Workshop sustainable electrode / cell production | September 19th 2024

greenSPEED

Project Presentation

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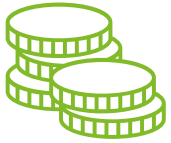
greenSPEED in a Nutshell

Project Duration

1. July 2022 – 31. December 2025
42 Months

Consortium

11 Partners
5 Countries



Project Budget

5,3 Mio. EUR

Funded Under Horizon Europe

HORIZON-CL5-2021-D2-01-04

The Challenges

LITHIUM-ION CELL TECHNOLOGY NOT SUPPLIED BY EUROPEAN INDUSTRY

HIGH ENERGY CONSUMPTION OF SINGLE PRODUCTION STEPS

LOW ENERGY DENSITY

HIGHER DEMAND FOR BATTERY ELECTRIC VEHICLES (BEVs)

USE OF ENVIRONMENTALLY HARMFUL SUBSTANCES

HIGH COSTS OF LITHIUM-ION CELLS

Our Mission & Vision

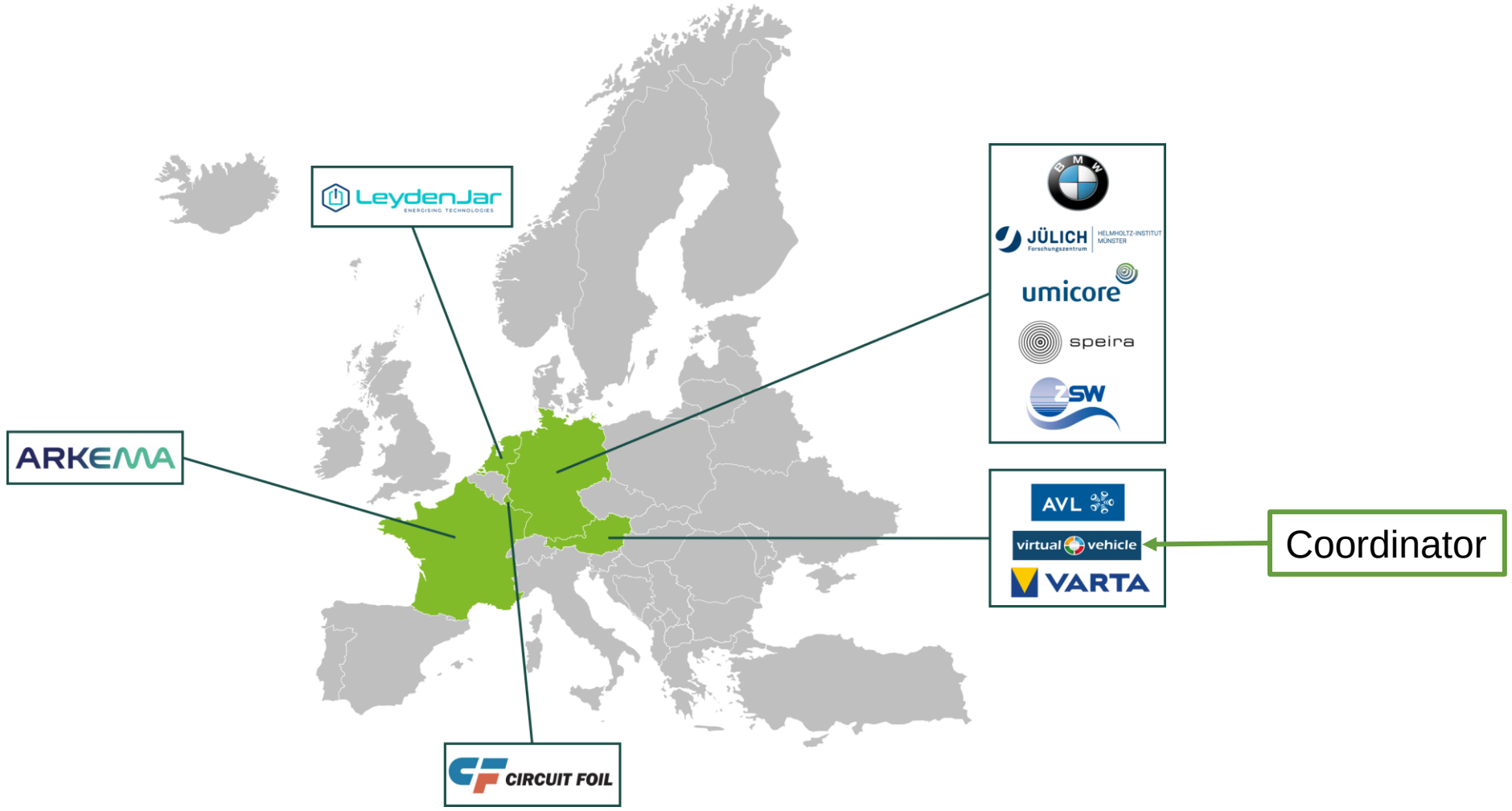
Mission

Developing a battery cell consisting of electrodes manufactured using innovative dry processes **to reduce energy consumption**, **lower the carbon footprint** and achieve **ZERO emissions of VOCs** (Volatile Organic Compounds).

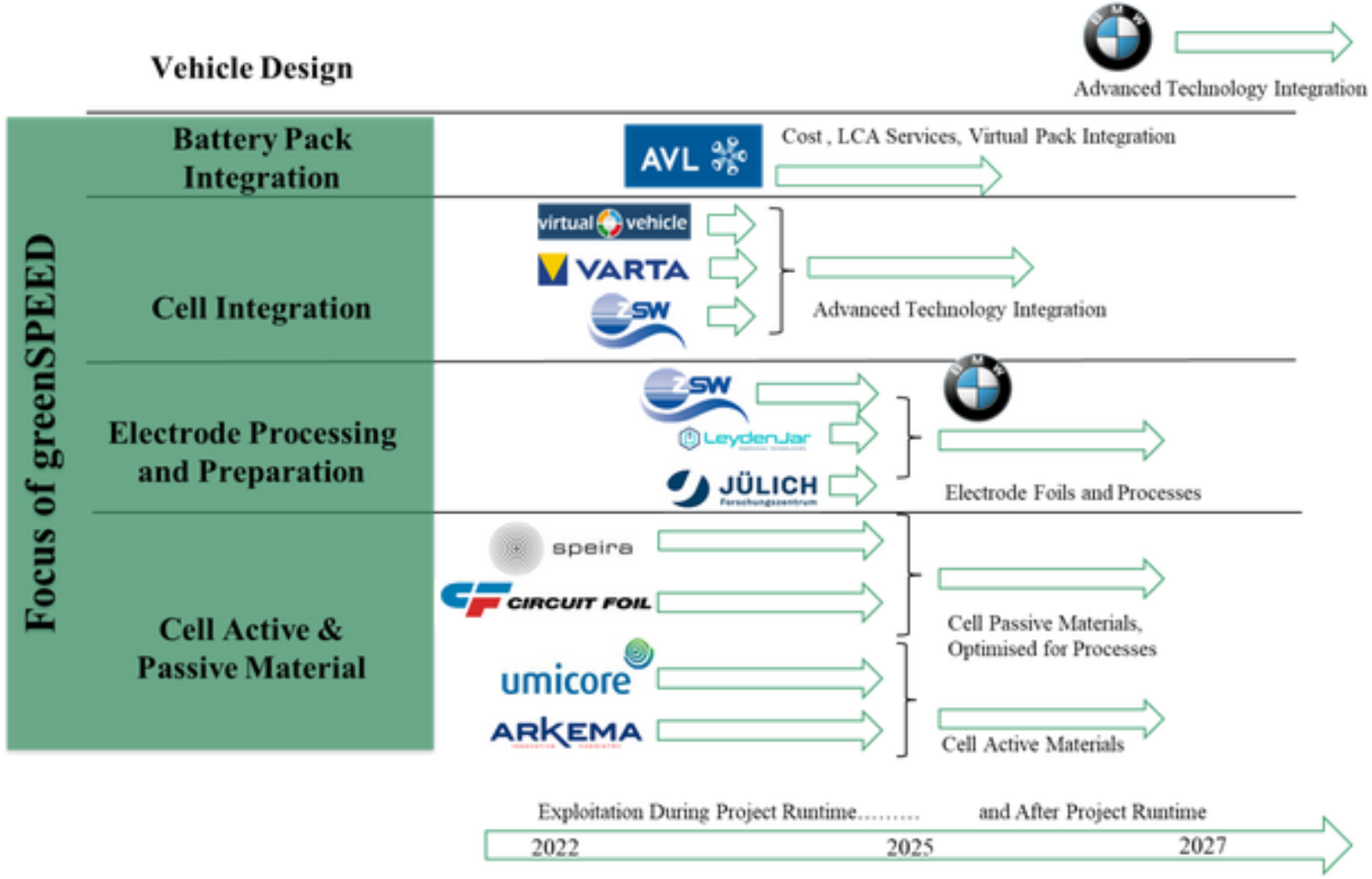
Vision

Achieving European **leadership in battery production** with **lower carbon footprint**.

The Consortium



The Value Chain: From Material to Battery Pack



The greenSPEED Approach

Major drawbacks of current battery cell production techniques:

- High energy consumption of the individual production steps.
- Use of production processes that require organic casting solvents.

Compared to state-of-the-art Li-ion cells, the greenSPEED technology will

- reduce **energy consumption** of the production process **(-32%**).
- avoid **organic casting solvents** (**-100%**).
- increase **energy density** (**+69%**).
- lead to a significant reduction in the **cost of lithium-ion cells** (**-21%**).

The greenSPEED main approach is:

- Developing a battery cell comprised of electrodes manufactured by innovative dry processes.

The Key Targets

01 Anode: high-Si, innovative process, pre-lithiation

02 Cathode: Solvent-free, continuously processed from mixing to calendering

03 Current Collectors: Surface modified, ultra thin, high adhesion

04 Digital Twin & Artificial Intelligence for production upscale

05 Cost, GHG and production processes

06 Demonstrate technology in 21700 cells

The *greenSPEED* cell aims at increasing energy density (+69%) while reducing energy consumption (-32%) and costs (-21%) of production as compared to state-of-the-art Li-ion cells.

The greenSPEED Approach

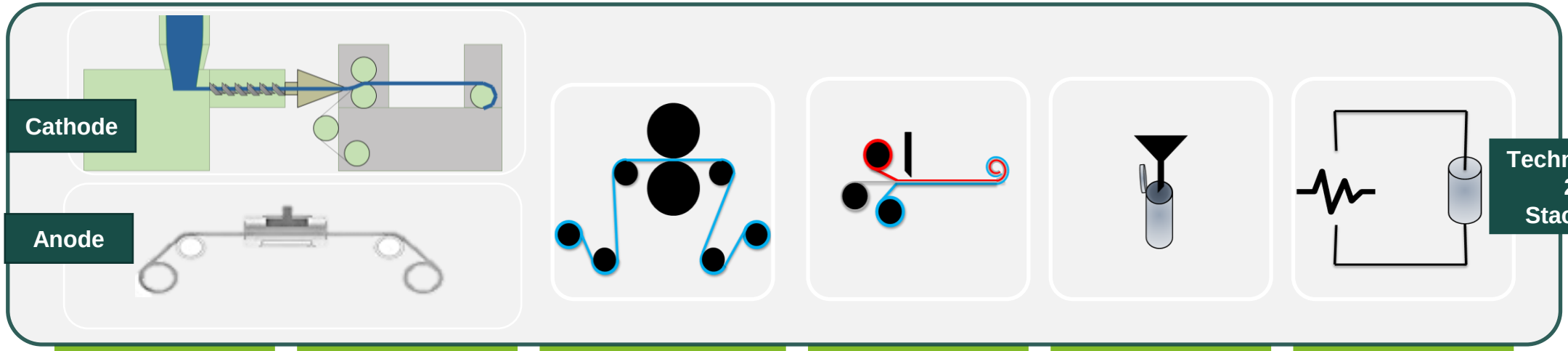
Cathode solvent free process, Ni-rich

AI supported coating process

Optimized current collectors

Simulation supported-calendering and winding

Low CO_2 formation process



Technology Demo 21700 & Stacked pouch

Dosing & Mixing | Coating | Calendering | Winding & Assembly | Electrolyte Filling | Electric Formation

close2market materials

Pre-lithiation

Anode dry process, pure Si, new technology

Electrolyte: Special additives

Three examples of approaches directed towards sustainable electrode / cell production pursued in the greenSPEED project

Approach Key Target 1: Pure Silicon anodes

LeydenJar **reduces the CO_2 footprint of the anode manufacturing process by 85%,** compared to conventional graphite anode manufacturing

No changes required towards cell design

Combines 4 steps into a **single process step**

Modular roll-to-roll tool, scalable up to GWh capacity

1. **Clean and abundant 100% pure silicon instead of polluting graphite**
2. **No need for energy intensive production processes (vacuum drying, calendaring, etc.)**
3. **Enabling a broad range of sustainable industries, like long range electric vehicles, electrified flight**

85%

kg CO_2 / kWh

Reduction in CO_2 through LJT's process (3.4 kg CO_2/kWh)

Source: LCA analysis on LeydenJar Silicon anode production as performed by Minviro

Approach Key Target 2: Solvent-free cathode production

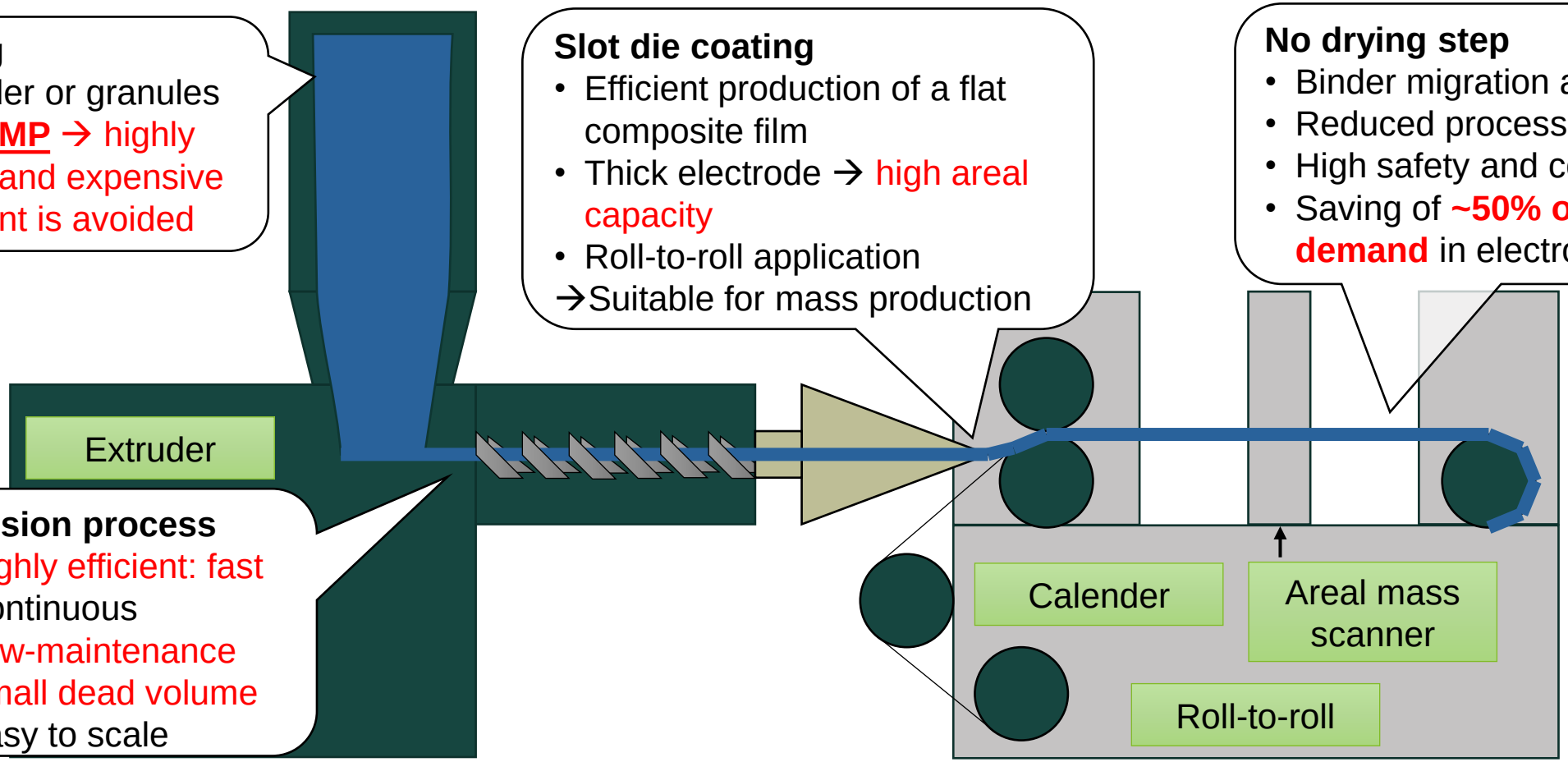
The ZSW solvent-free extrusion process

Dosing
- Powder or granules
- **No NMP** → highly toxic and expensive solvent is avoided

Slot die coating
- Efficient production of a flat composite film
- Thick electrode → high areal capacity
- Roll-to-roll application

→Suitable for mass production

No drying step
- Binder migration avoided
- Reduced process time
- High safety and cost are reduced
- Saving of **~50% of overall energy demand** in electrode production



Extrusion process
- Highly efficient: fast
- Continuous
- Low-maintenance
- Small dead volume
- Easy to scale

Customized passive materials from project partners

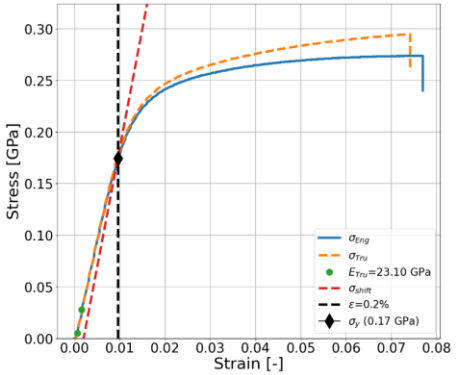
Approach Key Target 4: Digital Twin & Artificial Intelligence for production upscale

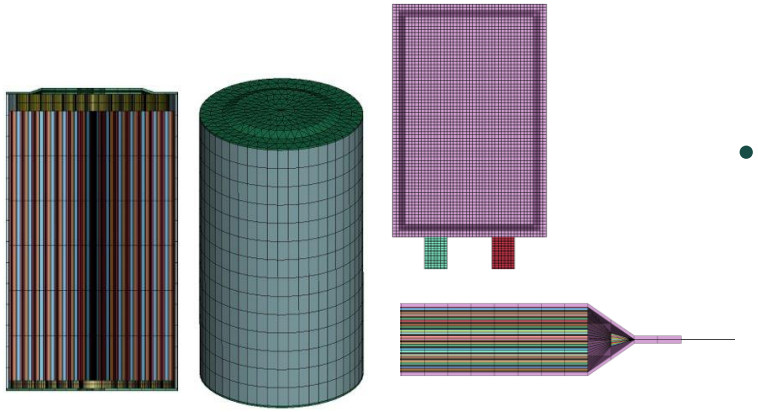
Use of advanced modelling and simulation techniques including digital twins, artificial intelligence, and machine learning to

- predict and optimise cell performance in early development stages.
- support the cell production process by virtually assessing the influence and importance of production parameters
- by this minimise the number of experiments and accelerate electrode production optimisation steps.

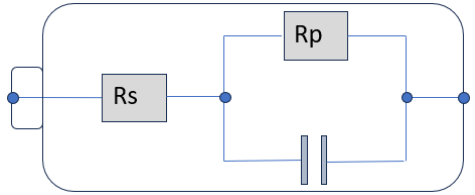
Approach Key Target 4: Digital Twin & Artificial Intelligence for production upscale

- Compression and tensile tests of cell components
- Extraction and optimization of material models in simulation environment
- Various cell formats electrothermal and mechanical simulations

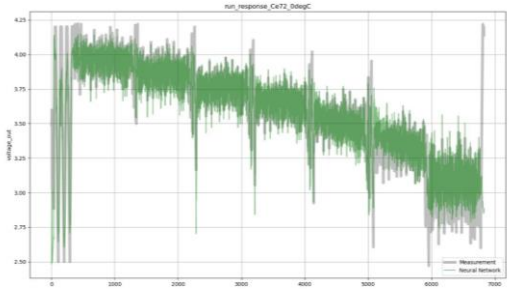




- Electrothermal simulation with simple RC-circuit



- Training machine learning model for hybrid modeling
- Goal: Hybrid model for electrode performance and processing parameter prediction



We would love to hear from you!

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Thank you!

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