



TBSI 清华-伯克利深圳学院
Tsinghua-Berkeley Shenzhen Institute

Digital Battery Passport: Towards a Sustainable and Smart Living

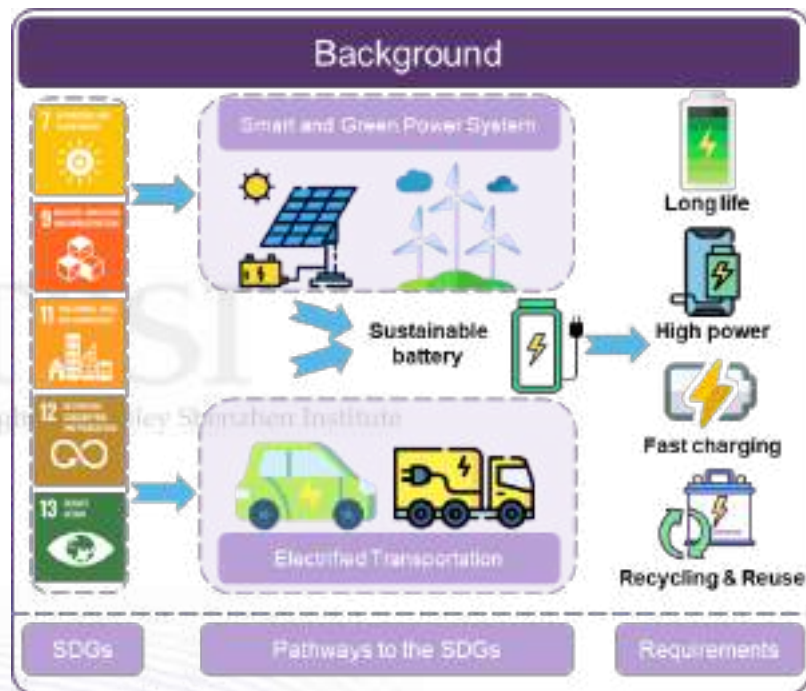
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^aLab 1C Smart Grid and Renewable Energy

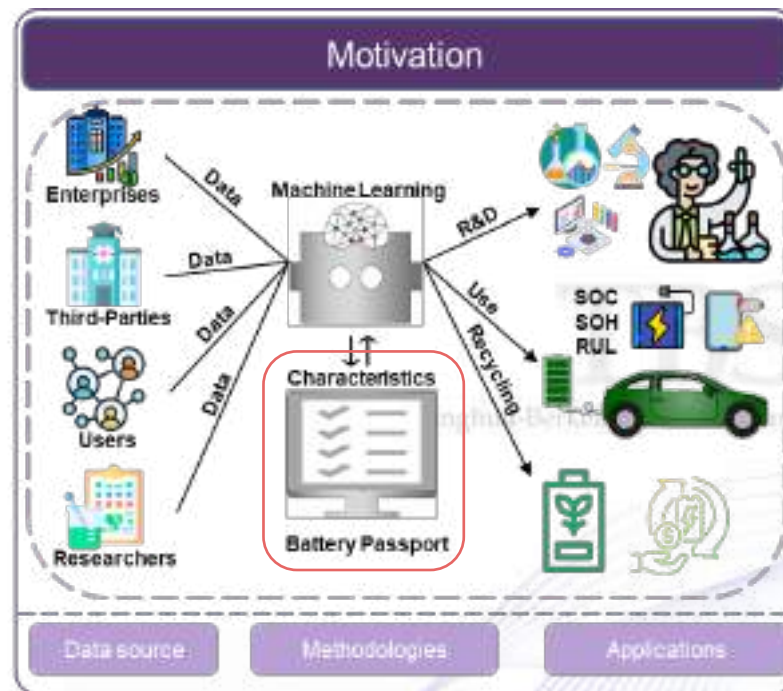
^bLab 2C Internet of Things and Societal Cyber Physical Systems

^cLab 1F Low-Dimensional Materials and Devices

7th July, 2023

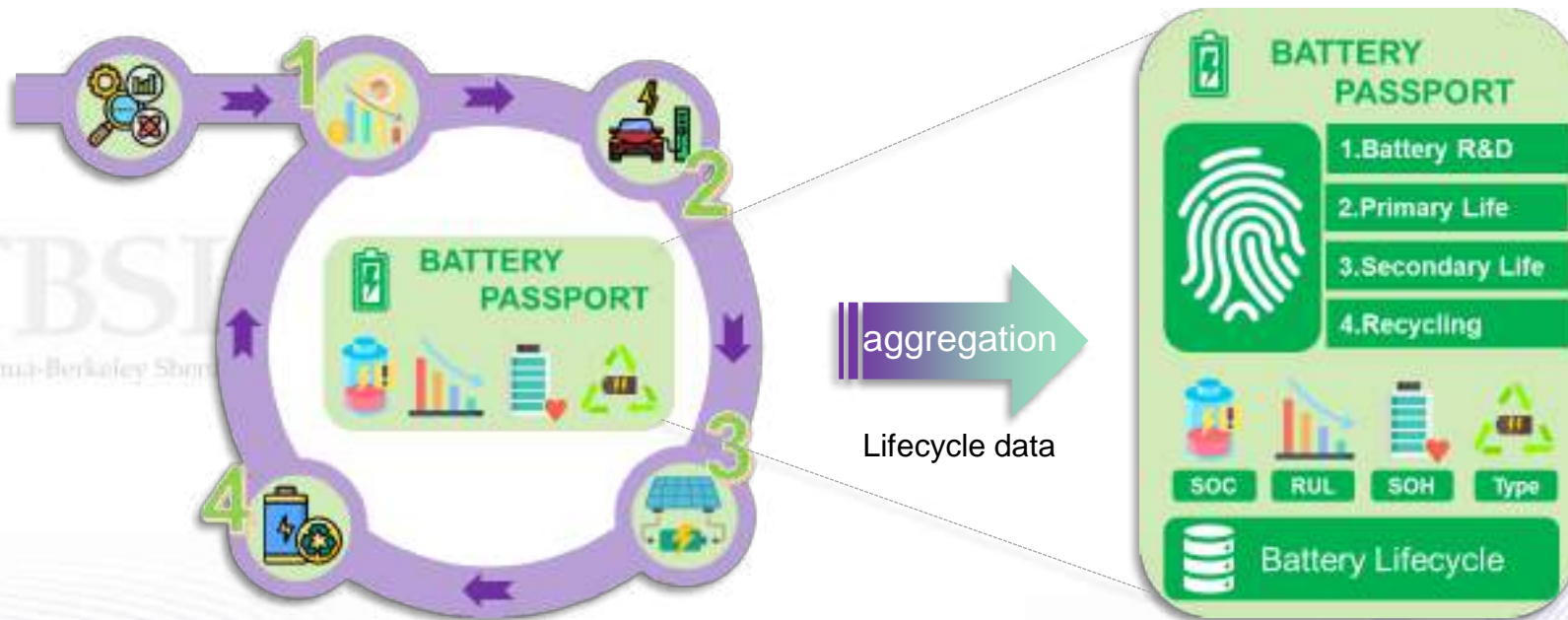


Battery empowers critical sustainable development goals (SDGs) while remains high requirements



Machine learning is promising in ensuring these requirements by leveraging data characteristics

The battery passport concept:

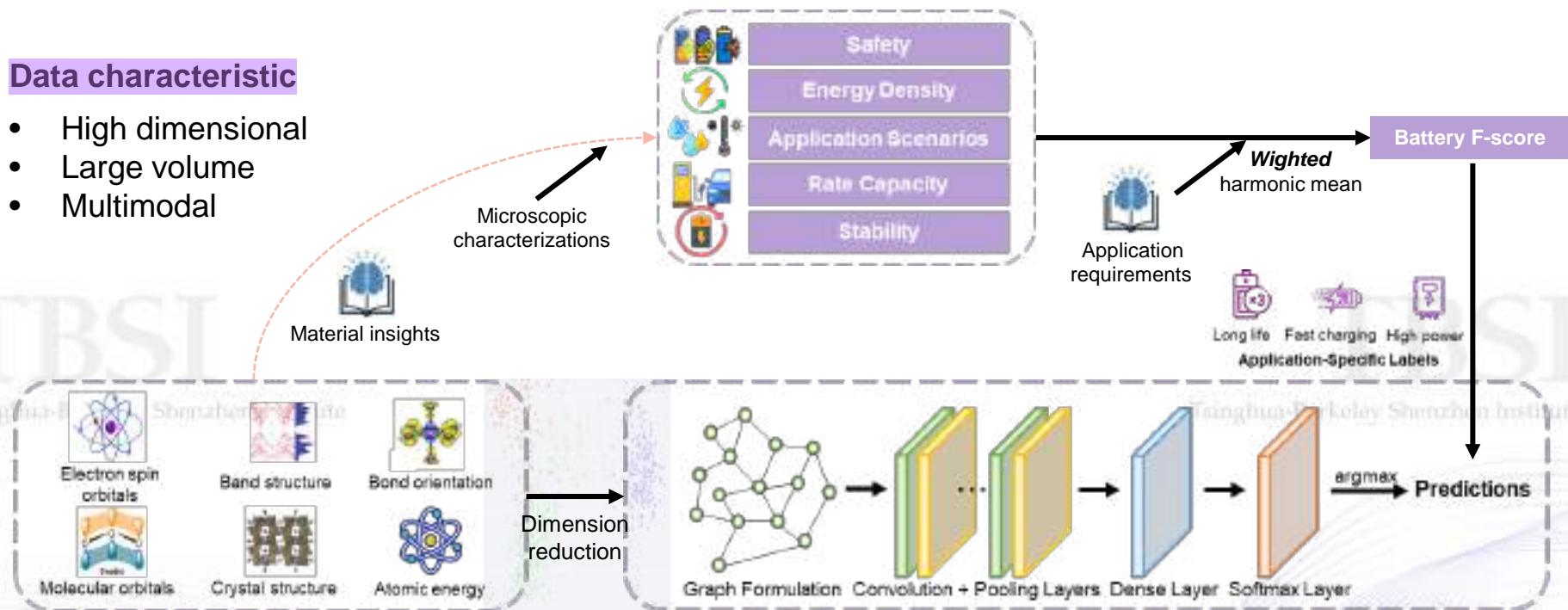


The battery lifecycle from prototype R&D, primary life, secondary life to battery material recycling

The battery passport, recording critical lifecycle data and highlighting different data characteristics

Data characteristic

- High dimensional
- Large volume
- Multimodal

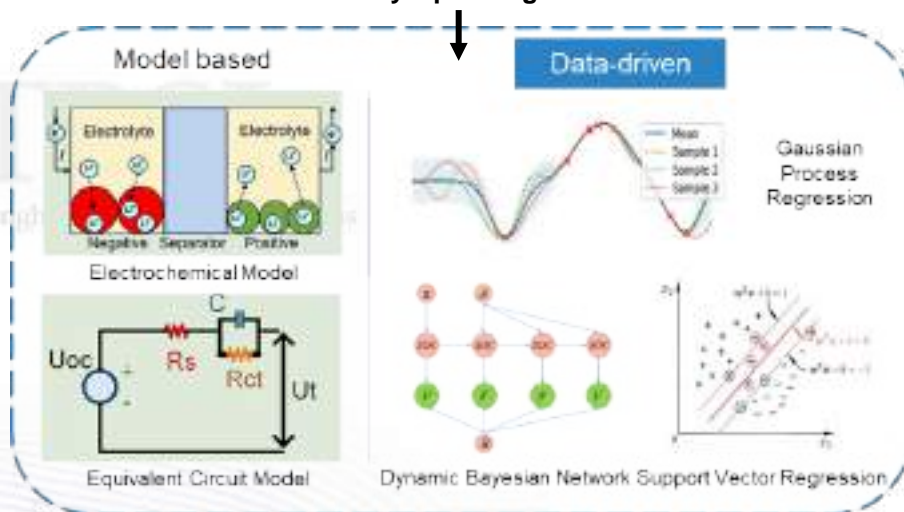


Material information

Battery Graph Convolutional Neural Network (BatteryGCN)



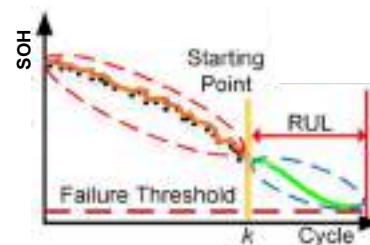
Battery Operating Data



SOC

SOH

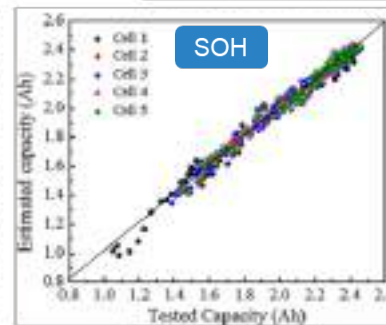
RUL



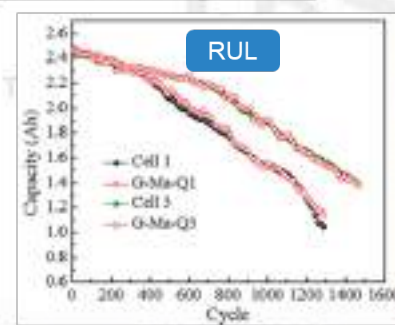
Data characteristic

- Low dimensional
- Highly noisy
- Highly random

Results of Gaussian Process Regression



10% cross validation:
RMSE < 0.02, $R^2 > 98\%$

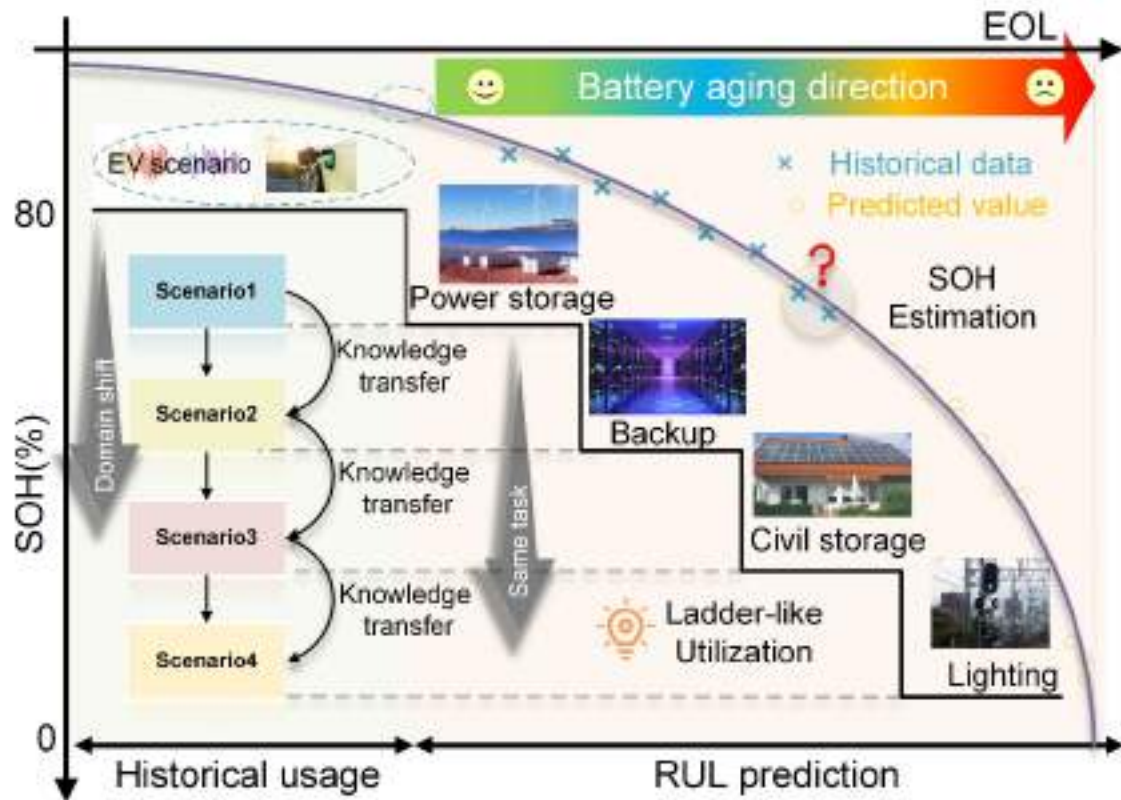
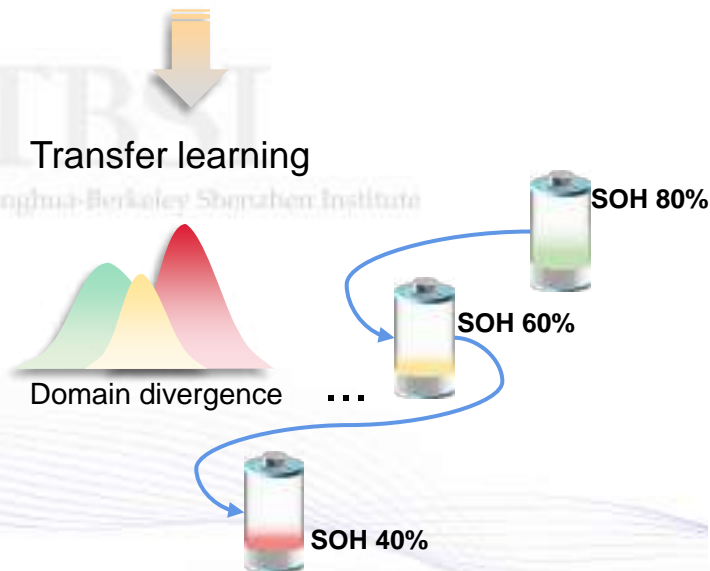


Estimation on cells:
RMSE ~ 0.02, $R^2 > 99\%$

Data characteristic

- Small volume
- Domain divergence
- Similar task

Transfer learning



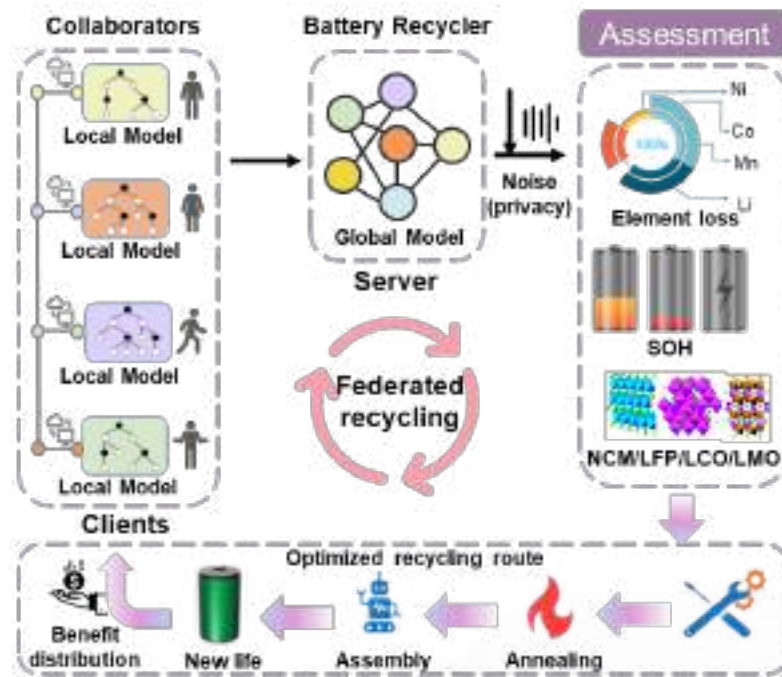
Data characteristic

- Heterogeneous
- Small volume
- Privacy concern (formulation leakage)



SOH 20%

Retired batteries



Collaborative and privacy-preserving battery recycling

Sustainable and profitable



Easy operation



Less cost



Less pollution

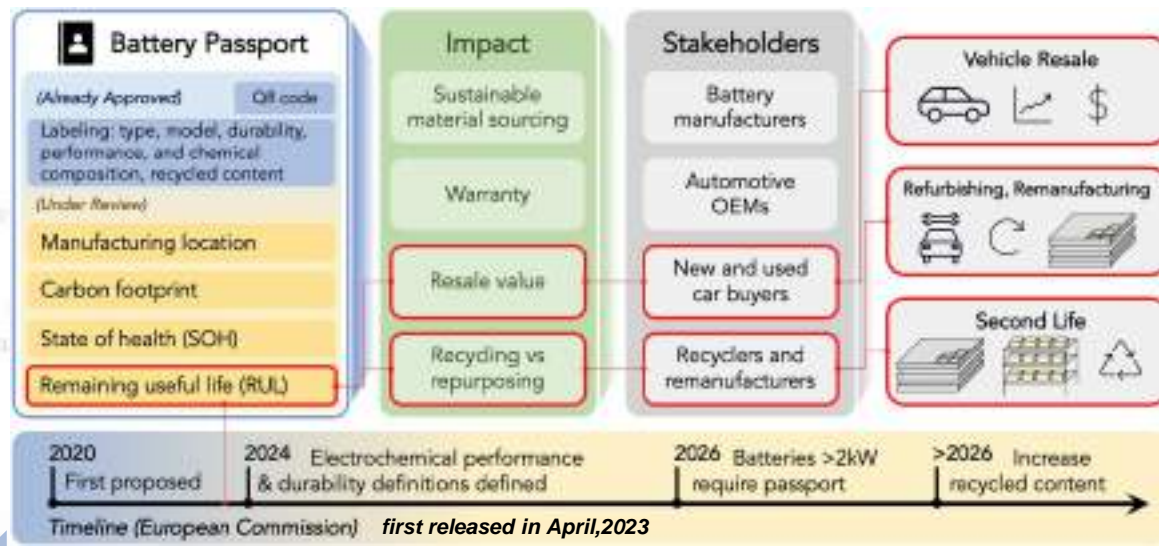


Save energy



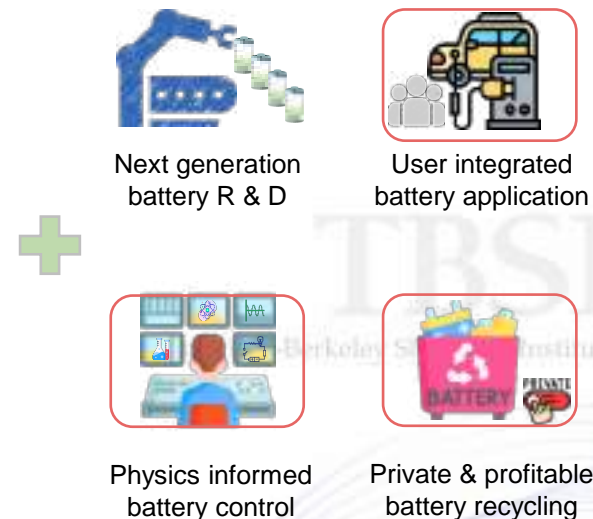
Let's check our repaired battery!

The digital battery passport renews future battery ecology:



Historical information and health conditions

Battery passport in European Commission,
a 'back-looking' way (where to go)



Different data (application) characteristics

A 'forward-looking' way, as an application-specific complement (how to do)



The digital battery passport enables machine learning driven battery lifecycle management and optimization by:

- accelerating battery R&D by efficiently searching for promising material candidates;
- ensuring safe and incentivized primary life applications by building user portrait;
- maximizing residual values in secondary life by leveraging historical usage patterns;
- empowering collaborative, privacy-preserving and profitable battery recycling.

Therefore, the digital battery passport is a valued asset, leading us to a sustainable and smart living in the future.

WE ARE SAD TO SHARE THE NEWS OF THE PASSING OF JOHN B. GOODENOUGH



July 25, 1922 – June 25, 2023

Credit: The University of Texas at Austin

Goodenough, the co-inventor of lithium-ion battery,
the Nobel Laureate Winner, 2019

Story continues...



Lithium-ion battery is still young
and will be forever with us



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Thanks! Q&A