

# Accelerating CFD Simulation of Immersive Battery Cooling

## Organizations

**Wamtechnik** is an SME focused on the development and manufacturing of battery packs, founded in 1992. Wamtechnik was the first company in Europe to develop batteries for an electric bus (Solaris Urbino Electric 8,9).

**QuickerSim Automotive** is an engineering & simulation software development company developing e-mobility applications. QuickerSim Automotive offers Q-Bat – a thermal simulation software for battery packs.



End User

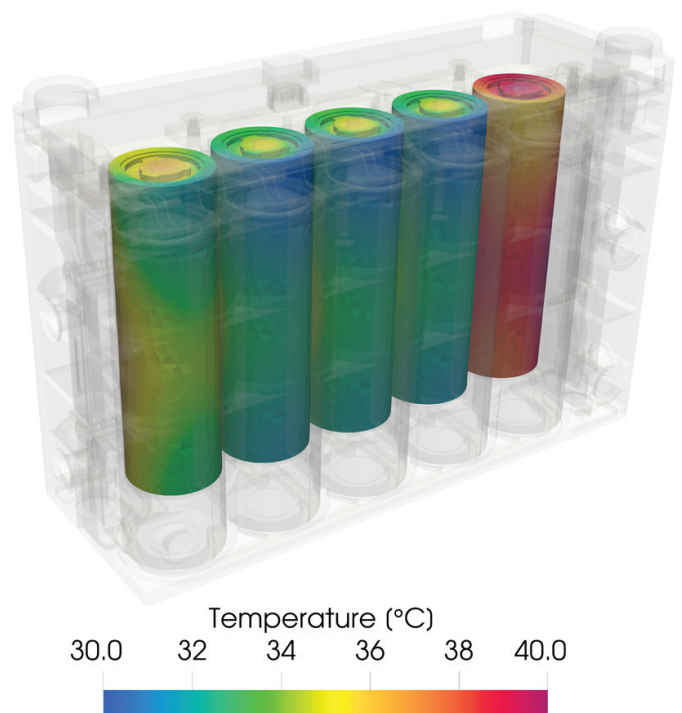
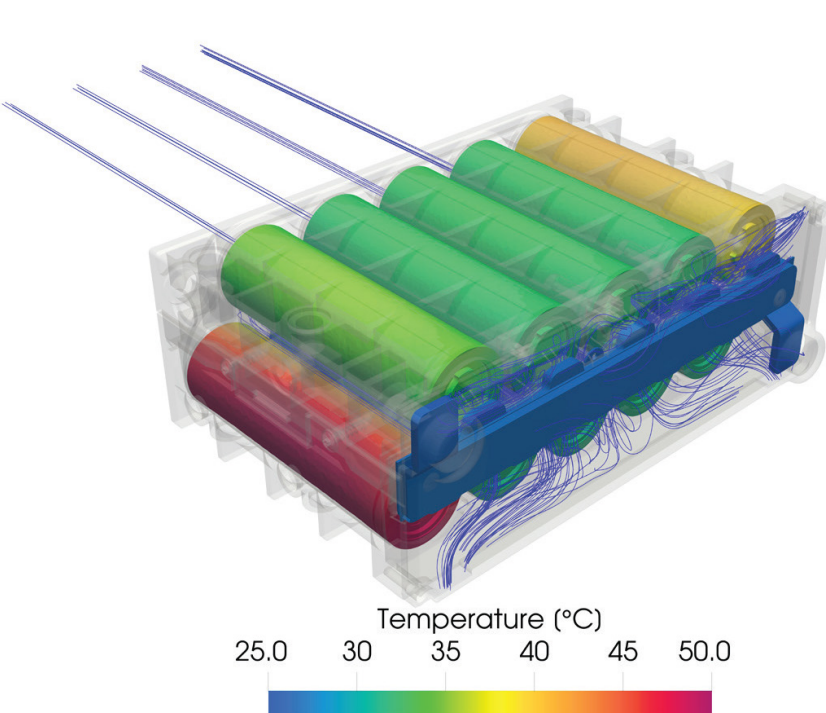


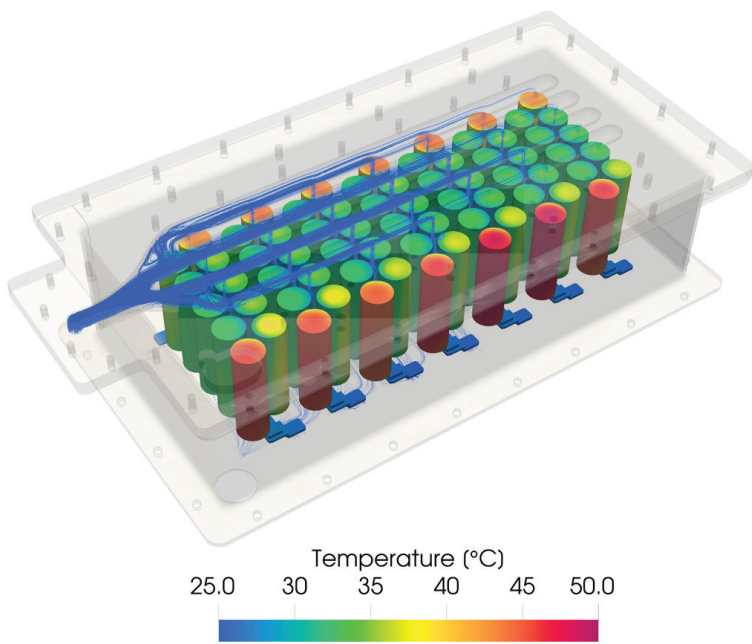
Simulations Expert & ISV



## The Challenge

The development of immersive cooling battery packs typically relies on prototyping and experimental testing, which is both time- and resource-intensive. While CFD numerical simulation can accelerate the design process, the use of general-purpose CFD codes is also significantly demanding of both expertise and computing resources, especially with transient phenomena and temperature-dependent material properties. Pre-processing (including meshing) for complex geometries is a further major challenge.





Industry Sector  
**E-mobility**

Technology used:  
**HPC,  
CFD Simulation**

## The Solution

The workflow is based on Q-Bat, a MATLAB application for the thermal analysis of battery packs. The solution reduces the computational complexity of conjugate heat transfer cases by solving fluid flow and heat transfer in the battery pack separately. QuickerSim developed a tool for importing and processing externally computed flow fields, as well as an automated tool for generating fluid flow cases for the open-source CFD library OpenFOAM. The latter tool was used to generate a large dataset of CFD cases, which were used to train a data-driven forced convection model. Lastly, a workflow was introduced for using the imported flow field to model heat transfer within the coolant, as well as between the coolant and the battery pack components.

## The Impact

For Wamtechnik, the developed simulation workflow can save considerable time and resources. Due to the manufacturing and testing of several prototypes in every design cycle, the total development cost amounts to approximately €60k/kWh. The developed simulation workflow enables Wamtechnik to test various designs concurrently, subsequently reducing the number of manufactured prototypes to only 1-3 for every design cycle. This allows them to reduce the development costs to approximately €48k/kWh, and shorten the development time by as much as 30%. Additionally, fewer prototypes mean a smaller environmental footprint. For QuickerSim Automotive, the development of the immersive cooling workflow for Q-Bat opens new revenue streams, both in software license fees and consultancy services. In the past, sales were limited to companies developing battery packs with cooling plates or passive cooling. The new features will aid the adoption of Q-Bat by OEMs, and the e-mobility market in general, where the development of immersive cooling solutions for applications such as fast charging is growing rapidly.

## Benefits

- The development cost of battery packs was reduced from €60k/kWh to €48k/kWh.
- Testing a design modification by means of simulation can be achieved within a couple of days, as opposed to 1-2 weeks if all components are manufactured in-house or 3-4 weeks if they are manufactured externally.
- Adopting the developed simulation workflow can shorten a 2-year design cycle by up to 7 months with an additional reduction in the number of battery prototypes.
- Physical prototypes cost approx. €2,000-2,500 per kWh, whereas the total HPC cost of simulating a battery pack does not exceed €250.