

DEVELOPING NEXT-GENERATION LI-ION BATTERIES FOR ELECTRIC VESSELS

Dr. Simon Clark – SINTEF Industry

NCE Maritime CleanTech Webinar, 23.06.2020

Battery technology is a main driver
of innovation and social change
today.

Batteries Power Modern Life



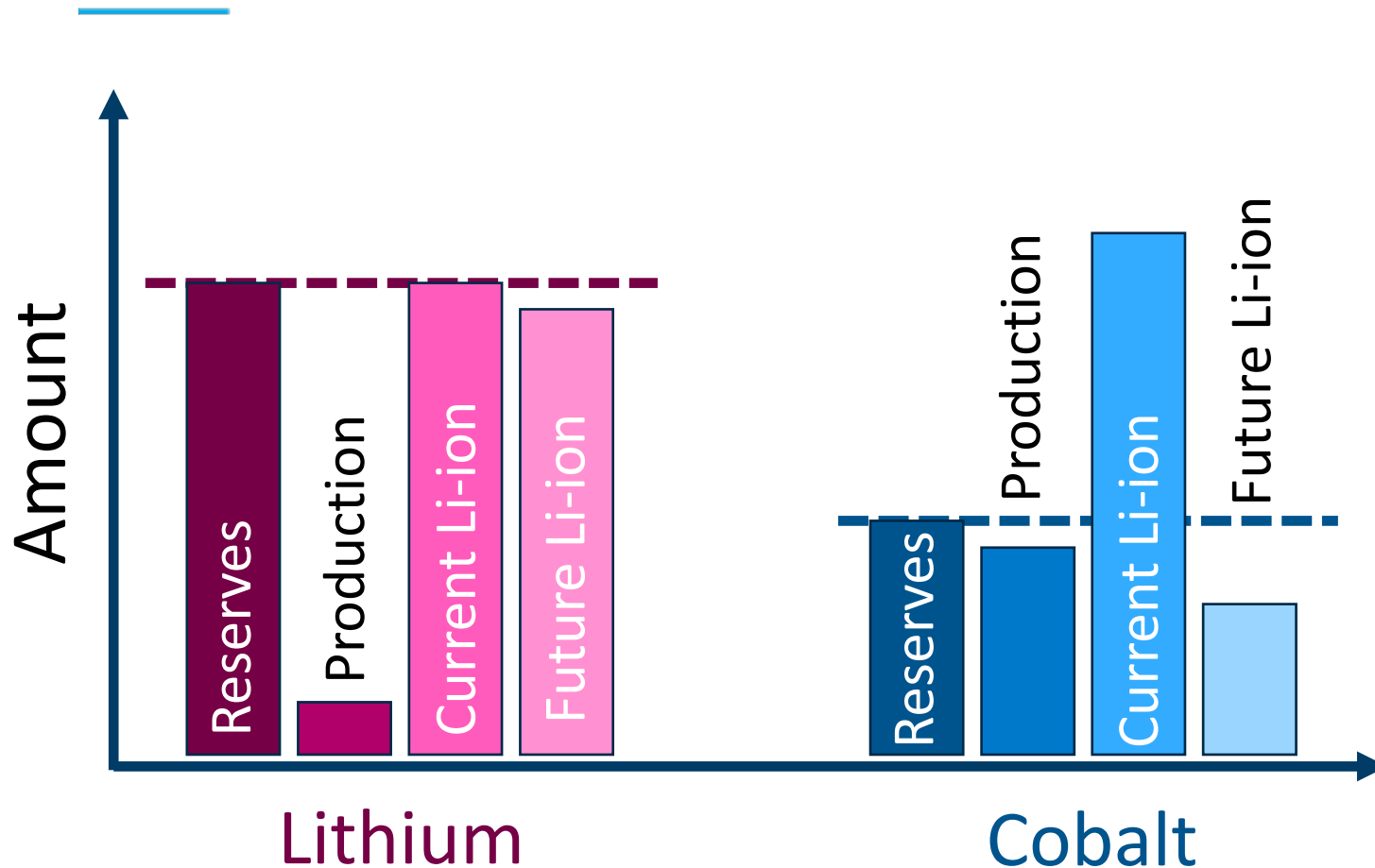
Batteries are expanding to new applications outside of traditional fields

Lower prices are making widespread EV uptake feasible

Improved performance is driving gains in electric shipping and aviation.

What does this mean for the future of battery development and design?

Li-ion Supply Limitations Through 2050

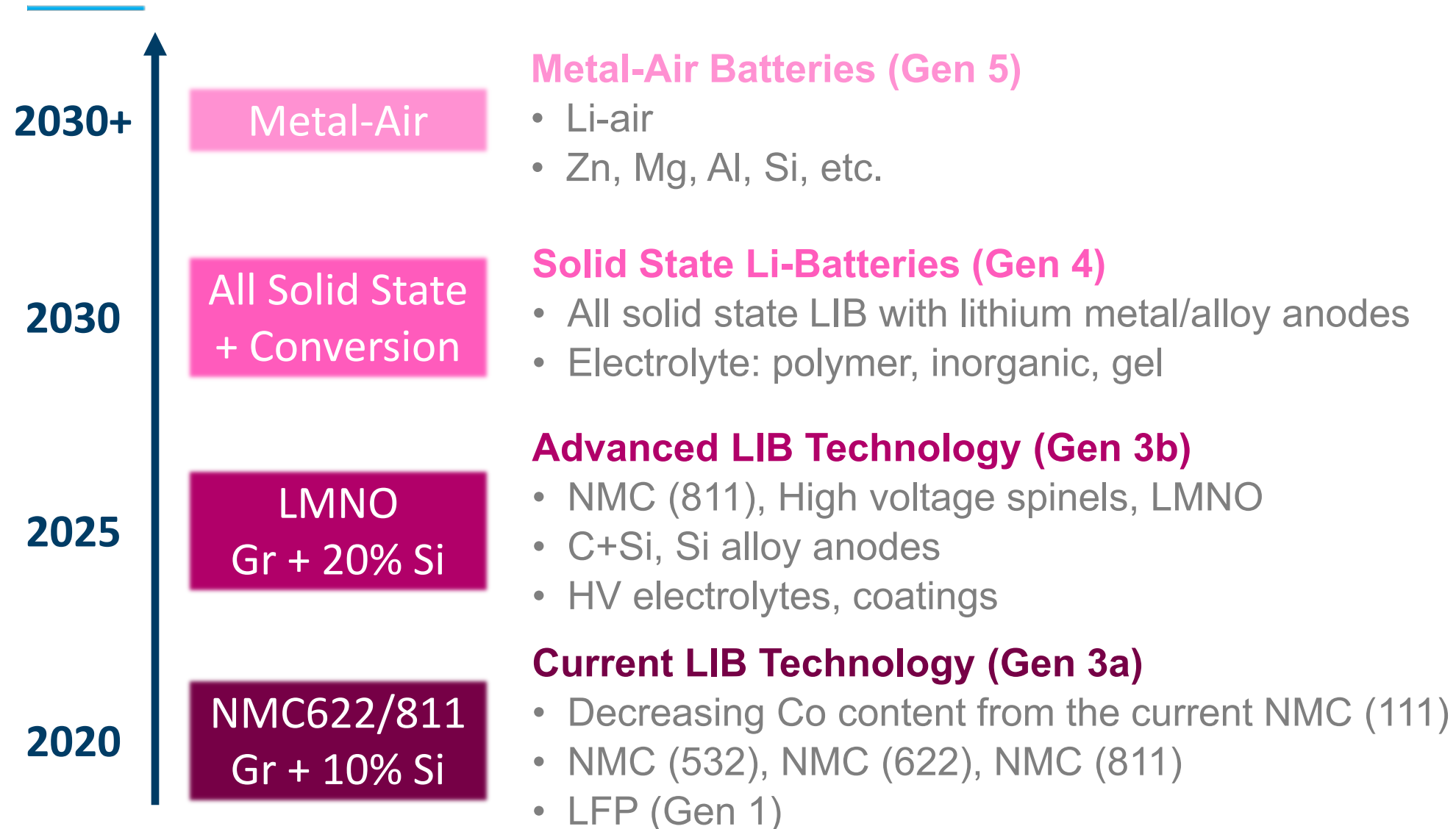


We Need:

- New Materials
- New Chemistries
- Better Cell Designs
- Improved System Engineering

...and we need them as quickly as possible

Vision for Battery Development



Li-ion Battery Technologies Today

Technology

Tesla battery supplier Catl says new design has one million-mile lifespan

Elon Musk: Tesla Battery Day happening in September

Battery Day is rumored to bring news on Tesla's "million-mile" battery.



Sean Szymkowski

June 22, 2020 11:41 a.m. PT



▶ LISTEN - 01:04



Enlarge Image

Big battery news could be just a few months away.

Tesla

Rumor: BYD Blade Battery Production Capacity To Reach 13 GWh



JUN 05, 2020 at 7:37AM

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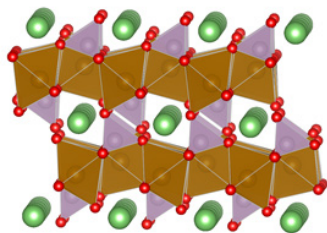


By: Mark Kane

2020 has seen some advances in Co-free battery development:

- CATL "million mile" LFP battery
- BYD LFP Blade

Li-ion Battery Technologies Today

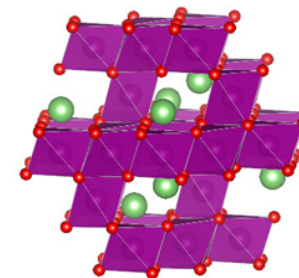


Lithium Iron
Phosphate (LFP)

Power	★★★★☆
Energy	★★☆☆☆
Cost	★★★★☆
Safety	★★★★★
Cycle Life	★★★★☆



**Hybridized
Electrodes for**
High Energy,
High Power and
Long Life



Lithium Manganese
Nickel Oxide (LMNO)

Power	★★★★☆
Energy	★★★★★
Cost	★★★★☆
Safety	★★★★☆
Cycle Life	★★☆☆☆

The Concept

HYDRA, taking its name from the mythological beast, will use a **multi-headed** integrative approach:

- Generation 3b Li-ion batteries **hybridizing high-power** with **high-energy** materials.
- **Si-C Anodes & Hybrid Cathodes**
- **Stable** electrolytes
- Model-based **novel component development**
- **Competitive EV batteries**
 - 750 Wh L⁻¹
 - 90 € kWh⁻¹



The Project & Consortium

- **Topic:** Gen 3b Li-ion Batteries
- **Start Date:** 1 September, 2020
 - Delayed from 1 May due to COVID-19
- **Coordinator:** SINTEF
- **Industry Partners:** JM, Elkem, Corvus, Lithops
- **Research Partners:** SINTEF, UCL, CEA, POLITO, ICSI, DLR, UU

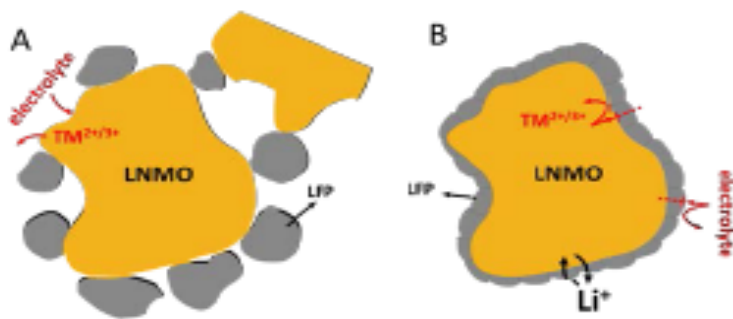


The Approach

HYDRA will have a strong focus on sustainability and theory-based design & development

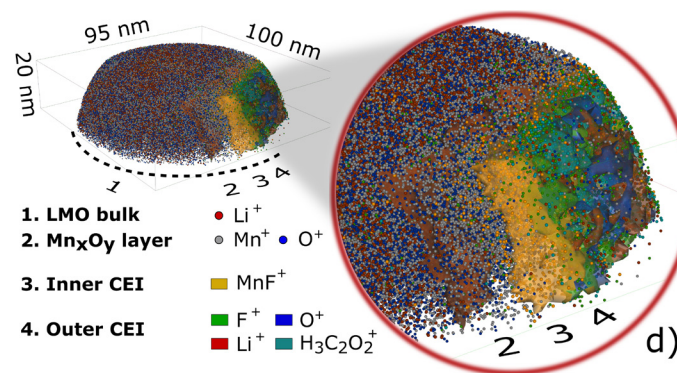
Cobalt-Free Battery

LMNO-LFP Hybrid Cathodes
Physical & Chemical Blends



Advanced Characterization & Models

Materials, Components, Cells
Linked Model-Experimental Workflow



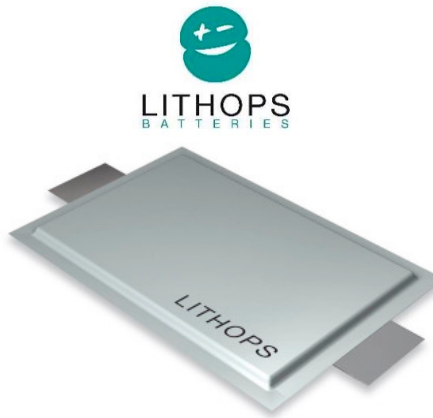
Sustainable, Optimized Manufacturing

Aqueous Processing
Pilot-Scale Production



The Approach

HYDRA has **strong industry commitment** across the value chain with a focus on **sustainability**. The project will demonstrate **pilot scale production** and achieve **TRL 6**.



Electrode
Materials

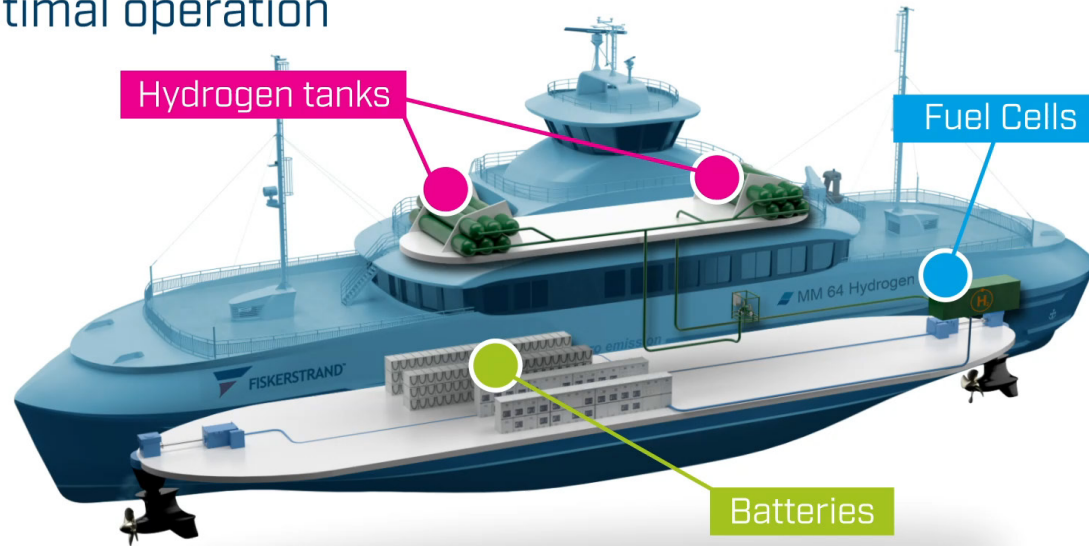
Electrolyte

Cells

Packs

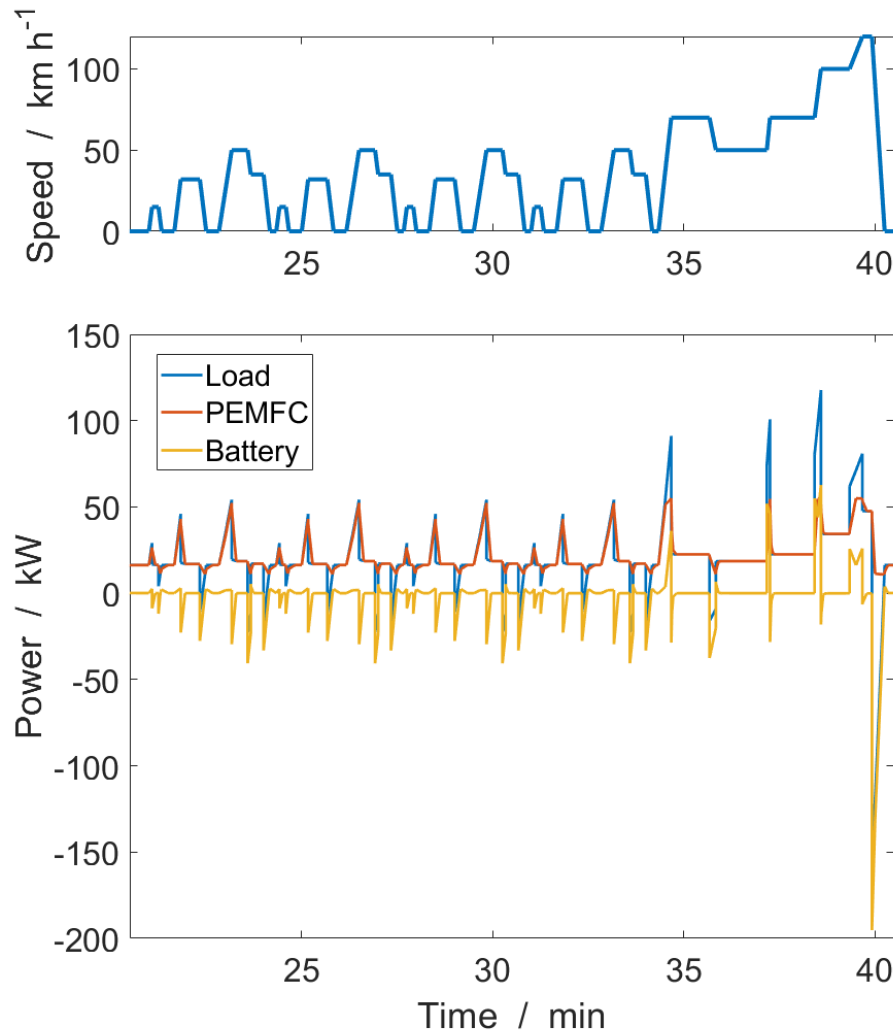
Electric Shipping Integration

Systemdesign and
optimal operation



ZESES is a SINTEF Platform for cost-performance-lifetime optimization of zero-emission hybrid ships.

- **Calculates** optimized system costs and lifetime
- **Considers** vehicle loading profile, system sizing, etc.



Virtual-FCS is a cyber-physical platform for X-in-the-loop development of hybrid PEMFC-battery systems

- **System level model** of electric vehicles
- Determine the performance of specific components (**model, software, or hardware**) under realistic conditions
- FCHJU-funded **open-source platform**.
- Initial release in **Jan 2021**.



—— 70 år ——
1950-2020

Teknologi for et bedre samfunn