Which measures and initiatives are needed if CCS is to be taken forward in Europe

EXPERT RECOMMENDATIONS FROM THE EUROPEAN SCIENTIFIC COMMUNITY ON CO_2 GEOLOGICAL STORAGE

31 May 2013

Introductory remarks

As indicated by the title, we have largely focussed this brief set of recommendations on those directly relevant to CCS. In the broader climate discussion, it should be clear that **CCS and renewables are both imperative** to meet stringent climate targets.

In order to facilitate injecting our input into the discussion, we have chosen to use the **topics** that were outlined in the **original letter** by Chris Davies[1], as the **backbone** for this short report. Boxed quotes from the letter from Chris Davies are provided for ease of reference.

Our input is ordered as **expert recommendations**, each well considered and discussed, and explained in **one concise paragraph**. In view of the complexity of the underlying motivation, we would welcome the opportunity to have an **additional oral discussion** to further explain and explore the views that can only be briefly presented here.

The **CO_2GeoNet Association**, the European network of excellence on CO_2 geological storage, in close connection with the **CGS Europe** FP7 project, here expresses the views of a pan-European consortium involving 34 research institutes from 24 EU Member States and 4 Associated Countries. As such representing the European scientific community on CO_2 Geological Storage (CGS), CO2GeoNet & CGS Europe like to share their expert input for the debate on taking CCS forward in Europe.

Issue 1. Public Perception

> *"We have to address public fears about the transport and underground storage or CO_2, as well as the claims that CCS is not a proven technology."*
>
> *Chris Davies, 06/05/2013*

1.1	**Promote CO_2 storage pilots:** Storage pilots are an excellent opportunity to demonstrate to the public the feasibility and safety of storage and to set up dialogue with the civil society. Therefore, CO_2 storage pilots with public participation are crucial. The approach of building a sound scientific basis for CCS is important.
1.2	**Explain that CO_2 storage is safe:** CO_2 can be stored safely if sites are carefully chosen, operated and monitored. Evidence is given by the first pioneers CCS projects and the existance of many natural CO_2 fields in the underground. Monitoring methods have been developed to detect early any leakage or irregularity, and mitigation and remediation techniques have been identified.

1 C. Davies. WHAT'S NEEDED TO TAKE CCS FORWARD? Letter by e-mail on 6 May 2013 (to undisclosed recipients).

1.3		**Scientific communication is key:** Scientists and stakeholders (including politicians) are facing a communication gap. Way forward:
	a	Propose Science Ambassadors for effective communication of CCS to important stakeholders.
	b	Support the relaunch of the CO2GeoNet talks from existing communication tours (e.g. the EAGE student tour).
1.4		**Put CCS in context:** CCS needs to be placed in context as one of the necessary measures to reduce emissions. Promote an integrated public dialogue on CCS and the other technologies of the mitigation portfolio.
1.5		**Ensure that the legislation includes appropriate involvement of the population in implementation plans:** No project proposal should start its planning stages without first verifying the interest and support of local communities. They should be kept involved throughout the further development of the project.
1.6		**Organise objective debates on CCS:** Use the current 'lack-of-projects' as the time slot for objective debates on CCS. Experience has learned us that discussing CCS can quickly become sensitive and personal once real projects are on the table, to the degree that public opinion changed the political standpoint on CCS.
1.7		**CCS is here to stay:** CCS is a key technology in CO_2-intensive industries such as cement and steel production. In industries where fossil fuels are irreplaceable as a fuel or feedstock, or where CO_2 production is chemically inevitable, CCS cannot be seen as a transitional measure towards sustainable production. It simply is the most sustainable solution.
1.8		**CCS, industry, and employment:** When Europe limits its industrial emissions of CO_2, CCS can prevent the delocalisation of industry to other continents ("carbon leakage"). As such, there is a direct link between economic activity and employment, and CCS.
1.9		**CCS gives the flexibility needed for efficient, climate-friendly, energy and industrial plans:** Reducing CO_2 emissions by 80% by 2050 in Europe is a huge challenge, which has to be backed up by specific strategic plans at territorial, regional, national and European levels. For each of these levels, It is important that the corresponding public authorities and civil society understand the benefits of CCS and the flexibility it gives them for building their own mix of solutions.

1.10	**Provide opportunities for increasing understanding of 'Climate Change':** Correct perception of Climate Change is key to accepting CCS. With e.g. the economic crisis at the top of the agenda, public attention for climate change has been fading in several countries. Although crossing the 400ppm atmospheric CO_2 marker has locally re-awakened the public attention, also the severity of the climate-situation must be fully grasped to understand that CCS is paramount. The acidification of the ocean and the impact on biodiversity should also be stressed.
1.11	**(Current) inaction is most dangerous:** Create a greater awareness of the consequences of inaction, and how these may outweigh the risk and cost of CCS. The risk of the entire ocean acidifying has for example much larger consequences than local discharge into the ocean. Regionally important examples should be used, such as sea-level rise in low lying regions, ocean acidification for fisheries dependent countries, reduced crop yields in agricultural areas, etc.

Issue 2. Cost, efficiency and EU legislation

> *"We (MEP's) have to examine the potential costs of CCS, consider how the efficiency of the technology is likely to improve, and question whether the EU Directive on the geological storage of CO_2 needs to be amended."*
>
> *Chris Davies, 06/05/2013*

2.1	**Cost of CCS:**	
	a	**Ensure a level playing field** between CCS and renewable technologies that, unlike CCS, benefit from feed in tariffs.
	b	**Stabilise and augment the ETS (or alternative or additional CO_2 emission cost) in Europe:** CCS is not a costly technology. In fact, including CCS makes reducing CO_2 emissions more cost effective. The current problem is that the general incentives for climate frienROIFdly technologies are insufficient or lacking. For Europe, this means that ETS is not delivering and other options needs to be considered that influence the performance and portfolio standards.
	c	**Reward negative emissions** via the capture and storage of biogenic CO_2 under the EU ETS.
	d	**Scaling up hurdle:** A specific problem for CCS (especially off-shore) that is not shared by renewables, is the 'scaling-up' issue: renewables can start small (and be profitable), and expand gradually. Due to the hurdle in the scaling-up cost curve (investment in infrastructure), only large to very large CCS projects can be cost competitive. This issue should be understood by all parties involved. See also recommendation 3.1 below.

	e	**CCS readiness for off-shore installations:** CCS-ready installations cost approximately the same as the normal off-shore installations and it should be made mandatory to install CCS-ready oil and gas installations in the European Waters, both on new and serviced installations. Retrofitting for CCS is costly, depending on the capture-readiness level. In general, costs are expected to drop 30-45% over the next 20 years on the capture side.
2.2	**Efficiency:**	
	a	**Promote CO_2 storage pilots:** More field experience is needed, especially as each storage site is unique due to local geology. We need to promote research across a wide range of experimental sites to increase our understanding of storage in different geological settings & conditions. More experience leads to greater confidence in tackling other new situations. Further research will make tools and methodologies the most efficient, reliable, cheap and as widely applicable as possible. Storage pilots are also an excellent opportunity to demonstrate to the public the feasibility and safety of storage and to experience a dialogue approach with the civil society.
	b	**Overarching country-scale plans** are required to use underground space in the most efficient way. They should investigate whether CCS can be combined with other uses of the subsurface to reduce costs (e.g. combined enhanced oil recovery schemes with CO_2 storage).
	c	**Correct siting of CO_2 intense industry**, with respect to the location of storage reservoirs, will reduce transport costs and alleviate public concerns related to storage aspects.
	d	**Planning of a North Sea Central Storage Facility** and pipeline-system for CO_2 must be started immediately, in order to connect the source and sink (capture and storage) regions for CO_2 in Europe to allow efficient use of the storage opportunities.
2.3	EU legislation:	
	a	**Make member states responsible to map their territory and precise the storage capacities:** Efficiently rolling out CCS requires a proper knowledge of the deep geology. Large parts of Europe, especially in regions without gas or oil reserves, still need to be mapped at a very basic level. This is a public responsibility of the member states that should be formulated stronger in the CCS directive. In this context, the importance of cross-border exploration (at basin scale) should be recognised (see also recommendation 4.2). Note that 'CCS-friendly' countries (e.g. NPD in Norway) have voluntarily already taken such initiatives.

b **It is imperative that the legislation for cross-border pipelines and export of CO_2 to other countries is resolved urgently.** Currently, the lack of CO_2, that needs to be pooled internationally, is holding back potentially large scale projects in the North Sea, particularly in the Norwegian and Danish areas. In particular Norway, which is without question the most proactive country in Europe on CCS, could help drive deployment of CCS. The absence of very few large point-sources for CO_2 on the mainland should not prevent this.

Issue 3. Implementation

> *"We (MEP's) need to encourage the promotion of CCS by industrial sectors, and identify means to ensure that it is mainstreamed into the business of fossil fuel power production."*
>
> *Chris Davies, 06/05/2013*

3.1 Understand laws of scale:
CCS can only be discussed realistically, if the scale at which successful operations need to be run, is properly understood by all parties involved. The famous Sleipner project, injecting 1 Mt of CO_2 annually, is a small CCS project. If 20% of excess 9,5Gt CO_2 (worldwide) is to be stored in CCS, we need almost 2000 Sleipners by 2050, or more realistically, fewer, but larger. Most projects, especially off-shore, will only become economic (and therefore interesting to industry) when exceeding a threshold between 5 and 10 Mt/y (after which ROI[2] rapidly increases). This puts very large producers, but especially also industrial clusters (e.g. neighbouring harbour regions), in the picture.

3.2 The timing of the implementation is crucial. We cannot afford to end up in a situation of "too little , too late". Hence, existing projects should be supported and matured rapidly. Early achievements will help to firm up the road map for a much needed overall infrastructure and give a better understanding of the reality of the technology to the public .

3.3 CO_2 utilisation:
An essential step towards a successful deployment of CCS in Europe is to provide a viable business case for CO_2 storage. In the USA, CCS is almost exclusively integrated in Enhanced Oil Recovery (EOR) projects, thereby called Carbon Capture, *Utilization* and Storage (CCUS). By allowing captured CO_2 to be used, CCUS gives an additional market and business case for companies to pursue the environmental benefits of CCS. By storing CO_2 in a CCS facility, the companies can in addition have CO_2 available when they need it for EOR.

3.4 Additional business opportunities:
Utilization may also extend to other industrial uses, often tightly linked to typical expertise in industrial petro-chemical clusters. Such opportunities need to be taken into account when discussing CCS in e.g. industrial port regions, and may add to the long-term forecast of using CO_2 as a local feedstock for spin-off production. The idea of using CO_2 for storing excess electricity from renewables, via the production of synthetic hydrocarbons, is also progressing (see also recommendation 4.5).

2 ROI: Return On Investment

3.5	**Carrot and stick:** There are two prime drivers for industrial players to be interested in CCS: profit and obligation. Lack of both is the reason that industry in the EU has been shelving plans for CCS projects.
3.6	**Factor out uncertainty:** Both economic and geological uncertainty are important and strongly related elements that determine the viability of a CCS project. Robust financing/penalty schemes, with clear long-term outlooks, are needed to sufficiently reduce economic uncertainty. In order to reduce geological uncertainty, existing knowledge needs to be compiled, field experience needs to be increased, and exploration efforts need to be intensified (see recommendations 2.1, 2.2.a, 3.7, 4.2).

Issue 4. Political Support

> *"And, above all, at a time when so few EU Member States are encouraging CCS development at a national level, we (MEP's) must identify financial and regulatory mechanisms to promote CCS that can secure the necessary political support."*
>
> *Chris Davies, 06/05/2013*

4.1	**Enforce coherent climate policy:** If a country's climate policy potentially relies on CCS, or in the absence of a clear, long term climate plan, if a countries energy poilicy mostly relies on fossil fuels, then that country should implement an action plan to realise CCS. One of the important lessons learned, is that the implementation hurdle of CCS is real, and public support for first and early stage CCS projects will normally be required. Investment in implementation of CCS may exceed national means, and therefore an EU support plan for such CCS projects is needed. Each country should have Interdisciplinary task teams that can communicate with the stakeholders and politicians in an efficient manner.
4.2	**CO_2 Storage Atlas:** In addition to making member states aware of the importance of exploring and understanding their underground territory for large scale deployment of CCS, a CO_2 storage atlas is needed at European scale. This has been realised in other continents, and means for Europe a continuation and scaling up of earlier projects (Joule II. GESTCO, Castor, EU GeoCapacity, CO2StoP). The storage atlas will be essential for European policymakers and stakeholders to answer the questions on how much, at which cost, where and when CO_2 can be stored.[3]
4.3	**Assess the costs of climate change** (economic, societal, ecological) and impact of not responding to the change and present these as part of the debate.

3 Development of CO_2 geological storage is a critical point in large deployment of CCS. The primary purpose of a European Atlas is to provide updated information on the CO_2 storage potential for the European planning of storage activities and the locations and storage potential of various geological storage sites. A key aspect of a European CCS Atlas will be the availability of the most current and best available estimates of potential CO_2 storage resource determined by a methodology applied consistently across all of Europe, Canada, USA and Australia.

4.4	**Refer to 'unburnable carbon' and 'carbon bubble' in techno-economic discussions:** Without CCS, emissions reduction targets may require that some of the fossil fuel reserves cannot be exploited and burned (the 'carbon bubble'). CCS provides the means to exploit these hydrocarbon reserves, realising their value, while avoiding CO_2 emissions.
4.5	**CCS has strong synergies with renewables:** • Due to the intermittent character of most renewables, a backup solution using fossil fuels for energy production is needed, and requires CCS. • Combined CCS & renewable energy schemes are emerging, e.g. with biomass leading to negative emissions (Bio-CCS) or with geothermal energy, combining heat production and CO_2 storage. • CO_2 storage could even open the door to the storage of excess electricity generated intermittently by renewables. Combined with hydrogen produced by water electrolysis, CO_2 could be transformed into gaseous or liquid hydrocarbons (methane, methanol, gasoline, DME ...) easy to transport, store and distribute, using mostly existing infrastructure. Those synthetic hydrocarbons will then substitute equal amounts of primary fossil resources.