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Joint European Commission / EPoSS / ERTRAC: Electric Vehicle Batteries Made in Europe"

„Large storage for smart grid applications"

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Dr. Wolfgang Weydanz
Siemens AG
Corporate Technology

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Overview of topics

State of the art of energy storage in stationary systems
- Motivation
- System comparison
- Energy storage at Siemens

Requirements and options
- Options for storage in grids
- Use cases for high voltage grids
- Use cases for medium voltage grids
- integration of eCars in grids

Topics for further development, funding opportunities

Energy Storage
The Motivation of Siemens

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- Quality, reliability and safety are essential requirements for corresponding applications in industrial systems.
- Siemens holds in-house expertise in the field of energy storage in order to control and assure above mentioned criteria, but also to design new system solutions.

➢ The new challenge: The increased implementation of volatile renewable energy in the energy mix will require advanced energy storage solutions.

➢ To buffer the volatile character of wind, solar and other discontinuous technologies for power generation.

Energy Storage
Segmentation of Electrical Energy Storage Systems

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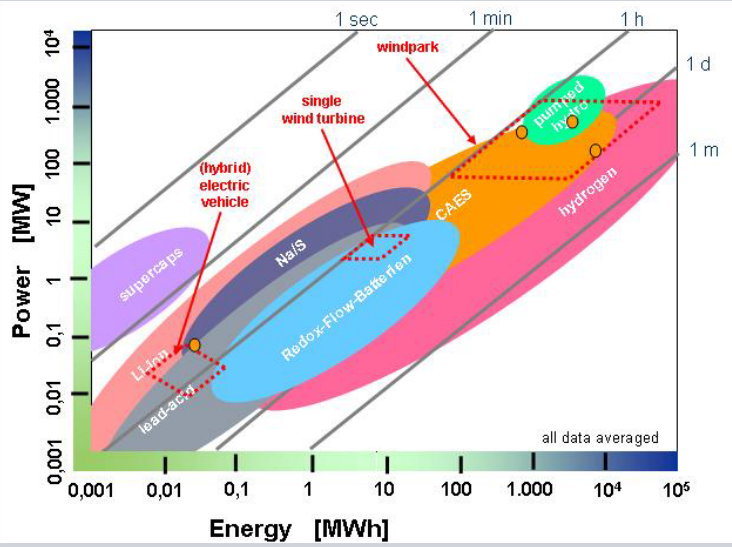

- There is no universal solution for electrical energy storage.
- For discharge times up to 100 seconds supercaps (double layer capacitors) are preferable.
- Requirements up to approximately 10 MW for max. 6-8 h can be addressed by battery-type solutions (e.g. PV and wind turbine)
- Among the large-scale solutions (pumped hydro, CAES, H_2) hydrogen provides the highest possible energy density and enables storage capacities > 100 GWh.

➢ Main criterion for choosing the right storage technology is the required discharge time. Beside that, other requirements such as energy density, user profile, etc. are decisive.

Energy Storage
Battery storage comparison, system efficiency

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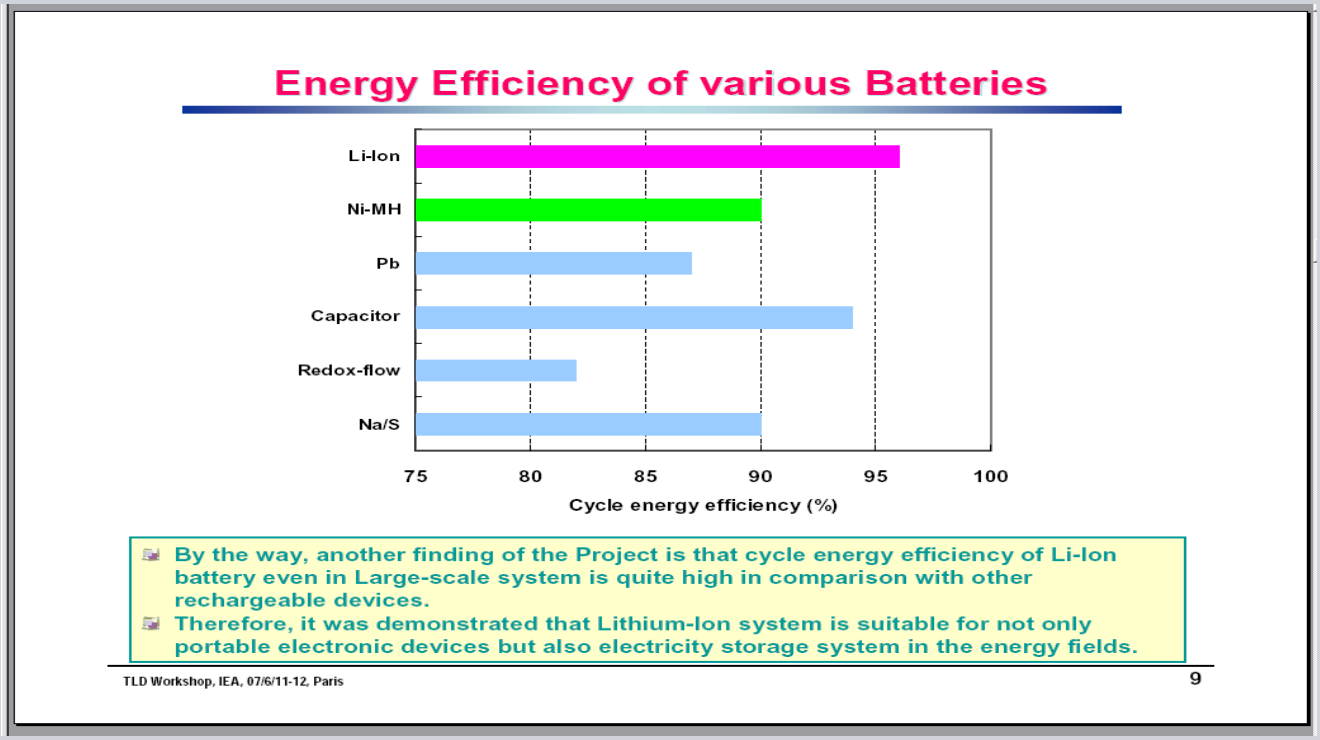

Energy Storage
Grid Integration

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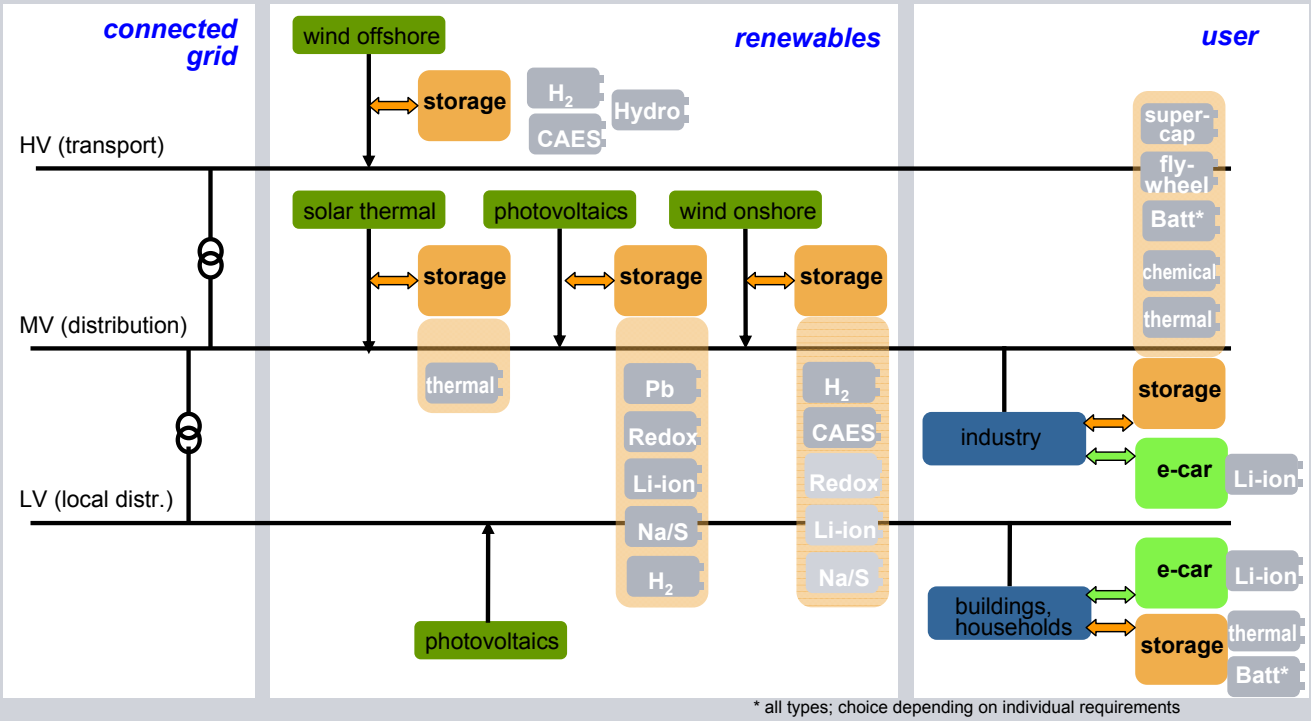

* all types; choice depending on individual requirements

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Corporate Technology group: “Energy Conversion and Environment”

Testbench (± 600A; -5V to +60V) with

climate chamber (-70°C to +180°C)

our service in the field of energy storage:

- consulting
- system design and modeling
- tests under application-relevant conditions
- battery monitoring systems

relevant systems:

- batteries (all types: lead acid, NiMH, Li-ion, NaS, flow batteries etc.)
- supercapacitors
- fuel cells for APU
- high-temperature polymer capacitors
- high-temperature energy storage

references:

- battery qualification for mobile phones
- battery testing and evaluation for electric vehicles
- support in supercap development
- benchmark tests and consulting for Transportation
- support in development for stationary storage
- development of low-cost fuel cells (aborted)
- power supplies for industrial PCs

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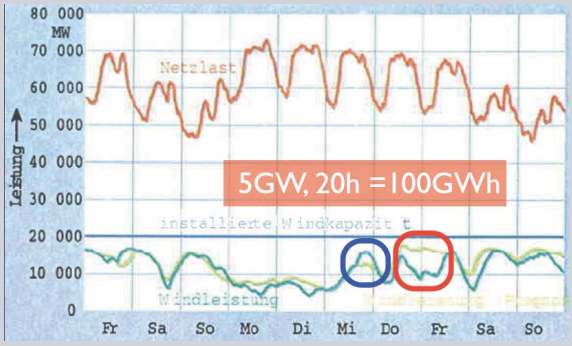
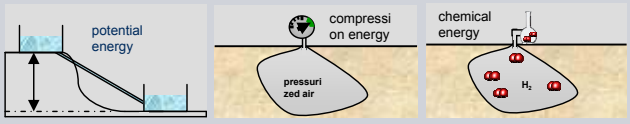
Energy Storage
Example: Energy Storage for Transmission Grids

mitigation errors are in the GWh-range !

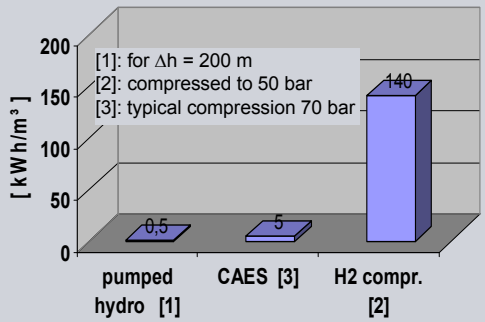


German electricity grid; selected situation in 2007

Pumped Hydro CAES Hydrogen



energy densities of large-scale options:



storage capacity: up to 1 GWh | up to 10 GWh | >100 GWh

➢ Hydrogen is the only option which enables storage capacities higher than 10 GWh (up to 1 TWh).

Energy Storage
Example: Energy Storage for Distribution Grids

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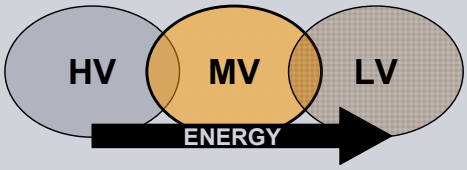
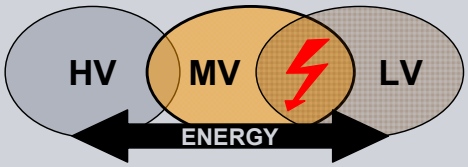
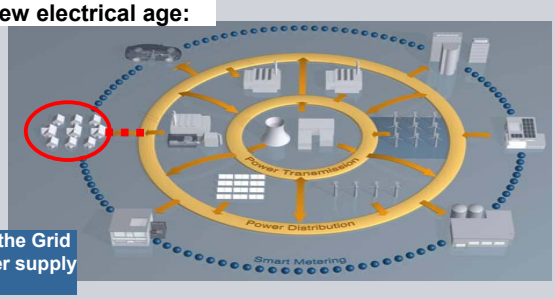
Yesterday



Today



The new electrical age:



Customers may use the Grid only as backup power supply in the future

characteristics:

increasing number of individual energy systems
- own electricity production
- decoupled from the grid

mismatch!

Generation ⟷ **Load**

demand in storage

use scenarios

- Peak shifting, e.g. day / night shift
- Peak shaving
- Storage vs. network enhancement
- Frequency regulating

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Summary

- There is no universal solution in energy storage. The use case determines the most suitable solution.
- Energy storage is one possibility to enable energy efficient operation.
- The usage of renewable energy sources in existing distribution grids is limited because power production of fluctuating renewable generation like solar and wind power varies heavily over time.
  → Energy storage can avoid help solve the issue.
- The successful integration of electrical storage into distribution grids requires a combination of application related know how, capabilities and experience regarding network design, storage system (incl. power electronics) and implementation as turn key solution projects.
- Among all electrical energy storage options, lithium ion batteries have a broad scope of applications.

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Thank you for your attention

Wolfgang Weydanz
Siemens AG
Corporate Technology