

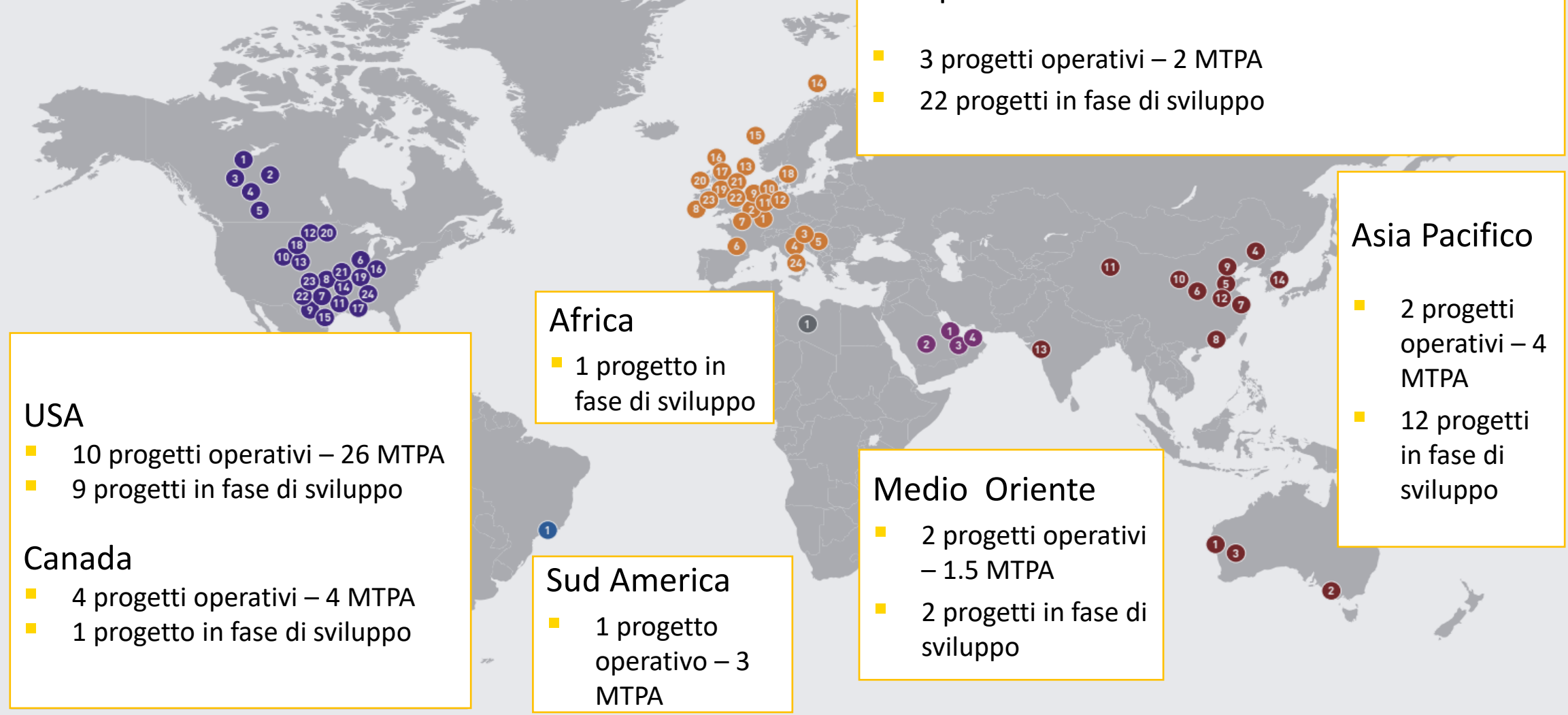
Progetti CCS nel mondo e focus in Europa

16 Giugno 2021



PROGETTI CCS NEL MONDO

Oltre 20 progetti operativi con 40 MTPA* di CO2 catturate e più di 40 progetti in sviluppo**



* MTPA sta per Milioni Ton CO₂ Per Anno

** il focus dei progetti in sviluppo si è spostato dalle applicazioni Enhanced Oil Recovery allo stoccaggio permanente a scopo ambientale

FOCUS PROGETTI CCS IN EUROPA

Con 3 progetti operativi e 22 in sviluppo l'Europa sarà protagonista dell'applicazione su larga scala della CCS

Pipeline di progetti in sviluppo pari a circa 60 MTPA

Norway

- 1. Sleipner CO₂ Storage**
- 2. Snøhvit CO₂ Storage**
3. Longship (including Northern Lights)



Republic of Ireland

1. ERVIA

UK

1. Acorn
2. Caledonia Clean Energy
3. H21 North of England
4. Liverpool-Manchester Hydrogen Cluster
5. Net Zero Teesside
6. Humber Zero Carbon Cluster
7. Liverpool Bay Area CCS Project



France

1. Lacq
2. DMX Demonstration in Dunkirk

Belgium

1. Leilac
2. Antwerp@C (Port of Antwerp)

Sweden

1. Preem CCS

Denmark

1. Greensand

The Netherlands

1. Porthos (Port of Rotterdam)
2. Athos (Ijmond)
3. Aramis (Den Helder)
4. Magnum (Eemshaven)

Croatia

1. iCORD
- 2. CO₂ EOR Project Croatia**
3. Bio-refinery Project

Italy



1. CCS Ravenna Hub

Projects listed in **bold** are in operation

Fonte: IOGP

SUPPORTO ALLA CCUS

La CCUS è considerata una importante ed imprescindibile componente della roadmap verso la decarbonizzazione da molti stati ed organizzazioni internazionali quali:

- **UNECE:** a marzo 2021 invita ad accelerare l'implementazione delle CCUS considerata cruciale per raggiungere gli obiettivi dall'Accordo di Parigi e dall'Agenda 2030 (Source: «UNECE – Technology Brief: Carbon Capture, Use and Storage (CCUS)»)
- **Parlamento Europeo:** a gennaio 2021 la Commissione Ambiente sostiene che "la CCUS e le infrastrutture compatibili con l'idrogeno" devono diventare "una priorità di spesa fondamentale nell'ambito dei piani per la ripresa e la resilienza". L'Innovation Fund (10 miliardi EUR) contribuirà al finanziamento delle iniziative
- **Norvegia:** a gennaio 2021 il Parlamento delibera un finanziamento a fondo perduto da 1,7 miliardi di EUR per il progetto Northern Lights CCS su 2,6 miliardi di euro tra investimenti ed i costi operativi per 10 anni.
- **UK:** a fine 2021 verranno emessi i modelli di regolazione di mercato basato sui contratti per differenza (CfD) e Regulatory Asset Base (RAB). Supporto a CCS e H2 tramite diversi fondi per un totale >1.5B£: CCS Infrastructure Fund (CIF); Net Zero Hydrogen Production Fund (NZHF); Industrial Decarbonisation Challenge (UKRI - IDC)
- **Olanda:** Stanziati 2,1 mld € per incentivare i costi di cattura dei primi 15 anni per gli emettitori (Exxon, Shell, Air Product e Air Liquid) che afferiscono al progetto Porthos nell'area di Rotterdam (la cui JV T&S guidata dal Porto di Rotterdam ha già ricevuto 100 M€ di fondi europei)
- **Germania:** febbraio 2021 – Il Ministero dell'Economia e dell'Energia annuncia un piano di supporto per stimolare lo sviluppo delle tecnologie legate alla CCUS. Il sostegno previsto è pari a : €105 mln per 2021 e poi €120 mln/anno dal 2022 al 2025
- **Canada:** Il Greenhouse Gas Pollution Pricing Act (GGPPA) prevede la crescita della carbox tax per C\$15 ogni anno dal 2020. Cap di C\$170/t nel 2030
- **Australia:** il governo ha annunciato ad Aprile 2021 un incremento del budget 2020-21 per accelerare lo sviluppo della CCUS da 50 a 313.7 milioni di dollari
- **USA:** Tax credit 45Q: 35 \$/ton per utilizzo/EOR e 50 \$/ton per stoccaggio; sostegno ai progetti di clean energy tramite un fondo da \$35 Bln (Consolidated Appropriations Act, 2021)



Sicurezza del contenimento geologico della CO₂

La CCUS è un processo **sicuro** ed adatto a stoccare l'anidride carbonica per un **tempo indefinito** in quanto:

- con oltre 20 progetti operativi nel mondo, alcuni attivi da decenni, non si è mai verificata alcuna fuoriuscita di anidride carbonica
- sfrutta l'esperienza di più di un secolo di attività di stoccaggio di gas naturale, settore che ha un track record di sicurezza esemplare
- i giacimenti esausti utilizzati hanno contenuto per milioni di anni grandi quantità di gas naturale senza che si creassero percorsi di fuga
- L'iniezione avverrà in giacimenti esauriti che si trovano in un regime di pressione di fluidi di strato molto inferiore a quello naturale originario, e per i quali non si sono mai registrati in decenni di attività petrolifera eventi sismici connessi alla produzione di gas
- il volume di CO₂ che verrà iniettato sarà tale da non raggiungere la pressione di regime originaria del giacimento
- prima, durante e dopo l'attività di stoccaggio della CO₂ saranno utilizzate le tecnologie più sofisticate come quelle di monitoraggio microsismico e di rilevazione delle deformazioni del suolo per verificare l'evoluzione delle operazioni
- Il contenimento della CO₂ nel giacimento è assicurato in primis dall'esistenza di una copertura impermeabile
- Meccanismi di contenimento secondari come la solubilizzazione del gas all'interno dei fluidi del giacimento, la trasformazione della CO₂ in minerali carbonati oppure l'effetto di ritenzione all'interno dei pori della roccia agiscono nel tempo, incrementando la sicurezza della permanenza della CO₂ nel sottosuolo negli anni successivi al termine delle operazioni di iniezione



PROGETTI CCS IN EUROPA – DETTAGLIO DA SLIDE 2 - 1/4

NO.	LOCATION	PROJECT NAME	PROJECT TYPE	INDUSTRY	DESCRIPTION	CO ₂ CAPTURED/ YEAR	STARTING DATE (OPERATION)	STATUS OF THE PROJECT	PARTICIPANTS
1	Belgium	Leilac	Industrial capture	Cement	Cement plant carbon capture (pilot project)	N/A	2018 until 2020	Pre-study	HeidelbergCement, Calix
2	Belgium <i>Antwerp</i>	Port of Antwerp	Industrial capture	N/A	CCS-equipped industrial cluster, CO ₂ transportation and storage in the North Sea and reuse	N/A	N/A	Feasibility study	Air Liquide, BASF, Borealis, INEOS, ExxonMobil, Fluxys, Port of Antwerp and Total
3	Croatia <i>Zagreb County</i>	CO ₂ EOR Project Croatia	EOR	N/A	EOR project started in 2014. Injected 1.400 kt CO ₂ in the EOR fields Ivanić and Žutica near Ivanić Grad [Zagreb County]. The pipeline Molve-Ivanić is 88 km long (30 bar)	0,560 Mt/y	2015	In operation	INA MOL
4	Croatia <i>Central Croatia</i>	iCORD	Industrial capture	Fertiliser	Capturing the CO ₂ produced at a fertilizer plant at Location in central Croatia and at a concrete production plant at Location in eastern Croatia, and storing it at Moslavina basin oil fields and Pannonia basin oil fields as part of INA EOR project	Approx. 1Mt/y	2025	Feasibility Study to be ordered by end of 2019, and to be prepared by Q3 2020	INA MOL
5	Croatia <i>Sisak-Moslavina County</i>	Bio-Refinery plant	Industrial capture	Bioethanol production	Bio-Refinery plant (bio-Ethanol production) on the Sisak Refinery location. On the existing pipeline route, new pipe of 16 km will be built for CO ₂ storage, for the yearly production of 60 kt of CO ₂	0,06 Mt/y	2024	Signing the contracts for basic design and technology selection	INA MOL
6	France <i>Pyrenees</i>	Lacq	Capture Storage (oxycombustion)	Natural gas	CCS Oxy fuel combustion CO ₂ captured and storage in depleted natural gas field at Rousee (Pyrenees)	Approx. total 50,000 tonnes	2009	Capture and storage phase ended on 15/03/2013	Total
7	France <i>Dunkirk</i>	DMX Demonstration in Dunkirk	Industrial capture	Steelmaking	CCS-equipped steel-making plant, CO ₂ transportation and storage in the North Sea	Approx. 1 Mtpa	2025		ArcelorMittal, IFPEN, Axens, Total, ACP, Brevik Engineering, CMI, DTU, Gassco, RWTH, Uetikon

PROGETTI CCS IN EUROPA – DETTAGLIO DA SLIDE 2 - 2/4

NO.	LOCATION	PROJECT NAME	PROJECT TYPE	INDUSTRY	DESCRIPTION	CO ₂ CAPTURED/ YEAR	STARTING DATE (OPERATION)	STATUS OF THE PROJECT	PARTICIPANTS
8	Ireland	ERVIA	Power & Capture	Natural gas power and refining	Large scale CCS project in Ireland, capturing CO ₂ from 2 existing power plants at the former Kinsale Gas Fields, then storing in a 300 m tonnes depleted gas field	Approx 2Mtpa	2028	Feasibility study	ERVIA
9	The Netherlands <i>Port of Rotterdam</i>	Porthos	Industrial capture	Chemical, refining	CO ₂ transportation and storage infrastructure to the industrial area of the Port of Rotterdam	Approx. 5Mtpa	2024	Feasibility study	Gasunie, the Port Authority and EBN
10	The Netherlands <i>IJmond</i>	Athos	Industrial capture	Steelmaking	CCUS network capturing CO ₂ from TATA steel plant and reusing it or storing it in empty gas fields under the North Sea	7.5 Mtpa	2030	Feasibility study	Gasunie, Port of Amsterdam, EBN and TATA Steel
11	The Netherlands <i>Eemshaven</i>	Magnum	Power & Capture	Hydrogen production	Three units of the Magnum gas-power plant in the Eemshaven in Groningen producing electricity from hydrogen by 2023. Statoil is responsible for converting Norwegian natural gas into hydrogen and CO ₂ . The CO ₂ captured will be gathered and stored in underground facilities off the Norwegian coast	Approx. 4 Mtpa	2023	Feasibility study	Equinor, Vattenfall, Gasunie, MHPS
12	The Netherlands <i>Den Helder</i>	Aramis	Industrial Capture		CO ₂ supplied by third parties from Den Helder and stored in the North Sea floor. This CO ₂ can be brought to Den Helder by boat or by pipeline (for example from IJmuiden)	N/A	N/A	N/A	N/A
13	Norway <i>North Sea</i>	Sleipner CO ₂ Storage	Industrial Capture	Natural gas	Pre-combustion capture CO ₂ is directly injected into an offshore sandstone reservoir	Approx. 1Mtpa, and over 17 million tonnes has been injected since inception to date.	1996	Operational	Equinor (operator), Vår Energi, Total
14	Norway <i>Barents Sea</i>	Snøhvit CO ₂ Storage	Industrial Capture	LNG facility	Pre-combustion capture at an LNG facility CO ₂ captured is via pipeline back to the Snøhvit field offshore where it is injected into an offshore storage reservoir	0.70 Mtpa	2008	Operational	Statoil (operator) Petoro, Total, Engie, Norsk Hydro, Hess Norge

PROGETTI CCS IN EUROPA – DETTAGLIO DA SLIDE 2 - 3/4

NO.	LOCATION	PROJECT NAME	PROJECT TYPE	INDUSTRY	DESCRIPTION	CO ₂ CAPTURED/ YEAR	STARTING DATE (OPERATION)	STATUS OF THE PROJECT	PARTICIPANTS
15	Norway <i>Norwegian Continental Shelf (NCS)</i>	Northern Lights	Industrial capture	Cement and waste-to-energy	Storage project will store CO ₂ captured from onshore industrial facilities in Eastern Norway. This CO ₂ will be transported by ship from the capture facilities to a receiving terminal located onshore on the west-coast of Norway. Then CO ₂ will be transferred to intermediate storage tanks, prior to being sent through a pipeline on the seabed to injection wells east of the Troll field on the NCS	Approx 1.5 Mtpa	2022	Final Investment Decision (FID)	Shell, Equinor, Total
16	Scotland <i>St Fergus</i>	Acorn	Industrial capture	Natural Gas power	Full chain CCS hub that will capture CO ₂ emissions from the St Fergus Gas Terminal in north east Scotland and store the CO ₂ at an offshore storage site (to be selected) under the North Sea	The Reference Case assumes a flat rate of 200,000T/yr can be captured from one of the gas terminals at St Fergus	2023	Feasibility Study	Pale Blue Dot Energy (Project leader) along with Chrysaor, Shell and Total with fund of UK and Scotland government
17	Scotland <i>Grangemouth</i>	Caledonia Clean Energy	Power & Capture	Natural gas power	Examining construction of a new natural gas feedstock power plant (The Caledonia Plant) with integrated CO ₂ capture facilities. Power is developing the Caledonia Clean Energy Project (CCEP), an electricity generating station of up to 1GW located near Grangemouth, central Scotland. The project would use a natural gas feedstock with integrated carbon capture, and has the potential to also co-produce clean hydrogen for modern heat and transport applications	3 Mtpa	2023	Feasibility Study	Summit Power
18	Sweden	Preem CCS		Refining	Full scale CCS plant for capture at the Lysekil refinery, transport by boat at the planned CCS hub on the Norwegian West Coast and permanently stored in Smeaheia	50000 tonnes	N/A	Pre-study	Sintef, Preem AB, Gassnova, Chalmers University of Technology
19	UK <i>North of England</i>	H21 North of England	Natural gas to H2	Hydrogen production	Conversion of natural gas to hydrogen with pre-combustion CCS for a 100% grid conversion of the Leeds area and CO ₂ storage in salt caverns and Teeside	Approx. 3 Mtpa	2020s	Feasibility study	Northern Gas Networks (Project Management), Kiwa Gastec, Amec Foster Wheeler, Wales and West Utilities, PSC, Cambridge Carbon Capture

PROGETTI CCS IN EUROPA – DETTAGLIO DA SLIDE 2 - 4/4

NO.	LOCATION	PROJECT NAME	PROJECT TYPE	INDUSTRY	DESCRIPTION	CO ₂ CAPTURED/ YEAR	STARTING DATE (OPERATION)	STATUS OF THE PROJECT	PARTICIPANTS
20	UK <i>Liverpool- Manchester</i>	Liverpool- Manchester Hydrogen Cluster	Natural gas to H2	Hydrogen production	Conversion of natural gas to hydrogen with pre-combustion CCS for a 10% H2 injection to the grid in the Liverpool-Manchester cluster area	1.5Mtpa (10% H2) - 9.5Mtpa (100% H2)	2020s	Feasibility study	CADENT
21	UK <i>Southern North Sea</i>	Net Zero Teesside	Power & Capture	Natural gas power	Large (~ 1 GW) Gas Abated Power Plant in North East England integrated with a Large (~ 5 M t per year) transportation & storage facilities offshore UK CS Southern North Sea	5 Mtpa	2026	Technical evaluation and business model options	BP, OGI
22	UK <i>North Sea</i>	Humber Zero Carbon Cluster	Industrial capture	H2 production, bioenergy	CCS-equipped industrial cluster, CCS-equipped hydrogen production, bioenergy with CCS (BECCS), CO ₂ transportation and storage in the North Sea	N/A	2020s	Technical evaluation and business model options	Drax Group, Equinor, National Grid Ventures
23	UK <i>East Irish Sea</i>	Liverpool Bay Area CCS Project	Carbon Capture Sequestration	Chemical, refining, Hydrogen production	CO ₂ capture from the existing industrial facilities and new hydrogen production plant in the North West of England	1-3 Mtpa phased program	2025	Concept Selection Phase	Eni
24	Italy <i>Pianura Padana</i>	CCS Ravenna Hub	Power and capture (post-combustion), Blue Hydrogen	Power generation and potential H2 production	CO ₂ capture in North of Italy (Pianura Padana Area) from Industrial Complex (i.e. Ravenna) and transportation to depleted Reservoirs in Ravenna Hub	0.04-5,0 Mtpa phased program	2025-2028	Prefeasibility Study	Eni