Advancing Implementation of Energy Storage Technologies in The United States

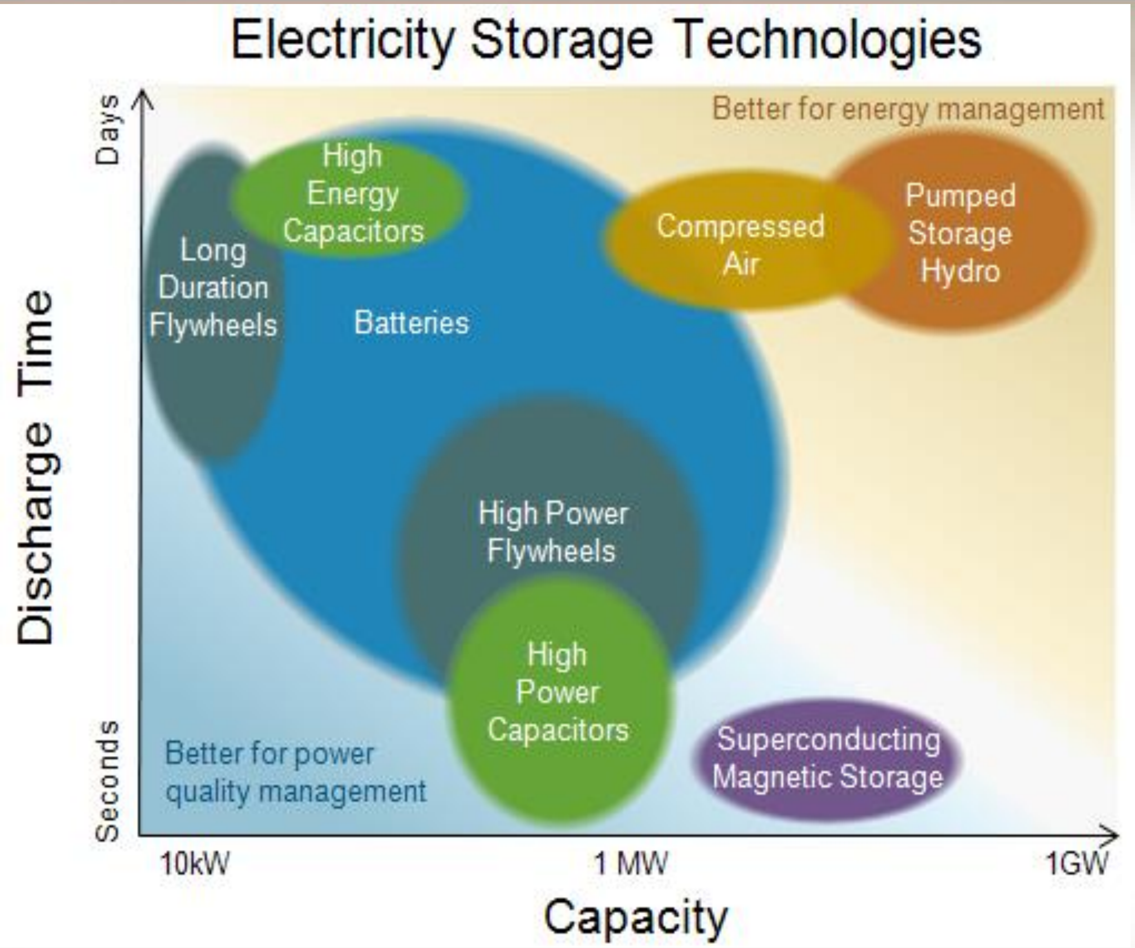
Dr. Miriam Lev-On and Dr. Perry Lev-On
The LEVON Group, LLC

Samuel Neaman Institute, Technion
Energy Storage Forum, 15 June 2015

Energy Storage Potential

- Supply daily fluctuating demand in a cost-effective manner with minimal waste,
- Keep the lights on during severe storms, supply shortages and power interruptions,
- Help consumers avoid high utility rates by offsetting the need to generate new electricity during peak demand
- Facilitate integration of variable renewable energy sources such as solar and wind power

Electricity Storage Technologies



- Significant activity to deploy energy storage technology and foster acceptance
- it is a challenge to compare the performance of different systems

Source: EIA and Energy Storage Association

DOE Global Energy Storage Database (GESDB)

- Freely accessible database with timely updates
  - World-wide energy storage projects and facilities
  - Information on U.S. state and federal legislation/policies information

    http://www.energystorageexchange.org/

- 1.8% of total electricity capacity is stored
  - Americas – 1.6%
  - Europe – 6.2%
  - Asia – 4.0%

Electricity Storage Projects

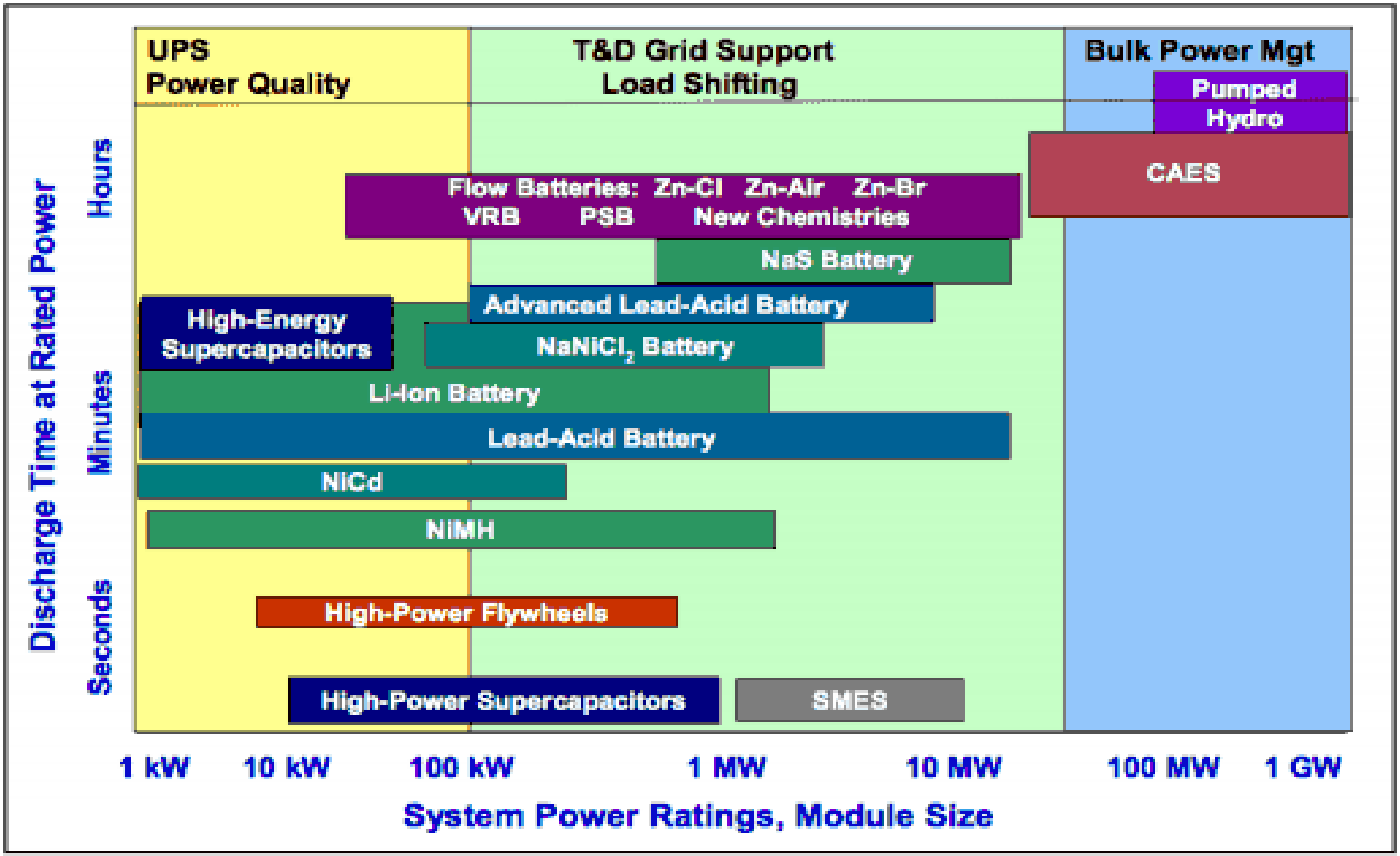
Source: U.S. DOE Global Energy Storage Database

Global Storage Capacity

- Global installations: 145,378 MW representing 50 technologies (August 2014)
  - Pumped Hydro – 141,926 MW (97.6%)
  - Thermal – 1,589 MW (1.1%)
  - Flywheel – 972 MW (0.7%)
  - Compressed air – 435 MW (0.3%)
  - Batteries* – 456 MW (0.3%)

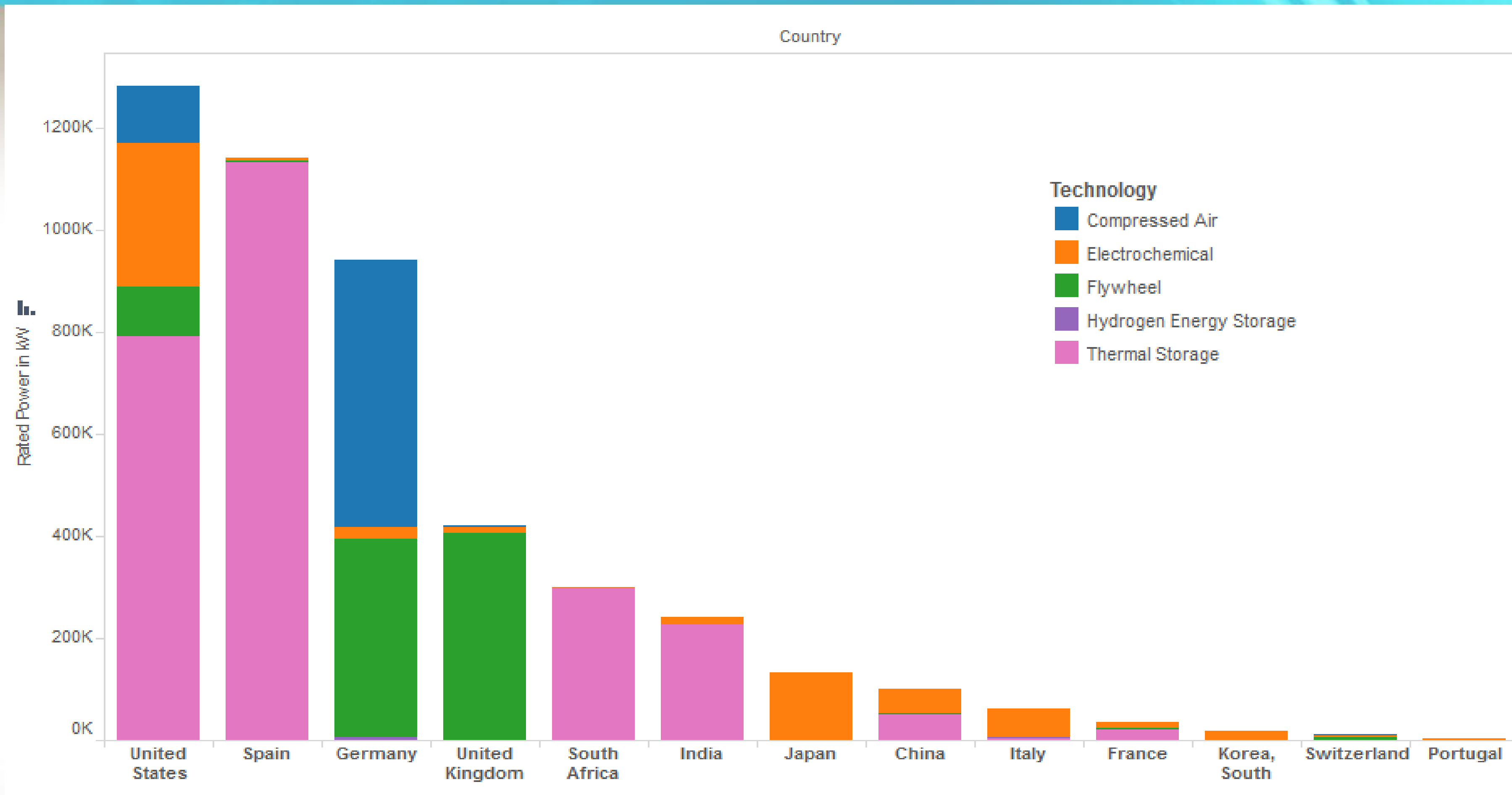
*Batteries include Flow, Lithium Ion, Sodium Sulfur, Nickel Cadmium, Lead Acid, Electrochemical Capacitors, and Ultra Batteries

Comparison of Existing Energy Storage Technologies



Source: U.S. DOE, Sandia National Laboratory

Energy Storage Technologies By Country w/o Pumped Hydro



Source: www.sandia.gov/ess/database

Challenges of Comparing Energy Storage with Traditional Generation

- Storage acts as both generation and load
- Generation is limited by the available energy in storage
- Value proposition can span across generation, transmission, and distribution systems (“value stacking”)
- Limited commercialization of many of the technologies
- Value proposition includes sub-hourly benefits that may not be captured with standard power system models or methods
- Lack of standardized and interoperability of communications and controls with existing utility control and communications systems

Electricity Storage Handbook

- U.S. DOE/EPRI Electricity Storage Handbook (July 2013)
  http://www.sandia.gov/ess/publications/SAND2013-5131.pdf
  1. Storage benefits and services
  2. Storage technologies, cost, performance and maturity
  3. Methods and tools for evaluating electricity storage
  4. Storage system procurement and installation
- Service-specific technical details and considerations of 18 services and applications in five services groups
  - Bulk energy services
  - Ancillary services
  - Transmission infrastructure services
  - Distribution infrastructure services
  - Customer energy management services

Energy Storage System Protocol

- Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems

  (Revision 1, June 2014)

  http://www.sandia.gov/ess/docs/ESS_Protocol_Rev1_with_microgrids.pdf

- Applications considered:
  - Peak Shaving
  - Frequency Regulation
  - Microgrids islands in three different scenarios

    (a) With renewables; (b) With renewables, but no frequency regulation;

    (c) Without renewables and without frequency regulation
  - PV Smoothing

    Use of an energy storage system to mitigate rapid fluctuations in variable photovoltaic (PV) power output

Federal Incentives for Energy Storage

- Federal Energy Regulatory Commission Order # 792
  - Directs transmission providers to define electric storage devices as generating facilities enabling the use of generator interconnection procedures
- Other support for energy storage
  - Business Energy Investment Tax Credit
  - U.S. Department of Agriculture High Energy Cost Grant Program
- U.S. DOE programs
  - Grants to fund research and demonstration of new technologies including storage

California Roadmap to Advance Energy Storage

- Challenges to advancing and maximizing the value of energy storage technology:
  - Expanding revenue opportunities
  - Reducing costs of integrating and connecting to the grid
  - Streamlining and spelling out policies and processes to increase certainty
- State Actions:
  - Energy storage targets for each of the Investor Owned Utilities (IOUs) totaling 1,325 MW (to be implemented by 2024)
  - Permanent Load Shifting and the Self Generation Incentive Program to incentivize customer-side energy storage
  - Fund critical research to further the effectiveness of energy storage as a viable grid resource

Texas Utility Scale Energy Storage

- Texas passed an act (SB 943, 2011) to classify energy storage installations as generation assets if they are intended to provide energy and/or ancillary services to the wholesale market. Giving them the right to
  - Interconnect; Obtain transmission service; and Sell electricity or ancillary services at wholesale
- The Electric Reliability Council of Texas lays the burden of interconnection costs on transmission
- New 2012 rulemaking treats energy storage as a wholesale market resource since the facilities are not consuming the charged energy but feeding it back to the grid later

New York Distributed Energy Storage Program

- The New York State Energy Research and Development Authority and ConEdison created an energy storage incentive program for utility customers:
  - $2,100/kW for battery storage and $2,600/kW for thermal storage
  - Integrated into the state's demand management program
  - Eligible projects need to be operational by June 1, 2016 and provide peak reduction of at least 50 kW
  - Bonus incentives available to projects that achieve a peak reduction of 500 kW

In Conclusion

- Protocols and codes are needed to measure the performance and realize the value of energy storage systems
- Energy storage includes both mature and emerging technologies so funding for further research is imperative
- Energy storage deserves to be evaluated on a par with other resources and integrated into utility resource plans
- Barriers to energy storage deployment necessitate policy intervention to promote competition among projects and technologies
- Standardized integration of the utility system and energy management systems may merit further development

Thank you for your attention

Contact Information

Dr. Miriam Lev-On, miriam@levongroup.net

Dr. Perry Lev-On, perry@levongroup.net