

CCS outlook for the UK

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www.ukccsrc.ac.uk

20th March 2024



Engineering and
Physical Sciences
Research Council

The UKCCSRC is supported by the Engineering and Physical Sciences Research Council (EPSRC) as part of the UKRI Energy Programme

UK CCS Research Community Network+



2,100+ members

350+ academic

550+ ECR

350+ associate

850+ network

2 conferences per year

600+ subscribed to webinar series

60+ attendees on CCS training course

Flexible funded research programme

2017-2022: 24 projects funded

2022 & 2023: 26 projects funded

ECR Programme

Awaydays (virtual and in-person)

Funding opportunities

1,923  newsletter subscribers

8,121  LinkedIn followers

3,373  (formally twitter) followers



Policy and funding for UK CCS deployment



November 2020: [‘The Ten Point Plan for a Green Industrial Revolution’](#) (HMG, 2020) was published



Point 8
Investing in Carbon Capture, Usage and Storage

Aim to “**establish CCUS in two industrial clusters by mid 2020s, and aim for four of these sites by 2030, capturing up to 10 Mt of carbon dioxide per year.**”

- The Industrial Decarbonisation Challenge (IDC) with £170M funding, this principally is co-funding FEED studies, with smaller amounts of research and cluster planning (Livesey, 2021)
- The £1bn CCS Infrastructure Fund, which will primarily support capital expenditure on CO₂ Transport and Storage networks and industrial carbon capture projects
- Business models being developed to provide 10-15 years of market-based support for CO₂ Transport and Storage, Power, and Industrial Carbon Capture, also for all types of low carbon H₂

15 March 2023: UK Spring budget confirmed funding for Track 1 and Track 2 clusters when it was announced that the government is supporting investment in the energy system by making up to £20 billion available for early deployment of CCS

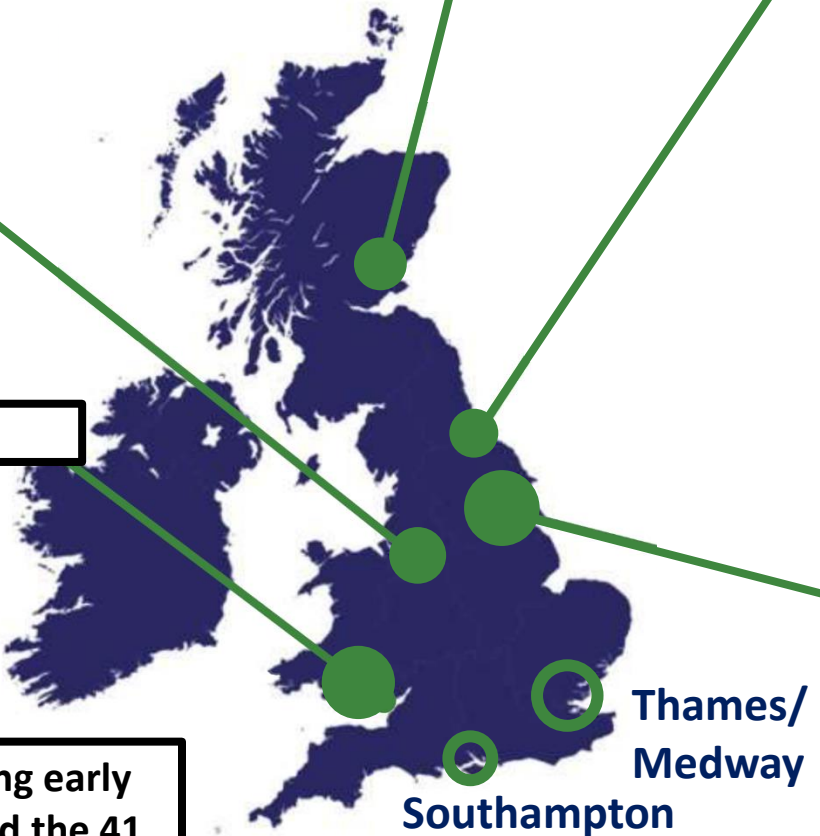
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| 13 | Project Cavendish |
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| SCOTTISH CLUSTER | |
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| 8 | Peterhead Carbon Capture Power Station |
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SOUTH WALES

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| 25 | ZerCaL250 |



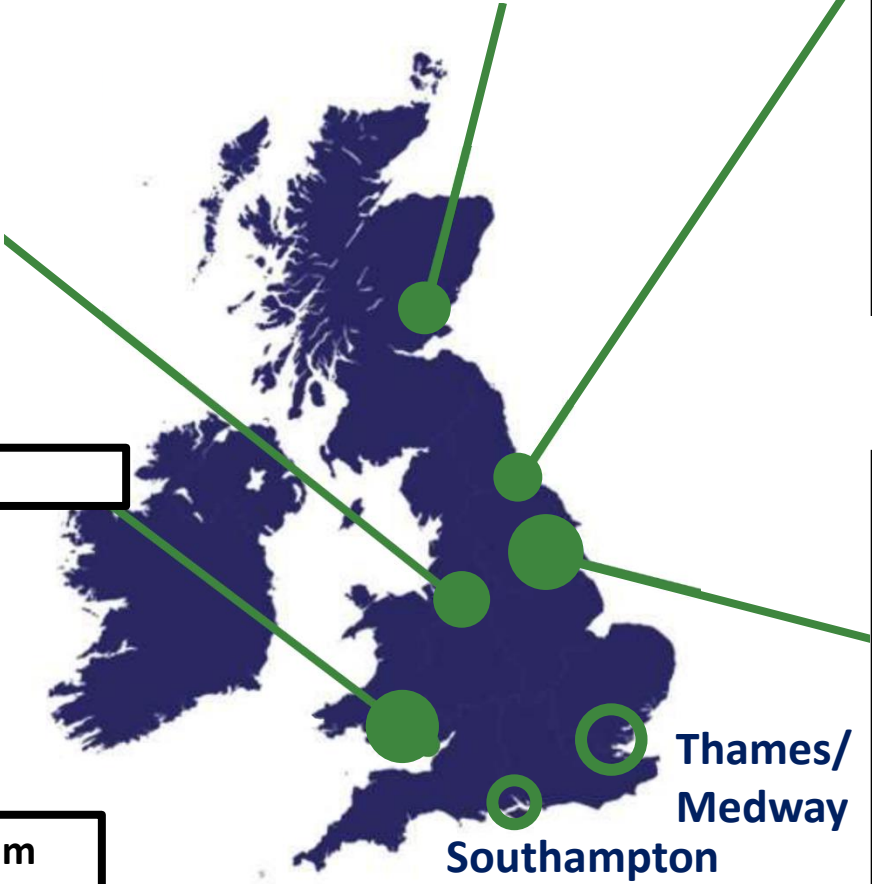
Incomplete overview of UK CCS projects showing early clusters (solid green circles), some later ones and the 41 CO₂ capture projects selected for evaluation in March 2022

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Projects in bold text made the interim cut of 20 in April 2022

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Thames/
Medway

Southampton

Type of project:
 Black - Industry
 Red - Power
 Blue - Blue Hydrogen

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Thames/
Medway
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The 2 clusters and 8 projects selected for final negotiations in March 2023 highlighted in green

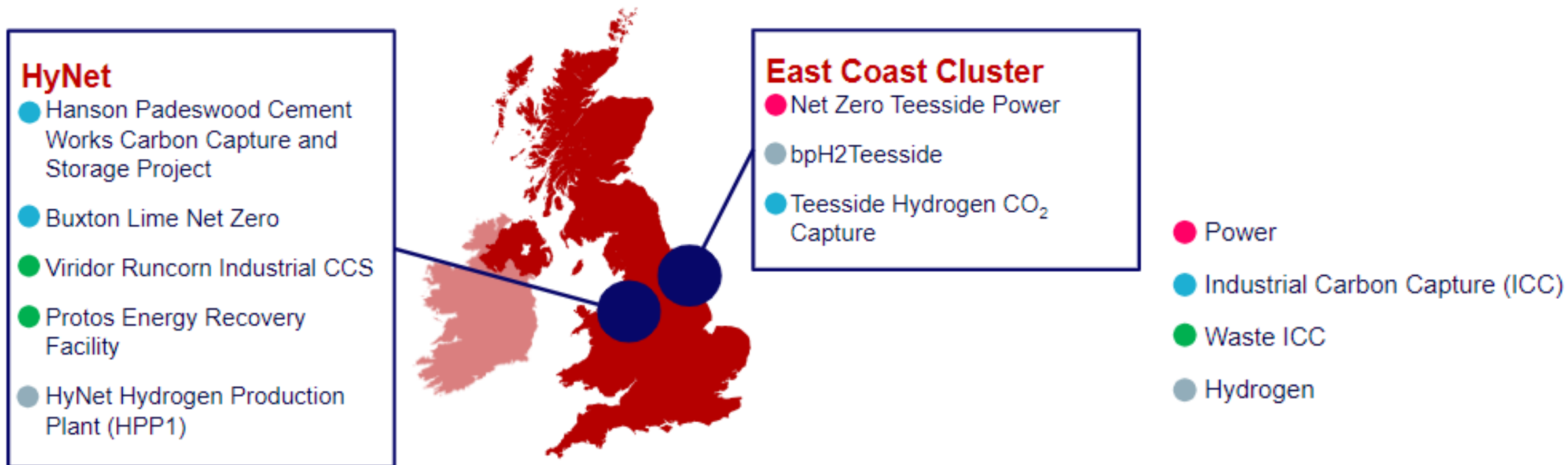
Track-1 CCUS clusters for the mid-2020s

Policy paper

CCUS Net Zero investment roadmap: Capturing carbon and a global opportunity

Published 5 April 2023

Delivering first of a kind carbon capture projects in the UK



Cluster sequencing for carbon capture, usage and storage (CCUS): Track-2. The Track-2 process will establish 2 new clusters as part of the further development of CCUS.



Department for
Energy Security
& Net Zero

Government is committed to further development of CCUS, including through the Track-2 process which will establish 2 new clusters.

We are at this stage seeking 2 transport and storage (T&S) systems that:

- are located within the UK
- are able to credibly demonstrate that they have a clear pathway to rates of injection consistent with the at least 10Mtpa ambition by 2030
- do not form part of the HyNet or East Coast Cluster (ECC) Track-1 cluster proposals
- are able to credibly demonstrate that they can connect via pipeline to at least two projects for an initial phase of capture and non-pipeline transport in future phases

Government views the **Acorn and Viking T&S systems** as able to meet the Track-2 eligibility criteria, and best placed to deliver on the objectives for Track-2, subject to value for money and due diligence assessments.

Other T&S systems that are able to meet the eligibility criteria now have the opportunity to express an interest in being considered for Track-2.

2016: Delivering Cost Effective CCS in the 2020s – a new start

<https://ukccsrc.ac.uk/delivering-cost-effective-ccs-in-the-2020s/>



Simple formula to deliver cost-effective CCS with offshore storage

Cost-effective CCS = Multiple Sources + Large-scale Pipeline & Storage

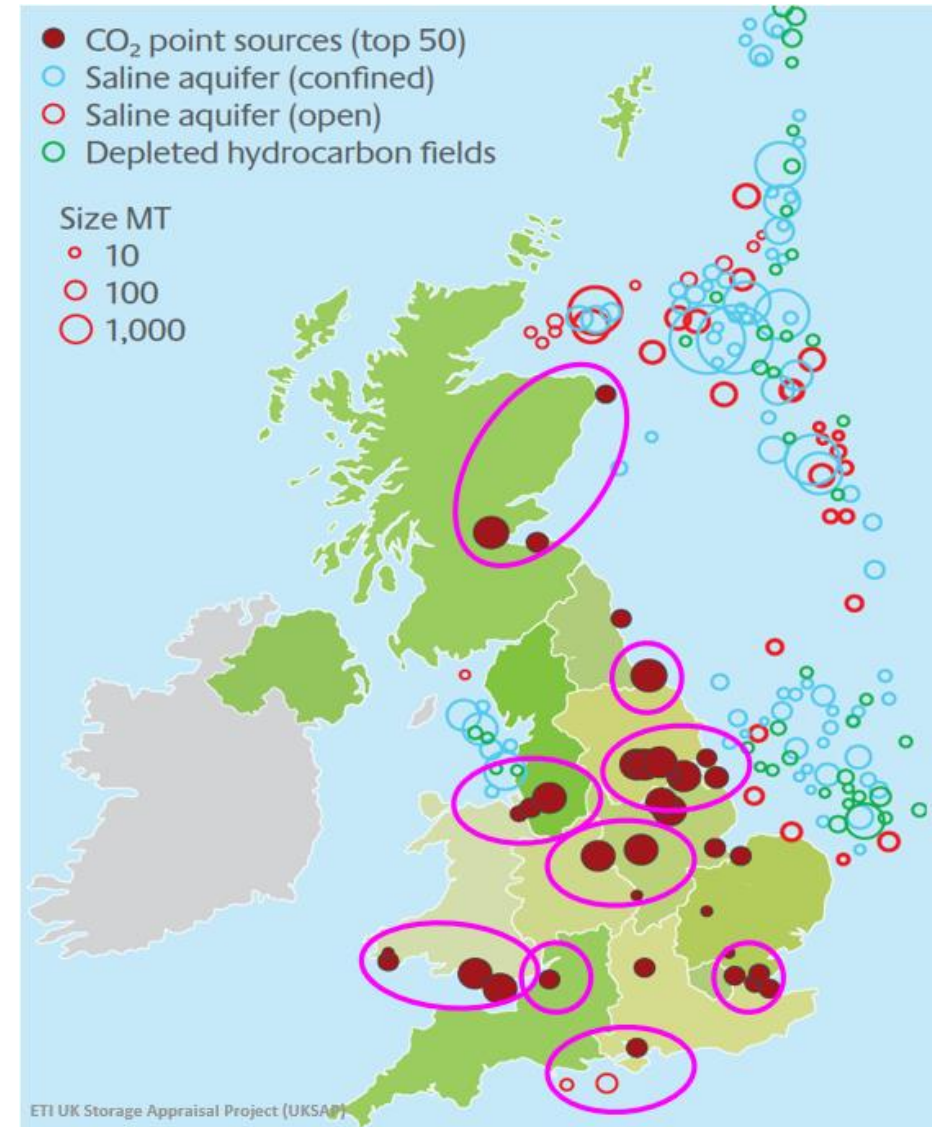
(>5 units per cluster)

(>10MtCO₂/yr)

Key points from ETI UK Storage Appraisal study*:

- All of the nation's requirements for an aggressive CCS programme can be accommodated in the North Sea, to 2050 and beyond
- With a national plan including successful aquifer appraisal, this programme could be serviced by as little as **six shoreline hubs feeding less than 20 stores**, and having a net present infrastructure cost of less than £5bn
- **Without a national CCS infrastructure, the cost of reaching UK Climate Change targets will double** from a minimum of around £30bn per year in 2050
- **For successful commercialisation to be efficient, assets need to be shared** and onshore and offshore networks developed to achieve economies of scale
- Development of the **Southern North Sea is important as Eastern and South East England will be the country's largest emitters**
- Aquifers offer low cost storage facilities – appraisal work on these needs to start soon

* <http://www.eti.co.uk/ccs-a-picture-of-co2-storage-in-the-uk/>










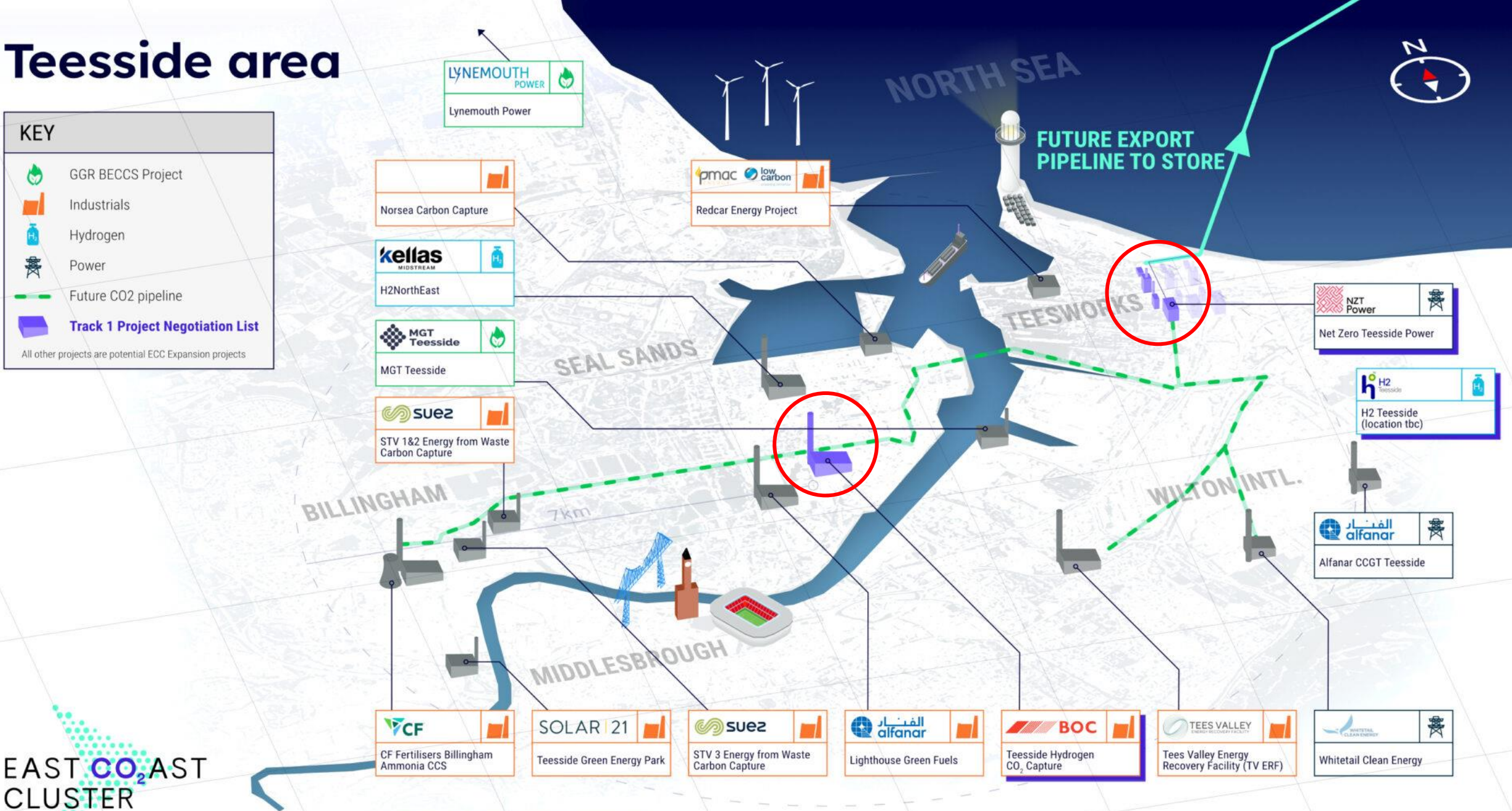
<https://www.ccsassociation.org/all-news/ccsa-news/ccsa-blog-recent-ccus-announcements-and-delivering-the-next-wave-of-clusters-in-the-uk-by-ruth-herbert-ccsa-ceo/>

Teesside area

KEY

-  GGR BECCS Project
-  Industrials
-  Hydrogen
-  Power
-  Future CO2 pipeline
-  **Track 1 Project Negotiation List**

All other projects are potential ECC Expansion projects



EAST CO₂ AST CLUSTER

• Pipeline routing for illustrative purposes only

<https://www.netzeroteesside.co.uk/>

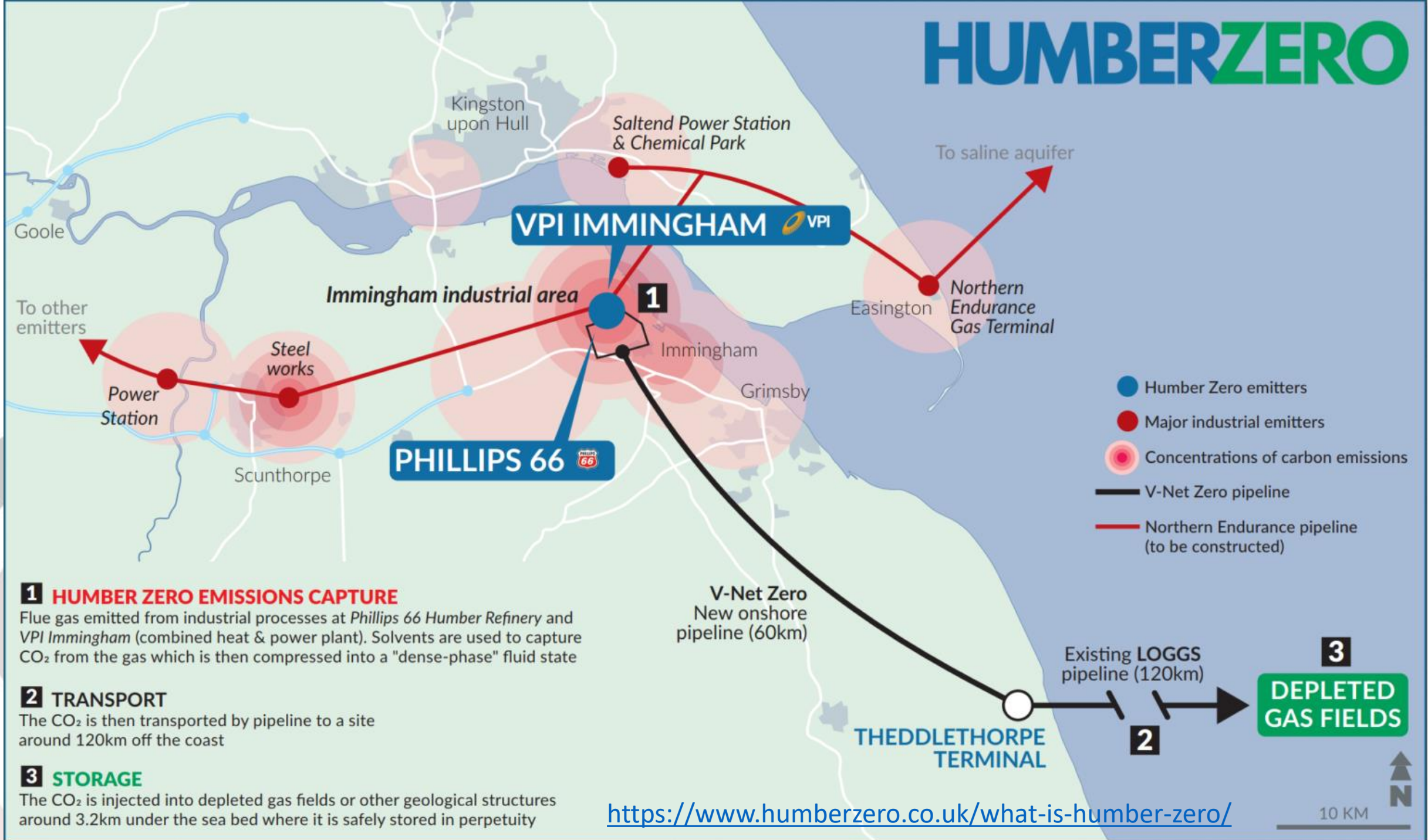


KEY

-  INITIAL PHASES OF CADENT'S H₂ PIPELINE
-  FUTURE PHASES OF CADENT'S H₂ PIPELINE
-  CO₂ TRANSPORTATION AND STORAGE SYSTEM
-  FUTURE CO₂ PIPELINE CONNECTIONS
-  INDUSTRIAL CO₂ CAPTURE
-  CO₂ STORAGE
-  LOW CARBON H₂ PRODUCTION
-  UNDERGROUND H₂ STORAGE
-  INDUSTRIAL H₂ USER
-  FLEXIBLE H₂ POWER GENERATION
-  CO₂ SHIPPING
-  H₂ BLENDING FOR HOMES AND BUSINESS
-  H₂ FUELLING FOR TRANSPORT
-  H₂ FROM OFFSHORE WIND
-  H₂ FROM SOLAR AND WIND

<https://hynet.co.uk/about/>

HUMBERZERO



1 HUMBER ZERO EMISSIONS CAPTURE

Flue gas emitted from industrial processes at *Phillips 66 Humber Refinery* and *VPI Immingham* (combined heat & power plant). Solvents are used to capture CO₂ from the gas which is then compressed into a "dense-phase" fluid state

2 TRANSPORT

The CO₂ is then transported by pipeline to a site around 120km off the coast

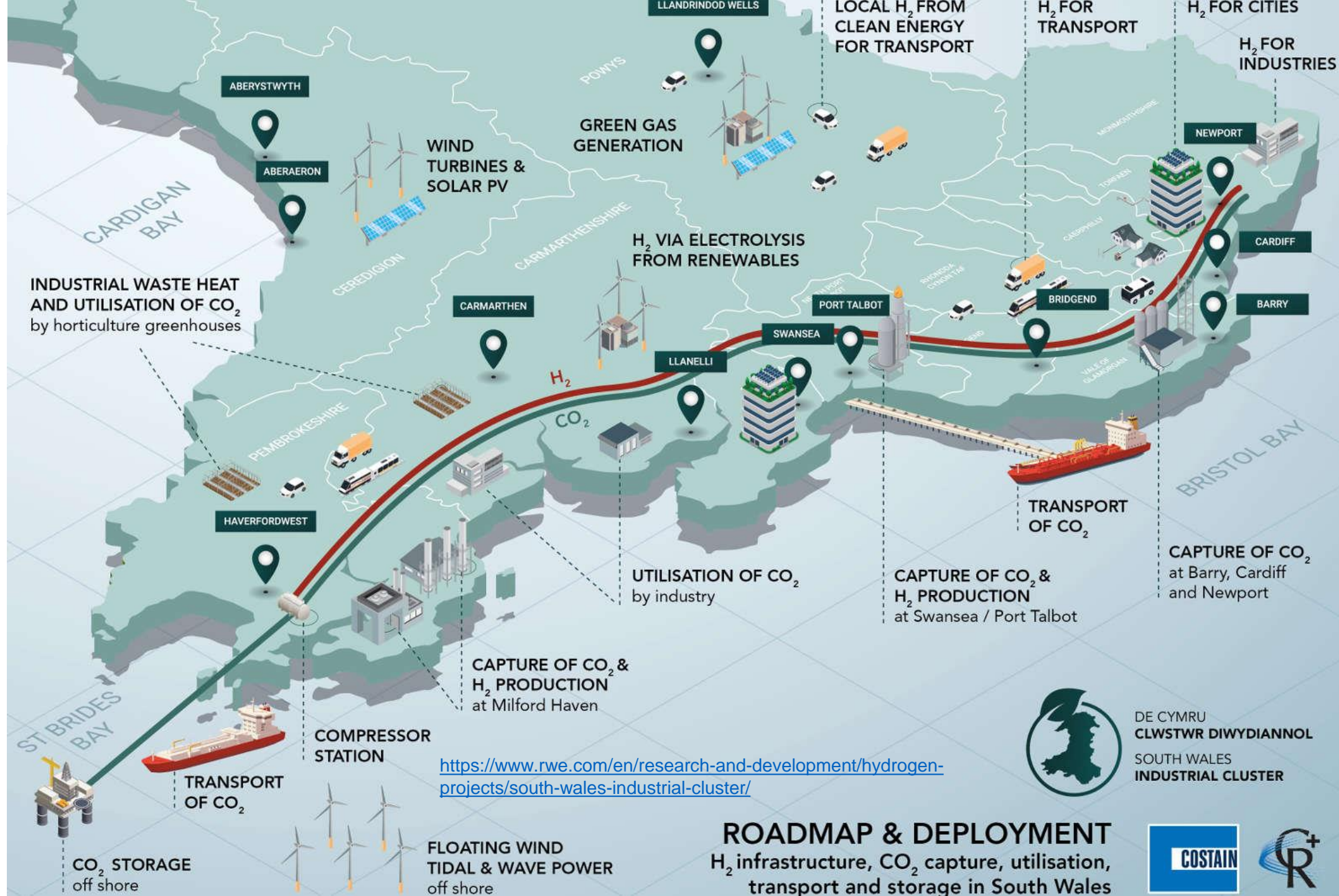
3 STORAGE

The CO₂ is injected into depleted gas fields or other geological structures around 3.2km under the sea bed where it is safely stored in perpetuity

<https://www.humberzero.co.uk/what-is-humber-zero/>

10 KM





<https://www.rwe.com/en/research-and-development/hydrogen-projects/south-wales-industrial-cluster/>

DE CYMRU
CLWSTWR DIWYDIANNOL
SOUTH WALES
INDUSTRIAL CLUSTER

ROADMAP & DEPLOYMENT

H₂ infrastructure, CO₂ capture, utilisation, transport and storage in South Wales



Emerging UK clusters



<https://www.peakcluster.co.uk/>; <https://uk.linkedin.com/company/7co2>; <https://www.eni.com/static/bactonthamesnetzero/>; <https://www.mnzcluster.com/>; <https://bcinc.org.uk/>;

December 2023 updates



- Track-1 Phase 2 Expansion: HyNet cluster
- CCUS Cluster Sequencing Track-2: to establish clusters at pace
- Business model updates for BECCS and GGR's
- Policy paper setting out the government's vision for the UK CCUS sector in the 2030's

<https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-ccus-deployment-track-1-expansion-hynet-cluster>

<https://www.gov.uk/government/publications/cluster-sequencing-for-carbon-capture-usage-and-storage-ccus-track-2/ccus-cluster-sequencing-track-2-market-update-december-2023>

<https://www.gov.uk/government/publications/greenhouse-gas-removals-ggr-business-model>

<https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-a-vision-to-establish-a-competitive-market>

Conclusions



UK CCS at an advanced stage following UKCCSRC initiated cluster-building discussions in 2016

- Two CO₂ pipeline clusters identified as 'Track 1', moving toward Final Investment Decision (FID), now expected late 2024
- Two further CO₂ pipeline clusters at an advanced stage of preparation
- Eight capture projects in first two clusters moving towards FID
- 100+ other capture projects at various stages of planning
- CO₂ shipping, rail and road transport also being planned

Conclusions



- Detailed regulatory work is now happening (<https://ukccsrc.ac.uk/best-available-technology-bat-information-for-ccs/>; see <https://consult.environment-agency.gov.uk/psc/dn40-3dz-vpi-immingham-llp-epr-bj8022iz-v014/> for a detailed environmental permit application example
- Complex business models for liberalised markets are also being finalised (<https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-ccus-business-models>)
- Since 2016 the UK CCS community is growing rapidly
- **UKCCSRC membership** has grown from 1,600+ to 2,100+!
- Projects are now waiting on a coordinated investment decision by government, with expectation that the general increase in construction costs and recent economic stresses are a challenge
- And contracts need to be awarded before the election or uncertainty introduced

Thank you

Any questions?

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