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On the path to sustainability: Key issues on Nigeria's sustainable energy development

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ABSTRACT

In the face of scarcity of energy resources and rising energy prices due primarily to a world of increasing demand, energy security concerns becomes more crucial both for private and public sector alike. At the same time, energy policies have been shifting and policy changes have become hard to predict because of radical changes in energy supply. This paper analyzes the barriers to sustainable energy development in Nigeria which are: (1) cost and pricing barriers, (2) legal and regulatory barriers, (3) market performance barriers. It concludes by highlighting some key policies that can help address some of the identified barriers in order to ensure a secured sustainable energy future for Nigeria.

1. Introduction

Energy infrastructures materializes through the services it provides us (Shove et al., in press). This simply implies that more energy infrastructure will be required as we embrace more energy intensive practices which then puts pressure on the provision of more services that are energy dependent. Increasing levels of associated costs of providing new energy infrastructure, as well as the complexities associated with making such provisions, makes it imperative that people, organizations, agencies, and governments thread along the path of sustainability transition in energy use (Verbong and Geels, 2010).

Fossil markets are important and will continue to be important. However, we, and particularly the developed world, have gotten addicted to fossil fuels. This is not sustainable for two fairly obvious reasons:

- Fossil fuels are a finite resource and is reserve based. Reserves will necessarily deplete and run out (Höök, 2009).
- Burning fossil fuels increases carbon-dioxide emission which is a major contributor to the climate change crises today (Schock et al., 2007).

In many developing countries, the big challenge is energy access (Kerrigan, 2001). Increasing pressure from both international agencies and the people of most developing countries to improve on energy infrastructure provisions seems to distract the governments in seeking sustainable energy pathways as they plan such provisions (IEA, 2012). As such, many countries end up with inappropriate energy infrastructure mix to satisfy the growing demand for energy.

The energy history and profile of a country is a major factor to consider in assessing their current and future journey towards a sustainable energy path, particularly for developing countries. This is crucial as most countries with fossil fuel resources will necessarily focus on using their available resources to satisfying their energy need and alleviating themselves from energy poverty (OECD/IEA, 2010). The following sections delves into the Nigerian energy profile, the various barriers to developing sustainable energy, as well as some policy directions to address the barriers towards a sustainable energy path.

2. Methodology

Research involves investigating new and innovative aspects of any branch of knowledge. It also involves defining and redefining problems, formulating hypotheses, suggesting solution approaches, and deducing new conclusions. It involves a search for knowledge through an objective and systematic method so as to find solutions to problems or developing a theory (Rajasekar et al., 2006).

Research employs the use of some tools to collect data, which is then analyzed in order to have a better understanding of the problem and help proffer possible solutions or solution approaches. One of such tool is exploratory research tools. Exploratory research tools is used to gather preliminary data which helps to define a problem within a suggested hypothesis. Exploratory research mostly relies on secondary data which could

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take the form of quantitative approach – such as reviewing works in published literature or manual – or qualitative approach – such as informal discussions with target participants. Exploratory research can take other formal approaches such as: case studies, in-depth interviews, pilot studies, or focus groups (Kothari, 2004).

This paper uses exploratory research tools for data collection from already published statistical reports to analyze the Nigerian energy profile with specific focus on: historical energy production and consumption trends; trends in fossil fuel use for electricity generation; and issues around energy resource vulnerability, with the view of understanding the link to the current barriers towards achieving a sustainable energy future. Data from different sources such as the US Energy Information Administration, British Petroleum Statistical Review on World Energy, among other documents were used for the analysis of the Nigerian sustainable energy barriers.

3. Nigeria's energy profile

This section delves into different aspects of the Nigerian energy profile. It covers the aspects of the steady growth in energy production and consumption since the 1970s; the increased use of fossil fuels for electricity generation from the limited primary energy sources; and the increased vulnerability of the limited energy resources.

3.1. Energy production and consumption since the 1970s

Since the 1970s, there has been tremendous growth in energy exploration and production in Nigeria with crude oil being the most explored. However, the fastest growing energy resource with regard to production is natural gas. Fig. 1 shows a graph of the historical energy production in Nigeria as released by the United States Energy Information Administration (EIA). The graph highlights the heavy reliance on fossil fuels for satisfying the Nigerian energy requirements (EIA, 2015) with hydropower being the largest renewable energy source.

Fig. 2 shows a graph of the growth in consumption of the various constituents of crude oil. This is a clear indication of the over-reliance on fossil fuels (particularly crude oil) for secondary energy provision. Some sectors such as: transport, electricity generation, and residential use, are major contributors to the uncontrolled growth and heavy dependence on crude oil and their constituent by-products.

Since energy sources from fossil fuels are reserve based, continuous exploration, production, and use is bound to cause a downward movement of the amount of the available reserves. Inasmuch as Nigeria's exploration activities has led to the discovery of new energy fields (thus, increasing the reserves) it is imperative that continuous excessive exploration, production and use is not sustainable. As such, there is need to look out for alternatives. Fig. 3 shows Nigeria's crude oil production and reserves as released by the British Petroleum Statistical Review of World Energy. Fig. 4 shows the Nigeria's oil and gas fields.

3.2. Increased use of fossil fuels for electricity generation

The chart in Fig. 5 shows the increased dependence on fossil fuels for electricity generation. This trend, however, still continues. Policy direction by the Nigerian government points towards encouraging the use of gas fired power plants due to the availability of natural gas and the high natural gas reserves. This will only cause a shift from the use of biofuels and waste to natural gas for electricity generation as shown in Fig. 6.

3.3. Increased vulnerability of energy resources

Vulnerability is a very important issue within the Nigerian energy resource context. There have been varying degrees of susceptibility to the various effects of activities in the Nigerian energy extractive industry. This includes crude oil and natural gas pipeline vandalism, gas flaring, unrest among youth groups in the energy producing regions, among other interconnected factors (Osuoka, 2005). Fig. 7 gives a breakdown of the number of incidences of pipeline vandalism in Nigeria between 2002 and 2011, while Fig. 8 provides a breakdown of the world's top gas flaring nations of which Nigeria is a part.

Following careful consideration of the various aspects of the Nigerian energy profile, the following sections delves into the key barriers that pose a threat to the effective development of a sustainable energy pathway for Nigeria.

4. Key barriers to Nigeria's sustainable energy development

Sustainability and saving energy is important as we need to safeguard the future both for our planet and for the upcoming generation. To move on the path to sustainability, we can either go for energy supplies that has no carbon release, or find ways to use less energy. Energy sustainability barriers has evolved in various ways. Some of them come in the forms of attitudinal, legal, regulatory, market, and/or financial barriers (Beck and Martinot, 2004). This section describes the three major barriers affecting the transition to sustainable low-carbon energy system in Nigeria.

4.1. Cost and pricing barriers

Cost and pricing barriers within the Nigerian context manifest in the following ways:

I. *High initial capital cost*: Required investment cost for new energy infrastructure, as well as infrastructure upgrades can be quite high as most investors are faced with one of two challenges:
   a. *Highly dilapidated existing energy infrastructure*—in which case cost of revamp and upgrade tend towards the high side.
   b. *Unavailable infrastructure*—which makes the initial cost of investment high. At this stage, the cost of planning, design, routing, siting location(s), etc. add up to the high initial cost.

II. *Difficulty of fuel price risk assessment*: Risk assessment of fuel prices and inability to make a fairly accurate forecast (with some acceptable tolerance levels) are major factors contributing to the initial high cost of investment. They come in two forms:
   a. *Inconsistency in supply*—caused by activities of vandals of fuel (oil and gas) pipelines and associated infrastructure.
   b. *Fluctuations of oil prices*—which are functions of other external forces such as crude oil price benchmarking set by the Organization of Petroleum Exporting Countries (OPEC). Other external market forces that affects fuel prices include: market demand and supply, market abuse—in which case some players in the market tend to do things or carry out actions that are against the traditional market principles in order to get more business to their favor (Abrams, 2000).

III. *Transmission Cost*. High cost of transmission of generated energy is affected by two main factors:
   a. *Insufficient transmission infrastructure*.—The current Nigerian electrical transmission infrastructure was last upgraded in the 1980s. With respect to capacity, it is unable to transmit electrical power above 6000 MW (megawatts) consistently. This poses a challenge as any investor in the Nigerian electrical power sector must think of how the generated power will be evacuated. Some possible solution to this is embedded generation.