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TOGETHER - DELIVERING SUSTAINABLE ENERGY INFRASTRUCTURE

MURPHY

WORLD-CLASS INFRASTRUCTURE

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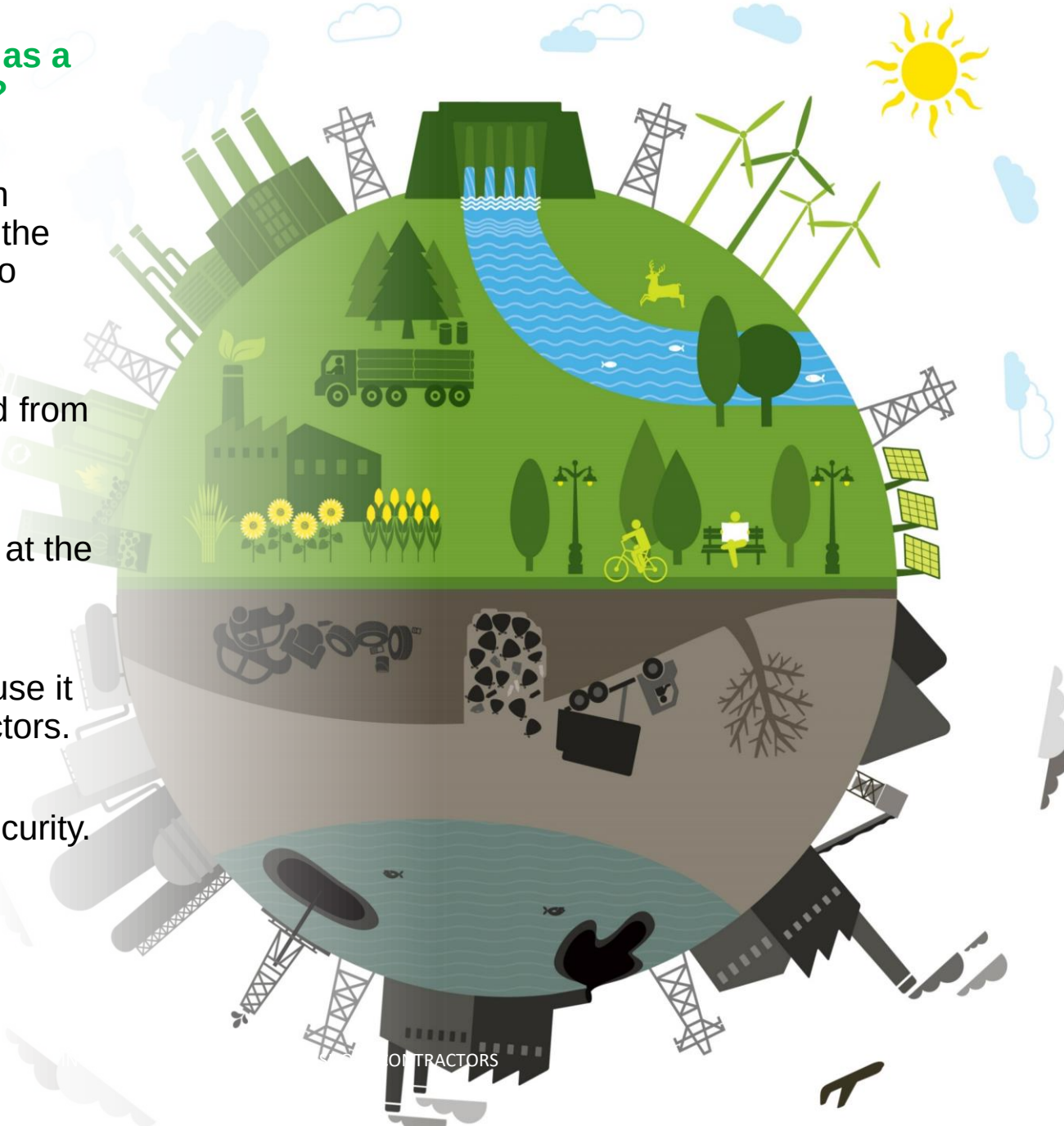
Are you ready for a green flame ?

Santa Cruz de la Sierra

Why is hydrogen important as a future clean energy source?

- Hydrogen can offer a clean energy solution to parts of the economy that are difficult to decarbonise.
- Hydrogen can be extracted from fossil fuels and biomass.
- Hydrogen is emission-free at the point of use.
- Hydrogen is exciting because it can be used in several sectors.
- Hydrogen offers energy security.
- Hydrogen is storable.
- *And its not New !*



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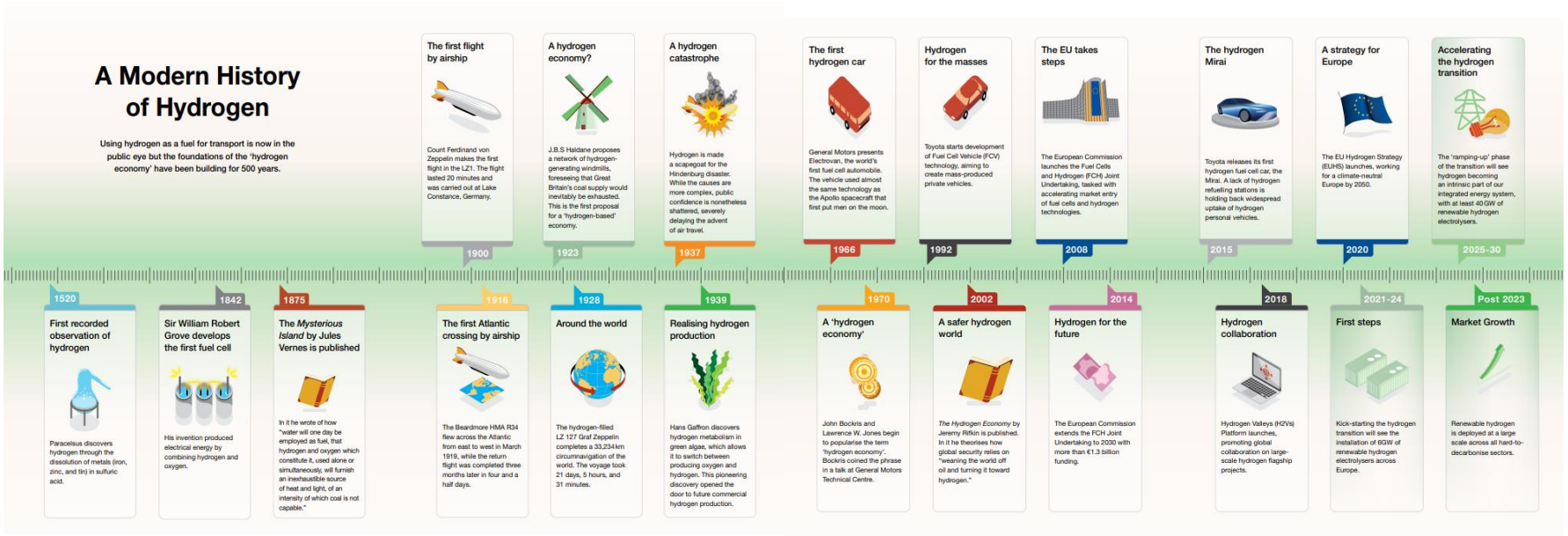

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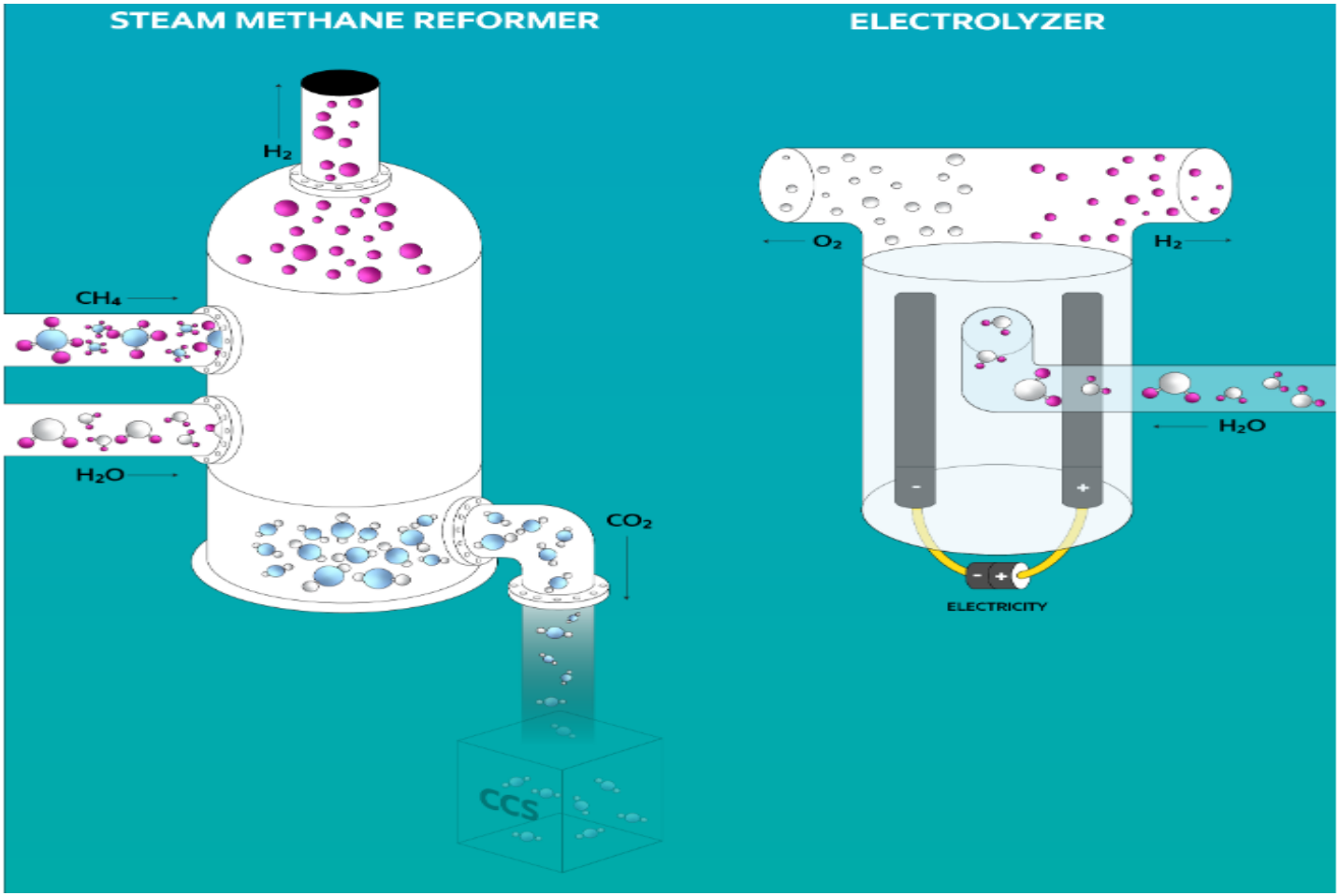
Two most common methods Steam-Methane Reforming & Electrolysis



Green hydrogen

Produced with **no harmful greenhouse gas emissions**, **using clean electricity renewable energy sources**, such as **solar or wind power**, to electrolyse water. Green hydrogen currently makes up a small percentage of the overall hydrogen because **production is expensive**. Just as energy from wind power has reduced in price, **green hydrogen will come down in price as it becomes more common.**

Blue hydrogen

Produced **mainly from natural gas**, using a **process of steam reforming**, which brings together natural gas and heated water in the form of steam. The output is hydrogen – but also **carbon dioxide as a by-product**. That means **Carbon Capture & Storage (CCS) is essential** to trap and store this carbon.

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Grey **hydrogen**

Is created **from natural gas**, or methane, using steam methane reformation but **without capturing the greenhouse gases.**

Black and brown hydrogen

Using **black coal in the hydrogen-making process**, these black and brown hydrogen are the **absolute opposite of green hydrogen** in the hydrogen spectrum and the most **environmentally damaging**.

Just to confuse things, any hydrogen made from fossil fuels through the process of ‘gasification’ is sometimes **called black or brown hydrogen interchangeably**.

Pink, Purple & Red hydrogen

Generated through electrolysis powered by nuclear energy. Nuclear-produced hydrogen **can also be referred to as purple hydrogen or red hydrogen**.

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Turquoise hydrogen

This is a **new entry** in the hydrogen colour charts and production **has yet to be proven at scale.** Hydrogen is made using a **process called methane pyrolysis to produce hydrogen** and solid carbon.

Yellow hydrogen

Yellow hydrogen is a **relatively new phrase for hydrogen made through electrolysis using solar power.**

White hydrogen

White hydrogen is a **naturally-occurring geological hydrogen** found in underground deposits and **created through fracking**. There are **no strategies to exploit this hydrogen currently.**

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What are the potential brakes to speeding up hydrogen use as a clean energy?

For hydrogen to be a viable alternative to methane, **it has to be produced at scale, economically** and the **current infrastructure needs to be adapted**.

Existing infrastructure and New infrastructure equipment, materials and fitting will need to be analysed for **"fit for purpose**".

The journey to **100% Hydrogen** can **embrace Blending**.

The good news is that hydrogen could **be transported through existing gas pipelines, minimising disruption, and reducing the amount of expensive infrastructure** needed to build a new hydrogen transmission network.

Stakeholders, Energy companies, and Governments, **support is required at scale.**

There would also be a need for a **culture change** in our home lives, as people are used to using natural gas for cooking and heating, and hydrogen energy equivalents are emerging.

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2030	2035	2050
50GW offshore wind	Up to **70GW** solar	**24GW** civil nuclear deployment
10GW hydrogen production	Decarbonised UK electricity system	
4 CCUS industrial clusters		Climate Change Act 2008 **Net Zero by 2050**

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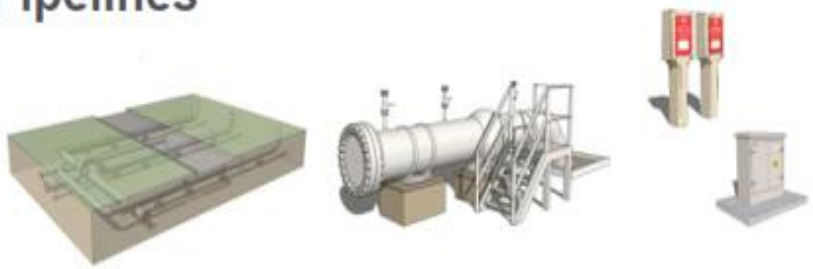
Pipelines



Below ground pipelines, above ground installations, cathodic protection systems, PIG traps and Protection Sleeves

Compressors

Gas Generators, Variable Speed Electric Drives, Compressors, Power Turbines, Starter Motors & Vent Systems

Valves

Valves, Scrubbers, Filters, Strainers, Preheaters, Pressure Reduction, AGI CP systems, etc

Electrical & Control

Standby Power Supplies, HV Switchgear, Transformers, LV Switchboards & Distribution, Standby Generators, site lighting and site electrical systems

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Offline hydrogen test facility

NTS assets of different types, sizes & material grades will be tested with 2, 20 & 100% hydrogen

Testing 3 concentrations of hydrogen:

- 2%
- 20%
- 100%

Understanding the impact on a range of key NTS assets including:

- Steel Pipeline & Bends
- Welds
- Valves
- Flow Control Valves
- Pre-Heater and Regulators
- Filters & Meter Streams

NTS hydrogen safety case review

Understanding the impacts of difference concentrations of hydrogen and develop our safety standards:

- Procedure Review
- Hazard Assessment of Transmission System (HATS)
- Quantitative Risk Assessment (QRA)
- Hazardous Area Impact
- Overpressure Risk (OR)
- NGGT Safety Case

Standalone hydrogen tests

Standalone hydrogen tests will provide key data required to feed into the main facility

Conducting a range of standalone hydrogen tests to feed into the main facility:

- Materials testing
- Pipe coating testing
- Fatigue testing
- Flange testing
- Asset leak testing
- Rupture testing






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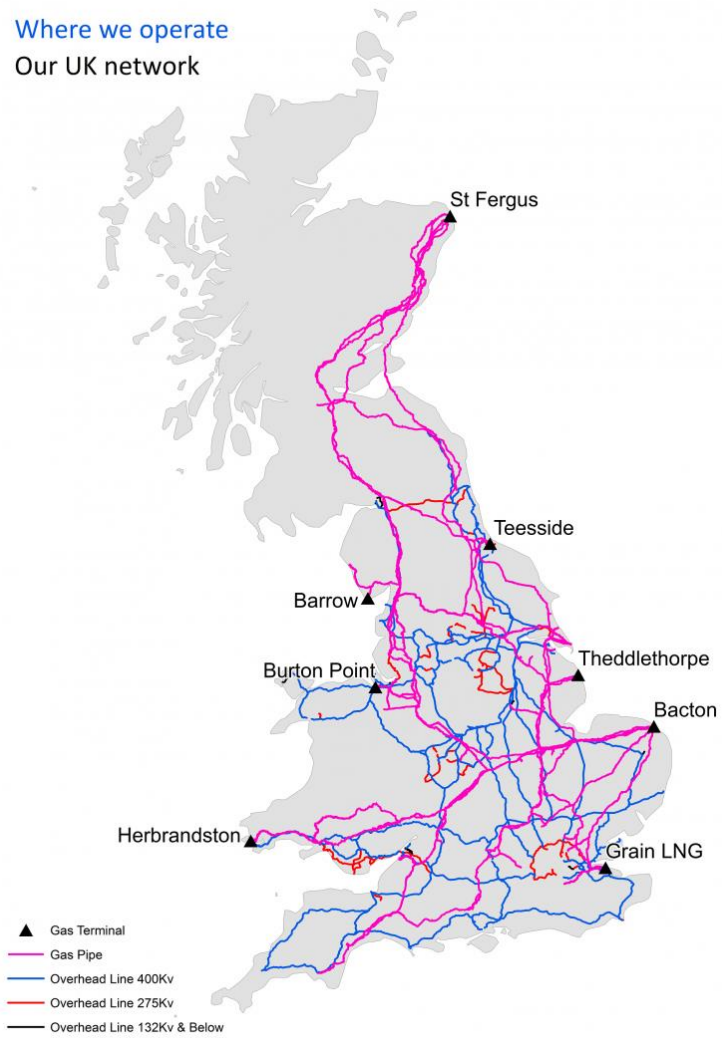
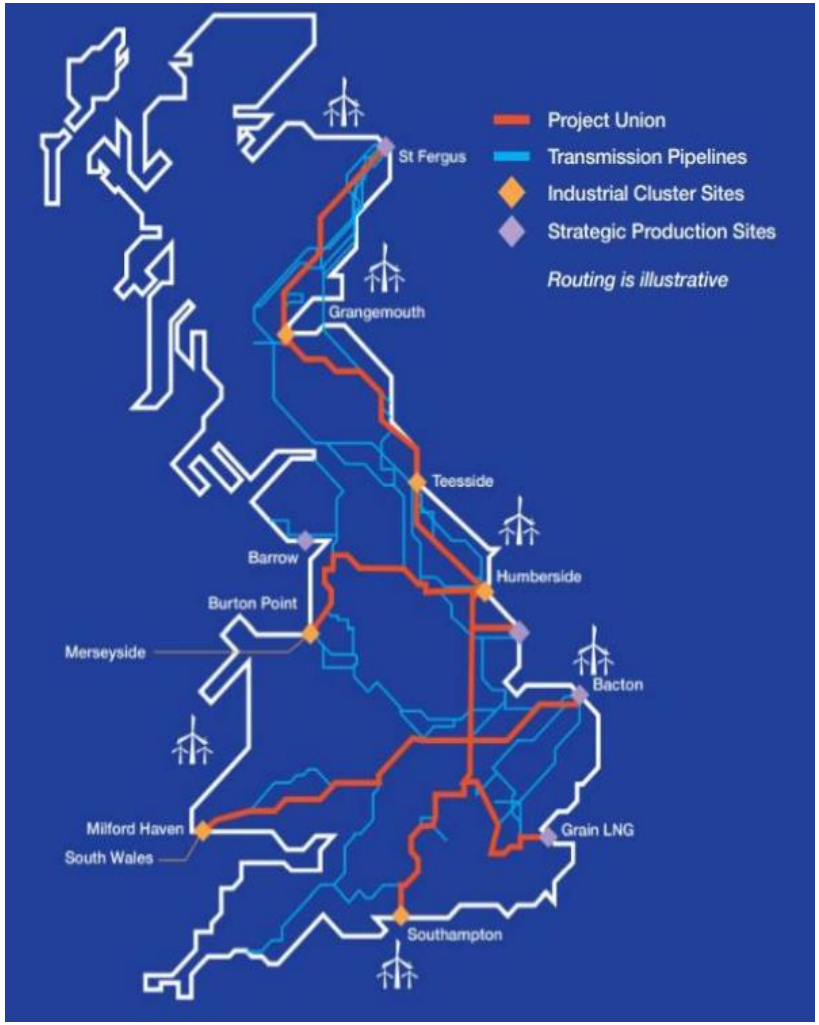
Where we operate

Our UK network





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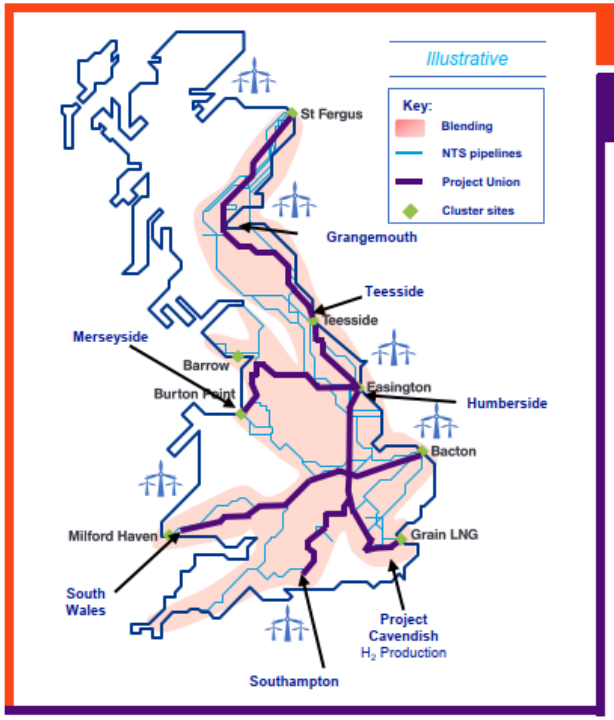

Rollout of blending across the NTS

Strategic rollout of 100% pipeline connections

Delivering a Dual Pathway to transitioning the NTS to hydrogen:

- In 2024/5 low level hydrogen blending will be facilitated on the transmission network
- From 2025 onwards blending could extend and increase up to 20% and greater if deblending technologies can be proven.
- In 2028/9 Project Union will deliver the first phases of 100% hydrogen transmission pipeline between the northern clusters
- By 2033 Project Union will have delivered a circa 2000km hydrogen backbone joining key production and use clusters
- Asset conversion continues to 2045 to deliver a complete 100% hydrogen network.

Net Zero 2050

Levelling up, Job Creation

Global Leader in Green Innovation

Providing flexibility and optionality

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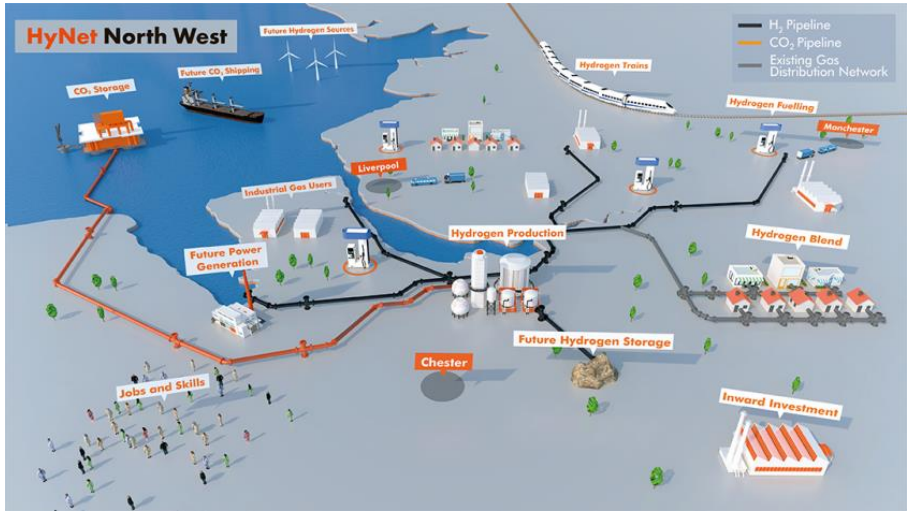
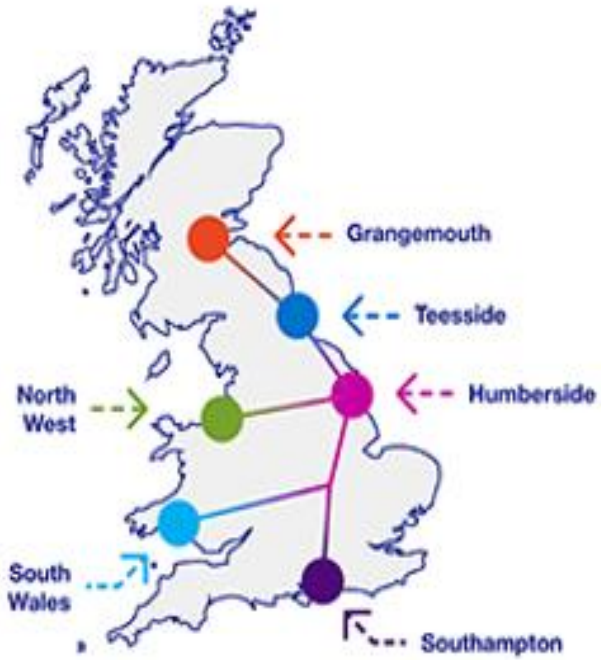
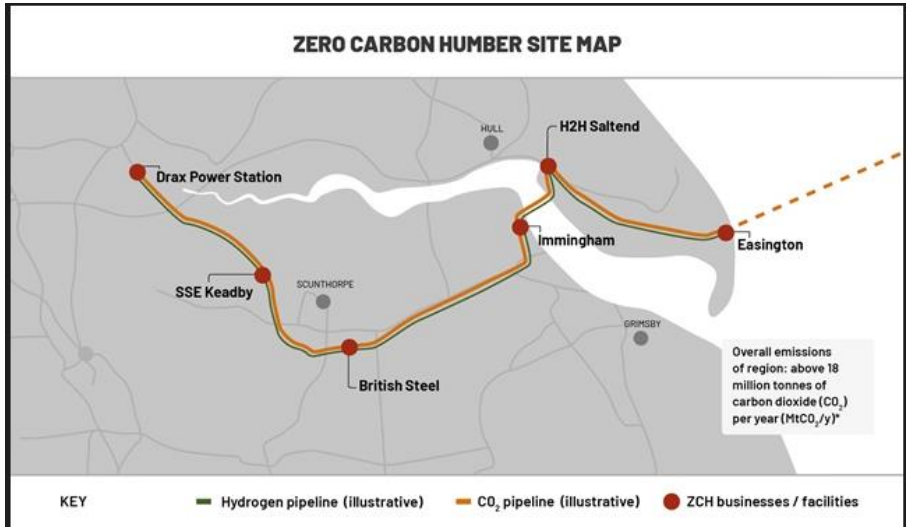
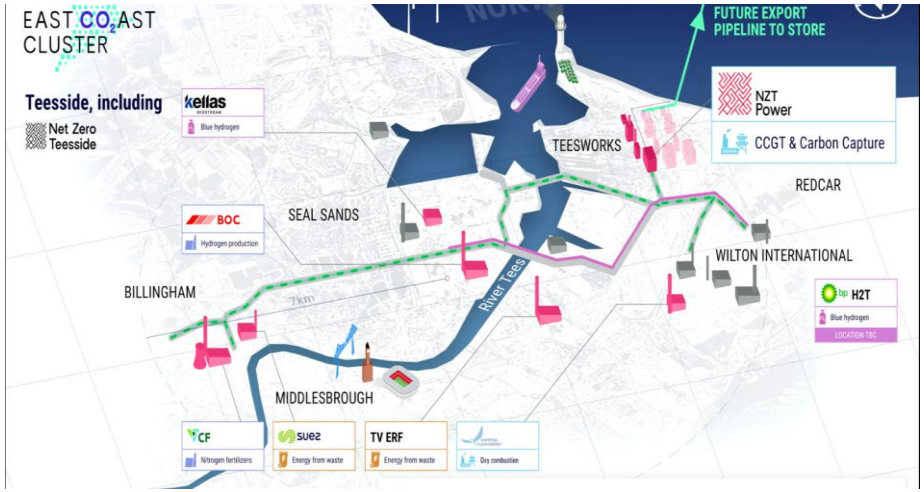
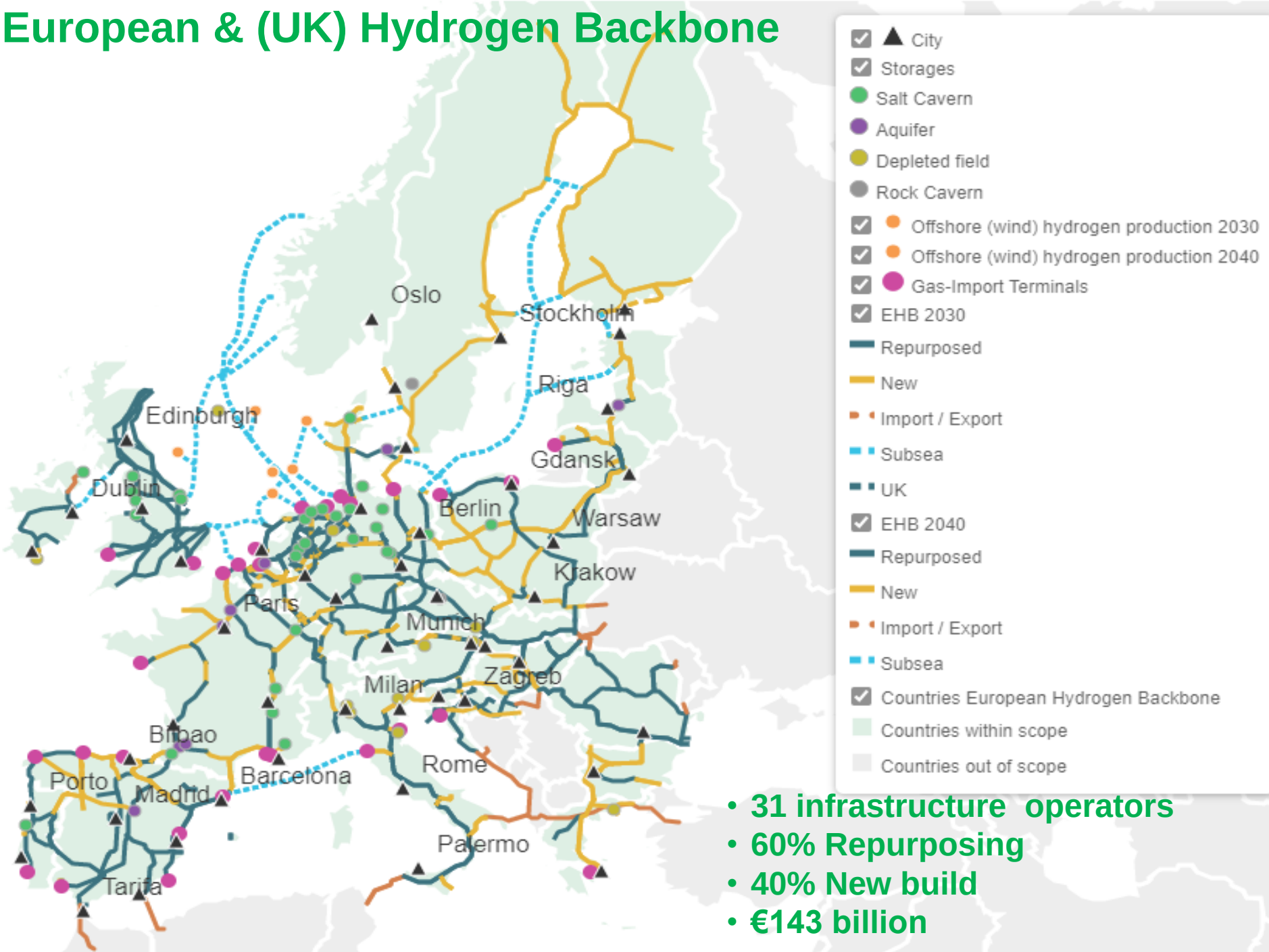








European & (UK) Hydrogen Backbone



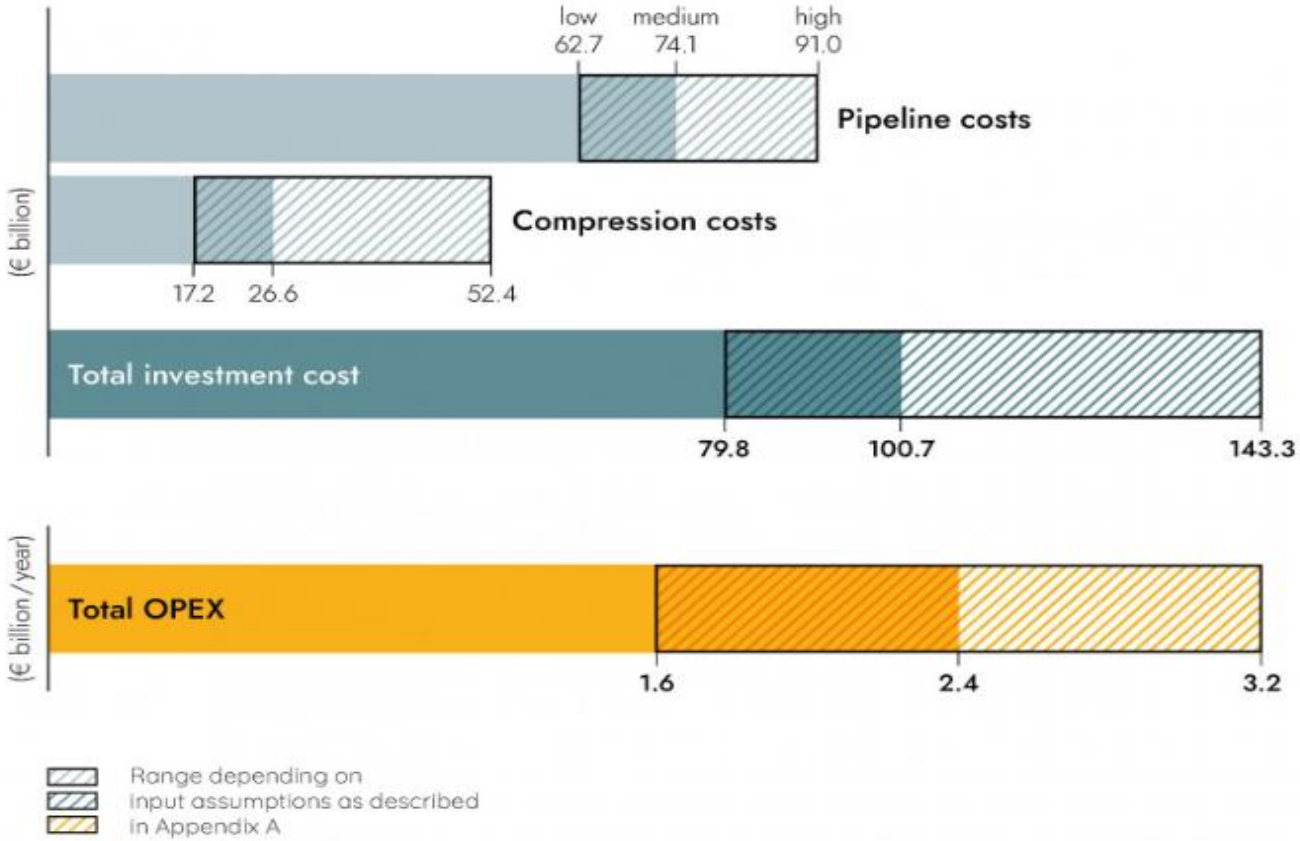
- **31 infrastructure operators**
- **60% Repurposing**
- **40% New build**
- **€143 billion**

Estimated Investment & Cost

The 53,000 km European Hydrogen Backbone for 2040 as proposed in this report requires an estimated total investment of €80-143 billion, based on using 60% of repurposed natural gas pipelines and 40% new pipeline stretches.

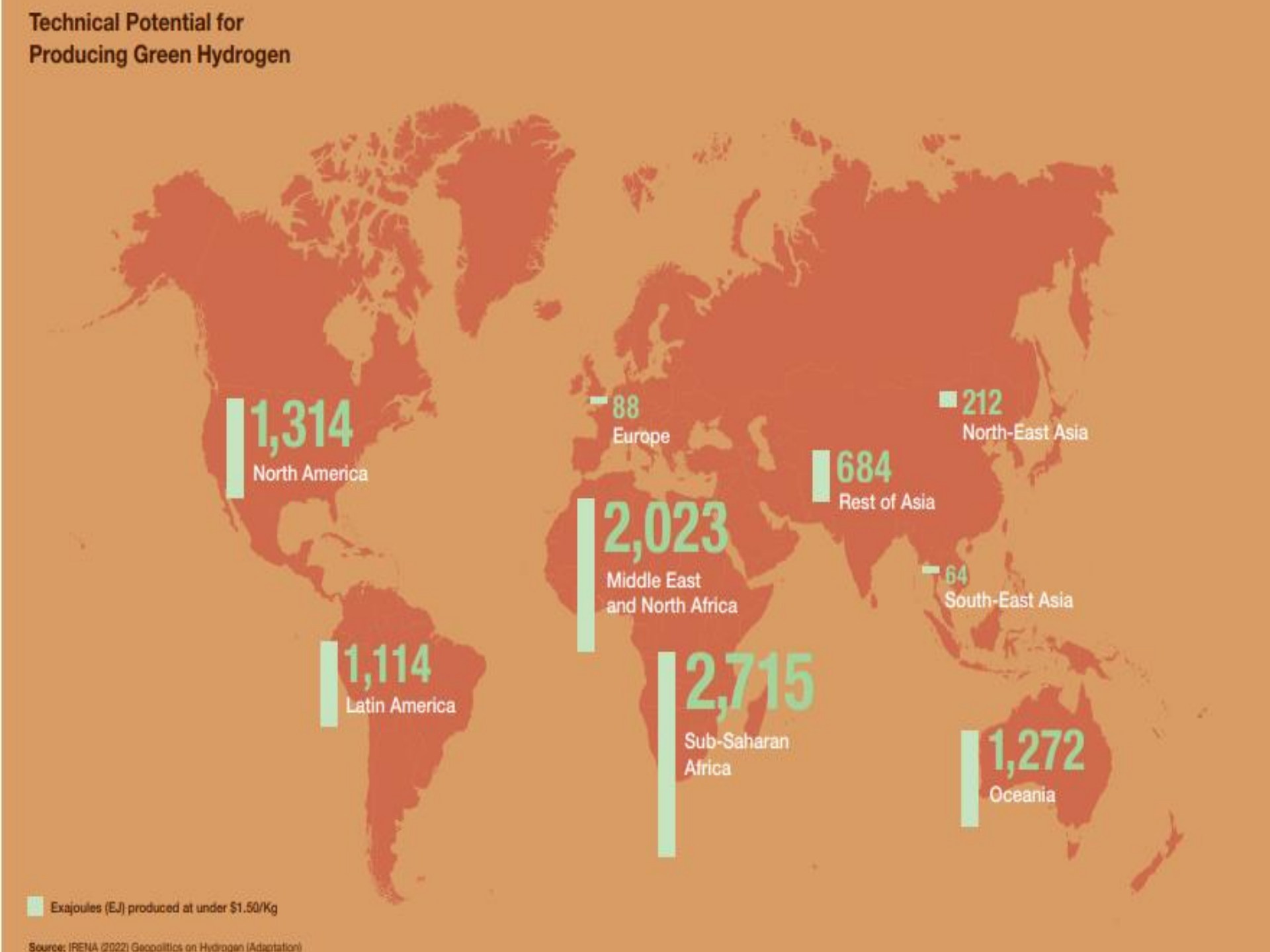
This investment cost estimate, which is relatively limited in the overall context of the European energy transition[GLG2], includes subsea pipelines and interconnectors linking countries to offshore energy hubs and potential export regions such as Norway. Taking into account offshore pipelines, the levelised transport cost for the entire EHB amounts to €0.11-0.21 per kg of hydrogen when transporting over 1,000 km.

Investment cost



Estimated investment and operating costs of the European Hydrogen Backbone (2040)

Technical Potential for Producing Green Hydrogen



Source: IRENA (2022) Geopolitics on Hydrogen (Adaptation)

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Hydrogen/CCS – The Opportunity:

- For contractors, the opportunities in a growing hydrogen and CCUS economy are extensive:
    - Development of standards and specifications
    - Design & Development
    - Assurance
    - Production assets and pumping stations
    - Retrofit of existing assets
    - Asset repurposing
    - Storage
    - New Build
    - Decentralised energy hubs
    - Distribution

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Energy Transition Committee

INFORMATION SHARING AND EXCHANGE

Key areas of focus to be collated and stored for members reference on the IPLOCA website under

- **Policy & Standards**
  - Government policy, Standards & Specifications
- **Technologies & materials**
  - Welding*
  - Equipment, Fittings, and Pipe*
  - Plant and Machinery*
- **Research & Development**
  - Skills development, and Education
- **Net Zero**
  - Net Zero construction*
  - Net Zero projects*

*Information will be stored in **5** region* **North & South America, Europe, East & Far East, Middle East & Africa and Latin America**

green products & services

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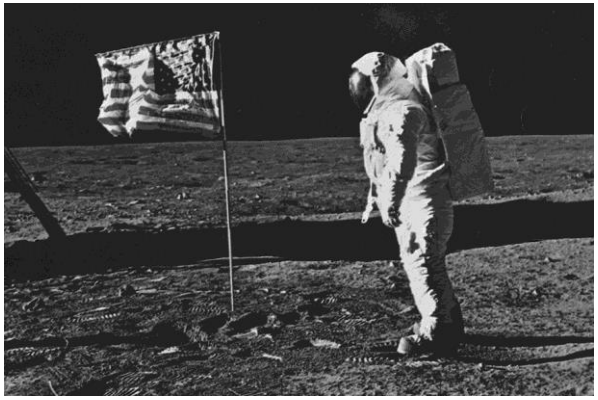
Decarbonization & Hydrogen – Reality or a Dream



When **Kennedy** said we would send a **man to the moon**, people were doubtful this could, or should happen. History may paint a rosier picture, **but in 1969, only 47% of the public supported the moon landing**. They weren't necessarily on board, but for the teams of scholars, researchers, scientists and engineers working around the clock, **failure was not an option.**

Today, we're seeing a lot **of parallels** when it comes to decarbonization and the hydrogen future, this transformation is being referenced as "***the new "moon shot" - of the 21st century*"**, the mass promises of delivering net-zero carbon emissions or carbon-free energy in a rapidly decentralizing marketplace.

There's no clear path to decarbonization and **no single rocket ship** that will get us there. Although it's **a common goal, all of the stakeholders, energy companies, and governments,** are at **different starting points, with different drivers, timelines, investments and network and asset complexity.**

What is known is that **decarbonization will require a colossal effort. The energy sector knows where they want to go, and they know that a moon shot is necessary to get there, but the exact trajectory remains unclear.**

The energy sector has more **options than ever before,** to **embrace alternative energy. government and energy companies are actively evaluating all of these technologies as they build their "rocket ships."**

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We're currently used to a blue flame from gas, so what colour will a hydrogen flame be?

The industry has not yet reached a consensus on this, but it will be the most obvious difference for customers who've been used to seeing a blue gas flame inside their boilers or when igniting their appliances

Hydrogen burns with a pale blue flame that is nearly invisible in daylight.

The flame colour for hydrogen would be specifically added.

Are you ready for a green flame?

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Thank You

and

Questions