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CO_2 geological storage

Where do we stand in Europe?

Since the very first European research project initiated in 1993 under the 3rd Framework Programme, called Joule II 'The underground disposal of carbon dioxide', many developments have led towards the emergence of a new technology, CCS for CO_2 capture and storage, which could contribute 20% of the CO_2 reduction needed by 2050 in order to combat climate change. According to the EU Energy Roadmap 2050, CCS needs to be applied from around 2030 in the power sector in order to reach emission reduction targets. It is also an important option for decarbonisation of several heavy industries and, combined with biomass, could deliver 'carbon negative' values. The timeline in Fig. 1 describes key milestones at European and international levels. Much progress has been made on the scientific, technical, economic, regulatory and societal aspects. So, where do we stand now in Europe? Will we be ready for starting progressive commercial deployment from 2020?

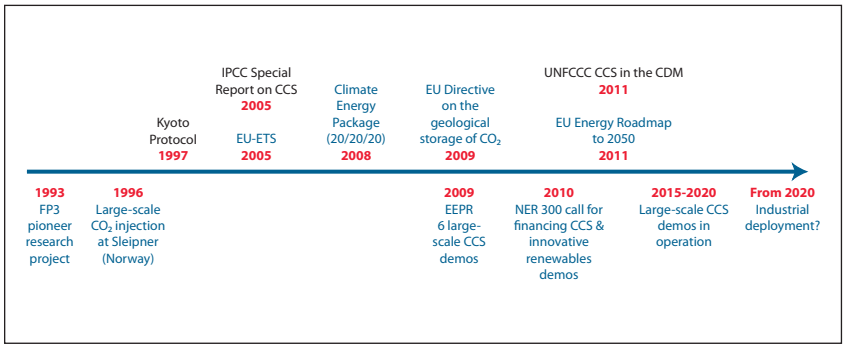

Fig. 1: Timeline from pioneer research project to large-scale demos and industrial deployment

CO_2 geological storage can be done safely

A good level of confidence has been reached in terms of safety, based on a variety of previous experience and know-how:

- Studies of many natural sub-surface CO_2 accumulations;
- CO_2 injection for Enhanced Oil Recovery (EOR);
- Seasonal natural gas storage (CH_4);
- Major cooperative research programmes on CO_2 geological storage since 1993;
- Pioneer large-scale industrial CCS projects, eg Sleipner (Norway) from 1996, Weyburn (Canada) from 2000, In Salah (Algeria) from 2004;
- Small-scale CO_2 injection pilots: Frio (USA), Nagaoka (Japan), Ketzin (Germany), Otway (Australia), Lacq (France), etc;
- Best practice manuals;
- Networking and knowledge-sharing activities at national, European and international levels.

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Europe is preparing for large-scale demonstration

Robust technical expertise already exists, and the world is now moving into a large-scale demonstration phase. In Europe, the first CCS demonstration projects are under preparation (see Fig. 2), under the leadership of major power and industrial companies and with the financial support from the European Economic Plan for Recovery, the NER300 mechanism for the co-financing of CCS and innovative renewables in the framework of the European Union's Emissions Trading Scheme, and member states. The goal is to have some 12 large-scale demonstration projects up and running by 2015 to harness knowledge and experience from a number of different geological, geographical and industrial contexts, both onshore and offshore.

Directive 2009/31/EC on the geological storage of CO_2

An EU Directive on the geological storage of CO_2 was issued in 2009 and is currently being transposed in national legislations. By end 2011, this process was complete for three member states: Spain, the Netherlands and France. This directive gives the legal framework for the permanent geological storage of CO_2, whilst preventing or reducing as far as possible negative effects on the environment and any resulting risk to human health. A permit application will be required for each storage site.

Europe Geological Map © BGR

Fig. 2: Europe is preparing large-scale demonstration of CO_2 geological storage. Countries where the first CCS demonstration projects are under preparation are indicated, as well as the 34 research institutes from 28 countries forming the CGS Europe pan-European scientific body on CO_2 storage

Costs and economics

The storage costs range between €1 and €20 per ton of CO_2 stored, depending on the storage types and characteristics. Onshore storage is cheaper than offshore storage. Storage costs represent only 10-20% of the costs of the full capture, transport, storage value chain. The CO_2 price in the EU Emissions Trading System (EU ETS) is currently below €10 per ton. This low level will not enable the funding of as many NER300 demos as anticipated and does not provide a secure environment for long-term investment. The selection, characterisation and permit application for a storage site is a long process that takes several years, as well as its connection to a CO_2-emitting power or industrial plant via the set up of an appropriate transport infrastructure. The need for early planning means that other incentives will be needed.

Social support

Demos and further deployment will require support from all stakeholders. A few pilot and full-scale projects have already been implemented successfully. However, some societal and policy issues still need to be addressed, such as the NIMBY syndrome for onshore storage, denial of climate change or of the role of CCS, alternative perspectives on energy mix and economic development. A constructive societal dialogue demands early communication and continuous interaction involving local and national stakeholders in the decisions. The scientific community can play a key role in such a dialogue by providing advice and high-quality information.

> ‘Demos and further deployment will require support from all stakeholders. A few pilot and full-scale projects have already been implemented successfully. However, some societal and policy issues still need to be addressed…’

Current R&D challenges

Research efforts must be increased at national and European levels for supporting and valorising the demos, enabling progressive large-scale deployment from 2020, and preparing next-generation technologies. Cheap, efficient and quickly implementable methods and tools are needed for improving storage site characterisation, capacity assessment, monitoring, risk assessment and, if necessary, remediation. In addition to the large-scale demos, more small-scale CO_2 injection pilots and research infrastructures are needed to test and validate these methods and tools.

CO_2GeoNet and CGS Europe – a pan-European scientific body durably engaged in providing knowledge for sustainable Geological Storage of CO_2

From 2004, the FP6-founded CO_2GeoNet European Network of Excellence on CO_2 Geological Storage, supplemented by the FP7 CGS Europe coordination action, has enabled to develop a pan-European scientific body composed of 34 key research institutes over 28 countries coordinating their efforts in four domains of activity: research, scientific advice, training, information and communication. The lighthouse event is the annual CO_2GeoNet Open Forum in Venice enabling dialogue between the scientific community and all stakeholders. The seventh edition will be held on 17-19th April 2012.

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