

The Green Frontrunner Project – Advancing Electrochemical CO₂ Conversion from Concept to Pilot Scale

The Green Frontrunner project demonstrates the technical and economic feasibility of electrochemical CO₂ conversion from captured carbon dioxide into valuable base chemicals and fuels. Building upon laboratory research and a patented three-compartment electrolyzer stack (A 50943/2022), the project develops, constructs, and operates a pilot plant designed for a conversion capacity of up to 1.76 kg CO₂ per hour at an electrolysis power of 5 kW. The core innovation lies in a modular three-compartment cell configuration that enables simultaneous generation and separation of gaseous and liquid products while increasing the electrochemically active surface area. The pilot system—fully containerized for flexible deployment—integrates advanced control as well as gas and liquid analysis systems to evaluate long-term stability, conversion efficiency, and product selectivity under industrially relevant conditions. Through systematic optimization of catalysts, electrodes, membranes, and process parameters, the project will provide validated scale-up data toward a 1 MW demonstration plant. Target products include syngas, formic acid, ethanol, ethylene, and other C₁-C₂ chemicals, contributing to a carbon-neutral circular economy. As part of Austria's FFG Green Frontrunner initiative, this project positions GIG Karasek as a technology leader in sustainable CO₂ utilization and supports the broader European Green Deal objectives by transforming industrial CO₂ emissions into valuable resources.