MAURO RISI

Head of Sustainable B2B New Initiatives and Partnerships

Energy Evolution

Energy Transition in the Maritime Sector

Ecospray Second Decarbonization Seminar

Athens – Intercontinental Hotel 21/09/23

ENI in a nutshell

NATURAL RESOURCES

ENERGY EVOLUTION

OIL, GAS, LNG, CCUS, NATURAL CLIMATE SOLUTIONS, AGRO-BIO FEEDSTOCK

CCUS

OFFSET

TRADITIONAL TO BIO, BLUE, GREEN PRODUCTS AND SERVICES

BEING A LEADER IN ENERGY TRANSITION

AGRI-FEEDSTOCK

CARBON CAPTURE, UTILIZATION, STORAGE

CARBON OFFSET

Power Generation & Marketing

plenitude

eni rewind

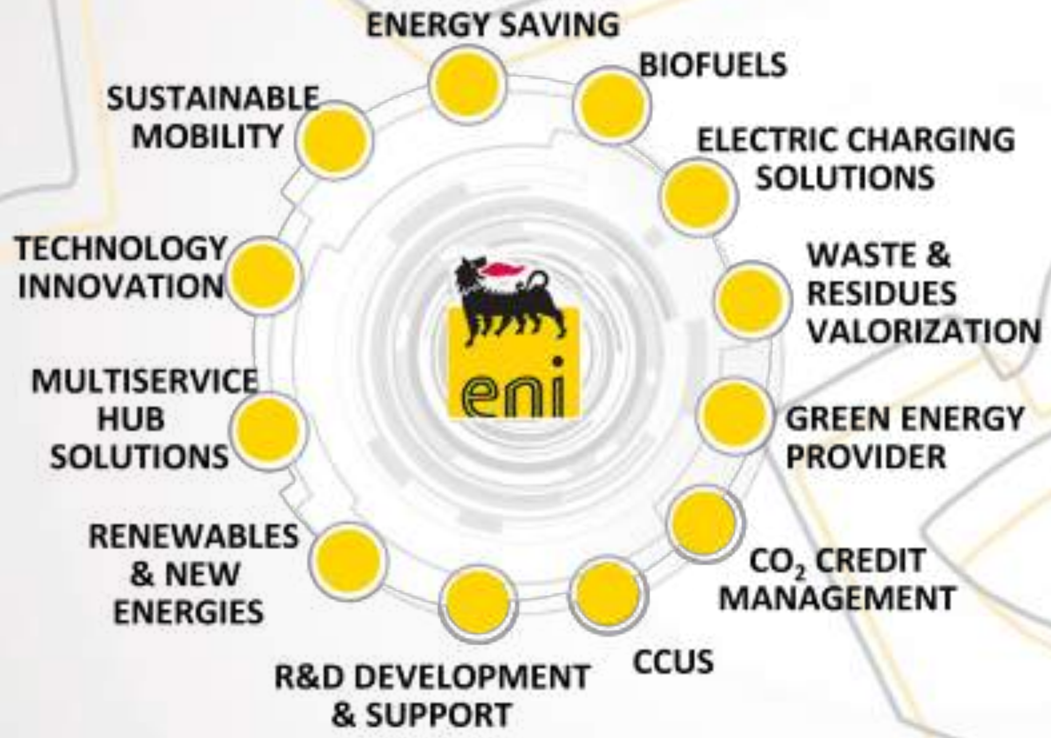
eni versalis

Sustainable Mobility

PROPRIETARY AND BREAKTHROUGH TECHNOLOGIES

A portfolio of technologies to meet decarbonized energy needs

Energy Vectors, Services and Solutions for Marine Decarbonization



SUSTAINABLE B2B COORDINATION

Decarbonization barriers and How to Overcome Them

ECONOMIC

Economic resources necessary gathering to carry out the transition of the fleets

TECHNOLOGICAL

Identification of the most promising fuels and mature and safe technologies

Structural need of «Alliance approach» and Parnerships

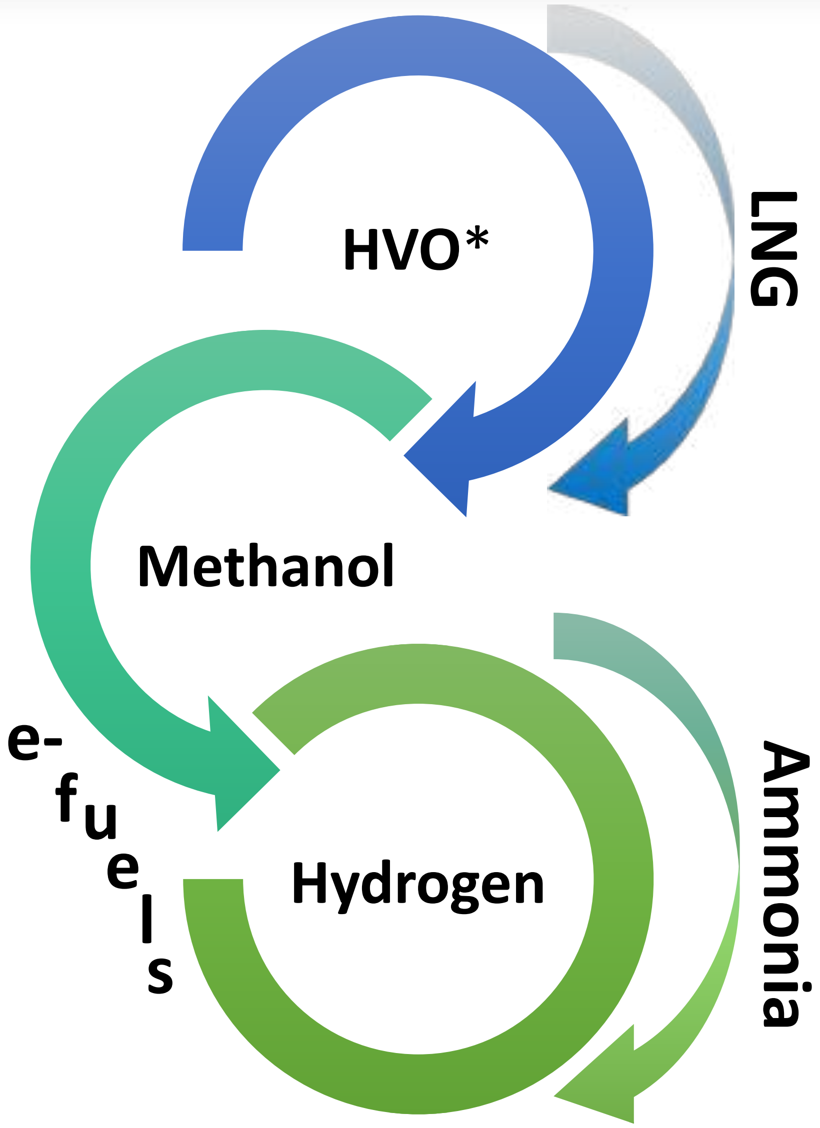
PRODUCTIVE

Development of land-based industries capable of producing the necessary quantities of alternative fuels

INFRASTRUCTURAL

Realization of an efficient and capillary distribution network in the ports

Energy vectors



<u>SHORT-MEDIUM</u> TERM
PRIMARY STRATEGY:

PROGRESSIVE BUT RAPID
FOSSIL FUELS REPLACE
WITH RENEWABLE FUELS

HVO AS PREMIUM ALTERNATIVE ALREADY AVAILABLE, ALONE OR COMBINED WITH RENEWABLE **METHANOL** (DUAL FUEL ENGINES)

BATTERY ELECTRIC POWERED SHIPS → <u>SHORT-DISTANCE</u> FREIGHT

SUBSTANTIAL TECHNOLOGICAL INVESTMENTS

FEEDSTOCK AVAILABILITIES

2050

**Hydrotreated vegetable oil*

Maritime decarbonization: a complex pattern of different possible solutions

Advantages

ISSUES

HVOlution

Great versatility drop in solution in substitution of marine diesel

Produced at large industrial level with well proven technology since more than 10 years

FOCUS ON NEXT SLIDES

LNG – Bio LNG

Competitive price at "normal market conditions"

Suitable for long distance transportation (high energy density)

Very scarce availability of Bio-LNG and high market price volatility

Complex and limited distribution logistic

Potential methane emissions associated to LNG vaporization during ship stops in port

METHANOL - RENEWABLE METHANOL

CH3OH

Emission reductions compared to conventional (fossil) fuels, ease in transport (liquid at room temperature)

Suitable for dual fuel enginees with HVO/diesel

Lower energy density of Diesel/HVO

Limited availability of renewable methanol still under development at large industrial scale.

Distribution logistic still under development

GREEN/BLUE HYDROGEN

Clean, no toxic, theoretical zero emissions

Low energy intensity per volume unit

Potential safety issues

Complex logistic (high pressure or criogenic liquid at ultra low temperature)

GREEN/BLUE AMMONIA

No carbon atoms, no greenhouse effect of fugitive leaks, no impact on ozone depletion and a very limited duration in the atmosphere (a few days).

Highly toxic by inhalation at high concentrations

Odorous emissions

Corrosive

CARBON CAPTURE

Teoretical no fuel change on existing or new vessels

Energy losses

Increased complexity of on board equipments and operations

HVO in a nutshell 1|2

HVOlution

Hydrotreated Vegetable Oil produced by Eni, a diesel fuel containing **100% of renewable** [1] component

Main aspects

Is composed by a **mixture of stable non-hygroscopic paraffins**, and, therefore, it's poorly subject to bacterial contamination

Complies with the **European specification EN15940** for paraffinic diesel fuel from synthesis or hydrotreatment (XTL)

It has a **high cetane number** which allows for excellent combustion, especially in cold start, and reduces engine noise

Benefits

Can be mixed to fossil diesel fuel in full range (up to **100 %)**

Is **already available** and can be used pure in **engines when validated for its use**

According to the conventional principle of Directive (EU) 2018/2001 "REDII", GHG emissions reduction of ENI HVOlution along the logistics and production chain in 2022 was between 60% and 90%, compared to the fossil fuel comparator (i.e. 94g CO_2eq/MJ), depending on the feedstocks used for its production[2].

1:The feedstocks used by Eni for HVOlution production during 2022 falls within the definition of renewable raw materials pursuant to Directive (EU) 2018/2001, so-called 'REDII'.
2: The calculation methods and the data obtained are certified by RINA according to the rules of the EU voluntary schemes (2BSvs and ISCC for Eni).
The calculation doesn't consider effects which methodology is not yet defined.

HVO in a nutshell 2|2: Deployment Plan

HVOlution is the results of the Eni's commitment: in 2014 with the **transformation of the Venice and Gela refineries into biorefineries** and, the **proprietary Ecofining™** technology allows the treatment of waste vegetable raw materials and non-edible oils to produce HVO and HEFA

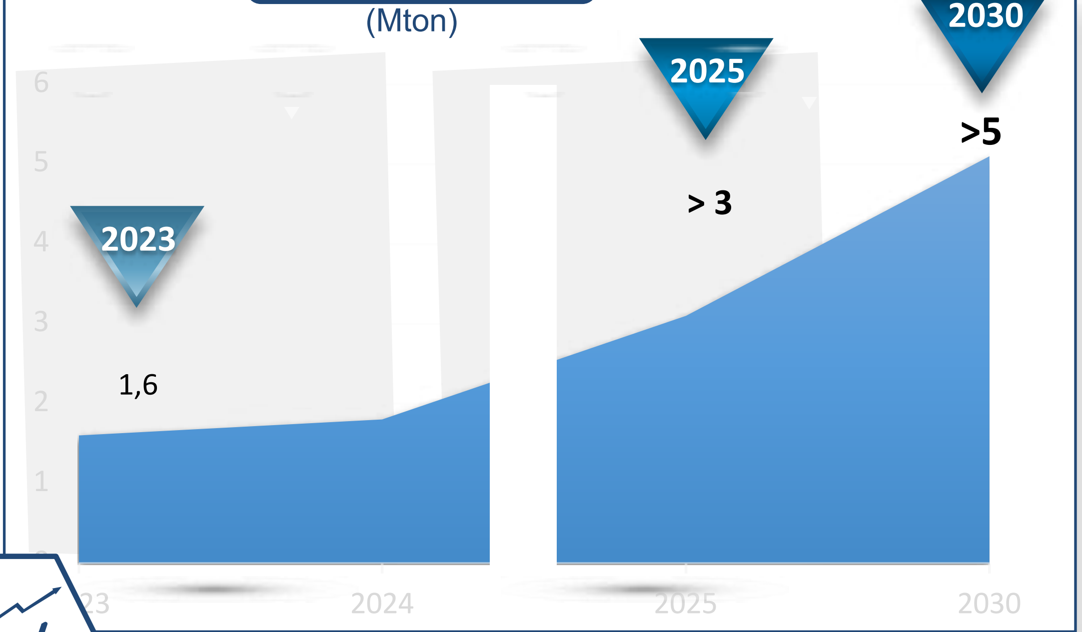
Feedstocks

Currently, the feedstock comes from used cooking oils (UCO), animal fats, vegetable oils and their processing waste, that do not compete directly with food and feed crops

Since the end of 2022, Eni biorefineries **are no longer using palm oil** and are increasing the use of advanced feedstocks (e.g waste oils, lignocellulosic materials)

Eni is developing, especially in Africa, the **Agrifeedstock**, where will be produced vegetable oil, not feed & food competing

Biorefining Deployment Plan



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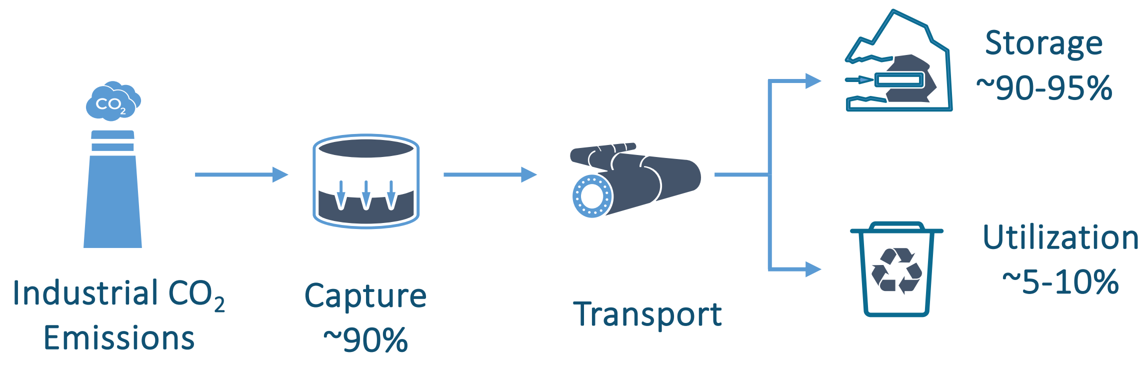
CCUS in Eni

CCUS as lever for decarbonization

CCUS is a mature technology that capitalizes on previous experiences and existing assets - playing a relevant role in international decarbonization scenarios

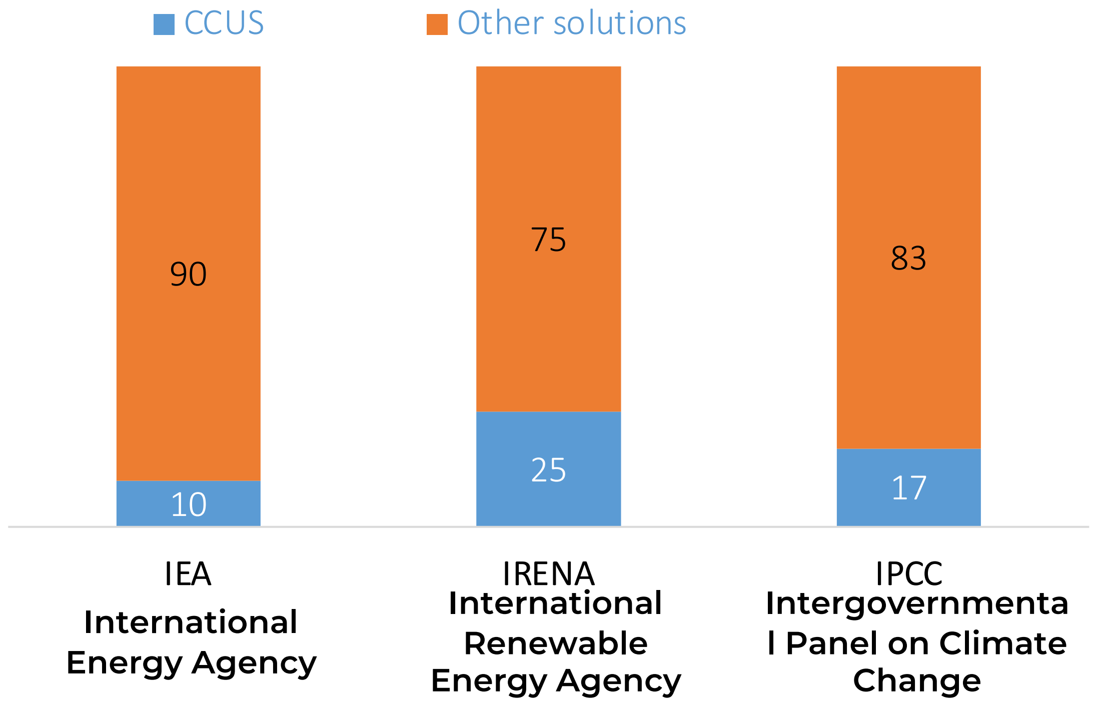
The CCUS Process



- **Inevitable for the HTA sectors** (e.g., Iron and steel, cement, chemicals) due to the impossibility of reducing emissions from production processes.
- Most effective and efficient process for the industry:
  - **Time and Costs**: reduced impact on existing processes and lower costs than other levers
  - **Higher CO_2 volumes** avoided
- It allows to abate **over 90% of the emissions.**

CCUS contribution in the different decarbonization scenarios

Cumulative removal of CO2 emissions



CO_2 **Annual storage by 2050**

IEA	IRENA	IPCC
6200 $MtCO_2$/anno	**7900** $MtCO_2$/anno	**7100** $MtCO_2$/anno

IEA Energy Technology Perspectives (2023)
IRENA Reaching Zero with Renewables: Capturing Carbon (2021)
Eni Analysis based on data from IPCC AR6 scenarios <1.5°C (2022)

CCUS: the distinctive model of Eni

Integration with Upstream for long-term value creation

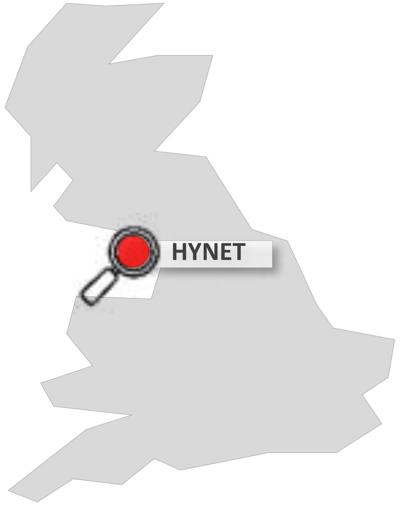
PROJECTS PORTFOLIO

- **Reutilization of depleted gas fields and facilities (plants, wells, pipelines)**
- **Knowledge of reservoirs and skills in managing projects from previous to upstream experience**
- **CCS Hub near industrial sites**

- **Time to market: accelerating implementation and start-up times**
- **Competitive technical cost vs other solutions and compared to the price of CO_2 on the ETS market**
- **Low-risk and easier projects**

TARGET: ~30 MTON CO_2 STORAGE CAPACITY BY 2030

HYNET Industrial Cluster (Liverpool Bay)



ENI TRANSPORTATION AND STORAGE OPERATOR

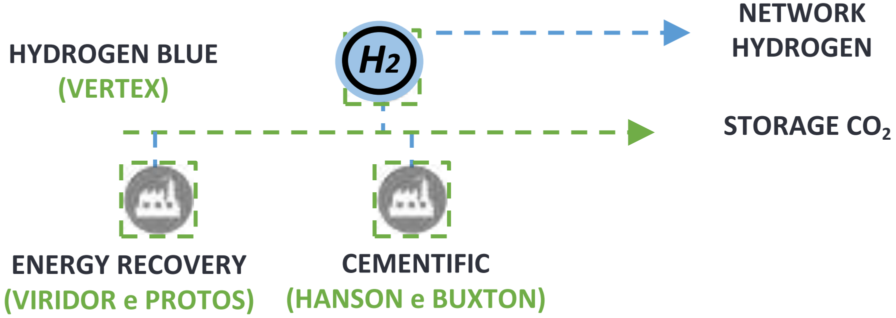
KEY PROJECT TO DECARBONIZE THE IMPORTANT INDUSTRIAL DISTRICT IN NORTHWEST OF UK

CO_2 STORAGE IN EXHAUSTED OFFSHORE RESERVOIRS USING ENI FACILITIES

DEVELOPMENT OF A BLUE ECONOMY INCLUDING HYDROGEN PRODUCTION

STORAGE
200 MLN TON CO_2

IN OCTOBER 2020 AWARDED STORAGE LICENCE TO ENI OPERATOR OF THE T&S PROJECT



STORAGE CAPACITY:
PHASE 1: 4.5 MTPA CO_2 from 2027
PHASE 2: 10 MTPA CO_2 from 2030

IN OCTOBER 2021 SELECTED BY DESNZ** AS ONE OF TWO PRIORITY PROJECTS, OUT OF 5 COMPETING, TO ACCESS FUNDING FROM THE UK GOVERNMENT

***UK Research and Innovation è l'Ente pubblico responsabile per il support alla Ricerca e Innovazione ** Public Department for Strategy and Net Zero (ex BEIS)**

B2B TOGETHER

Ravenna CCS

DECARBONIZATION OPPORTUNITIES FOR THE ITALIAN INDUSTRIAL SYSTEM

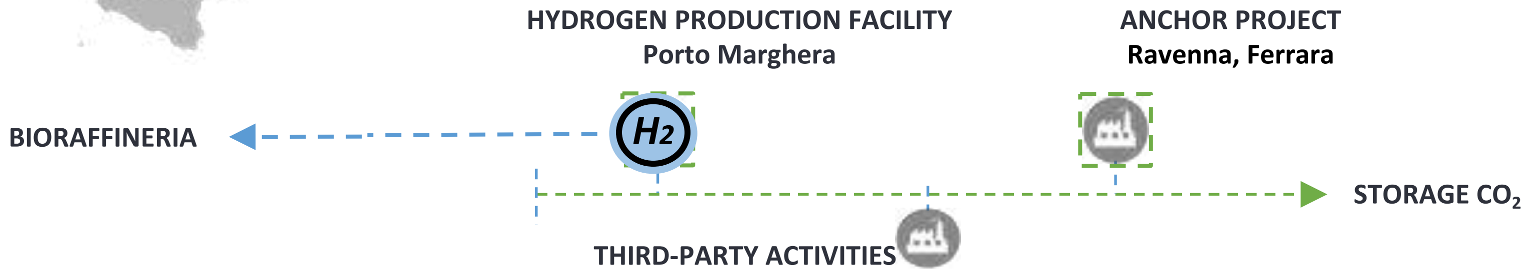
POTENTIAL REFERENCE CCUS POLE FOR SOUTHERN EUROPE AND THE MEDITERRANEAN

USE OF EXISTING INFRASTRUCTURE WITHOUT OCCUPATION OF NEW AREAS

REDEVELOPMENT AND ECONOMIC REVIVAL OF AN IMPORTANT INDUSTRIAL DISTRICT

SIGNIFICANT INCREASE IN EMPLOYMENT LEVELS TECHNOLOGICAL ENHANCEMENT OF THE SUPPLY CHAIN

STORAGE
> 500 MLN TON CO_2



CO_2 STORAGE CAPACITY:
Phase 1: 0,025 MTPA from 2024
Phase 2: 4 MTPA from 2026

EXPANDABLE STORAGE CAPACITY UP TO 16MTPA IN THE YEARS FOLLOWING THE START-UP FOR THE DECARBONIZATION OF OTHER ITALIAN INDUSTRIAL DISTRICTS

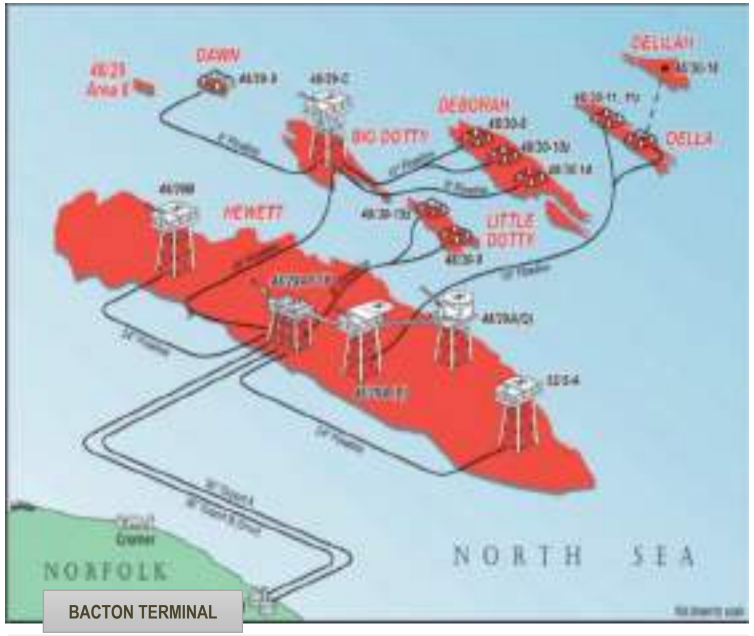
Bacton Industrial Cluster (Hewett)

KEY PROJECT TO DECARBONISE IMPORTANT LONDON INDUSTRIAL DISTRICT AND SW UK

DEVELOPING AN ENERGY HUB BASED ON HYDROGEN PRODUCTION (BLUE TO GREEN)

CO_2 STORAGE IN DEPLETED OFFSHORE RESERVOIRS USING ENI ASSETS (HEWETT RESERVOIRS)

DEPLETED FIELDS AVAILABLE FROM 2022-2023

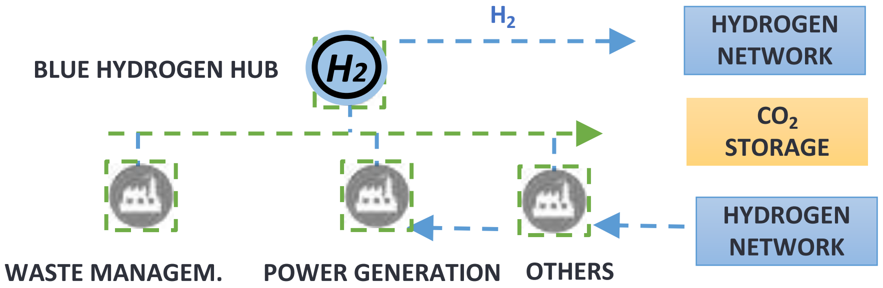


STORAGE
300 MLN TON CO_2

CO_2 STORAGE CAPACITY:
Phase 1: 4 MTPA
Phase 2: 10 MTPA

SEPTEMBER 2022: "BACTON THAMES NET ZERO" (BTNZ) CONSORTIUM ALREADY COMPRISING 13 COMPANIES WITH ENI AS "ORCHESTRATOR"

AUGUST 2023 STORAGE LICENSE AWARDED



Carbon Capture and Utilization

CCU technologies considered necessary in different decarbonization scenarios **for the long term**.

These technologies can play a role where favourable local business conditions exist and /or storage is not a viable option

Potential Applications

Materiali da costruzione

Curing del cemento con CO_2
SCM ed aggregati

E-Fuels

E-kerosene
E-Methanol

Chimica

Poliuretani
Policarbonati

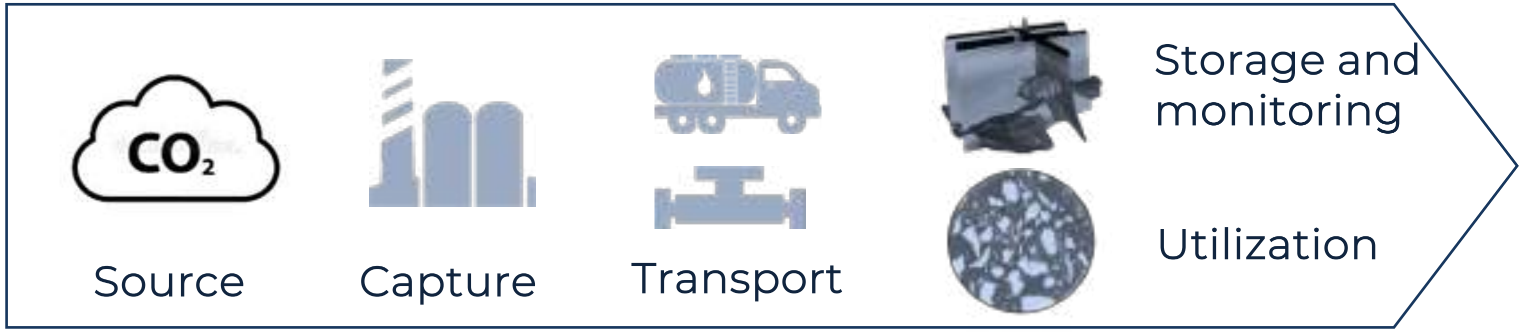
Alimentare ed altri usi diretti

Bioproteine, gas tecnici

Today CCU processes rely on high amounts of clean energy.
Relevant decarbonized products struggle to reach market competitiveness against traditional counterparts.

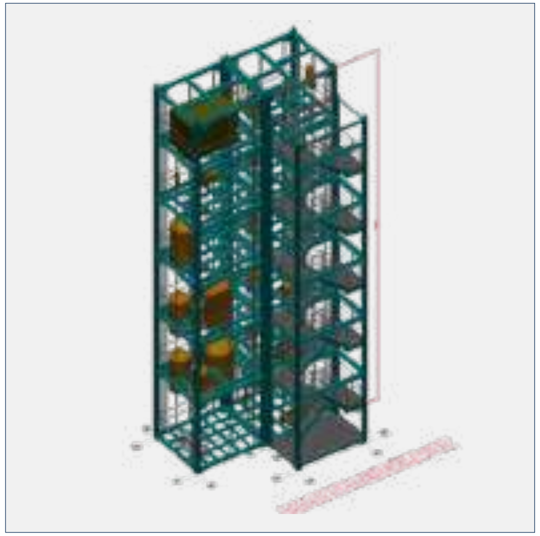
The deployment at a large scale of CCU still requires extensive **R&D activities to make it economically viable**.

Eni CCUS – Ongoing R&D Activities

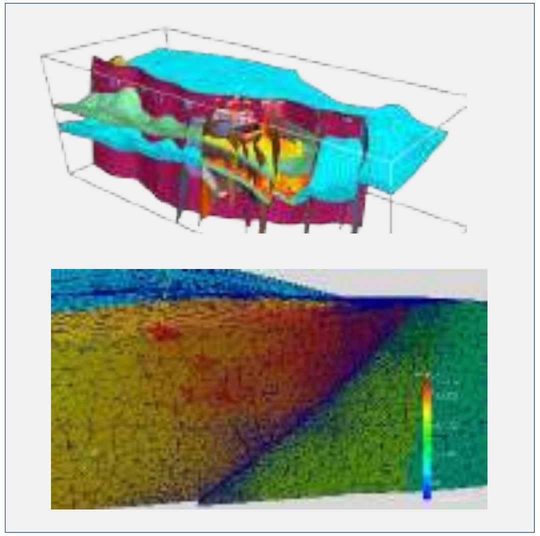


CCUS will have a crucial role in the decarbonization strategy,
R&D will have a significant impact on cost reduction and performance improvement along the whole CCUS chain

CO_2 Capture (CC)



Modelling



Monitoring

CO_2 Utilization

CC R&D Main initiatives

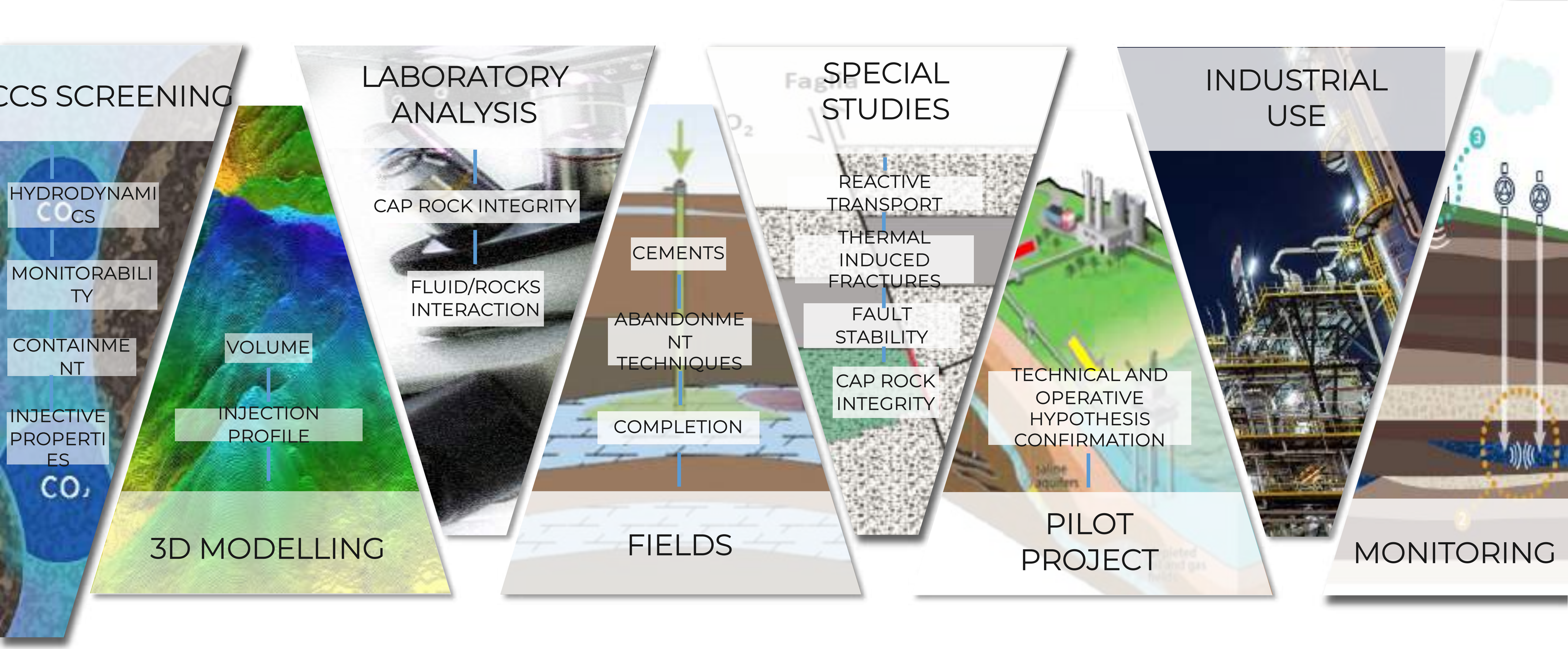
New Technological trend

Solvent Absorption	*Carbonate Absorption*	*Thermal Swing Adsorption)*	*Polymeric Membrane*
Chemical absorption with Switchable Ionic Liquids (SILs) + physical solvent	Chemical absorption with potassium carbonate + Carbonic Anhydrase (enzymatic promoter)	Adsorption on solid materials with lower regeneration time if compared with common TSA)	Thin film membrane separation (advanced polymeric membranes, in a compact, modular and flexible process)

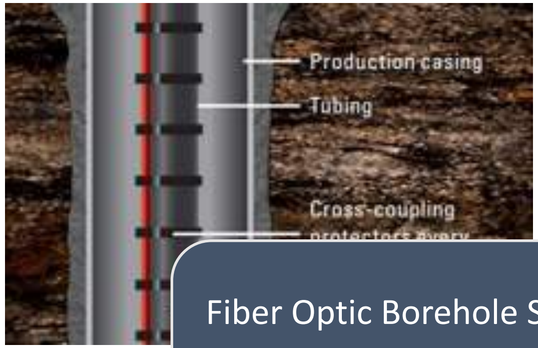
Applications

Hydrogen	Power generation Hard to Abate industry	Hard to Abate industry Power generation Hydrogen	Hard to Abate industry

Carbon storage subsurface workflow



CCS Monitoring

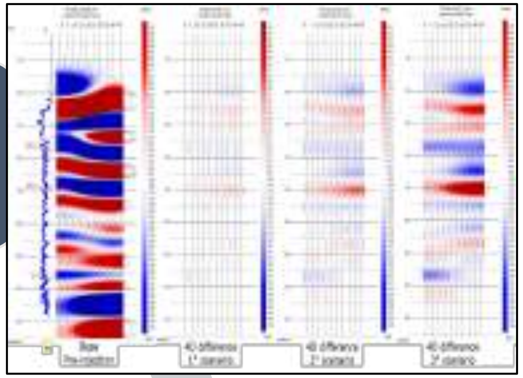


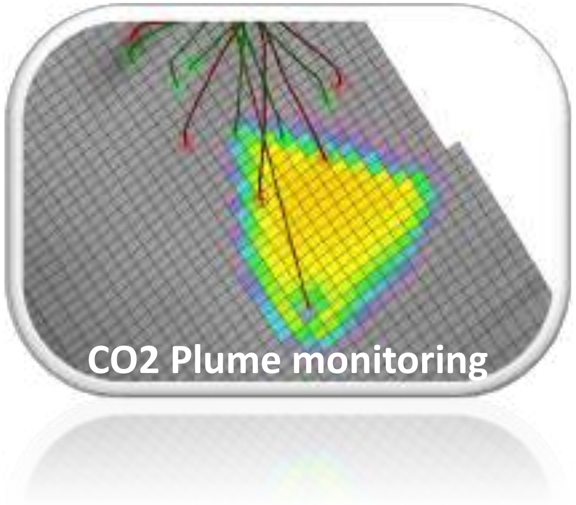
Fiber Optic Borehole Seismic Monitoring

Permanent borehole monitoring via Fiber Optics allows to improve and detect tiny details in the CO_2 Plume evolution with great accuracy

4D Seismic Monitoring

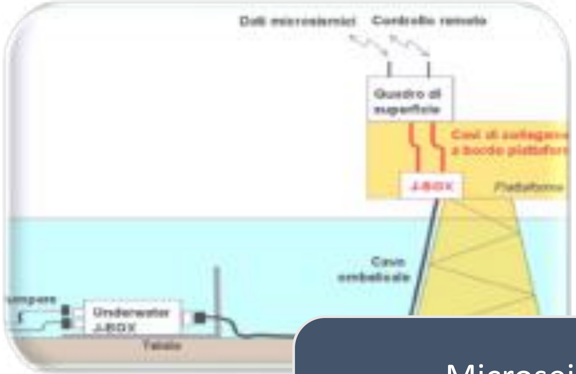
3D High Density seismic surveys periodically repeated over the same area are mandatory to reconstruct the shape and direction of evolution of the CO_2 Plume





Ground Deformation Monitoring

By the integration of different technologies (CGPS, INSAR Satellite based systems) allow to detect positive or negative ground deformation at millimetric scale



Microseismic Monitoring

Detection of injection-induced microseismicity via on purpose developed recording networks and advanced interpretation tools

Surface Monitoring

Robotic solution for onshore and off shore monitoring : Clean Sea ,Roger and VPMS (Vibro-acustic pipeline monitoring system)

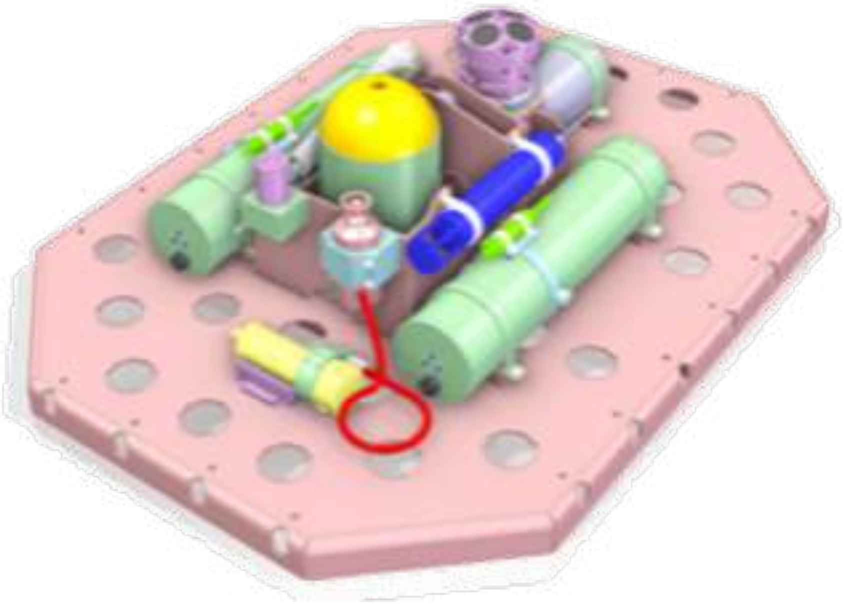
R&D for CCUS monitoring

Clean sea for CCS

System designed for monitoring both injection assets and storage complexes to ensure absence of leakages.

Sonar 3D already in place for Ravenna CCS baseline

Lander CCS



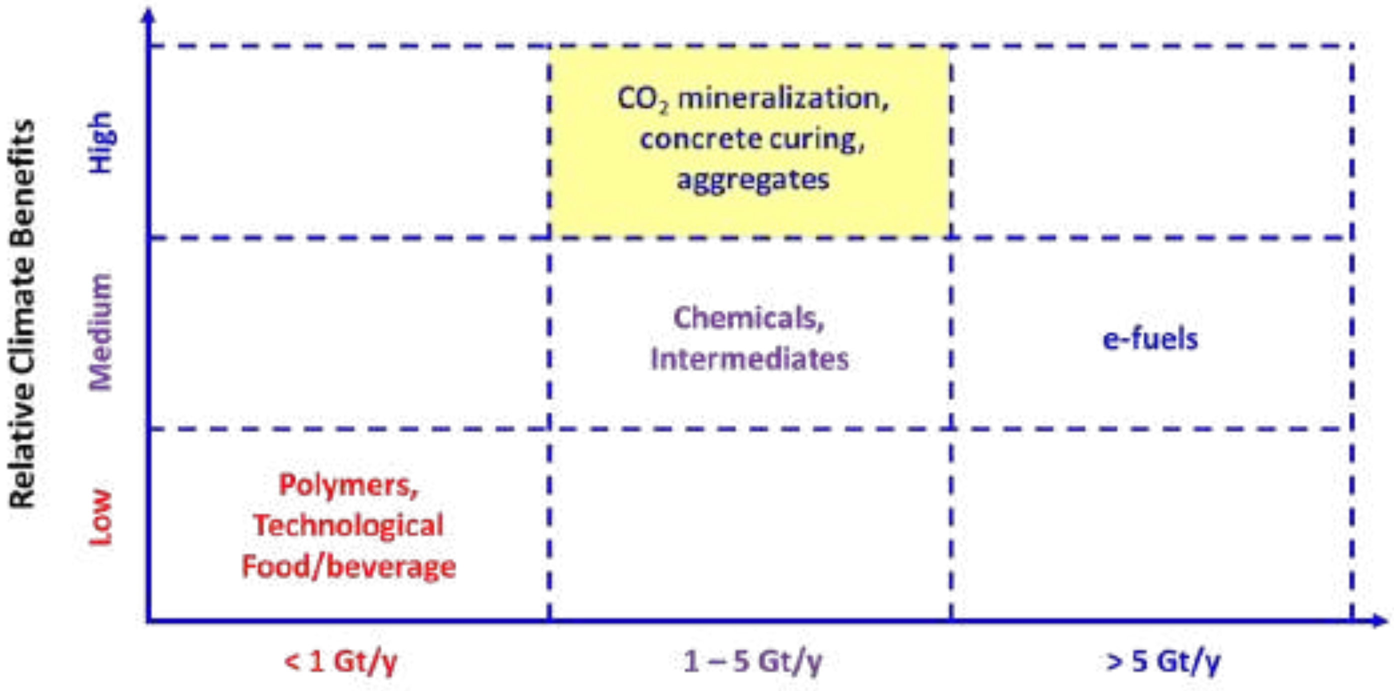
- Design, realization and test of a fixed station (lander) for the environmental monitoring of the CCS Ravenna offshore pilot -Activity Completed 2Q 2023

CO_2 mineralization

- CO_2 becomes a **solid mineral (carbonate)** through its reaction with suitable inorganic substrates. The spontaneuos reaction can be enormously **accelerated** by adopting suitable conditions

- Among the different CCUS options, CO_2 mineralization offers important **market perspectives** associated with clear **environmental benefits**

- CO_2 can be used in the construction industry for: curing of concrete and mortars, produce aggregates and cement additives (**Supplementary Cementitious Materials, SCM**)



Adapted from: "Putting CO_2 to Use: Creating Value from Emissions" IEA, Sep 2019

THANK YOU!