Roads to the Future 2021

Swedish Electromobility Centre

No Joule Left Behind:

Using power electronics to get the most out of large batteries

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BrillPower

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Expert in lithium-ion batteries, their degradation, and renewable energy technologies. Royal Academy of Engineering Enterprise Hub lifetime member.

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CTO & Director

Power electronics expert
Previous experience in successful solar power start-up

Carolyn Hicks, MASc, MBA
CFO/COO & Director

More than 10 years experience in engineering, project management, and finance
Managed major projects in public and private sector in UK and Canada

Adrien Bizeray
Chief Data Scientist

Expert in battery modelling.

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*“Integrate **power electronics** into battery packs to improve their **performance**”*

Cells

Cell size agnostic
Chemistry agnostic

BMS

Circuit boards and designs
Battery models
Control algorithms
User Interfaces
System interfaces

Packs

Integrate into any pack
Work with pack builders

Systems

Residential
Commercial and Industrial
Electromobility

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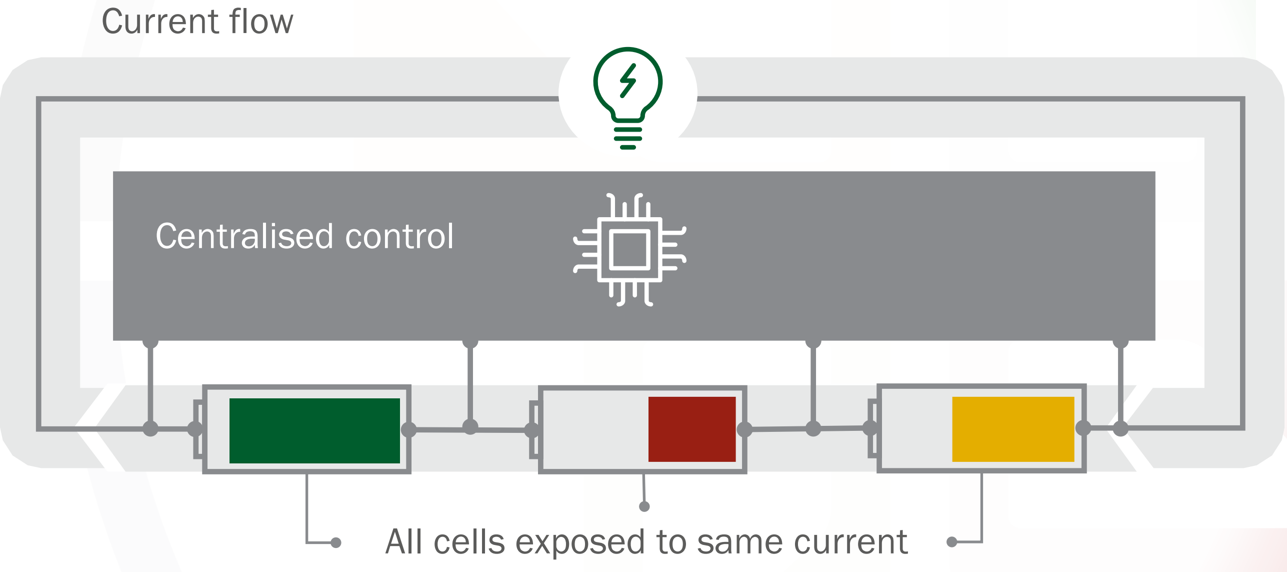
The Problem

Performance:
Limited by weakest cell

Lifetime:
Limited by weakest cell

Cost:
High due to replacements/oversizing

Sustainability:
Low due to battery waste from replacements



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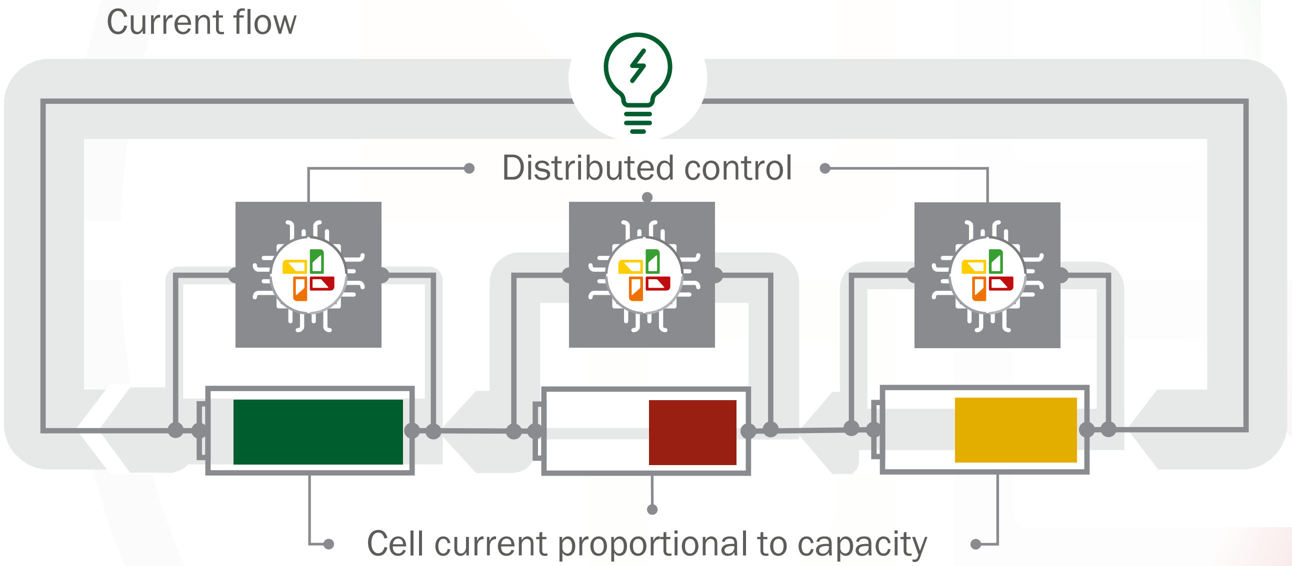
Performance:
Up to 46% more energy

Lifetime:
Up to 60% longer lifetime

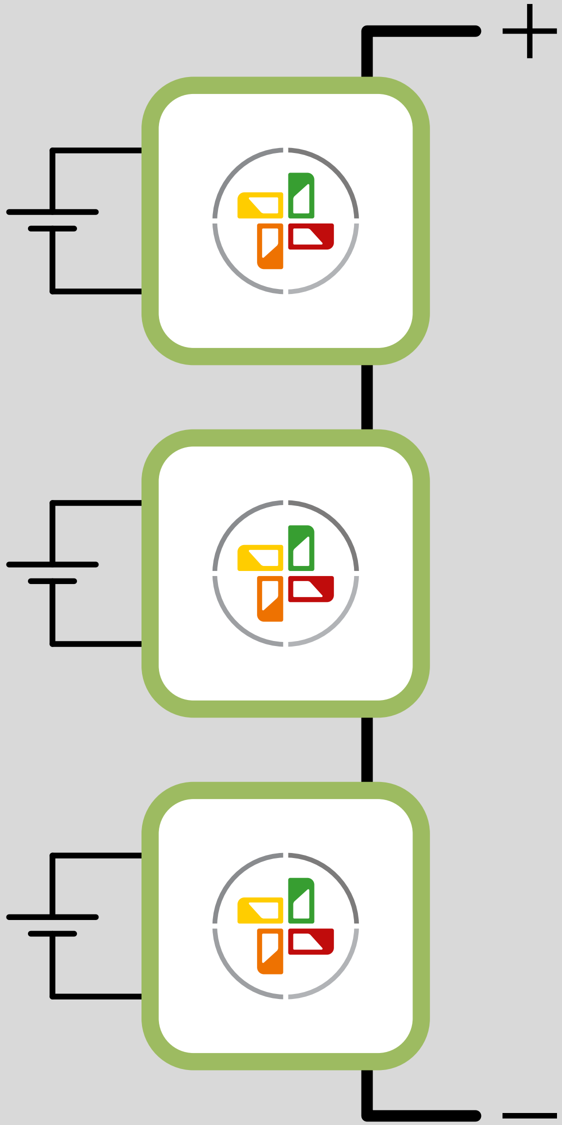
Cost:
Low - no replacements/oversizing

Sustainability:
High – no unnecessary battery waste



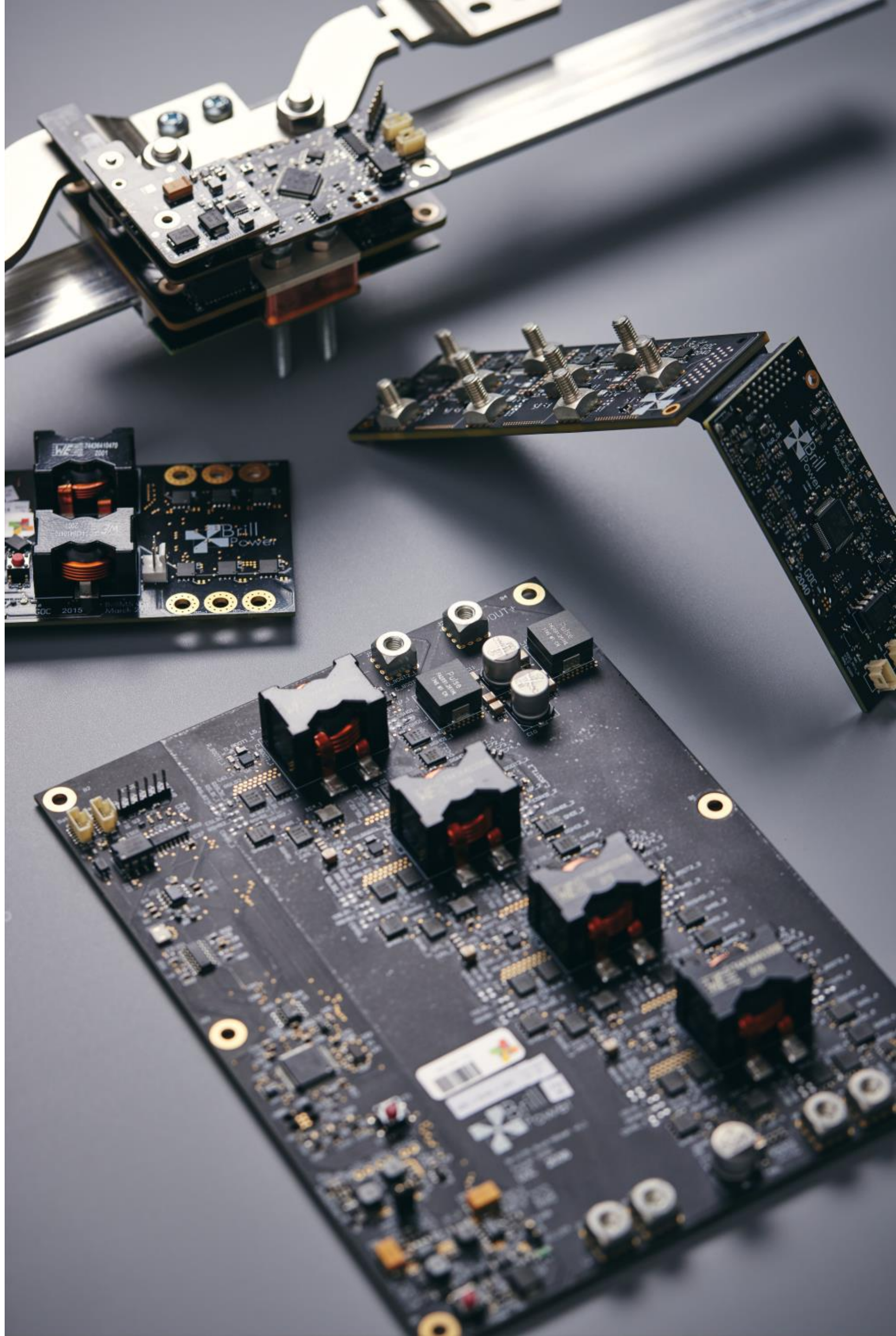
How it works

- Modified MMC topologies
- Distributed, integrated, dc/dc converter within the battery pack
- Regulated output voltage and regulated output current



Why Power Electronics

- Increasing controllability improves safety
- Being able to act on data
- Use cells to the end of their life
- High voltage packs are more susceptible to the weakest link problem
- As cells become part of the structure of the vehicle, longevity is imperative



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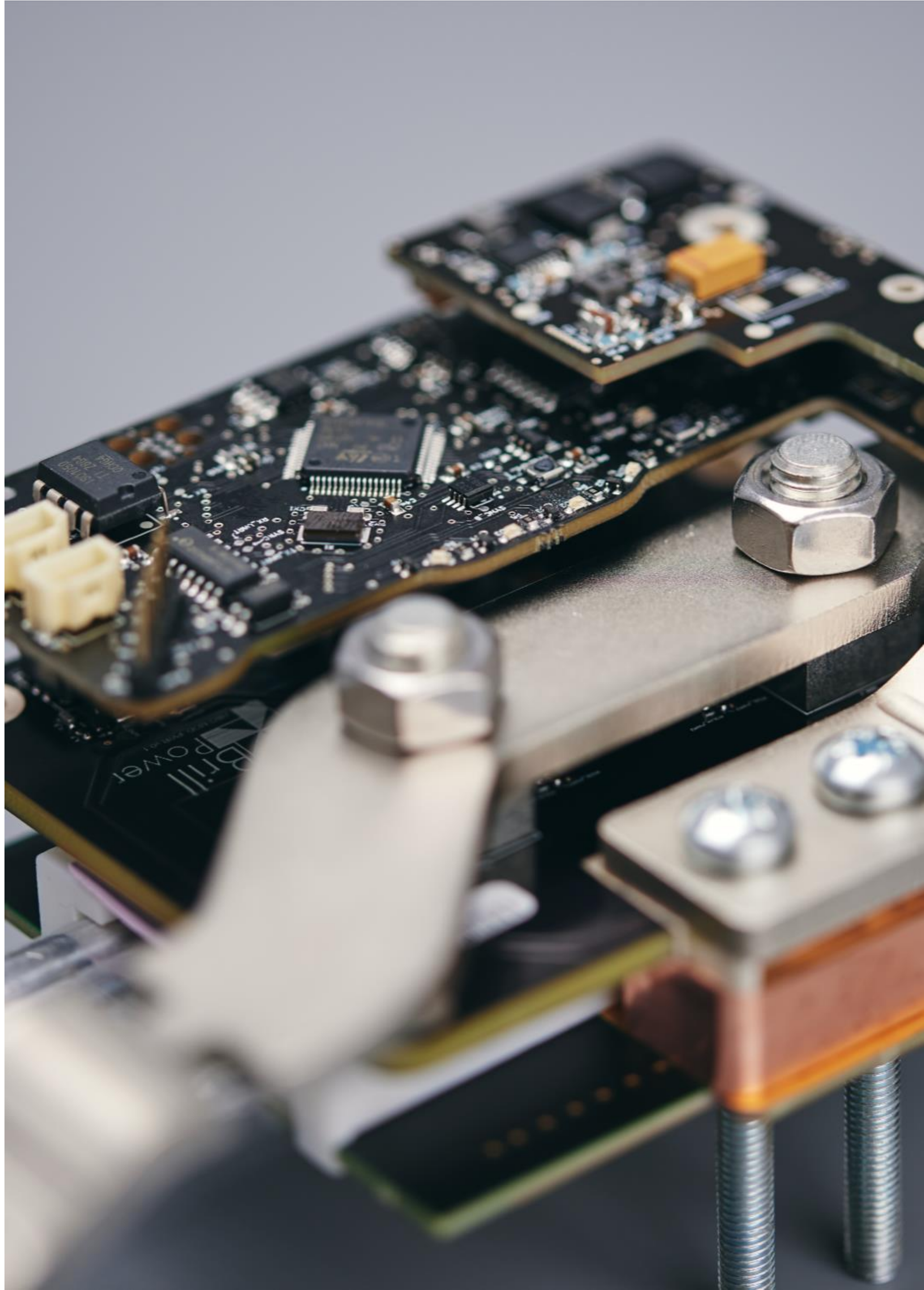
System level benefits

- Inverter and motor can be optimised to a single voltage level
- At low power, the inverter and motor can operate at a lower voltage level
- Integrate the inverter into the pack



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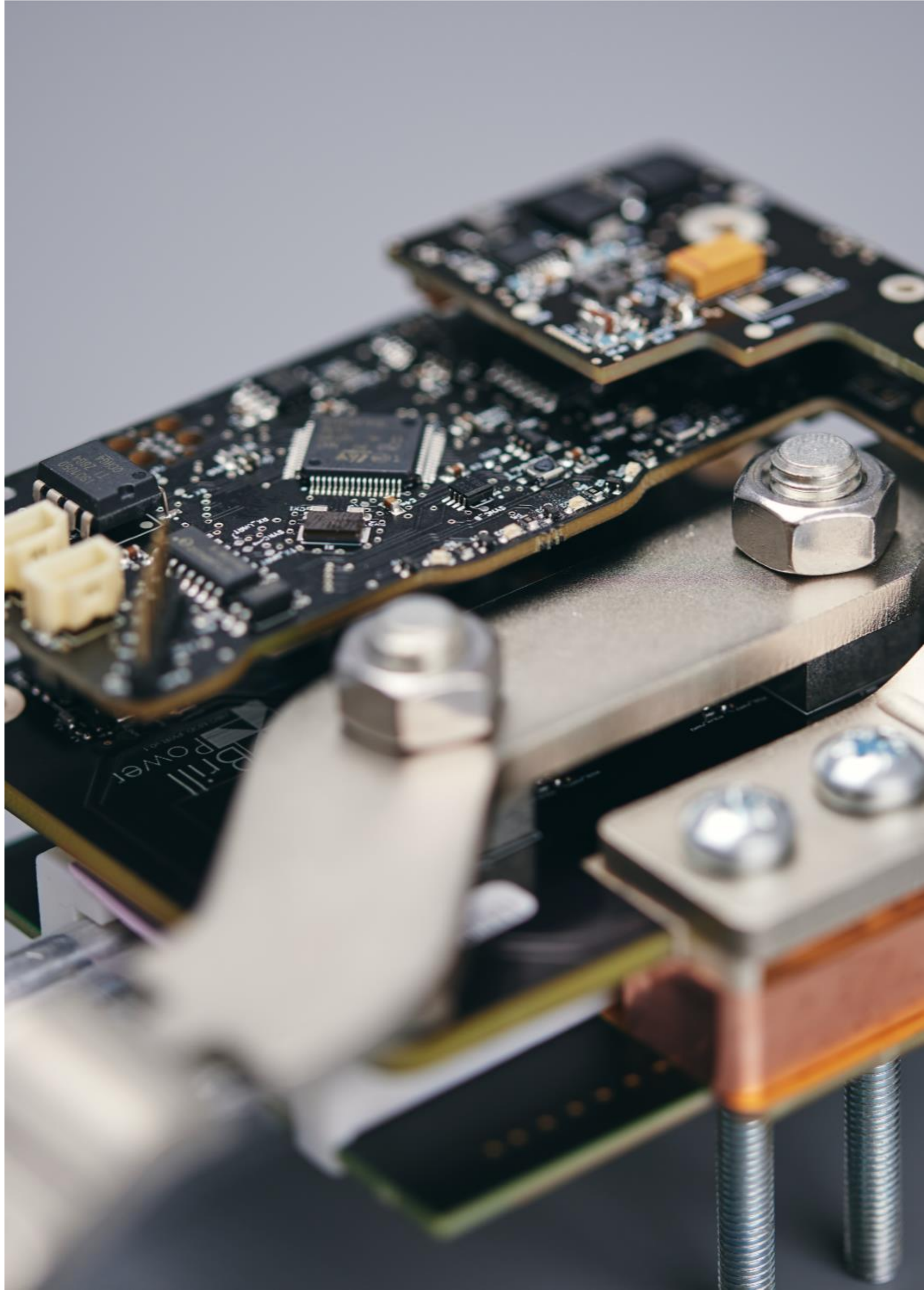
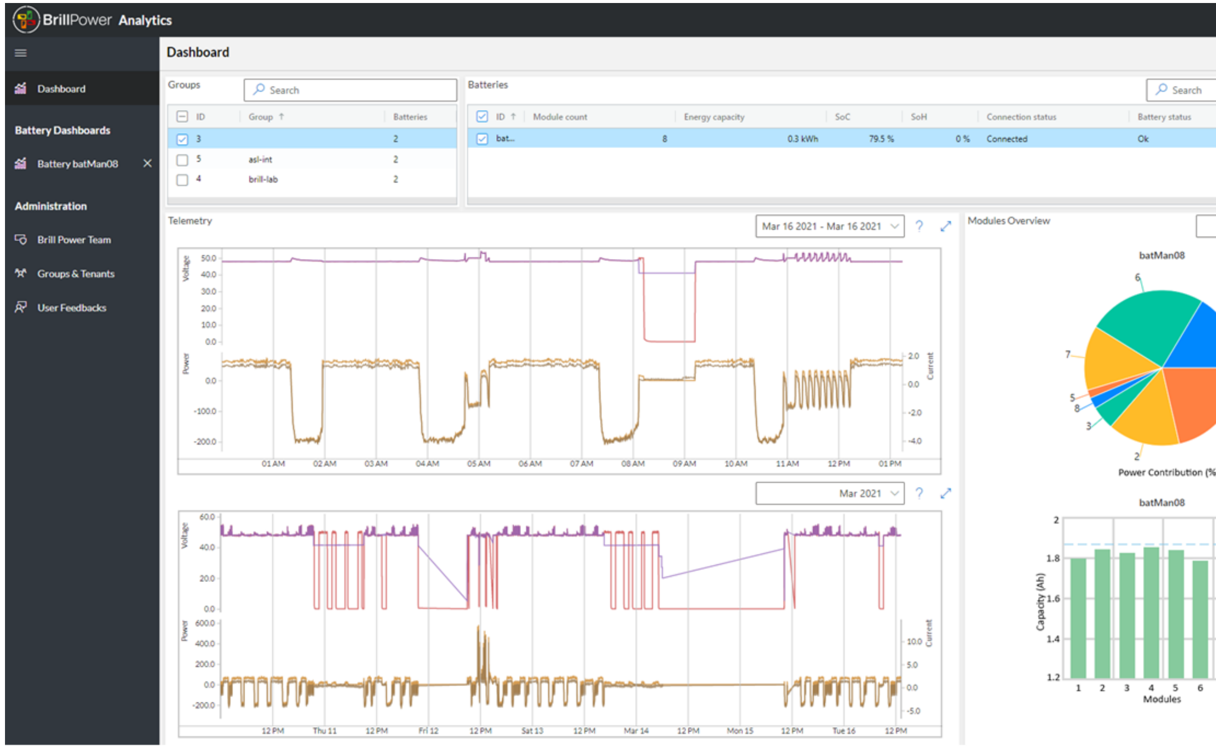
Charging Benefits

- Can be charged at any charger
- Charged at max power
- Avoid long balancing step



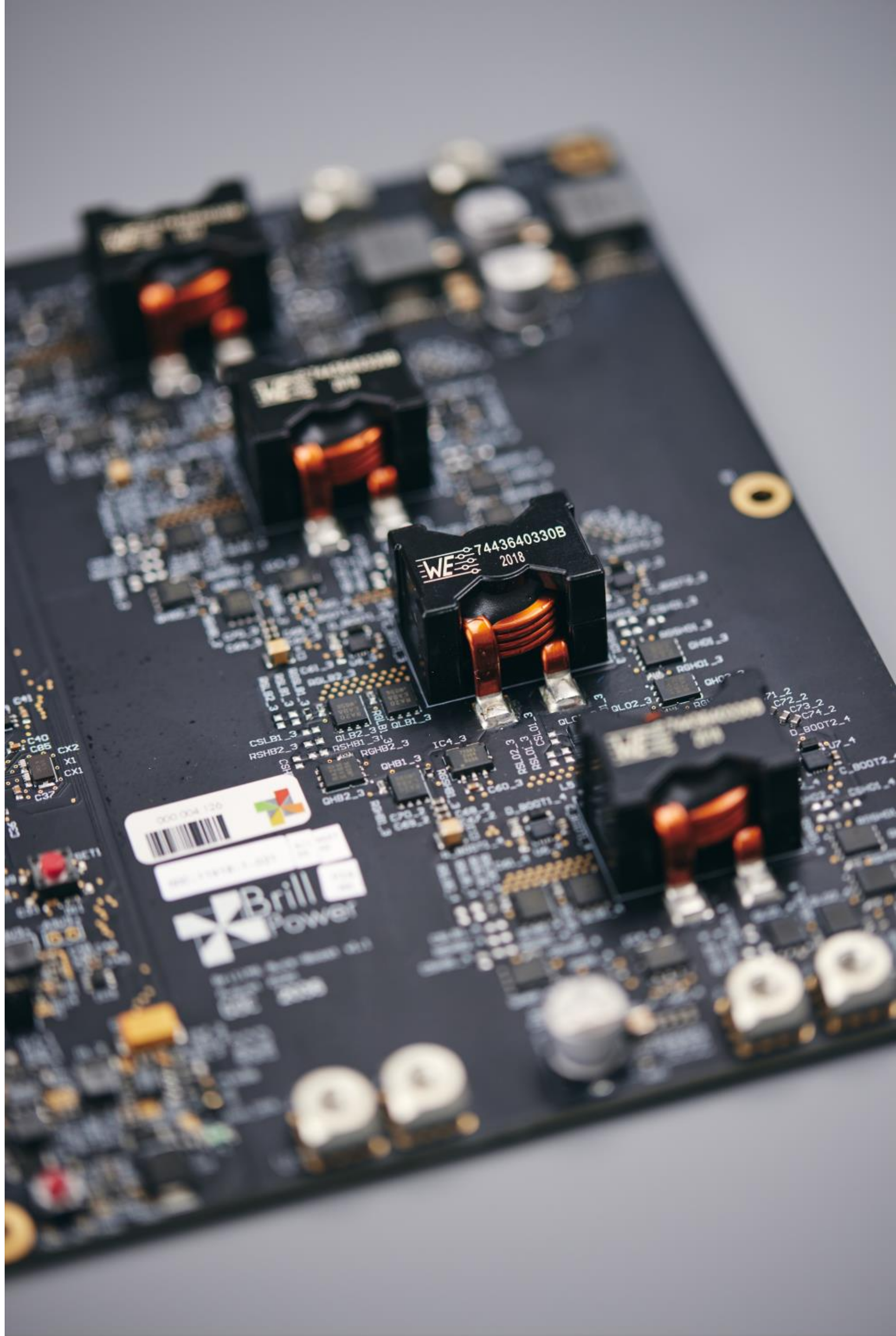
Software

- High accuracy SoX modelling
- Unique real-time resistance measurement enabled by the hardware
- Cloud-based analytics platform
- IoT communication and security based on Microsoft Azure



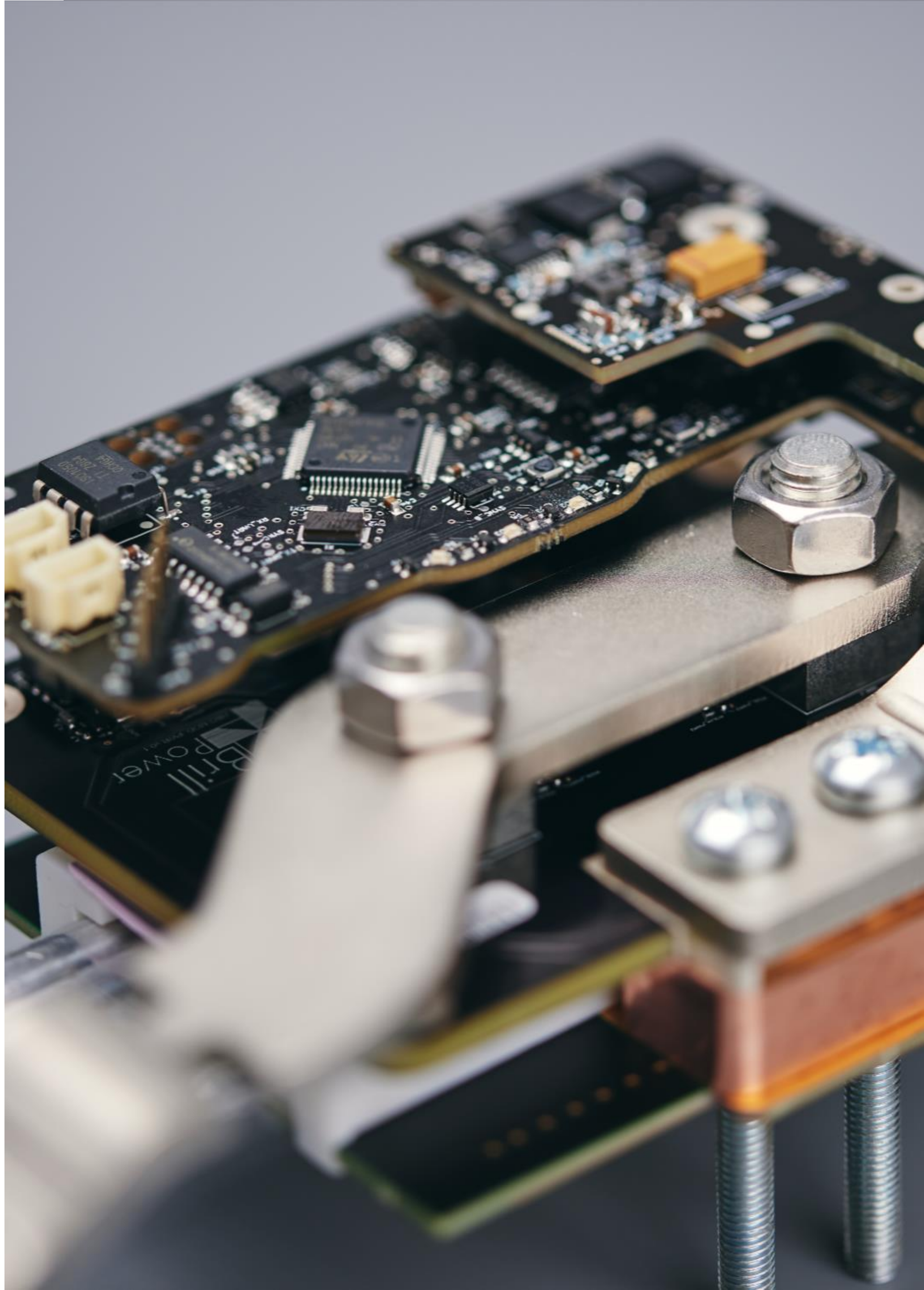
Hardware: Stationary

- 48 V to 800 V
- 62 A pack current
- Nominal 2x boost topology
- Replaces dc/dc converters



Hardware: Electromobility

- 48 V to 800 V
- 500 A pack current
- Modified MMC topology



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Work in Electromobility

- Recently wrapped up a high performance project
  - Hybrid energy storage system with BrillMS
  - Developed supervisory controller for pack energy management
  - Key performance metric: power over SoC range
  - 1000 A battery pack
- Sorry

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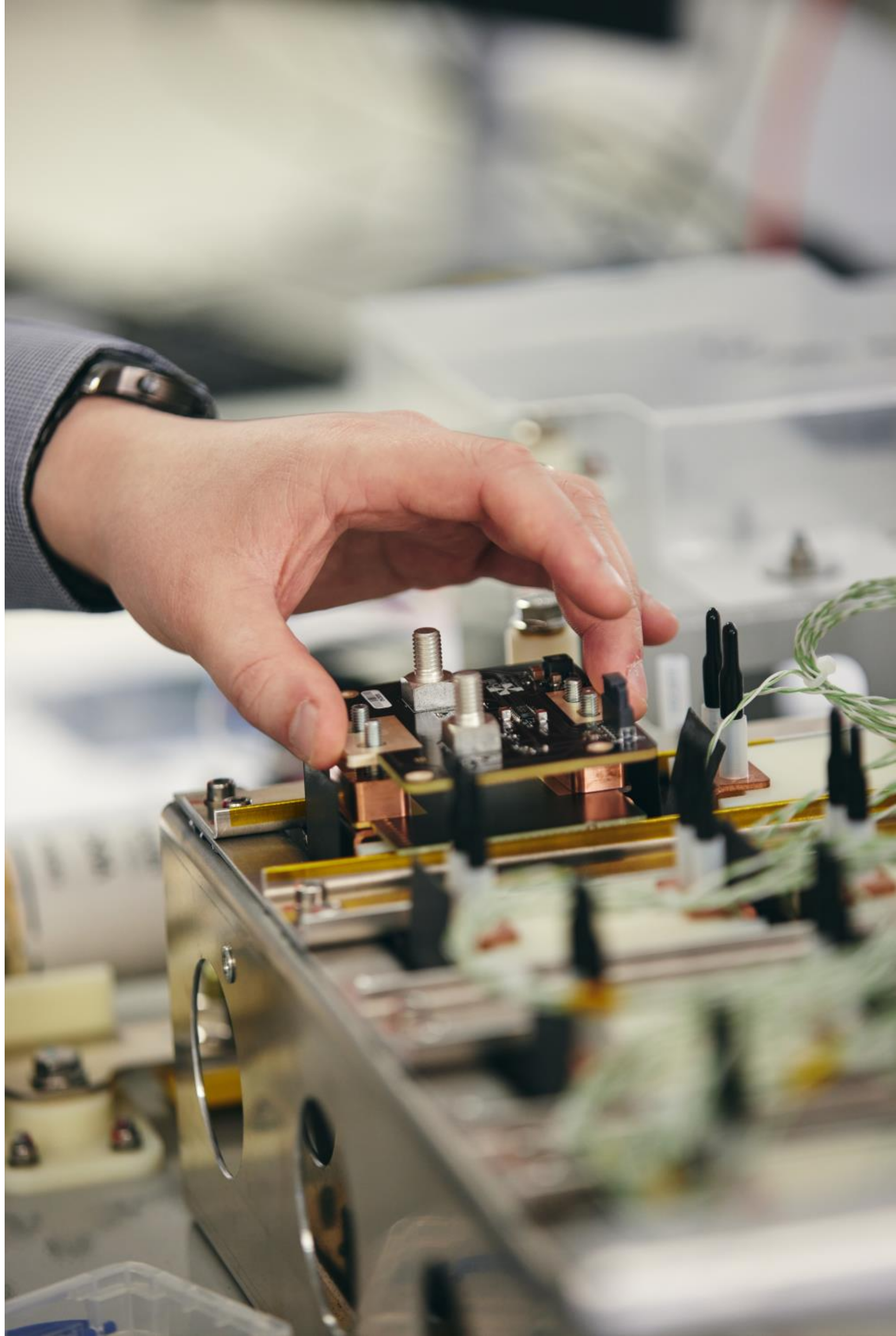
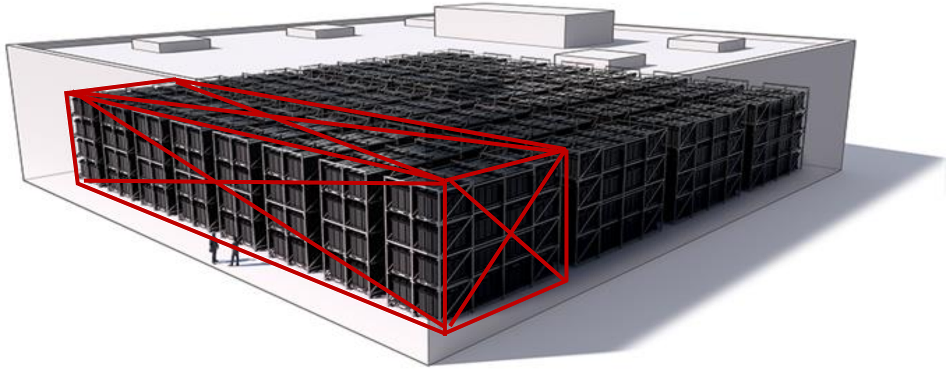
delta
A Cosworth Company



Cost

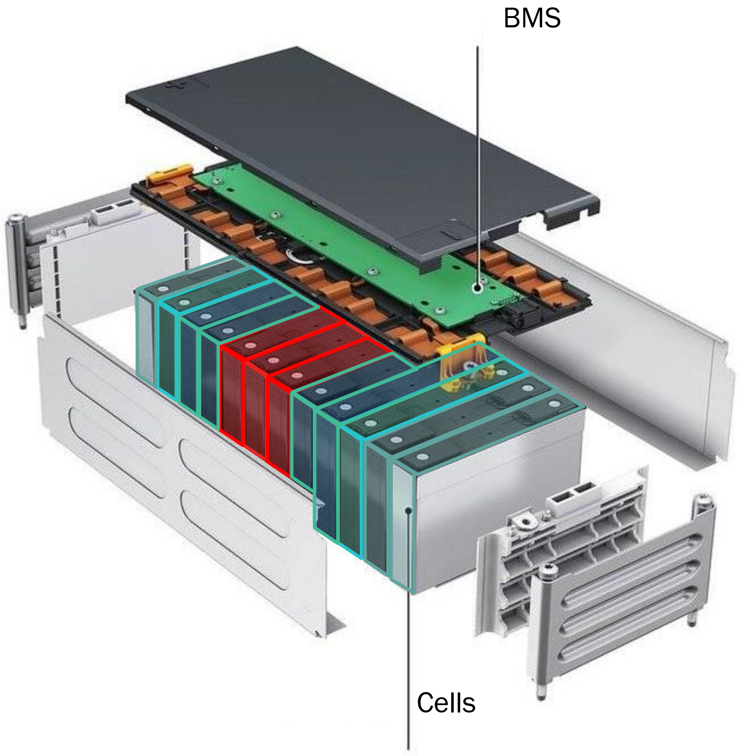
- We are a power electronics solution
- Independently evaluated by WSP showing 5 year shorter payback for stationary storage system
- 20% lower cost of ownership in electromobility due to mitigated battery replacement


Source: www.renault.co.uk



Reliability

- Design for reliability
- Research indicates that power electronics can enhance the reliability of electrochemical energy storage systems[1]



1. E. Chatzinikolaou and D. J. Rogers, "A Comparison of Grid-Connected Battery Energy Storage System Designs," in *IEEE Transactions on Power Electronics*, vol. 32, no. 9, pp. 6913-6923, Sept. 2017, doi: 10.1109/TPEL.2016.2629020.

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Thank you!

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