Research Project

CCS Global

Global Perspectives of Carbon Capture and Storage (CCS) Technologies in Emerging Countries – The Possible Role of China, India and South Africa

Project Background

Carbon capture and storage (CCS) for reducing carbon emissions from fossil-fired power plants and industrial sources is the subject of intensive global debate. CCS is considered a technology option that could contribute significantly to achieving the objective of decreasing greenhouse gas emissions by 50 to 85% by 2050. This radical reduction is imperative in order to prevent the rise in global average temperature from exceeding a threshold of 2°C.

CCS is often viewed to be a bridging technology into a future in which renewable energy sources prevail and energy is used as efficiently as possible. Before this future can be reached, emissions from coal-fired power plants and other fossil fuel sources have to be reduced to the greatest extent possible. For the time being, however, use of coal is on the rise. Such development is mainly driven by emerging economies that face a rapidly growing demand for energy.

This study therefore focuses on three emerging countries that all hold vast coal reserves marked to be fired for energy production: China, India and South Africa (CISA). These key countries were selected as meaningful examples to explore whether CCS could present a viable, significant CO_2 reduction option in regions other than industrialised countries.

This scientific study is being funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). It is being conducted by the Wuppertal Institute for Climate, Environment and Energy and the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) over a two-year time frame stretching from October 2009 to September 2011. Local project partners will be involved to support the German scientists with in-depth knowledge of the energy economy and geology in their respective countries in order to ensure that the study's envisaged tasks and goals are achieved.

The Various Steps within the Project

Figure 1 shows the project architecture which consists of five main steps:

1. General Framework for CCS
The *first step* comprises presentation of an overview of the viable CCS technologies and current technological developments in CISA. Options for deploying this technique in future low-carbon scenarios in CISA are to be highlighted.

2. CO_2 Sources Analysis
The *second step* will investigate the reduction potential of CCS in the selected countries. Based on an analysis of current CO_2 emissions, a scenario analysis of potential emissions up to 2050 will be conducted. Analysis focuses on large point sources, especially large-scale power plants. The amount of CO_2 emissions that could be captured is assessed and quantified.

3. Assessment of CO_2 Sinks
Sufficient storage space for CO_2 must be available in order to prevent the greenhouse gases produced by large fossil-fired installations from entering the

atmosphere. The overall question addressed in the *third step* is how much CO_2 could be potentially stored in appropriate geological formations in a secure and long-term manner in CISA. So far, the estimation of CO_2 storage potential is widely uncertain. The geology of potential storage formations in CISA will be subject to in-depth assessment based on a review of existing studies and relevant information and data to be gathered by local partners.

4. Source-Sink Matching

The *fourth step* will consist of determining the extent to which CCS could be feasible in CISA giving due consideration to the fact that potential sinks must be matched to the large emission point sources. It must be clarified whether implementation of this technology is possible even if vast pipeline infrastructure has to be erected between sources and sinks. The longer the distance CO_2 has to be transported, the less economical CCS becomes, thus some of the potential storage sites assessed in the third step could be excluded in this step. This analysis will produce a more realistic estimate of the possible CCS capacity available to China, India and South Africa.

5. Integrated Assessment

In the *fifth and final step*, possible applications of CCS will be analysed from economic, ecological and resource-strategic standpoints. A life cycle assessment is conducted to demonstrate the environmental impacts of the overall CCS process chain. Economic analysis considers the additional cost of capturing and storing CO_2. The quality and quantity as well as the geographical location of coal reserves and resources

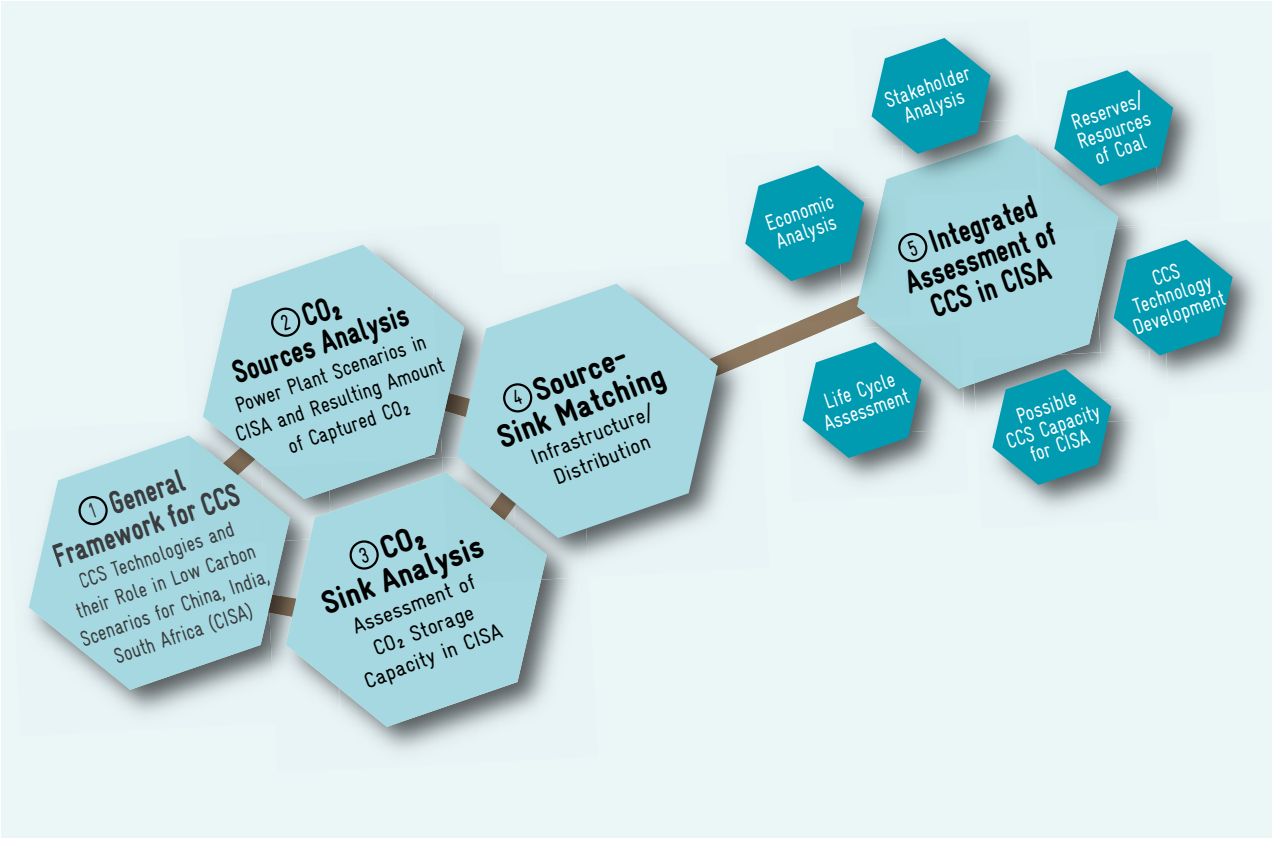

Figure 1: The five main steps of the study

in CISA are studied. The location issue is particularly relevant, as the study must consider where new power plants will be sited, i.e. close to fuel reserves, near to consumers or adjacent to potential storage sites. Quantity could become a relevant factor because CCS requires anywhere from 20 to 30% more coal for the same electrical generating output. Yet another part of this integrated assessment analyses the industrial, political and social stakeholders involved with an eye to identifying drivers of CCS implementation and those who may prove to be barriers.

The results of these individual steps will be compiled to create an integrated assessment of CCS in CISA and presented in a final report. Conclusions will encompass recommendations and information for the German Government on how to proceed in future with regard to technology cooperation and climate policy as well as research and development in the field of CCS. The final results of this research will be presented at workshops in the three countries with stakeholders and policymakers from the international community.

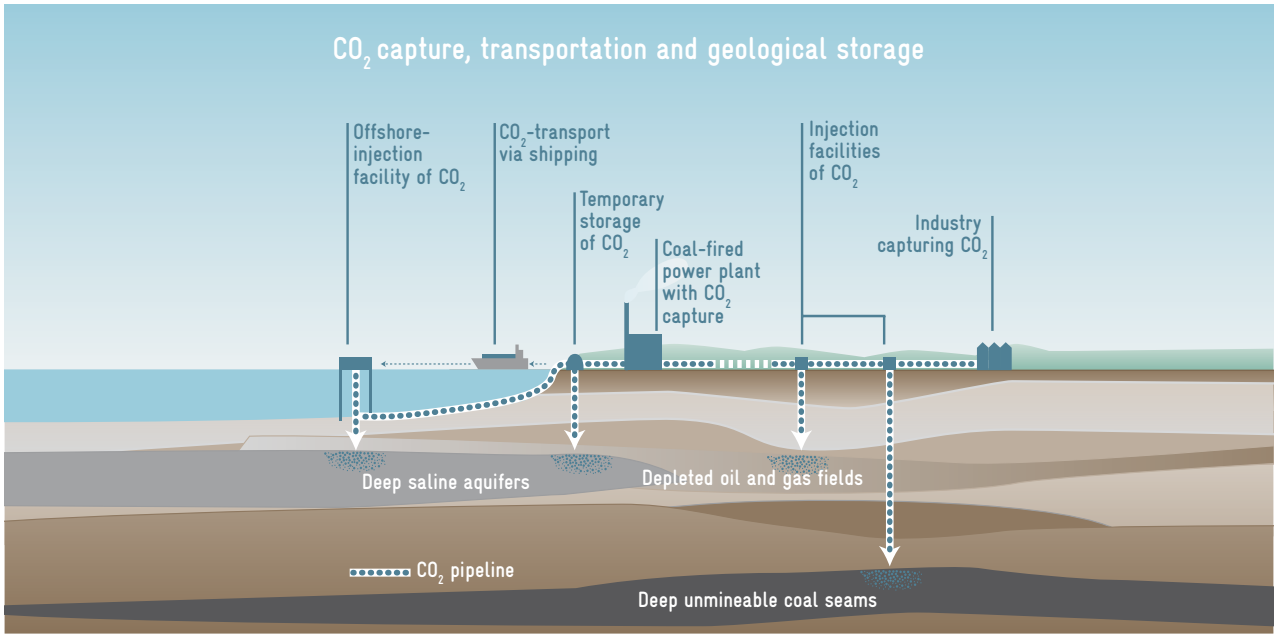

Figure 2: Overview of the CCS process chain (Source: Wuppertal Institute)

What is CCS?

Carbon *dioxide* capture and storage (CCS), as officially termed under the United Nations Framework Convention on Climate Change (UNFCCC), is a technique for separating carbon dioxide in fossil fuels either before or after combustion as it is emitted from large point sources. The carbon dioxide is compressed and transported to a suitable storage site where it is injected deep underground. It must remain underground over the long term (10,000 years or more), trapped in the geological formations of depleted oil or natural gas fields, deep saline aquifers or unmineable coal seams. CCS is envisaged to possess international significant potential as a technique for mitigating the effects of climate change, particularly in countries that contain large reserves of fossil fuels.

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Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety – in short: Environmental Ministry or BMU – is responsible for environmental policies of the Federal Government. Protection against pollutants and radiation, intelligent and efficient use of resources and energy as well as preservation of biodiversity are only a few of the goals of the Environmental Ministry.

Wuppertal Institute for Climate, Environment and Energy

Wuppertal Institute for Climate, Environment and Energy. The Wuppertal Institute explores and develops models, strategies and instruments to support sustainable development at local, national and international level. Sustainability research at the Wuppertal Institute focuses on ecology and its relation to economy and society. Special emphasis is put on analysing and supporting technological and social innovations that decouple prosperity and economic growth from the use of natural resources. Research at the institute is based on long-term scenarios and systems analysis as well as comparative studies of resource use, energy systems and ecological structural change in various countries.

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