# Electrochemical Pathways for $CO_2$ Conversion: Toward Sustainable Formic Acid Production in the Cement Industry

With ambitious climate policies driving the need for significant carbon emission reductions, energy-intensive industries face the dual challenge of achieving these targets while remaining competitive in global markets. Carbon capture, utilization, and storage (CCUS) technologies provide a promising pathway to address this challenge by capturing $CO_2$ emissions and converting them into valuable energy carriers. The CAPTUS project, funded by the European Union under the Horizon Europe program, is exploring this approach through the development of renewable energy carriers derived from $CO_2$ emissions. CAPTUS brings together 18 European partners from industries such as steel, chemicals, and cement to advance scalable CCU solutions, with particular emphasis on producing liquid energy carriers powered by renewable energy [1].

This communication highlights the pivotal role of the University of Cantabria (UC), SINTEF Industry, and Cementos Portland Valderrivas in the CAPTUS project. The Chemical and Biomolecular Engineering Department from UC leads one of the project's key demonstrations: an industrial pilot scale system that converts captured $CO_2$ into formic acid using an advanced electrochemical reactor. This pilot system, set up at a cement plant (APRIA Systems - Cementos Portland Valderrivas), integrates a high-efficiency Continuous Swing Adsorption Reactor (CSAR) developed by SINTEF to capture $CO_2$ from flue gases using only electricity as energy input. The captured $CO_2$ is then processed in a 1,000 $cm^2$ electrochemical stack (developed by UC) optimized for formic acid production, under the coordination of CIRCE. CAPTUS aims to demonstrate not only the scalability and economic viability of formic acid production but also the adaptability of this technology to synthesize other low-carbon chemicals, thus contributing to a sustainable, circular economy.