Response to HM Treasury Consultation on 'Carbon capture and storage: A consultation on barriers to commercial deployment', March 2006

1. The Association of Electricity Producers (AEP) is the UK trade association representing electricity generators. It has around 100 members ranging from small firms to large, well-known public limited companies. Between them they embrace nearly every generating technology used in the UK, including not only conventional large-scale generation but a variety of technologies, some of them innovative. Contact details for the Association are given at the end of this paper.

2. The Association recognises the potential contribution of carbon capture and storage (CCS), as part of a diverse portfolio of generating technologies, to delivering the twin objectives of reducing carbon emissions and ensuring security of electricity supply. This response focuses solely on the application of CCS technology to power plants, although the Association understands that the technology can also sequester emissions from other large industrial processes.

3. The barriers to commercial deployment of CCS technology are both technical and regulatory. CCS technologies require further development and full scale demonstration at a substantial cost before they will be market-ready. Significant regulatory and legal issues must also be resolved to make the process feasible and provide investors with the confidence to invest in the technology. The government should
    - Provide pump-priming support for the development of CCS technology well beyond the £35 million currently committed.
    - Secure the explicit inclusion of CCS as a carbon abatement mechanism within the EU Emissions Trading Scheme (ETS).
    - Exert all possible influence to extend the post-2012 EU ETS allocation period to a timeframe of 15 years.
    - Establish a clear legal framework for CO_2 storage, which would involve amending the OSPAR and London Conventions.
    - Assume the long-term liabilities associated with CO_2 storage and engage in dialogue with industry to establish the terms under which it would bear this liability.

4. Several members of the Association have already announced that they are actively involved in the development of CCS, undertaking studies into the feasibility of constructing demonstration plants that employ the technology. On 23 January 2006, E.ON UK announced a feasibility study into a coal-

fired power station incorporating CCS. On 12 April 2006, RWE npower announced a similar feasibility study in respect of its plant at Tilbury. Scottish and Southern Energy had previously announced, on 30 June 2005, that it would work together with BP, ConocoPhillips and Shell on a project at Peterhead to use pre-combustion carbon capture technology to remove CO_2 from natural gas for use in Enhanced Oil Recovery (EOR) in the Miller oil field.

Technology

Scope to apply CCS technologies in power generation

5. Pre-combustion carbon capture technology is suitable for use in both coal- and gas-fired plant, while post-combustion capture is most suited to coal-fired plant. Theoretically, CCS could also be used in the future with biomass or co-firing to produce negative net carbon emissions. Using CCS as part of clean coal technology in power stations would provide an opportunity to continue exploiting coal reserves and prevent over-dependence on gas-fired generation while reducing carbon emissions. In 2004, 33 per cent of the UK's electricity was generated by coal-fired power stations. However, nearly 30 per cent of the UK's coal-fired capacity (10 per cent of the UK's total installed capacity) is scheduled to close by 2015 under the Large Combustion Plant Directive (LCPD).

6. Although CCS technologies are sufficiently well developed to enable full-scale power generation with CCS to be demonstrated, these technologies do not represent the final most efficient or cost-effective designs. There is still considerable uncertainty in the technology and hence the potential future costs of generation incorporating CCS. Further research and development (R&D) and full scale demonstration is therefore required to establish the potential role of CCS in power generation.

7. CCS technologies could be installed both on the basis of new-build and retrofitting. However, carbon capture causes a considerable loss of plant efficiency. Fuel burn increases by around 25 to 50 per cent per kilowatt hour for new plant with CCS or more for older, less efficient plant. It would not, therefore, be cost-effective to fit carbon capture equipment to older, low efficiency coal plant.

8. In general, the higher the base efficiency of a unit, the lower the efficiency loss due to the operation of the abatement equipment. Future build supercritical or Integrated Gasification Combined Cycle (IGCC) coal plant (either new plant or replanting of existing power stations following closure) will have higher efficiencies than existing plant and so will be more suited to the application of CCS technology. Support for plant that is 'capture ready' could provide a first stage in the investment cycle. Capture ready plant could allow investment prior to finalisation of other aspects of the carbon capture chain (such as demonstration at scale, transport and storage) and clarification of the planning and regulatory issues. The government should be prepared to give consent to the development of

projects which have been designed to facilitate the fitting at a later stage of carbon capture technology.

9. There is an opportunity for recommissioning existing sites with new boilers, turbines and carbon capture technology. The re-use of the existing infrastructure would offset some of the increase in capital costs. Pilot projects of this nature would need to take into account the likely timescales of closure of existing assets. For example, coal-fired plant opted out of the LCPD will be closed by 2015.

Level of market readiness of technological options

10. Not all component technologies of the CCS process have been proven at the scale necessary for commercial operation of a power plant. For example, post-combustion CO_2 capture via amine scrubbing has only been demonstrated on plant producing 1,000 tonnes of CO_2 a day, which is about an eighth of that produced by a 500MW coal-fired unit. Similarly, there is no IGCC plant (which would form the basis for a pre-combustion CCS power plant) operating commercially with the load factors required to be competitive in the UK market. Although transport and injection of supercritical CO_2 is already common, the volume of CO_2 and injection pressures expected in the CCS process associated with power stations would be much greater. The various component technologies have never been brought together in a full-size power plant with CCS. Further development of the technologies, followed by full scale demonstration, is therefore required before they will be market-ready.

11. We expect CCS technology to make a significant contribution to low carbon electricity generation on a timescale of 20 years. R&D and demonstration of the technologies need to take place at a suitable pace with appropriate funding. Several demonstration plants will need to be constructed in the UK before enough experience has been gained to attract significant investment in the technology. Although demonstration plant overseas will contribute to the development of the CCS process, not all the findings from these projects will be directly relevant to the application of CCS in the UK. Investors are likely to need to have seen 3 to 5 years of operating experience in the technology before making any significant investment decisions. This would suggest that in order to see any significant investment in retrofitting coal plant with CCS by the 2020s, a full scale demonstration plant will need to be operational in the period 2012 to 2016. Investment in any pilot projects needs to address all elements of the CCS chain required to demonstrate the viability of the option.

Limitations to forming a full CCS process

12. The potential for CO_2 storage is much greater offshore than onshore. Although research has shown that there is extensive potential for CO_2 to be stored in saline aquifers in the North Sea, not enough detailed geological work has been carried out to establish the most suitable storage sites. Potential sites for EOR only exist in the northern part of the North Sea. These factors mean that the location of plant fitted with carbon

capture technology will be very important. If existing power stations or sites are re-used for CCS, new CO_2 pipelines could be costly and there may be a lengthy timescale to obtain the necessary consents for their construction. Consequently, a full scale demonstration project is not likely to be built with any associated CO_2 pipework. It may be necessary to reinforce existing pipe infrastructure to carry supercritical CO_2 and alternative options for CO_2 transport (such as by tanker) may need to be considered. In this regard, coastal sites are more likely to be the preferred option for initial CCS projects. The government will need to consider the potential impact on grid infrastructure if CCS resulted in significant new build in areas most suitable for access to offshore CO_2 disposal.

Engineering and manufacturing capability

13. CCS is being considered by electricity generators as a way of ensuring a diverse fuel mix, not because there would be any first mover advantage to them in developing this technology. The greatest potential beneficiaries from developing CCS projects are likely to be the providers of equipment and services.

Regulation, liability and public acceptance

Regulatory framework

14. Significant regulatory and liability issues must be clarified before there will be any significant investment in CCS technologies. The necessary regulatory framework would need to:
    - Establish a clear legal framework for CO_2 storage both onshore and offshore. This would involve amending the OSPAR and London Conventions and London Protocol to take account of CO_2 storage. Other legislation may also require amendment in order to give legal clarity.
    - Clarify who owns the long-term liabilities of CO_2 storage and under what conditions.
    - Establish clear requirements for monitoring and inspection of CO_2 installations, including storage sites.
    - Establish the treatment of CCS under the EU ETS and Kyoto mechanisms.
    - Establish the planning and authorisation processes for all stages in the lifecycle of a CCS project.

15. The Association's members suggest that, from their experience of the planning system, a new-build or retrofit coal-fired power station, even without CCS, could take around 8 years to obtain consent, build and commission. Regulatory and liability issues would need to be resolved before companies invest time and resources in applying for planning consents. The government should provide pro-active support in obtaining the necessary consents by, for example, carrying out a strategic environmental assessment and issuing clear guidance to government agencies and planning authorities. There must be a joined up planning

and permitting process that takes into account the overall benefits of low carbon generation.

16. The government should use the opportunity of the proposed Marine Bill to introduce a licensing regime for offshore CO_2 storage.

Liabilities

17. We do not consider that it would be practical for any company to assume the long-term liabilities associated with CO_2 storage. Given the timescales involved, the only institution capable of bearing the liability is the government. The government must initiate a dialogue with industry as soon as possible to clarify at what point the long-term liabilities would transfer to government and under what conditions.

Public reaction

18. Industry and government should work together to inform and engage the public on how CCS works and what its potential benefits are. Clear requirements for the monitoring and inspection of CO_2 installations, including storage sites, may help to allay some public fears about the risks of capturing, transporting and storing carbon dioxide. Further research into the integrity of CO_2 storage and its possible environmental impacts is also desirable.

Cost

Current and future costs

19. The current costs of fossil-fired generation with CCS are uncertain. Costs will vary depending on individual project design and location. The development of practical demonstration projects on a reasonable timescale will clarify the costs associated with the available technologies. We expect that CO_2 capture will substantially increase costs of generation compared with new build coal- and gas-fired plant. Some early estimates have placed this increase in the region of 50 to 100 per cent. This does not include the additional costs associated with CO_2 transport and storage, which are highly uncertain. It is likely that experience will reduce costs of CCS projects over time.

Enhanced Oil Recovery

20. There is a potential cost benefit to using CO_2 for EOR in the North Sea. The linkage between CCS and EOR not only makes CCS more economically attractive, but also helps to increase oil production. EOR could provide a useful initial application for CCS technology, with the following advantages:
    - Reduction of time taken for implementation of CCS approach as this technique of EOR has already been successfully employed in the USA and we understand that CO_2 injection as part of EOR operations requires no amendments to international treaties.
    - Economic advantage of using existing pipeline connections and infrastructure.
    - Use of existing detailed geological information.

21. However, the extent of any cost benefit will be dependent on the details of individual projects. There are also significant timing issues associated with linking the development of CCS to EOR. Many North Sea oil fields will soon be exhausted and decommissioned. Their pipework and associated infrastructure will then begin to degrade. This provides a narrow window of opportunity for using CO_2 captured at power plants for EOR. Furthermore, the effectiveness of CO_2 storage when injecting for EOR may need additional study. The technical feasibility and economics of using CO_2 captured at power plants for EOR therefore require further evaluation.

Profitability of CCS

22. CCS is not a technology that is currently ready for commercial deployment. The cost advantages of building plant with CCS rather than without have not been proven. The first generating units fitted with CCS technology will have less than optimal design and efficiency and may have unforeseen technical challenges to overcome. The demonstration projects currently planned will show that the technology is viable and assist in its development. Developing CCS technology will require financial support from government to bring it to a stage where it can compete, technically and commercially, with conventional generating technologies. The government needs to provide considerable capital grant funding for development of CCS technology well beyond the £35 million currently committed. In addition, CCS will only become commercially viable once significant regulatory and legal issues have been resolved. These include issues surrounding carbon transport and storage infrastructure, treatment of CCS under the EU ETS and international agreements, and the ownership of long-term liabilities.

23. Provided these issues can be overcome, the economic viability of CCS then hinges on further technology advances as well as on a clear carbon pricing mechanism which provides long-term reward for the carbon emissions reductions achieved by CCS. The government must continue to promote the explicit inclusion of CCS as a carbon abatement mechanism within the EU ETS. CCS technology represents a significant additional investment cost to power production. In order for a company to invest in CCS, the company needs confidence in the long-term value of carbon emissions. A closer alignment of carbon allocation periods with investment cycles is therefore required. The government should exert all possible influence at EU level to extend the post-2012 allocation period to a timeframe of 15 years.

Economic incentives

24. Any demonstration plant with CCS would face two significant barriers – substantial first of a kind costs and the lack of a long-term framework for establishing a carbon price. Until this market failure can be overcome, CCS development will require substantial financial support from government. We envisage that support would be necessary for several demonstration plants over roughly 5 years. Any economic incentives

would need to take into account that each pilot project will be different in terms of capture technology and the requirements imposed by its location.

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