

เทคโนโลยีแบตเตอรี่ไฟฟ้าเคมี และการบริหารจัดการพลังงาน

Thanya PHRAEWPHIPHAT

Energy Storage Technology Research Team (ESTT)

Energy Innovation Research Group (EIRG)

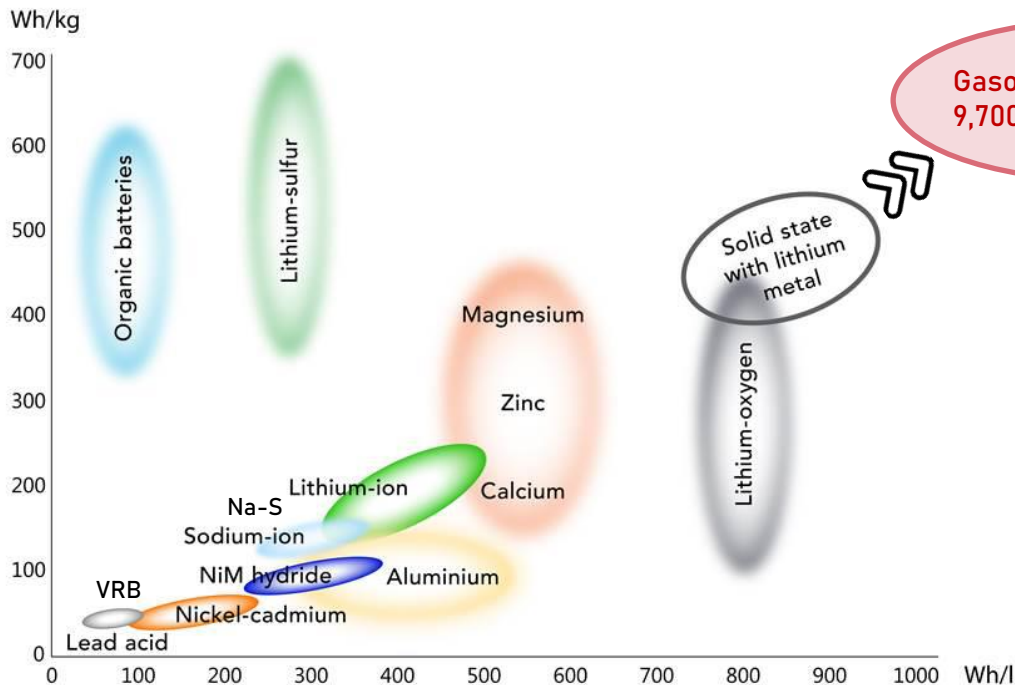
National Energy Technology Center (ENTEC)

National Science and Technology Development Agency (NSTDA)



Current Commercial Batteries

By Chemistry



Lead-acid: 55 Wh/kg, 110 Wh/L

Ni-MH: 125 Wh/kg, 310 Wh/L

Li-ion: 200 Wh/kg, 500 Wh/L

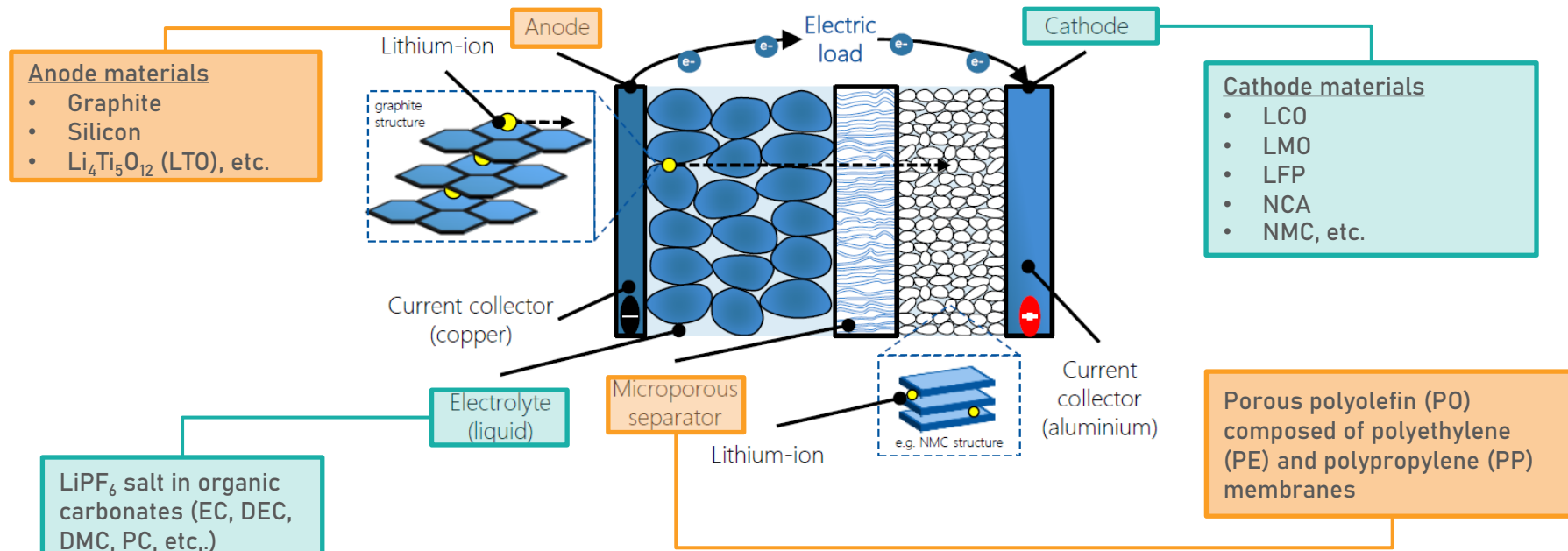
Na-S: 250 Wh/kg, 300 Wh/L

VRB: 50 Wh/kg, 70 Wh/L



Lithium-ion Batteries

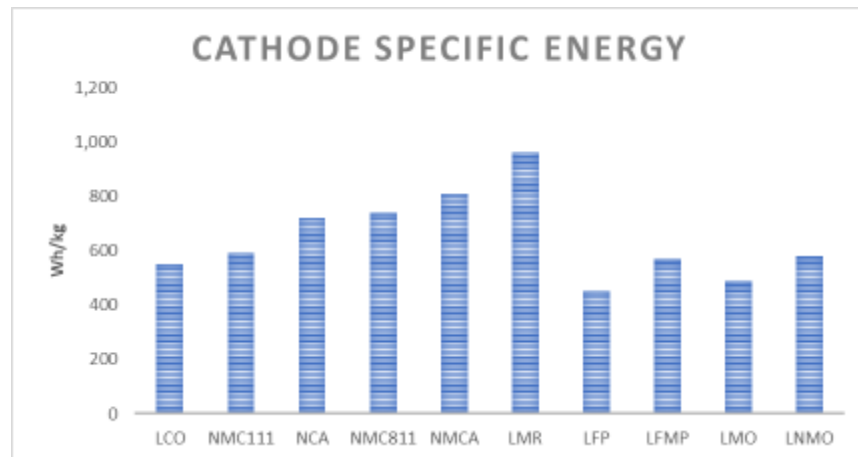
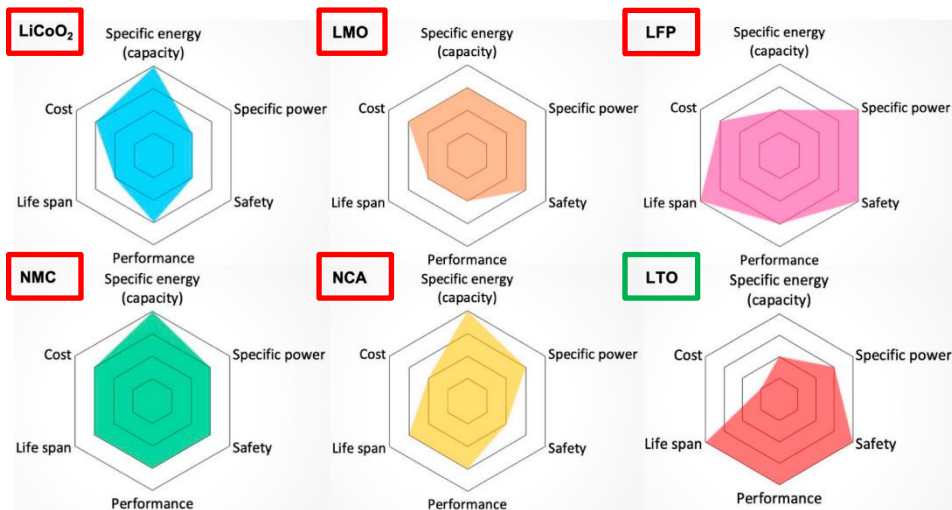
Overview





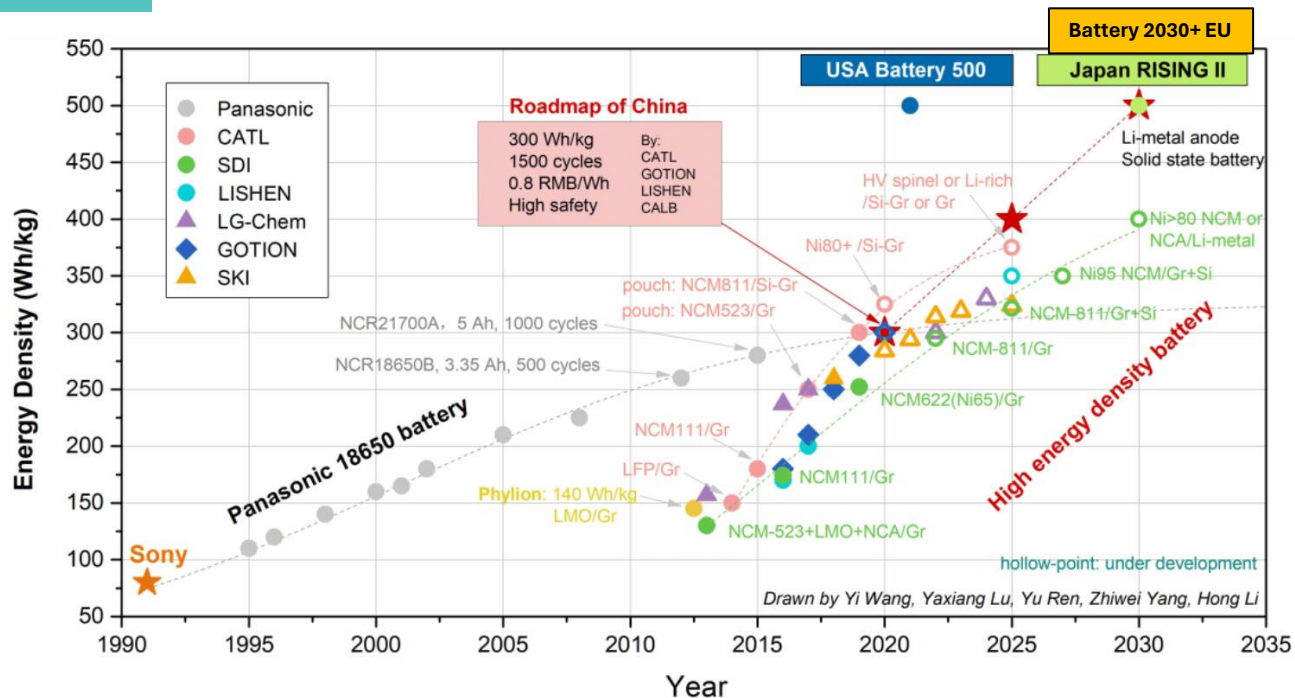
Lithium-ion Batteries

By Cathode Materials





Battery Chemistry Roadmap



Roadmap of China
Li-ion batteries: 300 Wh/kg



RISING II (Now RISING III)
Fluoride batteries: 500 Wh/kg
Zn anode batteries: 200 Wh/kg



Battery 500
Li-ion batteries: 500 Wh/kg



Battery 2030+
All batteries: 500 Wh/kg



Next Generation Batteries

BATTERY 2030+

BATTERY 2030+ TRANSFORMATIONAL CHEMISTRY-NEUTRAL RESEARCH:

- Accelerated battery material discovery & interface engineering
- Smart sensing & self-healing functionalities
- Cell design & manufacturability (cross-cutting)
- Recyclability (cross-cutting)

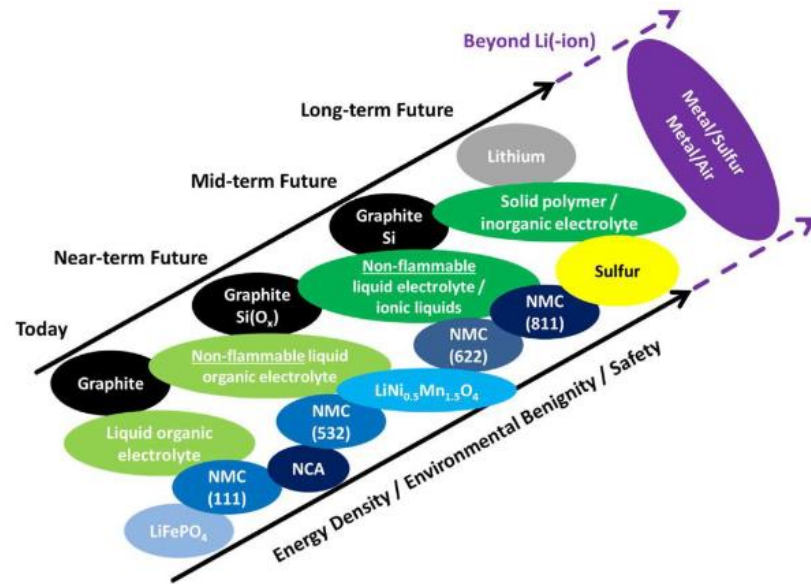
FUTURE BATTERY CHEMISTRIES

POST-LITHIUM BATTERY CHEMISTRIES

Sodium-ion, multivalent metal-ion, metal-air, redox flow, etc.

LITHIUM BATTERY CHEMISTRIES

Gen 5 (lithium-air, lithium-sulfur)
 Gen 4 (all-solid-state lithium-ion or lithium-metal)
 Gen 3 (advanced lithium-ion)





Battery Technology Comparison

Keys Metric for Each Application



Planes Wh/Kg > Rate > Safety/Reliability	Moped Wh/Kg > Cost > Self Discharge	Computers & Tablets Wh/L > Cost > Safety / Reliability	Loading Balancing Cost/kWh/Cycle > Safety / Reliability > Cycle Life	Defibrillators Safety / Reliability > Rate > Wh/L	Infantry Safety / Reliability > Wh/Kg > Wh/L
Drones Wh/Kg > Rate > Cost	Motorcycle Rate > Wh/L > Wh/Kg	Smart Phones & Smart Watches Wh/L > Cost > Safety / Reliability	Frequency Balancing Cost/kWh/Cycle > Safety / Reliability > C-Rate	Surgical Tools Safety/Reliability > Rate > Cycle Life	Backup Power (Communications) Safety/Reliability > Wh/Kg > Wh/L
Low Earth Orbit Satellites Wh/kg > Cycle Life > Safety/ Reliability	Sports Car Wh/L > Rate > Cycle Life	Power Tools & Gardening Equipment Rate > Cost > Safety / Reliability	Residential Storage + Smart Grid Safety / Reliability > Cost/kWh/Cycle > Cycle Life	Pacemakers Safety/Reliability > Cycle Life	Missiles Rate > Wh/Kg > Wh/L
Medium Earth Orbit Satellites Cycle Life > Wh/kg > Safety / Reliability	Sedan Cost > Wh/L > Cycle Life	E-Bikes Cost > Wh/Kg > Rate		Monitoring Devices Cycle Life > Cost > Safety / Reliability	Drones Wh/Kg > Rate > Safety / Reliability
Geostationary Orbit Satellites Cycle Life > Wh/kg > Safety / Reliability	Sports Utility Vehicle Wh/L > Cost > Cycle Life				
	Pickup Trucks Wh/L > Wh/Kg > Cycle Life				
	Heavy Duty Trucks Wh/Kg > Cycle Life > Cost				



Battery Value Chain

at ENTEC

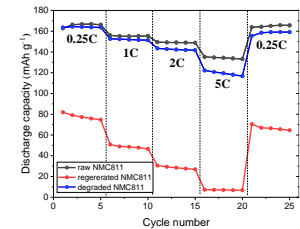
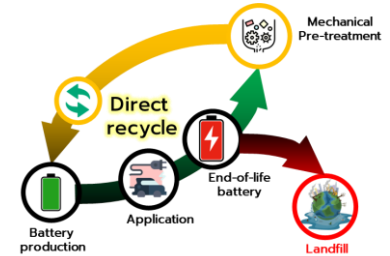
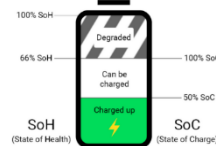
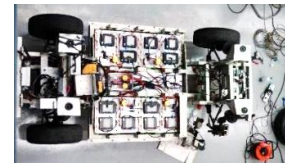
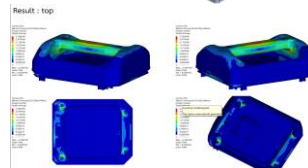
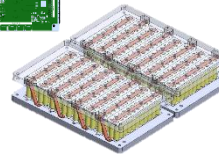
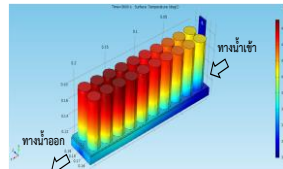
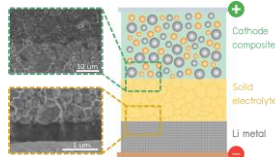
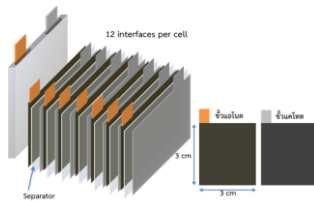
Cell components

Cell design & production

Pack design/ assembly

Battery data and EV/ESS application

Recycling and 2nd life



Performance vs. Cost





ENTEC Partner (Partial)

Batteries and Energy Storage Sectors



Thank you



Thanya PHRAEWPHIPHAT, Ph. D.

thanya.phr@entec.or.th

National Energy Technology Center (ENTEC)

National Science and Technology Development Agency

