
ESS ENERGY STORAGE
SPECIALISTS
Experts in the field of sustainable energy storage solutions

ENERGY STORAGE

Content

- Our sectors
- System engineering/ optimisation
- Modelling capabilities
- Electrical engineering
- Testing solutions
- Manufacturing – Process development and review
- Manufacturing – Battery pack production cost
- Cell & module teardown
- Cell & module sourcing
- Lithium-ion battery training
- Lithium-ion battery testing training
- Big data analysis for failure prevention or feature development

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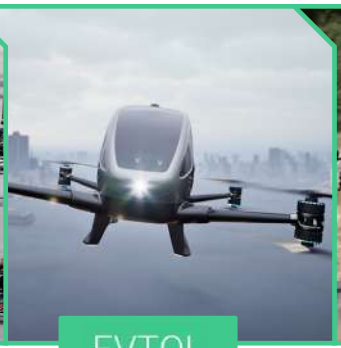
Our Sectors


AUTOMOTIVE


UPS


MOTORSPORT


EVTOL


MOTORCYCLE


LIGHT URBAN


OFF-HIGHWAY


RAIL


MARINE


CLEAN ENERGY


INDUSTRIAL


OFF SHORE

STRATEGY → DEVELOPMENT → PRODUCTION

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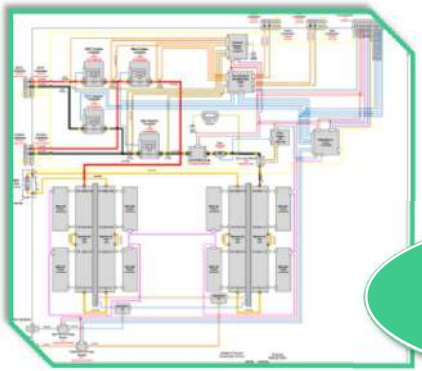
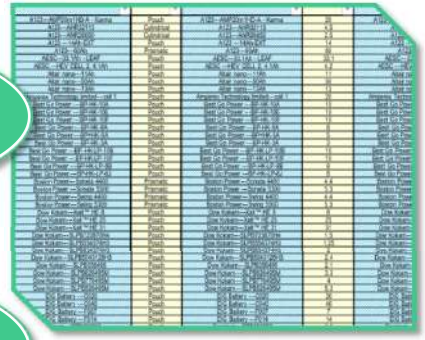
System Engineering / Optimisation



Requirement development/ analysis

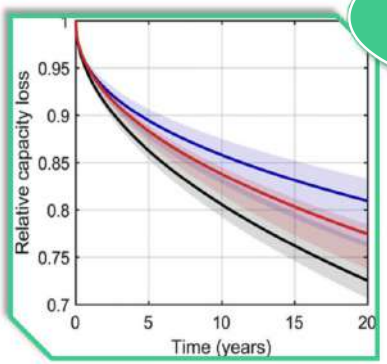
Architecture

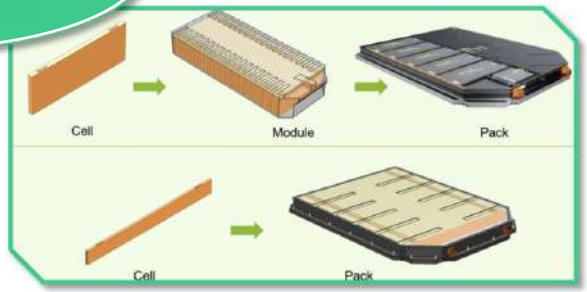
Cell selection



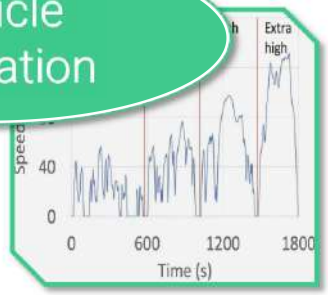
Initial lifetime estimation

Battery pack concept



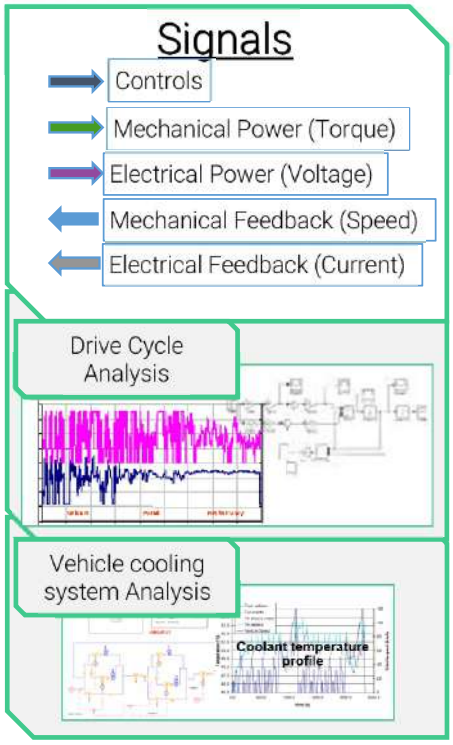


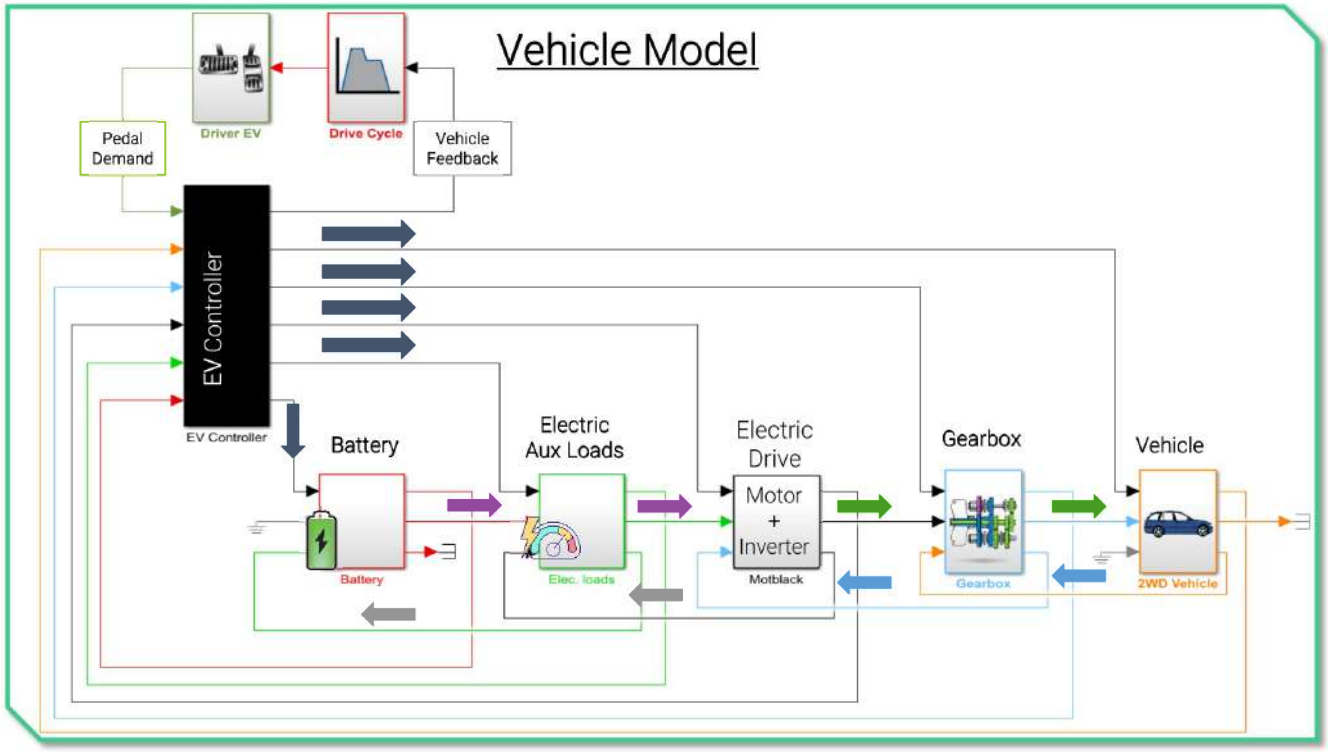
Vehicle simulation



Modelling Capabilities – Vehicle Modelling

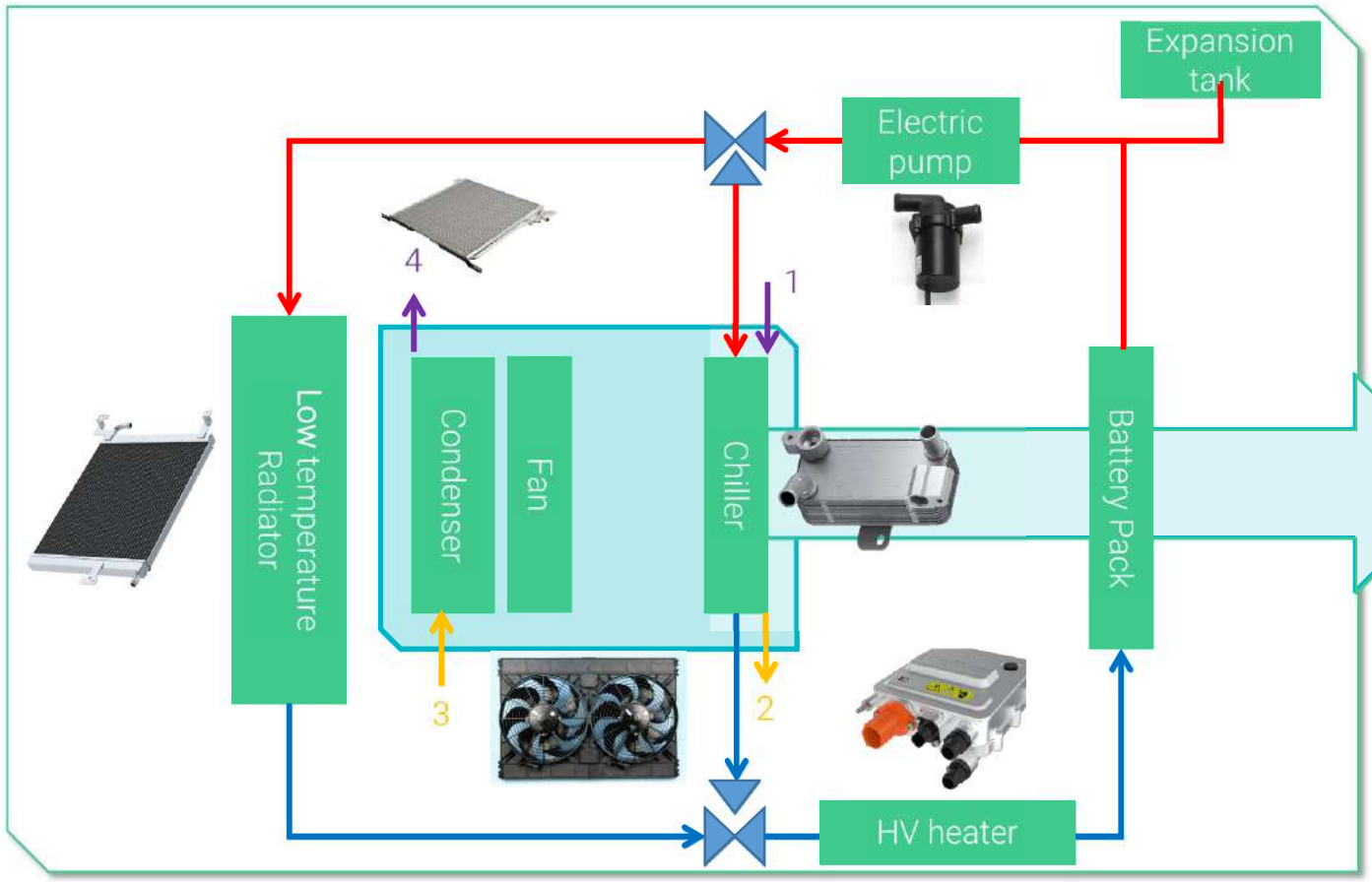
- The vehicle simulation model is a MATLAB SIMULINK based, forward facing model, currently setup in a modular-type schematic layout
- Model is variable time-step based, with system efficiencies and performance characteristics being map-based lookups
- The model architecture represents an all electric powertrain with a DCT transmission attached to a basic vehicle dynamics block





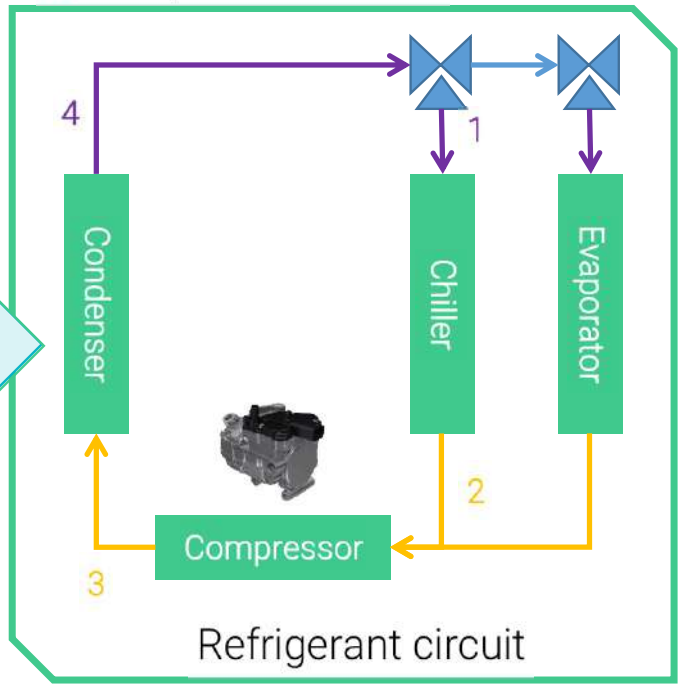
Modelling Capabilities – Vehicle Thermal Management System

- Vehicle thermal management component sizing for both the hydraulic and refrigerant cooling circuit using Matlab/ Simulink

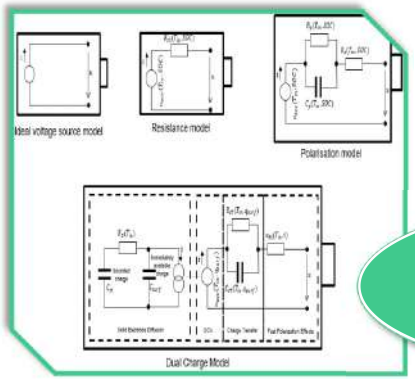


Capabilitiy areas

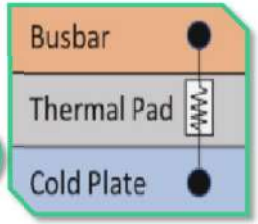
- Concept study
- Design of cooling circuit
- Component selection



Modelling Capabilities – Battery Digital Twin

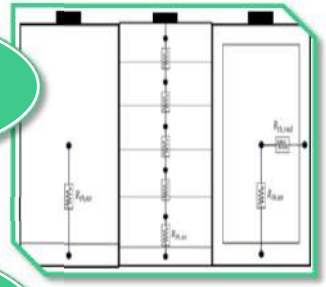


Bus bar model

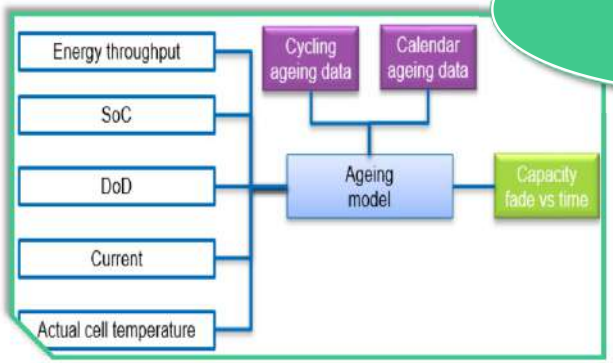


Electrical model

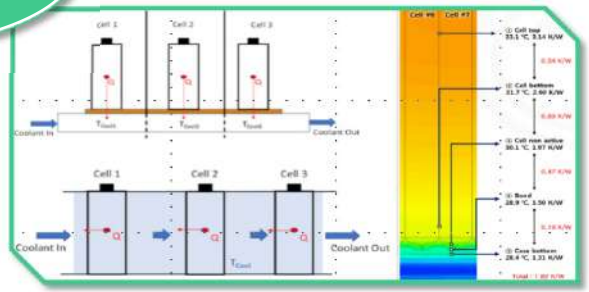
Thermal model



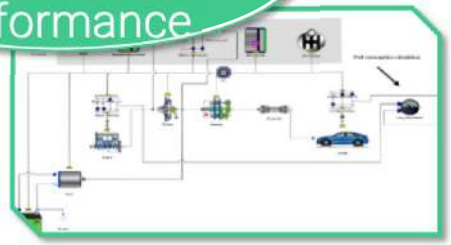
Lifetime analysis



Cooling system model



Vehicle modelling & performance



Modelling Capabilities – Thermal Management System

Air (forced)

- Separate cooling loop not required
- Simple design
- Low cost
- Low maintenance

- Low heat transfer capacity
- More temperature variation within the pack
- May need blower to help heat transfer (noise)

Cold plate (EG/water mix)

- More uniform pack temperature
- Good heat transfer capacity
- Better thermal control
- Lower volume, compact design

- Potential liquid leakage
- Higher cost
- Requires cooling loop to cool the liquid in high ambients

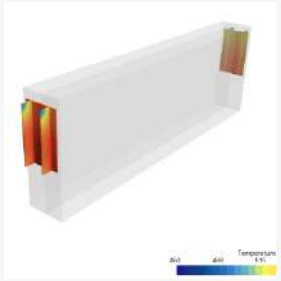
Immersion - single phase

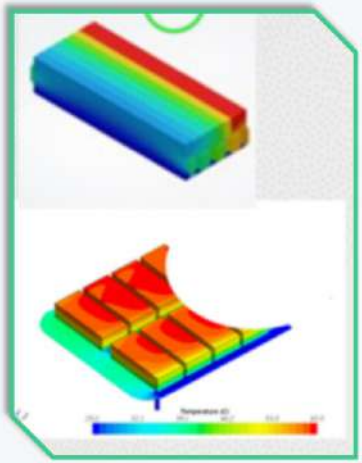
- Highest heat tranfer capacity
- Does not require thermal paste, pads or interface material
- Forced convection
- Mitigate against thermal runaway

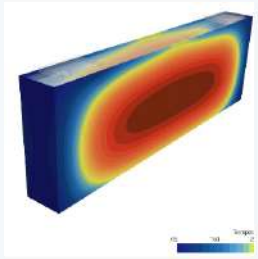
- High mass and volume of fluid
- Cost of dielectric fluid
- Requires cooling loop to cool the liquid in high ambients

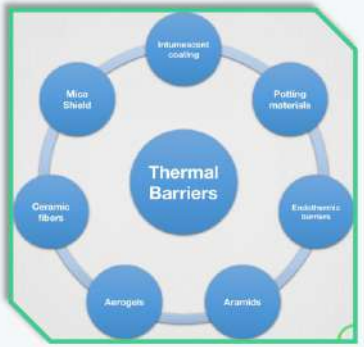
Modelling Capabilities – Venting & Thermal Runaway

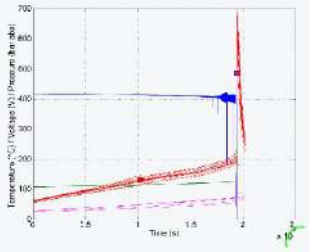
- CAD
- BoM
- Electro-thermal model
- Load case(s)
- Boundaries
- Cell venting and gas analysis

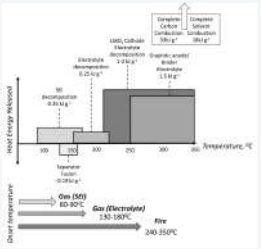












Together with our partners we have capabilities to perform cell level TR and gas analysis for any cell format and capacity

Modelling Capabilities - Battery FEA

Battery module FE analysis

Detail module model to assess:

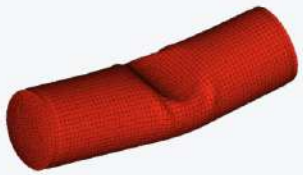
- Modal analysis
- Assembly cooling plate contact pressure
- Module vibration
- Hazard level of safety critical components under abuse tests
- Crush

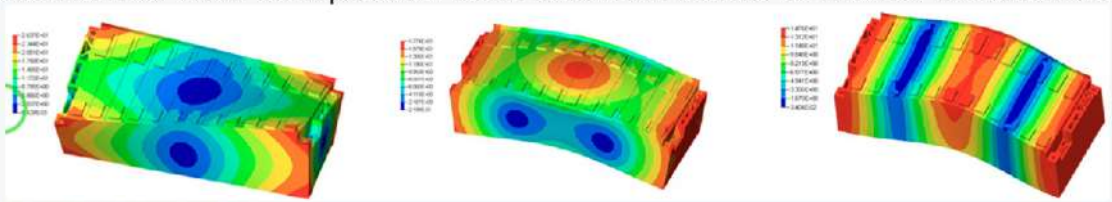
Battery pack FE analysis

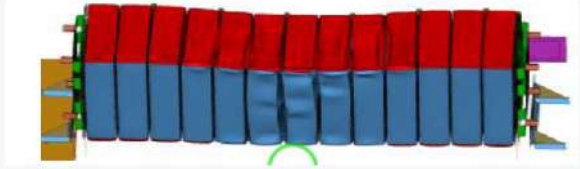
Battery pack analysis and optimisations according legislation tests and/or customer requirements:

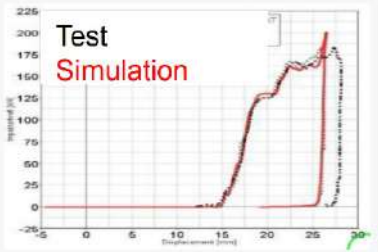
- Battery crush / vibration
- Battery drop
- Battery vibration
- Intrusion
- Bolt calculations
- Battery seal integrity

Coarse mesh model can be combined with complex tuned material models to model mechanical behaviour









Modelling Capabilities - Why use ESS Ltd?

01

Generic or Specific

Models can be provided depending on where you are in the product development

02

Model optimisation

We can support you from R&D to production

03

Knowledge sharing

We share our knowledge with your team during the development of the models

04

Open application code

Your team can reverse engineer our models for future programmes

05

User manual

All models come with user manual so anyone in your team can learn new skills

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Electrical Engineering - Component Design and Selection

ELECTRICAL CONFIGURATION
Series / Parallel

POWER REQUIREMENTS
Charge / Discharge

BUS BAR
Thermal modelling, material selection, size and weight

HIGH VOLTAGE CONNECTORS

SAFETY STRATEGY
Contactor Fuse / Pyrofuse

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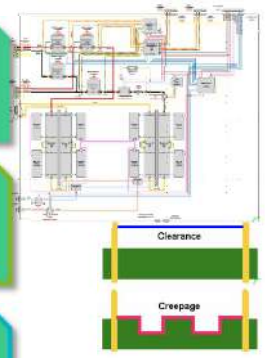
SAFETY STRATEGY
Contactor Fuse / Pyrofuse



Electrical component selection

Testing Solutions - Development and commissioning of Li-ion cell/module/pack test lab

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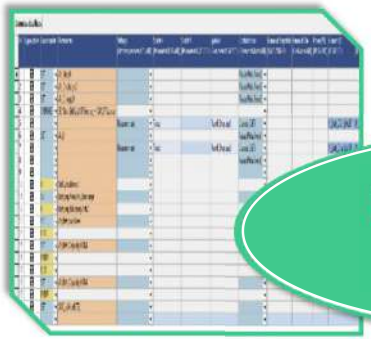

Feasibility study

Specification of test equipment

	Specification	Unit
teristics:		
ge input	4.75-5.5	VDC
wer consumption	300	mW
Target gases	Lithium-ion battery electrolyte	n/a
Off-gas indication	Digital output	Sinking Transistor
Response time	< 2	seconds
Monitoring capacity	3	racks
Environmental Conditions:		
Ambient temperature	5 - 80	°C
Relative humidity	5 - 95	%R.H.

RFI/RFQ/RFP of test equipment

Management of equipment installation & integration

Commissioning of equipment

Development of test scripts

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Testing Solutions - What We Are Able To Offer

Test Plans and Procedures

- Cell to pack planning
- Critical path optimisation
- Robust acceptance criteria
- Technical specification

Physical Testing & Management

- Functional testing
- Environmental testing
- Abuse testing
- Thermal testing
- Project management and reporting
- Data processing (Uniplot and Concerto)

Accreditation for transport & storage

- UN 38.3
- UN ECE R100-03
- Europe, USA, China and Korea specific legislative testing & accreditation

Planning

Requirements

Timing Optimisation

Transport

Acceptance (Pre-inspection)

Test Preparation

Cell – Pack Testing
Functional
Environmental
Abuse
Lifecycle
Legislative

Appraisal / Inspection

Reporting & Test Data

Data processing

Storage

Disposal

Return to Client

Planning

Testing

Certification & Reporting

Testing Solutions - Dynamic Test Planning and Execution

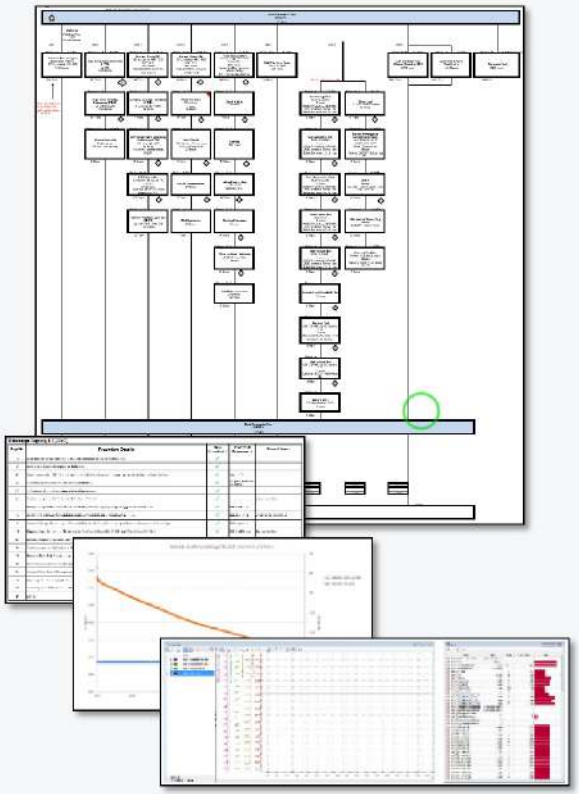
Test Requirements

Test list

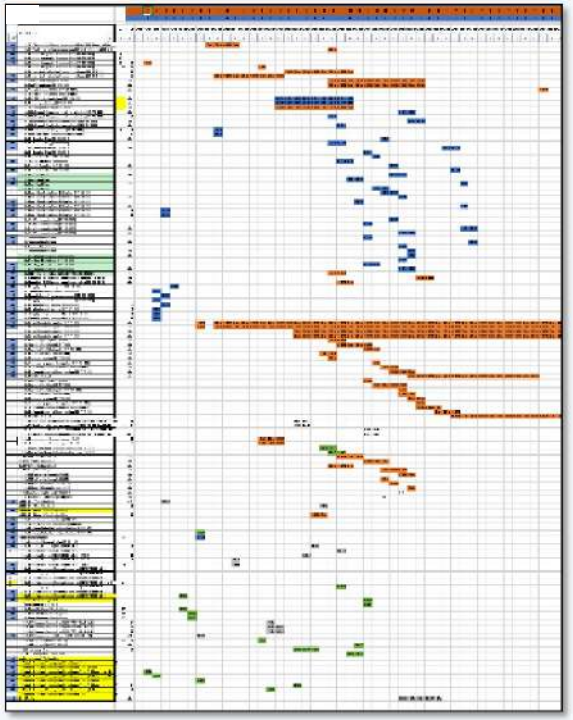
Detailed test procedures written based on Client specifications

Test plan developed based on pack availability and priority

- Test spec
- Pack
- BMS software
- Timing
- Sequence



Test schedule



Test Results

A robust process to perform tests accurately and efficiently

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Testing Solutions - Example of Facilities We Have Access To

01
Cell testing

- 0 - 8 V per channel
- Up to 1000 A

02
Module testing

- 0 - 100 V per channel
- Up to 1200 A

03
Pack Testing

- 0 - 1200 V
- Up to 750 kW

04
Thermal environment

- Thermal chambers
- Walk-in chambers
- -40°C - 90°C & 20 % - 90 % RH

05
Abuse testing

- Short circuit
- Overcharge
- Over discharge
- Thermal runaway

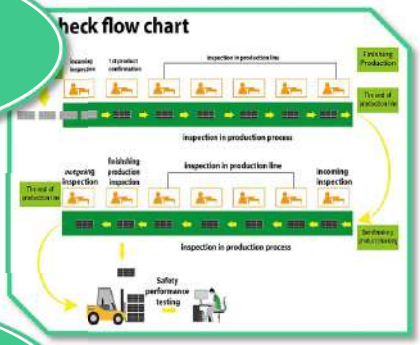
06
Homologation testing

- ECE R100
- UN 38.3

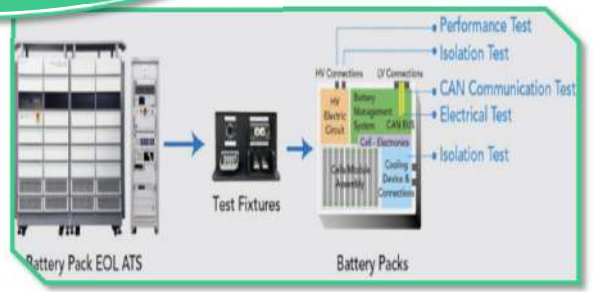
Manufacturing - Process Development and Review

Process development / Review

In-line quality control process development



End-of-line testing development

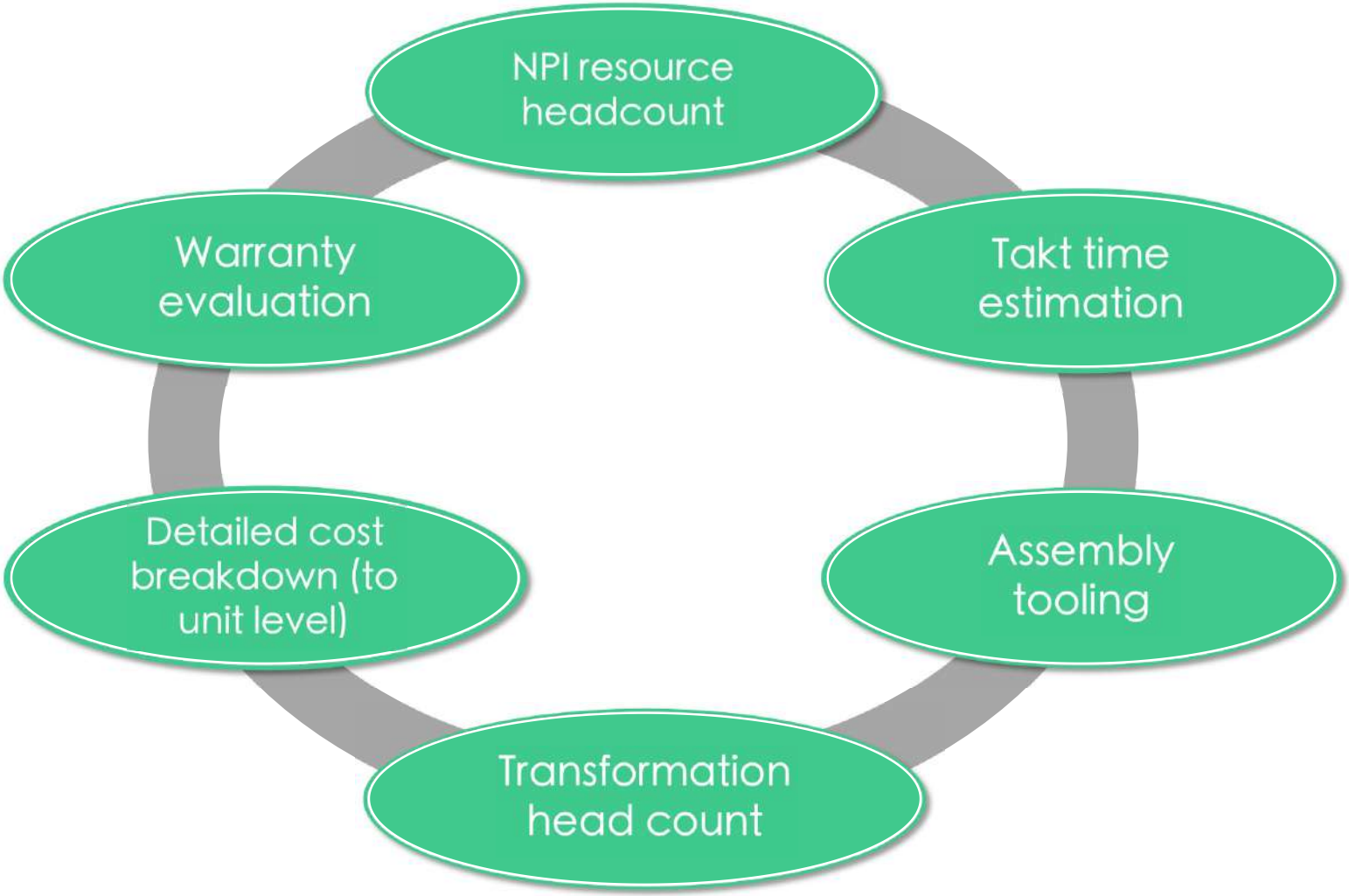


Quarantine, disposal process development

Storage, shipping and quarantine process development

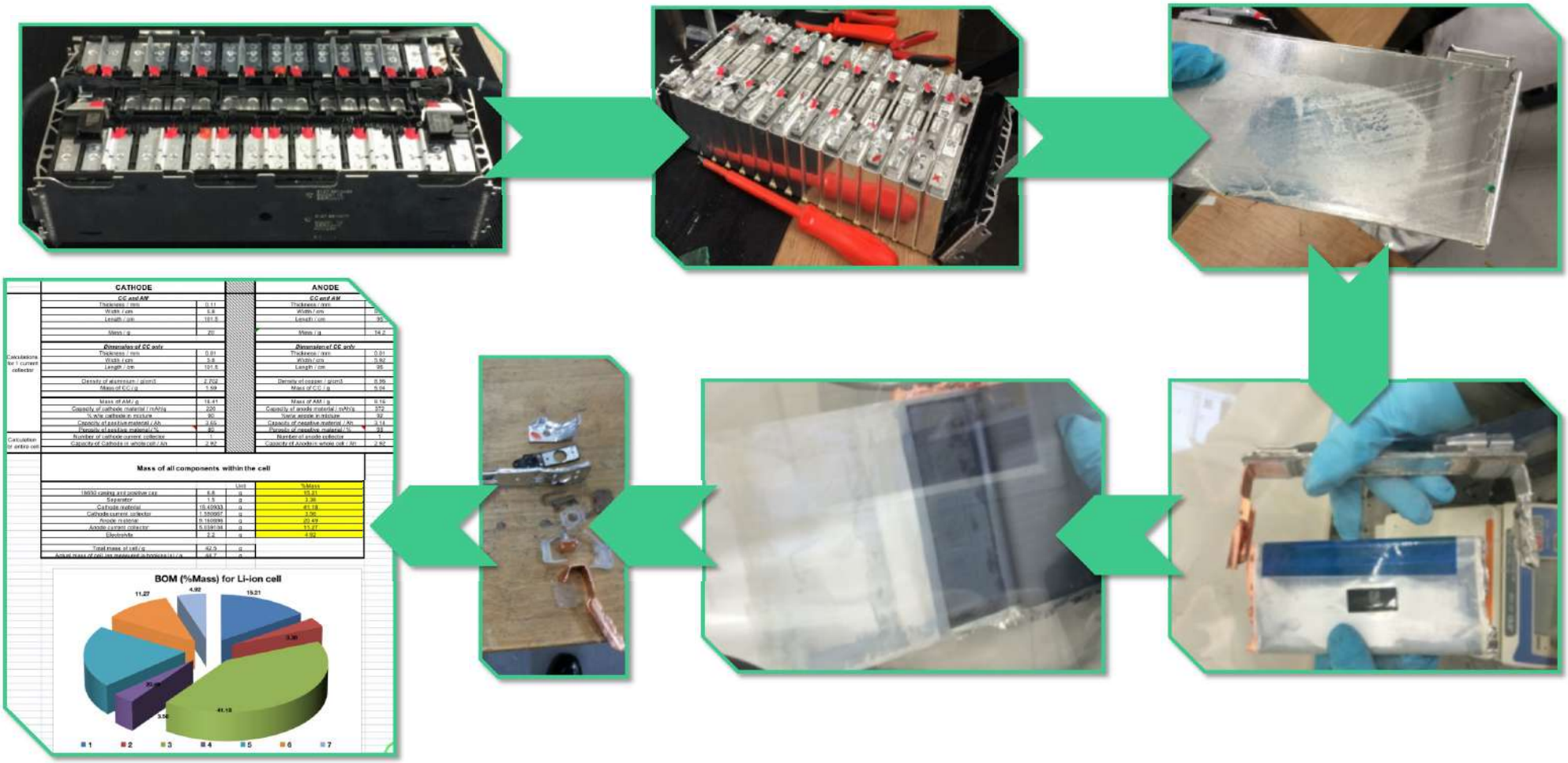
Goods inwards process development

Manufacturing - Battery Pack Cost Modelling



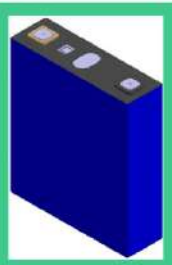
Cell & Module Teardown

- We are capable of performing cell and module teardown to gain engineering insights or to support troubleshooting activities



Cell & Module Sourcing

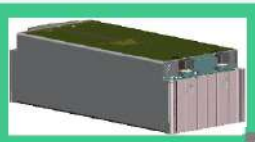
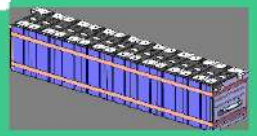
Cell


Cells with high energy density:

- Greater than 280 Wh/kg for pouch cell
- Greeater than 270 Wh/kg for prismatic cells
- 46XX cells

Module

Module with high energy density:

- Module with chinese certification
- VDA size and modular module dimensions and specification
- LFP and NMC chemistry

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Lithium-ion Battery Training

01

Li-ion battery fundamentals

02

High voltage safety awareness

03

Battery roadmap

04

Thermal environment

05

Battery testing

06

Battery teardown

We are able to develop specific training materials tailored to your needs

ENERGY STORAGE

Big Data Analysis for Failure Prevention or Feature Development

01

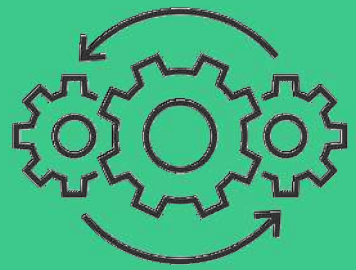
- Data capture
- Data cleaning

02

- Data driven mode
- Rare event detection
- Failure prevention

03

- Processes Optimisation
- What-If analysis



We encode/translate expert knowledge in a way that the machine can use to ensure robust results are provided.

We can also use explainable AI to explore any model and any individual prediction to understand why it made this prediction.