

# **xEV thermal management – heat transfer improvement requirements**

Cedric Rouaud

Ricardo Plc

## **Abstract:**

Market analysis are clearly showing increased electrification of powertrains and especially in 2030, Battery Electric Vehicle (BEV), market could be as high as 30%. The key element for the electrification is the battery. Among the different challenges for developing a battery pack for HEV (Hybrid Electric Vehicle) and BEV, the cooling method can account for up to 5-10% of the total cost of the battery pack, as well as impacting weight and packaging volume. With the forecasted cost reduction of the battery cell, the required increase in power and energy density, the cooling method plays an even greater role. Electric motor and power electronics thermal management is another important aspect of the xEV successful integration.

The presentation will show different methods to manage temperatures of electric components on xEVs and how to handle all the cooling and heating requirements depending on the driving conditions thanks to the help of multi temperature cooling circuits and advanced thermal control methods (such as Model Predictive Control and electronic Horizon) requiring reduced order thermal models.

Improving the cooling performance for durability (battery ageing) improvement, ultra fast charging capabilities (as enabler for increased BEV market penetration), cost reduction, performance (electrical power) increase will be discussed.

## **Bio:**

**Dr. Cedric Rouaud** is Global Technical Expert for Ricardo in thermal management and waste heat recovery for conventional and electrified vehicles (passenger car and commercial vehicles including battery, electric motor, power electronics). He is also chief engineer on powertrain development. He joined Ricardo in 2008. He began his professional career in Renault as a research engineer in 2000, while fulfilling his doctorate diploma in the University of Poitiers.

During his career, he has managed and developed several projects among which include:

- development of technologies for reducing CO2 emissions on gasoline&Diesel engines;
- thermal management of hybrid and electric vehicles (battery, electric motor, power electronics, vehicle integration);
- development of waste heat recovery systems for passenger car, HDD, railway, gensets;
- performing thermo-hydraulic simulations for reducing fuel consumption, improving EV range, optimisation of energy management;
- performing powertrain and vehicle tests (testbed, chassis dyno, Climatic Wind Tunnel, hot/cold environment tests).