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Accompanying document to the

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on the geological storage of carbon dioxide

SUMMARY IMPACT ASSESSMENT

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Executive summary

Problem and objectives

(1) The central problem is to reconcile the need for urgent action to tackle climate change with the need to ensure security of energy supply. In the context of a global reduction of CO2 emissions of 50% by 2050 needed to meet the 2°C target, a reduction in emissions of 30% in the developed world by 2020 is required, rising to 60-80% by 2050. This reduction is technically feasible and the benefits far outweigh the costs, but to achieve it all mitigation options must be harnessed, among them carbon capture and storage.

(2) To enable the use of carbon capture and storage, two problems must be solved. The first is to manage the environmental risks of the technology, in order to ensure that CO2 captured and stored remains isolated from the atmosphere and biosphere, and so is environmentally secure and effective as a climate change mitigation option.

(3) The second is to address commercial barriers to the deployment of CCS. If left to the market investments in CCS technology development may be insufficient for six reasons:

- First, currently the positive CO2 reductions from CCS are not rewarded since CCS is not enabled as part of the EU-ETS nor the Clean Development Mechanism. If included, the CO2 reduction through CCS would be valued at the carbon price.
- Second, the positive impacts from developing the technology on the costs and its efficiency (so called learning-by-doing effects based on adoption) are not captured by the market (positive externalities).
- Third, potential positive externalities relating to security of supply would not be captured by the market.
- Fourth, potential positive externalities relating to export potential would not be captured.
- Fifth, potential positive impacts on achievement of global climate objectives from deployment in the EU would not be internalised.
- Sixth, any positive reductions in traditional air pollutants from deployment of CCS are not internalised.

Impact assessment of a framework to manage environmental risks

(4) The three components of CCS – capture, transport and storage – were considered separately. A conservative approach was taken, in the sense that the default option for regulating a CCS component was taken to be the existing legal framework that regulates activities of a similar risk (if one exists).

(5) Capture presents similar risks to those of the chemical/power generation sector, and so it was concluded that Directive 96/61/EC (the IPPC Directive) is also the appropriate

regulatory framework for it. CO_2 transport presents similar risks to natural gas transport and so will be regulated in the same way. Pipelines of diameter greater than 800mm and length greater than 40km will require environmental impact assessment under Directive 85/337/EC, and further regulation will be for Member States.

(6) For storage, existing legal frameworks were also examined (IPPC and the waste legislation) but were found not to be well adapted to regulating the risks. The kind of controls required differ from those under the IPPC Directive, which mainly deals with emission limit values for industrial installations. Many parts of the waste legislation potentially apply to CO2 storage, but they do so in a fragmented way and are not designed to cover the particular risks in question. Neither framework could be adapted to regulate CO2 storage without substantial and fairly complicated amendment. Thus it was decided to develop a free-standing legal framework for CO2 storage in the form of a draft Directive, and remove CCS as regulated above from the scope of the waste legislation.

(7) Some issues concerning the content of the draft Directive were subject to additional analysis. The first is the issue of how best to ensure sound implementation of the risk management framework in the early phase of storage, where it was decided to propose Commission review of draft permits, but with the final permitting decision remaining with the competent authority. The second is how to deal with liability, and in particular to assess the implications of requiring a financial security to cover obligations in case of operator insolvency, any corrective measures required, and liability for surrender of Emissions Trading Scheme allowances for any leakage. Based on previous experience and consultation with insurers, it was concluded that it is reasonable to require such a security. Other issues covered are composition of the CO2 stream, access to the transport and storage networks, and the administrative implications of the enabling legal framework for storage.

Impact assessment of options to internalise externalities

(8) Four options were considered:

- Option 0: No enabling policy for CCS at EU level, including no inclusion of CCS in the EU ETS (that is, achievement of climate objectives without CCS).

- Option 1: Enable CCS under the EU Emissions Trading Scheme.

- Option 2: In addition to enabling under the ETS, impose an obligation to apply CCS from 2020 onwards and assess the impact on the potential positive externalities not captured by the carbon market. Four principal sub-options were considered:

(a) Making CCS mandatory for new coal-fired power from 2020 onwards.

(b) Making CCS mandatory for new coal- and gas-fired power from 2020 onwards.

(c) Making CCS mandatory for new coal-fired power from 2020 onwards, together with retrofit of existing plants (built between 2015 and 2020) from 2020.

(d) Making CCS mandatory for new coal- and gas-fired power from 2020 onwards, together with retrofit of existing plants (built between 2015 and 2020) from 2020.

- Option 3: In addition to enabling under the ETS, apply a subsidy so as to internalise the positive externalities not captured by the market.

(9) These were assessed using the PRIMES[1] model which simulates the European energy system and markets on a country-by-country basis and provides detailed results about energy balances, CO2 emissions, investment, energy technology penetration, prices and costs by 5-years intervals over a time period from 2000 to 2030. While the modelling provides useful quantitative indications of the scale of potential impacts, predictions of the behaviour of a complex system decades in advance are inevitably uncertain, and the main uncertainties and sensitivities are identified. The employment impacts were assessed by PRIMES and the air quality impacts by IIASA and a source-sink matching exercise was done by TNO to determine the transport and storage network that would result from the main deployment scenarios (market-based and mandatory). The non air quality environmental impacts of deployment were assessed by ECN and ERM.

(10) Analysis of Option 0 showed that without CCS the costs of meeting a reduction in the region of 30% GHG in 2030 in the EU could be up to 40% higher than with CCS[2]. Thus not enabling CCS would have substantial negative impacts on Europe's capacity to meet the 2 degrees Celsius target and on competitiveness, and also for employment, and would have a slight negative impact on security of supply.

(11) On the understanding that the ETS is implemented so as to deliver the EU's climate objectives, Option 1 (enabling under the market) internalises positive climate externalities of CCS deployment. With the carbon price resulting from the efforts required to meet the 20% reduction in greenhouse gas emissions by 2020, CCS becomes a significant part of the energy mix, but not before 2030. Because this option leads to a significant reduction in fossil fuel use, all the environmental impacts associated with fossil fuel use decline relative to the baseline. There would be offsetting impacts from the transport and storage infrastructure but at these modest deployment levels the impacts are not significant. Similarly, the CO2 storage requirement is well within the capacity of projected EU storage capacity: the significant uncertainties in projected capacity do not even begin to have an impact at this storage level.

(12) The additional cost of Option 2 (making CCS mandatory) compared with Option 1 (around €6bn/year in 2030) must be justified by additional non-climate benefits. The additional impact on learning compared with Option 1 may lead to around 10% reduction in the additional resource costs of CCS. It is hard to quantify what difference this would make to export potential and the ability to meet global climate objectives, and thus hard to distinguish between Option 2 and Option 1 on these counts. The variant whereby CCS is made mandatory for coal and gas has a positive effect on

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[1] P. Capros et al (2007) Energy systems analysis of CCS Technology; PRIMES model scenarios, E3ME-lab/ICCS/National Technical University of Athens, Draft Report 29 August 2007, Athens (available upon request).

[2] P. Capros and L. Mantzos (2007) Final report SERVICE CONTRACT TO EXPLOIT SYNERGIES BETWEEN AIR QUALITY AND CLIMATE CHANGE POLICIES AND REVIEWING THE METHODOLOGY OF COST-BENEFIT ANALYSIS, Contract No 070501/2004/382805/MAR/C1, Final Report to DG Environment.

security of supply, but the remaining options have a negative impact (by increasing gas use and hence imports).

(13) For the extreme mandatory Option (coal plus gas, new plus retrofit) the societal risk, from asphyxiation as a result of CO_2 leakage, is around 5 people per year in 2030 assuming a fatal concentration of 10% CO_2. Note in this context that the Thematic Strategy on Air Pollution estimated the annual premature fatalities from air pollution in 2005 at 390 000[3]. Because there is a further reduction in fossil fuel use over the baseline, there is a further reduction in the related environmental impacts. Against this must be set the correspondingly greater burden on the environment posed by the transport network, estimated at just over 30,000 km. (As a reference, this can be compared with the natural gas pipeline length of 110 000 km in 2001). While the land take associated with this deployment may be relatively small, the major impact on biodiversity would come from land fragmentation. This impact would be subject to assessment in the Environmental Impact Assessments that are proposed to be required for CO_2 pipelines, and appropriate measures taken, for instance using existing pipeline rights of way where possible.

(14) The CO_2 to be captured would put a greater strain on EU storage capacity, but there is some evidence that it can be accommodated. While the storage scenarios provided are purely indicative and do not provide a realistic estimate of what a practical CO_2 transport and storage network would look like, they show that broadly speaking, there is enough storage capacity for each Member State to store its own emissions, provided that the optimistic estimates that have been made regarding aquifer storage potential are borne out. However, it is clear that even without aquifer storage potential, the emissions on an extreme deployment scenario can probably be accommodated in Europe in high-security sites. There would be substantial storage under the North Sea, and the transport infrastructure required would increase the transport and storage cost to between €5 and €10/t CO_2 avoided. These costs are still reasonable (the assumptions made in assessing deployment assumed marginal costs rising to €20/t in some cases).

(15) The impact of mandatory CCS would fall mainly on a small number of Member States. For the extreme mandatory scenario (Option 2d above), three-quarters of the CO_2 capture would happen in four Member States (in descending order, Germany, Poland, UK and Belgium) with 35% of the effort in Germany alone. Employment impacts are negative, an increase in employment in the coal industry being offset by negative effects resulting from the increased energy costs.

(16) The impacts of Option 3 (subsidy for post-demonstration CCS) showed that by 2030 a 10% investment subsidy leads to 50% higher deployment (and hence total investment) than would be the case under Option 1, at small resource cost (i.e. a subsidy of €5.5bn stimulates €27bn additional investment). However, the impact on learning of the additional deployment is small and impacts on achievement of global climate objectives and export potential would be correspondingly low. The impacts on air quality, employment and security of supply relative to the market-based option are also slight.

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[3] Thematic Strategy on Air Pollution, p. 3: 3.6 million life years lost annually, equivalent to 390 000 premature deaths.

(17) On this basis, there is little evidence justifying going beyond the carbon market. For mandatory CCS, the additional learning resulting from the increased deployment does not compensate for the cost of the policy, and the impact on other externalities is also not significant. For subsidy, although substantial extra investment would be leveraged, the impact on positive externalities seems not to match the level of the subsidy. For this reason, the Commission recommends to enable CCS under the ETS, but not to make CCS mandatory or consider subsidy for the technology in the post-demonstration phase. Subsidy for the demonstration phase itself is a different matter, and that is dealt with separately under the Communication on Supporting Early Demonstration of Sustainable Power Generation from Fossil Fuels.

Consultation

(18) Consultation was conducted mainly via meetings with stakeholders. The European Climate Change Programme Working Group III on CCS met four times during the first half of 2006. An internet consultation "Capturing and storing CO2 underground - should we be concerned?" was conducted which received 787 responses. A large-scale stakeholder meeting was held on 8 May 2007 where the Commission presented an outline of its intended regulatory framework and gave the opportunity to comment. Further ad-hoc meetings with smaller groups were held on particular aspects of the proposal. Discussions with the Technology Platform on Zero Emissions Power from Fossil Fuels (TP-ZEP) were particularly useful.