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ECCSEL ERIC ANNUAL REPORT 2024

Table of Contents

ECCSEL ERIC at one glance

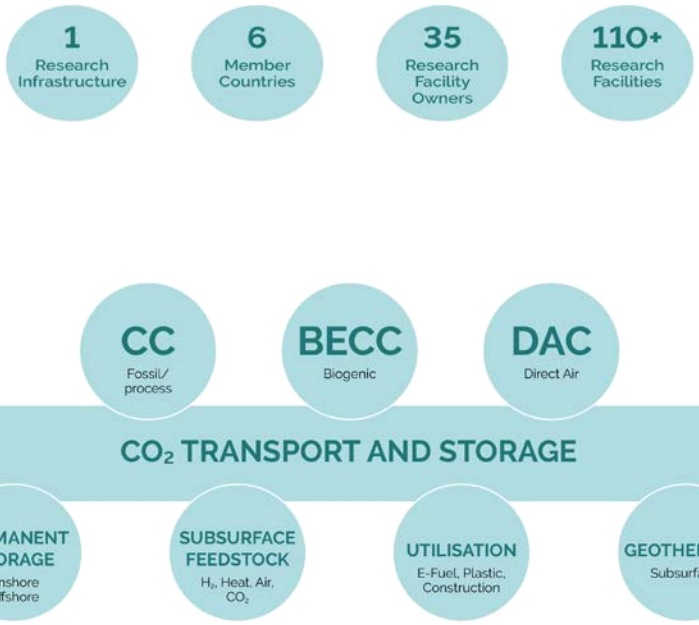
ENHANCE EUROPEAN SCIENCE, TECHNOLOGY DEVELOPMENT AND INNOVATION

About us

ECCSEL is the European research infrastructure for CO2 Capture, Utilisation, Transport and Storage (CCUS) and Carbon Dioxide Removal (CDR). Our vision is to enable net zero CO2 emissions from industry, power generation, and air to combat climate change. ECCSEL is a permanent, distributed, integrated research infrastructure encompassing interlinked transnational scientific facilities and national nodes.

Our Mission

ECCSEL provides open access to over 110 world class CCUS and CDR research facilities across Europe to support national strategies and the EU Industrial Carbon Management Strategy. The research infrastructure works with relevant industry, academia and research communities to determine their research infrastructure needs to enable at-scale deployment of CCUS and CDR in Europe, within TRL1-TRL7



Director's Statement

In 2024, Carbon Capture, Utilisation and Storage (CCUS) and Carbon Dioxide Removal (CDR) are gaining momentum across Europe, driven by EU climate targets and industrial decarbonisation needs. Several large-scale CCUS projects are in development or early operation, particularly around the North Sea. E.g. Longship project in Norway, or PORTOS in the Netherland. CDR technologies, including bioenergy with BECCS and direct air capture DACCS, are in pilot stages with increasing policy and funding support. Key challenges remain in scaling infrastructure, cross-border CO_2 transport, and creating viable business models. Collaboration through initiatives like ECCSEL ERIC and EU funding programmes continues to play a critical role in advancing R&I and deployment.

In 2024, ECCSEL ERIC has continued to evolve as a key European research infrastructure aligned with EU and national priorities, including the ICMS and initiatives in countries such as Germany, Denmark, and the UK. We have advanced efforts to expand our regional footprint by engaging potential new member countries and extending our scope beyond CCUS to include Carbon Dioxide Removal (CDR), Low Carbon Energy Storage, and Geothermal technologies. A stronger industry focus has been pursued by integrating more industry-relevant facilities and promoting ECCSEL as a preferred partner for industrial decarbonisation. To support this, we enhanced our marketing and communication strategy, increasing visibility and outreach. Transparency and facility utilisation remain high priorities, with measures being defined to better assess and communicate capabilities and capacities across our infrastructure. Finally, we continue to sharpen ECCSEL's value proposition by highlighting not only our world-class facilities, but also the unique expertise and know-how of our people.

The reporting year concluded with a significant milestone: at the General Assembly meeting in December, Denmark was formally approved as a full member of ECCSEL ERIC. We are delighted to welcome Denmark, with INNO-CCUS as the national node lead, supported by four outstanding research institutes and universities. Denmark is rapidly establishing itself as a leader in CCUS and CDR, driven by strong policy support and pioneering projects such as Greensand, which leverages North Sea storage capacity. Its integrated approach enables full value-chain development, including cross-border CO_2 transport and storage, while also advancing CDR technologies like BECCS and DAC within its renewable energy and district heating systems.

Looking ahead to 2025, ECCSEL ERIC is set to accelerate its regional expansion and fully deliver on its broadened scope, driving research & innovation and impact across the carbon management landscape.

Klaus Tobias Mosbacher, Executive Director

Intro statement Denmark

The Organisation

With its statutory seat in Norway, the ECCSEL ERIC Operations Centre is situated on the campus of the Norwegian University of Science and Technology in Trondheim. Our main tasks are central management and planning as well as coordination and development of the Research Infrastructure. We are three full time staff and six part time staff. The ECCSEL ERIC Operations Centre is coordinating the ECCSELERATE project, a 3-year Horizon 2020 project running until 31.12.2023 (the project was extended with one due to the Covid-19 pandemic). All nodes are participating and all ECCSEL facility owners are involved in the project.

ECCSEL HQ, Trondheim

Klaus Tobias Mosbacher
Executive Director (since February 2024)

Volker Rohling
Deputy Director

John Ivar Eidsmo
Marketing & Communication (consultant)

Debbie Koreman van den Bergh
Administration

ECCSEL Node Representatives

Helen Taylor-Curran
United Kingdom

Valentina Volpi
Italy

Sébastien Dupraz
France

Robert de Kler
The Netherlands

Morten Grønli
Norway

Lasse Rosendahl
Denmark (from 2025)

Our Mission

ECCSEL offers open access to over 100 world class CCUS research facilities across Europe to support national CCUS strategies and the EU Industrial Carbon Management strategy.

ECCSEL coordinates European development of CCUS facilities and their services to meet identified needs. In future the Research Infrastructure will also cover carbon dioxide removal (CDR) and subsurface Low Carbon Energy storage (LCES).

The research infrastructure reaches out to relevant industry, academia, and research communities to determine their research infrastructure needs to support full-scale deployment of CCUS in Europe.

Our Vision

The ECCSEL vision is to enable research & science activities to achieve net zero CO_2 emissions from industry, power generation and air to combat climate change.

Main objectives

- Coordinate, operate and further develop a world-class distributed CCUS Research Infrastructure in Europe
- Provide access to integrated, upgraded and newly constructed CCUS research facilities
- Enhance European science, technology development, innovation and education in the field of CCUS
- Be the Centre of Excellence for training and education in CCUS.

ECCSEL ERIC Research Infrastructure

ECCSEL ERIC operates a distributed, integrated European research infrastructure (RI) based on a selection of the best research facilities in Europe for carbon capture, transport, utilisation, and storage (CCUS). The over 100 research facilities make up ECCSEL ERIC; they are in five member countries and owned by 28 different facility operators. The number of operators and facilities will continue to increase over time.

Examples of Transnational Access and Use of ECCSEL ERIC Research Facilities

ECCSEL RI facilities have been used for many different research projects during 2024. Below are some examples of transnational use of ECCSEL facilities in Italy, United Kingdom, France, the Netherlands and Norway for CCUS research.

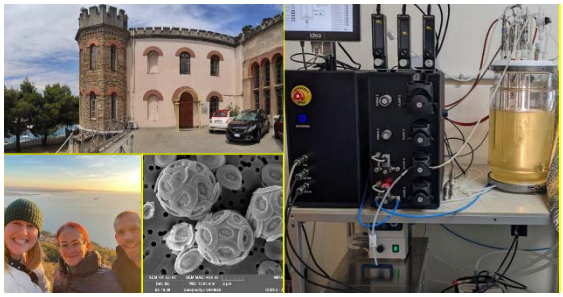
ECCSEL-IT: 8th Scientific Diving Summer School

The 8th edition (the second within the ECCSELLENT project) of the Summer School of Scientific Diving took place in Panarea from September 18 to 23, 2024. The school was organised by OGS and La Sapienza Rome University in collaboration with the Istituto Nazionale di Geofisica e Vulcanologia – INGV, Università di Napoli Parthenope and CO2GeoNet. The school was dedicated to the study of the geology, chemistry, biology and ecology of shallow hydrothermal vents, as the volcanic complex of the island of Panarea (Aeolian Archipelago, Italy) is one of the largest hydrothermal fields in the entire Mediterranean area and a unique natural laboratory for scientific diving studies and for the study of various aspects related to CO2 storage (e.g. natural processes, monitoring, impacts of CO2 leakages on ecosystems). For this edition of the school, 37 applications were received from all over the world, of which 10 candidates from different countries were shortlisted. The activities included 6 scientific dives, 7 multidisciplinary theoretical lessons, and practical sessions. In conjunction with this edition of the Summer School, on September 18, a workshop on CCUS technology was organised at the ECCSEL-NatLab of Panarea, on site or online.

Some of the underwater activities carried out during the Scientific Diving Summer School. Photo: OGS

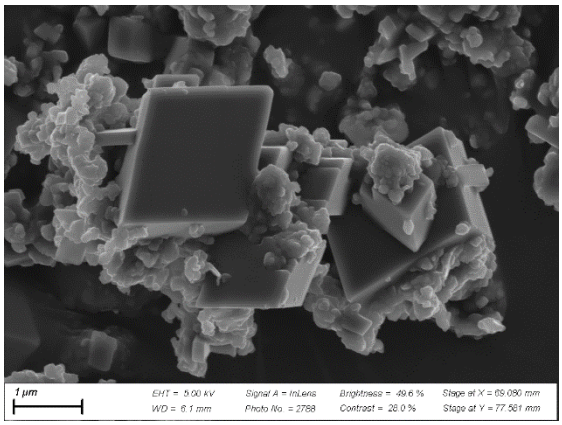
ECCSEL-IT: BioMarine Lab of OGS

As part of the ECCSELLENT project, access to the Italian ECCSEL-ERIC facilities was funded through a call for transnational access (TA). During the TA of Gerald Langer (ICTA-UAB, Spain) and Jelena Godrijan (Ruđer Bošković Institute, Croatia) to the Biomarine Lab (IT1.2), from 10 to 24 November 2024, the biomass and calcite production of calcifying microalgae (coccolithophores) were tested under high CO2 levels to investigate the potential of these organisms within the CCUS. The 10-litre photobioreactors available in the Biomarine laboratory, equipped with numerous sensors to monitor CO2 consumption and seawater properties, allowed the identification of more suitable strains of coccolithophores for CO2 sequestration and opened new perspectives for the application of this little-studied group in the CCUS.



T.A. at BioMarine Lab of OGS. Photo: OGS

ECCSEL-UK:

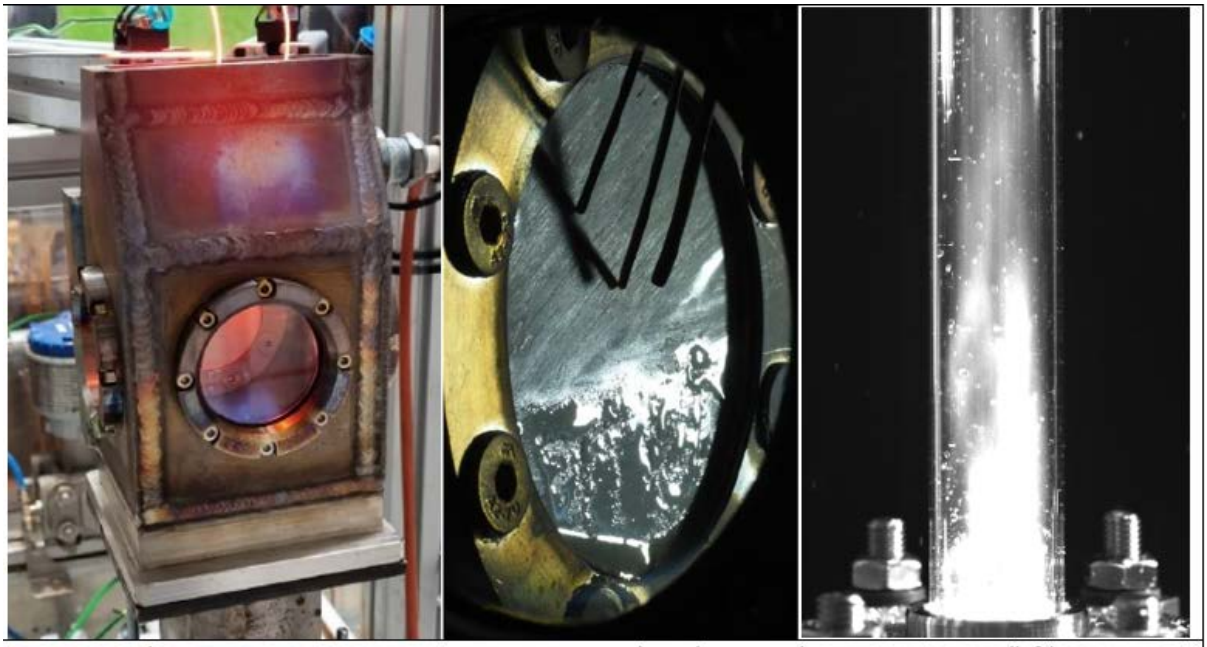


Experimentally-produced magnesite crystals, that sequestered CO_2 during fluid-rock interaction experiments performed at the HTL. Photo: Blazei Cieslik, Alicja Lacinska

Four ECCSEL-UK storage facilities are collaborating to benchmark field instruments to improve the detection of fugitive CO_2. The Gas Mon and GeoMicro facilities, along with expertise from HTL, have joined forces to develop and improve methods to locate and quantify leaking CO_2 at the GTB field site, as part of a project funded jointly by CO2GeoNet and UKCCSRC. A possibly unique example of three ECCSEL facilities all working together on location at a fourth ECCSEL facility.

ECCSEL-NO: COMBLAB

Transnational Access was granted to a post-graduate student of Gdansk University of Technology to use COMBLAB (NO2.2) for testing porous WHIPOX plates and a burner dedicated to a novel Wet oxy-Combustion Chamber (WCC) aimed to fit the gas turbine of a negative CO_2 power plant using sludge as its primary fuel. COMBLAB offered a ready to use combustion bench and measurement capabilities where the prototype equipment has been hooked up and tested. The WHIPOX plates, to be used as combustor wall with transpiration cooling, were tested in cold and hot air conditions for calibration and validation purposes, before being operated in contact with a hydrogen-methane flame. These experiments allowed evaluation of the performance of the WHIPOX plate and its (transpiration) cooling, and particularly identified the critical point at which evaporation begins and observed the disappearance of the liquid water film on the plate surface as a function of flame power and cooling water flow rates. The data will help guide future R&D efforts to improve the performance and functionality of the WHIPOX material as combustor wall. The second set of experiments focussed on the novel oxy-fuel burner to assess the stability and characteristics of the flames generated. The challenges highlighted were ignition and in-flame water injection. Results were presented at TCCS-12 in Trondheim (2023) and published at the ASME Turbo Expo 2024.



Transnational Access to COMBLAB-NO2.2. Transpiration cooling plate - combustion experiment (left), visualisation of water evaporation point at plate surface subject to a flame (middle), and oxy-flame with water injection (right).

ECCSEL ERIC Research Facilities

ECCSEL ERIC consists of research facilities from universities, research institutes and industry in five ECCSEL member countries. ECCSEL provides researchers across the globe with easy access to these facilities through our website. ECCSEL coordinates facility upgrades and new builds. ECCSEL RI facilities are categorised by CCUS technology. Detailed lists of the ECCSEL RI facilities and their operators/owners can be found at www.eccsel.org

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Category	Technology
Capture	Membranes
	Solvents
	Sorbents
	Combustion
	Cryogenic
	Full chain systems

Category	Technology
Transport 	Security/troubleshooting Fluid characterisation Flow characterisation Material testing CO_2 pipeline transport and integrity Shipping of CO_2
Storage 	Pressure/injection Migration Caprock/well integrity Leakage mitigation/remediation/impact Micro-seismicity Reactivity/mineralisation Leakage prevention Monitoring
Utilisation 	CO_2 thermochemical conversion and hydrogenation CO_2 electrochemical and photochemical conversion CO_2 conversion to solid carbonates Smart integration with carbon capture and re-use into valuable products

ECCSEL RI facilities are categorised by CCUS technology (detailed lists of the ECCSEL RI facilities and their operators/owners can be found on the ECCSEL website). More technologies are being added on a continuous basis.

Innovation and Investment Plan

ECCSEL produces Research Priorities documents to identify key research challenges and strategic objectives for ECCSEL. The strategy covers all areas of CO_2 capture, transport, utilisation, and storage (CCUS). In future it will also cover CDR and sustainable underground energy storage.

ECCSEL research priorities have set out national research activities and interests before synthesising into key research priorities for capture (including CDR), transport, storage, and utilisation, that will need to be addressed to facilitate broad-scale deployment of CCUS, and that are of common interest beyond national borders. Where appropriate, key research facilities towards which ECCSEL could usefully focus resources and investment, design and development efforts in the medium term have been identified.

ECCSEL has also performed an analysis of current CCUS research facility gaps. Based on the gap analysis, combined with input from national CCUS roadmaps, facility upgrades and new builds have been planned and, in many cases, funding has been approved and construction has commenced. Upgraded and new capture, transport, utilisation, and storage research facilities are in the process of joining ECCSEL.

National Nodes, Innovations, and Investment

The Italian Node

[Note: Completed -VV]
Overview of ECCSEL IT-node

The high-level expertise of the seven members of the Italian node is highly complementary and allows Italy to be well represented in the ESFRI context and in the CCUS arena. All partners are internationally recognised institutes in the field of CCUS, coordinating international projects and representing Italy on European and international boards.

ECCSEL-IT expanded in the number of facility owners and facilities. Two CNR facilities, partners of OGS in a recent funded project (ECCSELLENT), have joined ECCSEL. Discussions are currently underway with Politecnico of Milano and INGV (National Institute of Geophysics and Vulcanology) for the inclusion of several relevant facilities in capture and storage. The Italian Node currently consists of eighteen CCUS facilities owned and operated by seven Italian institutes:

ECCSEL partners Italy	Research Facility
OGS	Seven CO_2 storage research facilities
Sotacarbo	Two CO_2 capture facilities, one CO_2 use facility, one CO_2 capture and use facility and two CO_2 storage research facility
ENEA	One CO_2 capture and use facility
The University of Bologna (DICAM)	One CO_2 capture facility
LEAP	One multicategory facility (mostly focused on CO_2 capture and transportation)
CNR-ITAE	One CO_2 utilisation and transport facility
CNR-STEMS	One CO_2 capture and transport facility

Activities in 2024 in Italy

In 2024 most of the Italian partners worked on the ECCSELLENT project funded under Italy's National Recovery and Resilience Plan (PNRR), Mission 4 "Education and Research" – Component 2 "From Research to Business", Investment Line 3.1.1 "Fund for the construction of an integrated system of research and innovation infrastructures." The total investment amounts to €16.5 million.

The general objective of the ECCSELLENT project, coordinated by OGS, is to upgrade most of the Italian facilities part of the ECCSEL ERIC in the full chain of CCUS. The facilities are owned by OGS, the University of Bologna, the LEAP/Politecnico di Milano, and ENEA, and the two facilities owned by CNR Messina (ITAE) and CNR Naples (STEMS), that by means of this project became part of ECCSEL. The project goal is to enhance CO_2 storage facilities to improve site assessment, leakage detection, impact evaluation on marine ecosystems, and monitoring strategies. CO_2 capture technologies will be diversified, addressing various industrial sectors (e.g., cement, steel, chemical, biogas, power, syngas, DAC) and flue gas conditions. Transport technologies will provide robust testing for materials used in CO_2 containment and transport. All developments will be digitally

integrated, using data sharing and digital twin models. CO_2 utilization technologies will gain new tools and methods, fostering innovative catalytic processes to produce renewable fuels with net-zero emissions. A dedicated digital work package will ensure data discoverability, accessibility, and interoperability through international metadata standards. These advancements will boost Italy's scientific competitiveness, support cross-sector connections (energy/environment), and inform policy and best practices on CCUS. The collaboration among research units will ensure the sustainability and expansion of the ECCSEL national node within ECCSEL ERIC.

ECCSEL-IT is actively involved in the Italian Energy cluster (https://www.cluster-energia.it/en/ctne/), grouping all energy actors, and discussing energy issues. Outcomes from the cluster are addressed and serve to help implement ECCSEL research priorities.

The link with ICDI (https://www.icdi.it/en/), the Italian initiative connected to EOSC, has been reinforced, to better align strategies on data at national and European level. OGS has representatives in the shadow working groups representing the institute and RIs, among others.

In 2024 ENEA conducted multiple experimental campaigns aiming at CO_2 valorisation within the framework of the PTR and POR H_2 National Projects. Through Sorption Enhanced Gasification (SEG) tests, carried out in a double fluid bed (DFB) reactor and in a Rotary Drum Reactor (DRM) at ZECOMIX plant, ENEA successfully showcased the technical feasibility of the intensified gasification process of biomasses coupled with CO_2 capture at ambient pressure. ENEA has also modelled the SEG process at pressures up to 10 bar, aiming at improving the efficiency of the process, and is going to implement a new reactor working up to 10 bar for its experimental validation. Additionally, investigations conducted within a Discharge Barrier Reactor (DBD) integrated into the SFERO-Lab, for the dissociation of captured CO_2 into CO and O_2, have been carried out implementing perovskite membranes for O_2 separation. Moreover, experimental campaigns focused on CO_2 mineralisation utilising metallurgical slags and industrial wastewater were also undertaken, with preliminary tests indicating a good CO_2 storage capability under controlled temperature and pressure conditions.

Facility innovations and investments in Italy

As part of the Eccsellent project, previously described, all planned implementations were completed in 2024. For the Panarea laboratory, instruments for marine geophysical investigations were purchased, such as a multibeam sonar, gravimeter, and a seismic acquisition system. In addition, a comprehensive monitoring approach that combines seismic and GNSS sensors was implemented. This will allow for the monitoring of low- and high-frequency (and possibly also high-amplitude) ground motion either continuously or during experiments, and in the event of leakage episodes. At the PITOT site, the implementation involved the deployment of cutting-edge Distributed Acoustic Sensing (DAS) fiber optic technology using the Silixa Carina® system, a new borehole source for crosswell surveys, and electrode arrays for resistivity measurements installed along one borehole, with one portable unit for surface measurements. The ECCSEL Aircraft facility has been enhanced through the addition of two UAV (unmanned aerial vehicle) drones, as well as upgrades to our airborne instruments. These two UAV platforms can be used to characterize the surface and subsurface of the territory through gravimetric and magnetic modeling, providing highly useful tools for assessing vegetation and soil response to potential CO_2 leakages. The technological enhancement of BioMArine Lab involved improvements to the main systems (hydraulic, wiring, and Wi-Fi) and upgrades to existing systems for marine water withdrawal and filtration. Additionally, three mobile laboratories will be set up: two dedicated to incubators and the third to experiments with invertebrates. Most

experimental conditions will be monitored and adjusted remotely via the internet.

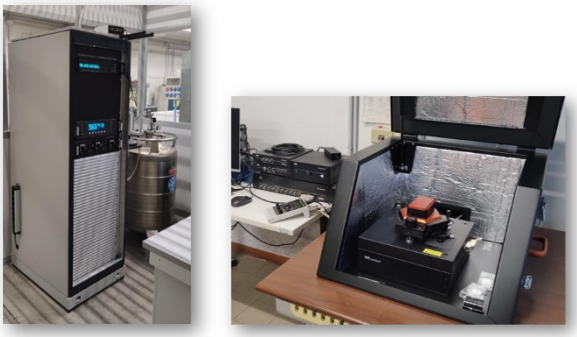
In 2024, Sotacarbo was involved in several research activities on low carbon technologies, with particular reference on hydrogen production by means of advanced electrolysis and gasification of waste materials (biomass and non-recyclable plastic waste) and on hydrogen and CO2 conversion into renewable fuels (i.e. methanol, dimethyl ether, methane, sustainable aviation fuels). Most of these research activities – supported by fundings provided by both the national and regional Governments – are based on experimental campaigns on some ECCSEL facilities, such as the XtL and the "Power-to-fuels" units, with the collaboration of relevant international partners such as the U.S. Department of Energy – National Energy Technology Laboratory (NETL) and the Indian Institute of Technology Madras. In parallel, Sotacarbo is engaged in three new projects aimed at the development of advanced research infrastructures and facilities that will be proposed to be part to the ECCSEL Research Infrastructure as soon as they will be available for operation.

In 2023, LEAP finalised measurement campaigns in its upgraded CO2_box facilities in research activities dealing with phase equilibria measurements of hydrogen-hydrocarbon mixtures (binary or multi-component) of interest for H2 storage. Databases obtained in the CO2_box were used to calibrate equations of state, useful for characterising and modelling the effect of hydrogen on the thermodynamic properties of hydrocarbon blends.

In 2024 ENEA, with its Laboratory of Sustainable Combustion and Thermal & Thermodynamic Cycles (CCT) located in Casaccia Research Center, has carried out in the frame of ECCSELLENT Project the enhancement and the expansion of ENEA's infrastructures, i.e. the Double Fluidized Bed (DFB) test bench at ZECOMIX Infrastructure and the SFERO laboratory dedicated to materials preparation and testing. The new laboratory facilities consisted of i) a high pressure Termogravimetric Analyser (HP-TGA), ii) a Micrometrics FR-100 benchtop reactor for the test of catalysts, iii) two high pressure reactors (1 liter and 8 gallons) for catalysts' synthesis and CO2 mineralization tests, iv) a Fourier-transform infrared spectrometer (FTIR) for materials' characterization, v) a spheronizer/extruder system for the preparation of granulates, vi) a ball miller for powder grinding and mechanochemical synthesis, vi) a high temperature furnace, vii) and a high speed centrifuge. The enhancement of the laboratory for powder manufacturing and characterizations allowed ENEA to settle the new ECCSEL ERIC Research facility SFERO-Lab (Systems for Flexible Energy Reusing carbOn Laboratory).

In 2024, the University of Bologna continued the development of new research infrastructure under the ECCSELLENT project, funded by the Italian government's National Recovery and Resilience Plan. Considering the equipment acquisitions made in 2023, the installation and commissioning of several advanced instrumental systems were successfully completed during the year (2024). Specifically, the University is now equipped with the following upgraded facilities: i) a high-pressure sorption system for the analysis of CO_2 and other gases across a wide temperature range (from -200 to 45°C) and pressure up to 150 bar; ii) an infrared (IR) system for the study of CO_2/polymer interactions under various pressure and temperature conditions; iii) an Atomic Force Microscope (AFM) for structural analysis of selective coatings in membranes for CO_2 capture; iv) a Dielectric Spectroscopy system that allows to determine the polymeric chain mobility and relaxation, both in pristine state and after been exposed to high pressure CO2 in order to better understand the effect that this gas has on material's conductivity and permittivity; v) a fast field cycling NMRD system to investigate interactions between CO_2 and porous rocks and minerals for geological storage applications. In addition, 2024 marked the implementation of a

new high-pressure permeation system for polymeric membranes, capable of performing tests at pressures up to 150 bar and temperatures down to –15 °C. This system enables advanced testing under extreme conditions, representative of real-world scenarios in CO2 transport applications. Finally, the laboratory renovation work was completed, including the installation of new lab benches for the test-rig, gas lines and DPI (Individual Protection Device) sensors, ensuring full integration and safe use of all newly installed instruments.



On the left, Dielectric spectroscopy system and AFM Microscopy on the right.

In 2024, CNR with its unit ITAE “Istituto di Tecnologie Avanzate per l’Energia” located in Messina is completing the realization of a new research facility, the "Green Tech Lab for CCU applications" (GTL4CCU). GTL4CCU is a research facility completely dedicated to the enhancement of CO2 utilization technologies. The facility is dedicated to the development of innovative catalytic systems for an efficient conversion of CO2 into e-fuels, in a continuous feedback between kinetic studies and thermodynamics predictions. There are four main research lines:
1. Design and preparation of powdered and structured multi-functional materials with tailored properties for the CO2 activation;
2. Lab-scale test rigs equipped with fixed-bed and stirred reactors to study and validate catalytic behaviour, performances and stability of catalytic materials during CO2 hydrogenation to e-fuels, like methane, methanol, dimethyl ether or higher hydrocarbons;
3. Advanced bulk and highly located surface characterization of catalysts by optical and electronic microscopy;
4. Spectroscopic techniques for the study of catalytic processes of CO2 hydrogenation under real conditions.
In this regard, for each line of activity, a broad investment plan is being completed, mainly including the acquisition of tools for the full functionality of a Cartesian robot for the additive manufacturing of catalytic architectures, devices for the scale-up of synthetic procedures, industrial-type ultrasonic processors, the setting up of TRL 4-5 test benches for the catalytic hydrogenation of CO2 to e-fuels, the enhancement of IR spectroscopic techniques for in situ/operando measurements through hyphenation with thermo-analysis or quadrupole spectrometry, latest-generation optical and electronic microscopes. In the field of electronic microscopy, the major investment is represented by a SEM-FEG-UHR-FIB Thermo Scientific HeliosTM 5 UC Dual Beam instrument, a fully digital, extreme High Resolution (XHR) field emission Scanning Electron Microscope (FE SEM) equipped with Focused Ion Beam (FIB) technology. It allows for the fast characterization of nanometer details and analysis in 2D and 3D, best in class sample preparation and flexible nano-prototyping.

The first accesses to the infrastructure by foreign researchers/students are already scheduled for 2025 through the Transnational access call, launched with the ECCSELLENT project.

Furthermore, the full functionality of the facility will be tested during the CO2Cat School, a catalysis school that will be held between 7 and 11 April 2025 at the premises of the GTL4CCU research facility.

In 2024, CNR, through its STEMS unit “Istituto di Scienze e Tecnologie per l’Energia e la Mobilità Sostenibili” based in Napoli is completing the

establishment of the “Laboratory of Materials Development for CO2 capture” (MADE4CO2-Lab) research facility. The facility is devoted to the synthesis (in lab scale), characterization and testing of advanced solid sorbents with a focus on their CO2 capture performances. The laboratory equipment comprises advanced instrumentation aimed to a full and comprehensive characterization of the sorbents chemico-physical features relevant for gas sorption applications. CO2 adsorption performances of novel and commercial materials are also probed in realistic scenarios. The MADE4CO2 Lab will offer the opportunity for the stakeholders (R&D, industrial sector, small and medium-sized enterprises) to characterize and test materials and sorbents in conditions mimic real operation making use of the consolidated experience of the scientific staff in the development of multifunctional materials and preparation of composites and hybrids with a specific chemistry and structure. The development of materials starts from the design of chemical formulation up to the production of objects in a structured form, involving engineering with a multi-scale approach. The design of sorbents with distinctive characteristics for CCS applications is part of the MADE4CO2 Lab vision of sustainability as it hinges on the recovery and enhancement of production wastes both as regards the conception and development of sorbents (low cost and eco-friendly approaches) and for their use for specific applications (greenhouse mitigation). MADE4CO2 Lab devotes a particular attention to the optimization of the sorbents from the point of view of the cost/performance ratio. The equipment that will be available at MADE4CO2 Lab covers a wide range of operative conditions and can be used to characterize many different materials (polymeric, MOF, carbon-based, nanocomposite, ceramic and metallic sorbents). The MADE4CO2 Lab will be the first Italian node in the South Italy specifically devoted to the study of advanced materials for CCS applications.

The MADE4CO2 Lab comprises lab scale facilities for material synthesis (furnaces for pyrolysis and carbonization; hydrothermal carbonization reactors) and advanced instrumentation for material characterization as X-ray photoelectron spectroscopy (XPS/ESCA); Breakthrough Selective Adsorption analyzer for the assessment of CO2 adsorption under dynamic flow; Atomic Adsorption spectrophotometer; 3D Stylus profilometer for surfaces characterization; high-performance adsorption analyser to measure pore size, surface area and pore volume of particulate materials and powders, equipped with a high-performance pretreatment station for sample degassing in inert flow; Thermobalance coupled via a transfer line with a FTIR analyser; Electrokinetic Analyzer for Solid Surface Analysis; spray coater.

The first accesses to the infrastructure by foreign researchers/students are already scheduled for April 2025 through the first Transnational access call, launched through the ECCSELLENT project.

Research projects 2024 in Italy

The ECCSELLENT project will upgrade most of the Italian ECCSEL facilities. The project started in November 2022 with a total investment of 16.5 M€ over 30 months. During 2023, most of the objectives of the project have been reached.
In 2023 ENEA has proceeded with the Programme “Piano Triennale della Ricerca di Sistema Elettrico, PTR 2022-2024" focused on H_2 production from biomass gasification intensified with CO_2 capture at high temperature with solid sorbents.
In 2023 the ENCASE (http://www.encase-eu.com/) project started, involving LEAP RI and POLIMI Italian partners. ENCASE aims to continuously improve seven world-leading CCS-related facilities with state-of-the-art scientific instruments, tools, and methods, to become the backbone for research and development of CCS technologies. Coordinated by IFE, the project integrates 20 partners organisations from five countries, and it will run until June 2026.

LEAP is enhancing the experimental capabilities of its CO_2_box facilities with a new calorimeter and a new viscometer and will focus, with POLIMI, on experimental characterisation.

The CLEANKER project, aimed at demonstrating the Calcium Looping (CaL) concept at TRL7 (CaL, configuration highly integrated with the cement production process, making use of entrained flow reactors), has performed final pilot scale tests in 2023 to demonstrate the potential of one of the most promising technologies for CO_2 capture in cement plants. The pilot plant, opened in Vernasca in 2020, is a CaL demonstration system that captures the CO_2 from a portion of the flue gas of the cement plant operated by Buzzi Unicem, using the same raw meal used for clinker production as a CO_2 sorbent. Coordinated by LEAP, the project integrated 13 research organisations from seven countries and concluded in March 2023.
In 2023 relevant activities in CCUS at UNIBO were focused on testing polymeric materials for both CO_2 capture and transport. In capture, a series of high free volume glassy polymers provided by the University of Edinburgh were tested to understand their potential in CCS. In transport, the CO_2 EPOC project - Characterisation and prediction of the CO_2 effect on polymeric materials within the CO_2 transport chain, continued through a series of tests focused on the analysis of CO_2 sorption on polymeric materials used in CO_2 transport infrastructures (i.e. as sealing elements in valves and pipelines). The data were modelled to extend the results to operational conditions not currently attainable in the laboratory.

Outlook for 2025 and beyond: Activities, upgrades, new builds, future projects

The Italian Ministry of University and Research (MUR) has supported OGS activities with an annual contribution dedicated to research infrastructures, specifically to the two natural laboratories of Panarea and Latera (ECCSEL NatLab–Italy project). The contribution in 2024 was 550 K€ and is expected to be confirmed for 2025.

In the framework of the IPANEMA project, highly innovative high-tech instruments have been acquired and are now fully operational. Several researchers and industrial stakeholders have shown great interest in the upgraded infrastructure and requested access for joint research activities in 2024. The IPANEMA HR proposal, linked to the IPANEMA project, aimed at strengthening human resources in the Panarea NatLab and CTMO facilities, will be active until May 2025.

During 2023, OGS started a series of bilateral meetings with an Italian life company A2A, interested in testing both bio-based and geological sequestration of CO2 through specific laboratory experiments at OGS BioMarine Lab facility. In 2024 a project was finalized, with the aim of constructing a pilot plant for the capture of CO2 through marine microalgae by 2030.

In 2025, the enhancement of UNIBO research infrastructure under the ECCSELLENT project will progress further. On one front, formal procedures will be undertaken to integrate the newly installed facilities into the ECCSEL framework. In this context, the MEMLAB laboratory will be expanded to include the recently commissioned AFM, FT-IR and permeation system, thereby strengthening its capabilities in gas separation studies. Additionally, a new research infrastructure, named the “Transport Lab,” will be proposed and implemented. This facility will consolidate all experimental platforms dedicated to the investigation of high-pressure interactions between CO_2 and polymeric materials, supporting advanced research in material compatibility for CCS applications.

On the other side, the administrative work will focus on the finalization of the last purchases in the framework of ECCSELLENT project, such as new equipment for hollow fiber membrane production.

Moreover, the last instrumentation bought at the end of 2024 will be installed together with the final implementation and design of some permeometer test-rig for Carbon capture system that will confer increased flexibility with respect to the currently available facilities. In 2025, the University of Bologna will be actively engaged in new international research projects and collaborations, including: Polhymer, H2Durapol (in partnership with SINTEF Industry), Charmpol, and a newly funded PNRR initiative titled E-Kerometh, which focuses on methanation processes.

In 2025, ENEA will proceed with activities on CCUS funded by a new "Piano Triennale della Ricerca di Sistema Elettrico, PTR 2025-2027, Project 1.6, WP3", focused on the development of CCS Technologies for the efficiency of the HtA industry and the achievement of Net-Zero objectives and will proceed with CHemPGM project, continuing to develop catalysts for CO2 use and valorization. The enhancement of ENEA research infrastructures ZECOMIX and the SFERO-Lab, carried out thanks to ECCSELLENT project, will progress further. Moreover, the new facilities in the SFERO-Lab will be exploited during a Transnational Access scheduled in June 2025. In September 2025 ENEA will organize a Technical Session devoted to CCUS topics at NanoInnovation 2025 Conference.

In 2025 CNR will try to arrange a mid-term plan for the sustainability of its Research Infrastructures, eventually to be aggregated with other initiatives carried out within the Recovery and Resilience Fund.

ECCSEL-IT is planning to expand with the inclusion of the Politecnico di Milano with its "POLICAP" pilot plant, already designed, currently under procurement and to be commissioned by the end of the ECCSELLENT project. The pilot aims to test new solvents and process configurations in post-combustion capture applications. POLIMI presented a poster about the design of this pilot at the 17th Greenhouse Gas Control Technologies Conference (GHGT-17) in Calgary in October 2024. A paper published in the open access conference proceedings is available at this link.

In the framework of the ENCASE project, in June 2025 POLIMI is going to organize a PhD summer school on Thermophysical properties of fluids for energy and CCS applications. Within the ECCSELLENT IT project, different webinars are going to be organized on the different steps of the CCUS chain by the partners in year 2025.

The French Node

[not completed yet, SD, end of week 20)

Overview of ECCSEL FR-node

France has been involved in the development of the ECCSEL Research Infrastructure since 2008, and from 2017 ECCSEL-FR has been officially constituted and structured around four public research institutes (ANDRA, IFPEN, INERIS, BRGM) and two private companies (EDF, TOTAL). In 2021, the French node expanded with the entry of CNRS, the national centre for scientific research, and then in 2022 with Lafarge and ARMINES.

The French node is coordinated on behalf of the French Ministry of Research by BRGM through a partnership agreement. ECCSEL-FR has nine facility owners providing access to eighteen research facilities. Three additional facilities are in development and are not yet accessible. These facilities cover the whole CCUS chain:

ECCSEL partner France **Research facility**

EDF	One capture facility
INERIS	One transport and one storage facility
TOTALEnergies	One storage facility
ARMINES	One capture, transport and storage facility
LAFARGE	One capture facility
Andra	One storage facility
BRGM	Two storage and utilisation facilities
IFPEN	Two storage facilities
CNRS	Three storage facilities, three storage and utilisation facilities, and one storage, utilisation and transport facilities

News and Activities in 2024

On June 23rd, the French Prime Minister unveiled a Carbon Capture, Utilization, and Storage (CCUS) strategy during a meeting of the National Industry Council (CNI) in Le Bourget. This strategy aims to reduce greenhouse gas emissions, aligning with commitments made under the Paris Agreement. The plan emphasizes the importance of CCUS technologies in achieving climate goals and outlines key aspects for industry stakeholders to consider.

The proposed strategy includes a phased deployment plan for CCUS technologies, prioritizing industrial zones such as Dunkirk, Le Havre, Fos-sur-Mer, Lacq/Southwest, Loire Estuary, and Grand Est. Support for decarbonization projects, particularly through Contracts for Difference (CCfD) awarded via competitive bidding, will be integral to advancing industrial carbon capture and storage efforts.

The framework also addresses the need for infrastructure development for CO_2 transport, regulated by the Energy Regulatory Commission (CRE), with risk-sharing mechanisms between the government, infrastructure operators, and industrial users. Furthermore, diversification of CO_2 storage options is highlighted, with plans for exploration campaigns and injection tests in pilot sites by 2024/2025, potentially utilizing former hydrocarbon extraction areas.
Additionally, the strategy explores opportunities for CO_2 utilization as an alternative to storage, particularly in sectors like aviation and maritime, offering potential pathways for decarbonization.

France's strategy emphasizes that CCUS is not a means to maintain business as usual but rather a solution for unavoidable residual emissions or as a transitional measure when other decarbonization options are economically infeasible. Key aspects of the strategy include prioritized deployment trajectories for CCUS in major industrial zones, supported by Contracts for Difference (CCfD) to incentivize decarbonization projects identified through the 50-site exercise.

This comprehensive strategy reflects France's commitment to leveraging CCUS technologies to meet climate targets while promoting industrial sustainability and competitiveness.

Three important national events were organised in 2023, with the support of the ECCSELERATE project:

- An ECCSEL stand 12-13 October in Paris at "Les Rendez-vous Carnot 2023", a national business convention at which companies with innovation needs can meet R&D providers. The ECCSEL stand was in the 'Village of research infrastructures' and B2B meetings were held
- Two regional seminars held in Marseille and Paris, respectively the 27th of March and 18th of September: "Potentials for deploying CCUS? What role for the regional actors?", jointly organised by ECCSEL-FR and the French Club CO_2. It brought together over 100 participants from academic, public, and industrial sectors.

Several other conferences involving CCUS activities were also held in France, namely a conference about the role of EDC (Energy-Driven Decarbonization) in France's climate strategy (School of Mine, Paris 10th of July) and the 8th edition of ADEME Industrial Transition Meetings on Decarbonizing the steel and ammonia industries by 2050 (online meeting, 27Th of June).

Facility innovations and investments in 2024

BRGM's MIMAROC facility was inaugurated in January 2023. Lafarge's PYCATEST project entered the engineering phase, and EDF built its new CO2 LAB capture facility, scheduled for inauguration in April 2024. Substantial modifications have also been made to the SAFETY and Sphere CO2 (INERIS) facilities, with the addition of further pressurized chambers, a hydrogen explosion chamber (2m3) and a leak test rig (flare fire and flaming leak). In addition, some minor investments were made to update or improve services at existing BIOREP and GEM facilities.

Major research projects in 2024

French facilities were accessed multiple times in 2023:
The facility GasGeoCHEM (IFPEN) was used in several projects: (1) the ADEME Aquifer CO2 Leak project, which study the development and implementation of methodologies for locating a leak of CO_2 and associated gases using a multi-well, multi-tracer approach (impacts on the hydrosystem in a storage context). (2) the

ANR Hystoren project on Hydrogen storage in an underground hydrosystem (physicochemical behaviour, monitoring and environmental impact).

SAFETY platform (INERIS) has been employed to perform training activities for jobs in the hydrogen sector (Symbio Hydrogen Academy). Sphere CO_2 (INERIS) was used in the ENCASE European project. ENCASE is a project aimed at advancing Carbon Capture and Storage (CCS) research and technology in Europe to address the EU's ambitious goals of reducing greenhouse gas emissions. It brings together various stakeholders, including research institutions, operators, manufacturers, academia, and small and medium-sized enterprises (SMEs), with the goal of enhancing competitiveness in the CCS industry.

GEM (CNRS) was accessed to perform studies on carbonatation as storing processes in the Institut Carnot Grant ISIFoR, the CO2MET grant and the ANR-LISZT LISZT project that aims at identifying and modelling the thermo-hydro-chemical mechanisms of CO2-metasomatism producing mantle-derived listvenites and at defining criteria for evaluating their potential as sources of rare and critical metals.

BIOREP (BRGM) has followed to perform tests on CO2 storage through the Pilot Strategy project. The Pilot STRATEGY project is investigating geological CO_2 storage sites in industrial regions of Southern and Eastern Europe to support the development of large-scale carbon capture and storage. It involves 16 research partners from seven European countries and builds on research carried out by the STRATEGY CCUS project.

Additionally, the platforms activities have leaded this year to the submission and acceptation of 6 scientific publications.

Plan and Outlook for 2025

ECCSEL-FR plan for 2024 is to:

- Maintain effort to extend ECCSEL-FR in accordance with ECCSEL's extended scope including new node members as well as new facilities from current members.
- Produce a position paper to better communicate and promote the services and provision of our platforms in the national calls and initiatives.
- Adapt the strategy of the French participation to trans-national access.

Sylvain Stephant at the ECCSEL FR boot at the "Rendez-vous CARNOT 2023" Photo: BRGM

CO_2 Capture module ready to be assembled into the CO2 LAB (EDF) Photo: BRGM

The Norwegian Node

[separate document-MG, end of this week)

Overview of ECCSEL-NO node

The Norwegian government sees Carbon Capture and Storage (CCS) as very important. The main goal of its CCS policy is to identify measures that can contribute to CCS technology development and cost reductions. The government has an ambition to realise a cost-effective solution for full scale carbon capture, utilisation, transport, and storage (CCS) in Norway, provided this will result in technology development internationally.

The Longship and Northern Lights Projects

The Longship project, initiated by the Norwegian government, represents a groundbreaking effort in carbon capture and storage (CCS) technology. It aims to capture CO_2 emissions from industrial sources, transport them, and store them safely beneath the seabed. This initiative is critical for Norway's commitment to achieving its climate goals under the Paris Agreement

Longship involves capturing CO_2 at two main facilities: Heidelberg Materials' cement factory in Brevik and Hafslund Oslo Celsio's waste incineration plant in Oslo. The captured CO_2 is liquefied and transported by ships to an intermediate storage terminal in Øygarden, near Bergen. From there, it is pumped through pipelines to a storage reservoir located 2,600 meters below the seabed on the Norwegian continental shelf.

Northern Lights: Northern Lights is the transport and storage arm of the Longship project. It is a joint venture between Equinor, Shell, and TotalEnergies and is the world's first cross-border CO_2 transport and storage facility. Operational since late 2024, Northern Lights provides open-access infrastructure for industrial emitters across Europe to store CO_2 safely underground

The project's first phase includes a storage capacity of 1.5 million tonnes per year. However, plans are underway to increase this capacity to more than 5 million tonnes annually by 2028. This expansion will involve additional infrastructure such as new storage tanks, injection wells, and transport vessels.

Northern Lights has already signed agreements with European industrial emitters like Yara (Netherlands) and Ørsted (Denmark), showcasing its potential as a pan-European solution for decarbonization

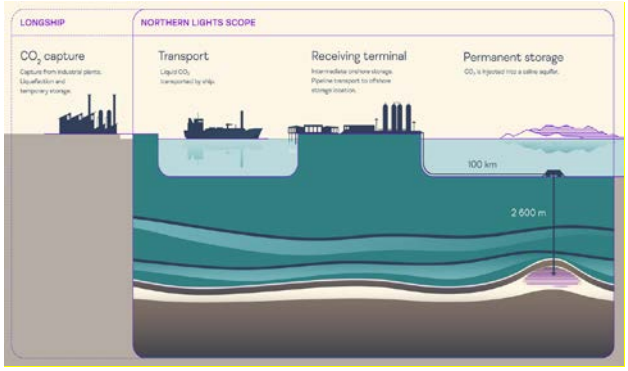


Figure 1. Longship and Northern Lights (www.norlights.com/about-the-longship-project)

The Norwegian CCS Research Centre (NCCS). After eight years of pioneering research, the Norwegian CCS Research Centre (NCCS) held its closing conference in Trondheim, Norway in November 2024. NCCS was a Centre for Environment-friendly Energy Research (FME), that unites 11 research partners, 21 industry partners, and 18 associated partners with the goal of accelerating large-scale CCS implementation. This cross-border and cross-sectoral collaboration has ensured the relevancy of its research and uptake by industry[1)]. NCCS has actively contributed to advancing relevant skills and expertise for CCS. The Centre has educated over 100 students, including 24 PhD students, 55 master's students, and 11 postdoctoral researchers. In addition, NCCS has financed 16 mobility grants, which has led to researcher exchanges between the Centre and 17 research institutes in 10 different countries.

The Norwegian node of ECCSEL with its partners and research facilities

ECCSEL Partner Norway	Research Facility
NTNU - Norwegian University of Science and Technology	Three CO_2 capture facilities One CO_2 storage facility
SINTEF Industry	Seven CO_2 capture facilities and six CO_2 storage facilities
SINTEF Energy Research	Two CO_2 capture facilities and seven CO_2 transport / cross-cutting facilities
Institute for Energy Technology (IFE)	One CO_2 storage and one CO_2 transport facility
NORSAR	One CO_2 storage / transport facility

News and activities in 2024

NTNU ABS laboratories have been actively used in 2023. Some examples of projects using the laboratory are FME NCCS (Task 2), EU project AURORA and the ACT project SCOPE. In NCCS Task 2 solvent stability and degradation was studied. In the AURORA project the focus was on closing knowledge gaps of a specific solvent (CESAR1) while the SCOPE project performed experiments related to understanding solvent emissions.

The FALCON facility has served the testing and benchmarking of equipment provided by a range of vendors. This equipment has been subjected to rigorous development and testing processes, employing carbon dioxide in both its liquid and gaseous states across various pressures and temperatures. This approach has been instrumental in assessing material compatibility and establishing benchmark results.

The Turbulent Combustion Lab was used in 2023 in several projects, including the FRIPRO Stability Through Asymmetry project, in which measurements in an acoustically forced annular combustor were made, and the Low Emission centre, in which dynamics and emissions measurements were made in a simple axially-staged combustor. The lab also hosted international researchers from France and Hong Kong, investigating ignition dynamics with hydrogen fuels, and genetic algorithms for the active control of combustion instabilities.

In 2023 DeFACTO was used in the KSP projects MACON CCS, and PUSCO. In MACON CCS experiments provided sensor data for assessment of thermodynamics and fluid flow models for CO_2 flow assurance. VISC-DENS was used in 2023 for H_2 and $H_2 – CH_4$ tests, under the HYDROGENi and HySTorm projects. Results of the latest work were presented in the Thermodynamik Kolloquium 2023, Hannover.

HPC-PE was used in the EU project ACCSES, the Green Platform project LINCCS and the POLNOR project Energizers, to measure the Energizers, as

well as to measure phase equilibrium of CO_2-H_2O and CO_2-brine mixtures.

Depress was employed as part of the research work in FME NCCS Task 7 on CO_2 Transport and in the new competence-building project CO2FFER. One full-bore pipe experiment and six vessel experiments with different nozzles were conducted. Two journal publications were produced. In addition, experiments conducted at the facility formed part of the basis for a PhD thesis.

A guest researcher from Darmstadt University visited the CLC pilot unit as part of the ECCSELERATE project. Tests of waste derived fuel (SRF) and biomass (wood) at different operational conditions were undertaken. The results will be presented at the 7th International Conference on Chemical Looping Combustion.

The HIPROX facility that is part of the CombLab was used for combustion characterisation studies of ammonia blends. The results have been published in the peer-reviewed Combustion and Flame journal. Through ECCSELERATE, a researcher from Gdansk University of Technology used the facility to test a novel oxyfuel evaporative cooled porous wall combustor.

The MLAB facilities have played a crucial role in implementation of several European and national research and innovation projects. For example, the HEU project HICCUPS proposes a resource efficient solution to convert biogenic CO_2 emissions from bio-gas into bio-based polymers for the packaging industry. The H2020 project eCOCO2 is developing membrane reactors for electrochemical conversion of CO_2 into chemical energy carriers. The facilities are used to assess the electrical and catalytic properties, materials, and long-term stability of high temperature membrane reactors. Finally, the facilities have been used in several national projects related CCUS

The Core Flooding facilities were used in the ACT RETURN project, which aims to enable safe and cost-efficient long-term CO_2 storage in depleted O&G reservoirs by understanding and handling cooling and CO_2 phase change effects during injection.

Facility innovations and investments in 2024

The CO_2 Mix facility underwent upgrades in 2023 to handle toxic mixtures. The facility hosted a student who undertook her summer internship preparing CO_2-H_2O and CO_2-SO_2 mixtures.
SEPPIL has also undergone upgrades in 2023. Several new temperature sensors and shut off valves have been installed in one of the separation tanks. These will be used for accurate measurements of the phase and temperature distribution of stored CO_2 over time.

A new measurement cell was manufactured in 2023 for the HPC-PE. With the new cell the facility can be used for phase equilibrium measurements of mixtures containing hydrogen.

Major research projects in 2024

Ongoing projects using the Norwegian ECCSEL facilities:.

- FME-NCCS, the Norwegian CCS Research Centre (www.nccs.no)
- HYDROGENi, the Norwegian R&I centre for hydrogen and ammonia (www.hydrogeni.no)
- Low Emission Research Centre (www.lowemission.no)

Projects: CO_2 EPOC, MORE, OxHyPro, Stability through TA, MACON CCS, PUSCO, CO_2Flow, AMbCS, CO_2FFER, HySTorm, e$COCO_2$, ENCASE, ACT LOUISE, WINNER, H_2GLASS, ACCESS, HICCUPS, ACT LOUISE, PROTOSTACK, SUSTAINCELL, ANNULIGhT, LAUNCH, REALISE, SCOPE, AURORA, METCCUS, ECCSELRATE, LINCCS.

Plan and outlook for 2025

NCCS's successor, **FME gigaCCS**, was launched in March 2025. The main research objective of gigaCCS is to advance Norway's CCS leadership and support the global implementation of CCS at giga-tonne scale by conducting targeted, interdisciplinary industry-driven research and generating innovation in a

centre of excellence dedicated to fostering capacity and world-leading expertise [2]. The research is organized into four mission areas:

- Capture and CDR
- Infrastructure
- CCS Value chains
- Storage

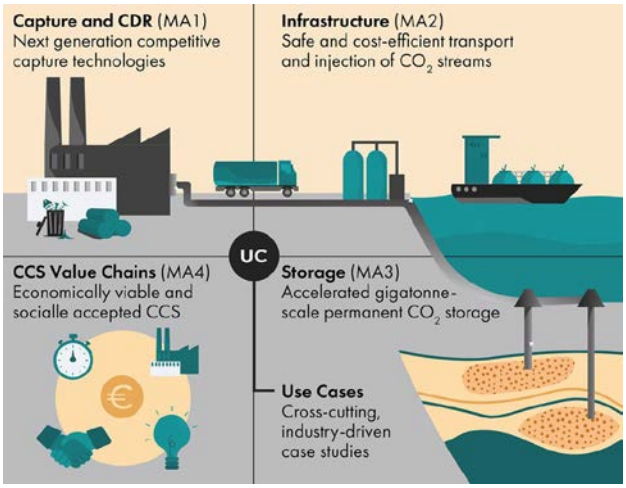


Figure xx. gigaCCS Mission areas[2]

[1] www.nccs.no/news/norwegian-ccs-research-centre-looks-to-the-future-after-eight-years-of-pioneering-research-and-collaboration/

[2] www.gigaccs.no/research/

ECCSEL-Enhancing Norwegian Capabilities (ECCSEL - ENC) is a crucial initiative to support large-scale CCS deployment and reinforce Norway's global leadership in this field. The project focuses on establishing one new experimental facility, upgrading twelve existing ones, and promoting enhanced utilization of CCS infrastructure. These efforts aim to advance research and innovation, positioning Norway as a central figure in CCS deployment.

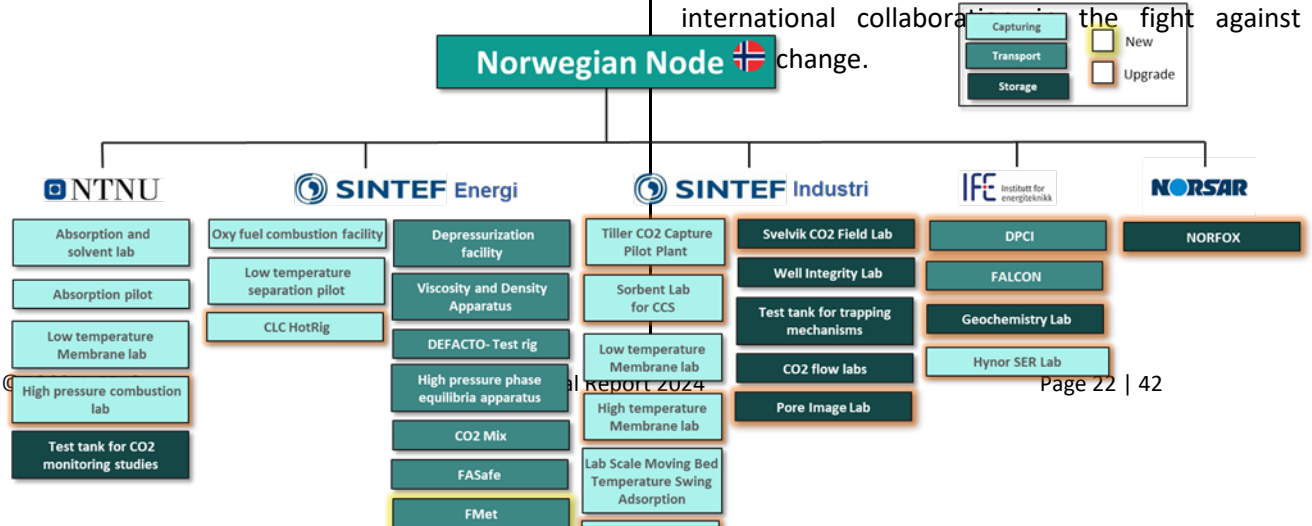
The project's infrastructure spans the entire CCS value chain, covering:

- Capture: Developing technologies like sorbents, membranes, and Oxy-fuel processes to enhance efficiency.
- Transport: Implementing systems for fiscal metering, CO2 flow monitoring and addressing corrosion challenges.
- Storage: Improving methods for monitoring containment and optimizing CO2 storage.

ECCSEL-ENC targets three main objectives:

1. Advance cost-effective capture technologies with higher rates and purities, linking CCS to the blue hydrogen economy.
2. Enable secure, reliable, and traceable CO2 transport technologies.
3. Ensure permanent and safe CO2 storage.

The project's partners include SINTEF, IFE, NTNU, NORSAR, and ECCSEL-ERIC. The Norwegian node of ECCSEL ERIC will feature over 30 state-of-the-art research facilities, backed by funding exceeding 300 million NOK (28 million EUR) from the Research Council of Norway over a 10-year period. This initiative underscores Norway's commitment to advancing CCS technologies and fostering international collaboration in the fight against climate change.



Facilities from the partners of the Norwegian node to be approved for inclusion in 2024:

Name of Research Facility	Upgrade, New	Area
DPCI - Kjeller Dense Phase CO2 Impurity Test Facility at IFE	Upgrade	Transport
MPSolv - Upgrade for higher pressures operation of Tiller CO2 test facility - SINTEF Industry	Upgrade	Capture

The United Kingdom Node

[not completed yet, HTC-tis and next week]

Overview of ECCSEL-UK node

The UK has participated in ECCSEL since 2010 and became a founding member of ECCSEL ERIC in 2017. The UK node, coordinated by BGS, has been proactive in engaging and promoting ECCSEL towards policy and research stakeholders, potential RI users and UK CCS facility owners. ECCSEL's ambitions, activities, opportunities, strategy, and future plans have been communicated regularly throughout ECCSEL's evolution at national and international CCS events. The UK has a busy annual schedule of CCS research and policy events. Aligning with these opportunities continues to prove extremely successful in securing engagement, participation and buy-in amongst ECCSEL's UK stakeholders.

The UK node currently consists of 31 facilities owned and operated by seven UK institutes coordinated from three hubs; these facilities cover the whole CCUS chain. As the node looks to grow, discussions with other UK institutes and facilities are ongoing.

ECCSEL Partner UK	Research Facility
British Geological Survey (BGS)	Seven CO2 storage research facilities
Translational Energy Research Centre (TERC)	Six pilot-scale CO2 capture facilities
Scottish Carbon Capture & Storage (SCCS)	Thirteen multicategory facilities from five Scottish facility owners, coordinated by Scottish Carbon Capture & Storage
The University of Edinburgh	Five research facilities, part of SCCS
Herriot-Watt University	Four research facilities, part of SCCS
The University of Aberdeen	Two research facilities, part of SCCS
University of Strathclyde	Two research facilities, part of SCCS
Altrad	One research facilitiy
TUV NEL	One research facilitiy

News and activities in 2024

The UK Government established its Department for Energy Security and Net Zero (DESNZ) on 7 February 2023. This new department took on the energy policy responsibilities of the former Department for Business, Energy, and Industrial Strategy (BEIS): (i) to ensure the UK is on track to meet its legally binding carbon budgets and Net Zero commitments; (ii) to speed up significantly the delivery of network infrastructure and green energy. DESNZ is also leading the review of UK's membership of the Energy Charter Treaty, a multilateral treaty signed in 1994 to promote international investment in the energy sector, and pressing for revisions to the treaty that would place a stronger emphasis on CCS, hydrogen, and renewables, and remove protections for investments in fossil fuels.

In March 2023, the Chancellor pledged €23 bn in investment in carbon capture over the next 20 years, and several projects have been announced. Each of the areas of CCUS (Transport and Storage (T&S), power, industrial carbon capture, bioenergy with carbon capture and storage and low carbon hydrogen) will be supported differently and business models are being designed which will provide bespoke commercial frameworks for each area.

The Carbon Capture and Storage Infrastructure Fund (CIF) primarily contributes to the capital costs of establishing T&S infrastructure and early industrial capture projects and is further supported by a mechanism to provide revenue support. Power CCUS is supported through a Dispatchable Power Agreement (DPA), funded by levies on energy consumers.

The UK Government published its carbon capture, usage, and storage net zero investment roadmap in April 2023. It outlines joint government and industry commitments to the deployment of CCUS in the UK and sets out the approach to delivering four CCUS low carbon industrial clusters, capturing 20-30 $MtCO_2$ per year across the economy by 2030 to help meet the UK's 2050 net zero target. It summarises the continued engagement and outlines further opportunities to deliver on national CCUS objectives in collaboration with investors, building on the progress presented in the April 2022 edition of the Investor Roadmap. It also provides an update to the UK's Green Finance Strategy to set out how government will align the UK world-leading financial centre to a net zero, nature positive and climate resilient world, and how government will mobilise public and private financial flows to meet the UK's climate and environmental targets.

In October, the UK Energy Act 2023 became law with major changes to create a more efficient and clean energy system including provision on licensing of CO_2 transport and storage and commercial arrangements for CCS.

Ahead of the COP 28, SCCS re-launched its live-moderated, world-leading, Massive Open Online Course free course on carbon capture and storage that over 33,600 individuals previously completed this course.

In December 2023, SCCS partner University of Glasgow last week launched the *Glasgow Centre for Sustainable Energy*, dedicated to finding equitable ways to meet energy needs without contributing to climate change, and led by a SCCS Directorate member.

Facility innovations and investments in 2024

The UK node welcomed Altrad Babcock Ltd, who bring their Emissions Reduction Test Facility (ERTF) to the portfolio of ECCSEL facilities coordinated at SCCS. The ERTF is a large-scale pilot test rig for the development and demonstration of flue gas clean up technologies through oxy-combustion and post-combustion capture technologies.

The University of Sheffield Energy Institute also opened its newest world class research facilities, the Translational Energy Research Centre (TERC) that contains pilot-scale production facilities suitable for investigating different methods of carbon capture,

utilisation, and storage. TERC is one of the three ECCSEL-UK poles. Furthermore, Mission Zero Technologies has sold one of only two commercially financed direct air capture (DAC) systems operational in the world to TERC as part of a project with the University of Sheffield to enable jet fuel made from air.

A seventh BGS research facility also joined the UK node of ECCSEL in 2023: the Core Scanning Facility. It brings further capacities for non-destructive imagery and analysis on whole, split, plugged, or slabbed rock and sediment cores, a key element of reservoir and CO_2 storage volume characterisation. More details are available on ECCSEL facility access catalogue and the facility webpage.

Major research projects in 2024

The UK node facilities have been part of many CCUS projects during 2023.

The Hydrothermal Laboratory at BGS hosted a doctoral researcher from University of Wrocław (Poland) in June 2023 benefitting from ECCSELERATE transnational access funding. The project focused on carbon storage by mineral carbonation of ultramafic rocks, looking at the effect of carbonation product composition on the long-term security of CO_2 storage. An experimental-microanalytical study of the fate of metals during mineral carbonation of ultramafic rocks and serpentinites was undertaken.

BGS continued its collaboration in the €13m H2020 ConsenCUS (CarbOn Neutral cluSters through Electricity-based iNnovations in Capture, Utilisation and Storage) project (grant agreement N° 101022484), contributing to experimental investigation on the temporary storage of carbon dioxide in underground salt caverns and to the risk assessment of licensed storage sites.

Funding from the Natural Environment Research Council (NERC) has been awarded to NERC research centres to promote collaborations between institutes to tackle some of the most significant environmental challenges facing the UK. BGS leads the £2.6 m project 'Managing the environmental sustainability of the offshore energy transition (MOET)' started in 2022 which involves two ECCSEL facilities. MOET is assessing the environmental sustainability of offshore wind, blue and green hydrogen, and carbon capture and storage for selected test areas of the UK offshore. It is also developing solutions for planning the technology and infrastructure of the offshore energy transition. It also assesses public understanding and acceptance of those technologies.

BGS funded a project for 'Emissions reduction and enabling clean growth in India through CO_2 storage' (IGRD programme). Additional research work and collaboration with India's National Geophysical Research Institute (NGRI) and IIT Bombay.

The €3m H2020 HyStories (Hydrogen Storage In European Subsurface) project was completed in June, involving two UK node facilities. Whilst focused on the technical development and market insights for storage of pure hydrogen in the subsurface, it looked at the potential of hydrocarbon depleted fields or saline aquifers as geological hydrogen storage space. It places new competition on the subsurface storage capacity and usage, strengthening the need for ECCSEL role to expand and develop expert knowledge and coordination on subsurface storage management.

SCCS partners are participating in the recently started SolDAC project from the European Union's Horizon Europe research and innovation programme under the Grant Agreement no. 101069359 to enable solar-powered carbon capture to produce fossil-fuel-free ethylene.
SCCS is also one of the 16 partners in the ERA-NET ACT3 programme EverLoNG CCUS project (project number 327332) to demonstrate the technical feasibility of ship-based carbon capture and accelerate its uptake by international shipping companies.

TERC has been awarded £711,418 to develop the UK BECCS-MCFC: Next Generation CCUS Technology for Net-Zero 2050 project through the Department for Energy Security and Net Zero's £20 million CCUS Innovation 2.0 programme. TERC is further involved in a second project, 'Pilot UNIt for CO2 filtRatioN' (UNICORN), led by carbon capture company Nuada (MOF Technologies), to showcase Nuada's technology and demonstrate the ability of a new class of solid sorbents – absorbent materials used to capture impurities – called metalorganic frameworks (MOFs) to remove carbon from flue gas in an ultra-efficient way. In November 2023, OXCCU, Coryton and TERC secured a £2.8m grant of the UK government investment to transform carbon dioxide into sustainable aviation fuel. The capital will be used to demonstrate the world's first direct carbon dioxide (CO_2) hydrogenation process, turning CO_2 directly into aviation fuel range hydrocarbons, also known as sustainable aviation fuel (SAF).

Outlook for 2025

The UK node will endeavour to expand with a focus on additional facility owners in CCUS and, if ECCSEL's scope extension application succeeds, other sustainable subsurface energy transition technologies. The node expects also to make a good contribution to the design and implementation of ECCSEL Data Management Plan.

The Dutch Node

[not completed-RdK check, next week]

Overview of ECCSEL-NL node

The Netherlands has been involved in the development of the ECCSEL Research Infrastructure since 2008, when ECCSEL was established. The Dutch node has been officially constituted and structured in TNO with support from RVO. As such the Dutch node is coordinated by TNO and RVO.

TNO	Five CO_2 capture research facilities Two CO_2 storage research facilities

News / activities in 2024

In 2023 we completed the ECCSELERATE project. Our equipment was used in several commercial projects with onsite testing and solvent development.

Other ECCSEL equipment was used regularly in 2023. The demand for solvent characterisation, solvent management and online testing is still high, leading to many requests from the market.
Besides commercial (confidential) projects, our equipment was used in the NCCS project and in the Everlong project where we are preparing a flue gas measurement campaign onboard of a ship. Furthermore, on site measurements were conducted at Twence and HVC, two waste incinerators in the Netherlands, and at RWE in Germany for the SCOPE project.

Facility innovation and investment in 2024

VLE equipment. Photo: TNO

In 2023 we invested in maintaining and upgrading our solvent development equipment (VLE and Kinetic setup) to improve the quality and reliability of our measurements to better support our customers.

Kinetic equipment. Photo: TNO

Major research projects in 2024

In 2023 Dutch facilities in ECCSEL have been used extensively. Both Mini Plants were used in various commercial project and in a national project (LNG-ZERO) for the shipping industry. Our ECCSEL aerosol characterisation equipment was used at various plants as part of the ACT-SCOPE project and in national and commercial projects in 2023 as well as our solvent test street. There is also an increased interest in the well characterisation equipment.

Outlook for 2025

Dutch node's action plan for 2024 is to:

- Continue to grow the Dutch node by including additional research facilities and their providers.
- Expand the network to include facilities outside of TNO like universities, this already started in 2023 and discussions are ongoing with several universities;
- The interest in our equipment is very promising. We have defined exploitation actions in 2024.

Facility Access

During 2023 many research projects were carried out using the ECCSEL Research Infrastructure. They included transnational access from across Europe and beyond, national access, as well as work conducted as part of members' own projects and projects carried out on behalf of others.
On the ECCSEL website you can see many research projects carried out in 2023 using ECCSEL facilities.

Publications resulting from facility use are listed under each facility and links to documents are provided where possible. National and European instruments such as Horizon Europe, ACT (Accelerating CCS Technologies) ERA-NET Cofund, NCCS (Norwegian CCS Research Centre) provided funding to access ECCSEL facilities for CCUS research

in 2023. In addition, self-funded projects were carried out.

Looking ahead

We expect continued growth of ECCSEL in the coming years, through increasing numbers of users and research projects, and expansion of ECCSEL's scientific scope and, thereby, ERIC membership. Several new research facilities and upgrades will become operational in 2025. The recently updated ECCSEL Infrastructure Development Plan (IDP) will pave the way for even more ECCSEL RI investments in future.

ECCSEL has applied to the European Commission to extend its scientific scope beyond CCUS. If approved, ECCSEL will also serve research and deployment in additional sustainable subsurface energy systems. We see potential for closing gaps in the current research infrastructure landscape, needed for the green energy transition.

Projects

In 2023, ECCSEL received funding from the European Union's Horizon 2020 and Horizon Europe research and innovation programmes:

ECCSEL is leading the project **ECCSELERATE** (2020-2024) (GA no. 871143) which is aimed at increasing the use and ensuring the long-term sustainable operation of ECCSEL ERIC. Project end is 31.12.2023.

RItrainPlus (Research Infrastructure Training Plus) (2021-2024) is a Horizon 2020 project which will design and deliver a training programme to fulfil the competency requirements for the current and future managers of European Research Infrastructures and core facilities. ECCSEL is a beneficiary in the project.

ERIC Forum2 Project: ECCSEL is a beneficiary of the ERIC Forum2 project (2023-2026) which

brings together established European Research Infrastructure Consortia (ERICs) to strengthen coordination between the ERICs, and their impact.

StoRIES (Storage Research Infrastructure Ecosystem) (2021-2025) is a European Green Deal project (H2020) which brings together a consortium of 30 beneficiaries from 15 countries to jointly improve the economic performance of energy storage technologies. The main objectives of **StoRIES** are linked to the energy storage development by providing transnational access to world-class Research Infrastructures and services.

The following ECCSEL research facilities are contributing to StoRIES: BIOREP (BRGM), PEC Lab (Sotacarbo), Nano-Microfluidic lab (CNRS), GML (BGS).

Geo-INQUIRE (Geosphere INfrastructures for QUestions into Integrated REsearch) (2022-2026) is funded by Horizon Europe. Modern scientific endeavours already have the capacity to call upon a vast variety of data, often in huge volumes. However, the challenge is not only how to make the most of such a resource, but also how to make it available to the wider scientific community, especially when encouraging curiosity-driven research. Online seminars were held in 2023 and ECCSEL contributed to preparations of the first transnational access call opening in 2024.

The following ECCSEL facilities are part of Geo-INQUIRE: CATLAB (INERIS), PITOP Borehole Geophysical Test Site (OGS), Svelvik CO_2 Field Lab (SINTEF), MOBSEIS (TNO).

CCUS ZEN (2022 – 2025). CCUS ZEN is exploring the potential for accelerating deployment of CCUS in two regions with lower maturity level for CCUS compared to the current development in the North Sea region. The two additional ZEN regions are the Greater Baltic Sea region and the Mediterranean Sea region. In 2023 CCUS ZEN focused on mapping of technical aspects and infrastructure needs like emissions sources, capture and utilisation technologies, storage sites, transport solutions. The focus was also on non-technical aspects and stakeholder needs. There is now a high-level regional map of emission sources using Endrava CaptureMap. Local business models are setup for the Baltic and the Mediterranean areas.

In 2023 the CCUS ZEN consortium met in Copenhagen.

Photo: CCUS ZEN, SINTEF

More information on past and ongoing projects can be found on the ECCSEL website [1] (https://www.eccsel.org/abouteu-grants/other-ongoing-projects/).

Memberships

ECCSEL is member of the European Steel Technology Platform. **ESTEP** brings together all the major stakeholders in the European steel industry. This includes major steel manufacturers; universities and research institutions active in steel research; major users of steel such as car manufacturers; and public bodies like the European Commission and national governments. ESTEP's mission aims to engage in collaborative EU actions and projects on technology, which are tackling EU challenges (notably on renewable energy, climate change (low-carbon emission), circular economy) to create a sustainable EU steel industry (Source: ESTEP - ESTEP at a glance).

ECCSEL is member of the A.SPIRE Association. **A.SPIRE** is the European Association which is committed to manage and implement the Processes4Planet co-programmed Partnership. It represents innovative process industries, 20% of the total European manufacturing sector in employment and turnover, and more than 170 industrial and research process stakeholders from more than 20 countries spread throughout Europe (Source: The Association | A.SPIRE (aspire2050.eu)

APPENDIX

Annual Report

Annual report for

ECCSEL EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM

919298243

Financial year
01/01/2024 - 31/12/2024

Income Statement

ECCSEL EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM
919 298 243

Income statement

	Note	2024	Budget 2024	2023
Operating income				
Revenue	1	378 046	350 000	350 346
Other operating income	2	106 874	150 000	122 814
Total operating income		**484 920**	**500 000**	**473 160**
Operating expenses				
Employee benefits expense	3, 4	11 423	410 000	91 200
Other operating expenses	3	493 125	90 000	292 166
Total operating expenses		**504 548**	**500.000**	**383 366**
Result of operations		**-19 628**	**0**	**89 794**
Financial income				
Other interests		34 296	0	28 804
Other financial income		43 514	0	62 529
Total financial income		**77 810**	**0**	**91 333**
Financial expenses				
Other interests		111	0	5
Other financial expense		57 112	0	78 783
Total financial expenses		**57 223**	**0**	**78 788**
Net financial items		**20 588**	**0**	**12 545**
Annual result		**960**	**0**	
				102 339
Appropriations				
To/from other equity	5	960	0	
Total appropriations		**960**	**0**	102 339

Balance Sheet

ECCSEL EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM
919 298 243

Balance

	Note	31.12.2024	31.12.2023
ASSETS			
Current assets			
Receivables			
Trade receivables		249 345	6 119
Other short-term receivables		34 532	60 177
Total receivables		**283 877**	**66 296**
Bank deposits, cash in hand, etc			
Bank deposits, cash in hand, etc.	6	1 059 642	1 365 927
Total bank deposits, cash in hand, etc		**1 059 642**	**1 365 297**
Total current assets		**1 343 519**	**1 432 223**
TOTAL ASSETS		**1 343 519**	**1 432 223**

ECCSEL EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM
919 298 243

Balance

	Note	31.12.2024	31.12.2023
EQUITY AND LIABILITIES			
Equity			
Retained earnings			
Other equity	5	164 466	171 586
Total retained earnings		**164 466**	**171 586**
Total equity		**164 466**	**171 586**
Liabilities			
Current liabilities			
Accounts payable		8 372	11 216
Public duties payable	6	1 290	1 383
Other currents liabilities	2	1 169 391	1 248 038
Total current liabilities		**1 179 053**	**1 260 637**
Total liabilities		**1 179 053**	**1 260 637**
TOTAL EQUITY AND LIABILITIES		**1 343 519**	**1 432 223**

Klaus Tobias Mosbacher
CEO

Notes

ECCSEL EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM
919 298 243

Notes

Accounting principles

The annual financial statements have been prepared in accordance with the Accounting Act and Good accounting practice for small enterprises.

Current assets and current liabilities
Current assets and current liabilities generally include items due for payment within one year after the last day of the accounting year, as well as items related to the product cycle. Current assets are valued at the lower of cost and assumed fair value.

Fixed assets and long-term liabilities
Fixed assets comprise assets intended for permanent ownership and use. Fixed assets are valued at acquisition cost. Tangible fixed assets are capitalized and depreciated over the expected economic life of the asset. Tangible fixed assets are subject to a written-down to recoverable amount in case of impairment, which is not expected to be temporary. The write-down is reversed when the basis for the write-down is no longer present.

Recognition
Revenue from members participating in ECCSEL ERIC are invoiced annually, half yearly or quarterly according to the agreements in place. The four national nodes are given a membership deduction on their invoice according to their agreed contribution to ECCSEL ERIC. This is documented directly in the invoice.

Other operating income
The European Union has provided grants that are agreed upon with ECCSEL ERIC, where the total grant is transferred to ECCSEL ERIC at the beginning of the project. The transferred total amount is classified as other current liabilities until the grant is earned as other operating income. Annual income from the grant is earned as other operating income as the project incurs expenses.

Receivables
Trade receivables are capitalized at nominal value after deduction of deposition for expected losses. Deposition for expected losses are made based on an individual assessment of the individual receivables. In addition, for other accounts receivable, an unspecified deposition is made to cover expected losses.

Tax
The company is not taxable.

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919 298 243

Note 1 - Member Countries

Member Country	Member Countries Representing Entity
Norway (ERIC Statutory seat)	Norwegian University of Science and Technology (NTNU) together with SINTEF Energy Research (SINTEF ER)
France	The French Geological Survey (BRGM)
Italy	National Institute of Oceanography and Experimental Geophysics (OGS)
The Netherlands	Netherlands Organisation for Applied Scientific Research (TNO)
United Kingdom	British Geological Survey (BGS)

Operating revenue provided by ECCSEL ERIC annual member fees.

Note 2 - Public grants

In 2024, the company has been awarded a grant from the EU for five projects. Earned grants in 2024 are EUR 106 874.

As of 31 December2024, the company has received an advance payment for the grants of EUR 1 166 480.

Note 3 - Salary costs

Specification of labor costs	2024	2023
Salary	7 352	19 387
Employer's National Insurance contributions	3 741	318
Pension costs	0	2 395
Other related benefits	329	69 100
Total	**11 423**	**91 200**

More about full-time equivalents and salaries
The company has two employees seconded from NTNU in 2024, along with a CEO from Co2control AS. The total salary expense amounted to EUR 388 352 excluding VAT.

Note 4 - Number of full-time equivalents

Number of full-time equivalents employed in the financial year:	3

Note 5 - Equity

	Other equity	Total
Equity 31/12/2023	171 586	171 586
Annual result	960	960
Currency differences	-8 080	-8 080
Equity 31/12/2024	**164 466**	**164 466**

Note 6 - Restricted Bank Deposits

	31.12.2024
The item for bank deposits includes a separate account for restricted tax deduction funds with	653
Tax deduction owed	-653

Independent Auditor Report

Participant List GA Meeting

Participant List GA Meeting 18.06.2024

Pos.	Attendance	First name	Last name	Role at GA	From	Role	Country
1	In person	Jonathan	Pearce	GA-Chair	BGS	CO2 Storage team leader	UK
2	tbc	Christopher	Matthews	Member	Department for Science, Innovation and Technology UK (DSIT, former	Head of International Research Infrastructures	UK
3	in person	Helen	Taylor-Curran	Member	BGS	Geophysicist EE-OC/Repr. UK Node	UK
4	In person	Sébastien	Dupraz	Member	BRGM	Program Coordinator EE-OC/Repr. French Node	France
5	online	Xavier	Montagno	Member	French Ministry for Education, Higher Education and Research	Government representative	France
6	online	Cristiana	Genua	Member	MESRI	Repr. Ministry of Education	Italy
7	online	Fausto	Ferracioli	Member	OGS	Director of Geophysics Section	Italy
8	online	Valentina	Volpi	Member	OGS	Researcher/Contact person for EERA CCS Joint Program	Italy
9	excused	David	Barratt-Due	Member	Norwegian Ministry of Energy	Adviser	Norway
10	excused	Nils	Røkke	Member	SINTEF Energy	Executive Vice President Sustainability	Norway
11	online	Rune	Bredesen	Member	SINTEF Industry	Chief of Research	Norway
12	in person	Åse	Slagtern	Member	Research Council Norway	Special Adviser	Norway
13	in person	Gerdi	Breembroek	Member	Rijksdienst voor Ondernemend Nederland	Adviser Geothermal Energy, CCS, CET Partnership	The Netherlands
13	online	Soledad	van Eijk	Member	TNO	Senior Business Developer/ Repr. Dutch Node	The Netherlands
15	in person	Klaus Tobias	Moshacher	Executive Director	ECCSEL ERIC	Executive Director	Norway
16	in person	Volker	Röhling	Assistant Director	ECCSEL ERIC	Operation & Projects	Norway
17	online	Sina	Blix Prestmo	ECCSEL Advisor	ECCSEL ERIC	Affair, Marketing, Communication	Norway
18	online	Debbie	Koreman van (	Protocol keeper	ECCSEL ERIC/NTNU	Adm. coordinator	Norway
19	excused	Marie	Bysveen	Guest	SINTEF Energy	Chief Market Developer	Norway
20	in person	Morten	Grønli	Guest	NTNU	Chief of Lab EE-OC/Rep. Norwegian Node	Norway
21	online	Robert	de Kler	Guest	TNO	Consultant Expertise Group for Gas Treatment EE-OC/Rep NL Node	The Netherlands
22	excused	Sarah	Webb	Guest	NERC	Associate Director for Internal, Business and Policy Intelligence	UK

Industrial Advisory Group

Name	Company
Audun Faanes	Equinor
Barthold Schroot	EBN
Francesco Magli	Buzzi Unicem
Matthieu Aragones	Holcim
Patrick Morilhat	EDF
Philip Llewellyn	Total Energies
Pål Helge Nøkleby	Aker Carbon Capture
Runo Mijnarends	Taqa Global

Scientific Advisory Board

Name	Representing entity
Adam Smolinski	Central Mining Institute GIG
Axel Liebscher	Federal Company for Radioactive Waste Disposal
Eric Favre	University of Lorraine
Grégoire Léonard	University of Liège
Sergio Persoglia	Independent

Ethics and Environmental Advisory Board

Name	Institute	Involvement
Behnam Taebi	Delft University of Technology	Professor Ethics of Technology, Faculty of Technology, Policy and Management, Delft University of Technology
Derek Taylor	The University of Nottingham	Honorary Professor in Geo-Energy
Øyvind Mikkelsen	NTNU	Professor of Chemistry, The National Committee for Research Ethics in Science and Technology