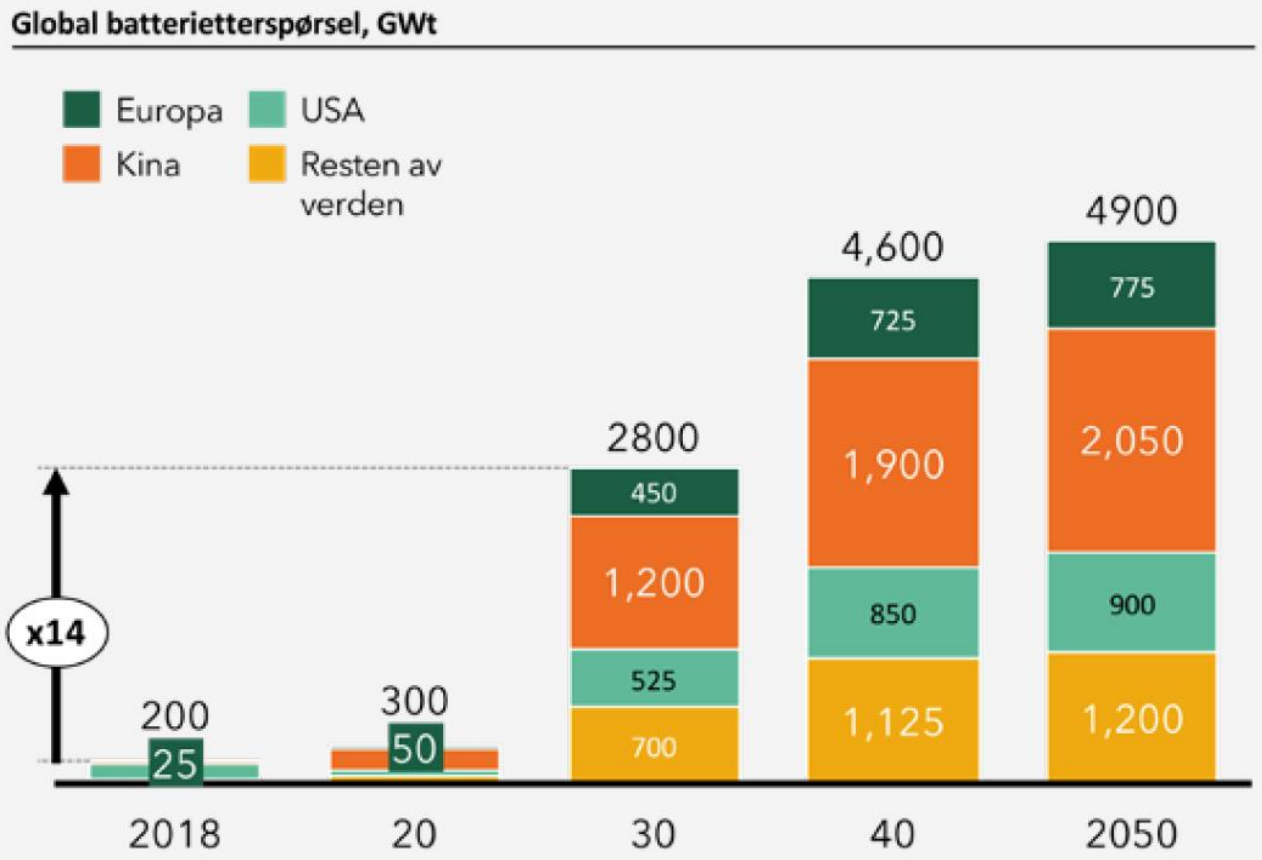
The role of batteries in society and the green transition

Hanne Flåten Andersen
Head of Department Battery Technology

Motivation

- Batteries are becoming increasingly important as an enabling technology in the world's green shift
- Shifting to renewable energies, batteries are the preferred energy storage solution
- Demand for future batteries is expected to grow exponentially



Source: NHO – Grønne elektriske verdikjeder

Why batteries in Norway?

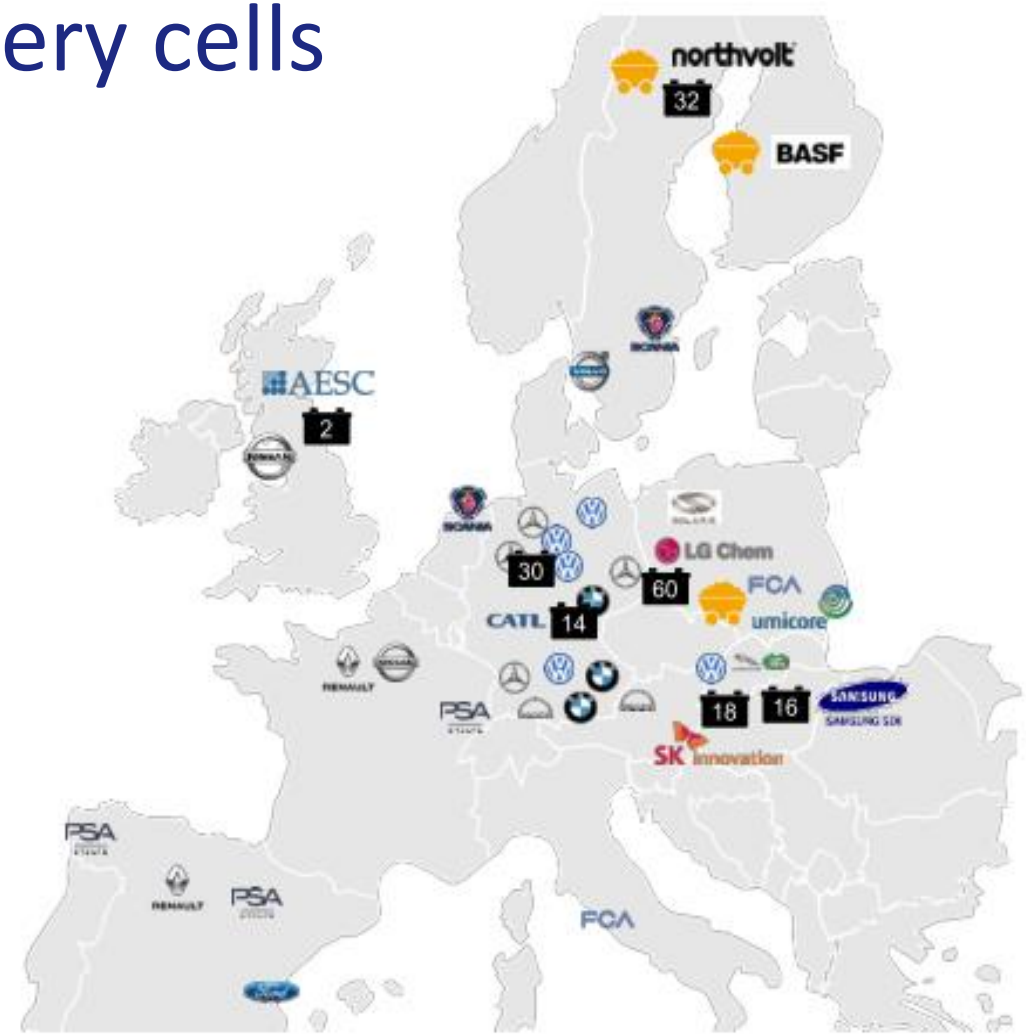
- Battery value chain was recently outlined in NHO's project «Grønne elektriske verdikjeder» as one of six promising focus areas for Norwegian industry

- Synergy between the six focus areas, where batteries are key component as enabling technology that will be important in many segments

- Norway has a competitative edge within:
  - Processing of raw materials
  - Integration in maritime sector
  - Recycling of batteries
  - Production of battery cells (if established soon enough

Production of battery cells

- New and planned factories are announced to keep up with the future demand
- Wish to establish more of the cell production in Europe to supply the European car manufacturers and have control of the value chain



Production location legend

- 10 — Existing/ planned cell production in GWh
- Cathode production
- Auto OEM EV production[1]

Source: McKinsey

Battery activities at IFE

Battery Technology department

- Working with battery research for over 10 years
- Close cooperation with Norwegian industry
- Mostly NFR funded projects, with more EU activities lately

Hydro
BEYONDER
Elkem
EYDE CLUSTER
CENATE
Borregaard
equinor
TechnipFMC
ABB
EVONIK POWER TO CREATE
FMC
FREYR RENEWABLE ENERGY STORAGE
ROLLS ROYCE
EST-Floattech
UiO
RI. SE
corvus energy
SINTEF
DYNATEC
université de TOURS
FFI Forsvarets forskningsinstitutt
NTNU

Battery value chain – where are we?

Raw materials

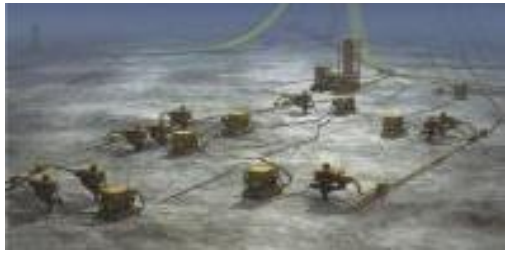
Adapted materials

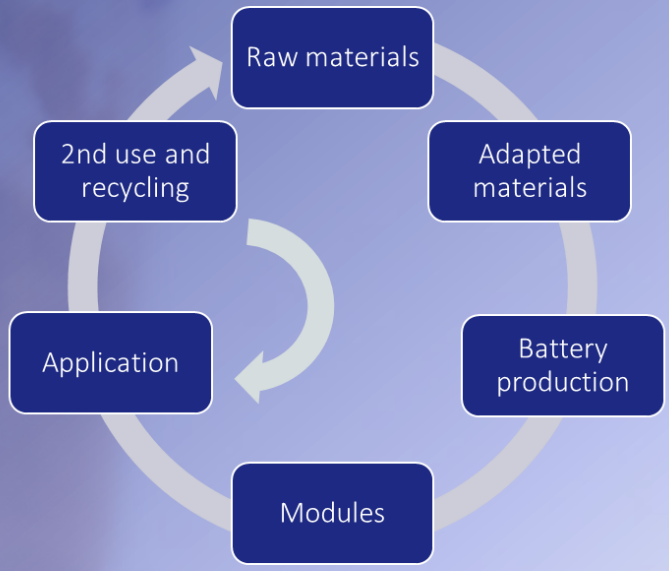
Battery production

Modules

Application

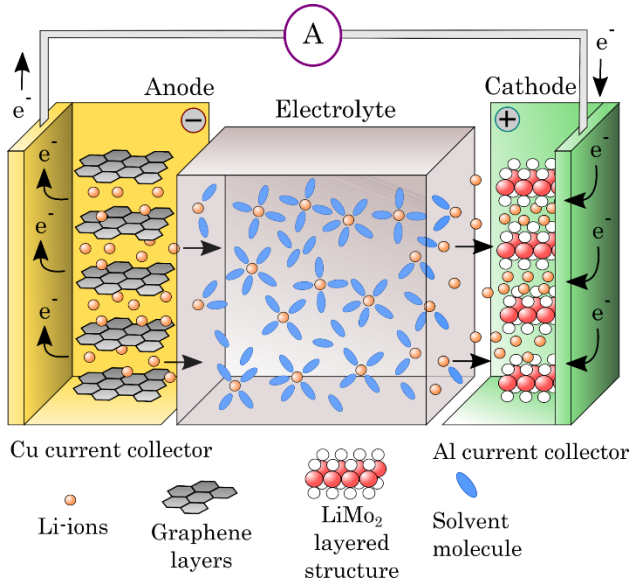
2nd use and recycling

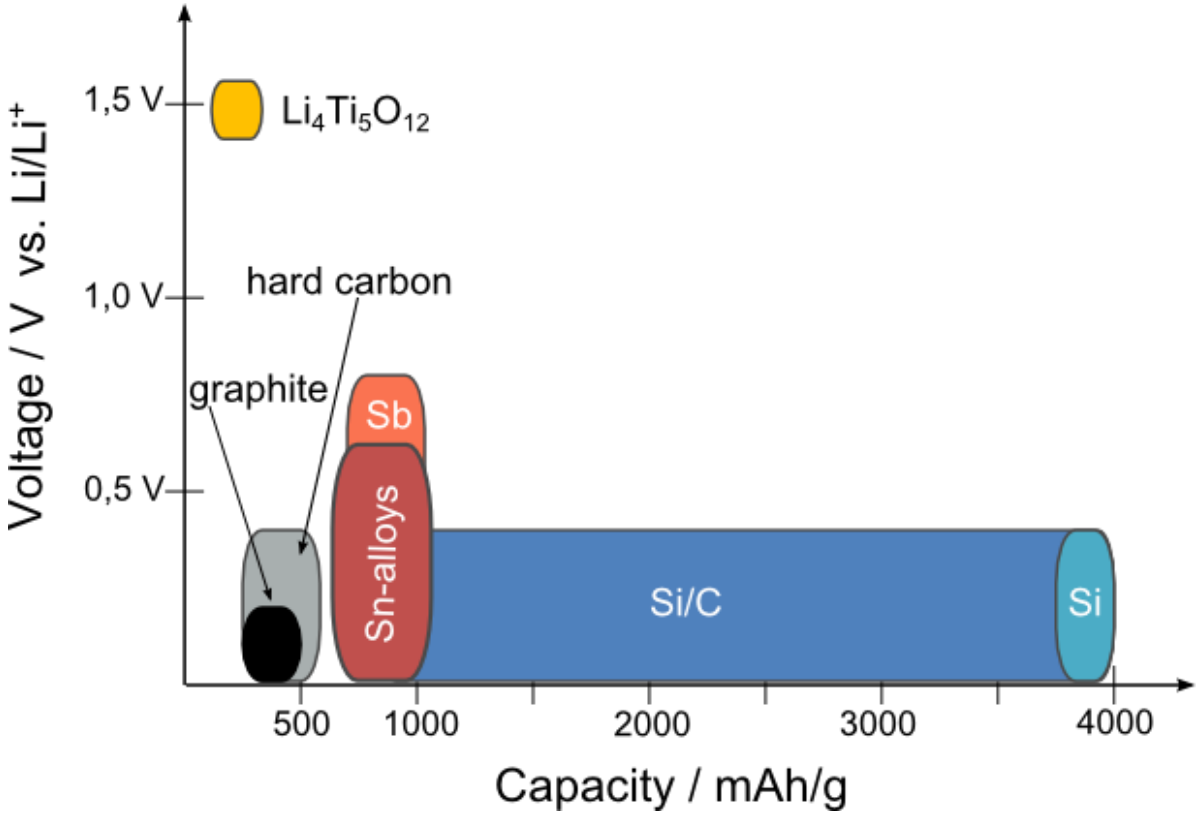




Materials development

Focus on anode materials at IFE

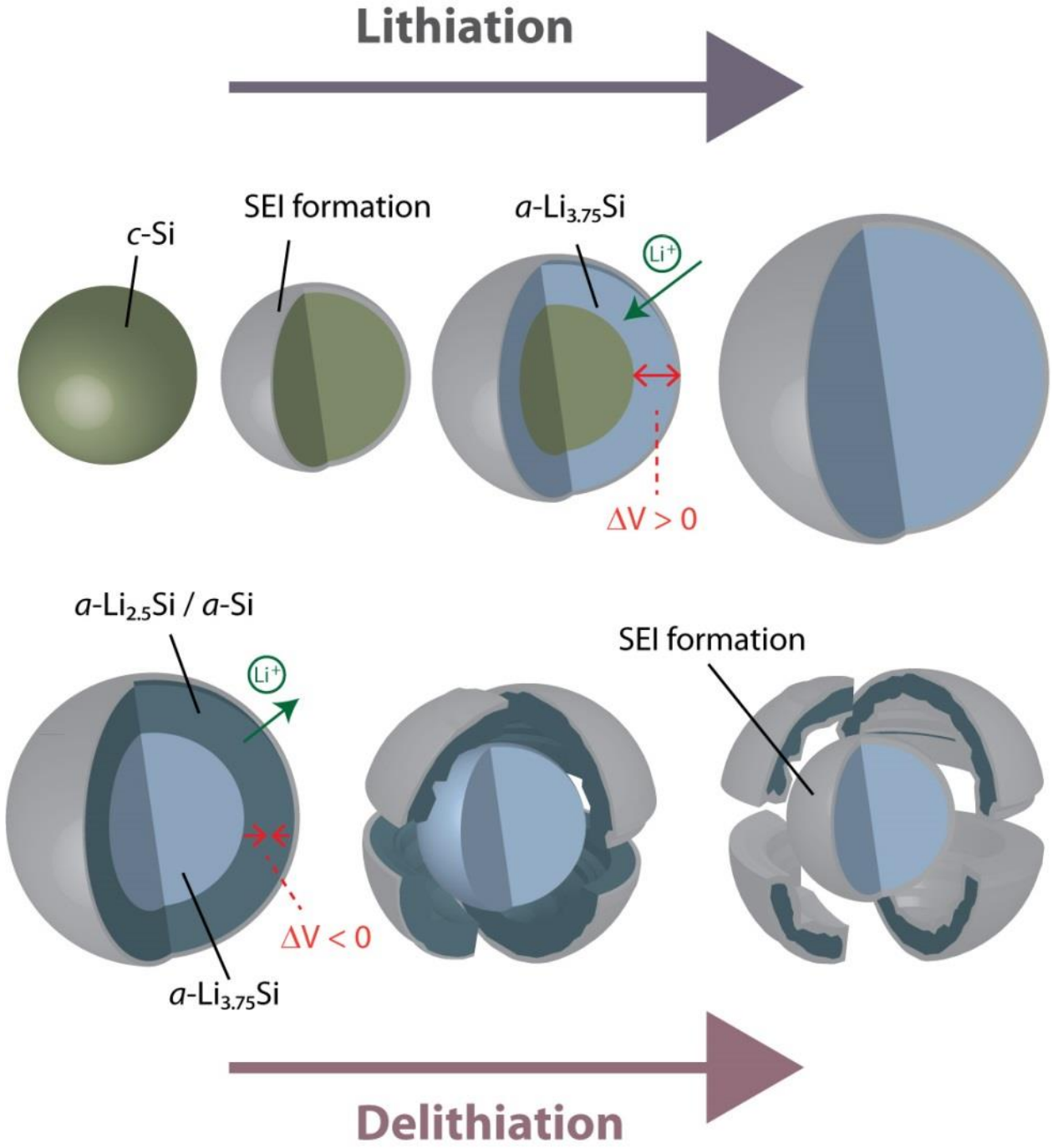




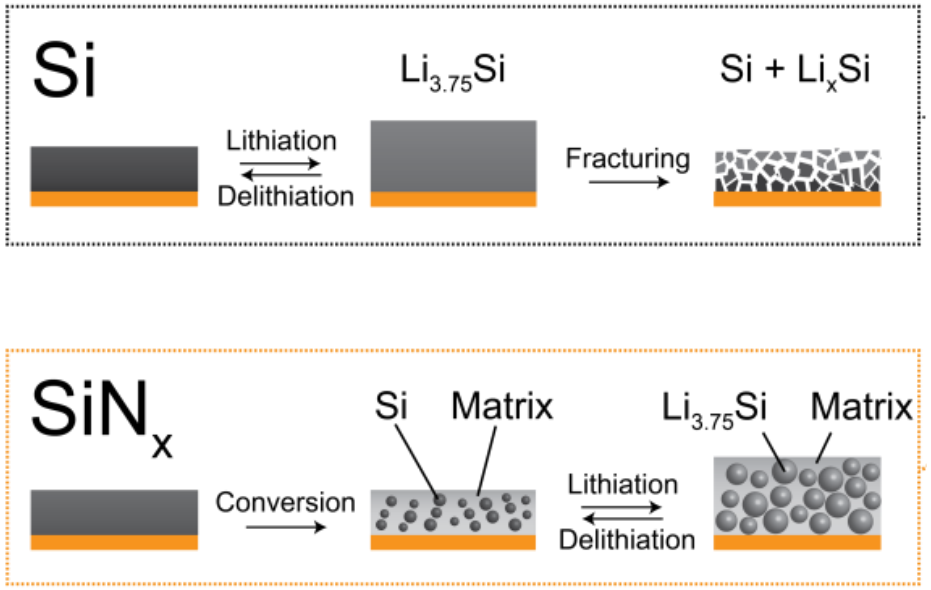
- Focusing on anode material development at IFE
- Extensive experience on silicon and silicon-based anode materials
- Improving the capacity of the anode by replacing C with Si, while maintaining lifetime of the battery

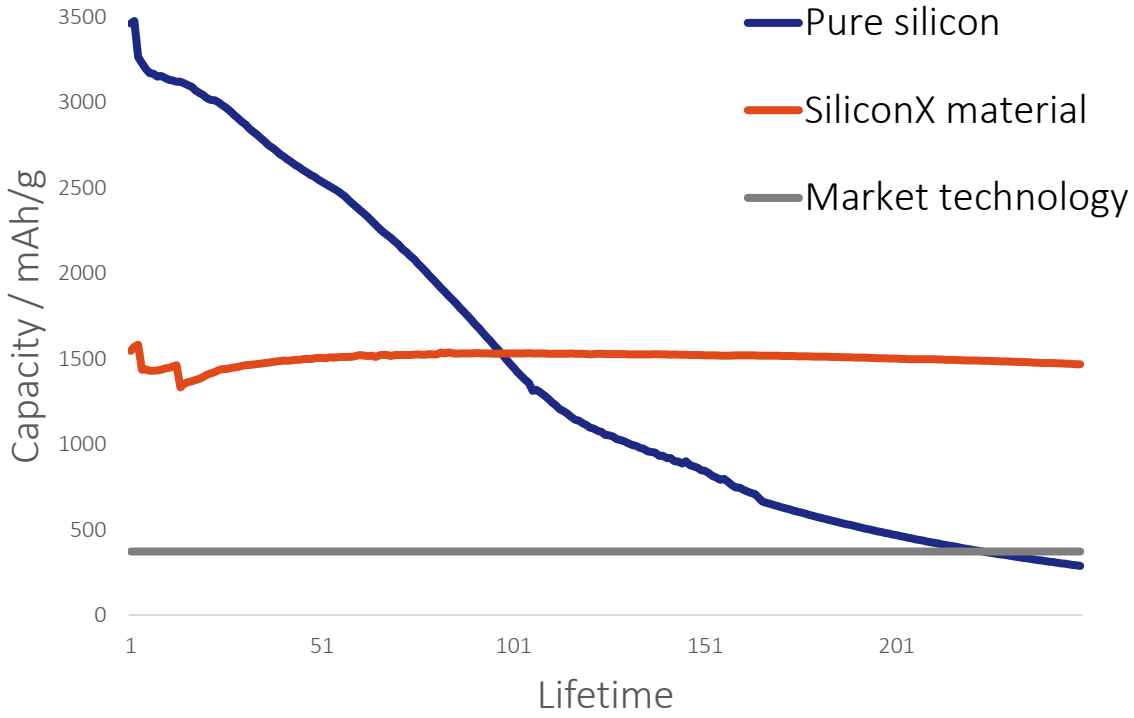
Challenge

- Leads to degradation and loss of stability
- Preventing the commercial breakthrough of silicon anodes
- Can be overcome by nanotechnology, carbon coatings or the use of Si alloys



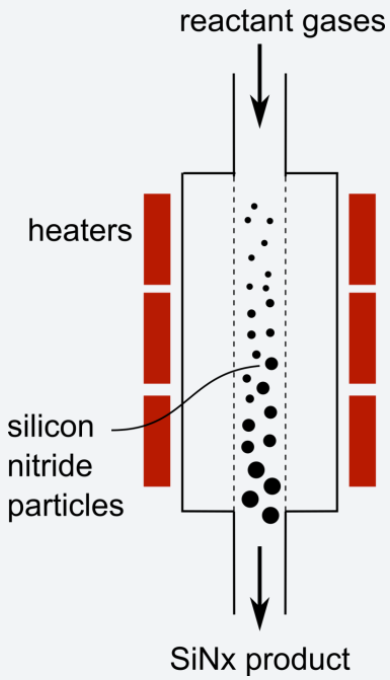
SiliconX – silicon nitride



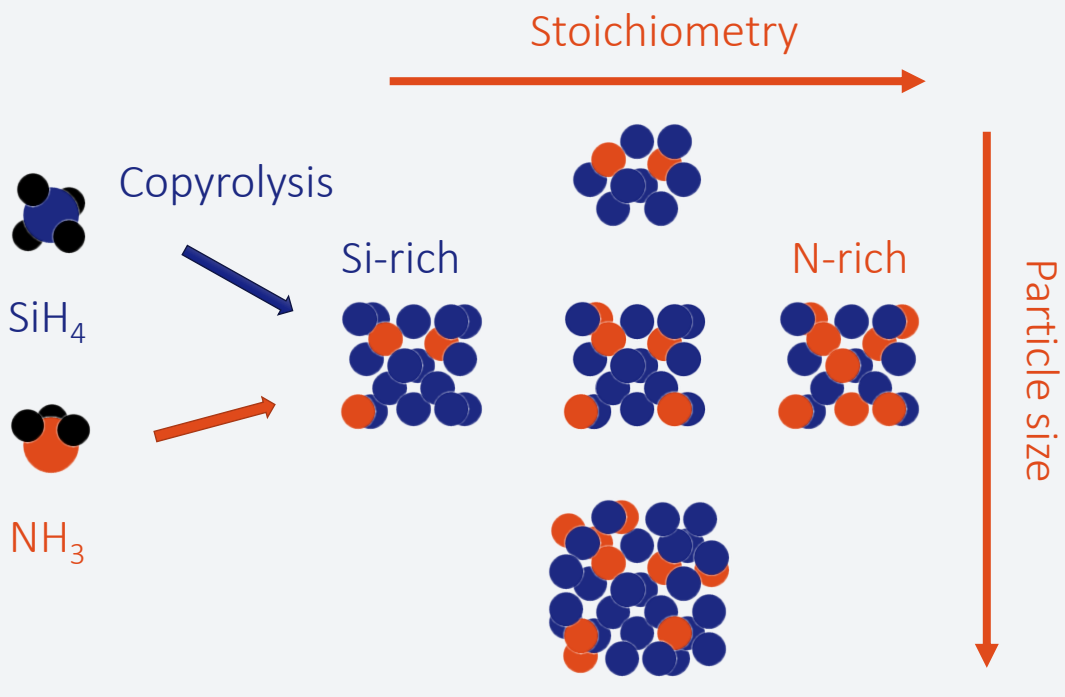


- Using silicon nitride material produced at IFE
- Improvement of both capacity and lifetime
- Patent granted

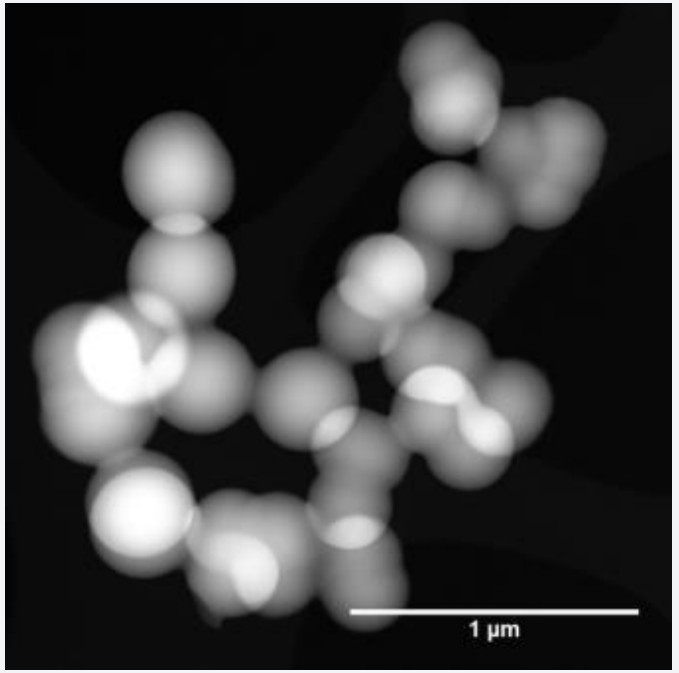
Production of SiliconX at IFE



Free Space Reactor

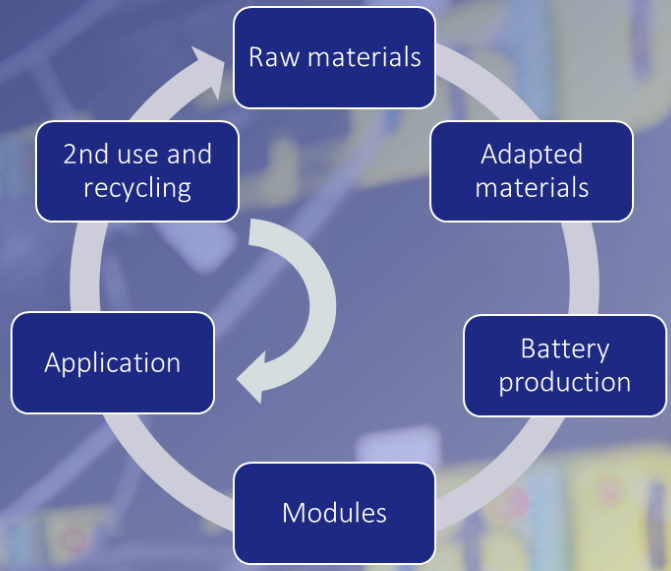


Pyrolysis of silane and ammonia



Particles as seen in TEM

Commercial battery testing



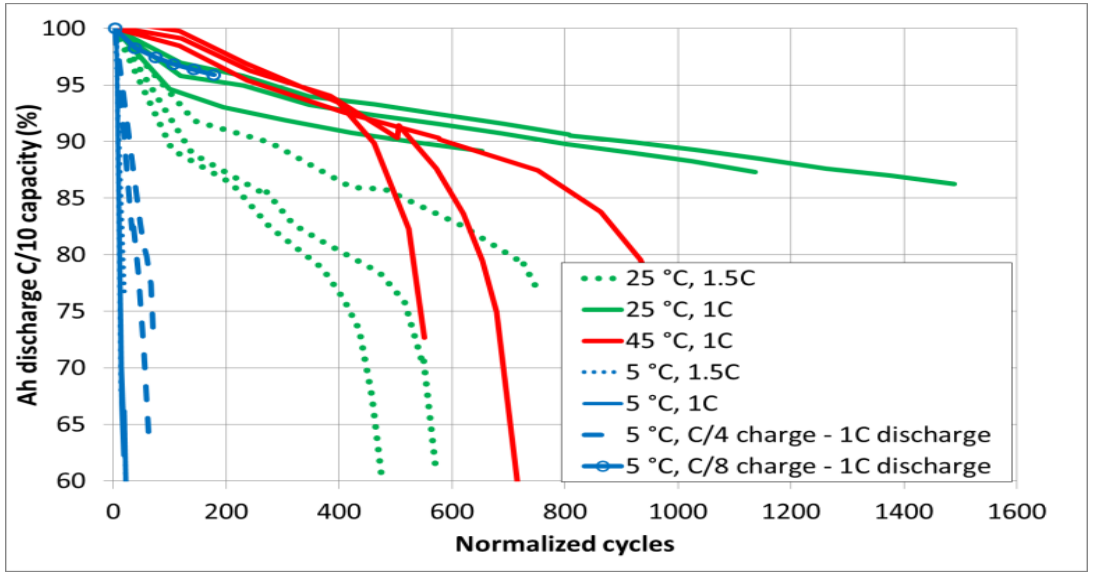
Life time testing of commercial cells

- Cooperation with partners from the maritime industry
  - Fast growing sector in Norway
  - Hybrid solutions are necessary

- Safety and life time evaluation of large Li-ion cells and packs
- Develop new measurement techniques
- Risk reduction – physical and economical

Li-ion battery ageing

- Calendar life – loss of capacity during storage
  - Factors:
    - Temperature
    - State-of-charge
- Cycle life – loss of capacity due to cycling
  - Factors:
    - Temperature
    - Current – charge and discharge
    - SoC
    - Mechanical pressure

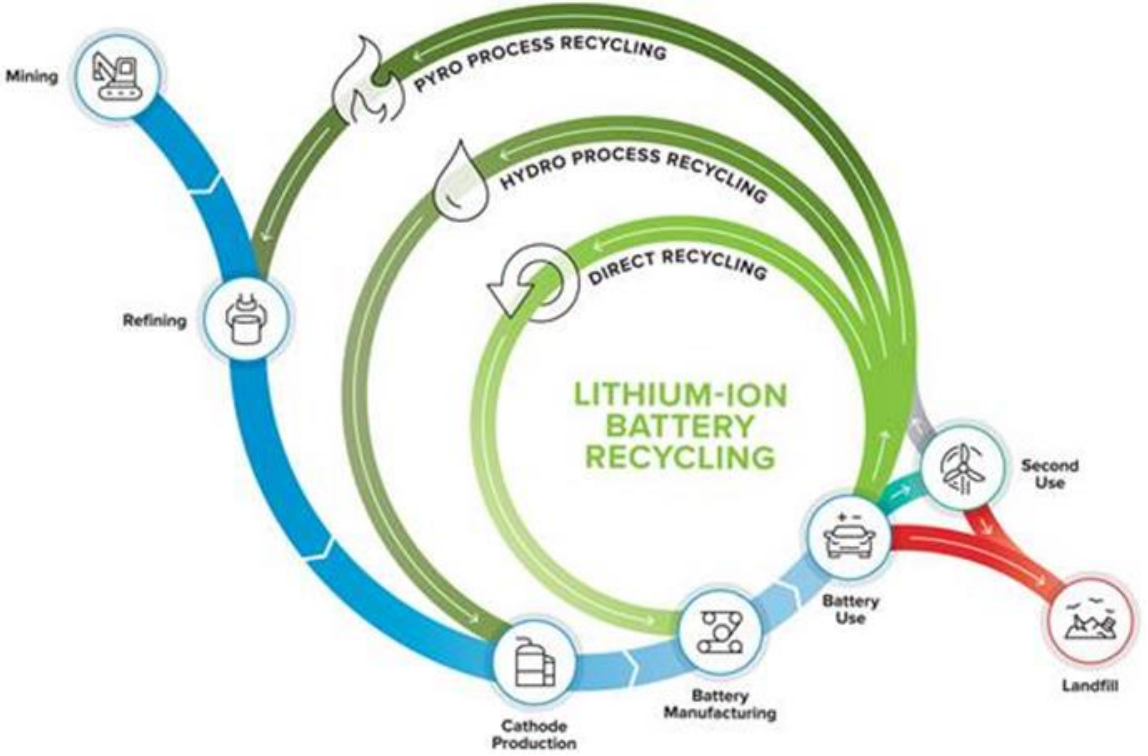


Recycling and reuse

Recycling and reuse
- motivation

- Large need for sustainable handling of used batteries
- Control material flow within Europe
  - Urban mining through recycling possibilities
- Norwegian industry wants to position themself within recycling

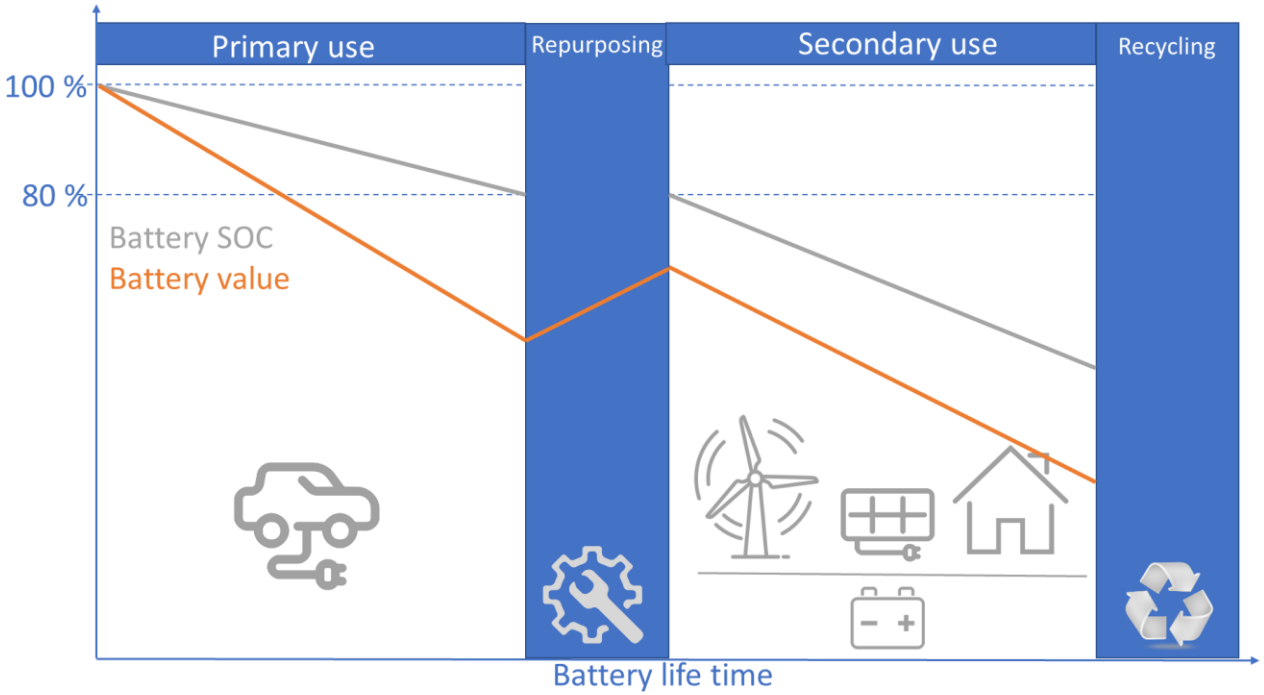
- Norway will be one of the first countries to get large volumes of spent EV-batteries going into recycling or reuse
  - 50 % of all new car sales in 2019 was electric
  - Second largest market worldwide for EVs



Possible reuse of Li-ion batteries (2nd life)

- Starting research on safe and sustainable re-use of batteries
- Evaluating value, safety and cost-optimized use of Li-ion batteries at End-of-Life (EOL)

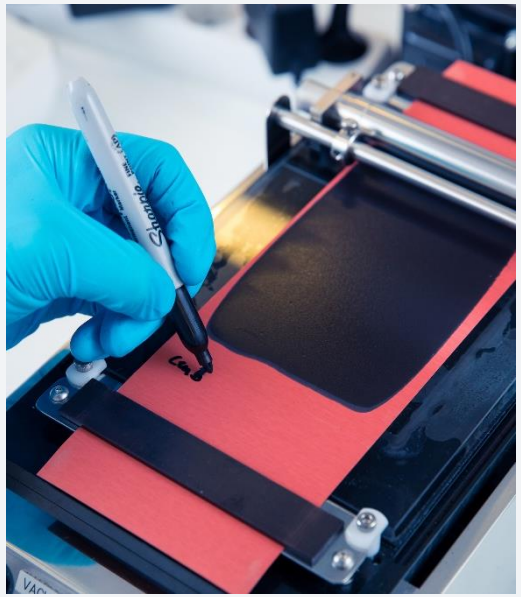
- Open questions:
  - Economical feasibility (and at what battery cost)
  - Safety ensured in second life use?
  - Integration into current energy system



Opening of battery development lab

IFE Battery laboratories

Battery materials synthesis laboratory



Battery development laboratory

Commercial battery testing laboratory

Thank you!

Hanne Flåten Andersen
Battery Technology

@energiteknikk