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The European CCS Research Laboratory Infrastructure (ECCSEL) And Its Contribution To Future Geological CO2 Storage In Europe

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Summary

The mission of ECCSEL ERIC is to establish a world class, distributed, pan-European CCS Research Laboratory Infrastructure to enable the removal of research barriers and facilitate wide scale deployment of CO₂ capture, transport and geological storage in Europe. We present the rationale and development of ECCSEL ERIC, and consider ECCSEL in three phases: its current status, its medium term plans, and its longer term ambitions. ECCSEL will deliver its mission by a programme of integration (Phase 1), upgrade (Phase 2) and construction (Phase 3) of CCS research facilities. The first two phases are ongoing. ECCSEL already provides access to a high quality CO₂ capture, transport and storage (CCS) research infrastructure. ECCSEL has also drafted its initial research strategy, which will underpin Phase 3.

Introduction

The European Strategy Forum on Research Infrastructures (ESFRI) is a strategic approach to address European research needs by setting a Europe-wide framework for the efficient provision of critical research infrastructure. ESFRI research infrastructures can be single sited or distributed. The European Carbon Dioxide Capture and Storage Laboratory Infrastructure (ECCSEL) is a distributed research infrastructure with a pan-European dimension. ECCSEL provides access to a high quality CO₂ capture, transport and storage (CCS) research infrastructure, encouraging the removal of research barriers and facilitating the wide scale deployment of CCS in Europe.

ECCSEL first appeared on the ESFRI Roadmap in 2008, and completed its preparation and implementation phases before it entered its lean operational phase in 2017. ECCSEL also transitioned from a European Commission grant-supported project to ECCSEL ERIC, a European Research Infrastructure Consortium and a legal entity in its own right, with its legal seat and Operations Centre based at the NTNU campus in Trondheim.

We present the rationale and development of ECCSEL ERIC, and consider ECCSEL in three phases: its current status, its medium term plans, and its longer term ambitions.

Theory

The European Strategy Forum on Research Infrastructures (ESFRI) is mandated by the Competitiveness Council of the European Union to provide a coherent and strategic vision, ensuring that Europe has excellent world-class research infrastructures (RIs) in all fields of science and innovation. It produces the ESFRI Roadmap, a strategic approach to addressing research needs by setting a Europe-wide framework for the efficient provision of critical research infrastructure. ESFRI research infrastructures can be virtual (e.g. European Plate Observing System) or physical, and single sited (e.g. European Spallation Source ERIC, in construction, Lund Sweden) or distributed/pan-European (e.g. ECCSEL). ESFRI RIs tend to begin as Framework Programme projects, but the intention is ultimately to become self-sustaining legal entities. The preferred option is ERIC where membership is at national, not institute, level and the RI is sustained by membership fees. Other legal frameworks are available.

The mission of ECCSEL ERIC is to establish a world class distributed European CCS Research Laboratory Infrastructure. ECCSEL's scope is the full value chain, comprising CO₂ capture (2nd and 3rd generation technologies), transport and storage and its application to power generation and, increasingly, to other carbon intensive industries. The aim is to become a key instrument that the European Commission can utilise to meet the objectives of the Strategic Energy Technology (SET-) Plan and to work with relevant bodies such as European Energy Research Alliance (EERA), the CO₂GeoNet European Network of Excellence on the geological storage of CO₂, the ZEP-ETIP, lighthouse projects, Energy Intensive Industries and others, including other European RIs. ECCSEL will facilitate projects in the European Commission's Framework Programme. ECCSEL is already embedded in the ERA NET Accelerating CCS Technologies (ACT) Cofund, a European Commission tool established under the Horizon 2020 (H2020) Programme. ECCSEL will also facilitate future European industrial initiatives, and help educate specialists for the nascent CCS industry.

ECCSEL will deliver its mission by a programme of integration (Phase 1), upgrade (Phase 2) and construction (Phase 3) of CCS research facilities. The first two phases are ongoing, and ECCSEL has drafted its first Research Strategy, which will underpin Phase 3.

Phase 1 Integrate and Open ECCSEL Facilities for Access

The underlying principle of ECCSEL is to provide open access to high quality infrastructure to allow the CCS community to carry out research. Providing access to at least one existing CCS research facility is a requirement for a country to become a member of ECCSEL. So far, ECCSEL's five

founding members have opened 56 existing CCS research facilities across France, Italy, the Netherlands, Norway and the UK, among which 24 are dedicated to CO₂ storage. ECCSEL tested its access procedures with c.20 projects completed between 2015 and 2017 during its H2020 InfraDev-3 Implementation Phase project. This included funding to support ECCSEL's first Transnational Access Programme. Research papers now beginning to emerge. These facilities are available for access today via the ECCSEL website (www.eccsel.org).



Figure 1 ECCSEL ERIC geographical structure. The Operations Centre (ECCSEL OC) is connected through a hub and spoke model to National Nodes (hubs), who manage national facilities (spokes).

Phase 2 Upgrade and Expand ECCSEL

In the short term, ECCSEL must grow its membership to broaden its pan-European reach and relevance, and provide additional resources to allow the Operations Centre more flexibility in its core activities. ECCSEL maintains contact with all countries previously involved in ECCSEL's development phases but who, for national reasons, were not able to join ECCSEL ERIC as a founder member; several show promise that they will be able to join ECCSEL ERIC in the next year or so. ECCSEL is also continuously developing collaborations with eastern European countries and other overseas institutions to attract potential new members.

ECCSEL is continuously expanding the range of facilities it offers. The five country Nodes propose additional existing national CCS facilities for the ECCSEL portfolio, which are assessed on the basis of uniqueness and demand, and the added value they bring to the overall ECCSEL RI. This constitutes a second tier of existing facilities for the ECCSEL RI.

Furthermore, the facilities that make up ECCSEL's current offering are also undergoing nationally-funded programmes of improvements, upgrade and construction which have already been approved for inclusion in ECCSEL. The national investment that the ECCSEL RI will benefit from amounts to about €35 million overall, and c.€8 million for CO₂ storage facilities. We will summarise examples of where these investments are being made.

Phase 3 Significant New ECCSEL Facilities

Arguably, the real value of ECCSEL to European CCS and to its members is the long term mission to construct its own CCS research facilities. This will likely require shared multi-national investment, since no single country is expected to have the resources to fund the high complexity, high value research infrastructure needed to de-risk CCS. [Note that the scope of ECCSEL does not include demonstration scale facilities, but the research pilots and facilities that will help to de-risk future demonstration and ultimately operational sites].

ECCSEL's preliminary research strategy formed an objective basis for initial prioritization. It is a living document first drafted during ECCSEL's Implementation Phase, and it reflects the views of the institutes participating in ECCSEL at the time. We consider the three elements of the CCS chain independently, but using the same approach. For example, we first identified the key research priorities that need to be addressed to enable CO₂ storage at sufficient scale. From there we identified infrastructure needs, based partly on an earlier gap analysis (2012), and our understanding of the current research infrastructure landscape. The final step was to shortlist the research infrastructure requirements that ECCSEL could usefully focus on. This was shortlisted according to the priority level of the research need first, followed by the potential for co-investment by two or more countries according to the views the institutes participating in ECCSEL. This approach allowed ECCSEL to arrive at a shortlist of two key CO₂ storage facilities, an injection testbed and a pressure pilot, both in a saline aquifer setting. We will set out the thinking that lead ECCSEL to this initial shortlist, and the constraints/caveats associated with it.

The research strategy is about to undergo a major review and ECCSEL is keen to hear the views of stakeholders on where ECCSEL should focus its long term construction plans. The strategy for CO₂ capture particularly needs developing and industry engagement here is critical. We would welcome input from the industrial sector through our Industry Advisory Group, composed of external representatives, helping ECCSEL improve in subjects like innovation and technology transfer.

Conclusions

Since its inclusion in the ESFRI roadmap in 2008, ECCSEL has benefitted from two preparatory phases and one implementation project to become a fully independent legal entity in its own right in 2017. The process for ECCSEL to become an ERIC legal entity is now complete with five founding Member countries: Norway (host and Operations Centre), France, Italy, the Netherlands and the UK, and plans to expand to new countries.

The ECCSEL RI is now operational. It offers access to 56 CCS facilities, 24 of which are dedicated to CO₂ storage research. Access has already been tested for these facilities and they are available for the CCS research community to use now.

ECCSEL members are constantly investing in improvements, upgrades and construction of CCS facilities that will become part of the ECCSEL RI. ECCSEL has developed a preliminary research strategy document as the basis for prioritization. ECCSEL has so far identified two significant subsurface CO₂ storage research facilities for future investment, design studies and construction. In this way, ECCSEL will achieve its principle task of removing research barriers to the wide-scale deployment of CCS in Europe by becoming a key instrument the European Commission can use to meet the objectives of the SET Plan.

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For information on accessing ECCSEL facilities to carry out research please see www.eccsel.org. To become a member of ECCSEL ERIC, please contact the ECCSEL Director at info@eccsel.org. For information about including additional member countries' CCS facilities in ECCSEL ERIC please contact your National Node; please see www.eccsel.org or email info@eccsel.org for contact details. For information about panel membership or stakeholder engagement events, or sharing your views on ECCSEL's activities, please email info@eccsel.org.