


A battery of challenges, a Simcenter solution

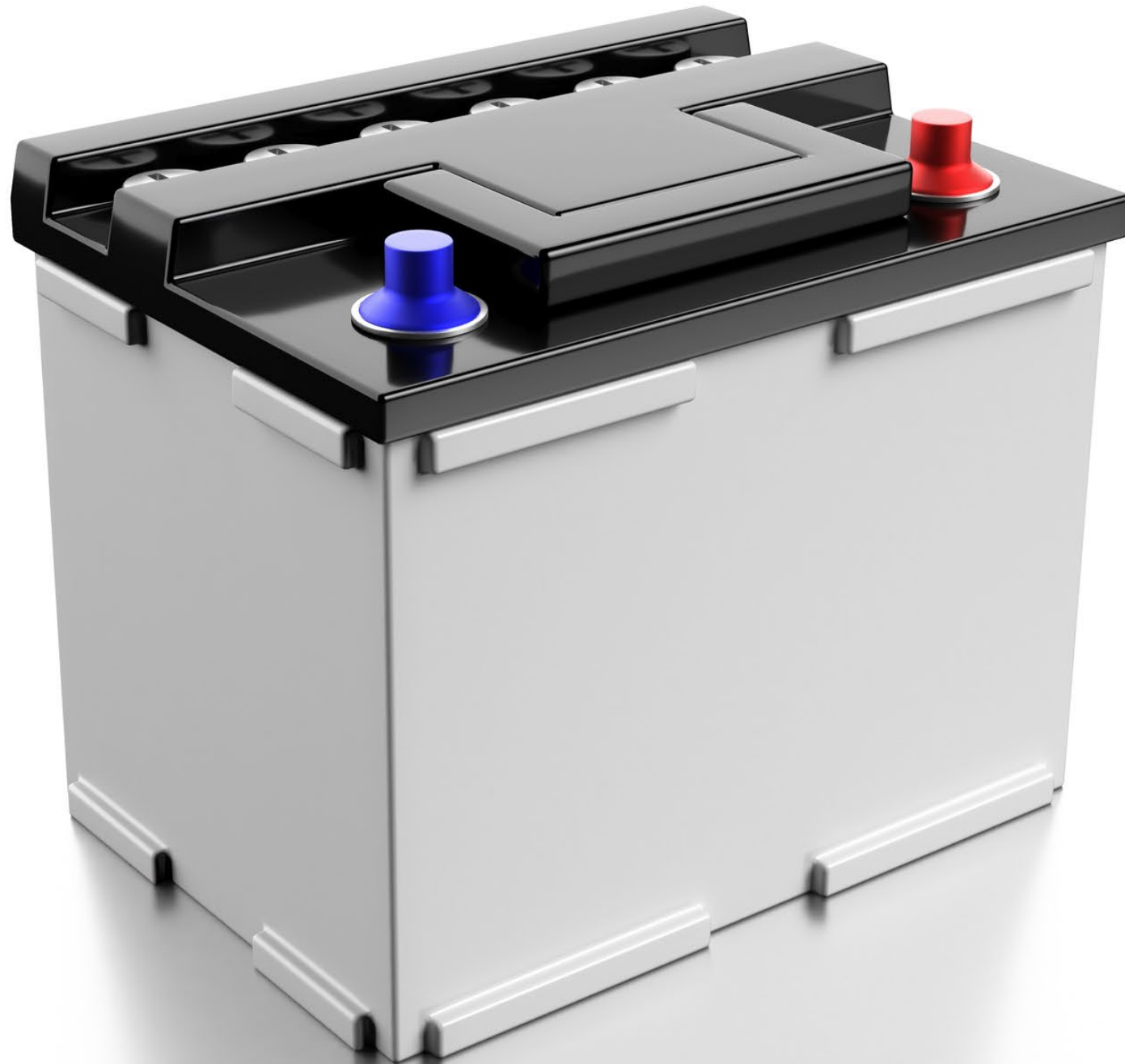


Simcenter Korea 2023

Patrick Niven, Director Fluids & Thermal Product Management

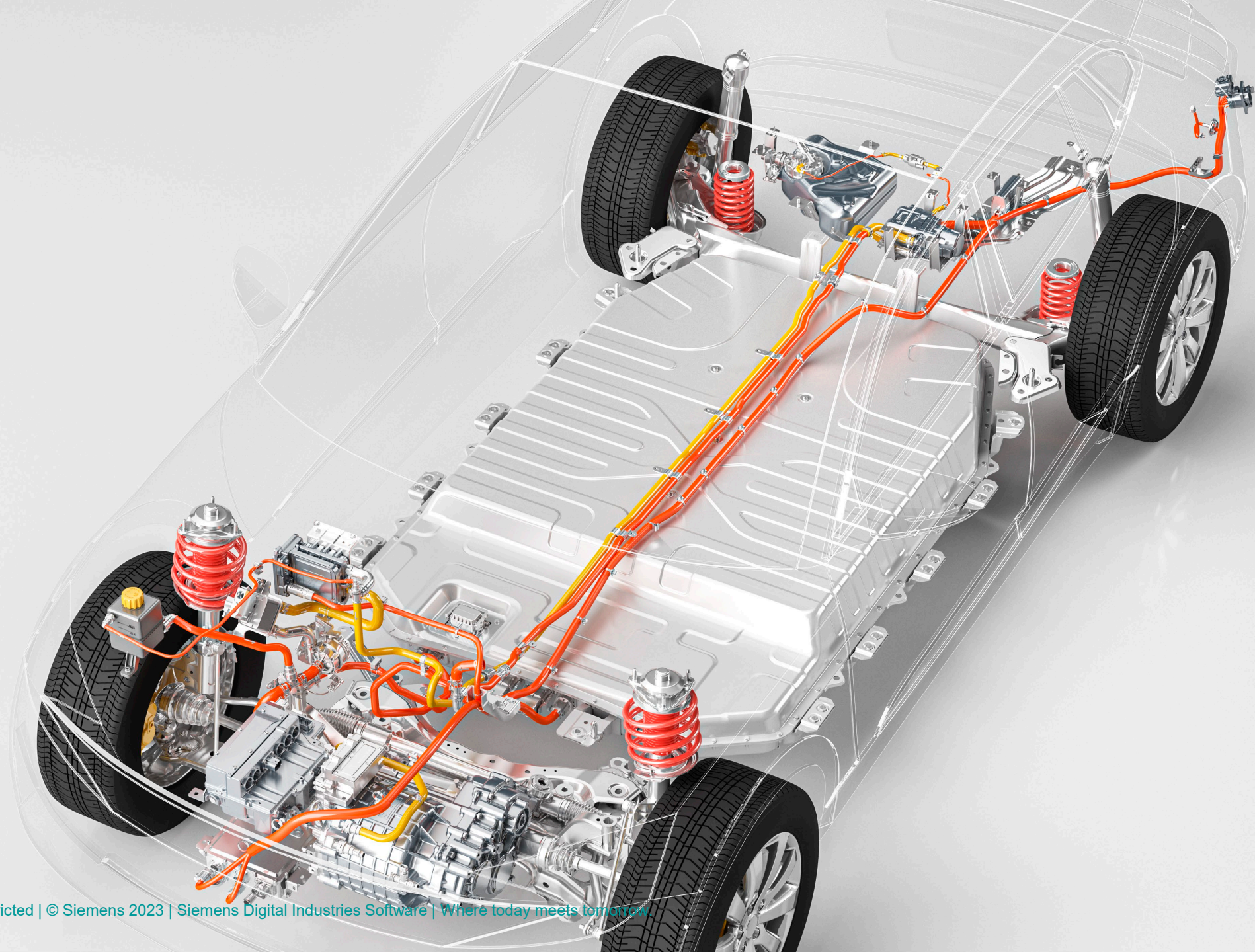


Not so long ago...

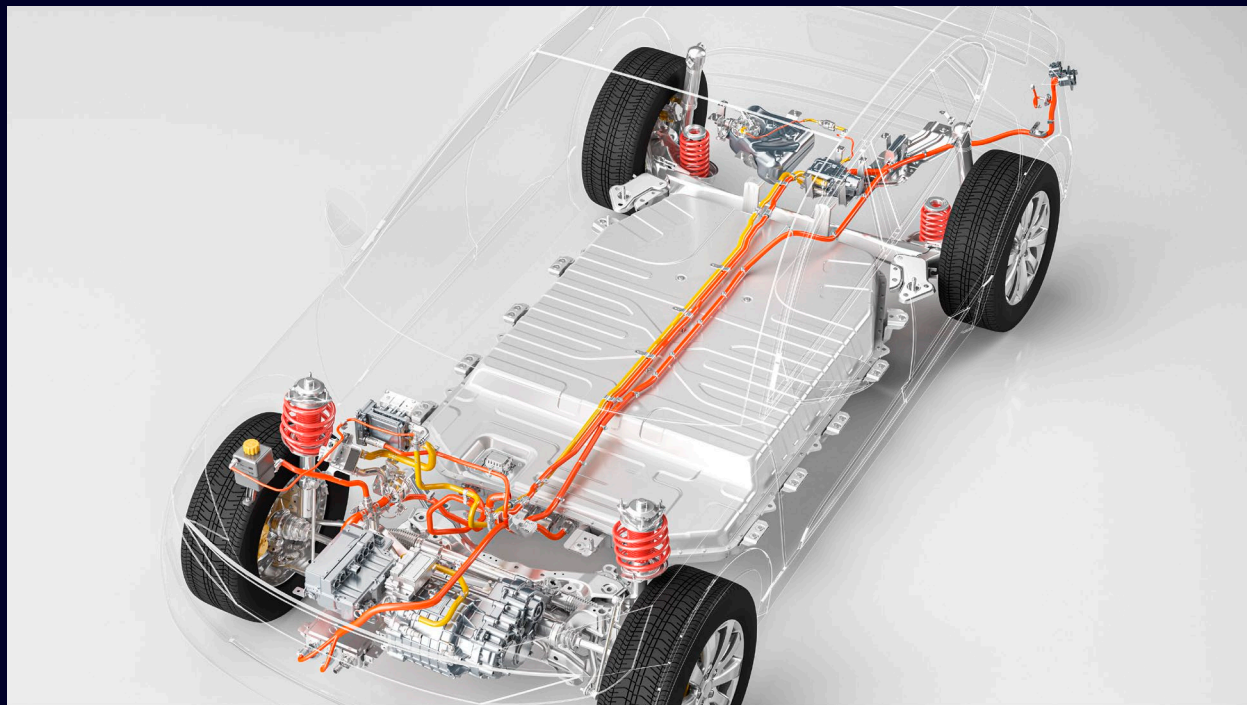




Today



Today



Cylindrical cells
Packaging space
Damage testing
Thermal runaway
Charge rates
Discharge rate
Formulations
Supply chain
Pouch cells
SAFETY
Ageing
Range
Emissions
\$\$\$
Energy management
Power density
Efficiency
Life cycle
Weight
Propagation rate
Prismatic cells
Geopolitics



Battery 2030: A Share to Take

+30%

annual growth rate (CAGR) from 2023 to 2030.

Source: [McKinsey 2022](#)

\$100bn

in revenue by 2026.

Source: [MarketWatch](#)

4.7

TWh will be needed in 2030.

Source: [McKinsey 2022](#)

15

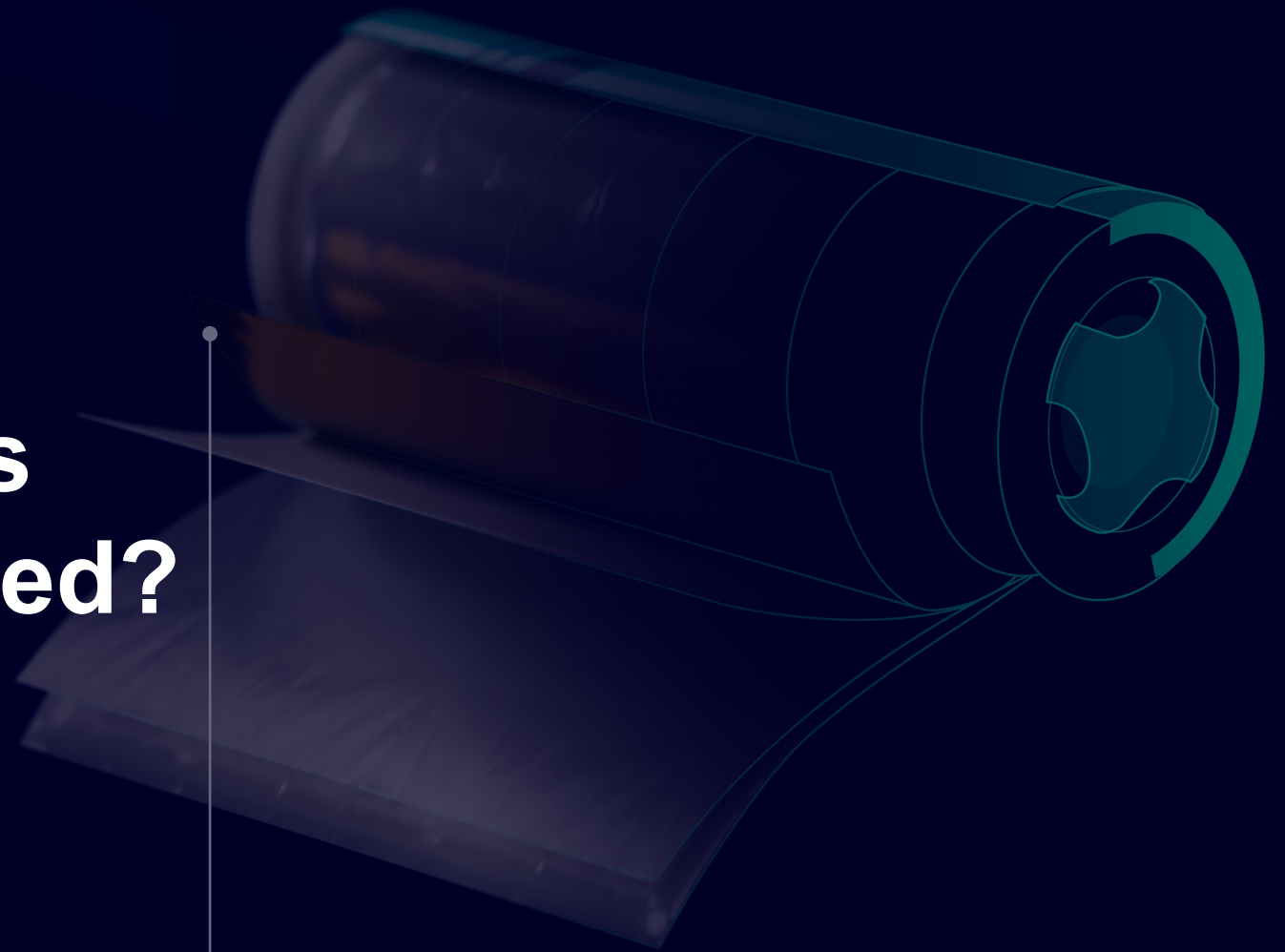
global suppliers are predicted to lead the industry.

Source: [McKinsey 2022](#)



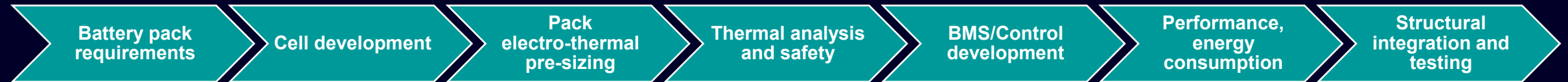
How can you ...

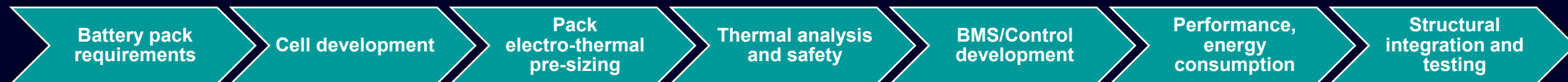
**deliver next gen
battery innovations
at scale and at speed?**





A Simcenter solution





Battery pack requirements

Cell development

Pack electro-thermal pre-sizing

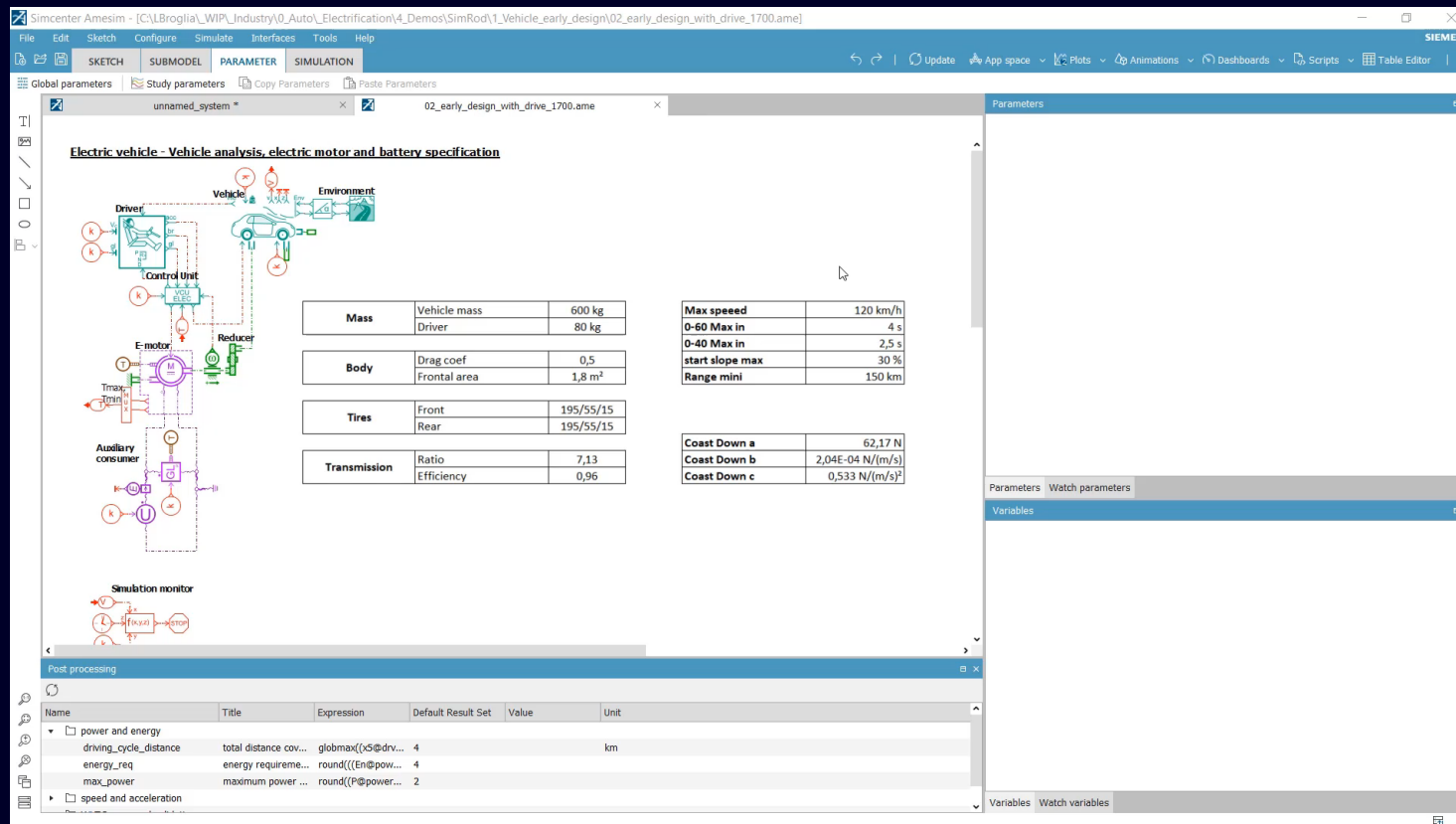
Thermal analysis and safety

BMS/Control development

Performance, energy consumption

Structural integration and testing

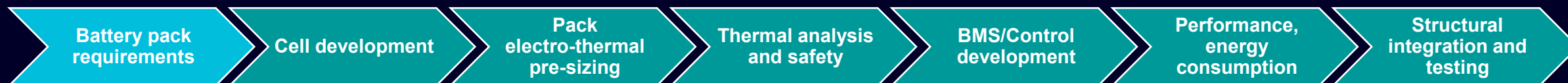
Early battery sizing for any kind of vehicle architecture



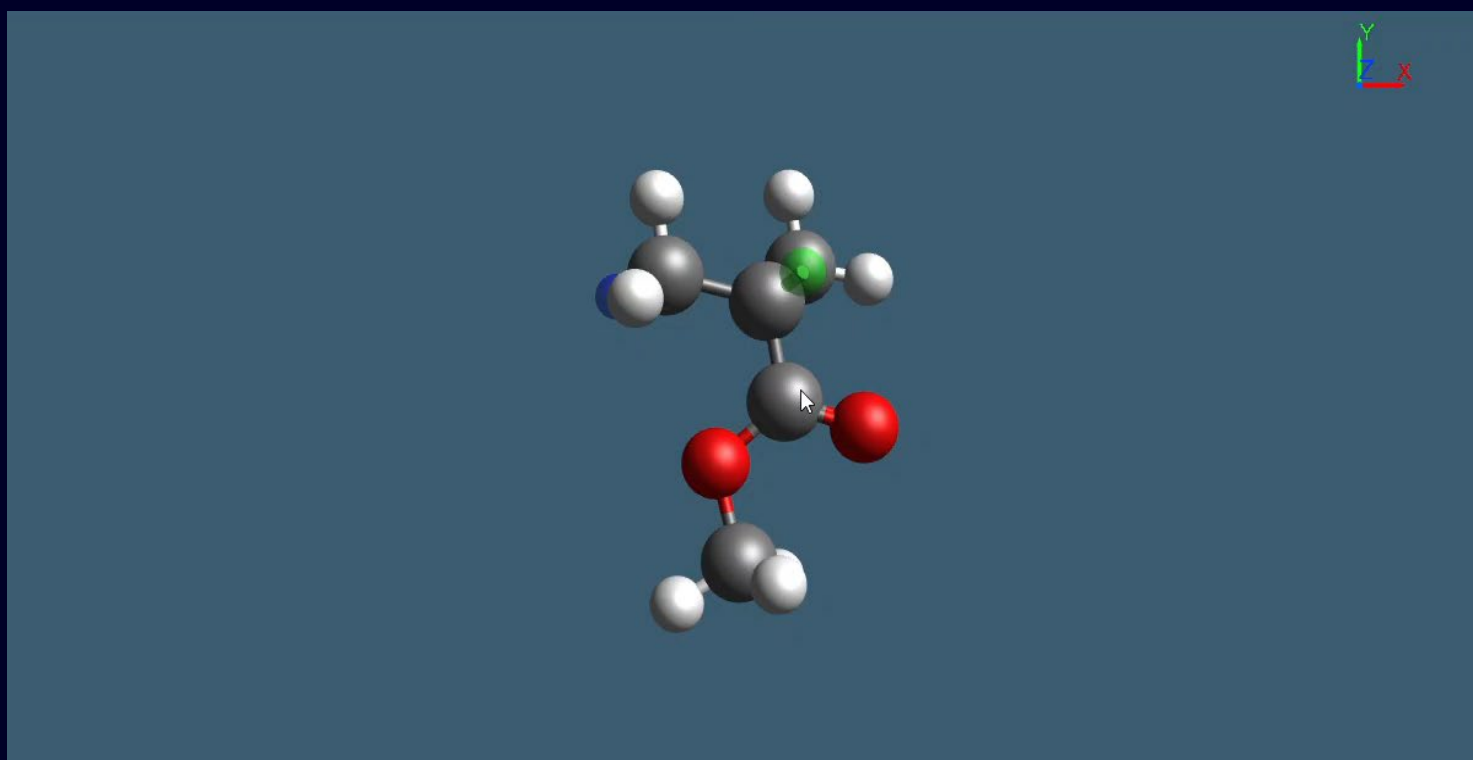
Start from the requirements at the full system level: passenger car, truck/bus, heavy equipment, etc.

Define the battery capacity and power on certified test procedures or custom drive cycles

Benefit from a database of commercial battery cells to compare various battery chemistries and their impact on the full system performance



Drive innovation efficiency of your chemistry research



Increase labs efficiency with robust, traceable and collaborative material innovation processes

Predict ionic mobility and conductivity and provide material property for cell design stage

Shorten time for material characterization and chemistry validation

Battery pack requirements

Cell development

Pack electro-thermal pre-sizing

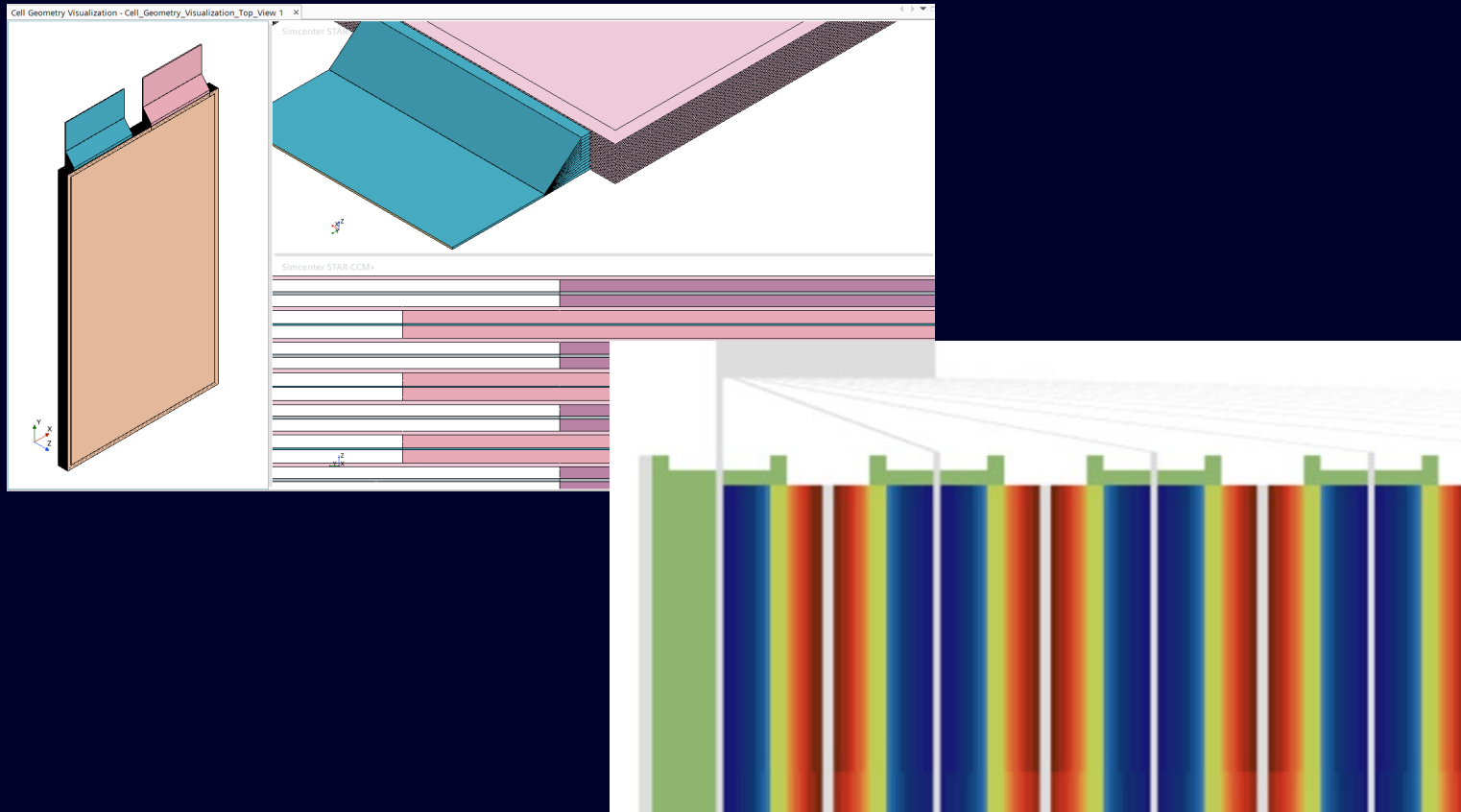
Thermal analysis and safety

BMS/Control development

Performance, energy consumption

Structural integration and testing

Investigate fundamental cell design early



Design and analyze electrochemical reactions and detailed geometry of battery cells

Model charge/discharge tests to better understand performance

Predict costs, packaging volume, weight of the cell

Battery pack requirements

Cell development

Pack electro-thermal pre-sizing

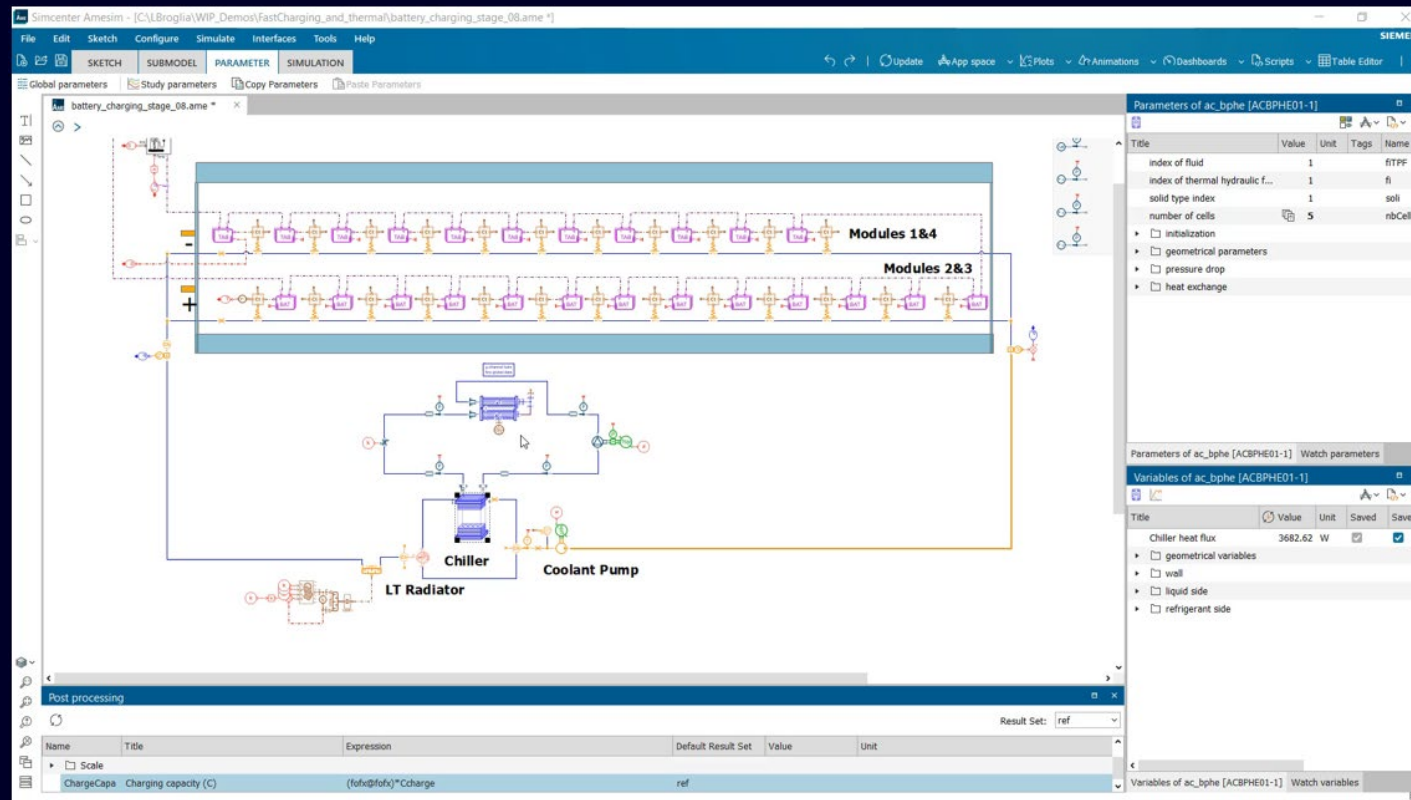
Thermal analysis and safety

BMS/Control development

Performance, energy consumption

Structural integration and testing

Assess the pack performance and define the cooling demand



Check vehicle energy consumption and range for various driving cycles and different temperature conditions

Evaluate battery safety strategies and its impact on performance and range for various configurations

Size the thermal management circuit during drive cycle and charging

Battery pack
requirements

Cell development

Pack
electro-thermal
pre-sizing

Thermal analysis
and safety

BMS/Control
development

Performance,
energy
consumption

Structural
integration and
testing

Flow, thermal & electrochemistry analysis



Simulate cell electrochemical
behavior within the thermal
environment

Compute the 3D cell heat
distribution for high accuracy
temperature map prediction

Understand thermal runaway
propagation to meet safety
requirements

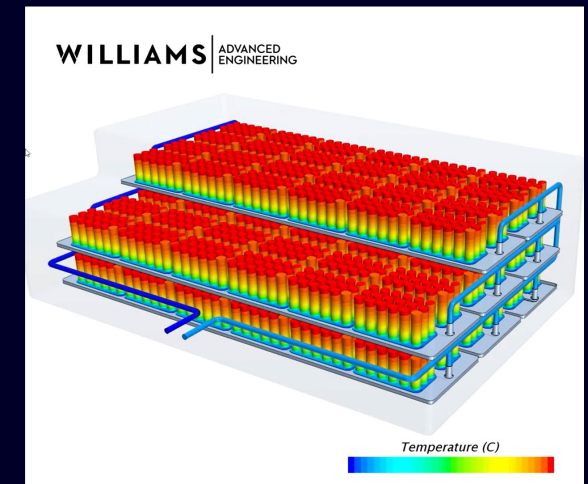
Williams Advanced Engineering (WAE) develops high-performance Li-ion batteries using Simcenter



WAE obtains the highest accuracy in simulating thermal battery performance.

<1C°

deviation compared to
experimental data



Battery pack
requirements

Cell development

Pack
electro-thermal
pre-sizing

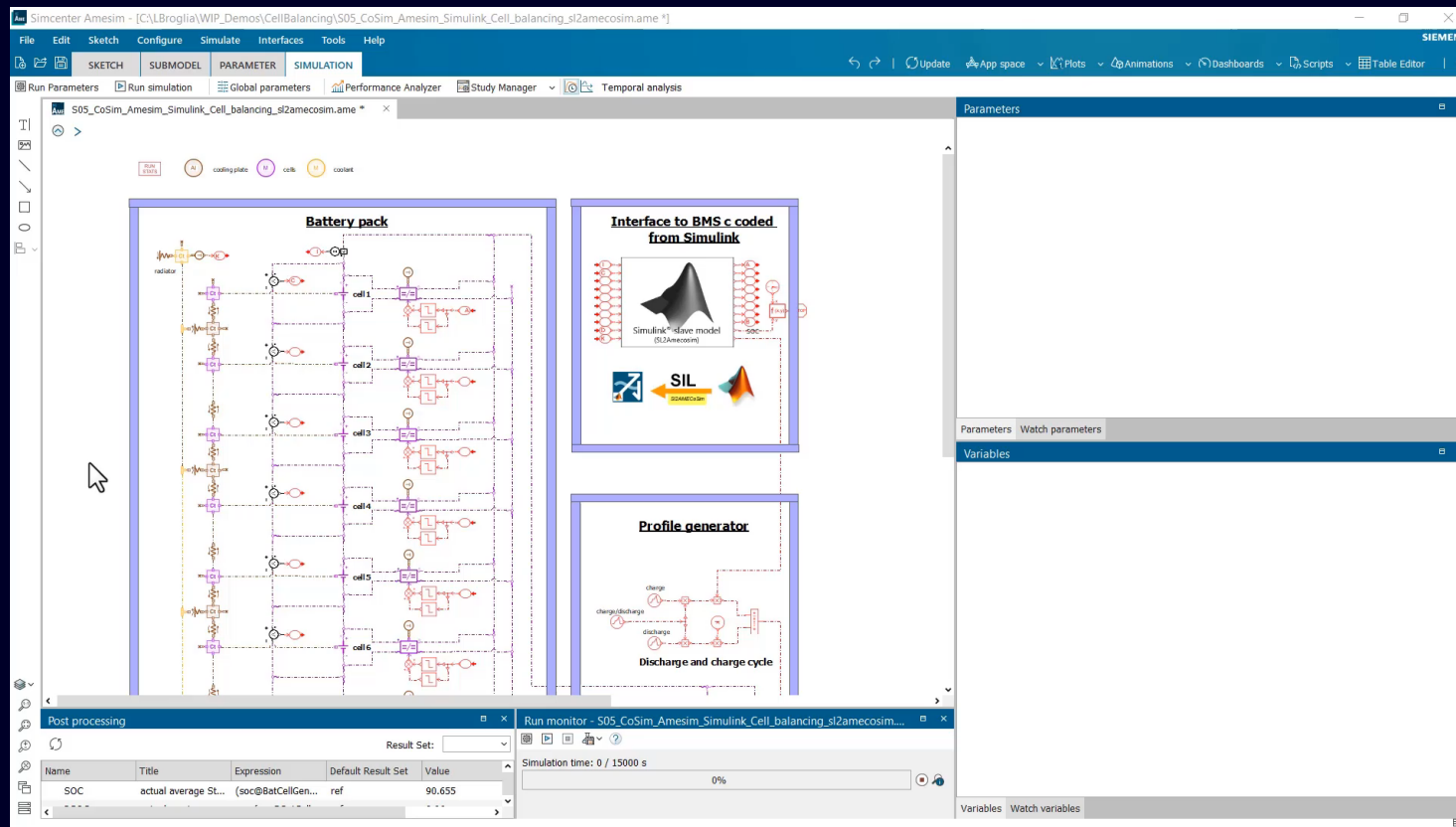
Thermal analysis
and safety

BMS/Control
development

Performance,
energy
consumption

Structural
integration and
testing

Closed-loop testing of control algorithms



Virtual prototyping and continuous closed-loop testing

Validate the BMS ability to manage an efficient utilization of the battery energy while ensuring safe operation

Anticipate conflicting control strategies and speed-up design iteration loops

Battery pack requirements

Cell development

Pack electro-thermal pre-sizing

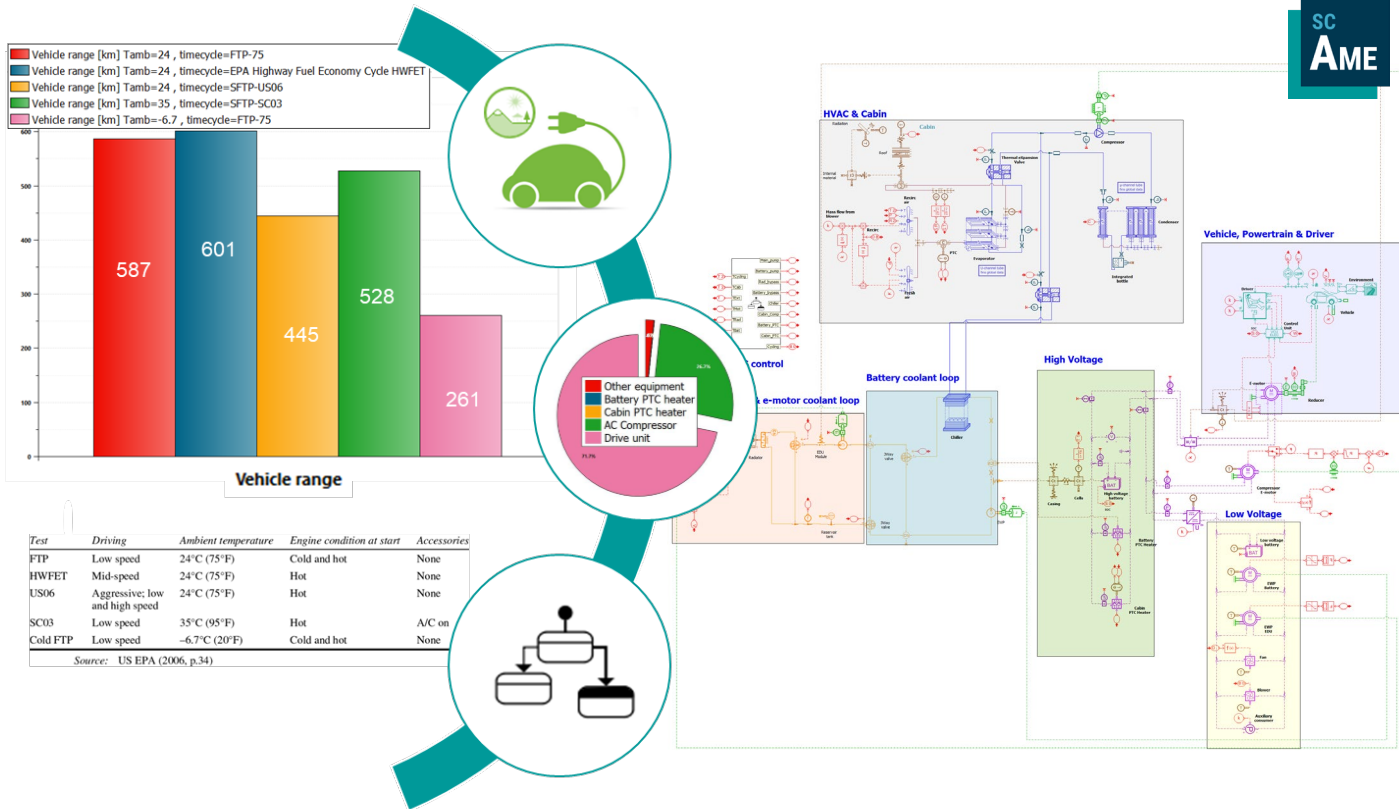
Thermal analysis and safety

BMS/Control development

Performance, energy consumption

Structural integration and testing

Balance multi-attribute objectives at vehicle level



Study the impact of driving cycles and climate conditions on the vehicle range

Check the balance between battery cooling, range, and thermal comfort at the vehicle level

Test the thermal management control strategy

PSA Peugeot Citroen uses Simcenter to optimize battery pack performance

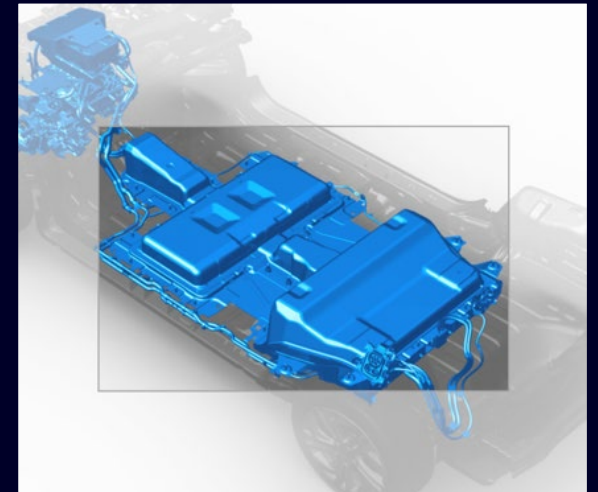


PSA uses multilevel modeling and multiphysics simulation to rapidly analyze battery performance and investigate alternative safe designs

2x faster simulation results

2x heat rejection

Reduced dev. time from months to weeks



Battery pack
requirements

Cell development

Pack
electro-thermal
pre-sizing

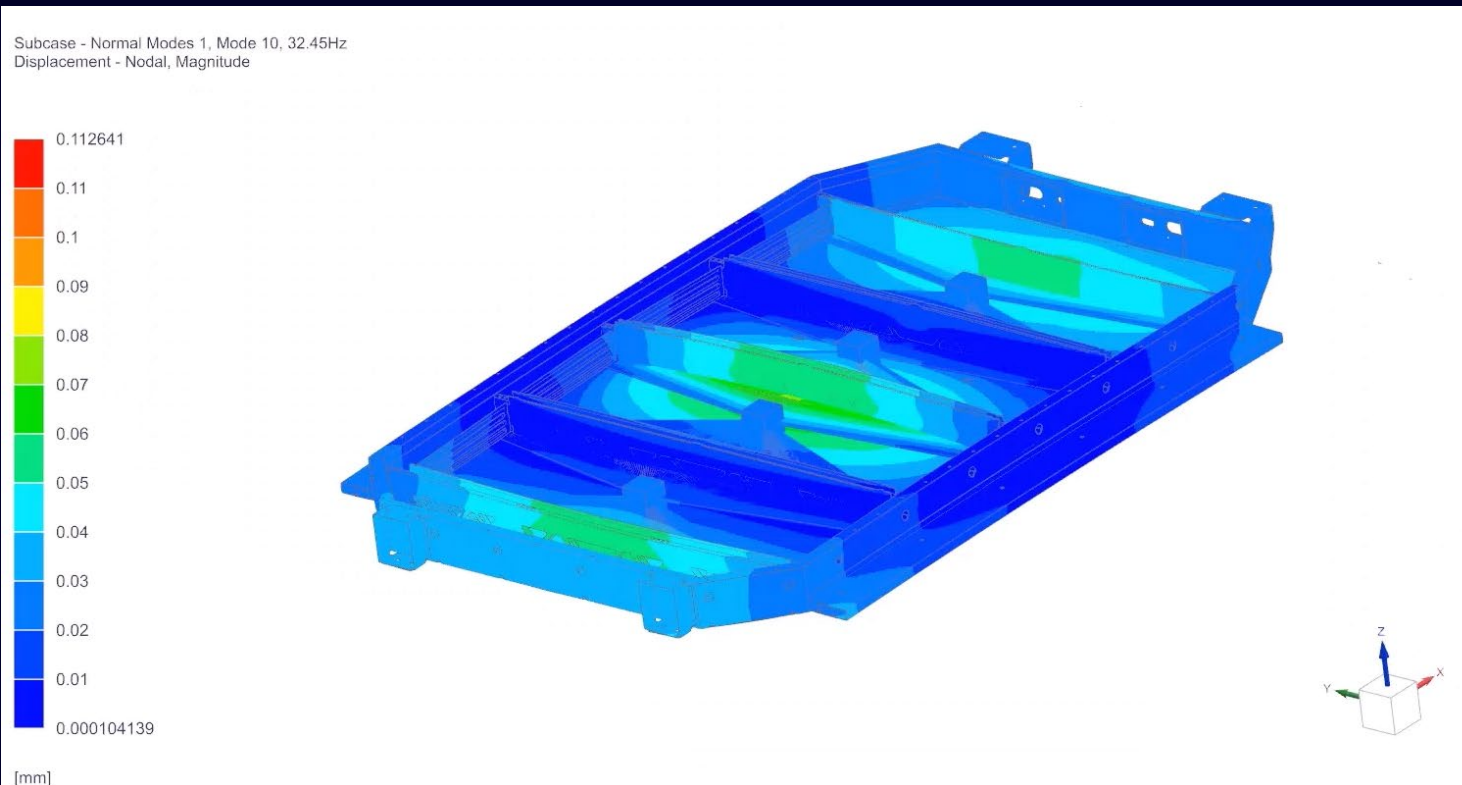
Thermal analysis
and safety

BMS/Control
development

Performance,
energy
consumption

Structural
integration and
testing

Optimization considering stiffness, NVH, and durability targets

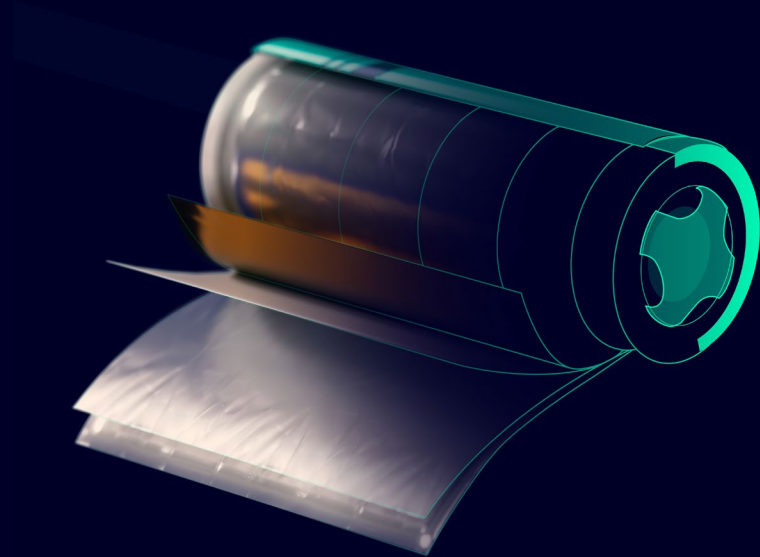


Investigate structural modification on NVH performance while considering weight and cost

Ensure stiffness to avoid costly damage

Include variables such as geometry, material properties, and assembly connections

Where next?



Effective collaborative engineering



Shift left & shift right

Creating a life-time value from the Digital Twin



Personalized & adapted processes

Specific workflows, leveraging state-of-the-art technologies



Cloud-based operation

Strengthen collaboration



A battery of challenges, a Simcenter solution

Simcenter Korea 2023

Patrick Niven, Director Fluids & Thermal Product Management