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ScienceDirect

Energy Procedia 4 (2011) 6157–6162

Energy Procedia

www.elsevier.com/locate/procedia

GHGT-10

The Current Status of CCS development in South Africa

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Abstract

The IEA CCS Roadmap highlighted the significance that CCS will need to play in achieving an atmospheric CO_2 concentration stabilization of 450ppm. In the scenario it is based on, CCS will provide approximately 20% of the total CO_2 emissions reductions out to 2050. Achieving this contribution of emissions reductions will require an ambitious CCS growth-path, with 100 projects needed globally by 2020 and over 3000 by 2050. In both 2020 and 2050 the major developing countries, including South Africa will need to contribute to CCS deployment.

South Africa has a heavily coal-dependent economy with 94 % of electricity production coming from coal. In addition to this, South Africa also meets approximately 30% of its domestic fuel-oil demand through the conversion of coal and gas to transportation fuels. The combination of these two factors means that South Africa is as dependant on coal as any country in the world, placing the country as the 13th largest CO_2 emitter in the world. Currently South Africa is experiencing electricity shortages where the reserve margin is below desired levels on a daily basis. Consequently, deployment of electricity generation capacity is seen as a priority. With the slow development of renewable energy and the deployment of nuclear energy currently under review, the required short term increase in electricity production is likely to come from new, coal plant that will be expected to be in operation for 50-60 years, thus continuing the country's dependence on coal for some time to come. At the climate change negotiations in Copenhagen, South Africa announced that it would take nationally appropriate mitigation actions to enable a reduction in national GHG emissions equating to a deviation of 34% below the "Business as Usual" emissions growth trajectory by 2020 and a 42% deviation below the below "Business as Usual" emissions growth trajectory by 2025, pended upon the provision of sufficient funding and technology support. Given all these factors, CCS could be a crucial technology for South Africa in the near future.

This paper looks to discuss the current status of CCS in South Africa. This includes looking at the key outcomes of the recently released South African CCS Research and Development Roadmap and the milestones it outlines, such as the development of a geological storage atlas by 2010, a CO_2 test injection by 2016, and a demonstration project operating by 2020. It also looks at how the South African government is positioned toward CCS, including how CCS fits with the countries priorities of poverty alleviation, economic growth, sustainable development, job creation and ensuring the most efficient use of domestic resources. In addition the paper looks at the manner in which the South African government could go about regulating the operation of CCS projects. The paper will discuss the

doi:10.1016/j.egypro.2011.02.625

options available to South Africa to fund CCS demonstration and deployment domestically including via the clean development mechanism (in the event that the question of using this mechanism in the CCS context is dealt with at the international level), development banks and other, appropriate, development finance institutions. Public awareness and engagement on CCS will also be covered, given the crucial role the public play in the smooth progress of projects. Finally the paper will look at international collaboration on CCS including the role South Africa can play internationally and what more the international CCS community can offer.

Keywords: Carbon dioxide capture and storage; CCS; South Africa; developing country

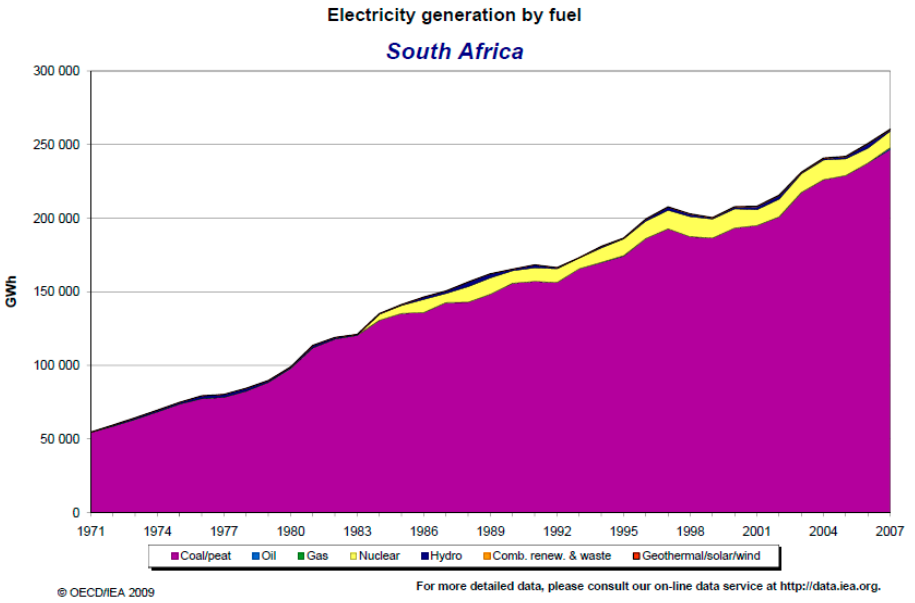
1. Background

The IEA CCS Roadmap highlighted the significance that CCS can play in achieving an atmospheric CO_2 stabilisation of 450ppm. In the scenario on which the Roadmap is based, CCS will provide approximately 20% of the total CO_2 emissions reductions out to 2050. To achieve this contribution it will require an ambitious CCS growth path with 100 projects needed globally by 2020 and over 3000 by 2050. In both 2020 and 2050 the major developing countries such as South Africa will need to contribute to this deployment.

2. South African energy and CO_2 emissions profile

South Africa has a heavily coal-dependent economy with 94% of electricity production coming from coal (Figure 1). In addition to this, South Africa also meets approximately 30% of its domestic fuel-oil demand through the conversion of coal and gas to transportation fuels. The combination of these two factors means that South Africa is as dependant on coal as any country in the world, placing the country as the 13th largest CO_2 emitter in the world.. Currently South Africa is experiencing electricity shortages where the reserve margin is below desired levels on a daily basis. Consequently, deployment of electricity generation capacity is seen as a priority. With the slow development of renewable energy and deployment of nuclear energy currently under review, the required short term increase in electricity production is likely to come from new coal plant that will be expected to be in operation for 50-60 years, continuing the country's dependence on coal for some time to come. At the climate change negotiations in Copenhagen, South Africa announced that it would take nationally appropriate mitigation actions to enable a reduction in national GHG emissions equating to a deviation of 34% below the "Business as Usual" emissions growth trajectory by 2020 and a 42% deviation below the below "Business as Usual" emissions growth trajectory by 2025, pended upon the provision of sufficient funding and technology support. Given all these factors, CCS could be a crucial technology for South Africa in the near future.

Figure 1: South African Electricity Generation by Fuel



South Africa does not have a quantified emissions limitation and reduction obligation (QELRO) under the Kyoto Protocol. However, as the global consciousness about CO_2 emissions and climate change increases, South Africa is endeavouring to demonstrate a responsible approach towards reducing its CO_2 emissions profile. South Africa is, however, a developing country, so as well as CO_2 reductions and climate change mitigation, it's also has a need for poverty alleviation, economic growth, sustainable development and ensuring the most efficient use of domestic resources.

3. CCS potential

During 2009, the South African Centre for Carbon Capture and Storage (SACCCS) was established and completed a CCS Research and Development Roadmap for South Africa that provides a very good summary of the steps toward CCS deployment in South Africa. The CCS roadmap identifies good potential for the deployment of CCS domestically. Key milestones from the Roadmap include: the development of a geological storage atlas by 2010, a CO_2 test injection by 2016, and an operational demonstration project by 2020. To accompany these major milestones, the roadmap also identifies other critical issues associated with the development of CCS. One of the key issues for South Africa, as a developing country, is that of CCS capacity building. South Africa enjoys significant experience in coal production and utilisation, including in the chemical processes required for coal conversion. The country also retains some, albeit limited, experience in oil and gas exploration and production. For successful implementation of CCS, this experience from the oil, gas and coal sectors must be reapplied to CCS development. In addition to this technical capacity, South Africa also needs to build institutional, financial, legal and human capacity. To address these capacity requirements, it is likely that South Africa will require assistance from developed countries, across all these areas.

The South African Carbon Geological Storage Atlas is scheduled to be released during the third quarter of 2010 and will be the first step towards the realisation of the SACCCS vision of a demonstration project by 2020. The Atlas will indicate, at a high level, the potential for the geological storage of carbon dioxide in South Africa. Earlier assessments performed by the (then) South African Department of Minerals and Energy have indicated that South Africa does, indeed, possess geological storage capacity. The Atlas will be the next step in confirming this potential storage capacity and the approach and results are in-line with similar efforts performed in other countries. Based on the results of the Atlas, funding needs to be obtained to progress the work beyond the desktop study stage to include site selection and appraisal phases.

Two of the largest CO_2 emitters in South Africa are Eskom, the nationally-owned electricity utility, and Sasol, a private oil, gas and coal company that operates South Africa's significant coal and gas to liquids operations. Eskom is a government owned public service entity that generates and distributes approximately 95% of South Africa's electricity. It is also active in the distribution of electricity in areas where such a service is not covered by local authorities. Given that Eskom is state owned, it will act in accordance with government instruction, including with regard to the deployment of CCS. Eskom's current priorities are to increase power supply, contain costs of energy, and obtain funding to build new capacity. Electricity tariffs in South Africa are regulated by the National Energy Regulator of South Africa (NERSA) which would be instrumental in including CCS costs in electricity pricing. Eskom is already active in addressing CCS matters and how such technology would affect its operations.

Sasol is among the largest companies in Africa and is listed on both the Johannesburg and New York stock exchanges. Sasol is in a very energy intensive business, in particular with the coal and gas to liquids operations. This issue is well understood internally by Sasol which has led it to develop a CO_2 management plan and to establish an internal unit dedicated to the development of CCS. Currently energy efficiency improvements are seen as the prime tool for CO_2 reductions within Sasol; however they do see CCS as a very important technology. Sasol has in-house experience in CCS-related processes including significant capacity to undertake its own R&D. As a publically listed company, Sasol is required to obtain buy-in from its stakeholders, the first step of which is raising the awareness about CCS and climate change in general.

PetroSA is a state owned entity involved in gas-to-liquids industry, albeit to a lesser extent than Sasol. Whereas Sasol is located inland, PetroSA is located on the south coast of South Africa and is also nearby depleting off-shore oil and gas fields.

The synthetic fuel industry in South Africa produces around 30Mt of concentrated CO_2 per year, which would be a lower-cost early opportunity application for CCS. Storage from inland sites may be more of a problem with limited large storage opportunities nearby. However, Sasol possess the in-house capability to construct pipelines that would allow it to access storage opportunities farther afield. Sasol also has a significant amount of engineering capacity for technology development and deployment associated with CCS and is also well versed in leveraging international contractors when required. The company also has experience with large, complex plants such as the Secunda coal-to-liquids facility.

The expertise within Eskom, Sasol and PetroSA will be very important in meeting the CCS milestones laid out in the South African CCS roadmap.

4. Financing

Financing is one of the key issues for CCS deployment in South Africa and globally. When discussing funding, there are two distinct requirements; firstly, funding for demonstration projects and other preparatory work and secondly, longer-term, larger-scale funding for the deployment of CCS.

The South African Centre for Carbon Capture and Storage, in its CCS Research and Development Roadmap, has identified a path towards the demonstration of CCS by 2020, with a CO_2 test injection identified for 2016. However, the Centre's five year budget of ≈ZAR 30 million (≈USD 4 million) is unlikely to fully cover the test injection project and so will need to look to additional sources of funding. Internationally funds becoming available for CCS in developing countries from a number of organisations. For the purposes of the initial test injection, such funds may most likely be gathered through a consortium of South African and international contributors. This model has been used successfully for similar projects in the USA and Australia.

For larger CCS demonstration the Industrial Development Corporation of South Africa Ltd (IDC) may be an option to assist with funding. IDC is a self-financing, national development finance institution that was established in 1940 to promote economic growth and industrial development in South Africa. The IDC has experience of funding projects of the scale of a CCS demonstration project, but need to be presented with a strong project proposal for it to be in a position to consider new areas of investment. The IDC is currently looking at different financial drivers that could push CO_2 reduction with or without an agreement at the climate change negotiations in Copenhagen.

Currently, the Clean Development Mechanism (CDM) under the Kyoto Protocol is the only market based mechanism to fund CO_2 emissions reductions in developing (Non-Annex 1) countries that could potentially provide the large-scale funding for greater CCS deployment. CDM works by leveraging funds from developed countries for the reduction of CO_2 emissions in developing countries. CCS is, however, not yet permitted in the CDM although negotiations in this regard are still ongoing. The South African view of these negotiations is that according to the Marrakesh Accords, only nuclear energy should be excluded from the CDM. It is worth noting that including CCS under the CDM is not a key priority for South Africa in the international climate change negotiations.

Without CCS in the CDM or other ways to leverage funds from developed countries, CCS deployment in South Africa is unlikely to progress beyond the demonstration, or even test-injection level.

5. Government and Regulatory Issues

The South African government has stated that they are looking for national CO_2 emissions to plateau between 2020 and 2030. This target is unlikely to be achieved without the application of CCS given the countries dependence on coal. Apart from the Long Term Mitigation Scenarios (LTMS) recently approved by the South African Cabinet, currently there is little detail around how the government intends to meet this target. Such detail is currently under investigation. Moreover, recently introduced 'carbon taxes' are being studied with regard to widening their scope.

Currently, the main focus of the South African government is on job creation. In the case of South Africa, it may therefore be prudent to focus the discussions around CCS, not on financing issues but rather on GDP, growth, and job creation, and in particular low skilled job creation. For this to progress, more understanding needs to occur into the skill level of jobs created by CCS. If CCS creates only highly skilled, technical jobs then government institutions will need a lot of convincing to invest in the technology. This is due to pressure on the government from the public to address other pressing needs within the country such as poverty alleviation and the construction of houses. More research needs to be done into the type of job creation offered by CCS. However, CCS could be seen as job provision, protecting jobs in CO_2 intensive industries and securing energy supply.

As with any country, there are a number of different government departments who will have to be engaged in CCS policy development. A preliminary list includes:

- Energy
- Environment
- Mineral resources
- Science and technology
- Trade and industry
- Labour
- Water
- Treasury
- Public enterprises

The first three departments listed above are considered the most important to the process. There is also a discussion ongoing in South Africa about the creation of a climate change branch under the Department of Environment. The aim of the branch would be to create a more centralised body to look at all issues climate change. This is a process that would be worth following and engaging on CCS at the earliest possible opportunity. There is also the National Climate Change Committee already existing who has kept abreast of CCS activities.

South Africa has implemented a CCS-ready requirement for new coal plant built in the country via the legal regime requiring written environmental authorisation for so-called "listed activities" which have the potential significantly to impact on the environment. This can be seen as a very positive development, however, more details around the expectations of what the notion of CCS-readiness constitutes, are needed.

6. Public awareness

Awareness about CCS is currently very low in South Africa, so will need to be raised significantly before large-scale deployment can occur. When engaging the public about the development of CCS, it is important to communicate the reasons for pursuing the technology. Without an explanation of the benefits, no one would accept the additional cost and risk. It is also important to consider the public opinion of those who are advocating CCS

7. International collaboration

With respect to international collaboration, bodies such as the IEA, IEA GHG, CSLF, and GCCSI (South Africa is a member of the latter three) are very important to South Africa as they can provide both the detailed technical information about the technology as well as an objective voice about the rational and importance of CCS. This international community will need to be drawn on for both technical and financial support for the development of CCS in South Africa.

8. Next Steps

South Africa's extensive use of coal means it could be comparatively far more dependent on CCS than other countries in a carbon constrained world. The challenges to deployment of CCS in South Africa, however, are similar to those elsewhere in the world and include, the need for an early start, how to address the cost of CCS, what regulatory regime would be appropriate, and to build human capacity in this comparatively new industry. South Africa is in a reasonable position to further the development of CCS with very good awareness, interest and buy-in amongst a number of stakeholders in a short period of time. This awareness and buy-in means that South Africa could be considered "country-ready" for CCS, however this readiness needs to be better advertised in order to attract investment from the developed world. South Africa is unlikely to host one of the first large-scale integrated CCS projects, but they could well be candidates for the 18^{th}, 19^{th}, or 20^{th}. To continue to prepare for this, it will be important for South Africa not to replicate what is going on around the world but rather leverage the work being done by organisations such as the IEA, IEA GHG and GCCSI.