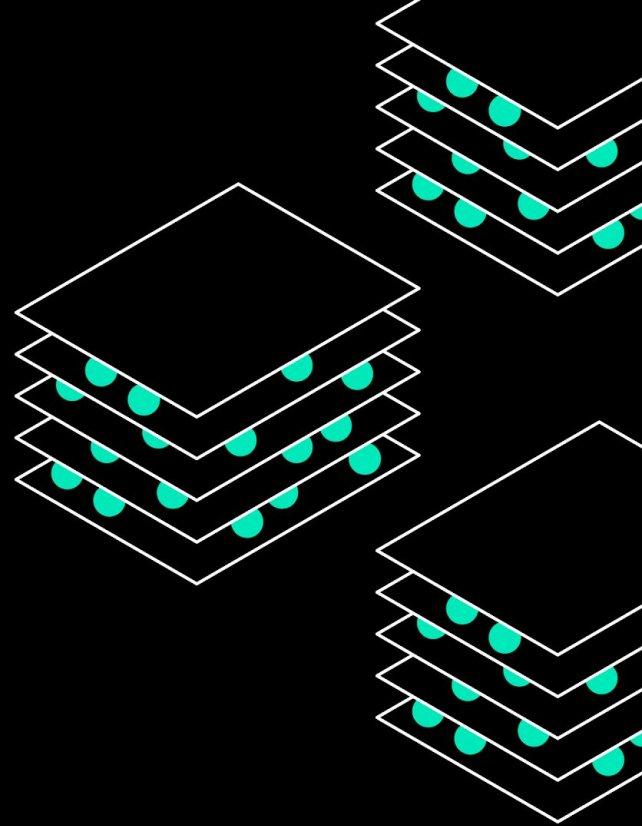


VOLTAIQ

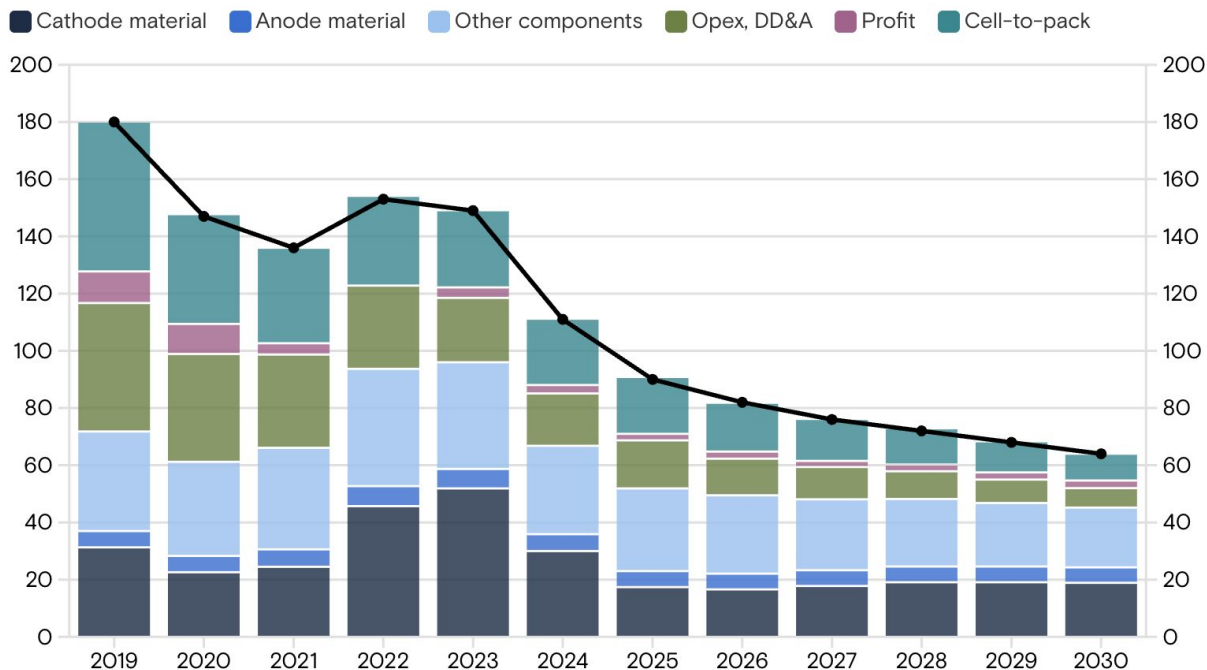
Enhanced cell & pack qualification

Tal Sholklapper, CEO & Co-Founder
Space Power Workshop
April 29, 2025



Battery prices forecast to continue to fall

Global: average battery pack prices (US\$/kWh)



Source: Company data, Wood Mackenzie, SNE Research, Goldman Sachs Research
2024- 2030 are forecasts

Goldman
Sachs

**We've entered the
golden age of
electrification**

**Powered by
economies of
scale in China**

**So how do we take
advantage of
these cells?**



Poor battery quality creates a warranty time bomb



Bloomberg

"A fire broke out at Vistra Corp's. Moss Landing complex in California [the fourth since 2019], one of the world's biggest battery storage facilities"



"Samsung SDI has been informed that 180,196 U.S. vehicles are potentially involved in three recalls broken down as follows – FCA US 155,096, AUDI 4,616 and Ford 20,484"

THE WALL STREET JOURNAL.

"Burning Electric-Vehicle Batteries Complicate Efforts to Fight Fire on Drifting Ship in Atlantic Ocean"

There are two fundamental challenges with batteries:

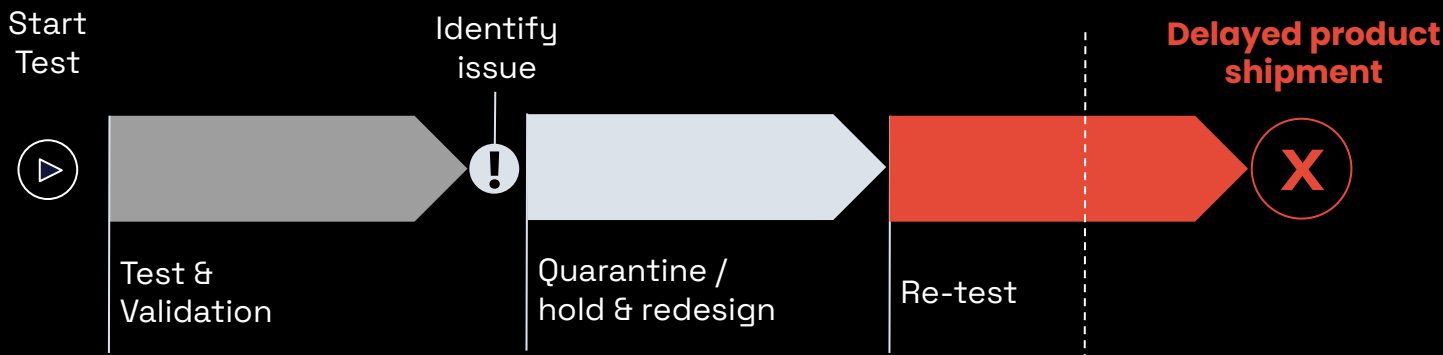
Problem 1:

Battery problems take a long time to surface

Problem 2:

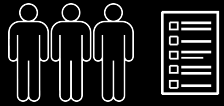
Once you find a problem, your team doesn't know how to fix it

Battery issues jeopardize shipping product



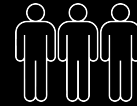
Rigorous quality testing is vital, but it's slow, expensive and escapes are still common, **leading to delays and recalls**

1. Engineering / factory generates request



Zero visibility to results for weeks

4. Engineering analyzes test data



Quality issues identified late or not at all

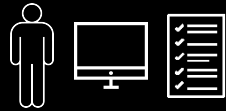
Days

Weeks to Months

Days

Weeks to Months

Bad batteries shipped



Tests often set up or run incorrectly



Slow manual analysis offers limited insight

2. Quality test team runs program

3. Quality test team processes data for engineering

You think you're solving the problem, **but you're not!**

Scattered & reactive

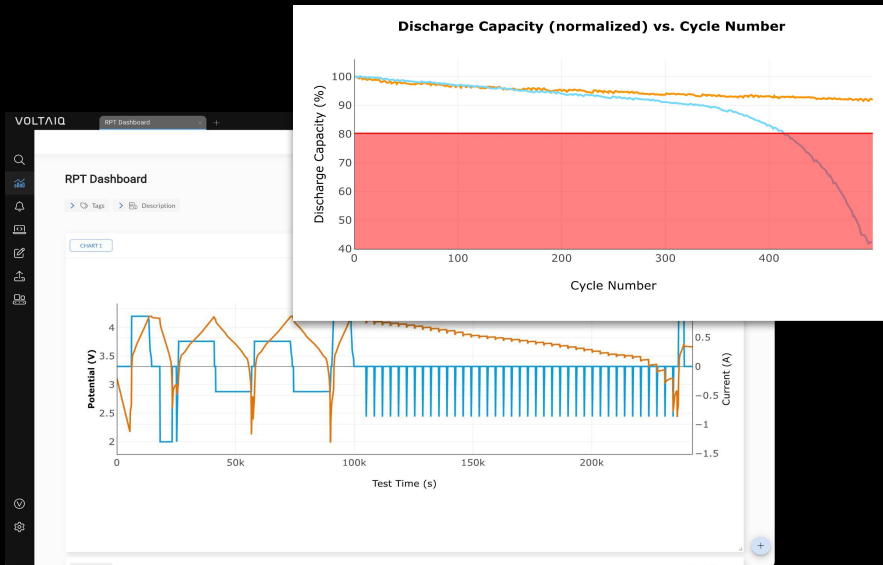


VOLTAIQ

Prevent battery — related launch delays & minimize liability.

An enterprise software platform that helps you detect quality issues early, avoiding expensive delays, warranty issues, and recalls.

A collaborative platform for battery analysis supporting all teams involved in product launch.



A Voltaiq-enabled test program offers faster time to insight at lower cost, helping you remediate quality issues **while there is still time**

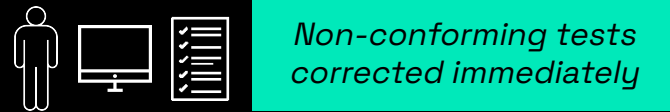
1. Engineering / factory generates request



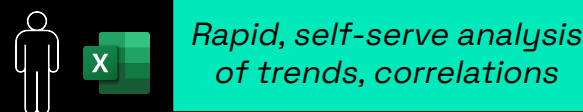
4. Engineering analyzes test data



**Don't
ship bad
batteries**



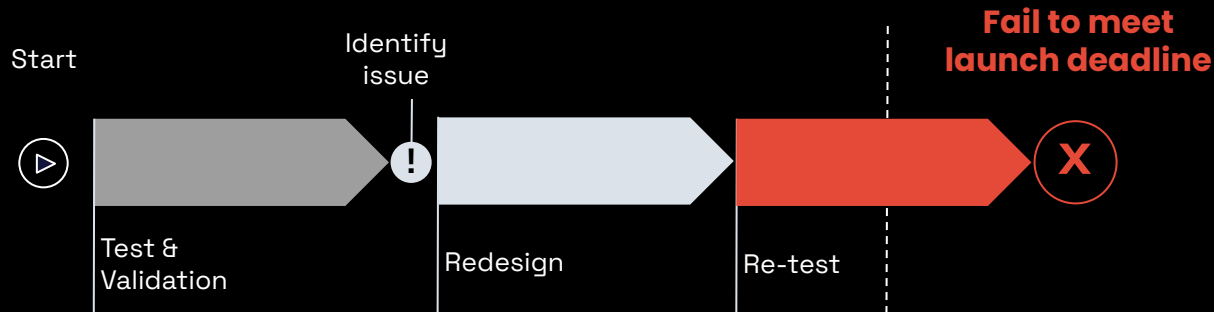
2. Quality test team runs program



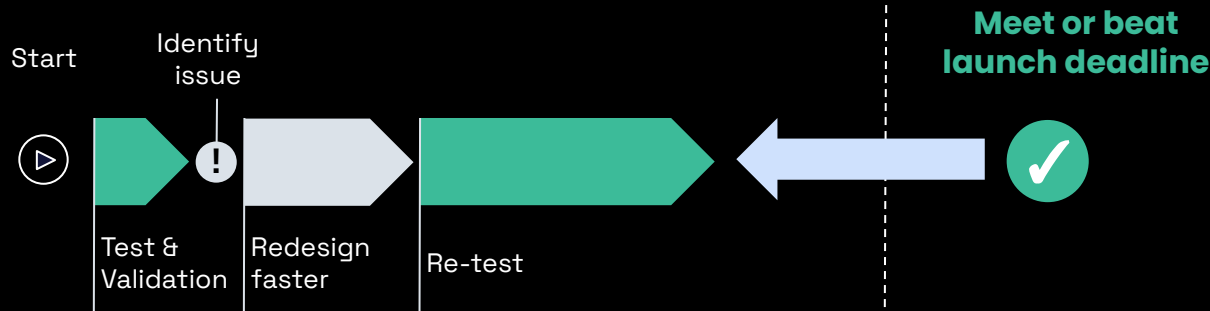
3. Quality test team processes data for engineering

Voltaiq examines every battery's charge-discharge heartbeat to find problems faster, **protecting launch timelines**

Typical product launch

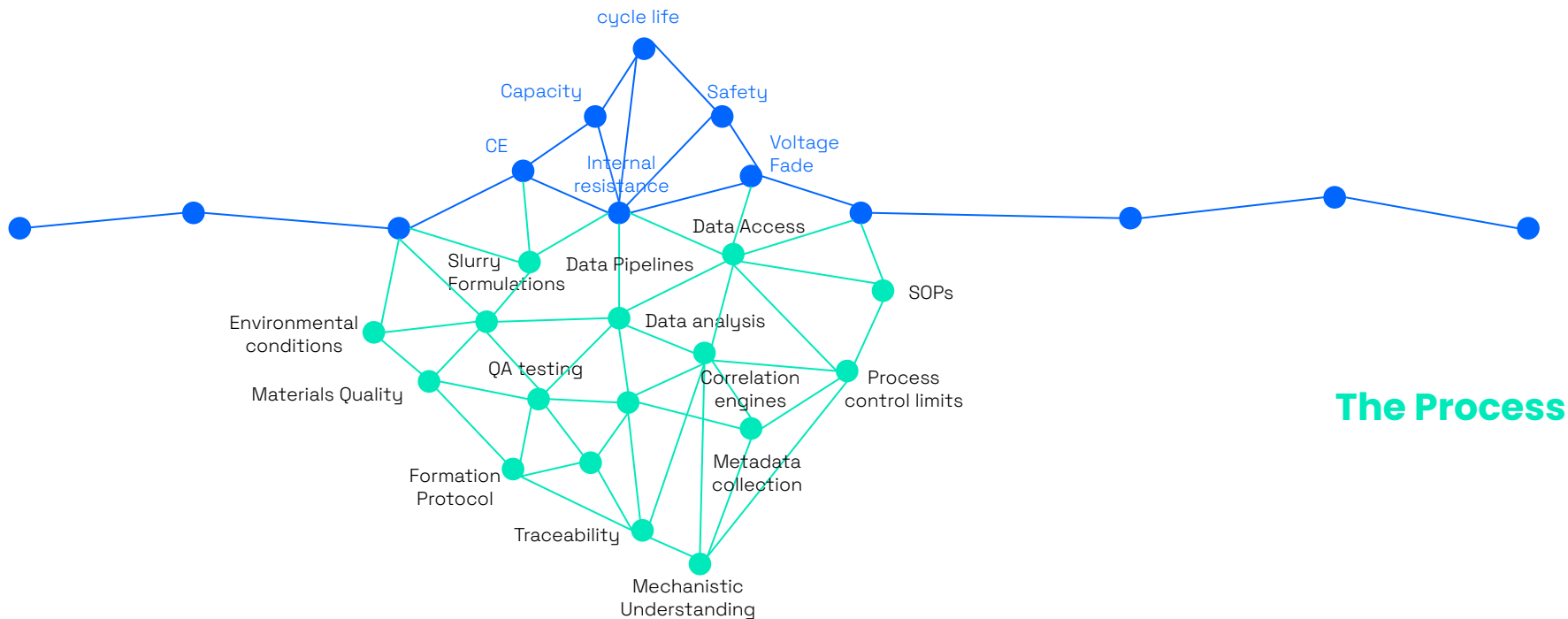


Voltaiq-optimized launch



The Battery Iceberg: Performance or Process

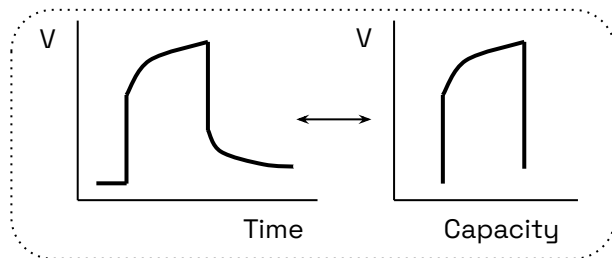
The Performance



The Process

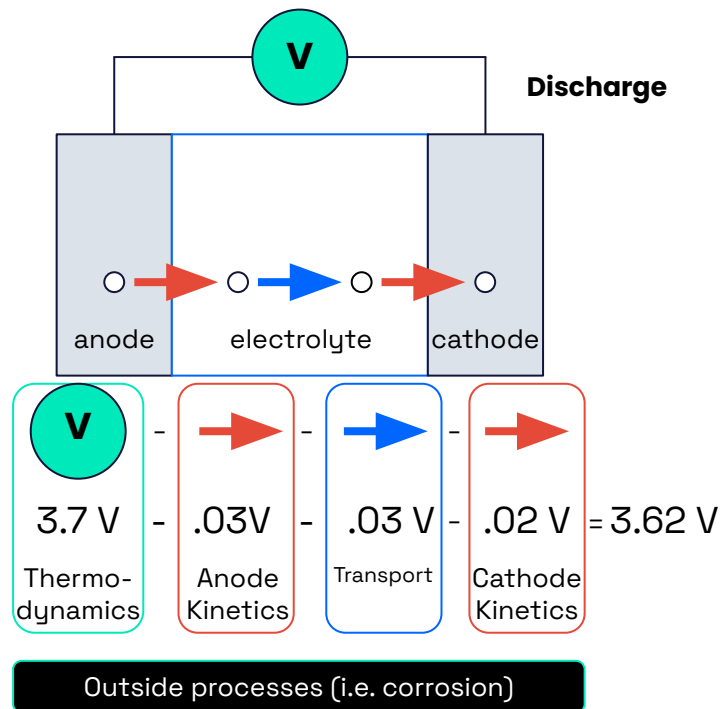
Voltage changes inform us of fundamental phenomena

Thermodynamics, kinetics, and transport

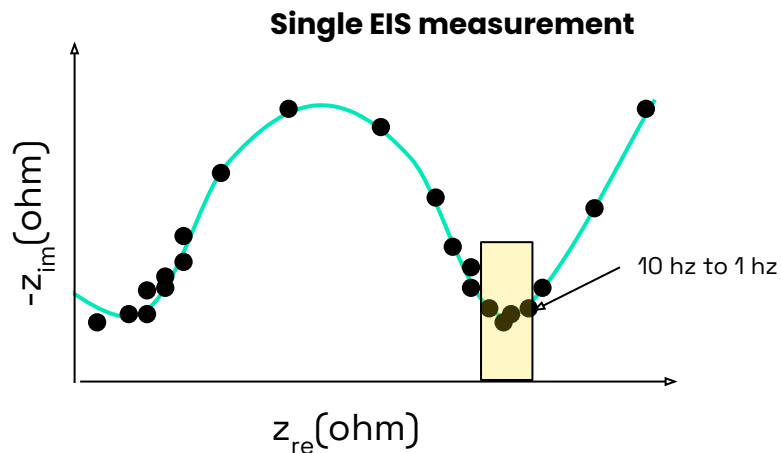
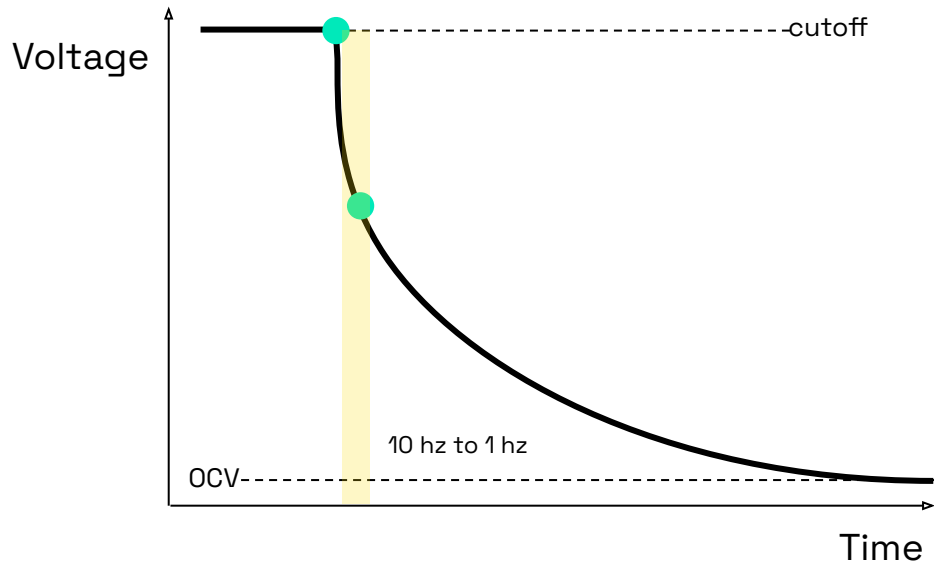


Voltage can change due to:

1. Changes in standard electrode potential
2. Anode kinetics
3. Transport phenomena
4. Cathode kinetics
5. Outside processes

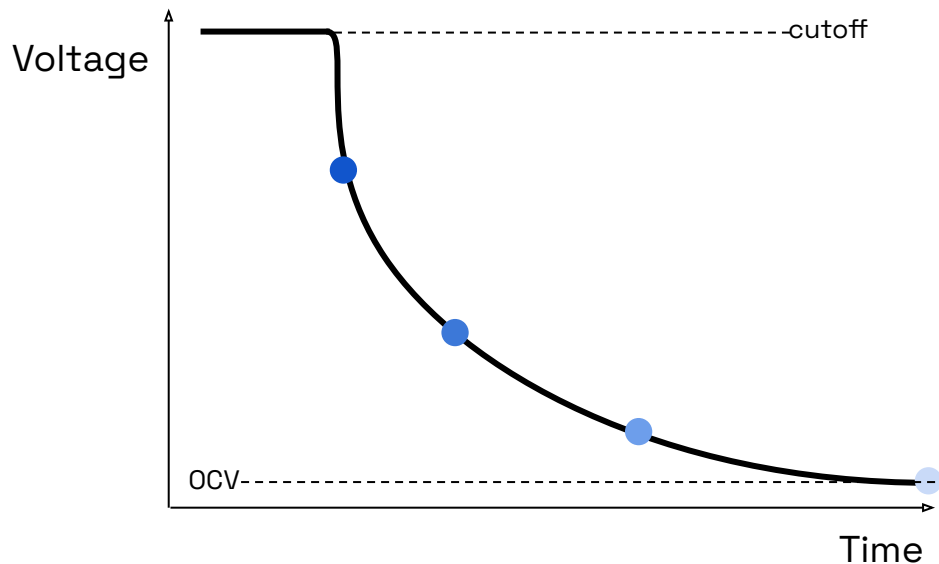


Kinetics account for initial change after current interruption

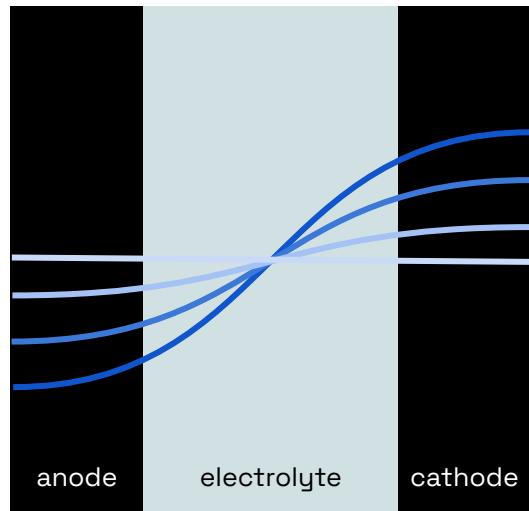


- Some potential must be sacrificed at each electrode to move an ion from electrolyte to electrode
- This potential change is removed after the current is removed

Transport accounts for change after initial drop

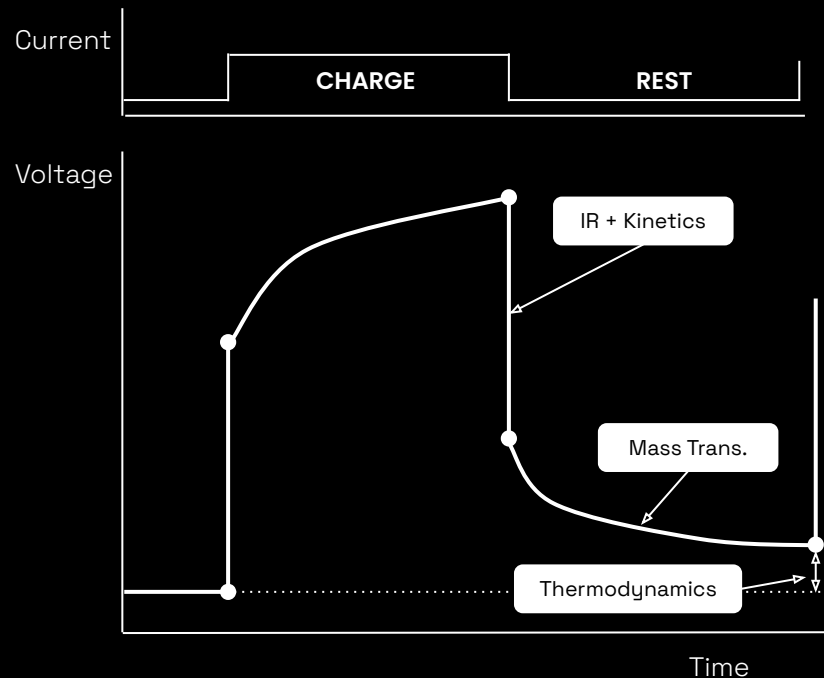
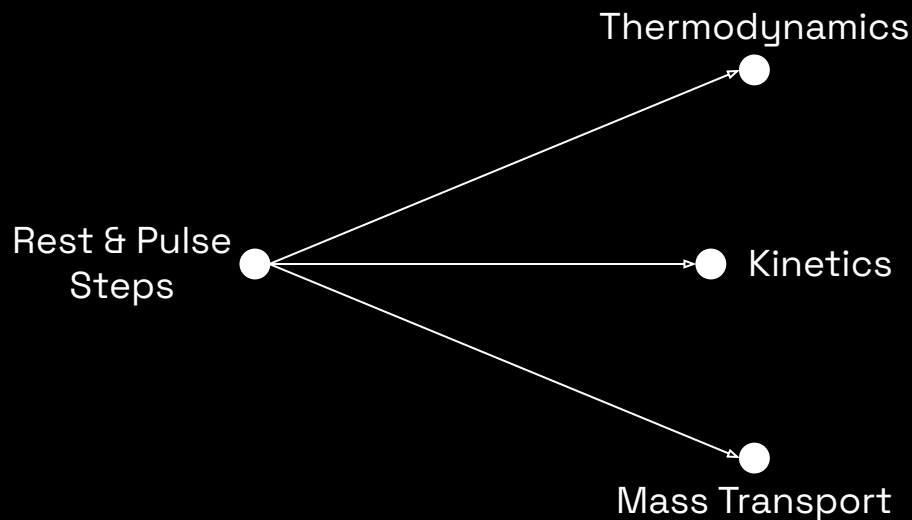


Concentration Across Cell



- After current perturbations are removed Li-ions can move back to equilibrium
- The change in concentration affects cell voltage

A better way towards mechanistic understanding



The pulse is not new but the *ANALYSIS* and *STRUCTURE* is...

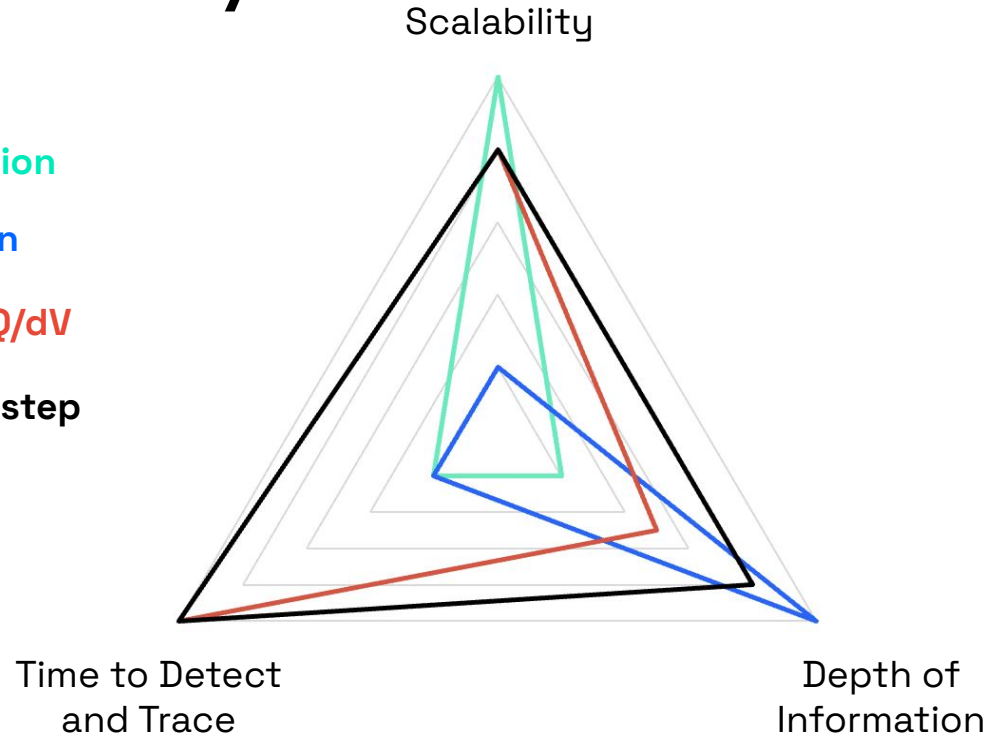
dQ/dV and rest & pulse analysis: Scalable, fast, and deep root cause analysis

Final Inspection

Cell Teardown

Formation dQ/dV

Rest & pulse step analysis



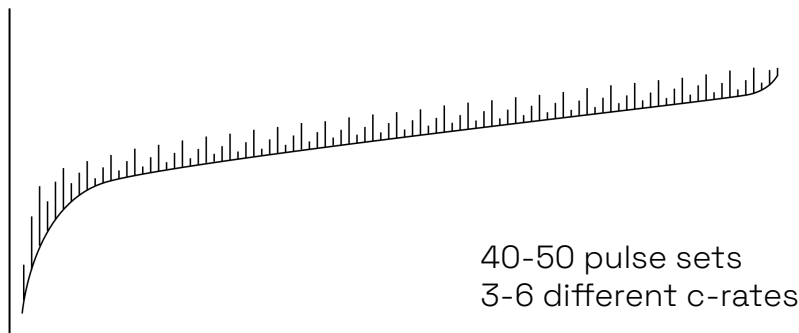
Get more insight from your existing protocols or get more insight from enhanced protocols



Example enhanced Analytics Pulsing Profile (APP) to provide full mechanistic insight

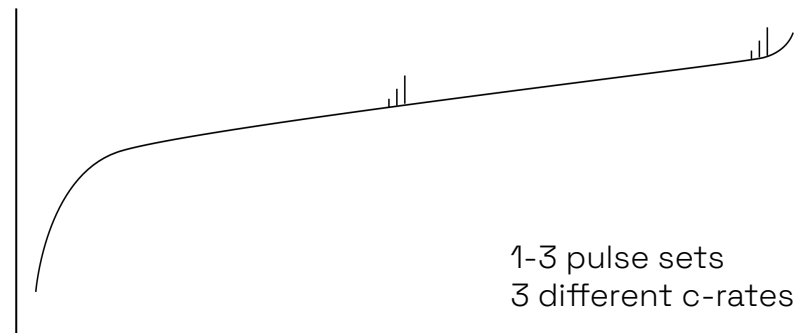
K. N. Wood, W. B. Hawley, G. Less, J. Gallegos, J. Electrochem. Soc. 171 (2024) 080501.

Cell Qualification



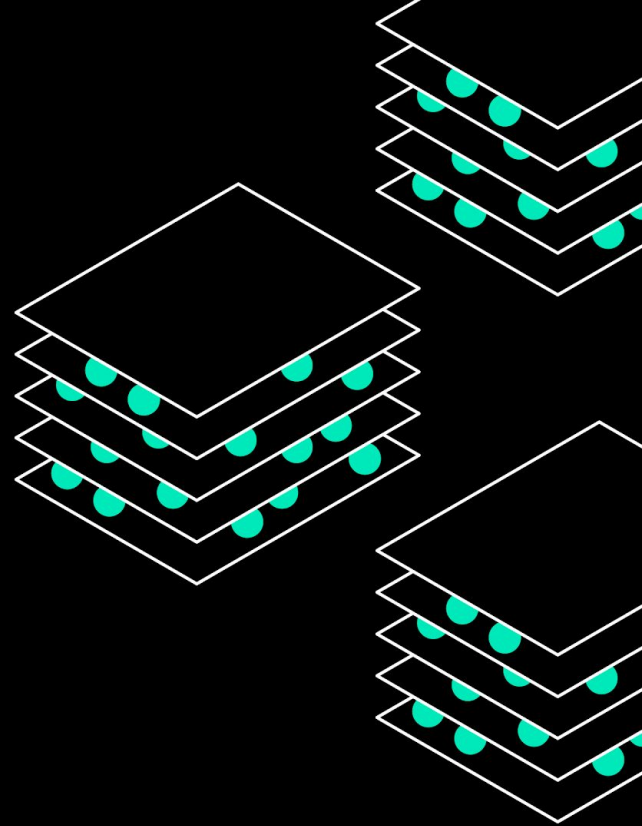
- Graphical Analysis
- Cell level mechanistic information
- Understanding of chemistry and process

Rapid Benchmarking



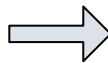
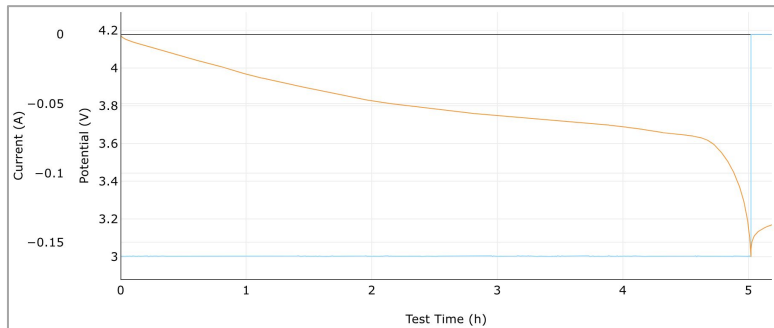
- Device level information
- Identify outliers mechanistically
- Understand process deviations

Examples of advanced electrochemical insight hidden in your data

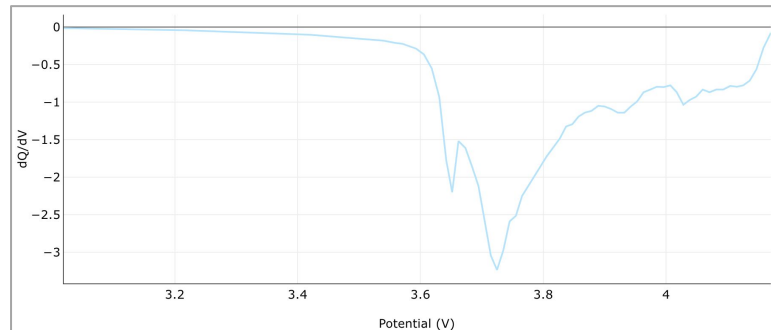


Advanced electrochemical metrics like differential capacity (dQ/dV) are available in all of your formation and testing data

Typical Discharge Curve



dQ/dV Discharge Curve



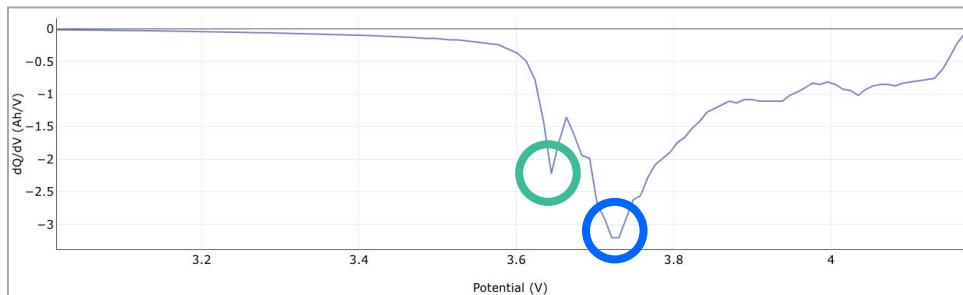
dQ/dV signals are available in the data
before the cycles even finish

dQ/dV challenges:

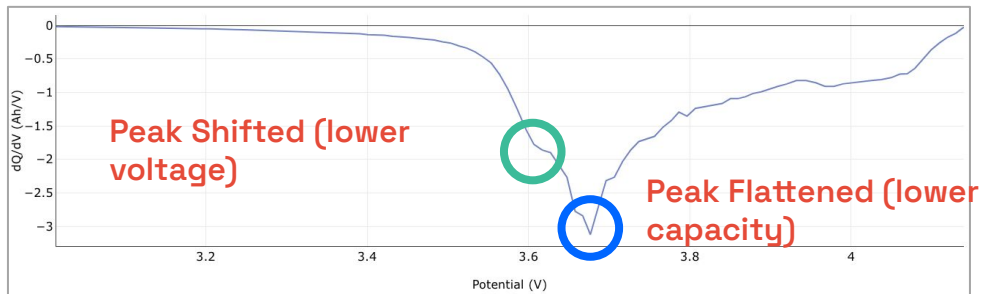
1. How do I access the data?
2. How do I clean the data?
3. How do I interpret the data at scale?

Example dQ/dV analysis in formation data – feature extraction

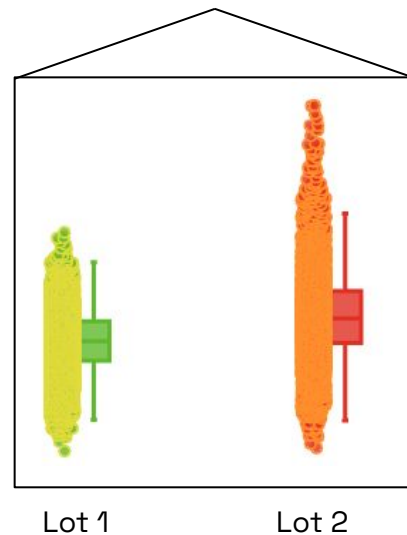
Baseline



Defective Cell



dQ/dV signals across production lots



Higher peak voltage
Possible: Contaminants

Catch battery defects in hours — not weeks.

Your formation and quality test data are hiding key insights needed to identify problems faster

Raw formation,
cycling, build data



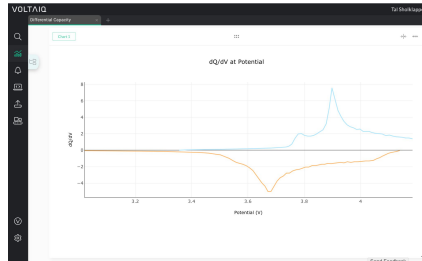
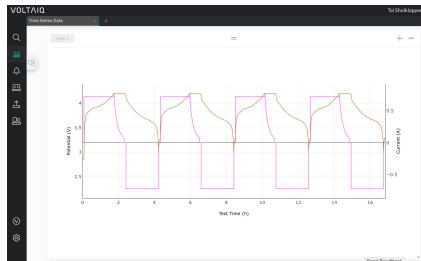
Electrochemical
insights



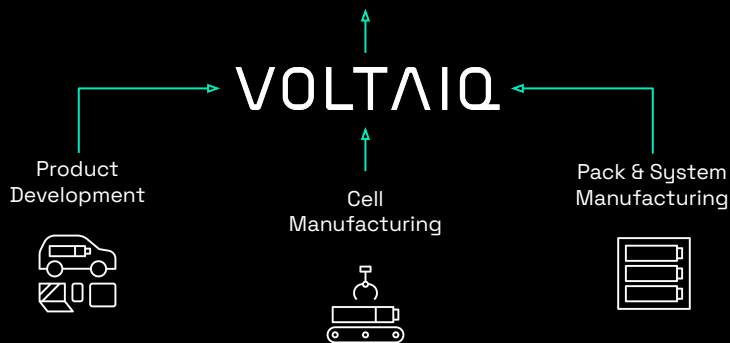
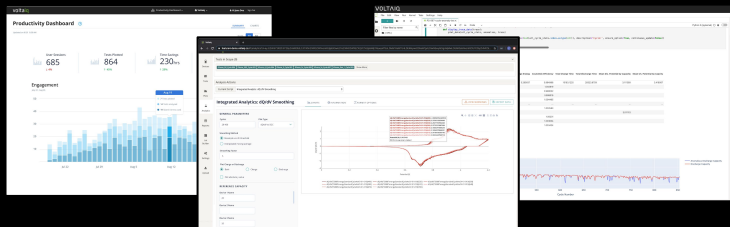
Catch battery
defects faster



Diagnose root
cause promptly



Voltaiq: the standard for enterprise-grade battery analytics



Up to 20,000x faster for key workflows

Clear ROI in under 3 months

Built-in battery workflows and expertise

A single source of truth for battery insights, used by R&D, AI/modeling, supply chain, manufacturing, quality, & more

Customizable for your battery application

Configurable metrics, data science tools, & API integrations to work with any chemistry, format, or application

Get up and running in under a month

Comprehensive productized integrations to all industry-standard hardware & software data sources

Proven success at enterprise scale

Industrial-grade security, horizontal scalability, in production for over a decade at global companies

VOLTAIQ

**Bringing batteries and
battery-powered
products to market
faster since 2012**

The first and only battery-specific analytics solution, Voltaiq is the world's most trusted platform for developing, producing, and optimizing batteries and battery-powered products.



Mercedes-Benz



VOLTAIQ

Thank you!

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+1-415-742-1055