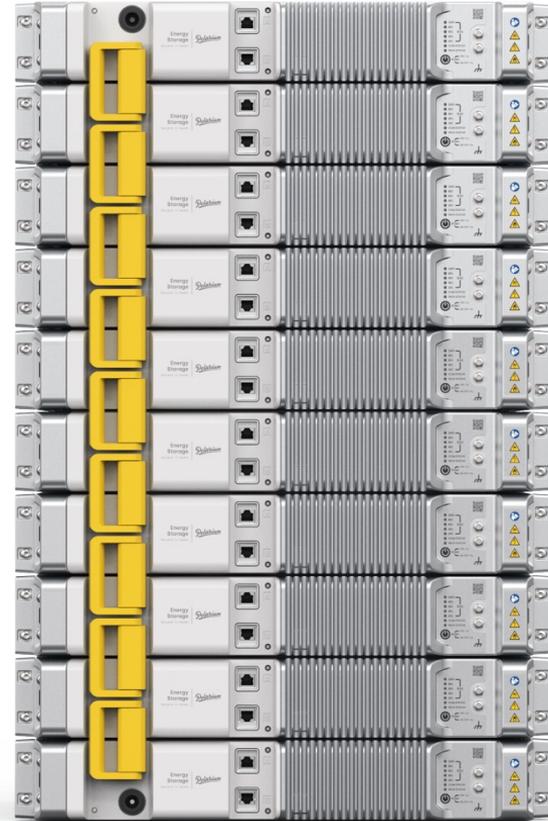


How Lithium Battery Technology is Powering Sustainable Development

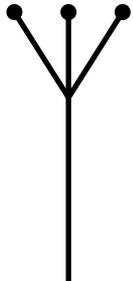
Dr. Henrik Lundgren, Senior Battery Technology Engineer at Polarium

Agenda

- Three ways that energy storage is enabling global development
- Lithium-ion battery technology explained
- Future Outlook



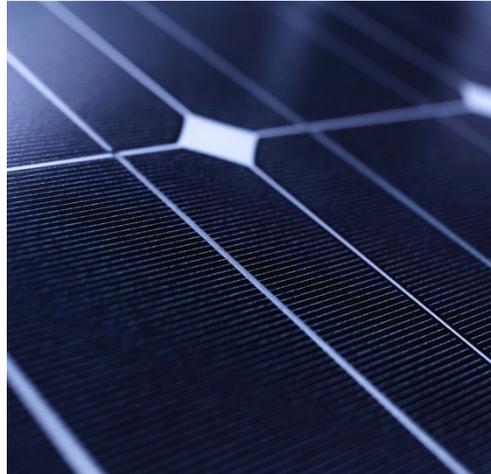
Three Ways – that energy storage is enabling global development



1. ■

Being the missing link in the renewable energy system

By enabling us to store energy when it is abundant, inexpensive, and green, and then use it when needed.



5x

Solar and
Wind capacity
by 2035.

2.

Answering to the 5G energy challenge

By securing network availability and service continuity. While enabling back up energy from renewable sources, obviating the need for led batteries and diesel generators.



81x

Compounded growth of overall mobile data traffic, 2020-2030.

3 ■

Enabling the shift towards electric vehicles

By providing the flexibility to adapt to changing electricity demand patterns and daily peaks in electricity consumption, and by enabling self-sufficient, alternative-grid energy supply.



230 M

Electric vehicles 2030
(10M today)

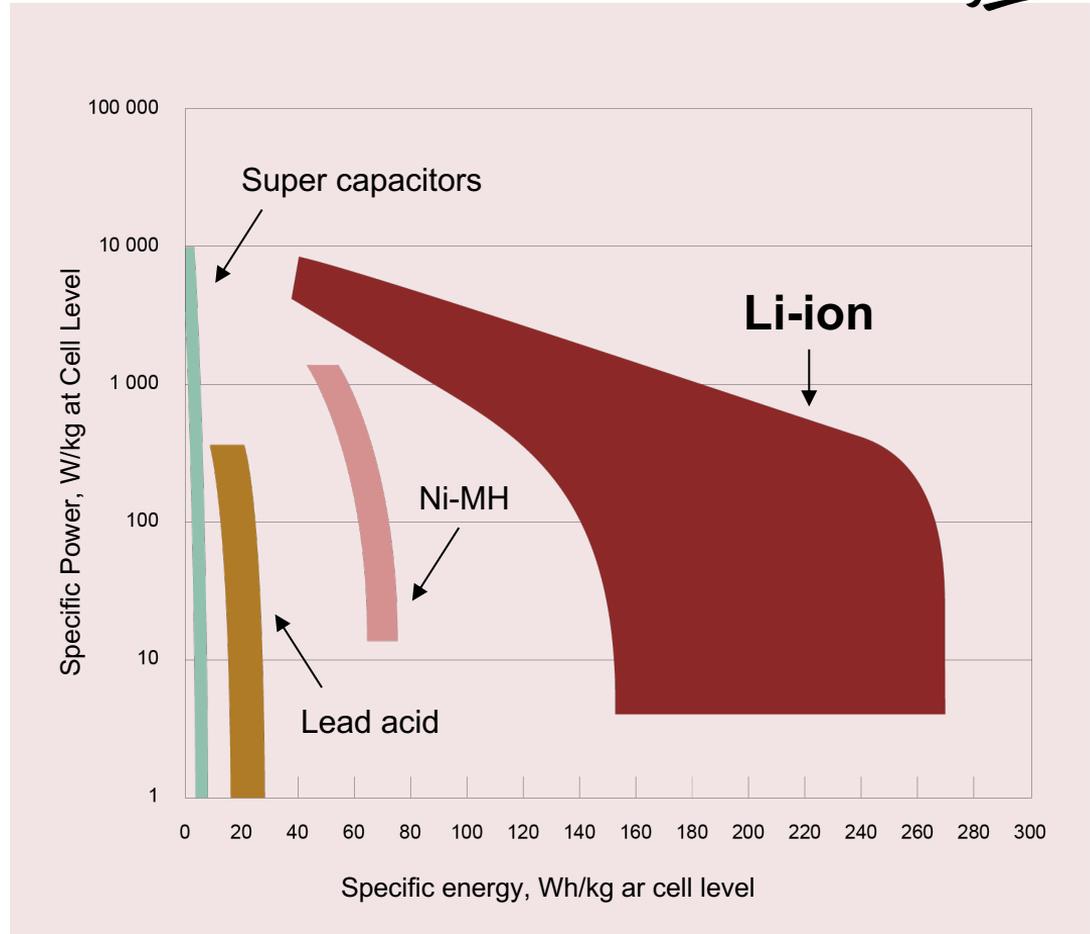
Lithium-ion Battery Technology Explained



Why Lithium?

Smaller and lighter batteries that last longer

- Half of the volume compared to VRLA
- Fourth of the weight compared to VRLA
- 6 000 cycles
- 15-20 years calendar life



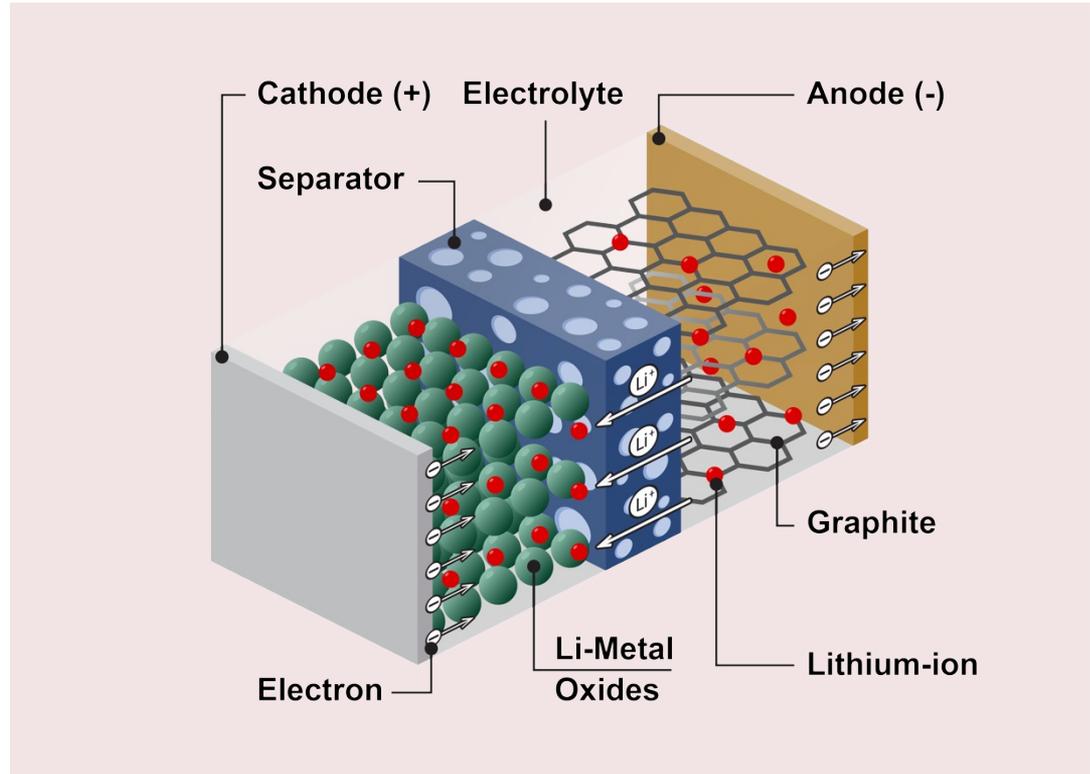
How Does Lithium-ion Batteries work?

Positive electrodes “Cathodes (+)”

- Nickel Manganese Cobalt Oxide (NMC)
- Nickel Cobalt Aluminium Oxide (NCA)
- Lithium Iron Phosphate (LFP)

Negative electrodes “Anodes (-)”

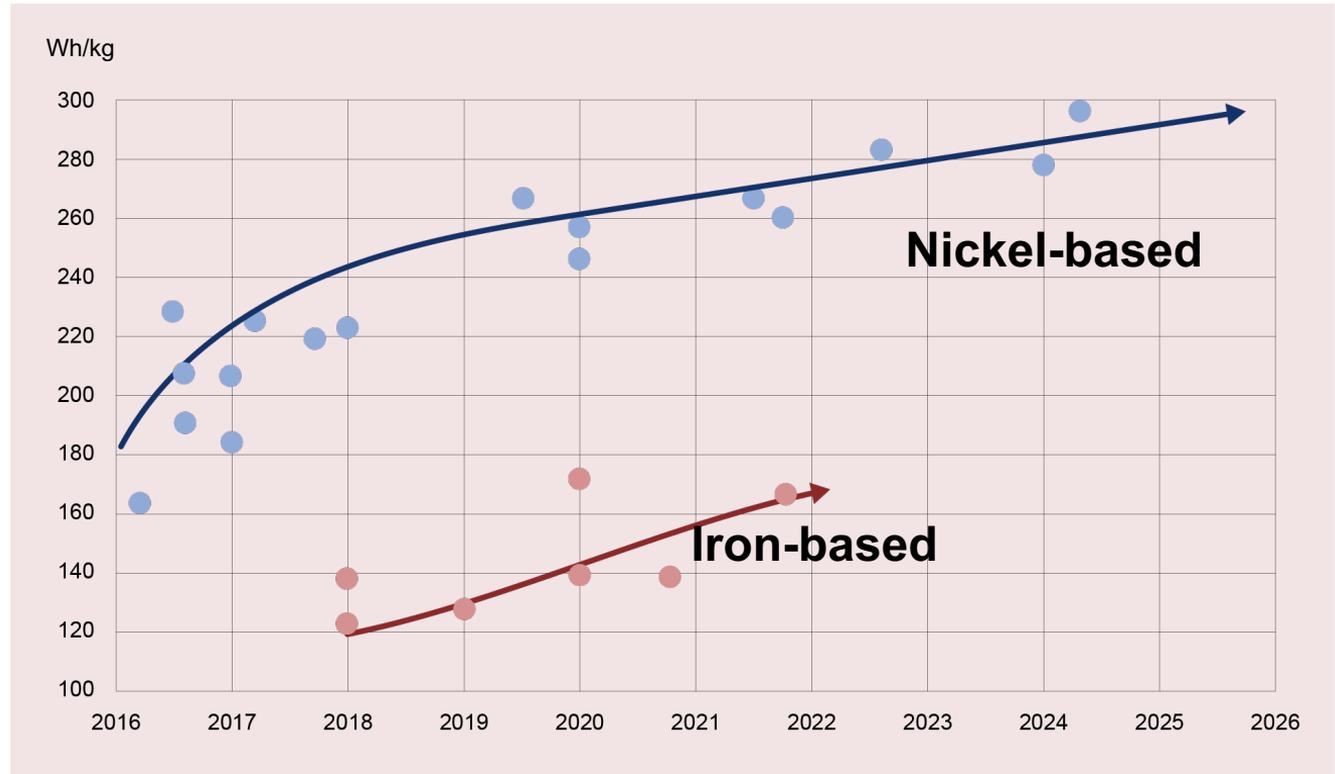
- Graphite
- Silicon
- Lithium Titanate (LTO)



Iron-based vs Nickel-based Chemistries

Grav. Energy density Li-ion Cells

● Cells



Safety is Key



We Have Done it Before

Overcoming safety risks and handling energy dense products is in no way new to humanity.



Elements of Safe Lithium-ion Batteries

- High-quality products
- Robust design
- Battery management system with built-in redundancy
- Advanced propagation prevention solutions
- Fire suppression systems

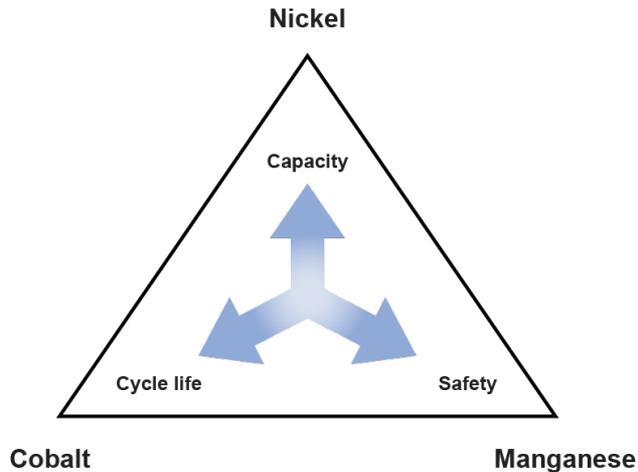


Future Outlook

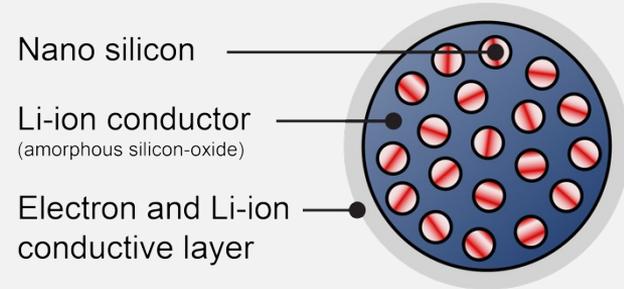


Near-term Evolution

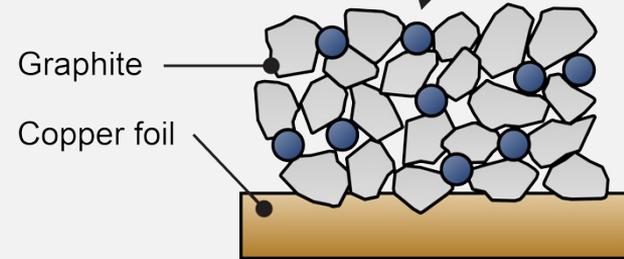
- High-Nickel NMC
- Hybrid materials
- Silicon



Nano silicon composite



Hybrid electrode



Battery Chemistries of the Future

- Lithium-ion batteries
- Solid-state materials
- Sodium-ion batteries



Conclusion

- Energy storage solutions will play an increasingly important role in the sustainable transition
- Safety is key in powering the future – and we have done it before
- Innovation drives continued rapid development, within several technologies.

