Barents Blue clean ammonia project

Carbon intensity and sustainability factors

26 April 2022

Horisont energi

Horisont Energi in brief

Horisont Energi is accelerating the transition to carbon neutrality through pioneering projects

- A clean energy company founded in 2019, with offices in Norway and the UK
- Experienced team with a "get it done" attitude - first pureplay carbon offshore company
- Listed on Euronext Growth Oslo early 2021, strong investor line-up
- Focusing on Industrial Scale, Value Creation and Carbon Neutrality in all we do

Our business: Clean ammonia, carbon capture and storage, and shipping

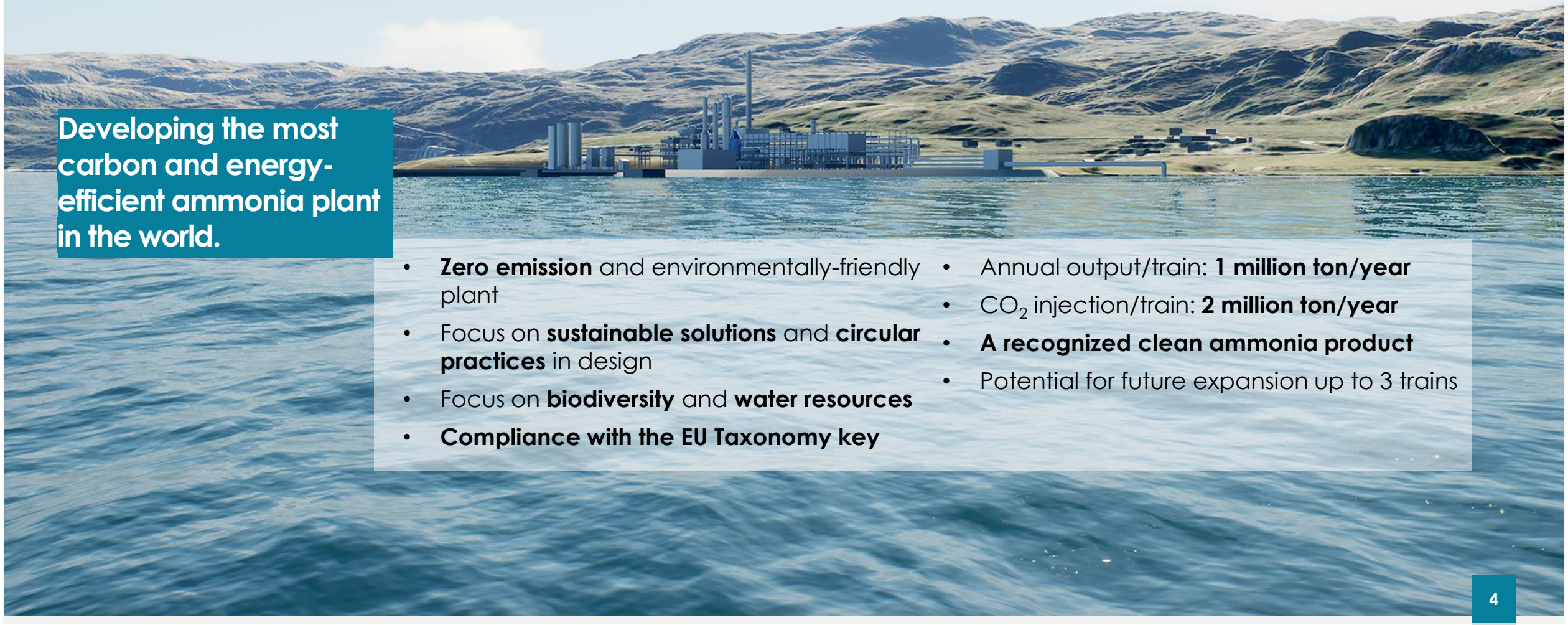
- **Clean hydrogen/ammonia:** We develop Europe's first world-scale clean ammonia plant – Barents Blue
- **Carbon storage:** Polaris carbon storage project – the first after Northern Lights
- **Carbon removal**: Commercialization of negative emissions – a key part of energy transition


Horisont energi
Mission Statement
ACCELERATING THE TRANSITION TO CARBON NEUTRALITY THROUGH PIONEERING PROJECTS
Vision
A NEW STANDARD FOR OTHERS TO FOLLOW
Overarching Goals
PREFERRED
PROFITABLE
PLURALISTIC

Project Barents Blue

Europe's first world-scale clean ammonia plant

European Commission | IPCEI Hydrogen Project



Developing the most carbon and energy-efficient ammonia plant in the world.

- **Zero emission** and environmentally-friendly plant
- Focus on **sustainable solutions** and **circular practices** in design
- Focus on **biodiversity** and **water resources**
- **Compliance with the EU Taxonomy key**

- Annual output/train: **1 million ton/year**
- CO_2 injection/train: **2 million ton/year**
- **A recognized clean ammonia product**
- Potential for future expansion up to 3 trains

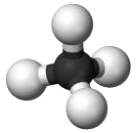
Ultra low carbon clean ammonia

Power purchase

Renewable hydro and wind power

Power

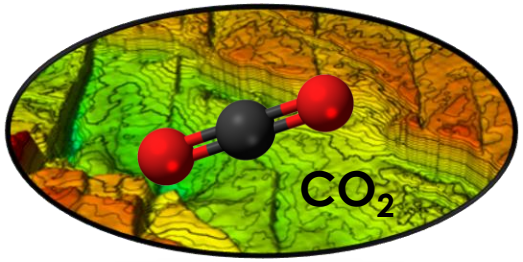
Gas purchase



CH4 +

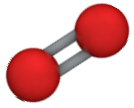
Gas feedstock

Reservoir sequestration

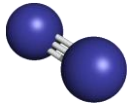


Carbon dioxide

>99%



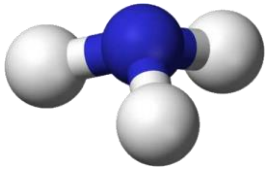
O_2 (from air)



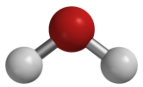
N_2 (from air)

Scope 1 and scope 2:
Less than 20 kg CO_2e/ton NH_3

NH_3



H_2O



Great interest for the Barents Blue project in Norwegian and international press

Equinor and Horisont progressing Barents Sea carbon capture project

Proposed CCS project will have the capacity to store roughly double Norway's annual greenhouse gas emissions as Equinor targets blue ammonia production

Horisont Energi and E.ON Enter Cooperation Agreement With E.ON Acquiring 25 Percent Stake

Norway awards CCS licenses to Equinor, Horisont Energi, Vår Energi

CARBON CAPTURE USAGE & STORAGE

April 5, 2022, by Sanja Pekic

The Norwegian Ministry of Petroleum and Energy has awarded carbon capture and storage (CCUS) licenses to Equinor, Horisont Energi, and Vår Energi.

Illustration; Courtesy of Horisont Energi

CCUS is necessary for achieving the climate goals. Carbon transport and storage infrastructure (CCS) is crucial for providing CO2 solutions on a commercial basis.

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Horisont Energi, Equinor and Vår Energi join for blue ammonia plant

Sep 09 2021

The companies have entered into a cooperation agreement for the development of Barents Blue, Europe's first large-scale production facility for blue ammonia.

Horisont Energi and Port of Rotterdam join forces on blue ammonia shipping

BUSINESS DEVELOPMENTS & PROJECTS

August 5, 2021, by Sanja Pekic

Norwegian clean energy company Horisont Energi and the Port of Rotterdam have agreed on transporting blue ammonia from Norway to Rotterdam.

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THE FUTURE OF OFFSHORE ENERGY & TECHNOLOGY.

REGIONS ENERGY GEOSCIENCE ENGINEERING TECHNOLOGY VESSELS SUBSEA

Horisont Energi Taps Saipem, Technip Energies for Barents Blue Ammonia Project

June 15, 2021

Credit: Zerbor/AdobeStock

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Norwegian carbon tech company Horisont Energi has selected Saipem and Technip Energies for two independent concept studies for the full conceptual design of the Barents Blue carbon-neutral ammonia plant in Hammerfest, northern Norway.

– Blå ammoniakk en viktig del av det grønne skiftet

Pensjons- og finansselskapet KLP eier 7,4 prosent av Horisont Energi og har stor tro på den planlagte ammoniakkproduksjonen i Hammerfest.

Horisont Energi completes Barents Blue project feasibility phase

BUSINESS DEVELOPMENTS & PROJECTS

May 26, 2021, by Adnan Bajic

OFFSHORE ENERGY NEWS PREMIUM EDITORIALS PARTNERS

Horisont Energi completes Barents Blue project feasibility phase

BUSINESS DEVELOPMENTS & PROJECTS

Horisont Energi Barents Blue project awarded NOK 482 million Enova grant for IPCEI Hydrogen participation

17 DEC 2021 08:05 CET

Summary
Setting the standard for clean ammonia

Carbon intensity and sustainability factors is key for clean production:

- High Environmental standard
- Higher safety level
- Ultra low carbon footprint (>99%)

Carbon intensity of the gas source origin:

- Low carbon gas source
- Ultra low methane emissions

Illustration picture

ACCELERATING THE TRANSITION TO **CARBON NEUTRALITY THROUGH PIONEERING PROJECTS**

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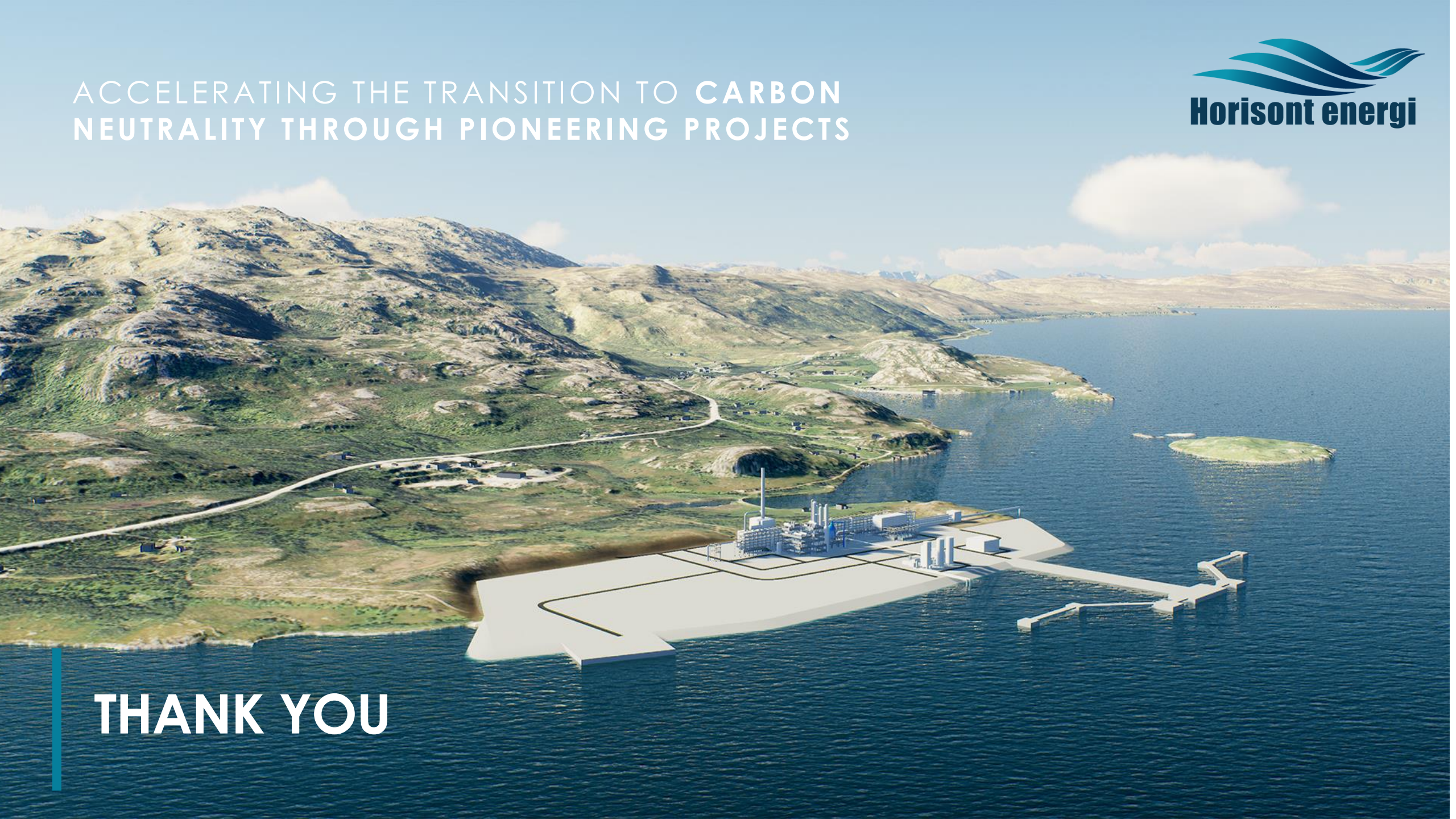


THANK YOU

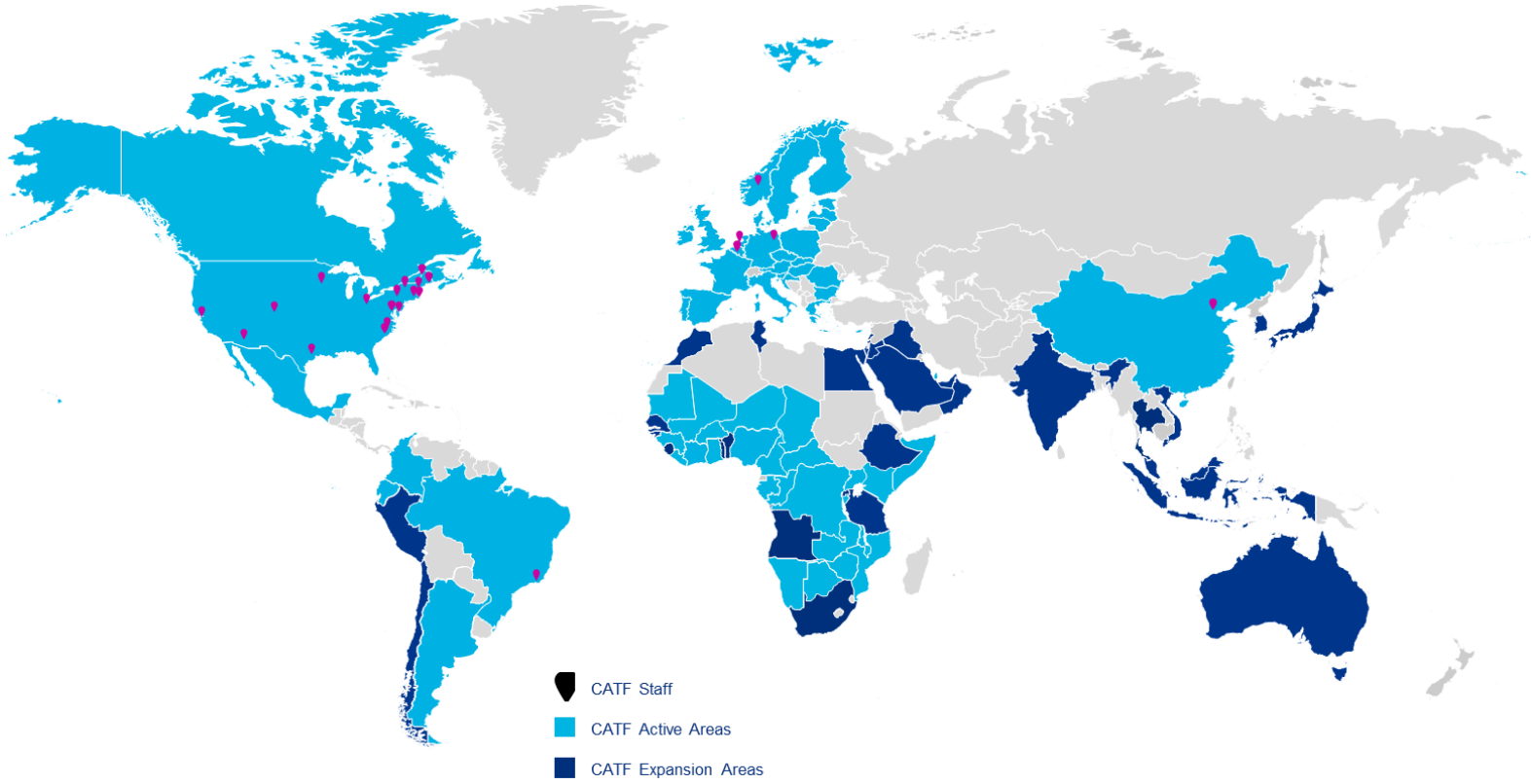
CLEAN AIR TASK FORCE

Carbon capture and storage for low-carbon fuel production in Europe

Shades of blue ammonia – Ammonia Energy Association webinar, 26th April 2022

About the Clean Air Task Force

- Founded 1996
- Headquartered in Boston, 80+ global staff
- Funding is philanthropic
- **Our Mission:**
  Create an affordable, zero carbon energy system by advocating for pragmatic policies, new business strategies, and advanced technologies.
- **Our Vision**:
  Meet the world's rising energy demand in a way that is financially, socially, and environmentally sustainable.



Carbon management technologies offer …

The only way to fully decarbonize cement production and one of two main pathways to decarbonize steel production
which together account for 12% of emissions reductions and are crucial for the global transition to net-zero

Emissions reductions solutions for power assets to become sources of clean, firm power

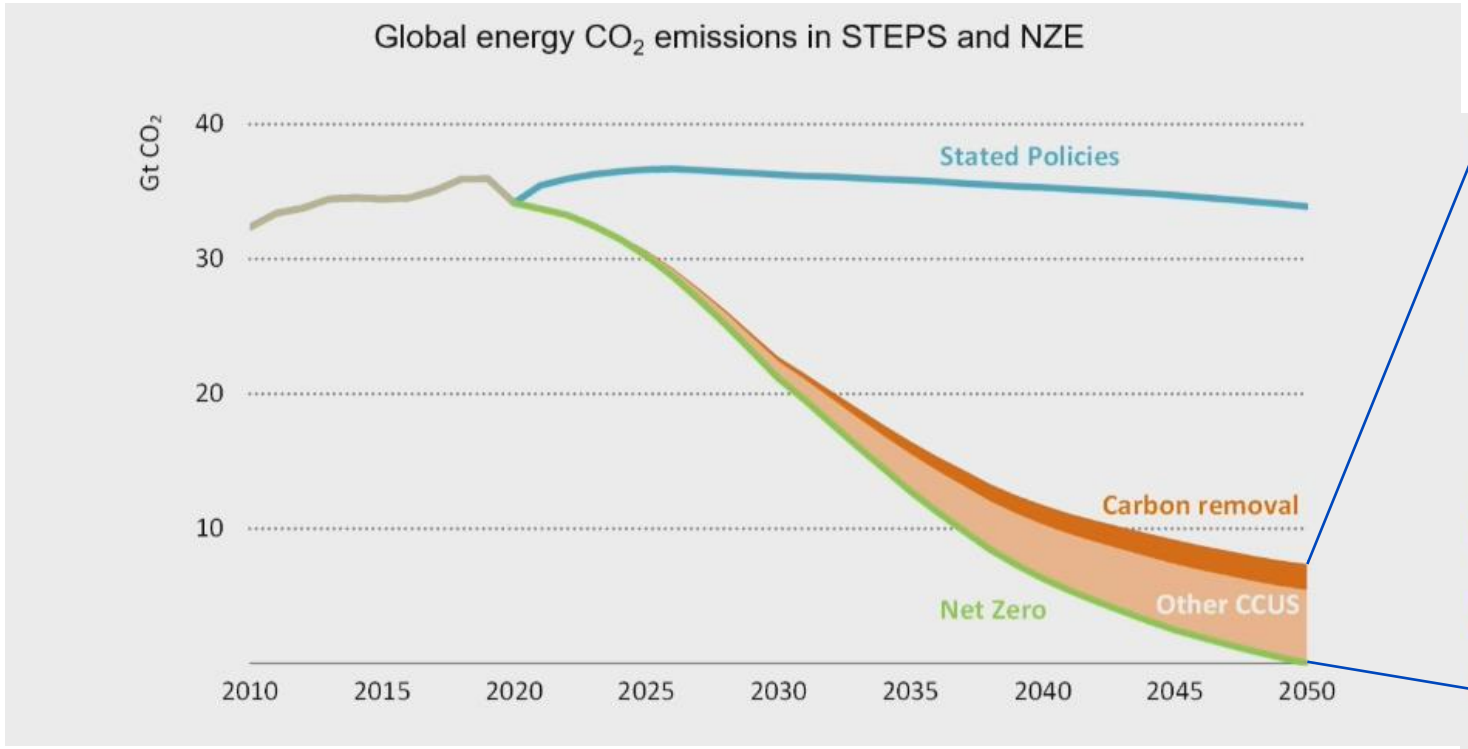
The opportunity to unlock cheap low-carbon hydrogen production to kick-start the hydrogen market

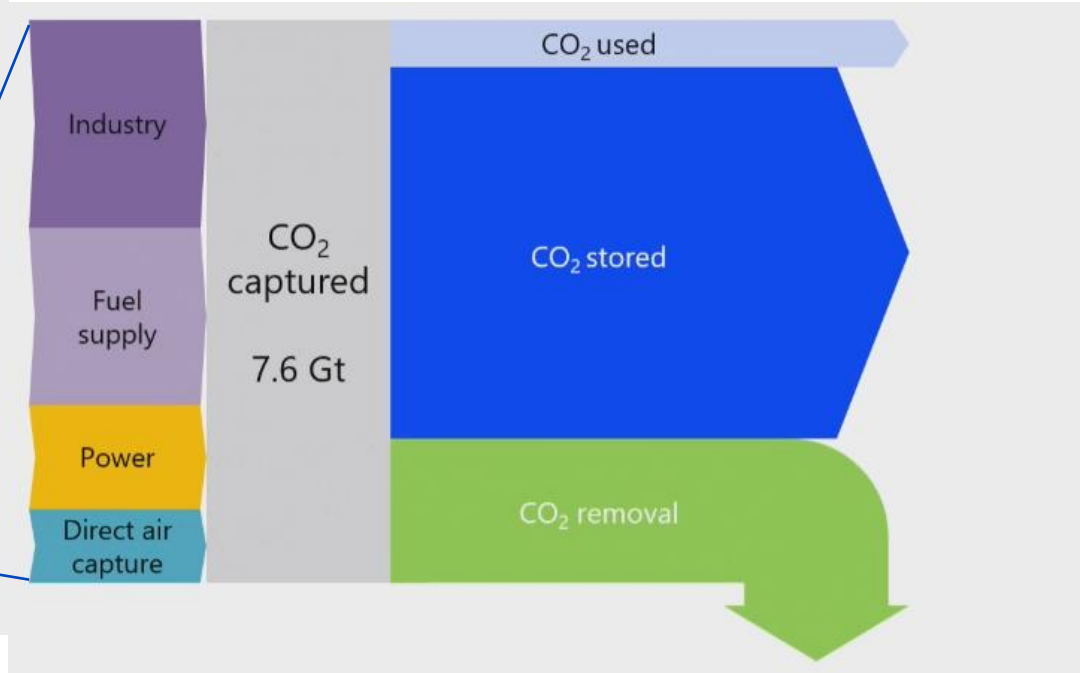
A pathway to permanent carbon dioxide removal via CO_2 storage

A pathway for industrial transformation of energy companies
enabling job retention and creation in productive industries while keeping productive assets in use and enhancing energy security

How much carbon capture do we need?

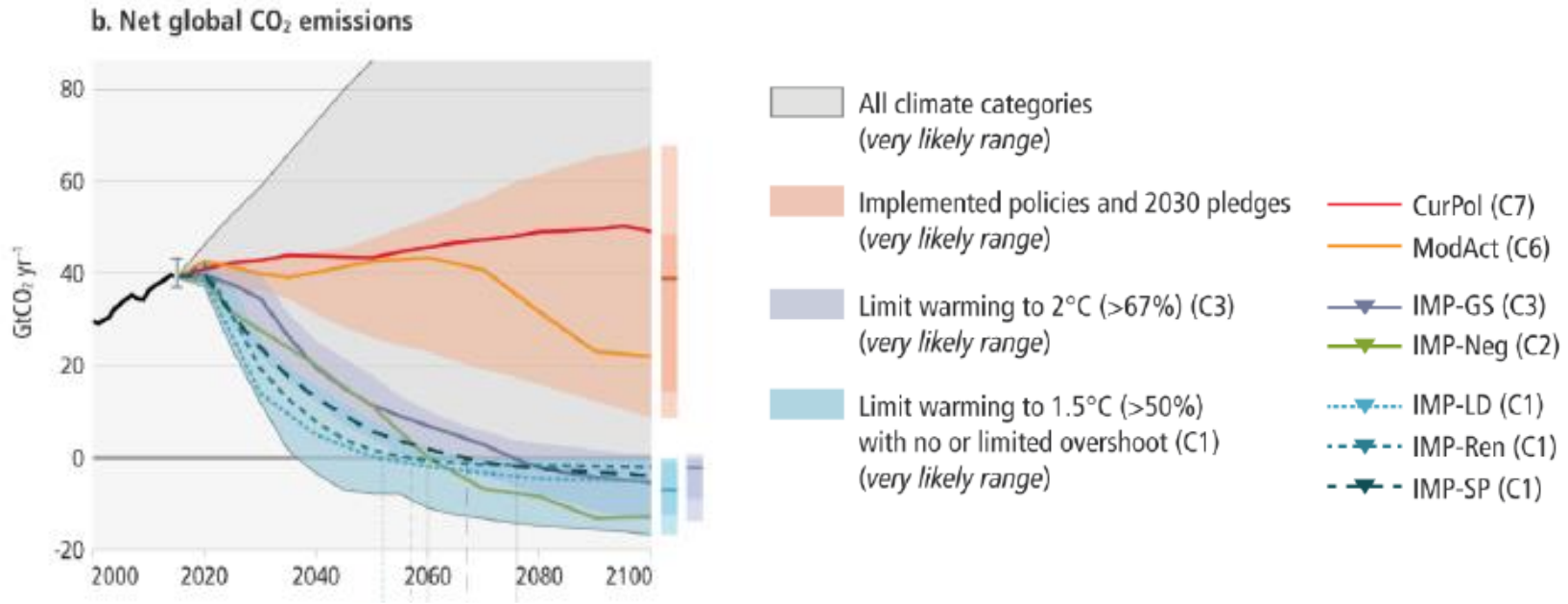
- Net zero targets require a significant contribution from carbon capture and removal
- The IEA's 'Net zero by 2050' roadmap reaches 7.6 Gt/year of CO_2 captured by 2050 – from industry, hydrogen, power, and direct air capture (7.1 Gt is geologically stored)





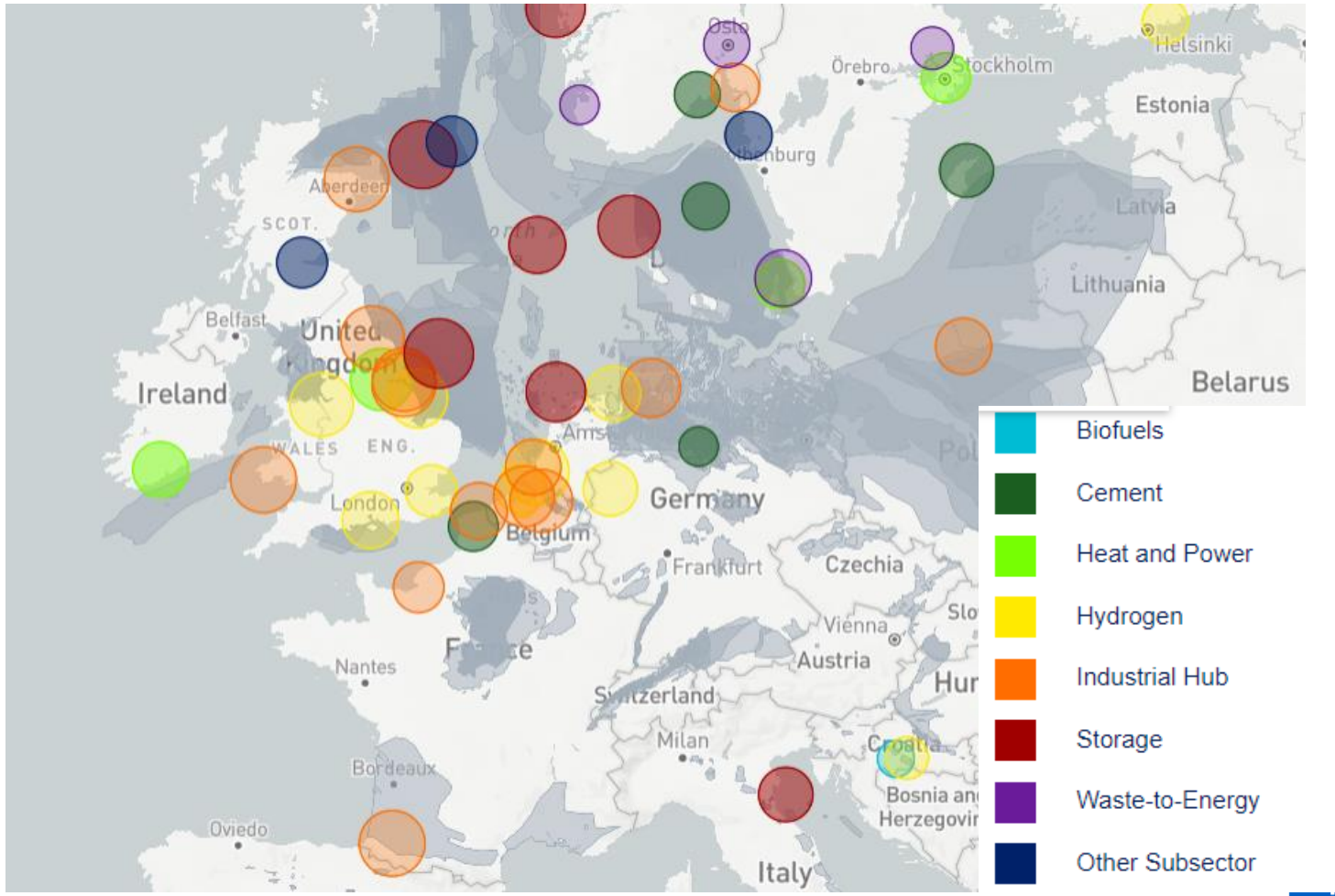
Carbon capture in the IPCC AR6

- IPCC 6th Assessment Report WGIII pathways that achieve 1.5°C with limited overshoot have a median of 665 Gt CO_2 cumulatively stored by 2100
  - Carbon removals are key in 1.5°C pathways: median bio-energy CCS is 334 Gt, direct air capture is 50 Gt
  - Of the **Illustrative Mitigation Pathways**, only 'low demand' includes no CCS – but also sees energy consumption nearly halve by 2050
  - High renewables pathway includes nearly 2 $GtCO_2$/year captured from industry



Carbon capture and storage – state of play in Europe

- Over 50 capture and storage projects announced/planned across Europe
- Shift in focus to industrial emissions and development of open-access CO_2 transport and storage infrastructure
- Most activity around the North Sea due to most progressed storage sites
- EU Innovation Fund first call for large-scale projects awarded up to €778 million to four projects based on carbon capture
- Low-carbon hydrogen projects in the UK, Belgium, Netherlands, Germany, Finland…



Where is there a commercial case for carbon capture and storage in Europe?

- **Norway** – Longship project has full-chain funding, but no repeatable mechanism for other emitters
- **Netherlands** – Porthos project, driven by framework of SDE++ contracts (12-15 years)
- **UK** – Regulated T&S industry and contract for difference incentives upcoming – two priority clusters
- **Denmark** – 20-year contracts for 0.9 Mt/year capture upcoming (€2.15 billion)
- **Sweden** – long-term contracts for bioenergy CCS (€3.35 billion)
- **EU** – Innovation Fund provides up to 60% of additional capital and operating costs (4 CCS projects), also Connecting Europe Facility (limited funding), Recovery and Resilience Facility, Just Transition Fund…

- **Projects but inadequate support:** France, Belgium, Italy, Ireland, Croatia, Germany, Greece, Poland…

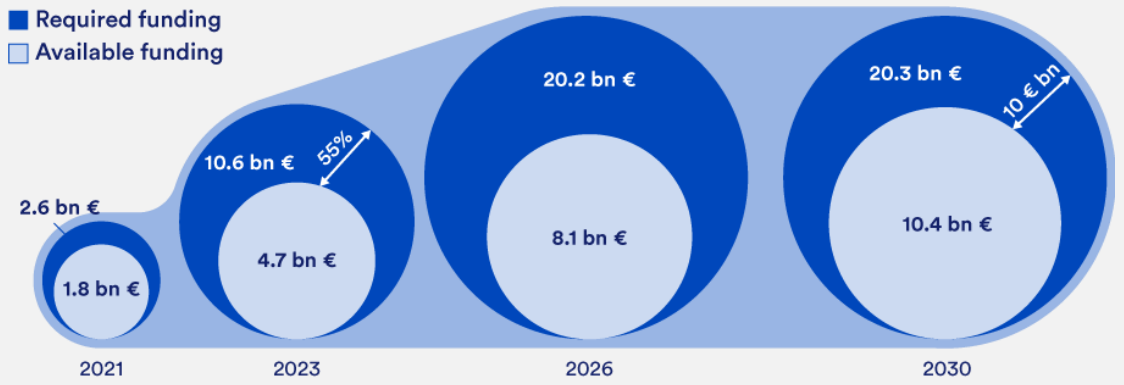
Carbon capture needs better funding and more storage sites

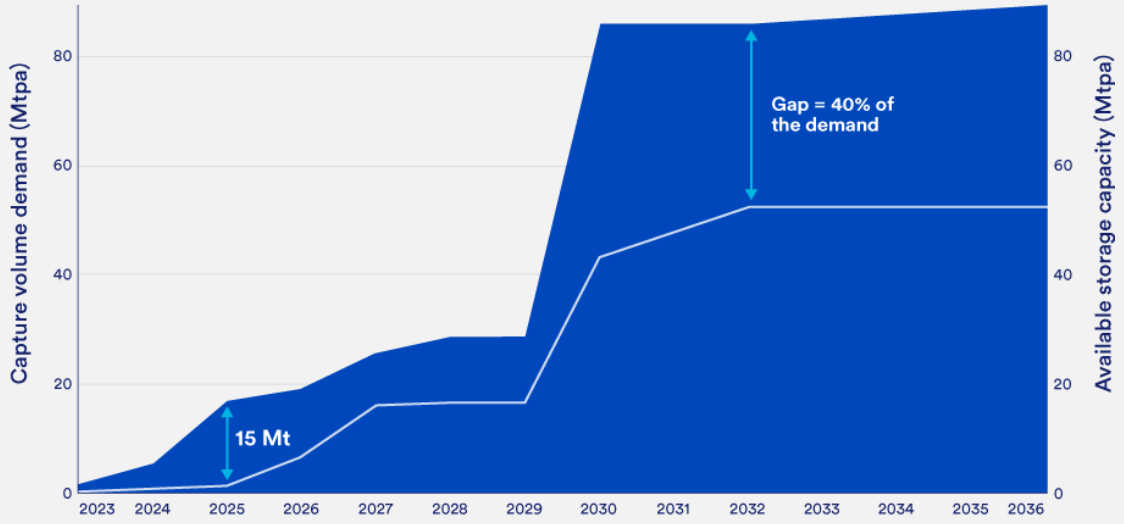
Storage:

- Europe has around **500 Gt of theoretical CO_2 storage capacity**
- But only around **50 Mt/year** of storage capacity is under development – **50% less than demand** from planned CO_2 capture projects by 2030
- Long lead times – takes multiple years to develop storage sites

Funding:

- By 2030, announced projects see a cumulative shortfall of **€10 billion** from break even
- Rising ETS carbon price can help – but too volatile for early projects





A net-zero world will still need fuels

80% of global end-use energy consumption is through fuels – several sectors are difficult to electrify

Marine Shipping

Heavy Trucking

Industrial Process Heating

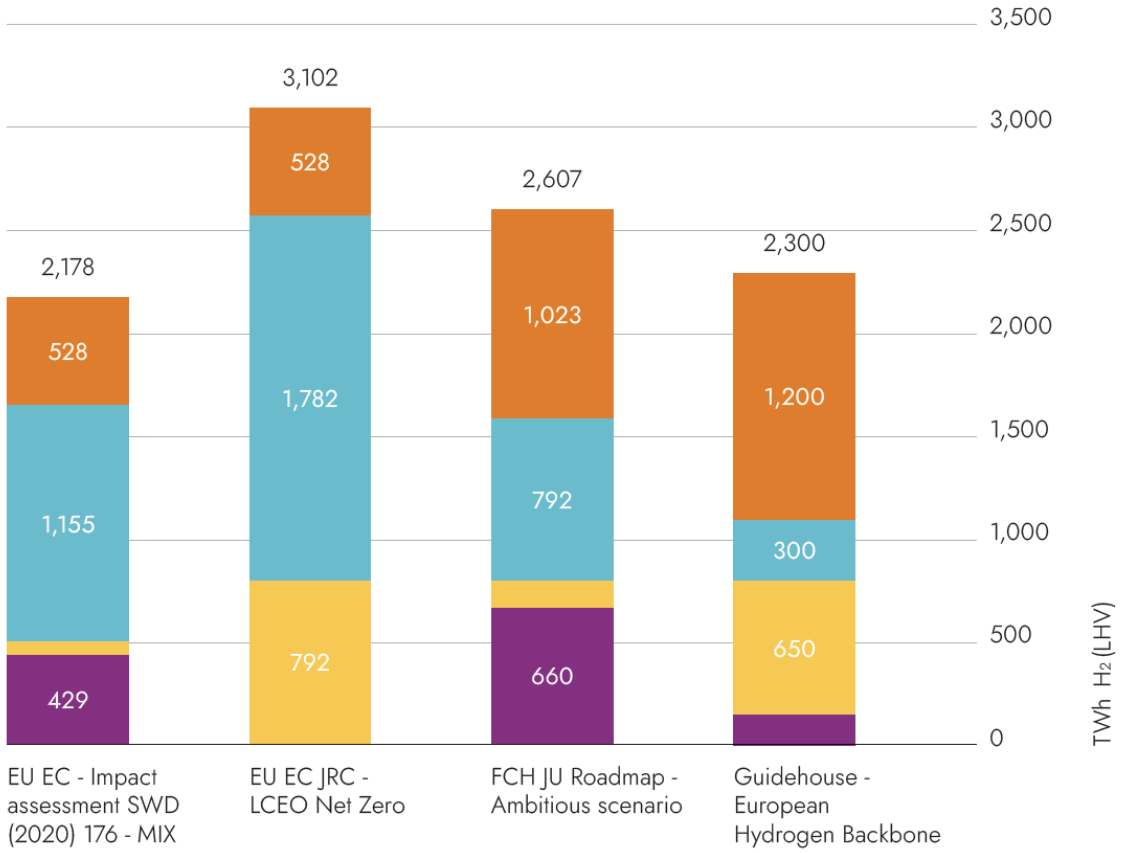
Ironmaking

Aviation

Power Balancing

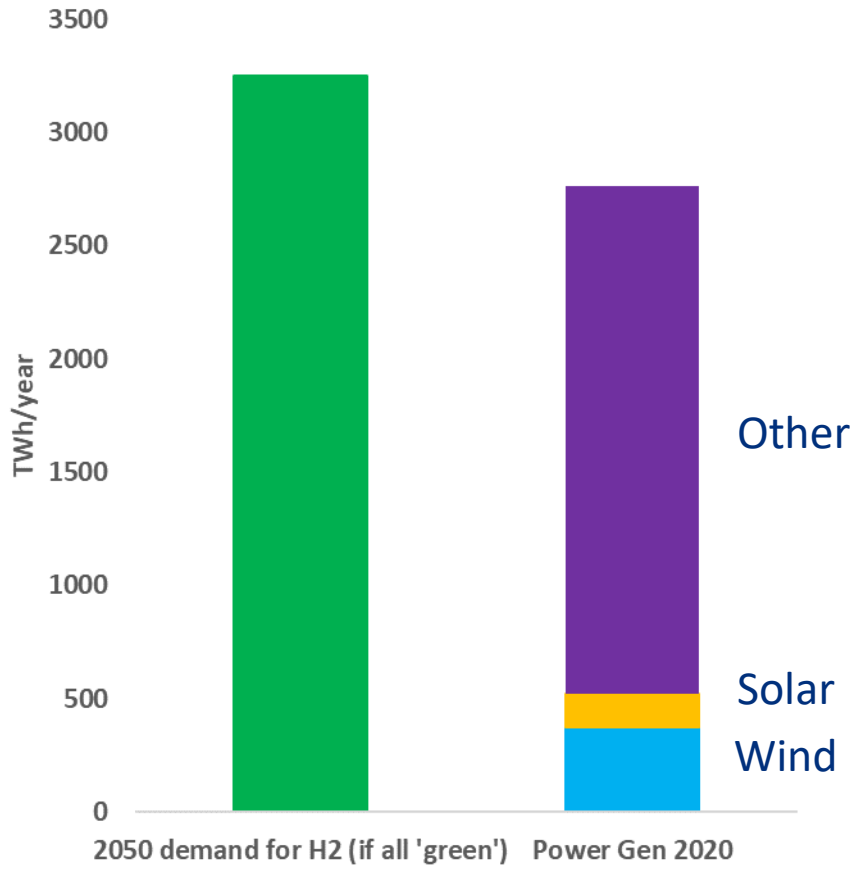
Studies project an increase of hydrogen demand in all sectors by 2050

- **Current Demand** - Current EU hydrogen demand is about 280 TWh/y or 8.3 Mt/y.
- **Projected demand** - Studies project an estimated hydrogen demand increase from 280 TWh/y to >2,000 TWh/y or >70 Mt/y.
- **Scaling** will be critical to meet the EU's forecasted hydrogen demand.



Renewable generation must expand rapidly to decarbonise the grid and meet growing demand

- **Renewable Electricity** – In 2020 only one-fifth of Europe's electricity was generated from solar and wind energy.
- **Growth** - Europe's renewables generation must triple to meet the required 2030 Green Deal Targets (based on 2010 - 2020 period)
- **Renewable Hydrogen** – Challenges associated with green hydrogen production include principle of additionality, renewable electricity availability and cost competitiveness. Production costs of renewable hydrogen are estimated at €5-6/kg
- **Low-carbon Hydrogen** – Unfavorable environment for investment due to uncertainty around energy supply and elevated gas prices

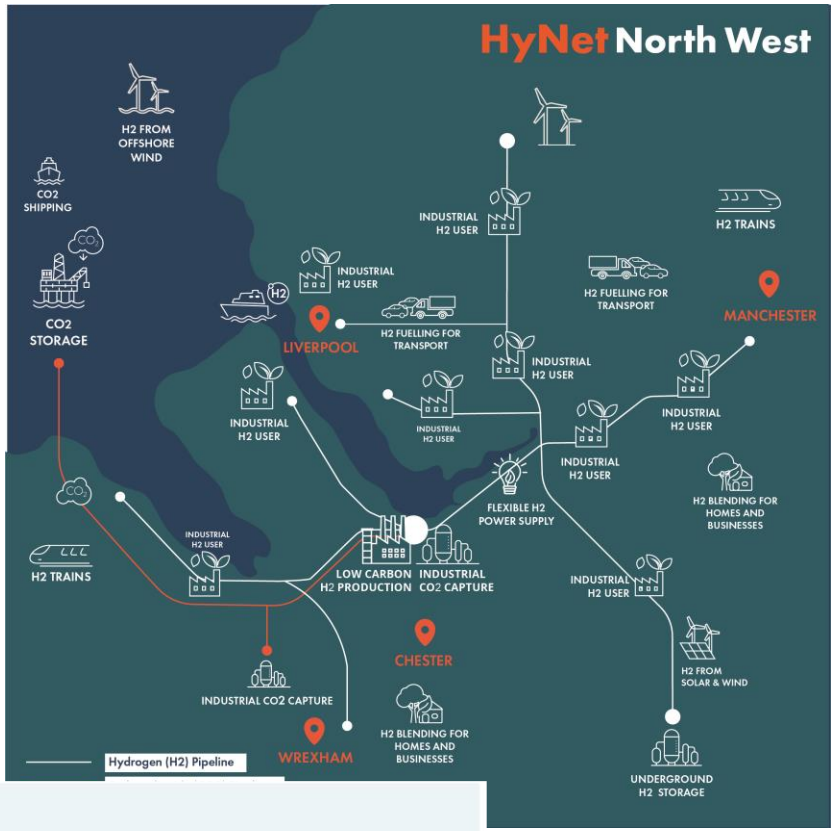


Realising low-carbon hydrogen projects

- A combination of public and private funding is required
- Need a robust certification system for low-carbon hydrogen (with ambitious thresholds including upstream emissions) – **EU's Delegated Act expected in 2025**
- Regional planning and coordination of hydrogen network with CO_2 networks – including reuse of gas pipelines

UK case study:

- Low-carbon hydrogen at the heart of both prioritised carbon capture and storage clusters
- Proposed business model based on 'contract for difference' using a strike price and an achieved sales price
- Net Zero Hydrogen Fund provides capital and development support (£240 m)



Europe has been focused on hydrogen colours rather than volumes

- The current European legislative framework fails to provide a narrative about the deployment of low-carbon fuels in Europe that creates an ecosystem suitable for investment and technology deployment.
- Whilst the need for hydrogen as an energy vector is widely recognised in Europe, not all hydrogen production pathways are equally accepted
- Low-carbon hydrogen is considered in the European political and civil society debate as a potential pathway to lock fossil fuels into Europe's future energy landscape

CATF is building a core set of content to help reframe the hydrogen debate in Europe.

The issue we're focusing on is shifting thinking from 'blue vs green' to how Europe can actually get enough hydrogen to hit decarbonization targets

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