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COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

Demonstrating Carbon Capture and Geological Storage (CCS) in emerging developing countries: financing the EU-China Near Zero Emissions Coal Plant project

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Demonstrating Carbon Capture and Geological Storage (CCS) in emerging developing countries: financing the EU-China Near Zero Emissions Coal Plant project

1. INTRODUCTION

Both developed and developing countries need to act to reduce their greenhouse gas emissions, to achieve the objective of limiting average global temperature increase to less than 2°C compared to pre-industrial levels. This Communication sets out the plan of the European Commission to establish an investment scheme to co-finance the construction and operation of a power plant to demonstrate carbon capture and storage (CCS) technology in China. This investment scheme could serve as a model for other technology cooperation activities between developed countries and emerging/developing countries in the context of a post-2012 climate change agreement.

While energy efficiency is expected to deliver the greatest emissions reductions, for reasons of security of supply and economy, coal will continue to drive development, especially in emerging economies with substantial domestic reserves, such as China. It is therefore necessary to make the inevitable combustion of coal more climate-compatible. CCS technologies, if developed and deployed in an appropriate timeframe, could make a significant contribution by mitigating the emissions of this key energy source. CCS would be a bridge technology while alternatives to fossil fuels are further developed and deployed. European Commission analysis[1] indicates that under an emissions scenario compatible with the 2ºC target around 18% of global fossil fuel power generation would have to be fitted with CCS in 2030.

EU leaders have committed to the establishment of a network of up to 12 CCS demonstration plants in the EU by 2015[2], to maximise the range of technology and storage options demonstrated and knowledge sharing. The European Council and Parliament have agreed to a Directive setting out an enabling legal framework for CCS to enable the safe operation of CCS in Europe and to incentivise CCS demonstration i.e. through the EU Emissions Trading Scheme (CO_2 safely stored will not count as emitted) and through EU ETS New Entrants Reserve (providing funding which can be used to co-finance CCS demonstration plants) as well as revised State Aid rules. The European Economic Recovery Plan has allocated €1050 million to CCS demonstration projects inside the EU. Several EU companies have announced demonstration plants to be completed in the EU over the next 5-10 years. CCS is one of the technologies promoted under the European Strategic Energy Technology (SET) Plan[3] along with renewable energy and other low carbon technologies.

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1 See Figure 2 of the Impact Assessment which accompanies this Communication.

2 European Council Conclusions, March 2007.

3 Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions - A Strategic Energy Technology Plan (SET Plan) - towards a low-carbon future"

Of particular concern are the emissions trajectories for the coal-dependent emerging economies. The Intergovernmental Panel on Climate Change (IPCC)[4] has projected that, in the absence of any additional policies, CO_2 emissions from energy use are expected to rise between 2000 and 2030 by 45 to 110%. Two thirds to three quarters of that growth will come from developing regions. Even with strong action on renewables and other low-carbon technologies, fossil fuels are estimated to account for half of the world's energy supply by 2050.

Due to abundant resources, coal is China's predominant energy source contributing 70% to the energy mix. It can be expected that coal will remain the primary energy source in the medium term – in 2007 alone, China built the equivalent of one 500MW coal-fired power plant every two and a half days[5]. This represents around 4 megatons of CO_2 a week increase in Chinese emissions from coal-fired power generation alone[6].

China itself is engaging strongly in cleaner coal technologies (CCT). In June 2007, China adopted a National Climate Change Programme (CNCCP), which specifically mentions the "development and dissemination of advance and suitable technologies" including "carbon dioxide capture, utilization, and storage technologies". China plans to publish CCS technology guidelines in the course of 2009. Furthermore, a group of seven state-owned energy sector enterprises has established Greengen, which has the objective to build an Integrated Gasification in Combined Cycle (IGCC) coal power plant, which should subsequently be complemented by CCS.

In March 2005, the EU and China signed an Action Plan on Clean Coal, which included cooperation on carbon capture and storage. The subsequent 2005 EU-China Summit[7] established the EU-China Climate Change Partnership, which includes a political commitment to develop and demonstrate in China and the EU advanced, near-zero emissions coal (NZEC) technology through carbon capture and storage (CCS) by 2020. Phase I of this cooperation will be completed in 2009. The motivation for the 2005 agreement between China and the EU was the desire to tackle emissions growth in the coal power sector. With plant lifetimes of around 30 years or more, the potential for carbon lock-in is enormous. The advanced state of the EU's cooperation with China under the EU-China Climate Change Partnership presents an opportunity for a first cooperative demonstration project in China.

The European Parliament[8] underlines the importance of cooperation with China, when it "recognises that rapid economic growth in China presents a huge challenge to global efforts to tackle climate change, with CO_2 emissions from coal-fired power stations set to double by 2030." CCS represents a potentially credible option for tackling the emissions from coal-fired power stations in China as part of a portfolio of technologies.

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4 IPCC Forth Assessment Report (2008), Working Group III Technical Summary (Barker, T. et al, 2007: Technical Summary. In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, L. A. Meyer (eds)], Cambridge University Press, USA).

5 IEA, Cleaner Coal in China, 2009, p. 50.

6 N Riley, British Geological Survey, oral evidence to the UK House of Commons, (http://www.publications.parliament.uk/pa/cm200506/cmselect/cmsctech/578/57805.htm#note18).

7 EU-China Declaration on Climate Change, made at the EU-China Summit, 2 September 2005: http://ec.europa.eu/environment/climat/pdf/china/joint_declaration_ch_eu.pdf.

8 Resolution 2005/2161 (INI): http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2006-0346+0+DOC+XML+V0//EN.

The EU CCS demonstration plants and the EU-China NZEC cooperation should be seen in the context of the G8 commitment to "20 large scale CCS demonstration projects… [to] be launched globally by 2010, taking into account varying national circumstances and with a view to supporting technology development and cost reduction for the beginning of broad deployment of CCS by 2020,"[9] as well as the endorsement by the G8 Energy Ministers, the European Energy Commissioner and Energy Ministers from several other countries including China, of advancing the demonstration of CCS at their meeting in May 2009[10].

This Communication sets out the next steps with a focus on financing the CCS demonstration plant. Such cooperation can also contribute to the commitment made by developed countries under the United Nations Framework Convention on Climate Change (UNFCCC) to promote, facilitate and finance the transfer of, or access to, environmentally sound technologies and know-how to other Parties.

With regard to the on-going negotiations for an ambitious global climate change agreement for the period post-2012, the EU-China cooperation on CCS could serve as an example for others. The Commission envisages the facilitation of information exchange between the NZEC project and European demonstration projects through the CCS project network, currently being established.[11] Furthermore, many of members of the European Technology Platform for Zero Emissions Fossil Fuel Power Plants (ZEP)[12] are key stakeholders for the EU-China cooperation.

2. CHALLENGES OF CCS

The individual components of the CCS process are already available and operational in pilot schemes[13]. But the combination of these elements in commercial scale power plants including the entire CCS chain from CO_2 capture, through transport to storage is yet to be demonstrated.

The demonstration of CCS technologies at commercial scale is necessary to test and subsequently reduce the costs for the technology as a precondition for its wide deployment in a functioning carbon market. Demonstration will promote a better understanding of the technical, methodological (including storage site selection and monitoring), environmental, public acceptance and financial issues and therefore facilitate a better estimation of the real potential for CCS as a key mitigation technology.

The development and deployment of CCS in developing and emerging economies, including China, can play a vital role in helping achieve global sustainable development but would be

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9 Joint Statement by G8 Energy Ministers, Aomori, Japan, 8 June 2008.

10 Joint Statement by the G8 Energy Ministers plus the European Energy Commissioner, the Energy Ministers of the G5 Countries (Brazil, The People's Republic of China, India, Mexico, South Africa) and the Energy Ministers of Egypt, Republic of Korea, and The Kingdom of Saudi Arabia, at their meeting in Rome on 24 May 2009.

11 See: http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/1315&format=HTML&aged=0&language=EN&guiLanguage=fr

12 See: http://www.zero-emissionplatform.eu

13 See IPCC, 2005: IPCC Special Report on Carbon Dioxide Capture and Storage. Prepared by Working Group III of the Intergovernmental Panel on Climate Change [Metz, B.,O. Davidson, H. C. de Coninck, M. Loos, and L. A. Meyer (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 8.

significantly delayed without assistance from developed countries. The EU's commitment, coupled with technological and financial assistance, is a unique offer which can help to maximise the potential for CCS in emerging economies.

The failure of the market in developing/emerging economies to reflect the real cost to society (eg via CO_2 price) of the use of fossil fuels to generate electricity means that CCS is not economically viable in the demonstration phase. EU public financing can help overcome some of the barriers outlined above and lever private financing, which would not otherwise be available for large scale CCS demonstration projects.

3. CCS IN KEY PARTNER COUNTRIES

In countries with abundant coal reserves, security of supply concerns dictate that coal will continue to be used to generate electricity, particularly in fast developing countries such as China. Therefore, it is important to develop a means of supporting the demonstration of CCS in such countries in order to exploit the economies of scale and ensure that, once demonstration is completed, deployment could happen at scale, if all challenges of deployment are adequately addressed (see Box 1).

Box 1: Challenges to deployment and diffusion of CCS in developing countries

- The increased cost of electricity generation due to the additional capital and operating costs of the capture, transportation and storage installations compared to conventional power plants, including the energy penalty, ie the additional energy requirements of the CCS process itself. This is due to the failure of the market to reflect the real cost to society including externalities caused by the use of fossil fuels to generate electricity.

- A lack of enabling environment: insufficient legislative framework for planning and permitting of CO_2 capture installations as well as transport and storage; furthermore, investment protection guarantees should be in place, and protection of intellectual property rights should be guaranteed.

- Even if the policy frameworks become increasingly conducive, the financing of CCS investments is not automatically ensured by the private sector. This financing gap is common for technologies that move into the pre-commercialization stage which is characterized by the "weaning-off" of grant support and by high-cost activities such as initial and secondary prototype development and testing, site development, supply chain formulation, construction, etc.

- A lack of public awareness/acceptance needs to be actively addressed.

In addition to the well-established cooperation with China, it is necessary to step up efforts to demonstrate and deploy CCT and CCS in other emerging economies in order to maximise the potential for global deployment and diffusion. The EC has committed itself to stepping up existing cooperation on carbon capture and geological storage with China and to extending it to other key partners, such as India and South Africa[14]. According to recent bilateral

[14] See COM(2006) 843.

exchanges, other countries which might also have an interest in capacity building for CCT and CCS are Russia and Ukraine.

The Commission intends to support cooperation with emerging and developing countries on CCS and other cleaner coal technologies through its Environment and Natural Resources Thematic Programme. Under a new activity called "Cooperation on clean coal technology (CCT) and carbon capture and storage (CCS) with coal-dependent developing and emerging country partners", the European Commission proposes to build capacity and conduct preparatory studies for CCT and CCS technologies in coal-dependent emerging economies and developing countries, taking a partner-driven, differentiated approach. In addition, it is envisaged to disseminate worldwide the experience gained in the demonstration project in China.

4. SUPPORTING CCS DEMONSTRATION IN CHINA

Given the extent of greenhouse gas emissions generated by China's coal-intensive power generation sector, the political commitment between the EU and China and the advanced stage of existing cooperation on CCS, China would be the most suitable country for a CCS demonstration plant supported financially by the EU.

The EU-China Near Zero Emissions Coal (NZEC) project is envisaged as having 3 phases. Phase I comprises several projects conducting initial research to explore options for demonstrating carbon capture and storage (CCS) for coal-fired power generation in China, namely the UK funded NZEC Assessment Project and the European Commission co-funded research projects COACH and STRACO$_2$ (see Box 2). Phase I is due to conclude in autumn 2009.

Box 2: Phase I of EU-China cooperation on CCS

The EC-China MoU (Feb 2006) is being supported by the COACH Project (**Co**operation **A**ction with CCS **Ch**ina-EU, with €1.5m of EC 6th Research Framework Programme funding). The COACH project has 20 European and Chinese partners from academia, research and industry and has the following objectives:

1. Enhance Knowledge sharing and capacity building
2. Prepare the ground for a demonstration of CCS in China using coal-based IGCC/ polygeneration schemes including CCS
3. Assessment of CO_2 geological storage potential in hydrocarbon reservoirs (EOR/EGR), deep saline aquifers, and the Bohai basin coal seams
4. Address cross-cutting issues such as public acceptance, and legal, regulatory, funding and economic aspects.

The China-UK MoU (Dec 2005) is supported by the UK-NZEC Assessment Project (£3.5M), which began in November 2007. The UK-funded UK-NZEC project is a collaborative project between Chinese and UK experts to:
– build capacity in China to determine the best options for carbon dioxide capture, transport and geological storage; and
– examine the potential for the development and demonstration of CCS technology in China and its deployment in the future.

There are four more EC co-funded projects on CCS which also involve Chinese partners:

- Support to Regulatory Activities for Carbon Capture and Storage ($STRACO_2$, €0.86m EC funding);
- Assessing European Capacity of Geological Storage of Carbon dioxide (EU GEOCAPACITY, €1.9m EC funding);
- CO_2 storage on enhanced coal bed methane (MoveCBM, with €1.25m EC funding), and
- Carbon Dioxide Capture and Hydrogen Production from Gaseous Fuels (Cachet, €7.5m EC funding)

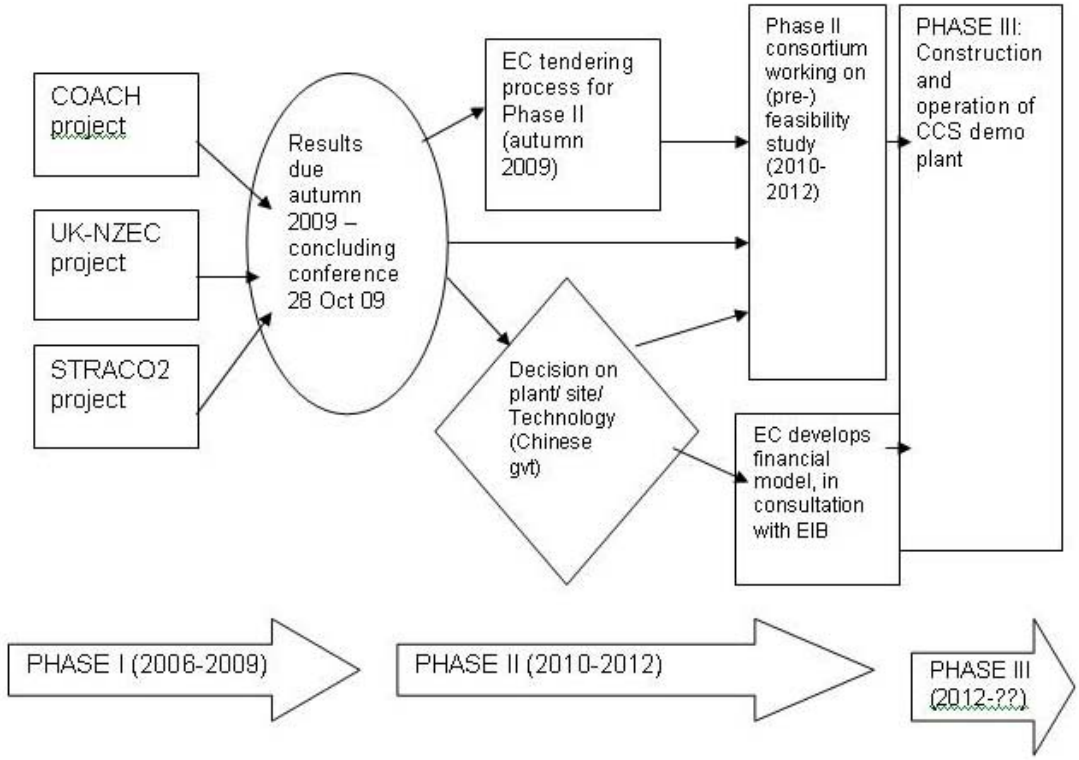
Phase II of NZEC will run from 2010-2012. It will build on the results described above of these projects and examine the site-specific requirements for and define in detail a demonstration plant and accompanying measures. It will include the technical and cost analysis of different options. Based on this analysis, the site of the power plant as well as the combustion technology (pulverised coal or IGCC), the capture technology and the transport and storage concepts will be determined. Phase II shall also include a detailed roadmap for the construction and operation of the demonstration plant as well as an Environmental Impact Assessment of the demonstration power plant and the carbon storage site.

Several issues remain for negotiation with Chinese partners in relation to Phase II. These include the timeline for the decisions on the project and the cost sharing arrangements. The European Commission intends to tender for a consortium to carry out Phase II later in 2009.

Phase III should commence thereafter and will see the construction and operation of a commercial-scale demonstration plant in China. The Commission is currently discussing with Chinese counterparts to start operation of the demonstration plant well before 2020 (the date agreed in 2005).

The final investment decision will be made on the basis of the Phase II feasibility studies and is subject to agreement by the relevant partners and the existence of a solid financing scheme. In order to speed up the process, technical preparatory work and fund raising will be done in parallel. Thus, the main purpose of this Communication is to trigger a financing scheme for phase III of the NZEC project in cooperation with the Government of China, EU and EEA Member States.

Figure 1: Flow chart of phases I to III of the NZEC project



5. CO-FINANCING A CCS DEMONSTRATION PLANT IN CHINA

The rationale for co-financing this CCS demonstration plant in China is to win time by accelerating the development of the technology. Experience in China shows that costs will go down once the technology is deployed at broad scale. However, a carbon price will be a precondition for large scale deployment of CCS in China.

5.1. Blending public and private financing in a public-private partnership

In order to bring together sufficient public and private funds and deploy them effectively the Commission plans to develop a public-private partnership (PPP), possibly in the form of a Special Purpose Vehicle (SPV). SPVs are highly flexible investment vehicles which can be designed for a one-off project and have a relatively light legal and managerial structure, which means that they can be established quickly and with minimal overheads. The rules governing the SPV are set down in advance and carefully circumscribe their activities. This mechanism allows the limitation of financial risk for the investor. SPV are suited for the transfer of assets to finance a large project achieving a narrow set of goals while limiting the risk to the investing entity. Hence the SPV model offers several advantages and can be tailored to suit the needs of the CCS demonstration project.

An advantage of this structure would be that the public donors can set out the investment policies to ensure full coherence with public policy objectives. Through a specified

investment policy this structure would offer an investment platform which can combine public and private funding.

The initiative has to be designed to inform and garner support from China, EU and EEA Member States, International Financial Institutions and private companies to contribute to this activity. Private investment in CCS is only attractive if there are prospects for a revenue stream, eg from the carbon market and/or enhanced oil recovery.

Chinese investment in the incremental costs of CCS will be essential to increase China's buy-in to the project. It will also ensure a greater Chinese ownership, familiarity with the technology and an increased likelihood of further deployment.

Box 3: Potential sources of financing for the NZEC plant

Private sector

Private sector involvement falls into two categories: active equity investors (operators, contractors, equipment suppliers) and passive equity investors (investment funds, institutional investors). The base plant may be funded through private sector investment (eg on a project finance or corporate finance basis). Private sector investors may also take on some of the additional CCS costs or provide in-kind support if they can see potential incentives.

Several European companies are already present in China's clean technology markets. Many of these are members of the ZEP and are key stakeholders for the EU-China cooperation. Cooperation between European and Chinese industry stakeholders will also be supported by the EU-China Clean Energy Centre, agreed at the 2007 EU-China Summit and due to be established in Beijing[15].

Carbon finance

Currently, CCS is not eligible for carbon finance (eg through the Clean Development Mechanism, CDM, which is a project-based approach offsetting developed country emissions through clean development projects in developing countries), although it might be eligible for post-2012 carbon financing, eg through a sectoral crediting mechanism (ie a mechanism to credit emissions reductions at the sector level) or through a specific CDM scheme for CCS demonstration plants in emerging/developing countries.

Enhanced Fossil Fuel Recovery

Depending on the nature of the plant, it is possible that a revenue stream could come from enhanced oil recovery (EOR).

Public financing

Contributions from the public budget would be required to co-finance for the additional CCS cost. There are a number of potential sources that it might be possible to leverage:

- EC budget

[15] See: http://www.eu-in-china.com/download/EC2.pdf

- EU or EEA Member States national budgets[16]
- concessional loans from public investment banks

The public finance could be used in the following ways:

– subsidy

– loan guarantees

– guarantee for private sector return (to guarantee price or regulatory risk)

– investment (with limited expected return)

5.2. Determining the scale of public financing

In order to attract private investment for the demonstration plant, it is necessary to create the possibility of return on investment. Possible sources of revenue are the carbon market or EOR. Different types of investors may require different level of return for their investment in clean technologies.

The future eligibility of CCS for carbon financing (as opposed to the imposition of a carbon tax) would generate a revenue stream that could attract private investment in the demonstration plant. Particularly interesting in this regard is the sectoral crediting mechanism currently being discussed in the context of the negotiations on a post-2012 global climate change agreement. In the Chinese power sector, for example, such an approach could enable the crediting of emissions reductions beyond a certain baseline. In this manner, only the action which is additional to business as usual is credited and companies would have an incentive to take more costly mitigation actions in return for financing through the carbon market. This could facilitate the uptake of more expensive technologies such as CCS, over and above other cleaner coal and efficiency technologies which are cost neutral or even negative over time. It is uncertain whether and at what time CCS in emerging and developing countries will be eligible for carbon market revenues. Therefore, public investment – with no or very low expectations for a return – will be required to reduce the risk for private investors and to allow for a sufficiently high internal rate of return (IRR). A financial analysis has been undertaken to determine the scale of public finance required[17]. The precise costs will be determined during Phase II of the NZEC project and the share of public contributions to the SPV (or other appropriate investment vehicle) is an issue which will be negotiated with government partners (European and Chinese).

The size, location, technology and storage site for the NZEC plant will be determined on the basis of studies conducted in NZEC Phases I and II, and with a view to replication potential in China. The cost estimates in this communication are preliminary – even though based on a set of reasonable assumptions, they may vary in the range of +/- 40% according to the specific technology and construction/storage sites chosen. The additional capital and operational cost

[16] If these public contributions qualify as State aid, they might need to be notified to the Commission under the State aid rules.

[17] See the Impact Assessment which accompanies this Communication, Annex VII.

over a lifetime of 25 years for this first-of-a- kind 400 MW demonstration plant[18] is estimated at around €730 million for an IGCC plant (€125m for capital cost, €340m for operational costs, and €265m for transport and storage costs[19], approximately) and around €980 million for a pulverised coal plant (€235m for capital cost, €445m for operational costs, and €300 for transport and storage costs[20], approximately).

Within the project lifetime a strengthening of the global carbon market and the emergence of a domestic carbon price in all major economies can be expected. Therefore, a price of €10/tCO_2 avoided is assumed in 2015, which gradually increases to €20[21]. Taking account of such a carbon price, and without pre-judging the technology choice, the financing gap is estimated at roughly €300 million for an IGCC plant and at €550 for a pulverised coal plant[22]. Should the carbon price reach higher levels, this financing gap would decrease and public support could be downsized.

Depending on the storage site chosen, it may be possible to source an additional revenue stream from EOR, which is already commercially viable, in addition to revenues from the carbon market. EOR refers to a variety of processes to increase the amount of oil removed from a reservoir, typically by injecting a liquid or gas (eg nitrogen, carbon dioxide).

In practice, CO_2-EOR use will be limited to power plants close to oil fields in order to limit transport costs. Even though the potential for EOR in China is limited to the relatively low number of oil fields, the development of CO_2-EOR could, however, jump-start the transport infrastructure required for full CCS deployment in some regions. The Phase I projects are examining options for EOR in China. If EOR is an option at the site selected by the Chinese government, this would considerably ease the financing of a CCS commercial scale demonstration plant.

A likely scenario is that the participation beyond government funding is of two types: Lenders (International Financial Institutions or public banks, such as the EIB) essentially providing debt financing requiring interest rates of around 5%, and investors providing equity, who require a gross return on investment of around 10-20%. One way to reduce the size of the initial investment required is through the competitive bidding process for the construction and operation of the plant, where partner companies in the consortium may bid at cost or reduced rates in order to gain first-mover and learning advantages from being in the first commercial scale CCS demonstration plant in China.

In order to make the proposition attractive for private investors, the public investors need to be willing to underwrite some of the risk. This could maximise the leverage of the public input by making the proposition more attractive to private investors.

The European Commission has earmarked €60m for cooperation on cleaner coal technologies and carbon capture and storage with emerging economies. The first tranche of €10m will be

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18 Expressed as net present value in 2010 over the 4 years of construction and 25 years of operation using a social discount rate of 2.5% (net of inflation).

19 This includes capital and operational costs over 25 years of 7€/t CO_2 stored.

20 This includes capital and operational costs over 25 years of 7€/t CO_2 stored.

21 Hypothetical assumption of 10€/tCO_2 in 2015, gradually rising to 20€/tCO_2 in 2040 and without pre-judging the policy instrument used to achieve this value.

22 Amounts vary depending on number of years of operation for which a CCS plant would receive public financing.

used to build capacity for CCS and other cleaner coal technologies in emerging economies and for the second phase of the EU-China NZEC project. Provided there is continued political support from China and satisfactory progress with the NZEC project, a second tranche of up to €50m could be made available for the construction and operation of a CCS demonstration plant in China. A viable financing scheme should be in place by 2013 at the latest, as a precondition for the construction of the demonstration plant.

6. CONCLUSIONS AND NEXT STEPS

Working closely with European and Chinese stakeholders, the Commission proposes the following:

i) to determine with international financial institutions such as the European Investment Bank, World Bank and Asian Development Bank the setting up of an appropriate financial structure, including possibly an SPV, to support Phase III of the NZEC project in close cooperation with interested Member States, States of the European Economic Area and Chinese partners;

ii) to invite EU Member States to pledge financial and political support. The target amount for public financing an IGCC plant would be around €300 million for an IGCC plant or €550 million for a pulverised coal plant;

iii) to further secure political support from China and ensure maximum value for European public money in the negotiation of the cost-sharing arrangements;

iv) to engage in the international negotiations on a post-2012 global climate change agreement in support of carbon financing for CCS technologies both in the first commitment period of the Kyoto Protocol (up to 2012) and in the new regime thereafter;.

The Commission also invites interested EEA States and China to pledge financial and political support to this novel initiative, and invites the European Parliament to provide its political support. Considering that this is a novel approach, the European Commission Services will continue to develop the detailed implementing arrangement together with entities that express a formal interest in co-financing this initiative.