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The rise of Renewable Energy implementation in South Africa

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Abstract

As the seventh coal producer in the world, around 77% of South Africa's electricity is generated from coal resulting in a high level of environmental degradation. South Africa's per capita greenhouse emissions are the highest in Africa. Besides, centrally generated power is not able to reach the remote areas because of the lack of distribution infrastructure. South Africa has a large potential for both, solar and wind power generation, with smaller potential for biomass, landfill gas and hydropower. Our focus in this paper is the solar and wind energy implementation in South Africa. With an average of 2,500 hours of sunshine per year, and 4.5 to 6.6 kWh/ m² of radiation level, South Africa is among the top three in the world. The total wind power potential of South Africa is estimated to be 6,7000 GW, and is found to be competitive with the solar potential. The Government of South Africa, Department of Energy, and the National Energy Regulator of South Africa have developed policies and projects for the procurement and implementation of renewable energy to supplement its fossil fuel based production for greater sustainability and diversification in energy sourcing. In turn the provincial and municipal leadership have produced their own strategies to instigate sustainable energy usage. The Renewable Energy Independent Power Producers Procurement Program (REIPPPP) has allocated to over 92 Power Producers to injecting over 6,300MW of power into the power grid, mainly from solar and wind generation. The embracing of green energy has led to reduction in energy production costs, job creation, foreign investment and buy-in from local stakeholders. These projects are often located in rural areas, impacting local communities through job creation, development and improved quality of life. However, a number of impediments still need to be addressed as South Africa assimilates this new industry.

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1. Introduction

Republic of South Africa is the southernmost country on the continent of Africa, lying between latitude 22° to 35° S, and longitude 17° to 33° E (Figure 1) [1]. South Africa is an upper-middle-income economy. It accounts for 24 percent of Africa's gross domestic product (PPP). It is the world's largest producer of platinum, and a major producer of gold, and chromium. Mining, automobile assembly, textile, iron and steel, chemicals, fertilizers, ship repair, and food production and processing are the main industries [2].

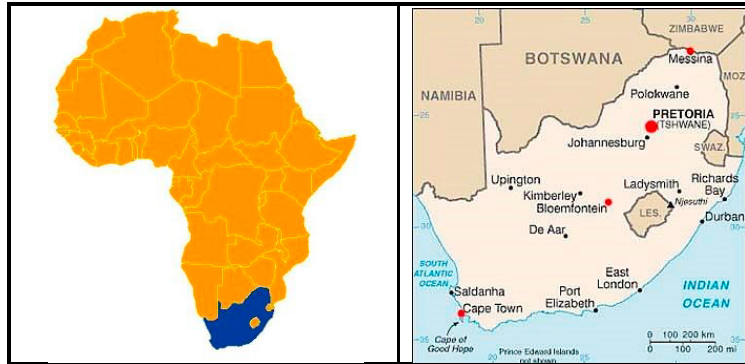


Figure 1: Location of the Republic of South Africa in the African continent [1].

1.1. Infrastructure, scientific and industrial development in South Africa

During the apartheid era from 1948 to 1994 a large number of countries imposed travel and trade sanctions on South Africa, boycotted scientific and technological exchange, and disinvestment by foreign investors. Despite isolation, South Africa is the most developed country in Africa. This includes infrastructure, roads, highways, express ways, communication, health, education, food production, and scientific and technological development. South Africa is amongst the top ten world producers of, grains, cereals, maize, oil seeds, fruits and vegetables, sugar cane, sisal and fiber crops. According to the African Universities Ranking, first seven, and 12 of the top 15 are the South African Universities [3]. On science and technology front South Africa initiated nuclear program in 1970, and produced six deliverable nuclear weapons within a decade, a nuclear power generation plant was erected, and nuclear medicines and their delivery systems were developed. South Africa has given eleven Nobel laureates to the world of whom eight received the prize during the apartheid era including two in medicine and one in chemistry. However, the remote and rural areas, home to the African majority population remained underdeveloped and poor. In 1990 the minority Government slowly began to soften its apartheid stance which was completely dismantled in 1994, and the country saw the black majority democratic rule for the first time in April 1994. Some of the ills of apartheid era began to be rectified by the majority government since 1994 by redistribution of land, offering preferential job opportunities and places in educational institutions to people from the disadvantaged communities.

1.2. Coal based energy scenario in South Africa

South Africa is the 7th largest producer of coal, and the 5th largest coal exporter in the world. Over 77% of energy needs of the country are derived from coal most of which is used for power generation. In 2014, 232 Twh of electricity was generated from coal (2.3% of world's coal power generation), making South Africa the 6th largest producer of electricity from coal [4]. Coal mining and use impacts negatively on all three elements of environment namely land, water and air. At 437.37 Mt of CO_2 emissions annually, or 8.10 t CO_2 per capita per annum, South Africa's greenhouse emissions are the highest in Africa.

Although, the national electrification rate stands at about 75%, highest in Sub-Saharan Africa, only 55% of rural population has access to electricity compared to 88% in urban areas [4] [5]. Low access to electricity has resulted in lack of industrial development, lack of opportunities for employment, low education level, persistent poverty and

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