TWAICE

Battery Analytics for ESS Failure Prediction and Preventative Maintenance

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TWAICE | www.twaice.com

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The Promise of Battery Analytics

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De-risk your battery ESS

Avoid underperformance & malfunctions

Enable Opportunities

Increase availability, performance, and revenue potential

Cloud-based battery analytics without additional hardware

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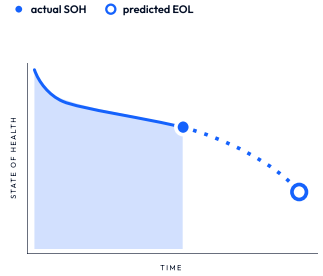
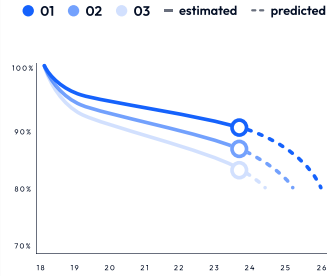
Health Analytics



Warranty Tracking



Safety Monitoring

\+

many more along the lifecycle

DASHBOARD & API & REPORTING

BATTERY ANALYTICS

DATA INTEGRATION

BMS / EMS Data

Data transfer to TWAICE

TWAICE

Standard options for ingesting storage data into the TWAICE Cloud

1

Data Push via **TWAICE API**

2

CSV via **TWAICE SFTP Server**

3

Data Pull via **TWAICE Pull Stack** from your API or database

TWAICE → Customer

Data requirements

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Our analytics leverages BMS and other data points around the battery

Required operational data
for guaranteed accuracy

	Ideal data resolution	Ideal time resolution
Current (I)	0.5 A	2 s
Voltage (V)	0.5 V	2 s
Temperatures (T_{min}, T_{max})	1°C	60 s
State of Charge (SoC)	1%	30 s
Cell Voltages (V_{min}, V_{max})	0.01 V	2 s

Meta data

- Complete system hierarchy
- Serial and parallel connections
- Initial energy and maximum power of the whole system
- Battery specifications, incl. manufacturer, type & chemistry

Risks #1

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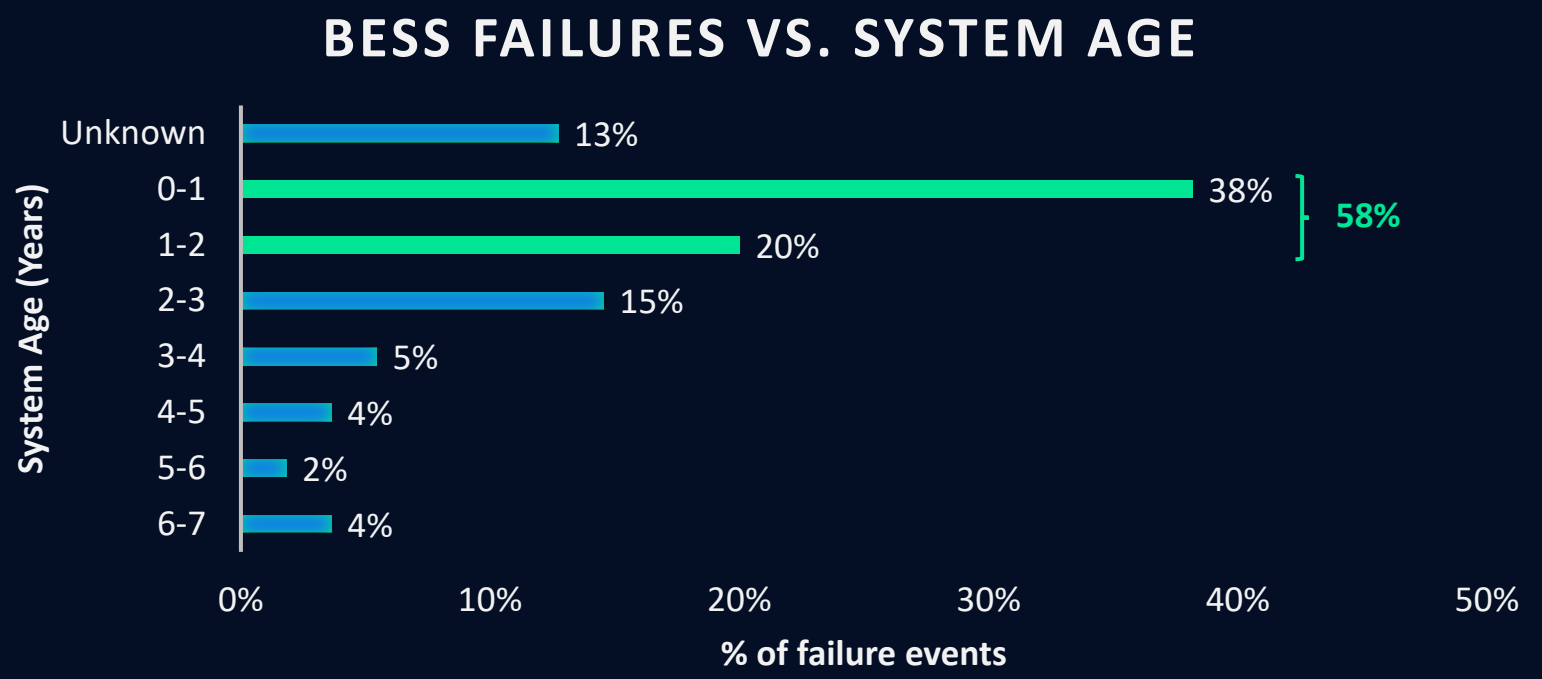
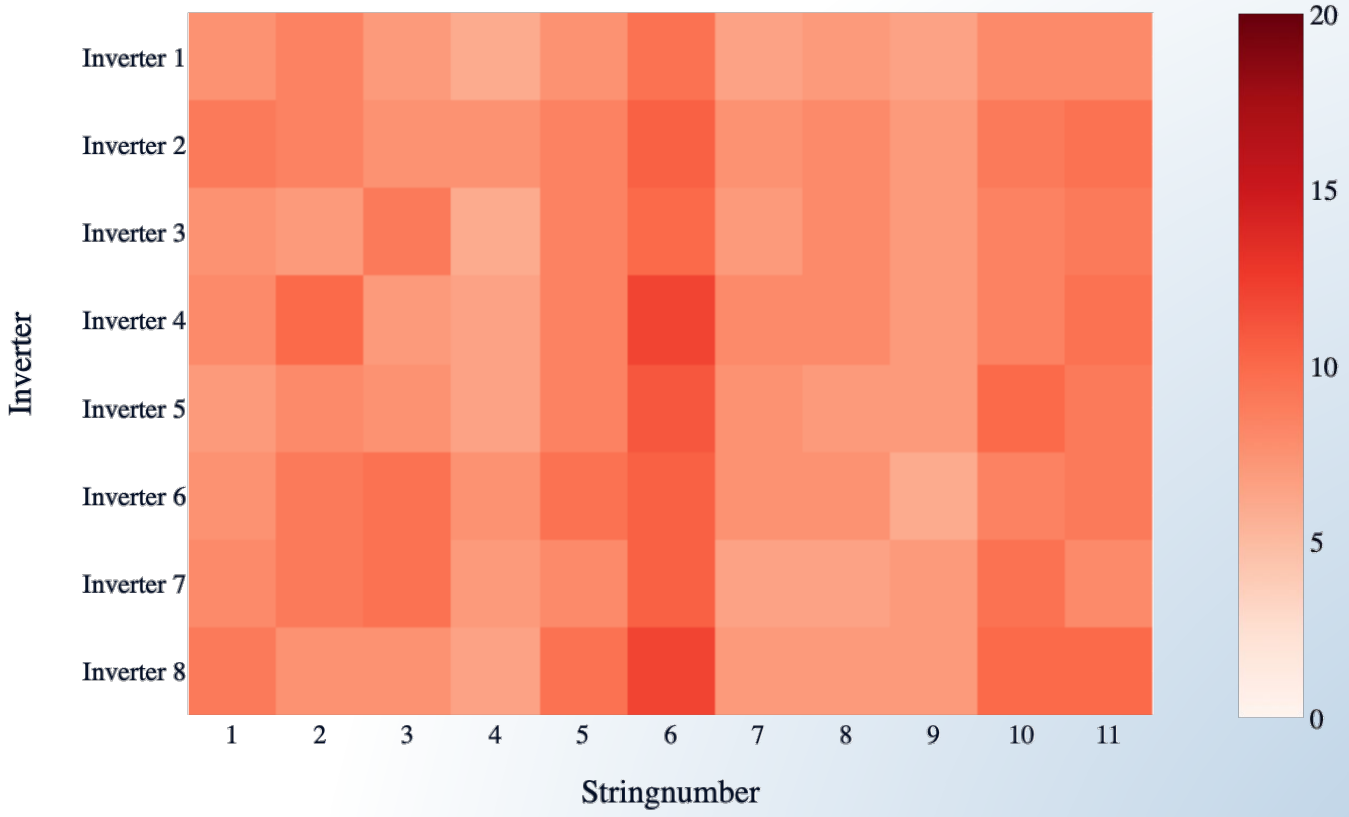
Most failures occur in the first two years of operation



Source: EPRI Failure Database

Case Study

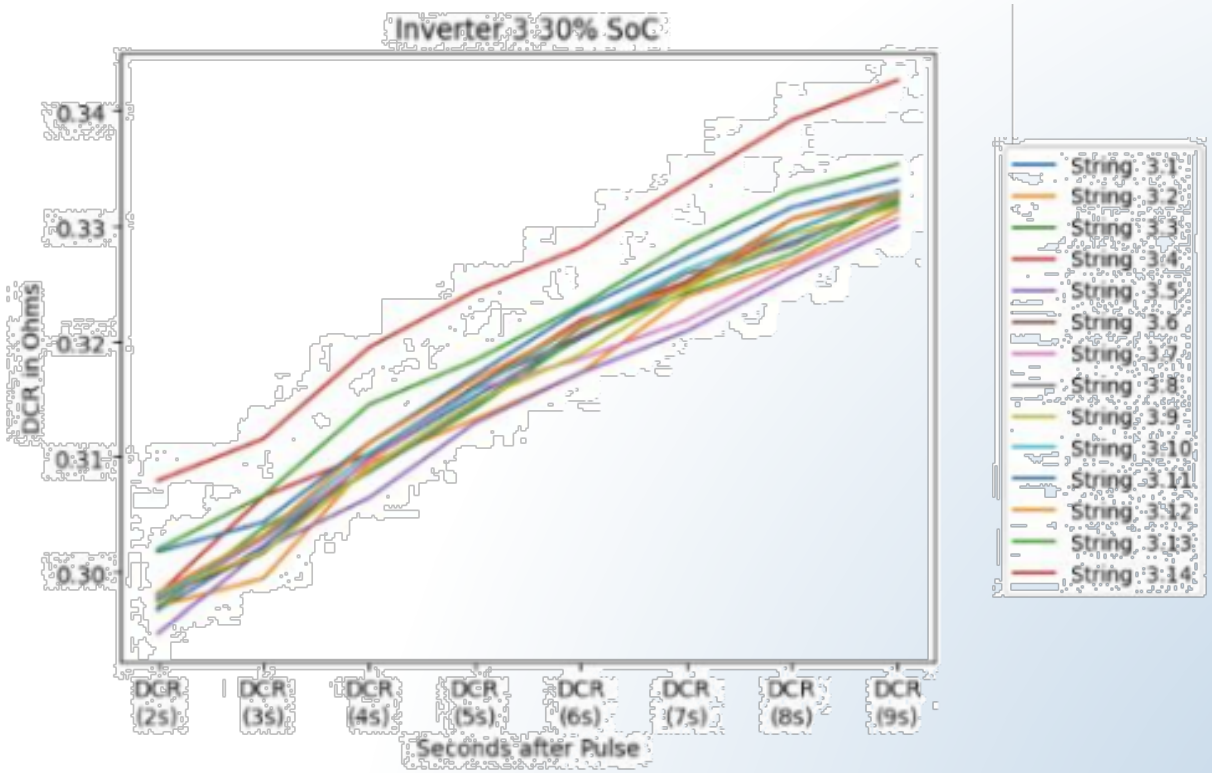
Temperature spreads as an indicator of problematic design/control



- System design failure diagnosis based on temperature analyses
- Weak cells are identified due to observations in various KPIs
- Strings and modules do not showcase datasheet-based behavior

Case study

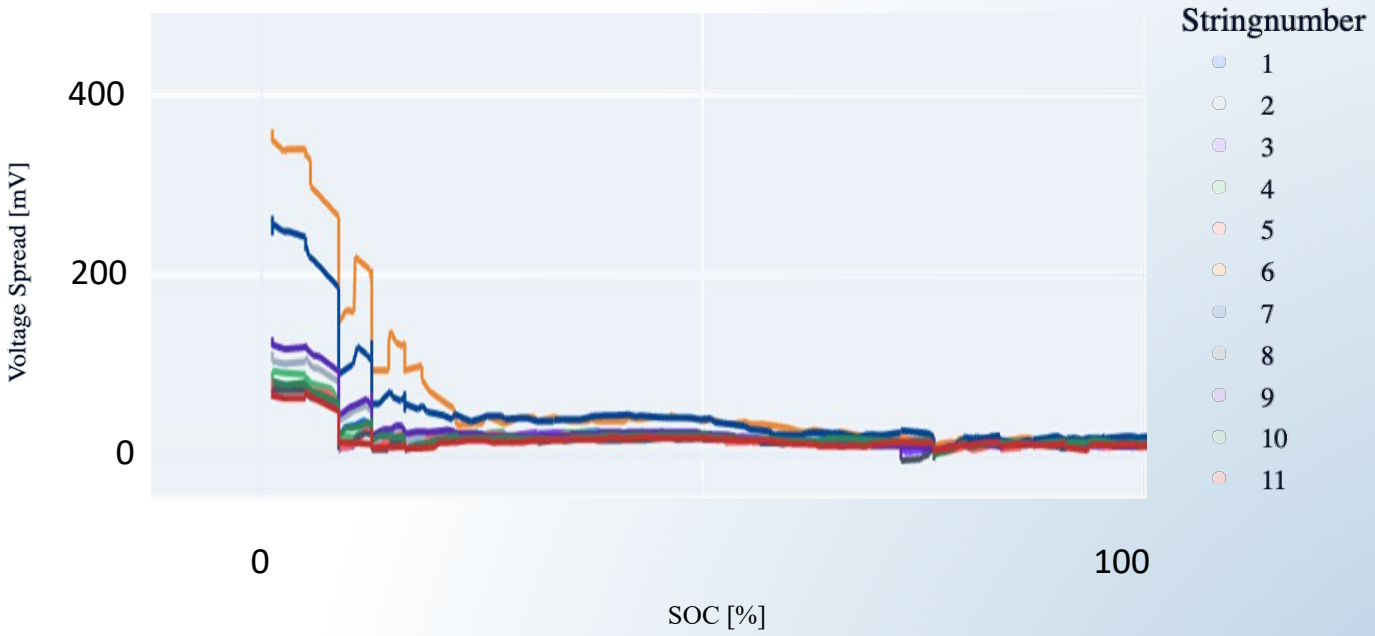
DC resistance as key indicator for potential failure points



- High DC resistances identified
- Identification of five modules containing faulty cells, likely due to manufacturing defects
- Ability to compare and benchmark now and in the future

Case study

Voltage spread as early indication for long-term storage underperformance



- Voltage spread detected at low SOC ranges in several modules
- 2% of modules contained defective cells
- Indicates weak cells that should be replaced

Risk #2

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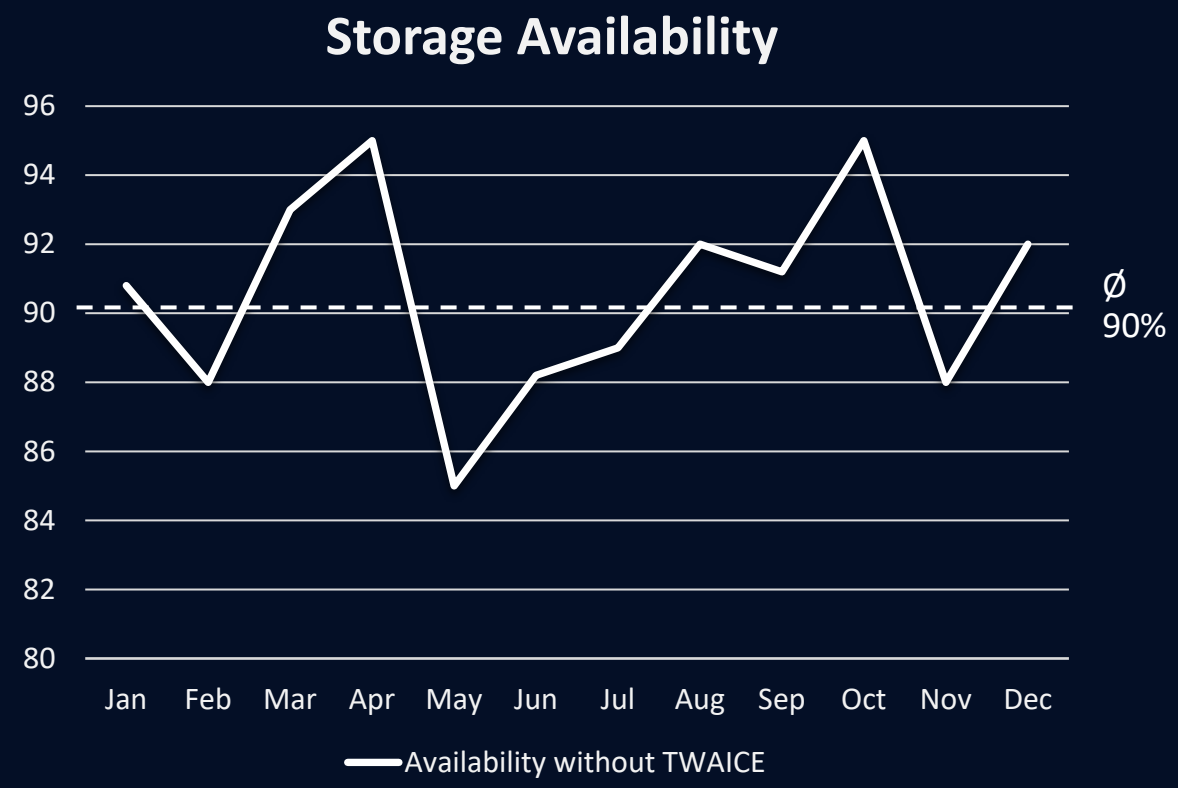
BESS availability is low on average in mature systems

Storage availability in UK in 2022 was 82%

- *Modo Energy*

"Unplanned downtime led to an average availability across our fleet of only 84% last year"

- US asset owner



Technology

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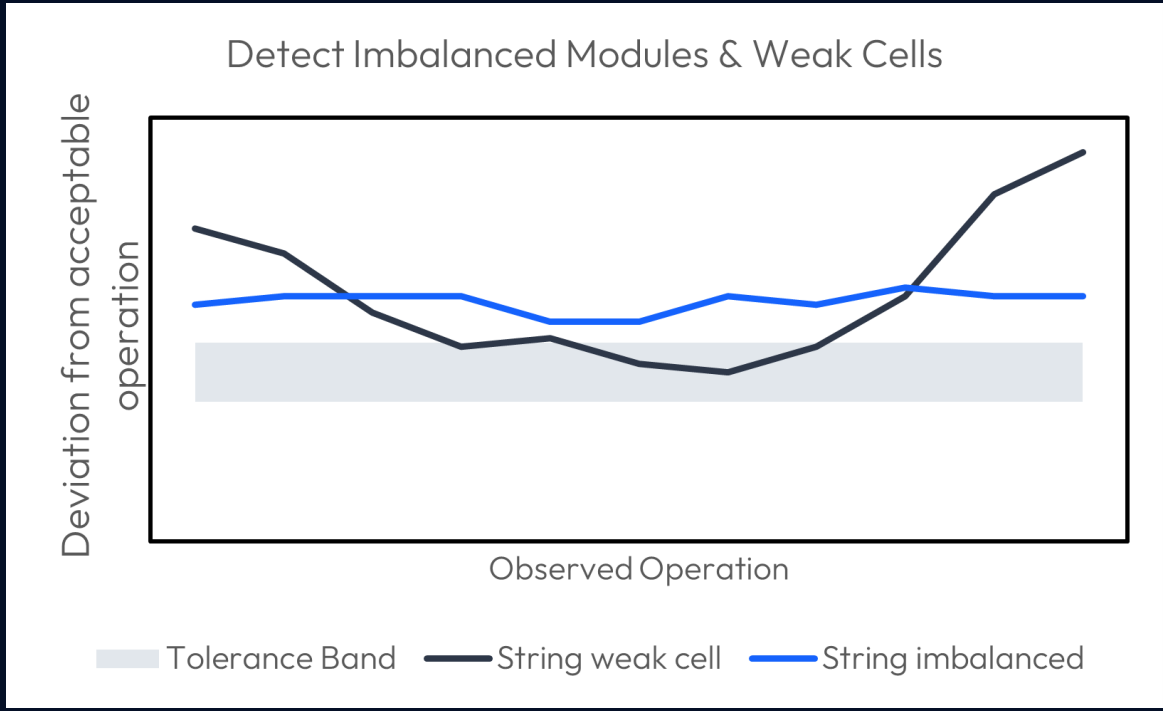
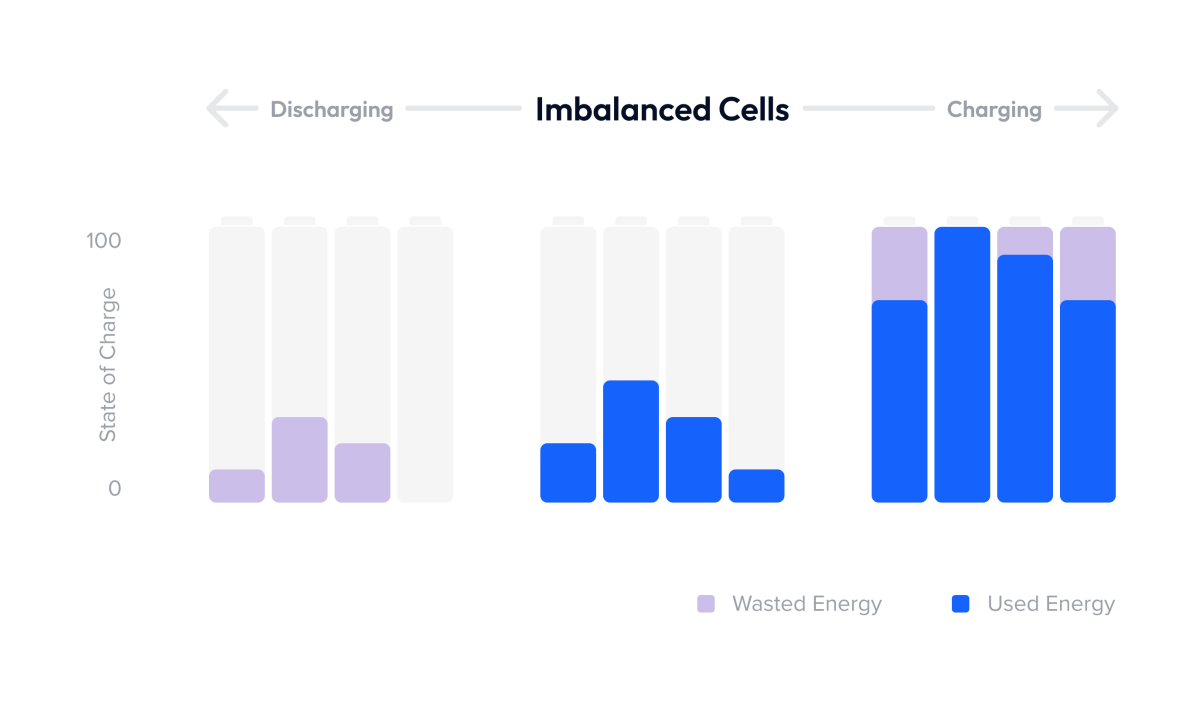
How to detect deep-seated battery problems





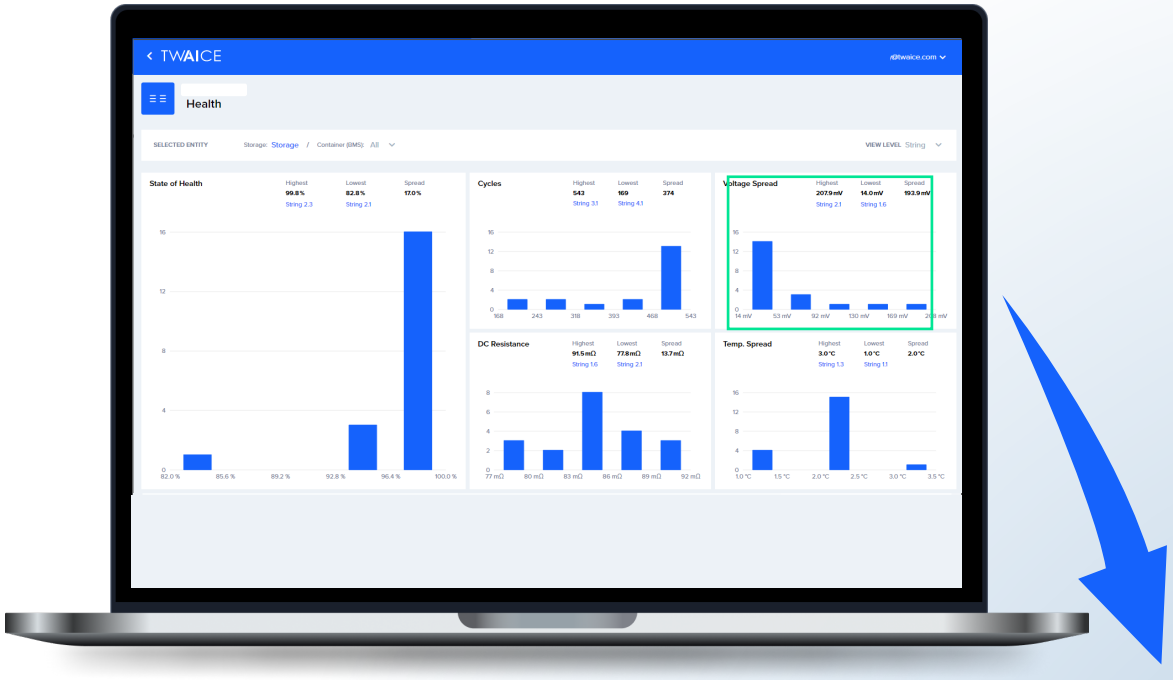
Case Study

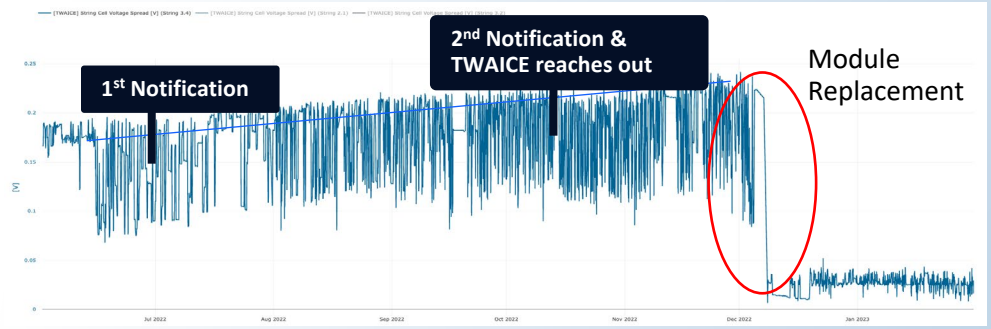
Power set point mismatch and its effect on availability

- Analysis at inverter then string level
- Set point differs from the active power
- Discrepancy between what the ESMS states and what the battery is capable of

Case Study

Replacement of faulty cells





- Voltage spreads exceeding two thresholds
- Negative trend identified in both modules even after balancing attempt
- Analysis revealed a single cell responsible for voltage spread

Risk #3

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Battery failures that lead to fires can mean high reputational damage

Investigation confirms cause of fire at Tesla's Victorian Big Battery in Australia

By Andy Colthorpe

May 11, 2022

Asia & Oceania, Southeast Asia & Oceania Grid Scale Market Watch, Technology

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NEWS

AES investigating cause of "thermal runaway" at Arizona site

By Cameron Murray

May 4, 2022

Americas, US & Canada Grid Scale Technology

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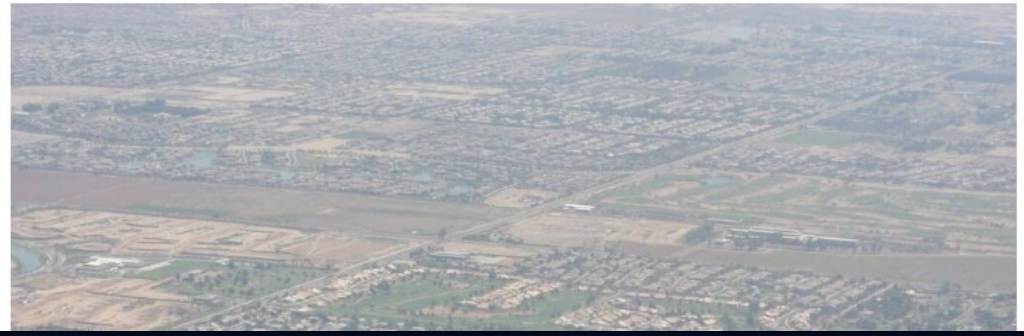
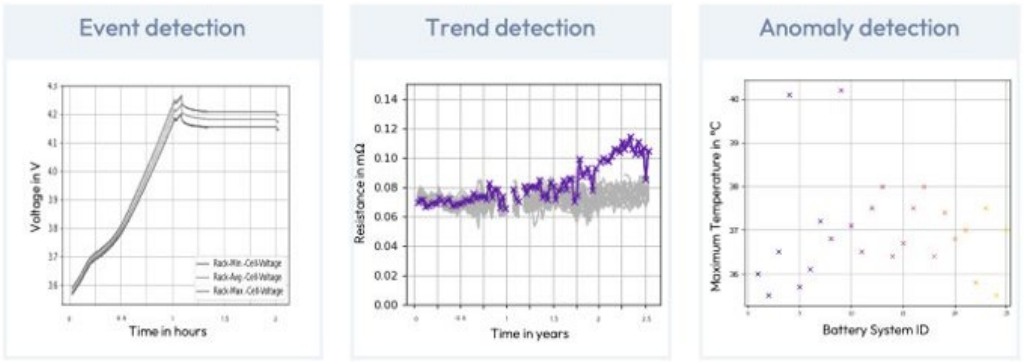
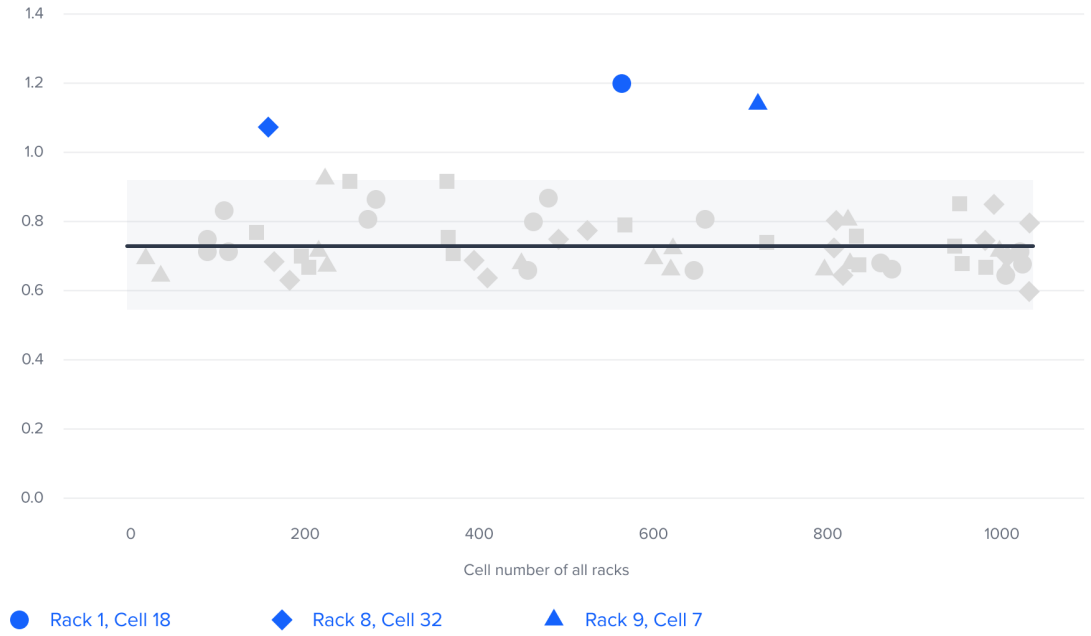


Case study

Prediction of incidents



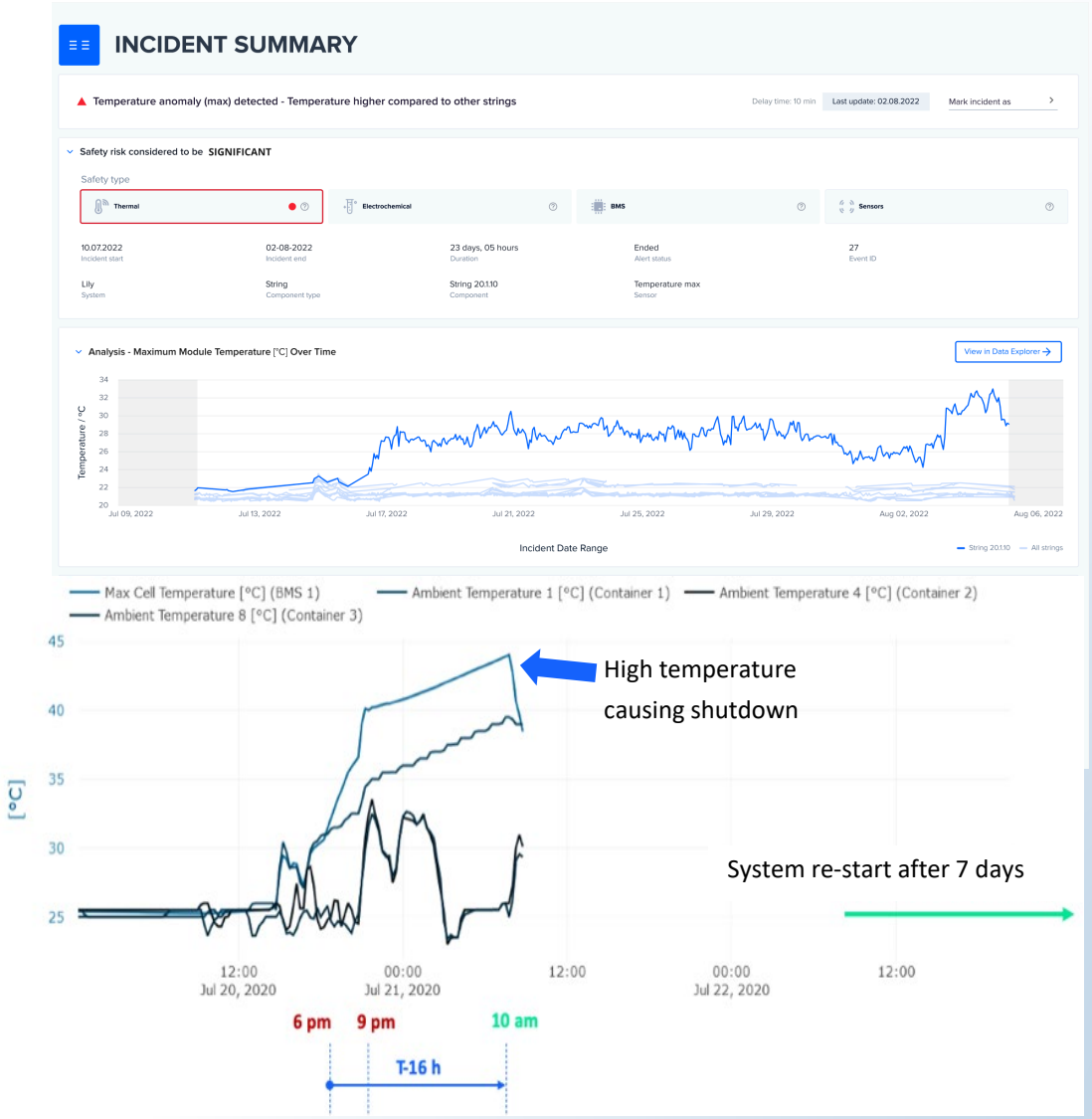
Individual cells



- Anomalies detected for single cells in multiple strings
- Identified the cell causing the fire due to manufacturing issues

Case study

Temperature alarming to maintain operations



- Automatic whole-system shutdowns occur due to temperature alarming
- Identification and isolation of which section of the ESS was causing temperature issues
- Proactive reprogramming of shutdown procedures

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SIMPLICITY AT SCALE

All storages sizes (especially for large storages)

GLOBALLY APPLICABLE

Take care of all your storages with one solution

120+	battery & software engineers and data scientists
30+	patents
10+	industry partners, incl. Munich RE & TÜV Rheinland
5GWh+	Battery capacity connected to platform
3	Offices in Munich (HQ), Chicago (US), and Paris (FR)
1	Onsite battery research center