COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 10.1.2007
COM(2006) 843 final

COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

Sustainable power generation from fossil fuels: aiming for near-zero emissions from coal after 2020

{SEC(2006) 1722}
{SEC(2006) 1723}
{SEC(2007) 12}

TABLE OF CONTENTS

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(Text with EEA relevance)

INTRODUCTION

This Communication is presented in the follow-up to the Commission Green Paper on "A European Strategy for Secure, Competitive and Sustainable Energy" adopted in March 2006. Its aim is to present a global view of the actions needed for the continued contribution of fossil fuels and particularly coal to the security and diversification of energy supply for Europe and the world in a way compatible with the sustainable development strategy and climate change policy objectives. This Communication takes account of the work done and opinions received during 2006 within the Second European Climate Change Programme (ECCPII), the High-level Group on Competitiveness, Energy and the Environment (HLG), the preparations for the 7th Framework Programme (FP7) for Research, and the Zero Emission Fossil Fuel Power Plant Technology Platform. It also reflects the consultations in the European Fossil Fuels Forum and the reactions to the above-mentioned Green Paper.

IMPACT ASSESSMENT STUDY

This Communication was preceded by an impact assessment study, the results of which are summarised in the Impact Assessment Executive Summary[1] accompanying this Communication. The results of the impact assessment study are reflected as appropriate in the Commission positions set out in this Communication.

1. ROLE OF FOSSIL FUELS IN ENERGY SUPPLY AND THE CHALLENGE OF KEEPING COAL IN THE ENERGY MIX

Fossil fuels represent an important element of the energy mix in the European Union as well as in many other economies. They are of particular importance for the generation of electricity: over 50% of EU electricity currently comes from fossil fuels (mainly coal and natural gas). Worldwide, growing total energy production is expected to rely increasingly on fossil fuels at least till 2050[2], particularly in a number of key geo-economic areas.

The use of fossil fuels (coal or natural gas) can also be envisaged for the co-production of electricity and hydrogen on a large scale, opening a realistic and economically viable route to a hydrogen economy.

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1 Commission Staff Working Document SEC(2006) 1723 (referred to hereafter as IAES).

2 IEA estimates in its WORLD DEMAND FORECAST 2006.

However, all use of fossil fuels leads to CO_2 emissions, currently the most critical cause of global warming. If fossil fuels are to continue playing their valuable role in the energy mix, solutions must be found to limit the impact of their use to levels compatible with sustainable climate objectives.

This is of particular importance for coal, which is traditionally the key fossil fuel in power production (used to generate some 30% of EU electricity) and also by far the most carbon-intensive[3].

Furthermore, most of the future growth in energy consumption in a number of large emerging economies is expected to be met from coal. Two-thirds of the increase in global coal use will come from China and India. Already today, one new coal-fired power plant is put into operation every week somewhere in the world.

Coal is a key contributor to the EU's security of energy supply and will remain so. Coal represents the fossil fuel with by far the largest and most widely distributed global reserves, estimated to last for some 130 years for lignite and 200 years for hard coal. Even with strategies to increase energy efficiency and the use of renewable sources, coal should remain an important option in the coming decades for covering essential electricity needs not satisfied by renewable energies[4].

However, coal can continue to make its valuable contribution to the security of energy supply and the economy of both the EU and the world as a whole only with technologies allowing for drastic reduction of the carbon footprint of its combustion. If such technologies are developed on a sufficient scale to allow the sustainable use of coal and are judged economically viable for commercial deployment, they can also provide solutions for combustion processes using other fossil fuels, including gas-fired power generation.

It is important to stress the global character and the urgency of the challenges associated with coal use. Coal is expected to continue supplying about a quarter of global primary energy needs. As global primary energy consumption increases by 60% in the next 20 years, so will the use of coal. With current technologies, this would result in a 20% increase in global CO_2 emissions by 2025. Two-thirds of this increase would arise in developing countries. The EU therefore needs to develop technological solutions for sustainable use of coal not only to retain coal in the European energy mix but also to ensure that global growth in coal use will be possible without irrevocable damage to the global climate. The urgency of this task stems from the fact that even with sincere and concentrated efforts, the necessary novel technologies may not be ready for commercial deployment on a global scale before 2020. It is therefore vital that the EU starts today to implement policies that will underpin and sustain its global leadership in fighting climate change in the decades to come.

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[3] Coal-based power generation in the EU-27 was responsible for around 950m tonnes of CO_2 emissions in 2005, representing 24% of all EU CO_2 emissions. Worldwide, emissions from coal-fired power generation amount to approx. 8bn tonnes of CO_2 per year. See IAES for further details.

[4] This is in line, inter alia, with the recommendations of the First Report of the HLG (http://ec.europa.eu/enterprise/environnement/hlg.doc_06/first_report_02_06_06.pdf). See also the Strategic EU Energy Review adopted concurrently with this Communication - COM(2007) 1.

2. TECHNOLOGICAL SOLUTIONS FOR A SUSTAINABLE USE OF COAL AND OTHER FOSSIL FUELS

Even though this Communication concentrates mainly on the possibilities for the sustainable use of coal, it should be clearly understood that many of the proposed solutions (notably CO_2 capture and storage) should be applicable, and applied as appropriate, to other fossil fuels, especially gas.

'Clean Coal' technologies have been developed and are now widely used in the power generation sector, substantially mitigating the problems of local pollution and acid rain by considerably reducing emissions of SO_2, NO_x, particulates and dust from coal-fired power plants.

Clean Coal technologies have also brought about a steady increase in the energy efficiency of the conversion of coal into electricity, although there is still scope for substantial improvements in the energy efficiency of large-size coal-fired power plants through the continued development of these technologies[5].

Such achievements are important stepping stones for further progress towards novel technological solutions (called hereafter "Sustainable Coal" technologies) incorporating the concepts of CO_2 capture and storage (CCS) in coal-based power generation. Processes for CO_2 capture and CO_2 storage already exist as established industrial practices in some sectors; the technology is well developed and tested but needs to be adequately adapted for a large-scale use in power generation in an integrated manner. Bringing CCS to commercial viability in coal-fired power generation will pave the way for its application also in combustion processes using other fossil fuels, notably gas. This will enable a transition to "Sustainable Fossil Fuels" in power generation.

3. ON THE WAY TO SUSTAINABLE FOSSIL FUELS

3.1. Demonstration of integrated technological solutions for Sustainable Coal

Past and ongoing research and development (R&D) programmes addressing Clean Coal and CCS technologies have produced positive results. It is now time to focus on the development and industrial demonstration of integrated technological solutions, combining in an optimal way Clean Coal and CCS for near-zero emission power generation from coal.

It emerges from the analyses undertaken by the Commission[6] that technological solutions involving only efficiency improvements through Clean Coal technologies or only CCS technologies are not able to meet in the long term the combined objectives of achieving near-zero CO_2 emissions at acceptable costs while preserving the diversity of the energy mix needed for security of energy supply. At the same time, and especially in the particular case of coal-fired power generation, it is clear

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5 While the oldest units still operating in the EU may have efficiencies of 30%, the most recently built coal-fired plants reach efficiencies of up to 43% (for lignite power plant) and 46% (for hard coal power plant). The technical limits are assumed to be above 60%.

6 See IAES for further details.

that CCS technologies cannot be envisaged without highly efficient coal conversion, allowing to limit the impact of the energy penalty associated with the use of CCS.

With sustained effort and with market conditions reflecting clear and ambitious carbon constraints, Europe stands a fair chance of achieving the commercial viability of Sustainable Coal technologies in the next 10 to 15 years. This will, however, require bold industrial investments in a series of demonstration plants, both within and outside the EU, and related policy initiatives for a relatively extensive period of time, starting practically now and lasting possibly until 2020 or even beyond. Even with demonstration projects under way, further R&D activities will continue to be needed in parallel throughout the demonstration phase. It should be seen as an iterative process where demonstration and further R&D go hand-in-hand.

A very positive signal in this area came in 2006 from industry through the Zero Emission Fossil Fuel Power Plant Technology Platform (ZEP TP). Major energy companies involved in coal-fired generation announced their plans to build 10-12 large-scale demonstration plants testing various ways of integrating CCS in coal- and gas-fired power generation. Once commissioned, these plants will need to be operated for at least five years before the tested solutions are considered to be fully demonstrated and ready for standard investment in zero-emission power plants, in 2020 and after.

Commission action: The Commission will substantially increase the funding for R&D in the energy area, making the demonstration of Sustainable Fossil Fuels technologies one of the priorities for 2007-2013. The Commission calls on Member States to show an equal commitment to R&D and demonstration in this area. The Commission will also seek to ensure that action at both EU and Member State level complement the efforts by industry in the framework of the ZEP TP. A European Strategic Energy Technology Plan will provide a suitable instrument for the overall coordination of such R&D and demonstration efforts and for the maximisation of synergies at both EU and national level.

The presence and bold initiative of the ZEP TP notwithstanding, successful and timely demonstration of the commercial viability of Sustainable Fossil Fuels may require the creation of a structure to coordinate and adequately support such industry-scale technology demonstrations. Its added value should lie primarily in avoiding duplication of effort and aligning priorities through enhanced coordination and knowledge sharing, both among activities undertaken in Europe (at EU level and within Member States) as well as between European activities and those in third countries.

Such an instrument should actively support not only the demonstration projects but also the advancement of international cooperation, the definition of exchange programmes, and links with other related EU initiatives (such as other platforms). Furthermore, it could also design and execute an affordable public awareness strategy.

Several types of arrangements may be considered, from enhancing the existing Technology Platform to establishing special Commission-driven instruments (such as a Joint Technology Initiative or Joint Undertaking) or specific financing instruments with the participation of the banking sector (possibly through the European

Investment Bank, EIB, and/or the European Bank for Reconstruction and Development, EBRD).

Commission action: The Commission will examine (inter alia by way of an in-depth impact assessment study to be undertaken in 2007) possible measures for achieving the demonstration of Sustainable Fossil Fuels, and particularly Sustainable Coal, technologies. On this basis, the Commission will determine the most suitable way to support the design, construction and operation by 2015 of up to 12 large-scale demonstrations of Sustainable Fossil Fuels technologies in commercial power generation.

3.2. Capture readiness as an integral part of fleet modernisation

Modernisation of the fleet of coal-fired power plants operating in the EU represents another early step towards Sustainable Fossil Fuels in Europe. More than a third of existing coal-fired capacity in the EU is expected to reach the end of its technical lifetime in the coming 10 to 15 years[7].

Using the best available and most energy-efficient conversion technologies in replacement (as well as new-build) investment can bring about an initial reduction of around 20% in CO_2 emissions from coal-based power generation by 2020. Recent developments in the European power industry show that reducing CO_2 emissions through improved coal conversion efficiency is considered a more economic solution than switching to gas, at prevailing gas-coal price ratios and levels of CO_2 restrictions. In the absence of a long-term and commercially viable perspective for coal, however, electricity operators may be reluctant to include coal-based technologies in their considerations when replacing ageing coal-fired plants; their decisions could then impact on the security of EU energy supply.

The expectations of higher costs associated with CCS-equipped power plants after 2020 give rise to a tangible risk. This is the risk of a "non-CCS technology lock-in" as the result of ill-considered investment decisions with respect to the coal-fired capacity due for replacement in the coming 10-15 years. It is imperative to avoid a situation where much of the new build before 2020 is undertaken in a way that would either preclude or insufficiently guarantee the addition of CCS components on a sufficiently wide scale after 2020.

Commission action: The Commission will assess on the basis of recent and planned investments whether new fossil fuels power plants built and to be built in the EU use best available technologies regarding efficiency and whether, if not equipped with CCS, new coal- and gas-fired installations are prepared for later addition of CCS technologies ('capture ready').

If this turns out not to be the case, the Commission will consider proposing legally binding instruments as soon as possible, after a proper impact assessment.

[7] Up to 70 GW of EU coal-fired capacity will need to be replaced (out of a total of 187 GW) by 2020.

4. ACTING NOW TO MAKE SUSTAINABLE FOSSIL FUELS A REALITY AFTER 2020

Smooth and definitive transition to Sustainable Coal and more generally to Sustainable Fossil Fuels technologies hinges not only on further development and commercial demonstration of CCS. It is also predicated on the existence of an economic and regulatory environment that will reward low-carbon technologies and provide sufficient motivation for investment decisions preferring technological solutions with CCS to non-CCS ones. Future gas-coal price ratios and CO_2 allowance prices will be determining factors for investment decisions in new power generation in coal, gas and renewables. Based on these market fundamentals, utilities will optimise their generation portfolio towards a combination of minimum risk and maximum return on investment.

In the context of the future emissions trading scheme, this transition will thus largely depend on the prevailing regime and prices for CO_2 emissions allowances, which will in turn depend on the overall environmental regulatory framework in the EU and indeed world-wide.

4.1. Consistent regulatory framework for CCS at EU level

While sufficient storage capacities are available in Europe to store CO_2 from power production for several centuries[8], a regulatory and policy framework for CCS in the EU is needed in order to:

– ensure the environmentally sound, safe and reliable operation of CCS activities;

– remove unwarranted barriers to CCS activities in current legislation;

– provide appropriate incentives proportionate to the CO_2 reduction benefits.

The regulatory framework for CO_2 storage must be based on an integrated risk assessment for CO_2 leakage, including site selection requirements designed to minimise the risk of leakage, monitoring and reporting regimes to verify storage, and adequate remediation for any leakage that does occur. R&D and demonstration support will be required to advance the requisite technology. The Commission has already launched a study to assess in detail the potential risks from CCS and to identify the safeguards needed to ensure that CCS can be operated safely. This process will be open and transparent and the Commission will also design and execute an awareness strategy to involve the wider public.

Commission action: In 2007, the Commission will assess the potential risks from CCS and lay down requirements for the licensing of CCS activities and for adequately managing the risks and impacts identified. Once a sound management framework is developed, it can be combined with changes to the existing environmental regulatory framework at EU level so as to remove any unwarranted barriers to CCS technologies. The Commission will also assess whether to amend existing instruments (such as the Environmental Impact Assessment Directive or the Integrated Pollution Prevention and Control Directive) or propose a free-standing

[8] See IAES for details.

regulatory framework. It will assess which aspects of the regulatory framework are preferably addressed at EU level or, alternatively, at national level.

The Commission will, in early 2007, hold a public internet-based consultation on different options for CCS to ensure the proper involvement of the European public in the evaluation of the environmental integrity and safety of the capture, transport and geological storage of CO_2.

In the review of the EU Emissions Trading Scheme (EU ETS), the Commission will address the recognition of CCS activities in the EU ETS. A proposal for the revision of the ETS is planned in the Commission Work Programme for 2007; it will relate to the period from 2013 and will aim at the projection of necessarily regulatory stability. It will seek a level playing field in line with the actual CO_2 benefits, both between various CCS options and across the EU for investment in CCS technologies. The Commission will also consider intermediate options to take account of CCS activities undertaken during the period 2008-2012.

4.2. CCS acceptance in international regimes

Europe's global leadership in combating climate change gives the EU a chance to engage other countries in international climate change negotiations for the period after 2012. This should facilitate the creation of a stable long-term international agreement on future emission-reduction objectives and thus support the deployment of low-emission energy solutions in other parts of the world as well. The geological storage of CO_2 needs to be recognised as part of the broad portfolio of options necessary for the implementation of such an agreement. There should also be recognition of CCS under flexible mechanisms such as the clean development mechanism (CDM), while respecting appropriate environmental safeguards.

Commission action: The EU will continue its efforts to achieve a global agreement to limit and subsequently reduce global emissions of CO_2 and other greenhouse gases, in line with the objective of limiting the increase in the earth's average temperature to a maximum of 2ºC above pre-industrial levels. The Commission will support the recognition of CCS activities respecting appropriate environmental safeguards as part of the broad portfolio of energy options necessary for the implementation of such agreement.

There may be unwarranted barriers at international level to CCS in certain international agreements drafted without CCS in mind. While addressing the management of the CCS-related risks, amendments to these agreements should be negotiated and adopted, as has been recently done for the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter (the "London Protocol"), so as to permit environmentally sound geological storage of CO_2 under the seabed.

Commission action: While assisting the development of a framework for CCS-related risk management, the Commission will support appropriate amendments to the international conventions (e.g. The Convention for the Protection of the Marine Environment of the North-East Atlantic – the "OSPAR Convention").

4.3. Clear framework for phasing in Sustainable Fossil Fuels

Further improvements in Clean Coal technologies and power plant efficiency, successful large-scale demonstrations and a suitable regulatory framework for CCS should make Sustainable Coal the business model of choice for coal-fired power generation in the period after 2020. Once the commercial viability of Sustainable Coal is demonstrated, appropriate framework should be in place so that new coal-fired power plants built after 2020 operate with CCS; capture-ready plants built in the previous period should be rapidly retrofitted. The future EU ETS should provide the primary incentives through stable and strong prices for CO_2 allowances. It remains to be considered how strictly (i.e. whether and to what extent) the same approach should be applied to power generation from other fossil fuels, particularly gas. While it is important to maintain a level playing field, the imperative of reducing CO_2 emissions is clearly much more evident with respect to coal.

Incentives may be justified to discourage traditional coal-based power generation and foster wide penetration and use of Sustainable Coal technologies. Relevant measures, although intended for the period after 2020, will need to be adopted sufficiently in advance to provide clear signals and useful input for investors' decisions. Such measures would need to be compatible with pro-active measures already in place for renewable energies, and their adoption would be preceded by an impact assessment evaluation.

Such incentives could be provided through various mechanisms, for example:

– Establishing a more favourable context for long-term investment decisions by ensuring the relative perpetuity of the emissions trading scheme and by facilitating commercial financing and risk-sharing instruments (e.g. through the EIB).

– Developing EU CO_2 storage sites (onshore, offshore) and pipelines for multi-user access or projects for CO_2 infrastructure development at Member State level.

– Adopting legally binding measures to regulate maximum allowed CO_2 emissions per kWh after 2020 and/or introduce a timed phase-out (for instance by 2050) of all high CO_2 emitting (i.e. non-CCS) electricity generation.

Commission action: In the light of the above, the Commission considers that a clear and predictable long-term framework is necessary to facilitate a smooth and rapid transition to a CCS-equipped power generation from coal. This is necessary to enable power businesses to undertake the required investments and research in the secure knowledge that their competitors will be following a similar course. On the basis of the information currently available, the Commission believes that by 2020 all new coal-fired power plants should be built with CCS. Existing plants should then progressively follow the same approach.

In order to make a decision, in terms of both the timing of any CCS obligation and the most appropriate form and nature of the requirement, the Commission will undertake in 2007 an analysis including a wide-ranging public consultation on the issue. On the basis of such an analysis, the Commission will evaluate what is the

optimal retrofitting schedule for fossil fuels power plants for the period after the commercial viability of Sustainable Coal technologies is demonstrated.

5. COSTS AND BENEFITS OF SUSTAINABLE FOSSIL FUELS TECHNOLOGIES

Economically viable Sustainable Fossil Fuels technologies can help achieve deep carbon reductions at acceptable cost. Sustainable Coal is of particular importance as it can bring about dramatic carbon reductions while ensuring cost-efficient security of energy supply, especially if prices for oil and gas remain high. While the transition from traditional coal to Sustainable Coal will certainly not be costless, it may prove a priceless contribution to climate change mitigation.

For regular new installations, the requirement of capture-readiness in the period up to 2020 may not necessarily entail additional costs: it will first and foremost call for new investment to be made with the right technology choices and for the needs of future CCS operations to be taken into account in selecting the location, spatial planning and configuration of any new power plant.

Industrial-scale demonstration of Sustainable Fossil Fuels will, on the other hand, require substantial financial resources to be mobilized in Europe over a short period of time. A fleet of up to 12 CCS-equipped coal- or gas-fired power plants, each at 300 MW_e, may, at current technology costs, require at least €5bn and possibly more[9]. CCS retrofitting after 2020 will also entail significant additional investments, which are currently difficult to predict exactly and will depend on the level of technology development in the 2020 horizon as well as on R&D and demonstration advances and industry commitment in the interim period. The total capital requirement for CCS-retrofitting of coal-fired power plants is estimated to be in the range of €600,000 – 700,000 for 1MW of installed capacity (for capture-ready installations built in the period between now and 2020 with currently available technologies). The costs of retrofitting (after 2020) older power stations, i.e. installations already in place today, will probably be higher.

5.1. CCS costs and costs of electricity produced

Cost estimates for CO_2 capture from power generation and subsequent storage at the current level of technology development range up to €70 per tonne of CO_2[10], rendering the large-scale use of these technologies prohibitively costly for the time being.

However, major technology improvements are anticipated for the coming years. Gains in the efficiency of future plants and reductions in CO_2 capture costs are expected in the near future, while the side-benefits of CCS (such as use of CO_2 streams for Enhanced Oil Recovery) will further reduce the net costs of particular CCS operations in power generation.

Available models and studies with a medium- to long-term perspective thus estimate the costs of CCS by 2020 at about €20-30/tCO_2. This translates in the models to costs

[9] See IAES for details.
[10] See IAES for details.

of coal-fired power generation with CCS by 2020 or soon afterwards at just 10% above or even on the par with the current levels[11].

It is also worth comparing the estimated initial increase in the costs of power generated with Sustainable Coal technologies with the production costs of some renewable sources available today. Both turn out to be at least in the same order of magnitude[12], for what are all viable and environmentally beneficial alternatives. When commercially available, Sustainable Coal technologies may thus offer an additional economically sensible opportunity for countries wishing to reduce their CO_2 footprint from electricity generation.

5.2. Electricity prices with Sustainable Coal

It is important to recognize that even if CCS does result in moderate increases in the costs of electricity production, these are unlikely to translate, at least not fully, into increased electricity prices for consumers. Sustainable Coal is expected to continue to provide a base-load electricity supply. As such, it would be unlikely to become the marginal electricity generation source on the economics of which electricity supply prices are generally based: this role would continue to be played by still more costly peak-load sources.

5.3. Environmental risks and benefits of Sustainable Fossil Fuels

The potential negative environmental impacts from sustained use of fossil fuels and the deployment of CCS stem mainly from potential leakage from CO_2 storage. The leakage impacts can be both local (on local biosphere) and global (on climate). However, the International Panel on Climate Change's report on the issue concludes that, based on existing experience, the fraction of CO_2 retained in well-selected and managed storage sites is very likely to exceed 99% over 100 years[13]. Site selection and management are thus the key factors for minimising risk. The Commission impact assessment for enabling legal framework will identify all potential risks and will put forth appropriate safeguards.

Continued use of fossil fuels in power generation, reinforced by the arrival of Sustainable Fossil Fuel technologies, may translate into increased global production of fossil fuels, coal mining in particular. This could pose challenges to local environments. Best practices in the production and use of fossil fuels, including coal mining, have been sufficiently developed to guarantee that the inherent risks can continue to be adequately managed, inter alia, through further improvement and dissemination of such best practices.

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11 Some research projects currently under way aim to produce electricity from coal-fired power stations with CCS by 2020 at costs higher by 10% compared to current technologies without CCS. Simulations run by the Commission in cooperation with the National Technical University of Athens and based on the PRIMES model show that the costs of electricity in 2030 may be as low as €ct 6.1/kWh. See IAES for details.

12 Costs of €ct 7.5-8.5/kWh for electricity from coal with present CCS technologies are comparable to the costs of wind-generated electricity reported by the European Wind Energy Association for sites with low wind speeds (€ct 6-8/kWh). Technology improvements by the time of full commercialisation of sustainable coal (2020-2030) should bring costs down significantly to around €ct 6/kWh, i.e. levels comparable to the average costs of wind power (roughly €ct 5-6/kWh).

13 See IAES for details. See also the IPCC Special Report on Carbon Capture and Storage, UN 2006.

On the positive side, Sustainable Fossil Fuels technologies, and particularly CCS, are expected to deliver significant positive results. First and foremost, of course, they can effectively eliminate up to 90% of the carbon emissions from fossil fuels power plants. This could translate into an overall reduction in EU-27 CO_2 emissions of 25-30% by 2030 compared to 2000.

Furthermore, the combined emissions of major pollutants traditionally associated with coal combustion and seen as major contributors to acidification, eutrophication and ground-level ozone are likely to be significantly reduced by the deployment of Sustainable Fossil Fuel technologies. Although the effects are technology-specific, Commission analyses show that some of the envisaged technologies could reduce NO_x and SO_2 emissions significantly (by around 80% and 95% respectively in comparison with traditional pulverized coal power plants). In all, this would bring significant social benefits in the form of an improved environment and better public health (and thus reduced healthcare costs)[14].

5.4. Contribution of Sustainable Fossil Fuels to the goals of prosperity and sustainability

The concept of Sustainable Fossil Fuels offers numerous potential benefits to the EU's efforts undertaken in the context of the Lisbon and Johannesburg agendas. The role Sustainable Fossil Fuels can play in the sustainable development strategy is, however, predicated on a strong international action taken by Europe as a leader in the development of the requisite technologies. By 2030, global annual electricity generation from coal alone is expected to increase by 7.8 TWh[15]. More than two-thirds (70%) of this increase will take place in India and China, additional 10% in other non-OECD countries. The international dimension of EU's Sustainable Fossil Fuels strategy will therefore be crucial for the sustainability of continued global use of fossil fuels as well as for accessing opportunities this may generate for EU businesses.

Commission action: The Commission has already laid groundwork for close collaboration with China in the 2005 EU-China Partnership on Climate Change and the subsequent 2006 Memorandum of Understanding (MoU), focusing on joint CCS demonstration. The collaboration follows a three-stage logic, starting with exploratory work, continuing by the definition and design of a concrete demonstration project to be constructed and operated in the final stage. The first stage of the project should be completed by 2008, the operation of the demonstration project was initially previewed for 2020.

While making efforts to accelerate the ongoing European collaboration with China in the demonstration of CCS (bringing the operation date from 2020 significantly forward), the Commission will look for opportunities to extend cooperation on demonstration projects to other key emerging economies (such as India, South Africa) and will seek to stimulate the creation of enabling policy and regulatory framework in those countries. The Commission will examine options for co-

[14] The overall benefits generated by some sustainable coal technologies (such as CCS-equipped IGCC power plants) could be as high as one-quarter to three-quarters of the costs of CCS. They could even outweigh the CCS costs for locations such as Central Europe. See IAES for details.

[15] Reference Scenario as presented in the IEA 2006 World Energy Outlook.

financing such projects and for close coordination of demonstration projects in the EU and in third countries.

At the same time, the Commission will seek to identify and exploit the synergies with efforts under way in other coal-using economies (including the US, Japan, Australia).

5.4.1. Sustainable Coal in the service of global sustainable development

An early involvement of third countries in the development and deployment of Sustainable Coal technologies and particularly the CCS component is essential for sustainable global economic development and for tackling climate change in a scenario with increasing global use of coal resources. Closer collaboration on zero-emission power generation with key third countries, with the focus on large fossil fuel exporters and large emerging economies, will therefore be imperative.

Concrete actions to reinforce collaboration with interested third countries should include projects in:

- increasing the energy efficiency of the coal chain
- identification and testing of potential sites for geological CO_2 storage (including possibilities in hydrocarbon fields)
- cooperation in the development of Sustainable Coal technologies and in the preparation and construction of demonstration plants
- establishing a suitable regulatory framework for CO_2 emission limits and the deployment of CCS using experience from the European model.

Furthermore, Energy Technology Centres could be established in key third countries, building on the closer energy cooperation already in place with e.g. the Gulf Cooperation Council (GCC), OPEC, China and India. Such centres could facilitate the launch and execution of projects in the areas mentioned above. They could also promote later on the penetration of Sustainable Fossil Fuels technologies in third countries.

5.4.2. EU as a competitive exporter of Sustainable Fossil Fuels technologies

European industry today plays a leading role on the world markets in developing and supplying advanced technological equipment to the coal-mining and coal-fired electricity generation sectors. By developing, demonstrating and further investing in Sustainable Fossil Fuel technologies, European industry will maintain a competitive advantage on world markets and contribute to growth and employment in Europe.

Sustainable coal mining and coal-fired power generation in developing and emerging economies creates opportunities for supplying new equipment to these countries. However, international competition in these markets will be fierce. It is therefore very important for European industry to seize early opportunities for developing Sustainable Fossil Fuels both in the EU and beyond, thus securing the EU's continued leadership in advanced environmentally beneficial technologies.

6. CONCLUSIONS

The Commission recognises the importance of fossil fuels and particularly the contribution of coal to the security of energy supply. At the same time, the Commission stresses that the future use of coal in particular must be made compatible with sustainability objectives and climate change policy.

The success of Sustainable Coal and particularly the commercialization of CCS on a large scale will also offer opportunities for the exploitation of the new technologies in applications for other fossil fuels, first and foremost in gas-fired power production.

The Commission is ready to play its part in the promotion of Sustainable Fossil Fuels by establishing a favourable context and supporting the implementation of the technological solutions needed. The Commission plans to undertake concrete initiatives in order to make Sustainable Fuels a reality both in Europe and globally in the shortest possible time.