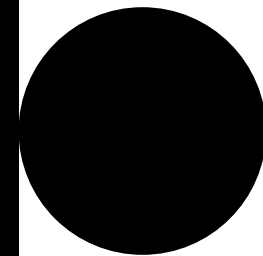


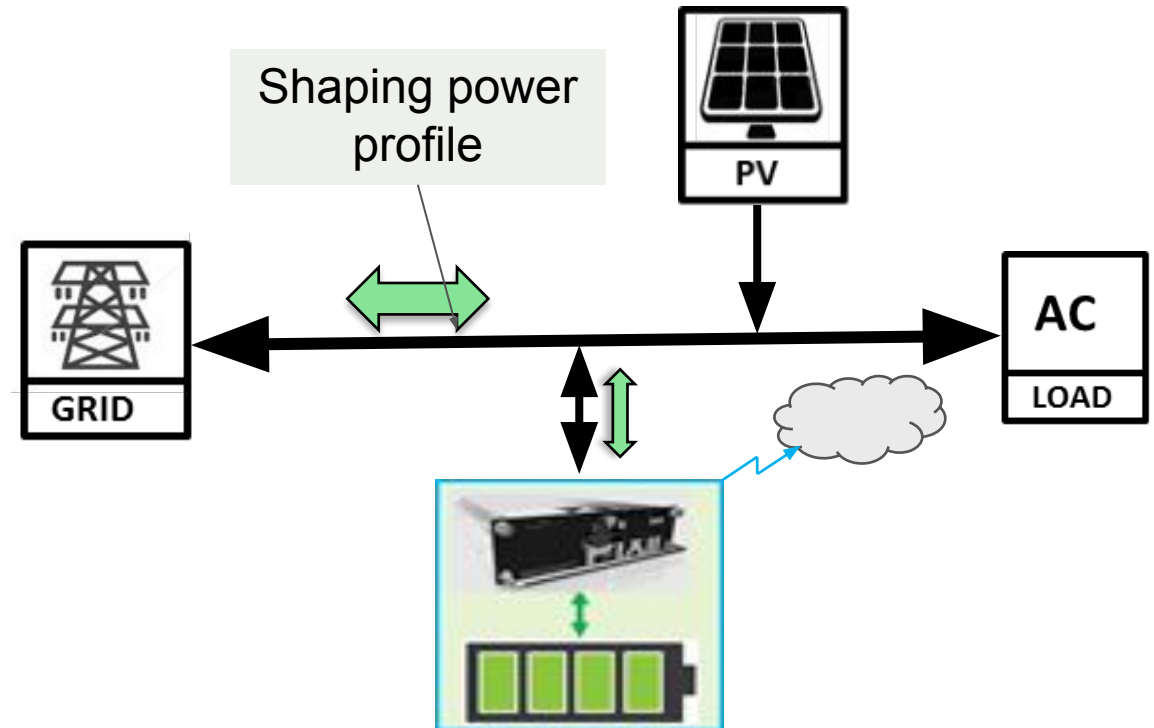
Electrical energy storage – status & trends

06.09.2018 Ole Jakob Sørдалen @ Solenergidagen



Pixii: «Shaping Power»

- Norwegian technology company
 - Established March 2018
 - 14 empl @ Sandvika & Kristiansand
- Product: Battery-based energy storage systems
 - Own technology
 - Power converters, gateway, system
 - 3rd party technology: batteries
 - Scalable power & energy capacities



Why consider battery-systems in combination with PV?

- **PROSUMERS**

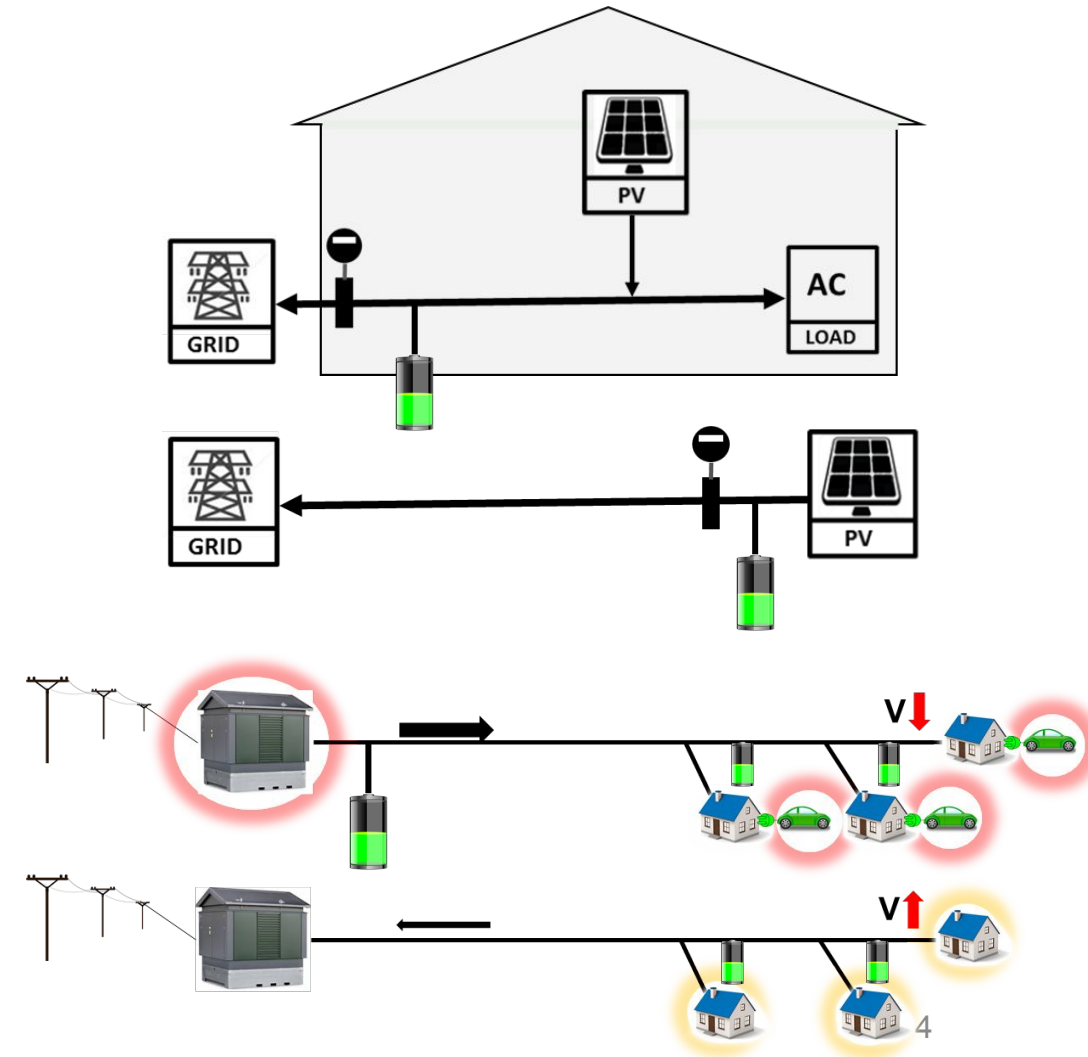
- Increase self-consumption of PV
- Reduce power peaks & demand charges
- Power back-up for critical loads
- Sell power flexibility

- **SOLAR ENERGY PRODUCERS**

- Renewable energy capacity «firming»:
compensate for rapid fluctuations
- Energy arbitration

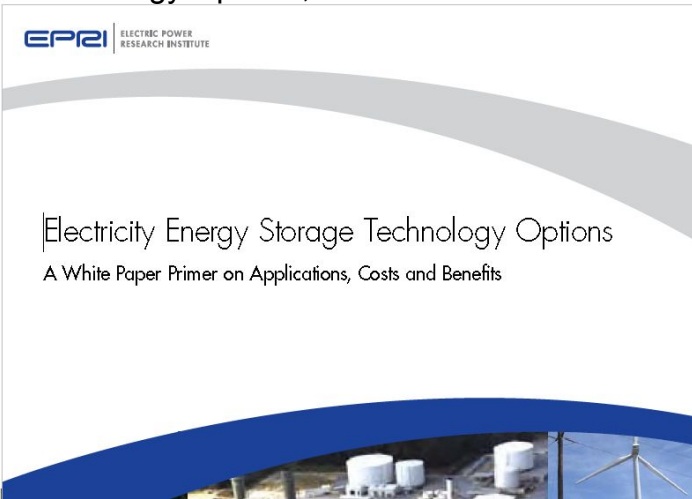
- **DISTRIBUTION SYSTEM OPERATORS**

- Increase distribution quality & capacity



Different technologies for various applications

Sources: EPRI Electricity Energy Storage Technology Options, 2010

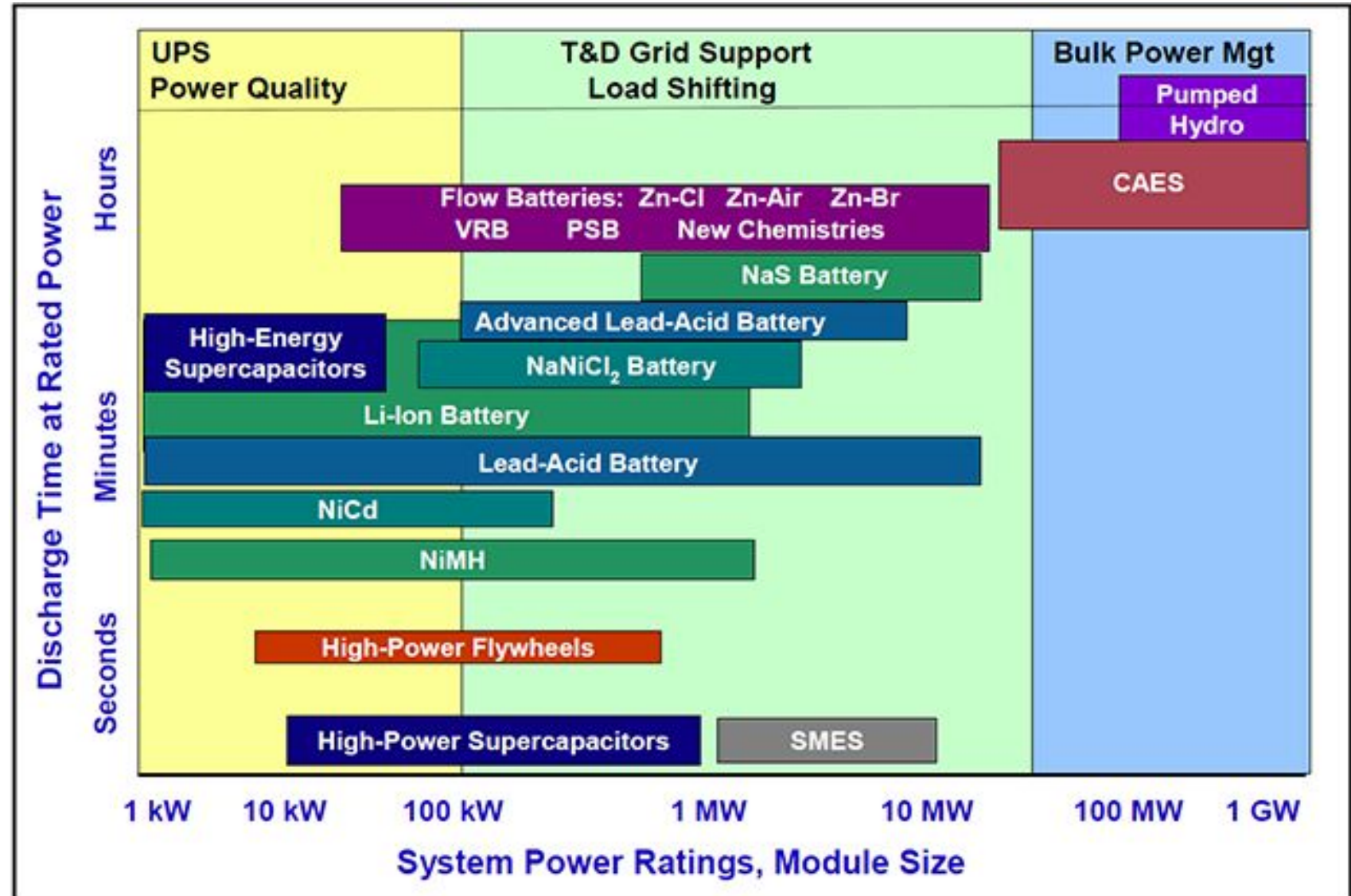


Sources: SANDIA DOE/EPRI Electricity Storage Handbook:, 2015

SANDIA REPORT
SAND2015-1002
Supersedes SAND2013-5131
Unlimited Release
February 2015

**DOE/EPRI Electricity Storage Handbook
in Collaboration with NRECA**

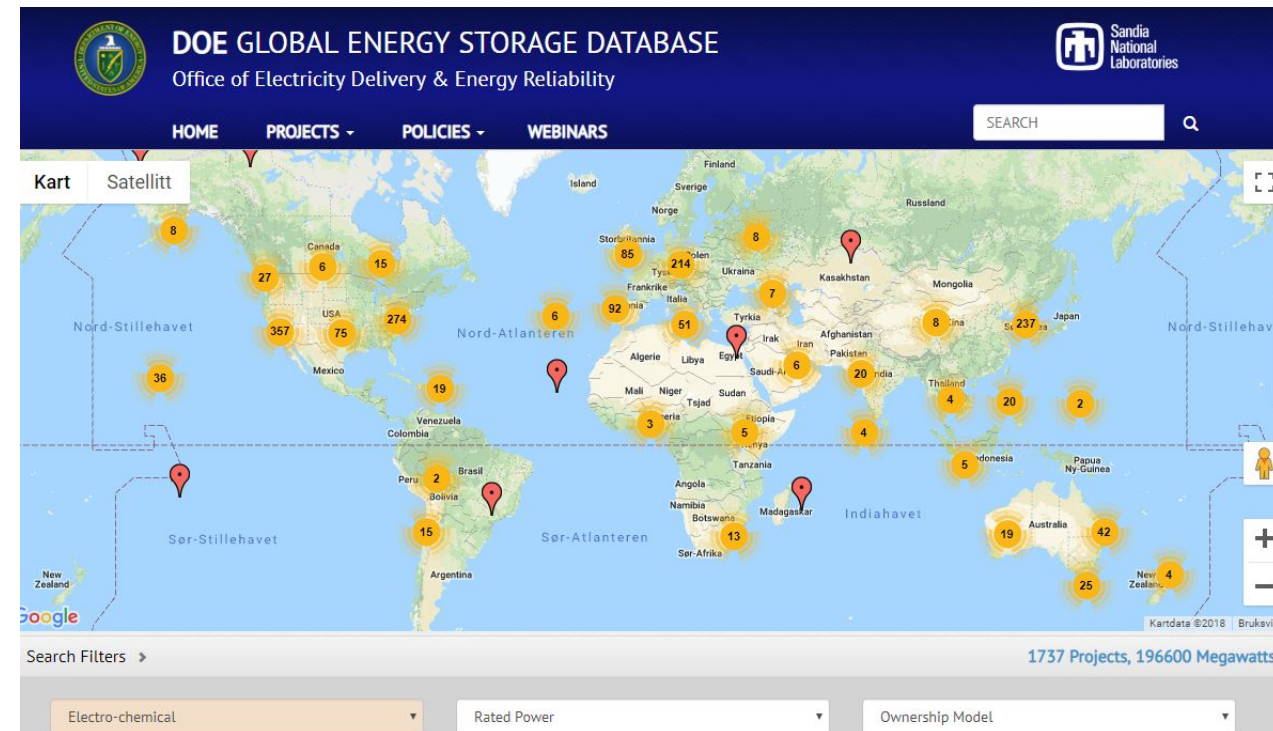
Abbas A. Akhil, Georgianne Huff, Aileen B. Currier, Benjamin C. Kaun, Dan M. Rastler,
Stella Bingqing Chen, Andrew L. Cotter, Dale T. Bradshaw, and William D. Gauntlett



Status energy storage projects

- DOE global energy storage database:
 - «All» technologies
 - 1737 projects
 - 196 GW (in various phases)
- «Electro-chemical» / Batteries:
 - In operation
 - 719 projects
 - 2068 MW
 - Announced / under construction
 - 212 projects
 - 214 MW
- Grid-connected batteries:
 - 3,8GW (2017) → **23,4GW** (2022)

Lead Acid: 44 MW Li-Ion: 1703 MW



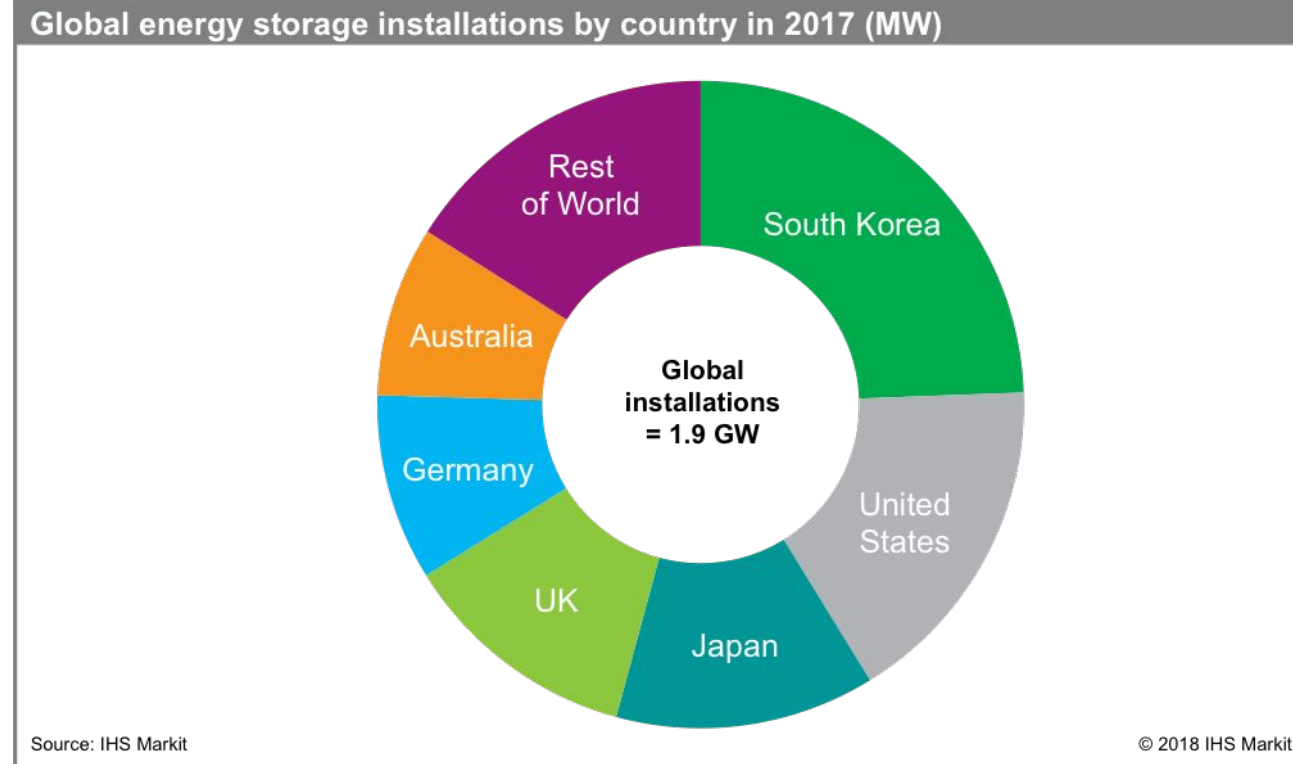
Source: <http://www.energystorageexchange.org/projects>

Source: GlobalData Energy

<https://www.power-technology.com/comment/grid-connected-battery-energy-storage-systems-market-reach-23-4-gw-2022/>

Where are batteries installed?

- What about Norway? My # estimates:
 - Commercial/public buildings: 7-10?
 - Farms: 1-?
 - Residential: 2-?
 - Off-grid cabins & microgrids: ?
 - In-front-of-meter Grid support: 6-10?
- Several new initiatives & projects!
 - Support opportunities from ENOVA



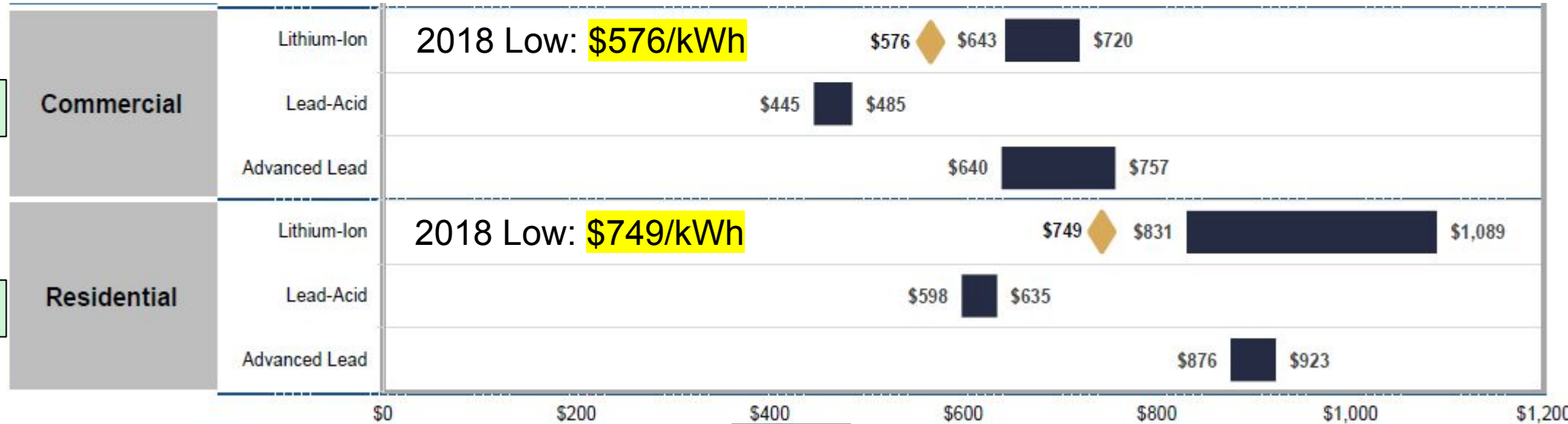
Capital Cost Comparison

\$/kWh

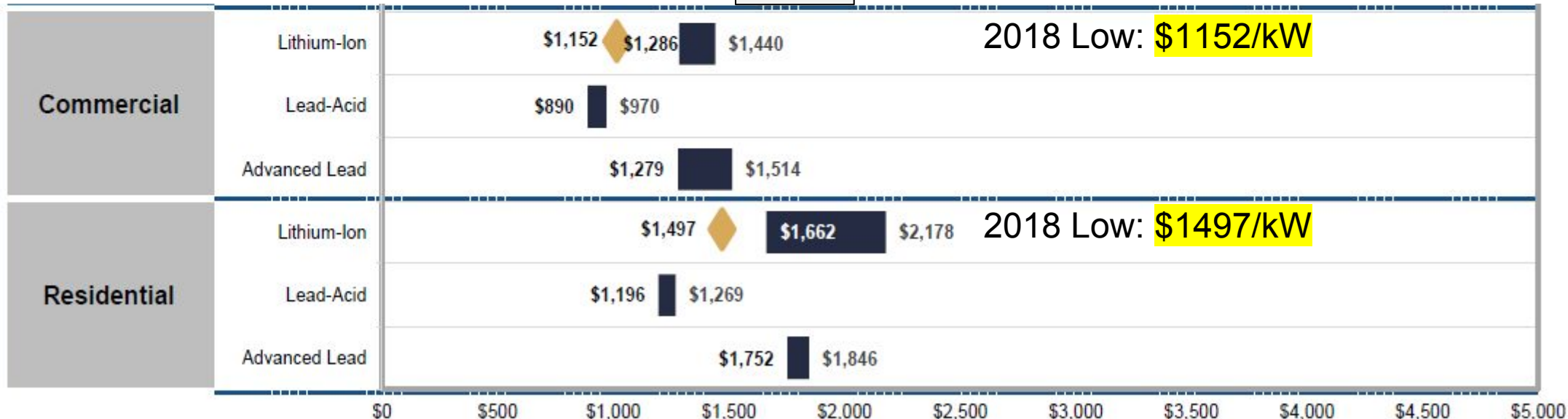
CASES:

125kW / 250kWh

5kW / 10kWh



\$/kW

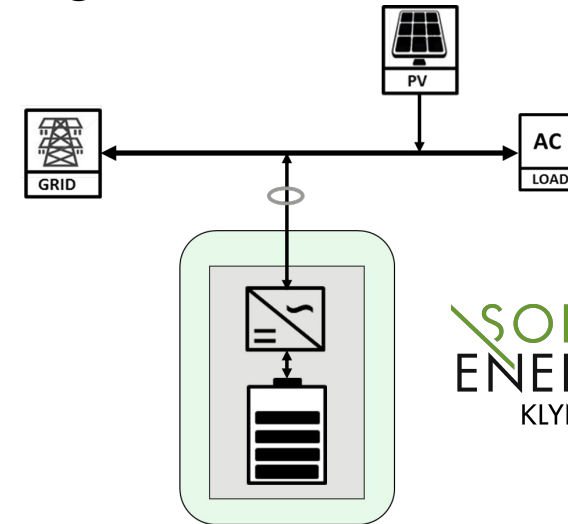


◆ 2018 estimate

Source: LAZARD'S LEVELIZED COST OF STORAGE ANALYSIS — VERSION 3.0, Nov 2017

Conclusions and way forward

- Increasing interest for battery based energy storage solutions, partially driven by increased PV
 - Can/should be combined with additional services
- Solenergiklyngen:
 - Developing a **GUIDELINE/CHECKLIST** for considering and specifying battery systems
- Relevant R&D project: «Smart Nærstrøm» – smart energy systems in buildings
 - 2018-2021
- Coming «Demo Storskala» projects?



Smart Nærstrøm

