If you have any enquiries please contact;

- **Carbon Capture - Technical**
  - Dr. Nina Cardinal – Technical Strategy Director
    - Nina.cardinal@heidelbergmaterials.com
- **evoZero Cement - Commercial**
  - Philip Matthew – Commercial Director - Bulk
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- **Concrete Technical**
  - Lee Baldwin – Technical Services Manager
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- **Future events at Heidelberg Materials evoHub**
- www.heidelbergmaterials.co.uk/en/cpd-registration-evohub

Heidelberg Materials

Carbon Capture and Storage

evoHub | Carbon Capture & Storage | Iain Walpole & Nina Cardinal

Iain Walpole

Head of Sustainability - CCS

Nina Cardinal

Technical Strategy Director

1. Introduction to Heidelberg Materials
2. Why do we capture carbon?
3. Brevik Carbon Capture Project
4. Padeswood Carbon Capture Project
5. Future Carbon Capture Technologies
6. evoZero: Our carbon captured cement
7. Key messages
8. Q&A

Heidelberg Materials

Heidelberg Materials

Business Overview

evoHub | Carbon Capture & Storage | Iain Walpole & Nina Cardinal

4/15/2026

Heidelberg Materials is one of the world's largest building material companies

Cement	Aggregates	Concrete	Asphalt
127	2934	45	8
Million Metric Tons	Million Metric Tons	Million Cubic Meters	Million Metric Tons

Providing the materials to build the future.

- > 150 years company history
- > 3000 locations
- ➢ 50 countries
- ➢ 51000 employees

until 2023....

Hanson

HEIDELBERGCEMENT Group

became...

Heidelberg Materials

Heidelberg Materials UK is leading the way

- World's first carbon capture cement plant producing **evoZero near-zero cement** – Padeswood cement plant
- World's first **hydrogen trial** at a cement plant – Ribblesdale cement plant
- UK's first **hydrogen asphalt trial** – Criggion asphalt plant
- UK's first use of an **electric paver** on a major road network

About Heidelberg Materials

- Leading supplier of lower carbon heavy building materials to the construction industry.
- Produces aggregates (crushed rock, sand and gravel), asphalt, ready-mixed concrete, cement and GGBS.
- Part of a global company represented in over 50 countries with more than 51,000 employees.
- Committed to decarbonising the built environment/growing the circular economy.
- Develops digital solutions to improve efficiency, productivity and customer service.

No.1
for cement and concrete

No.2
for aggregates

No.3
for asphalt and contracting

Heidelberg Materials' UK business

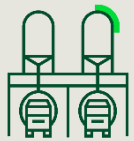
In the UK, Heidelberg Materials is split into five business lines:

- Aggregates
- Asphalt and contracting
- Cement
- Concrete
- Recycling incl.
  - Mick George Ltd
  - B&A
  - Agecroft

2,000+ Heidelberg Materials-liveried vehicles

25 rail depots and wharves supplied by road, rail and sea

4 marine dredgers



150+ ready-mixed concrete plants

6 landfill sites

3 cement plants

50+ sand, gravel and rock quarries

13 recycling centres

3 grinding plants making Regen GGBS (ground granulated blastfurnace slag)

35+ asphalt plants

8 packed products plants

1 joint venture rail company, Mendip Rail

10+ waste transfer stations

3 hazardous waste treatment sites

Supplying essential building materials

Our products are used to help build the infrastructure we need to live, learn, work and travel:

Residential:
Deansgate Square, Manchester

Commercial:
The Shard, London

Hospitals:
Christie Hospital, Manchester

Tunnels:
Thames Tideway super sewer, London

Bridges:
Second Severn Crossing linking England and Wales

Roads:
A414 resurfacing works, Hertfordshire

Power generation:
Hinkley Point C, Somerset

Sea defences:
Marine Parade, Dawlish, Devon

Sport:
Sir Chris Hoy Velodrome, Glasgow

Rail:
Channel Tunnel rail link

2

Why do we capture carbon?

Why do we need carbon capture and storage (CCS)?

CEM I = 840 kg CO_2e/tonne
Source MPA Factsheet 18 (2025)

CO_2 emissions from cement production

Process CO_2

68%

Fuel CO_2

32%

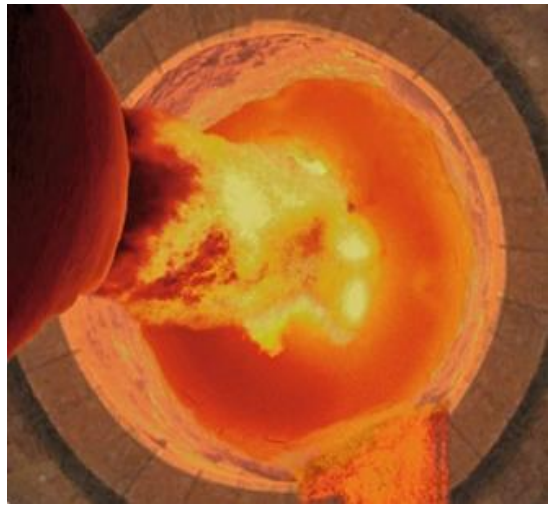
CO_2 reduction

Process CO_2

- Calcination of limestone
  - **CaCO3 + Heat = CaO + CO2**
- CaO needed for cement clinker
- Process CO_2 cannot be avoided
- Cement industry counts as ‘hard-to-abate’

Fuel CO_2

- High usage of alternative fuels
- SRF, waste oils, MBM are replacing coal
- Up to 90% AF usage
- Hydrogen trial with zero coal



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Heidelberg Materials

Brevik, Norway

Carbon Capture Project


CMA CGM
MAERSK

Northern Lights reception terminal at Øygarden, Norway

4

Padeswood Carbon Capture Project

Padeswood carbon capture and storage (CCS)

evoHub | Carbon Capture & Storage | Iain Walpole & Nina Cardinal
4/15/2026

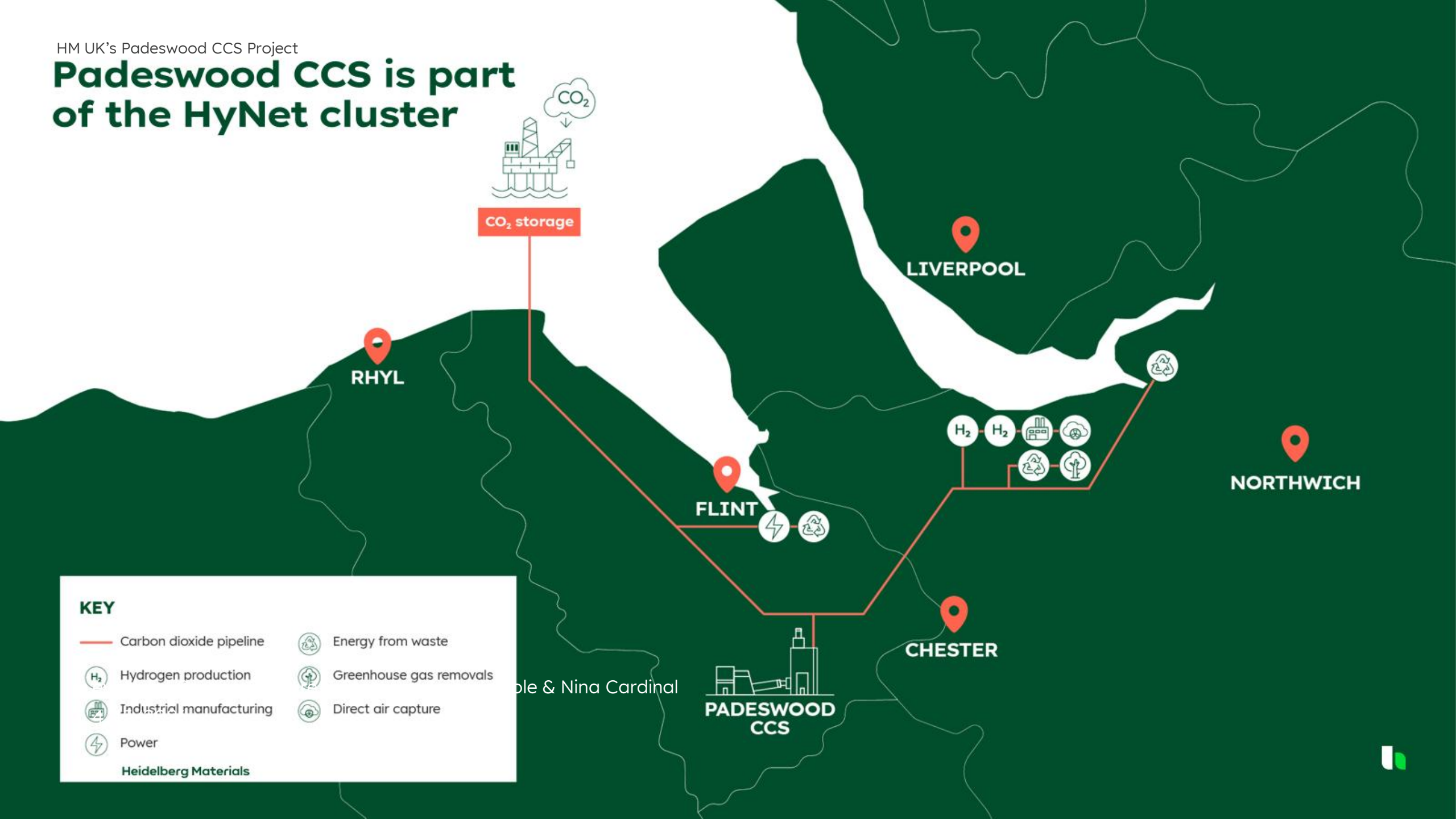
Heidelberg Materials

Padeswood cement works

- Opened in 1949 to supply cement to help rebuild post-war Britain, the works has been an important employer for local people ever since.
- Over the last decade we have been investing in our site to make it more sustainable.
- Carbon capture and storage (CCS) will enable us to achieve net zero manufacture by 2029.
- This plant is the best placed to adopt CCS due to its proximity to CO_2 storage.

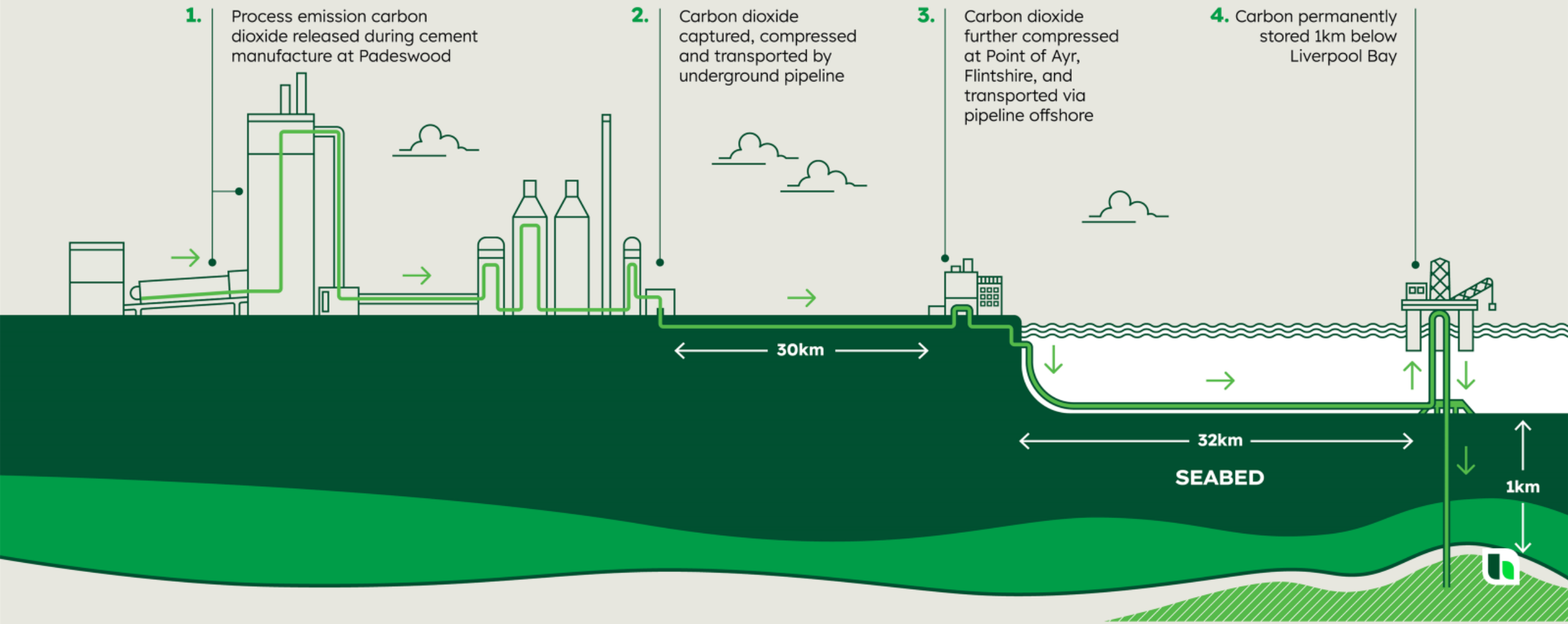
HM UK's Padeswood CCS Project

Padeswood CCS is part of the HyNet cluster



ble & Nina Cardinal

What is Padeswood CCS?



Padeswood project timeline

2025-2029
Capture plant construction and commissioning

Feasibility study

2021

- Heidelberg Materials pre-feasibility
- IDC feasibility study
- HyNet selected track 1 cluster

Pre-FEED

2022

- Cluster sequencing phase 2
- **Aug:** Project shortlisted
- **Oct:** Pre-FEED and community engagement

FEED

2023

- **March:** Padeswood selected for ICC contract negotiation
- **Feb:** Non-statutory consultation
- **Nov:** FEED started

Consultation & permit application

2024

- **May:** Statutory consulation
- **Sept:** Planning and permit application submitted

Construction and commissioning

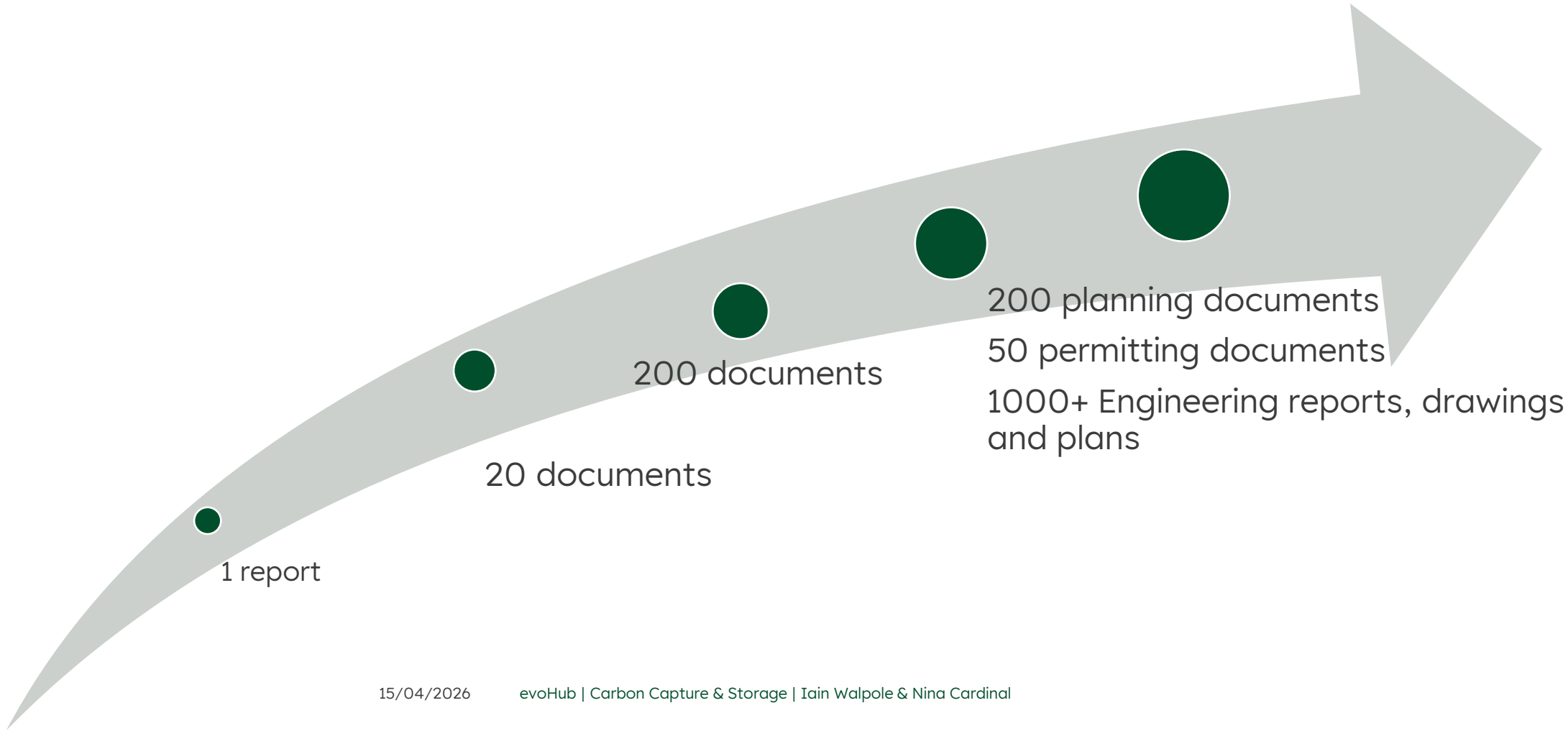
2025

- **April:** Transport and storage network take FID
- Padeswood CCS planning permission granted
- **June:** Padeswood spurline planning submitted by T&Sco
- **Sept:** Heidelberg Materials takes FID

2029 Commercial operation

Project Timeline

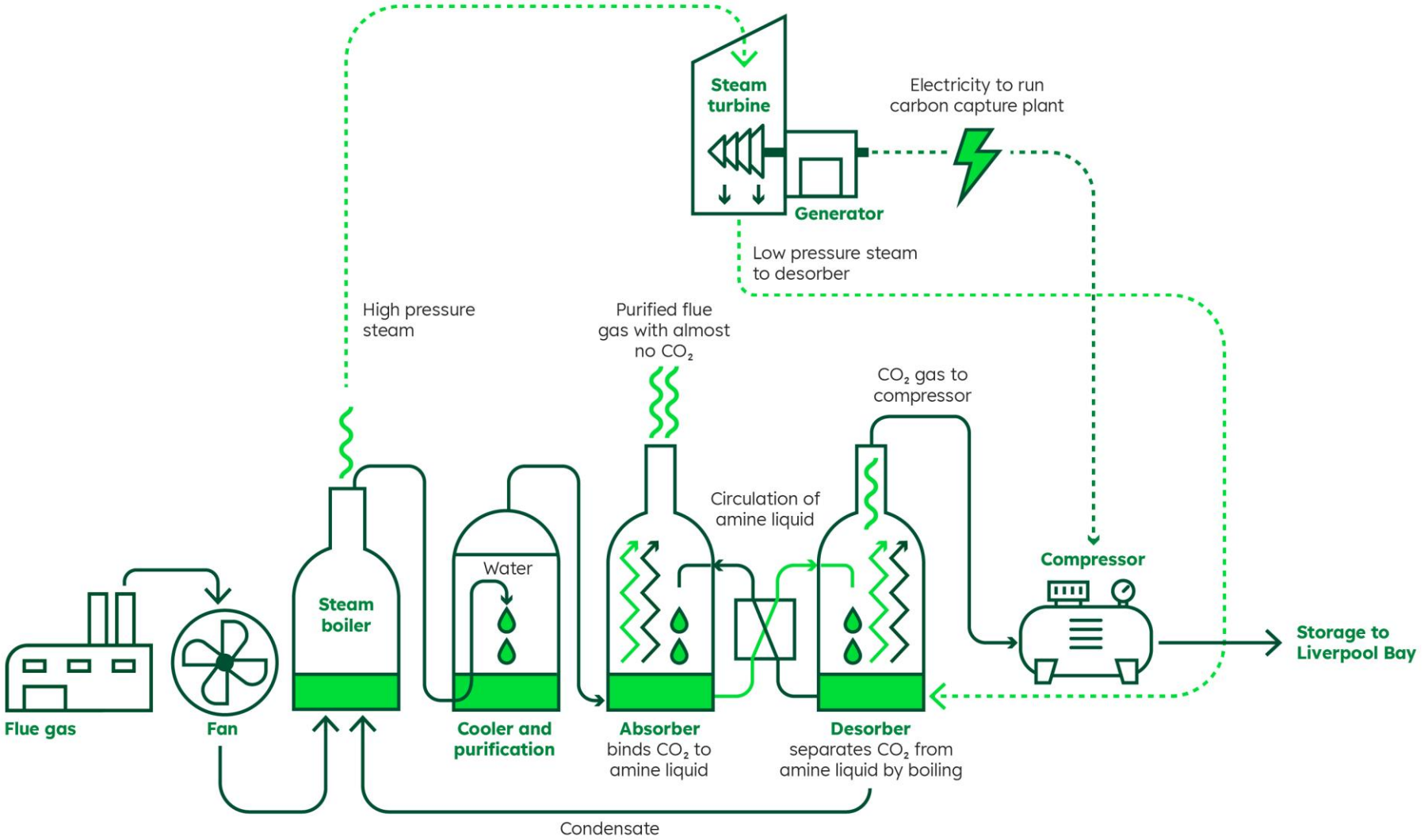
Pre-feasibility study 2020 → IDC Feasibility study 2021 → Cluster sequencing → Project Shortlisted → Technical due diligence → ICC contract



CCS is energy intensive

- 100 MW heat required
  - Amine reboiling
- 20 MW power
  - CO_2 compressor
  - Fans
  - Pumps
- Cooling
  - Heat exchangers
  - Cooling towers
  - Air fin coolers

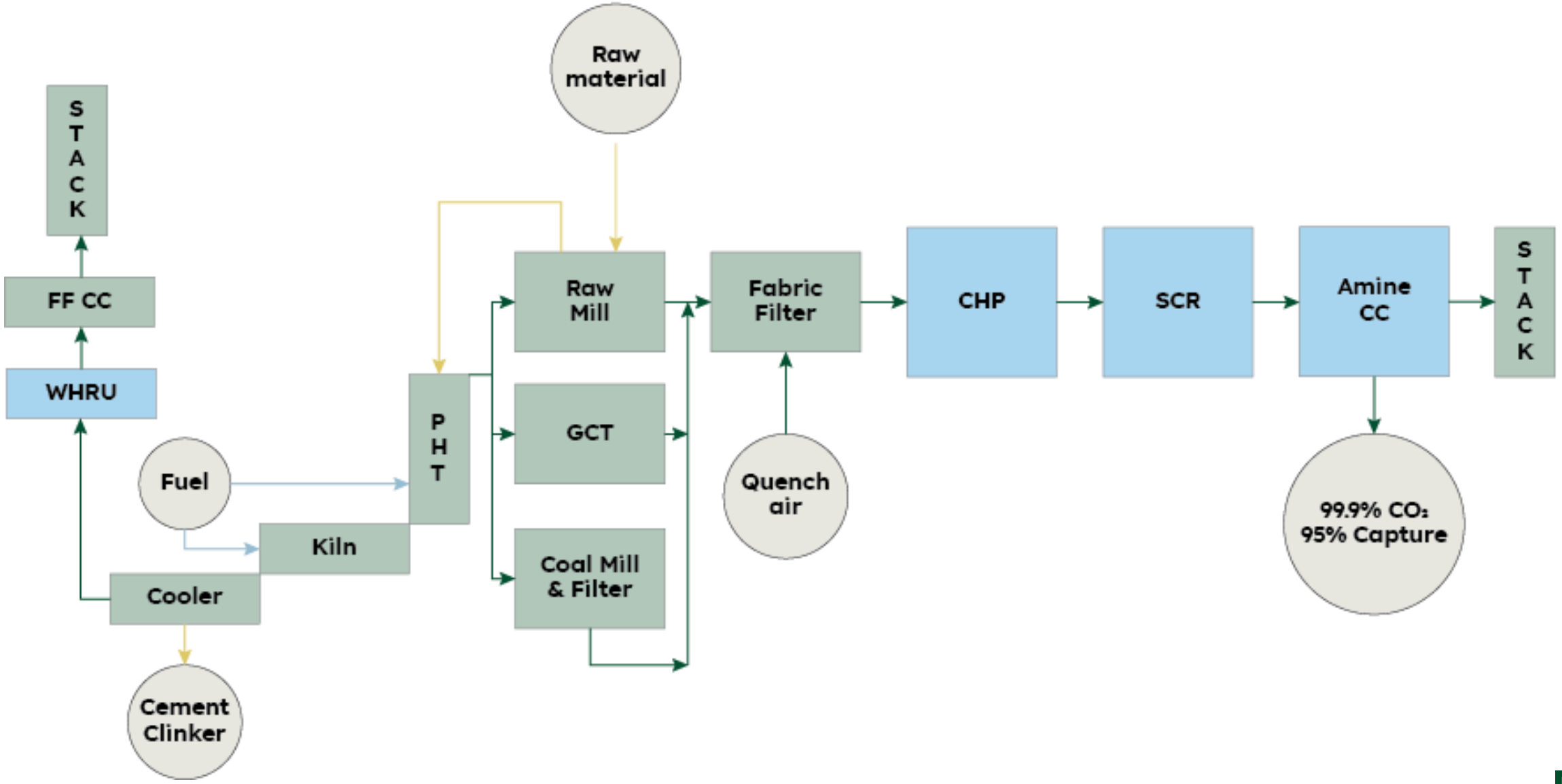
CO_2 is captured at Padeswood through the use of amine CCS technology



Meeting heat and power requirements

- Waste heat from the kiln can provide about 10-15% of the heat required therefore a boiler is needed to provide steam
- Over 20MW electricity is required around half of this is for CO2 compression and transport
- There is insufficient grid capacity to provide this, the earliest increase in grid capacity is not planned to be assessed until 2037
- A combined heat and power solution was chosen
- The CHP has been integrated with the capture plant using kiln gases
  - To enable CO2 from power generation to be captured
  - To reduce the volume of gas handled
  - To increase the CO2 (and reduce the O2) concentration in the CCP feed gas

Amine based carbon capture with integrated CHP block diagram

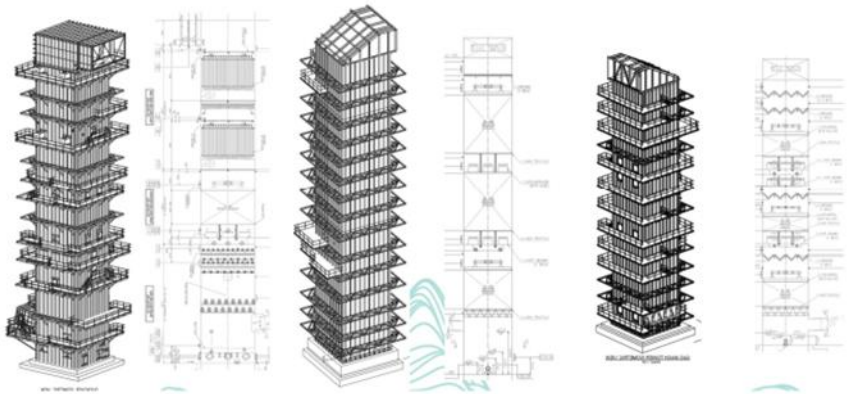


Process Integration

- Waste heat from the kiln transferred directly to the CHP
- Zero liquid discharge concept developed and implemented
  - Water consumption reduced from 180m^3/h to less than 40 m^3/h by use of air fin coolers
  - Demineralised water required for boiler and amine plant
  - Surface run off and drainage harvesting
  - Waste water from water treatment used for cooling in CCP
  - Mineral rich waste water from Reverse Osmosis plant used in cement plant for evaporative cooling replacing abstracted water
- Zero offsite waste concept
  - Waste from amine reclaimer used as fuel in cement kiln calciner
  - Organic waste from CO_2 purification used in calciner

Padeswood CCS is a massive project
A few facts and figures

- Over 5 km newt fencing installed
- Over 100,000 m3 earthworks
- Over 25,000 m3 concrete
- Over 2,000 piles
- 200 km of electrical and instrumentation
- 25 km piping
- Peak construction workforce over 600



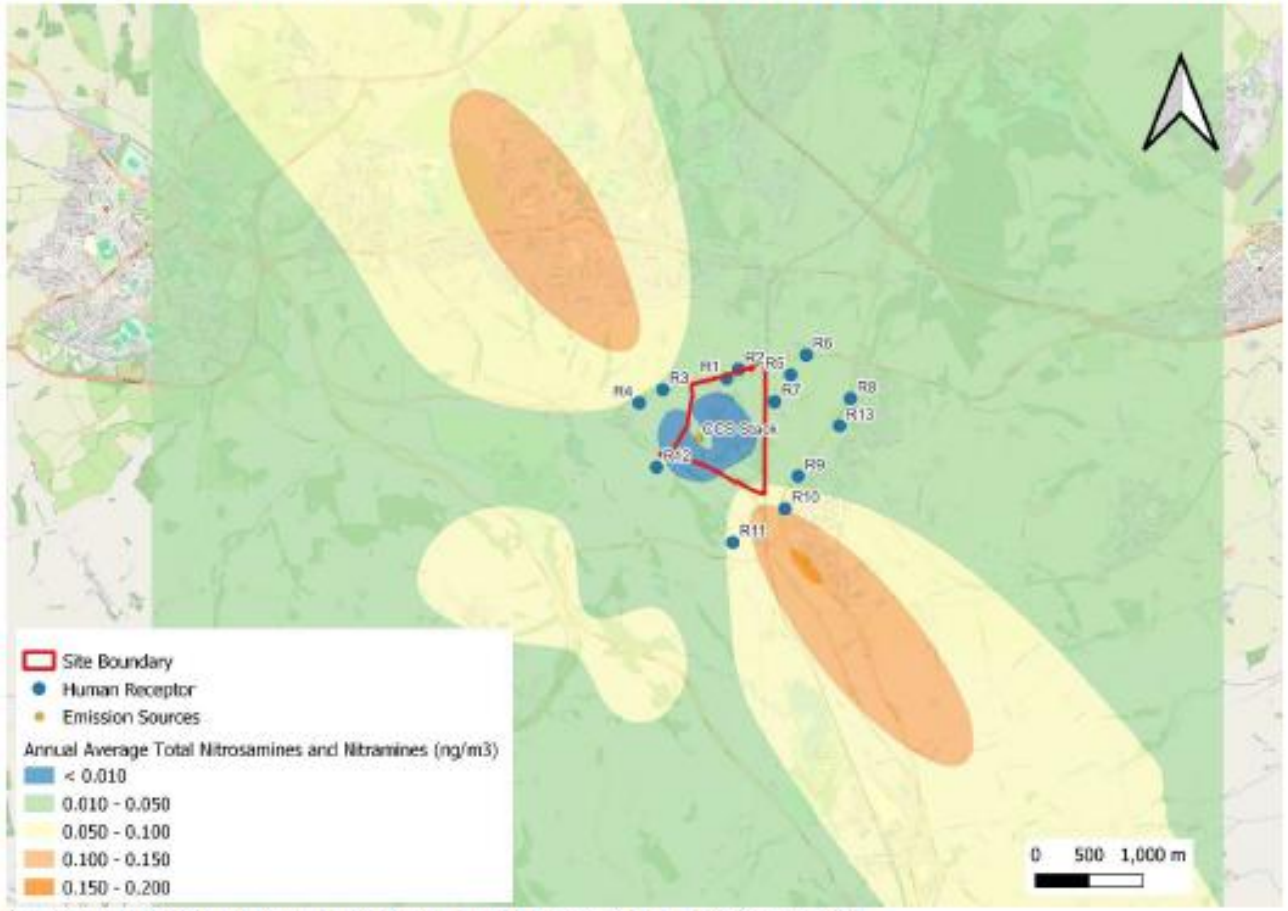
Construction Execution – Current Status

- Pre-commencement planning conditions discharged
- Environmental and Ecological mitigation completed
  - Great Crested Newts
  - Badgers
  - Bats
- Enabling works started in November
  - Initial Earthworks
  - Tree Removal
  - Demolition of old buildings
- Current activities
  - Road Construction
  - Installation of Piled retaining wall
  - Major earthworks cut & fill

Stringent emission limits and emission reductions

- Reduced emissions and air quality impacts
- Nitrogen deposition reduced at sensitive habitat sites Ammonia and NOx
- SO2 Padeswood is one of the lowest SO2 emitters in the UK cement industry further reductions achieved
- Particulate matter PM10 (and trace metals)
- Total organic carbon (TOC)
- New limits on amine and nitrosamine emissions

Figure C3 Predicted Annual Average Total (indirect + Direct) Nitrosamines and Nitramines (ng/m³) PCs– 2021 met data



@OpenStreetMap contributors, available under the Open Database Licence V3

CO2 Quality control

- System entry conditions and CO2 composition limits set to protect CO2 pipeline and storage reservoir.
- Specification developed to prevent corrosion, two phase flow, liquid dropout and toxicity
- Continuous monitoring of temperature, pressure, CO2, moisture, O2, NOx, SO2, NH3, CO, formaldehyde, acetaldehyde
- Offline sampling and analysis of over 30 other impurities
- Key limits <10ppm O2 and 50ppm H2O

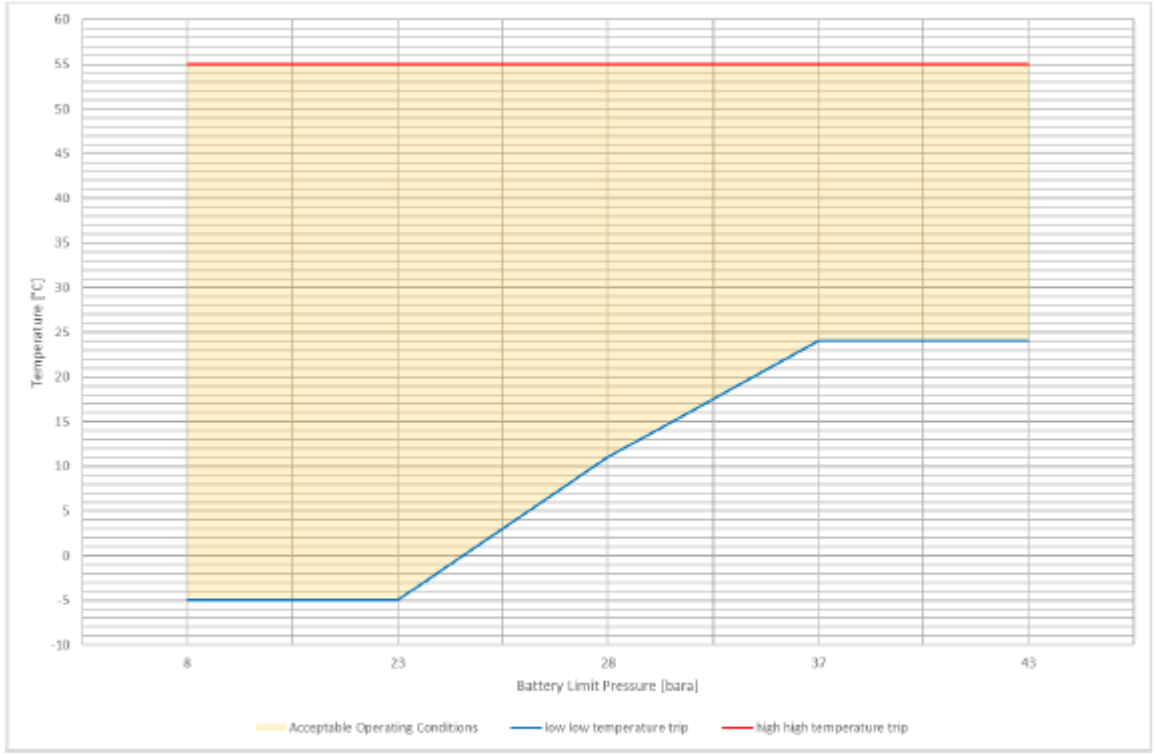
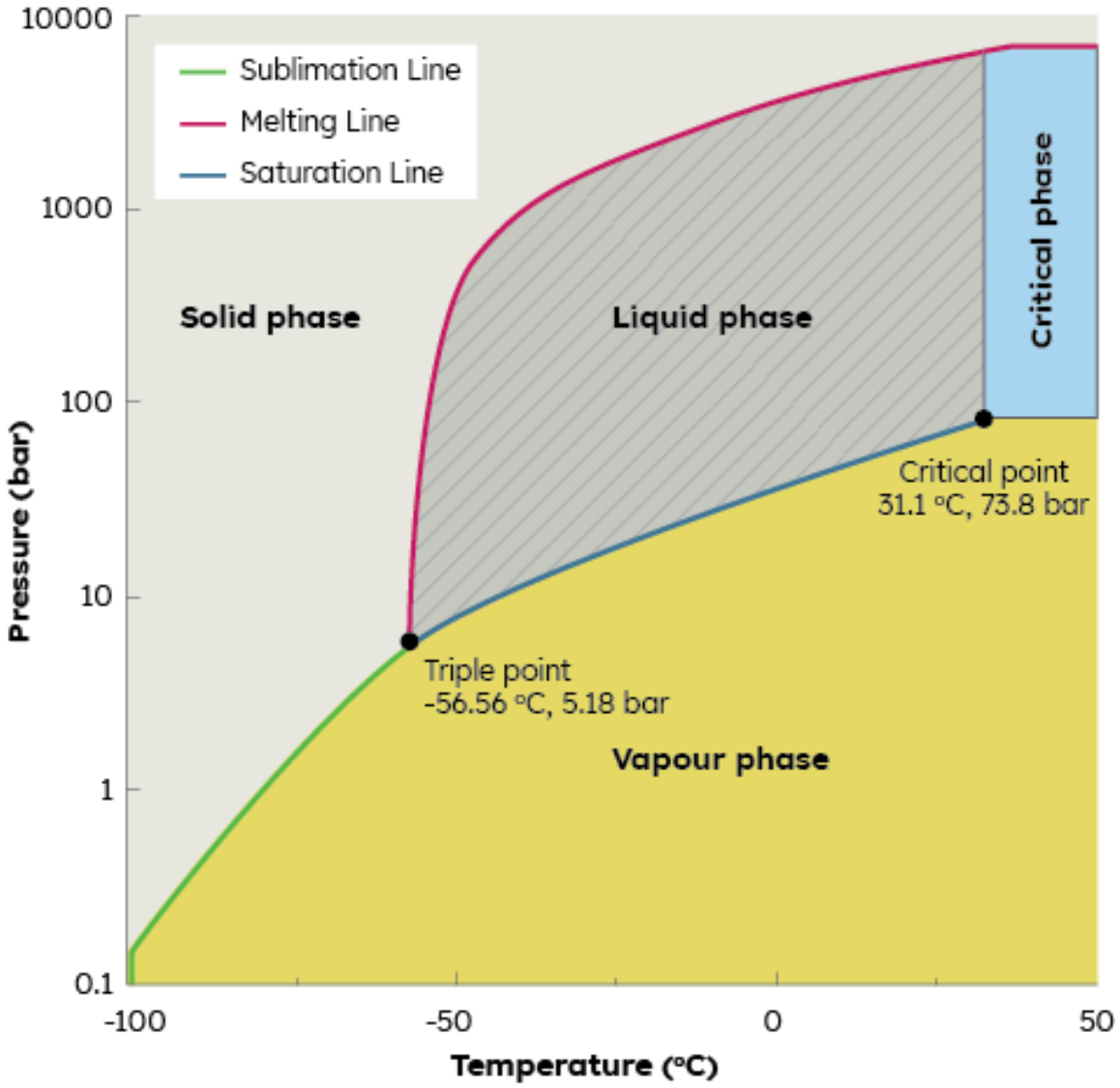


Figure 1-1: entry conditions at the Battery Limits

CO2 Quality control why is it important?

- The HyNet CO2 specification has been design for operation in the gas phase onshore and for future dense phase operation offshore
- Solid formation is possible eg reactions of ammonia in CO2 leading pipeline blockages
- Particulates can block pores in the reservoir reducing storage capacity
- Impurities move the phase boundaries CH4, N2, Ar
- Liquid dropout of water, methanol and amines can lead to rapid corrosion as acid formation can occur in the liquid phase
- Some impurities can cause running ductile fracture propagation eg H2



How is carbon stored? (1)

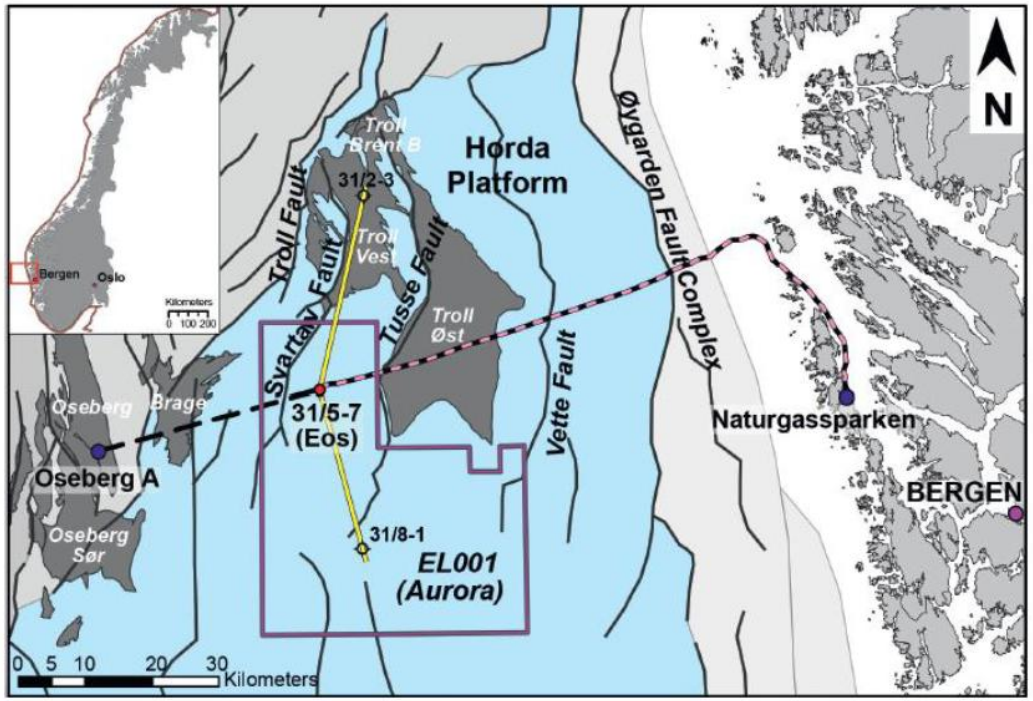


Figure 1.2 Map indicating the Exploitation License EL001 in the Aurora site, south of the Troll Field, as well as the Eos confirmation well shown in red point. The Horda Platform covering the Troll Field and the exploitation license EL001 is shown in light blue. Control umbilical and cable route shown by black stippled line. Yellow line is the trace of the cross section shown in Figure 1.3 and the Pink stippled line is the pipeline route. Blue point indicates the onshore terminal, Naturgassparken, located in Øyegarden, west of Bergen municipality (Furre et al., 2020).

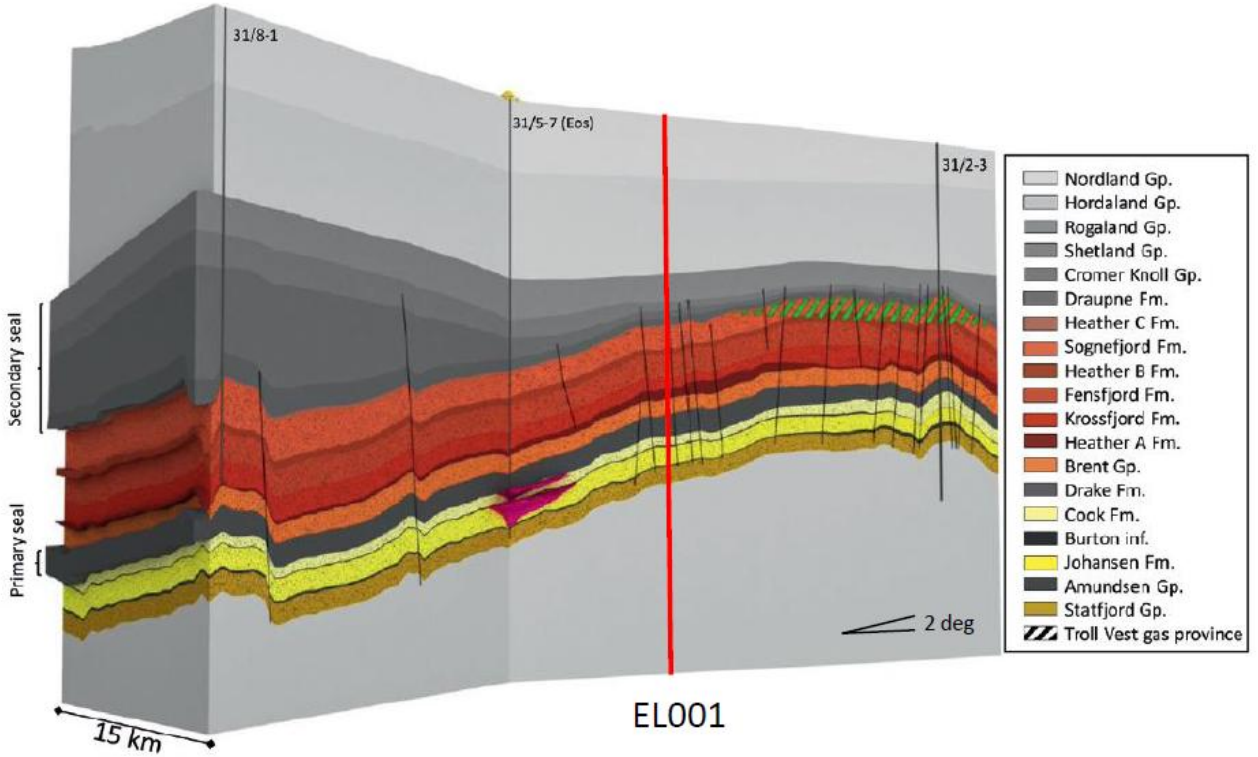
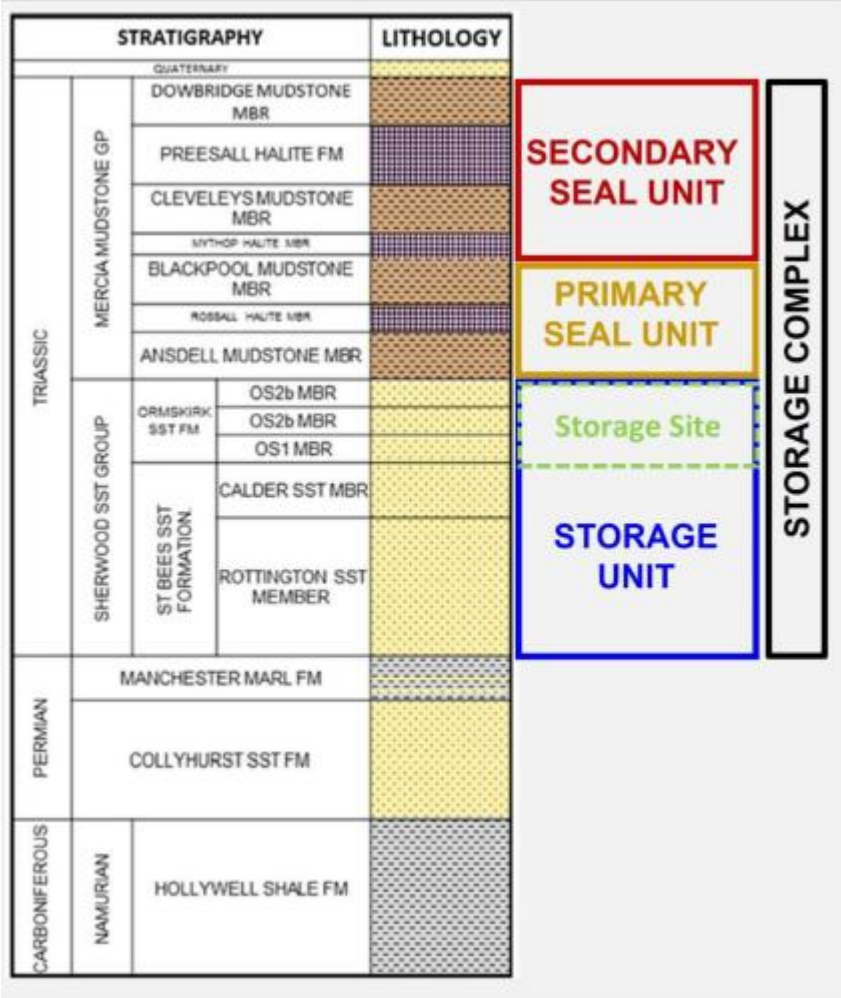


Figure 1.3 Schematic of the subsurface going from south to north through the 31/5-7 (Eos) confirmation well. The CO_2 plume extent after 37.5 Mt injection is illustrated in magenta. The red line indicates the extent of the exploitation license EL001 (Modified from Furre et al. 2020).

How is carbon stored? (1)



How is carbon stored? (2)

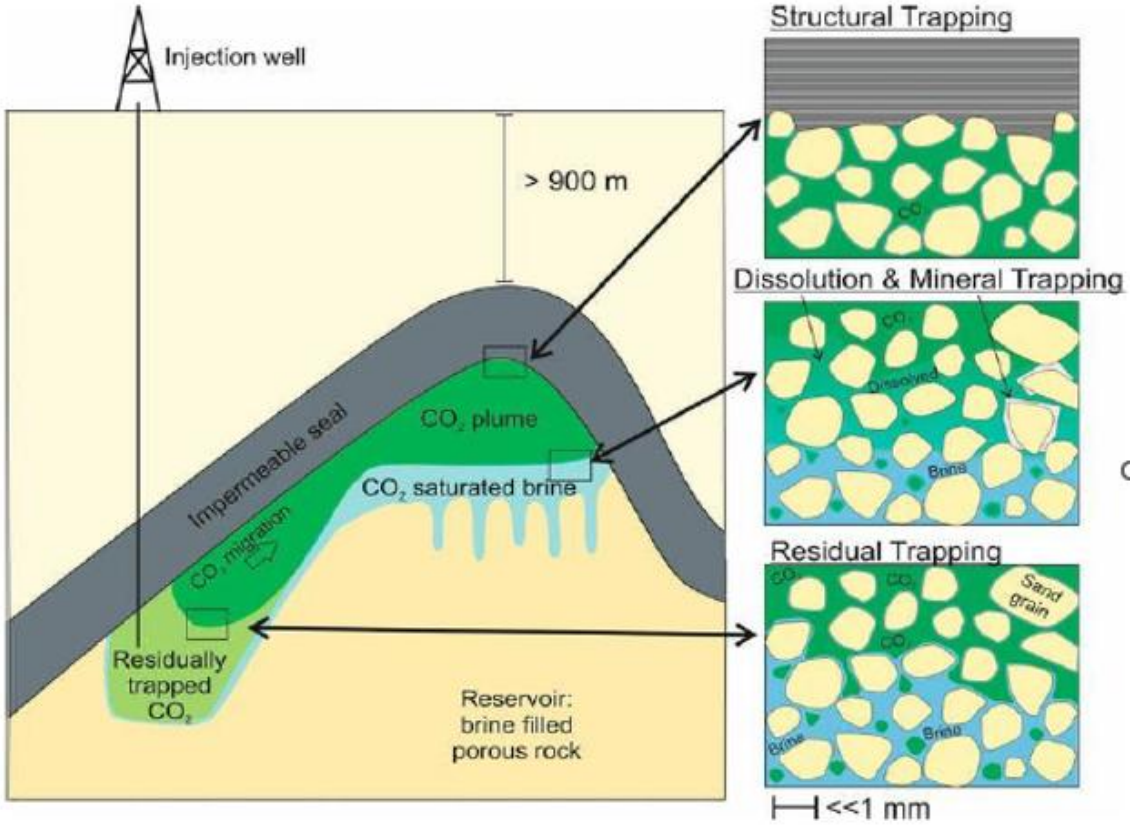
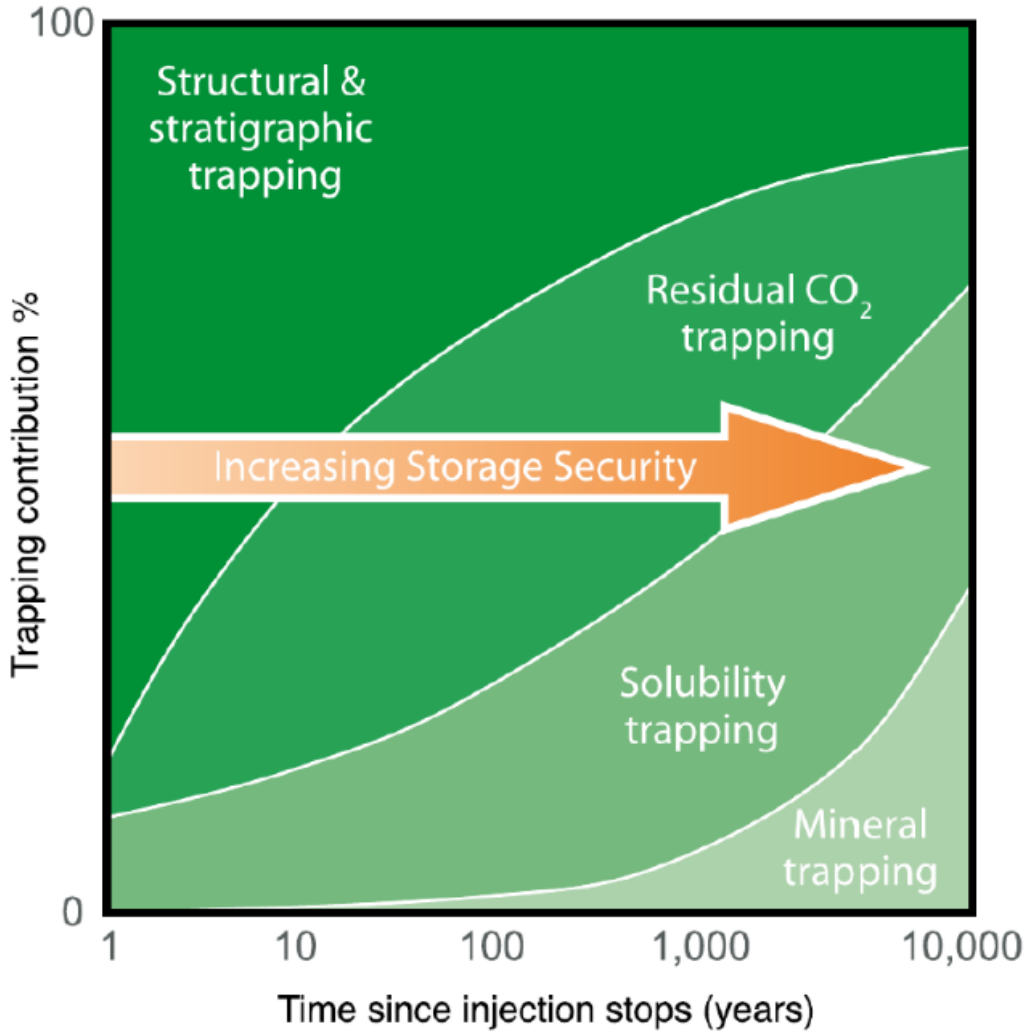


Figure 2.8 Sketch showing different trapping mechanisms retaining CO_2 underground, physically and geochemically (Flude & Alcade, 2021).



Is Carbon Capture and Storage proven technology?

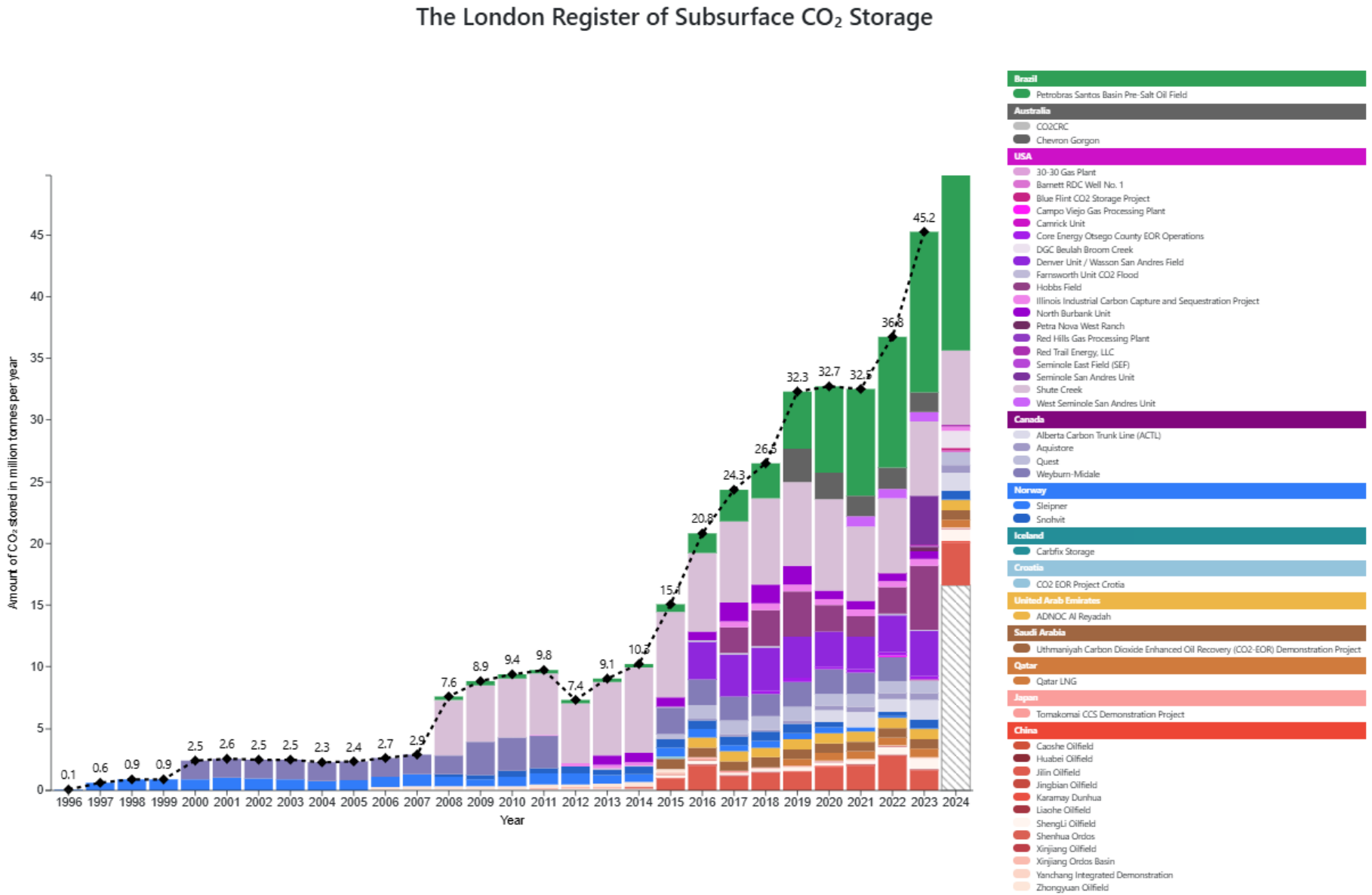
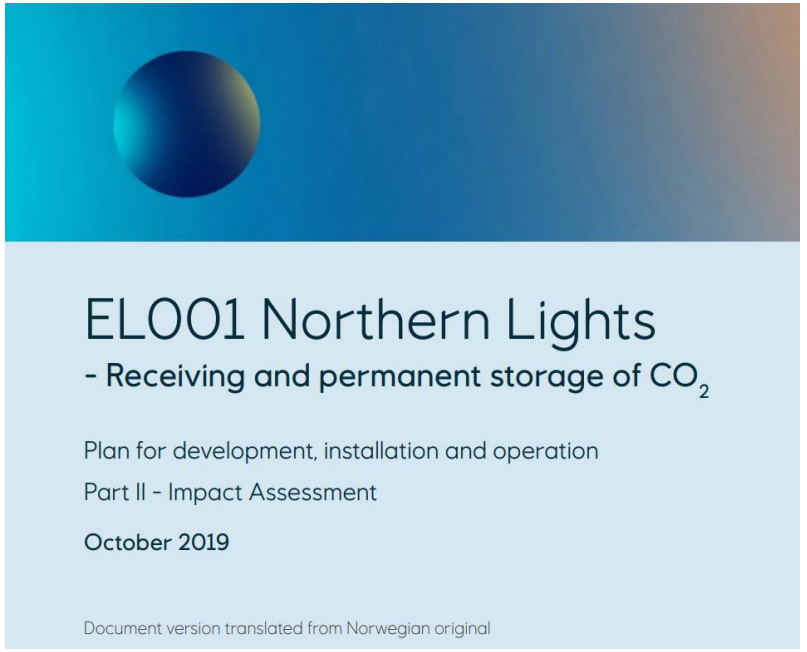
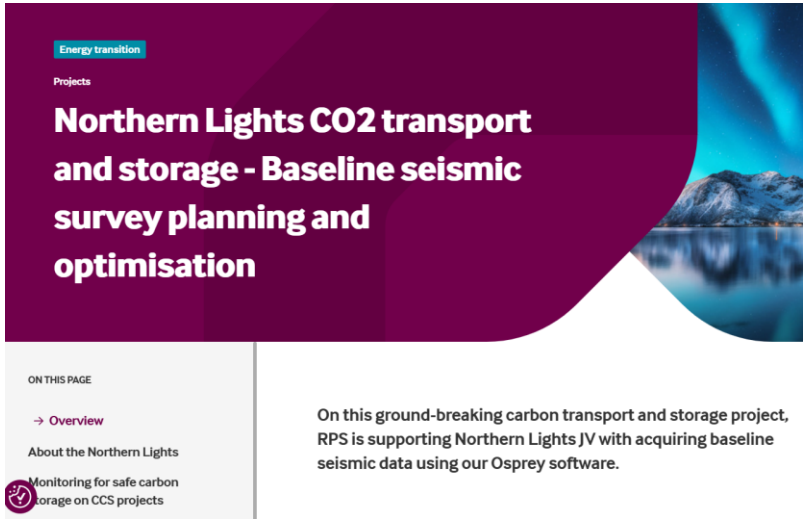


Figure 1: Annual amounts of CO_2 stored by project (Update Date: 12-Nov-25)

Leakage and environmental impact assessments

- Transport and storage is handled by partners with extensive relevant experience
- Existing experience provides confidence, e.g. Sleipner CO2 project running since 1996
- Comprehensive impact assessment study carried out prior to implementation
- Regular surveys to monitor changes in the reservoir and to allow modelling of the CO2 plume development
- Fluid Flowing modelling carried out by Bergen University: CO2 sinks in the reservoir





Follow our progress

- For more information visit:

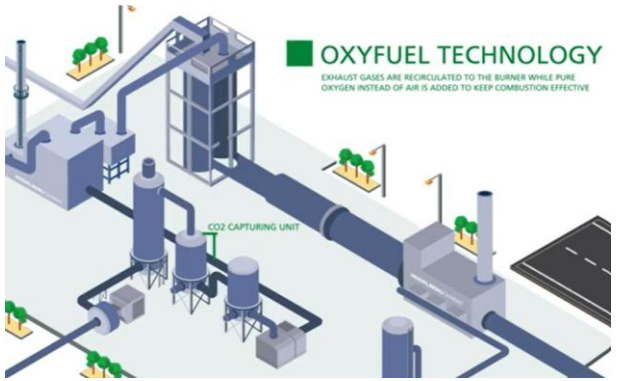
  padeswoodccs.co.uk

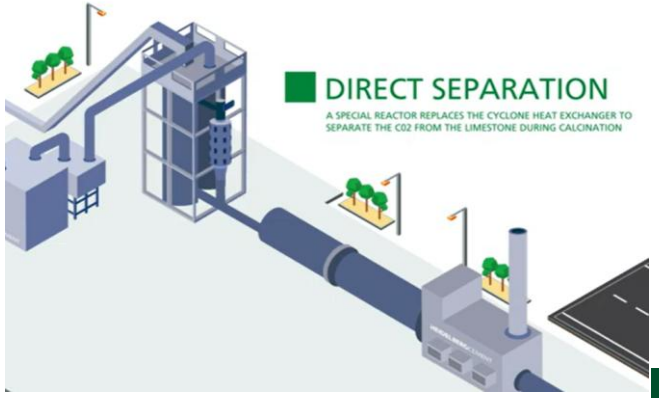
- Contact us:
  padeswoodccs@heidelbergmaterials.com

Future Carbon Capture Technologies

Other Carbon Capture Technologies

- **Other solvent technologies**
  - e.g. C-Capture
- **Oxyfuel**
  - Oxygen instead of air for combustion
- **Direct Separation**
  - Process CO_2 kept apart from combustion exhaust gas
- **MOFs**
  - Traps CO_2 in porous, solid atomic cages
- **Cryogenic separation**
  - In combination with Oxyfuel





We are only getting started – our CC(U)S pipeline

Operational

Brevik, Norway
400kt CO_2 p.a.

Lengfurt, Germany
CCU, 70 kt CO_2 p.a.

FID[1] stage

Padeswood, UK
800kt CO_2 p.a.

Close to FID[1] stage

Edmonton, Canada
1,100kt CO_2 p.a.

Advanced development

Devnya, Bulgaria
800kt CO_2 p.a.

Geseke, Germany
700kt CO_2 p.a.

Slite, Sweden
1,800kt CO_2 p.a.

Antoing, Belgium
800kt CO_2 p.a.

Airvault, France
1,000kt CO_2 p.a.

Mitchell, USA
2,000kt CO_2 p.a.

Rezzato, Italy
1,000kt CO_2 p.a.

Large-scale technology pilot projects

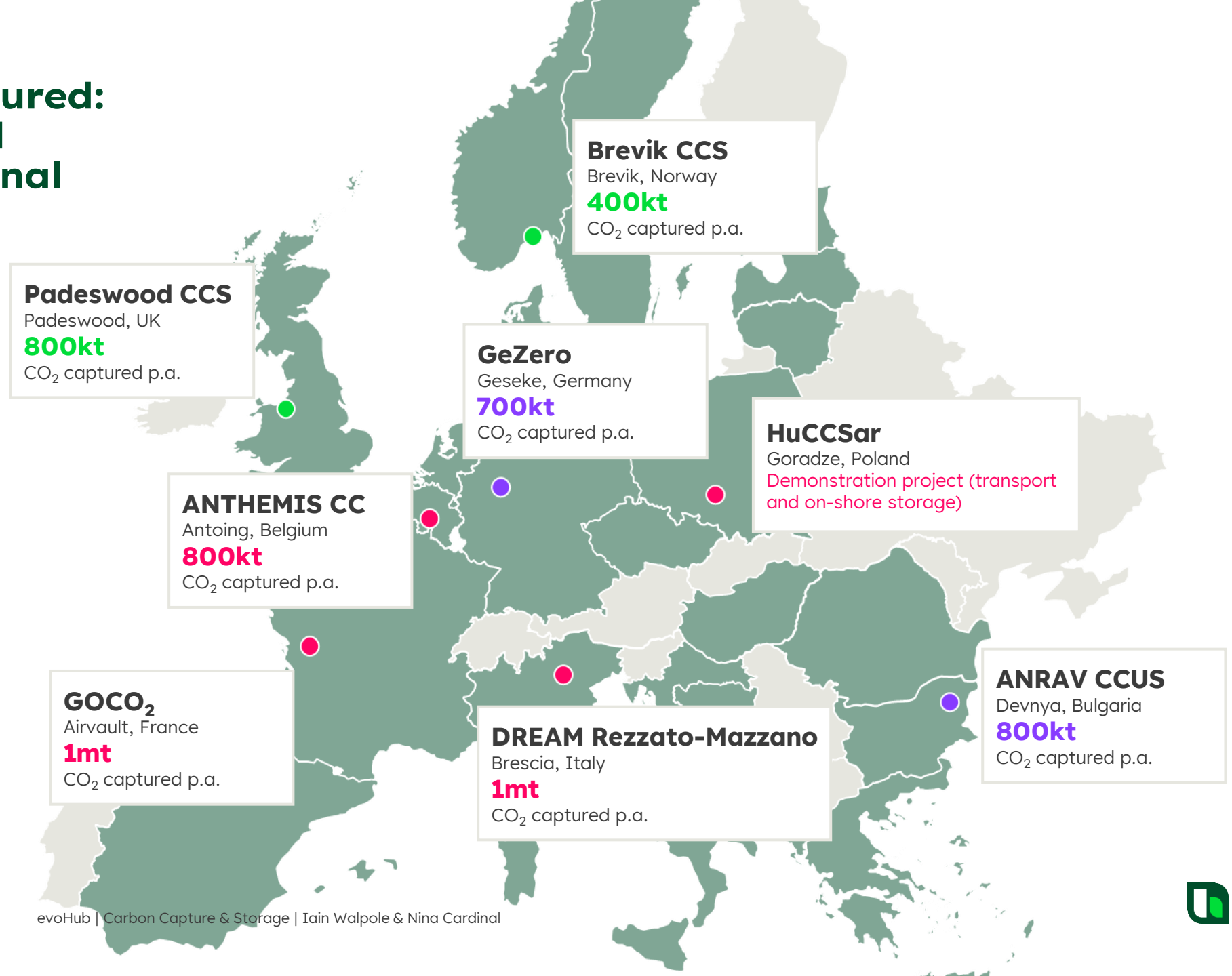
Ennigerloh, Germany
LEILAC 2, 100kt CO_2

Devnya, Bulgaria
OxyCal, 50kt CO_2

Mergelstetten, Germany
Oxyfuel, 100kt CO_2

1. Final investment decision

Further funding secured: EU Innovation Fund grants for 4 additional CCS projects

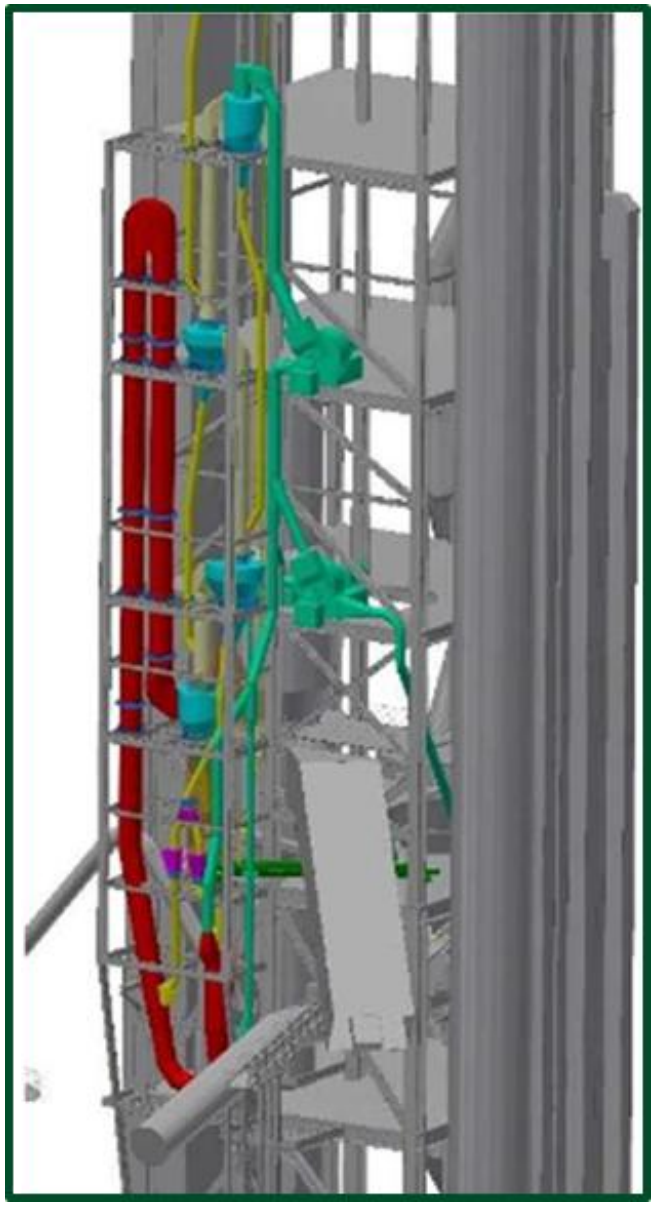


Funding:

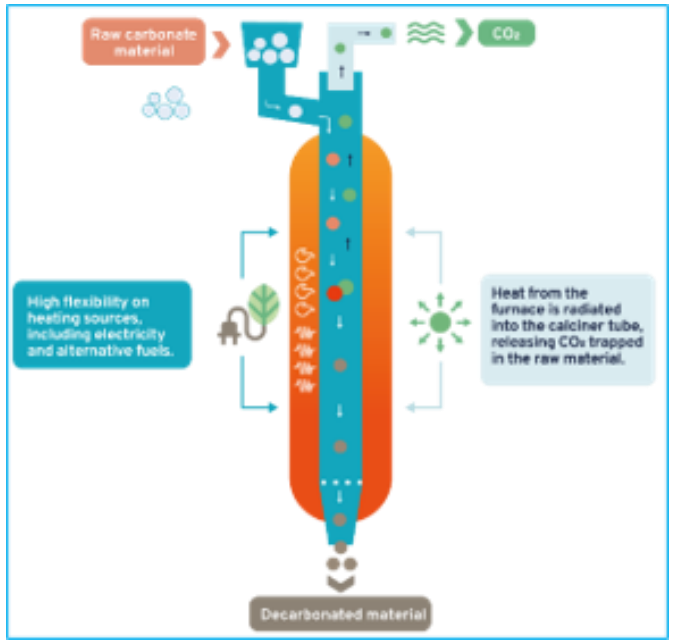
- EU Innovation Fund grants (2025)
- EU Innovation Fund grants (2022/23)
- Local government funding

DEVNYA Oxycal pilot

ANRAV CCUS
Devnya, Bulgaria
50kt
CO_2 captured p.a.



Development of Leilac Technology



Leilac-1

Pilot plant

Lixhe, Belgium 2019

CO_2 capacity: 25 ktpa

Clinker: 160 tpd

~5% throughput

TUBE QTY

Leilac-2

Demonstration plant

Ennigerloh, Germany 2027

CO_2 capacity: 100 ktpa

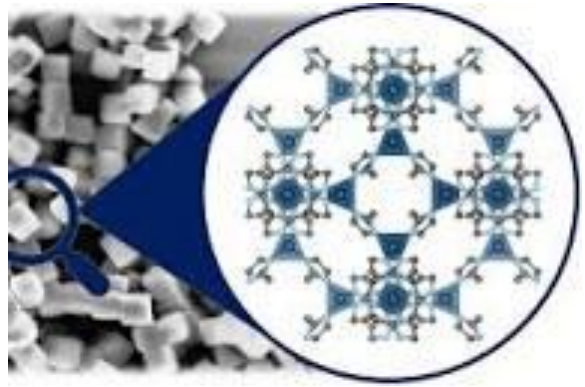
Clinker: 640 tpd

~20% throughput

TUBE QTY
4

What are MOFs?

- Metal Organic Frameworks (MOFs) capture carbon through physical rather than chemical means
- High surface areas – 1 gram could have the surface area of 1.5 football pitches
- Molecular sponges that selectively trap gases
- Gases can be released by changing temperature or pressure
- GCCA Innovandi program funding for MOF technologies



5

evoZero: our carbon captured cement

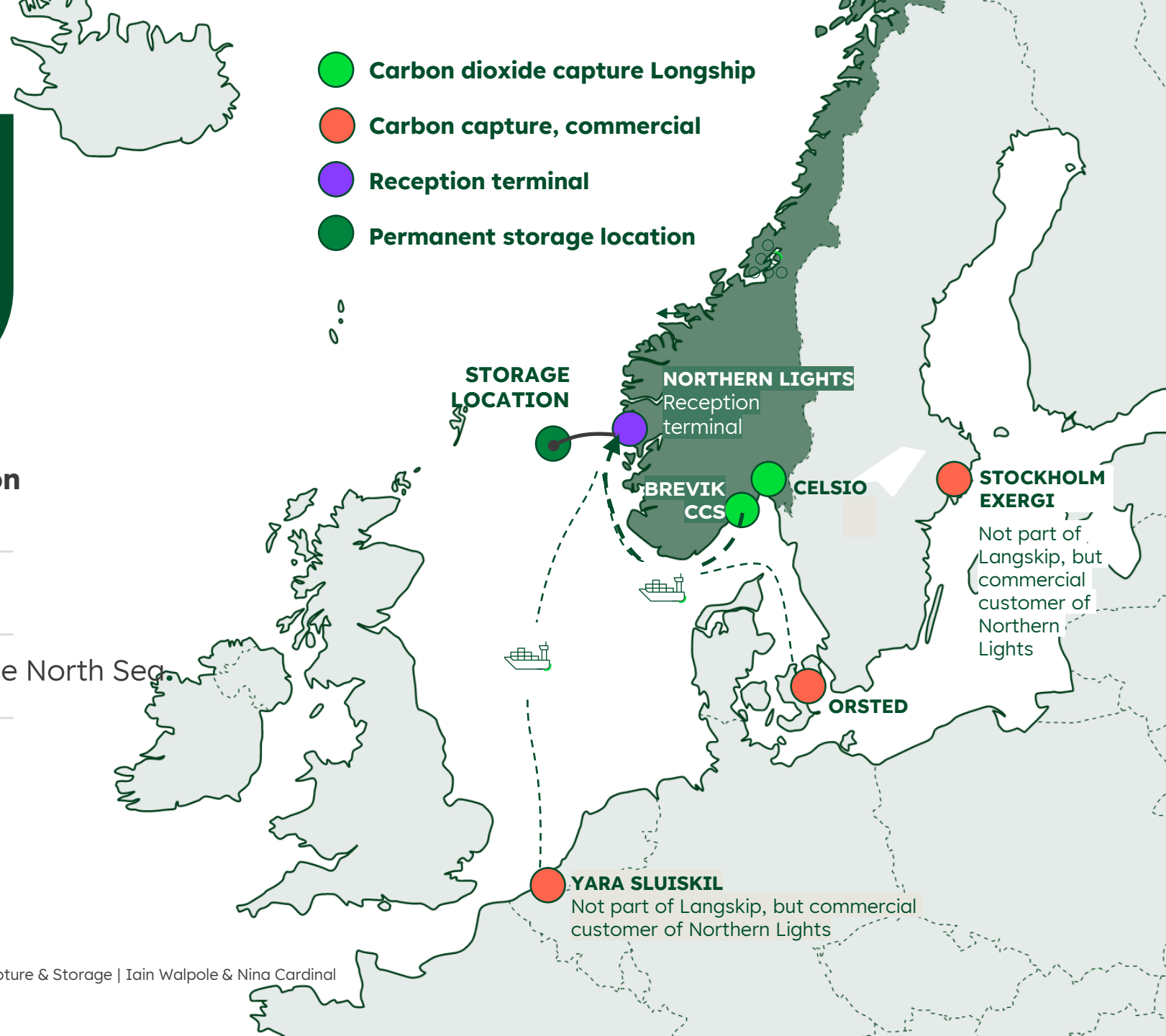
Longship

The Norwegian government's project to develop a full-scale CCS value chain.

01 | Carbon capture from **industrial emission sources**, including Brevik cement plant**.**

02 | Transport to Øygarden**.**

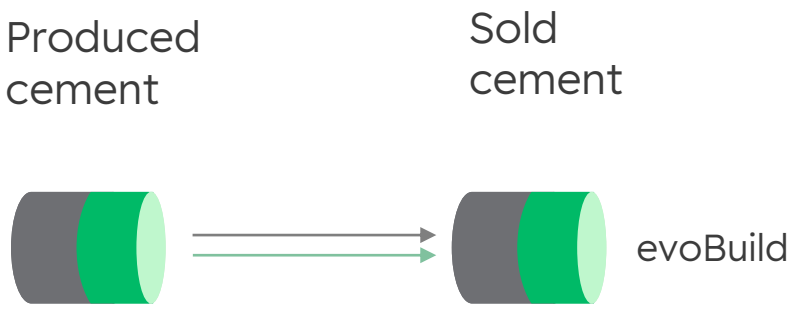
03 | Pipeline for permanent storage under the North Sea**.**



Two principal product ranges based on CCS in Brevik

evoBUILD

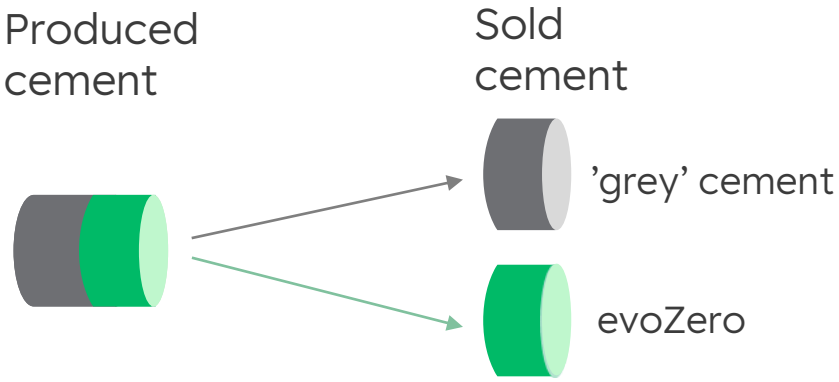
CO_2 reduction from CCS is attributed proportionally to the cement produced in Brevik.



evozero
Carbon captured near-zero cement

CO_2 reductions is attributed specifically to one product range according to free-attribution mass balance principle.

Mass balancing will be certified by DNV, who will also audit the accounting of the CO_2.



evozero

Industry leaders in Europe have access to two products

1

evozero

Carbon captured **Brevik**

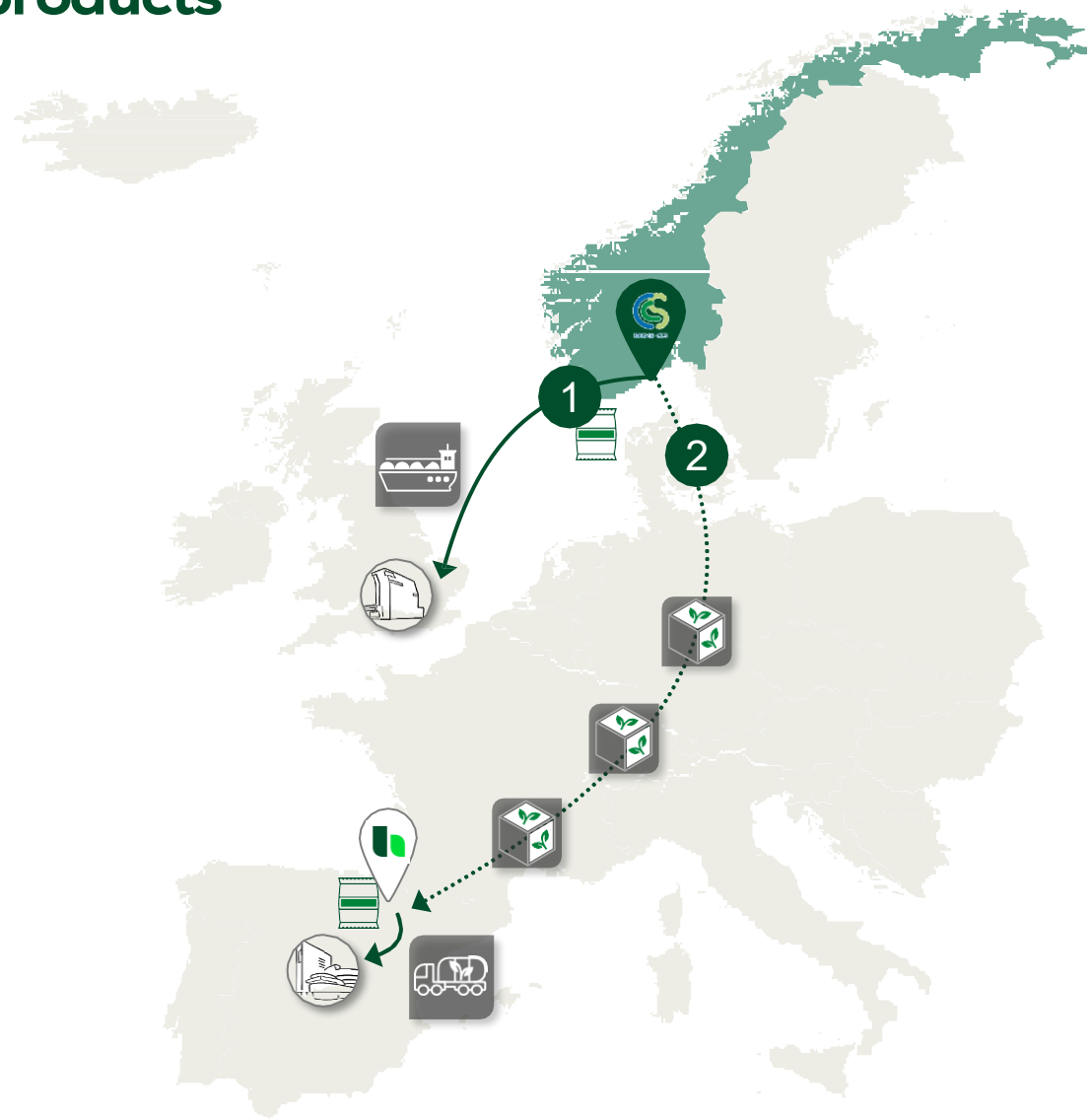
The ‘traditional way’: net-zero carbon cement **delivered directly from the Brevik plant** to the site of the project or production.

2

evozero

Carbon captured

For projects far away, CO_2 savings can be transferred and attributed **leveraging the local availability of Heidelberg Materials’ products in every given country**

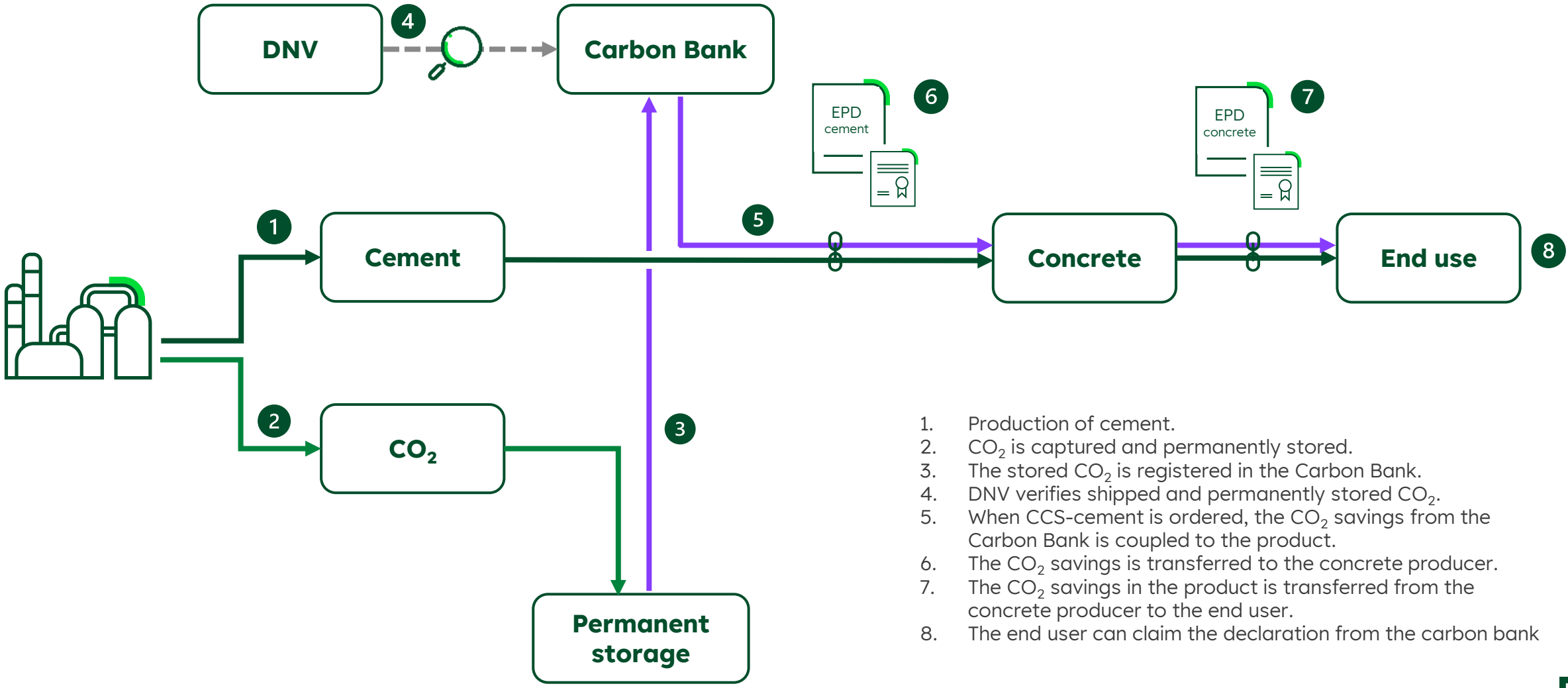


Third-party approved process

Transparent allocation

EPD based claims

The Carbon bank – keep track of the savings



1. Production of cement.
2. CO_2 is captured and permanently stored.
3. The stored CO_2 is registered in the Carbon Bank.
4. DNV verifies shipped and permanently stored CO_2.
5. When CCS-cement is ordered, the CO_2 savings from the Carbon Bank is coupled to the product.
6. The CO_2 savings is transferred to the concrete producer.
7. The CO_2 savings in the product is transferred from the concrete producer to the end user.
8. The end user can claim the declaration from the carbon bank

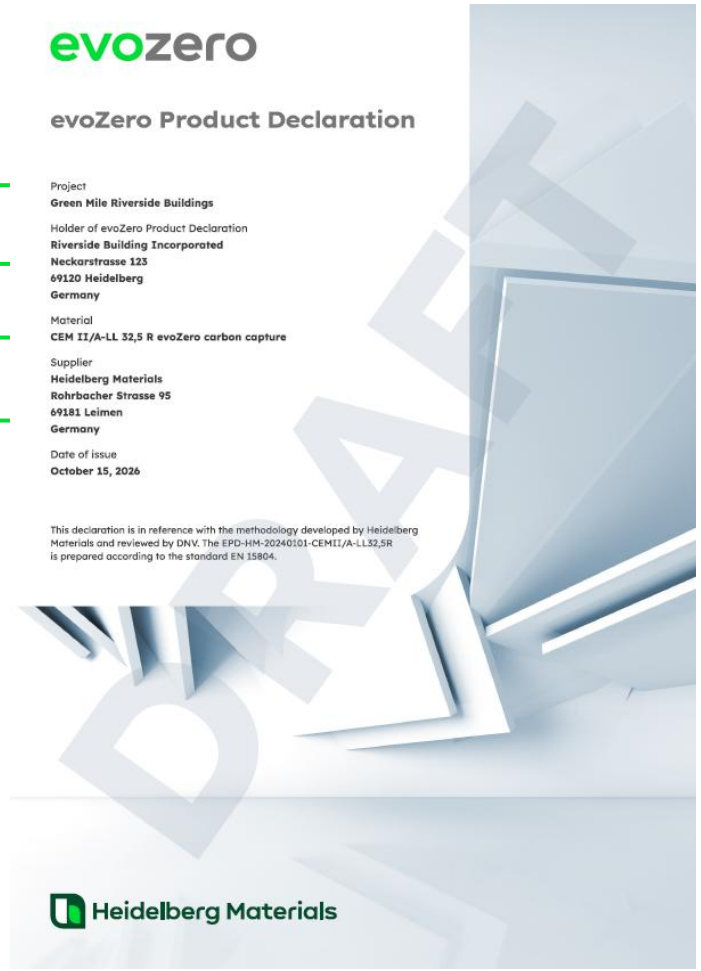
evoZero Declaration

Project
In which the cement product is used

Carbon reduction holder
e. g. general contractor

evoZero cement
Physical or virtual

Supplier
of cement-based product — HM's customer



evozero

evoZero Product Declaration

Project
Green Mile Riverside Buildings

Holder of evoZero Product Declaration
Riverside Building Incorporated
Neckarstrasse 123
69120 Heidelberg
Germany

Material
CEM II/A-LL 32,5 R evoZero carbon capture

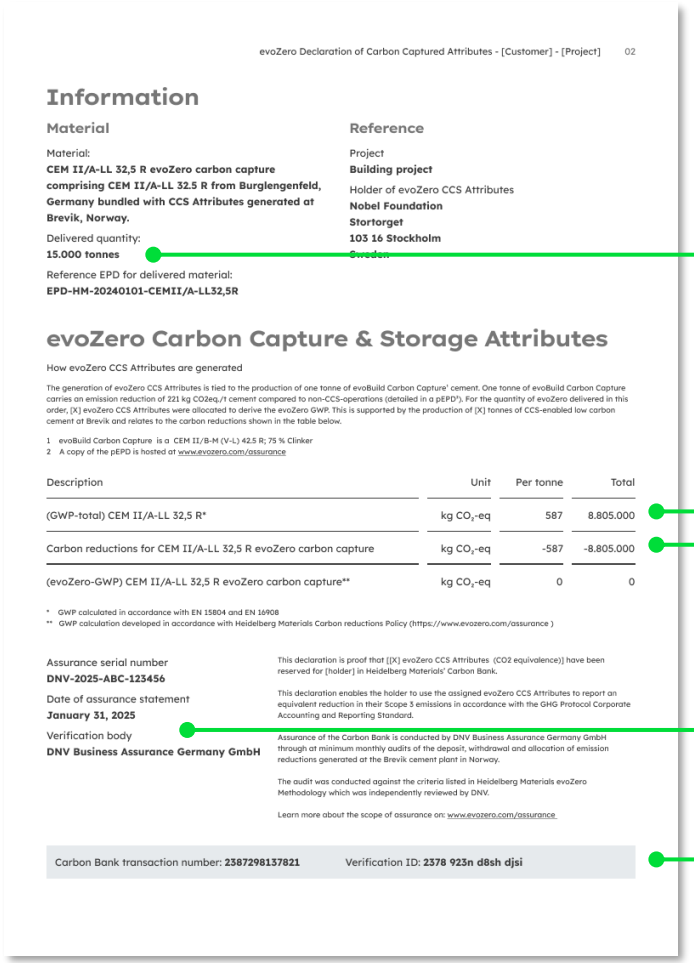
Supplier
Heidelberg Materials
Rohrbacher Strasse 95
69181 Leimen
Germany

Date of issue
October 15, 2026

This declaration is in reference with the methodology developed by Heidelberg Materials and reviewed by DNV. The EPD-HM-20240101-CEMII/A-LL32,5R is prepared according to the standard EN 15804.

DRAFT

Heidelberg Materials



evoZero Declaration of Carbon Captured Attributes - [Customer] - [Project] 02

Information

Material

Material:
CEM II/A-LL 32,5 R evoZero carbon capture comprising CEM II/A-LL 32.5 R from Burglengenfeld, Germany bundled with CCS Attributes generated at Brevik, Norway.

Delivered quantity:
15.000 tonnes

Reference EPD for delivered material:
EPD-HM-20240101-CEMII/A-LL32,5R

Reference

Project
Building project

Holder of evoZero CCS Attributes
Nobel Foundation
Stortorget
103 16 Stockholm
Sweden

evoZero Carbon Capture & Storage Attributes

How evoZero CCS Attributes are generated

The generation of evoZero CCS Attributes is tied to the production of one tonne of evoBuild Carbon Capture[1] cement. One tonne of evoBuild Carbon Capture carries an emission reduction of 221 kg CO2eq./t cement compared to non-CCS-operations (detailed in a pEPD[2]). For the quantity of evoZero delivered in this order, [X] evoZero CCS Attributes were allocated to derive the evoZero GWP. This is supported by the production of [X] tonnes of CCS-enabled low carbon cement at Brevik and relates to the carbon reductions shown in the table below.

1 evoBuild Carbon Capture is a CEM II/B-M (V-L) 42.5 R; 75 % Clinker
2 A copy of the pEPD is hosted at www.evozero.com/assurance

Description	Unit	Per tonne	Total
(GWP-total) CEM II/A-LL 32,5 R*	kg CO_2-eq	587	8.805.000
Carbon reductions for CEM II/A-LL 32,5 R evoZero carbon capture	kg CO_2-eq	-587	-8.805.000
(evoZero-GWP) CEM II/A-LL 32,5 R evoZero carbon capture**	kg CO_2-eq	0	0

* GWP calculated in accordance with EN 15804 and EN 16908
** GWP calculation developed in accordance with Heidelberg Materials Carbon reductions Policy (https://www.evozero.com/assurance)

Assurance serial number
DNV-2025-ABC-123456

Date of assurance statement
January 31, 2025

Verification body
DNV Business Assurance Germany GmbH

This declaration is proof that [X] evoZero CCS Attributes (CO2 equivalence)] have been reserved for [holder] in Heidelberg Materials' Carbon Bank.

This declaration enables the holder to use the assigned evoZero CCS Attributes to report an equivalent reduction in their Scope 3 emissions in accordance with the GHG Protocol Corporate Accounting and Reporting Standard.

Assurance of the Carbon Bank is conducted by DNV Business Assurance Germany GmbH through at minimum monthly audits of the deposit, withdrawal and allocation of emission reductions generated at the Brevik cement plant in Norway.

The audit was conducted against the criteria listed in Heidelberg Materials evoZero Methodology which was independently reviewed by DNV.

Learn more about the scope of assurance on: www.evozero.com/assurance

Carbon Bank transaction number: **2387298137821** Verification ID: **2378 923n d8sh djsi**

Delivered quantity
of cement in the cement-based product

GWP
of local grey cement or evoBuild Brevik

CO_2 reductions
Retired from the Carbon bank

DNV Assurance
Details on DNV assurance

Carbon bank data
Transaction number & Verification ID

Transparent allocation of CO_2 to enable decarbonisation throughout Europe

Supporting a transparent and traceable CO_2 accounting system

Chain of Custody Models

Enable assignment of emissions to different products

Flexibly transfer emission savings over wide geographic area

Adapted from successful rollout in similar heavy industry (e.g. Steel, Energy & Aviation Fuel)

Carbon Bank

A digital tool to track and allocate CO_2 savings

End to end management of CO_2 certificates

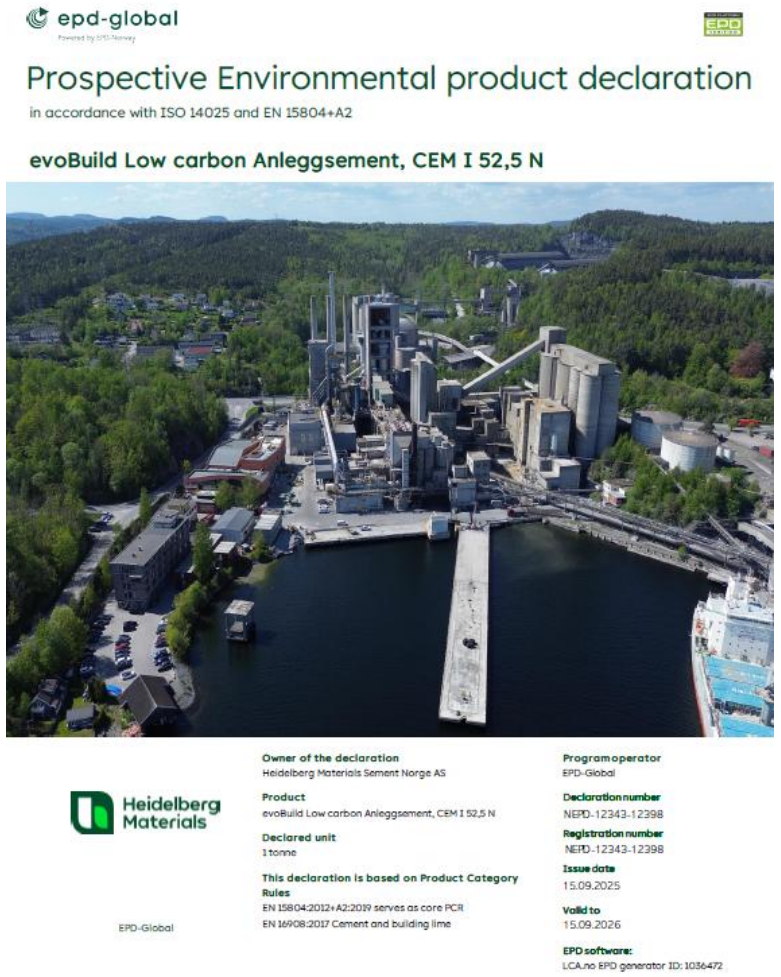
Decentralized Blockchain Technology

3rd Party Verified for transparency & trustworthiness

EPD for evoZero – Global Warming Potential (GWP)

CEM I 52,5N - GWP kg CO_2/t, gross

	Grey	evoBuild/ evoZero	Documentation
evoBuild	693	**416 + 10**	P-EPD
evoZero Carbon Captured Brevik	693	**41 + 10**	P-EPD + Declaration
evoZero Carbon Captured	804	**0**	Declaration


epd-global

Prospective Environmental product declaration

in accordance with ISO 14025 and EN 15804+A2

evoBuild Low carbon Anleggsement, CEM I 52,5 N

Heidelberg Materials

Owner of the declaration
Heidelberg Materials Sement Norge AS

Product
evoBuild Low carbon Anleggsement, CEM I 52,5 N

Declared unit
1 tonne

This declaration is based on Product Category Rules
EN 15804:2012+A2:2019 serves as core PCR
EN 16908:2017 Cement and building lime

EPD-Global

Program operator
EPD-Global

Declaration number
NEPD-12343-12398

Registration number
NEPD-12343-12398

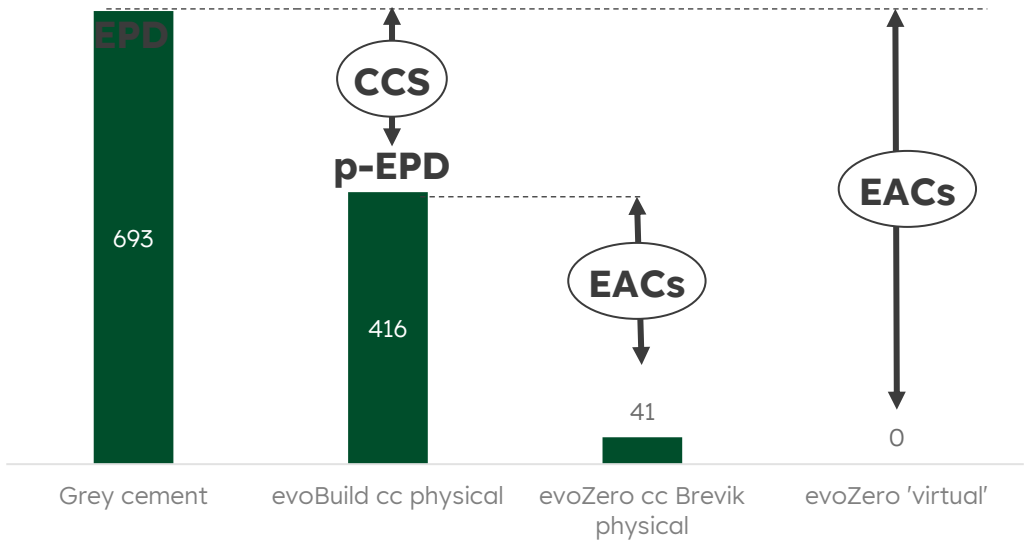
Issue data
15.09.2025

Valid to
15.09.2026

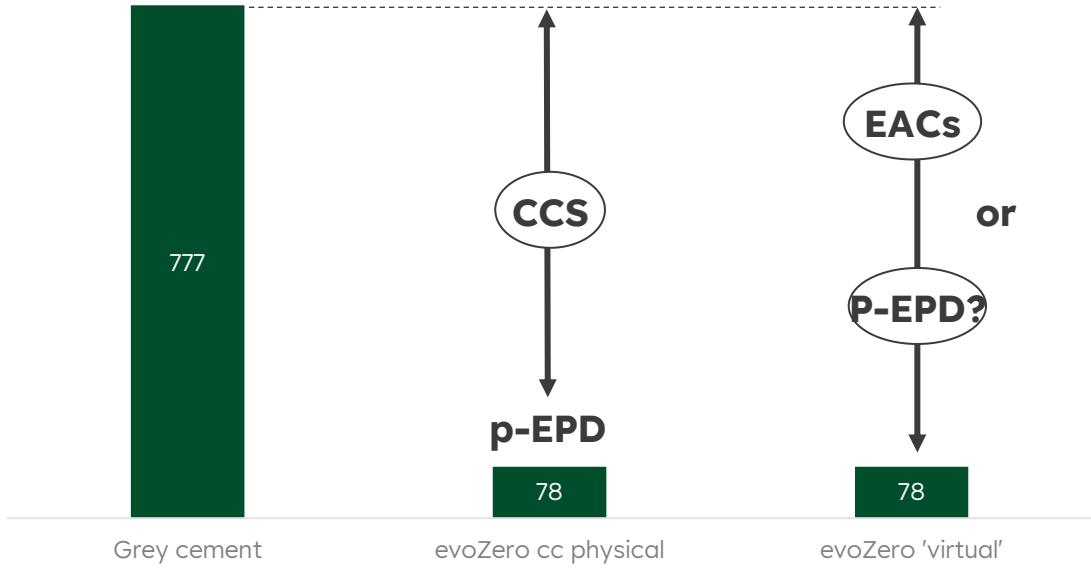
EPD software:
LCA.no EPD generator ID: 1036472

Global Warming Potential (GWP) Reductions

Brevik - 2026



Padeswood - 2029



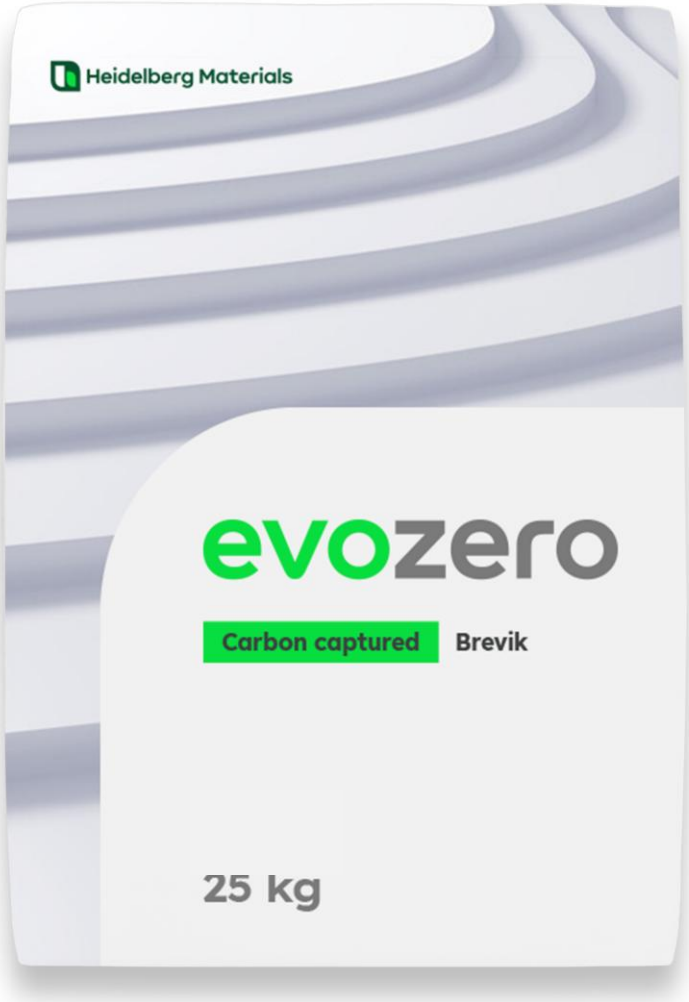
CEM I 52,5N, GWP kg CO_2/t, gross

6

Key messages

Carbon Capture has become reality

- Amine technology is established and used in current projects
- Alternative carbon capture technologies are under development
- CO_2 storage is permanent
- HM's Brevik project is the first commercial CCS project in the cement industry globally
- Padeswood will come on-line in 2029
- Padeswood will capture almost all CO_2 emissions
- evoZero is the first carbon captured cement globally
- evoZero is available in the UK now
- With evoZero we can make the lowest carbon evoBuild concrete
- evoZero reduces the carbon footprint of construction projects



NBS

Heidelberg Materials products are now available on NBS Source.

Search. Select. Specify.

Find products like our evoBuild low carbon concrete, fibre-reinforced, high-performance, waterproof and self-compacting concretes.

Search Heidelberg Materials at www.source.thenbs.com.


Any
questions?

If you have any enquiries please contact;

- **Carbon Capture - Technical**
  - Dr. Nina Cardinal – Technical Strategy Director
    - Nina.cardinal@heidelbergmaterials.com
- **evoZero Cement - Commercial**
  - Philip Matthew – Commercial Director - Bulk
    - Phillip.matthew@heidelbergmaterials.com
- **Concrete Technical**
  - Lee Baldwin – Technical Services Manager
    - lee.Baldwin@heidelbergmaterials.com
- **Future events at Heidelberg Materials evoHub**
- www.heidelbergmaterials.co.uk/en/cpd-registration-evohub