Physics-based Machine Learning for Accelerated Life Prediction and Cell Design

Accelerating Innovation Requires Failure Mode Prediction/Validation and Understanding Use Case

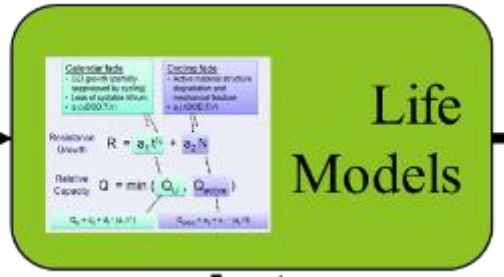
Common Data Storage

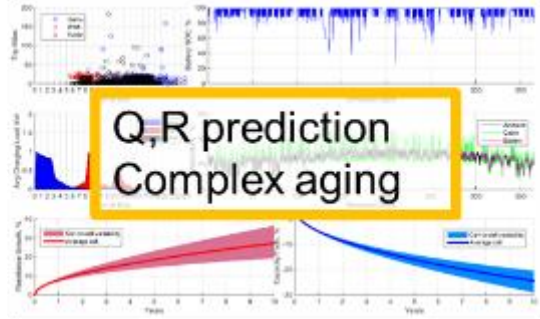
Combined open and restricted-access tools and data

Includes aspects related to both R&D and benchmark/testing data

NREL operated similar to EMN Datahubs (batterydata.energy.gov)

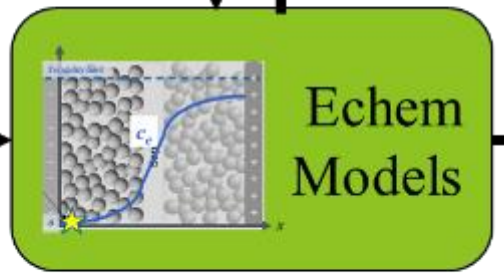
- Calendar aging
- Simple cycle aging
- Complex aging/validation
- Validation of degradation mechanisms

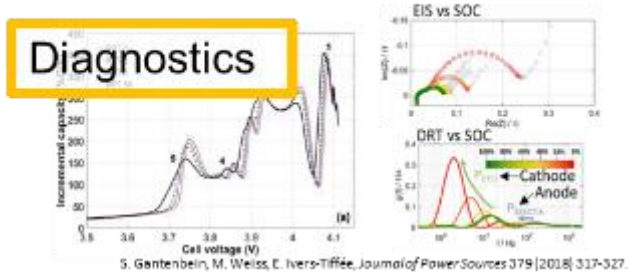


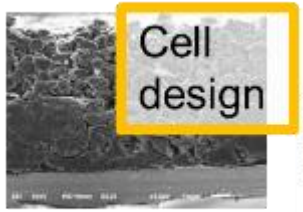


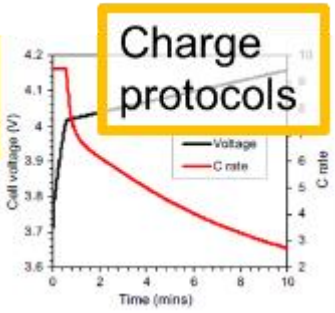
Mechanisms
Synthetic data
Observability

- XCEL Gr/NMC532
  - Li plating
  - Cathode cracking
- Future chemistries
  - Other mechanisms





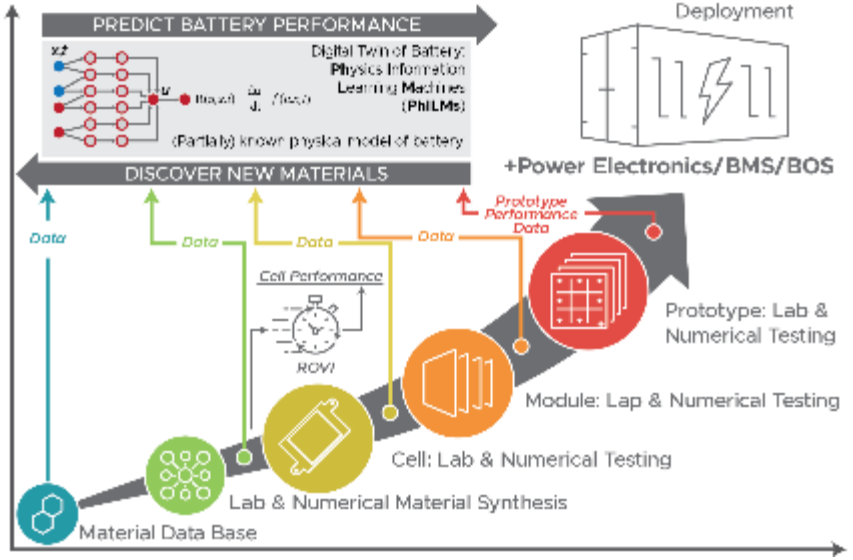




INL Idaho National Laboratory

NREL NATIONAL RENEWABLE ENERGY LABORATORY

Rapid Operational Validation Initiative (ROVI)



- Lack of means to predict the functional lifetime performance of emerging energy storage assets accurately and reliably in individual investment scenarios
- Evolving grid use scenarios impact value generation
- Coordinates across DOE OE and OCED for both R&D and deployments

Target: 15x reduction in time to validate to meet DOE 2035 Goals

CHALLENGE:

- Insufficient & imprecise life/performance information creates risks which shackle entire battery innovation-to-deploy cycle *especially those requiring large financial investments*
- Testing is both time and resource consuming – Waiting to get sufficient system data for validation doesn't align with achieving deployment targets

• ROVI OBJECTIVES: track with 2035 US Decarbonization Goals

- 15X reduction for validation by developing tools that broadly accelerate testing and validation
- Quantify predictive certainty & so risk – aim to ensure commercial impact