



Battery Design for Maintainability, Ruggedness and Safety

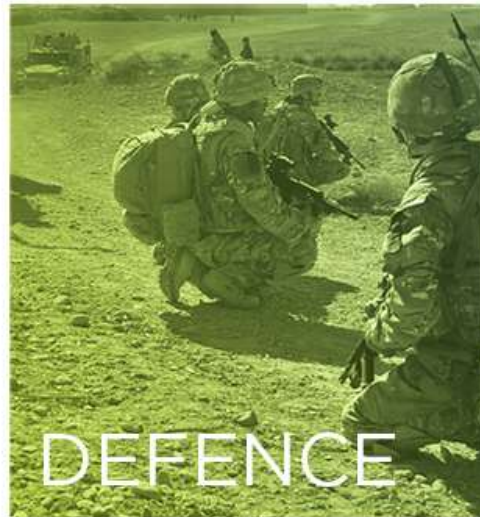
Andrew Cowie

SLICE Product Manager, Large Lithium-Ion Battery Design – Denchi Power

Session Sponsor:



Denchi Group



**Battery design for maintainability,
ruggedness and safety**

Andrew Cowie, Product Manager – Denchi Group

Battery Safety and Legislation

Cenex-LCV, 4 September 2019

Agenda

- Company Overview
- Denchi Group Product Lines
- Case Study 1: Armoured Vehicles
- Case Study 2: Large Scale Battery



Denchi Group - History



20+ years experience in designing and manufacturing high reliability batteries, especially Lithium-ion technologies

Denchi Group - Facility

Purpose Built Facility



- Employing 50 People

Located in Thurso, Scotland



Denchi Group – Capability and Expertise

- Bespoke Battery Design
 - Battery Management - Simple V & I control through to deep host integration
 - Power Transfer – Power electronics, busbar design
 - Enclosures – Low cost through to IP67 (and beyond)
- Battery Testing
 - Mechanical – Vibration, shock, thermal, altitude
 - Electrical – Automated cyclers up to 1500A @ 100v, or 400A @ 1kV
 - Abuse – Fully protected abuse chamber
 - Long-term – Climate-controlled test area

Denchi Group Brands and Product Families



Denchi Power

- Military Products
 - Vehicles
 - Dismounted Soldiers
 - UAV & UUAV
- Specialist & Bespoke
 - Oil & Gas
 - Industrial



SLICE

- Industrial
 - Modular & Scalable
 - 50kWh to >MWh
 - EV/Solar/Wind/Grid integration
 - Containerised or free standing
- Rail, Grid, Marine derivations



Oldham

- Mining
 - Battery Packs
 - Lamps
 - Charging accessories
- Marine
 - Safety lamps

Denchi Power 6T - Battery Overview

- Voltage: 21V – 27.8V
- Capacity: 85Ah (2.1kWh)
- Discharge Current:
 - Continuous – 350A
 - Peak – 900A
- Operating Temperature: -40°C to +60°C
- Integrated Charger
- J1939 Compliant CANBus
- IP 68
- Fuel Gauging – SOC & SOH



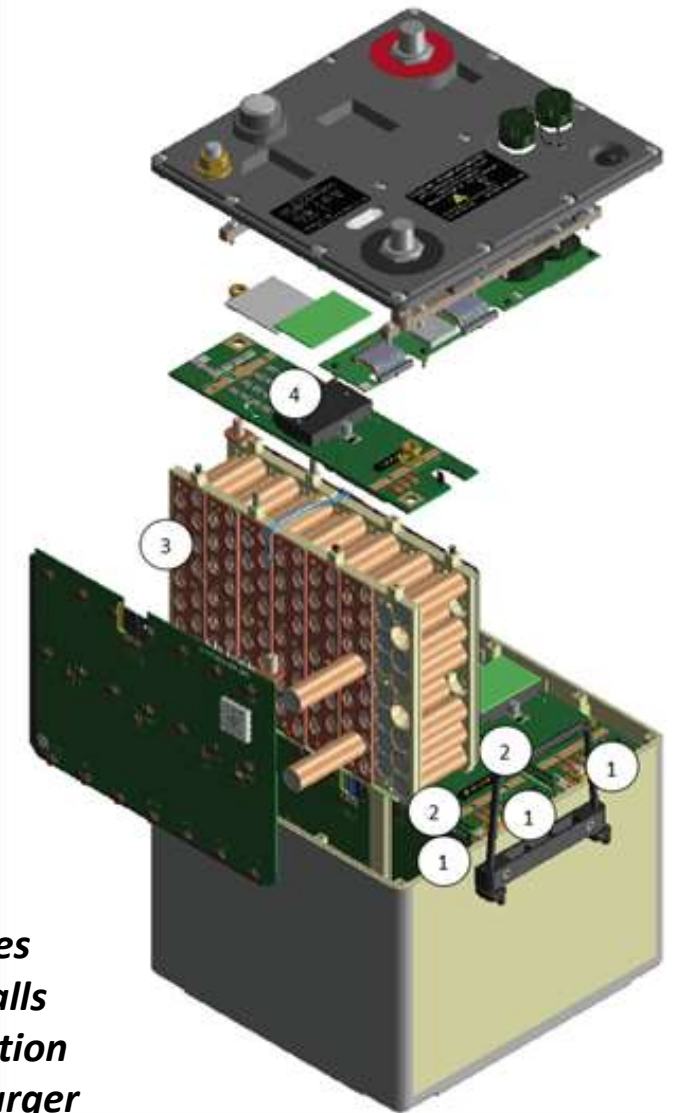
Denchi Power 6T - Design Overview

Mechanical/assembly

- Robust aluminium case
- Safety vent
- Shock and vibration resistant

Electronics

- Modular approach
- In-built redundancy – each module operates independently
- Multi-levels of protection



Key

- 1 – Cell Modules**
- 2 - Internal walls**
- 3 – Cell separation**
- 4 – In-Built charger**

Denchi Power 6T

- 6x PbA replaced by 3x Li-Ion gives:
 - More operational energy
 - Less weight (25kg instead of 40kg)
 - More than 15x working life
 - Installation time reduced to 7m36s from 28m
- State of Charge integration into system gives users clear view of mission capability
- State of Health information integration into main logistics chain reduces supply overheads and improves vehicle maintenance turn around at fleet level



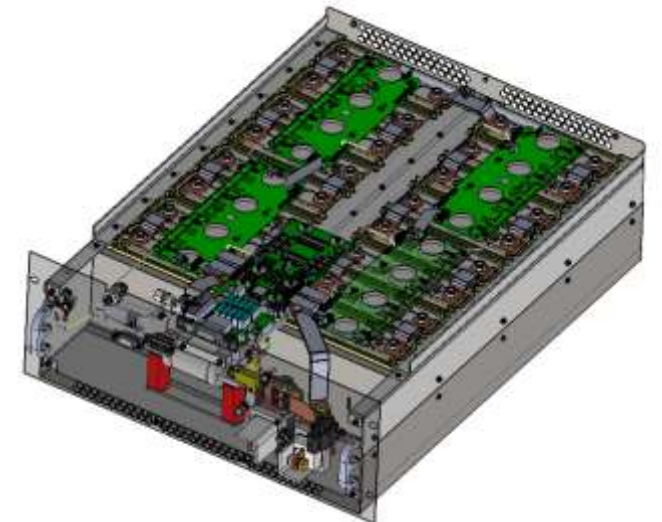
SLICE Industrial

- Scalable modular battery
- Core design usage case – Industrial site with significant base load
 - Peak shifting
 - Co-location with renewables
 - Participation in grid balancing services
- Expectation that further use cases will emerge as product matures

SLICE Industrial – Battery Overview - Modules

- Voltage: 48V – 56V
- Capacity: 69Ah (3.5kWh)
- Discharge/Charge : 100A/5.1kW
- Operating Temperature: 0°C to +45°C

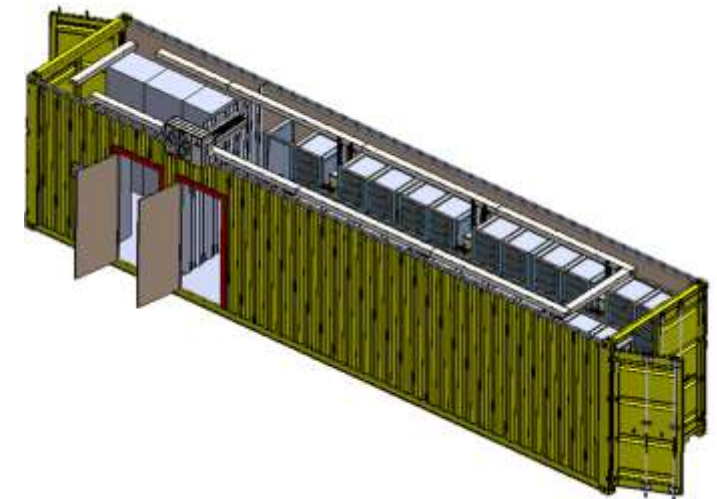
- 19" Rack Mounted
- Localised sensing & measurement
- Local safety devices
- Designed to be stacked up to 1000v system



SLICE Industrial – Battery Overview - System

- Voltage: 624V – 728V
- Capacity: 69Ah (45.9kWh)
- Discharge/Charge Current:
 - Continuous – 100A/66.6kW
- Operating Temperature: 0°C to +45°C

- Charge & Discharge Control
- Cell Balancing
- Fuel Gauging
- Pre-processing of usage data
- Parallel usage up to ~1.2MWh (26 Cabinets)



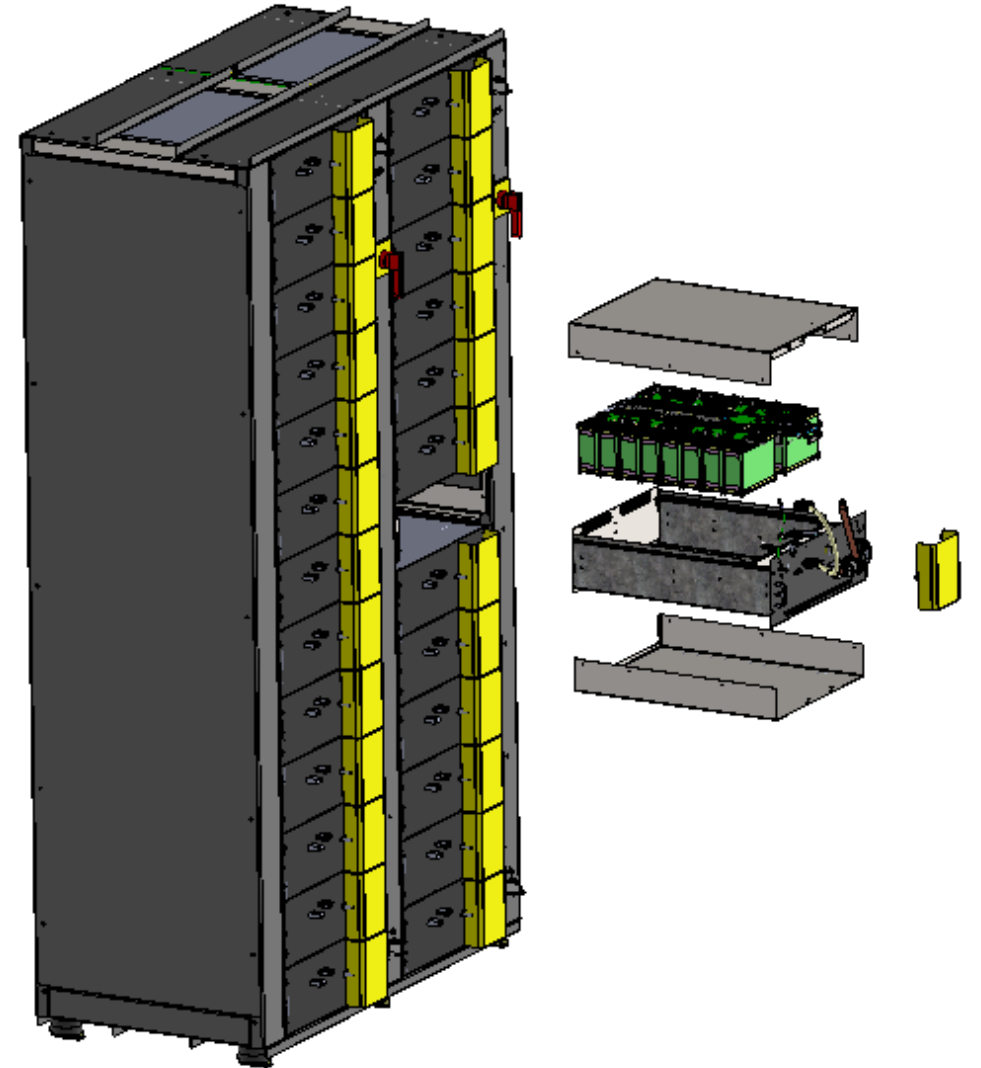
SLICE Industrial – Design Overview

Mechanical/assembly

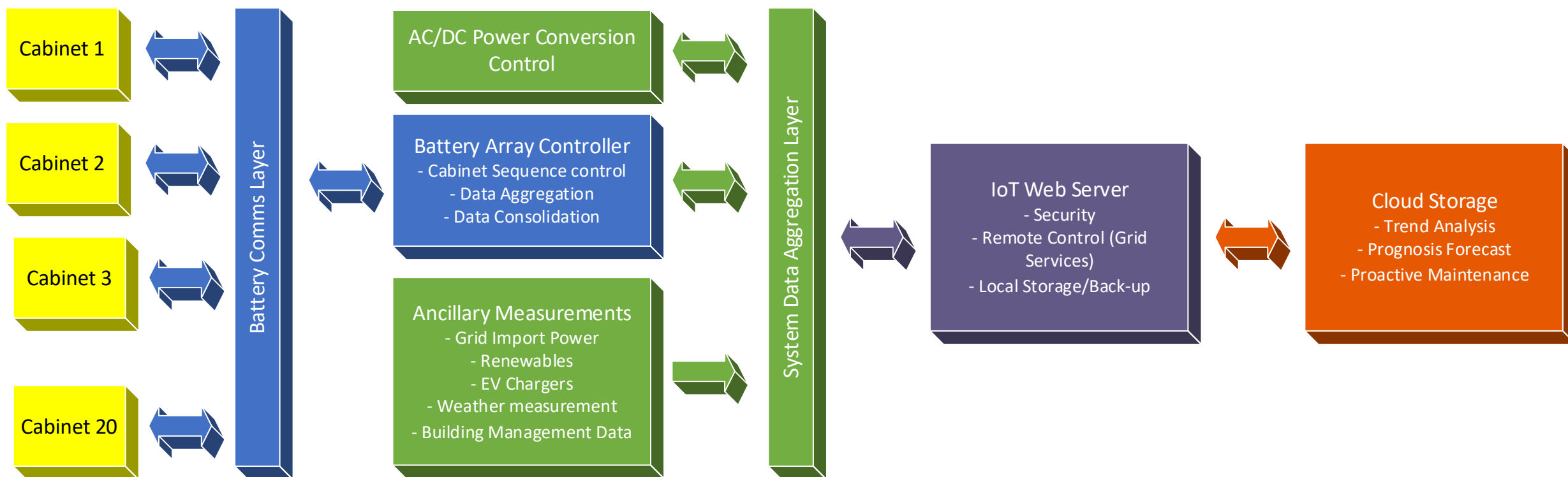
- LFP Cells with air gap between
- Multiple partitions between modules
- Shock and vibration resistant

Electronics

- Cabinet-level active safety
- Module-level passive protection
- Global auxiliary-power control



SLICE Industrial – Data Capture Scheme



- Maximise data capture opportunities
- Cloud processing across multiple systems, gives new insights

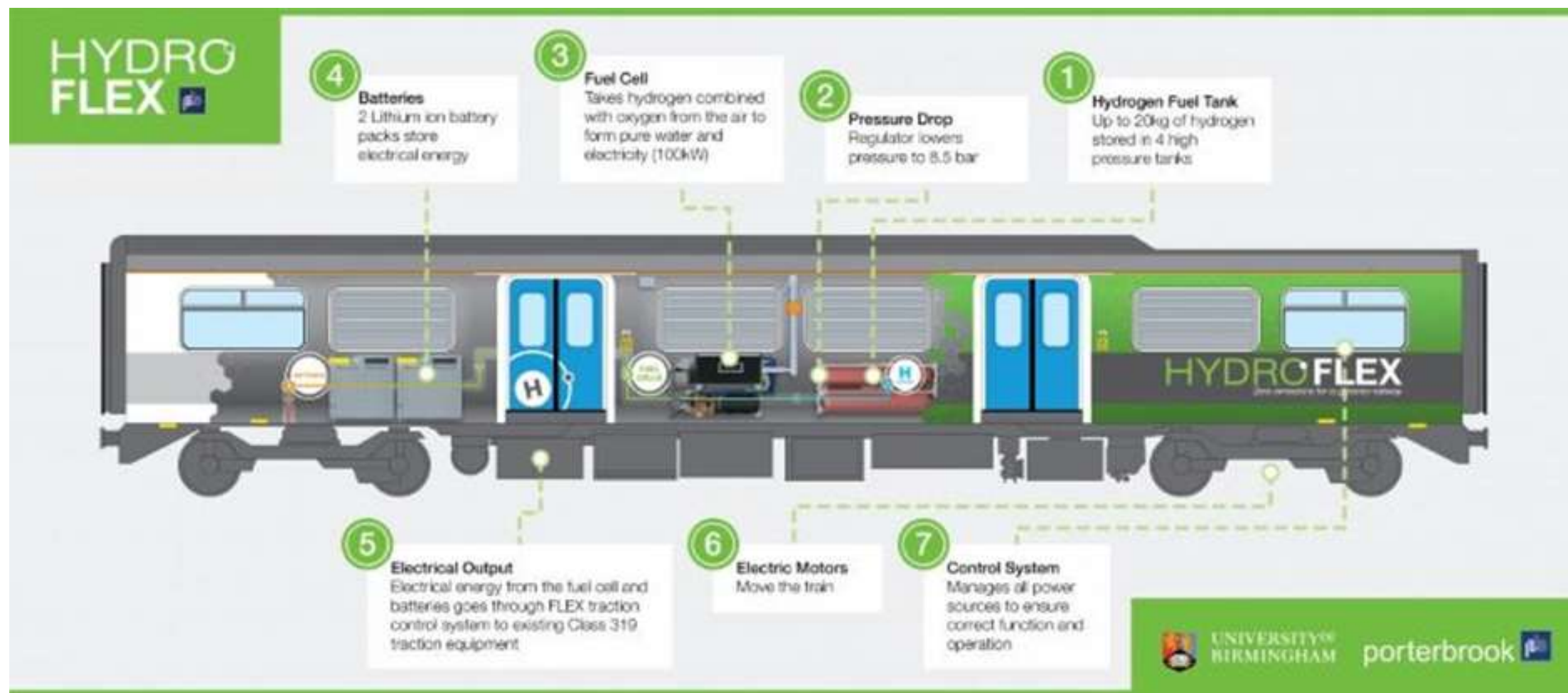
SLICE Industrial – Data Usage

- Use local energy data trends to create optimized ‘hybrid’ building
- Integrate with grid balancing schemes to generate revenue for asset owner
- Use cloud computing power to develop prognosis and improve usage to extend life

Large scale modular batteries

- Fast charging where grid prohibits
- Marine propulsion – Electric or hybrid
- Large vehicle propulsion – EV or hybrid
- Coupled with Hydrogen fuel cell technology

SLICE Industrial – HydroFLEX – UK's first Hydrogen Powered Train



HydroFLEX Installation

Vehicle



Installation



Battery Spec

- Voltage:
576V – 672V
- Capacity:
138Ah (84.8kWh)
- Current/Power:
200A/122.8kW

Pictures with permission of BCCRE



SLICE INDUSTRIAL

OLDHAM

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