

# Transforming industrial clusters with CCUS and Hydrogen

BIEE conference

London, 22 September 2022

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Chief Executive

Carbon Capture and Storage Association



# Contents:

1. About the CCSA

2. About CCUS

3. UK CCUS Delivery Plan 2035



**The CCSA is the trade association  
accelerating the commercial deployment of  
Carbon Capture, Utilisation and Storage (CCUS)  
through advocacy and collaboration**



# CCSA Members (89)



## CO<sub>2</sub> Storage



## Power & Industrial



## Carbon Capture Developers



## Engineering & Equipment



## CO<sub>2</sub> Transport & Distribution

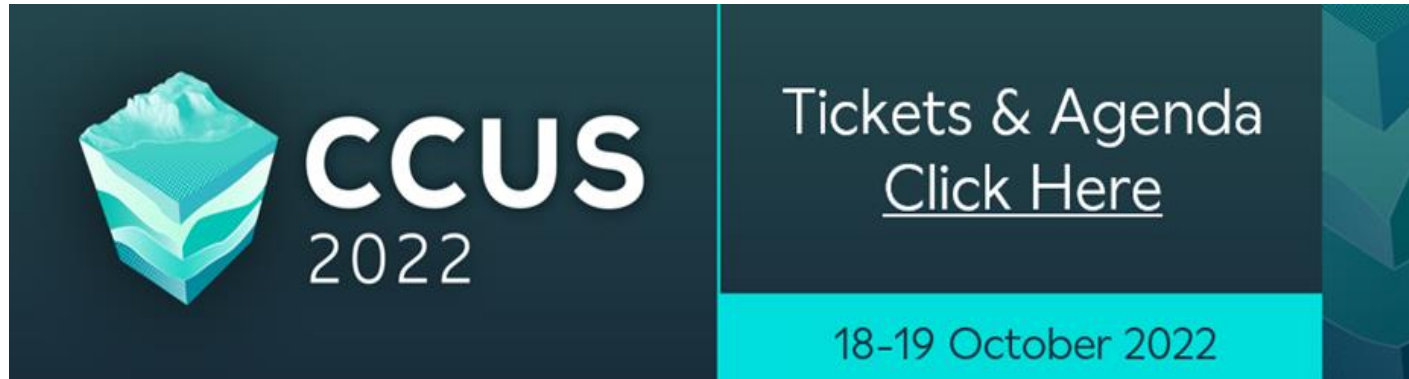


## Financial, Consulting & Others





# CCSA Conference: CCUS 2022 – Time to Deliver



A selection of keynote speakers from different markets confirmed for the conference:

- **Ben Rimmington**, Director General, Net Zero Buildings & Industry – **BEIS**
- **Sir David King**, former UK Government Climate Envoy
- **Dr Jennifer Wilcox**, Principal Deputy Assistant Secretary for the Office of Fossil Energy and Carbon Management – **US DoE**
- **Kevin O’Brien**, Director – **Illinois Sustainable Technology Center**
- **Claire Dorrian**, Head of Sustainable Finance, Capital Markets – **London Stock Exchange Group**
- **Zoe Forbes**, Deputy Director of Sector Skills – **Department for Education**
- **John Flint**, Chief Executive – **UK Infrastructure Bank**
- **Erik Rylander**, Head of Carbon Dioxide Removal – **Stockholm Exergi**
- **Jasper Heikens**, Chief Commercial Officer – **Ecolog**

# Contents:

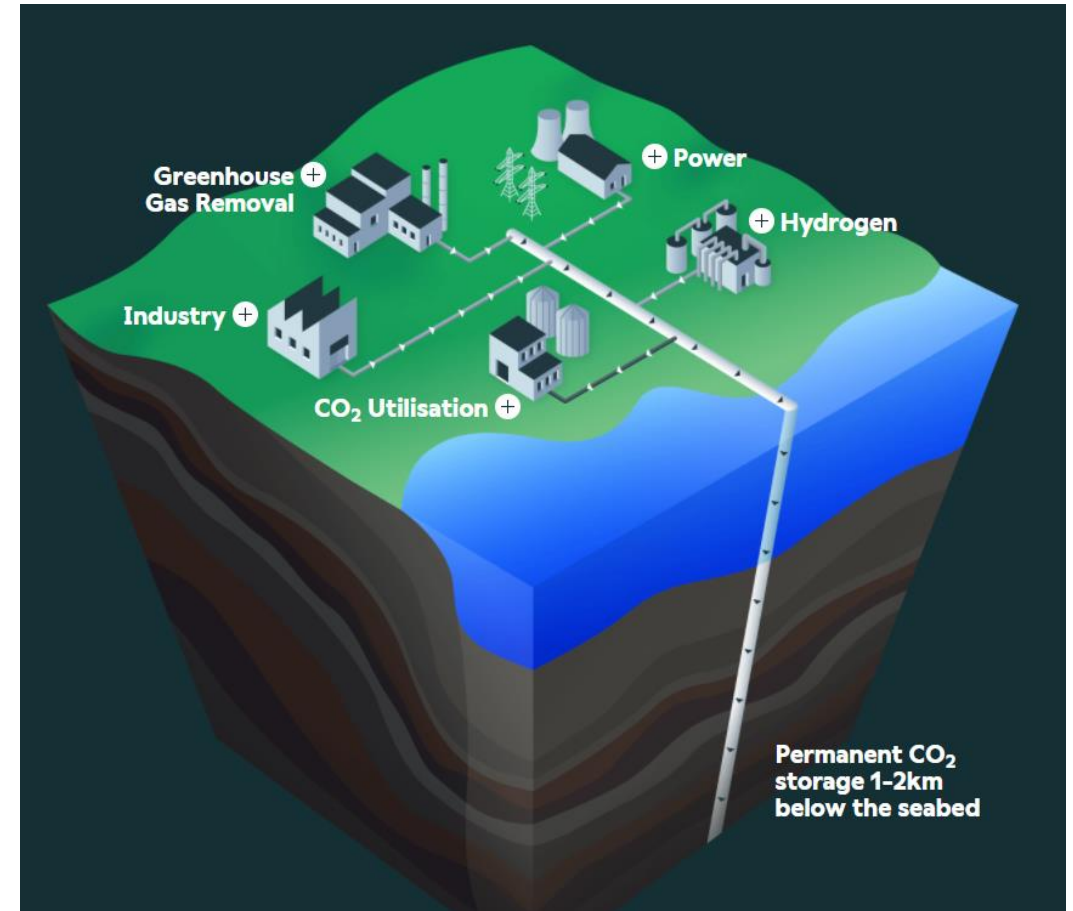
1. About the CCSA

2. About CCUS Clusters

3. UK CCUS Delivery Plan 2035

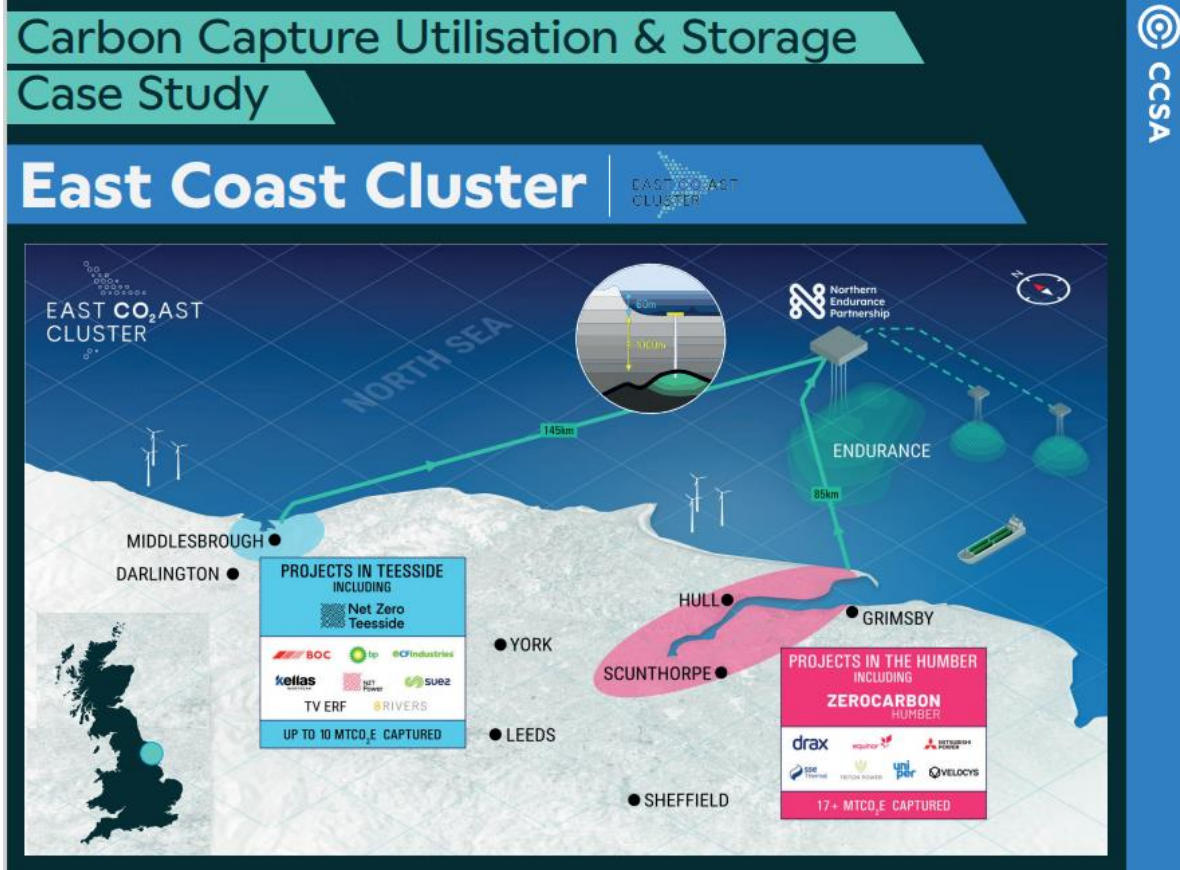
# CCUS technologies

- **Capture CO<sub>2</sub>**, typically using solvents, from:
  - Power generation
  - Industrial activity (cement, refinery, steel etc)
  - Hydrogen production
  - Bioenergy sources (BECCS) and the air (DACCS)
- **Transport CO<sub>2</sub>** via pipeline or ship
- **Store CO<sub>2</sub>** in deep geological formations, e.g. depleted oil & gas fields or deep saline formations.
- **Use CO<sub>2</sub>** in products, some of which can keep CO<sub>2</sub> from the atmosphere for long periods of time, and others that simply recycle the CO<sub>2</sub>, with less climate benefit.



Different applications of CCUS technology can be deployed at sites located close together to take advantage of the economies of scale in the CO<sub>2</sub> transport and storage network – referred to as “clusters”

# CCUS Case Studies



Visit [www.ccsassociation.org](http://www.ccsassociation.org) for more examples

## Carbon Capture Utilisation & Storage Case Study

### Leilac

#### ROBUST CARBON CAPTURE TECHNOLOGY

LEILAC Technology (direct separation) leads the industry towards a **decarbonized economy** through the **separation of process emissions and their capture.**

- Raw materials, including limestone and raw cement meal, are heated via a special steel reactor that separates fuel emissions from process emissions (CO<sub>2</sub>).
- Depending on the chosen fuel, the raw fuel footprint will be further reduced or even negative.

**PHASE 1** Construction of raw material

**PHASE 2** LEILAC: Contributing to delivery of lime production with an integrated carbon capture solution.

**PHASE 3** CO<sub>2</sub> transport and storage or utilization.

#### Capturing unavoidable CO<sub>2</sub> process emissions

LEILAC (Low Emissions Intensity Lime And Cement) will successfully pilot a breakthrough technology that aims to enable both Europe's cement and lime industries to reduce their emissions heavily while retaining, or even increasing international and cross sectorial competitiveness. The international and EU community recognises that CO<sub>2</sub> emissions contribute to climate change, and the only economical viable approach to reducing such emissions to-date for the cement and lime industries has been to increase kiln efficiencies and utilise alternative fuels with important waste biomass fractions. Once tested in LEILAC and scaled up, Direct Separation with CO<sub>2</sub> capture should reduce the costs of carbon capture considerably, and accelerate the deployment in both industries. Direct Separation provides a common platform for CCUS in both the cement and lime industries, and seeks to effectively "future-proof" these industries against tighter emissions standards for CO<sub>2</sub> emission reductions and CO<sub>2</sub> capture.

- No additional processes or chemicals required, novel "calciner" (kiln) design.
- Contributes to reaching EU's carbon neutrality objective by 2050.
- Requires limited amount of additional energy to capture process CO<sub>2</sub> emissions.
- Demonstrate cement & lime industries' leading position in carbon capture solutions.

**project-leilac.eu**

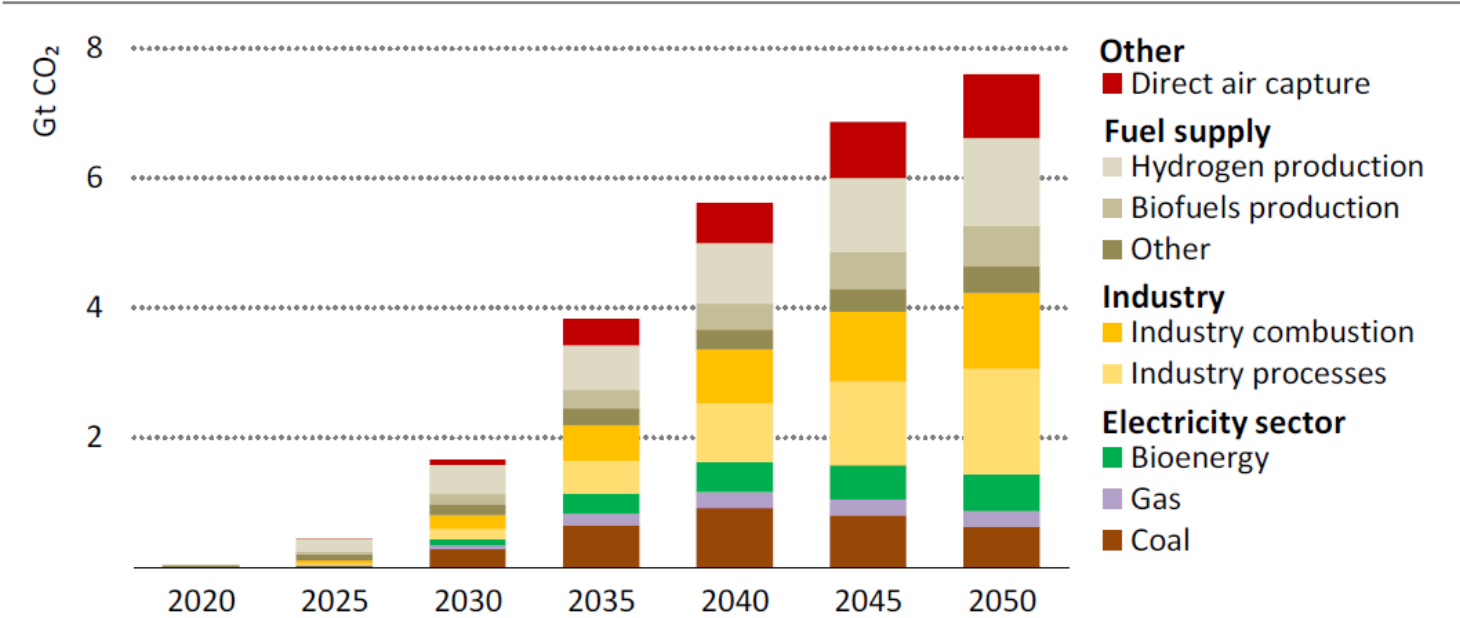
Logos: TNO, Camax, Calix, Lhoist, Imperial College, TAHMAC, European Union, Carbon Trust, PSE, HeidelbergCement, Quant4.



# CCUS is a global market estimated to be worth c. \$2tn by 2050



**Figure 2.21** ▶ Global CO<sub>2</sub> capture by source in the NZE



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*By 2050, 7.6 Gt of CO<sub>2</sub> is captured per year from a diverse range of sources. A total of 2.4 Gt CO<sub>2</sub> is captured from bioenergy use and DAC, of which 1.9 Gt CO<sub>2</sub> is permanently stored.*

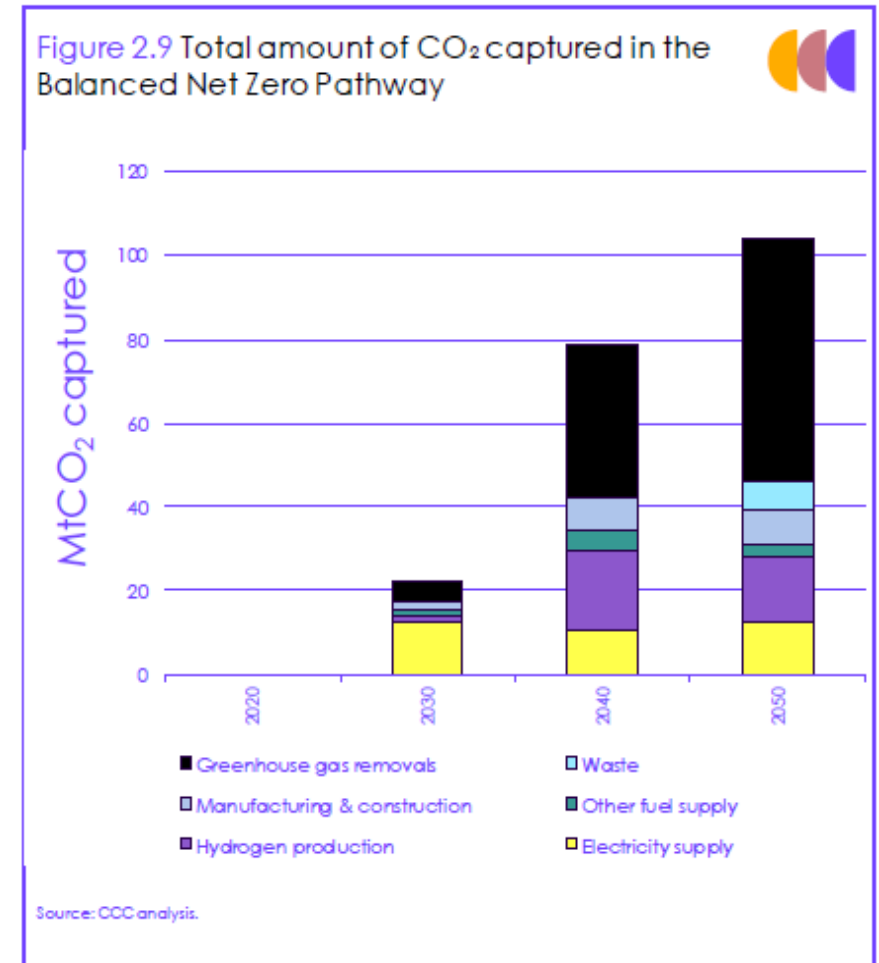
# Climate Change Committee: “CCUS is a necessity not an option for reaching net zero”

## 6<sup>th</sup> Carbon Budget Advice (2020)

- *CCUS reaches harder to decarbonise sectors* – it plays a critical role in multiple sectors of the economy that need to decarbonise by 2050:
  - Clean Hydrogen production
  - Greenhouse Gas Removals (BECCS & DACS)
  - Heavy Industry Decarbonisation
  - *Flexible* zero carbon power
- In the 6<sup>th</sup> Carbon Budget Balanced Net Zero Pathway, the UK requires **104Mt of CO<sub>2</sub> storage pa** by 2050; with **22Mt pa in 2030, 53Mt pa in 2035**

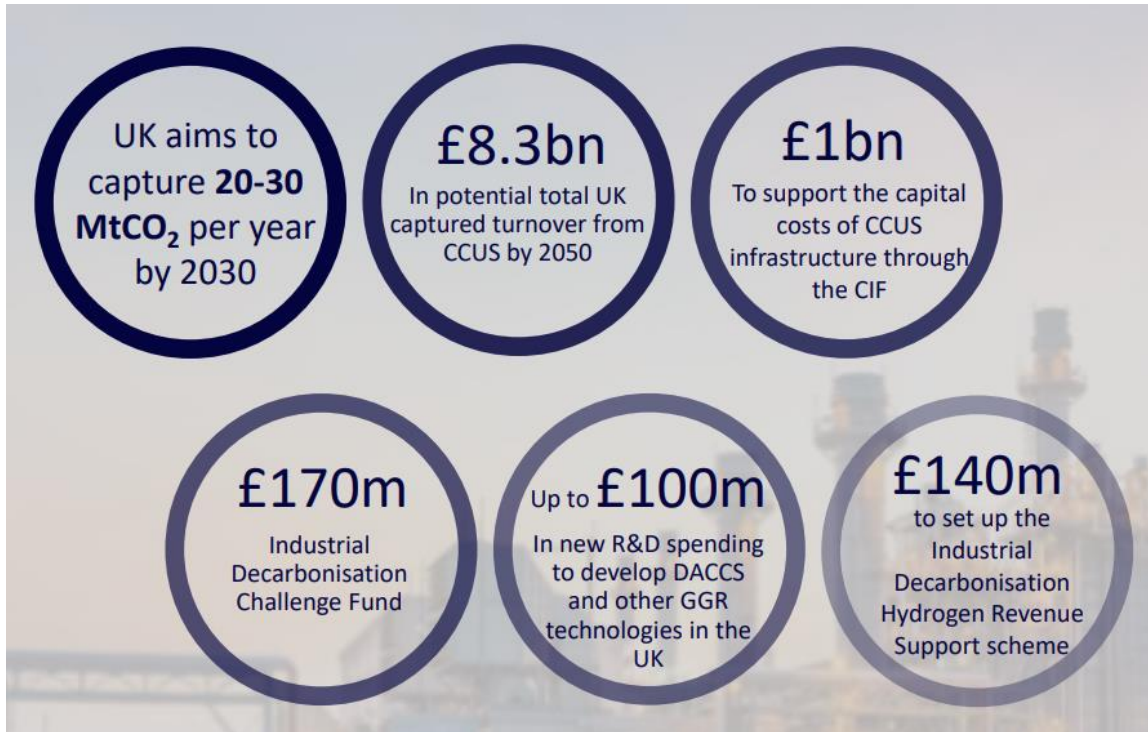
## Progress Report (2022)

- “progress on developing CCS in manufacturing is now a year behind the Government’s deployment pathway”.



# UK Government CCUS Strategy

- Ambition to capture 20-30 MtCO<sub>2</sub> a year by 2030, rising to over 50Mtpa by 2035
- Committed to **four CCUS clusters** with at least two operating by the mid-2020s and at least another two by 2030



UK Government “CCUS Investor Roadmap”

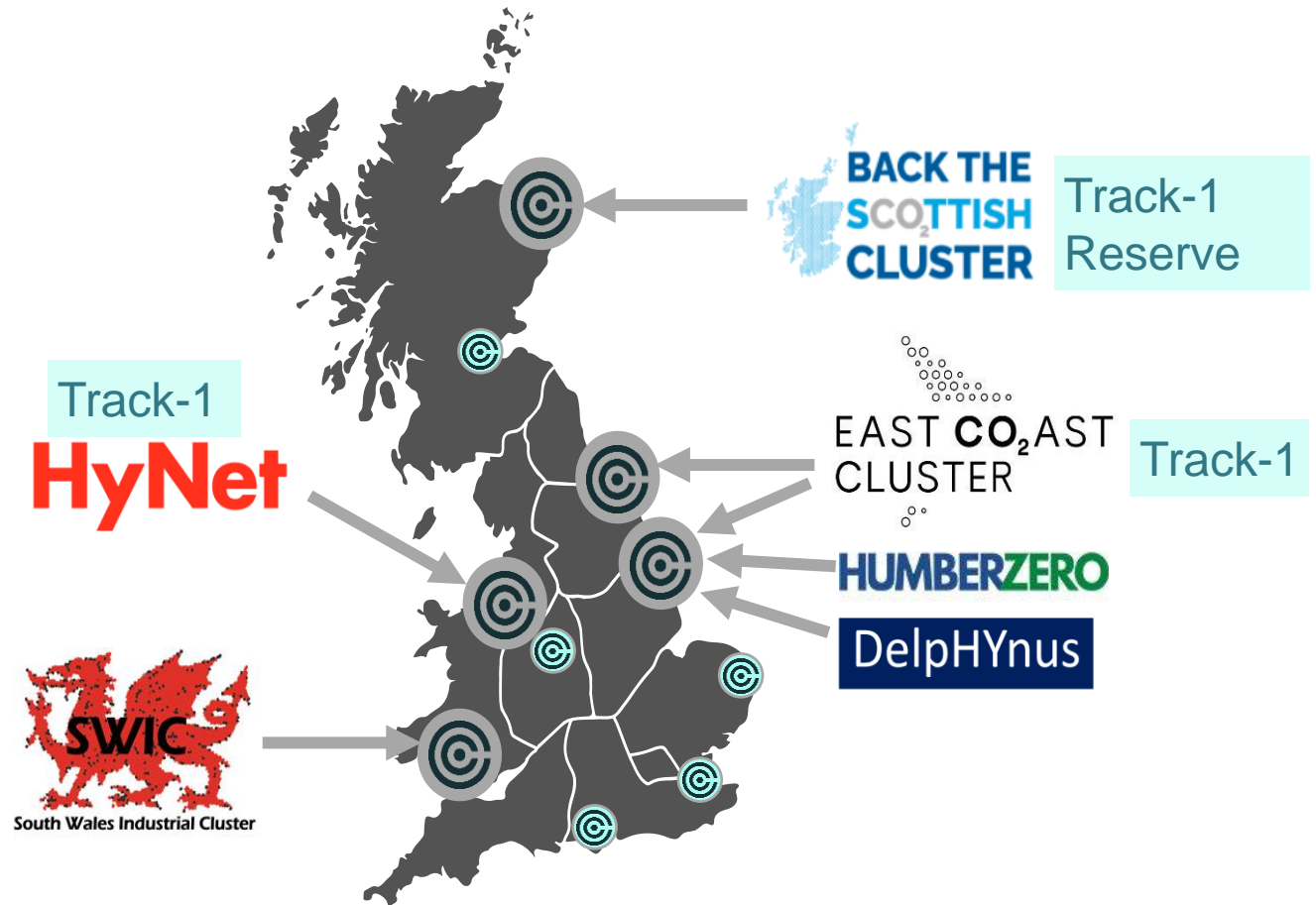




# CCUS Clusters in UK's industrial heartlands

## Government's Cluster Sequencing Programme:

- **Track-1:** at least two clusters operational by the mid-2020s
  - **Phase-1:** Provisionally sequence clusters onto Track 1 (announced November 2021)
  - **Phase-2:** Determine which carbon capture projects within clusters will proceed into negotiations (announced in August 2022)
  - Future phases of access to Track-1 clusters **not yet defined**
- **Track-2:** two additional clusters to be operational by 2030
  - Potential selection process **not yet defined**



# Shortlisted CO<sub>2</sub> capture projects in Track-1 clusters



## 3 power projects

*East Coast Cluster:*

- Net Zero Teesside Power
- Whitetail Clean Energy
- Keadby 3 Carbon Capture Power Station

## 4 hydrogen projects

*East Coast Cluster:*

- bpH2Teesside
- H2NorthEast
- Hydrogen to Humber (H2H) Saltend

*HyNet:*

- HyNet Hydrogen Production Project (HPP)

## 13 industrial capture projects

*East Coast Cluster:*

- CF Fertilisers Billingham Ammonia CCS
- Tees Valley Energy Recovery Facility Project (TVERF)
- Norse Sea Carbon Capture
- Redcar Energy Centre
- Teesside Hydrogen CO<sub>2</sub> Capture
- Humber Zero – Phillips 66 Humber Refinery
- Prax Lindsey Oil Refinery Carbon Capture Project
- ZerCaL250

*HyNet:*

- Hanson Padeswood Cement Works
- Viridor Runcorn Industrial CCS
- Protos Energy Recovery Facility
- Buxton Lime Net Zero
- Carbon Dioxide Capture Unit – EssarOil UK

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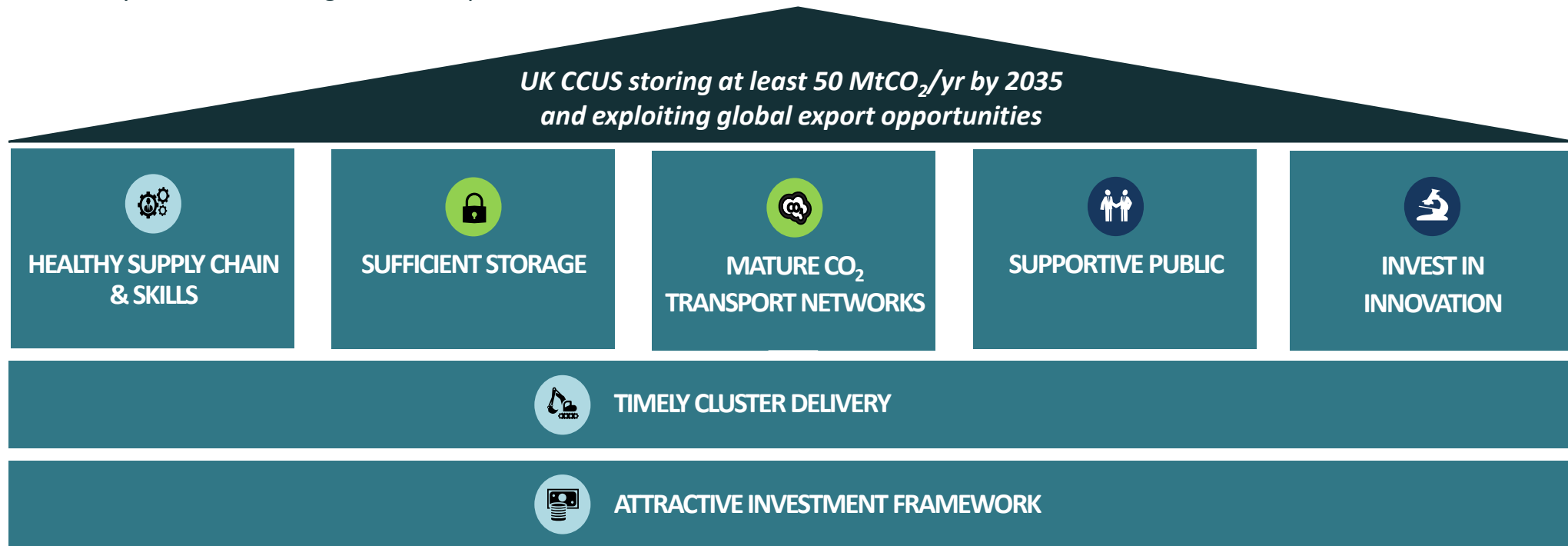
3. UK CCUS Delivery Plan 2035



# CCSA's response to the Net Zero Strategy: 'CCUS Delivery Plan 2035'

The report recommends how to best achieve the UK Government's 2035 CCUS ambition, in order to **remain on track for Net Zero by 2050**, based on the outcomes from the project:

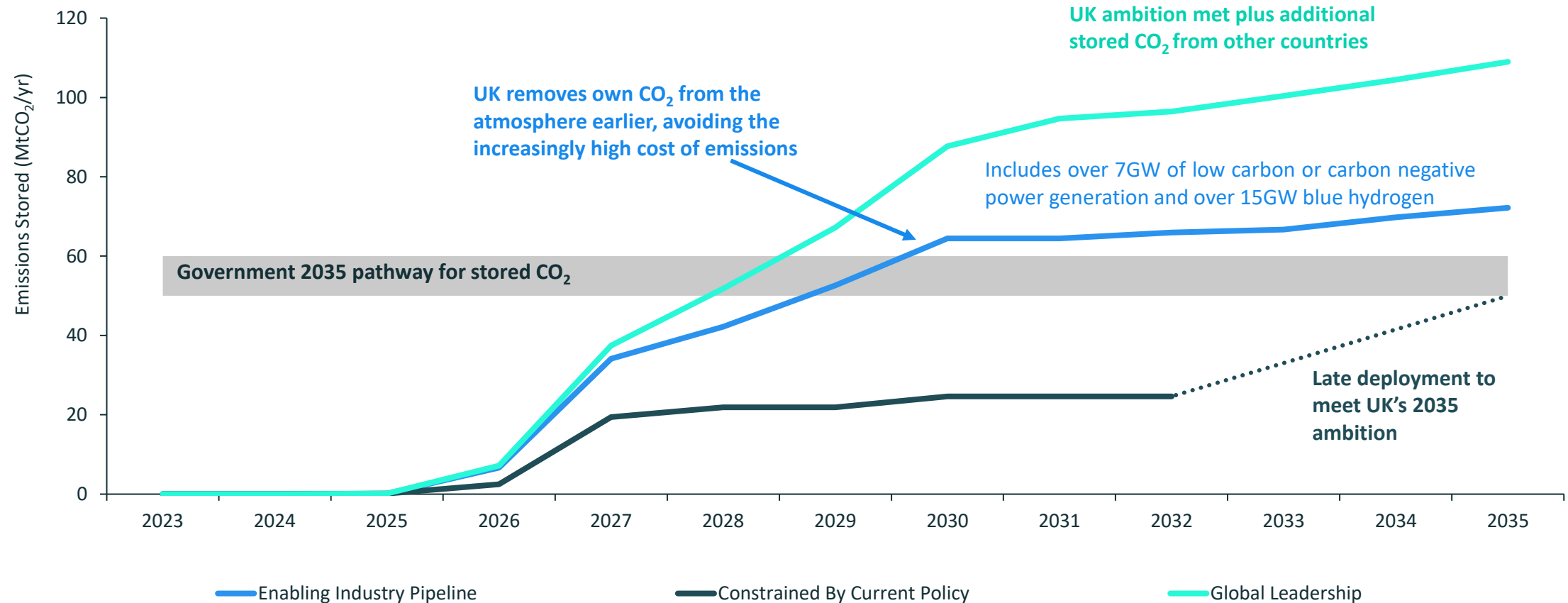
- Stage 1: Profiling the recommended build-out rate of CCUS in the UK to reach the government's 2035 ambition; and
- Stage 2: Members, industrial clusters across the UK, and external stakeholders were engaged in a series of workshops to identify the building blocks for a successful industry and the enabling actions required.



# Build out rate analysis

Anonymised project data was aggregated from cluster leads and major emitters to identify current and potential build-out rates

## Emissions captured and stored to 2035 by CCSA scenario



# Conclusions from modelling the CCUS deployment scenarios



## Our Recommendations:



The UK should pursue an **accelerated capture and storage build-out rate to significantly reduce total costs of deployment** and ensure it can stay on a pathway to storing 50MtCO<sub>2</sub>/yr by 2035



To enable this, the **government must implement a set of 10 urgent actions in the next 12 months** to create the necessary environment for industry to continue their planned investments



## We believe this approach will maximise the benefits from UK CCUS leadership, providing:



Certainty to enable the UK's domestic supply chain to grow



Reduced reliance on imported commodities, with low carbon products made in UK



Creation of a new export industry and attracting inward investment



Development of skills and the safeguarding of jobs



Enhanced competitiveness of UK manufacturing



# 10 urgent actions to enable recommended deployment pathway

We recommend that **10 urgent actions** are prioritised by Government, industry and wider stakeholders over the next 12 months to enable the rapid scaling needed to achieve the 2035 ambition:



Attractive Investment Framework

- 1) Hold regular funded contract allocation rounds
- 2) Finalise business models across the value chain



Timely Cluster Delivery

- 3) Launch of the next cluster selection process in the first half of 2022
- 4) Legislate a policy framework to enable projects to develop at pace



Healthy Supply Chain & Skills

- 5) Gain consensus on UK strengths in product and skill areas to prioritise for investment
- 6) Set policy and regulation to incentivise UK content
- 7) Accelerate entry into the workforce to meet demand



Mature CO<sub>2</sub> Transport Networks

- 8) Accelerate permitting and construction of the infrastructure



Sufficient Storage

- 9) Rapidly bring additional storage capacity to a commercial level of readiness




Supportive Public

- 10) Establish a strategy to support national, cluster and project-level communications

Full report available at [www.ccsassociation.org/resources](http://www.ccsassociation.org/resources)

Value chain focus

 Capture projects and Transport & Storage

 Transport & Storage

 CCUS ecosystem



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