ECCSELERATE Deliverable D4.1
How CCUS and ECCSEL ERIC are embedded in national strategies, roadmaps and funding programmes, both at EU country level and within in-country regions

Dissemination level: Public

RIA Research and Innovation Action project
Grant Agreement (GA) No. 871143
Main author: Isabelle Czernichowski-Lauriol
Lead participant: BRGM
Actual delivery date: 29th January 2021
**Type of funding scheme**

**RIA Research and Innovation Action: Development and long-term sustainability of new pan-European research infrastructures**

**Work programme topics addressed**

**INFRADEV-03-2018-2020 - Individual support to ESFRI and other world-class research infrastructures**

Start date of project: 01 January 2020  
Duration: 3 years

<table>
<thead>
<tr>
<th>Deliverable number</th>
<th>Deliverable name</th>
</tr>
</thead>
<tbody>
<tr>
<td>D4.1</td>
<td>How CCUS and ECCSEL ERIC are embedded in national strategies, roadmaps and funding programmes, both at EU country level and within in-country regions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work package</th>
<th>Lead participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP4</td>
<td>BRGM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dissemination Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU Public</td>
</tr>
<tr>
<td>PP Restricted to other programme participants (including the Commission Services)</td>
</tr>
<tr>
<td>RE Restricted to a group specified by the consortium (including the Commission Services)</td>
</tr>
<tr>
<td>CO Confidential, only for members of the consortium (including the Commission Services)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Organisation</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isabelle Czernichowski-Lauriol</td>
<td>BRGM, France</td>
<td><a href="mailto:i.czernichowski@brgm.fr">i.czernichowski@brgm.fr</a></td>
</tr>
<tr>
<td>Valentina Volpi</td>
<td>OGS, Italy</td>
<td><a href="mailto:vvolpi@inogs.it">vvolpi@inogs.it</a></td>
</tr>
<tr>
<td>Michela Vellico</td>
<td>OGS, Italy</td>
<td><a href="mailto:mvellico@inogs.it">mvellico@inogs.it</a></td>
</tr>
<tr>
<td>Jan Hopman</td>
<td>TNO, the Netherlands</td>
<td><a href="mailto:Jan.hopman@tno.nl">Jan.hopman@tno.nl</a></td>
</tr>
<tr>
<td>Peter van Os</td>
<td>TNO, the Netherlands</td>
<td><a href="mailto:peter.vanos@tno.nl">peter.vanos@tno.nl</a></td>
</tr>
<tr>
<td>Hanna Knuutila</td>
<td>NTNU, Norway</td>
<td><a href="mailto:Hanna.knuutila@ntnu.no">Hanna.knuutila@ntnu.no</a></td>
</tr>
<tr>
<td>Audrey Ougier-Simonin</td>
<td>BGS, United Kingdom</td>
<td><a href="mailto:audreyo@bgs.ac.uk">audreyo@bgs.ac.uk</a></td>
</tr>
<tr>
<td>Rebecca Bell</td>
<td>UoE-SCCS, United Kingdom</td>
<td><a href="mailto:rebecca.bell@sccs.org.uk">rebecca.bell@sccs.org.uk</a></td>
</tr>
<tr>
<td>Sina Blix Prestmo</td>
<td>ECCSEL ERIC, Norway</td>
<td><a href="mailto:sina.prestmo@ntnu.no">sina.prestmo@ntnu.no</a></td>
</tr>
<tr>
<td>Sverre Quale</td>
<td>ECCSEL ERIC, Norway</td>
<td><a href="mailto:sverre.quale@ntnu.no">sverre.quale@ntnu.no</a></td>
</tr>
</tbody>
</table>

**Abstract**

ECCSEL is the European Research Infrastructure on CO₂ Capture, Use and Storage (CCUS), a key climate change mitigation technology. It is recognised by the European SET Plan Implementation Working Group.
n°9 on CCS and CCU as ‘a world-class research infrastructure facilitating ambitious R&D activities, European industrial initiatives, and education of specialists for the new CCUS industry.’

ECCSEL has the legal status of ERIC since 2017, with 5 founding members: Norway (statutory seat), France, Italy, the Netherlands, UK. The Horizon 2020 ECCSELERATE project (2020-2022) is currently supporting the operational phase of ECCSEL ERIC to ensure its long-term sustainability.

Since ECCSEL ERIC is a pan-European distributed research infrastructure, its long-term sustainability is dependent on the evolution of national and in-country regional policies on CCUS. For enabling ECCSEL ERIC to develop as a key research and innovation tool for CCUS technology development in European countries, it is important that CCUS is included in national and regional strategies, roadmaps and funding programmes, whether they are related to research infrastructures, research and innovation, energy transition or climate change mitigation. This will facilitate:

- Long-term commitment of the ECCSEL ERIC founding country members and the involvement of new country members;
- Access to national and regional funds for building new ECCSEL research facilities and for performing research and innovation projects using existing ECCSEL facilities and services;
- Development of a wider offer of ECCSEL facilities and services to users for various technology readiness levels (TRLs);
- A more balanced development of the European Research Area.

Therefore, this report (ECCSELERATE Deliverable 4.1) gives an inventory and synthesis of the current CCUS situation in the founding member countries and in countries targeted for joining ECCSEL. This will be useful on one hand to guide the future actions of ECCSEL and its members, and on the other hand to inform national and in-country regional stakeholders about the relevance of CCUS for enabling carbon neutrality and the possible ways to accelerate research, demonstration and deployment, notably with the help of ECCSEL. The report will be updated in the last year of the project (ECCSELERATE Deliverable 4.2) in order to highlight the evolution through time.

<table>
<thead>
<tr>
<th>History of document</th>
</tr>
</thead>
<tbody>
<tr>
<td>First draft completed</td>
</tr>
<tr>
<td>• Template sent by Isabelle Czernichowski-Lauriol on 30th October 2020 to WP4 partners for input by 27th November 2020</td>
</tr>
<tr>
<td>• First draft compiled on 7th December 2020</td>
</tr>
<tr>
<td>• First review by WP4 partners by 16th December 2020</td>
</tr>
<tr>
<td>• Second draft compiled on 5th January 2021</td>
</tr>
<tr>
<td>• Second review by WP4 partners by 12th January 2021</td>
</tr>
<tr>
<td>• Third draft compiled on 14th January 2021</td>
</tr>
<tr>
<td>• Review by ECCSELERATE and ECCSEL ERIC GA members and national nodes, by 25th January 2021</td>
</tr>
<tr>
<td>Sent to PMG for approval</td>
</tr>
<tr>
<td>• Final draft sent to PMG for approval by 26th January 2021</td>
</tr>
<tr>
<td>• Deadline for PMG approval: 31st January 2021</td>
</tr>
<tr>
<td>Document completed</td>
</tr>
<tr>
<td>• Uploaded to Grant Management Services in the Participant Portal on 29th January 2021 by Volker Röhling</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  INTRODUCTION</td>
<td></td>
</tr>
<tr>
<td>1.1 The European Green Deal, Horizon Europe and CCUS</td>
<td>5</td>
</tr>
<tr>
<td>1.2 ECCSEL ERIC, the European CCUS Research Infrastructure</td>
<td>6</td>
</tr>
<tr>
<td>2  NATIONAL POLICIES ON CCUS</td>
<td>8</td>
</tr>
<tr>
<td>2.1 France</td>
<td></td>
</tr>
<tr>
<td>2.1.1 National strategies related to climate change mitigation, carbon</td>
<td>8</td>
</tr>
<tr>
<td>2.1.2 National CCUS roadmaps and initiatives</td>
<td>8</td>
</tr>
<tr>
<td>2.1.3 National funding streams suitable for CCUS research, demonstration and deployment</td>
<td>9</td>
</tr>
<tr>
<td>2.2 Italy</td>
<td></td>
</tr>
<tr>
<td>2.2.1 National strategies related to climate change mitigation, carbon</td>
<td>12</td>
</tr>
<tr>
<td>2.2.2 National CCUS roadmaps and initiatives</td>
<td>12</td>
</tr>
<tr>
<td>2.2.3 National funding streams suitable for CCUS research, demonstration and deployment</td>
<td>13</td>
</tr>
<tr>
<td>2.3 Netherlands</td>
<td></td>
</tr>
<tr>
<td>2.3.1 National strategies related to climate change mitigation, carbon</td>
<td>14</td>
</tr>
<tr>
<td>2.3.2 National CCUS roadmaps and initiatives</td>
<td>14</td>
</tr>
<tr>
<td>2.3.3 National funding streams suitable for CCUS research, demonstration and deployment</td>
<td>16</td>
</tr>
<tr>
<td>2.4 Norway</td>
<td></td>
</tr>
<tr>
<td>2.4.1 National strategies related to climate change mitigation, carbon</td>
<td>17</td>
</tr>
<tr>
<td>2.4.2 National CCUS roadmaps and initiatives</td>
<td>17</td>
</tr>
<tr>
<td>2.4.3 National funding streams suitable for CCUS research, demonstration and deployment</td>
<td>18</td>
</tr>
<tr>
<td>2.5 United Kingdom</td>
<td></td>
</tr>
<tr>
<td>2.5.1 National strategies related to climate change mitigation, carbon</td>
<td>20</td>
</tr>
<tr>
<td>2.5.2 National CCUS roadmaps and initiatives</td>
<td>20</td>
</tr>
<tr>
<td>2.5.3 National funding streams suitable for CCUS research, demonstration and deployment</td>
<td>21</td>
</tr>
<tr>
<td>2.6 Other countries approached to join ECCSEL ERIC</td>
<td></td>
</tr>
<tr>
<td>2.6.1 Introduction</td>
<td>27</td>
</tr>
<tr>
<td>2.6.2 Germany</td>
<td>27</td>
</tr>
<tr>
<td>2.6.3 Poland</td>
<td>27</td>
</tr>
<tr>
<td>2.6.4 Switzerland</td>
<td>28</td>
</tr>
<tr>
<td>2.6.5 Spain</td>
<td>28</td>
</tr>
<tr>
<td>2.6.6 Greece</td>
<td>29</td>
</tr>
<tr>
<td>2.6.7 Other Countries</td>
<td>30</td>
</tr>
</tbody>
</table>
2.7 Comparison of national situations ................................................................. 30
3 REGIONAL, IN-COUNTRY, POLICIES ON CCUS ........................................... 32
  3.1 France .............................................................................................................. 33
     3.1.1 Regional strategies related to climate change mitigation, carbon neutrality, energy and ecological transition ............................................. 33
     3.1.2 Regional CCUS initiatives ................................................................. 34
     3.1.3 Regional funding streams suitable for CCUS research, demonstration and deployment ................................................................. 36
  3.2 Italy ................................................................................................................. 37
     3.2.1 Regional strategies related to climate change mitigation, carbon neutrality, energy and ecological transition ............................................. 37
     3.2.2 Regional CCUS initiatives ................................................................. 37
     3.2.3 Regional funding streams suitable for CCUS research, demonstration and deployment ................................................................. 38
  3.3 Netherlands .................................................................................................. 38
     3.3.1 Regional strategies related to climate change mitigation, carbon neutrality, energy and ecological transition ............................................. 38
     3.3.2 Regional CCUS initiatives ................................................................. 38
     3.3.3 Regional funding streams suitable for CCUS research, demonstration and deployment ................................................................. 39
  3.4 Norway ......................................................................................................... 39
     3.4.1 Regional strategies related to climate change mitigation, carbon neutrality, energy and ecological transition ............................................. 39
     3.4.2 Regional CCUS initiatives ................................................................. 40
     3.4.3 Regional funding streams suitable for CCUS research, demonstration and deployment ................................................................. 41
  3.5 United Kingdom ............................................................................................ 41
     3.5.1 Regional strategies related to climate change mitigation, carbon neutrality, energy and ecological transition ............................................. 41
     3.5.2 Regional CCUS initiatives ................................................................. 43
     3.5.3 Regional funding streams suitable for CCUS research, demonstration and deployment ................................................................. 44
  3.6 Comparison of regional situations ............................................................... 44
4 CONCLUSION AND THE WAY FORWARD FOR ECCSEL ERIC .................................. 46
1 INTRODUCTION

1.1 The European Green Deal, Horizon Europe and CCUS

The European Green Deal presented by the European Commission in December 2019 is a response to the urgency in the climate and environmental-related challenges. Through this new European growth strategy, the EU aims to transform Europe into a continent where there are no net emissions of greenhouse gases in 2050, where economic growth is decoupled from resource use, and where no one is left behind. The full realisation of the European Green Deal will require the contribution of all EU actions and policies.

For Europe to deliver on the European Green Deal, there is a need to rethink policies for clean energy supply across the economy, industry, production and consumption. New strategies in areas like industry, energy system integration, hydrogen and biodiversity will support the European Green Deal. With the introduction of the first European ‘Climate Law’ (March 2020), all Member States will see the 2050 climate neutrality objective in legislation.

Achieving a climate neutral and circular economy across Europe requires the full mobilisation of industry. Building on this, to be ready in 2050, decisions and actions on CO₂ Capture, Storage and Use (CCUS) and other low-carbon technologies need to be taken in the next five years. Within priority areas like CCUS, energy storage and clean hydrogen, European industry needs forerunners to develop the first commercial applications of breakthrough technologies in key industrial sectors by 2030. Moreover, to achieve the European Green Deal goals, significant investment needs are necessary, and the mobilisation of both the public and private sector is required.

Horizon Europe (2021-2027), an ambitious research and innovation programme to succeed Horizon 2020 (2014-2020), will be essential for Europe to maintain its competitive advantage in clean energy technologies. The EU needs to increase significantly demonstration of new technologies, building new innovative value chains. In Horizon Europe, at least 35% of the budget will fund research and innovation on new solutions that are relevant for implementing the European Green Deal. It will also play a pivotal role in leveraging national public and private investments.

The Clean Energy Transition Partnership (CETP) is set out in the context of the ‘Energy, Climate and Mobility’ Cluster of Horizon Europe, within Pillar 2 ‘Global challenges and European Industrial Competitiveness’. One of the eight challenges in the CETP is to enable climate neutrality with storage technologies, renewable fuels, CO₂ Capture and Use (CCU) and CO₂ Capture and Storage (CCS). The CETP is a multilateral and strategic partnership of national and regional RDI programmes in European

---

1 Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. The European Green Deal COM(2019) 640 final

www.eccsel.org | Page 5
Member States and Associated Countries with the aim to contribute substantially to the implementation of the European Strategic Energy Technology Plan (SET Plan). The CETP is interlinked with the European Green Deal and is exploring how it can contribute to the implementation of the European Recovery plan set up in response to the Covid-19 pandemic crisis.

1.2 ECCSEL ERIC, the European CCUS Research Infrastructure

ECCSEL is recognised by the SET Plan Implementation Working Group n°9 on CCS and CCU as ‘a world-class research infrastructure facilitating ambitious R&D activities, European industrial initiatives, and education of specialists for the new CCUS industry.’

ECCSEL is a legal entity, with ERIC statutes (European Research Infrastructure Consortium), and a seat and Operations Centre in Norway. ECCSEL’s founding members are Norway, the Netherlands, Italy, France, and the UK. Each member country is represented by a National Node. ECCSEL is currently made up of more than 75 leading facilities on CO2 capture, transport, storage and use, provided by over 20 European institutions from the member countries. For the complete catalogue of facilities, please visit: www.eccsel.org. The ECCSEL facilities are currently available and open for access by researchers and the industrial community across the globe.

The setting up of the ECCSEL ERIC Research Infrastructure has been funded by the European Commission 7th Framework Programme for Research and Innovation, with two projects for ECCSEL Preparatory Phase 1 (2011-2012) and Preparatory Phase 2 (2012-2013), then by Horizon 2020 Research and Innovation funding programme to initiate the operation of ECCSEL (2015-2017). Since its creation mid-2017, ECCSEL ERIC is now funded by its member countries. The Horizon 2020 ECCSELERATE project (2020-2022) is currently supporting the operational phase of the ECCSEL ERIC to ensure its long-term sustainability.

---

2 Clean Energy Transition Partnership Strategic Research and Innovation Agenda v1.0 November 2020
4 https://cordis.europa.eu/project/id/262512/fr
5 https://cordis.europa.eu/project/id/312806/fr
7 https://cordis.europa.eu/project/id/871143/fr
www.eccsel.org  |  Page 6
Figure 1. The current composition of ECCSEL ERIC. The five Member Countries are highlighted in green. Facility owners are highlighted in red. A few facilities are displayed on the picture frame. The central hub, ECCSEL ERIC Operation Centre, is located in Trondheim, Norway, and is connected to the five National Nodes.

Since ECCSEL ERIC is a pan-European distributed research infrastructure, its long-term sustainability is dependent on the evolution of national and in-country regional policies on CCUS. For enabling ECCSEL ERIC to develop as a key research and innovation tool for CCUS technology development in European countries, it is important that CCUS is included in national and regional strategies, roadmaps and funding programmes, whether they are related to research infrastructures, research and innovation, energy transition or climate change mitigation. This will facilitate:

- Long-term commitment of the ECCSEL ERIC founding country members and the involvement of new country members;
– Access to national and regional funds for building new ECCSEL research facilities and for performing research and innovation projects using ECCSEL research facilities and services;
– Development of a wider offer of ECCSEL facilities and services to users for various technology readiness levels (TRLs);
– A more balanced development of the European Research Area.

Therefore in 2020, during the first year of the ECCSELERATE project, the partners attended a series of national events to raise awareness on CCUS and ECCSEL, to encourage the development of new research and innovation projects using ECCSEL facilities, and to influence when possible the inclusion of CCUS and ECCSEL in relevant strategies, roadmaps and funding programmes at national and in-country regional levels.

This report (ECCSELERATE Deliverable 4.1) gives an inventory and synthesis of the current situation regarding CCUS and ECCSEL in the founding member countries and in countries targeted for joining ECCSEL. This will be useful on one hand to guide the future actions of ECCSEL and its members, and on the other hand to inform national and in-country regional stakeholders about the relevance of CCUS for enabling carbon neutrality and the possible ways to accelerate research, demonstration and deployment, notably with the help of ECCSEL. The report will be updated in the last year of the project (ECCSELERATE Deliverable 4.2) in order to highlight the evolution through time.

2 NATIONAL POLICIES ON CCUS

2.1 France

2.1.1 National strategies related to climate change mitigation, carbon neutrality, energy and ecological transition

On an energy and climate policy perspective, different national documents highlight the potential strategic importance of CCS. The ‘Grenelle Law’ (2009) quoted CCS among the emission reduction options to be developed. In 2010, the Ministry of Ecology identified CCUS as a strategic industrial sector of the green economy, aiming at both French and global markets\(^8\). The Energies 2050 report issued in 2012 confirmed the strategic potential of CCS and advocated more research efforts and the introduction of incentives\(^9\). In 2015, with the law on energy transition for green growth (Loi relative à la Transition Énergétique pour la Croissance Verte - LTECV), the French Government released the National Low-Carbon Strategy (Stratégie Nationale Bas-Carbone - SNBC) to steer policy to meet the commitment to reduce national GHG emissions by 75% by 2050 compared to 1990 (Factor 4). The need to develop and deploy CCS was mentioned. End 2016, CCS was included among the new energy

\(^8\) [https://www.vie-publique.fr/sites/default/files/rapport/pdf/104000176.pdf](https://www.vie-publique.fr/sites/default/files/rapport/pdf/104000176.pdf)

\(^9\) [http://archives.strategie.gouv.fr/cas/content/rapport-energies-2050.html](http://archives.strategie.gouv.fr/cas/content/rapport-energies-2050.html)
technologies considered in the Energy Multiannual Programming (PPE)\textsuperscript{10} and the National Strategy for Energy Research (\textit{Stratégie Nationale de Recherche Energétique} - \textit{SNRE})\textsuperscript{11}.

In December 2018, in the face of the urgency to act on climate change and to be consistent with the commitments made in 2015 in the framework of the Paris Agreement, the Ministry for an Ecological Transition published the draft of the revised National Low Carbon Strategy (SNBC2) that sets out the path to carbon neutrality in 2050, a more ambitious target compared to the initial Factor 4. The revised strategy, which was adopted in April 2020, outlines ways to compensate for irreducible anthropogenic emissions of greenhouse gases with carbon sinks including natural sinks (forest, soils) and anthropogenic sinks such as CCUS, which is anticipated to reduce 15 MtCO\textsubscript{2}/year by 2050\textsuperscript{12}.

The energy and climate law (\textit{Loi Energie-Climat}\textsuperscript{13}) adopted in November 2019 enshrines the ecological and climatic urgency and the objective of a carbon neutrality in 2050: yesterday, France committed itself to dividing its greenhouse gas emissions by 4 (Factor 4) by 2050, today France commits to achieving net zero emissions by 2050; in other words, not to emit more greenhouse gases than can be absorbed. France is among the first countries in the world to enshrine carbon neutrality in law, and it will now be the compass of all national policies.

At European level, France’s 10-year integrated national energy and climate plan (NECP) for the period from 2021 to 2030 was submitted to the European Commission in March 2020\textsuperscript{14}. It is consistent with the national documents mentioned above and does mention CCS and CCU. Each EU Member State needs to submit a NECP to outline how it intends to address energy efficiency, renewables, greenhouse gas emissions reductions, interconnections, research and innovation, in order to enable the EU to meet its energy and climate targets for 2030.

2.1.2 National CCUS roadmaps and initiatives
A national CCS roadmap, with a vision to 2020, was established in 2008, under the leadership of the Environment and Energy Management Agency (ADEME), to emphasise research priorities and the needs for enabling the deployment of the technology. It was revised in 2011\textsuperscript{15}, with a 2050 perspective and including CO\textsubscript{2} use.

\textsuperscript{10} \url{https://www.ecologie.gouv.fr/sites/default/files/PPE\%20int\%C3\%A9gralit\%C3\%A9.pdf}
\textsuperscript{11} \url{https://www.ecologie.gouv.fr/sites/default/files/SNRE\%20vf\%20d\%C3\%A9\%20c\%202016.pdf}
\textsuperscript{12} \url{https://www.ecologie.gouv.fr/strategie-nationale-bas-carbone-snbc}
\textsuperscript{13} \url{https://www.ecologie.gouv.fr/loi-energie-climat}
\textsuperscript{14} \url{https://ec.europa.eu/energy/sites/default/files/documents/fr_final_necp_main_en.pdf}
\textsuperscript{15} \url{https://www.ademe.fr/sites/default/files/assets/documents/feuille-route-transport-stockage-geologique-co2-2011-7318.pdf}
CCUS entered the national roadmap for research infrastructures in 2016 through ECCSEL-FR, the French node of ECCSEL, with a status “in project”. ECCSEL-FR was given the status of “Research Infrastructure” (i.e. equivalent to landmark in ESFRI European nomenclature) in the 2018 edition of this roadmap\(^\text{16}\).

The SNBC2\(^\text{17}\) published in 2020 indicates that, by 2050, France expects to reach a level of emissions of around 80 Mt CO\(_2\)eq considered as incompressible, in particular in non-energy sectors (agriculture and industry), and anticipates that in 2050, CCS would need to avoid about 6 MtCO\(_2\)/year in industry and produce about 10 MtCO\(_2\)/year of negative emissions from biomass energy production plants (BECCS). It recommends to initiate today the development and adoption of disruptive technologies to reduce and if possible eliminate residual emissions, such as supporting the development of pilot and possibly commercial units in carbon capture and storage (CCS) and carbon capture and use (CCU) with the use of CO\(_2\) as a raw material for the manufacture of fuels or chemicals.

ADEME published in July 2020\(^\text{18}\) an advice on the potential of CCS for France, stressing that it is compatible with the objectives for CCS laid down in the SNBC2. According to ADEME, CCS is only applicable in France to a limited number of industrial sites in three specific areas of the territory (around Dunkerque, Le Havre and Lacq), due to technical, geological, economic, regulatory and social constraints.

However, plans for CCUS cluster development in France are presently being prepared as part of the H2020 STRATEGY CCUS project (2019-2022)\(^\text{19}\), coordinated by BRGM. STRATEGY CCUS aims at supporting the development of low-carbon energy and industry in Southern and Eastern Europe. The project is focusing on eight regions considered promising for CCUS. Two of them are in France: 1) the Paris basin, from Paris to Orléans, 2) the Rhône valley, from Fos-Berre-Marseille to Lyon metropole. The aim is to encourage and support initiatives within each region by producing local development plans and business models tailored to industry’s needs.

The Club CO\(_2\)\(^\text{20}\), the French CCUS team created in 2002, is carrying out many initiatives to stimulate the exchange of information between industry, research organizations and public authorities, and to steer new developments. It counts 28 member organisations in 2020. For 2021, the Club CO\(_2\) is preparing its CCUS roadmap and will organise, jointly with the French node of ECCSEL, a national CCUS seminar and a CCUS “tour of the regions”.

\(^{16}\) [https://cache.media.enseignementsup-recherche.gouv.fr/file/Infrastructures_de_recherche/04/6/Brochure_Infrastructures_2018_UK_1023046.pdf](https://cache.media.enseignementsup-recherche.gouv.fr/file/Infrastructures_de_recherche/04/6/Brochure_Infrastructures_2018_UK_1023046.pdf)

\(^{17}\) [https://www.ecologique-solidaire.gouv.fr/strategie-nationale-bas-carbone-snbc](https://www.ecologique-solidaire.gouv.fr/strategie-nationale-bas-carbone-snbc)


\(^{19}\) [https://www.strategyccus.eu/](https://www.strategyccus.eu/)

\(^{20}\) [https://www.club-co2.fr/fr](https://www.club-co2.fr/fr)
France is member of several European and international initiatives on CCUS, such as the IEA Greenhouse Gas R&D Programme (IEAGHG) created in 1991, the Carbon Sequestration Leadership Forum (CSLF) created in 2003, the ISO CCS Technical Committee (ISO/TC 265) created in 2011, the Mission Innovation Challenge 3 on CCUS created in 2015, and SET Plan Action 9 on CCS and CCU initiated in 2016.

2.1.3 National funding streams suitable for CCUS research, demonstration and deployment

In France, two national agencies fund CCS and CCU projects:

- Agence Nationale de la Recherche - ANR (National Agency for Research)\(^{21}\)
- Agence de l’Environnement et de la Maitrise de l’Energie - ADEME (Environment and Energy Management Agency)\(^{22}\)

ANR is the main agency, providing funding for low TRL research in all scientific fields including CCUS. ADEME focuses on energy and environmental topics, has a more restricted budget for low TRL research projects, but can provide significant funding for higher TRL projects, such as CCUS pilot and demonstration projects.

National research projects only started from 2003 through CCUS dedicated calls for projects by the Environment and Energy Management Agency (ADEME), followed by the National Research Agency (ANR) when created in 2005.

Today there is no national funding targeted on CCUS, as national calls by both ADEME and ANR are now of a more generic nature. However, France has joined in 2018 the European ERA-NET Cofund ACT\(^{23}\) initiative launched in 2016 to encourage transnational funding by Member States of CCUS research and innovation projects, ACT meaning “Accelerating CCS Technologies”. In the 2018 call, France committed 0.5 M€ of national funding through ADEME. In the 2020 call, France is providing 2.0 M€ of national funding through both ADEME and ANR. Each national funding body is providing funding for national entities only.

\(^{21}\) https://anr.fr/

\(^{22}\) https://www.ademe.fr/

\(^{23}\) http://www.act-ccs.eu/
2.2 Italy

2.2.1 National strategies related to climate change mitigation, carbon neutrality, energy and ecological transition

Italy’s final integrated national energy and climate plan (‘NECP’)\(^{24}\) submitted in December 2019 sets a 2030 reduction target for greenhouse gas (‘GHG’) emissions not covered by the EU emissions trading system (‘non-ETS’) at -33%, as compared to emissions in 2005. Italy aims to exceed this target, with planned measures expected to reduce Italian GHG emissions in the Effort Sharing Regulation (ESR) sectors by 35% in 2030 compared to 2005.

For energy efficiency, the Italian contribution to the collective 2030 EU target amounts to 125.1 Mtoe for primary energy and 103.8 Mtoe for final energy consumption.

In terms of secure energy, it consists of the security of gas supply from third countries and the security of the electricity system; the two systems are and will be even more strongly interdependent, since electricity production is essentially ensured by renewable sources and gas, with a minority role played by coal. Furthermore, the Government intends to abandon coal for electricity production by 2025. The security of energy supply will be guaranteed by a diversification of LNG supply routes and above all by the reduction of energy imports thanks to a sustained development of generation from renewable sources and the increase in energy efficiency.

In terms of national objectives and funding targets for research, innovation (R&I) and competitiveness, the final NECP confirms the objective to double the public funds for research into clean energy, from around EUR 222 million in 2013 to the approximately EUR 444 million from 2021. The overall R&I target is a 1.53% of GDP by 2020.

There is no specific mention to CCUS in the priorities, as described in the figure below, where the main targets of Italy are represented.

### National CCUS Roadmaps and Initiatives

The Italian National Roadmap on Research Infrastructures strongly supports ECCSEL ERIC, which in the 2014-2020 document was inserted in a priority list of 18 RIs, particularly relevant for the national research sector. A new prioritization list is about to be compiled for 2021-2027, after a consultation that took place in summer 2020.

At international level, Italy is member of the Carbon Sequestration Leadership Forum (CSLF), the Mission Innovation Challenge 3 on CCUS, and the ISO CCS Technical Committee (ISO/TC 265), and SET Plan Action 9 on CCS and CCU.

### National Funding Streams Suitable for CCUS Research, Demonstration and Deployment

National Ministry of Research financed the IPANEMA project, through the PON - National Operational Program for Research and Innovation 2014-2020, granting for a total amount of € 8,786,920.18, the implementation of ECCSEL NatLab-Italy laboratory in Panarea.

Other PON funds (1,602,497,00 €) have been recently assigned by the Italian Ministry of Research to the project IPANEMA HR; funds will be dedicated to empower the human capital in some ECCSEL facilities and in the Italian National Node.
In 2020 for the first time, Italy joined the European ERA-NET Cofund ACT initiative (Accelerating CCS Technology) launched in 2016 and supported with €600,000 ACT the 2020 call for CCUS research and innovation projects.

2.3 Netherlands

2.3.1 National strategies related to climate change mitigation, carbon neutrality, energy and ecological transition

The national strategy of the Netherlands is defined in the Dutch Climate Agreement of 2019.06.28. Main goal of the Dutch Climate Agreement is to reduce the emission of greenhouse gases by 49% (compared to 1990) in 2030, mainly by reducing CO₂ emissions.

CCS is part of the Dutch Climate Agreement and is expected to reduce CO₂ emissions in industry by 14.3 Mt by 2030.

The Climate Agreement envisages a subsidy scheme for implementing CCUS in the Netherlands, the SDE++ scheme (see 2.3.3).

2.3.2 National CCUS roadmaps and initiatives

There is not one national CCUS roadmap, but a commonly developed roadmap is the CCS Roadmap of 2018.03.05.

The roadmap shows three phases (see also figure 3):

1. Definition phase
2. Realisation phase
3. Deployment phase

During these phases, the following milestones need to be achieved:

- Generic Instruments for Industry: A long-term, stable incentive has to be created, to stimulate CCS for the industry. Preferably this incentive will also stimulate other decarbonisation techniques.
- Specific Instruments for First Projects: A specific incentive should be created to stimulate the First CCS Projects (e.g. Porthos & Athos), which will be large scale projects.

---


27 [www.rijksoverheid.nl/documenten/publicaties/2018/03/05/routekaart-ccs](www.rijksoverheid.nl/documenten/publicaties/2018/03/05/routekaart-ccs), in Dutch
- Optimize the Legal Framework: The Legal Framework needs to be optimised, to allow for the First CCS Projects and future CCS Projects.
- Realise a Public-Private R&D program: Because full scale CCS is new in the Netherlands, R&D will be necessary to answer the R&D questions which will arise during the First Projects and to reduce the cost for Future Projects.
- Realise a CCS Communication program: Public perception is important for CCS.

At international level, the Netherlands is member of several initiatives on CCUS, such as the IEA Greenhouse Gas R&D Programme (IEAGHG) created in 1991, the Carbon Sequestration Leadership Forum (CSLF) created in 2003, the ISO CCS Technical Committee (ISO/TC 265) created in 2011, the Mission Innovation Challenge 3 on CCUS created in 2015, and SET Plan Action 9 on CCS and CCU initiated in 2016.
2.3.3 National funding streams suitable for CCUS research, demonstration and deployment

The Dutch national funding streams for CCUS research, demonstration and deployment can be found at the website of RVO\textsuperscript{28}, the Netherlands Enterprise Agency, in Dutch.


d| Funding scheme | Website |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Energie en industrie: Joint Industry Projects (Energy and Industry: Joint Industry Projects)</td>
<td><a href="http://www.rvo.nl/subsidie-en-financieringswijzer/joint-industry-project-jip">www.rvo.nl/subsidie-en-financieringswijzer/joint-industry-project-jip</a></td>
</tr>
<tr>
<td>SDE++ Stimulering duurzame energieproductie en klimaattransitie (Stimulation of renewable energy production and climate transition)</td>
<td><a href="http://www.rvo.nl/sde">www.rvo.nl/sde</a></td>
</tr>
</tbody>
</table>

Table 1. Overview of Dutch national funding streams for CCUS.

The SDE++ scheme builds on the existing SDE+ scheme, which is the Dutch Feed-in-Premium scheme. The existing SDE+ scheme supported renewable energy production, both power and heat. The new SDE++ scheme has been published in 2020. It subsidises companies that want to operate a capture facility and supply the CO\textsubscript{2} to a CO\textsubscript{2} transport and storage operator, such as Porthos. True to the agreements in the climate agreement, the subsidy is limited by a cap (max 7 Mton subsidized), a sieve (no alternative cost-effective technologies available for the project) and in time (subsidies can be granted until 2035). This addresses the concern that CCS would get in the way of other demonstrably cost-effective alternative transitional technologies. At the time of writing, the Ministry\textsuperscript{29} has publicised information that shows that SDE++ proposals to capture 2,5 Mton/year have been filed last autumn. RVO is analysing the applications. The envisaged subsidy would be around 2.100 million euros for an operational period of 15 years. The actually paid subsidies will also depend on the CO\textsubscript{2} prices in ETS, the European Emissions Trading System.

\footnote{28 www.rvo.nl/onderwerpen/duurzaam-ondernemen/energie-en-milieu-innovaties/carbon-capture-utilisation-and-storage}

\footnote{29 https://www.tweedekamer.nl/kamerstukken/brieven_regering/detail?id=2021Z00582&did=2021D01587}

www.eccsel.org | Page 16
The Netherlands has been part of the European ERA-NET Cofund ACT\(^\text{30}\) initiative (Accelerating CCS Technologies) since its inception in 2016 to encourage transnational funding by Member States of CCUS research and innovation projects.

### 2.4 Norway

#### 2.4.1 National strategies related to climate change mitigation, carbon neutrality, energy and ecological transition

Norway’s climate target is to reduce at least 40% of greenhouse gas emissions by 2030 compared to 1990 levels. This goal has been submitted in 2015 as the Norwegian Intended Nationally Determined Contribution (INDC) to the UN Framework Convention on Climate Change\(^\text{31}\), and is consistent with the collective INDC for the 28 EU member states. The climate target of at least 40% reduction in 2030 is established by law in the Norwegian Climate Change Act.

The draft resolution Prop. 1 S (2014–2015)\(^\text{32}\) outlines the Norwegian government’s plan for implementation of CCS in Norway. In April 2016, the government sent to the ‘Stortinget’ (Norwegian parliament) a comprehensive white paper\(^\text{33}\) about energy policy towards 2030, supporting a strong commitment to CCS in Norway.

The main instruments of Norwegian climate policy are taxes and participation in the EU Emissions Trading Scheme (EU ETS) as well as supporting technology development and utilisation. Both taxes and EU ETS are cross-sectoral economic instruments. More than 80% of Norway’s emissions are either in the ETS sector or subject to the national carbon tax\(^\text{34}\) introduced in 1991. Considerable funding for the industry is available to reduce greenhouse gas emissions, for example, through Enova’s Green Fund for Climate, Renewable Energy and Energy Efficiency Measures.\(^\text{35}\) In addition considerable

---

\(^{30}\) http://www.act-ccs.eu/


\(^{32}\) [https://www.regjeringen.no/no/dokumenter/Prop-1-S-20142015/id2005418/?q=&ch=3#KAP4](https://www.regjeringen.no/no/dokumenter/Prop-1-S-20142015/id2005418/?q=&ch=3#KAP4)

\(^{33}\) Meld. St. 25 (2015–2016) Kraft til endring — Energipolitikken mot 2030 (in Norwegian)


\(^{35}\) [http://www.enova.no/about-enova/about-enova/259/0/](http://www.enova.no/about-enova/about-enova/259/0/)
funding is available from the Research Council of Norway to support research and development at universities, research organizations as well as industry within energy, transport and low emissions. ³⁶

In 2020 a strategic forum for the Norwegian process industry initiated by the Ministry of Trade, Industry and Fisheries published a report on low-emission process technologies and CCU³⁷. It recommended to include CCU in programs for research and piloting, demonstration and upscaling. At the same time, the report stressed that CCU technologies in the long term has to be either part of circular systems, use CO₂ from biomass or direct air capture, or lead to the permanent storage of the CO₂.

2.4.2 National CCUS roadmaps and initiatives

Norway has extensive experience related to storage of CO₂ in geological structures. Since 1996, approximately 1 Mt of CO₂ has been separated from natural gas production annually at the Sleipner Vest Field in the North Sea for storage in the Utsira formation. Carbon dioxide is also being separated for natural gas at Snøhvit and Gudrun and stored in nearby aquifers. With this experience, the Ministry of Petroleum and Energy decided to identify safe and effective areas for long-term storage of CO₂. The result was the CO₂ Storage Atlas of the Norwegian Continental Shelf.³⁸

In January 2016, the Ministry of Petroleum and Energy signed an agreement with Equinor for a feasibility study regarding CO₂ storage on the Norwegian Continental Shelf (NCS). The study included various development concepts for storing CO₂ at three different locations on the NCS: Smeaheia, Heimdal and Utsira. The study covered different development solutions.³⁹

In September 2020, in a Government White Paper to the Norwegian parliament (Storting), the government proposed to launch a carbon capture and storage (CCS) project in Norway. The project has been named ‘Longship’.⁴⁰ In the proposal, carbon capture at Norcem’s cement factory in Brevik, close to Oslo, would be implemented. Also, governmental co-funding of a capture plant at Fortum Oslo Varme’s waste incineration facility is planned. Longship comprises funding for the transport and storage project Northern Lights⁴¹, which is a joint project between Equinor, Shell, and Total. The first phase of Northern lights will be designed with a capacity to transport, inject, and store up to 1.5 MtCO₂/year. In a second phase, the capacity will be increased by additional 3.5 MtCO₂/year. Both

³⁶ Energy, transport and low emissions - portfolio (forskningsradet.no)
³⁷ "Ny prosessteknologi med redusert karbonavtrykk inkl. CCU", https://www.prosess21.no/
³⁸ http://www.npd.no/en/Publications/Reports/Compiled-CO2-atlas/
⁴⁰ Full-scale CCS project in Norway - Longship | Reaching the climate goals (ccsnorway.com)
⁴¹ https://northernlightsccs.com/en
phases will have flexibility to receive European volumes of CO$_2$ from other countries. Longship was approved by the Norwegian parliament in December 2020.

At international level, Norway is member of several initiatives on CCUS, such as the IEA Greenhouse Gas R&D Programme (IEAGHG) created in 1991, the Carbon Sequestration Leadership Forum (CSLF) created in 2003, the ISO CCS Technical Committee (ISO/TC 265) created in 2011, the Mission Innovation Challenge 3 on CCUS created in 2015, and SET Plan Action 9 on CCS and CCU initiated in 2016.

2.4.3 National funding streams suitable for CCUS research, demonstration and deployment

Public funding for CCS R&D in Norway is organized through the CLIMIT programme$^{42}$, the national programme for research, development and demonstration of CO$_2$ capture and storage technology (CCS). The CLIMIT programme is a collaboration between Gassnova and the Research Council of Norway. The Research Council’s projects are often referred to as CLIMIT R&D, while Gassnova’s part is referred to as CLIMIT Demo. CLIMIT R&D supports basic research and lower TRL technology development, while CLIMIT Demo supports upscaling and initial phase of cluster development. The 2021 budget of CLIMIT R&D is around 8 M€ (90 MNOK). Funding for each year is only committed after the parliament has passed the national budget. However, it is expected that future funding could be based on the assumption that the level of public funding in Norway for CCS research will stay at approximately the same level.

In addition, funding is given to Centers for Environmentally Friendly Research Centers (FME) within CCS. There is currently one center within CCS. The Norwegian CCS Research Centre (NCCS) started in 2017 and receives 2.5 M€ of public funding yearly.

There has also been funding for the Norwegian node of the ECCSEL research infrastructure through the Norwegian Research Council’s research infrastructure initiative, ‘INFRASTRUCTURE’, with calls every second year. Three projects have been granted (2012, 2014, 2018) with total funding of approximately 25 M€.

Industry funding for CCS research in Norway is roughly estimated to 5.4 M€ annually.

$^{42}$ https://climit.no/en/about-the-climit-programme/
In general, the public organisations ENOVA\textsuperscript{43}, Innovation Norway\textsuperscript{44}, Gassnova\textsuperscript{45} and the Research Council of Norway\textsuperscript{46} are cooperating on supporting development of sustainable industry including CCS\textsuperscript{47}.

Finally, Norway is leading the European ERA-NET Cofund ACT\textsuperscript{48} initiative (Accelerating CCS Technologies) launched in 2016 to encourage transnational funding by Member States of CCUS research and innovation projects.

No national research programme is currently specifically targeting CCU research in Norway, except for CO\textsubscript{2}-EOR in the Petromaks2 programme of the Research Council of Norway.

2.5 \textbf{United Kingdom}

2.5.1 National strategies related to climate change mitigation, carbon neutrality, energy and ecological transition

The United Kingdom’s Climate Change Programme was launched in November 2000 by the British government in response to its commitment agreed at the 1992 United Nations Conference on Environment and Development (UNCED). Amongst the following actions taken by the Department of Energy and Climate Change (DECC) to implement this programme are:

- The Renewables Obligation that requires all electricity suppliers who supply electricity to end consumers to supply a set portion of their electricity from eligible renewable sources;
- The CRC Energy Efficiency Scheme in 2007, which announced a mandatory carbon emissions reduction scheme from large energy-intensive organisations in the public and private sectors in the UK.

The Climate Change Act 2008 (c 27)\textsuperscript{49} is legally binding the net UK carbon account for all six Kyoto greenhouse gases for the year 2050 to be at least 80\% lower than the 1990 baseline, toward avoiding dangerous climate change.

\textsuperscript{43} https://www.enova.no/about-enova/
\textsuperscript{44} Start page (innovasjonnorge.no)
\textsuperscript{45} Gassnova - Norwegian state enterprise for CCS industrial
\textsuperscript{46} https://www.forskningsradet.no/en/
\textsuperscript{47} Grønn plattform (forskningsradet.no)
\textsuperscript{48} http://www.act-ccs.eu/
\textsuperscript{49} https://en.wikipedia.org/wiki/Climate_Change_Act_2008
As of September 2016, UK energy policy is set by the Department for Business, Energy and Industrial Strategy (BEIS). Following recommendations from the Climate Change Committee (CCC) - an independent, statutory body established under the Climate Change Act 2008, the UK government committed in July 2019 to achieving ‘net-zero’ emissions by 2050. The Sixth Carbon Budget report from the CCC, published on 09 December 2020, further advises to reach 78% of the 80% target by 2035.

In November 2020, the UK government published a 10-point Plan for a Green Industrial Revolution. Point 8 is dedicated to investing in CCUS, with the ambition to capture 10Mt of CO$_2$ a year by 2030.

The 26th session of the Conference of the Parties (COP 26) to the UNFCCC will be held under the presidency of the UK Government in 2021, with assistance from the Scottish Government.

2.5.2 National CCUS roadmaps and initiatives
A first roadmap for CCS in the UK was published in April 2012 by the DECC. It sets more than a decade of actions at national and international levels, including five key components:

- A £1 billion Commercialisation Competition to support practical experience in the design, construction and operation of commercial-scale CCS; 2012-2016.
- A £125 million, 4-year co-ordinated research, development and innovation programme
- A reform of the UK electricity market so CCS will be able to compete with other low-carbon energy sources.
- Commitments to working with industry to address other important areas including developing the CCS supply chain, addressing regulatory barriers and assisting the development of CCS infrastructure.
- International engagement focused on sharing knowledge generated through the UK programme and learning from other projects around the world.

On 7 August 2014, the “Next Steps in CCS: Policy Scoping Document”, which summarised the policies and actions that the government has taken to become a world leader in Carbon Capture and Storage, was published. In 2017, BEIS commissioned a study assessing the most promising CO$_2$ capture technologies in order to inform future innovation spending programmes and to shape future policy direction for carbon capture technologies in the power and energy intensive industries.

The UK is also a founding member of the European Carbon Dioxide Capture and Storage Laboratory Infrastructure (ECCSEL), establishing the British node of ECCSEL in 2016 as part of the UK roadmap.

---


In November 2018, the UK government and its international partners organised ‘Accelerating CCUS: A Global Conference to Progress CCUS’ in Edinburgh, Scotland. The Global Conference was held alongside a CCUS Summit (28 November 2018) co-hosted by the UK government and the International Energy Agency, bringing together world energy leaders from government and industry to discuss concrete actions to scale up CCUS globally. The UK government has established a CCUS Cost Challenge Taskforce to provide advice on the steps needed to reduce the cost of deploying CCUS in the UK. The government established a new CCUS Council with senior representatives from across the CCUS sector to review progress and priorities on CCUS. The Council is co-chaired by the Minister of State for Energy and Clean Growth and James Smith, Chair of the Carbon Trust. The CCUS Council is the primary forum for engaging the CCUS sector on CCUS. It replaces the CCS Development Forum.

BEIS published in 2018 an action plan\(^2\) setting out how government and industry can work in partnership to achieve the government’s ambition for CCUS. This document gives details on the next steps government and industry should take in partnership in order to achieve the government’s ambition of having the option to deploy CCUS at scale during the 2030s, subject to costs coming down sufficiently (see figures 4 and 5).

**Figure 4. Diagram to summarise actions and commitments necessary in order to achieve UK’s stated ambition of having the option to deploy CCUS at scale during the 2030s. BEIS 2018.**


www.eccsel.org   |   Page 22
Figure 5. Timeline showing the five key action areas and associated actions to achieve UK’s vision of becoming a global technology leader and ambition of having the option to deploy CCUS at scale during the 2030s. BEIS 2018.

The international integration of this national ambition can also be seen in the support to drive down the cost and accelerate deployment of CCUS, including by:

- participating in Mission Innovation and its Carbon Capture Challenge and working closely with private sector led initiatives such as the Oil and Gas Climate Initiative;
- participating in IEA Greenhouse Gas R&D Programme (IEAGHG), the ISO CCS Technical Committee (ISO/TC 265), and SET Plan Action 9 on CCS and CCU;
- joint working on innovation and carbon dioxide transport and storage solutions and working multilaterally through the Carbon Sequestration Leadership Forum and the North Sea Basin Taskforce;
- developing closer collaborative working with countries such as Norway, the United States, Canada and Australia;
- continuing to be a global leader in CCUS investments through the UK’s £60 million international CCS programme which has been running since 2012, by investing a further £10 million in the programme. This will further strengthen international action on CCUS and draw on technical expertise.
Point 8 of the Plan for a Green Industrial Revolution published in November 2020 by the UK government aims to establish CCUS in two industrial clusters by mid 2020s, and aims for four of these sites by 2030, in areas such as the North East, the Humber, North West, Scotland and Wales, capturing in total up to 10 Mt of carbon dioxide per year by 2030.

This is expanded on in the Energy White Paper\textsuperscript{53} (December 2020), which includes the following commitments:

- Establish the UK as a world leader in the deployment of CCUS and clean hydrogen, supporting up to 60,000 jobs by 2030;
- Supporting the deployment of CCUS in four industrial clusters including at least one power CCUS project, to be operational by 2030 and putting in place the commercial frameworks required to help stimulate the market to deliver a future pipeline of CCUS projects;
- Increasing the ambition in the Industrial Clusters Mission four-fold, aiming to deliver four low-carbon clusters by 2030 and at least one fully net zero cluster by 2040;
- Investing £1 billion up to 2025 to facilitate the deployment of CCUS in two industrial clusters by the mid-2020s, and a further two clusters by 2030, supporting the ambition to capture 10 MtCO\textsubscript{2} per year by the end of the decade;
- Working with industry, aiming to develop 5 GW of low-carbon hydrogen production capacity by 2030;
- Help to put in place a CO\textsubscript{2} transport and storage network, as the foundation for the scaling up of CCUS across the UK;
- Net Zero Hydrogen Fund to support low-carbon hydrogen production, providing £240 million of capital co-investment out to 2024/25.

The Scottish parliament has some devolved powers over energy policy and, recognising the potential CO\textsubscript{2} storage assets to be found in Scottish waters, continues to be a strong advocate for CCS. Although the number of large CO\textsubscript{2} emissions sources in Scotland has significantly decreased recently, the potential for Scotland to act as a hub for storage for wider UK and other nearby emissions, plus the potential to develop a hydrogen energy system for transport supplied by North Sea hydrocarbons, provide key drivers for the Scottish Government to safeguard the future of its hydrocarbon industry. Ongoing devolution and transfer of authorities from the UK parliament to the Scottish parliament has also included the separation of responsibilities for CO\textsubscript{2} storage leasing between the Scottish Ministers and the Crown Estate in England and Wales.


www.eccsel.org  |  Page 24
The Scottish government’s Climate Change Plan update⁵⁴ (December 2020) includes the following policies and proposals:

- Deliver an Energy Transition Fund (ETF) to provide support for a sustainable, secure and inclusive energy transition in the North-East.
- Establish and deliver a Scottish Industrial Energy Transformation Fund (SIETF) – to support the decarbonisation of industrial manufacturing through a green economic recovery.
- Making Scotland’s Future: multi-faceted programme will boost manufacturing productivity, innovation, and competitiveness, supporting manufacturing businesses to make the transition to net zero and realise the opportunities of a low carbon economy.
- Low Carbon Manufacturing Challenge Fund: to support innovation in low carbon technology, processes and infrastructure. Will be based on successful delivery of ERDF funded Advancing Manufacturing Challenge Fund.
- ACORN CCS Project: support the delivery of the CCS and Hydrogen capability at St. Fergus Gas Processing complex by 2025.
- Establish and deliver a Carbon Capture and Utilisation (CCU) Challenge Fund.
- Emerging Energy Technologies Fund – to support the development of Hydrogen, CCUS and Negative emissions technologies.
- Carbon Capture Utilisation and Storage (CCUS): work closely with the UK Government to get commercial, policy and regulatory frameworks required to support CCUS at scale in the UK.
- Forums for CCUS and Blue (low-carbon) Hydrogen: to bring together industry, academics and membership organisations to promote and attract investment in CCUS and Blue Hydrogen.
- Evidence for CCUS and Blue Hydrogen: building the evidence base on impact of technology, regulatory and market barriers.
- Hydrogen Demonstration: to replicate and scale-up demonstration projects and the evidence base for hydrogen-based technologies.
- In 2021/22 carry out a detailed feasibility study of opportunities for developing negative emissions technologies (NETs) in Scotland ready for the early 2030s. This will identify specific sites and applications of NETs, including developing work to support policy on Direct Air Capture and its role within NETs in our future energy system.
- From 2022, based on the outcomes of the feasibility work, we will provide support for commercial partners to develop NETs proposals including initial design and business cases.
- Put in place a continual process to review the development of NETs and progress against its envelope.
- We will work with UK Government to ensure that they bring forward suitable mechanisms to support the development of NETs business cases in relevant sectors.

• Strategic Innovation Challenge Fund – to support strategic investment in R&D and innovation to reduce CO₂ emissions, stimulate economic recovery and create jobs.
• Support the inclusion of NETs in the development of strategic, industry lead pathways for CCUS infrastructure in Scotland.
• Funding through the Scottish Industrial Energy Transformation Fund to consider the development of NETs demonstrators
• Provide a focus on integrating NETS projects with CCS infrastructure through the Emerging Technologies Fund.

2.5.3 National funding streams suitable for CCUS research, demonstration and deployment
Since legislating for net zero, the UK government has committed more than £2 billion (c. 2.15 billion €) to support decarbonisation in sectors across the economy from industry to transport, including:
• £390 million (c. 420 million €) of investment in hydrogen and low carbon technology to reduce emissions from industry, including steel - which accounts for 15% of industry emissions in UK
• £26 million (c. 28 million €) of additional funding for carbon capture technology, including investment in the UK’s largest project to be operational by next year
• plans to make it easier to recycle oil and gas infrastructure for carbon capture, including some of the 20,000km of UK pipelines

The funding is piloted by BEIS and available via the corresponding programme in operations and the UK Research Infrastructure (UKRI). BEIS has notably launched a call for CCUS Innovation in July 2018 of up to £24 million of grant funding for world-leading research and innovation projects that offer:
• a significant reduction in the cost of capturing and sequestering carbon dioxide; and / or
• a quicker, more widespread deployment of CCUS in the UK and internationally
The project funding period is up to 24 months, with projects finishing by 31 March 2021.

The UK is also participating in the ERA-NET ACT55 scheme to accelerate CCS technologies since 2016. BEIS has committed so far via this scheme £4.4 million, matched with a further £2.2 million in co-funding from the European Commission, to support UK participation in 5 of these collaborative projects.

Point 8 of the Plan for a Green Industrial Revolution published in November 2020 by the UK government announces the will to invest up to £1 billion to support the establishment of CCUS in 4 industrial clusters, creating ‘SuperPlaces’ in areas such as the North East, the Humber, North West, Scotland and Wales. In addition, the government will bring forward details in 2021 of a revenue mechanism to bring through private sector investment into industrial carbon capture and hydrogen projects via new business models to support these projects.

55 http://www.act-ccs.eu/

www.eccsel.org | Page 26
2.6 Other countries approached to join ECCSEL ERIC

2.6.1 Introduction
According to the ERIC regulation and ECCSEL ERIC Statutes, the following entities may become Members of ECCSEL ERIC, or they may become Observers:

- Member States of the European Union;
- Associated countries;
- Third countries other than associated countries;
- Intergovernmental organisations.

This means that Membership or Observer status commitment must be made/signed at ministry level. However, one public entity, or one private entity with a public service mission, may be appointed to represent the Member/Observer.

2.6.2 Germany
DLR, the German Aerospace Center, followed by University of Stuttgart were partners in the ECCSEL preparatory projects (FP7). However, due to lack of political support and national policies on CCS in Germany, they were not able to provide a signed Letter of Intent (LoI) from their Ministry to join ECCSEL ERIC from the start in 2017.

In recent years, the German Government position on CCUS has become more positive with support for and development of a national CCUS policy/strategy. Germany has also developed a strong CCUS scientific community, which has been approached by the ECCSELERATE project in 2020 in order to establish a German ECCSEL ERIC node/cluster, followed by meeting(s) at Ministry level.

Germany is member/partner of most relevant international CCUS organisations/programmes:

- SET Plan IWG 9 on CCS and CCU
- ERA-NET ACT ‘Accelerating CCS technologies’
- CSLF – Carbon Sequestration Leadership Forum
- Mission Innovation Challenge 3 on Carbon Capture
- ISO CCS Technical Committee (ISO/TC 265)

In addition, German research organisations are members of the CCS Joint Programme of EERA, the European Energy Research Alliance.

Thus, in 2021, ECCSELERATE continues its efforts to have Germany onboard as Member of ECCSEL ERIC.
2.6.3 Poland
PGI-NRI, the Polish Geological Institute – National Research Institute, was partner throughout both the ECCSEL preparatory projects (FP7) and implementation project (H2020), whilst GIG, the Central Mining Institute, joined the latter project.

Although a Letter of Intent (LoI) to join ECCSEL ERIC was signed by the Polish ministry, a final binding signature was missing when ECCSEL ERIC was established in 2017.

Since then, several attempts have been made to have Poland onboard. After a constructive dialogue throughout 2019 and early 2020, it seemed realistic to expect Poland would become an ECCSEL ERIC member from 2021. However, due to the Covid-19 pandemic, progress has since halted.

The Polish government has convened a group of experts and CEOs from energy companies intending to present how they see the future of the mining and energy industry in Poland, proposing a form of roadmap, in which technologies such as CCUS would be considered. This work has been delayed due to the Covid-19 pandemic situation but might be presented to the Polish government in 2021.

Poland is member of the following international CCUS organisations/programmes:
- CSLF – Carbon Sequestration Leadership Forum

In addition, Polish research organisations are members of the CCS Joint Programme of EERA, the European Energy Research Alliance.

2.6.4 Switzerland
ETHZ, Swiss Federal Institute of Technology in Zurich, was partner throughout both the ECCSEL preparatory projects (FP7) and implementation project (H2020).

A Letter of Intent (LoI) to join ECCSEL ERIC was signed by the Swiss ministry, and since CCUS and ECCSEL were part of a national roadmap, they were expected to sign up as one of the founding members/observers. However, a final binding signature was missing when ECCSEL ERIC was established in 2017.

Since then, several attempts were made to have Switzerland onboard. After a constructive dialogue throughout 2019 and early 2020, it seemed realistic to expect Switzerland would become an ECCSEL ERIC member from 2021. However, possibly due to the Covid-19 pandemic, progress has halted, and in late 2020 Switzerland decided to not join ECCSEL ERIC at that time. Switzerland did however not exclude membership at a later stage.

Switzerland is member/partner of the following international CCUS organisations/programmes:
- ERA-NET ACT ‘Accelerating CCS technologies’
- IEAGHG - IEA Greenhouse Gas R&D Programme
In addition, Swiss research organisations are members of the CCS Joint Programme of EERA, the European Energy Research Alliance.

2.6.5 Spain
CIUDEN (Fundación Ciudad de la Energía) was partner throughout both the ECCSEL preparatory projects (FP7) and implementation project (H2020).

Although a Letter of Intent (LoI) to join ECCSEL ERIC was signed by CIUDEN Management, a final binding signature by a Ministry was missing when ECCSEL ERIC was established in 2017.

Since then, initiatives have been taken to attract Spain, without success. Other universities/institutes than CIUDEN may be approached to discuss a future Spanish ECCSEL cluster.

Spain is member/partner of the relevant international CCUS organisations/programmes:
- SET Plan IWG 9 on CCS and CCU
- ERA-NET ACT ‘Accelerating CCS technologies’
- ISO CCS Technical Committee (ISO/TC 265)

In addition, Spanish research organisations are members of the CCS Joint Programme of EERA, the European Energy Research Alliance.

It is worth noting that in Spain’s long-term decarbonisation strategy to reach carbon neutrality in 2050, published in November 2020, the role of CCUS is recognised for the long-term decarbonization of industry.

2.6.6 Greece
CERTH, the Centre for Research and Technology-Hellas, was partner throughout both the ECCSEL preparatory projects (FP7) and implementation project (H2020).

Although a Letter of Intent (LoI) to join ECCSEL ERIC was signed by the Greek ministry, a final binding signature was missing when the ECCSEL ERIC legal entity was established in 2017.

Since then, several attempts were made through CERTH to have Greece on board, without success so far.

Greece is member/partner of these international CCUS organisations/programmes:
- ERA-NET ACT ‘Accelerating CCS technologies’
- CSLF – Carbon Sequestration Leadership Forum

In addition, Greek research organisations are members of the CCS Joint Programme of EERA, the European Energy Research Alliance.

2.6.7 Other Countries

In several other European countries, the need for CCUS is increasingly acknowledged. For example in some Nordic and Baltic Countries, where industries may feed captured CO$_2$ into a future infrastructure for transport and offshore storage underground in the North Sea. This could be connected with the Longship project which in December 2020 was approved by the Norwegian Parliament and will be financially supported over the State Budget.

It is interesting to note that:

- Denmark, Finland and Sweden are members of Mission Innovation Challenge 3 on Carbon Capture;
- Czech Republic, Romania and Serbia are members of CSLF, the Carbon Sequestration Leadership Forum;
- Denmark and Romania are also members of ERA-NET ACT ‘Accelerating CCS technologies’.

2.7 Comparison of national situations

Table 2 summarises the national CCUS situations both in the ECCSEL ERIC member countries and in the countries approached for ECCSEL ERIC membership.

In 2020, there has been a growing interest in CCUS which is increasingly seen as necessary to meet national greenhouse gas emission reduction targets, up to carbon neutrality for some countries. In ECCSEL ERIC member countries Norway, the Netherlands and UK, the CCUS momentum is very strong. As for France and Italy, the importance of CCUS as a climate measure is increasing on the political agenda. In the countries approached for ECCSEL ERIC membership (Germany, Poland, Switzerland, Spain, Greece), CCUS has not been ignored, but its place in national policies has not yet been asserted.

The general trend is good for the development of CCUS and therefore for a stronger positioning of ECCSEL as ‘a world-class research infrastructure facilitating ambitious R&D activities, European industrial initiatives, and education of specialists for the new CCUS industry’. Getting on board additional member countries would enhance the number and quality of the facilities and services provided by ECCSEL and would lead to a more balanced development of the European Research Area.
<table>
<thead>
<tr>
<th>Country</th>
<th>GHG reduction target</th>
<th>CCS in operation in 2020</th>
<th>CCS in construction and development*</th>
<th>CCS included in NECP</th>
<th>CCUS roadmap</th>
<th>CCS funding streams</th>
<th>Membership in CCUS international initiatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>Carbon neutrality by 2050</td>
<td>16 Mt CO₂/year in 2030</td>
<td>0</td>
<td>yes</td>
<td>National</td>
<td>• ADEME roadmap (2011) • Club CO2 roadmap (in prep.) • National Council of Industry Sector's roadmap (in prep.) • ANR • ADEME</td>
<td>yes</td>
</tr>
<tr>
<td>Italy</td>
<td>-33% by 2030 vs 2005</td>
<td>-</td>
<td>0</td>
<td>no</td>
<td>-</td>
<td>• PON</td>
<td>yes</td>
</tr>
<tr>
<td>Netherlands</td>
<td>-49% by 2030 vs 1990</td>
<td>34.3 Mt CO₂ by 2030</td>
<td>0</td>
<td>yes</td>
<td>National</td>
<td>• RTEU Demonstration Energy and Climate Innovation • Joint Industry Projects • NAUEA/FM IEA/NEA, the Ministry of Agriculture, Food, the Environment and the Energy Sector • Top5 Sector Energy Studies in Industry • ANSC (Mission-driven Research, Development and Innovation)</td>
<td>yes</td>
</tr>
<tr>
<td>Norway</td>
<td>-40% at least by 2030 vs 1990</td>
<td>1.7 Mt CO₂/year from 2020 (Sleipner + Snohvit)</td>
<td>+ 0.8 Mt CO₂ from 2020 (Longship)</td>
<td>-</td>
<td>National</td>
<td>• EU137 Programme for RD and Demo • Norwegian Research Council's Research Infrastructure Initiative</td>
<td>yes</td>
</tr>
<tr>
<td>UK</td>
<td>&quot;Net-zero&quot; by 2050</td>
<td>10 Mt CO₂/year by 2030</td>
<td>0</td>
<td>yes</td>
<td>National</td>
<td>• IEA Green Growth and Industrial Development Programme (2018) • R&amp;D project for a Green Industrial Revolution - Phase 2 on CCUS (2020) • BIS5</td>
<td>yes</td>
</tr>
<tr>
<td>Germany</td>
<td>-55% at least by 2030 vs 1990</td>
<td>0</td>
<td>0</td>
<td>yes</td>
<td>National</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Poland</td>
<td>-76% by 2030 vs 2005 in sectors not covered by the EU ETS system</td>
<td>0</td>
<td>0</td>
<td>no</td>
<td>National</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Carbon neutrality by 2050</td>
<td>0</td>
<td>-</td>
<td>no</td>
<td>National</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Spain</td>
<td>Carbon neutrality by 2050</td>
<td>0</td>
<td>0</td>
<td>yes</td>
<td>National</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Greece</td>
<td>+42% at least by 2030 vs 1990</td>
<td>0</td>
<td>0</td>
<td>yes</td>
<td>National</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

3 REGIONAL, IN-COUNTRY, POLICIES ON CCUS

Anchoring CCUS in in-country regional policies is important for enabling and supporting deployment of CCUS in territories and help these territories, as well as their countries, to achieve their greenhouse gas emission reduction targets, including carbon neutrality for the most committed.

Regional funding can be substantial for the development of CCUS projects. The regions have significant equity capital available for investments in strategic sectors and since 2014 have been the managing authorities of the European Regional Development Fund (ERDF) which focuses its investments on several key priority areas including ‘Innovation and research’ and ‘The low-carbon economy’. A prerequisite for mobilising regional and ERDF funding is to address the regional research and innovation priorities and the regions’ Strategies for Smart Specialisation (S3)\(^\text{57}\). Therefore, it is important that CCUS is, or become, included in such priorities, which is currently rarely the case.

Figure 6. Map of in-country administrative regions in the European Union (as of Sept. 2018).

\(^{57}\) [https://s3platform.jrc.ec.europa.eu/what-is-smart-specialisation-](https://s3platform.jrc.ec.europa.eu/what-is-smart-specialisation-)

www.eccsel.org  |  Page 32
CCUS deployment will only be possible if CCUS solutions are tailored to the needs and specificities of each territory and are elaborated through in-depth consultation with local stakeholders. For this reason, for example, the H2020 STRATEGY CCUS project\textsuperscript{58} (2019-2022) is working in this direction for identifying CCUS solutions, supporting the development of low-carbon energy and industry, in eight regions identified as promising for CCUS development, located in seven countries of Southern and Eastern Europe: Croatia, France, Greece, Poland, Portugal, Romania and Spain. Collectively, these countries produce 45% of Europe’s CO\textsubscript{2} emissions from the industry and energy sectors\textsuperscript{59}. However, they also feature assets that can unlock the means to tackle these emissions through CCUS. The eight promising start-up regions, for which local CCUS development plans are being elaborated, are the following:

1. Paris basin in France (from Paris to Orléans)
2. Rhône valley in France (including the Fos-Berre/Marseille CCU cluster targeted by the SET Plan Action 9 (as a Flagship Project), and Lyon metropole)
3. Ebro basin in Spain (including Tarragona industrial area, North Castellón and North Teruel areas)
4. Lusitanian basin in Portugal (including the CO\textsubscript{2} sources in the Leiria-Figueira da Foz axis, and extending to the Lisbon industrial region)
5. Northern Croatia (including Zagreb and the Croatian part of Pannonian basin)
6. Galati area in Romania (including Galati, a port town on the Danube river, and its surroundings)
7. West Macedonian area in Greece (including the Kozani and Ptolemaida industrial areas)
8. Upper Silesia in Poland (including the industrial areas of Katowice, Rybnik and Bedzi)

The following chapters present an analysis of the regional situations regarding CCUS in the current ECCSEL member countries.

\textbf{3.1 France}

\textbf{3.1.1 Regional strategies related to climate change mitigation, carbon neutrality, energy and ecological transition}

In each French administrative region, a Regional Planning, Sustainable Development and Territorial Equality Scheme (Schéma d’Aménagement de Développement Durable du Territoire - SRADDET) had to be elaborated by 2019 as a result of the 2015 law ‘NOTRe’ on the new territorial organization of the French Republic. The SRADDET replaces several sectoral regional schemes and must set medium- and long-term objectives in relation to several themes: territorial balance and equality, establishment of

\textsuperscript{58} \url{https://www.strategyccus.eu/}

\textsuperscript{59} \url{https://www.eea.europa.eu/publications/european-union-emission-inventory-report-1990-2016}

www.eccsel.org | Page 33
various infrastructures of regional interest, opening up of rural areas, economical management of space, intermodality and development of transport, energy management and efficiency, combating climate change and air pollution, protection and restoration of biodiversity, waste prevention and management.

CCUS is currently not mentioned in the SRADDETs, nor in the Regions’ Strategies for Smart Specialisation (S3)\(^{60}\), which is a prerequisite for mobilising substantial regional and ERDF funding for performing research and innovation activities on CCUS.

However, there are some positive early signals. The regional authorities of ‘Provence-Alpes-Côte d’Azur’ (around Marseille) and ‘Auvergne-Rhône-Alpes’ (around Lyon) are interested in circular economy and possibly CO\(_2\) utilisation (CCU), although they are not much aware about CCS as a mean for mitigating climate change. For instance, the S3 of the ‘Provence-Alpes-Côte d’Azur’ region in South-East France mentions the utilisation of CO\(_2\) for the production of algae (with biofuel objective). The ‘Centre-Val de Loire’ region in central France, around Orléans, has introduced from 2018 the geological storage of CO\(_2\) among the topics eligible in its annual call for research projects.

3.1.2 Regional CCUS initiatives

Below are listed the CCUS projects and initiatives that are currently ongoing or being prepared in several regions of France. Some of them benefit from regional or ERDF funding.

**Auvergne-Rhône-Alpes region (around Lyon)**

There is currently one ongoing project linked to CO\(_2\) capture and use (CCU):

- CimentAlgue - Algae production from CO\(_2\) at the VICAT cement plant at Montalieu-Vercieu, close to Lyon. Various microalgae culture systems are tested over a two-year period\(^{61}\).

**Centre-Val de Loire region (around Orléans)**

The region is currently funding two CCUS research projects following calls for projects in 2018 and 2019 mentioning CO\(_2\) geological storage among the eligible topics. Both projects are coordinated by BRGM.

- The GEOCO2 project (2019-2020) is studying the potential in the Centre-Val de Loire region of the concept combining the storage of CO\(_2\) in dissolved form with the production of geothermal heat, which was originally the subject of the “CO\(_2\)-Dissolved” project funded by ANR, the National Research Agency (Kervévan et al., 2017\(^{62}\)).

---


\(^{62}\) [https://doi.org/10.1016/j.egypro.2017.03.1549](https://doi.org/10.1016/j.egypro.2017.03.1549)

www.eccsel.org | Page 34
The CO2SERRE project (2020-2022) is studying the techno-economic feasibility of a pilot capturing CO₂ from a biomass plant in Orléans and storing it in local deep saline aquifers, leading to negative emissions (BECCS – Bio-Energy and CCS). Besides, a fraction of the captured CO₂ would be used in greenhouse crops for plants growth boosting.

In addition, the north part of the region, from Orléans, is part of the Paris basin area studied by the H2020 STRATEGY CCUS project for elaborating local CCUS development schemes. It is also the zone that will be investigated in France in the new H2020 PilotSTRATEGY project that will start early 2021 to further advance the understanding of deep saline aquifers for CO₂ geological storage in five industrial regions of Southern and Eastern Europe: Paris Basin (France), Lusitanian Basin (Portugal), Ebro Basin (Spain), West Macedonia (Greece) and Upper Silesia (Poland). Both projects are coordinated by BRGM.

Hauts-de-France region (around Dunkerque)
There is currently one ongoing H2020 project:

- 3D project – DMX demonstration project in Dunkirk

Launched in 2019, the H2020 3D project has 3 main objectives in the medium to long term:

1. Demonstrate the effectiveness of the DMX™ process on an industrial pilot that will capture 0.5 tCO₂/hour from steel mill gas by 2021.
2. Prepare the implementation of a first industrial unit at the ArcelorMittal site in Dunkirk, which could be operational starting in 2025 and that will capture more than 1 MtCO₂ per year (125 tCO₂/hour) to be stored in North Sea geological storage.
3. Explore the future European Dunkirk North Sea Cluster which should be operational by the year 2035 with more than 10 MtCO₂ per year captured and stored in North Sea geological storage.

On 8 October 2020, a European seminar entitled ‘CO₂, Industries and Territories’ was organised in Dunkirk by the Hauts-de-France Chamber of Commerce and Industry, the Hauts-de-France region, the city of Dunkirk, and ADEME.

Ile-de-France region (around Paris)
An application for building a CCS demonstration facility in the region was submitted end October 2020 to the first call of the European Innovation Fund. BRGM is part of the consortium.

Normandy region (around Le Havre)
The Axe Seine CCUS project, funded by ADEME, is currently running. The objective is to study the CCS potential between Le Havre and Rouen, in terms of quantities of CO₂ that could be captured and stored, also looking at export possibilities for storage under the North Sea.

---

63 [https://3d-ccus.com/](https://3d-ccus.com/)
Provençe-Alpes-Côte d’Azur region (around Marseille)

There are currently three ongoing projects linked to CO₂ capture and use (CCU) for producing algae, synthetic natural gas or biomethanol:

- **VASCO²⁶⁴** - Algae production from CO₂. Launched in the autumn of 2015 with funding from ADEME, VASCO² is a research programme led by the port of Marseille-Fos with twelve partners (industrialists from the industrial-port zone of Fos, research centres, VSEs, institutions) aiming to valorise the CO₂ emitted by industrialists. Their ambition: to contribute to the energy transition through innovation by testing a novel solution for the production of biomass based on the biological recycling of industrial CO₂.

- **Jupiter 1000⁶⁵** - Power to gas (CH₄). The Jupiter 1000 project is the first industrial demonstrator of Power to Gas with a power rating of 1 MWe for electrolysis and a methanation process with carbon capture. Green hydrogen will be produced using two electrolysers involving different technologies, from 100% renewable energy. The installation will be based on an innovative methanation technology and CO₂ will be captured on a nearby industrial site. The project is located at Fos-sur-Mer (Bouches-du-Rhône), on the Innovex platform dedicated to hosting demonstrators related to the Energy Transition, and at the intersection of gas and electricity networks. In the light of the performance levels shown by the demonstrator, further work will focus on future technical and economic standards of a full-sized installation of this type. Over the longer term, the idea is to launch the Power to Gas activity in France. More than 15 TWh of gas could be produced each year using the Power to Gas system by 2050.

- **HYBIOL⁶⁶** - Biomethanol production from CO₂ and green H₂ at the Gardanne-Meyreuil biomass plant site. Hybiol is a reconversion project for the Gardanne-Meyreuil power plant site with a view to the closure of coal boilers announced by the State by 2022. The project would contribute to the development of a territorial ecosystem with a circular economy of reference.

3.1.3 Regional funding streams suitable for CCUS research, demonstration and deployment

At present, very few regional funding has been mobilised. Examples of regional funding are the two GEOCO² and CO₂SERRE projects supported by research funds of the Centre-Val de Loire region, and the Jupiter 1000 Power to Gas demonstrator financed jointly by the Provence-Alpes-Côte d’Azur region, the European Union through ERDF funds managed by the region, and the French State (Investments for the Future, managed by ADEME).

---


⁶⁵ [https://www.jupiter1000.eu/english](https://www.jupiter1000.eu/english)

⁶⁶ [https://www.capenergies.fr/portfolio_page/hybiol/](https://www.capenergies.fr/portfolio_page/hybiol/)
3.2 Italy

3.2.1 Regional strategies related to climate change mitigation, carbon neutrality, energy and ecological transition

Smart Specialization Strategies (S3) differently address climate change and energy issues in Italian regions.

Friuli Venezia Giulia Region gives relevance to CCUS supporting ECCSEL ERIC and its activities, recognizing the importance of the National Node coordination in the Region (by OGS). The region is also interested in the link between ECCSEL/CCUS and the “blue hydrogen” and “green hydrogen” concepts; the region has recently signed an agreement with two industrial key players (A2A and SNAM), to develop a hydrogen hub.

Sardinia Region S3 is aligned with the Electrical Research System programme (RSE), which funds research activities on gasification, CCUS and energy efficiency. Actors in the RSE are ENEA and Sotacarbo. Sardinia Region recognizes “intelligent networks for an efficient energy management” as a priority for its strategy. It has included it in the plan as Priority n°2. CCUS activities can refer to this priority.

Sicily Region recognizes the relevance of the ECCSEL Panarea Natural Laboratory, attracting international and multidisciplinary research groups for performing research on CCUS, ocean acidification, and climate changes. The region has recently formally supported ECCSEL for its reconfirmation in the national priority list of Research Infrastructures.

3.2.2 Regional CCUS initiatives

Specific regional initiatives have been carried out for the Sardinia Region, in the Sulcis area, studied initially within an ENEA-funded project on potential CO₂-ECBM (Enhanced Coal Bed Methane) deployment. Sulcis site became the Sulcis Fault Lab (SFL), which provides the drilling through a fault plane and the CO₂ injection into the fault zone. The infrastructure will be installed within the “Centre of Excellence for Clean Energy –Phase II” project, managed by Sotacarbo and funded by the Regional Government of Sardinia. It will help to address the concerns and risks of CO₂ leakage through faults.

A CCS Ravenna Hub, in the Emilia-Romagna region, is being prepared under the coordination of ENI. The objective is to decarbonise the Ravenna industrial cluster, including hydrogen production, by capturing the CO₂ and storing it in depleted gas fields in the Adriatic Sea. The first phase may start in 2021, and from 2025 ENI may be able to store 4 to 5 million tons of CO₂ per year. With a storage capacity of between 300 and 500 million tonnes, these underground structures could make a very significant contribution to the mitigation of greenhouse gas emissions in Italy.

67 Catching CO₂ off the coast of Ravenna (eni.com)
3.2.3 Regional funding streams suitable for CCUS research, demonstration and deployment

**Friuli Venezia Giulia region** covers part of the operating cost of two ECCSEL facilities: Biomarine Lab and CTMO (Calibration and Metrology Laboratory).

**Sardinia Region** has supported important R&D and R&I initiatives on CCUS with a relevant funding stream, thus contributing accelerating the research and technological development not only regionally, but also nationally. The CCEP (Italian Centre of Excellence for Clean Energy) has been established in Carbonia, led by Sotacarbo, and is dedicated to advanced research on gasification, separation technologies, CO₂ utilization and storage.

**Lazio Region** has granted a call (POR FESR 2014-2020 - Asse I - Azione 1.5.1) aimed at funding Research and Innovation activities in Research Infrastructures, to which ECCSEL was allowed to participate.

3.3 Netherlands

3.3.1 Regional strategies related to climate change mitigation, carbon neutrality, energy and ecological transition

The Netherlands have no regional strategies, everything is organised at national (or international) level.

3.3.2 Regional CCUS initiatives

In the Netherlands the focus around CCUS is on the storage activities around the North Sea area and on the Waste to Energy (WtE) sector.

For CO₂ storage, there are large-scale projects being developed in the Netherlands. The two most important are Porthos⁶⁸ in the South Holland province, and Athos⁶⁹ in the North Holland province. Porthos is preparing a project to transport CO₂ from industry in the Port of Rotterdam and store this in empty gas fields beneath the North Sea. Porthos stands for Port of Rotterdam CO₂ Transport Hub and Offshore Storage. The Athos project aims to develop a public CO₂-distribution network in the North Sea Canal area, enabling the capture and transport of CO₂, for usage or to be stored in empty gas fields under the North Sea. Athos is an abbreviation for Amsterdam-Ijmuiden CO₂ Transport Hub & Offshore Storage. Companies in the respective clusters can supply their captured CO₂ to the network. Recently, the European Commission has nominated Porthos and Athos for a subsidy of about 102 million euros and 15 million euros for further development, respectively.

⁶⁸ [https://www.porthosco2.nl/](https://www.porthosco2.nl/)
⁶⁹ [https://www.athosccus.nl](https://www.athosccus.nl)
The WtE sector is investing considerably into CO$_2$ capture. With AVR having the first full scale CO$_2$ capture project running in Europe and Twence linking up with Aker Solutions to build a full-scale plant, the sector is in the frontline of implementing CO$_2$ capture in Europe. Both HVC and Twence operate a capture pilot plant and also HVC are considering scaling up. A number of other WtE companies in the Netherlands has also expressed an interest in capturing CO$_2$. In the Netherlands there is quite a unique situation that the greenhouses have a demand for CO$_2$ to increase plant growth. In 2020, this stands at some 0.5 Mton CO$_2$/year, and there is potential for more. Multiple projects are supplying CO$_2$ to the greenhouses which eliminates the need for greenhouses to produce their own CO$_2$ by burning fossil fuels. Waste-to-energy companies, TNO and other Dutch companies are involved in multiple projects to support the CO$_2$ capture activities and to accelerate the implementation. Knowledge is shared in workshops, where the sector exchanges results and discusses issues openly. This knowledge sharing is supported by RVO (Netherlands Enterprise Agency).

The Dutch initiative VOLTACHEM$^{70}$ is developing technologies to utilise CO$_2$ for the production of renewable fuels and chemicals like formic acid. A consortium led by TNO has recently won a H2020 project named TAKE OFF, with the aim to develop synthetic fuels for the aviation industry.

3.3.3 Regional funding streams suitable for CCUS research, demonstration and deployment
The Netherlands have no regional funding streams, everything is organised at national (or international) level.

3.4 Norway
3.4.1 Regional strategies related to climate change mitigation, carbon neutrality, energy and ecological transition
The different counties in Norway have their own regional strategies. However, most of the funding is organised on national level. Different counties have different focus points and many of the ‘regions’ have their own strategies. Some examples can be found in Table 3. The counties are part of a national network called Climate partners$^{71}$. The goal is to be present in all regions nationwide. The regional offices are free to choose the focus, but each network works according to the same method, overall strategy, and obligations.

$^{70}$ https://www.voltachem.com/
$^{71}$ About Klimapartnere | Klimapartnere
3.4.2 Regional CCUS initiatives

There are only a few emissions sources of CO₂ in Norway that are large enough to establish a commercial chain of CO₂ capture, transport, and storage alone. Therefore, many initiatives are based on regional cluster collaboration, where parts of the infrastructure are shared. Some examples are presented below.

**CO₂-Hub Nordland**[^72][^73] is an initiative that was supported by the CLIMIT-programme. The nine project partners produce approximately 2 million tonnes of CO₂ per year. They cover several different industrial sectors, like ferroalloy, aluminium and cement. This leads to a large spread in CO₂ concentration from less than 3% to more than 20% CO₂, which means that different technologies may be relevant for capture. The project will perform a feasibility study and estimate the costs of implementing CCUS using near-commercial technologies. Additionally, the benefits of using surplus heat and partial CO₂ capture will be evaluated. Part of the project will also look at process modifications that could be beneficial for CCUS, like changes that would increase the CO₂ concentration.

**Industrial cluster Grenland**[^74] in the county of 'Vestfold og Telemark' has come far in planning joint CCS-solutions. A chain for CO₂ capture is established from Yara’s ammonia production with the

[^72]: CO₂-Hub Nordland: [https://climit.no/project/co2-hub-nordland/](https://climit.no/project/co2-hub-nordland/)

[^73]: Jan Gabor. CO₂-Hub Nordland. 15.10.2020. [https://www.forskningsradet.no/contentassets/5b2cf0aa87a6401ca7ebcece73460610/6.-gabor_2020-10-15_co2-hub-nordland_ws_co2-hubs.pdf](https://www.forskningsradet.no/contentassets/5b2cf0aa87a6401ca7ebcece73460610/6.-gabor_2020-10-15_co2-hub-nordland_ws_co2-hubs.pdf)

[^74]: Om IGT - Industrial Green Tech: [https://industrialgreentech.com/om-igt/](https://industrialgreentech.com/om-igt/)
transport of CO\textsubscript{2} on ships\textsuperscript{75}. Similarly, CO\textsubscript{2} capture from the cement factory to Norcem in Brevik\textsuperscript{76} and a transport solution is included in Longship initiative discussed in chapter 2.4.2 on national CCUS roadmaps and initiatives.

The objective of Borg CO\textsubscript{2} company is to build an \textbf{industrial CCUS cluster on Øra} in the Viken county. A feasibility study ‘CCS cluster on Øra and regionally’, supported by the CLIMIT programme, evaluated the possibility of capturing CO\textsubscript{2} from five different sources at three different locations. Ongoing Øra CCS cluster -project\textsuperscript{77} focuses on cost-effective small-scale CO\textsubscript{2} capture combined with transport, utilization and storage.

### 3.4.3 Regional funding streams suitable for CCUS research, demonstration and deployment

In Norway, there are regional research funds. The funds will be used to support the region’s priority focus areas. Within these areas, they will also contribute to long-term competence building in relevant research environments. The goal is to develop good and competitive research environments in all administrative counties.

### 3.5 United Kingdom

#### 3.5.1 Regional strategies related to climate change mitigation, carbon neutrality, energy and ecological transition

Launched on 25 October 2000, the Nottingham Declaration saw over 300 councils committing to work towards reducing emissions. The Local Government Association (LGA) furthered it with a next initiative called 'Climate Local – a local commitment to action on climate change' that received the support of representative bodies such as Core Cities and the Carbon Action Network. Both initiatives do not address CCUS directly. The LGA climate actions are directed toward working on identifying local people’s vulnerability and needs from the impacts of climate change. It seeks at promoting climate education, diversification of the labour market, appropriate planning and housing, procurement and green finance, transport, etc. Regarding energy, it seeks at integrating sustainability and resilience into energy plans. The LGA produces a monthly Climate Change Bulletin that gives a summary of best practice examples and the latest news for councils on the topic.

\textsuperscript{75} Hans Aksel Haugen, Nils Henrik Eldrup, Anne Marie Fatnes, Eystein Leren. Commercial Capture and Transport of CO\textsubscript{2} from Production of Ammonia, Energy Procedia, Volume 114, 2017, Pages 6133-6140, \url{https://doi.org/10.1016/j.egypro.2017.03.1750}.

\textsuperscript{76} CCS at Norcem Brevik: Background | Norcem: \url{https://www.norcem.no/en/CCS%20at%20Brevik}

\textsuperscript{77} CLIMIT supports new CCS cluster project - Climit: \url{https://climit.no/en/news/climit-supports-new-ccs-cluster-project/}
The development of regional CCUS sites is thought to make an important contribution to addressing some of the pressing challenges facing us today. It is however decided and piloted a national scale; local authorities form various partnerships to support the job environment to support its development. On 9 December 2020, the Climate Change Committee (CCC) recommended in its 6th Carbon Budget report that the UK government should establish “at least two CCS clusters (terminals or cluster points) in the mid-2020s, at least four by the late 2020s, and further clusters around 2030, to ensure our BNZ Pathway (“balanced net-zero”) can be met”. A copy of the “illustrative” map of “potential cluster points and terminals” around the UK is provided below.

Figure 7. Potential locations for cluster points and terminals for CO₂ transport and storage infrastructure in UK. Source: Element Energy (2020), Deep-decarbonisation pathways for UK Industry, report for the Climate Change Committee. Taken from the CCC’s Policies for the Sixth Carbon Budget and Net Zero (2020).

National research projects are also shedding light on regional interests and capacities, such as the GeoEnergy Research Centre (GERC) or the UK GeoEnergy Observatories (UKGEO). Founded in 2015, the GERC goal is to address the global energy trilemma of affordability, security and sustainability of energy supply and enable the sustainable and cost-effective use of geoenergy resources. It GeoEnergy Test Bed⁷⁸ (GTB) notably aims to understand and monitor fluid-rock processes in the shallow

⁷⁸ [http://www.gerc.ac.uk/facilities/geoenergy-test-bed/gtb.aspx](http://www.gerc.ac.uk/facilities/geoenergy-test-bed/gtb.aspx)
subsurface for CO₂ storage. Funded by BEIS, owned by UKRI-NERC and run by the BGS, the UKGEO⁷⁹ are a major infrastructure for subsurface research and geoenergy innovation. The Glasgow Observatory provides a real underground laboratory to enable a range of research into using geothermal energy from mine workings at scale. The Cheshire Observatory will deliver a unique research infrastructure for the assessment of subsurface effects related to renewable energy storage and geothermal.

3.5.2 Regional CCUS initiatives
Examples of current regional UK projects are given below.

**CCUS in the North West of England**
The North West has a cluster of energy intensive industrial gas users around the Ellesmere Port area (Merseyside metropolitan county). Establishing CCUS in industrial areas such as this one maximises potential cost savings and supports the use of the technology across different sectors (e.g. heat and power). **HyNet North West** project sets out a low cost, practical and timely option for the UK’s first CCUS deployment through the re-use of the Liverpool Bay oil and gas fields and related infrastructure. Deliverable by 2026, it meets the UK Government’s ambition for CCUS deployment. The Liverpool Bay site, owned by ENI, has an estimated CO₂ storage capacity of 130 million tonnes. Gas extraction is likely to cease within the required project timeframe and reusing the site for CCUS would avoid or postpone substantial decommissioning costs, payable by government and industry. A 2016 study by the Energy Technologies Institute cited Hamilton Field at Liverpool Bay as the lowest cost scale UK CCS option (>100Mte.), on the basis of the overall project life cycle cost.

**CCUS in the North East of England**
End October 2020, oil major BP⁸⁰ said it had, together with Eni, Equinor, Shell, Total, and National Grid, formed a partnership to develop offshore carbon dioxide (CO₂) transport and storage infrastructure in the UK North Sea. This infrastructure will serve the proposed **Net Zero Teesside** (NZT) and **Zero Carbon Humber** (ZCH) projects that aim to establish decarbonized industrial clusters in Teesside and Humberside, which are two of the UK’s largest industrial clusters. Both projects are expected to be commissioned by 2026 with pathways to achieve net-zero as early as 2030 through a combination of carbon capture, hydrogen, and fuel-switching.

**CCUS in South Wales**
South Wales is home to some of the largest industrial facilities in the UK. To achieve climate goals, a group of companies have partnered together to deliver net zero emissions for industry in the region. The **South Wales Industrial Cluster project**⁸¹ will focus on the infrastructure required for the development of the hydrogen economy, for large scale CO₂ capture (CCUS) and transport as well as

---

⁷⁹ [https://www.ukgeos.ac.uk](https://www.ukgeos.ac.uk)


⁸¹ [https://www.swic.cymru/](https://www.swic.cymru/)
onsite strategic opportunities to each industry. The projects have the potential to strengthen the economic resilience of Welsh industry and communities by ensuring operations in the region are sustainable for the long term.

**CCUS in Scotland**

Acorn\(^82\) is an ambitious programme designed to tackle climate change by dealing with industrial CO\(_2\) emissions and other ‘hard to decarbonise’ sectors. Acorn is strategically located in Aberdeenshire, in the North East of Scotland, to make best use of legacy oil and gas infrastructure and Scotland's excellent offshore geology for CO\(_2\) storage. The region is also committed to developing hydrogen as a fuel of the future.

### 3.5.3 Regional funding streams suitable for CCUS research, demonstration and deployment

In the UK, 38 Local Enterprise Partnership (LEPs) are helping to drive that green innovation forward by managing a joint framework between government and local authorities to develop local industrial and employment solutions. There are currently 38 LEPs creating the environment which will nurture new skills and generate the jobs upon which the green revolution will depend.

### 3.6 Comparison of regional situations

Table 4 summarises the regional CCUS situations in the ECCSEL ERIC member countries.

Regional CCUS developments are mainly organised and steered at national level and with European support. There is still relatively little involvement of the administrative in-country regions, although there are signs that this is beginning to happen. For instance, the Friuli Venezia Giulia region in Italy is funding the operating costs of two ECCSEL facilities, the Centre-Val de Loire region in France includes CO\(_2\) geological storage among the eligible topics of its annual research call for projects, the Provence-Alpes-Côte d’Azur in France supports the Jupiter 1000 CCU demo project with regional & ERDF funds.

End 2020, the UK government has initiated a clearly regional approach for the development of CCUS, as part of its 10-point Plan for a Green Industrial Revolution. It will invest up to £1 billion to support the establishment of CCUS in 4 industrial clusters, creating ‘SuperPlaces’ in regions such as the North East, the Humber, North West, Scotland and Wales.

---

\(^82\) [https://theacornproject.uk/](https://theacornproject.uk/)
<table>
<thead>
<tr>
<th>Country Region</th>
<th>On-going CCUS initiatives</th>
</tr>
</thead>
</table>
| Auvergne-Rhône-Alpes              | • Supports circular economy and possibly CO₂ utilisation (CCU)  
• 1 CCU pilot project (CimentAlgue)                                                                                                                                                                                      |
| Centre-Val de Loire               | • CO₂ storage is eligible in regional calls for research projects  
• 2 CCUS research projects funded by the region (GEOCO2, CO2SERRE)  
• 2 H2020 CCUS research projects are studying the north part of the region as a case study (STRATEGY CCUS, PilotSTRATEGY)  
• 2 CCUS research projects funded by the region (GEOCO2, CO2SERRE)  
• 2 H2020 CCUS research projects are studying the north part of the region as a case study (STRATEGY CCUS, PilotSTRATEGY) |
| Hauts-de-France region            | • 1 H2020 CCS pilot project (3D)  
• 1 H2020 CCUS research projects are studying the region as part of a case study (STRATEGY CCUS)  
• Co-organises an annual seminar in Dunkirk entitled ‘CO₂, Industries and Territories’                                                                             |
| Ile-de-France region              | • 1 CCS project submitted end October 2020 to the first call of the European Innovation Fund                                                                                                                           |
| Normandy                          | • 1 CCUS project (Axe Seine CCUS)                                                                                                                                                                                         |
| Provence-Alpes-Côte d’Azur        | • Supports circular economy and possibly CO₂ utilisation (CCU)  
• 3 CCU pilot project (VASC02, Jupiter 1000, HYBIOL)  
• Jupiter 1000 benefits from regional & ERDF funds                                                                                                                                                                     |
| Emilia-Romagna                    | • CCS Ravenna Hub in preparation                                                                                                                                                                                          |
| Friuli Venezia Giulia             | • Recognises the relevance of CCUS, ECCSEL and the link to “blue hydrogen” and “green hydrogen”  
• Has recently signed an agreement with two industrial key players to develop a hydrogen hub  
• Covers part of the operating costs of two ECCSEL facilities (Biomarine Lab and CTMO)                                                                         |
| Lazio                             | • Has granted a call aimed at funding R&I activities in Research Infrastructures, to which ECCSEL was allowed to participate                                                                                          |
| Sardinia                          | • Has supported important R&I initiatives on CCUS with a relevant funding stream  
• Hosts and supports in Carbonia the Italian Centre of Excellence for Clean Energy, dedicated to advanced research on gasification, separation technologies, and CCUS  
• Hosts and supports the Sulcis Fault Lab (SFL) designed to study and monitor the migration of CO₂ along a fault                                                                                                     |
| Sicily                            | • Hosts and recognizes the relevance of the ECCSEL Panarea Natural Laboratory                                                                                                                                           |
| South Holland                     | • Porthos - Port of Rotterdam CO₂ Transport Hub and Offshore Storage, in preparation                                                                                                                                     |
| North Holland                     | • Athos - Amsterdam-IJmuiden CO2 Transport Hub & Offshore Storage, in preparation                                                                                                                                       |
| Nordland                          | • CO2-Hub Nordland in preparation                                                                                                                                                                                         |
| Vestfold og Telemark              | • Industrial cluster Grenland is planning joint CCS-solutions                                                                                                                                                           |
| Viken                             | • Øra CCS cluster in preparation                                                                                                                                                                                          |
| North East England                | • CCUS industrial cluster in preparation (Teesside and Humberside)                                                                                                                                                      |
| North West England                | • CCUS industrial cluster in preparation (Merseyside)                                                                                                                                                                    |
| Wales                             | • South Wales CCUS industrial cluster in preparation                                                                                                                                                                     |
| Scotland                          | • CCUS industrial cluster in preparation (Acorn)  
• The Scottish Government is a strong advocate for CCS                                                                                                                                                                     |
4 CONCLUSION AND THE WAY FORWARD FOR ECCSEL ERIC

The recent evolution of European and national policies is favourable for accelerating research, demonstration and deployment of CCUS. In the five ECCSEL ERIC member countries (France, Italy, Netherlands, Norway, UK), there has been in 2020 a growing interest in CCUS which is increasingly seen as necessary to meet national greenhouse gas emission reduction targets, up to carbon neutrality for some countries. In the countries approached for ECCSEL ERIC membership (Germany, Poland, Switzerland, Spain, Greece), CCUS has not been ignored, but its place in national policies has not yet been asserted.

There is still relatively little involvement of the administrative in-country regions, although there are signs that this is beginning to happen. It is expected that the roles of regions will grow as CCUS solutions need to be tailored to the needs and specificities of each territory, and as regions have significant equity capital available for investments in strategic sectors and are the managing authorities of the European Regional Development Fund (ERDF).

The external landscape is therefore favourable for a stronger positioning of ECCSEL as ‘a world-class research infrastructure facilitating ambitious R&D activities, European industrial initiatives, and education of specialists for the new CCUS industry’, as desired by the SET-Plan IWG9 on CCS and CCU.

The ECCSEL ERIC members and the ECCSELERATE consortium will continue to work hard to involve new member countries and to enhance the use and range of ECCSEL facilities and services. This is driven by the overall vision of ECCSEL ERIC addressing effective response to CCUS research, demonstration and deployment needs in Europe and beyond.