ERC PROOF OF CONCEPT

ERC Proof of Concept Grant

Commercialising a Selective CO2-to-Ethylene Electrocatalyst

CATALYX-PoC

Field	Value
Call Identifier	ERC-2026-PoC
Type of Action	ERC Proof of Concept Grant
Duration	18 months
Host institution	University of Cambridge, United Kingdom
Principal Investigator	ERC Consolidator Grant holder (University of Cambridge)
Source ERC grant	ERC Consolidator Grant (ongoing)
Call identifier	ERC-2026-PoC
Duration	18 months
Lump sum	EUR 150,000

Abstract

CATALYX-PoC bridges the gap between frontier electrocatalysis research and industrial deployment of a novel copper-based catalyst capable of converting CO2 to ethylene with unprecedented selectivity. Ethylene is one of the world's highest-volume petrochemicals, yet its production remains almost entirely fossil-dependent. The copper-based electrocatalyst developed under the Principal Investigator's ERC Consolidator Grant at the University of Cambridge now offers a credible electrochemical route to ethylene from captured CO2, with Faradaic selectivities and current densities that surpass the current state of the art. Over 18 months and using the EUR 150,000 ERC Proof of Concept lump sum, CATALYX-PoC will validate catalyst performance at an industrially relevant scale, secure intellectual property protection, conduct a rigorous techno-economic and market assessment, and engage chemical-industry partners and investors to establish a clear commercialisation pathway.

SECTION 1 - THE INNOVATION

1.1 The ERC Result Being Taken Forward

The result being commercialised is a copper-based electrocatalyst, discovered and characterised under the Principal Investigator's ERC Consolidator Grant, that electrochemically reduces CO2 to ethylene with high Faradaic efficiency and selectivity. The catalyst exploits a precisely engineered copper surface morphology and a tailored electrochemical microenvironment to suppress competing reduction pathways, most notably the hydrogen evolution reaction and methane formation, which have historically limited the practical utility of copper-based CO2 reduction systems. The result represents a substantive departure from prior art: the combination of selectivity, stability under continuous operation, and compatibility with renewable electricity inputs has not previously been demonstrated in a single catalyst system at this performance level.

The direct lineage between the ERC-funded frontier research and this PoC action is unambiguous. The Consolidator Grant investigation of structure–activity relationships in nanostructured copper electrocatalysts yielded the specific morphological and compositional parameters that govern ethylene selectivity. CATALYX-PoC now takes those parameters from the laboratory discovery stage and subjects them to the commercial stress-tests - scale, reproducibility, cost, and industrial relevance - required to attract investment and licensing partners.

1.2 Innovation and Proof-of-Concept Objectives

The central innovation is an electrocatalytic process that converts CO2, a waste or captured greenhouse gas, directly into ethylene using renewable electricity, without recourse to fossil feedstocks or the energy-intensive steam-cracking infrastructure that dominates current production. Ethylene is the precursor to polyethylene, polyvinyl chloride, ethylene oxide, and a broad portfolio of commodity and specialty chemicals; global demand exceeds 200 million tonnes per year. A selective electrochemical route powered by low-carbon electricity would therefore represent a systemic decarbonisation lever for the chemical industry.

The PoC objectives are: (i) to validate catalyst selectivity and stability at a prototype cell scale representative of industrial operating conditions; (ii) to file a priority patent application protecting the catalyst composition, fabrication method, and electrochemical cell configuration; (iii) to quantify the economic viability of the process through a techno-economic assessment benchmarked against steam-cracking and emerging competing CO2-conversion technologies; and (iv) to engage at least three industrial partners or investors and to determine the most viable route to market - licensing, spin-out formation, or a research collaboration agreement.

1.3 What Will Be Demonstrated

By the end of the 18-month project, CATALYX-PoC will demonstrate that the copper-based electrocatalyst retains its characteristic CO2-to-ethylene selectivity (target Faradaic efficiency ≥ 60 %) in a prototype electrolyser cell operating at current densities of industrial relevance (≥ 200 mA cm^{-2}), under continuous operation conditions over a period sufficient to establish stability data acceptable to industrial due-diligence processes. This constitutes a step-change in technological readiness relative to the current laboratory-scale validation.

The project will further demonstrate that the intellectual property surrounding the catalyst can be protected in key jurisdictions, that a credible cost trajectory towards price-competitiveness with fossil-derived ethylene exists under plausible renewable-electricity pricing scenarios, and that identifiable industrial partners operating in ethylene production, carbon capture utilisation, or electrochemical engineering are willing to enter into structured follow-on engagement. Collectively, these demonstrations will establish the commercial and societal feasibility of the innovation and position it for the subsequent development phase beyond the PoC.

SECTION 2 - INNOVATION POTENTIAL AND IMPACT

2.1 Application and Market Need

Ethylene is the world's most-produced organic chemical. Its synthesis via steam cracking of naphtha or ethane is among the most energy-intensive and carbon-emitting processes in the chemical industry, accounting for approximately 180–200 Mt CO_2-equivalent per year globally. Regulatory pressure through the EU Emissions Trading System, the Carbon Border Adjustment Mechanism, and equivalent instruments in other major economies is sharply increasing the cost of carbon-intensive production, creating structural demand for low-carbon ethylene pathways. Simultaneously, the falling cost of renewable electricity and the maturing of CO_2 capture infrastructure are improving the economic context for electrochemical CO_2 conversion.

The addressable market spans direct ethylene producers seeking to decarbonise existing assets, chemical companies building carbon-capture-and-utilisation portfolios, electrolyser and fuel-cell technology companies diversifying into value-added product streams, and emerging sustainable-chemistry ventures. Conservative market analyses place the low-carbon ethylene opportunity at multi-billion-euro scale within a decade. The societal impact extends beyond the chemical sector: by closing the CO_2 loop - capturing emissions and converting them to a high-value feedstock - the technology contributes directly to climate mitigation objectives under the European Green Deal and the Paris Agreement.

2.2 Competitive Advantage and IP Position

The primary competitive advantage of the CATALYX-PoC catalyst is its demonstrated combination of high ethylene selectivity and high current density in a single system. Alternative CO_2 electroreduction catalysts that achieve high selectivity typically do so only at low current densities impractical for commercial operation, while those optimised for high current density suffer from poor product selectivity or rapid degradation. The catalyst architecture developed under the Consolidator Grant addresses this trade-off through a proprietary surface-engineering approach whose mechanistic basis is now well understood, providing a defensible and reproducible performance advantage.

At the time of PoC submission, the intellectual property exists as an unpublished research result and associated know-how held by the University of Cambridge. A freedom-to-operate assessment conducted at project outset will map the existing patent landscape, and a priority patent application covering the catalyst composition, the scalable fabrication process, and the electrochemical cell configuration will be filed within the first six months of the project. The University of Cambridge's technology-transfer office (Cambridge Enterprise) will be engaged from the start to ensure that the filing strategy is aligned with the intended commercialisation route and that appropriate confidentiality agreements are in place with prospective industrial partners during engagement activities.

2.3 Commercialisation Pathway

Three complementary commercialisation routes will be evaluated and ranked during the PoC period. The first and most capital-efficient route is technology licensing: granting an exclusive or field-of-use licence to an established chemical or electrochemical engineering company with existing manufacturing, regulatory, and market infrastructure. The second route is a spin-out company, which would retain full control of the IP and capture a greater share of long-term value, but requires a higher level of investor engagement and would demand additional funding beyond the PoC horizon. The third route is a collaborative research and development agreement with an industrial partner that co-funds scale-up in exchange for preferential licensing terms.

Partner engagement activities during the PoC will target three categories of organisations: major integrated chemical companies with stated net-zero commitments and active carbon-capture-and-utilisation programmes; electrolyser technology companies with the stack engineering and manufacturing capability to commercialise a novel cathode material; and climate-technology venture capital funds active in the industrial-decarbonisation space. Engagement will be structured around a commercial-readiness package comprising the prototype validation data, the techno-economic assessment, and the IP filing status. The preferred route will be selected no later than month 15, allowing the final three months of the project to be devoted to structuring the chosen pathway and preparing the materials required to initiate it.

SECTION 3 - IMPLEMENTATION

3.1 Activities and Timeline

The project is organised into five interlinked activities executed across 18 months by the Principal Investigator, supported by a postdoctoral researcher and a part-time project manager, with targeted use of specialist subcontractors for legal and techno-economic work. Activities 1 and 2 run in parallel from month 1, establishing the technical and IP foundations. Activity 3 draws on the outputs of both and runs from month 6 to month 14. Activities 4 and 5 commence once preliminary data and the IP filing are in place and extend to project completion, ensuring that partner engagement is evidence-based and that the commercialisation strategy is fully formed and actionable by month 18.

All activities are designed to be feasible within the lump-sum budget and the 18-month duration. The work plan incorporates contingency measures for the key risks identified in Section 3.3. Progress will be reviewed internally at months 6, 12, and 16, and the Principal Investigator will take strategic decisions on commercialisation route and partner prioritisation at the month-12 review, informed by the outputs of Activities 1 through 3.

Activities

Activity	Objective	Timing
Activity 1 - Prototype Validation	Scale the copper-based electrocatalyst to a prototype electrolyser cell (≥ 25 cm² active area); demonstrate Faradaic efficiency ≥ 60 % for ethylene and current density ≥ 200 mA cm^{-2} under continuous operation; generate stability data over ≥ 200 hours runtime.	Months 1–12
Activity 2 - IP Protection	Commission freedom-to-operate analysis; file priority patent application covering catalyst composition, fabrication process, and cell configuration; establish confidentiality framework for partner engagement.	Months 1–6
Activity 3 - Techno-Economic Assessment	Model the full process chain from CO2 capture to ethylene output; benchmark capital and operating expenditure against steam cracking and competing electro-conversion routes under a range of electricity-price and CO2-cost scenarios; identify scale and operating conditions required for cost-competitiveness.	Months 6–14
Activity 4 - Industrial Partner Engagement	Identify and approach a shortlist of at least six target partners (chemical producers, electrolyser companies, and climate-technology investors);	Months 8–18

	conduct structured due-diligence presentations; evaluate licensing, spin-out, and co-development options; select preferred commercialisation route.	
Activity 5 - Commercialisation Strategy and Dissemination	Consolidate prototype data, IP status, and techno-economic findings into a commercial-readiness package; prepare term sheet or heads-of-agreement with lead partner; present results at one major industrial conference and one investor forum.	Months 14–18

3.2 Use of the Lump Sum

The EUR 150,000 lump sum will be deployed across the five activities described above. The largest share will support personnel costs, covering a portion of the salary of a dedicated postdoctoral researcher with expertise in electrochemical engineering who will lead the prototype validation work, and a part-time project manager who will coordinate partner engagement and administrative tasks throughout the project. The Principal Investigator's time commitment is covered by the existing Consolidator Grant host-institution arrangement.

A significant portion of the budget will be directed to consumables, materials, and equipment access required for prototype fabrication and extended stability testing, including copper precursor materials, gas-diffusion-layer substrates, membrane-electrode assembly components, and gas-analysis instrumentation time. Subcontracting costs will cover the specialist patent attorney engaged for the freedom-to-operate analysis and the priority filing, and an independent techno-economic consultancy with proven experience in electrochemical process modelling. The remaining funds will cover travel and subsistence for partner-engagement meetings, conference attendance, and indirect costs in accordance with the University of Cambridge's applicable overhead rates. No detailed breakdown by cost line is included, in line with the lump-sum nature of the ERC Proof of Concept grant.

3.3 Key Risks

Three principal risks have been identified and mitigation measures are in place for each. The first is technical: the catalyst may exhibit reduced selectivity or accelerated degradation when scaled from laboratory coupon to prototype cell format, a known challenge in electrochemical materials scale-up. Mitigation involves a staged scale-up protocol that identifies the performance-limiting factors at intermediate cell sizes before committing to full prototype assembly, and the engagement of an electrochemical engineering specialist in an advisory capacity from project month 1. Should selectivity fall below the target threshold at prototype scale, the activity will pivot to identifying the morphological or electrolyte parameters responsible and testing targeted modifications within the available timeline.

The second risk is intellectual property: a freedom-to-operate analysis may reveal blocking patents that constrain the freedom to commercialise, or a competing group may publish or file on a similar catalyst system before the priority date is secured. Mitigation is the early commissioning of the IP analysis (month 1) and the priority filing target of month 6, well within the standard 12-month priority window. The third risk is commercial: prospective industrial partners may judge the technology insufficiently mature for licensing or co-development at the PoC stage, or market conditions may shift. Mitigation involves targeting a broad portfolio of partner types rather than relying on a single route to market, and ensuring that the techno-economic assessment provides a quantified roadmap that reduces perceived investment risk by demonstrating the conditions under which the technology becomes cost-competitive.