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# DOE Global Energy Storage Database

*The Role of Storage in Energy System Flexibility*

October 22, 2014  
Georgianne Huff



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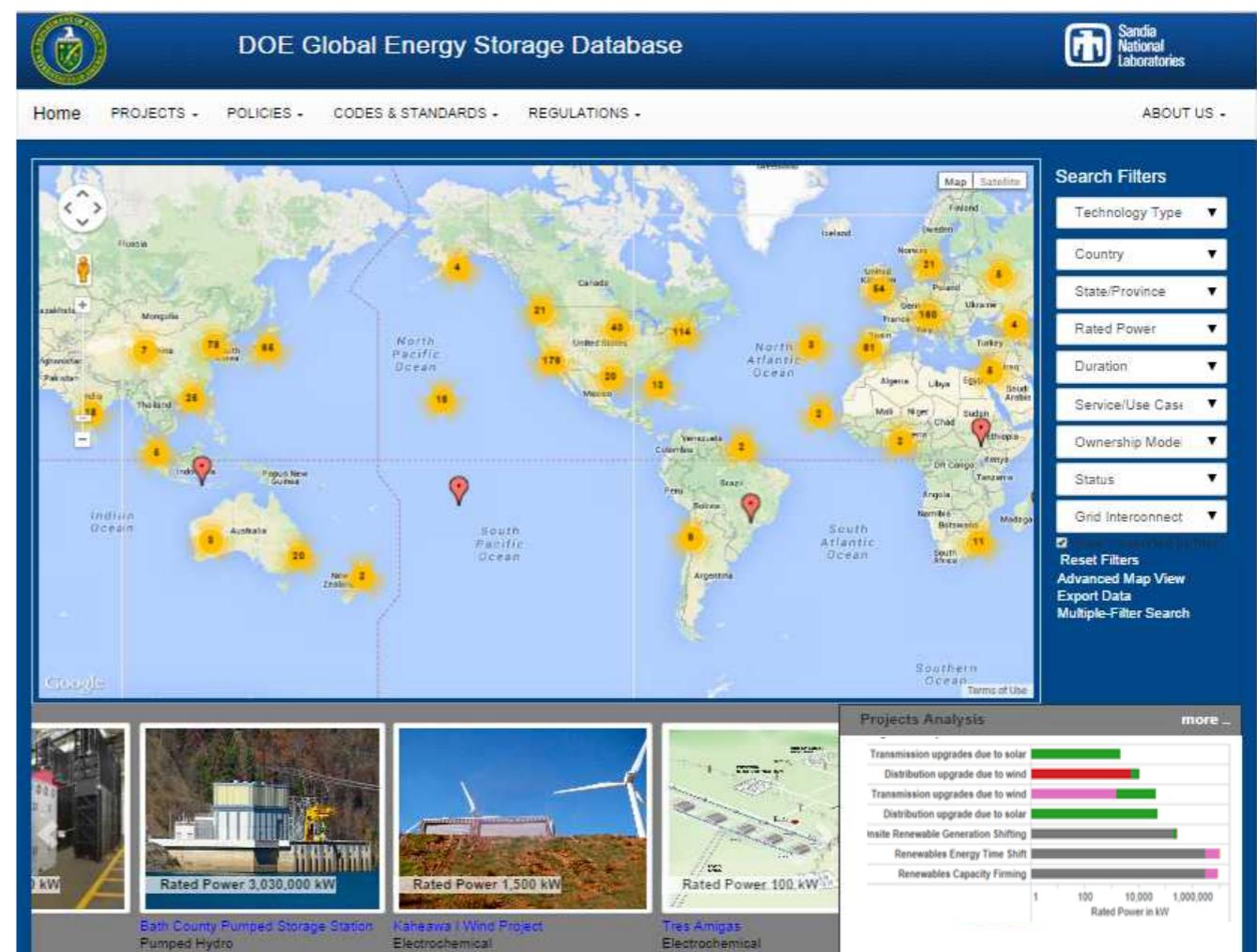
# Overview

## DOE Global Energy Storage Database(GESDB)



[www.sandia.gov/ess/database](http://www.sandia.gov/ess/database)

- What is the GESDB?
- Who uses the database?
- Examples

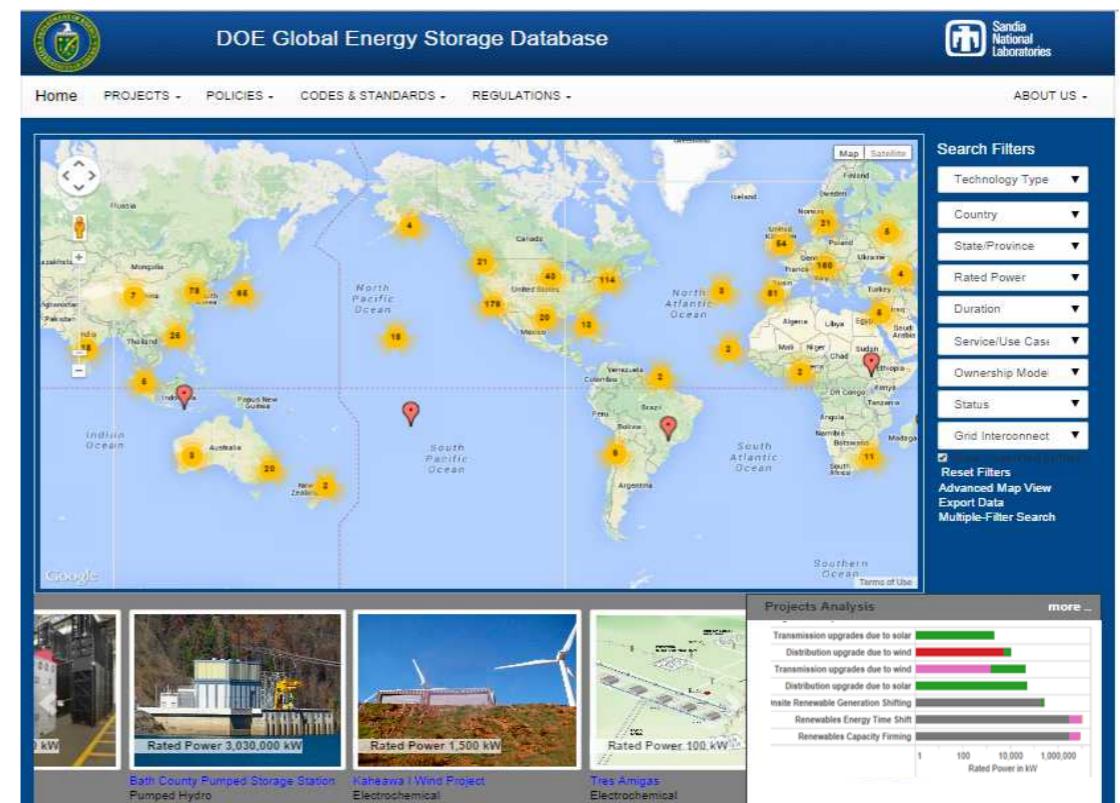




# What is it?

## DOE Global Energy Storage Database(GESDB)

- Only freely accessible database
  - World-wide energy storage projects and facilities
  - related US state and federal legislation/policies information
- Tool designed to be accessible to a wide variety of stakeholders

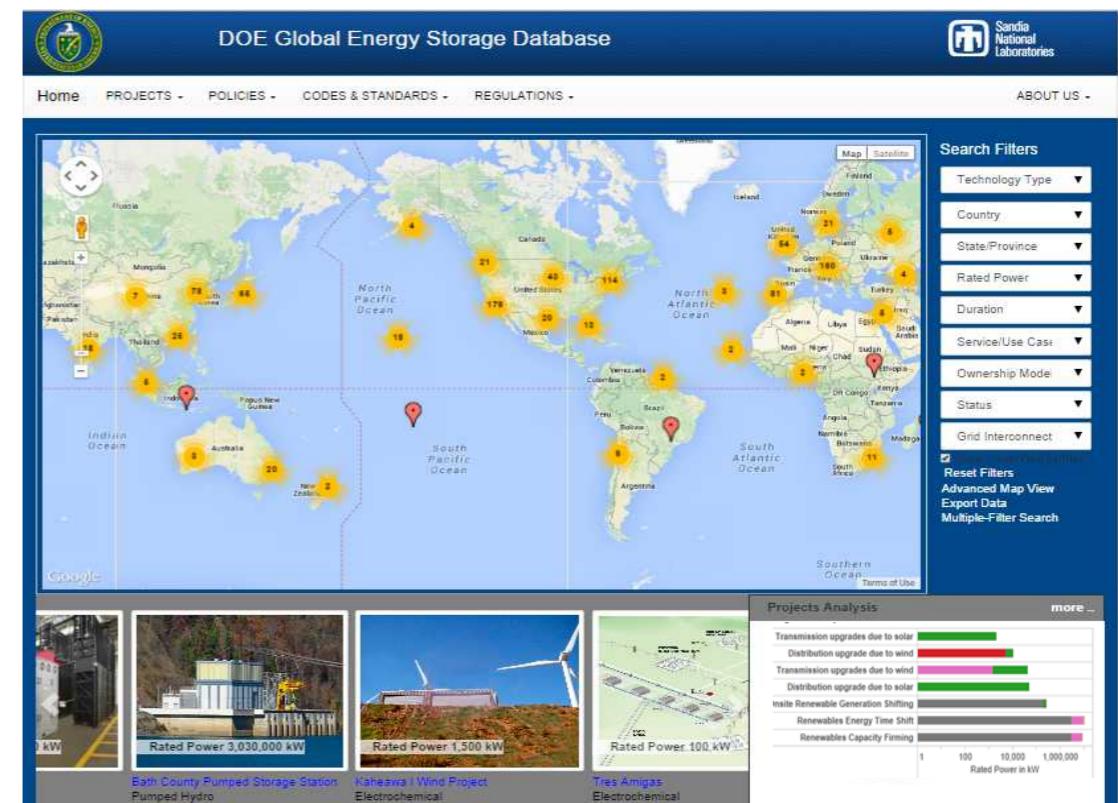




# Who uses it? DOE Global Energy Storage Database(GESDB)

- Policy makers
- Utilities and Power providers
- RD&D decision-makers, strategic planners, program managers
- Financial institutions
- Educators
- Energy Information Agency

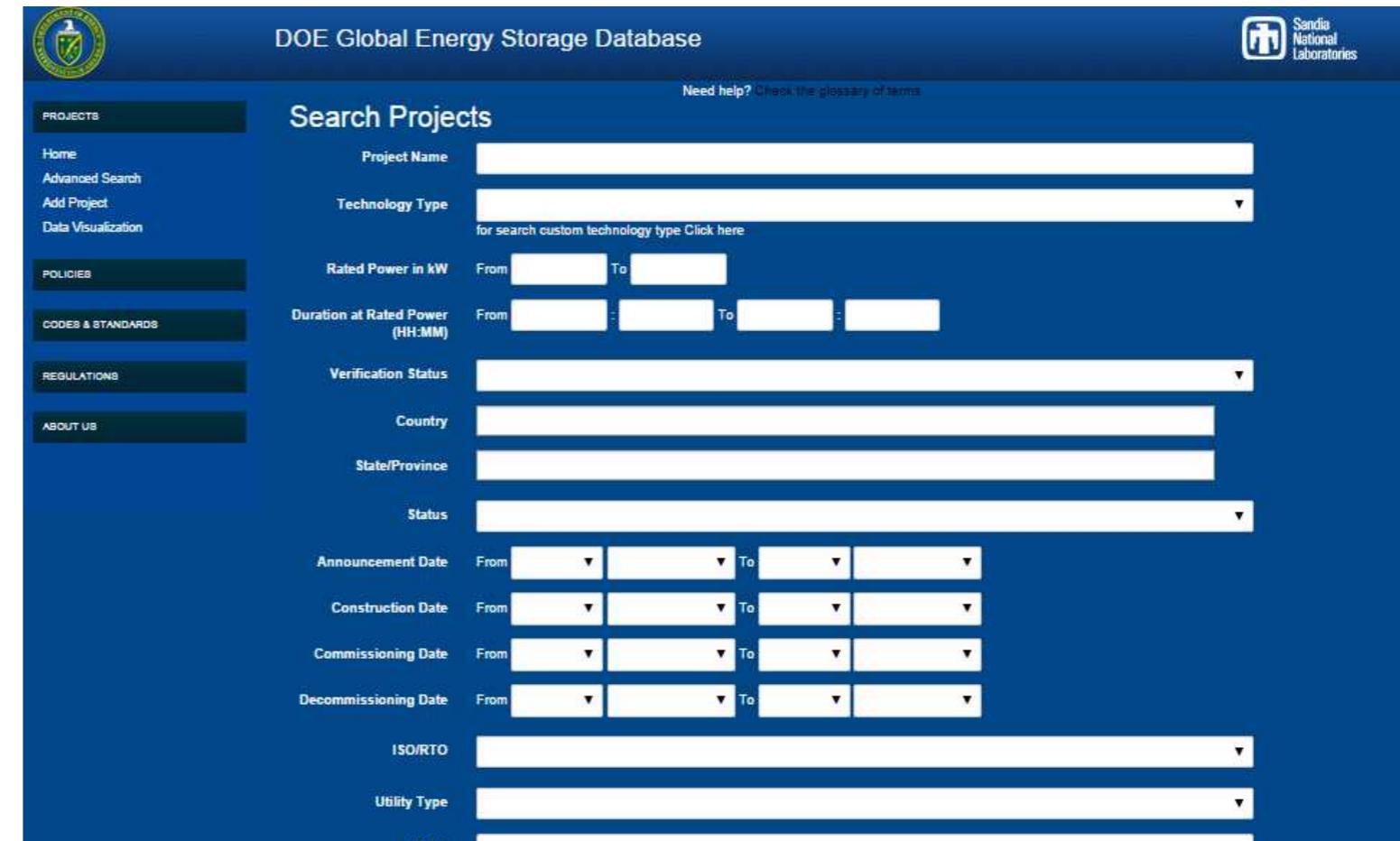
Help grow ES industry -  
providing data allowing analysis  
by a variety of users



# What does the database contain?

## Features:

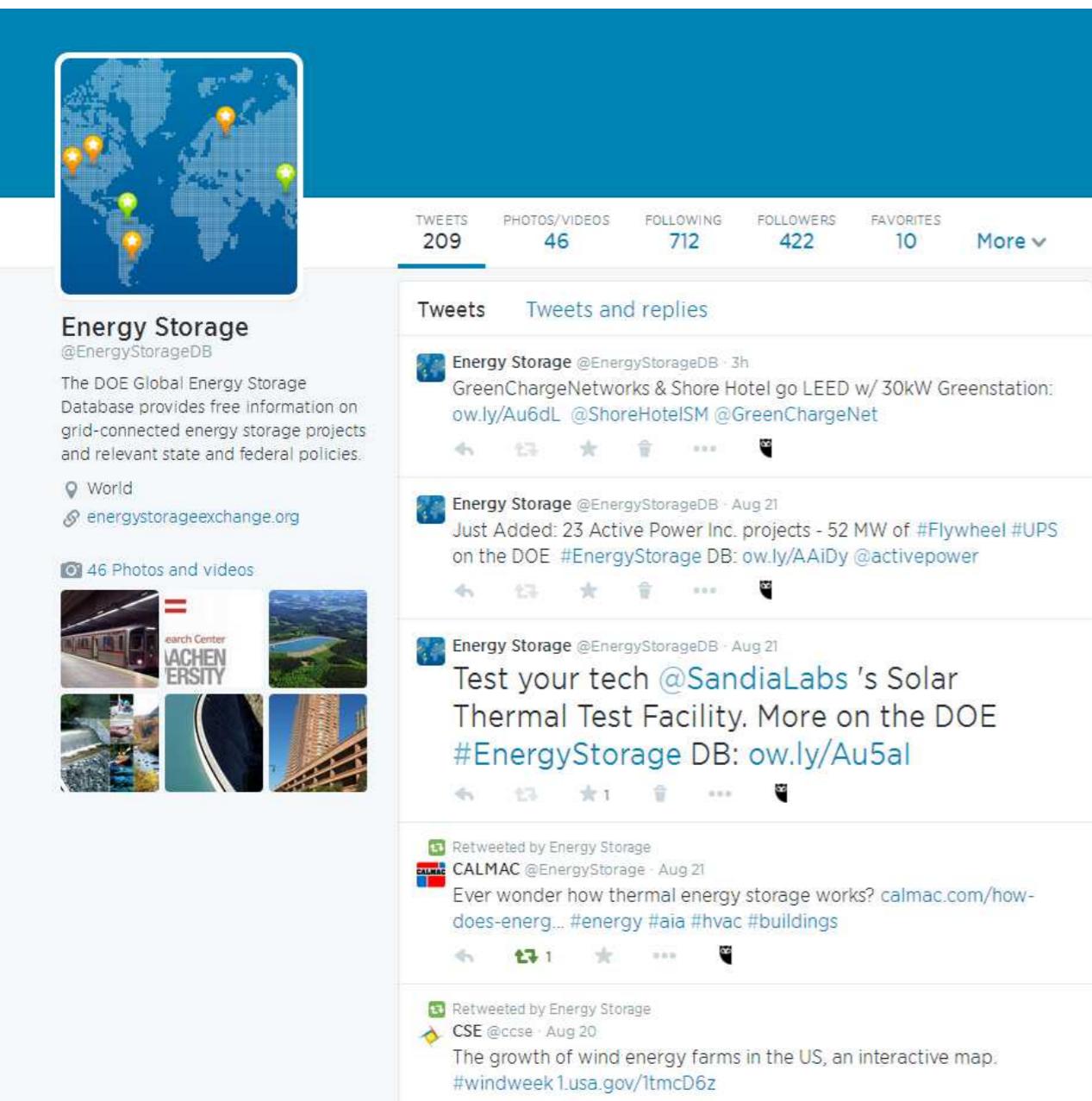
- 60+ data fields
- 50+ energy storage technologies
- 3<sup>rd</sup> party verification process
- Data exportable
  - Excel or PDF
- Data Visualization
- Easy Project Sharing
- Social media engagement



Continually evolving to address the data needs of emerging industry

# Social Media Engagement

[www.sandia.gov/ess/database](http://www.sandia.gov/ess/database)



**Energy Storage**  
@EnergyStorageDB

The DOE Global Energy Storage Database provides free information on grid-connected energy storage projects and relevant state and federal policies.

World  
[energystorageexchange.org](http://energystorageexchange.org)

46 Photos and videos



TWEETS 209 PHOTOS/VIDEOS 46 FOLLOWING 712 FOLLOWERS 422 FAVORITES 10 More ▾

Tweets Tweets and replies

Energy Storage @EnergyStorageDB · 3h GreenChargeNetworks & Shore Hotel go LEED w/ 30kW Greenstation: [ow.ly/Au6dl](http://ow.ly/Au6dl) @ShoreHotelISM @GreenChargeNet

Energy Storage @EnergyStorageDB · Aug 21 Just Added: 23 Active Power Inc. projects - 52 MW of #Flywheel #UPS on the DOE #EnergyStorage DB: [ow.ly/AAiDy](http://ow.ly/AAiDy) @activepower

Energy Storage @EnergyStorageDB · Aug 21 Test your tech @SandiaLabs 's Solar Thermal Test Facility. More on the DOE #EnergyStorage DB: [ow.ly/Au5al](http://ow.ly/Au5al)

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GreenChargeNetworks @GreenChargeNet · Sep 3 Here's @EnergyStorageDB on our project that helps @Avis charge 21 electric vehicles simultaneously near Laguardia [energystorageexchange.org/projects/143](http://energystorageexchange.org/projects/143)

View conversation

Energy Storage @EnergyStorageDB · Sep 3 CALMAC's Ice #EnergyStorage Saves School District \$5 Million in Utility Costs: via ACHRNEWS [achrnews.com/articles/12748...](http://achrnews.com/articles/12748...) @energystorage

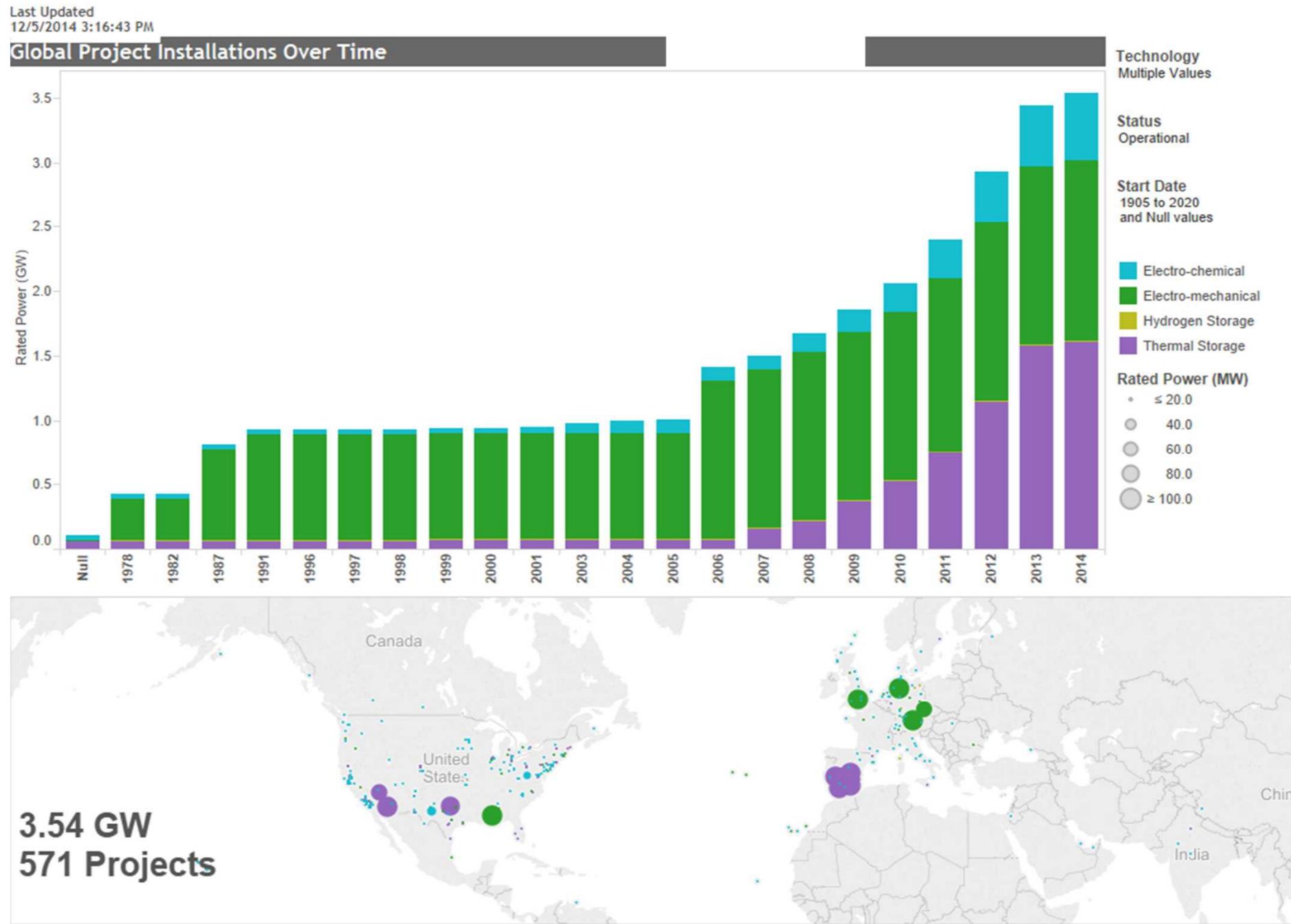
Energy Storage @EnergyStorageDB · Sep 3 Check out Stafford Hill Solar Farm & Microgrid - 4MW of #EnergyStorage on the DOE Database: [ow.ly/ANfD9](http://ow.ly/ANfD9)



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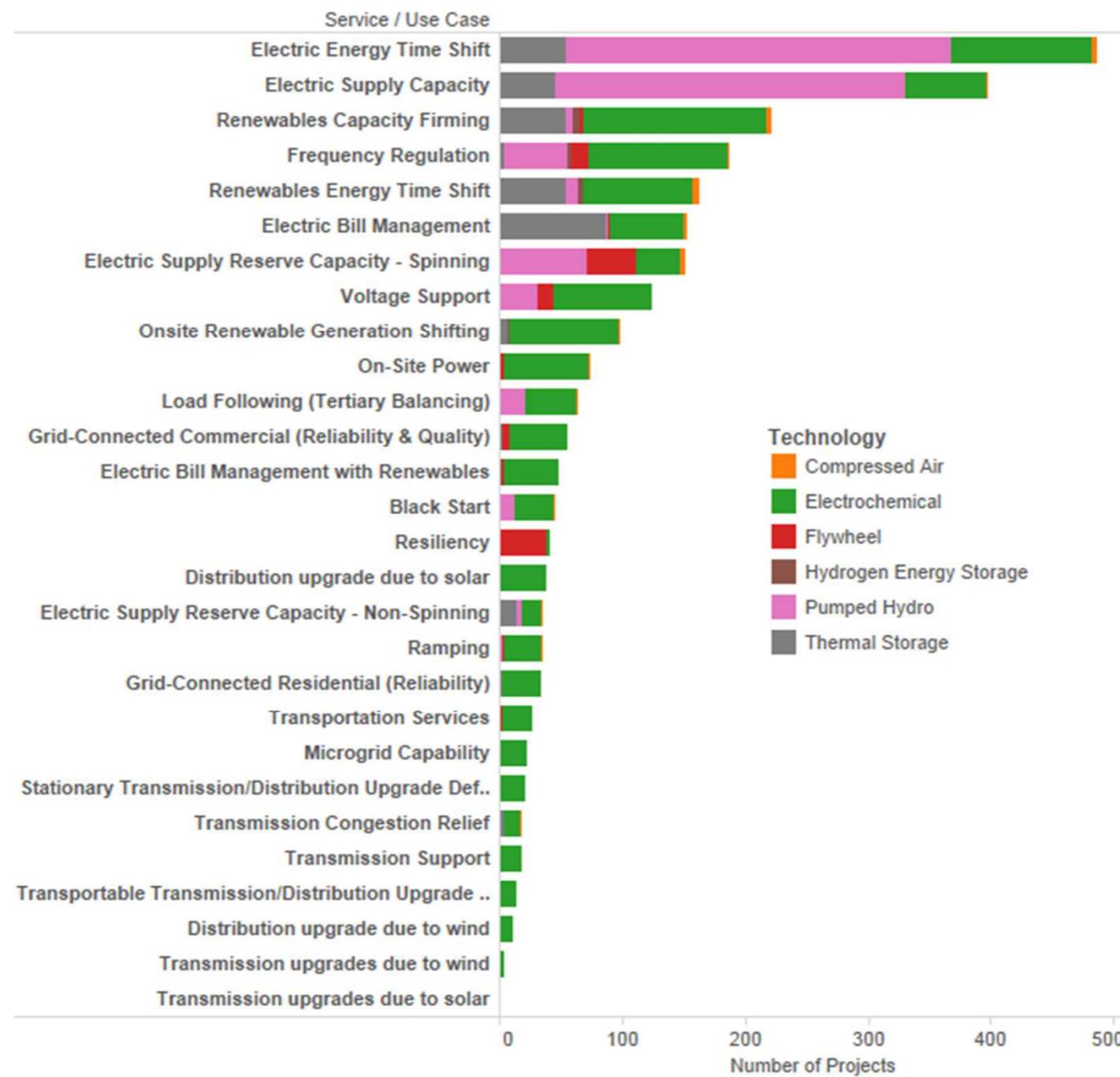
# Example of Embedded, Data Visualization Tool

## DOE Global Energy Storage Database



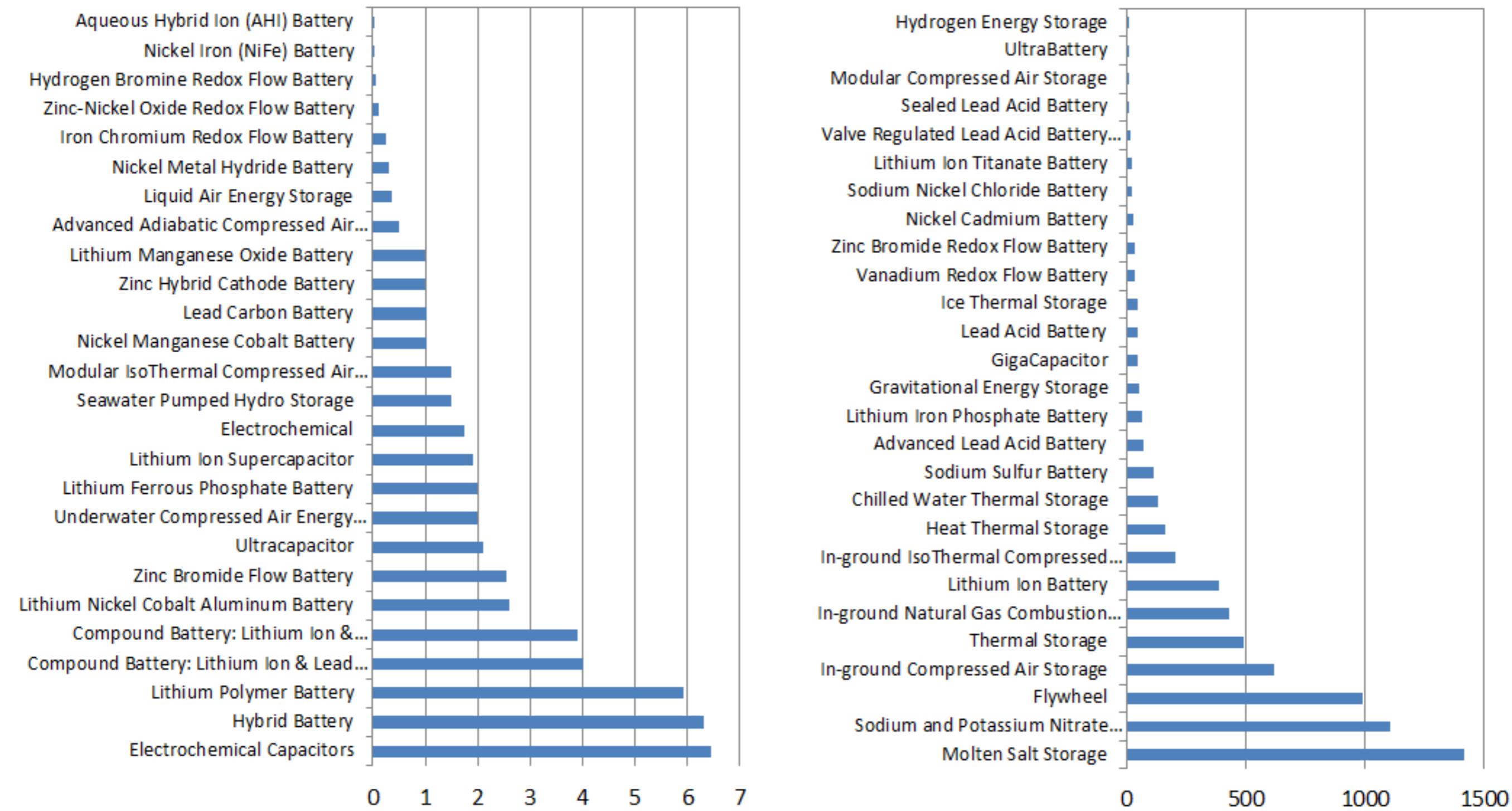
# How are others using Storage?

Service / Use Cases



Data: [https://public.tableausoftware.com/views/EnergyStorageUseCases/ServiceUseCases?:embed=y&:display\\_count=no](https://public.tableausoftware.com/views/EnergyStorageUseCases/ServiceUseCases?:embed=y&:display_count=no)

# Total Power by Technology (MW)



Not Shown on Graph

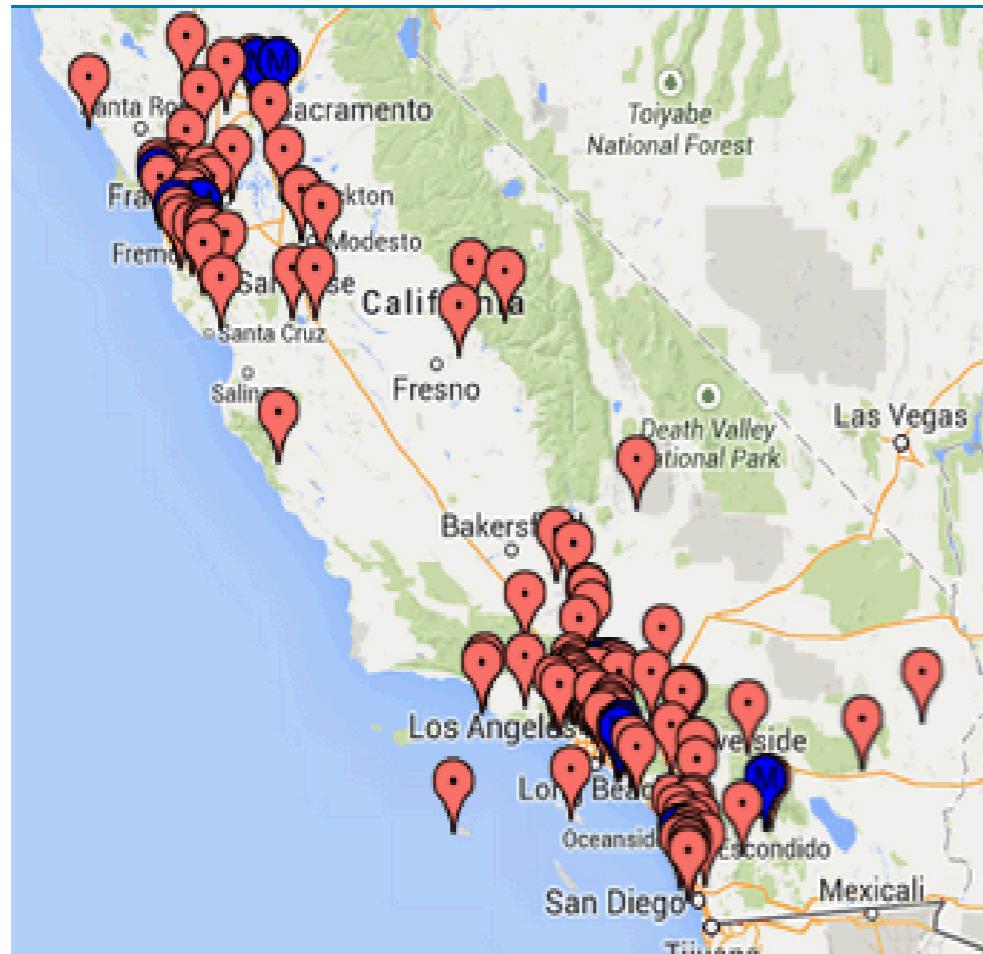
Open Loop Pumped Hydro: 170.7 GW

Closed Loop Pumped Hydro: 6.3 GW

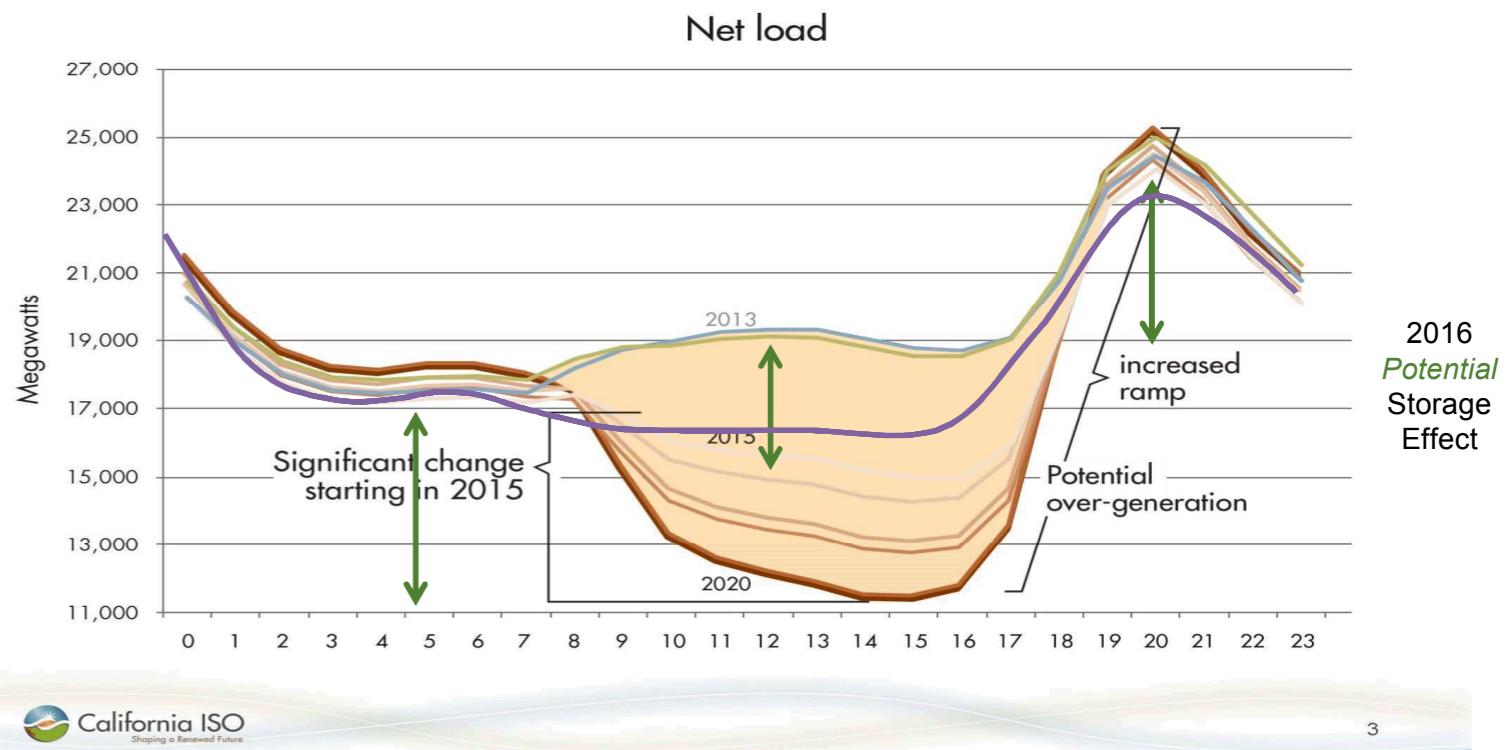
# Use Cases by System Operator

Service / Use Case	CAISO	F	Iso/Rto		
			ERCOT	MISO	PJM
Electric Bill Management		35	11	6	9
Electric Energy Time Shift	31		13	12	22
Grid-Connected Commercial (Reliability & Quality)	22		2	1	4
Electric Bill Management with Renewables	20		1	2	2
Renewables Capacity Firming	20		3	8	3
Onsite Renewable Generation Shifting	17		1	1	6
Transportation Services	13				3
Renewables Energy Time Shift	12		1	7	2
Electric Supply Capacity	11		1	3	2
Electric Supply Reserve Capacity - Non-Spinning	11		2	3	4
Grid-Connected Residential (Reliability)	10			7	2
Electric Supply Reserve Capacity - Spinning	9		9	2	11
Load Following (Tertiary Balancing)	9			1	1
Frequency Regulation	7		3	1	19
On-Site Power	7			1	2
Voltage Support	7		2	2	5
Microgrid Capability	6				2
Stationary Transmission/Distribution Upgrade Deferral	6				
Transmission Congestion Relief	6				1
Resiliency	4		8	1	3
Transportable Transmission/Distribution Upgrade Deferral	3				4
Distribution upgrade due to solar	2				
Ramping	2		1	1	2
Black Start	1				1
Transmission Support					2

# What effect is Storage Policy having?



Growing need for flexibility starting 2015



California Assembly Bill 2514	<p>This law requires the California Public Utilities Commission (CPUC) to open a proceeding to determine appropriate utility procurement targets, if any, for energy storage systems that are commercially available and cost-effective.</p> <p>The CPUC opened the rulemaking (R.10-12-007) on December 19, 2010. The rulemaking consisted of several phases of workshops, modeling of energy systems, staff reports, proposed decisions, and stakeholder input. The full timeline of the rulemaking process, as well as many pieces of documentation, can be found at <a href="http://www.cpuc.ca.gov/PUC/energy">http://www.cpuc.ca.gov/PUC/energy</a></p>	AB 2514	California Legislature	Jan 2011
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# Media uses

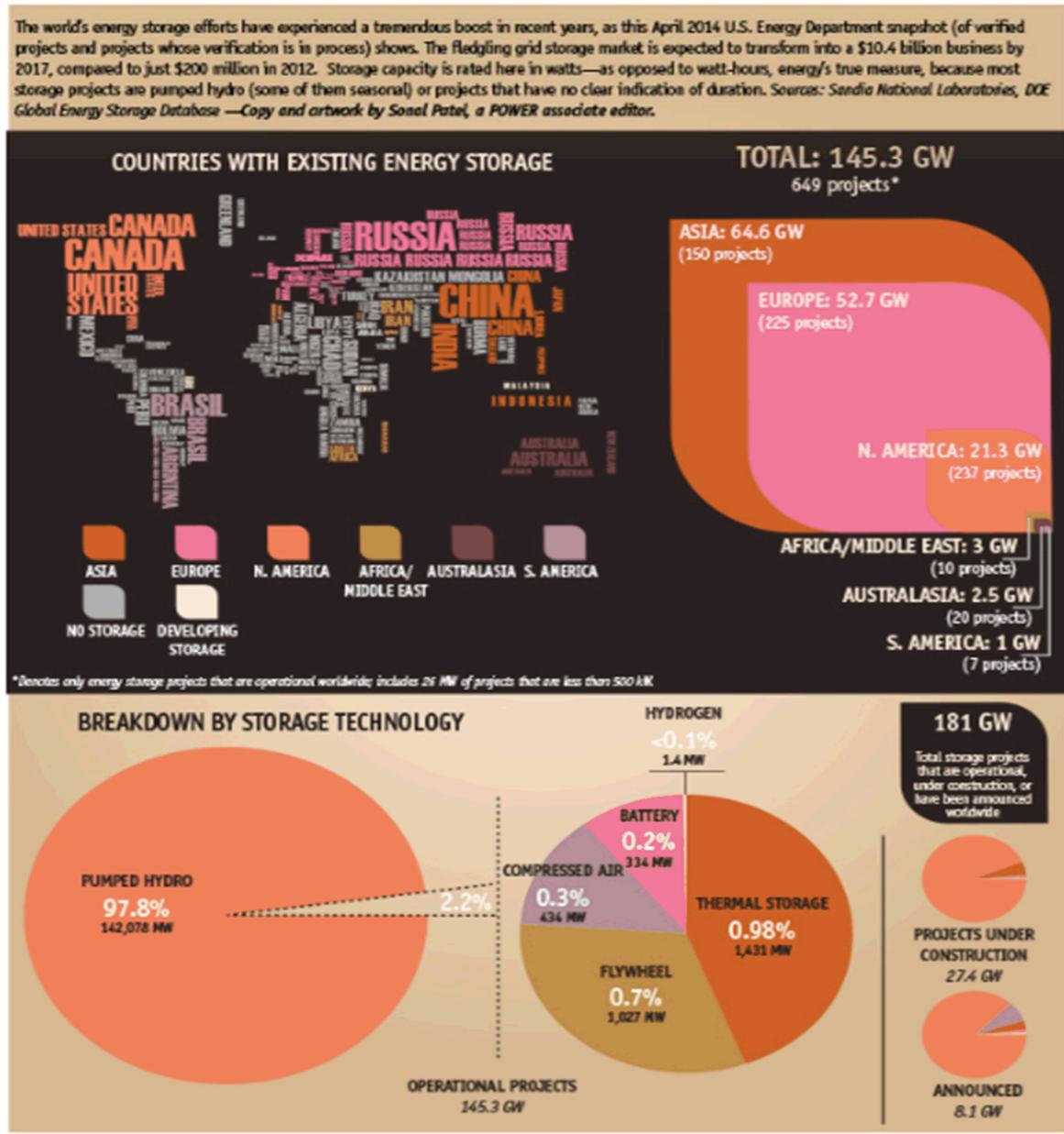
[Home](#) / [Energy Storage](#) / THE BIG PICTURE: Storage Snapshot

## THE BIG PICTURE: Storage Snapshot

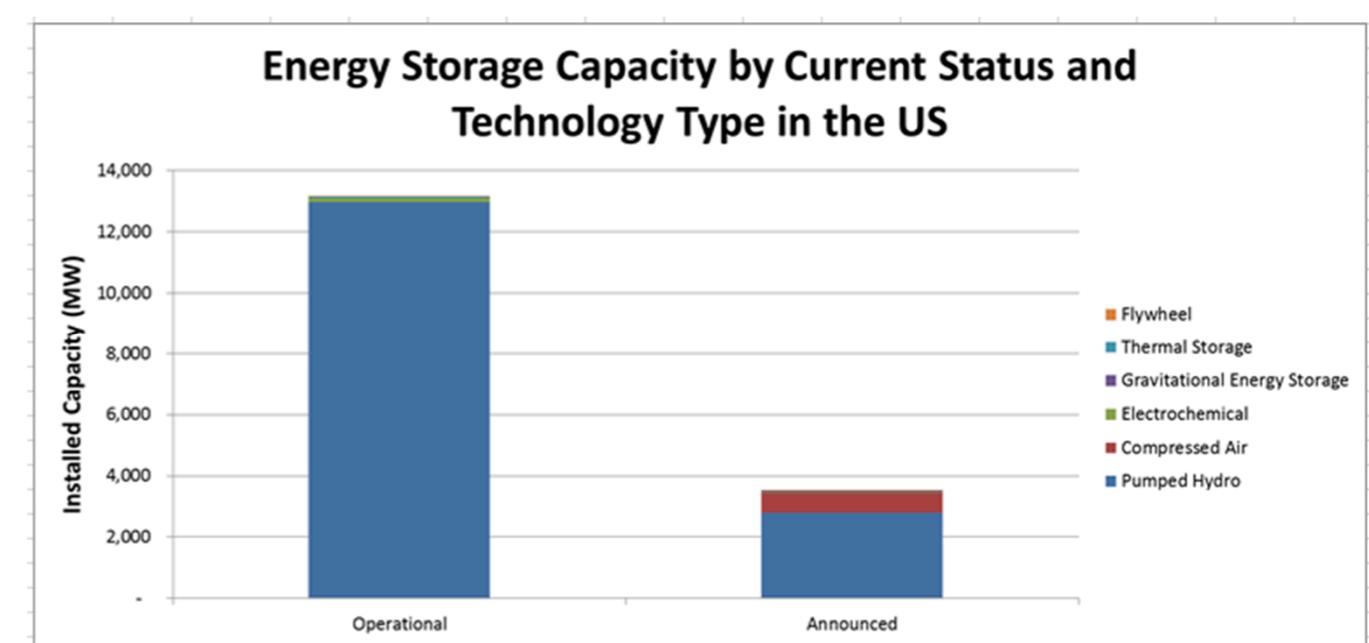
04/30/2014 | Sonal Patel

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Magazines, Blogs  
and other reports



<http://energytopicstrends.blogspot.com>

<http://www.powermag.com/the-big-picture-storage-snapshot/>

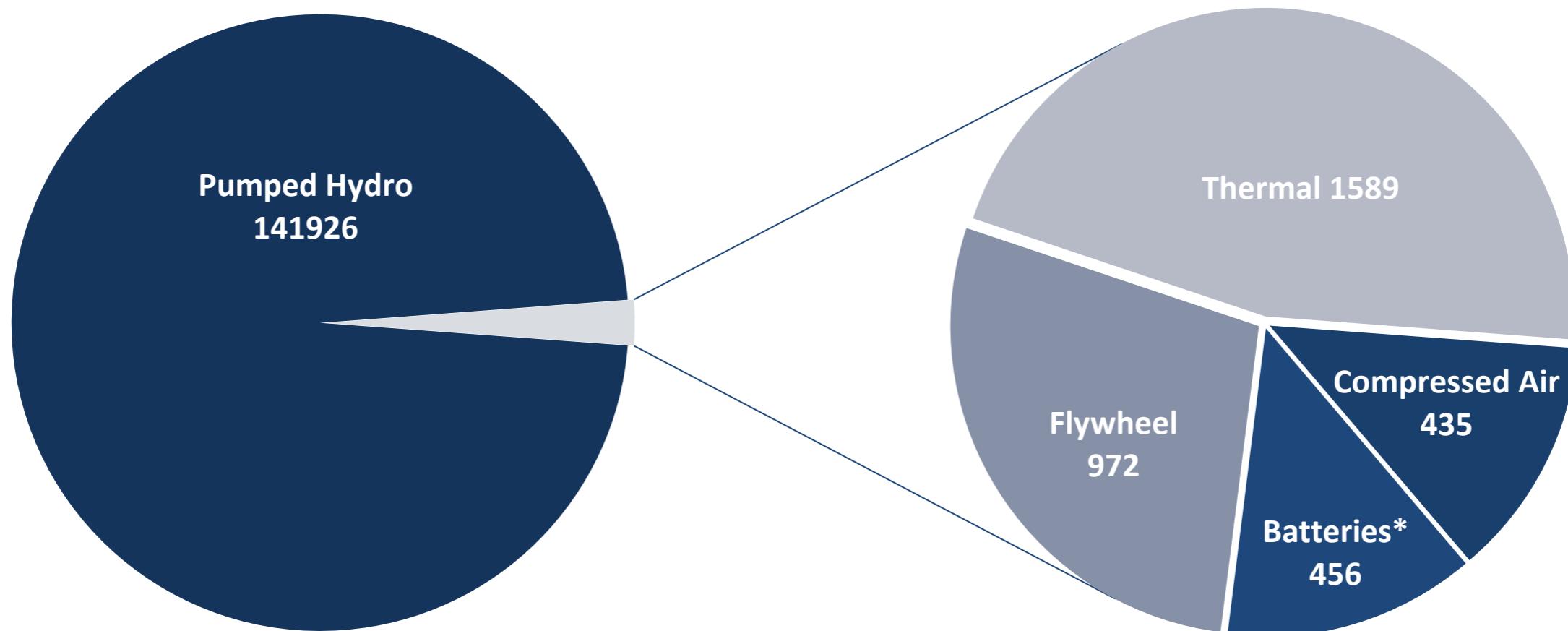
# The Role of Storage in Energy System Flexibility

- *Which electricity storage technologies are currently used ...?*
- *What are the ways in which such devices be integrated into the energy market?*
- *How is energy storage handled in different countries?*
- *How is Renewable Energy Sources are Being Integrated with Storage?*

# Which electricity storage technologies are currently used ...?

145 GW installed

50 Technologies Represented



Source: Based on **DOE Global Energy Storage Database** (<http://www.energystorageexchange.org>)

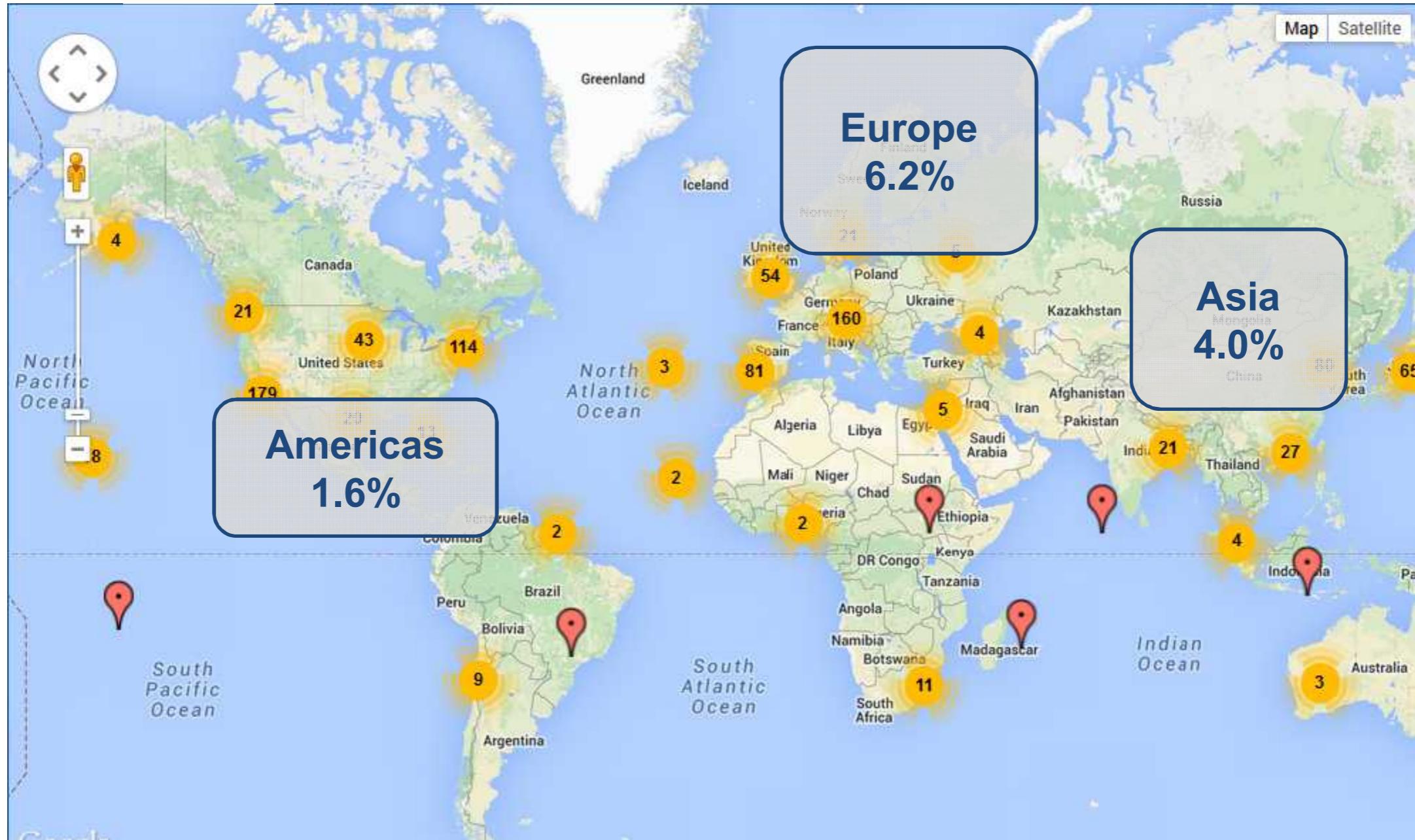
August 2014

\*Batteries include Flow, Lithium Ion, Sodium Sulfur, Nickel Cadmium, Lead Acid, Electrochemical Capacitors, and Ultra Batteries

# 1.8 % of the Total Electric Capacity

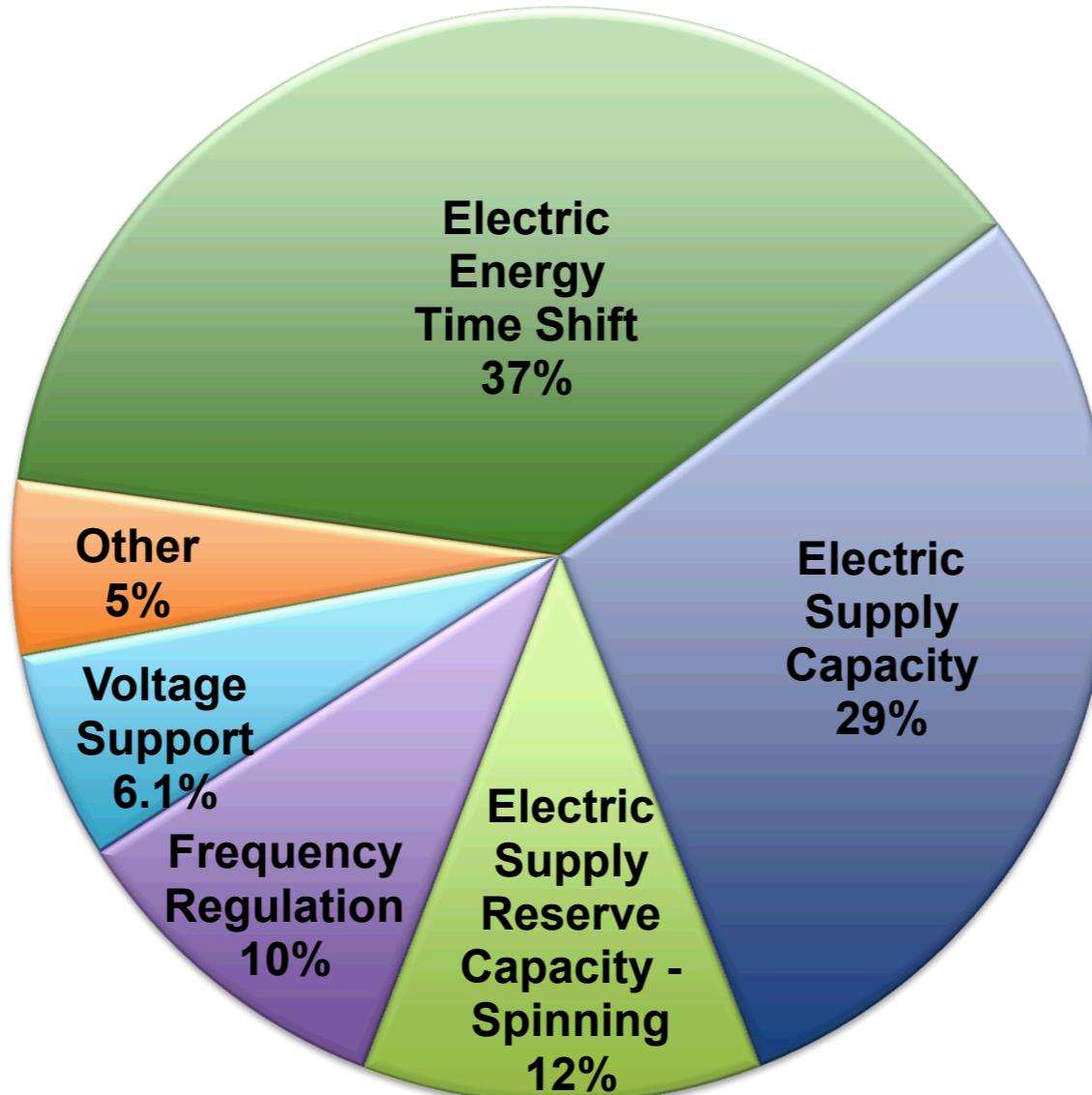


## World wide is Stored!



Sources: 2014 EIA - Total Capacity est. and  
DOE Global Energy Storage Database

# *What are the ways in which such devices be integrated into the energy market?*



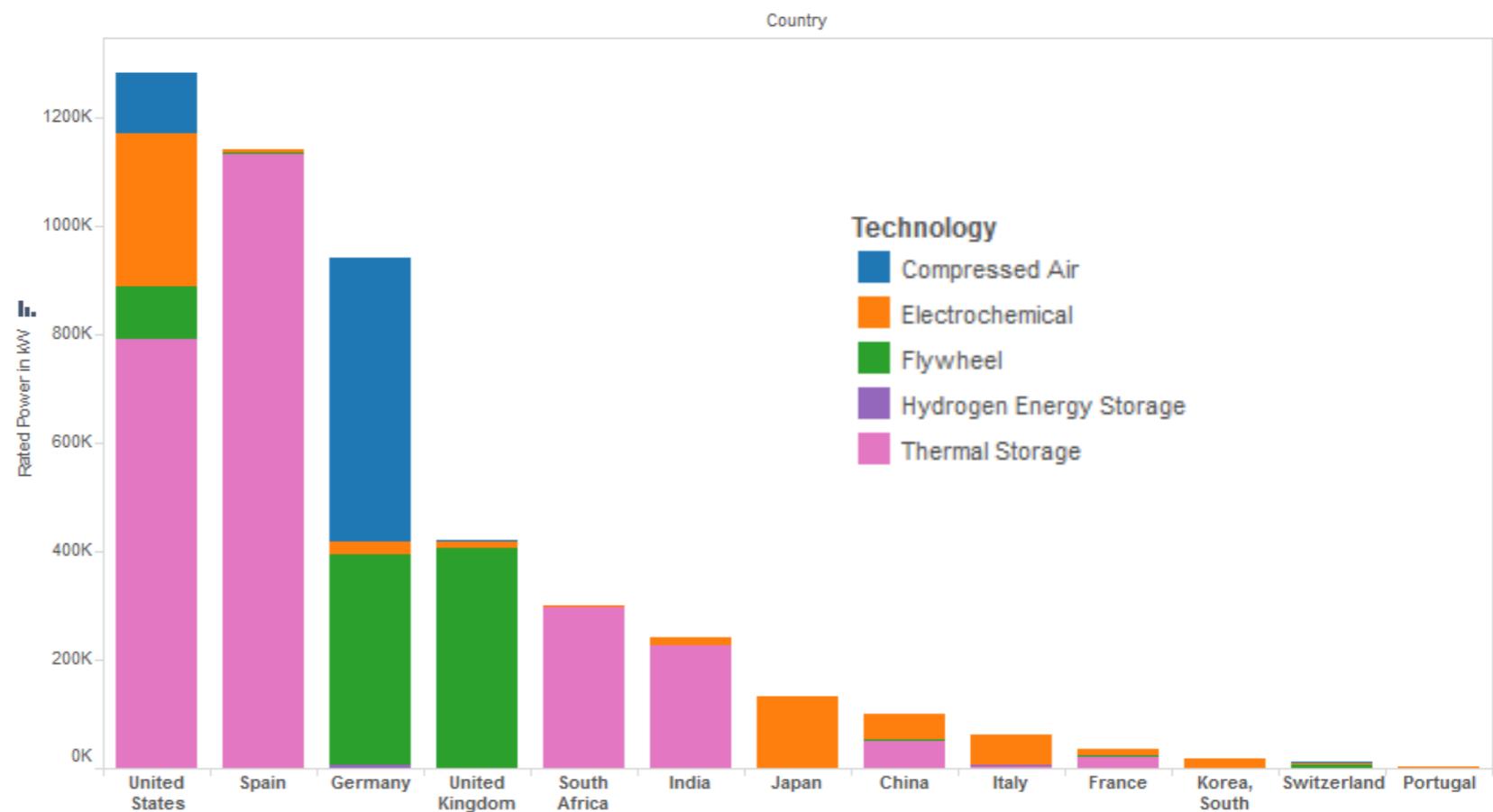
**145 GW of Global Energy Storage**

# How is energy storage handled in different countries?

## ES Technology by Country

Technology	Country										Rated Power in kW
	China	Japan	United States	Italy	Spain	India	Switzerland	Germany	France		
Compressed Air			113,580				500	521,000			
Electrochemical	45,990	130,921	280,415	55,777	6,326	15,045	1,110	24,377	11,042		
Flywheel	2,000		97,575		2,100		9,000	389,400	700		
Hydrogen Energy Storage				1,200				3,520	150		
Pumped Hydro	33,199,000	28,651,780	21,682,700	7,484,700	6,889,200	6,772,000	6,427,000	6,228,420	5,812,000		
Thermal Storage	51,500		790,751	4,720	1,131,800	226,175		1,500	23,500		

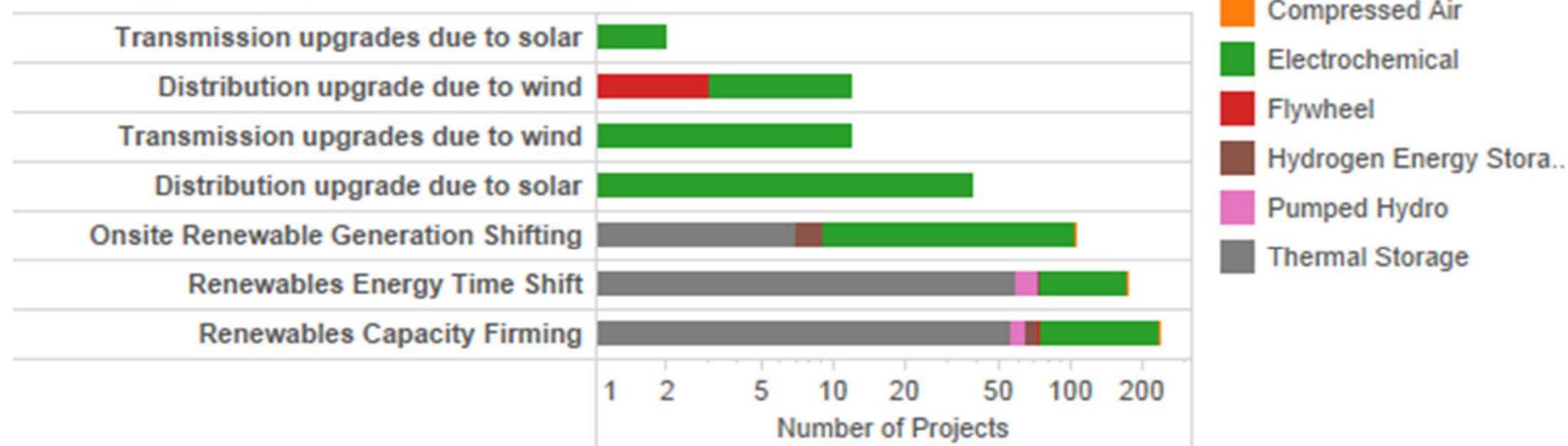
Without pumped hydro



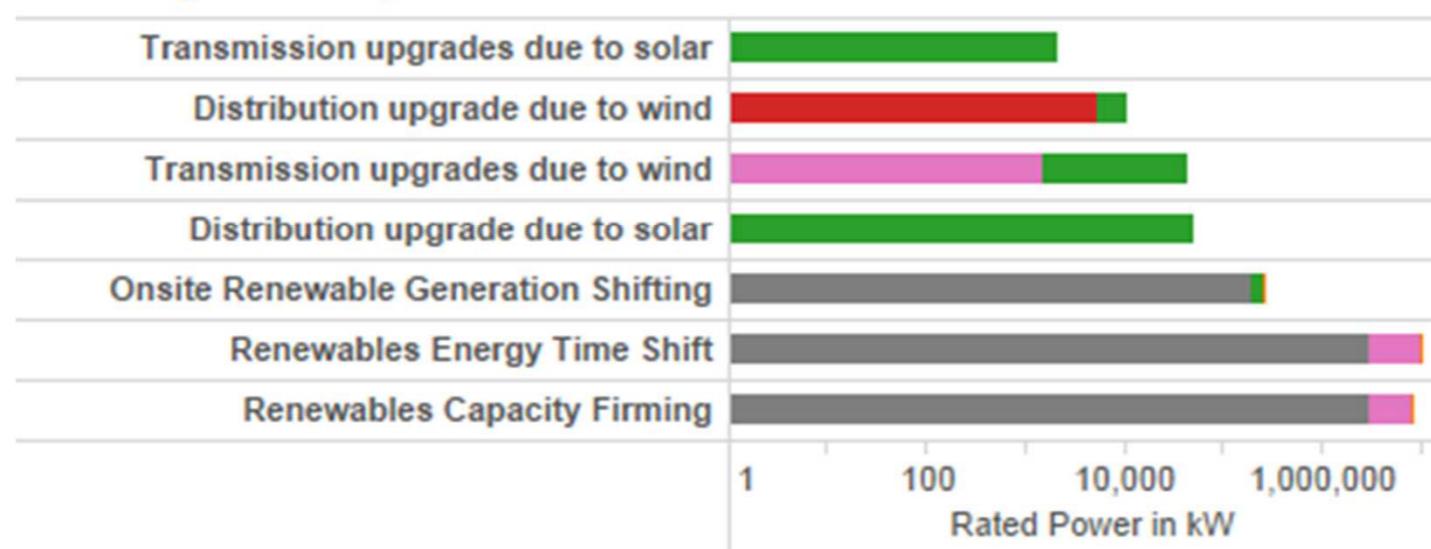
Data and charts: [https://public.tableausoftware.com/views/EnergyStorageByCountry/ESTechnologybyCountry?:embed=y&:display\\_count=no](https://public.tableausoftware.com/views/EnergyStorageByCountry/ESTechnologybyCountry?:embed=y&:display_count=no)  
[https://public.tableausoftware.com/views/EnergyStorageByCountry/ESTechnologyWithoutHydro?:embed=y&:display\\_count=no](https://public.tableausoftware.com/views/EnergyStorageByCountry/ESTechnologyWithoutHydro?:embed=y&:display_count=no)

# How is Renewable Energy Sources are Being Integrated with Storage?

RE Integration by Number of Projects



RE Integration by Rated Power



[https://public.tableausoftware.com/views/EnergyStorageUseCases/REIntegrationUseCases?:embed=y&:display\\_count=n](https://public.tableausoftware.com/views/EnergyStorageUseCases/REIntegrationUseCases?:embed=y&:display_count=n)  
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## 2015 Plans

- Build out the Policy section
- International partnerships
- Create Codes, Standards and Regulations section
- Provide Data visualization tools
- Increase publicity and visibility
- Improve usability
- Maintenance and Project verification



[www.sandia.gov/ess/database](http://www.sandia.gov/ess/database)

## Summary

- Database went live in May 2012
- 1088 Total Projects = 183.5 GW (145 GW Operational)
- Tool designed to be accessible to a wide variety of stakeholders
- Help grow ES industry - providing data

Users: 41,000 visitors  
161 Countries  
635,000 page views  
October 2014



# Acknowledgement

Thank You to the DOE OE and especially  
Dr. Imre Gyuk for his dedication and support  
to the ES industry and Sandia's ES Program.

# Questions?

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*Thank You...*