PROJECT FINAL REPORT

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Project acronym: ECCSEL-PP

Project title: European Carbon Dioxide Capture and Storage Laboratory Infrastructure – Preparatory Phase

Funding Scheme: Combination of Collaborative Projects and Coordination and Support Actions for Construction of New Infrastructures – Preparatory Phases

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[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the grant agreement

[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm ; logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

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0. Final publishable summary report

1. Executive summary

The main objective of the ECCSEL Preparatory Phase project is to prepare for the establishment and operation of a world class pan-European distributed Research Infrastructure (RI) for CO2 capture, transport and storage (CCS).

It is recommended that ECCSEL should be organized as a European Research Infrastructure Consortium (ERIC). The ECCSEL legal entity should have two governing bodies with decision making powers; the General Assembly and the Board of Directors. ECCSEL should set up secure IPR rules between the ECCSEL members and towards visiting researchers. ECCSEL access policy should be based on the principle of "open access" and the Applicants should bear access costs.

ECCSEL should continue to explore funding possibilities to ensure that funding for capital investments, operation and access are defined and in place. Three scenarios for the development of the ECCSEL RI between 2015 and 2030 have been assessed, a reference case with total cost of M€ 345, and a moderate and a progressive case with respect to availability of funding.

Experts from relevant ECCSEL partners have identified 91 RI gaps between current research infrastructure and the capabilities that are required to address the critical issues in CO2 capture, transport and storage. The ECCSEL RI is suggested to develop by organic growth in two layers, one layer consisting of network of complementary laboratories and one layer of large pilots and demo sites.

Dissemination of information about ECCSEL at different levels such as the scientific community, industry, national governments, etc. has been carried out for the anchoring of ECCSEL. ECCSEL is defined by the Commission to be on the ESFRI Roadmap as the CCS research infrastructure in Europe.

It is vital to ensure strategic industry and political anchoring of ECCSEL in the partner countries. ECCSEL should be recognised as a strategic network of infrastructures for CCS aligned to EERA, EII and ZEP commitments for supporting the implementation of the European SET-Plan.

ECCSEL has the ambition to support the Commissions strategy for increasing education and training in Europe within the CCS thematic area.

2 Summary description of project context and objectives

2.1 Concept

There are more than 100 areas in which further Research and Technological Development is urgently needed if Carbon dioxide Capture and Storage (CCS) technologies are to become viable, cost-effective, global key technologies. As has been pointed out by the Intergovernmental Panel on Climate Change (IPCC), G20 and other global authorities within climate change; we need urgently to reduce carbon dioxide emissions from, in particular, the energy sector.

The areas where further R&D is needed have been identified by the European Zero Emissions Technology Platform (ZEP-TP), the IPCC, and in our discussions involving the international research

groups working in the field, prior to the submission to ESFRI. The ECCSEL team wishes to develop research infrastructure to tackle these challenges in a coordinated manner, their transnational integration and their use by individual researchers.

The ECCSEL consortium teams up selected Centres of Excellence on CCS across Europe (Norway, Poland, France, Italy, Germany, Spain, Greece, UK, Netherlands and Switzerland). The mission is to develop (i.e. build and operate) a European distributed, goal-oriented, integrated Research Infrastructure, to:

- Provide a dynamic scientific foundation to respond systematically to the urgent R&D needs in CCS at a pan-European level in a short and long term perspective.
- Maintain Europe at the forefront of the international CCS scientific community.
- Increase the attractiveness of the European Research Area, reinforcing the research-based clusters and improving their socio-economic impacts.
- Optimise the value of the Community financial support.

ECCSEL will establish a robust and sustainable legally independent entity. The ambition is to become one of several important instruments that the European Commission initiates and supports to meet the objectives of the SET-plan, and to strategically interact with relevant bodies such as European Energy Research Alliance (EERA), the ZEP-TP, Lighthouse projects, EII, etc.. In particular, ECCSEL aims to serve projects in the European Commission's Framework programmes, future European industrial initiatives, and education of specialists for the new CCS industry.

The existing and new ECCSEL laboratories will be owned by the involved partner institutions. They will, however, be developed and made available for the ECCSEL program, governed by an overall agreement. It is foreseen that ECCSEL will gradually become ready and accessible starting from 2015.

2.2 Objectives of the Preparatory Phase project

The main objective of the ECCSEL Preparatory Phase project (PP) is to address the primary tasks necessary to establish a new distributed, goal-oriented, integrated pan-European infrastructure for state-of-the-art research on technologies enabling CO2 capture, transport and storage (CCS).

The PP is split into two phases; phase I and II that are built on each other. The outcome of the two phases will ensure that the ECCSEL pan-European infrastructure:

- is established and operated by an organisation with legal and management arrangements which are most effectively and transparently pursued, avoiding at the same time unnecessary administration. The administrative, financial and management structures for the establishment and operation of ECCSEL will be in place before the first of the new infrastructures is built.
- is capable of being used seamlessly by researchers from industry, universities and research institutes across the whole of Europe, and, in the future, from other countries.
- will transcend current national facilities' limitations and bring socio-economic benefit to Europe.
- has robust financial plans (including e.g. use of structural funds) and inspires new commitments based on the strategic development plan.
- responds to the SET-plan and the strategic needs expressed by ZEP-TP, IPCC and others, and can most quickly and cost effectively be developed and utilised for basic and applied research, in facilities that comply with high technical and HSE standards.
- develops according to a strategic development plan (ECCSEL business plan), with unanimous support from the ECCSEL stakeholders, where scientific, financial and socio-economic aspects are taken into account. The strategic plan will be dynamic, so that as new research needs are identified, they can be implemented in the strategic plan, determining where and when new facilities requiring support may be most appropriately constructed and financed.

The objective of the phase I of the PP is to address the primary tasks necessary to establish a distributed, pan-European RI on CCS. The first phase of the PP will primarily focus on legal, financial and strategic work and lay the foundation for the RI.

The core hub of ECCSEL RI will be the *Operation Centre* (OC), which will house the ECCSEL Management supported by administrative personnel. ECCSEL OC will be governed by the ECCSEL *Board*, which will be made up by representatives from the partner organizations. ECCSEL RI will build on a variety of existing and new 'satellite' RI's located at partner research institutes and universities in Europe, which is to be upgraded, integrated and expanded.

The *Operation Center* will have a coordination function responsible for the daily operation of ECCSEL, continuously updating the RI development plan, funding issues (investment, operation, and access costs), education and outreach component and being the access point for applications from visiting scientist and students. Each 'satellite' RI's will have a *Laboratory Coordinator* responsible for the daily contact between the OC, giving advice in the evaluation process for approving access to the RI, and for putting them to disposal to visiting scientists and students.

The close dialogue with national funding bodies in the operation phase will be of outermost importance to secure funding of new infrastructure and operation. The interaction and collaboration with the national funding bodies, which will be established in WP2 in the PP, will need to continue also after the PP. There should in every country be one contact point that is continuously being held updated about the progress and needs of ECCSEL. In addition to this *Funding Advisory Group*, the Board should be supported by a *Science and Technology Advisory Group*, consisting of expert members selected from academia and Industry. This expert group should review the scientific quality and progress of ECCSEL and give advice for new infrastructure.

The geographic location of the ECCSEL OC will still need to be agreed upon during the PP, however, it should be located at, or in close proximity to, a university or research institute well-known for its excellence on CCS.

The formal output of phase I of the PP will be the Implementation strategy report. This report will coordinate the technical work and summarize the results. The report will also draw conclusions, suggest any necessary subsequent steps for realization of the RI, and provide concrete actions that have not already been identified for the phase II.

<u>The specific objectives of the phase I include:</u>

- Identification of suitable **legal and governance structure**, including rules for IPR, access to and use of the facilities, and HSE standards. The recently established legal framework for European Research Infrastructure Consortium (ERIC), and other possible frameworks, will be evaluated.
- To develop a **financial strategy**, including analysis of available funding mechanisms for new investments and operational and transnational access costs, fund flow, and cost scenarios.
- Review of priority research needs (as identified by ZEP-TP, IPCC and others), mapping and subsequent gap analysis to create the Infrastructure development plan.
- To develop a document with an inspiring **vision and long term goal** for ECCSEL, that may help to attract partners from industry, research and education, and secure national funding and participation.
- **Web site development** and dissemination and a **strategy for expansion of the consortium** and collaboration with Third countries - such as USA, China, Australia, etc.
- **Strategic interaction and coordination** with European bodies such as European Energy Research Alliance (EERA), the ZEP-TP, Lighthouse projects, EII etc.
- Management and coordination.

The phase II will build on the first phase. It will deepen the analysis and provide a detailed suggestion on the future organization of the ECCSEL RI, including legal, financial, strategic and geographic aspects. It will have the infrastructure development plan ready for implementation. A major part of

phase II will be technical work, as well as rules for infrastructure access. Specific objectives of the phase II include the development of the ECCSEL Business plan and to deliver a signed Contract of Association between the ECCSEL consortium members. In addition, funding agreements should be in place, and the location and structure of the ECCSEL Operation Centre should have been agreed upon.

3 Main scientific and technological results and foreground

ECCSEL PP is not a research project, but an infrastructure project. The results from the project is therefore not regular scientific and/or technological research reports, but implementation plans and business plans.

3.1 Implementation strategy to establish the ECCSEL legal entity

3.1.1 Recommendation for legal form and governance structure

Based on an analysis of different legal forms[3] it is recommended that ECCSEL should be organized as a **European Research Infrastructure Consortium (ERIC)[4].** The recommendation is based on an assessment of identified benefits and disadvantages for the different legal forms. Organising ECCSEL as an ERIC will ensure an optimal legal basis for its operation as a distributed pan-European research infrastructure.

ERIC is a legal form that is particularly adapted to large-scale RIs of European interest. It offers a neutral and fairly flexible mechanism for international cooperation. It enjoys privileges as an international organisation (e.g. VAT exemption) and is not subject to the directive on public procurement as implemented in national law. Membership is restricted to countries and intergovernmental organisations. However, Member States may be represented by one or more public entities, including regions or private entities with a public service mission.

It is recommended that the ECCSEL legal entity shall have two governing bodies with decision making powers; the General Assembly (ultimate decision making body) and the Board of Directors (executive body and legal representative of ECCSEL). These bodies are in line with the minimum requirements according to the ERIC Regulations. A Director should be responsible for the day-to-day management of ECCSEL operations. Furthermore, it is recommended to have two advisory bodies, the Research Infrastructures Coordination Committee (with representatives of the Research Infrastructures of the ECCSEL RI) and the Innovation Advisory Board (with high-level representatives from global industrial stakeholders who are independent of ECCSEL). The governing structure will be part of the ECCSEL Contract of Association (i.e. statutes).

[3] The legal forms that were considered were: European Research Infrastructure Consortium (ERIC), European Economic Interest Grouping (EEIG), Belgian International Non-profit Association (AISBL), and Norwegian limited company (AS)

[4] See e.g., Legal framework for a European Research Infrastructure Consortium – ERIC, Practical Guidelines, European Commission, DG Research, http://ec.europa.eu/research/infrastructures

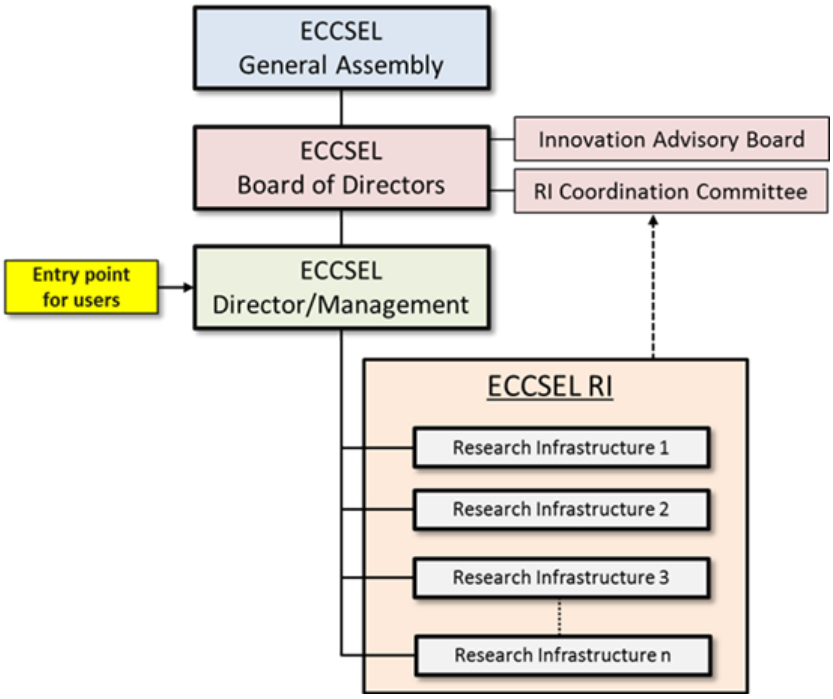


Figure 1 Recommended ECCSEL governing structure

The recommendations for the legal form and governance structure are provided in detail in Deliverable 1.1 and 1.2 respectively.

3.1.2 Common Intellectual Property Rights (IPR) provisions

The ECCSEL IPR Policy should create a common understanding and foundation for efficient utilisation of any IP used or controlled within the ECCSEL RI and should ensure that the rights of ECCSEL and of its members[5] are properly taken into account. It should also set up secure IPR rules between the ECCSEL members and towards visiting researchers engaged in research activity within ECCSEL.

The basic IPR principles will be specified in the ECCSEL Contract of Association (i.e. statutes). The detailed principles will be part of a specific agreement between the ECCSEL members.

Table 2 Recommended principles for ownership and access rights granted to the members and ECCSEL

	BACKGROUND	**FOREGROUND**
OWNERSHIP	Each member keeps the exclusive ownership of its background and/or sideground	Foreground shall be the property of the member(s) carrying out the work generating that foreground. Foreground generated by ECCSEL itself belongs to ECCSEL.
ACCESS RIGHTS	Access rights to background shall be granted on fair and reasonable conditions, if needed for the implementation of the ECCSEL RI activities or for use of a member's or ECCSEL's own foreground. If a member wishes to list specific background as excluded from access rights, it should be identified in an attachment to the specific agreement. Access rights to background shall be granted provided that the member concerned is free to grant them.	Access rights to foreground, if needed for the implementation of the ECCSEL RI activities or for internal use of a member's or ECCSEL's own foreground, shall be granted on a royalty-free basis. Access rights to foreground if needed for use of a member's or ECCSEL's own foreground (including for third-party research) shall be granted on fair and reasonable conditions.

[5] For the purpose of this section 2.2, members mean the legal entities taking part in ECCSEL and signing the specific agreement detailing the IPR principles.

Results produced by a researcher visiting a research infrastructure shall be the property of that user. The access provider shall ensure that all visiting researchers enjoy, on fair and reasonable conditions, access rights to the foreground of the access provider, if such foreground is needed to carry out their own work under the research infrastructure.

The IPR provisions here above mentioned (incl. definitions) are detailed in Deliverable 1.4.

3.1.3 Access Policy for visiting scientists and students

The access policy should be based on the principle of 'open access', meaning that the access should not just be reserved for the members but also be open to users from all European countries. The application procedure should be based on fair and transparent rules and the applications should be dealt with as efficiently as possible, while maintaining respect for the required confidentiality.

ECSSEL should provide model **Application Forms** for access to the research infrastructures, where updated, adequate and detailed information are requested. Applications should be evaluated and prioritized based on their scientific and technological excellence and their appropriateness towards ECCSEL and the infrastructure. It is recommended that applications for access can be submitted bi-annually for basic research and at any time for collaborative and contract research.

Applicants should bear all access costs. Dependent on the nature of the application, for example collaborative research, some access costs *may* be covered by other sources including the host RI (e.g. EU grants). The access should be based on daily rates that apply to each infrastructure.

It is recommended that ECCSEL and the members conclude time-limited **Service Level Agreements** related to the access to the infrastructures. The Service Level Agreements should include information about the infrastructures and assure compliance with relevant rules, regulations and standards. ECSSEL should provide standard model Service Level Agreements.

The access provider and the applicant should conclude an **Access Agreement** prior to access to the infrastructure. This agreement should regulate the detailed conditions and responsibilities for use of the infrastructure, as for example liability, insurance, confidentiality, IPR rights, supervision and confidentiality. ECSSEL should provide standard model Access Agreements.

It is recommended that the basic principles of the access policy should be included in the ECCSEL Contract of Association and that the General Assembly should have the power to amend the access policy.

The access policy is detailed further in Deliverable 1.5.

3.2 Implementation strategy to establish an economically sustainable ECCSEL infrastructure

3.2.1 Funding of operational and access costs for existing research infrastructures

To analyse the present cost and funding structure a survey was distributed to the consortium partners. 61% of ECCSEL RIs were addressed. The results show that the prevailing size of ECCSEL RIs is full laboratories and the dominant operational costs are staff expenditures. The size of the RI affects the operational costs and the type of expenditures, and also the access costs for external personnel. The main funding mechanism for the operational costs is national and European public financing, with 46% of the answers assessing such funding as good or very good. In contrast, 35% of the infrastructures assess their private funding as poor to very poor. 83% of the answers state that access costs are not funded. It should be noted that most of the surveyed infrastructures are quite young, i.e.

established after year 2000. Furthermore, some very recent infrastructures have not had time to fully optimise their financial operation.

3.2.2 Development of funding instruments and mechanisms

The results showed that more than half of the research infrastructures expect that their funding structure will be significantly changed in the next five years, moving especially towards generating their own funding (for example by renting out their facilities to users). The changing strategies and priorities of the European public funding instruments will lead to increased demand for private funding from industry. In general the advantages of public funding concerns the ownership of results and the long-term perspective of the research, while private funding in general has higher funding levels and quicker responses, and more restrictions on publication. The difficulty for the industry to assume risk has also been mentioned. The results from the survey about advantages and drawbacks are shown in Table 3.

Table 3 Advantages and drawbacks for operational cost funding as reported by the ECCSEL partners

ADVANTAGES		DRAWBACKS	
Private	**Public**	**Private**	**Public**
It can cover upgrades/ maintenance/operating costs	Ownership usually stays with RI operator	Focus on industrial interests. Confidentiality issues.	It doesn´t cover 100% of costs. No long-term warranty of funding
Funding of 100% of costs, cooperation with industry.	Lower risk	May be difficult to make private sector assume risk	Comprehensive application procedure, may take too long from initiation to grant
Quick response	Relative flexibility of work plan.	May require handover of equipment at end of contract	Problems with longer terms investment in infrastructure and its maintenance
	Operational cost well understood by public funding agencies	Significant operational cost often not understood by private bodies	We depend on getting new projects
	It could have experimental campaigns during the coming 4 years		Requires private partnership for funding

The wide range of different ECCSEL research infrastructures will be able to exploit a corresponding variety of funding instruments. For example, FP7 People, Marie Curie actions would likely be suitable for infrastructures with high staff costs and funding from “Integrating Activities" of FP7 will be likely suitable to finance access costs in larger infrastructures, where external users can find difficulties in providing budgets for experimental work.

While private funding should be strongly promoted, the public funding should also be developed further in line with research priorities allowing the governments to include these costs in future budgets. One approach to encourage industry participation is to partially fund access costs, hence allowing the RI to sell experimental time to industry or others on a lower cost.

3.2.3 European funding

3.2.3.1 Horizon 2020 and Structural Funds

The European Commission is supporting the development of a policy on research infrastructures at European level, providing added value by pooling talent, maximising resources, and helping to generate a strategic vision for the reinforcement of research infrastructures in the European Research Area.

These aims are as well the challenges for the research infrastructures. There is a need to ensure *national commitments* to the construction and operation and to ensure *open access* for researchers across Europe. As potential financial instruments, the Risk Sharing Finance Facility (RSFF) of the

European Investment Bank and the Structural Funds are mentioned for complementing the regional, national or European funds for the implementation of research infrastructures[6].

In a *Report of consultation workshop on the possible content of "Horizon 2020"*[7] held in July 2011 by the DG Research and Innovation and the DG Information Society (Subject Research Infrastructures, RI)[8]; some key messages were included in this aspect like the following:

- Horizon 2020 should be complemented by the use of Structural Funds including for RI
- Member States are expected to earmark structural funds for RI construction
- In the present model RI sustainability is not guaranteed and deploying the ESFRI roadmap needs an implementation engine
- There is a risk to build new RI and not being able to afford operating costs
- A significant budget increase is needed for the transnational access to allow open access in an affordable manner
- Training and education should be part of the RIs
- The Commission reminds that plans need to be made because programming of Structural Funds will start in 2014 and dialogue with Member States should be promoted
- It is important not to underestimate the need for funding certain operational costs including access and upgrading costs

Research infrastructures and the funding required will play an important role in Horizon 2020. In the presentation *Research Infrastructures and Horizon 2020 - The EU Framework Programme for Research and Innovation 2014-2020* given by the EU DG Research & Innovation in June 2012[9] the stated European priorities seem to be in line with those of ECCSEL:

- Excellent science
- Retain research talent
- Access to the best RI

The European Research Area (ERA) is aiming for stronger partnerships with Member States and the private sector to invest more efficiently, open access to results, and to boost support to infrastructures. At the same time the objective is to ensure the implementation, long term sustainability and operation of the ESFRI and other world class infrastructures, where ECCSEL is part of at the moment. Horizon 2020 will pay special attention to strengthening the human capital by, for example, supporting training of staff, exploiting innovations to stimulate the use of infrastructures by industry; exploitation of synergies between national and EU activities, and to facilitate strategic international cooperation.

The *Berlin funding model* aims at a stronger action from Member States and other interested countries. It comprises a three step approach:

1. Potential project partners from different countries identify a joint research project and a draft proposal.
2. Upon positive evaluation of the draft proposal by all national funding agencies, project partners submit a full proposal to their national funding agencies, taking into account the alignment of different evaluation procedures in different countries.
3. Following a positive decision by the national funding agencies, the project partners ask the EU-commission for additional support that can serve to incentivise collaboration and coordination between partners.

[6] http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=new_ri

[7] Horizon 2020 is the next large Framework Programme of the European Commission, which will replace FP7. The first calls for proposals from Horizon 2020 are expected in 2014.

[8] http://ec.europa.eu/research/horizon2020/pdf/workshops/research_infrastructures/summary_report_workshop_on_4_july_2011.pdf#view=fit&pagemode=none

[9] https://indico.desy.de/contributionListDisplay.py?confId=5641

Regarding the Structural Funds, the *Working Document on Specific Programme Implementing Horizon 2020*[10] includes the work carried out by the Committee on Industry, Research and Energy for building synergies between Horizon 2020 and the Structural Funds. The Structural Funds can be used to finance equipment, human resource development and the creation of clusters in the priority of Horizon 2020. The Structural Funds can be used to valorise research results in such a way as to encourage easy access to knowledge.

Some examples of financial instruments for Horizon 2020 are included in the presentation *Financial Instruments 2014-2020 – Doing more with less*[11], given by the DG Research and Innovation in May 2012 where an indication to a financial instrument such as loans and guarantees to R&I (non-SMEs) activities of mid-caps and large firms, universities, research institutes, research infrastructures, etc. is included.

3.2.3.2 European Investment Bank and NER300

It is also worth mentioning the European Investment Bank (EIB), where funds for climate change research are available that could support activities within CCS. From the *Report of Clean Energy for Europe - A Reinforced EIB Contribution*[12] published in 2007 all financial instruments for CCS seem to pass through the NER300 and the EIB specifies that it is ready to finance demonstration plants and other experimental clean coal technologies as RDI projects. NER300 is a financing instrument for installations of innovative renewable energy technology and CCS managed jointly by the European Commission, the European Investment Bank and the Member States.[13]

Nevertheless the EIB also promotes the creation of the knowledge economy as a generator of economic growth and hence finances capital investments, including recurrent "intangible" expenditures like researchers' salaries and research consumables, acquisition of Intellectual Property Rights and technology licenses, aimed at developing EU research networks, platforms and programmes like collaborative actions initiated at European level, e.g. European R&D Infrastructures (ESFRI) or European Technology Platforms.[14]

A financial instrument already mentioned is the Risk Sharing Finance Facility (RSFF). The EU magazine *Research-eu Focus* included an edition covering this instrument in June 2011. The article points out that RSFF loans are available to public and private sector promoters of any size and ownership from the EU Member States and associated countries to FP7, which are seeking funding for RDI activities. It also mentions that Research infrastructures involving at least three countries are supported through the 'Capacities' Specific Programme, but a special RSFF sub-facility is being developed by the EIB for financing significant research infrastructures. Apparently loans can be used to fund new laboratories and equipment, as well as soft investments such as R&D operating costs, personnel costs, and the costs of acquiring or protecting patents. For Large Research Infrastructure projects the EIB offers the individual direct financing solution known as the ESFRI RSFF Capital Facility (ERCF).[15]

However, during the workshop *How can we improve access to risk finance in Europe?*, held in July 2011, the document points out that for purely public research infrastructures without sufficient revenues, debt finance requiring repayment and debt servicing was regarded as an inappropriate instrument.[16]

Figure 2 gives an overview of currently identified funding scheme, i.e.

[10] http://www.europarl.europa.eu/sides/getDoc.do?type=COMPARL&reference=PE-488.047&format=PDF&language=EN&secondRef=01
[11] http://www.slideshare.net/IserdIsrael/horizon-2020-financial-instruments-jeandavid-malo-israel-may-16th-2012
[12] http://www.eib.europa.eu/attachments/clean_energy_for_europe.pdf
[13] http://www.ner300.com/
[14] http://www.eib.org/projects/topics/innovation/research-and-development/index.htm
[15] ftp://ftp.cordis.europa.eu/pub/news/research-eu/docs/focus-10_en.pdf
[16] http://ec.europa.eu/research/horizon2020/pdf/workshops/access_to_risk_finance/summary_report_workshop_on_13_july_2011.pdf

- National research programs typically funded via research councils or ministries
- The cost to execute the research might be covered by the proposed funding scheme of Horizon 2020
- The financial support for upgrading or new research infrastructure (trans-national) might be covered by the Cohesion Policy funding instrument together with industrial participation and national funds.

During the Preparation phase 2 research proposals must be developed for the *initial phase* and *advanced phase* of the project, which should be in compliance with the ECCSEL innovation plan.

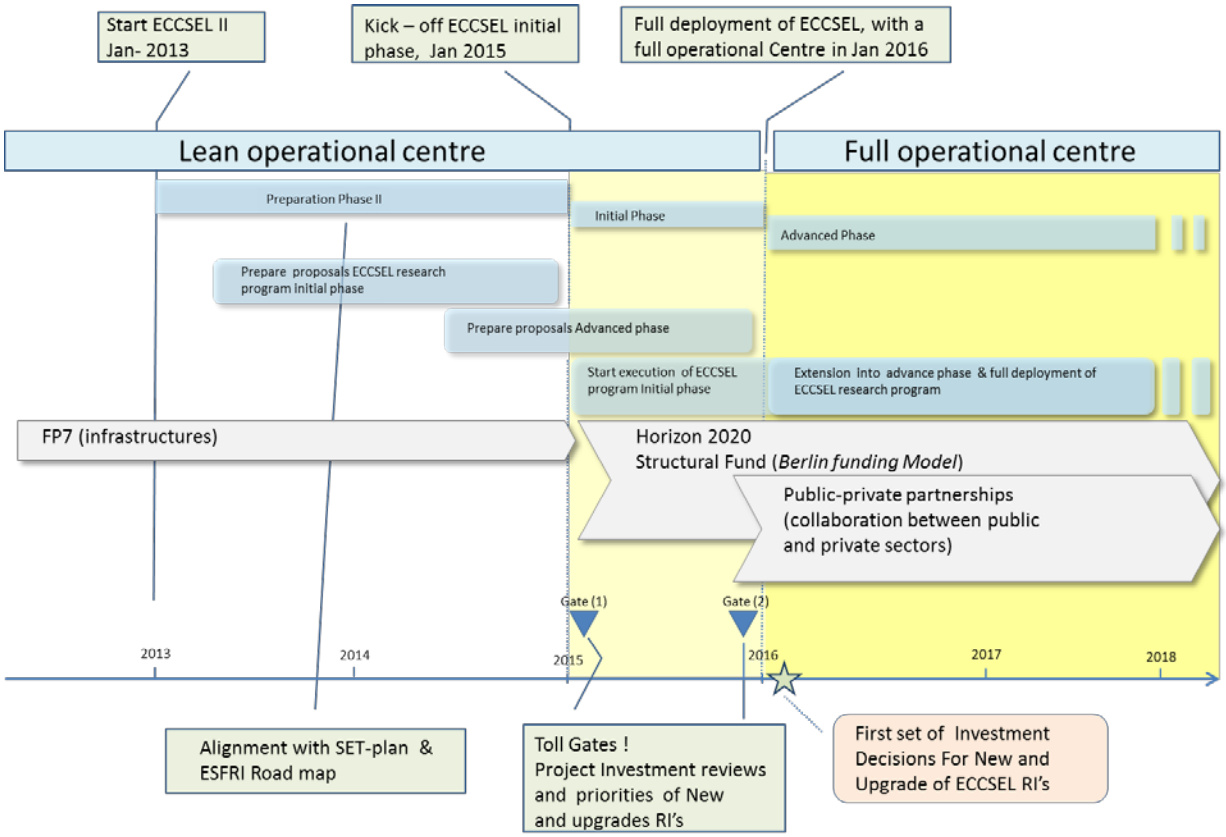


Figure 2 Overview funding scheme

3.2.3.3 International funding outside Europe

Some of the present research infrastructures include funding from countries outside the EU. ECCSEL should aim at strengthening the cooperation with CCS programmes in countries outside EU, such as Australia, Canada, China, India and Japan.

3.2.4 Cost scenarios

Three different cost scenarios have been investigated in ECCSEL PP 1: a base case, a more conservative "moderate" scenario and an ambitious "progressive" scenario. It was assumed that ECCSEL will expand gradually by "organic growth" and the time-frame for the analysis is the period 2015-2030.

3.2.4.1 Base case cost scenario

Within the base case organic growth scenario the development of ECCSEL will slightly increase to a level of approx. 37 M€ /year in 2030. The scenario assumes that the first two years requires time for alignment, time for the commissioning of the ECCSEL organization and time to stress test operational

procedures. From thereon it is assumed that the Research will be more and more centralized and as such will grow in size in terms of RIs and related CCS research in all categories with reasonable level of fund flow.

3.2.4.2 Moderate organic growth cost scenario

In the moderate case, the organic growth process is hampered by lack of funding and reasonable member state support. This scenario assumes that most of the RIs are contracted out by ECCSEL and new built RIs are delayed. As such the ECCSEL RI network growth will be limited. There might be two large demo sites managed by ECCSEL which will be the dominant cost element for ECCSEL. The lab/full-lab and pilot test rigs will be about 40% of the total costs.

3.2.4.3 Progressive organic growth cost scenario

The progressive organic growth process is heavily supported by industrial partners and public funding from member states. This scenario assumes that most of the RIs are fully contracted out by ECCSEL and new built RIs are part of the ECCSEL network. As such the ECCSEL RI network growth will be significant. Large demo sites are managed by ECCSEL which will be the dominant cost element for ECCSEL mainly underpinned by private funding. The lab/full-lab and pilot test rigs will be about 40% of the total costs.

The funding mechanism for the base case cost scenario for ECCSEL should cover a total cost of approx. 345 M€, with an average cost level of 22 M€/annum. This is a significant amount of Capex and Opex. The main funding sources will depend on the scale of the infrastructure.

Table 4 gives an overview of the expected total costs for the three scenarios and primary funding sources:

Table 4: Overview of cost scenarios

Scenario	Lab/Full Lab	R&D pilots/ Test rigs	Industrial pilots/ Large demo	Total
RI layer, see Section 4.4	1st		2nd	
Base case (M€)	74	56	215	345
Moderate growth (M€)	47	23	85	155
Progressive Growth (M€)	109	75	417	601
Main funding sources	Public (Horizon 2020/Structural funds) and private		NER300/demo project/ private funding	

The scenarios are explained in more detail in Deliverable 2.3. The development of the funding structure is discussed further in Deliverable 2.1 and 2.2.

3.3 Implementation strategy to establish ECCSEL as an infrastructure for CCS Research and Innovation

3.3.1 Europe's CCS infrastructure requirements in a medium to long term perspective

ECCSEL Preparatory phase 1 has analysed the future necessary CCS Infrastructure. The analysis is based on roadmaps published by different entities in Europe and worldwide. Starting from knowledge needs, the infrastructure required for obtaining the necessary knowledge is defined for capture, transport and storage. The required infrastructure within **capture** and **transport** is categorised according to technology development stage:

i) Invention (basic and applied research)
ii) Innovation (creating new commercial products or processes)
iii) Adoption (demonstration until use)
iv) Diffusion (increased industrial adoption)

For **storage** the required infrastructure is categorised according to:

i) Laboratories
ii) Mobile laboratory
iii) Research and development pilot storage site
iv) Natural laboratory

CCS technologies are at an initial stage of development and most of the promising technologies are in an invention or innovation stage. For these technologies to move to a more advanced stage of development there is a need for R&D to shift from small scale to pilot and industrial scale demonstrations. The findings are described in detail in Deliverable 3.2.

3.3.2 Existing and already planned European CCS infrastructure

The project has surveyed the existing and already planned research infrastructure in Europe. It should be noted, however, that the survey covered almost only the ECCSEL members' own infrastructure and plans. Questionnaires were sent out to external organisations, but the responses were limited, most probably due to the detailed and lengthy form. Several important research infrastructures in Europe were thus not included in the survey, and these will be contacted during ECCSEL Preparatory phase 2.

Important findings for **capture** are:

- Post combustion RI is dominant (34%), while pre-combustion and oxy-combustion are equally divided (22% each)
- 60% of the RIs are operative, 19% are under start up, 5% in planning stage and 7% under construction
- 41% of the RIs are R&D pilots, 29% laboratory units, and 27% full laboratory, while industrial pilots (2%) and demonstration plants (2%) are very limited
- The ECCSEL partners cover all main technology elements of capture RIs (Absorbent (24%), adsorbent (17%), membrane (13%), cryogenics (4%), combustion (17%), gas turbine (6%), chemical looping (11%) and gasification (10%)
- There are 31 available RIs for external users (after 2013), 15 are uncertain and 2 are not available, while in the next 3 years 24 RIs are available, 15 are uncertain and 9 are excluded
- RI owners are not very willing to transfer rights or ownership to ECCSEL
- RI owners generally require payment for the use of their RI

Only two CO_2 capture RIs have been characterized as "industrial pilot" or "demonstration plant". This can be explained by the fact that those large units were not in the initial perimeter of the RI mapping. In fact, we know that there exist some large industrial pilots, for example the Vattenfall Schwarze Pumpe plant and the TCM Mongstad plants. Whether infrastructures of this kind could or should be part of ECCSEL RI should be further elaborated during the ECCSEL PP 2 project.

Important findings for **storage** are:

- Out of 34 RIs, 26 are completely operative and 5 are starting up, while 20 out of 33 concern full laboratories.
- Use of the RI is for: Storage site characterisation (23), Storage operation (18), Monitoring (20), Risk management (18) and "Other" (7).
- Within Storage site characterisation, Operation and Monitoring, RIs can address all the main research topics. For Risk management topics, RIs that address corrective measures for the storage complex and the overburden are limited.
- Most Storage RIs are covering several research topics and several phases of the storage project.
- The RI descriptions have been categorised in 7 clusters:
  a. Rock/Fluid characterization laboratories: Laboratories to study cores and fluid samples and define its properties

b. Geochemical and thermodynamic batch laboratories: Laboratories where batch experiment of geochemical and thermodynamic evolution on static samples can be studied.
c. Biology and ecosystem laboratories: Laboratories (including in situ instrumentalised laboratories) where reaction of ecosystems to CO_2 can be studied.
d. Flow simulation laboratories: Laboratories where dynamic (flowing) behaviour can be simulated.
e. Mobile monitoring systems: Mobile full systems that can be used in different sites for monitoring or characterization.
f. Analogue or field experiment sites: Where larger scale processes can be studied
g. Pilot injection sites.

The findings are described in detail in Deliverable 3.3.

3.3.3 Analysis of the gap between existing infrastructure and the infrastructure that is required to meet future needs

Experts from relevant ECCSEL partners have identified and analysed the key gaps between current research infrastructure and the capabilities that will be required to undertake research to address all critical issues in CO_2 capture, transport and storage. Particular importance has been attached to identifying missing infrastructures that can address the main bottlenecks of the technology. A total of 91 gaps were identified: 69 gaps in capture infrastructures, 10 gaps in transport infrastructures, and 12 gaps in storage infrastructures.

Without prejudice to the future findings of ECCSEL PP 2, it can be stated that there is a general need in the CO_2 capture domain for up-scaled RIs. Research has been accomplished at a certain scale and the most urgent needs for new RIs arise from the need to step up to the next scale. Furthermore, RI gaps identify the need to go to more severe/realistic experimental conditions (temperature, pressure, gas composition, etc).

In the storage domain, there is an urgent need for a variety of test sites to validate numerical and laboratory studies under realistic and sufficiently large scale. Different issues, such as rock-fluid interactions, leakage detection, injection strategies, remediation techniques, may require different types of test sites in terms of geology and size. However, it must also be stated that one of the differences between capture and storage RIs in general, and pilot RIs in particular, is that storage pilots should and could be used to test and evaluate many, if not all, storage related R&D issues (in contrast to capture where a post combustion pilot is, for example, of no interest for chemical looping combustion). Thus, several small to medium size storage sites could be set up where the complete life cycle of a storage operation can be studied in a short time frame. Examples include a limited size reservoir/infrastructure can be filled up and pressurized rapidly. Monitoring and possibly leakage/remediation studies can be performed also in a much shorter time window and at much lower costs than in the case of large industrial size infrastructures.

The ECCSEL consortium is aware that it has not been possible to include all relevant facilities during the survey of existing or planned research infrastructures. It may be that some of the identified gaps may be filled by existing European infrastructures that have not yet been surveyed. This risk will be reduced by Preparatory phase 2, which will carry out more thorough surveys of external organisations.

See Deliverable 3.4 for detailed descriptions of the gaps.

3.3.4 Implementation plan for establishment of the ECCSEL infrastructure

Based on the analyses performed in ECCSEL PP 1, it is recommended to organize the ECCSEL RIs with two layers, one consisting of a network of distributed complementary laboratories, and another consisting of ECCSEL pilot and test sites:

- A network of complementary distributed laboratories. These laboratories are typically of smaller size and managed in the longer term under the whole responsibility of a single network member. The selection of these laboratories should be based on specific quality criteria that have to be fulfilled and that would be defined early on in the next phase of the project.

- A prioritized, limited set of pilots and test sites, being characterized typically by a larger scale and, most importantly, by the necessity of joint efforts (scientific, technical and financial) between different organizations and countries to ensure their set-up and long term viability. They would consist of "R&D pilots" (both capture and storage), including natural laboratories and storage test sites, or of a geographical cluster of such RIs.

Large industrial pilots such as the Vattenfall Schwarze Pumpe plant and the TCM Mongstad plants have not been considered and the feasibility of including such installations in the ECCSEL RI, either as full or associated members should be considered in Preparatory phase 2. The reason for distinguishing these two layers is that their development paths and kinetics are likely to be different.

In view of the nature of this type of RI complexity and the current political and financial context, it is recommended to apply an "organic growth" approach, starting small and becoming bigger over time, with strong governance overseeing the growth process. In particular, only a few qualified, motivated and committed infrastructure owners should be selected to form the network of ECCSEL laboratories from day one. In parallel, one or two cases for setting up and developing larger scale ECCSEL pilot/test sites, with ambitious objectives, should be selected. Using input from international information exchanges may be useful for avoiding pitfalls, overlaps and delays. Although organic in nature, proactive and efficient growth will require detailed strategic and operational planning in Preparatory phase 2.

Efforts should also be undertaken to evaluate potential benefits and possibilities of closer cooperation with current industrial pilot and demonstration project owners worldwide.

The implementation plan is discussed further in Deliverable 3.5.

3.4 ECCSEL dissemination strategy

3.4.1 ECCSEL dissemination policy

Dissemination of information about ECCSEL at different levels such as the scientific community, industry, national governments, etc. is very important for the anchoring of ECCSEL. Dissemination in the many forums and meetings where the ECCSEL members are represented is therefore encouraged.

ECCSEL should facilitate knowledge sharing among stakeholders, funding bodies, project proponents, and industry. ECCSEL should also make use of analytical approaches to add value to raw data, knowledge and experience arising from projects, in order to yield best practices from lessons learnt. These activities will spin off new knowledge products.

In order for ECCSEL to reside within the knowledge triangle (Figure 3) emphasis should be placed also on education and innovation. This implies that research facilities and services should be made available for higher education and training. In turn, this will have a significant impact on the skills and capabilities of the next generation of engineers and researchers specialising in topics related to CCS. As these persons will subsequently make use of their experience and new knowledge, they will contribute to enhance the European knowledge base – scientifically and technologically.

The dissemination activities are reported in Deliverables 4.1-4.10.

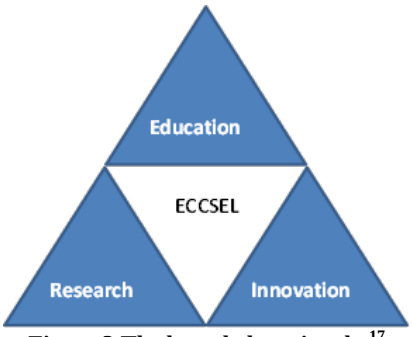


Figure 3 The knowledge triangle [17]

3.4.2 Actions to implement communication channels to citizens, users and funding bodies

An ECCSEL web site has been established, www.eccsel.org, where updated information about ECCSEL is given. An ECCSEL contact data base and Electronic Newsletter with approx. 350 subscribers have been established and will be extended with time. The web site and the data base should be up-dated frequently and new newsletters should be issued on a regular basis.

3.4.3 Actions to attract new ECCSEL partners and establish co-operation on a global scale

An important task in ECCSEL PP 2 should be to attract new members. To prepare for this activity, PP 1 has identified 28 universities, institutes and demonstration projects that are potential new partners, as listed in Table 5.

Deliverable 4.11 gives more details about the potential future partners in ECCSEL.

Table 5 Potential new ECCSEL partners

DEMONSTRATION PROJECTS	
Callide	Australia
CO2CRC Otway storage project	Australia
Gorgon CO2 injection project	Australia
Lacq	France
Schwarze Pumpe	Germany
Porto Tolle	Italy
ROAD Project/Rotterdam	Netherlands
Technology Centre Mongstad	Norway
Belchatów	Poland
Compostilla	Spain
Don Valley/Hatfield	United Kingdom
INSTITUTES AND RESEARCH CENTRES	
CNRS	France
GFZ	Germany
SINTEF Petroleum Research	Norway
Sotacarbo – Società Tecnoligie Avanzate Carbone - SpA	Italy
ECN	Netherlands
NIVA	Norway
Matgas 2000 AIE	Spain
CSIC/INCAR	Spain

[17] Source: A vision for strengthening world-class research infrastructures in the ERA, Report of the Expert Group on Research Infrastructures. 2010

Nagra	Switzerland
UNIVERSITIES	
Technische Universität Wien	Austria
Universität Stuttgart	Germany
Sapienza – Università di Roma	Italy
Delft University of Technology	Netherlands
University of A Corun	Spain
Middle East Technical University	Turkey
The University of Edinburgh	United Kingdom
The University of Nottingham	United Kingdom

3.5 ECCSEL strategic position as a pan-European infrastructure

3.5.1 ECCSEL's strategic position

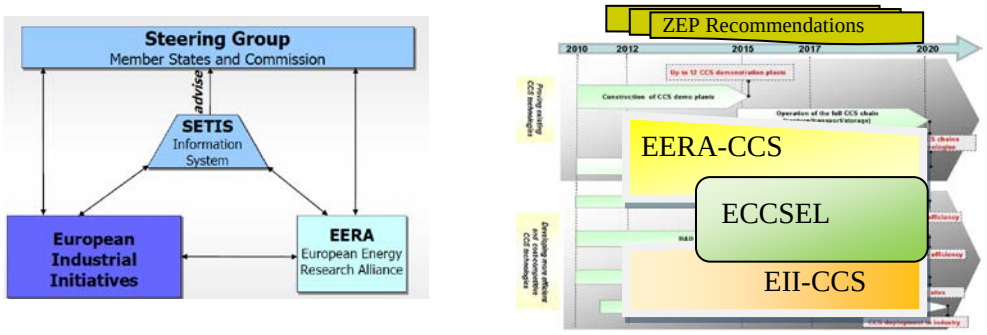
The ESFRI Energy Strategic Working Group (ESFRI - ESWG) Report 2010[18] recommends for the CCS thematic field of the SET-Plan, that ECCSEL should be in the ESFRI roadmap. The ESFRI - ESWG that assessed the ECCSEL proposal before it was recommended for the 2008 roadmap, and the subsequent development of ECCSEL until 2010, comprised expert members appointed by 18 European countries, with one member from each state. The idea of a distributed CCS RI in different European countries with one coordination centre was adopted by the ESWG.

Recently the Commission has approved the Preparatory Phase II of the ECCSEL preparatory work. By this, the Commission shows its continuing support to the ECCSEL idea as a pan-European distributed CCS RI. In this respect ECCSEL is justified as part of the SET-Plan only by being attractive to the best scientists and innovators through offering unique and state-of-the-art CCS RI facilities. According to the ESFRI Energy Strategic Working Group (ESFRI - ESWG) Report 2010, an ESFRI RI should:

- Help researchers accessing the best facilities
- Structuring of ERA
- Supporting innovation
- Improving efficiency

To fulfil these expectations, ECCSEL should reflect the needs *in real time*. These needs may change as CCS technology develops as predicted in the CCS Technology Roadmap or the objectives of Horizon2020 where technological development and innovation, support of industry and capacity building through education and training, are crucial. This means that ECCSEL must have a dynamic strategy to ensure that a relevant RI is made available when needed. Taking into consideration current structures for the implementation of the SET-Plan, a sustainable strategy for ECCSEL is to operate as the RI platform that provides the best services to stakeholders operating within CCS-EERA, CCS-EII and ZEP. These strategic structures with overarching governance as depicted in Figure 4 are already defined as a measure for the implementation of the SET-Plan.

[18] European Strategy Forum on Research Infrastructures – Energy. *Thematic Working Group Report 2010*. Contact: ESFRI Secretariat, e-mail; ESFRI@ec.europa.eu



a b

Figure 4 a) Simplified SET-Plan governance (from Wiktor Raldow, European Commission, IEA-MOST CCUS Workshop, Beijing 18-19 Sept., 2011). b) Illustration of the proposed close interaction of strategic structures EERA-CCS, ECCSEL and EII-CCS for the implementation of the SET-Plan.

ECCSEL has the ambition to support the Commission's strategy for increasing education and training in Europe within the CCS thematic area to achieve technology development and innovation, capacity building and industrial commercialisation of the CCS technology.

3.5.2 Anchoring of ECCSEL as a pan-European infrastructure

The ECCSEL Policy Contact Group (PCG) with representatives from ministries and funding bodies has been established to ensure political and strategic anchoring in the Partner's states. This group had the first meeting hosted by the Research Council of Norway in Copenhagen on March 21st, 2012. In her welcome address Deputy Director General Live Haaland from the Norwegian Ministry of Education and Research made the important point that "*the ECCSEL project never will become a reality unless the stakeholders represented here (i.e. PCG) also find that ECCSEL is a worthwhile project to participate in and contribute to*". The representative from six European states presented the CCS activities in their countries and agreed on a next meeting early in 2013. In this meeting the ECCSEL RI Development Plan, which was prepared during ECCSEL Preparatory Phase I, is to be discussed by the PCG. For the future strategic position of ECCSEL in Europe, the comments, discussion and recommendations from the PCG are vital and essential as input to the work in Preparatory Phase 2.

3.5.3 Outreach to other stakeholders

Several meetings, workshops and presentations have been given with the aim of anchoring ECCSEL with different stakeholders in Europe and Australia. Of many activities one should mention that the ECCSEL Steering Board Chairman, Dr. Nils Røkke, SINTEF Energy, has presented ECCSEL to the ZEP Advisory Committee and discussed the implications of ECCSEL in the 7th General Assembly of the ZEP, held in Brussels the 3rd of October of 2012. ZEP includes the most important industrial stakeholders as well as institutes, and the platform has taken an important role in defining a roadmap for the required research and development to meet the technical challenges for the realisation of broad deployment of CCS. Members of the ECCSEL partnership have also participated in meetings with the ESFRI Working Group, the ESFRI Implementation Group and the **Co**mmunication and **Po**licy development for **R**esearch **I**nfrastructures in Europe (CoPoRI) group. The Coordinator of the CCS grouping of the European Energy Research Alliance (EERA), Dr. Andreas Ehringer, IFPEN, is an Observer in the ECCSEL Steering Board and Work Package leader in the ECCSEL PP 1. EERA is a pan-European research effort created to support the implementation of the Strategic Energy Technology (SET) Plan. The close contact between EERA and ECCSEL ensures that the necessary interaction is continuously maintained.

The strategic position of ECCSEL in Europe is detailed further in Deliverable D5.2

3.6 Main recommendation for ECCSEL and PP 2

3.6.1 Recommendation from Preparatory phase 1

- Based on an analysis of different legal forms it is recommended that ECCSEL should be organized as a European Research Infrastructure Consortium (ERIC). Organising ECCSEL as an ERIC will ensure an optimal legal basis for its operation as a distributed pan-European research infrastructure. It enjoys privileges as an international organisation (e.g. VAT exemption) and is not subject to the directive on public procurement as implemented in national law. Membership is restricted to countries and intergovernmental organisations.

- The ECCSEL legal entity should have two governing bodies with decision making powers; the General Assembly (ultimate decision making body) and the Board of Directors (executive body and legal representative of ECCSEL). Furthermore, it is recommended to have two advisory bodies, the Research Infrastructures Coordination Committee (with representatives of the Research Infrastructures of the ECCSEL RI) and the Innovation Advisory Board (with high-level representatives from global industrial stakeholders who are independent of ECCSEL).

- The ECCSEL IPR Policy should create a common understanding and foundation for efficient utilisation of any IP used or controlled within the ECCSEL Research Infrastructure (RI) and should ensure that the rights of ECCSEL and of its members are properly taken into account. It should also set up secure IPR rules between the ECCSEL members and towards visiting researchers – which will include professors, students, and other persons engaged in research activity within ECCSEL.

- The access policy should be based on the principle of 'open access', meaning that the access should not just be reserved for the members but also be open to users from all European countries. The application procedure should be based on fair and transparent rules and the applications should be dealt with as efficiently as possible, while maintaining respect for the required confidentiality. ECSSEL should provide model Application Forms for access.

- Applicants to ECCSEL RIs should bear all access costs. Dependent on the nature of the application, for example collaborative research, some access costs may be covered by other sources (e.g. EU grants). The access should be based on daily rates that apply to each infrastructure.

- A variety of potential funding mechanisms have been identified for ECCSEL. It is recommended to continue exploring these possibilities to ensure that funding for capital investments, operation and access are defined and in place.

- It is recommended to organize the ECCSEL Research Infrastructures with two layers, one consisting of a network of distributed complementary laboratories, and another consisting of ECCSEL pilot and test sites.

- It is recommended that expansion of ECCSEL is by organic growth starting small and becoming bigger over time, with strong governance overseeing the growth process. ECCSEL should contact several important CCS research infrastructures in Europe and expand existing partnership to fill identified RI gaps. Furthermore, to include industrial pilots and demo plants in ECCSEL should be evaluated. Moreover, there is a general need in the CO2 capture domain for up-scaled RIs and to go to more severe/realistic experimental conditions (temperature, pressure, gas composition, etc). In the storage domain, there is an urgent need for a variety of test sites to validate numerical and laboratory studies under realistic and sufficiently large scale. Several small to medium size storage sites could be set up where the complete life cycle of a storage operation can be studied in a short time frame.

- ECCSEL should strategically align to EERA, EII and ZEP commitments for supporting the implementation of the European SET-Plan. It is recommended to work with these instruments and the Commission to safeguard the strategic position of ECCSEL in the SET-Plan.

- ECCSEL should strengthen the cooperation with CCS programmes in countries outside EU, such as Australia, Canada, China, India and Japan.

- The Policy Contact Group plays a decisive role in the establishment of the ECCSEL RI. The work of the PCG is vital to ensure sufficient commitment and strategic anchoring of ECCSEL in the partners' political systems. It is recommended that this work is intensified considerably.

- It is recommended to work for securing that the Commission recognises ECCSEL as a strategic network of infrastructures for CCS aligned to EERA, EII and ZEP commitments for supporting the implementation of the European SET-Plan.

- ECCSEL should support the Commission's strategy for increasing education and training in Europe within the CCS thematic area.

- ECCSEL targeted goals as defined in the Description of Work of Preparatory Phase 2 should be followed up and work to develop the actual RI should start already in 2013.

4 Potential impact and main dissemination activities

4.1 Potential impact

The scope of the project is to complete the preparatory phase leading to the construction of a new CCS research infrastructure of European laboratory facilities and test sites devoted to CCS. The aim is to bring the project of this new research infrastructure (ECCSEL) up to the level of legal and financial maturity, as required for its implementation.

Although the immediate impact of the project (per se) will be rather limited, the end result will have a huge impact, as ECCSEL PP2 will pave the ground for a new type of research infrastructure to be formed in 2015 which will provide a clear added value.

4.1.1 Expected impacts listed in the Work Programme

The Work Programme states as follows:

> *Research infrastructures play an increasing role in the advancement of knowledge and technology and their exploitation. [---] By offering high quality research services to users from different countries, including from the peripheral and outermost regions, by attracting young people to science and by networking facilities, research infrastructures help structuring the scientific community and play a key role in the construction of an efficient research and innovation environment.*

ECCSEL responds directly to the overall objective of the Work Programme: ECCSEL intends to optimise the use and development of the best CCS research facilities in Europe, and to create in the field of science and technology a new research environment of pan-European interest needed by the European scientific community.

The Work Programme furthermore lists the following expected impacts (under its section 1.2.2 *Construction of new infrastructures (or major upgrades) – preparatory phase*). The bullet points in italics (below) are extracted from this part of the Work Programme.

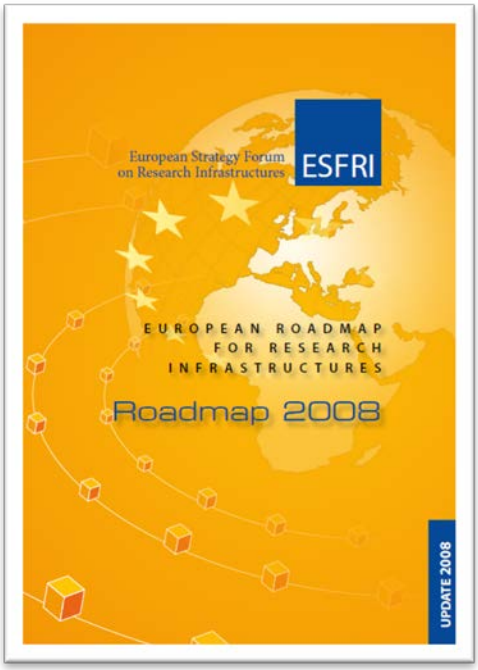


Figure 5 The ESFRI Roadmap 2008

- *How the project may help the new research infrastructure – identified in the periodic updates of the ESFRI roadmap – to reach the level of technical, legal and financial maturity required to enable the construction work to start.*

ECCSEL was first posted on the roadmap by the European Strategy Forum on Research Infrastructures (**ESFRI**[19]**) in December 2008** (cf. Figure 8), and it was then the only new entrant within the energy domain.

The process behind this important event includes a close scrutiny of the European position, and a broad consultation with regard to the obvious gaps that need to be closed within existing European research laboratories and their recent availability.

The project is made up by proficient European research institutions and laboratories. The partners are desirous of creating a new research infrastructure of pan-European interest. From this base, joint efforts will be made mainly to complete the prerequisites for establishing ECCSEL, which requires a legal framework, governance structure, financing strategies, infrastructure development and technical work.

Emphasis will be placed on the structuring of future capacities, capabilities and operations needed to remain at the forefront of the advancement of research, thus enabling industry to strengthen its knowledge base and its technological know-how.

Throughout its operational life, the ECCSEL research laboratory infrastructure will offer:

- access to world-class laboratory facilities by prominent researchers and reputable industrial players
- profound CCS expertise, enhancing the thematic discussions and activities of ECCSEL
- extensive analytical skills, allowing and delivering new knowledge that will have the maximum beneficial impact on the field.

In this way the project will have a significant role to play in fostering cooperation among partners and stakeholders within the European (and global) CCS society.

- *Contribution to the technological development capacity and to the scientific performance and attractiveness of the European Research Area.*

The scope of the project is limited to accomplishing the preparatory phase, as required to form a new European research infrastructure. This preparatory work builds on a vision of ECCSEL as a future distributed research laboratory infrastructure devoted to CCS.

Main elements of this vision are based on the state-of-the-art in science and technology combined with future needs and opportunities. Success means that all steps and actions must be addressed, understood and made operational.
Three challenges that need to be addressed in order to scale up CCS research in Europe are cost, coordination and cross-fertilisation of ideas.

[19] Formed in 2002 by the European Commission as the strategic instrument of the EU, ESFRI aims at developing the scientific integration of Europe and strengthening international outreach. Its members are the EU Ministries for Research. The mission of ESFRI is to support a coherent and strategy-led approach on research infrastructures (RIs) in Europe, and to facilitate multilateral initiatives that lead to better usage of RIs, at EU and international level. The first ESFRI roadmap was published in 2006. (http://ec.europa.eu/research/esfri).

Subordinate to the objective of the project (Section 1.1.3), a subset of specific targets set out in Section 1.1.5 will be used to define criteria for choosing direction of the scientific and technological development – including capacities and capabilities required to form ECCSEL.

Adherence to these targets will affect the quality and quantity of the planning, which will have later impacts on the scientific performance and attractiveness of the European Research Area, as it relates to promotion and cross-fertilisation of new research ideas.

Research along the CCS chain will be promoted in order to integrate work that is currently organised in capture/ transport/ storage silos. Research efforts within specific discipline areas may be pooled in order to overcome institutional barriers that separate researchers within the same disciplines. A main purpose of ECCSEL is to facilitate interaction between researchers from different organisations in order to create new synergies and motivation.

Once ECCSEL becomes operational it will draw upon expertise from its consortium to set up and integrate its operations. ECCSEL will make use of analytical approaches to add value to raw data, knowledge and experience arising from projects, in order to yield best practices from lessons learnt and to accelerate the deployment of CCS in Europe and worldwide.

It is through the providing of tangible information and the sharing of advanced laboratory equipment at the present critical stage in technology development that issues of techno-economic viability can be quickly addressed and solutions for commercial deployment be devised. This kind of derisking of the commercial CCS development – still at laboratory scale – will increase the public confidence in CCS.

The increased research within Europe will be met via cross-institutional and transnational access to laboratories and facilities that must be coordinated within and between countries. ECCSEL will foster commitment to common research objectives and priorities between researchers, industry and EU demonstration projects.

Duplication of efforts and/or poor utilisation of resources shall be avoided by adjusting research priorities according to industrial needs and EC strategy.

- *Contribution to the Innovation Union commitment (n.5) to complete or launch by 2015 the construction of 60% of the priority European research infrastructures currently identified by ESFRI*

ECCSEL contributes to the innovation objectives in two different ways:

1. by establishing and operating a world-class CCS research infrastructure aimed at offering transnational access and conducting joint research, thus enabling researchers to generate substantial knowledge which can lead to new innovative solutions, such as more efficient products, processes and services relating to CCS, and thereby help to address societal challenges – especially the issues of climate change and security of energy supply. Innovation is reflected in the stated objective and the scope of the specific work packages, as well as in the expected impact statements.
2. by increasing the potential for innovation within ECCSEL and its affiliated research facilities, in particular by reinforcing links with companies that drive innovation. This includes activities and partnership with industry such as transfer of knowledge and other dissemination activities. ECCSEL will also carry out activities involving industrial researchers, and it will include industrial players in reference groups and for peer review.

Hence, the project contributes directly to commitment (n.5) by preparing all necessary aspects needed to form the new research infrastructure, ECCSEL, by 2015. This will require a new approach to funding CCS research laboratories to achieve future goals in a cost-effective manner.

The expected operations of ECCSEL will be considerable. ECCSEL will coordinate the funding of new and upgraded research laboratories to an estimated value of 250 million Euros provided by European, regional and national agencies. Industrial funding will be additional.

- *Increasing the potential for innovation of RIs*

Innovation is the creation of better or more effective products, processes, technologies, or ideas that are accepted by markets, governments, and society. Innovation differs from invention or renovation in being a substantial positive change rather than a modest incremental change.

In this project, a specific work package designated "Innovation" has been defined as part of the project. This work package addresses innovation and innovative ways of doing research within the research laboratories.

A key task of ECCSEL will be the facilitation of knowledge sharing between members, and from members to stakeholders, and funding bodies such as (inter alia) European governments, the European Commission, project proponents, and industry.

In prioritising research activities to be carried out in ECCSEL, two main directions are emphasised, i) the academic research (generic/fundamental) and ii) innovation (i.e. applied, operational, pre-normative research).

Projects belonging to the latter direction will be ranked according to their potentiality and capability for reducing the overall energy penalty and lowering the levelised cost of the CCS chain, and also for ramping up the speed and capacity needed for CCS to become material. These aspects are all research topics that call for cost-effectiveness, increased research and innovation.

Increased costs may be expected to take the form of high CAPEX and OPEX for new and/or upgraded laboratories and equipment. In this context, ECCSEL is prepared to

- allow for **resources and budgets to be pooled** in order to meet these higher costs. Cost sharing between ECCSEL partners may allow for reduced contributions from single sources.
- provide a **mechanism to create research facilities that would otherwise be unaffordable to any single institution**, thus increasing the breadth and depth of research that will be performed.

4.1.1.1 Education and innovation

ECCSEL also responds to Commitment n. 4, as referred to in the Work Programme: "*Opening of Member State operated RIs to the full European user community*". This will enable researchers to make decisive contributions to the grand societal challenges in energy supply and climate change via actions.

For ECCSEL to reside within the knowledge triangle (Figure 3), it is necessary to place emphasis on education and innovation. Hence, ECCSEL will make research facilities and services systematically available for higher education and training. This will in turn have a significant impact on the skills and capabilities of the next generation of engineers and researchers specialising in topics related to CCS. As these persons will subsequently make use of their experience and new knowledge, they will contribute to enhance the European knowledge base – scientifically and technologically. In any case, they will contribute to the ability of developing industry and bringing forward CCS for successful utilisation by society. In this manner, the value created via ECCSEL may become quite substantial.

4.1.1.2 Stakeholder engagement

ECCSEL also responds to the Work Programme with regard to stakeholder involvement and engagement. Reference is given to Section 1.1.7 ECCSEL Business Plan (developed in WP1), and activities specially addressed in WP5 Communication and Networking – seeking Stakeholder engagement.

4.1.1.3 Socio-economic impact of ECCSEL

The project addresses socio-economic issues in various ways, such as knowledge, scientific and technological development, education and training, knowledge transfer and collaboration within the consortium, transnationally within Europe and internationally, especially in consideration of Australia, China and USA. In addition, the successor of the project (ECCSEL) will have a significant impact on the employment in Europe. First, ECCSEL will contribute to employ graduates (at MSc and PhD level) trained in facilities belonging to ECCSEL, and students using ECCSEL. Secondly, it will provide knowledge and innovation for industries to commercialise, which will create job opportunities among technology providers, energy providers and industry.

The impact of knowledge can be measured by the number of publications of scientific papers in impact factor journals and other periodicals, as well as the value granted to external researchers through the open access policy. Likewise, the impact of development can be recognised via the number of national and international patents, and also by the number of technologies developed and transferred (including prototypes, methodologies and designs). Finally, the impact of knowledge transfer and collaboration is identifiable via the number of collaborative projects, the volume of research contracts and competitive funding and/or international grants.

Furthermore, a successful socio-economic analysis (i.e. an analysis proving a solid base for investment in ECCSEL) can only be derived from an excellent business case. The business case has been duly developed and included in the ECCSEL Business Plan (WP1).

4.1.2 Strategic impact

4.1.2.1 Impact of EU policy on CCS

In meeting the upcoming urgency and need for technological development and improvement within CO_2 capture, transport, and storage (CCS), it becomes obvious that moving the frontier in technology from the state-of-the-art is far beyond the capacity of a single nation. Therefore, the principal aim of the Work Programme – through establishing the European Carbon Dioxide and Storage Laboratory, ECCSEL, – is to ensure that the policy goals of the European Union can be achieved as concerns the safe and swift commercial deployment of CCS within Europe by 2020 and beyond.

Through its mission, ECCSEL will support industrial initiatives of implementing CCS, pursuant to the European roadmap and the SET-Plan. From a SET-Plan perspective, ECCSEL will promote efficiency within the European Research Area (ERA) and it will link to the European Energy Research Alliance (EERA). Furthermore, as indicated in Figure 10, the new *CCS Research Infrastructure* (ECCSEL) and the *CCS Demo Secretariat* (CCS PNS) may have and reciprocal impact on knowledge and capacity building in the interaction between research and the commercial deployment of CCS.

ECCSEL responds to the expressed needs for further technological development to ensure that CCS can be deployed on a large scale in Europe and elsewhere, to cut the global emissions of greenhouse gases by 50-80% by 2050. According to climate modelling this tremendous reduction is necessary to limit global warming by 2°C – as pronounced by the UN and the IEA (cf. the Blue Map scenario of Figure 11. Although the reduction must be regarded as an unprecedented challenge in terms of funding resources, ECCSEL responds directly to the core of this issue.

The European and international impact of accelerating the development of CCS for commercial use complies to the dedication of significant and specific CCS legislation (i.e. the CCS Directive and amendments to other Directives), the granting of significant funds to CCS commercial demonstration (EERP and NER300) and numerous CCS research projects, as well as the inclusion of CCS within the European emissions trading system (EU ETS).

ECCSEL is considered to have a key role to play in achieving this acceleration. The most obvious reason is that granting access to a pool of test facilities on a time-sharing basis will enhance the intensity and value of experimental research.

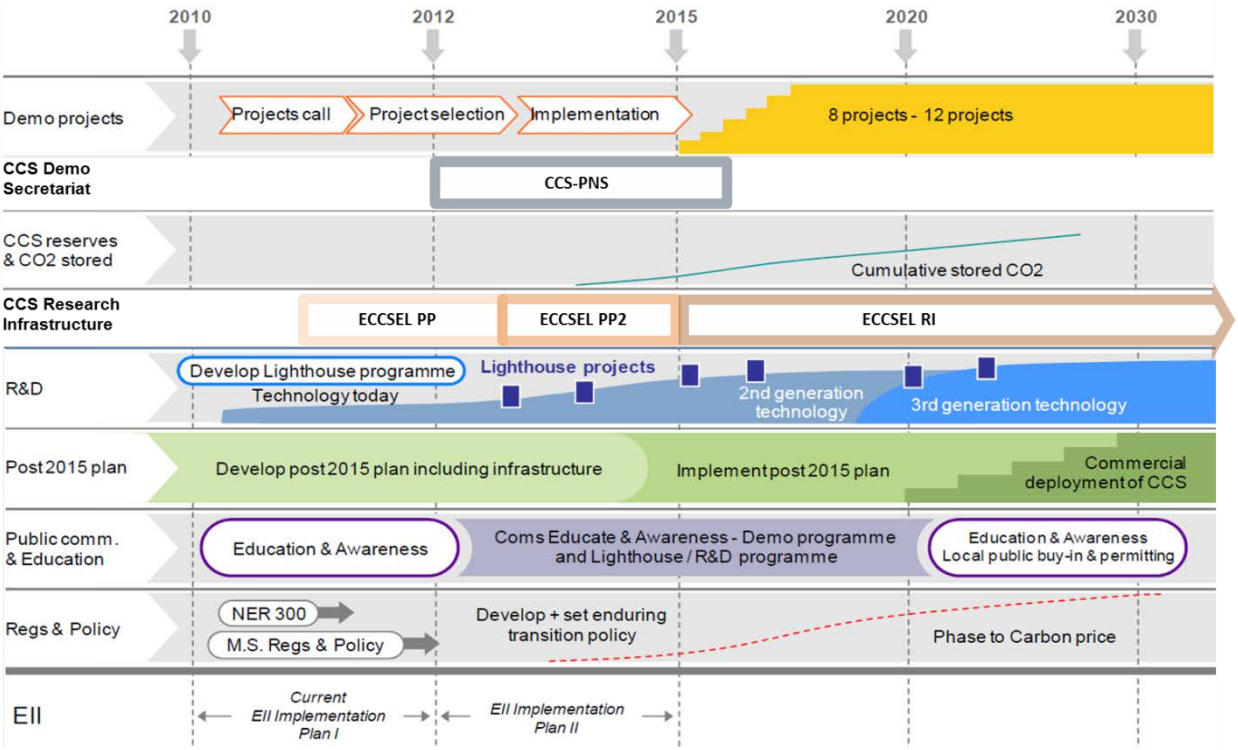


Figure 6: Positioning the ECCSEL initiative in the technology roadmap of the ZEP jointly with the new CCS-PNS project. (Source: The CCS EII implementation plan 2010-2012, Zero Emission Platform – manipulated to fit the intended purpose of this proposal)

Seen as a toolbox for joint programming within the EERA CCS Joint Programme, ECCSEL may boost innovation through joint and extended use of new research laboratory infrastructure, and also respond to the industrial needs via ZEP and other European CCS initiatives.

In this respect ECCSEL undertakes a critical role to ensure that the targets of the EII Implementation plan and those of the Roadmap can be achieved in due course.

4.1.2.2 Impact on the European approach

The idea of ECCSEL is to enable excellent researchers from all regions of Europe (and, where appropriate, from third countries) to undertake research that requires the most advanced equipment and facilities. The partners are open to discussing further inclusion of research facilities from other nations if it can be justified that this will add value to the results (synergy).

The project will imply a European approach, rather than a local or national approach, as ECCSEL is based on a pan-European collection of CCS research laboratories and test sites, and it will direct significant investments into new advanced research laboratories devoted to CCS (cf. Figure 4). ECCSEL will therefore benefit from having a pre-existing collection of internal CCS expertise.

On a medium-to-long term basis the project (ECCSEL) will have additional impacts on:

- **European competition**, contributing – as a world-class CCS research laboratory infrastructure – to accelerate CCS towards industrial exploration and deployment
- **innovation**, by forming a breeding ground for invention, exploration and pre-commercial testing of CCS techniques and technologies
- the **regulatory framework**, pertaining to safety and environmental aspects of CCS and also the working environment (i.e. HSE issues)

- **mobility and joint programming** of European CCS resources

Moreover, via its consortium, ECCSEL will be capable of collecting relevant information on institutional research projects world-wide – and on the majority of all CCS-focused networks and groups.

ECCSEL will also be well positioned to assess all strategic impacts on or of CCS in a societal context.

4.1.2.3 Impact on the issue of climate change

The United Nations ranks *climate change* as the most severe issue of our time. Nonetheless, in some nations the issue of *security of energy supply* appears to represent an even more severe concern. Since energy demand is believed to grow in the foreseeable future, these issues can hardly be combined unless a larger part of the global energy is provided with less greenhouse gas emissions.

CCS is seen as a key technology in tackling climate change. The IEA anticipates that CCS will contribute 19% of the emissions reductions required world-wide by 2050 (Figure 11). The IEA further anticipates that the level should be as high as 24% within OECD Europe.[20] (It should be noted, however, that in OECD Europe this does not solely apply to the power sector, as 50% of the reductions must be achieved within industry.)

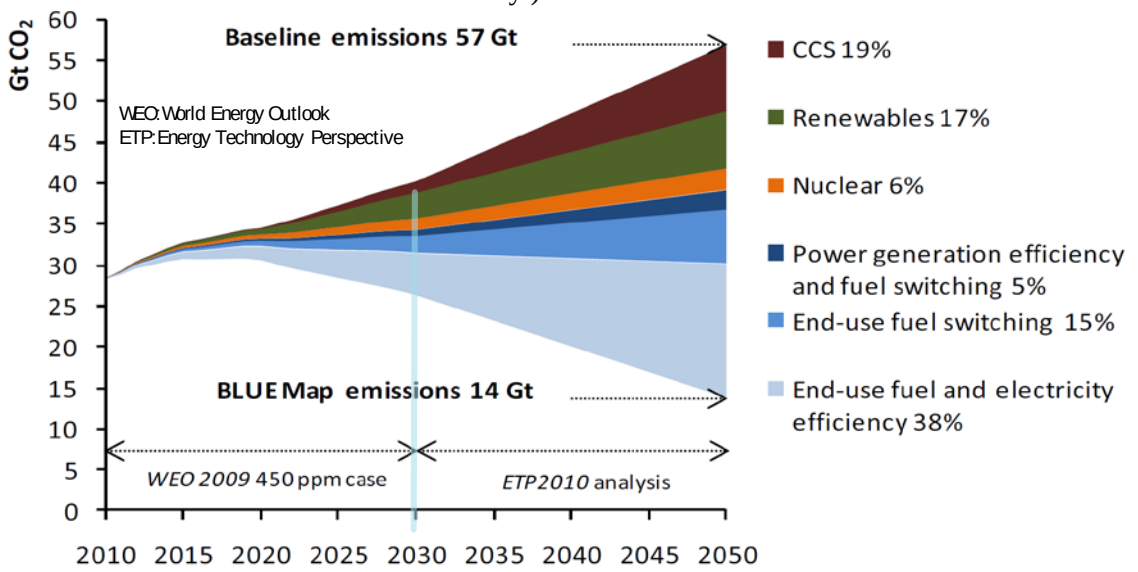


Figure 7: IEA scenario for abatement of world energy-related CO_2 emissions (Source: IEA 2010, Energy Outlook)

IEA analyses also tell us that without CCS, the overall cost of reducing emissions to 2005 levels by 2050 will increase significantly.

Against this back-drop the impact of ECCSEL is deemed to be significant.

Furthermore, in order for ECCSEL to have the expected impact in Europe, concepts for mitigating the CO_2 emission in industrial processes must become an essential part of ECCSEL.

4.1.2.4 Impact on national and international networks

Structural Funds – including the European Regional Development Fund (ERDF) – have made the financing of infrastructures for knowledge-based development a top priority. It is hoped that more partners from the convergence regions where ERDF is available may wish to build new facilities to extend the scope of research.

[20] IEA Technology Perspectives, 2010, page 333

One expected impact of this project is that discussions with research groups in Convergence Regions will lead to a broadening of the partnership and facilities to be managed by ECCSEL.

In terms of other national and international activities, the ECCSEL Operations Centre will be well placed to interpret, understand and engage with the CCS groups involved in experimental research actions.

4.1.2.5 Impact - external factors

The outcome of ECCSEL, and the success of the project, will rely heavily on the participation, openness, and trust of the partners and stakeholders. Potential obstacles will be analysed as part of the risk assessment (see Section **Error! Reference source not found.**) and the impacts these obstacles may have.

4.1.3 Dissemination and/or exploitation of project results, and management of intellectual property

The outcome of the project will mainly result from structural planning, legal and financial strategies, operational issues, recommendations and pre-engineering studies intended mainly to support the technical planning and budgeting. The intangible results will be summarised and presented in the ECCSEL Business Plan. The results also comprise assessment of assets viable for the subsequent CCS research infrastructure – ready to be established in 2015 – subject to appropriate funding and partner agreement.

Intellectual property will be handled as background information vested in the partner that is entitled to such intellectual property rights. As the nature of the project is mainly preparatory, it is not expected that ECCSEL PP2 will raise any new IPR issues. However, should this happen, it will be handled according to the rules set out in the consortium agreement.

Furthermore, the intangible results will per se have only minor interest for the public domain. They will, however, be highly appreciated by the stakeholders as presented in the prospectus (ECCSEL Business Plan) and the implications of the planned services. Dissemination will therefore be made part of a communication plan targeting the specific stakeholders to ensure proper understanding of the message, thus seeking further engagement.

The results will be exploited in two directions: i) for the planning of operations and further investments in laboratory, research facilities and installations, ii) for funding – by attracting sponsors, investors and users of ECCSEL and its services.

Risk assessment also includes a contingency plan suggesting (if required) adequate corrective actions. This approach will be pursued to assess risks pertaining to the planning phase (ECCSEL PP2).

4.2 Dissemination activities

In the aim of ECCSEL to outreach important stakeholders regarding CCUS, ECCSEL interacted with the European CCS platform Zero Emission Platform (ZEP). The ECCSEL Steering Board Chairman, Dr. Nils Røkke, SINTEF Energy, is member of the ZEP Advisory Council (AC) and the Working Group Taskforce Technology (WG-TFT) and has presented ECCSEL to the ZEP AC and discussed the implications of ECCSEL in the 7th General Assembly of the ZEP, held in Brussels the 3rd of October of 2012. ZEP includes the most important industrial stakeholders as well as institutes, and the platform has taken an important role in defining a roadmap for the required research and development to meet the technical challenges for the realisation of broad deployment of CCS.

The coordinator of the CCS grouping of the European Energy Research Alliance (EERA), Dr. Andreas Ehinger, IFPEN, has a role as Observer in the ECCSEL Steering Board, as well as being a Work

Package leader in the ECCSEL Preparatory Phase I. EERA is a pan-European research effort created to support the implementation of the Strategic Energy Technology (SET-) Plan. The close contact between EERA and ECCSEL ensures that the necessary interaction is continuously maintained.

The ECCSEL partners are also involved in different strategic efforts that support erection of ECCSEL as a pan-European research infrastructure. In particular, members of the ECCSEL partnership have participated in meetings with the ESFRI Working Group, the ESFRI Implementation Group and the Communication and Policy development for Research Infrastructures in Europe (CoPoRI) group. In Table 2, a list of important events is given where ECCSEL has been promoted to external organizations and stakeholders.

Table 6 ECCSEL – Communications with external organizations and strategic efforts to positioning ECCSEL as a European Research Infrastructure for CCS

Date	Event/Place	Person/Partner	Purpose
2008-12-09/10	ECRI2008 (European Conference on Research Infrastructures)/Versailles,	Morten Grønli & Arne Bredesen/ NTNU	ECCSEL Poster presentation
2010-03-23/24	ECRI2010 (European Conference on Research Infrastructures)/Barcelona	Morten Grønli & Arne Bredesen/ NTNU	ECCSEL Poster presentation
2010-11-29/30	ENERI2010 (Infrastructures for Energy Research)/ Brussels	Morten Grønli/ NTNU, Nils Røkke/ SINTEF	ECCSEL poster and oral presentation
2010-April	5th CO2GeoNet Open Forum/Venice	Morten Grønli/ NTNU	ECCSEL poster and oral presentation
2010-09-19/23	GHGT-10 (10th International Conference on Greenhouse Gas control Technologies)/ Amsterdam	Morten Grønli/ NTNU	Poster presentation
2011-09-23	ZEP Technology Task Force meeting/Leiden, NL	Andreas Ehinger/ IFPEN	ECCSEL oral presentation
2011-12-03	EU CCS mission to Australia	Nils Røkke/SINTEF	ECCSEL oral presentation
2011-12-15	EERA –CCS meeting/Paris	Morten Grønli/ NTNU	Observer at the EERA General Assembly meeting
2012-03-21/22/23	ICRI2012 (International Conference on Research Infrastructures)/ Copenhagen	Sverre Quale & Morten Grønli/NTNU	Lessons, priorities and future directions on Research Infrastructures. ECCSEL Poster
2012-03-21	Policy Contact Group (PCG)meeting/Copenhagen	Åse Slagtern/RCN ++	Kick-off meeting of the PCG. Anchoring of ECCSEL on ministry level in ECCSEL Partner states. Oral presentations
2012-03-30	ESFRI Working Group visit to ECCSEL/Trondheim	Sverre Quale & Morten Grønli/NTNU, Nils Røkke SINTEF ++	Informing ESFRI WG about the status and plans for ECCSEL. Visit to Trondheim CCS labs
2012-04-16	Technoport Conference 2012/Trondheim	Sverre Quale/NTNU	ECCSEL oral presentation
2012-04-17/18/19	7th CO2GeoNet Open Forum/Venice	Sverre Quale/NTNU	ECCSEL oral presentation
2012-04-17/18/19/20	2nd European Energy Conference, Maastricht	Morten Grønli/ NTNU	ECCSEL oral presentation
2012-05-08/09	Global CO2 Institute Conference and GA/Bergen	Sverre Quale/NTNU Nils Røkke/SINTEF	Informing about ECCSEL and sharing experiences
2012-05-24	ESFRI Implementation Group meeting/Brussels	Sverre Quale/NTNU	Informing about ECCSEL and sharing experiences
2012-06-11/12	Communication and Policy development for Research Infrastructures in Europe (CoPoRI) meeting/Hamburg	Sverre Quale & Morten Grønli/ NTNU	Informing about ECCSEL and sharing experiences
2012-06-26/27	EU/ECCSEL –Australia Workshop/Brussels	Sverre Quale/NTNU, Nils Røkke/SINTEF	Future cooperation areas with Australia within CCS. Oral presentations
2012-06-28	EERA –CCS meeting/London	Sverre Quale/NTNU	Observer at the EERA General Assembly

			meeting
2012-08-28/29/30/31	Offshore Northern Seas (ONS) Exhibition/Stavanger	Liv Randi Hultgreen, Sverre Quale/NTNU	Stand with posters, brochures etc Oral presentation of ECCSEL on CCS conference
2012-08-28	Workshop with Norwegian CCS groups and industry/RCN Oslo	Morten Grønli/NTNU, Sverre Quale/NTNU, Rune Bredesen/SINTEF	To inform Norwegian industry and research groups about ECCSEL. Oral presentation
2012-09-10	Workshop; R & D at TCM, Mongstad/RCN Oslo	Nils Røkke/SINTEF Sverre Quale/NTNU	Presenting and discussing future collaboration opportunities /arrangements with TCM
2012-09-26	ZEP AC-meeting/Brussels	Nils Røkke/SINTEF	Oral presentation of ECCSEL
2012-10-02	ZEP GA meeting Brussels	Nils Røkke/SINTEF	Panel debate- boosting innovation

5 Project public website

As described in “ECCSEL dissemination strategy” a project public website was established, providing information and updates to partners, stakeholders and other interested parties.

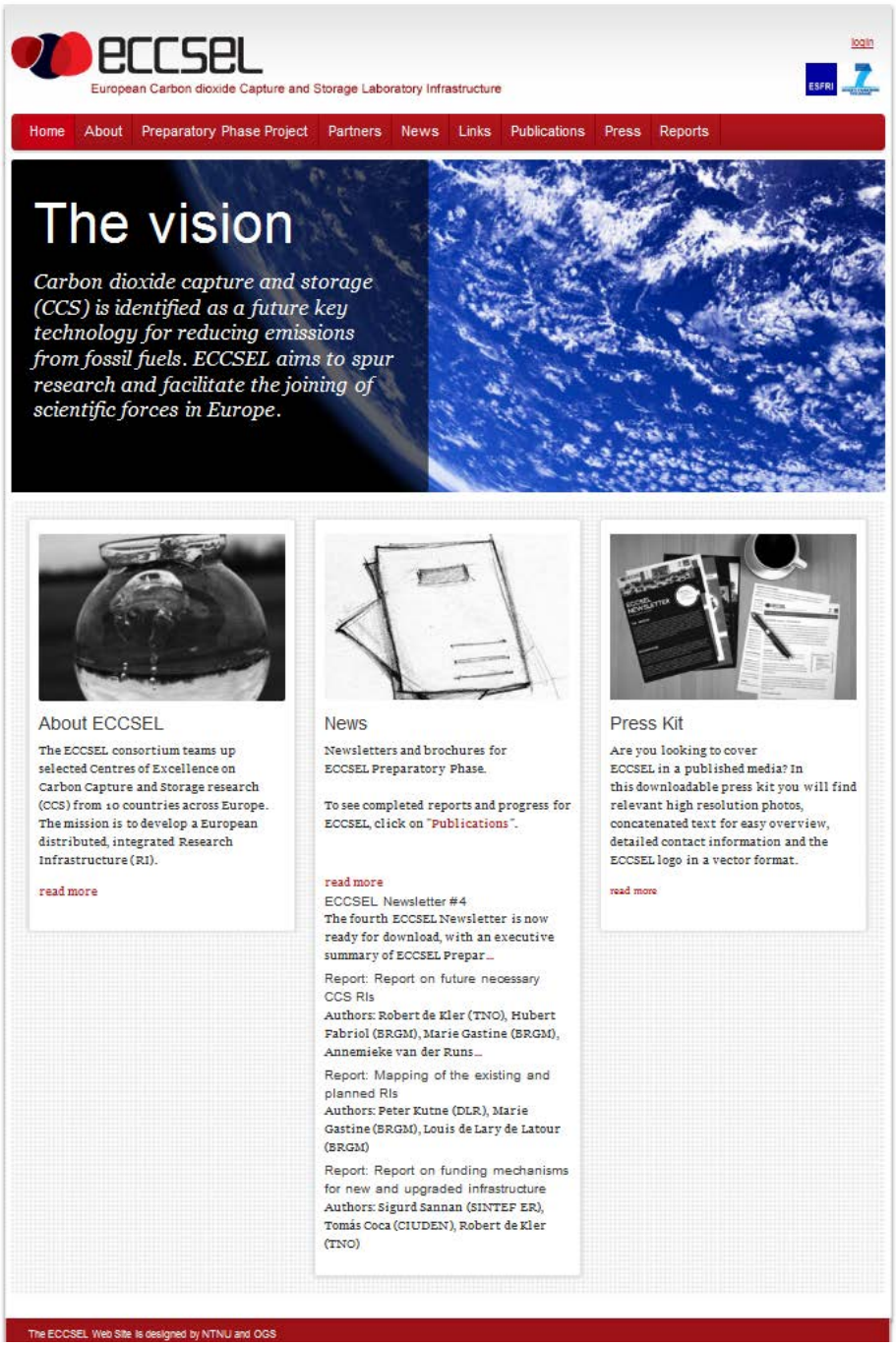


Figure 8 ECCSEL public web site

6 Use and dissemination of foreground

ECCSEL PP1 is the first phase of two. The scope of the project is to complete the preparatory phase leading to the construction of a new CCS research infrastructure of European laboratory facilities and test sites devoted to CCS. The aim is to bring the project of this new research infrastructure (ECCSEL) up to the level of legal and financial maturity, as required for its implementation.

Due to the nature of the project, there has been performed no research during PP1, and a plan for use and dissemination of foreground was therefore not applicable for this project.

6.1 Dissemination measures

Due to the nature of the project, not many scientific publications have been published. The one published article is listed in table 7.

Table 7 A2 List of all scientific (peer reviewed) publications relating to the foreground of the project

No.	Title	Main author	Title of the perio-dical	Number, date og fre-quency	Publisher	Place of public-cation	Year of public-cation	Relevant pages	Open access
1	ECCSEL	Morten Grønli, NTNU	Science Direct, Energy Procedia	4, 2011	Elsevier	Science Direct http://www.sciencedirect.com/science/article/pii/S1876610211009064	2011	6	Yes

Table 8 is a list of dissemination activities performed during PP1, this list can also be found in article "Dissemination activities".

Table 8 A2 List of dissemination activities

No.	Type of activity	Main leader	Title Event/Place	Date / period	Place	Type of audience	Size of audience	Countries addressed
1	Conference, poster presentation	NTNU	ECRI2008 (European Conference on Research Infrastructures)	2008-12-09/10	Versailles, France	Scientific community	900	Europe
2	Conference, poster presentation	NTNU	ECRI2010 (European Conference on Research Infrastructures)	2010-03-23/24	Barcelona, Spain	Scientific community	1000	Europe
3	Conference, poster and oral presentation	NTNU and SINTEF ER	ENERI2010 (Infrastructures for Energy Research)	2010-11-29/30	Brussels, Belgium	Scientific community	200	Europe
4	Poster and oral presentation	NTNU	5th CO2GeoNet Open Forum	2010-April	Venice, Italy	Scientific community	50	Europe
5	Conference, poster presentation	NTNU	GHGT-10 (10th International Conference on Greenhouse Gas control Technologies)	2010-09-19/23	Amsterdam, the Netherlands	Scientific community	1500	International
6	Oral presentation	IFPEN	ZEP Technology Task Force meeting/	2011-09-23	Leiden, the Netherlands	Scientific community	30	Europe
7	Oral presentation	SINTEF ER	EU CCS mission to Australia	2011-12-03		Scientific community	20	Europe, Australia
8	Other, observer	NTNU	EERA –CCS meeting	2011-12-15	Paris, France	Scientific community	50	Europe
9	Conference,	NTNU	ICRI2012	2012-	Copenhagen	Scientific	1000	Europe

	poster presentation		(International Conference on Research Infrastructures)	03-21-23	, Denmark	community		
10	Other	RCN	Policy Contact Group (PCG)meeting/	2012-03-21	Copenhagen, Denmark	Policy makers, other	30	Europe
11	Other, oral presentation	NTNU, SINTEF ER	ESFRI Working Group visit to ECCSEL	2012-03-30	Trondheim, Norway	Scientific community	10	Europe
12	Conference, oral presentation	NTNU	Technoport Conference 2012	2012-04-16	Trondheim, Norway	Scientific community	100	Norway
13	Other, oral presentation	NTNU	7th CO2GeoNet Open Forum	2012-04-17-19	Venice, Italy	Scientific community	50	Europe
14	Conference, oral presentation	NTNU	2nd European Energy Conference	2012-04-17-19/20	Maastricht, the Netherlands	Scientific community	200	Europe
15	Conference, oral presentation	NTNU, SINTEF ER	Global CO2 Institute Conference and GA	2012-05-08/09	Bergen, Norway	Scientific community, policy makers	50	Europe
16	Other, oral presentation	NTNU	ESFRI Implementation Group meeting	2012-05-24	Brussels, Belgium	Scientific community	50	Europe
17	Other, oral presentation	NTNU	Communication and Policy development for Research Infrastructures in Europe (CoPoRI) meeting	2012-06-11/12	Hamburg, Germany	Scientific community	50	Europe
18	Workshop, oral presentation	NTNU, SINTEF ER	EU/ECCSEL – Australia Workshop	2012-06-26/27	Brussels, Belgium	Scientific community	20	Europe, Australia
19	Other, observer	NTNU	EERA –CCS meeting	2012-06-28	London, UK	Scientific community	50	Europe
20	Conference, exhibition, oral and poster presentation	NTNU	Offshore Northern Seas (ONS) Exhibition/	2012-08-28-31	Stavanger, Norway	Scientific community, policy makers, others	15000	Norway
21	Workshop, oral presentation	RCN, NTNU, SINTEF	Workshop with Norwegian CCS groups and industry	2012-08-28	Oslo, Norway	Scientific community	15	Norway
22	Workshop, oral presentation	RCN, NTNU, SINTEF ER	Workshop; R & D	2012-09-10	TCM, Mongstad/ RCN Oslo, Norway	Scientific community	20	Norway
23	Other, oral presentation	SINTEF ER	ZEP AC-meeting	2012-09-26	Brussels, Belgium	Scientific community	30	Europe
24	Other, Panel debate-boosting innovation	SINTEF ER	ZEP GA meeting	2012-10-02	Brussels, Belgium	Scientific community	30	Europe

6.2 Exploitable foreground

Due to the nature of the project, there has been performed no research during PP1. Template B1 “List of applications for patents, trademarks, registered designs, etc” is therefore not applicable. Template B2 “Description of exploitable foreground” is also not applicable.