Can the Law Embrace Disruptive Technologies?

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What are "disruptive" technologies?

- Solar PV
- Energy Storage
- Fuel Cells
- Wind

EV

Gas-powered
 Micro turbines

- Demand
 Response
- Energy
 Efficiency
- Conservation

Energy Storage









Reliability of the Grid Under Increasing Pressure

- Increase in Distributed Generation
- Increased Penetration of Renewable Energy
- Increase in Demand-side Measures
- EPA Clean Power Plan
- Climate Change



Source: CPUC, http://www.caiso.com/Documents/FlexibleResourceAdequacyCriteria-MustOfferObligation-ISOPresentation.pdf

Energy Storage Essential for Reliability Toolkit

- ♦ Fast-ramping
- Load-leveling
- Firms renewables (reduced emissions)
- Reduces peak load
- Improves reliability
- Defers transmission and distribution upgrades

Evolution of Energy Storage

- The Original Pumped Storage
- Early adopters
- Mandated adopters

The Original – Pumped Storage

Figure 1 – Rated Power of US Grid Storage projects (includes announced projects)



Early Adopters

Figure 3 - Maturity of electricity storage technologies



Mandated Adopters

Table 2

Proposed Energy Storage Procurement Targets (in MW)²²

Storage Grid Domain					
Point of Interconnection	2014	2016	2018	2020	Total
Southern California Edison					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal SCE	90	120	160	210	580
Pacific Gas and Electric					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal PG&E	90	120	160	210	580
San Diego Gas & Electric					
Transmission	10	15	22	33	80
Distribution	7	10	15	23	55
Customer	3	5	8	14	30
Subtotal SDG&E	20	30	45	70	165
Total - all 3 utilities	200	270	365	490	1,325

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STORAGE GRID DOMAINS (Grid Interconnection Point)	REGULATORY FUNCTION	USE-CASE Examples	
	Generation/Market	(Co-Located Energy Storage) Concentrated Solar Power, Wind + Energy Storage, Gas Fired Generation + Thermal Energy Storage	
Transmission- Connected		(Stand-Alone Energy Storage) Ancillary Services, Peaker, Load Following	
	Transmission Reliability (FERC)	Voltage Support	
Distribution- Connected	Distribution Reliability	Substation Energy Storage (Deferral)	
	Generation/Market	Distributed Generation + Energy Storage	
	Dual-Use (Reliability & Market)	Distributed Peaker	
Behind-the-Meter	Customer-Sited Storage	Bill Mgt/Permanent Load Shifting, Power Quality, Electric Vehicle Charging	

Success Stories

- Wisconsin Distributed-Superconducting Magnetic Energy Storage System (D-SMES) on the Rhinelander loop
- Presidio, Texas Sodium-Sulfur NaS) battery used to support power quality on a 100 km, radial 69 kV transmission line that feeds the border town of Presidio.
- Southern CA Edison- 250 MW procurement



SCE selected the following resources from the LCR RFO:

West LA Basin

Seller	Resource Type	MWs	Number of Contracts
NRG	Energy Efficiency	102.5	8
Onsite Energy Corporation	Energy Efficiency	11.0	11
Sterling Analytics LLC	Energy Efficiency	16.7	7
NRG	Demand Response	75.0	7
SunPower Corp.	Behind-the-Meter Renewable	44.0	4
Ice Energy Holdings, Inc.	Behind-the-Meter Thermal Energy Storage	25.6	16
Advanced Microgrid Solutions	Behind-the-Meter Battery Energy Storage	50.0	4
Stem	Behind-the-Meter Battery Energy Storage	85.0	2
AES	In-Front-of-Meter Battery Energy Storage	100.0	1
AES	Combined Cycle Gas Fired Generation	1284.0	2
Stanton Energy Reliability Center	Peaking Gas Fired Generation	98.0	1
	TOTAL:	1891.8	63

The Problem: Energy Storage Disconnects

Disconnect 1: Single Categories and Multiple Value Streams

What Energy Storage Provides

End-Use

- Power Quality/Reliability
- Peak Load Reduction
- Distributed Generation
 & Smart Grid Support

Renewable Penetration

- Reduced Variability
- Ramp rate control
- Load time shifting
- Reserves
- Dispatchability

Transmission and Distribution

- Line and Transformer
 Deferral
- Stability
- Voltage/Frequency Regulation

Generation

- Spinning Reserve
- Capacity Deferral
- Voltage/Frequency Regulation
- Load Leveling



Disconnect 2: Mismatched entities may be destabilizing and stabilizing reliability

> **Entities Causing Reliability Strain**

- EPA regulations
- States with RPS
- PUC with mandates
- Customers installing DG

Entities Responsible for Reliability

- NERC PUCs
- ♦ FERC● Utilities
 - DOE Transmission
- Coordinating Councils
- Transmission
 Operators
- Customers

RTOs/ISOs

"Because the grid is so critical to all aspects of our society and economy, protecting its reliability and resilience is a core responsibility of everyone who works in the electric industry"

FERC Chairman Cheryl LaFleur

Customer Owned - 181



Third-party Owned - 112



Utility Owned - 160





Source: Energy Information Administration

Disconnect 3: Jurisdictional Tensions



Generator

Transmission

Distribution

Jurisdiction

Wholesale Market

- FERC Regulated
 - Order 890 (consider non-gen)
 - Order 755 (premium for fast acting)
 - Order 784 (speed and accuracy of regulation)
- State Regulated

Potential Solutions

- Amending market rules to allow for multiple value streams without double-counting
- More coordination between entities
- Clearer accountability for reliability among multiple stakeholders
- Assess the adequacy of the substance and scope of NERC reliability standards
- Enhanced reliability obligations for customers siting DER, including mandated transparency of customer-sited PV and energy storage

Thank You

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