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## Green growth in oil producing African countries: A panel data analysis of renewable energy demand



Ishmael Ackah, Renatas Kizys\*

University of Portsmouth, Portsmouth Business School, Subject Group of Economics and Finance, Richmond Building, Portland Street, Portsmouth, Hampshire PO1 3DE, United Kingdom

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## ABSTRACT

Renewable energy has been considered as the solution to the hydra-headed problems of energy security, energy access and climate change, especially in Africa. In addition, renewable energy sources, such as the sun, wind, wave and waste abound in Africa are in need of investment. In order to provide both policy and investment guide, this study investigates the drivers of renewable energy demand in oil-producing African countries. Three panel data models – a random effect model, a fixed effects model and a dynamic panel data model – are used to estimate renewable energy demand with a comprehensive set of determinants. The estimation results indicate that the main drivers of renewable energy in oil-producing African countries are real income per capita, energy resource depletion per capita, carbon emissions per capita and energy prices. The study recommends that policies should encourage the consumption of commercial sources of renewable energy to attract the needed investments.

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## 1. Introduction

Economic growth has long been considered a solution to unemployment, poverty and equity issues [6] making growth the ultimate goal of every economy. This is because economic growth

enhances the standard of living and aids the development of human capital. It has further been established that energy is a key determinant of economic growth [36]. According to Stern and Cleveland [36], energy is the pivot on which the wheels of society turn. Energy facilitates heating, lighting, transport, and the transformation of inputs into outputs. Thus, energy is a key factor for economic development. This means that energy challenges such as the oil price crises in 1973 and 1979 and 2008, climate change and potential depletion of fossil energy sources, present an

\* Corresponding author. Tel.: +44 2392 844635.

E-mail addresses: [ishmael.ackah@myport.ac.uk](mailto:ishmael.ackah@myport.ac.uk), [ackish85@yahoo.com](mailto:ackish85@yahoo.com) (I. Ackah), [renatas.kizys@port.ac.uk](mailto:renatas.kizys@port.ac.uk) (R. Kizys).

opportunity to the World to reflect and consider energy issues since they could be a limiting factor to economic growth.

Coupled with these factors, energy access has been a critical challenge to economic development in Africa. Access to modern form of energy is necessary, and a requirement for development since energy has been found to be a key factor of production. However, in Sub-Saharan Africa (SSA), just 31% of the population access to modern energy [14]. Out of about 1.4 billion people without access to energy globally, 15% are in SSA. Out of the 587 million people without access to electricity in Africa, 585 million are in SSA. Can one imagine London or New York without electricity for one hour? That will be disaster! Many businesses will come to halt and many will become inefficient without energy. This makes the use of energy indispensable. These statistics therefore threaten sustainable development, may hinder development and prevent many countries from achieving the Millennium Development Goals. The World Bank [41] finds a strong correlation between electricity access and reduction in poverty. The study also indicates that efficiency and clean energy are crucial to the reduction of poverty and essential for economic growth, particularly in rural areas. For instance, business activities, including opening of cold store to sell fish, selling chilled water and drinks, night-time sewing and hair dressing can be undertaken in rural areas when there is access to electricity. These activities increase employment, income and overall development of the area.

This notwithstanding, energy use has negative environmental consequences. The World Resource Institute estimates that 61.4% of global greenhouse emissions emanate from energy consumption. Thus, any solution that reduces the negative effect of energy consumption should include investment in cleaner and reliable sources of energy to allow energy to play its role in the economy without endangering the environment. Hence, two key forms of energy – energy efficiency and renewable energy consumption – stand out.

Renewable energy such as wind, solar, geothermal, wave and waste have the advantage of being carbon-neutral and non-depletable [34]. Renewable energy therefore becomes the solution to the recent concerns of energy security, sustainable development and climate change for three reasons. First, renewable energy sources abound in Africa and can continually supply energy over a long term if developed. Second, renewable energy can aid the provision of modern energy to rural areas and other places that are difficult to be reached by the electricity grid. Third, renewable energy can help to offset the proportion of foreign exchange that is used to import oil. In order to enhance sustainable energy supply, there is the need to invest in renewables whilst curbing the use of fossil fuel. This calls for a forced choice between fossil fuel and renewable energy. However, this choice can have environmental, investment and growth consequences.

Global investment in new renewable capacity increased to USD 120 billion in 2008 [31]. Annual percentage gains for 2008 also show significant achievements in all types of renewable energy, especially the grid connected solar photovoltaic capacity, which grew by 70%. In addition, wind power grew by 29%, solar hot water increased by 15%, and small hydro expanded by 8% [12]. Notably, such investments usually take place in developed economies, such as the European Union. By contrast, the major forms of renewable energy consumption in Africa are biofuels and waste [14]. These traditional and typically unprocessed renewable forms of energy consumption comprise wood fuel, charcoal, animal waste and agricultural residues [22]. They trigger both health and environmental effects, such as respiratory diseases, degradation and deforestation [20]. There is the need to harness the modern forms of renewable energy to curb these problems. According to Deichmann et al. [11], Africa has a renewable energy potential in the

form of abundant sunshine all year round for solar energy, river and water bodies for hydroelectric dams and wind energy potential. Karekezi et al. [21] found that only 7% of Africa's hydro potential is harnessed. Since renewable energy investments require huge capital outlay, the drivers of renewable energy need to be examined to guide policy design.

Africa features 1.1 GW hydropower capacity, 900 MW of geothermal potential, abundance wind and solar potential [24]. To transform these potential energy resources into energy supply, there is a need for both private and public investments in the sector. This calls for studies that aid renewable energy policy designs and help to make investment decisions in the sector. Unfortunately, few studies have been conducted on renewable energy in Africa. For instance, Bugaje [8] reviews renewable energy policies of Egypt, Mali, Nigeria and South Africa and finds that (i) the use of fuel wood can create environmental damages, and (ii) Africa has the potential of harnessing the renewable energy potential given the right investment and human capital. Karekezi and Kithyoma [23] suggest that for Africa to harness its renewable energy potential there is the need for long term planning and financing.

This study contributes to the literature on energy in four main ways: first, we attempt to fill both the literature and policy gap by investigating the impact of energy resource depletion on renewable energy consumption in oil-producing African countries. The inclusion of energy resource depletion allows assessing whether the potential depletion of fossil fuels has effect on the amount of renewable energy consumed. Second, the effect of energy-related carbon emissions on renewable energy demand is evaluated. That is, since carbon emissions in Africa can be attributed to several factors such as bush burning, farming activities and energy consumption, it is prudent to distinguish the effect of energy related emissions on renewable energy consumption. Third, by means of a dynamic panel data model, the effects of past values of renewable energy demand on current consumption are assessed. The study further employs a one-way random effects and fixed effects models with instrumental variables. Fourth, a distinctive feature of the study consists of using a comprehensive set of determinants of renewable energy demand.

This paper is organized as follows. Section 2 provides a review of the existing literature on the determinants of renewable energy demand and looks at the relation between renewable energy and sustainable development in Africa. Section 3 summarizes the data and outlines the methodology. Section 4 presents and analyzes research findings. Section 5 concludes and provides policy recommendations.

## 2. Literature review

The need to control the environmental effects of energy consumption and enhance energy security has led to the design of renewable energy policies. An example is the 20-20-20 policy of the European Union, which seeks (i) to reduce greenhouse emissions by 20% (relative to the 1990 level), (ii) 20% improvement in energy efficiency and (iii) increase the share of renewable energy in the energy mix to 20% by 2020. Due to such policies, there has been a gradual increase in studies on the factors that influence renewable energy in Europe in particular and in the developed countries in general. The data envelope analysis is applied to 45 economies by Chien and Hu [10] to analyze the effects of renewable energy on the technical efficiency of 45 economies over the period 2001–2002. They find that an increase in the use of renewable energy improves an economy's technical efficiency while an increase in the use of traditional energy (fossil fuel) decreases technical efficiency.

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