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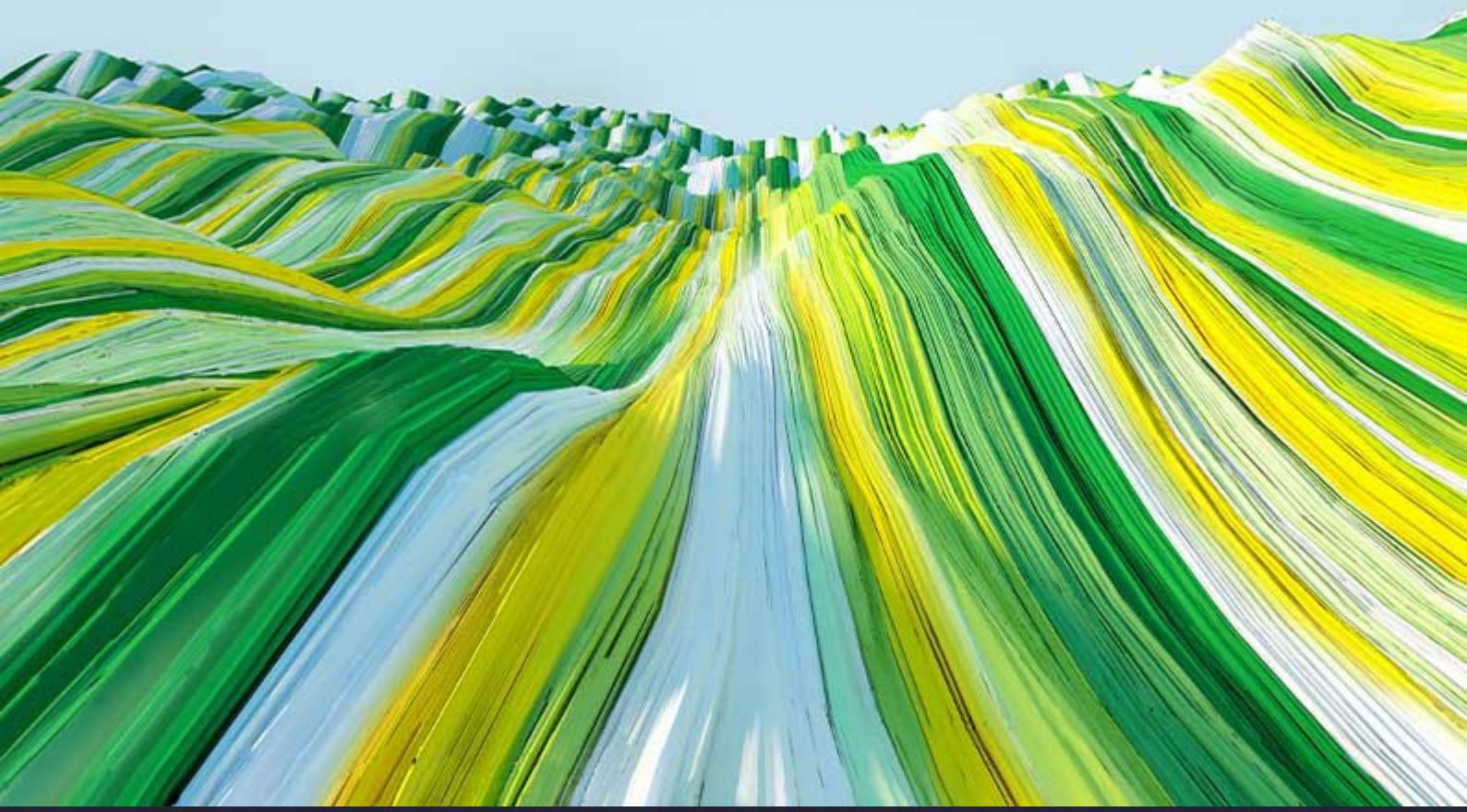

Green Ammonia from nitrogen, Water, and Renewable Power

This invention provides a renewable, scalable, and hydrogen-free route to ammonia production. It eliminates fossil fuel dependence, decentralises manufacturing, and brings one of the most carbon-intensive industrial processes into the renewable era.

Valeska Gonzalez

Commercialisation Senior Executive

– Faculty of Engineering

v.gonzalez-montilla@imperial.ac.uk

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Intellectual property information
GB Patent Application No. 2513753.0

Inventor information
Professor Ifan Stephens
Boxi Ye

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Proposed Uses

This invention enables decentralised and fossil-free ammonia production using renewable electricity, nitrogen, and water. The technology directly addresses global agricultural and energy challenges, offering sustainable ammonia synthesis without the greenhouse gas footprint of the Haber–Bosch process. Agriculture is the largest and most immediate market: local fertiliser production units can provide farmers and cooperatives with reliable access to ammonia-based fertilisers without depending on centralised industrial plants. Energy applications include ammonia as a carbon-free fuel for power generation, shipping, and hydrogen storage. The global infrastructure for ammonia handling already exists, making integration seamless. Chemical manufacturing can adopt this technology to produce feedstocks for polymers and specialty chemicals using renewable inputs. Together, these applications represent an opportunity to decarbonise an USD 80 billion market while enabling distributed, on-demand ammonia production for food, fuel, and materials.

Problem addressed

Ammonia synthesis remains one of the largest single industrial emitters of greenhouse gases, with the conventional Haber–Bosch process producing over 500 million tons of CO_2 annually and consuming up to 2% of global energy. Its reliance on fossil-fuel feedstocks and centralised temperature and pressure plants drives high capital intensity and restricts local ammonia production in developing regions. Electrochemical alternatives have struggled to scale: aqueous systems fail to achieve measurable ammonia output above contamination level, while lithium-mediated processes, require hydrogen supply from an external water electrolyzer. Both approaches remain costly and challenging to deploy beyond the laboratory scale. This approach addresses the limitations of existing electrochemical routes by enabling hydrogen-free, ambient-pressure ammonia synthesis through an energy-efficient, modular, and fully electric design, suitable for distributed production powered by renewable energy.

Technology Overview

The system is a monolithic electrochemical flow cell that synthesises ammonia directly from nitrogen and water under renewable electricity. It couples oxygen evolution and nitrogen reduction reactions in separate aqueous and organic electrolytes, divided by a proton-selective membrane. The design prevents cross-contamination while maintaining ionic conductivity and operational stability. The cell achieves a Faradaic efficiency of 61%, comparable to state-of-the-art flow cells. Also, this invention eliminates the need for an external hydrogen supply. Its integrated, compact configuration supports low-cost scaling and compatibility with standard flow-cell manufacturing. By simplifying ammonia production into a single, modular device, the technology bridges the gap between laboratory innovation and industrial deployment. Enabling distributed, emission-free ammonia generation anywhere renewable power is available. It also allows other applications, e.g. electrochemical CO_2 reduction, or PFAS remediation in non aqueous solvents or redox flow batteries.

Inventor information

Dr Ifan Stephens, Professor in Electrochemistry, Department of Materials.

Boxi Ye, Research Postgraduate, Department of Materials.

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Benefits

- High efficiency (61% Faradaic)
- Zero fossil fuel input
- Hydrogen-free process
- Industrial compatibility
- Replaces centralised plants with modular, distributed systems.