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European Science & Technology 17

an independent review

Stephan Lechner
makes the link between science and cyber security

Janusz Lewandowski
explores the financial framework for innovation

Lesley Dickie
discusses the role of research in zoos and aquaria

Jonathan Sheffield
highlights UK clinical research developments

Hailing the Higgs

The big questions on the small particle's potential

analysis•opinion•debate

Scratching beneath the subsurface

Bruno Saftic, of the University of Zagreb, considers the untapped potential of CO_2 geological storage as a carbon reduction strategy...

Energy production today is still largely dependent on fossil fuels, meaning that human influence on changes to the Earth's atmosphere continues to intensify – as the observed climatic changes in various parts of the world underline. Our technology-dependent civilisation recently started to face climate change as a serious global problem. Apart from obvious responses, like increasing energy efficiency and switching to alternative energy sources (in particular renewables like wind and solar power), there are still some sectors that simply can't be transformed that quickly in the required timeframe.

To effectively smooth the transition of such a large system, CO_2 emissions will have to be reduced at the same time as global energy demand grows, in parallel with economical development. In the case of large stationary sources of CO_2 (not only power plants, but other industrial sources like steelworks and cement mills, etc.), the problem could be reduced by a technological response known as carbon capture and storage (CCS).

Ideally, a CCS system would consist of a number of geographically concentrated industrial sources equipped with CO_2 capture facilities, an extensive transport system combining pipelines with ship transport where appropriate, and a group of storage options, i.e. locations where CO_2 could be safely injected into deep subsurface rock formations. This idea of returning the carbon back to the subsurface, where it will remain for more than 1,000 years, was conceived in the 1990s and has been refined and developed ever since.

Most of the people involved now know that the purely technical aspects of CCS (capture and transport) are feasible, although a price will have to be paid for 'clean electricity from fossil fuels'. Significant improvements in terms of equipment and process will soon follow as a result of intensive research, technological development and demonstration projects. Naturally, the deep subsurface aspect carries more uncertainties, which brings us to the main issue.

There can be no large CCS operation without defining 'the menu' of prospective storage destinations. Drawing an analogy from the upstream petroleum industry, it is known how this could be done and which rocks, depth range and geological settings are favourable. The largest storage potential lies in deep saline aquifers (large regional formations saturated with mineralised water), followed by depleted oil and gas reservoirs – for example, an atlas of CO_2 geological storage capacity has been prepared for North America and Norway. Initial mapping (and in some cases more detailed mapping) has been done in many European countries, financed through the Framework Programme projects as well as national governments. However, if Europe wants to have a reliable planning document – and this is actually the most important step because of the complexity of systems, large investments and large geographical spread – we should bear in mind that there is no European atlas available with a unified methodology for assessment of the storage capacity in deep saline aquifers as a resource.

Knowledge-based decisions in spatial planning are the only way forward, and it is the responsibility of both the European Commission and national governments to prepare the information base. The European CO_2 storage atlas is an important and necessary step in that direction if we want to get an extensive CCS system up and running in time.

A legal framework was set by the European Directive on the geological storage of CO_2 in 2009 and demonstration projects are commencing, with plans for injection from 2015 onwards. Therefore the uncertainties relating to both the availability and distribution of storage capacity, and the knowledge of the rock properties and geological processes in various subsurface conditions, need to be resolved. To facilitate knowledge sharing and distribution and to better coordinate their research plans, leading European research institutes involved in CO_2 storage research have grouped together in the CO2GeoNet Network of Excellence, which has now gained additional support from an FP7 coordination action called 'CGS Europe', spreading to 34 institutes from 28 European countries. This is an infrastructure to share experiences, discuss the problems, to map research needs and accurately inform other stakeholders.

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