

CENTER OF EXCELLENCE IN TRANSPORTATION ELECTRIFICATION AND ENERGY STORAGE OF HYDRO-QUÉBEC

Perspectives on emerging battery technologies towards a sustainable energy transition



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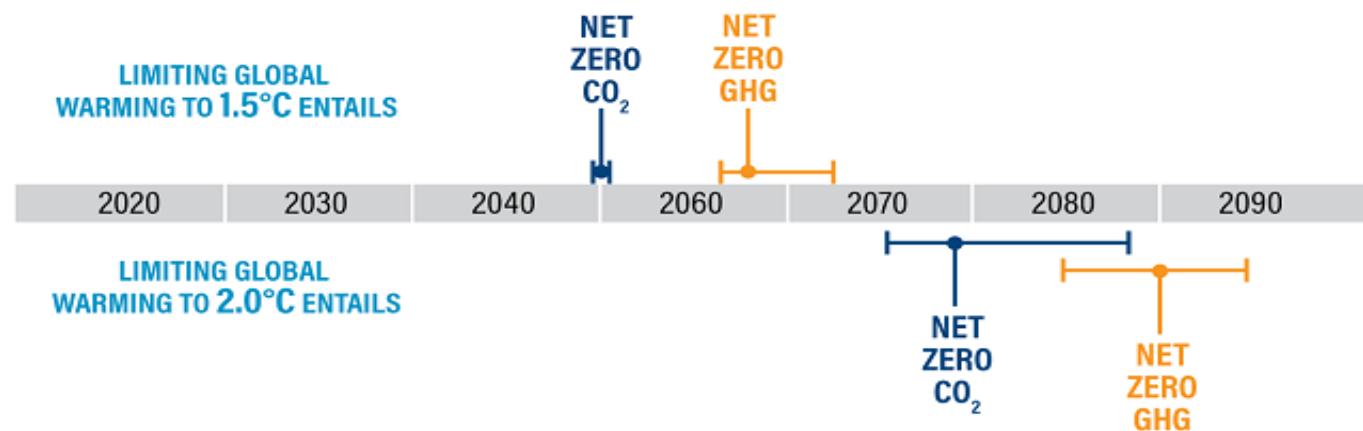
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Net Zero Scenarios

Global timeline to reach net-zero emissions



Source: IPCC Special Report on Global Warming of 1.5°C

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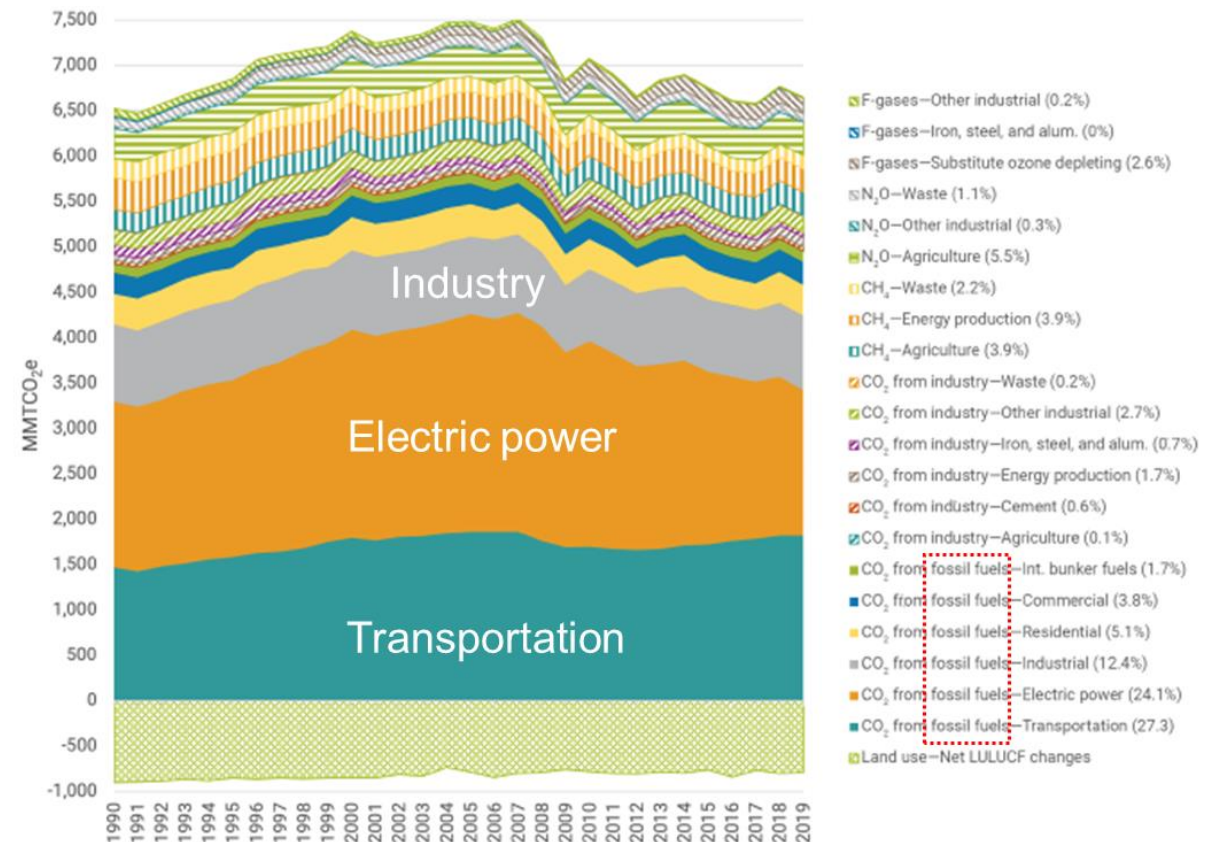
	1.5°C	2°C	IMPACT of 2°C compared to 1.5°C
 LOSS OF PLANT SPECIES	8% of plants will lose 1/2 their habitable area	16% of plants will lose 1/2 their habitable area	2x worse
 LOSS OF INSECT SPECIES	6% of insects will lose 1/2 their habitable area	18% of insects will lose 1/2 their habitable area	3x worse
 FURTHER DECLINE IN CORAL REEFS	70% to 90%	99%	up to 29% worse
 EXTREME HEAT	14% of the global population exposed to severe heat every 1 in 5 years	37% of the global population exposed to severe heat every 1 in 5 years	2.6x worse
 SEA-ICE-FREE SUMMERS IN THE ARCTIC	At least once every 100 years	At least once every 10 years	10x worse

Sources of GHG Emissions

“Energy Transition”

- 74.4% of GHG originate from the fossil fuels
- **Clean electrification** will be the primary route to decarbonization

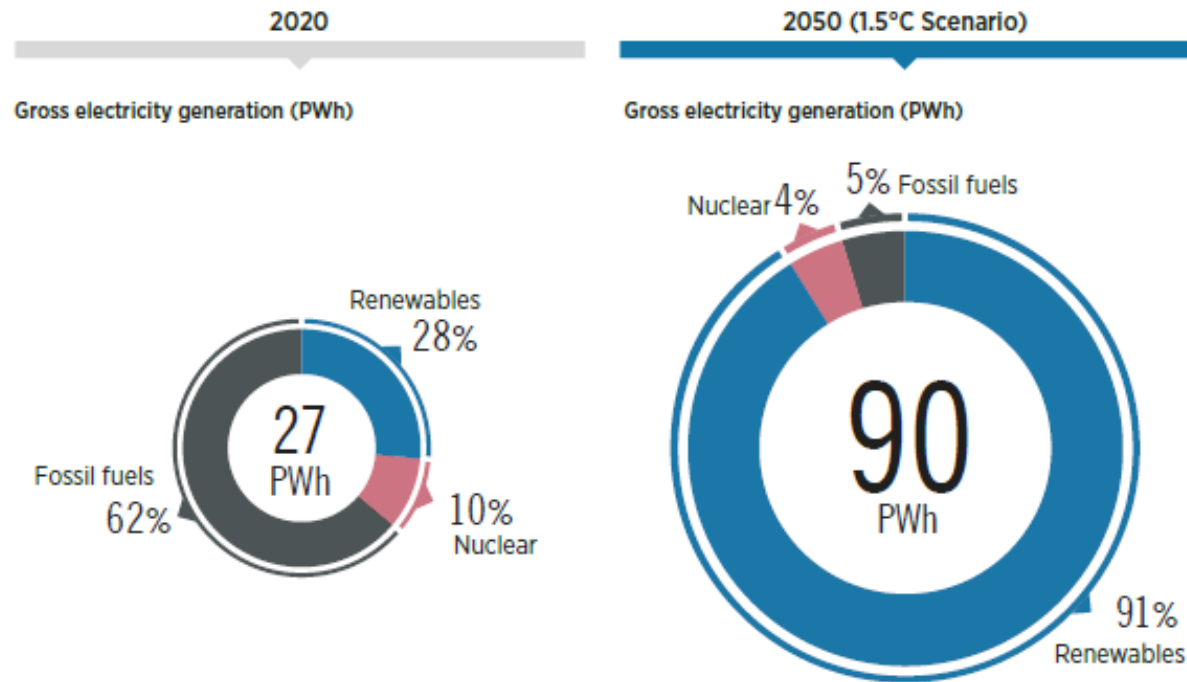
Figure 2. Historical US GHG emissions by gas and source



Source: EPA (2022).

Renewable Energy : The Pathway to Net-Zero

FIGURE 1.1 Power generation needs to more than triple by 2050 in the 1.5°C Scenario

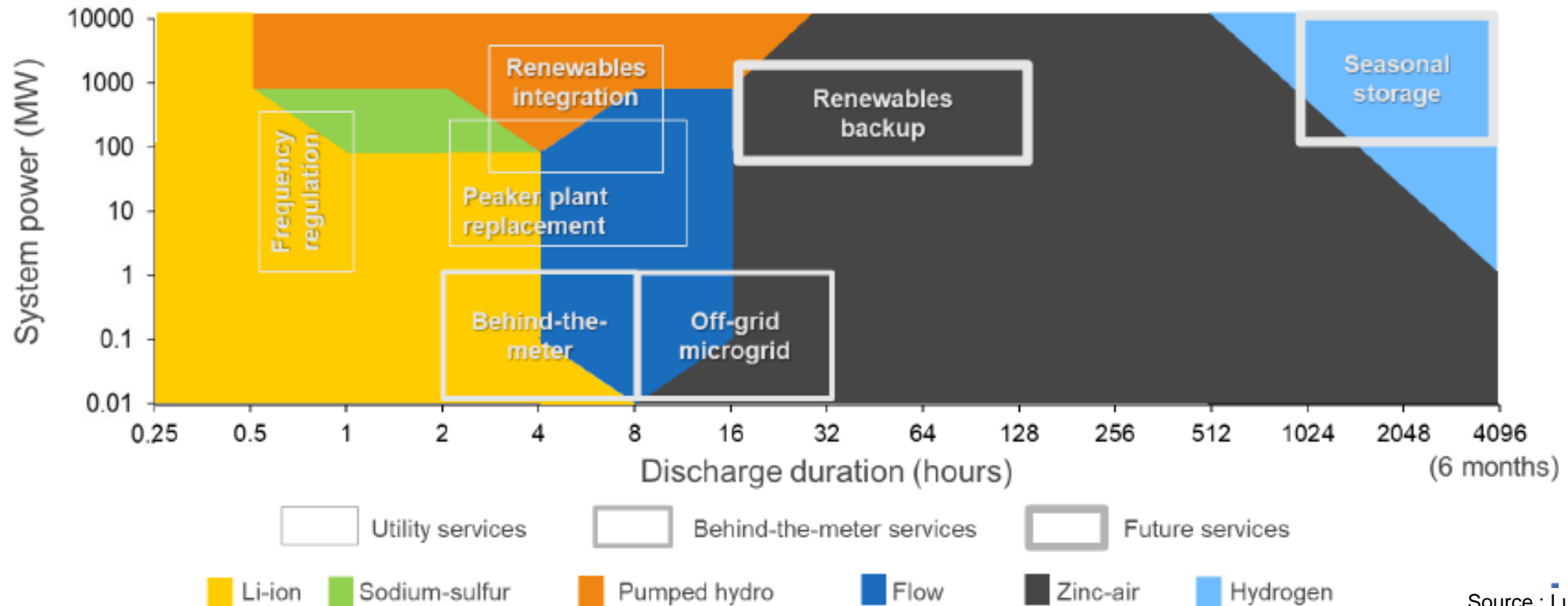


Note: PWh = petawatt hours.

Source: IRENA report 2023

- Need a **tripling of global installed renewable power** capacity by 2030 and then a further doubling by 2040.

Energy Storage Systems for Renewable Power



LIBs play a key role in the short- to mid-duration ESS market for applications requiring less than 8 hours of storage.

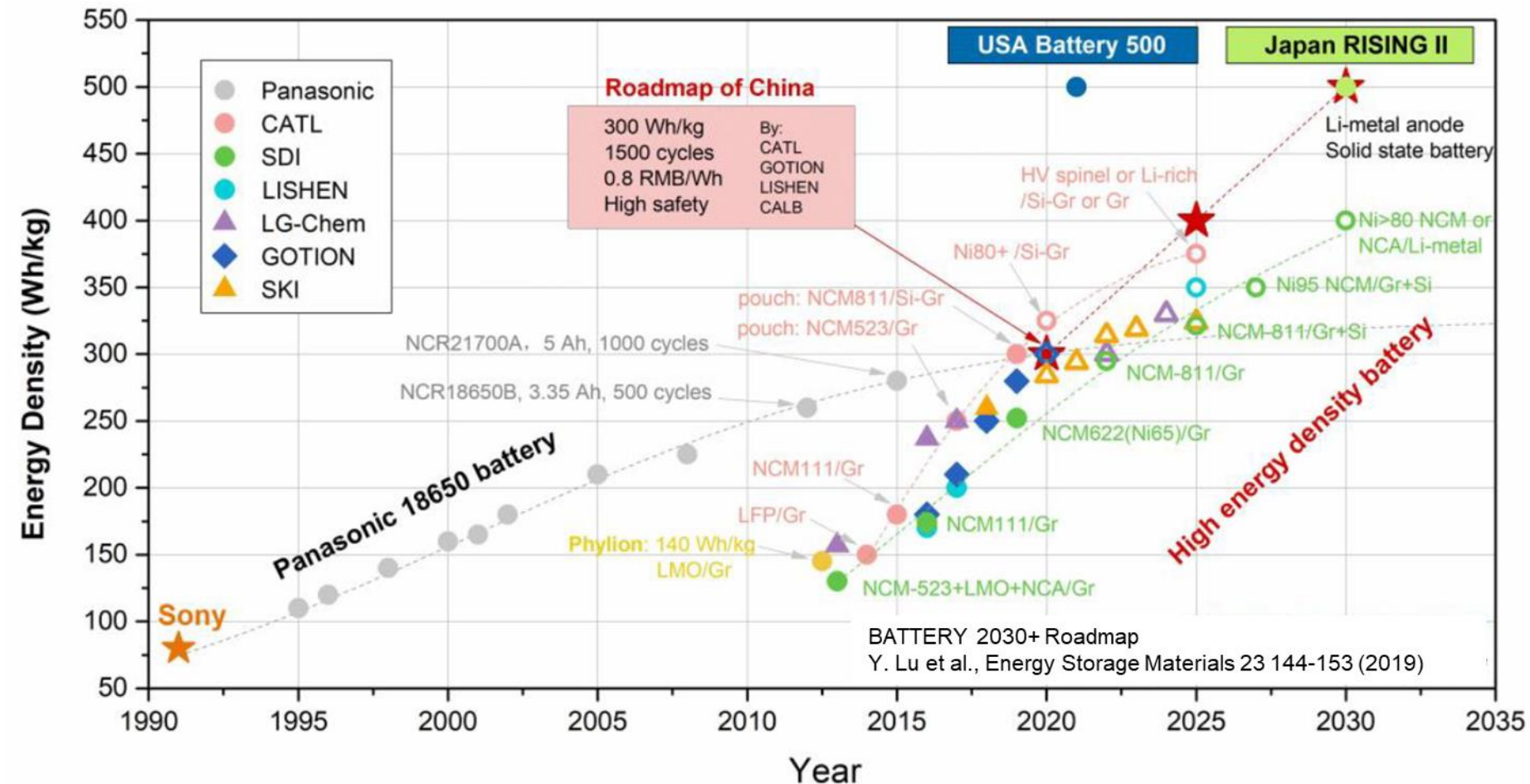
Emerging Technologies – New Materials

Cathode Active Materials

- LCO
- LNO
- LMO
- NCM
- LFP, LMP
- LMX
- LMR
- DRX

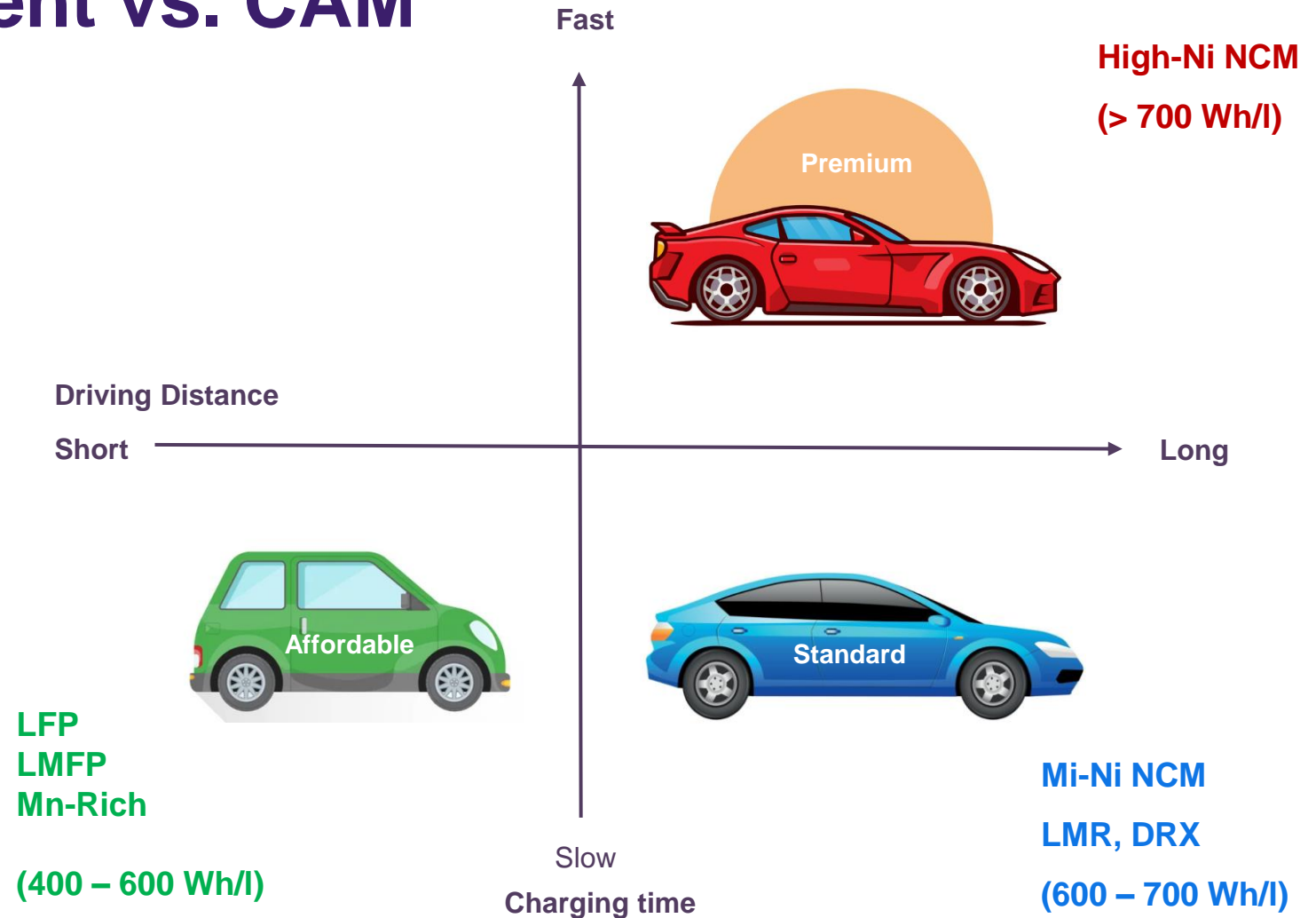
Anode Active Materials

- Graphite
- Si, Si-C, SiO_x
- LTO, LNT0
- Li metal



EV Market Segment vs. CAM

Different active materials with balanced **cost** and **performance** characteristics can be selected based on the specific requirements of various **market segments**.



Take Aways

- **Electrochemical energy storage** systems, particularly secondary batteries, play a vital role in the **energy transition toward net-zero emissions**
- **Enhancing upstream sustainability** of LIB production is essential to ensure both supply chain resilience and a reduced carbon footprint.
- A **diversity of battery chemistries** should be pursued to meet the specific needs of various applications and market segments, including the development of '**Co/Ni-free**' and '**Beyond Li**' active materials.

Thank You!



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