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DOE Global Energy Storage Database

International Energy Agency Workshop:

The Role of Storage in Energy System Flexibility

October 22, 2014

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Overview

DOE Global Energy Storage Database(GESDB)



www.sandia.gov/ess/database

- What is the GESDB?
- Who uses the database?
- Examples
- Answer IEA Questions

The screenshot displays the DOE Global Energy Storage Database interface. At the top, there is a navigation bar with links for Home, PROJECTS, POLICIES, CODES & STANDARDS, REGULATIONS, and ABOUT. The main content area features a world map with numerous yellow circular markers indicating the locations of energy storage projects across various continents. To the right of the map is a 'Search Filters' panel with dropdown menus for Technology Type, Country, State/Province, Rated Power, Duration, Service/Use Case, Ownership Mode, Status, and Grid Interconnect. Below the map, there is a 'Projects Analysis' section with a horizontal bar chart showing the distribution of projects across different categories: Transmission upgrades due to solar, Distribution upgrade due to wind, Transmission upgrade due to solar, Distribution upgrade due to solar, Waste Renewable Generation Shifting, Renewables Energy Time Shift, and Renewables Capacity Firming. The x-axis represents Rated Power in kW on a logarithmic scale from 1 to 1,000,000. Below the chart are four project thumbnails with their respective details: Bath County Pumped Storage Station (Pumped Hydro, 3,030,000 kW), Kaheawa I Wind Project (Electrochemical, 1,500 kW), and Tres Amigas (Electrochemical, 100 kW).

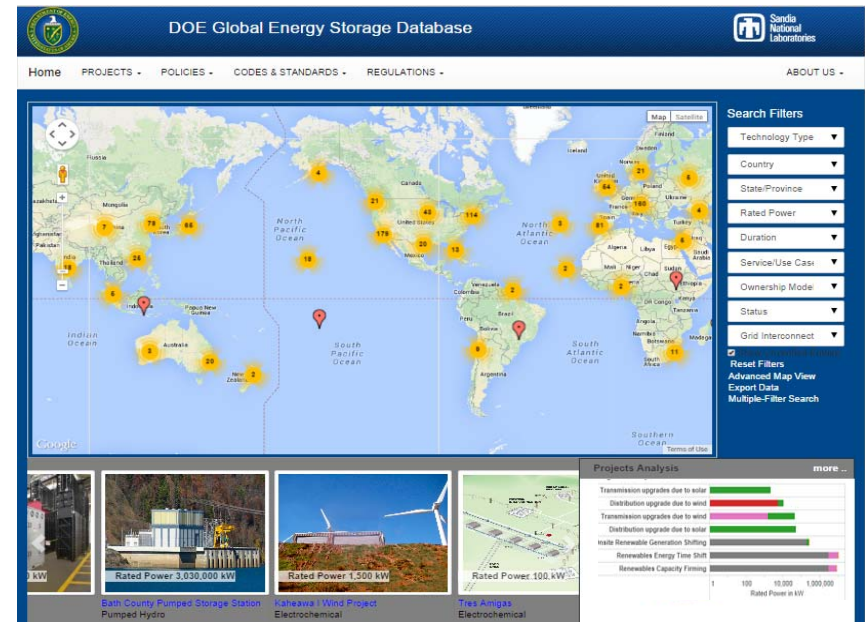


What is it?

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



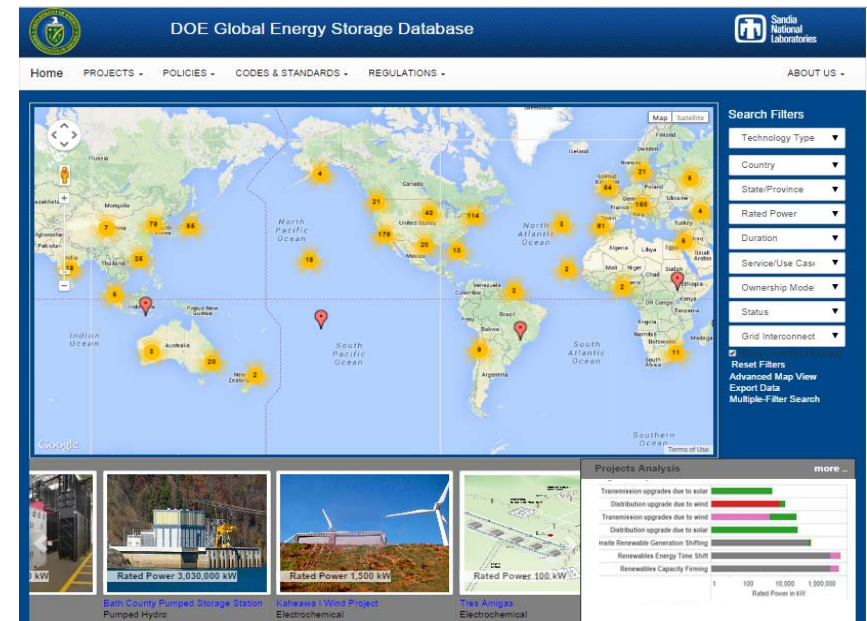


Who uses it?

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

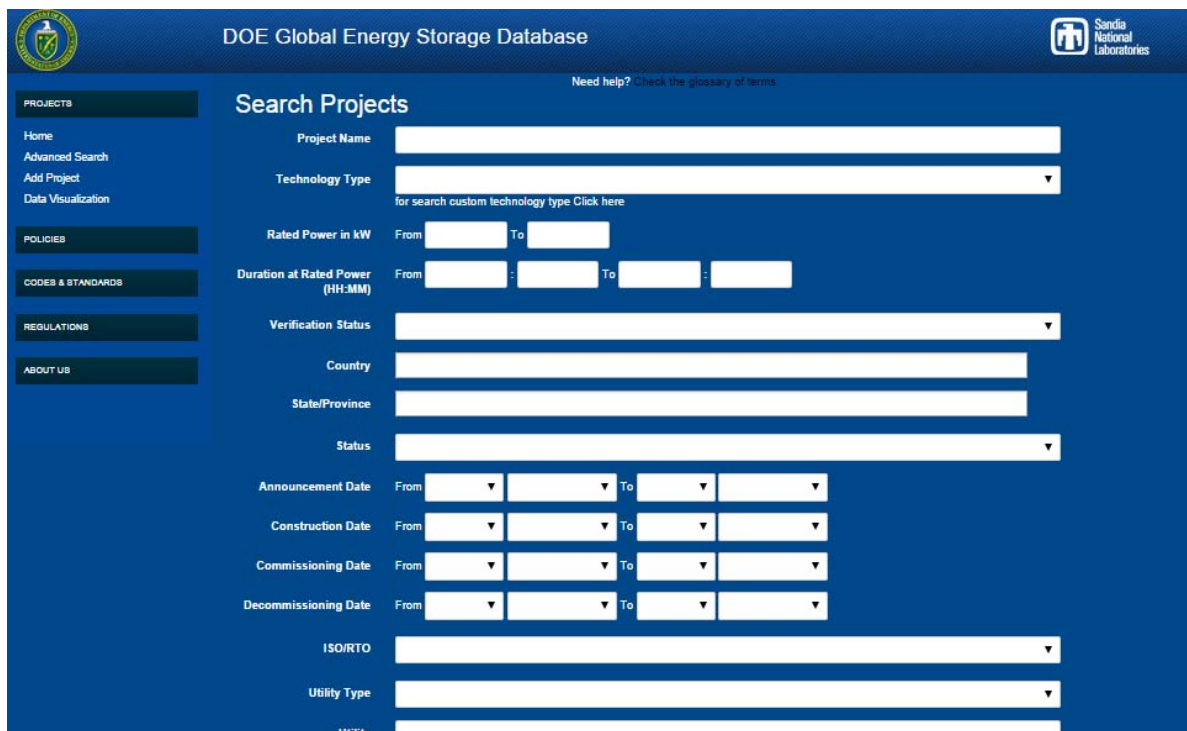
Help grow ES industry -
providing data allowing analysis
by a variety of users



What does the database contain?

Features:

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



The screenshot shows the 'Search Projects' page of the DOE Global Energy Storage Database. The page has a dark blue header with the DOE logo on the left and the Sandia National Laboratories logo on the right. Below the header is a navigation menu with categories: PROJECTS, POLICIES, CODES & STANDARDS, REGULATIONS, and ABOUT US. The main content area is titled 'Search Projects' and contains several search filters: Project Name (text input), Technology Type (dropdown menu), Rated Power in kW (From/To range), Duration at Rated Power (HH-MM) (From/To range), Verification Status (dropdown menu), Country (text input), State/Province (text input), Status (dropdown menu), Announcement Date (From/To date range), Construction Date (From/To date range), Commissioning Date (From/To date range), Decommissioning Date (From/To date range), ISORTO (dropdown menu), and Utility Type (dropdown menu). A 'Need help? Check the glossary of terms' link is also present.



DOE Global Energy Storage Database

Continually evolving to address the data needs of
emerging industry

Social Media Engagement

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

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 @ShoreHotelSM @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 @activepower

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

Retweeted by Energy Storage
CALMAC @EnergyStorage · Aug 21
Ever wonder how thermal energy storage works? calmac.com/how-does-energ... #energy #aia #hvac #buildings

Retweeted by Energy Storage
CSE @ccse · Aug 20
The growth of wind energy farms in the US, an interactive map. #windweek 1.usa.gov/ltmcD6z

Energy Storage @EnergyStorageDB · 9m
Gangneung Low Carbon Green City #Korea - 100kW #EnergyStorage from Kokam and SK C&C: ow.ly/APtt0 @skcc_twt



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



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

2 1

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... @energystorage

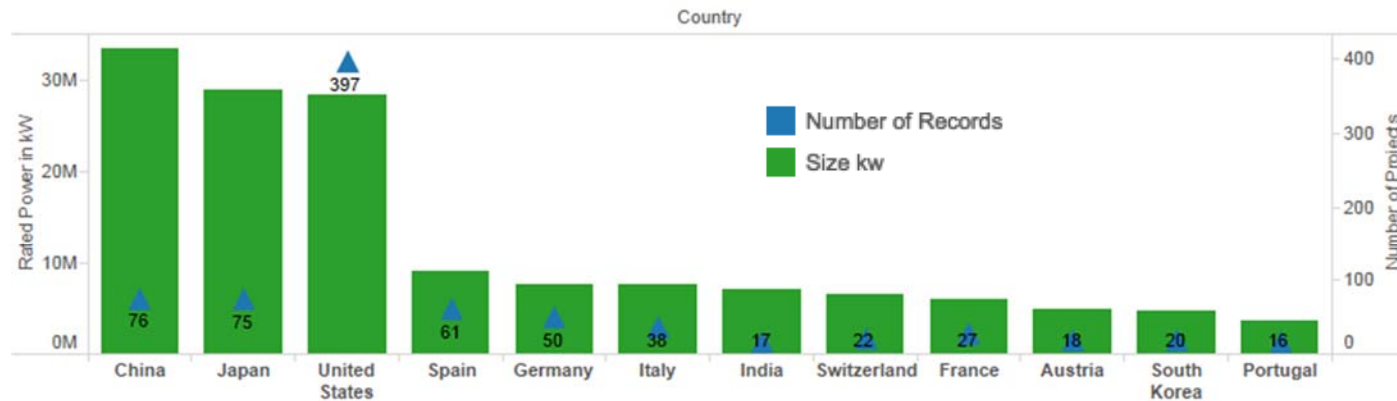
1

 Follow

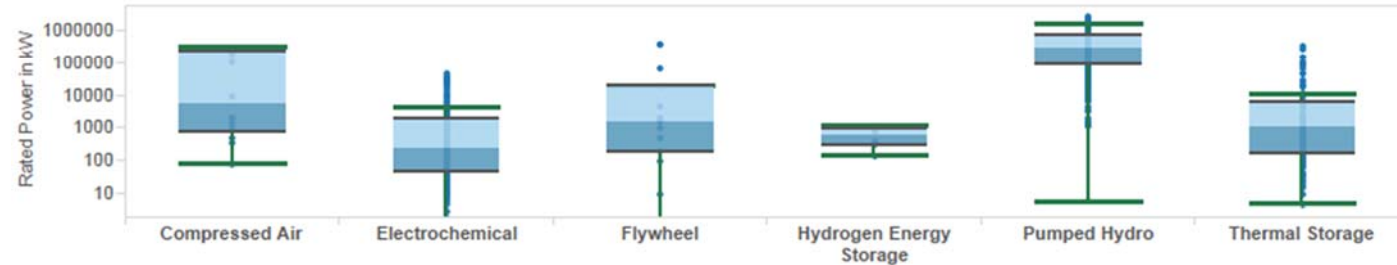
us @EnergyStorageDB

Example of New Embedded, Data Visualization Tool

Leading Countries



Size + Technology Type

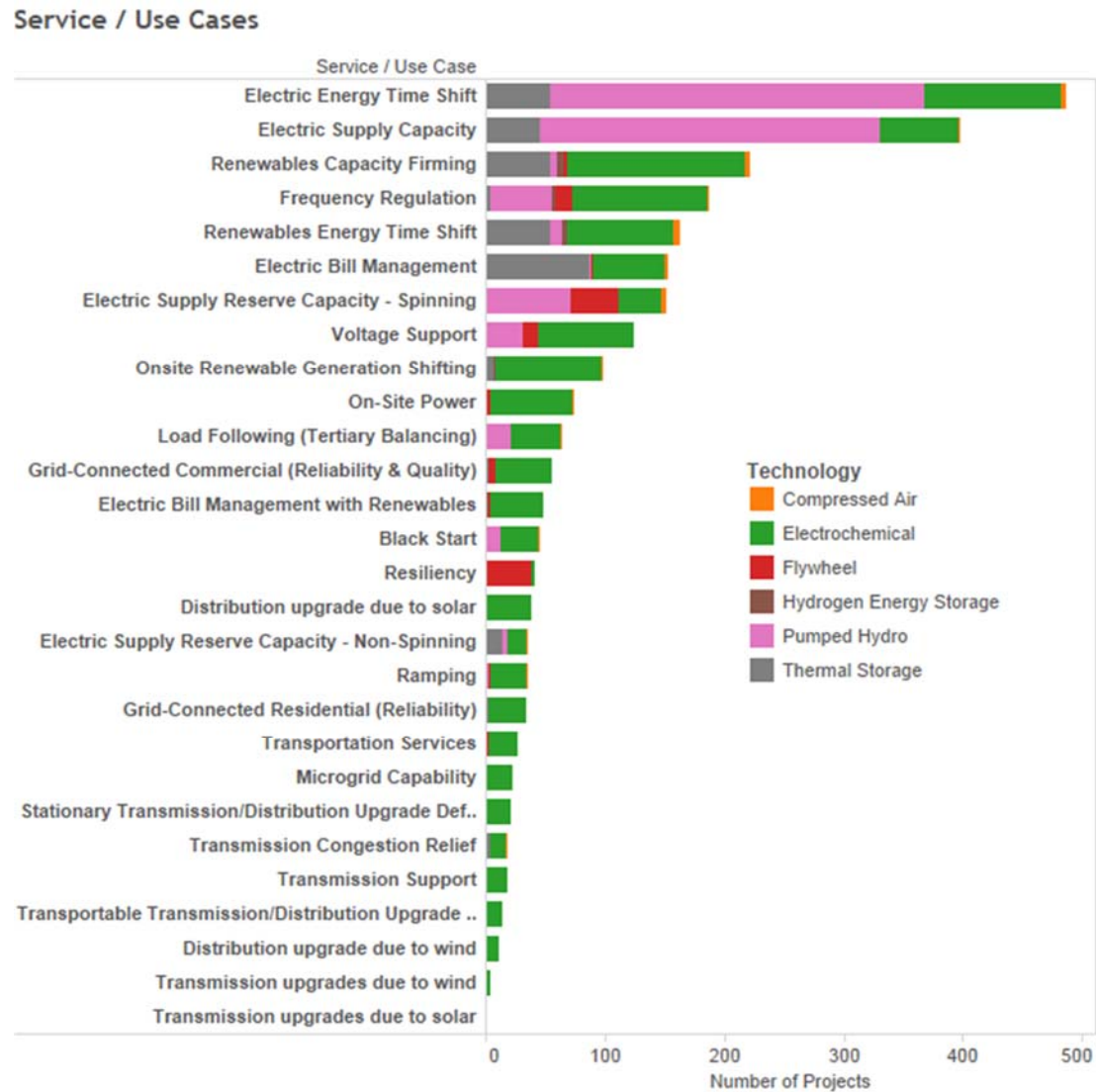


Status + Technology Type

Technology Type Category	Status					
	Operational	Announced	Contracted	De-Commissioned	Offline/Under Rep..	Under Constructi
Pumped Hydro	141,926,506	5,015,500	1,872,000		2,254,000	25,871,0
Thermal Storage	1,581,461	51,400	65,000	100	205	1,528,7
Flywheel	906,100		2,110	1,400		5,1
Compressed Air	434,850	626,000	1,000			201,5

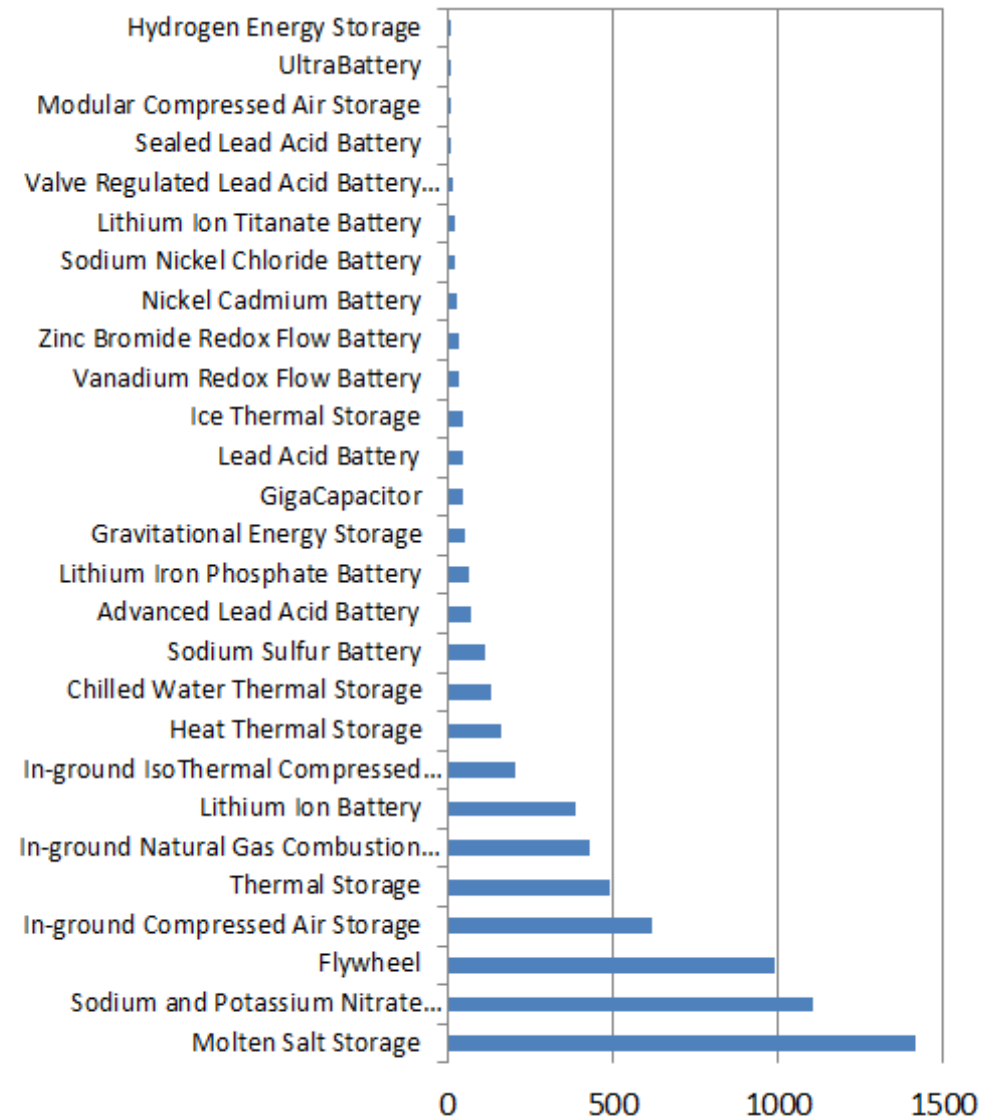
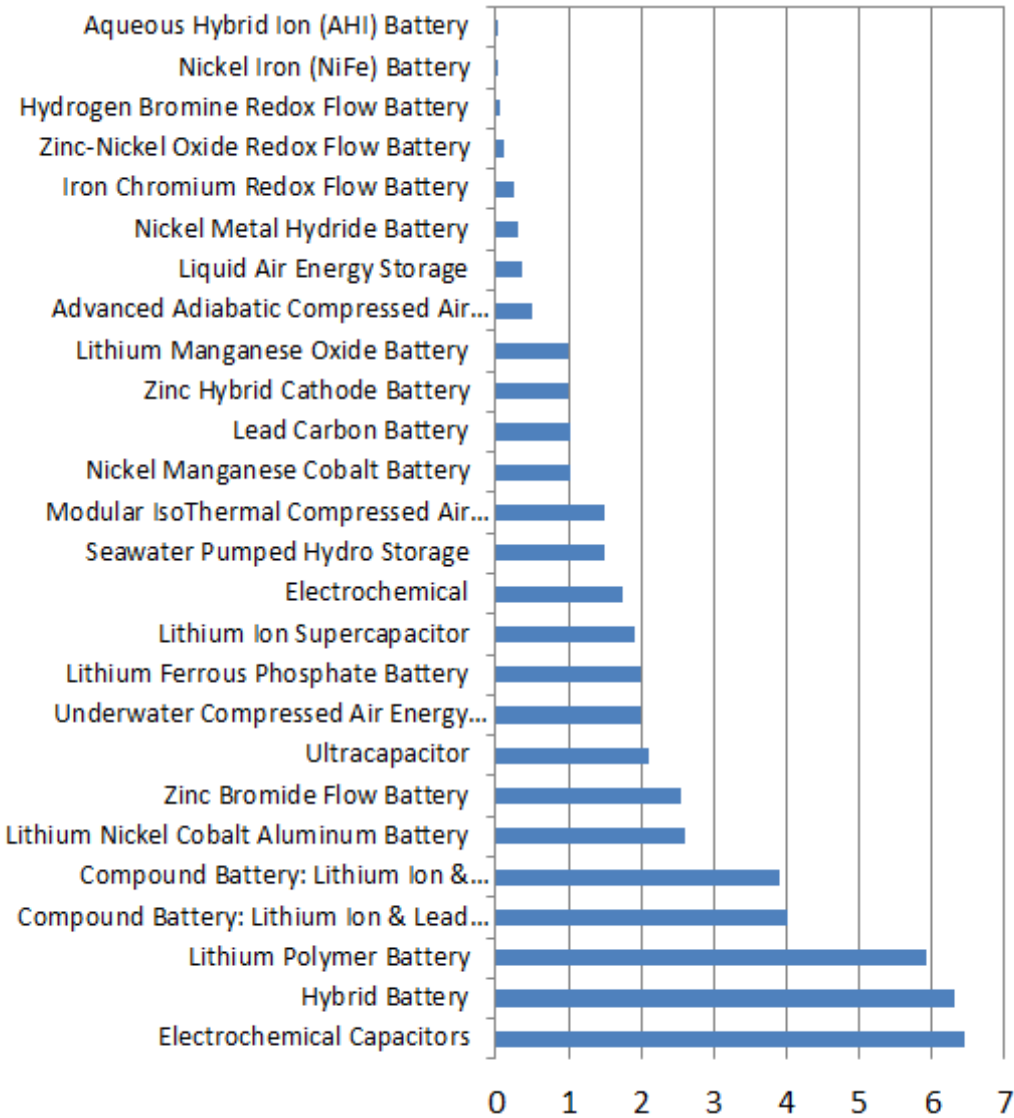


How are others using Storage?



Data: https://public.tableausoftware.com/views/EnergyStorageUseCases/ServiceUseCases?:embed=y&:display_count=no

Total Power by Technology (MW)

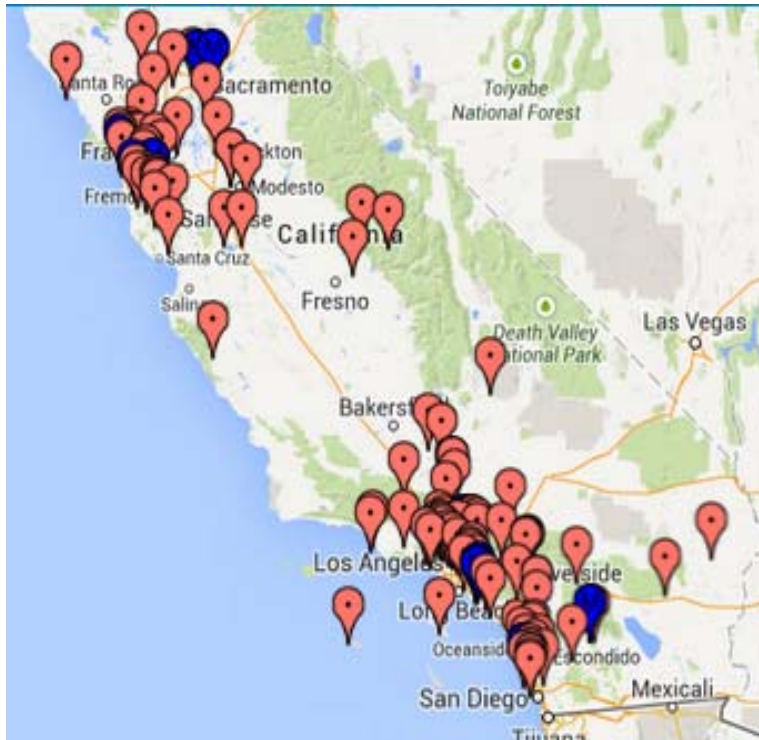


Not Shown on Graph
 Open Loop Pumped Hydro: 170.7 GW
 Closed Loop Pumped Hydro: 6.3 GW

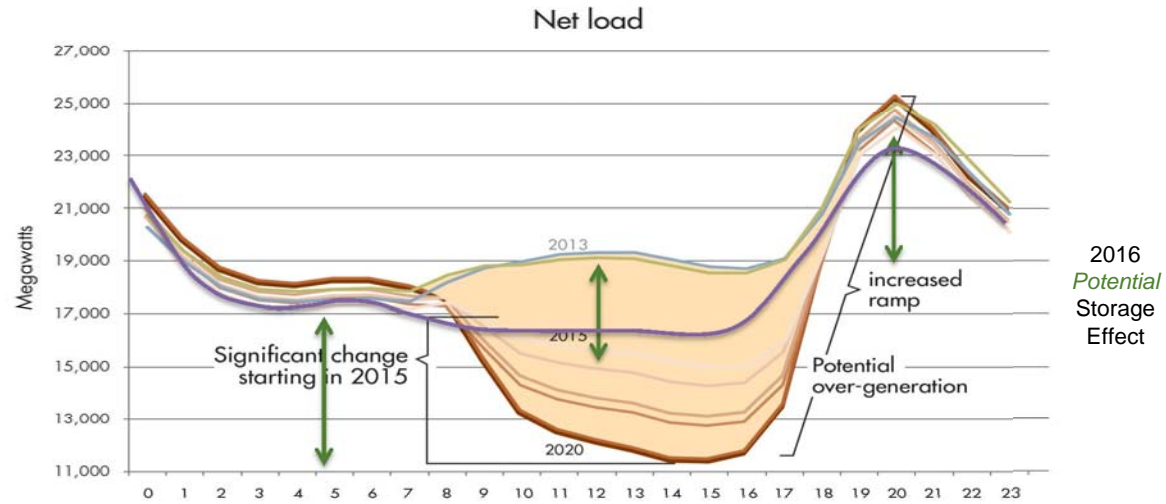
Use Cases by System Operator

Service / Use Case	Iso/Rto				
	CAISO	FERC	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 ISO
Supporting a Sustainable Future

3

<p>California Assembly Bill 2514</p>	<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 http://www.cpuc.ca.gov/PUC/energy</p>	<p>AB 2514</p>	<p>California Legislature</p>	<p>Jan 2011</p>
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Media uses

Home / Energy Storage / THE BIG PICTURE: Storage Snapshot

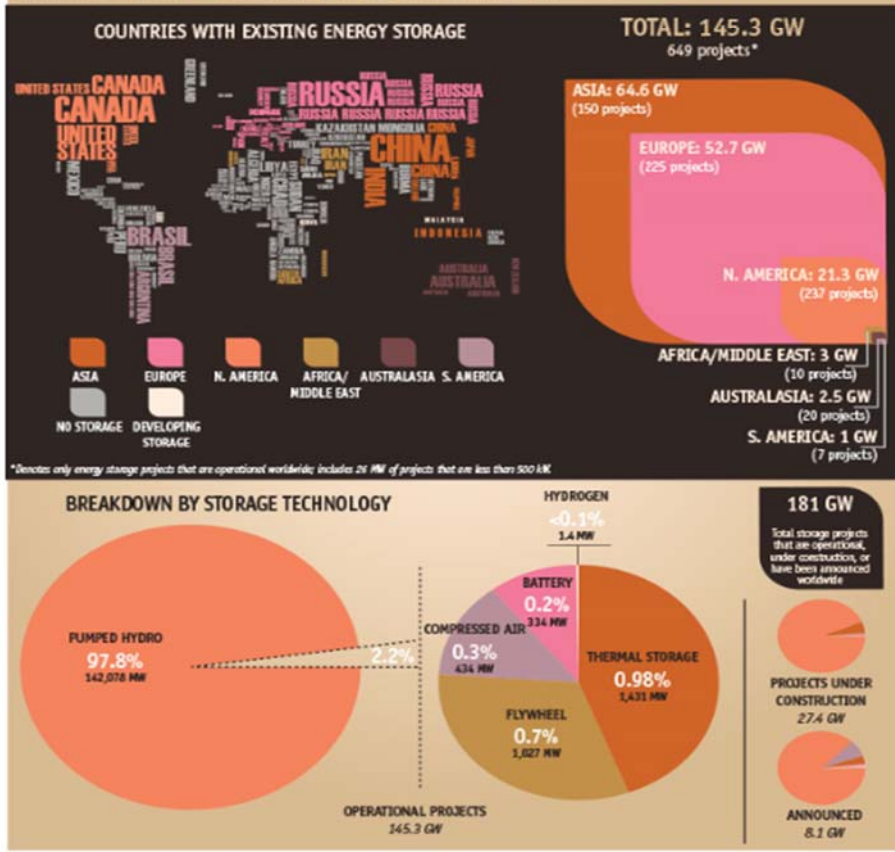
THE BIG PICTURE: Storage Snapshot

04/30/2014 | Sonal Patel

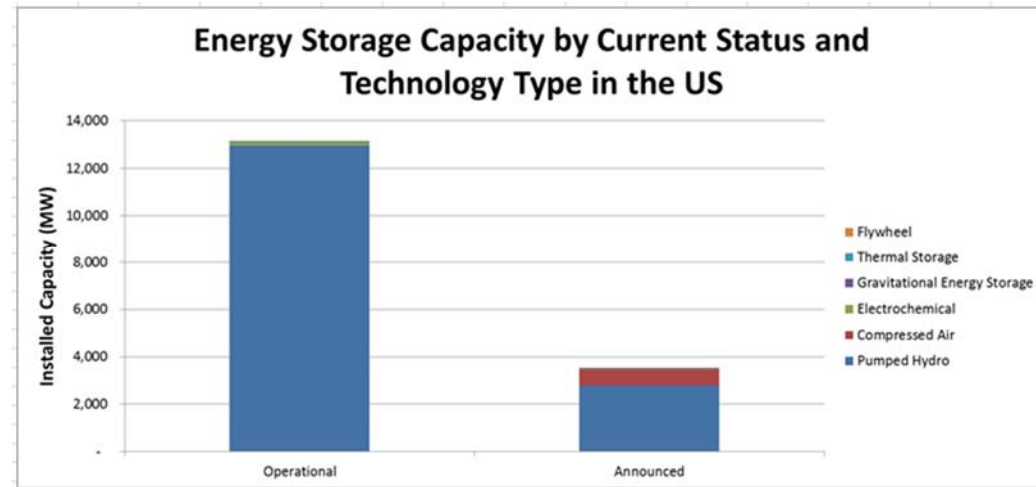
PRINT MODE : OFF

Like 0 Tweet 10 +1 1 Share 4

The world's energy storage efforts have experienced a tremendous boost in recent years, as this April 2014 U.S. Energy Department snapshot (of verified projects and projects whose verification is in process) shows. The fledgling grid storage market is expected to transform into a \$10.4 billion business by 2017, compared to just \$200 million in 2012. Storage capacity is rated here in watts—as opposed to watt-hours, energy's true measure, because most storage projects are pumped hydro (some of them seasonal) or projects that have no clear indication of duration. Sources: Sandia National Laboratories, DOE Global Energy Storage Database—Copy and artwork by Sonal Patel, a POWER associate editor.



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



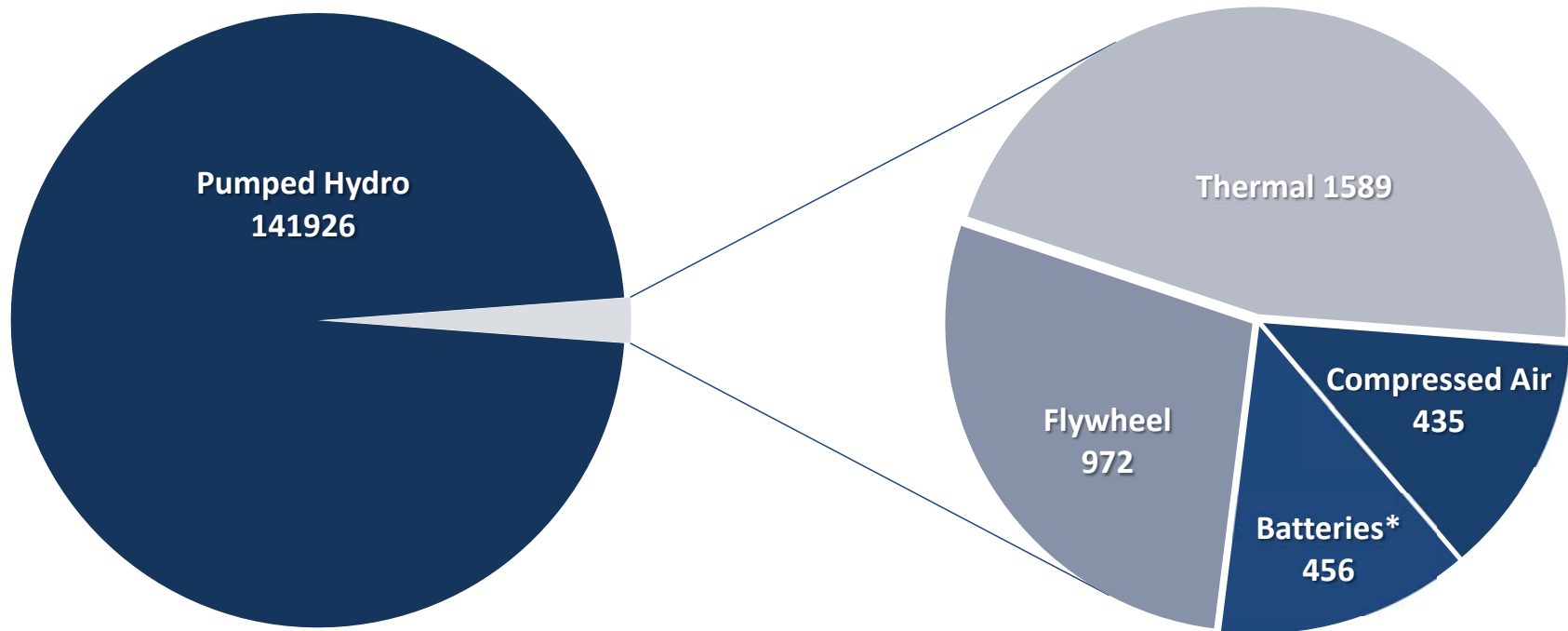
The workshop will address a broad range of topics concerned with innovation and R&D strategies for energy storage and electricity grid enhancement with a focus on how best to welcome the inclusion of variable energy sources.

- *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?*

<http://www.iea.org/publications/freepublications/publication/TechnologyRoadmapEnergyStorage.pdf>

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>)

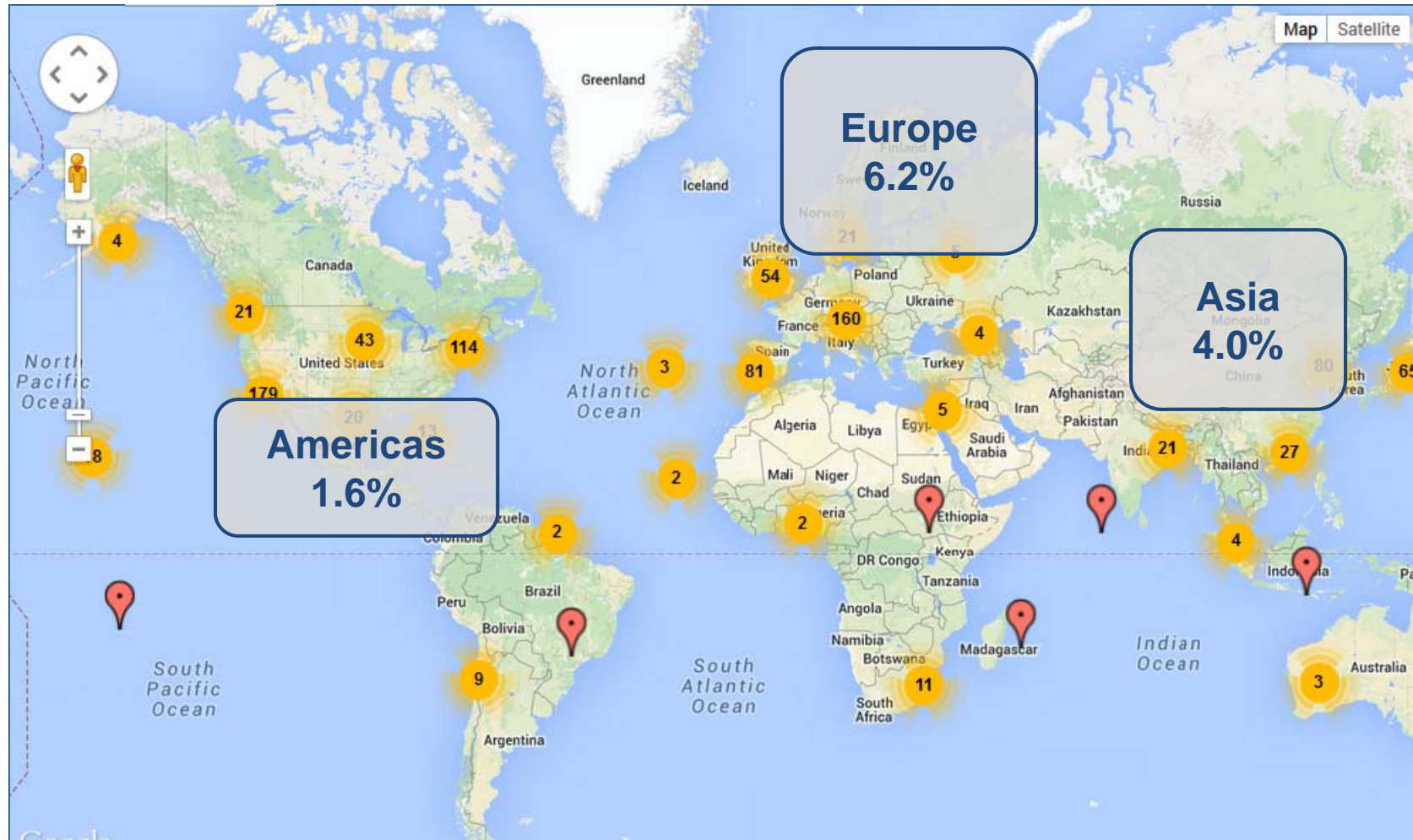
August 2014

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

1.8 % of the Total Electric Capacity

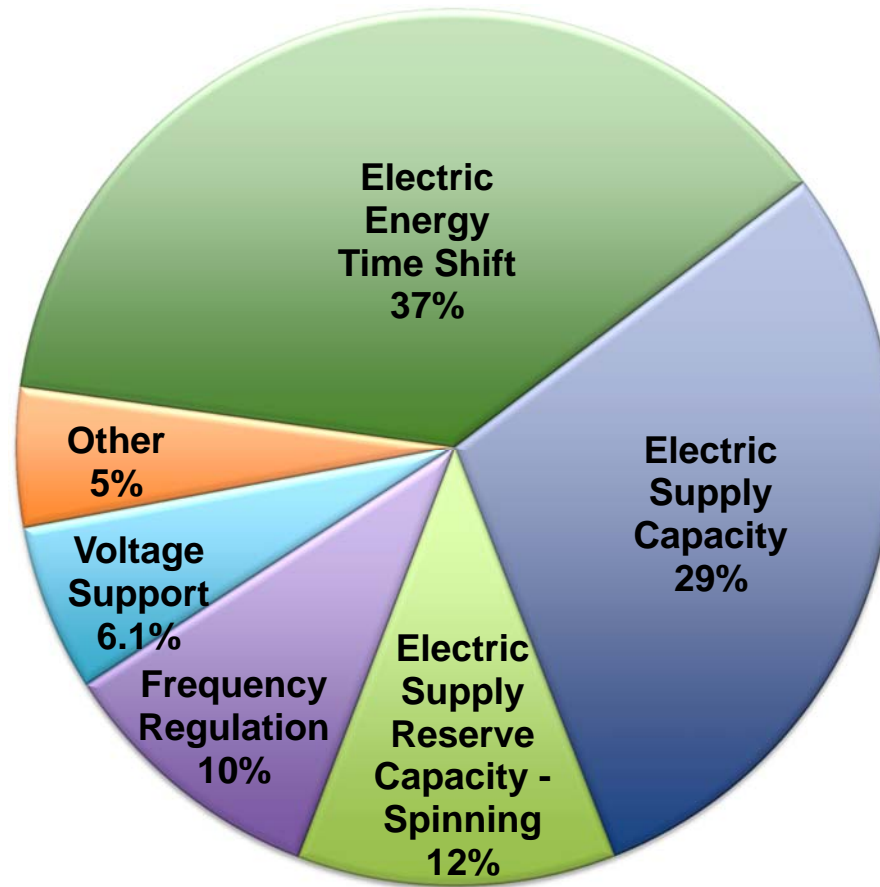


World wide is Stored!



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?



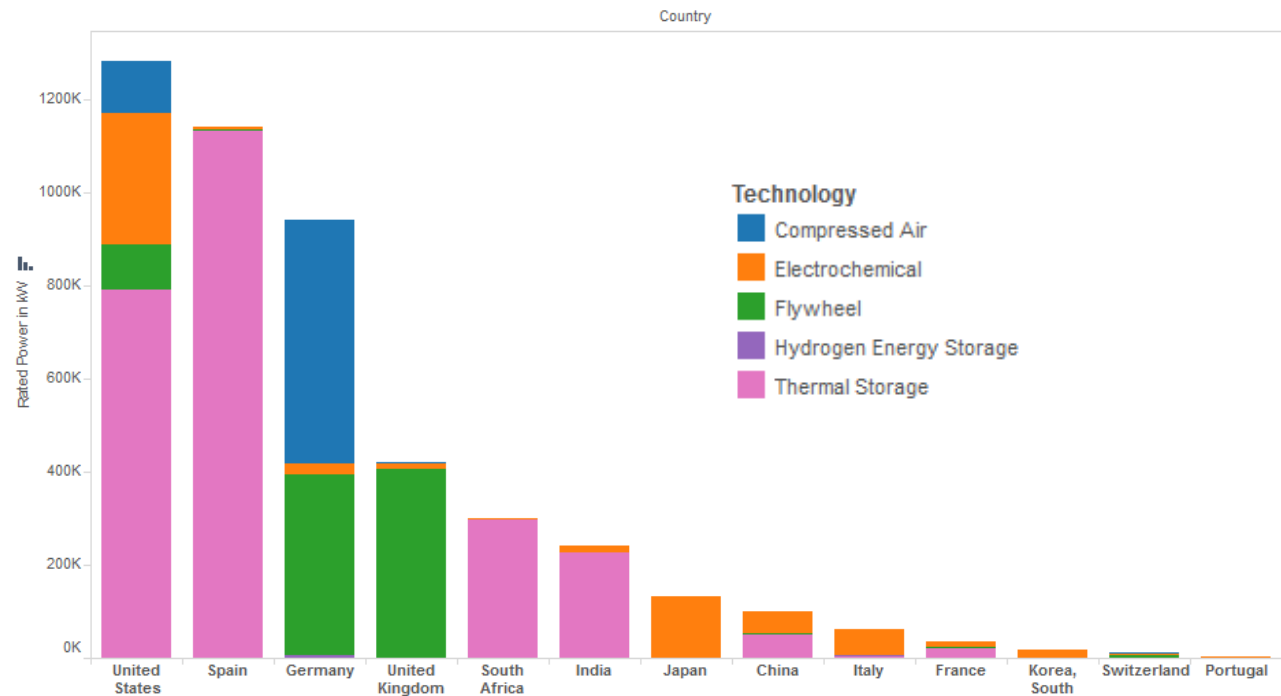
145 GW of Global Energy Storage

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	

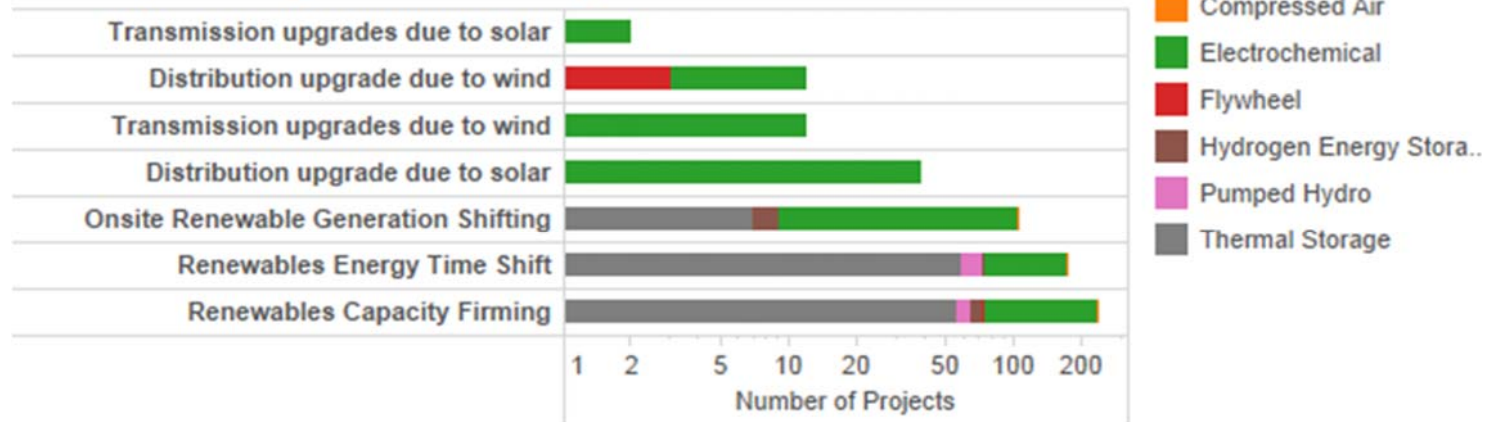
Without pumped hydro



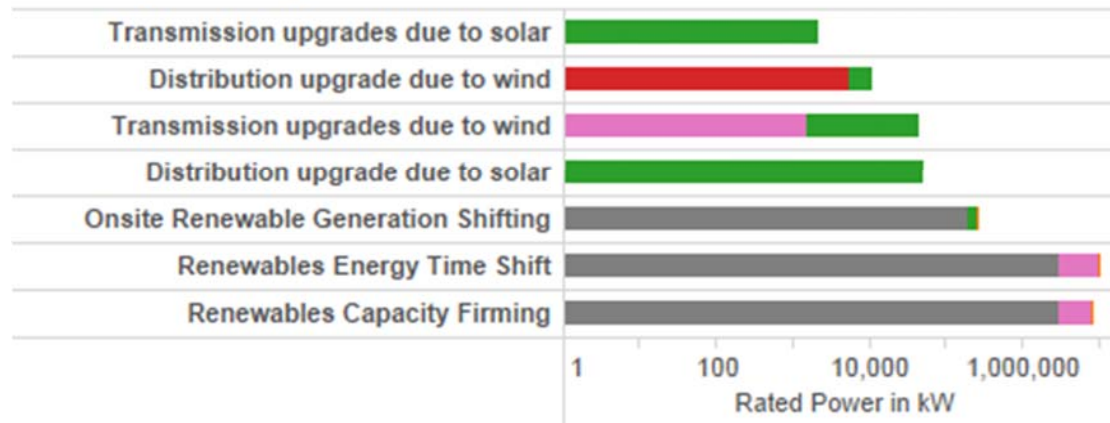
Data and charts: https://public.tableausoftware.com/views/EnergyStorageByCountry/ESTechnologybyCountry?:embed=y&:display_count=no
https://public.tableausoftware.com/views/EnergyStorageByCountry/ESTechnologyWithoutHydro?:embed=y&:display_count=no

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

0



DOE Global Energy Storage Database



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

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



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...