The future of carbon capture and storage in Europe

Response to COM (2013) 180 final

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1) SCCS is the largest carbon capture and storage research group in the UK. Our internationally renowned researchers provide connected strength across the full CCS chain. With our unique position SCCS is able to act as the conduit between academia, industry and government. SCCS is funded by government grants, research councils, with several projects funded in partnership with commercial CCS developers. SCCS is independent, and does not speak for, or represent, any industry or political grouping.

2) The position of SCCS, is that carbon capture and storage provides one essential part of a pathway towards a sustainable future for industrialised nations. CCS provides direct, and large, reduction of carbon emissions at point sources such as power plant, refineries or carbon intensive industries. Several studies in the UK (ETI, UK government DECC) have shown that CCS is a no-regrets option, providing substantial cost saving to decarbonisation trajectories which is resilient to a wide range of future scenarios for electricity and heat supply.

3) In principle, CCS is capable of being enacted simply, within the existing industrial and power supply systems. CCS can provide substantial decarbonisation, with minimum disruption.

4) Well-known problems for CCS, which are currently acting as barriers to experimentation or to deployment, include amongst many
A) The high cost of experimental or first projects at industrial scale.
B) The energy penalty involved from parasitic loading of capture and regeneration equipment.
C) The uncertainty of reliable geological storage for CO2.
D) Lack of a persistent business model which increases costs of existing polluting operations, such that CCS becomes commercially viable in its own right.
E) Long-term ownership of stored carbon dioxide.

5) These problems can be simplified into two factors, which require to be solved in a way which is credible by industry and public, for timescales beyond the lifetime of individual projects.

Firstly, there is no direct incentive for any commercial organisation to undertake CCS. European or Member State policy on climate, translated into the energy supply system, fails to make a direct connection which can drive business investment. A much more direct connection is required, such as targeted taxation, or price increase, on the emissions from hydrocarbon combustion at point sources. That will embed the cost of carbon into the price for the product transmitted to public or other end users of power or heat, and thereby make attractive the alternative route where carbon is stored, not emitted.

Secondly, there is no coherent industry grouping promoting CCS, or genuinely seeking to co-develop projects, share knowledge, or reduce costs. This contrasts with the manifest success of renewable energy (RES) installation across the EU. RES has the benefit of well organised and coordinated engagement between developers and politicians and policymakers. RES also has the benefit of guaranteed premium prices for low carbon electricity, on a project-by-project appraisal, during 15 to 20 year project time spans.

6) It is clear that requesting Member States to voluntarily develop and deploy CCS has not happened successfully. By contrast, mandatory Europe wide targets for renewables installation for 2020 are proving extremely successful. However, over specification of granularity can be counter-productive. Current developments show that forcing installation of multiple units of offshore wind power before cost reduction benefits have been realised through a number of learning cycles, appears to be poorer value per megawatt hour than a more relaxed progress. Consequently, any mandate may be better positioned in terms of overall carbon emissions reduction for a Member State, which can be satisfied by a chosen mix of CCS, fuel switching, renewables, nuclear, or efficiency gains. It will be necessary to counteract the possibility of carbon reductions by offshore export of manufacturing or other industries, which merely leak the CO2 to elsewhere outside the EU. Likewise, the principle of burden sharing across the European Community means that Member States with large portfolios of fossil fuel generation should not be selectively disadvantaged. Using CCS certificates, tradable between states may be a way of sharing this burden

Question one: *Should Member States that currently have a high share of coal and gas in their energy mix as well as in industrial processes, and that have not yet done so, be required to:*

a) develop a clear roadmap on how to restructure their electricity generation sector towards non-carbon emitting fuels (nuclear or renewables) by 2050,

We strongly support such a requirement. These roadmaps should include defined milestones and carbon budgets at intermediate stages in order to assess Member State progress. It is expected that substantial quantities of CCS will feature for many Member States, unless using different technologies (and lower costs) can credibly deliver the same emissions reductions. This is of particular concern for energy-intensive industries, where CCS currently remains the sole credible de-carbonisation technology.

b) develop a national strategy to prepare for the deployment of CCS technology.

To be credible, national strategies for CCS deployment must address the points raised in 4) and 5) above. Critically, Member States reliant on CCS for decarbonisation must either:

A) Enable, and support CO2 storage (should appropriate geology be available) within their territories. For Member States without a considerable oil and gas sector and associated data to build upon it should be recognised that proving up possible geological storage to a confidence sufficient to allow for large volumes of CO2 injection is estimated to take at a minimum 5-10 years. To reduce investor risk, such work should be undertaken in advance of the specific planning of CO2 capture facilities.

B) Or, in the event that a Member State would be reliant on the development and access to CO2 storage located in another Member State, it should ensure that such access is agreed to an appropriate timetable, and in doing so potentially formally support the early stage CCS development in the prospective CO2 storage host – CCS certificates tradable between states, may be a way of sharing the burden of development.

Reliance on trans-boundary storage is technically logical, as certain Member States possess storage potential in considerable excess to their own needs, along with more acceptable siting and industry and government experienced in sub-surface operations. However, enabling trans-boundary movement of CO2 requires both international and bi-lateral permissions to be granted. As with A) above, such negotiations are necessary prior to any

detailed deployment planning, and given the relative lack of experience of government and regulators with CO2 may take many years to complete[1].

7) The system of EU allowances to identify emissions has been successful. Converting that into a European trading scheme has clearly been a failure. A critical aspect of this failure is the extraordinarily low carbon price, which currently has no impact on business decisions. Another critical aspect of failure has been the strategy of releasing large numbers of EU allowances into the market several years ahead of need. This, combined with grandfathering of EU allowances, has enabled industries which use fossil power to beat the system and purchase allowances at unintended low prices.

Question two: *How should the ETS be re-structured, so that it could also provide meaningful incentives for CCS deployment? Should this be complemented by using instruments based on auctioning revenues, similar to NER300?*

Realistically, even if the currently proposed reforms should be successful in enacting the ETS, carbon price alone cannot be relied upon to provide meaningful incentive for early CCS deployment, and may even struggle to sufficiently incentivise much cheaper fuel switching.

The ETS restructuring should keep its scope of included emitter sites as wide as now, or potentially even wider. The most critical policy failures are: A) the lack of price control over EU-Allowances, and: B) the lack of an index-linked reliable base-price which can become bankable over a 10-20 year period enabling loans or guarantees to fund large power plant and CCS projects.

The use of auctioning revenues has been explored as a financing mechanism, but clearly needs both much greater confidence in the sums expected to be raised, and considerable structural alteration from that of the NER300. Any future auction measures could include re-designing the eligibility criteria, to allow a broader (and potentially more pro-active) range of sectors and actors to engage in the early development of CCS. These should include gas power, and relatively small scale (≤10^5 tonnes CO2 per year) high concentration industrial sources of CO2 which could play a cost effective role in establishing transport and storage infrastructure, independent of the complexity and cost of low-concentration CO2 capture from power plant.

8) Early deployment of projects is initially a blockage of finance lending. To remove this blockage requires attention to all the problems in 4) above.

Question three: *Should the Commission propose other means of support or consider other policy measures to pave the road towards early deployment, by:*

a. support through auctioning recycling or other funding approaches
b. an Emission Performance Standard
c. a CCS certificate system
d. another type of policy measure

[1] Exploratory discussions undertaken between government representatives in the North Sea Basin Task Force suggest that while existing bi-lateral agreements for e.g. natural gas transit might provide an initial basis for transboundary storage of CO2 negotiations, the nature of the required very-long term stewardship of imported CO2 by the storage host has few precedents. As a result, multiple years of negotiation might be necessary to establish trans-boundary storage agreement between producer and host. The EC can play a role in shortening this lead-in time.

A suite of measures such as those listed above is available to incentivise CCS. We argue that all (individually or in combination) are capable of delivery should their design be sufficiently robust. Whichever package is chosen it must:
i) be reliable and resilient to change during a 20 year outlook,
ii) provide "sticks" of penalties making present-day behaviour progressively more difficult,
iii) provide "carrots" of benefits, making future types of behaviour inevitably acceptable, and giving incentive and advantage to 'first-movers' and 'early-movers'.
See also 11) below.

9) It is very clear from analysis by the International Energy Agency that the existing global fleet of power plant and industrial sources can emit through its lifetime more than enough CO2 to produce rapid and dangerous climate change. It is also clear from climate modelling that it is not the rate of CO2 emission that is important, but the total amount of CO2 emitted. Consequently it is necessary, from a scientific analysis, to require that CCS be fitted to all new power plant and industrial sources, and that CCS has to be retrofitted and operated on much of the existing power plant and industrial facilities.

Experience in the UK shows CCS-ready to be a meaningless definition unless the details of design and planning are strictly inspected and enforced. In particular, the identification of, commercial appraisal of, and transportation route to high quality CO2 storage in the tonnages required, in the timescales required, has proven to be a major loophole which needs to be closed. We refer to response to Q1 above.

Question four: *Should energy utilities henceforth be required to install CCS-ready equipment for all new investments (coal and potentially also gas) in order to facilitate the necessary CCS retrofit?*

CCS has to be fitted to all new coal and gas fuelled power plant, and also needs to be retrofitted to any existing power plant or large industrial facility operating beyond 2030. The expected volumes of CO2 requiring transportation and storage should this be realised are such that immediate investment in confirming storage potential and establishing major transportation corridors is essential.

10) It is likely that CCS pathways will diverge between North America and Europe. In North America the cost of capture may be driven down by requirements to provide low-cost CO2 in very large tonnages to projects undertaking CO2-EOR. It may not be necessary for Europe to devote specific and abundant attention to cost reduction in capture. By contrast the development and validation of geological storage within Europe can only be undertaken within Europe, and is a valuable asset, which cannot be exported or imported. We suggest that the availability of commercially tested storage will very rapidly become a limiting step immediately following the operation of very first grant funded CCS projects in Europe. Consequently, a much greater attention needs to be devoted to creating a system which can enable routine exploration and appraisal, and development and exploitation of CO2 storage within Europe capable of securely accommodating billions of tonnes of CO2. This storage has to be commercially acceptable before it can be included as part of the bankable business proposition for commercial CCS projects. In terms of scale, 3 billion tons of CO2 storage is required for the UK alone by 2025, and across Europe it is possible that 10-20 Billion tonnes of CO2 storage will need to be commercially identified by 2025. This contrasts to the current situation where only a few tens of millions of tonnes of storage is validated.

Question 5: *Should fossil fuel providers contribute to CCS demonstration and deployment through specific measures that ensure additional financing?*

11) Additional financing is required, on a routine basis, to ensure that CCS can become business as usual in multiple Member States. The most direct method would be direct taxation on fossil fuel production at source, or when fossil fuel is imported into the EU. We note that the substantial grants given (voluntarily) by the Norwegian government to support CCS projects in Poland (€130 million) and Romania (€30 million) provide a precedent which in essence direct revenues generated from the sale of fossil fuels towards CCS.

However, regulating such measures may raise substantial objections from established practice, and may also become difficult when considering the import of goods from outside the EU with high embedded carbon liabilities. A second method could be to selectively impose a base carbon price, in order to stimulate initial CCS developments. This carbon price would inevitably be passed through to consumers, but the effects of such a price would be minimised by electricity providers who undertook effective CCS to avoid paying the carbon price on emissions. A third method is to authorise a higher price for low carbon electricity derived from CCS power plant. If that is combined with a mandate to develop CCS, then the additional revenue can be directed by power companies towards construction of CCS projects. A final method can be to impose a carbon production levy on shale gas or coal bed methane production within member states. As these unconventional hydrocarbon resources are anticipated to be very low price, then a small amount of levy taxation may not be noticeable on top of an already reduced price for fuel. Levy taxation receipts would be hypothecated to support CCS and low carbon developments.

12) In several Member States there are substantial resources of partially depleted hydrocarbon fields, particularly oil. It is possible to use CO2 injection as a means to increase the efficiency of oil production (CO2-EOR), while also storing CO2. Research undertaken by SCCS shows that it is possible to achieve overall carbon storage while allowing the additional oil to be produced. Regulatory frameworks designed to encourage carbon storage combined with CO2-EOR have the potential to generate serious interest and investment from oil companies and access their expertise in managing subsurface fluids. Additional oil production could also generate additional production tax revenues giving a net financial returning available for government investment in CCS.

Question 6: *What are the main obstacles to ensuring sufficient demonstration of CCS in the EU?*

For obstacles to bringing forward CCS projects we refer to 4) above. Even the first wave of projects will need to operate on a commercial basis for 15 to 20 years. The distinction between ‘demonstration’ and ‘deployment’ is therefore not clear cut, and is currently a useful excuse for sectors seeking to avoid active consideration of future deployment of CCS. Achieving ‘sufficient demonstration’ should therefore be measured as to how the first wave of projects assists the ability for Europe to enact rapid and widespread CCS deployment before 2030 as envisaged in current de-carbonisation scenarios e.g. Energy Roadmap 2050. We re-iterate from 10) that Europe has a serious deficit in proven capable geological storage to receive the quantities of CO2 resulting from envisaged levels of CCS deployment.

13) By far the largest European resource of CO2 storage lies offshore in the North Sea, and potentially in the Southern Baltic. These resources have been, and are, evaluated by

prospective desk studies, but remain to be commercially validated. There is no incentive for large commercial companies, or pipeline operators to validate storage beyond the immediate need for isolated demonstration project proposals. Consequently, the development of the capability to store hundreds of millions of tonnes of CO2 has no inherent champion, and is likely to lag behind (and hence restrict) commercial power plant propositions. This is a market failure.

14) Utilising existing sources of high-purity CO2, at sites around coastal Europe, is under evaluation by SCCS. It seems very feasible to construct a programme utilising shipping tankers to collect CO2 from multiple sources. Collected CO2 can be transported by tanker to offshore platforms for injection, or use converted port facilities to connect to existing CO2 compliant pipelines, which can take this CO2 offshore for injection. Calculations indicate that, for a budget of € 200-300 million, it will be possible to undertake the first injection of CO2 in late 2014, and to undertake a rolling programme during the subsequent 5 -10 years, where CO2 is injected into 10 different substantial saline storage formations offshore. Injection of 1-3 million tonnes CO2 in each of these geological storage formations will confirm their suitability and provide commercial proving sufficient to enable these storage regions to become developed during the 2020s. Such a common interest project can use some of the existing un-spent or returned CCS support monies held within Europe.

Question seven: *How can public acceptance for CCS be increased?*

Public acceptance has created a barrier to CO2 storage below land in a few member states, but its responsibility for the failure of CCS has been overstated. However, it is clear that offshore storage is at present the more generally accepted option. We refer to our response to Q1, that while the energy mix remains a reserved topic, Member States will have to decide between the possible additional cost of not undertaking CCS (or negotiating storage of captured CO2 to outwith their territory) versus the possible unpopularity of local CO2 storage.

Public discomfort about subsurface usage is much wider than CO2 storage (including gas storage, shale gas, nuclear waste), and a much broader public engagement on the usage of subsurface resources should be encouraged.

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