Kurt.energy

Altreonic

ENERGY FOR LIFE, BLUE CELL POWER

Eric Verhulst, CEO/CTO

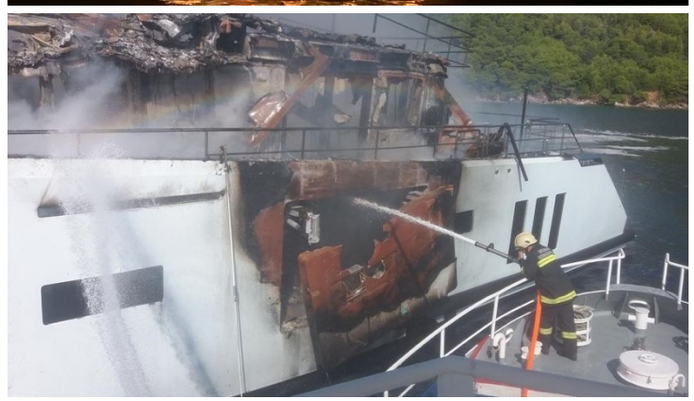
THE SHIFT TO CLEAN ENERGY NEEDS BETTER BATTERIES NOW:
We have them!

Lithium-ion: Sustainable? Practical? Cost-efficient?

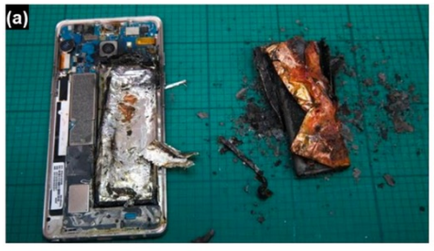
GM asks Chevy Bolt EV owners not to charge overnight or park inside after 2 more fires

Sean Graham - Jul. 14th 2021 1:59 pm PT

Batteries are full of very inflammable products)



Recall will cost 2 billion US$



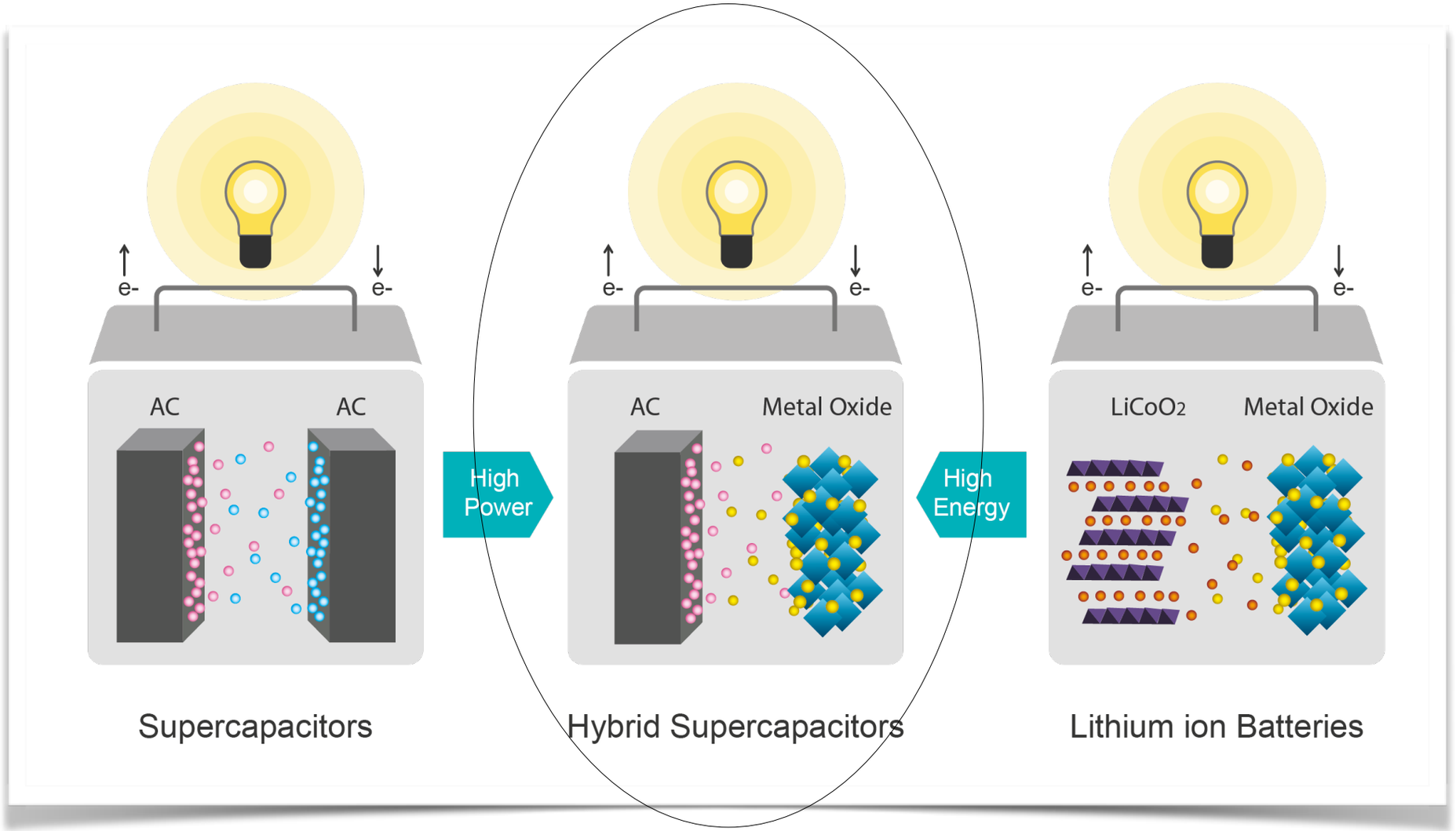
From smartphones to warehouses

Toxic smoke 10 km away

Our Power Capacitors are safe, and more…

The step beyond Lithium-ion batteries

- First cells in 2018
- Unique carbon based hybrid super capacitors with energy of Li-ion
- Customer and volume production snce 2 years



Game-changing hybrid carbon-based power capacitors

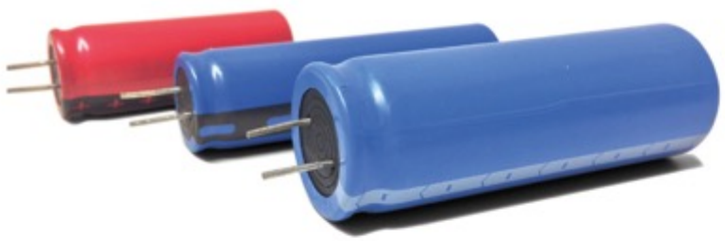
A practical and sustainable battery must meet many criteria combined

Lithium-ion battery cells	Hybrid Carbon-based Power Capacitors
Fire risk	**NO fire risk**
Complex to use	**Simple and robust. No BMS needed**
Active cooling/heating	**No need for active thermal management**
Short time limited power	**Sustained high power capability (up to 20x)**
Energy, 60 to 80 % usable	**Energy, 100% usable**
Limited temperature range	**Works from -40°C to +80°C**
Fast charging is problematic	**Fast charging in 5-10 min**
Lifetime too short	**1 million km or 20 years and more**
Sustainable?	**10 to 20X lower environmental footprint**
Cost efficient	**Lowest cycle life cost**
Many announcements	**In production since 2 years**

Kurt.energy develops and delivers batteries world-wide

Small cells, enabling a high potential

CARBON BASED
POWER CAPACITORS



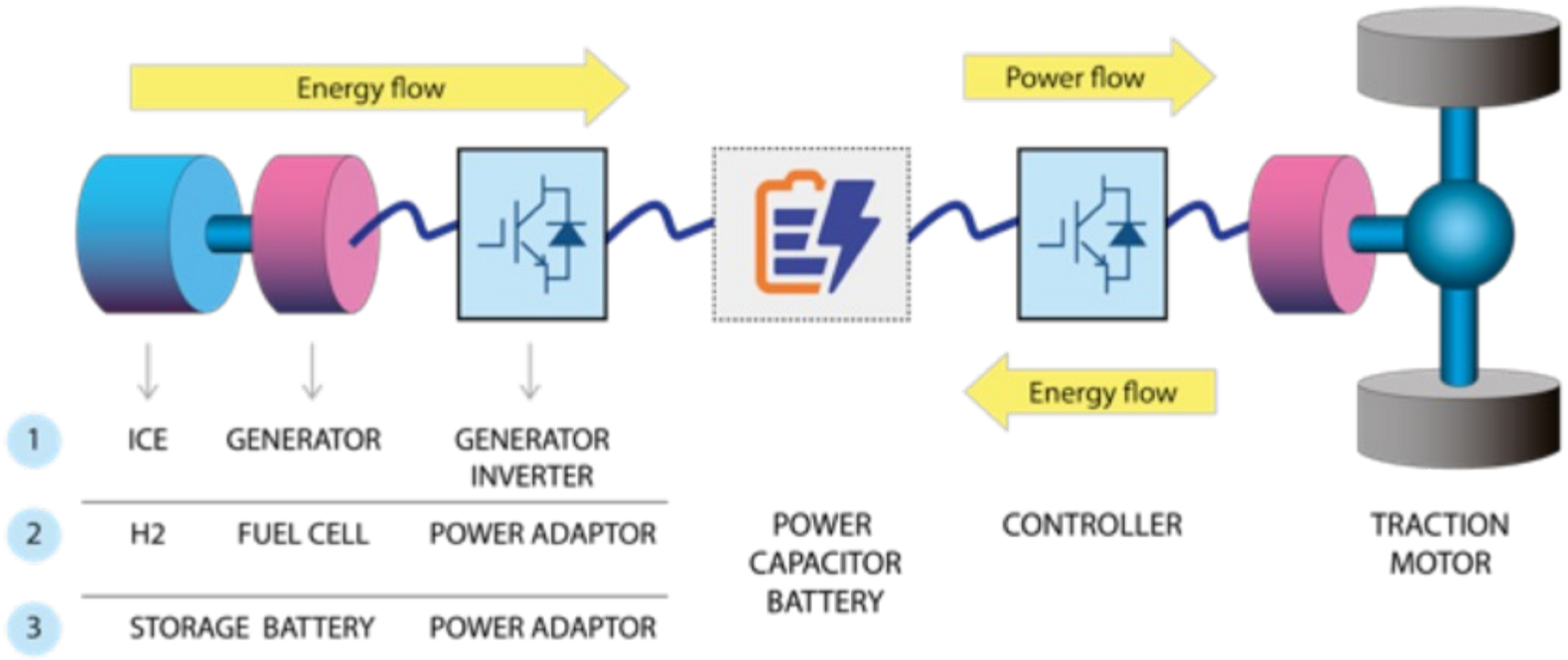
www.kurt.energy

Hybrid vehicles application

Extreme temperature, lifetime and power requirements

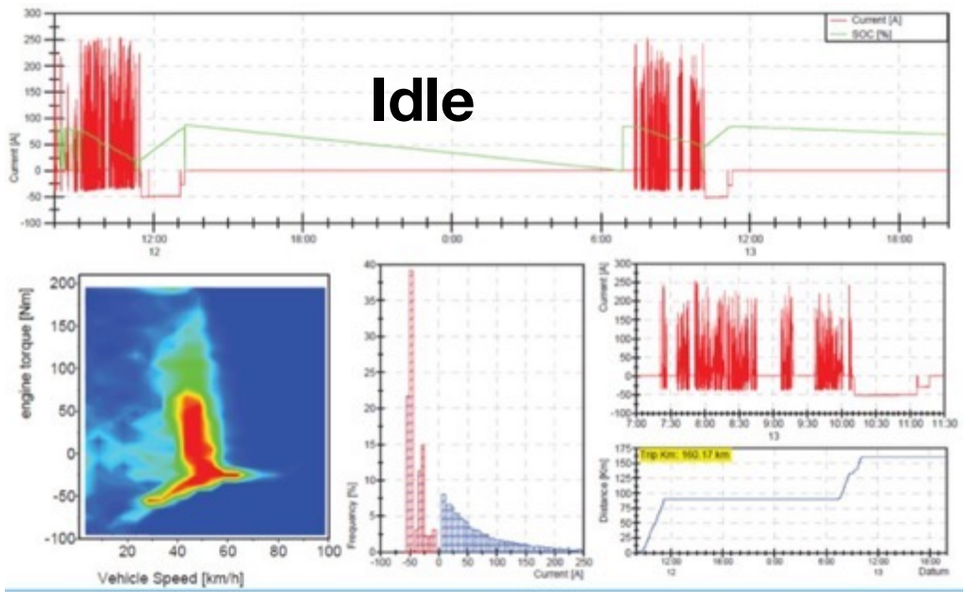
Hybrid carbon-based power and energy capacitors

Power capacitor = energy + power



charging + regen braking

Pull-up

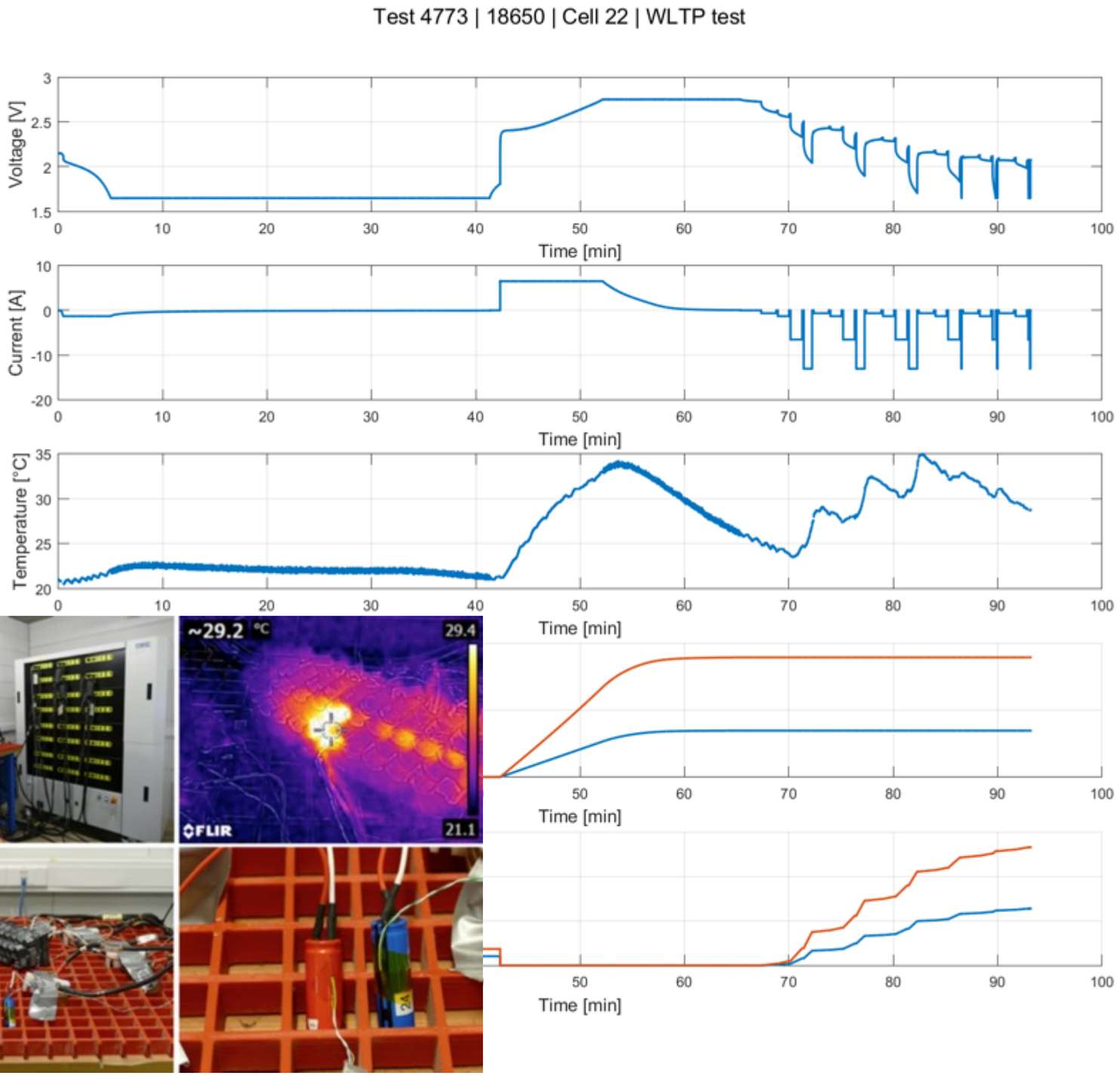


Unbeatable benefits in hybrid propulsion:

- Safe (H2 fuel cells!)
- Robust
- Power (upto 20C)
- Simple: no BMS, no active cooling
- Works from -40 to +80°C
- Lifetime: upto 30 years

Power needs happen in bursts: the killer for Li-ion

Stress and abuse tests at Flandersmake



Charging in 5 minutes to 75%

Discharging at 0.5, 1C, 5C, 10C

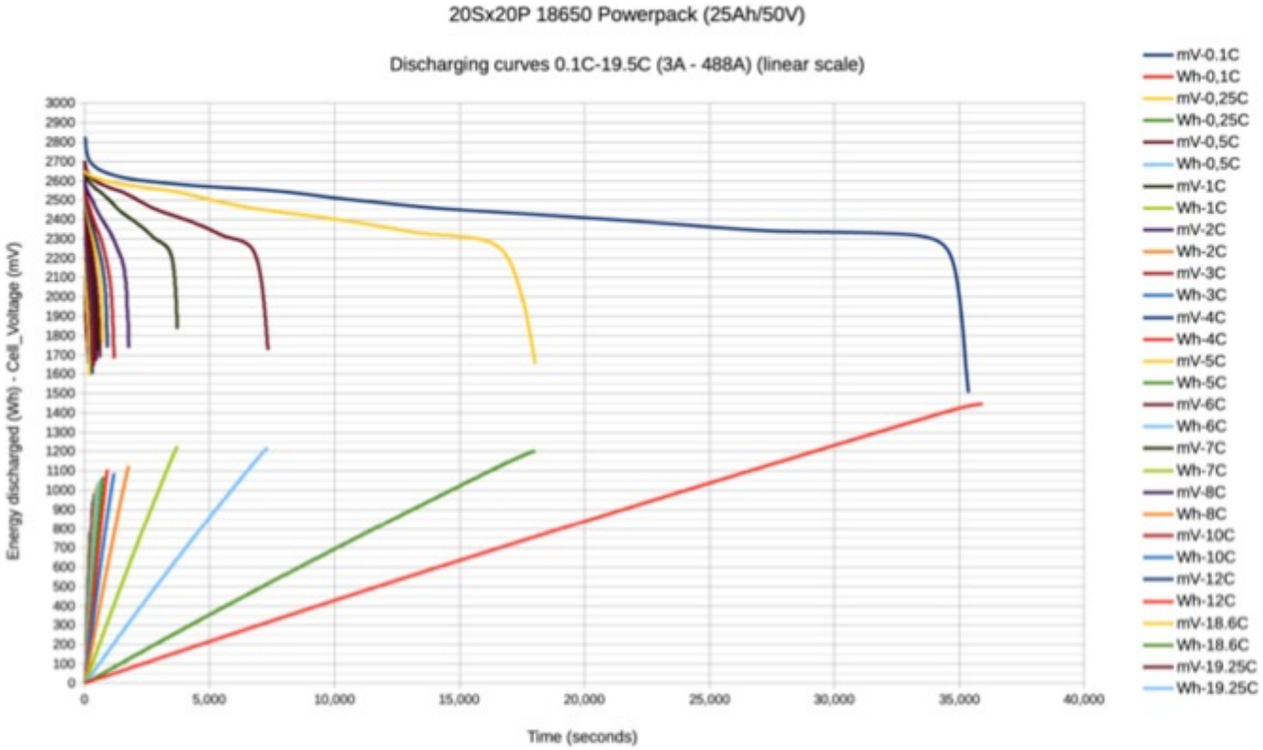
T < 35 °C in ambient air

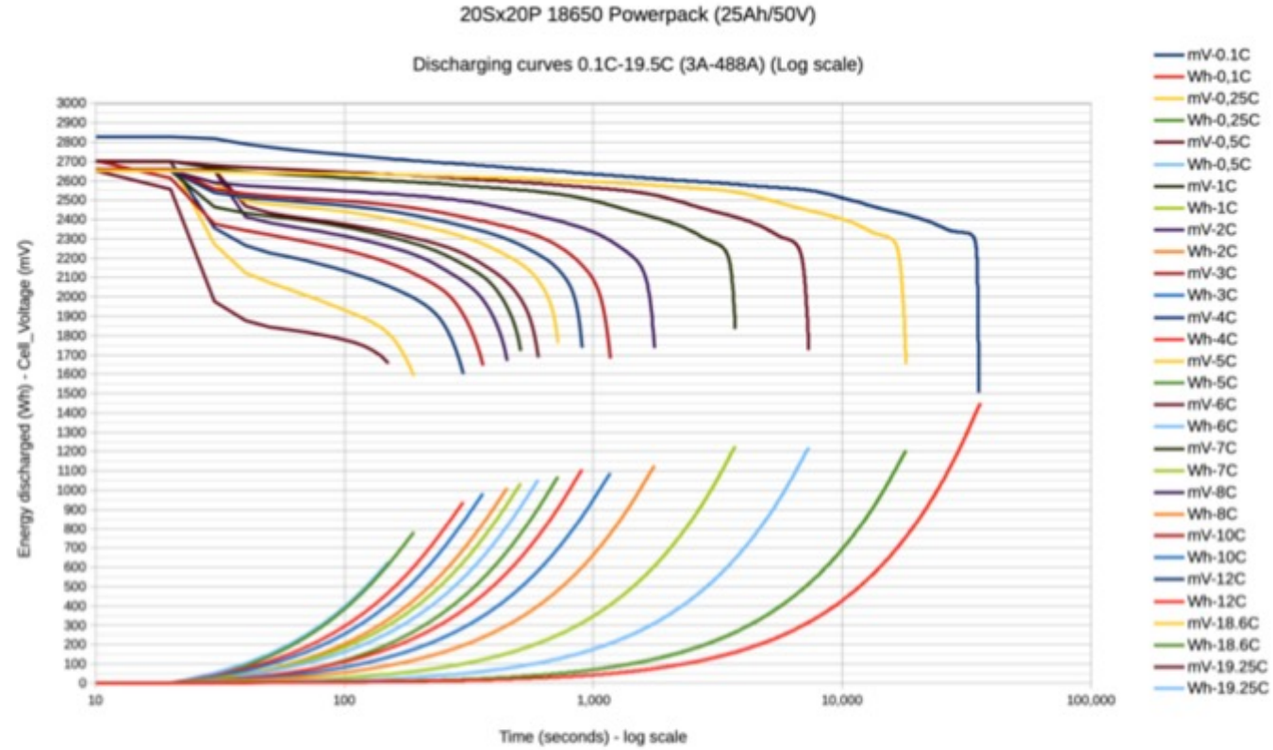
3.4 Wh charged & discharged

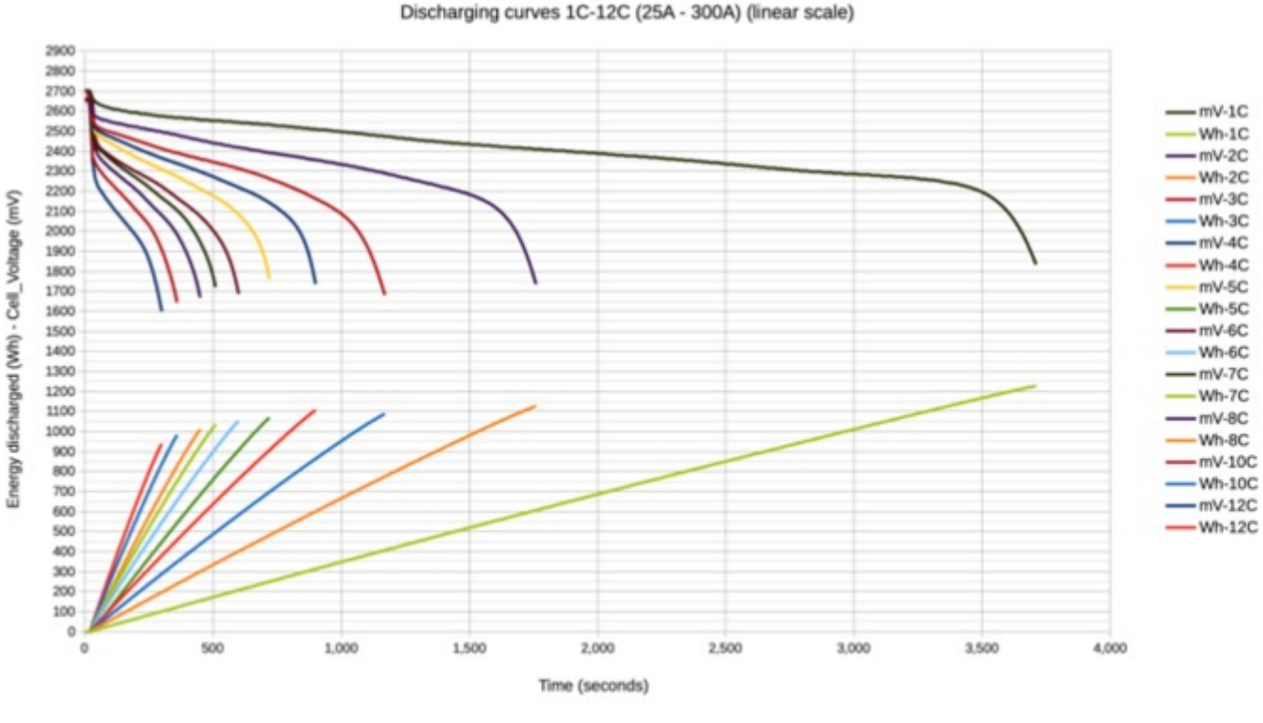
Charging at 5C (6.5 A), discharging at 0.5C, 1C, 5C, 10C, simulating WLTP cycle

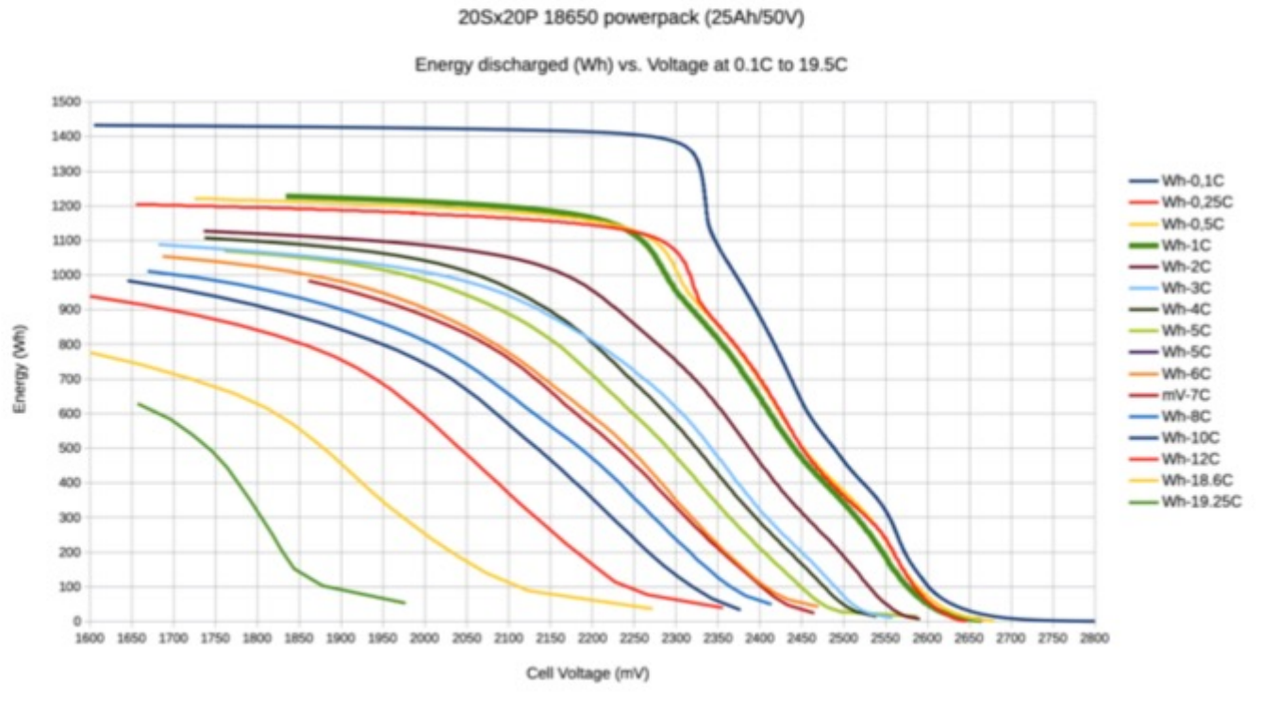
Discharging at 2x max. C-rate (40C), overcharging, short-circuit show extreme robustness

From 3A to 488A on a non-cooled battery

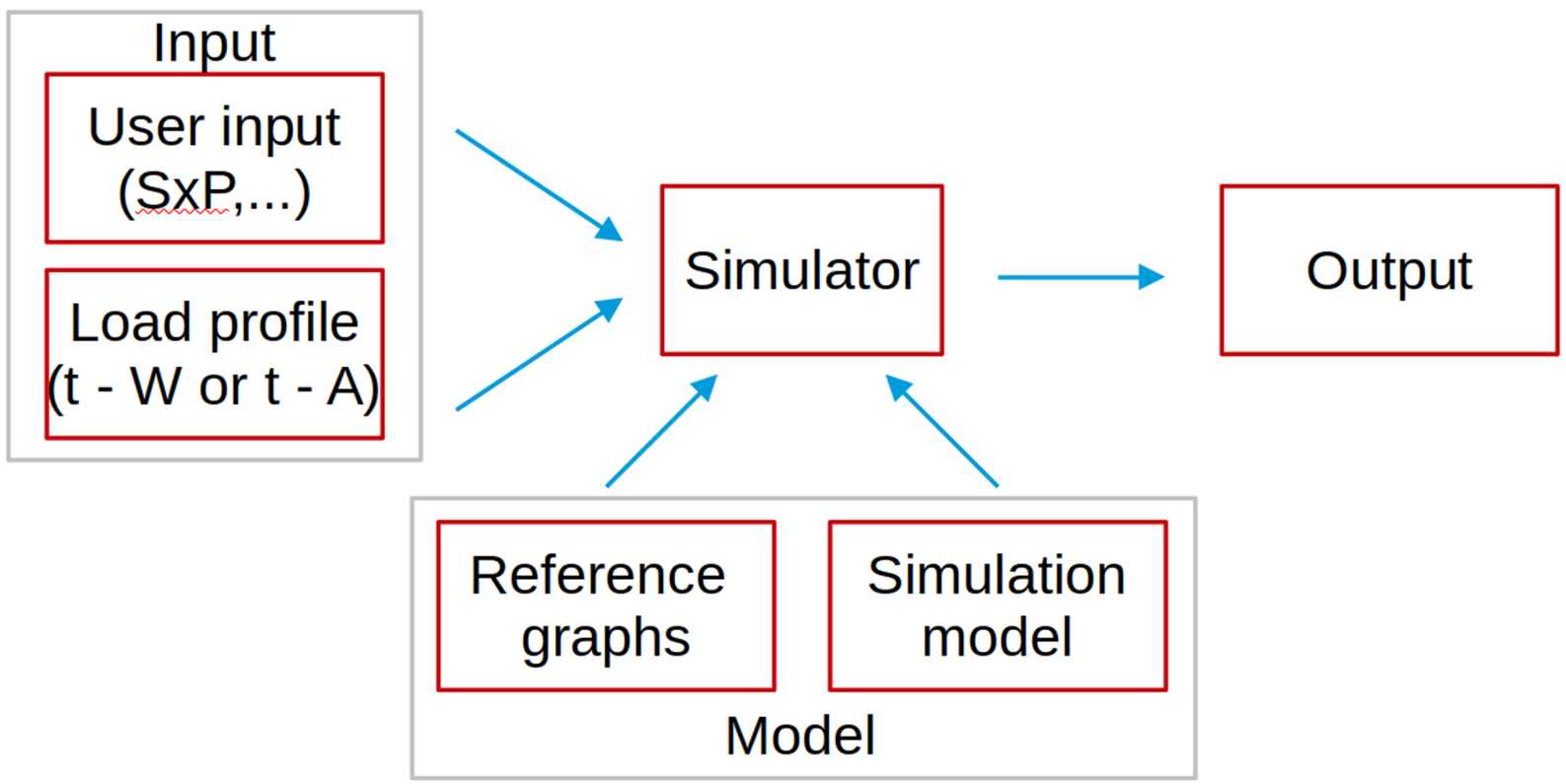


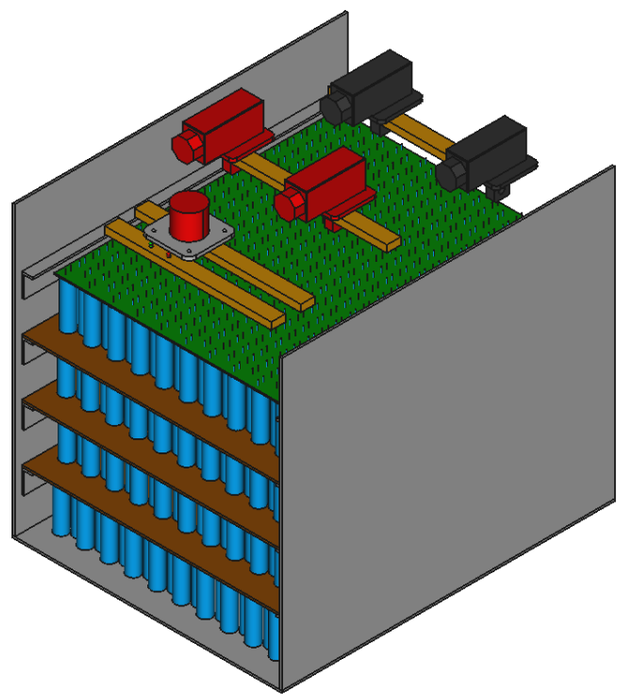




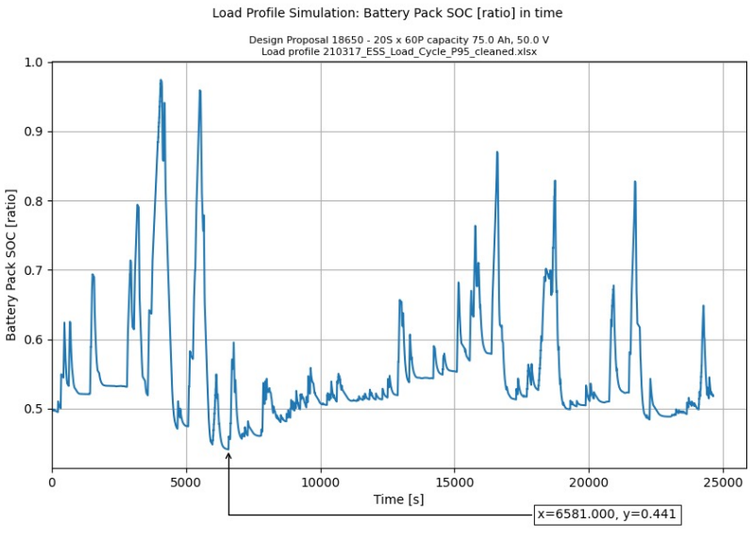


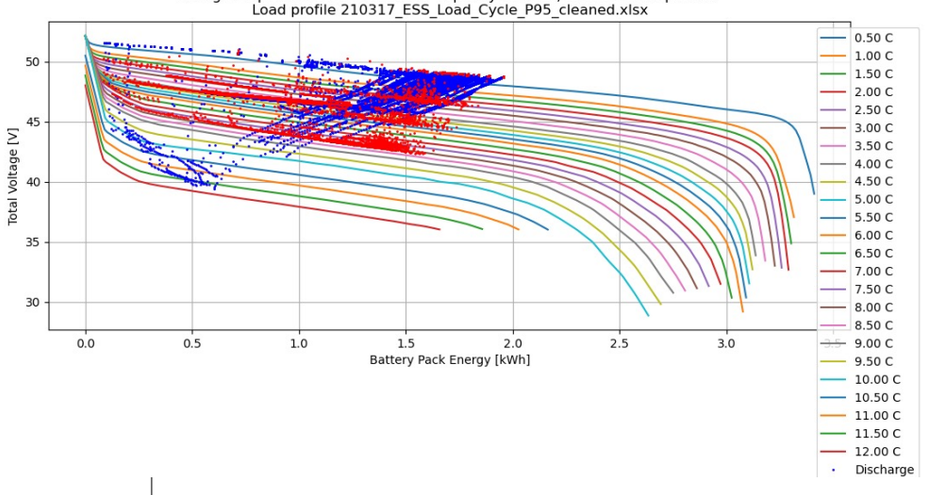
Simulation before building: htpps://batterybuilder.kurt.energy

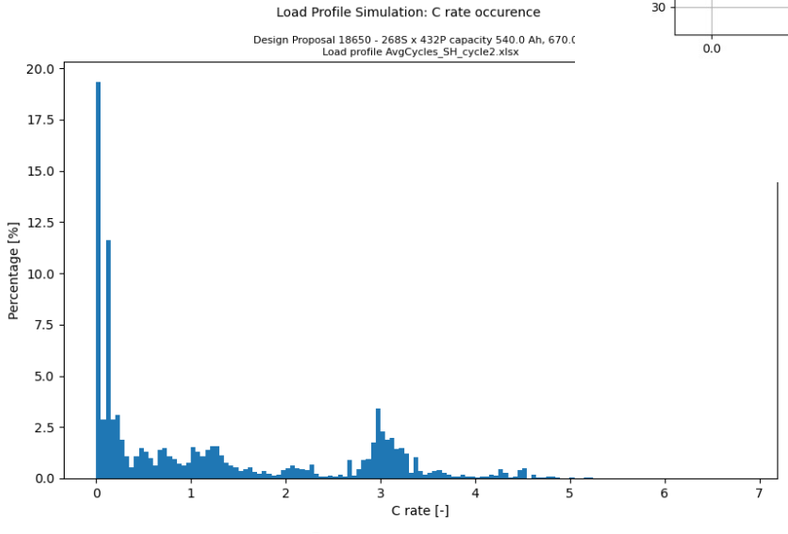




Load Profile Simulation
Design Proposal 18650 - 20S x 60P capacity 75.0 Ah, 50.0 V -- interpolated

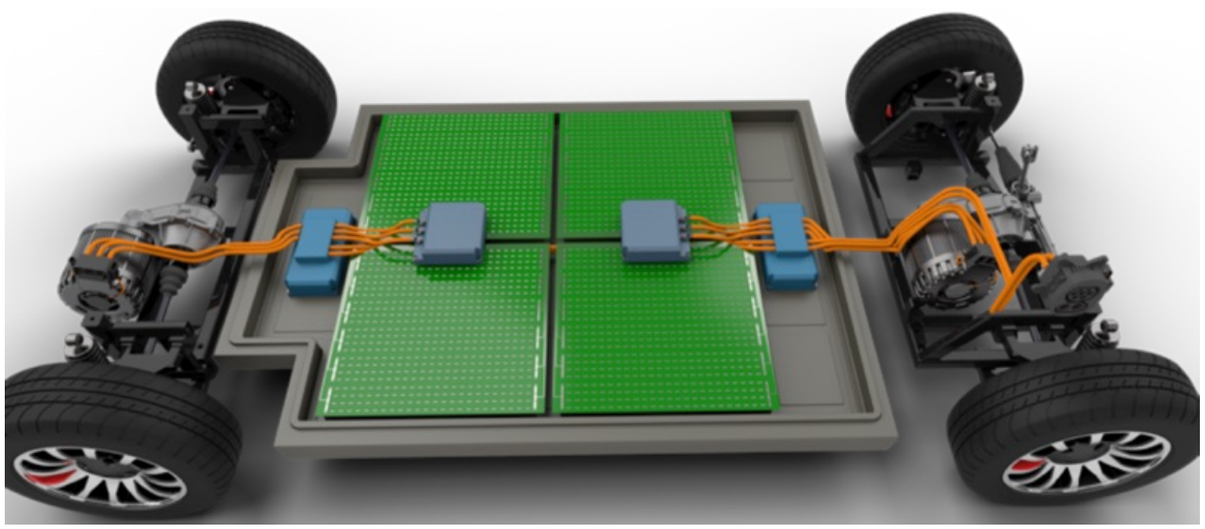






Seal of Excellence:
Recognition by external experts

- **Multi-Moby EU H2020 project: a novel modular and autonomous urban class e-vehicle**
- **Can be charged in 5 to 10 minutes**




SEAL OF EXCELLENCE

European Commission

Certificate delivered by the European Commission, as the institution managing Horizon 2020, the EU Framework Programme for Research and Innovation 2014-2020

The project proposal
101009152, HybridPower
Business Development and Automated Pilot Assembly Line for game changing Carbon –based Hybrid Powercapacitors

submitted under the Horizon 2020's **SME Instrument (grant only and blended finance)** call **H2020-EIC-SMEInst-2018-2020 (H2020-EIC-SMEInst-2018-2020-4)** of **19 May 2020** in the area of **H2020-EIC-SMEInst-2020-4**

H2020-EIC Accelerator pilot –SME Instrument - Green Deal

by
ALTREONIC NV
GEMEENTESTRAAT 61A BUS 1
3210 LINDEN
Belgium

following evaluation by an international panel of independent experts

WAS SCORED AS A HIGH-QUALITY PROJECT PROPOSAL IN A HIGHLY COMPETITIVE EVALUATION PROCESS*

This proposal is recommended for funding by other sources, since Horizon 2020 resources available for this specific Call were already allocated following a competitive ranking.

* This means passing all stringent Horizon 2020 assessment thresholds for the 3 award criteria (excellence, impact, quality and efficiency of implementation) required to receive funding from the EU budget Horizon 2020.

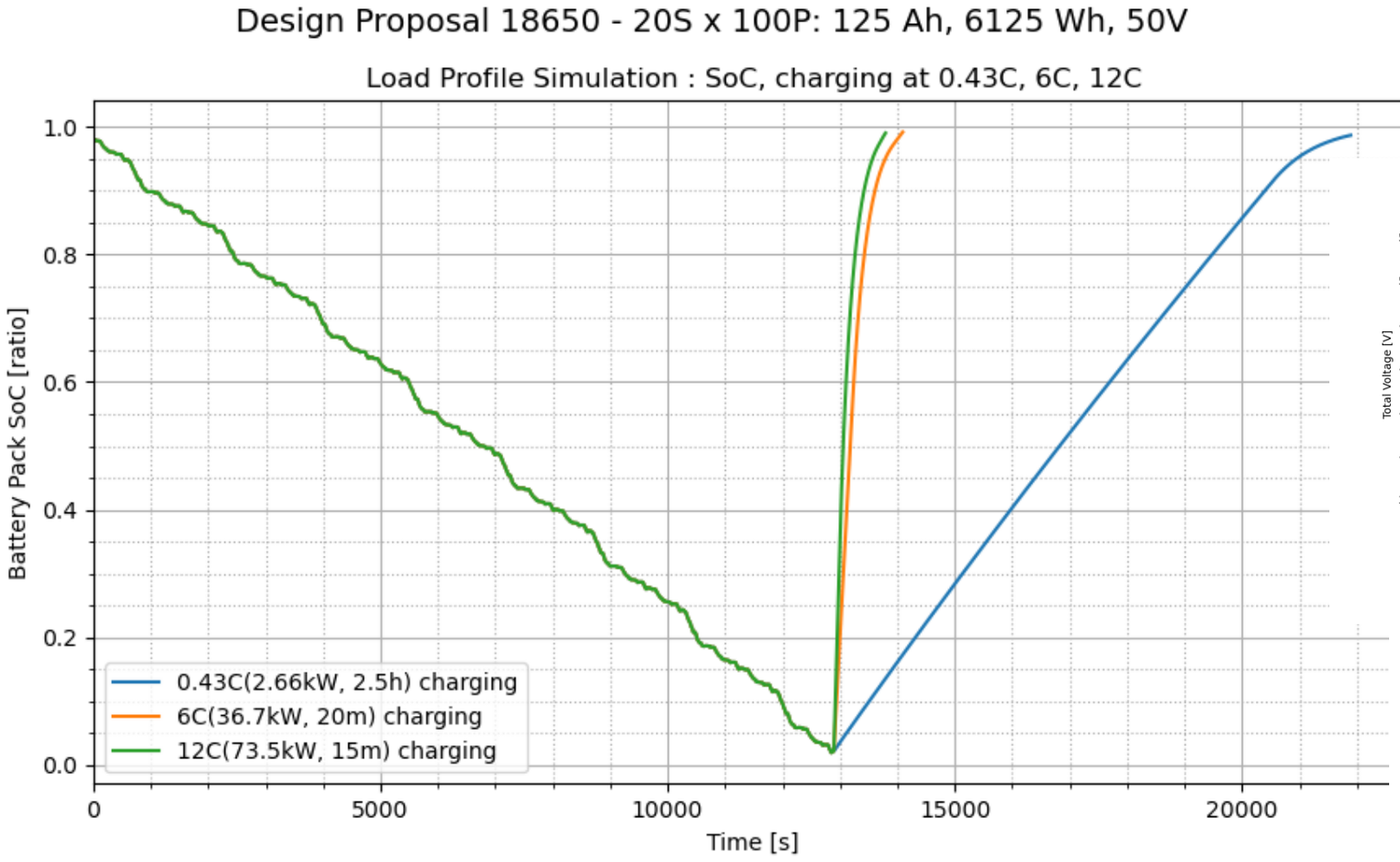
Elisa Ferreira,
Commissioner for Cohesion and Reforms

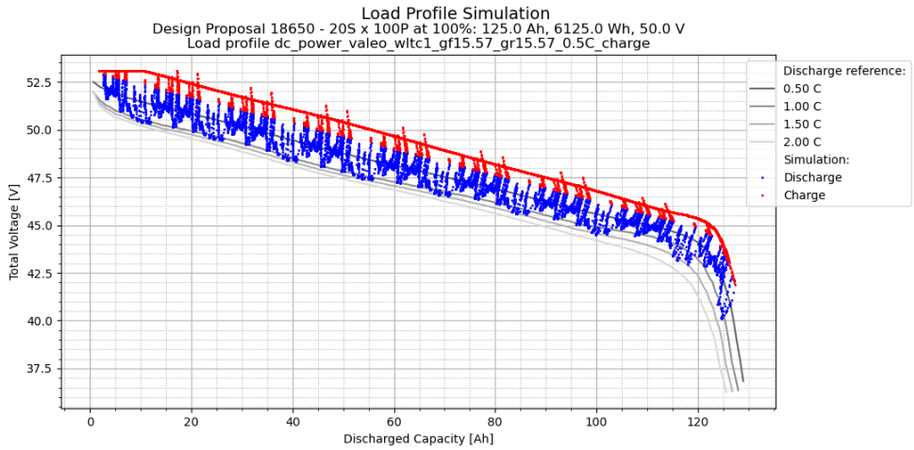
Mariya Gabriel,
Commissioner for Innovation, Research, Culture, Education and Youth

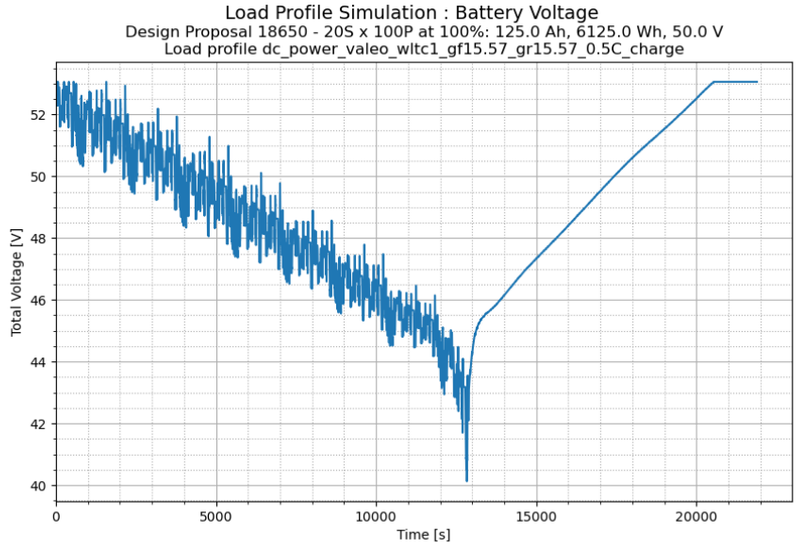
Brussels, 29/06/2020

Fast charging @ 6C after 8 WLTC1 cycles

18650: fast charging

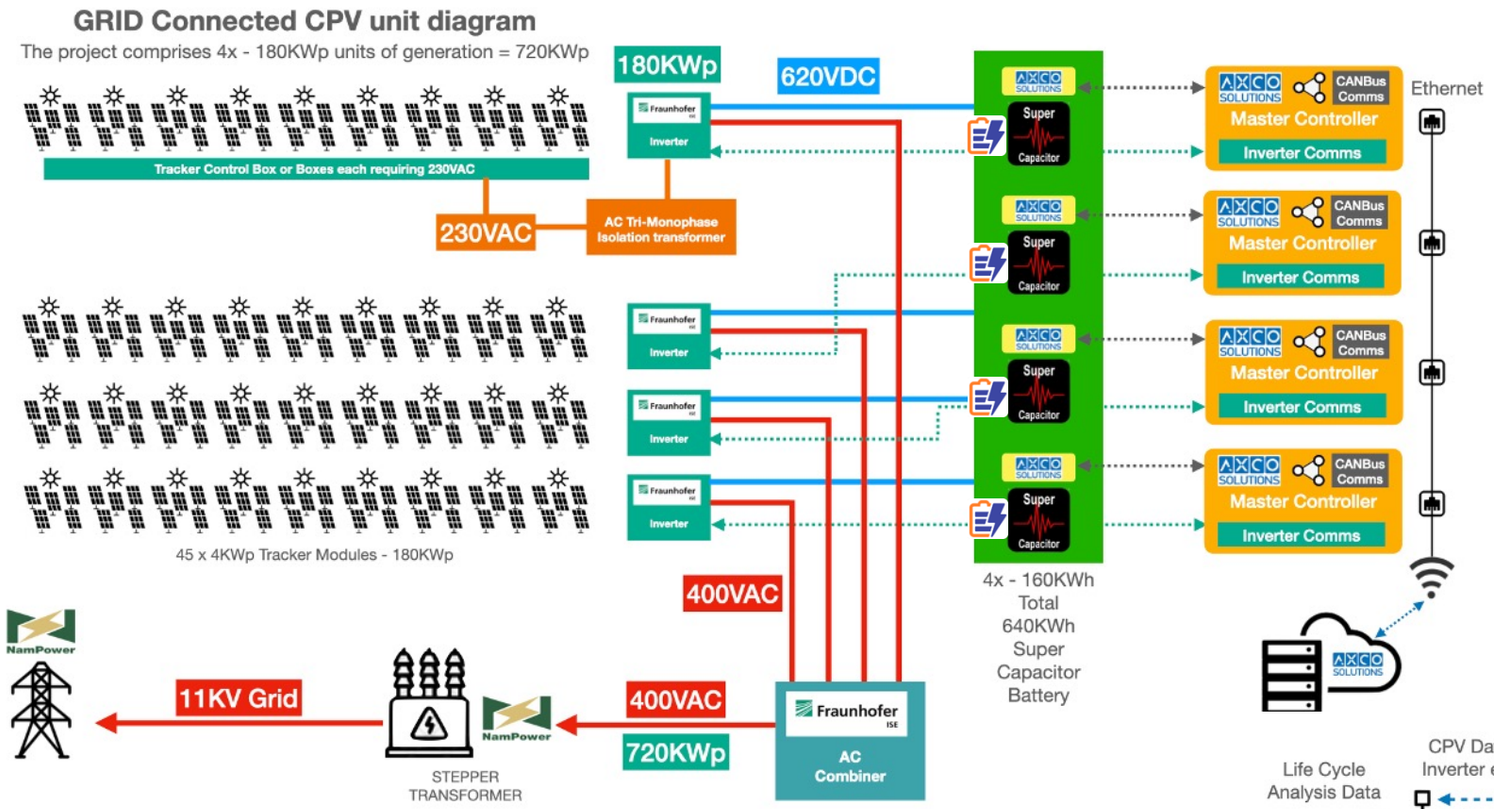


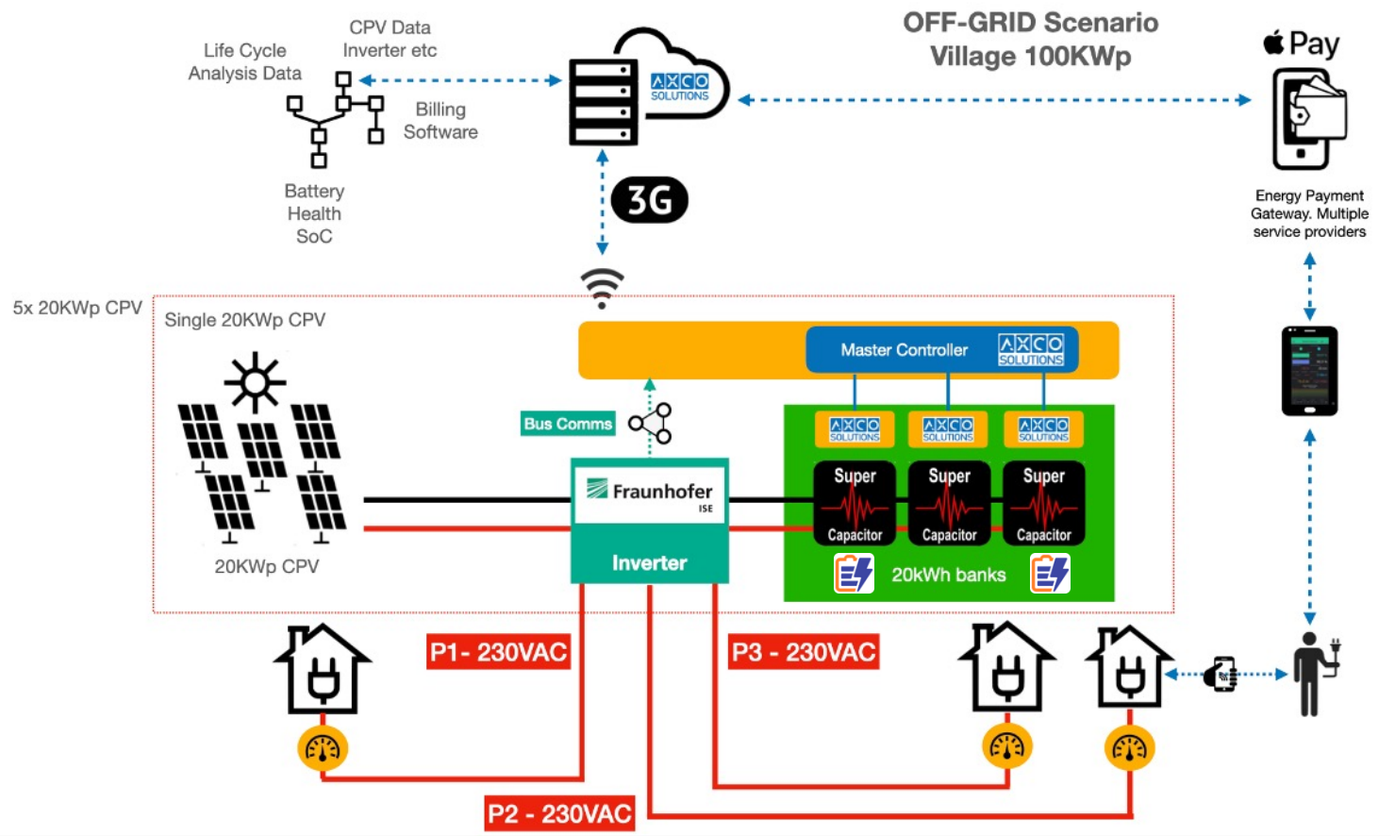




- **0 – 75%: 5 min @ 12C, 8 min @ 6C**
- **0 – 100 % SoC: 2.5 hrs @0.5C, 20 min @ 6C, 15 min @ 12C**

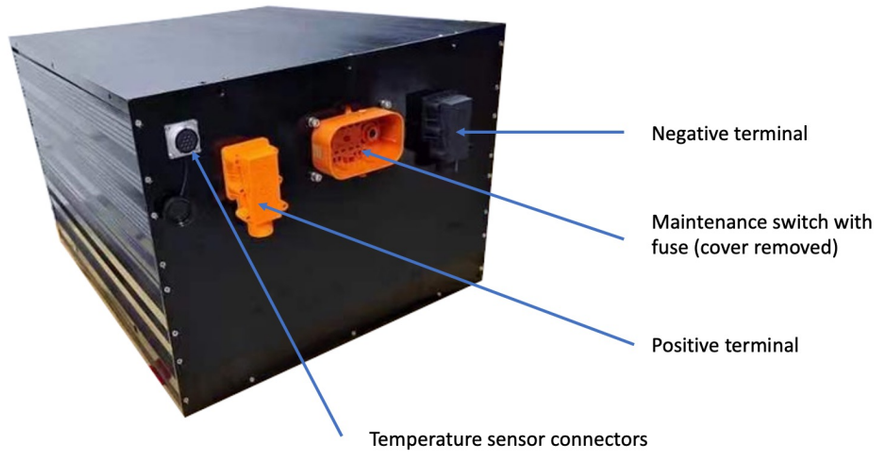
H2020 Green Deal project with Fraunhofer





Solar energy farms and micro-grid for in demanding temperatures and circumstances of Africa

Excellent choice for hybrid energy systems



Use case:

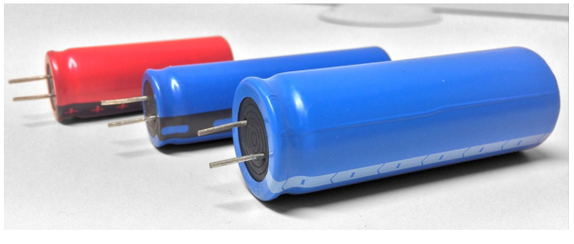
- 250 KWh hydrogen fuel cells
- 30 kWh / 800V powercapacitor battery
- Delivers 250 kW at cold start
- Absorbs 300 kW upon load disconnect

Use with hydrogen fuel cells:

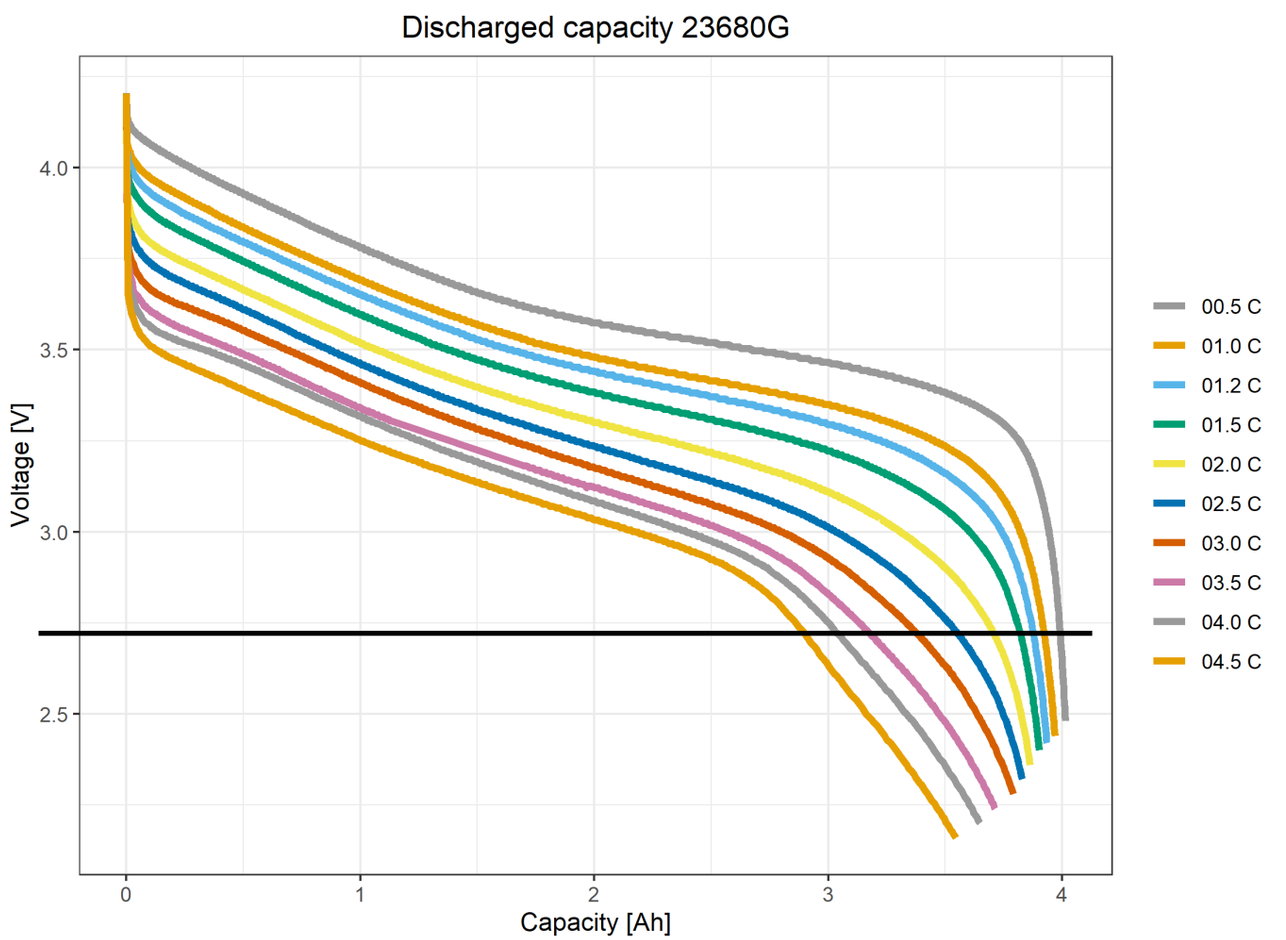
- Safety: no spontaneous fire risk
- Handles high power demands (e.g. cold start)
- Absorbs excess energy
- Robust: no BMS, no active cooling, 20000 cycles, zero maintenance
- Similar with ICE generators, liquid air, … also for traction

New 23680 cells

- 4V / 4 Ah 23680 cell, 1.5C / peak 4C / 200 Wh/kg / hybrid AC+NMC
- Tests done:
  - Capacity measurement @ room temperature (1C) with air circulation
  - Charging/discharging at higher C-rates
  - ESR: 13-15 mOhm
  - Temperature increase: 6.5 °C at 1.25C, 22 °C at 4C
  - Abuse test: discharging > maximum current on datasheet
  - Also in small pouch cell format



Test in ventilated room air
At 22 – 25°C air temp,
36.6 °C on skin at end of 4C test



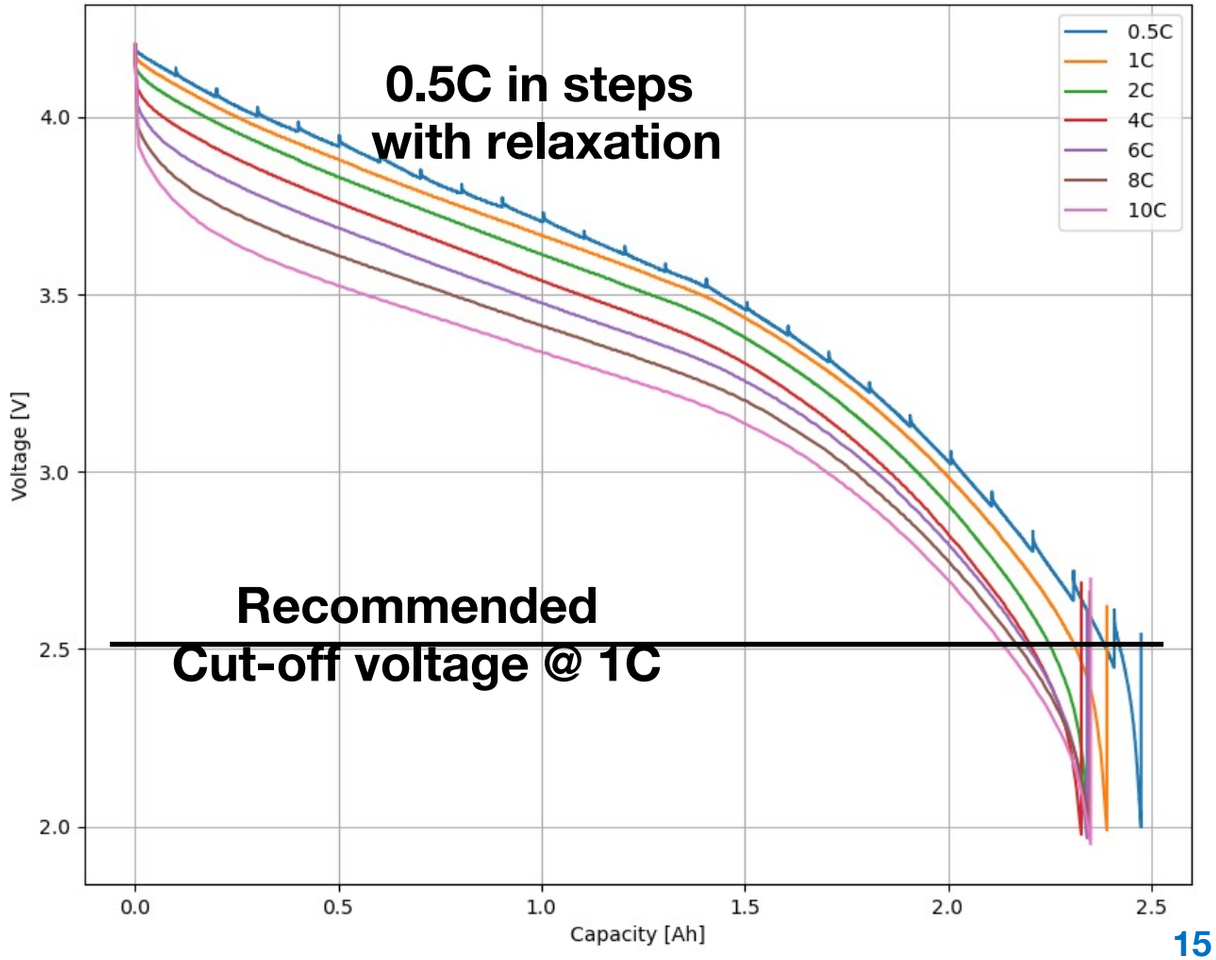
New 21700 cells

4V / 2.5 Ah 21700 cell, 10C / peak 14C / 140 Wh/kg - hybrid AC+NMC

Tests done:

- Capacity measurement @ room temperature (1C)
- Charging/discharging at higher C-rates
- ESR: 8 – 10 mOhm
- Temperature increase: 6.5 °C at 1.25C, 22 °C at 4C
- Abuse test: discharging > maximum curent on datasheet
- Hard short-circuit test: pass (CID triggered)
- Overcharging test: pass (CID triggered)

Test in ventilated room air
At 22 – 25°C air temp.
41.1°C on skin at end of 10C test

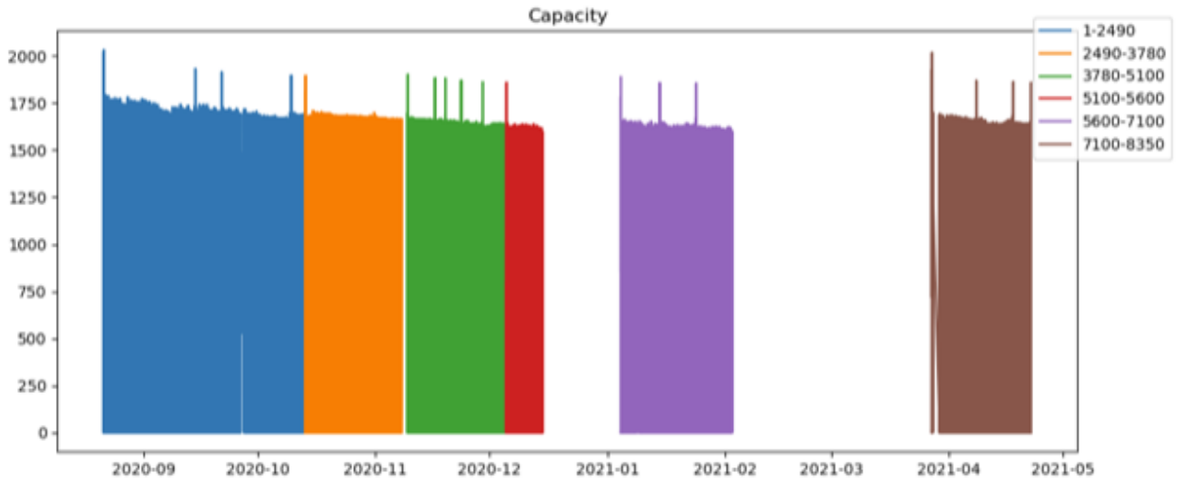


New 21700 cells cycle life testing

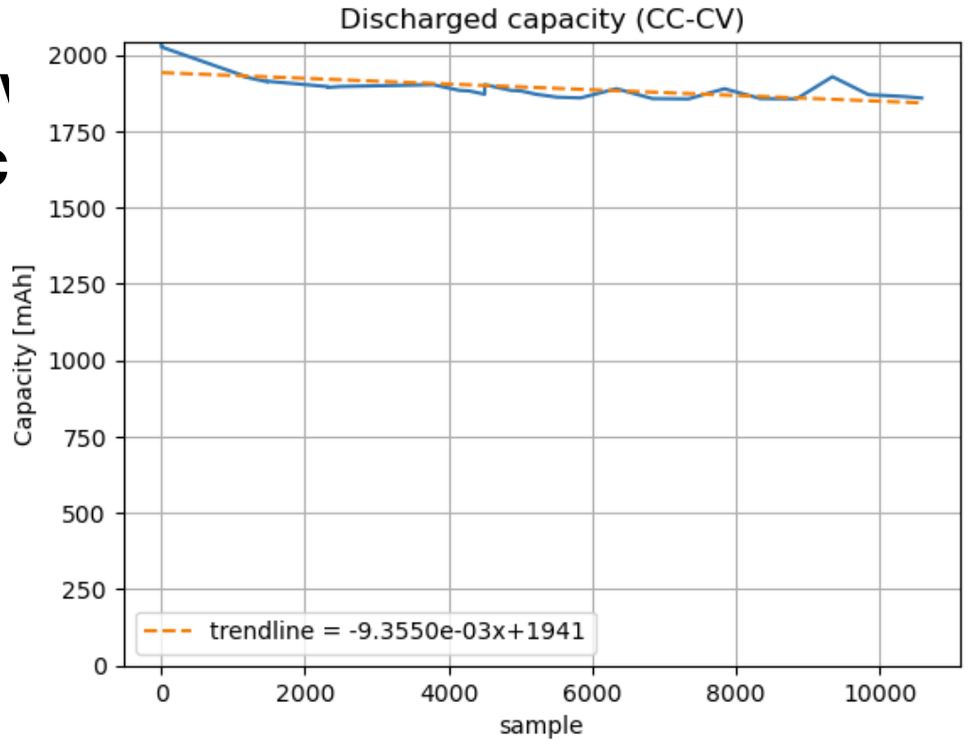
Tests > 1 year

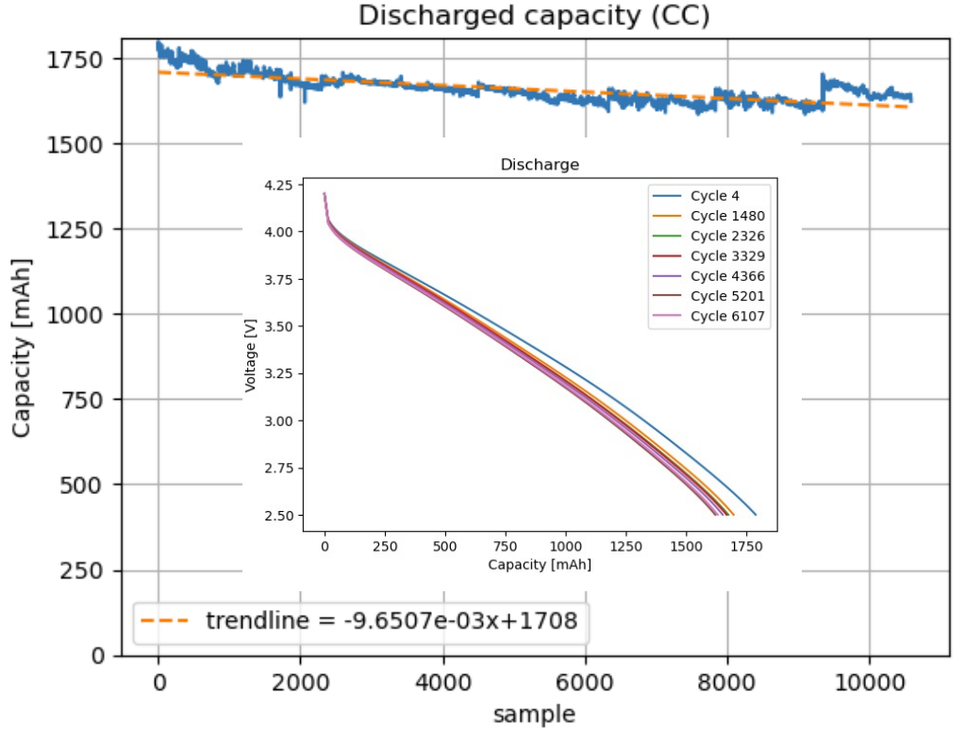
Shows some recovery due to rest time

Estimated cycle life: 20000 cycles

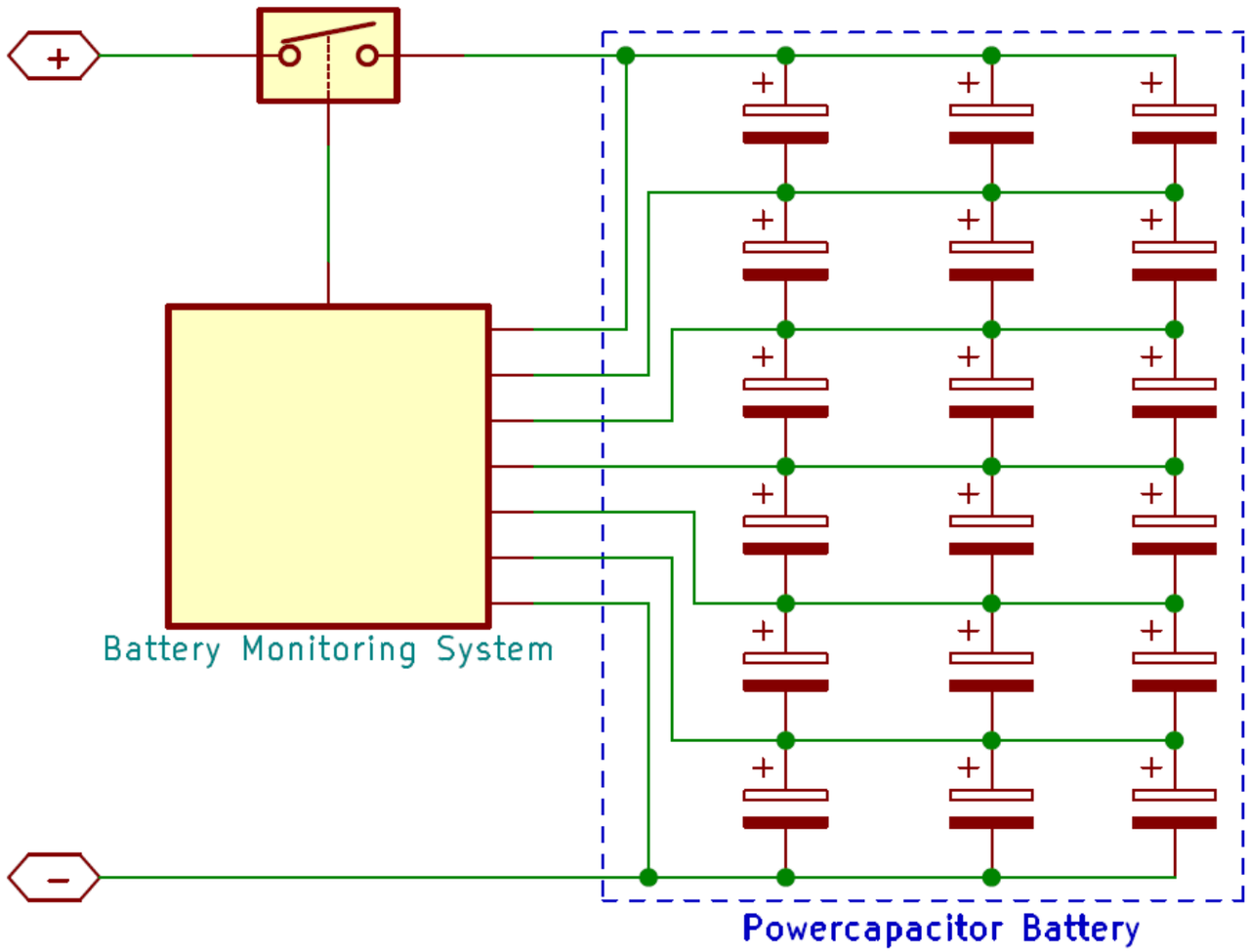


- **4** **) Wh**
- **C**





Battery construction



- Parallel first, then serial at module level
- BMS (active balancing) optional
- Battery Monitoring sufficient
- Paralel modules only at battery level to increase capacity
- Heat aborbing silicon gel inside
- Or forced airflow for high C-rates

For illustration only

From small UPS to MWh hybrid, BEVs and energy storage worldwide: medical, satellites, vehicles, trains, ferries, solar energy farms

Kurt.energy develops customer-specific power capacitor batteries
Our customers get trust and a sustainable investment

Process flow for customer specific solutions

1. **Requirements collection:**
   - Understanding the application and the system
   - Understanding the boundary conditions
2. **Feasibility study:**
   - Selecting powercapacitor cell types
   - Initial battery configuration: (S xP), multi-module, …
3. **Load profile simulations**
   - Beginning of Life – End of Life
   - Calendar lifetime calculations
4. **CAD design**
   - Enclosure, safety devices, etc.
5. **Assembly and test**

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