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Renewable energy in South Africa: Potentials, barriers and options for support

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ABSTRACT

The challenge of transforming entire economies is enormous; even more so if a country is as fossil fuel based and emission intensive as South Africa. However, in an increasingly carbon constrained world and already now facing climate change impacts South Africa has to reduce greenhouse gas emissions intensity soon and decidedly. The South African electricity sector is a vital part of the economy and at the same time contributes most to the emissions problem. First steps have been taken by the South African government to enhance energy efficiency and promote renewable energy, however, they fail to show large-scale effects. This paper seeks to identify the relevant barriers to renewable energy investments and, based on experience from other countries, provide policy recommendations.

The major barrier identified in the paper is based on the economics of renewable energy technologies, i.e. their cost and risk structures, two main factors in investment planning. As a solution, the South African government introduced several renewable energy support measures, such as a feed-in tariff. The paper discusses the potential and possible shortcomings of this and other existing support schemes and identifies complementing measures on a national scale.

1. The challenge

Climate change is one of this century's most serious problems. The Fourth Assessment Report of the Intergovernmental Panel on Climate change (IPCC) points to human activity as one of the major causes of global warming. Business as usual may lead to a disastrous transformation of the planet, and recent scientific findings emphasize the growing urgency of reducing greenhouse gas emissions (Meinshausen et al., 2009).

The parties to the climate negotiation process under the UN Framework Convention on Climate change (UNFCCC) are struggling to find an agreement that may prevent dangerous climate change. Yet the emission reduction proposals on the negotiating table are not strong enough to ensure that global warming stays at a manageable level. Rapid and substantial emission reductions are vital, and they require a global structural change, mainly in the energy sector.

Most past emissions have stemmed from the energy sector in high-income countries. Less than 25 per cent of cumulated emissions have been caused by developing countries (Stern, 2007, 175).[1] However, in recent years, the developing countries' share of global emissions has been rising. In 2000 they already accounted for about 55 per cent of yearly global greenhouse gas emissions (WRI, 2009). High economic growth in some of these countries has led to quickly rising energy demand. As this demand has been satisfied mostly by fossil fuels, emissions have also been rising. Estimates predict a continuation of this trend unless the energy sector, and especially electricity generation, is converted to using low-carbon technology. In a business-as-usual scenario put forward by the International Energy Agency (IEA) global energy-related emissions will rise by 45 per cent between 2006

Abbreviations: ANC, African National Congress; BMU, Bundesministerium für Umwelt Naturschutz und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety); CAIT, climate analysis indicators tool; CDM, Clean Development Mechanism; CSP, concentrating solar power; DEAT, South African Department of Environmental Affairs and Tourism; DLR, Deutsches Zentrum für Luft- und Raumfahrt; DME, South African Department of Minerals and Energy; DNA, Designated National Authority; GDP, gross domestic product; HFC, hydrofluorocarbon; IEA, International Energy Agency; IPPs, independent power producers; IPCC, Intergovernmental Panel on Climate Change; LTMS, Long-Term Mitigation Scenario; MW, megawatt; Nersa, National Energy Regulator of South Africa; PV, solar photovoltaic; REFIT, Renewable Energy Feed-In Tariff; SABS, South African Bureau of Standards; UNDP, United Nations Development Programme; UNEP, United Nations Environment Programme; UNFCCC, United Nations Framework Convention on Climate Change; USD, US dollar; US EIA, U S Energy Information Administration; WRI, World Resources Institute; ZAR, South African rand

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[1] Stern (2007) defines the group of developing countries as equivalent to Non-Annex I parties to the Kyoto Protocol. To achieve comparability, this definition shall be kept in the following.

and 2030 (IEA, 2008b, 11). Almost all of this increase (97 per cent) is expected to occur in non-OECD countries, mostly due to greater use of coal.

Even though the contribution of South Africa to total global emissions is still moderate (1.1 per cent in 2005), its per capita emission rate of 9 tonnes CO_2e per person in 2005 was above the global average of 5.8 tonnes and more than six times higher than the sub-Saharan average of 1.4 tonnes (WRI, 2009).[2]

At the same time, the lack of access to energy and the consequent restrictions to development remain major challenges. In 2004, 28 per cent of South African households were not electrified. The government aims to achieve universal access by 2012 (Eskom s.a.). However, in the past enhanced energy access has always been linked to rising emissions. The challenge therefore lies in decoupling energy and greenhouse gas emissions so that more widespread energy use and decreasing emissions can be achieved simultaneously. The deployment of low-carbon technologies[3] on a massive scale must be part of the solution.

Part of the funding for these massive investments may come from public sources. However, as public resources are scarce they must be used wisely to leverage additional private funding. Furthermore, they must be accompanied by appropriate policy frameworks to create markets for low-carbon technologies.

This paper seeks to analyse South Africa's domestic options for a low-carbon development path by examining the prospects for renewable energy markets. It is arranged as follows. Section 2 discusses the impact of climate change on South Africa and thus its motivation to join in the global effort to reduce greenhouse gas emissions. Section 3 lays the foundations for the analysis by illustrating the structure and sources of South African emissions. Section 4 focuses on electricity generation as the sector accounting for the largest share of total CO_2 emissions. Section 5 explores and evaluates measures to reduce emissions in the electricity sector through the promotion of private investment in renewable energy. A discussion of the need for further action and policy recommendations in Section 6 complete the analysis.

2. South Africa in the face of climate change

Africa is regarded by the United Nations as one of the continents most vulnerable to the impacts of climate change as a consequence of its high dependency on agriculture, the water stress from which it already suffers and its weak adaptive capacity (IPCC, 2007, 435). The likely impacts are numerous, ranging from changes in water availability and extreme weather events to sea level rise and adverse health impacts.

However, the impacts of climate change differ in the various African regions. In South Africa, water supply is a particularly vulnerable area with respect to climate change. Even without climate change, South Africa might utilise most of its surface water resources within a few decades (DEAT, 2005). Climate change is likely to intensify water scarcity, increase demand for water and lead to deterioration of water quality. Desertification may thus be exacerbated. This is already a widespread problem in the country, much of South Africa being arid and subject to droughts and floods. Agricultural output, which needs to increase to meet the needs of a growing population, can be expected to decline unless corrective measures are taken.

According to World Bank estimates, agricultural yield losses of up to 20 per cent can be expected in South Africa (World Bank, 2009, p. 145). As a consequence of the expected decrease in river flows, the areas suited for the country's fauna and flora may shrink to about half of their current size, resulting in huge losses of biodiversity. This may in turn affect tourism, which contributes as much as 10 per cent of South African GDP, the potential economic loss thus being considerable (Turpie et al., 2002, iii). Climate change can further be expected to have an adverse effect on health in South Africa. The higher temperatures may cause an increase in the occurrence of skin rashes, dehydration and death due to heat strokes. Moreover, temperature rises and changes in rainfall patterns will enlarge the breeding grounds for diseases such as malaria and bilharzia, leading to a higher proportion of deaths, higher treatment costs and a greater loss of earnings (DEAT, 2005).

In addition, the adaptive capacity of large sections of the South African population is low. According to the United Nations Development Programme, 43 per cent of the population still live on less than USD 2 per day (UNDP, 2008, 34). The majority of the poor live in rural areas and rely on agricultural incomes (Mbuli, 2008, 4), which are sensitive to changes in weather patterns likely to occur as a result of global warming. The low saving capacity of poor households and the frequent lack of access to financial services mean limited financial reserves for use in the event of a bad harvest. If households are forced to sell income-earning assets to survive a bad year, they can fall into extreme poverty.

3. South Africa's contribution to climate change

South Africa is already being affected by global climate change, and the impacts will intensify in the coming decades. However, it is also a contributor to global greenhouse gas emissions. In 2005, it was responsible for about 1.1 per cent of global emissions and about 40 per cent of emissions in sub-Saharan Africa (WRI, 2009). At an average of 9 tonnes CO_2e per person in 2005, the per capita emission rate almost equalled the average per capita emissions of 10.7 tonnes in the European Union. The validity of average values is, however, limited. As in many developing countries, the distribution of available income and thus household expenditures is highly uneven in South Africa (see Fig. 1). It is likely that expenditures on energy and thus emissions follow a similar distribution pattern.

As incomes rise and the South African government continues its attempts to provide universal access to electricity, emissions intensity is expected to increase, at least if the current carbon intensity of electricity production is maintained. At about 850 g CO_2/kWh, the South African average is nearly twice as high as in the industrialized countries. CO_2 consequently accounts for the largest proportion of total greenhouse gas emissions in the country (about 80 per cent), and it stems mainly from electricity production (WRI, 2009). Reasons for this high emissions intensity are discussed in the analysis of the South African electricity sector in the following section.

4. The electricity sector

4.1. Structure of the South African electricity sector

The sector is dominated by Eskom, a state-owned enterprise. Eskom not only produces almost all of South African electricity (95 per cent), but also owns and operates the national transmission system. Only about 2 per cent of South African electricity is produced by private companies.

[2] Including emissions of CO_2, CH_4, N_2O, PFCs, HFCs and SF6. 2005 data on emissions from land-use change and forestry are not yet available.

[3] As this paper focuses on renewable energy, the use of the term "low-carbon technologies" seems appropriate. However, the deployment of technologies that reduce the emission of greenhouse gases other than CO_2 is also important.