AFC Energy

To Infinity and Beyond

Ammonia is the future net-zero fuel

The End-to-End Solution

Decarbonisation of the energy chain using ammonia

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Ammonia

Hydrogen

Power

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Ammonia Cracking Systems

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Fuel Cell Generator Systems

- AFC Energy PLC are an end-to-end clean energy solutions provider
- UK manufacturer & exporter of Fuel – Cell solutions up to 500kW
- Manufacturer of Ammonia Crackers for local low-cost hydrogen production, Subsidiary created [HYAMTEC] to rapidly commercialise

How to decarbonise heavy industry

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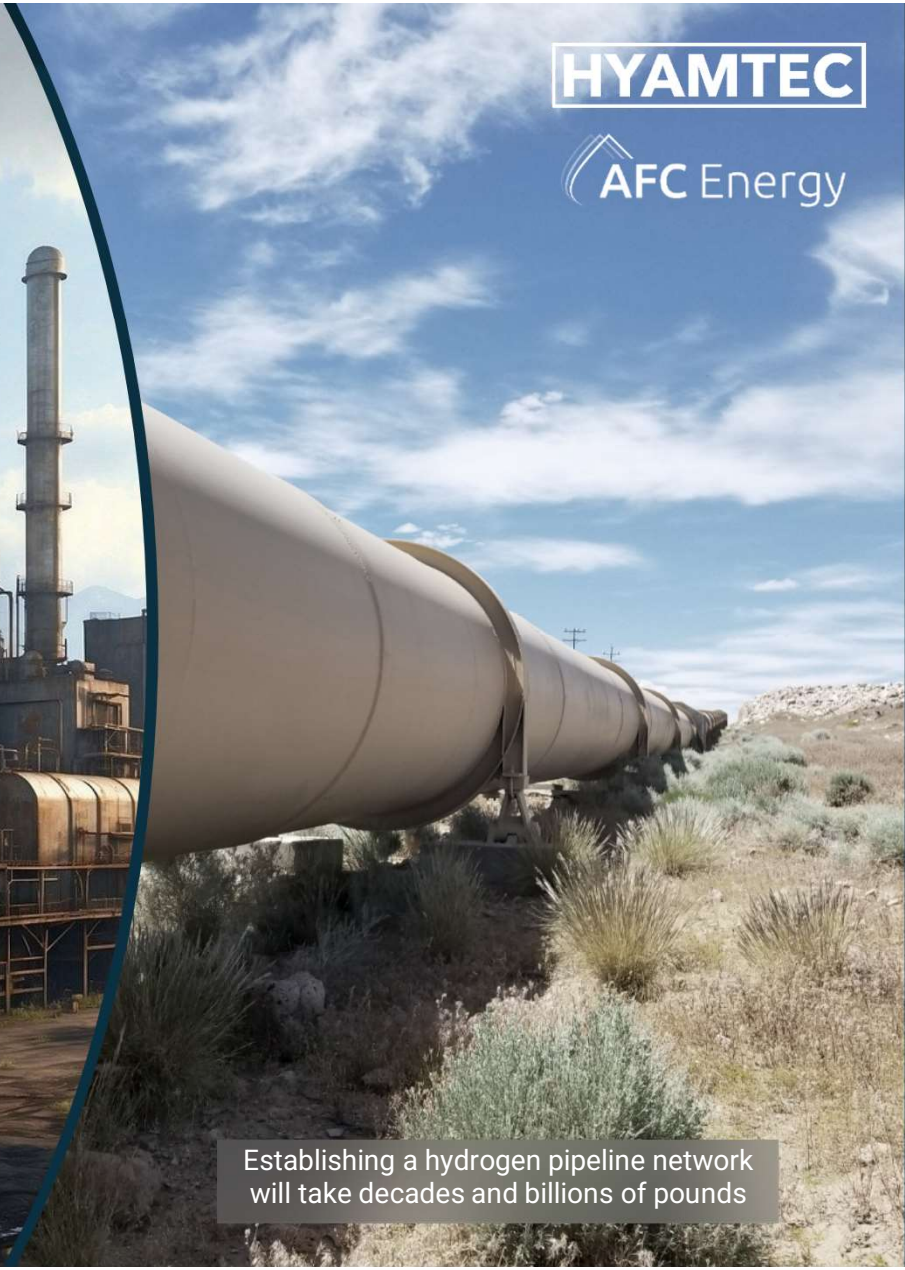
Over 50% of global emissions come from hard to abate heavy industrial sectors.

Hydrogen is the obvious clean fuel solution to decarbonise heavy industry, but…

- It is difficult to store and transport in industrial quantities
- It will take too long to install hydrogen pipelines
- Making hydrogen on site from electrolysis requires a levels of power that the current grid cannot accommodate.

Ammonia as a hydrogen carrier fuel coupled with a modular ammonia cracking technology could address all of these barriers

Hydrogen should be the future fuel for heavy industry



Establishing a hydrogen pipeline network will take decades and billions of pounds

Why do we think ammonia is the future?

Superior energy density with no carbon emissions

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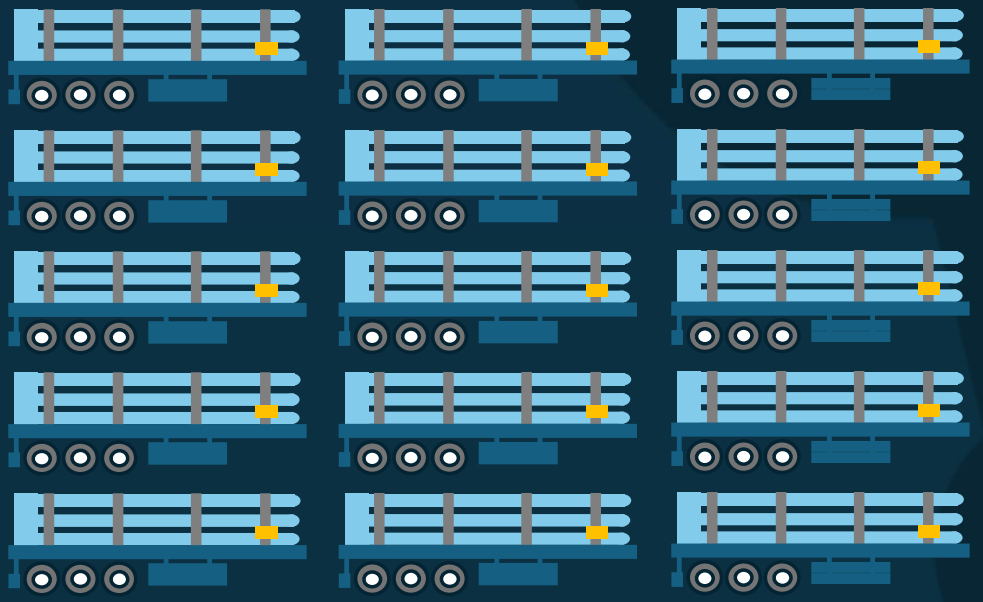
26 Tonnes of Ammonia and a HY5 Cracker



Fifteen 300Kg Hydrogen Tube Trailers

The AFC Energy / Hyamtec Ammonia cracker technology unlocks access to low-cost, readily transportable hydrogen

Industry use case example : Asphalt production

Why ammonia makes sense as a future cleaner fuel

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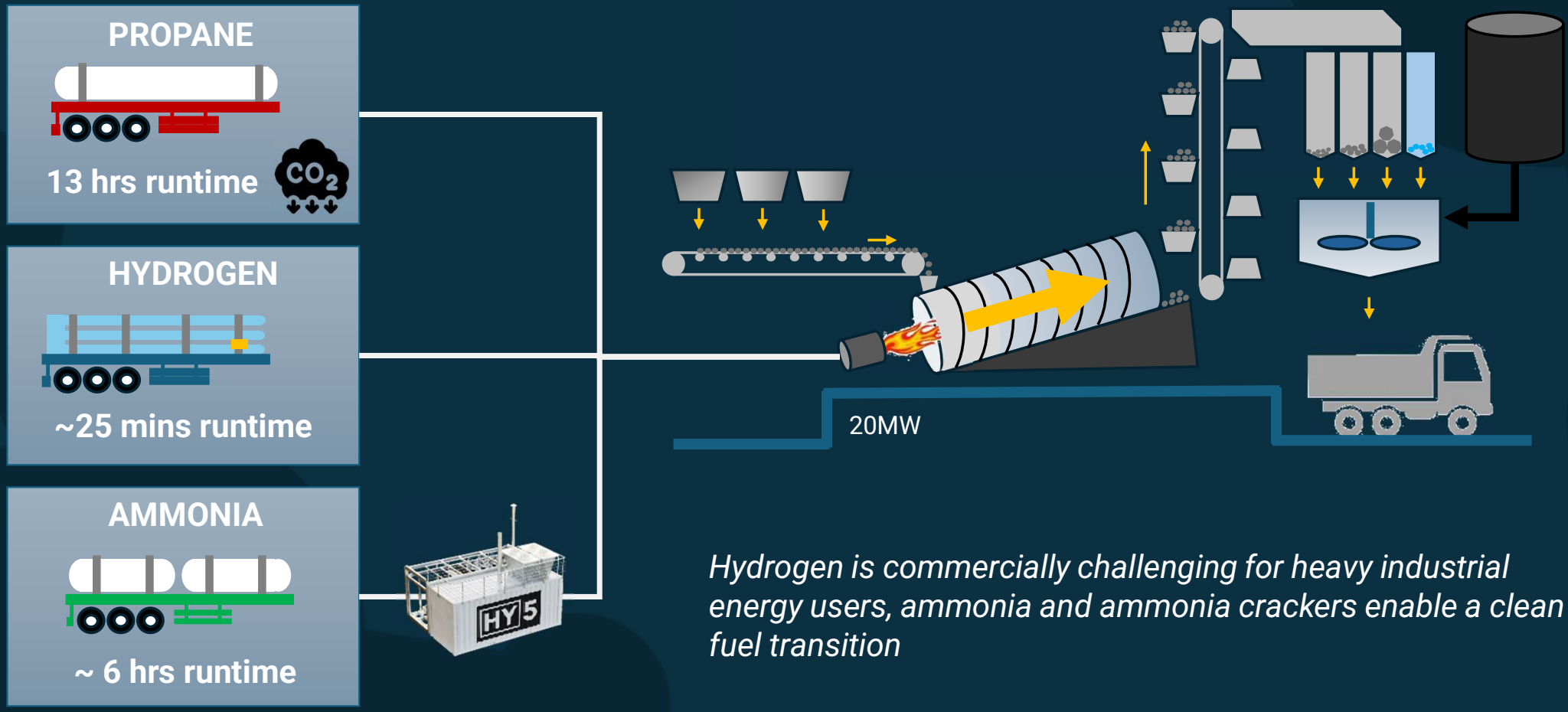
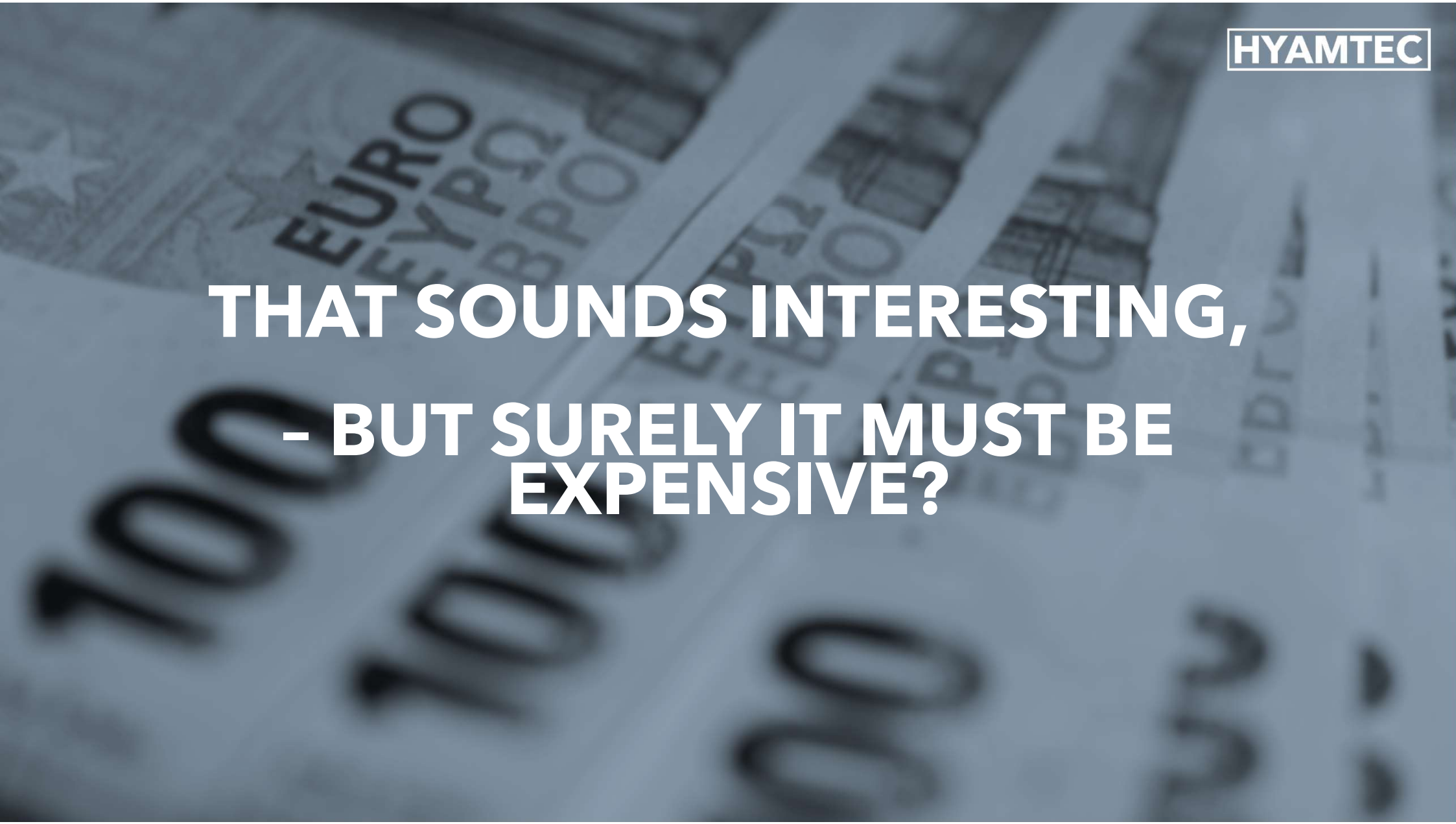


Hydrogen is commercially challenging for heavy industrial energy users, ammonia and ammonia crackers enable a clean fuel transition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THAT SOUNDS INTERESTING,
– BUT SURELY IT MUST BE EXPENSIVE?

Making Hydrogen at a 90% cost reduction

Why ammonia makes sense as a future cleaner fuel

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*Historical grey ammonia pricing **

* Source : Bloomberg

Raw Commodity cost of hydrogen

One Tonne of Ammonia

0.176 Tonnes of Hydrogen

$ ~500 per Tonne NH_3

$ 2.84 per kg

~ £ 2.15 per kg

LCOH = Ammonia Pricing + Ammonia Logistics + Cracker costs + Site Services + Profit

What about comparing costs with electrolysers?

Making hydrogen in locations with cheap renewables and shipping as ammonia makes sense

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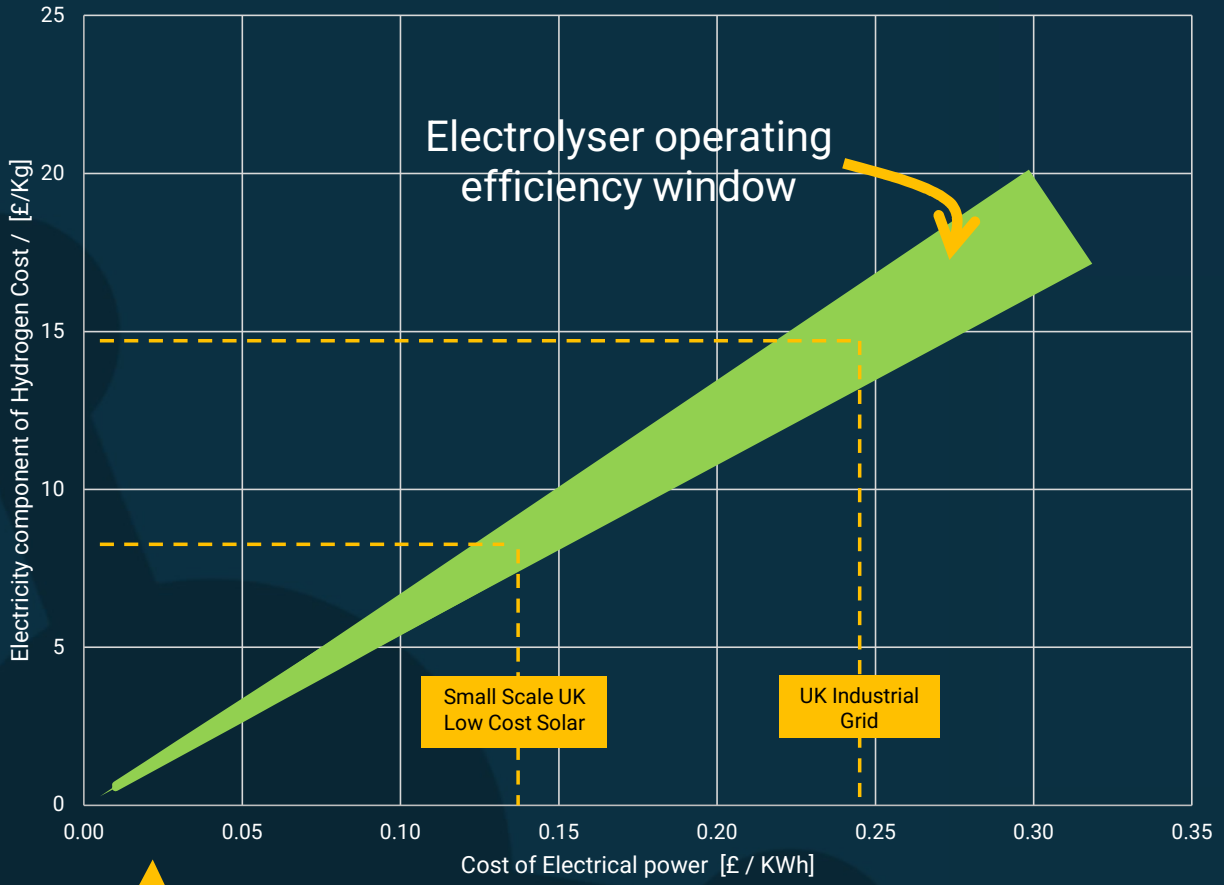

To achieve low hydrogen costs with electrolytic generation, the cost of electrical power needs to be below £ 0.05 / kWh

- You need very low-cost power (i.e. large renewable installations)
- Very low-cost land
- Easy permitting

LCOH = Electricity cost + Water Cost + Electrolyser costs + Site Services + Profit

But How Green Is Ammonia?

Isn't ammonia currently made from fossil fuels?

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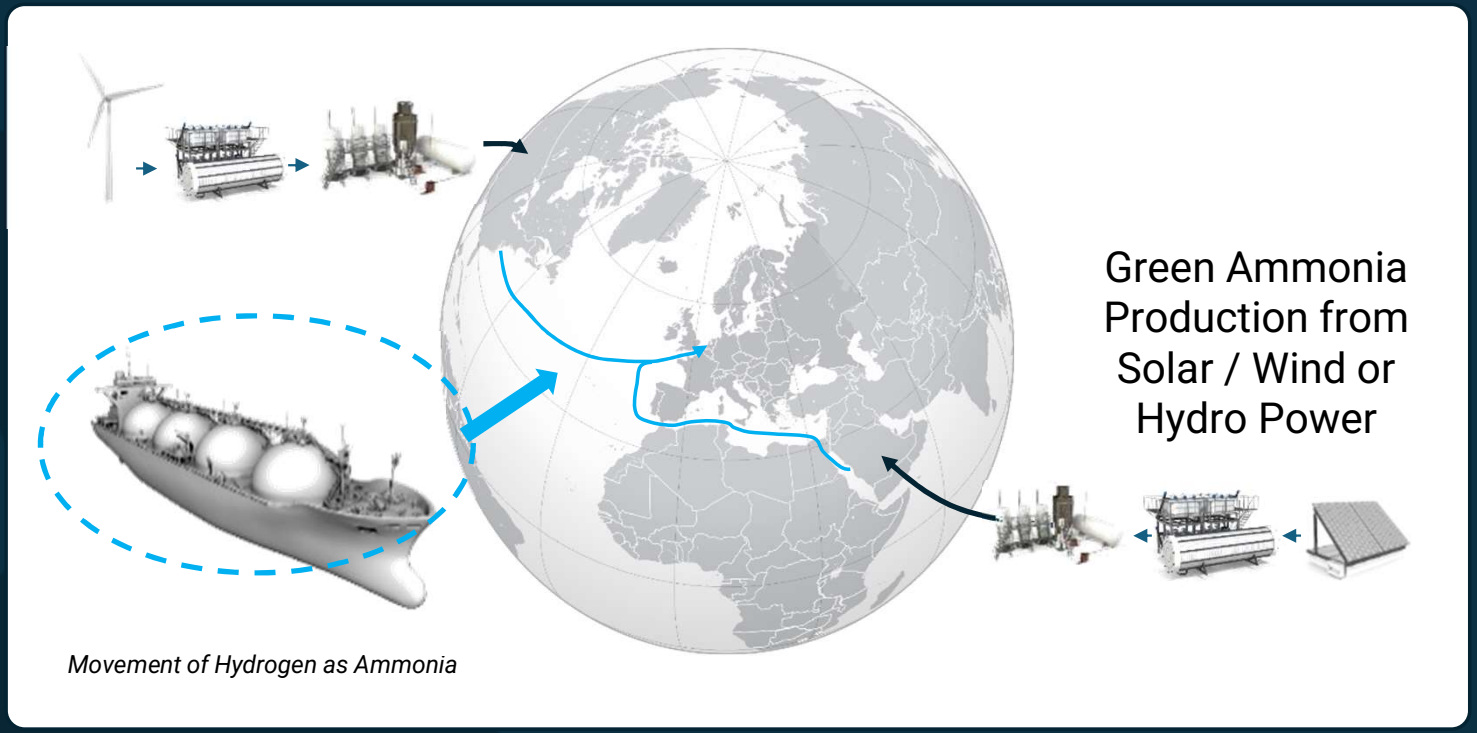

Movement of Hydrogen as Ammonia

1 Make Hydrogen where renewable energy is cheap and plentiful

2 Easily turn it into ammonia and ship it to where there is an energy demand

3 Crack the green ammonia back into hydrogen where and when you need it

But What Is The Availability Of Clean Ammonia?

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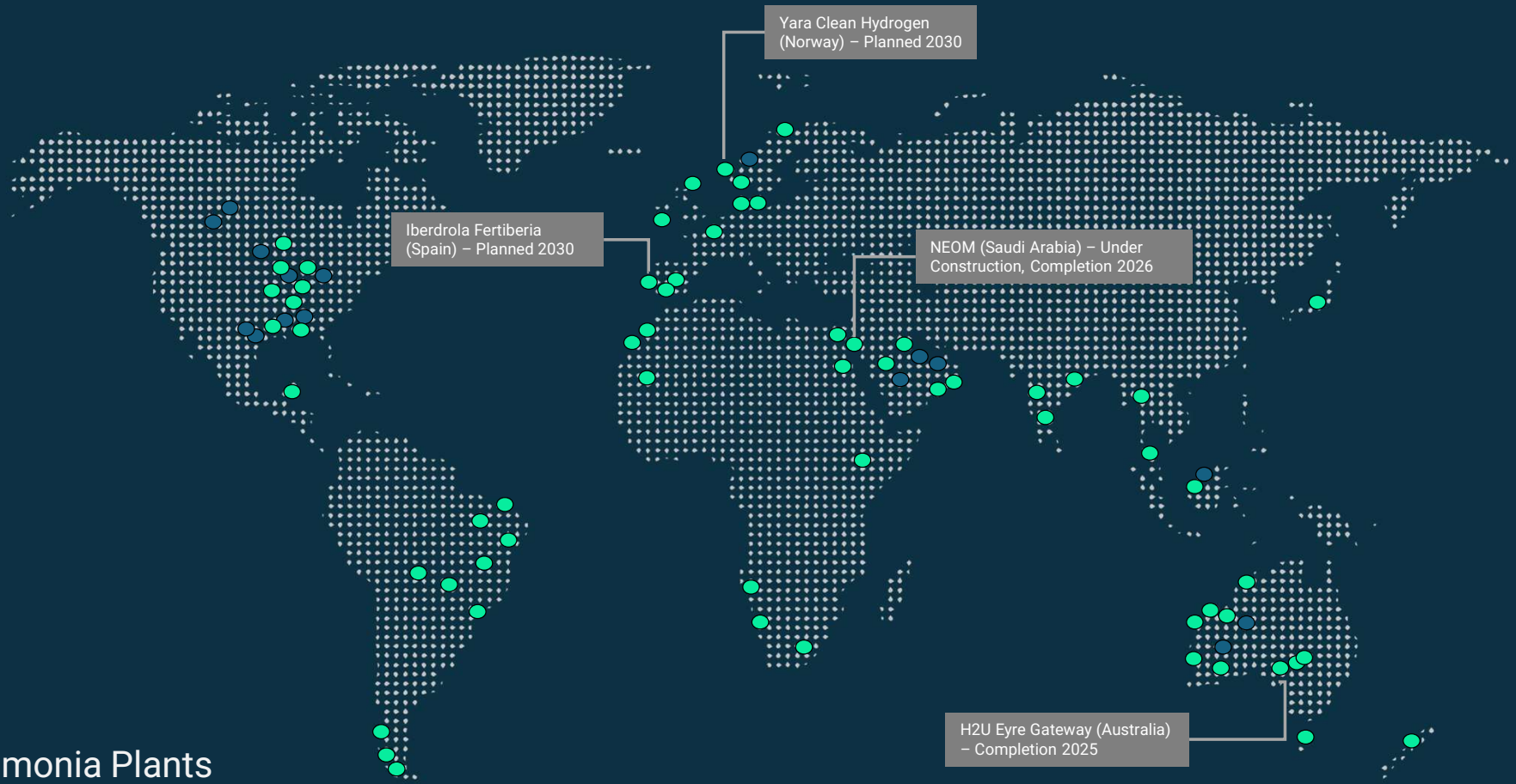
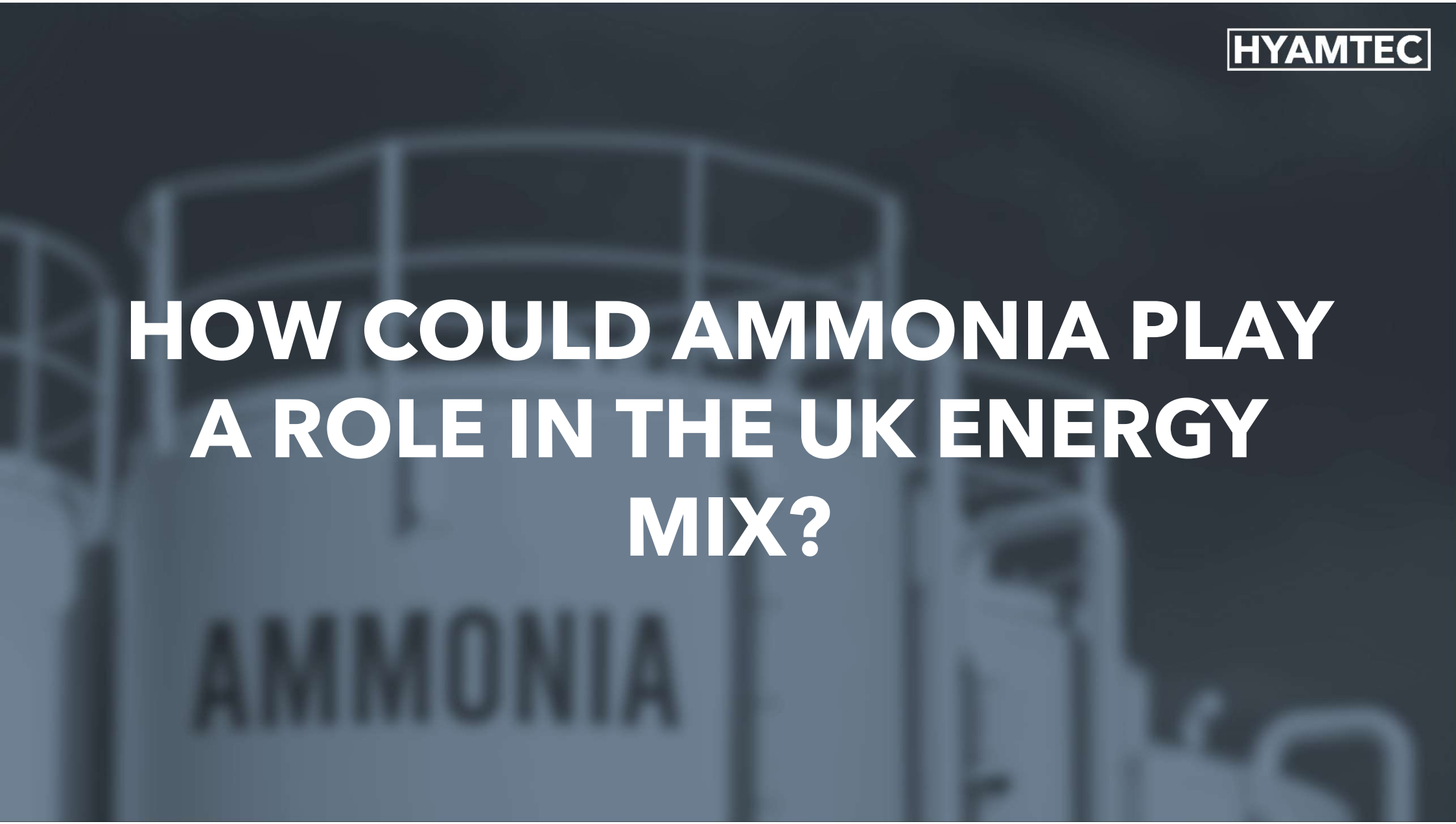
Global footprint of planned clean ammonia production



- Blue Ammonia Plants
- Green Ammonia Plants

Source : Argus Clean Ammonia Projects Tracker Map 2023

Current list of current and proposed clean ammonia projects. Some projects will be at an advanced (Post FID) stage, whereas many would still be at a speculative and scoping stage



HOW COULD AMMONIA PLAY A ROLE IN THE UK ENERGY MIX?

UK Energy Makeup - 2023

Fossil Fuels make up nearly 80% of the total energy supply

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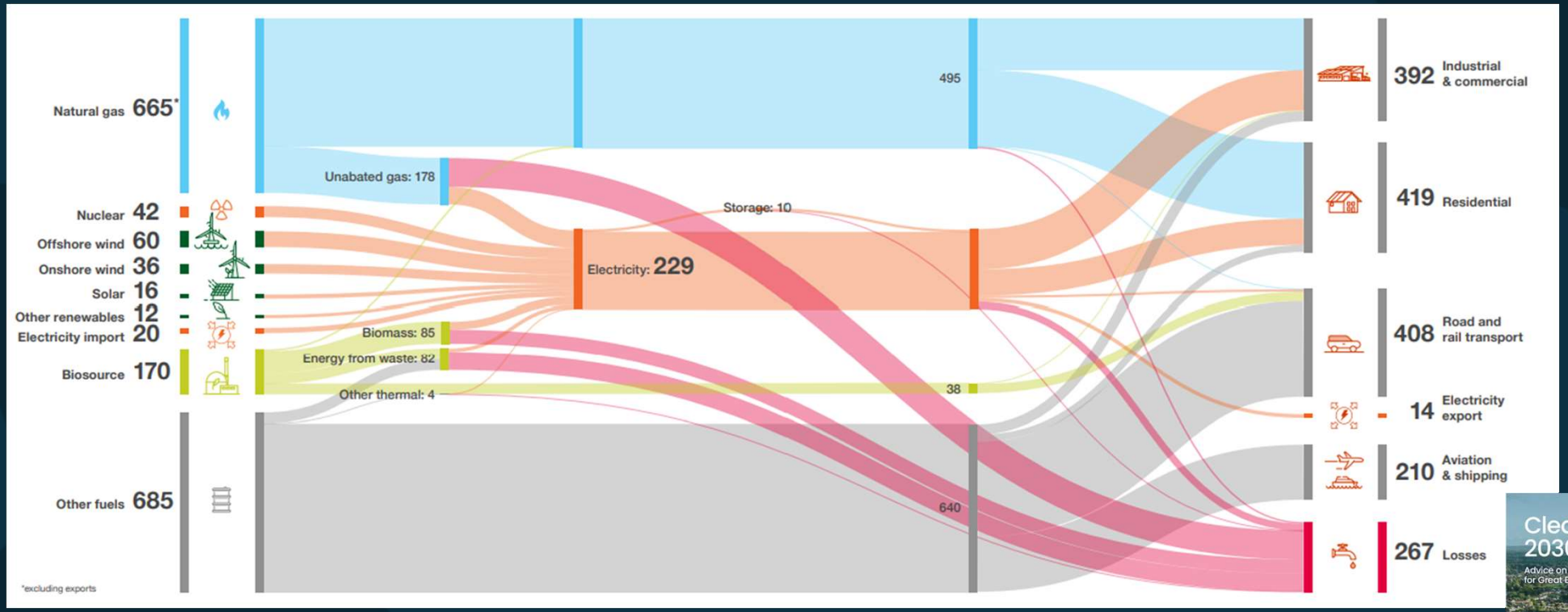

Future Energy Scenarios – July 2024 – National Energy Systems Operator

- UK Energy needs are currently predominantly met by unsustainable chemical fuels
- UK Government are spear-heading net-zero scenarios by 2050

Energy Supply & Demand in 2050

Hydrogen Evolution Scenario

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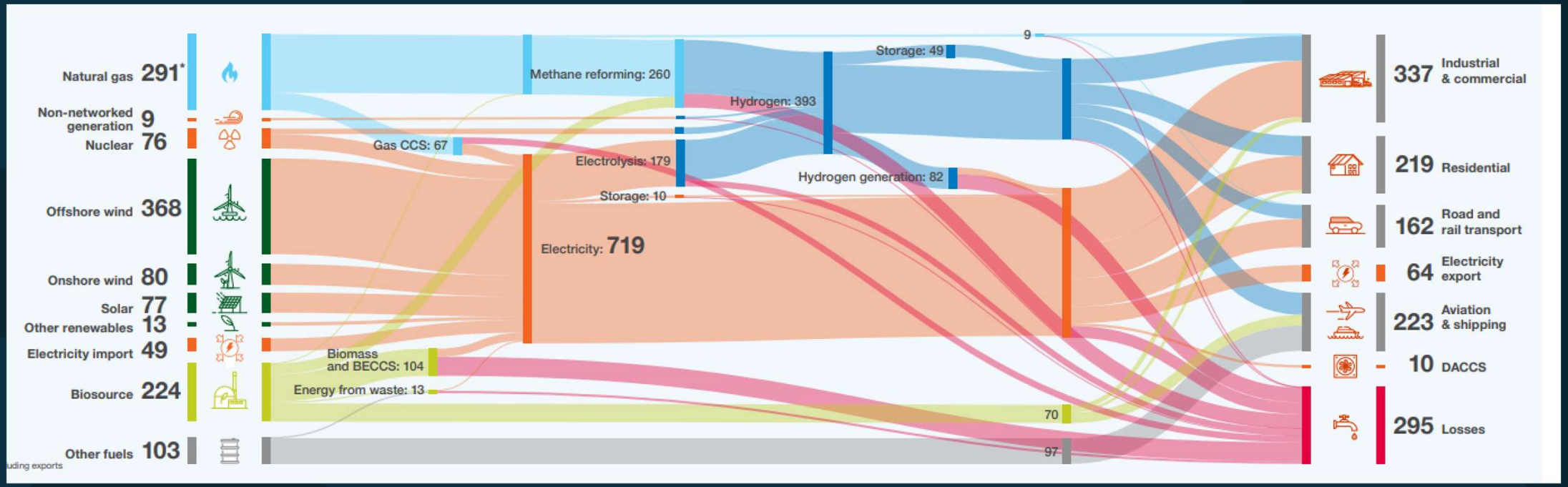

- Positioning to electrification as the dominant energy source
- 30% of energy needed in 2050 supplied by Hydrogen (Made by Steam reforming with CCS)
- 49 TWh of Hydrogen storage required by 2050
- 10 TWh of batteries = 4 Million Battery Containers! (2.5MWh per container) or 3x pumped storage reservoirs

The Rough Gas Fields

Repurposing Geological Salt Caverns (Ex-Gas Fields) for Hydrogen Storage

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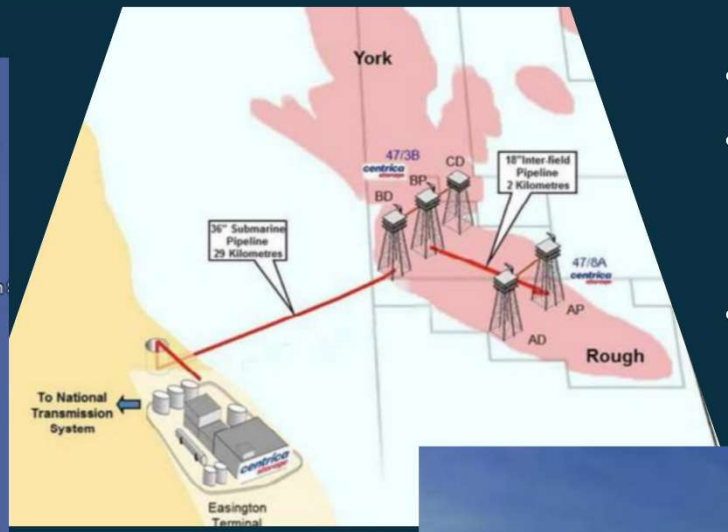
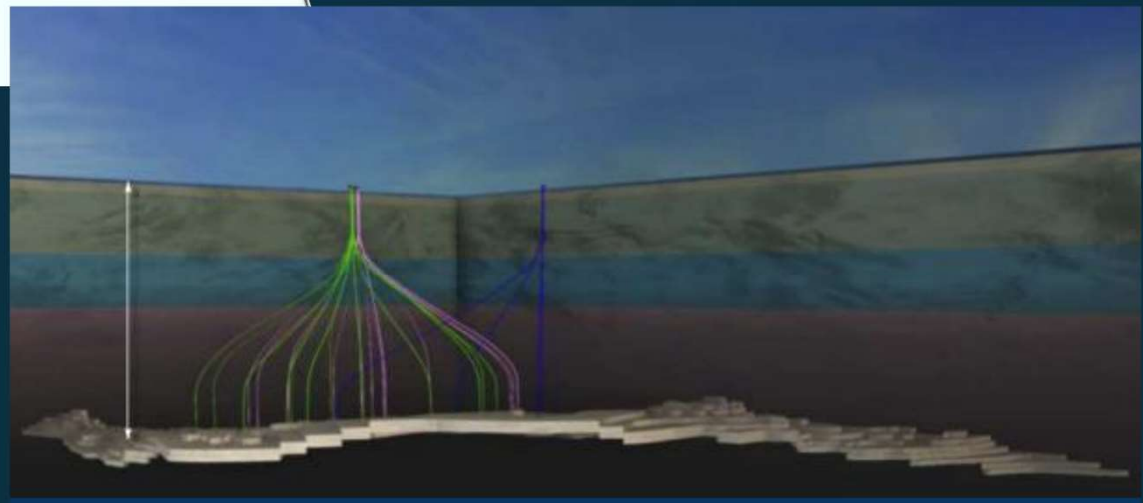


- Located 29 km off-shore (Humber)
- Approx 30 km^2 area and storage capacity of 28 Million Cubic Metres
  - *(or 280 Albert Halls)*
- 3 TWh as Hydrogen (up to 10 TWh)

- Hydrogen Stored between 40 – 70 barg
- Meets temperature, dryness, geological integrity and proximity to land



2743m under the seabed
approximately nine Shards deep

Why not use Ammonia as the energy store

Instead of large-scale storage of hydrogen, store the energy as ammonia

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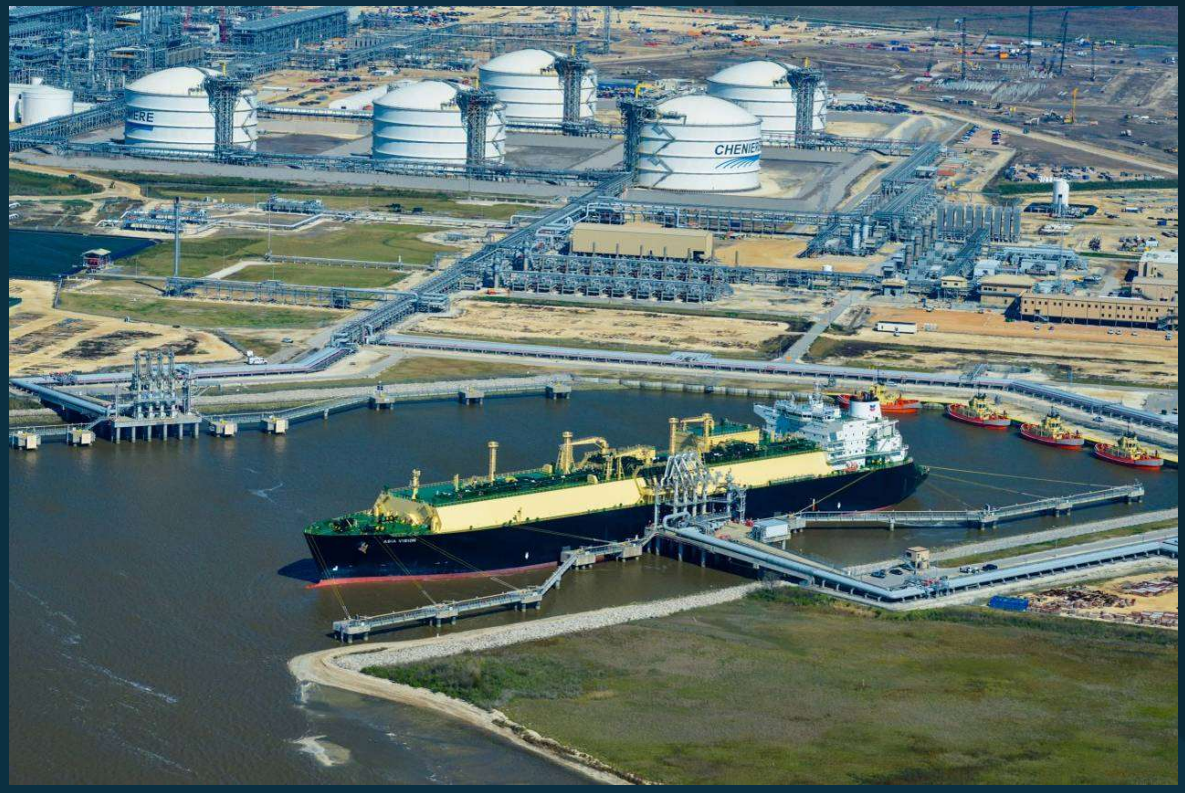
- Using the LNG Analogy
  - Each Storage Tank = 160,000 m^3
  - ~0.5 TWh per tank (As Ammonia)
  - Typical Facility ~ 2.5 – 5 TWh
- UK Maximum Energy Storage Demand in 2050 could be met by 100 ammonia tanks

- Across multiple locations
- Improved Energy Security & Resilience
- Aligned with H_2 Pipelines



Cheniere Energy Louisiana LNG Facility as a model for a future ammonia storage facility

Key Takeaways

To Infinity and Beyond ….

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- Energy storage is going to be one of our biggest future challenges to get away from fossil fuels
  - A significant drive away from carbon-based fuels
  - Large Capacity Long-term storage of electricity is not viable.

- Renewable power needs to be stored in chemical form, either as hydrogen or more likely as a derivative such as ammonia

- We have energy solutions for about 10% of the UK's total 2050 Energy storage needs

- We only have 25 years to solve the other 90%
  → ***And ammonia hopefully will play an infinitely big role!***