



The Association for Energy, Mobility, Industry & Community

***GREEN HYDROGEN
THE PATHWAY
SUSTAINABILITY***

PRESENTATION

NET2ZERO

15TH APRIL 2026

Paul McCormack

NET ZERO

- Deadline NET ZERO. As we accelerate toward 2030 and 2050 targets, the gap between ambition and deployable technology is widening.
- Hydrogen is expected to play a central role in decarbonising industry, transport, and energy systems. Yet the technologies we rely on today— particularly electrolysers— were not designed for the world we are building:
- a world dominated by intermittent renewables,
- constrained by water scarcity,
- and under pressure to deliver low-cost, low-carbon molecules at scale.
- Let's focus on the barriers we must overcome and the skills and research gaps we must close, to make next-generation electrolysis a reality.

Challenge: Where the System Breaks

Barrier 1: Electrolysers not designed for intermittency

- Most commercial electrolysers were engineered for steady operation. But the future grid is anything but steady.
- Wind and solar variability forces rapid cycling.
- Frequent ramping accelerates degradation.
- Efficiency drops when operating off design.
- This mismatch creates a fundamental bottleneck: renewables are intermittent, but our hydrogen production technologies are not yet flexible enough to match them.

Most commercial PEM and alkaline electrolysers lose between 5 –10% efficiency and experience up to a 2–3× increase in component degradation when operated under highly intermittent, stop-start renewable conditions.

Challenge: Where the System Breaks

Barrier 2: Water quality constraints

- Electrolysis has traditionally assumed access to pure deionised water. But globally, water scarcity is increasing. Industrial sites often have access only to: grey water, wastewater, brackish water, or recycled process water.
- Current electrolysers struggle with impurities, fouling, and membrane degradation. This is a major barrier to scaling hydrogen in regions where water is already under stress.

Every kilogram of green hydrogen requires up to nine litres of purified freshwater .

Electrolysis competes directly with drinking water, agriculture, and sanitation, especially in regions already facing scarcity.

This creates a paradox at the heart of the energy transition:

We cannot solve the climate crisis by worsening the water crisis.

Challenge: Where the System Breaks

Barrier 3: PFAS dependency and regulatory pressure

- Many PEM membranes rely on PFAS-based materials. Regulators are tightening restrictions. Industry needs PFAS-free, high-performance alternatives—urgently.

Over 90% of commercial PEM electrolyzers rely on PFAS-based membranes and gaskets, meaning that proposed EU PFAS restrictions could render the majority of today's PEM stack designs non-compliant without major redesign or re-certification.

Why Next -Generation Electrolysers Are Essential

To meet Net Zero, electrolysers must evolve in three critical ways:

1. True Flexibility

Electrolysers must operate like modern renewables: fast-ramping, high-cycling, digitally optimised, and capable of responding to real-time carbon intensity signals.

2. Water Resilience

Next-generation systems must be able to operate with: grey water, industrial effluent, municipal wastewater, or desalinated water with minimal treatment. This is not optional— it is a global deployment constraint.

3. PFAS-Free, Sustainable Materials

We need membranes and catalysts that are: PFAS-free, durable under cycling, tolerant to impurities, and manufacturable at scale. This is a major research and industrialisation gap.

Connect with us



@IrelandHydrogen

info@hydrogenireland.org

<https://hydrogenireland.org/>

[HydrogenIreland: Overview | LinkedIn](#)

