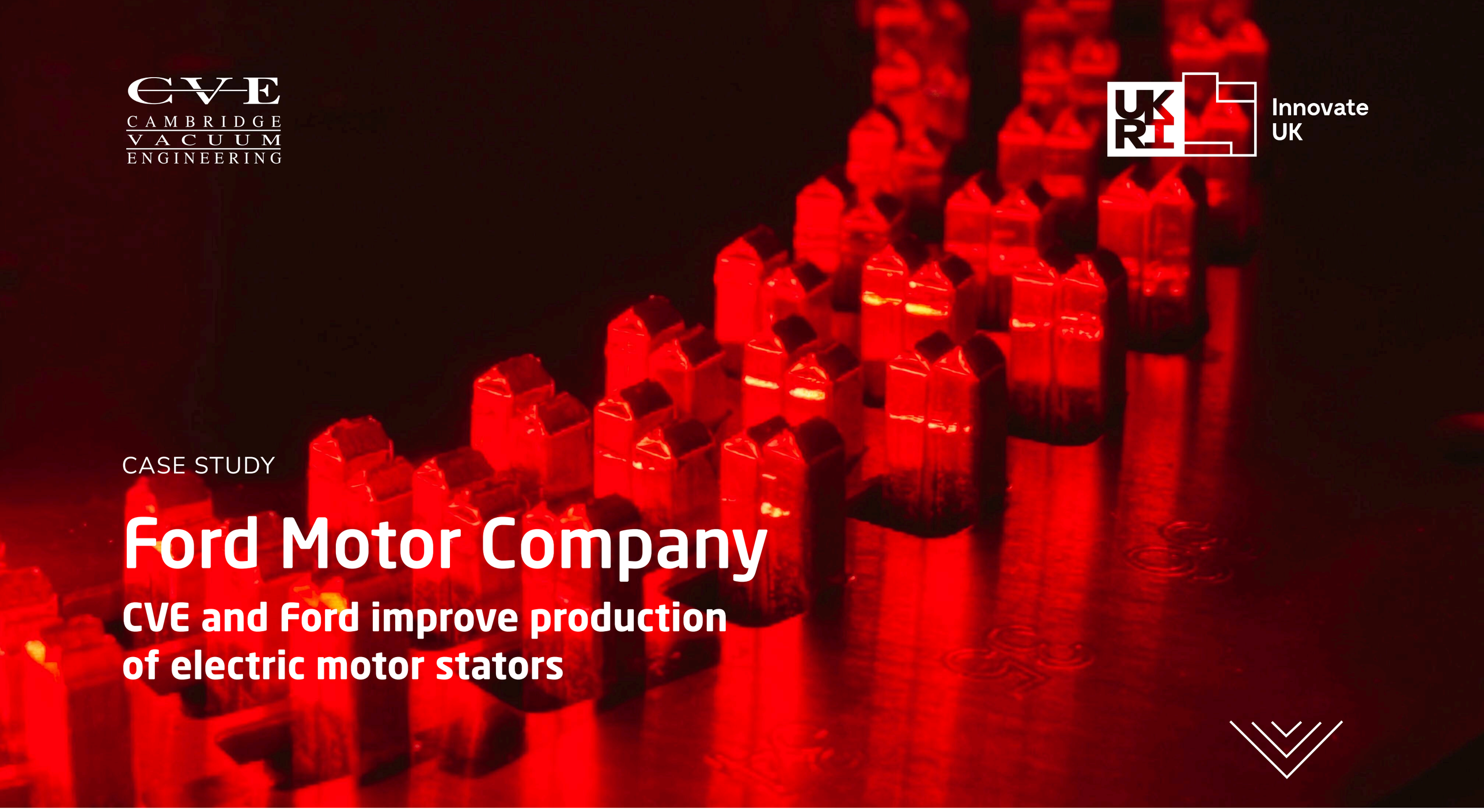

CASE STUDY

Ford Motor Company

CVE and Ford improve production of electric motor stators

Ford Motor Company, a global automotive leader, is accelerating its shift to electric vehicle (EV) production and seeking innovative manufacturing technologies to enhance the durability, quality and scalability of key EV components - particularly electric motor stators.

Problem

With growing demand for electric vehicles, manufacturers need to find ways to scale production efficiently, whilst maintaining the highest quality standards. One major obstacle is the production of copper hairpin stators, which requires extreme precision. Conventional joining methods often struggle with copper's reflectivity, sometimes leading to incomplete joints and pore formation. These challenges can affect product consistency and add to production costs - limiting broader EV adoption and progress toward net-zero carbon goals.

Solution

Cambridge Vacuum Engineering (CVE) partnered with Ford on the £430,000 Innovate UK funded EB-eDrive project as part of the Driving the Electric Revolution Challenge. The project explored the use of electron beam (EB) welding to manufacture electric motor stators more efficiently and reliably.

Results

Through this collaboration, CVE and Ford proved EB welding is a highly effective and repeatable method for joining copper hairpins in electric motor stators that can play a pivotal role in the global shift towards more sustainable modes of mobility. Together, they demonstrated that EB welding:

- Removes the need for hairpin preparation: Electron beams are unaffected by copper's reflectivity, eliminating the need for trimming or pre-processing
- Enhances production quality, delivering exceptionally strong welds: Resulting joints exhibited an average tensile strength six times higher than the minimum required limit.
- Reduces manufacturing costs by increasing reliability: Welding in a vacuum produces consistent, high-quality welds, minimising the risk of defects and the need to rework components.

"The Ford Powertrain Manufacturing Engineering team are continuously engaged in work to deliver improvements in the quality and efficiency of motor (stator) hairpin weld processes. Our developments of laser parameters set-up and repair processes have been industry-leading but we now see clear opportunity to make significant further progress through the potential adoption of Electron Beam welding. We are grateful to have collaboration partners like CVE to work with as we investigate routes to full scale industrialisation of this technology. Their unparalleled knowledge, experience and expertise are invaluable in the delivery of the project."

Lee Turner, Director of EU Powertrain Manufacturing Engineering at Ford

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