Carbon CCS Financing in the Developing Countries: Prospects, Problems and Possible Solutions

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Abstract - Developing countries comprise of mostly Asian, African, and Latin American countries that make up the overwhelming majority of the world's population, containing more than two-third of the population. These countries constitute the majority of annex2 countries as defined in Kyoto Protocol; they have little or no emission restrictions. Carbon Capture and Storage (CCS) is one of the most recent and important climate mitigation technologies, it allows the capture, transportation and storage of the CO2 (The major green house gas) from the mixture of flue gases emitted from coal fired plants and from oil and gas industries. Most of the Industrialized Countries however, constitute the annex1 countries in Kyoto Protocol and hence, are faced with emission restrictions. Recent reports have shown that the developing countries have more potential to enjoy clean development mechanism (CDM) projects as stipulated by article 12 of the Kyoto Protocol, but it is obvious that most of these countries have few or no CCS projects, especially at this time when CCS is given serious consideration under the Protocol. Many CCS and renewable energy financing programs are obtainable from Carbon Sequestration Leadership Forum (CSLF) and World Bank Group such as; International Bank for Reconstructions and Development (IBDR), International Finance Corporation (IFC) and Multilateral Insurance Guarantee Agencies (MIGA). Unfortunately, most of the funds are enjoyed by the developed countries. Only a few of the developing countries access the fund and at low percentage compared to the former. Therefore, this article reviews the CCS financing in the Developing Countries, its prospects, problems and possible solutions.

Keywords: Carbon Capture, Developing Countries, Climate Mitigation, Project Financing, Carbon finance.

1. INTRODUCTION

The International Energy Agency (IEA) stated that CCS could provide 19% of the required global CO2 reductions by 2050, but this would mean that, about 18 CCS projects would be needed by 2015, and a significant number of 3, 400 CCS projects would be needed by 2050. The split was made in such a way that, about 35% of these projects should be located in non-Organization for Economic Cooperation and Development (OECD) member countries, and the remainder to be located in OECD member states (South African Centre for Carbon Capture and Storage, 2010). Climate change poses a serious threat to sustainable development, with adverse impacts expected on human health, food security, economic activity, the environment, water and other natural resources, as well as physical infrastructure. CCS involves separation of carbon dioxide from industrial and energy related sources, its transportation to a storage location and its long-term isolation from the atmosphere. Although CCS can be implemented mainly by applying known technology developed for other purposes, its potential role in tackling climate change was not recognized as early as some other mitigation options (CDM Conference, 2006). However, one of the most important parameters that will strongly aid the CCS development is the issue of financing. According to Natalia Kulichenko-Lotz (2010), conventional Financial Instruments for Energy Sector include: Loans, equity, guarantees and debts. All these have to do with finance. Developing countries more especially, have a lot of uncertainties with respect to the viability and sustainability of CCS projects. The issue of financing constitutes the greater percentage of such uncertainties. According to the South African Centre for Carbon Capture and Storage, Financing is one of the key issues for CCS deployment in South Africa because even if a huge effort on preparatory work is done and with a strong support for CCS, nothing will happen without adequate funding. There are two distinct requirements regarding funding: Firstly, funding for demonstration projects and other preparatory work such as regulatory framework, national human and technical expertise; Secondly, longer-term and larger-scale funding for the deployment of CCS. None of these seems to be adequate in most developing countries.

The African Development Bank (AFDB) Boards of Directors have authorized the signing of financial procedures agreements with the International Bank for Reconstruction and Development acting (IBRD) as the trustee of the two Climate Investment Trust Funds (CIFs): the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF) in Tunis, 20th September, 2010. Through the AFDB, the CIFs will be channeling approximately US$625 million for clean technology projects. The Bank will blend these funds with its own resources to support several large-scale renewable energy projects, including Morocco's 500MW solar power complex in Ouarzazate; the Egyptian 200MW wind farm and transmission infrastructure on the Gulf of Suez; and an IFC and the AFDB joint initiative that will target two to three commercial private banks or financial

leasing companies in South Africa for on-lending of funds for renewable energy and energy efficiency investments. The AFDB is also supporting nine other African nations selected by CIF governing bodies - Mozambique, Niger, Zambia, Ghana, Burkina Faso, DRC, Ethiopia, Kenya and Mali - to develop investment strategies and projects promoting innovative approaches to climate resilience, sustainable forest management and small-scale renewable energy supply system, particularly in areas where on-grid, centralized energy supply systems are not cost-effective (African Development Bank Group, 2010).
Furthermore, Richard Zechter, Coordinator of the World Bank's Carbon Partnership Facility, stated that the World Bank has relationships with developing country governments based on assistance programs. The World Bank is working to help these countries meet their energy requirements in sustainable way through lending operations and technical assistance. The World Bank has also developed risk insurance programs that could have relevance for CCS financing and risk (Carbon Sequestration Leadership Forum, 2009). With all these glad tidings to the developing nations, how committed are the nations towards carrying out CCS projects? This rhetorical question and many others prompted the authors of this paper to review the current status of the subject matter. The article looks into the prospects and problems of CCS financing in the developing countries and suggest some possible solutions to the problems. This is in order to motivate the countries on the significance of the CCS projects in achieving the CDM objectives by the year 2050.

1.1 CARBON FINANCE

Africa makes little use of carbon finance mechanisms on offer for investment in the renewable energy sector. This has been due to combination of financial and capacity barriers encountered by investors. These barriers range from high start-up cost of project development, to limited funding sources, to high risk perception (NEPAD-OECD, 2009). Of all the carbon finance mechanisms on offer today, the CDM has been the most prominent in reducing CO2 emissions in several developing countries. While financial and softer energy crisis caused a dip in the value of CDM transactions in 2008, the CDM market remains an important and useful mechanism for investing in mitigation activities in developing countries and a significant source of finance to help promote sustainable development (UN economic commission for Africa, 2009).

CDM is a project based mechanism and generates certified emission reduction credits (CERs). Credits may be gained through emission reduction, such as through investment in carbon sequestration. These credits may then be used to either achieve regulatory platform or else traded on the international carbon market using the emission trading mechanism (NEPAD-OECD, 2009).

More and more countries will look for cost-effective alternatives to achieve emission reduction, and carbon sequestration is certainly one of them. However, Africa still lags in international carbon market in contrast to other developing regions like Asia and Latin America where such markets are already developed. This section looks at possible reasons for slow growth in Africa and how investment in carbon market can be improved.

2. PROSPECTS OF CARBON FINANCING IN DEVELOPING COUNTRIES

2.1 Recycling C02:

C02 can be recycled into other useful materials such as hydrocarbon, sodium carbonate, sodium bicarbonate and Hydrogen gas. The compressed captured CO2 can be processed by chemical reactions to produce other useful and marketable gases. In 2002, at the Industrial Chemistry Conference in new Burinwick, New Jersey, Nakamichi Yamasaki of the Tokushima Industrial Technology Center in Japan says he has a process that makes propane and butane at relatively low temperatures and pressures. The work suggests that CO2, the main greenhouse gas, could be recycled instead of being pumped into the atmosphere. Yamasaki has used hydrochloric acid as his source of hydrogen ions. If Yamasaki's technology can make heavier hydrocarbons such as petroleum, then we can say that CO2 is no more a problem if we can process it properly, because at least we can recycle it to obtain useful products. Therefore, apart from preventing the emission of CO2 to the atmosphere we can also benefit from it.

And of recent, Surendra Sexena, a Professor of Mechanical and Materials Engineering at Florida International University has patented a new method of creating cheap hydrogen from coal, reacting the CO2 (produced from the coal combustion) with inexpensively available sodium hydroxide to produced sodium carbonate, sodium bicarbonate and Hydrogen gas which can all be sold. Mr. Sexena has calculated that, sodium hydroxide is about $100 to $ 200 per ton and sodium carbonate can be sold for $100 per ton. This will enable hydrogen to be produced below $0.16 per kg, not including cost of energy (Kaisan et al, 2010).

World Bank Commitments Towards Carbon Financing In Developing Countries:

Since the first World Bank carbon fund, the Prototype Carbon Fund, was conceived in the late 1990s, carbon finance has entered a stage of maturity after more than a decade of operations. Today, the World Bank manages over $2.5 billion across its 11 operational carbon funds and

facilities, of which more than $1.9 billion is committed. A collaborative and inclusive approach with fund participants, donors, and host countries is a key to the building World Bank carbon finance partnerships. Twenty four governments and government agencies, and 63 private companies from various sectors have made financial contributions to these funds and facilities (goworldbank.org).

The funds and facilities are:

a) The Prototype Carbon Fund (PCF)

b) The Community Development Carbon Fund (CDCF)

c) The Bio Carbon Fund (BioCF)

d) The Netherlands Clean Development Mechanism Facility (NCDMF)

e) The Netherlands European Carbon Facility (NECF)

f) The Italian Carbon Fund (ICF)

g) The Danish Carbon Fund (DCF)

h) The Spanish Carbon Fund (SCF)

i) The Umbrella Carbon Facility (UCF)

j) The Carbon Fund for Europe (CFE)

k) Renewable Energy Enhancement Using CCS

2.2 Renewable energy projects can be enhancing through carbon capture and storage. This will go a long way in helping the developing countries to lower their green house gas emission, gain more carbon credit and enhance their oil reserve. If developing countries would implements joint projects with developed countries under the clean development mechanism (CDM). It would assist them to do away with those factors that may bottleneck the successful implementation of CCS projects, such as long implementation time, inefficient technology, gas leakage from geological storage and high capture and storage cost (Galadima and Garba, 2009).

Clean Development Mechanism is an agreement under Kyoto protocol which stimulates sustainable development and emission reduction while giving industrialized countries some flexibility on how they meet their emission reduction limitation targets. The CDM allows emission reduction projects in developing countries to earn Certified Emission Reduction (CER) credits, each equivalent to one ton of CO2. The CERs can be traded, sold and used by industrialized countries to meet part of their emission reduction target under Kyoto protocol. The Mechanism has registered over 1000 projects and is expected to produce more than 2.7 billion tons of CO2 equivalent in the first commitment period of Kyoto protocol from 2008-2012. A CDM project activity may involve for example, a rural electrification project, using solar panels or the installation of more energy efficient boiler (Kaisan et al, 2010).

CO2 as a Means of Enhancing the Recovery of Fossil Fuel

The recovery of fossil fuels through CO2 is one of the most important prospects of CCS. This is in phases:

- CO2 Enhance Oil Recovery: CO2 is currently a means of enhancing oil recovery, injecting CO2 to enhance the recovery of fossil fuels has been applied for almost three decades and shall be considered an established technology and also it can generate revenues that offset all or part of CO2 capture and transportation costs. In the US only CO2 EOR oil production amounted to 206 thousand barrels per day in 2003 (Moritis G, 2004). This is equals to the 31% of total US enhanced oil recovery, or about 0.25% of global oil production.
- CO2 Enhance Gas Recovery: Using CO2 for enhanced gas recovery (EGR) is a speculative method for re-pressurizing depleted gas fields that can be applied to certain fields when 80-90% of the gas has been produced. Although target reservoirs for CO2 sequestration are depleted in methane with pressures as low as 20-50 bars, they are not devoid of methane. Additional methane can be recovered by injecting CO2 using EGR (Oldenburg and Benson, 2001). The injected CO2 will flow in the reservoir due to pressure and gravitational effects. Regardless of phase (gaseous, liquid or supercritical) CO2 is notably denser than CH4 at all relevant pressures and temperatures and will tend to flow downwards, displacing the native CH4 gas and re-pressurizing the reservoir (Oldenburg and Benson, 2001). If CO2 is injected at the bottom of a gas reservoir, it will 'chase' the gas toward the top where it can be produced.
- CO2 Enhanced Coal-bed Methane Recovery: CO2 enhanced coal-bed methane (ECBM) is a speculative method for methane (coal gas) recovery from coal seams. While conventional coal-bed methane recovery may achieve 40-50% recovery (close to the wells), the recovery increases to 90-100% in the case of ECBM. Enhanced Coal Bed Methane is limited to coal seams that will not be mined. Although the ECBM can only be applied to coal seams of sufficient permeability. Because of the increasing pressure, the CO2 adsorption increases from 2 mole per mole methane at 700 metres, up to 5 mole per mole at 1,500 metres (Bergen et al., 2000). The coal reserve should not be deeper than 2,000 metres because the increasing temperature limits the methane content

of the coal and the increasing pressure at greater depth reduces the coal seam permeability.

2.1 SOME OF THE EXISTING CCS PROJECTS IN DEVELOPING COUNTRIES

- The InSalah gas CO2 storage in Algeria-According to Fred Riddiford et al, 2006, around 1.2 million tons of CO2 is injected in to the reservoir of Insalah storage every year.
- Kwale Project: The Kwale Project is run in Nigeria by Nigeria National Petroleum Corporation, (NNPC), Nigerian Agip Oil Company ltd and Philips Oil Company Nigeria limited. Total emission reduction generated by the project to date is 791,325 tonnes of CO2.
- Ovade Ogharefe Project. The developer of this CDM project is Pan Ocean Oil Corporation, Nigeria. The gas capture began in 2007, and expected to continue for 22 years. The estimated emission reduction for the first ten year period is 25,315,000 tonnes of CO2 eq
- Sleipner and Snohvit projects in Norway
- The Natuna project in Indonesia.

3 PROBLEMS OF CCS FINANCING

Many African countries face political volatility and unpredictable governance system making carbon sequestration investment a risky preposition. Several Sub-Saharan countries are under the grip of a long-term civil strife making international carbon sequestration investment difficult.

In Africa, most rural people are small land holders. Although privately held lands present an opportunity for large carbon sequestration project, sustainable development of poor African communities would require projects to be taken up with small land holders. The prospect of high transaction cost with small-scale projects usually makes these ventures unattractive to investors.

Many African countries lack institutional capacity to recognize, package and promote potential opportunities for funding carbon projects. This is due to the absence of supporting policy and legal frame work. Some countries even lack general awareness about carbon payment processes (Kituyi, 2002).

Most African tenure systems are characterized by the existence of multiple tenures, i.e several users may have access to different resources on the same piece of land (Lund 2000). This can often cause confusion as to whether the land belongs to the group or to a specific individual, thereby making it difficult for the investor to identify the actual service provider. This may lead to insecurity, a big impediment for a long gestation carbon project.

4. POSSIBLE SOLUTIONS

4.1 Governance: Good governance is critical for most market mechanisms to function properly. A stable and well defined regulatory environment is necessary to promote international carbon investment. Considering that most carbon sequestration projects have a long gestation period, any investment is liable to be risky unless backed by long-term economic and political stability.

4.2 Transaction Cost: Design and Formulation of carbon sequestration projects can be simplified thereby encouraging the participation of intermediary organizations with experience in setting up small scale projects.

4.3 Institutional Capacity: Countries should be willing to invest in capacity building. Developing national level CDM/carbon projects in line with national development and poverty reduction strategies will ensure that carbon projects meet the goal of sustainable development for the country and convey a transparent set of project assessment criteria to investors. Investments in capacity building to yield long-term economic gains have been successful in developing countries like Morocco.

4.4 Property Rights and Land Tenure: Tenure security is crucial for implementing carbon sequestration projects. Without clear and defendable rights to land, forest or the sequestration service itself, suppliers cannot make a credible commitment to supply carbon offsets (Gutman, 2003).

5. CONCLUSION

Conclusively, most of the developing countries (Which are mostly Asian and African) are faced with a lot of problems when it comes to the issues of CCS financing. Although the CCS financing has a very high prospect and receives a continuous global attention, problems of governance, transaction costs, institutional capacity and land tenure system are being experienced by the developing countries which create a great barrier for such countries in carrying out CCS projects. The authors made a remarkable effort towards proffering lasting solutions to the problems. Whence, there is a special need for the developing countries to embark fully on Carbon Capture Storage and Processing projects, so as to benefit from the popular global financing systems. Other carbon funds through CDM and UNFCCC will also be useful to the developing countries and hence, they need to maximize their chances of winning all the

stated funds so that they could overcome the barriers, achieve climate mitigation by reducing GHG emission and possibly compete with the developed nations through the enhanced oil and gas recovery.

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