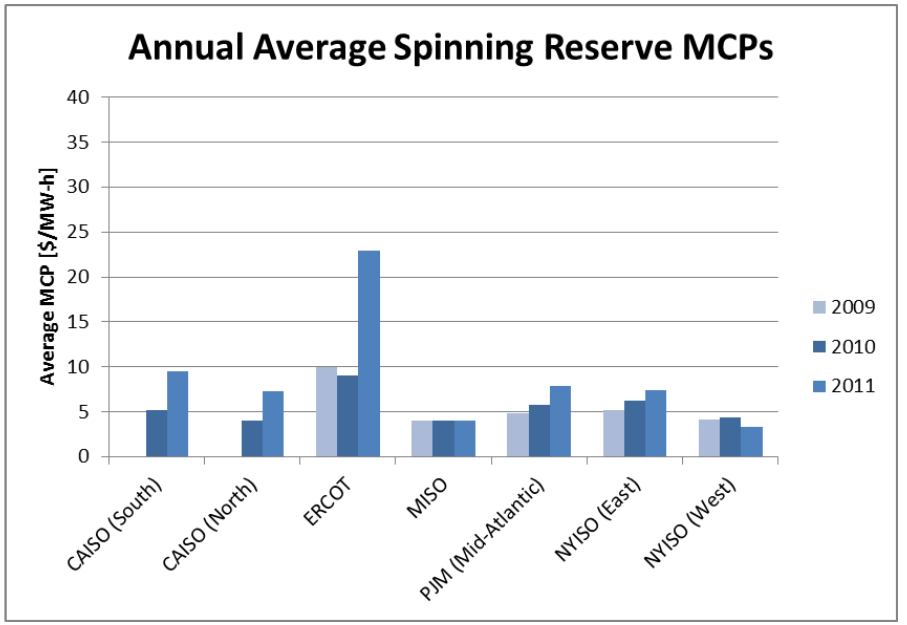
What is the Market Clearing Price?



- Resource Cost = sum of its lost opportunity cost and availability bid
- The Market Clearing Price (MCP) is paid to every resource that is economic

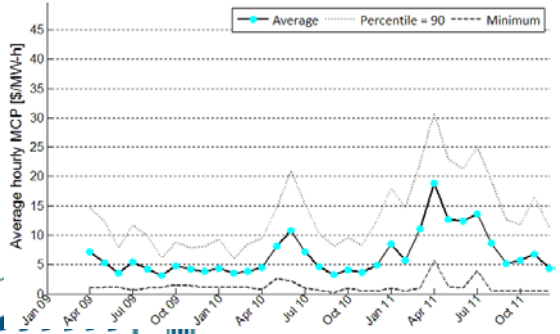
Average Annual MCPs





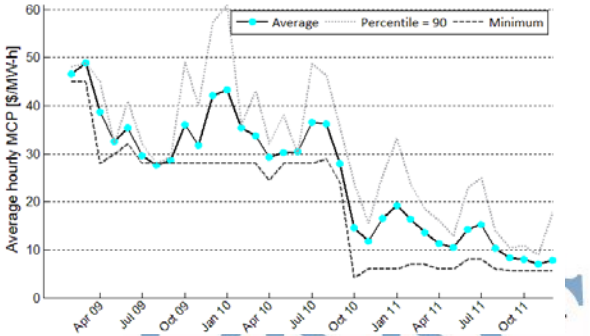
* Below the red line is Regulation Up and above is Regulation Down

Spinning Reserve – CAISO (South)

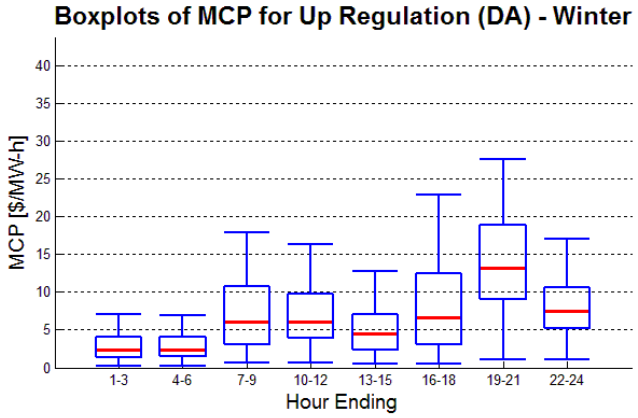


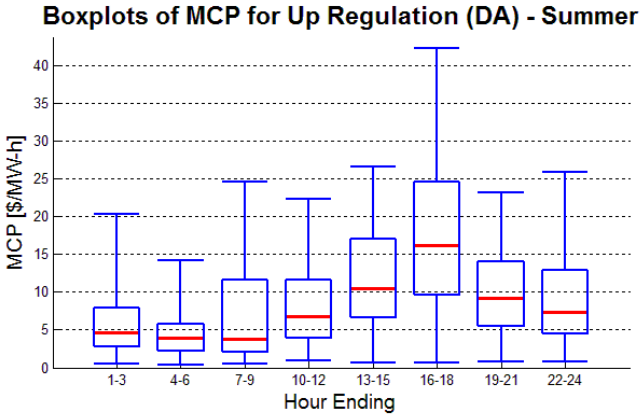
Examining monthly average MCP's illustrates that sometimes seasonal trends may dominate annual trends

Regulation - NYISO



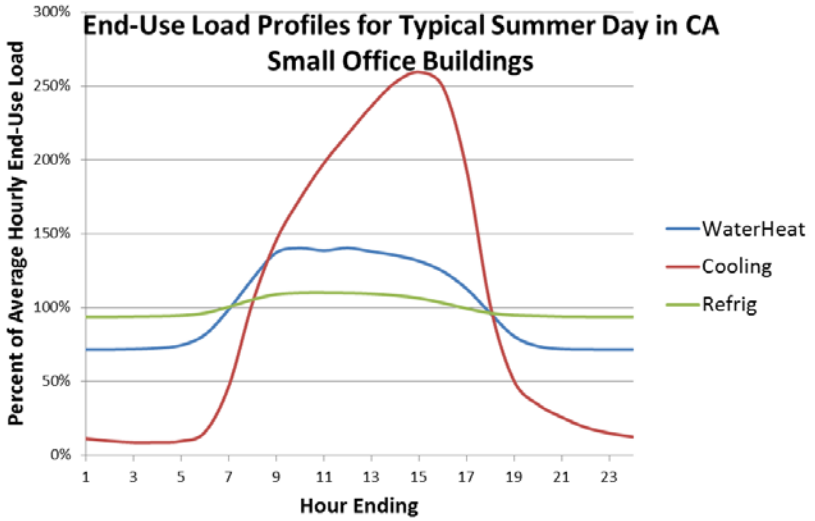
Daily Trends in MCP





Southern California Data (Winter and Summer Prices)

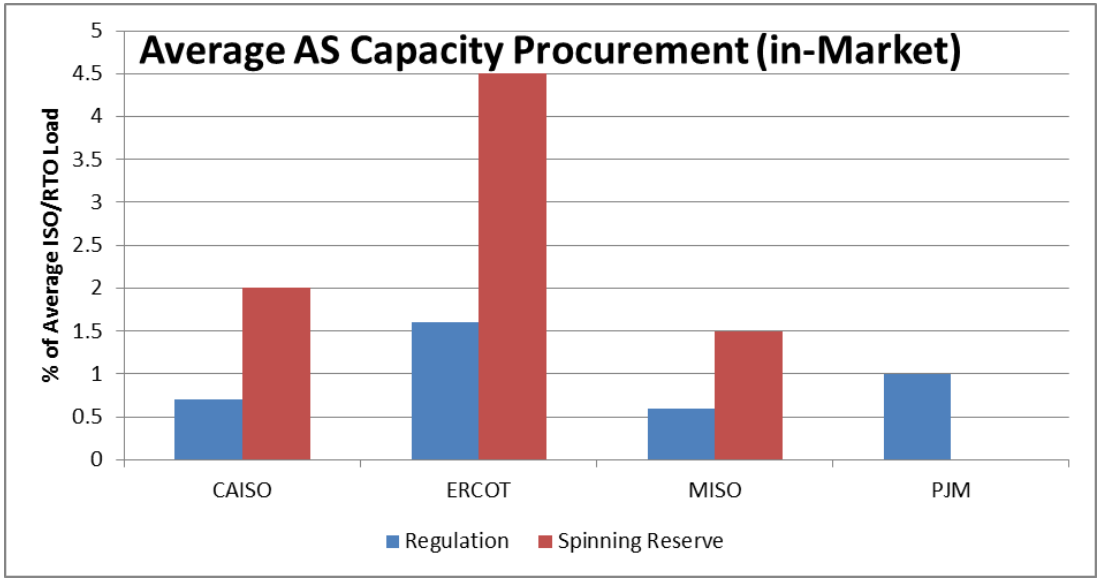
- Daily Trends in MCP show more seasonal effects.
- Additionally, daily trends indicate additional opportunity for loads that can provide AS during hours of higher price.



Source: California Commercial End Use Survey (CEC)

Market Size

- Two procurement mechanisms:
  - In markets
  - self-scheduled
- Absolute market procurement is in the hundreds of MW.



Annual Market Size

[M$/yr]		CAISO-S	CAISO-N	ERCOT	MISO	PJM
Regulation	2009	-	-	105	-	160
	2010	12	12	118	43	126
	2011	18	12	152	38	123
Spinning Reserve	2009	-	-	119	-	24
	2010	11	14	122	33	32
	2011	19	18	462	23	51

- Market Size = ∑Procurement(t)*MCP(t)
- PJM spinning reserve market size based on Mid-Atlantic Reserve Zone

Market Rules: Resource Size

- DR resources are smaller than traditional grid resources
- DR resources are not symmetric in their ability to shed and take load
- Some DR Resources are limited in the length of response at full power

Regulation Rules

	Min. Size (MW)	Aggregation Allowed	Symmetric Bid Req'd	Continuous Energy Period
CAISO**	0.5	No	No	60 min
ERCOT	0.1	No***	No	NA
MISO	1	No	Yes	60 min
PJM	0.1	Yes*	Yes	NA
NYISO	1	No	Yes	NA
ISO-NE	NA***	NA***	NA	NA

Spinning Reserve Rules

	Min. Size (MW)	Aggregation Allowed	Continuous Energy Period
CAISO**	0.5	No	30 min
ERCOT	0.1	No***	NA
MISO	1	Yes	60 min
PJM	0.1	Yes*	NA
NYISO	1	No	60 min
ISO-NE	1	Yes	NA

*Requires approval.
** Forthcoming, WECC does not currently allow demand side resources to provide this product.
*** Pilots are underway to examine the ability to change this rule.

Market Rules: M&V

- DR is more cost effective with less stringent M&V requirements
  - Accuracy requirements are different for revenue metering and telemetry, but cost may dictate that the same device perform both functions
  - Telemetry is necessary for regulation, but in some cases, also required for Spinning Reserve
  - Maintaining data for every DR resource in an aggregation is resource intensive

	Telemetry Rate	Revenue Metering Accuracy	Telemetry for Spin Res	Data Source Level
CAISO	4 sec	+/- 0.25%	Yes	Resource
ERCOT	3-5 sec	+/- 2%	No	Aggregate
MISO	4 sec	State Spec	Yes	Resource
PJM	2 sec*	+/- 2%	No	Aggregate
NYISO	6 sec	+/- 2%	Yes	Resource
ISO-NE	10 sec	+/- 0.5%	Yes	Resource

*Can be batch sent once every minute

Concluding Remarks

- Wide range in AS value between ISO/RTOs, although relatively thin.
- Currently, the most favorable wholesale AS market conditions for DR exist at PJM and ERCOT.
- Reducing the minimum resource size and allowing aggregation may be the most important rules for promoting DR participation in AS.
- Ancillary services will be one of a portfolio of applications of fast demand response.

Questions?

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Reference paper (presented at Grid Interop 2012):

http://drrc.lbl.gov/sites/drrc.lbl.gov/files/LBNL-5958E.pdf

This work was coordinated by the Consortium for Electric Reliability Technology Solutions and was funded by the Office of Electricity Delivery and Energy Reliability, Transmission Reliability Program of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231