

Deliverable 4.1

REPORT ON OPPORTUNITIES FOR JOINT PROGRAMMING
OF R&I FUNDING FOR CCUS

APRIL 2022



Project's name: IMPACTS9. IMPACTS9 is a Horizon 2020 project (Coordinated and Support Action) funded by the European Commission for 3 years (from 1 May 2019 until 30 April 2022). Its purpose is to accelerate the progress realised within the CCUS SET-Plan and to support delivery of the R&I activities in the CCUS Implementation Plan.

<https://www.ccus-setplan.eu/>

Disclaimer

This document reflects only the authors' view and the European Commission and CINEA are not responsible for any use that may be made of the information it contains.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 842214

CONTACT DETAILS

Carbon Capture & Storage Association

Rue de la Science 14b
B-1040 Brussels
Belgium

CO₂ Value Europe AISBL

Avenue de Tervueren 188A
B-1150 Brussels
Belgium

Table of contents

Background.....	3
EU funding mechanisms for CCUS R&I	4
Horizon Europe.....	5
Partnerships.....	6
ETS Innovation Fund	10
Connecting Europe Facility for Energy (CEF-E)	11
Other European mechanisms	13
Other partnerships and funds	14
National strategies and funding for CCUS R&I	17
Norway	18
Netherlands	19
UK	22
Germany	24
France	25
Denmark	27
Sweden	27
Switzerland	27
Turkey.....	28
Romania.....	28
Other countries.....	28
Summing up.....	29



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 842214

CONTACT DETAILS

Carbon Capture & Storage Association
Rue de la Science 14b
B-1040 Brussels
Belgium

CO₂ Value Europe AISBL
Avenue de Tervueren 188A
B-1150 Brussels
Belgium

Background

During this decade, it is crucial to put in place the policy and regulatory framework for the large-scale deployment of CCS and CCU technologies, making the technologies investable. While the mitigation role of CCS is demonstrated and acknowledged by several modelling scenarios, securing broad political support for the technology has been a barrier for large-scale CCS projects in the early 2000s. It is crucial to build awareness and political support in this decade to ensure the necessary scale-up.

Funding for CCUS R&I plays an important role in this picture, as research and innovation are key actions towards a climate neutral and competitive Europe.

Implicitly, this responds to the 'Overview of Actions for the period 2022-2024' of ERA (European Research Area) Policy Agenda¹, namely:



1. Deepening a truly functioning market for knowledge across the union
2. Taking up together the challenges posed by the twin green and digital transition, and increasing the society's participation in the ERA
3. Amplifying access to research and innovation excellence across the union
4. Advancing concerted research and innovation investments and reforms

A key motivation for this deliverable has been interest from major national and European actors to better understand how joint R&I programming can considerably increase the deployment rate for CCUS in Europe and world-wide.

This report focuses on the main funding opportunities for joint programming for CCUS R&I in Europe, where public support is part of the scheme. In addition, private actors invest substantially in R&I, but this will not be further elaborated in this report.

Figure 1: European Research Area (ERA) Policy agenda 2022-2024

¹https://ec.europa.eu/info/sites/default/files/research_and_innovation/strategy_on_research_and_innovation/documents/ec_rtd_era-policy-agenda-2021.pdf



CONTACT DETAILS

EU funding mechanisms for CCUS R&I

A way of illustrating how European funding streams is organised is seen in Figure 2:

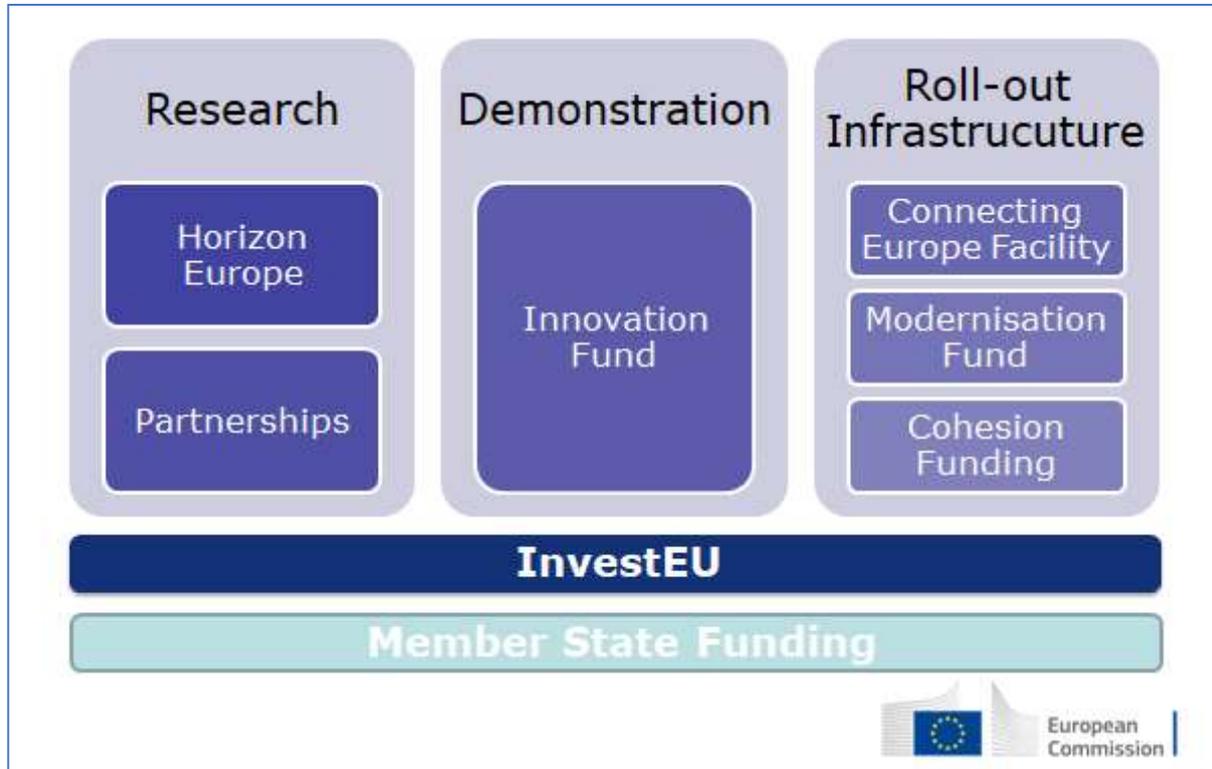


Figure 2: European R&I funding streams for low-carbon technologies, including CCUS

To help achieve its climate goals, the EU has decided to integrate, or mainstream, climate action across the entire EU budget². Alignment of member states and European funding is a key to the success of the SET Plan.

In December 2021 the European Commission agreed to update the Guidelines on State aid for climate, environmental protection, and energy ('CEEAG')³. This might also influence the funding opportunities for State aid directed towards CCUS R&I.

² https://ec.europa.eu/clima/eu-action/funding-climate-action/supporting-climate-action-through-eu-budget_en

³ https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6982?mc_cid=f16e39d7cd&mc_eid=a2e5c1fcac

Horizon Europe

Several European funding synergies exist and are coordinated in support of CCS and CCU. Among those, *Horizon Europe*⁴ is a major pillar for public funding for CCUS in Europe, where CCUS is included in Cluster 'Climate, Energy and Mobility'.

The draft Horizon Europe work programme for 2023 and 2024 was recently launched, and the expected main calls relevant for CCS and CCU focus on CO₂ capture, CO₂ storage, CO₂ utilisation, integration in hubs and clusters and Carbon Dioxide Removals⁵.

The overall budget for Horizon Europe is approximately 95 billion €. Figure 3 shows how Horizon Europe is organised.

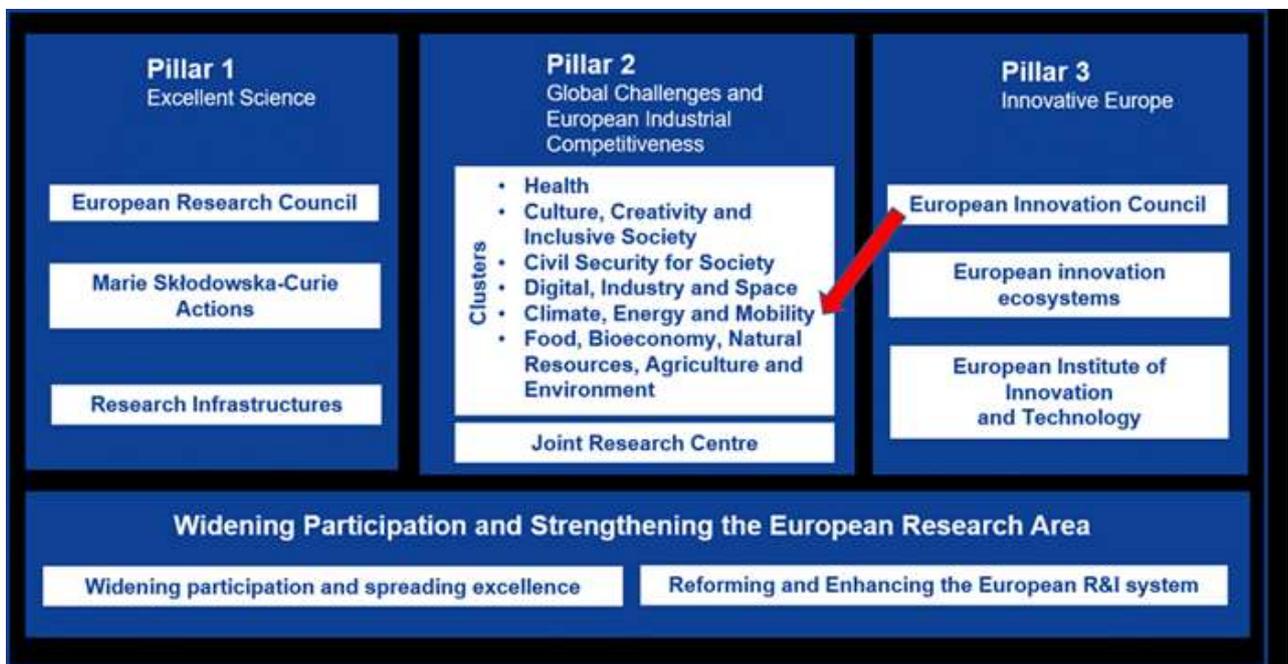


Figure 3: Overview of how Horizon Europe is organised

⁴https://ec.europa.eu/info/sites/default/files/research_and_innovation/strategy_on_research_and_innovation/presentations/horizon_europe/ec_rtd_he-investing-to-shape-our-future.pdf

⁵ https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2021-2022/wp-8-climate-energy-and-mobility_horizon-2021-2022_en.pdf



CONTACT DETAILS

Partnerships

The EU COM⁶ describes these as (direct reference):

The European Partnerships bring the European Commission and private and/or public partners together to address some of Europe's most pressing challenges through concerted research and innovation initiatives. They are a key implementation tool of Horizon Europe and contribute significantly to achieving the EU's political priorities.

There are 3 types of partnerships:

- Co-Programmed European Partnerships: These are partnerships between the Commission and mostly private (and sometimes public) partners.
- Co-funded European Partnerships using a programme co-fund action: These are partnerships involving EU countries, with research funders and other public authorities at the core of the consortium.
- Institutionalised European Partnerships: These are partnerships in the field of research and innovation between the Union, EU member states and/or industry.

ERA-NET ACT

A main pillar for joint public funding of CCUS R&I in Europe is the partnership ERA-NET Accelerating CCS Technologies (ACT)⁷, which started as a co-funded partnership. With an ever-growing number of partners countries and members, funds have successfully been allocated to CCUS projects in Europe and beyond.

Norway has played an important role in the co-ordination of ERA-NET ACT. The initiative was kicked off in 2016 and has since then funded 33 transnational projects with a total budget of 100 M€. In addition to making fund for projects available, a strong focus on knowledge sharing activities has been given. Such international collaboration is needed for a successful implementation of CCUS as an essential climate measure.

The ACT partners (16 since 2020, see Figure 4) have established themselves as a powerful multilateral funding scheme for research and innovation dedicated to CCUS. ACT is a fit-for-purpose, partner-driven, flexible and an easy-to-join funding scheme that serves ACTs ambition: to make CCUS a commercially viable climate mitigation technology. The ACT-funded projects have delivered results complying with the SET plan implementation Plan and Mission innovation Research Priorities. The ACT projects have provided results of relevance to the development of Longship, Porthos and the Scottish CCUS cluster. A

⁶ https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe_en

⁷ <http://www.act-ccs.eu/>



CONTACT DETAILS

status report from ACT⁸ describes the value of such a transnational program and the projects funded⁹. In the paper 'From national to international focus – results and impacts from the Norwegian national RD&D programme for CCS (CLIMIT)^{10,11} the authors conclude as follows (quote):

CLIMIT changed its focus towards more international collaboration in 2016. Since then, 20% of the funds has been allocated to international calls, mainly the ACT partnership. In ACT 16 countries, regions and provinces collaborate in bi-annual, transnational joint calls and multinational knowledge sharing.

The shift from national to international joint calls has given the following positive impacts for CLIMIT: Larger projects possible, able to address industrial needs more efficiently. Results and knowledge needed by the Longship¹² project provided. ACT calls provided strategic priorities in the SET plan¹³ and Mission Innovation¹⁴. Several ACT calls have joined forces and set up international seminars where key results have been communicated to stakeholders and important stakeholders. National CLIMIT projects have not been able to address awareness in a similar way.

There are also some disadvantages when international calls are priorities over national calls: Funding for basic research has decreased... Number of PhD candidates educated has decreased.



Figure 4: Global spread of ERA-NET ACT partners

An overview of financial contributions to the three ACT calls is presented below:

⁸https://static1.squarespace.com/static/5672ab009cad60e553e3529/t/61bb01b8f5042d76c412f176/1639645628182/D1.4+FINAL+Report+final+to+the+ACT-web_03.12.2021_RR.pdf

⁹<https://static1.squarespace.com/static/5672ab009cad60e553e3529/t/61bb01ced34d6b0039291d1e/1639645653387/D4.4+Evaluation+report+on+project+results+Final+30.11.2021.pdf>

¹⁰ <https://climit.no/en/>

¹¹ <https://sintef.brage.unit.no/sintef-xmlui/bitstream/handle/11250/2785937/From%20National%20to%20International%20Focus.pdf?sequence=1>

¹² <https://ccsnorway.com/>

¹³ <https://www.ccus-setplan.eu/>

¹⁴ <http://mission-innovation.net/missions/carbon-dioxide-removal/>

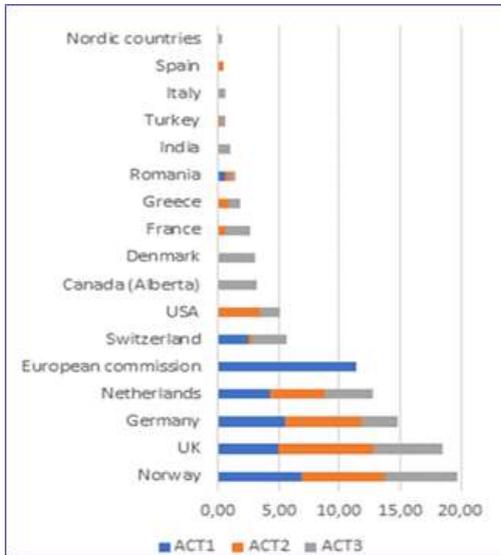


Figure 5: Financial contributions from each country/region in each ACT call

In the following a list is presented on how the different ACT projects responds to the targets in the SET Plan action 9 Implementation plan:

SET Plan Targets (2030) (summarized)	ACT1 projects	ACT2 projects	ACT3 projects
Delivery of 15 commercial-scale CCS projects linked to industrial sources	ALIGN, ELEGANCY	LAUNCH	ABSALT, ENSURE, SCOPE
Delivery of 10 commercial-scale CCS project for clean flexible power and heat	ALIGN	LAUNCH	ABSALT, ENSURE, SCOPE
SET Plan countries have roadmaps for dedicated CO2 transport infrastructure for the EU Ten-Year Network Development Plan.	ALIGN, ELEGANCY	0	ACTION
10 additional EU Projects of Common Interest for CO2 transport infrastructure	ACORN, ECOBASE	0	0
Inventory of geological storage capacity	0	0	0
CO2 capture pilots for different industrial and climate-neutral applications, TRL 7-8 and TRL 5-6	GasTECH, 3D-Caps	LAUNCH, NEWEST-CCS, ANICA, EC2OCCEM, PRISMA, MEMCCSEA	ABSALT, EverLoNG
6 New storage sites in preparation or operating by 2030, in different settings	Pre-ACT, DETECT, ECOBASE	SUCCEED, DIGIMON, ACTOM, REX-CO2, SENSE	RETURN, SHARP, CEMENTTEGRITY
Several CCU demonstration installations for fuels and chemicals based on CO2	ALIGN	FUNMIN	CoCaCO2La, CooCE, CREATE, LOUISE, NEXTCCUS
By 2030, first large-scale commercial CCU installations, supported by regulatory framework			CREATE, LOUISE
All European countries have identified the role of CCS/CCU in meeting climate neutrality by 2050	All	All	All

Figure 6: SET Plan targets versus ERA-NET ACT projects

The same type of mapping has been done for the ERA-NET ACT projects towards the Mission Innovation Goals.

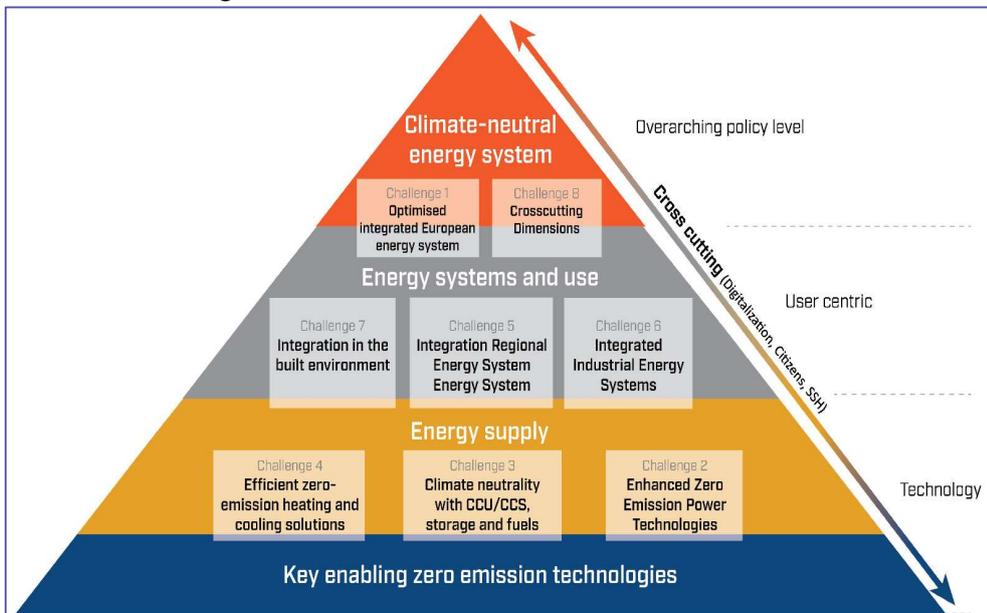
Clean Energy Technology Partnership (CETP)

The Clean Energy Transition Partnership (CETP) aims to empower the energy transition and contribute from a R&I perspective to the EUs goal of becoming a climate-neutral continent by 2050. With robust investment in innovation and technology development, the CETP will pool national and regional resources/funding programmes, thus overcoming a fragmented approach. CCS and CCU is one of the areas described in the Strategic Research and Innovation Agenda (SRIA)¹⁵. The CETP proposal was approved by the EC in December 2021.

Around 70 funding agencies from 32 countries have indicated their interests to participate and allocate budget to the CETP-calls. The indicative funds from Member states and Associated countries are ~500 M€ for the 7 years period, which indicate a release of ~210M€ from EC. CETP has been granted 70 M€ from EC for implementing the two first calls (in 2022 and 2023) and the follow up of projects for these calls.

The research challenges identified in CETP has been bulked in 8 Transition Research Initiatives (TRI), as described in the figure below.

The CCUS activities in the CETP will mainly be within (TRI3)- *'Enabling climate neutrality with storage technologies, renewable fuels and CCU/CCS'* and is also described as an important part of the TRI6 – *Integrated Industrial Energy Systems*. TRI3 builds very much on the experience from the ACT program, as illustrated in Figure 7:



¹⁵ https://eranet-smartenergysystems.eu/global/images/cms/CETP/CETP_SRIA_v1.0_endorsed.pdf



CONTACT DETAILS

Figure 7: Clean Energy Transition Partnership (CETP)

As of February 2022, a total of 18 countries/regions have confirmed interest in participating in TRI3:

Czech Republic, France, Germany, Greece, Hungary, Iceland, Italy, The Netherlands, Norway, Portugal, Romania, Spain, Sweden, Switzerland, Turkey, UK/Scotland, Canada/Alberta, USA.

The call is planned to be launched in September 2022. The indicative budget for TRI3 for the call in 2022 is ~35-40 M€ (incl. the 5-7 M€ as top-up-funds from the EC). (Please be aware that these are not confirmed contributions). Other European partnerships of relevance for the CCUS part of TRI3 is the Clean Hydrogen Partnership¹⁶.

ETS Innovation Fund¹⁷

The European Trading Scheme (ETS) Innovation Fund (IF) is one of the largest funding support schemes funded by credits from the EU ETS¹⁸ in Europe for pre-commercial projects in the areas of renewable energy, energy efficiency, energy storage, CCS and CCU. The IF that can provide substantial GHG emission reductions and reach financial closure within four years. An increasing carbon price means an increasing size of the Innovation Fund.

The IF will last for 7 years from 2021. A major oversubscription¹⁹ in the first calls indicates a need for increased budget and possibly also frequency.

Among all the applications received, 14 projects that applied under other categories included parts of the CCS and CCU value chain²⁰, see Figure 8:

¹⁶ <https://hydrogeneurope.eu/clean-h2-partnership/>

¹⁷ https://ec.europa.eu/clima/eu-action/funding-climate-action/innovation-fund_en

¹⁸ https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets_en

¹⁹ https://ec.europa.eu/clima/system/files/2022-01/policy_innovation-fund_lsc_statistics_en_0.pdf

²⁰ https://ec.europa.eu/clima/news-your-voice/news/first-innovation-fund-call-large-scale-projects-311-applications-eur-1-billion-eu-funding-clean-tech-2020-11-05_en



CONTACT DETAILS

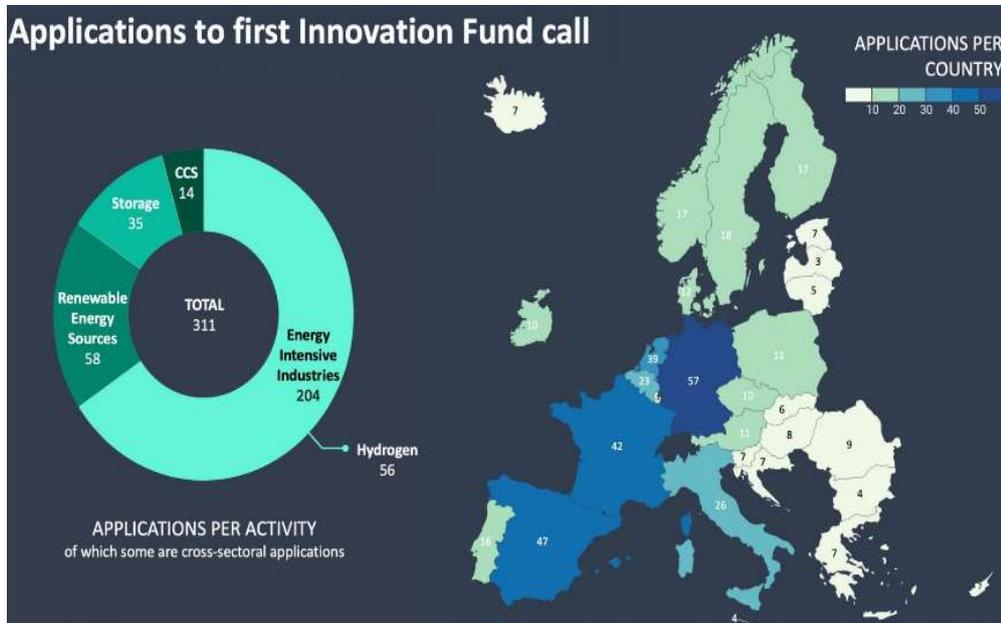


Figure 8: Applicants to the first large-scale Innovation Fund call

The award winners of the first round of Innovation Fund call were announced in November 2021²¹. 4 of 7 projects which were awarded granting in the first large-scale call were CCUS-related projects, namely:

- Kairos@C²²
- BECCS@STHLM²³
- K6 Programme (in France)
- SHARK in Finland²⁴

The European Commission has launched a second large-scale Innovation Fund call with application deadline in March 2022²⁵.

Connecting Europe Facility for Energy (CEF-E)^{26,27}

The Connecting Europe Facility (CEF) is a key EU funding. It supports the development of interconnected trans-European networks in the fields of transport, energy, and digital services. For CO₂ infrastructure projects having gained the status of European Projects of Common Interest (PCI), funding is available

²¹ https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6042

²² <https://www.basf.com/global/en/media/news-releases/2021/11/p-21-385.html>

²³ <https://www.stockholmexergi.se/minusutslapp/beccs/>

²⁴ <https://www.neste.com/about-neste/who-we-are/production/porvoo#5007b3f5>

²⁵ https://ec.europa.eu/clima/eu-action/funding-climate-action/innovation-fund/large-scale-projects_en

²⁶ <https://ec.europa.eu/inea/en/connecting-europe-facility>

²⁷ <https://ec.europa.eu/inea/connecting-europe-facility/cef-energy/calls>



CONTACT DETAILS

under the CEF for Energy (CEF-E). This funding stream is connected to the Multiannual Financial Framework (MFF), and for the 2021-2027 period the budget available under the CEF-E is 5.84 billion€. Currently, six CO₂ infrastructure projects are included in the 5th PCI list, being the first one to be adopted with the objective of net-zero GHG emissions enshrined in EU law, namely (more information found here²⁸):

- CO2TransPorts²⁹
- Northern Lights³⁰
- Athos³¹
- Aramis³²
- Dartagnan
- Poland-EU CCS interconnector

See the map of Clean Air Task force illustrating the ongoing CCUS projects in Europe³³, reflecting the north-west European focus, and thereby potential for CEF-E funding p.t:

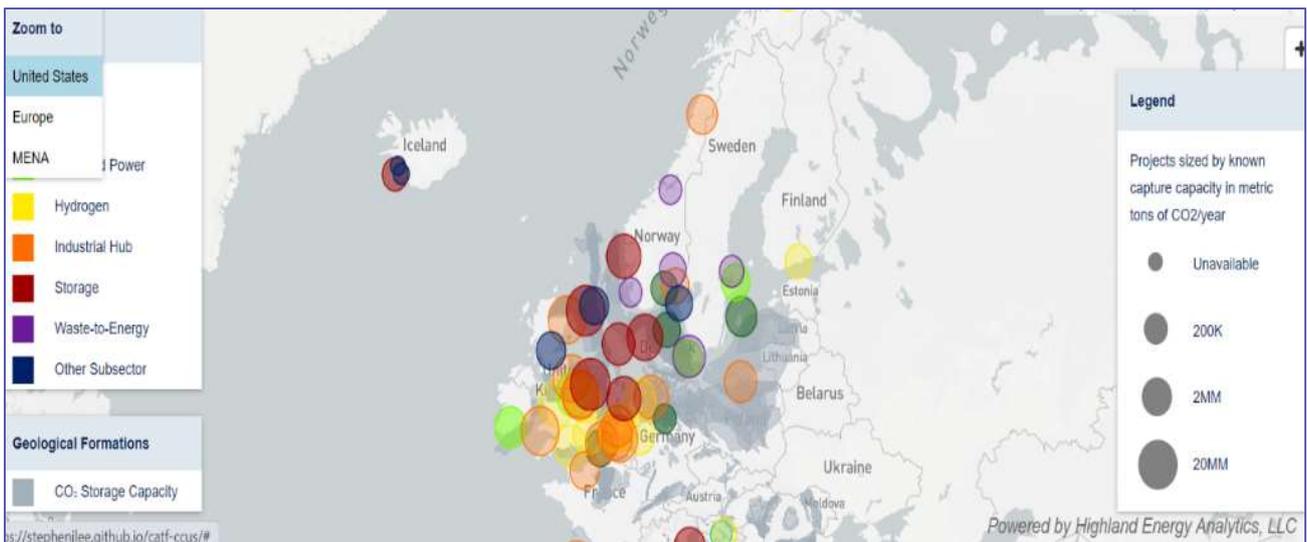


Figure 9: Clean Air Task force CCUS map for Europe

²⁸ https://ec.europa.eu/energy/sites/default/files/detailed_information_regarding_the_candidate_projects_in_co2_network.pdf

²⁹ <https://www.porthosco2.nl/en/>

³⁰ <https://northernlightsccs.com/>

³¹ <https://www.ccusnetwork.eu/network-members/athos-consortium>

³² <https://www.gasworld.com/aramis-ccs-project-aims-for-large-scale-carbon-reduction/2021701.article>

³³ <https://www.catf.us/ccsmapurope/>

Other European mechanisms

Modernisation Fund³⁴

The Modernisation Fund is a dedicated funding programme to support 10 lower-income EU Member States in their transition to climate neutrality. The beneficiary Member States are Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovakia.

Cohesion Fund

The Cohesion Fund provides economic support to environment and transport infrastructure projects in the 13 newest Member States from Central and Eastern Europe, in addition to Greece and Portugal. Allocation of funding is shared between the Commission and the Member States governments.

InvestEU

This is the operational tool of the overall European Fund for Strategic Investment, which aims at providing financial guarantees for projects benefiting from other EU funding sources such as Horizon Europe, Connecting Europe Facility, or the Innovation Fund. The Regulation and Investment Guidelines explicitly refer to CCS (although the funding is based on EIB loans). The programme is intended to leverage other funding sources, by providing EU guarantees for loans through the European Investment Bank.

The Recovery and Resilience Facility

This facility serves to inject capital and investments into each Member States' economy with a view to boost activities following the Covid pandemic. It is up to each Member State to prioritise activities, ranging from, inter alia, transport, renovation, infrastructure, new technologies or education and training. More than 30 percent of the activities must be related to funding Green Deal related activities. It is therefore up to each Member State to prioritize CCUS related activities to kick start the economy.

European Regional Development Fund

This traditional EU funding tool is aimed at levelling out economic and social disparity of EU Member States. EU leaders have decided that the funding opportunities should support Green Deal goals, with emphasis on low carbon technologies and resilience measures in the energy market. In addition, Heads of State asked that the fund should increasingly be spent on complementing other EU funded projects, such as Horizon Europe, Life, Connecting Europe Facilities, etc.

³⁴ https://ec.europa.eu/clima/eu-action/funding-climate-action/modernisation-fund_en



CONTACT DETAILS

Just Transition Fund

In addition to funding research and innovation projects, this fund is primarily aimed at funding transformation of existing carbon-intensive regions and installations, where investments lead to substantial emission cuts and job preservation.

Structural Fund

Structural Fund is a bag of several EU funding sources aimed to support economic development in all EU countries. It is constituted of the European Regional Development Fund, the European Social Fund, Cohesion Fund Agricultural fund for Rural development and the Maritime and Fisheries Fund. CCS projects need to be prioritized in national administrations to receive funding.

IPCEI ³⁵(Important Projects of Common European Interest)

The following is stated by the EU Commission about the IPCEI instrument³⁶ (quote):

'IPCEIs make it possible to bring together knowledge, expertise, financial resources and economic actors from across the Union, in a bid to address important market or systemic failures or societal challenges that could not otherwise be addressed. They are designed to bring together the public and private sectors to undertake large-scale projects of significant benefit to the Union and its citizens'
'The deployment of IPCEIs often requires a significant participation from public authorities whenever the market would not otherwise finance such projects'

There are IPCEIs for hydrogen, but not for CCUS. Initiatives for establishing a potential IPCEI on CCUS would need to come from one/a group of countries.

Other partnerships and funds

The urgency of the climate crisis and the need to meet the UN Sustainable Development Goals (including the EU Taxonomy for sustainable finance) has resulted in different kinds of private-private and public-private partnerships and funds. This represents an important opportunity for CCUS RD&D funding too.

Mission Innovation Mission Innovation³⁷

Mission Innovation is the main intergovernmental platform addressing clean energy innovation through action-oriented cooperation to accelerate the implementation of the Paris Agreement. A second wave of missions is now being launched under the Mission Innovation initiative, each with a five-year horizon. One mission being Carbon Dioxide Removal (CDR) with the following goal: *Enable CDR technologies to achieve net reduction of 100 million metric tons of CO₂ per year globally by 2030.* The CDR mission is divided into four work streams (technical areas):

³⁵ https://ec.europa.eu/competition-policy/state-aid/legislation/modernisation/ipcei_en

³⁶ https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.C_.2021.528.01.0010.01.ENG&toc=OJ%3AC%3A2021%3A528%3ATOC

³⁷ <http://mission-innovation.net/about-mi/overview/2021-joint-launch-statement/>



CONTACT DETAILS

Direct Air Capture (DAC), BiCRS (or Bio-CCS), Mineralization, Analysis (Life Cycle Analysis, LCA & Techno Economic Analysis, TEA). Co-leads of the CDR mission are USA, Canada and Saudi Arabia. Norway is core member.

EU-Catalyst partnership³⁸

This is a partnership between the EU Commission, European Investment Bank and Breakthrough Energy Catalyst (Gates Foundation) that aims to mobilise up to 820 M€ between 2022-2026 to accelerate the deployment of innovative technologies. Each euro of public funds is expected to leverage three euros of private funds within in four sectors: clean hydrogen; sustainable aviation fuels; direct air capture; and long-duration energy storage.

Carbon Sequestration Leadership Forum (CSLF)³⁹

This is a Ministerial-level international CCS technologies initiative, including aspects of awareness, legal, regulatory, financial, and institutional environments relevant to CCS technologies.

ECCSEL Research infrastructure⁴⁰

ECCSEL is a distributed, integrated pan-European research infrastructure, providing open access to over 80 facilities in 5 countries, for researchers worldwide. ECCSEL ERIC encompasses interlinked transnational scientific facilities and national nodes. A European Research Infrastructure Consortium (ERIC) is a full legal entity under EU law, with the goal to establish and operate, through its members, a research infrastructure of European importance on a non-economic basis. ECCSEL responds well with some of the priority areas of the updated European Research Area (ERA)⁴¹.

EEA grants and Norway Grants⁴²

The EEA and Norway Grants are funded by Iceland, Liechtenstein and Norway. The Grants have two goals – to contribute to a more equal Europe, both socially and economically – and to strengthen the relations between Iceland, Liechtenstein and Norway, and the 15 Beneficiary States in Europe (Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, Slovenia). Norway Grants include all 15 EEA Grants beneficiaries, except Greece and Portugal.

³⁸ https://ec.europa.eu/commission/presscorner/detail/en/IP_21_5586

³⁹ <https://www.csforum.org/csrf/>

⁴⁰ <https://www.eccsel.org/>

⁴¹ https://ec.europa.eu/info/sites/default/files/research_and_innovation/strategy_on_research_and_innovation/documents/ec_rtd_era-policy-agenda-2021.pdf

⁴² <https://eeagrants.org/>



CONTACT DETAILS

Carbon Capture & Storage Association

Rue de la Science 14b
B-1040 Brussels
Belgium

CO₂ Value Europe AISBL

Avenue de Tervueren 188A
B-1150 Brussels
Belgium

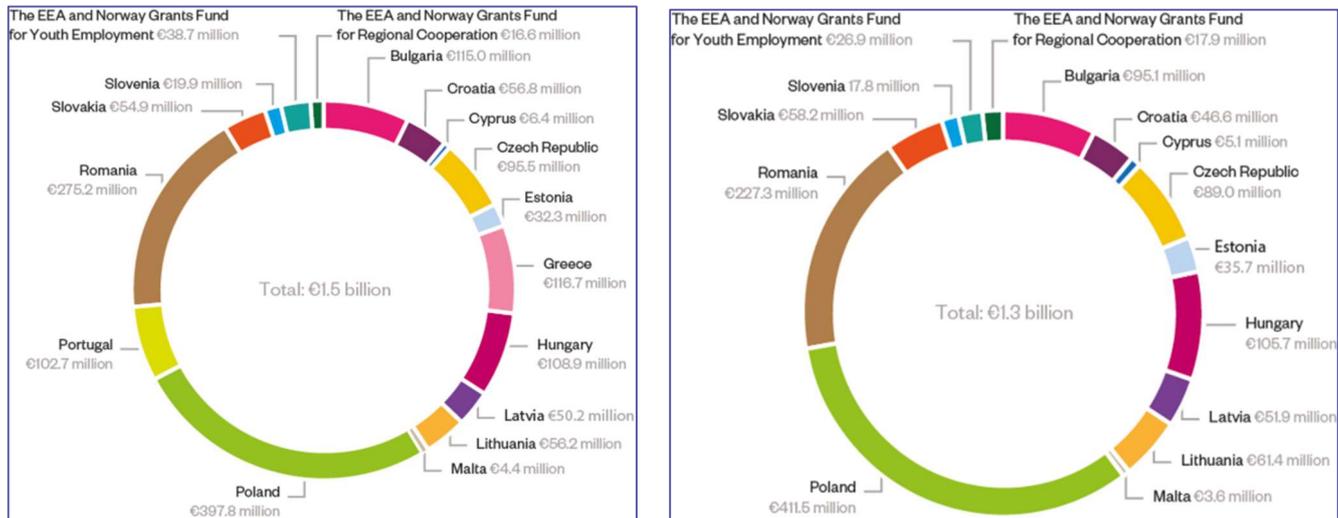


Figure 10: Left; EERA Grants (in total 2014-21). Right: Norway Grants (2014-21)

National strategies and funding for CCUS R&I

Table 1 lists information about national funding programmes for CCUS, in addition to the engagement in ACT, CETP and EERA JP CCS from partners with each of the listed countries. Information is included for those countries having responded to the request to provide this information to this deliverable and/or being active in either ERA-NET ACT and/or CETP (see here⁴³ for national contact points).

In addition to these countries, the following countries should be considered in order to get the full overview:

Belgium, Poland, Ukraine, Ireland, Croatia, Malta, Hungary, Bulgaria, Cyprus, Serbia, Lithuania, Slovenia, Latvia, Estonia, Moldova, Slovakia, Kosovo, Montenegro, Bosnia. Some of these countries are, for example, included in the EEA.

Following Table 1, in the following section more information is presented for some of the countries being most active/with the largest budgets in CCUS R&I: Norway, Netherlands, UK, Germany, France, Denmark, Sweden and France.

Table 1: Overview of national funding agencies, partnerships in ACT, CETP and role in IWG9 and EERA CCS

Country	Funding agency	ERA-NET partner (x= all phases)	ACT	CETP partner (TRI3, CCUS)	EERA JP CCS partner
Norway	RCN/Gassnova	x		x	x
UK	BEIS	x		x	x
Germany	PtJ	x		x	x
Netherlands	RVO	x		x	x
Denmark	EU DP	x			x
Sweden	SWEA			x	x
France	ADEME ANR	x x			x
Greece	GSRI	x		x	x
Italy	MUR	x		x	x
Spain	AEI-FeCyt	x		x	x
Switzerland	SFOE	x		x	x
Turkey	TUBITAK	x		x	x
Romania	UEFISCDI	x		x	x
Czech republic	TA CR			x	x

⁴³ <http://www.act-ccs.eu/about-us>



CONTACT DETAILS

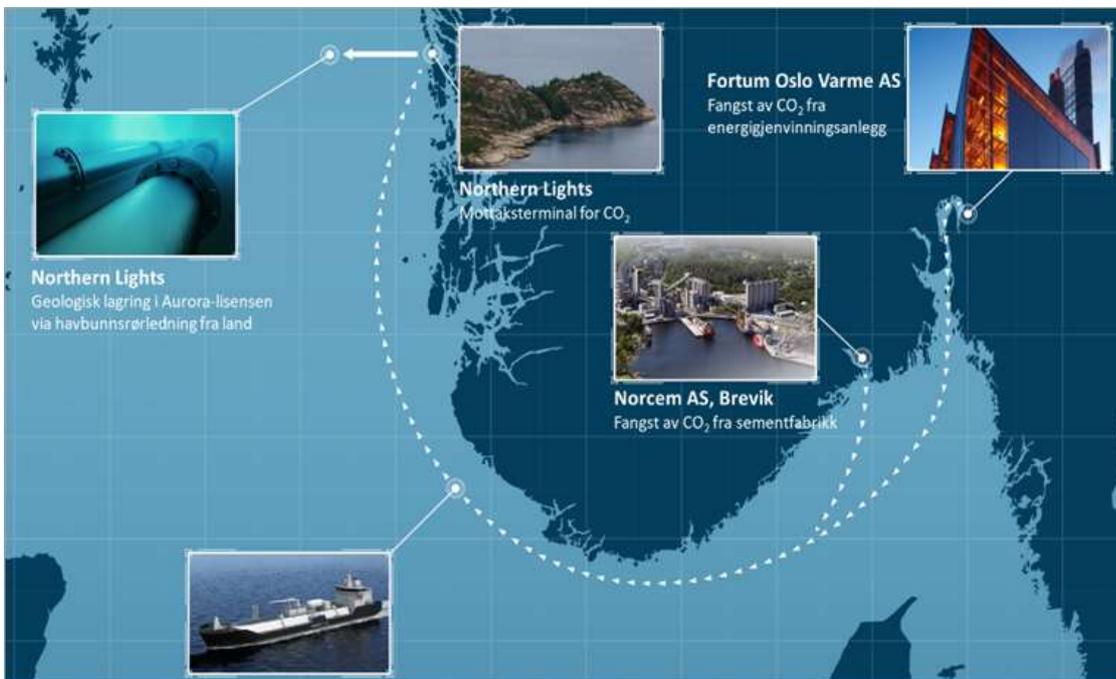
Finland	Business Finland	No	x	x
Portugal	FCT	No	x	No
Iceland	RANNIS	No	x	No
USA	DoE	x	NA	NA
Alberta/Canada	ERA	x	NA	NA

Norway

Norway has an internationally strong technological community in the field of CCS and has, for decades, safely operated the CO₂ storage projects on the Sleipner and Snøhvit fields.

Longship⁴⁴

Longship is one of the first industrial CCS projects to develop an open access infrastructure with the intent and the capacity to store significant volumes of CO₂ from across the European continent. In phase 1, the Longship project will develop and operate by 2024 a full-scale CCS value chain with a capacity of up to 1.5 million tonnes of CO₂ per year. The full-scale CCS value chain includes capturing CO₂ from industrial sources in the Oslo-fjord region (cement and possibly waste-to-energy) and shipping liquid CO₂ from these industrial capture sites to an onshore terminal on the Norwegian west coast.



⁴⁴ <https://ccsnorway.com/the-project/>

CONTACT DETAILS

Figure 11: Norwegian full scale CCS project Longship

CLIMIT programme⁴⁵

Norway has allocated 16 M€ for funding of research and innovation of CCS in 2022. This budget is made available for the CLIMIT programme, administrated by Gassnova and the Research Council of Norway, and is approximately the yearly budget over the past years. The programme can support all aspects of CCS, but not utilization projects. The available budget will cover national calls and Norway's part contribution to ACT calls.

A new CLIMIT programme plan was launched in January 2022⁴⁶. The main updates are:

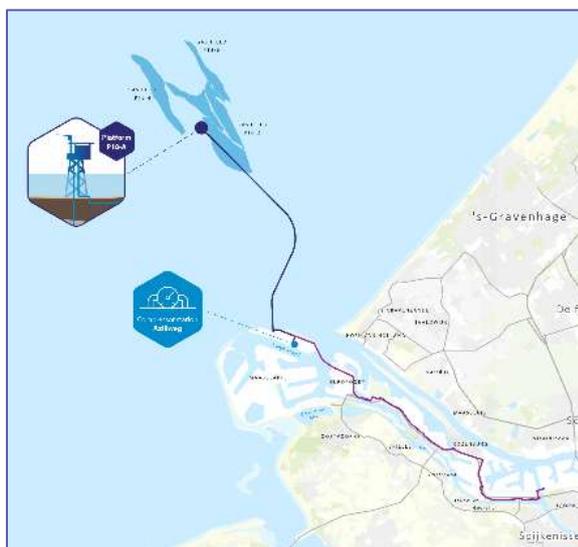
- Clear emphasis on realisation of gains of Longship
- A new focus area is the decarbonisation of industrial and energy resources
- Hydrogen production, combined with CCS is a top priority
- Increased focus on direct air capture and bioenergy combined with CCS
- A clearer position of social scientific research



Netherlands

PORTHOS⁴⁷

Porthos is developing a project in which CO₂ from industry in the Port of Rotterdam is transported and stored in empty gas fields beneath the North Sea. Porthos will store around 37 Mton CO₂, approximately 2.5 Mton CO₂ per year for 15 years.



⁴⁵ <https://climit.no/en/>

⁴⁶ <https://climit.no/en/news/climit-has-a-new-programme-plan/>

⁴⁷ <https://www.porthosco2.nl/en/project/>



CONTACT DETAILS

Figure 12: The Dutch PORTHOS project

ATHOS⁴⁸

The Athos Project is short for 'Amsterdam-IJmuiden CO₂ Transport Hub & Offshore Storage' aims for developing a CO₂ transport and storage network in the North Sea. The Athos Project has been set up with the aim of developing a CO₂ transport and storage network in the North Sea Canal area to enable the utilisation and storage of large volumes of CO₂. The North Sea Canal runs from the port of Amsterdam to the North Sea at IJmuiden. The network will comprise onshore CO₂ transport pipelines, offshore storage facilities, and exit- and feed-in points for companies directly connected to the network, or those connected via other forms of CO₂ transport.

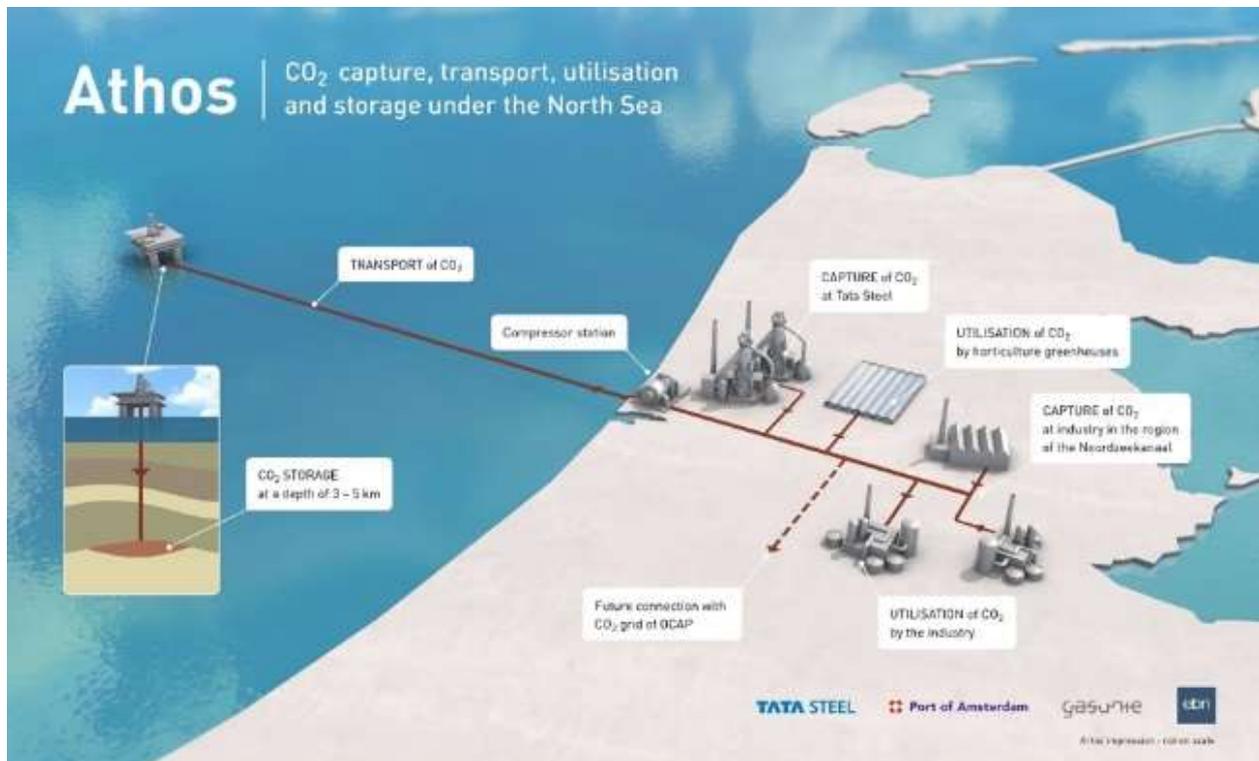


Figure 13: The ATHOS project

⁴⁸ <https://www.portofamsterdam.com/en>

SDE++ subsidy scheme

The Stimulation of Sustainable Energy Production and Climate Transition (SDE++) subsidy scheme^{49,50} in the Netherlands is intended for companies and organisations that produce sustainable energy or apply CO₂-reducing techniques. In 2021 a budget of 5 billion € was available.

Netherlands' funding opportunities for CCUS

Netherlands will allocate budget to CCUS in 2022 as part of broader programmes. Support for CCUS can be through MOOI (TRL4-6), through TSE Industrie (TRL4-6), through “TSE Haalbaarheidsstudies” and through the pilot and demonstration schemes DEI+ and HER+. Information about all of these instruments is available from www.rvo.nl/tse. Depending on the number of successful projects, the budget is expected to be between 2-10 M€. On top of that, the Netherlands government will participate in the ACT Call 2022.

Cato programme⁵¹

CATO is the Dutch national R&D programme for CO₂ capture, transport and storage in which a consortium of nearly 40 partners co-operate.

⁴⁹ <https://business.gov.nl/subsidy/sustainable-energy-production/>

⁵⁰ <https://bellona.org/publication/the-industrial-ccsupport-framework-in-the-netherlands>

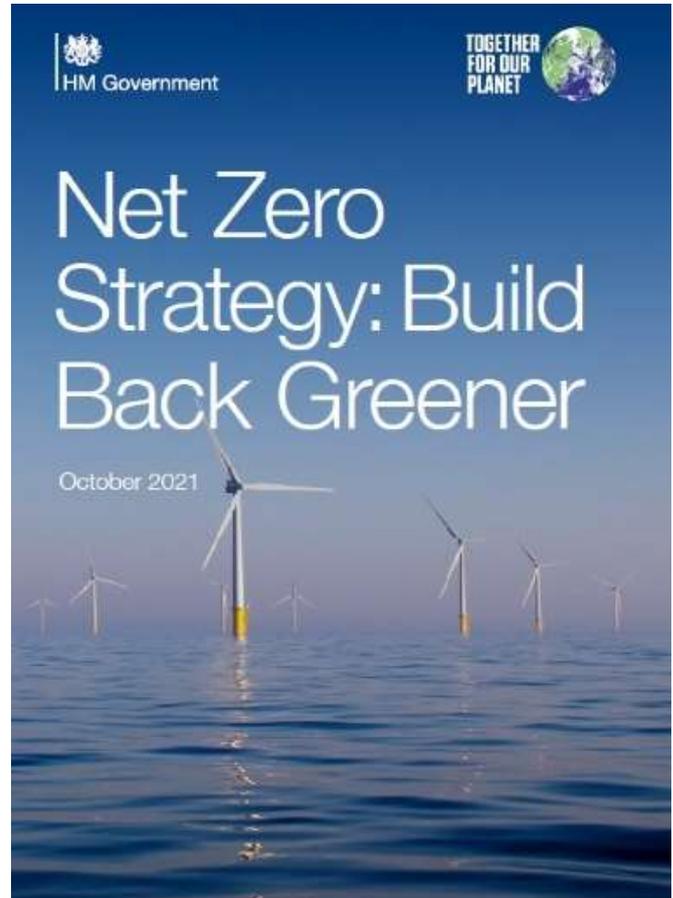
⁵¹ <https://www.co2-cato.org/>



CONTACT DETAILS

UK

The UK climate and industry policies have developed rapidly in recent years. In 2020, a ten-point plan was launched, which was further updated with the Net-Zero Strategy⁵² late 2021.



The key headlines from the Ten Point plan⁵³ of most relevance to UK CCUS policy development and financing of CCUS are:

- £12 billion Government investment planned by 2030 which will leverage up to £42 billion private investment.
- Net Zero is planned to be achieved through only domestic actions, i.e. no offsetting of emissions will be included.

In order to support the development of CCUS, commercial frameworks are currently being developed and are due to be published in 2022. They are expected to be based on a Contracts for Difference model

⁵² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf

⁵³ <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>



CONTACT DETAILS

to complement current renewable frameworks. The UK Industrial Decarbonisation Research and Innovation Centre (IDRIC)⁵⁴.

IDRIC is part of the £170m Industrial Decarbonisation challenge, and is backed by £20m funding until 2024. IDRIC has launched its first 40 research and innovation projects. Projects are grouped into 9 Multidisciplinary Integrated Programmes (MIPs), each addressing a key challenge or pathway for industrial decarbonisation (with some themes, e.g. hydrogen or CCUS, or policy and social aspects, covered in more than one MIP).

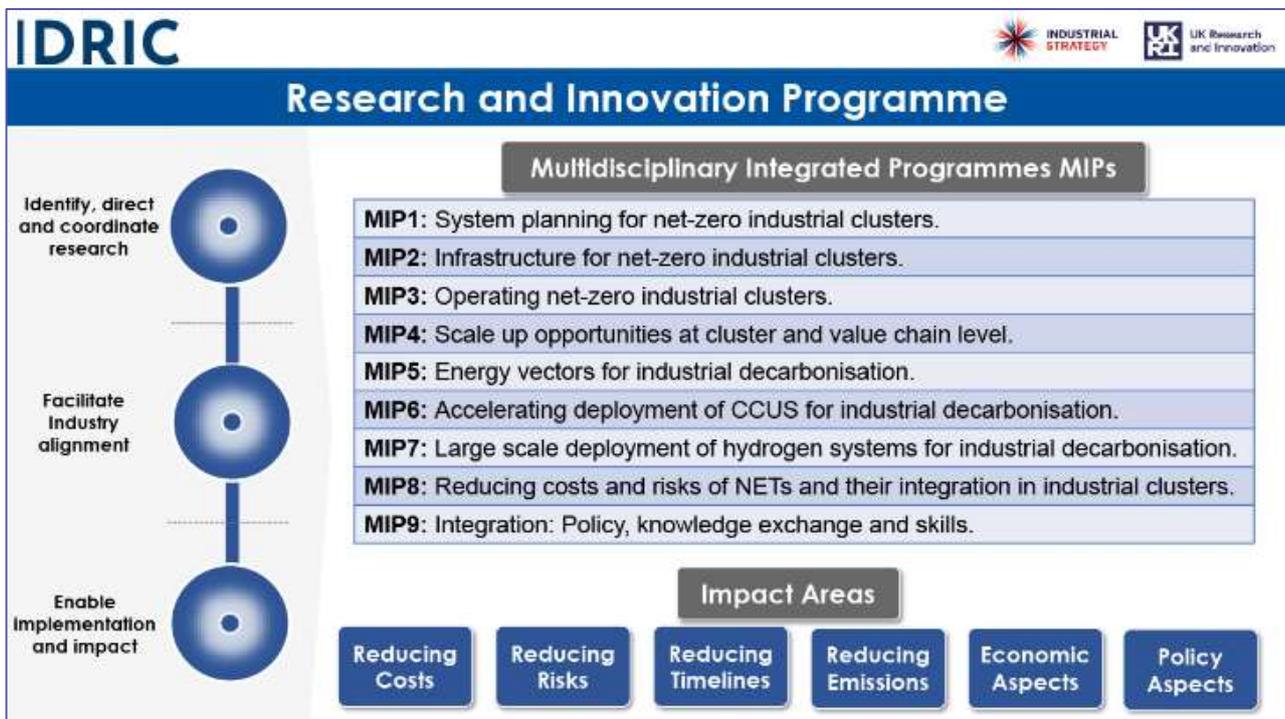


Figure 14: The UK IDRIC Research and Innovation programme

MIP6 is entitled 'Accelerating CCUS deployment of CCUS for industrial decarbonisation', and is organised as shown below:

⁵⁴ <https://idric.org/>



CONTACT DETAILS

IDRIC		Anna Korre	INDUSTRIAL STRATEGY	UK Research and Innovation
MIP6: Accelerating deployment of CCUS for industrial decarbonisation				
<ul style="list-style-type: none"> CCUS is vital to reducing industrial emissions at lowest cost globally. However, CCUS deployment needs to accelerate significantly and important barriers still exist, e.g. fast-tracking routes to market, dynamic storage capacity, access to UK CO₂ storage capacity appraisal and socio-economic aspects. Building upon our current international collaborations in CCUS, as well as UKRI related funded programmes, these internationally leading projects will enable IDRIC to support the UK role in the deployment of CCUS for industrial decarbonisation globally. Collaborating with the individual clusters, skills will be developed and shared throughout IDRIC and beyond. 				
6.1	Accelerating the deployment of cost-competitive capture technologies, Garcia (Heriot-Watt).		Heriot-Watt University	
6.2	Thermodynamic models for application in industrial decarbonisation, Trusler (Imperial).		Imperial College London	
6.3	Advanced multitemporal modelling and optimisation of CO ₂ Transport and Storage Networks, Korre (Imperial).		Imperial College London	
6.4	CO ₂ Stored 2.0 - Next generation of the UK's CO ₂ storage database, Akhurst (BGS).		BGS	
6.5	Protective space and social licence to operate industrial decarbonisation, Gough (Manchester).		University of Manchester	

Figure 15: Multidisciplinary Integrated Programme (MIP) 6 – CCUS

Germany

German politics has rejected CCS solutions for a long time, while CCU has been considered an option to supply carbon to post-fossil industries. Carbon management was considered the main challenge. In the power sector, Germany entirely relies on renewable power, and sector coupling is envisioned to make use of renewable electricity for heat supply and mobility as well. However, by now hydrogen ready gas turbines initially operated with natural gas are considered a necessary solution to stabilize the electricity grid and to cover longer periods without sufficient supply of fluctuating renewable power. In this context, CCS is considered indirectly when blue hydrogen is seen as a chance for fast build-up of a sufficient hydrogen supply.

To mitigate industrial CO₂ emissions, Germany also focusses on hydrogen as an energy carrier, whereby blue hydrogen is seen as an interim solution. However, there is a growing consensus that CCS and CCU will be necessary to deal with industrial CO₂ emissions that are hard to abate. The government of North Rhine-Westphalia, as the state with the highest share of industrial CO₂ emissions in the Federal Republic of Germany, estimates its amount of hardly abatable industrial CO₂ emissions to be 7 to 27 million tons per year, depending on the scenario. Federal government and state governments have issued hydrogen and carbon management roadmaps. See for example:

- The National Hydrogen Strategy⁵⁵
- The Hydrogen Roadmap of North Rhine-Westphalia⁵⁶

⁵⁵ https://www.bmwi.de/Redaktion/EN/Publikationen/Energie/the-national-hydrogen-strategy.pdf?__blob=publicationFile&v=6

⁵⁶ https://www.wirtschaft.nrw/sites/default/files/asset/document/mwide_br_wasserstoff-roadmap-nrw_eng_web.pdf



CONTACT DETAILS

- Carbon Management Strategie NRW⁵⁷

High TRL R&I on CCUS

High TRL R&I related to CCUS is funded by different state programs and by the federal ministry for economy & climate protection (BMWi). The largest program is the “7th Energieforschungsprogramm⁵⁸”, which will be followed by an 8th program in 2023. The available funding is about 1.3 billion € per year. Most funding is invested in large demonstration projects not linked to CCUS, but projects related to blue hydrogen are included. There are signs that demonstration of CCUS in combination with industrial CO₂ will play a more prominent role in the “8th Energieforschungsprogramm”.

Research relevant for CCUS is partially funded institutionally via the Helmholtz and Fraunhofer communities. At smaller scale, low TRL and fundamental research relevant for CCUS is funded by the Deutsche Forschungsgemeinschaft (DFG, German Science Foundation).

Blue hydrogen

The coalition treaty of the new government clearly focusses on solar and wind power to drive the energy transition and on hydrogen to reduce the consumption of fossil fuel and feedstocks in industry. However, the need for bridging technologies and pragmatic solutions is explicitly mentioned. This can be understood as an openness towards blue hydrogen and CCUS, whereby CO₂ storage in Germany is not foreseen. Storage concepts always include cooperation with European neighbors who develop storage capacity.

Carbon Contracts for Difference (CCfD)s are intended to provide CO₂-intensive industry with a security needed to switch to climate-neutral production. In Germany, the aim is that the state sets up 15-20-year contracts promising companies to take on the additional costs of CO₂ emissions reductions that exceed the EU ETS allowances. Investors are responsible for payment if the carbon price exceeds the contract’s price.

France

In France both the National research agency – Agence Nationale de la Recherche (ANR) and Agence de la Transition Ecologique (ADEME) – are important in funding CCUS projects.

France finances RDI on CCUS projects through several programs and entities depending on the subject and the maturity of the project, although no specific budget has been allocated to the subject for the moment. The National Research Agency focuses on low-TRL projects while ADEME, the French Ecological Transition Agency, currently finances R&D projects but also pilot and demonstration projects via the PIA

⁵⁷https://www.wirtschaft.nrw/sites/default/files/asset/document/mwide_carbon_management_strategie_barrierefrei.pdf

⁵⁸https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/7-energieforschungsprogramm-der-bundesregierung.pdf?__blob=publicationFile&v=16



CONTACT DETAILS

program (Programme Investissement d’Avenir). Valuable international collaboration on CCUS R&D is achieved via the participation of ANR and ADEME to the ERA-NET ACT program since 2019.

France has been playing a key role in the development of global climate policies, as illustrated by the adoption of the Paris Agreement in 2015. The Climate Plan sets a target of carbon neutrality for France by 2050 which is declined in 4 priorities in the National Low-Carbon Strategy:

1. Fully decarbonise energy production, through the use of biomass resources and carbon-free electricity;
2. Reduce energy consumption in all sectors in particular through an increase of energy efficiency and sobriety;
3. Reduce non-energy-related emissions as much as possible;
4. Increase carbon sinks -natural and technological sinks-.

CCS is estimated to contribute to a reduction of 15 Mt CO₂ per year: 5 Mt CO₂ from the reduction of “hard-to-abate” industrial emission, and 10 Mt CO₂ from negative emissions thanks to BECCS.

ADEME estimates the potential for CO₂ capture on the national territory at a level of 24 Mt CO₂ / year and has identified three industrial regions as favourable to CCS deployment:

1. Hauts-de-France with a capture potential of 15Mt CO₂ / year and storage offshore in the North Sea;
2. Normandy with a capture potential of 6 Mt CO₂ / year and possible connection with the Dunkirk CO₂ hub for offshore storage in the North Sea;
3. Nouvelle Aquitaine with a capture potential of 3 Mt CO₂ / year and storage in depleted gas fields.



French CO₂ Club⁵⁹



In 2002, Club CO₂ was initiated by the ADEME and supported by IFPEN and BRGM, the former acting as chair. A key element in the organization of French research in the field of carbon capture, storage and utilization, it serves as a response to the need of a more effective management for national efforts, while facilitating projects creation, and contributing to better public visibility.

The members of the Club are all key players in the industry, research and development. Club CO₂ has published a position paper in October 2021 promoting CCS technology as an opportunity to contribute to the decarbonization of many emitters on national territory and maintain the competitiveness of French industry and its products. The first French industrial CCS

⁵⁹ <https://www.club-co2.fr/en/content/research-initiatives>

installations could be put into service between 2025 and 2030 thus making it possible to avoid emissions of the order of 1 to 5 million tonnes of CO₂ per year.

Denmark

Late 2021 Denmark decided to allocate €2.2bn towards CCUS subsidies over the coming decade, starting in 2022. Denmark initially plans to fund CCUS projects in energy and industrial sectors, and pave the way for local collaborations on CCUS in Copenhagen, Aarhus, Odense, Aalborg, Esbjerg and Fredericia and possibly other major Danish cities. See: 'The Green CCUS Roadmap - Towards a fossil free future: Roadmaps for mission-driven green research and innovation partnerships'⁶⁰

The largest public funding programs in Denmark are The Energy Technology Development and Demonstration Program (EUDP) and Innovation Fund Denmark (IFD). EUDP has in 2022 allocated 52 M€ for development and demonstration of energy technology projects including CCUS. In 2022 there are no earmarked funding for CCUS, which is in contrast to 2021 where an earmarked pool of 26,5 M€ for CO₂ storage in the North Sea was granted. IFD has in 2022 allocated 39,5 M€ within strategic and challenge-driven research within four green missions. One of the missions are "Capture and storage or use of CO₂".

Sweden^{61,62}

Sweden is the first country in the world to investigate a state support system for bio-CCS. Once the support is introduced, Sweden can become a leading nation in the field. The Swedish Energy Agency proposes a system of reverse auctions, which in short means that the players submit bids on how much carbon dioxide they can capture and store and at what cost. The player who can deliver bio-CCS at the lowest cost wins the tender and receives the support.

Switzerland

Switzerland run several funding programs that are partially also aimed towards CCUS.

- Other R&D programs (Bioenergy, Industrial processes, etc) that partially cover additional aspects of CCUS
- A R&D program that finances CCUS projects (among others) with strong industry participation
- The funding program SWEET plans to launch a call on "Addressing Residual Emissions to Reach the Net-Zero Target" (about 15 MCHF) in 2024
- The R&D program Geoenergy as well as the P+D program contribute to the ACT calls
- The R&D programs on Geoenergy (0.8 MCHF) which focuses on both geothermal research and CCS

⁶⁰ <https://innovationsfonden.dk/sites/default/files/2021-08/Appendix%20%20-%201112-00004A%20-%20Mission%20CCUS%20%E2%80%93%20a%20roadmap%20for%20Carbon%20Capture%2C%20Utilisation%20and%20Storage.pdf>

⁶¹ <https://www.energimyndigheten.se/nyhetsarkiv/2021/statligt-stod-kan-gora-sverige-ledande-inom-bio-ccs/>

⁶² <https://energimyndigheten.a-w2m.se/Home.mvc?ResourceId=203642>



CONTACT DETAILS

Turkey

The CCUS R&D activities are supported by two national bottom up TUBITAK programs, namely the 1001 and 1501. While the 1001 Program aims to support research projects following scientific principles to produce new knowledge, make scientific comments or solve technological problems, the 1501 program aims to support project-based research-technology development and innovation activities of Small and Medium-Sized Enterprises (SMEs). However, there is no specific call program for CCUS. On the other hand, as part of the Clean Energy Partnership, Turkey's financial contribution is expected to be 0.5 M€.

Romania

The CCUS R&D activities are supported by UEFISCDI nationally, but also through the EEA & Norway Grants. Even though there is no specific national program for CCUS, Romanian participation in ACT and the funded projects are valuable results in this domain, that were also the arguments for continuation as partner in the Clean Energy Partnership.

Other countries

In this report only ten countries have been presented, and those are those countries having responded to a request for information from either the author and/or from the ERA-NET ACT secretariat. More updates could be included at a later stage.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 842214

CONTACT DETAILS

Carbon Capture & Storage Association
Rue de la Science 14b
B-1040 Brussels
Belgium

CO₂ Value Europe AISBL
Avenue de Tervueren 188A
B-1150 Brussels
Belgium

Summing up

1. There are several opportunities for joint programming of R&I funding for CCUS in Europe today. The most important ones are the Horizon Europe and ERA-NET ACT, the latter is planned to be followed by the upcoming Clean Energy Technology Partnership (CETP).
2. ERA-NET ACT has shown to be extremely successful – both in delivering high impact project results, but also in the collaborative methodologies necessary for such a complex funding programme. New partnerships and similar collaborations should aim to learn from that collective effort.
3. Four European countries (Norway, UK, Germany and Netherlands) have so far contributed to more than 60 % of the ERA-NET ACT national funding contributions from 2016-2021. 16 partners (13 European) have been involved so far. 18 European countries have so far shown interest in the CCUS-part of the CETP.
4. Regional cooperation on joint R&I programming could become more important following the crisis in Ukraine. This includes potential joint programming for R&I for specific items, such as CCUS and blue hydrogen.
5. EERA Joint Program on CCS is a key actor in the SET Plan for CCUS (action 9), representing the main alliance of CCS R&I institutes and universities doing CCUS R&I. EERA JP CCS, together with the industry platform ETIP ZEP, are important in contributing to pointing towards European CCUS R&I needs and gaps.
6. In the revamped SET-Plan funding should be secured for core actors like the ETIPs and EERA JPs in order to strengthen the European Research Area for energy in general – including CCUS.



CONTACT DETAILS