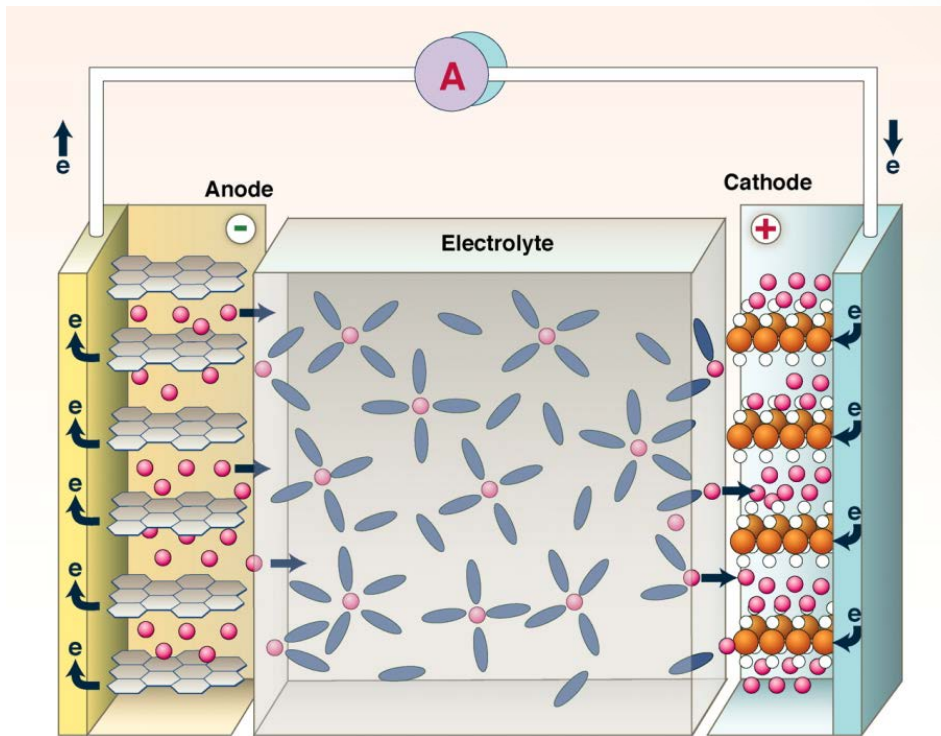


BATTERIER SOM ENERGILAGER

Tommy Mokkelbost
Seniorforsker, SINTEF

13.juni 2017
Longyearbyen

Hva er et batteri?



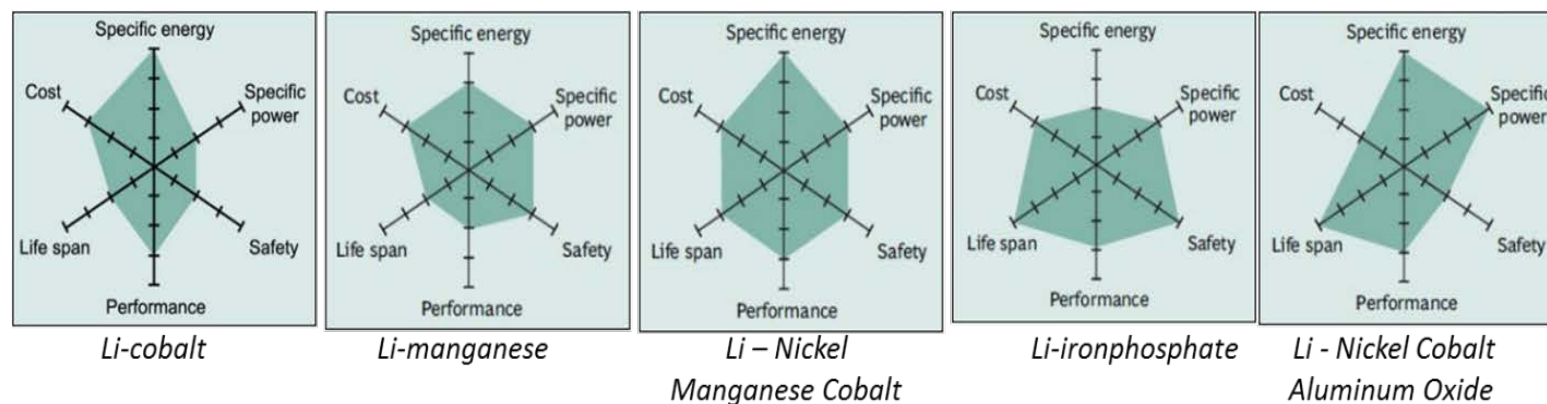
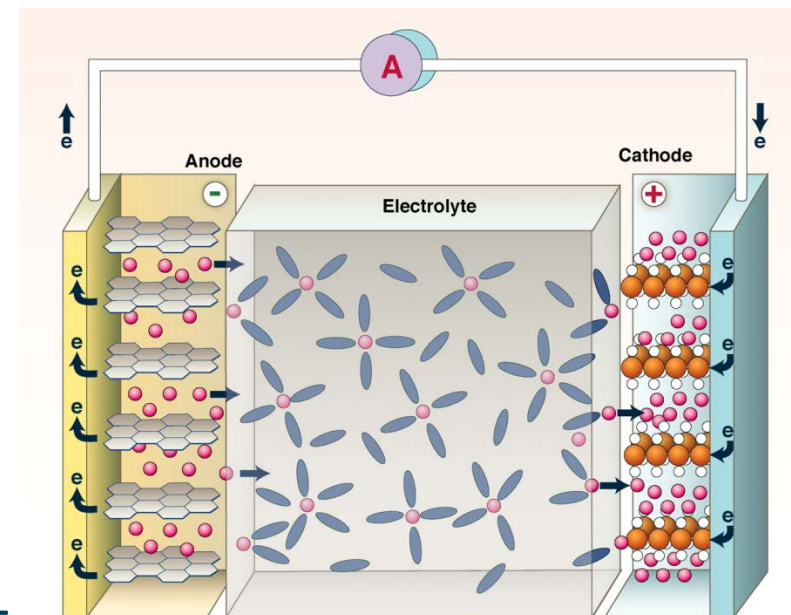
30 kWh



80 kWh

Lithium ion batterier

- Høy energitetthet (både volum og vekt)
- Mange opp og utladninger
- Brukes hovedsakelig I forbrukerelektronikk og transport
- Temperatur sensitiv
- Høye materialkostnader



Lithium ion batterier

- AES Laurel Mountain, USA
- Koblet til 98 MW vind park for fleksibel kraft produksjon /frekvens regulering
- 32 MW
- 8 MWh



Lithium ion batterier

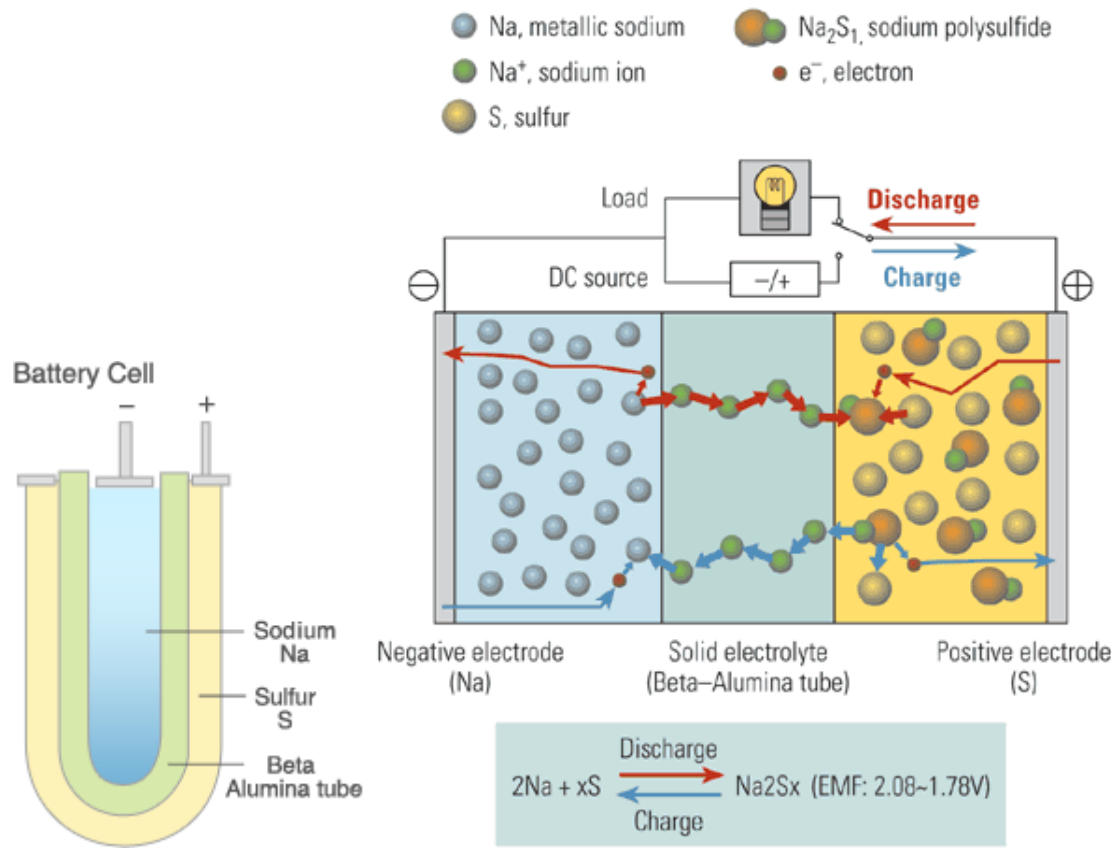
- Minami-Soma (JP), Toshiba (februar 2016)
- 40 MW – 40 MWh
- Balansere produksjon fra fornybare energikilder og kraftbehov
- Lagre overskudd av energi.
- SCiB



Minami-Soma Storage System.

NaS batterier

- Høy energi tetthet
- Lange utladning syklus
- Hurtig respons
- Lang levetid
- Lave materialkostnader
- Høy driftstemperatur (250-300 °C)
- Forurensinger (Væske som electrode, glass sealing)
- Sikkerhet



NaS batteries

Rokkasho Village Wind Farm, Japan, installed 2008.

"Smart Grid" wind park. Batteries used for energy storage/shift (day/night)

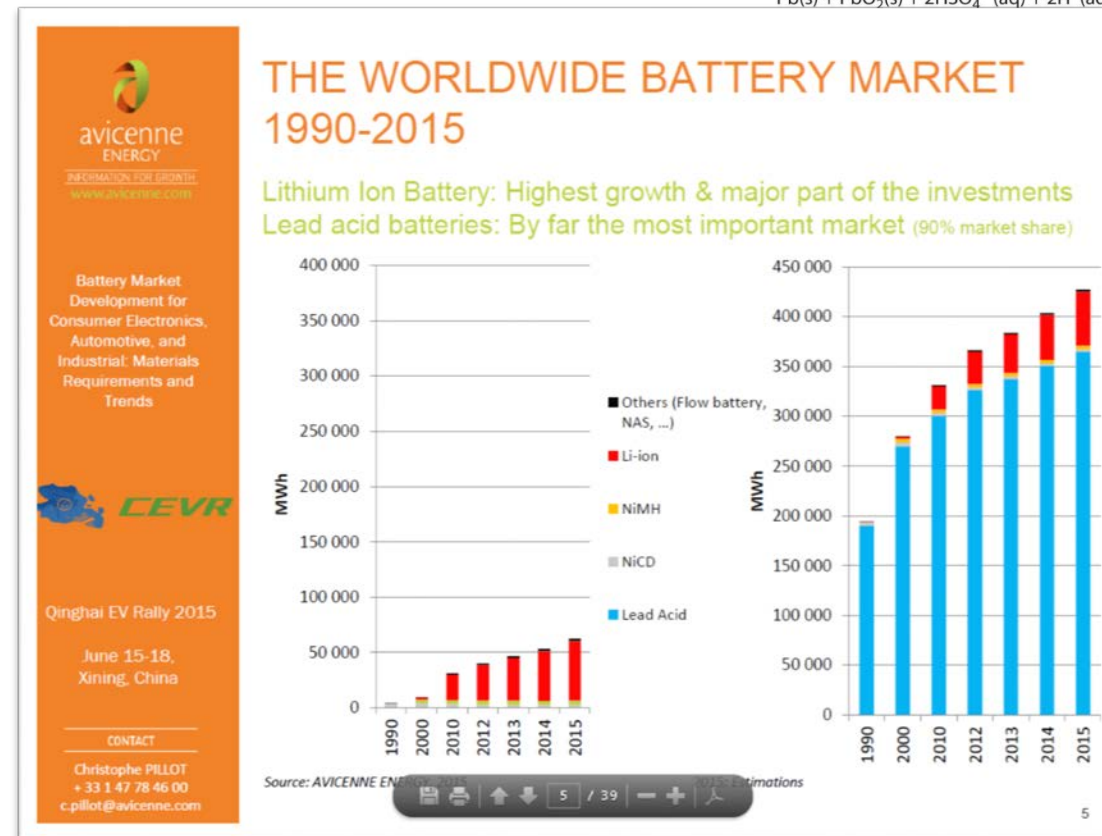
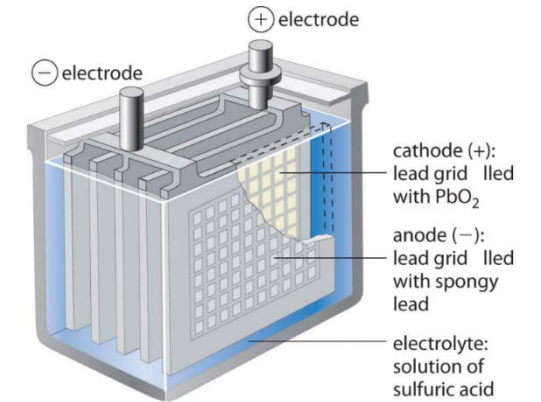
34 MW

245 MWh



Bly batterier

- Kjent og moden teknologi
- Lave kostnader
- God batteri levetid
- Begrenset depth of discharge
- Lav energi tetthet
- Krav til vedlikehold



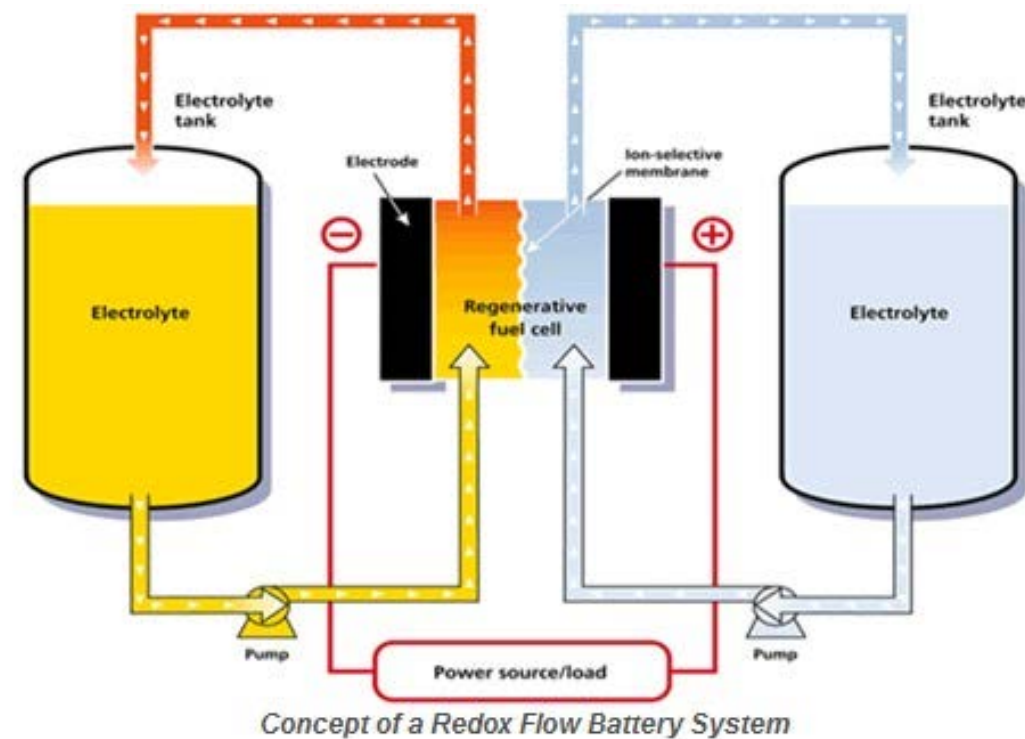
Bly batterier

- Duke Energy Notrees Wind Storage Demonstration Project, USA
- Installeret i tilknytning til 153 MW vind park for peak shaving, frekvens regulering
- 36 MW
- 20 MWh



Flow Batteries

- Vanadium , Zinc-Bromine, Iron-Chromium
- Mulighet for mange sykler
- Lang levetid
- Kapasitet avhengig av mengde elektrolytt
- Effekt avhengig av elektrode overflate areal
- Komplisert design (pumper, ventiler etc)
- Varierende energitetthet



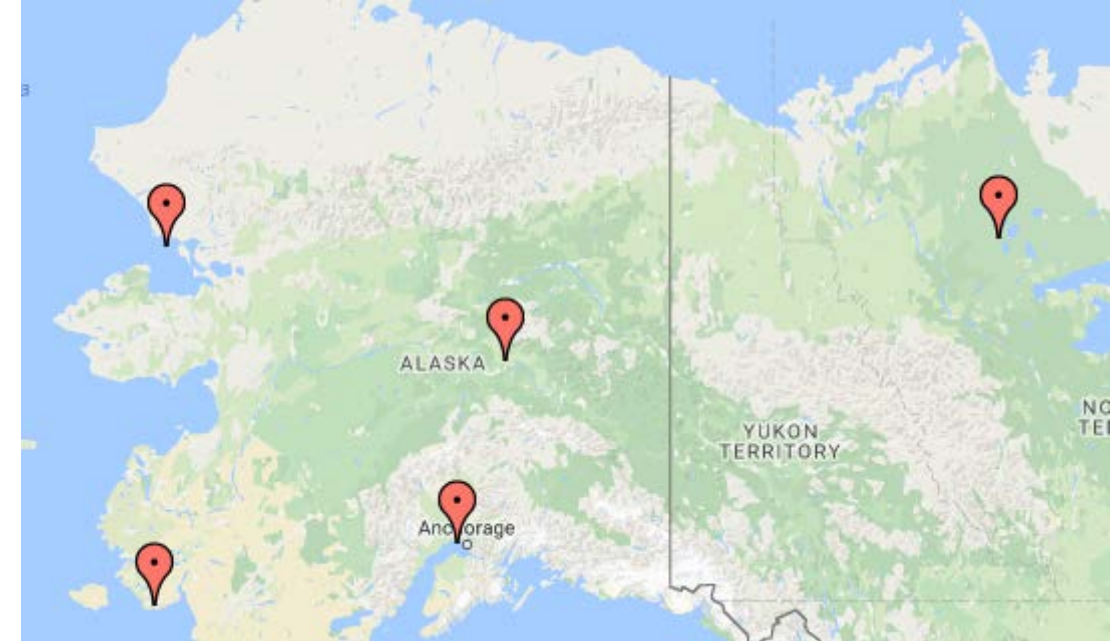
Flow Batteries

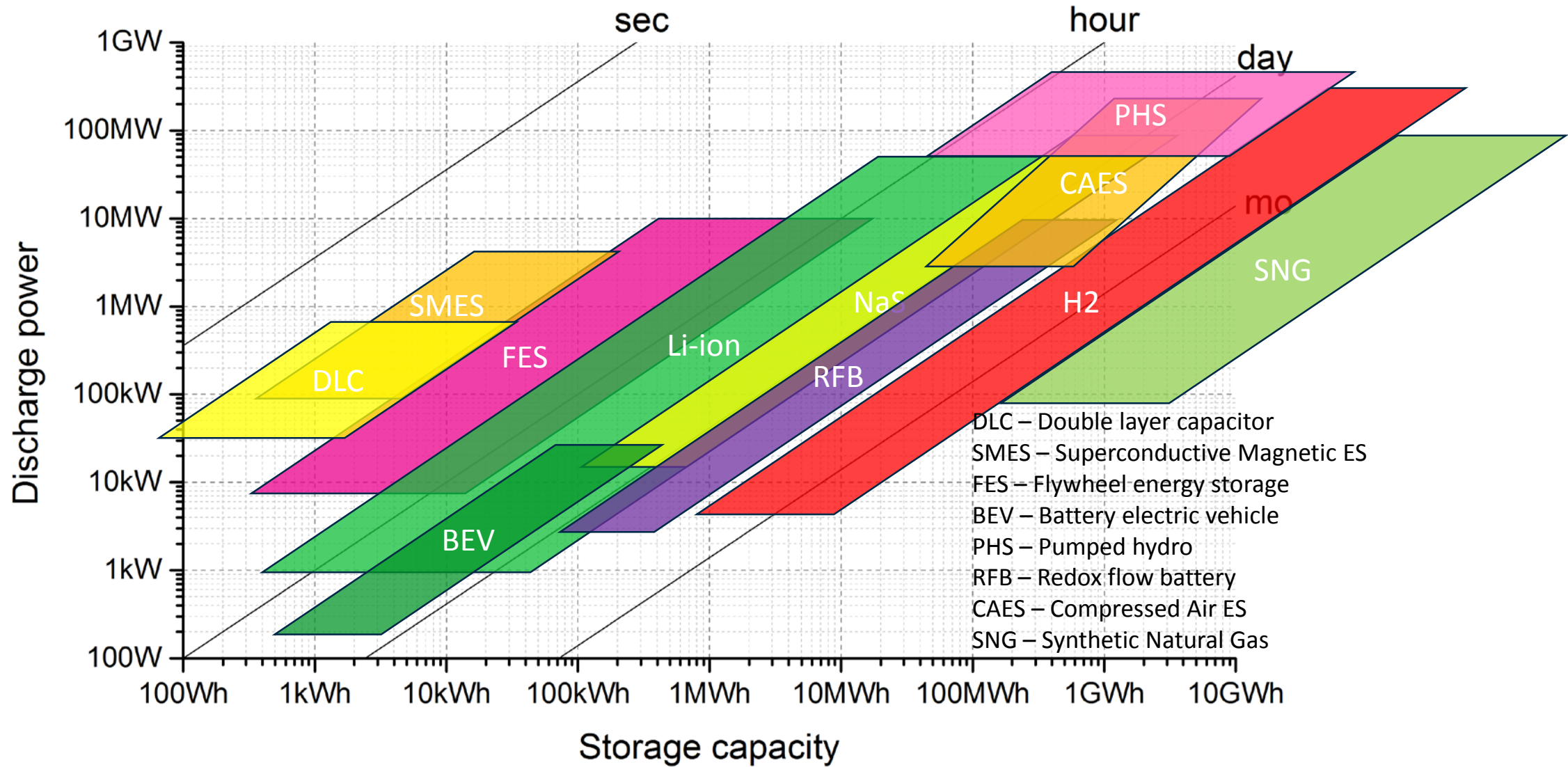
- Vanadium redox flow battery
- Gills Onions, located in Oxnard, California (Onion processing plant)
- Peak shaving, load shifting of electricity use
- 600 kW
- 3.6 MWh



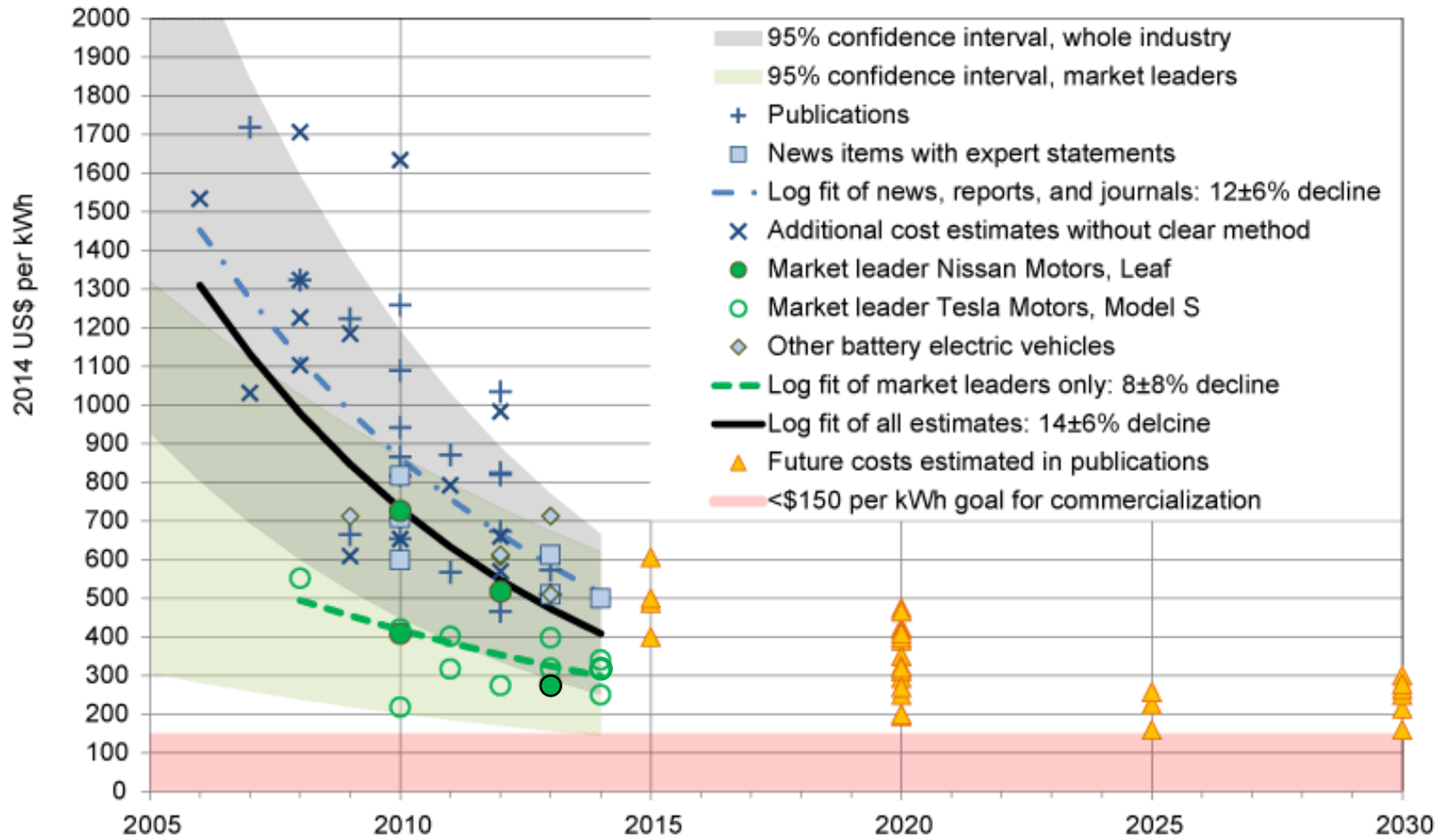
Arktisk energilagring

- Flere steder i Canada og Alaska
- Kotzebue SAFT BESS Li-ion 1.2 MW og 950 kWh
 - Time-shift, Fluktuering i vindenergi. Redusere dieselforbruk
 - "Cold temperature package"
- Colville SAFT 232 kWh batteri og 200 kW
- Golden Valley Electric Association 27 MW for 15 minutter. Ni-Cd (2003)





Estimates of costs of lithium-ion batteries for use in electric vehicles

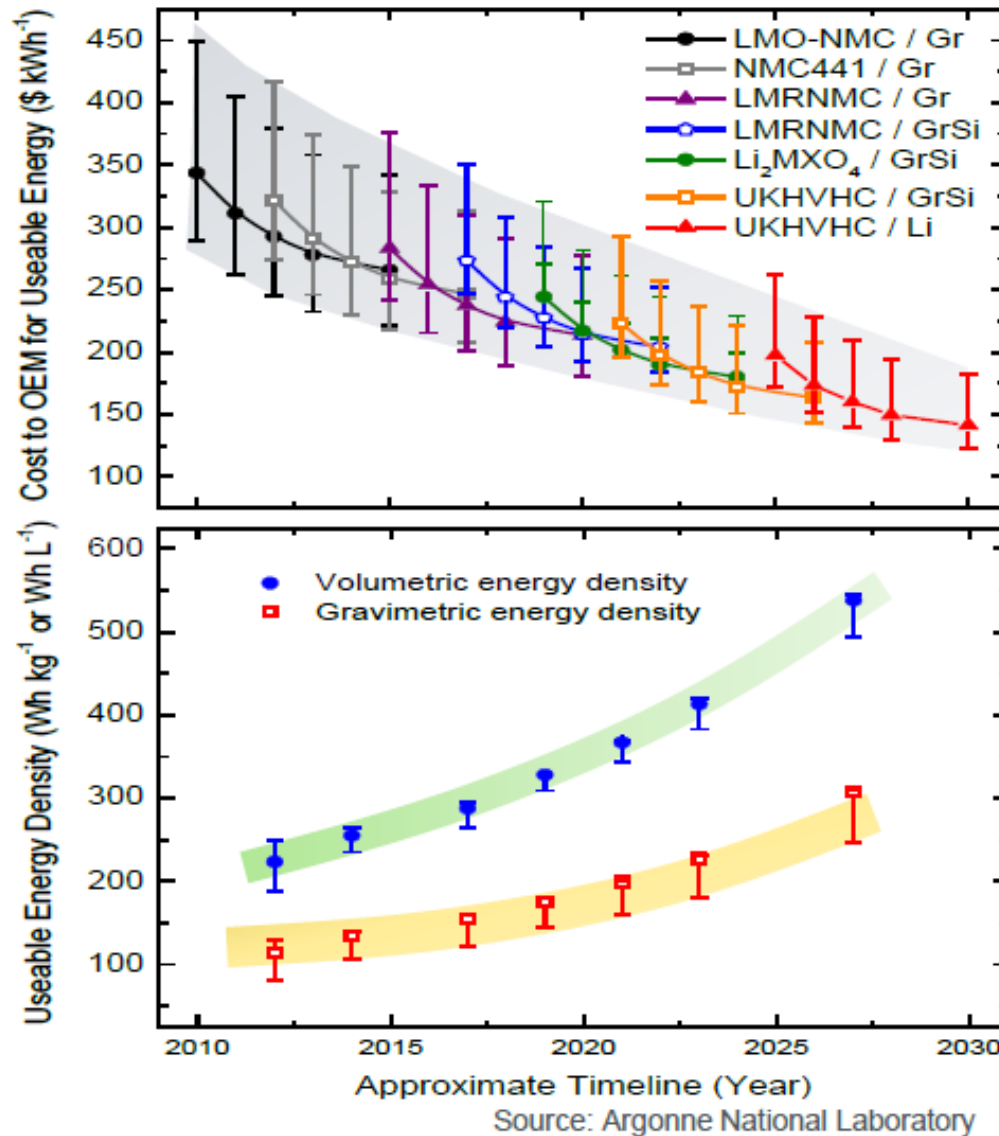


Björn Nykvist and Måns Nilsson, 2015

"Nissan makes zero margin on the replacement program,"
"In fact, we subvent every exchange." - Jeff Kuhlman, vice president of global communications. Nissan

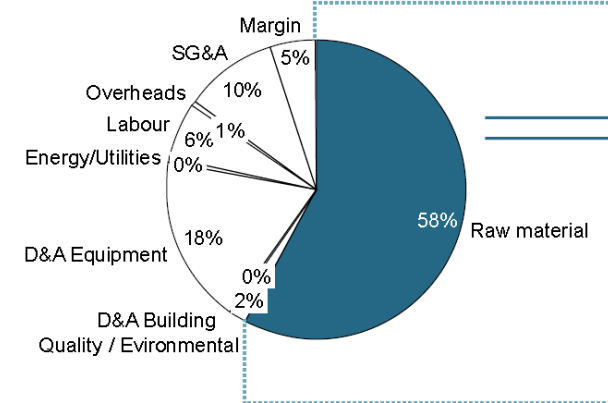
Battery Cost Model Calculations (BatPaC v1.0) for a 100 mile range Electric Vehicle (EV100)

- Battery Specs: 30 kWh, 80 kW, 360V
- Total cost to OEM includes purchased battery, battery management system, and liquid thermal management (w/o electric compressor).
- If high-risk research is successful, material advances may lead to a 60% reduction in cost and 250% increase in energy density
- Larger batteries (EV200+) will have higher energy densities and lower costs for energy.

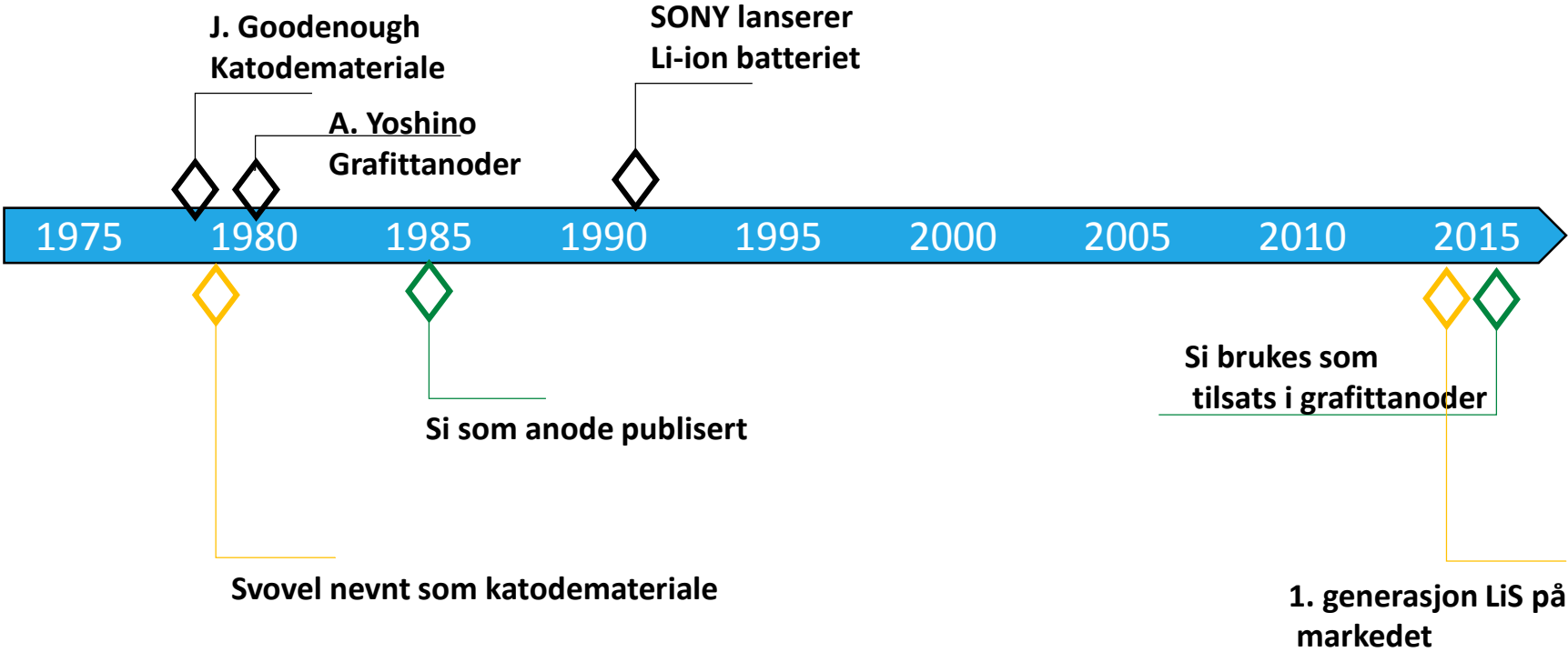


Cell cost breakdown, 2015

Total cost: approximately USD 23.3/cell (~ 249 USD/kWh)



Batteriutvikling tar tid (spesielt når de lavthengende fruktene er plukket)



Batterier på Svalbard

- Reservestrøm (kort periode) / redusere topplast for dagens energiverk
- Lokal energiproduksjon fra solceller på boliger – energilagring
- Energilagring på "off-grid" anlegg / redusere dieselforbruk
- Transport biler, scooter, busser
 - "Green snowmobile ice cave trip"
 - "Silent, zero emission whale safari"



Teknologi for et bedre samfunn