

# Demand Response Providing Ancillary Services

A comparison of opportunities and  
challenges in US Wholesale Markets

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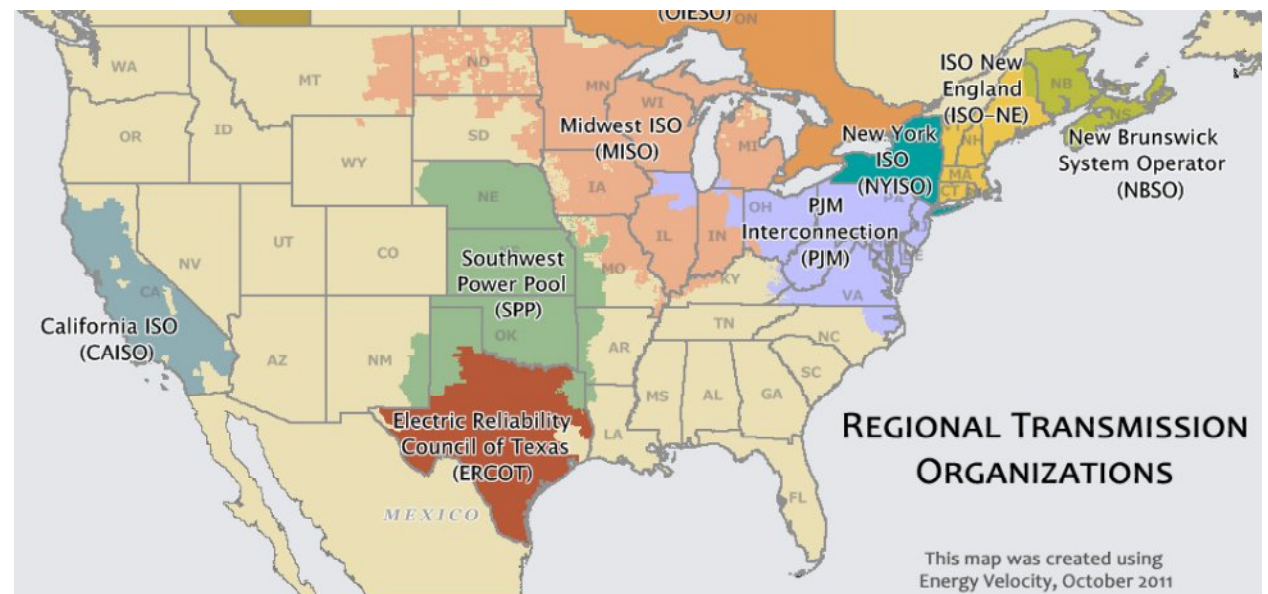
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# Ancillary Services in US ISO/RTOs

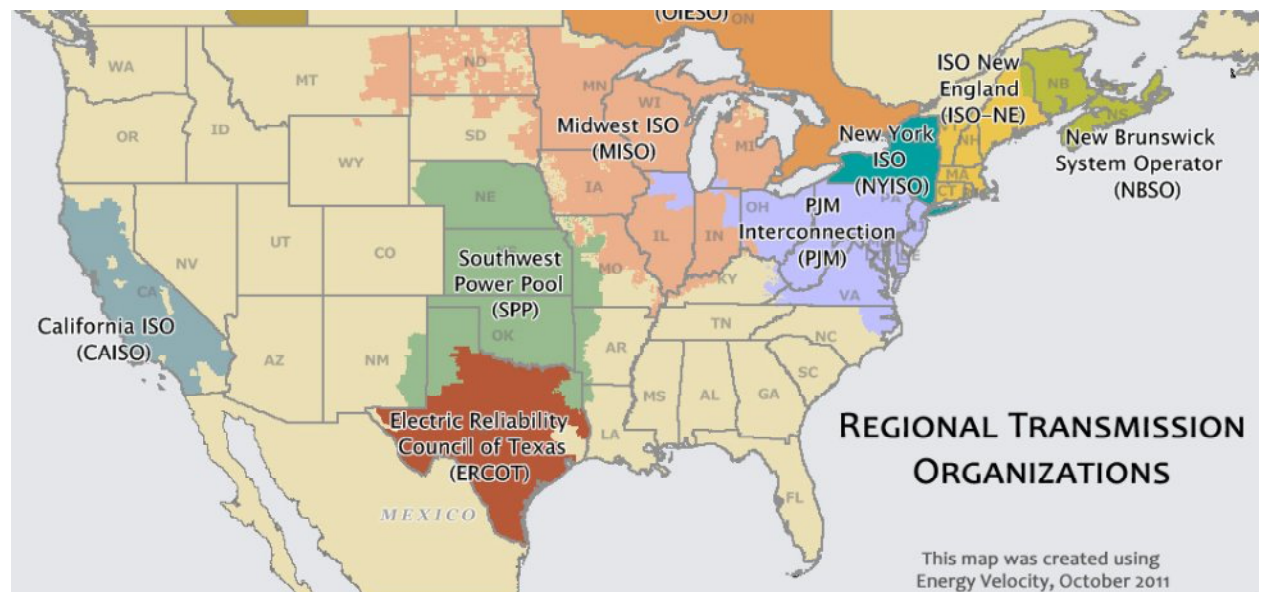
- ISO/RTOs are balancing authorities that operate transmission systems and run open wholesale markets for both energy and Ancillary Services (AS)
- AS maintain reliable functioning of the bulk power system
- AS in ISO/RTO markets include:
  - Frequency Regulation
  - Spinning Reserve
  - Non-Spinning Reserve
  - Supplemental Reserve
- AS traded in markets are capacity reserve products
- Expressed in units of MW-h, one MW held in reserve for one hour



Source: FERC.gov

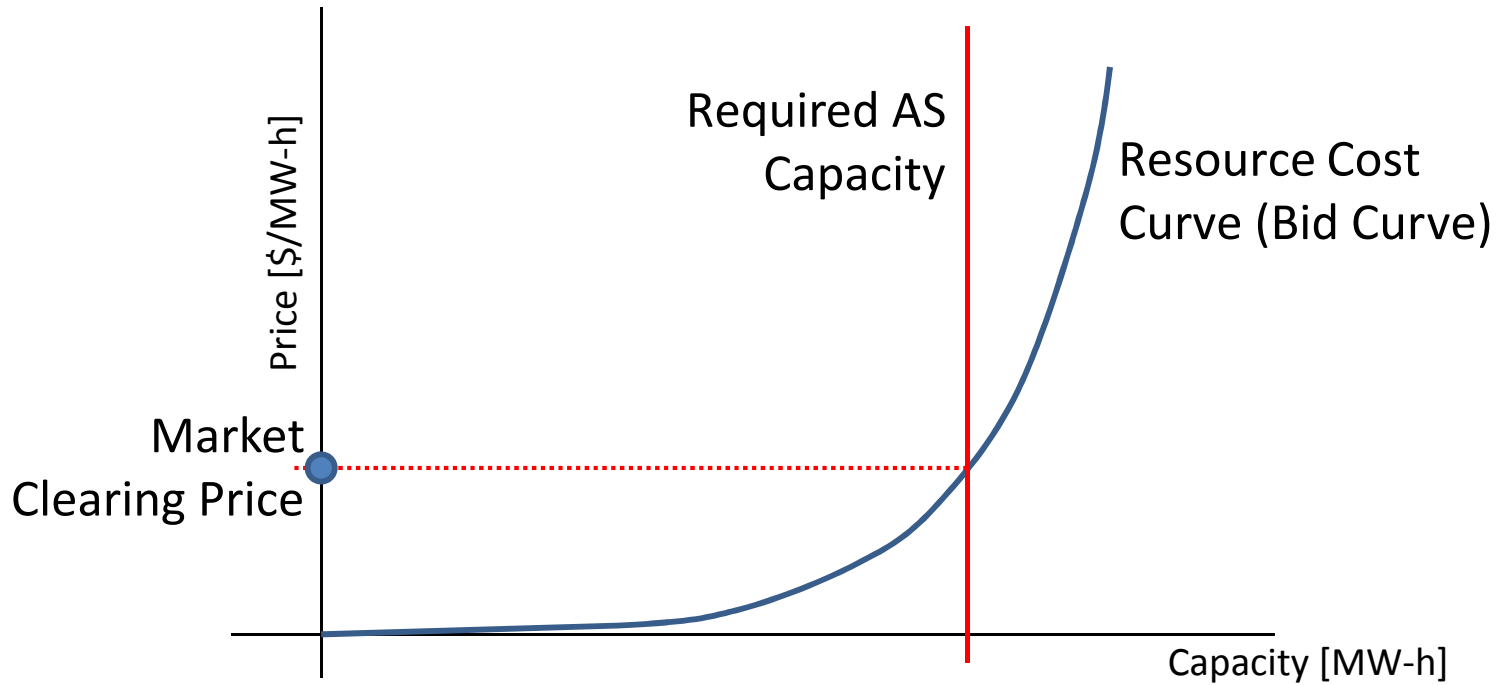
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# What is the Market Clearing Price?

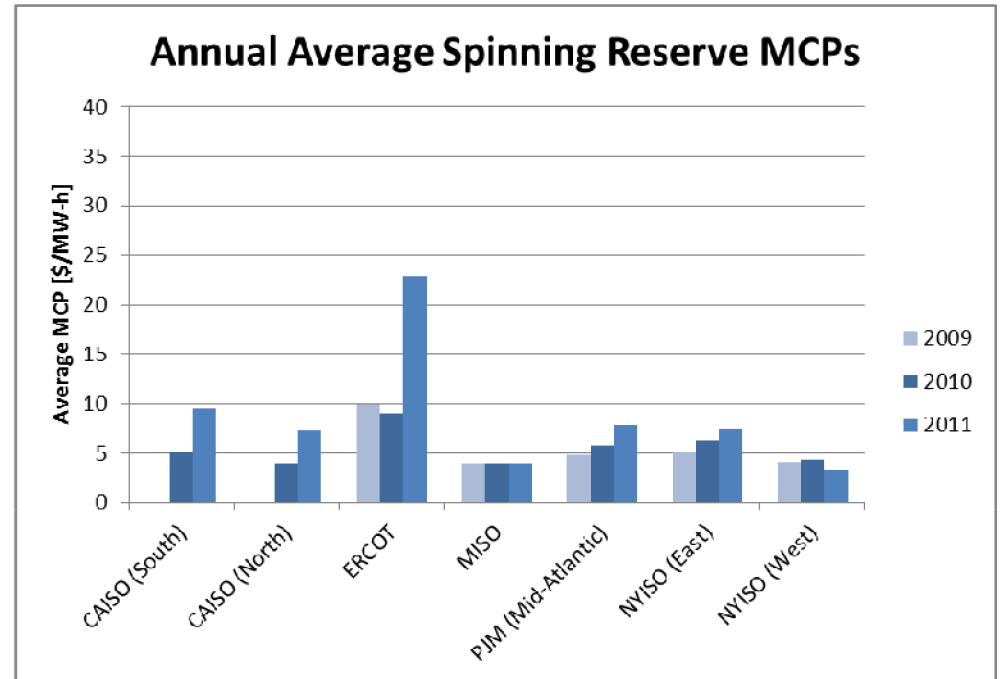
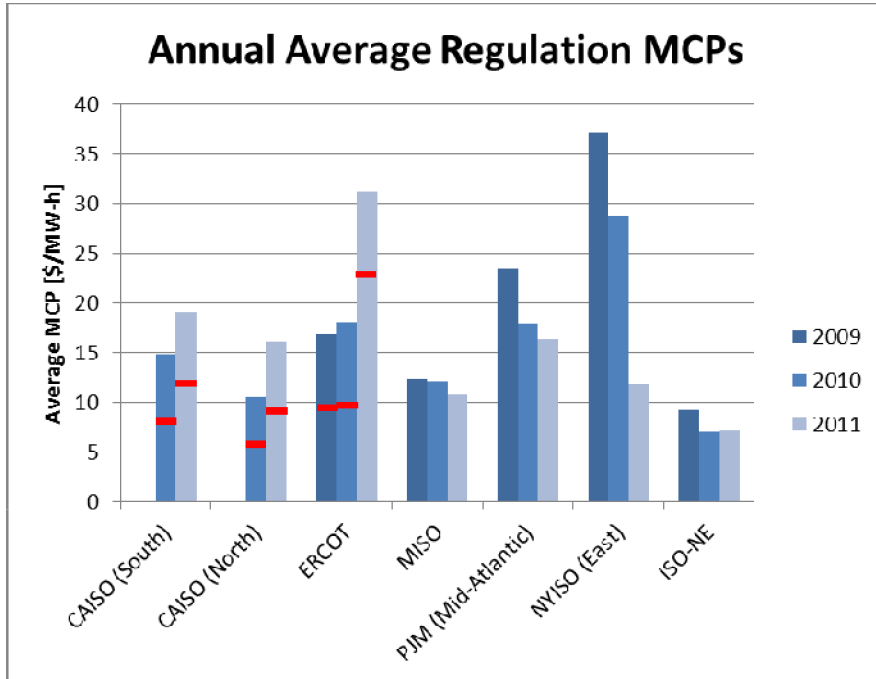


- Resource Cost = sum of its lost opportunity cost and availability bid
- The Market Clearing Price (MCP) is paid to every resource that is economic

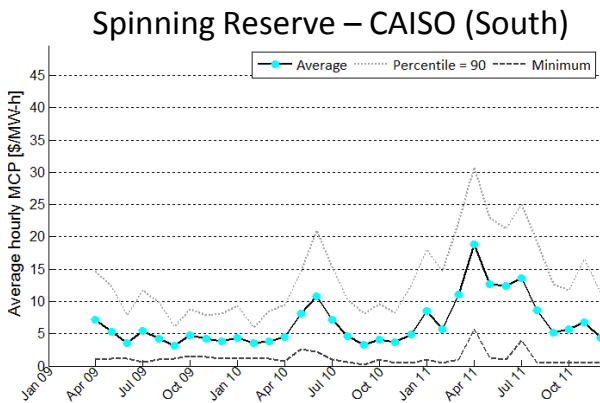


Driving to Grid 2020

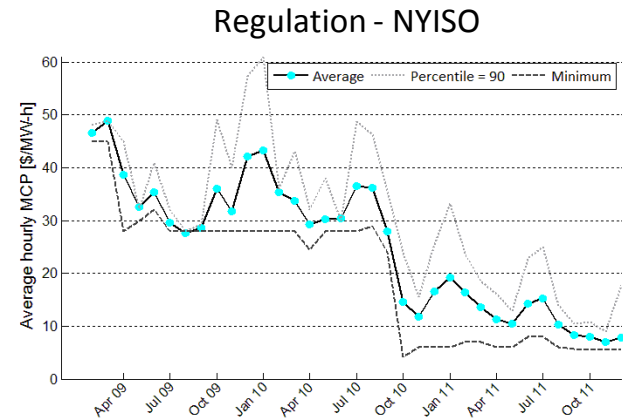
# Average Annual MCPs



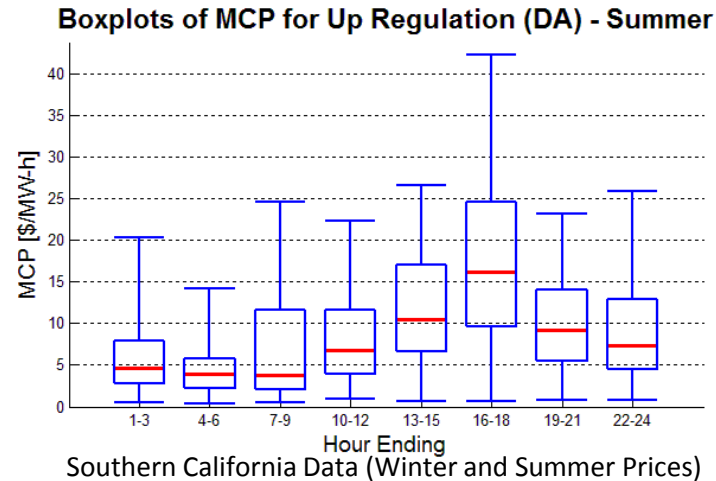
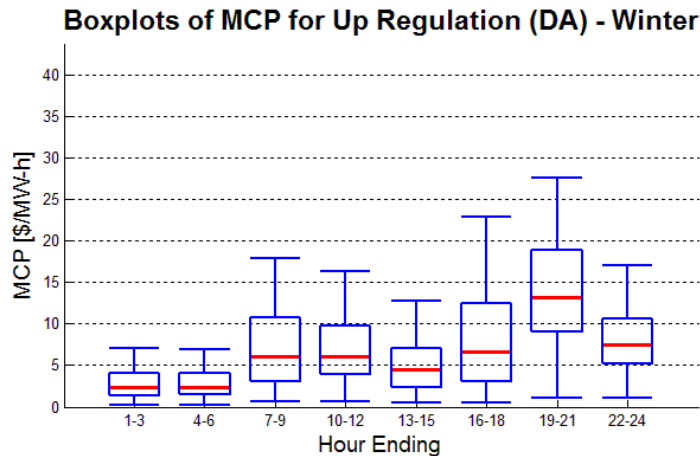
\* Below the red line is Regulation Up and above is Regulation Down



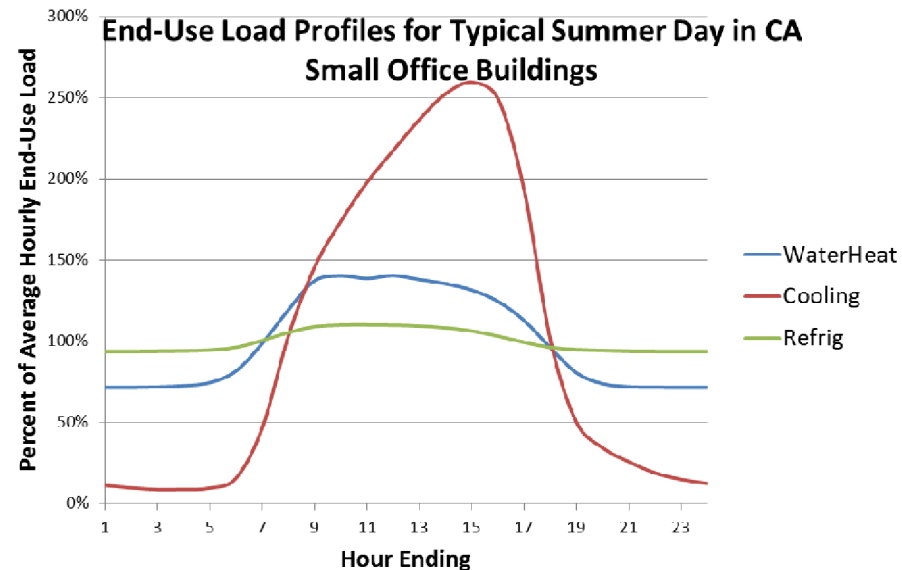
Examining monthly average MCP's illustrates that sometimes seasonal trends may dominate annual trends



# Daily Trends in MCP



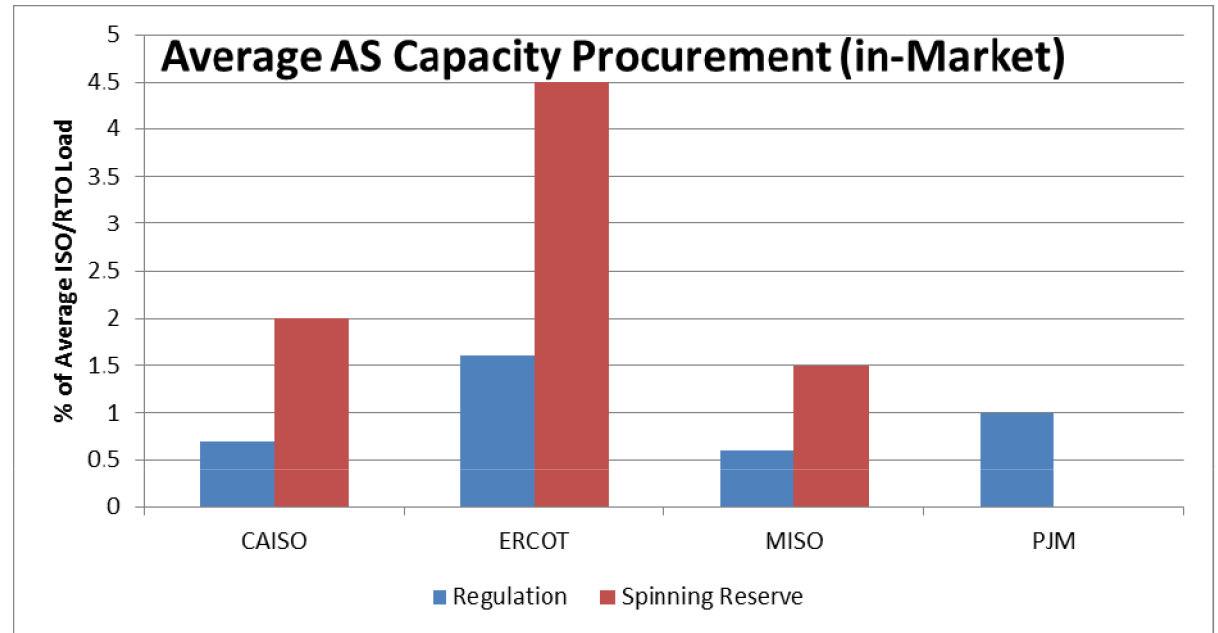
- Daily Trends in MCP show more seasonal effects.
- Additionally, daily trends indicate additional opportunity for loads that can provide AS during hours of higher price.



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 =  $\sum \text{Procurement}(t) * \text{MCP}(t)$
- 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.



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# Questions?

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