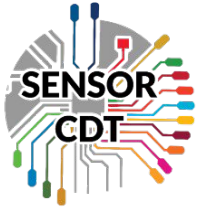
LIFETIME+

Developing predictive models for Li-ion Cell Health

Enabling second-life battery production.



What’s the context?


WARNING
Authorized Service Provider Only
Potential for fire or burning. Do not disassemble, puncture, crush, heat, or burn.
Li-ion Polymer Battery
3.8V ⎓ 5.92Whr
APN: 616-0718
VPN: A69TA006H
Li-ion
1440mAh
Apple Japan


Battery
© Getty Images/AFP/S. Ka

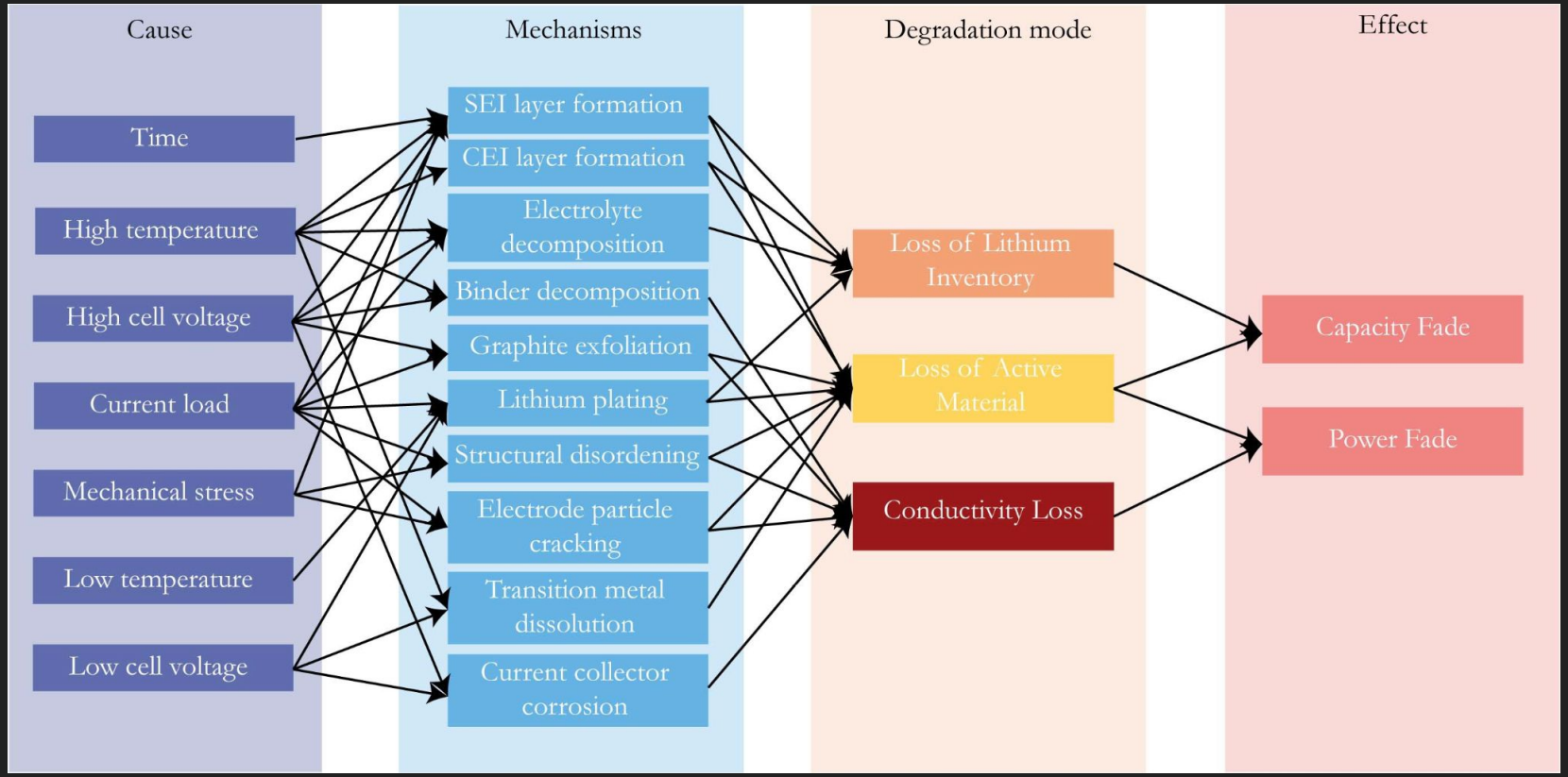

LIFETIME+


7
AFFORDABLE AND
CLEAN ENERGY


11
SUSTAINABLE CITIES
AND COMMUNITIES


12
RESPONSIBLE
CONSUMPTION
AND PRODUCTION

How do cells fail?



Pathways of cell degradation. Source: Vermeer, W.; Mouli, G. R. C.; Bauer, P. - IEEE TRANSACTIONS ON TRANSPORTATION ELECTRIFICATION, VOL. 8, NO. 2, JUNE 2022\10.1109/TTE.2021.3138357

What does failure look like?

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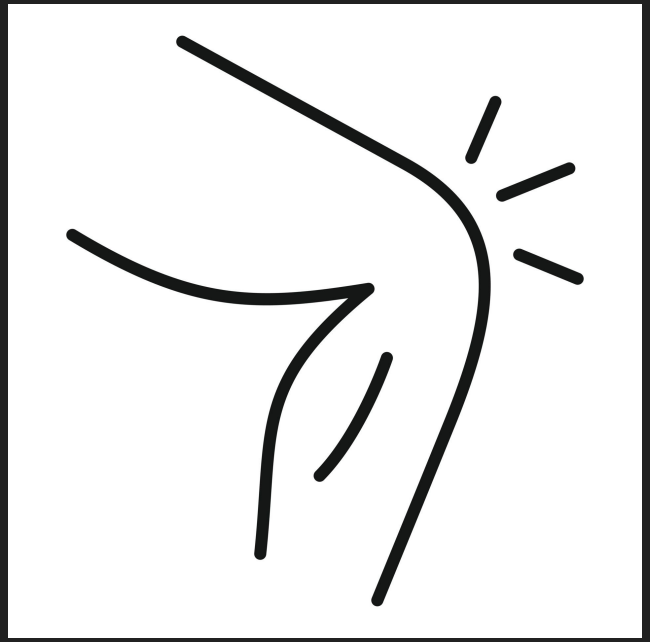
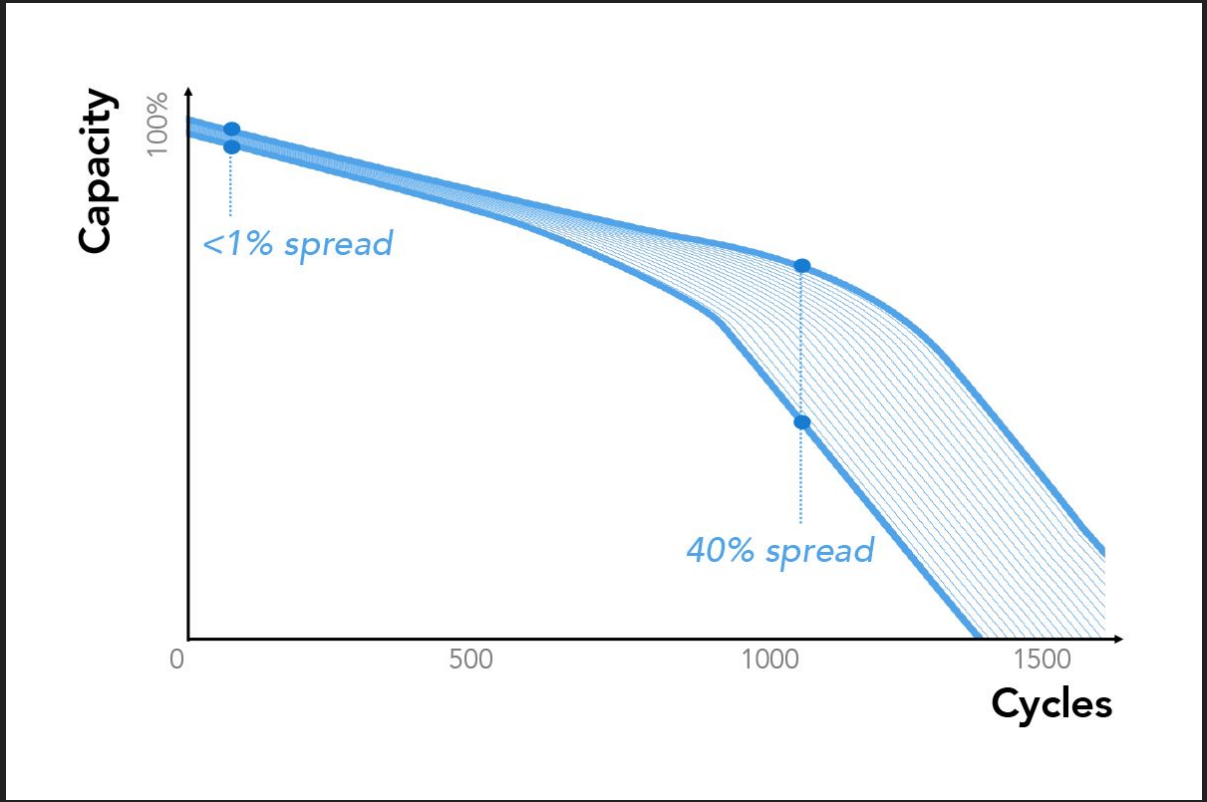


What does failure look like?



How do we measure failure?

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EIS (Electrochemical Impedance Spectroscopy)

- Voltage frequency sweep across the cell.
- Measure impedance.
- Plot on a Nyquist diagram.

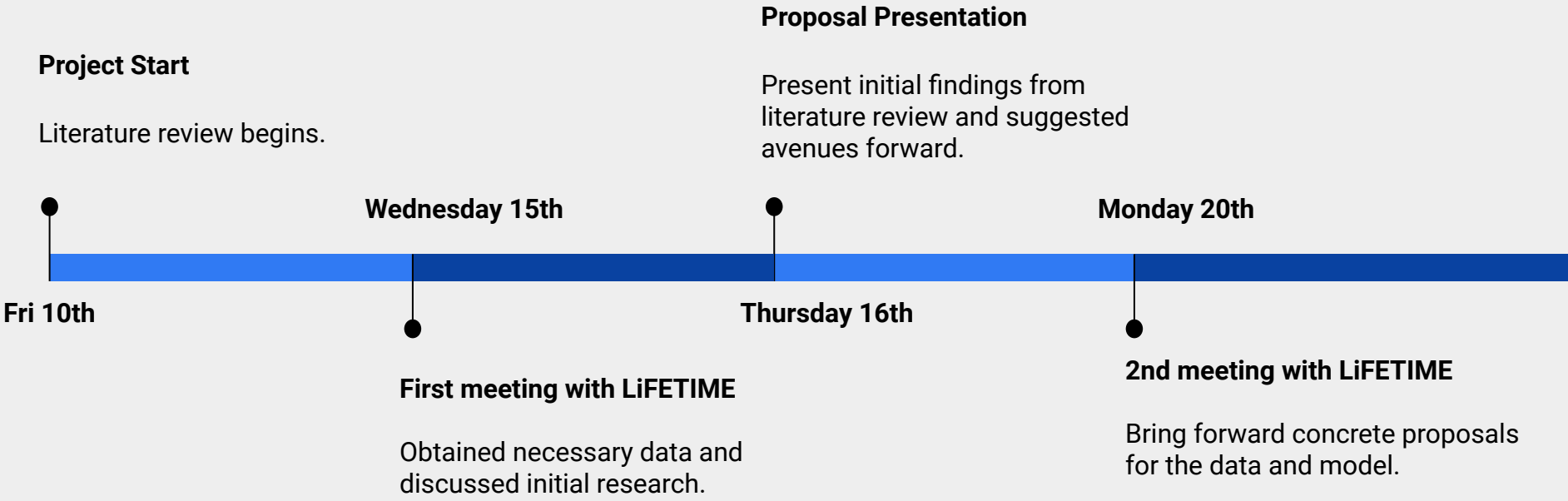
How can it indicate degradation?

- Rate of electrochemical reaction (or degradation process) -> relevant frequency range.

ICA (Incremental Capacity Analysis)

- Battery voltage and charge measured over a full or partial cell cycle.
- Produces a plot of dQ/dV which can be used to infer battery characteristics.
- Useful in the field as it uses properties that are already measured by battery management systems (current, voltage).
- ICA curves have been shown to be dependent on cell environment and state of health (Xu 2022 & Bloom 2005).
- Existing analysis suffers from chemistry dependencies that reduce model generality.

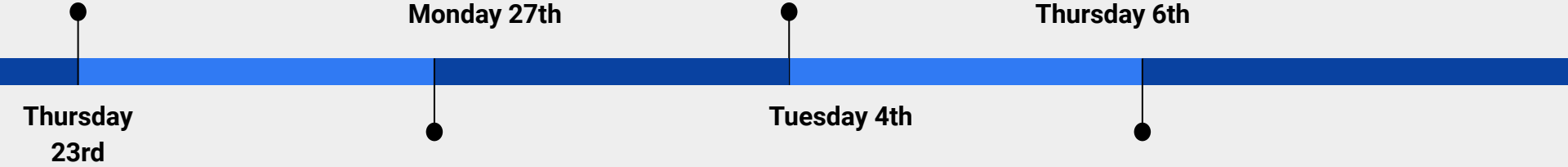
Project Plan



Project Plan

Interim Presentation

Deadline for deciding choice of model, dataset and measurement.



Final Presentation

First Functional Model

Enact contingency plan if incomplete by this date.

Documentation Completion

Contingency?

The chance of producing a useful model in this timeframe is slim.

Alternatives:

- **Replicate existing study on new dataset.**
- **Provide analysis and visualisation of LiFETIME data.**
- **Provide recommendations for future research based on literature review.**
- **Provide comprehensive, open-source documentation of work completed, with particular attention paid to pitfalls.**

Risk?

The only risk is poor management.

Hazard	Possible effects/harm	Risk Rating	Detail mitigations	Revised risk rating H, M, L
Eye Strain	Headaches, discomfort, blurry vision.	L	Regular breaks. Spread project schedule to reduce the need for long periods of sustained work.	L
Stress	Reduced ability to concentrate, sleep. Cardiovascular issues.	L	Regular discussion of project schedule. Planned contingencies allowing for a reduction in scope during the project.	L
Repetitive Strain Injury (RSI)	Short and long-term musculoskeletal pain.	M	Regular breaks, maintain proper workstation ergonomics.	L