



**Innovative ideas to use
liquid ammonia as a
fertilizer of fuel**



Σ smart
advanced manufacturing

The background of the image is a collage of industrial scenes, including a robotic arm, a CNC machine, and a welding process, all overlaid with a semi-transparent green filter. A large, stylized green sigma symbol (Σ) is positioned to the left of the text.

ORGANISATION PROFILE

Hydrogen Refinery Ltd is a SME founded in the UK in June 2021, to commercialize technology that has been under development by the British military since 2003.

Hydrogen Refinery uses a patented Plasma Electrolyser System (PES) to process hydrocarbon waste to make 99.9% pure hydrogen within the IEA target price of \$1,000 per tonne or \$1 per kilogram (kg). The hydrogen produced is not only green because the PES system works without producing any gaseous carbon emissions, but also carbon negative because waste processed by PES avoids the emissions of landfill or incineration. The hydrogen can be used directly in a Haber-Bosch process to make ammonia.

Industry facts:

‘Grey’ ammonia produced from natural gas costs around \$400 per tonne (p/t) today. Emissions from global production of c.200 million tonnes per annum of ammonia based nitrogen fertilizers, emissions estimated 600 million tonnes of CO₂e. (Source: McKinsey).

According to Fertiberia, the fertilizer market in EU in 2021 was valued at \$41bn with 71 million tonnes used.

There are over 9 million farms in the EU.

PROPOSAL INTRODUCTION (I)

Vision: main project goal

Innovative solutions to use liquid ammonia to make solid nitrogen fertilizers or to use liquid ammonia as a low-emission fuel

Motivation: why the project is necessary : See video <https://youtu.be/UcDzpxrEOml>

50% of the food we eat is grown with the benefit of ammonia based fertilizers. The EU is a net importer of ammonia fertilizers, two of the largest producers are Russia and China. This presents a major food security exposure in the EU. Ammonia fertilizer production is the most carbon emitting chemical process globally as almost all ammonia is produced from natural gas. The price of natural gas has a direct effect on fertilizer costs, that in turn affects the price of food. This makes it very difficult for farmers to plan. For example the rise in natural gas prices immediately following the start of the Ukraine crisis caused fertilizer prices to rise 6-fold and significant food inflation.

There is a 200 million tonne global trade in ammonia and fertilizers. Product is bulk shipped around the world adding emissions and cost. With a multitude of brokers and middlemen adding further cost to farmers. This project removes the uncertainty for farmers by producing the fertilizer they rely on locally in regional plants at a low fixed price, enabling them to plan effectively. There is no need to bulk ship products around the world and because the starting point is waste, not natural gas, the price is no longer variable.

PROPOSAL INTRODUCTION (II)

Content: which are the developments to be made in the project

- Process to turn liquid ammonia into solid fertilizer prill at small scale
- Innovative uses of liquid fertilizer or ammonia as a fuel

Expected outcome: descriptions of the results to be obtained in the project

Technologies at early TRL level (1 to 4) that can be proven at prototype scale (TRL 5 to 7)

Impacts: what will be the expected market impact of the project

Regional ammonia plants could be replicated all around the EU and the world, removing significant emissions and reducing cost of food production and fuel

Schedule: start and end dates for the project. Duration.

June 2024 to June 2027 (timescales subject to change)

PARTNERS

Current Consortium: list of partners already involved in the project

Hydrogen Refinery

Partner search: type of partner searched and countries of origin (if necessary).

Innovative solutions to :

- turn liquid ammonia into solid ammonia nitrate, urea or similar.
- methods to use liquid fertilizers directly
- Use of liquid ammonia as a fuel

In the USA it is common to inject liquid ammonia directly into the soil, but in the EU most fertilizers is scattered as a solid prill

CONTACT INFO

Contact info: of the person coordinating the project proposal

Stephen Voller
Founder

Hydrogen Refinery Ltd

M +44 780 122 6160

E Stephen.voller@h2refinery.co.uk

www.h2refinery.co.uk

Registered in England No. 13433617

Registered office 20-22 Wenlock Road, London, N1 7GU

