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A review of the Nigerian biofuel policy and incentives (2007)

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ABSTRACT

Nigeria is blessed with abundant energy resources including crude oil, natural gas, coal and lignite, nuclear elements, wind, solar, biomass, and hydropower, but due to lack of infrastructure the country is experiencing a shortage of electricity, liquid transportation, and cooking fuel. Despite being a major exporter of petroleum, Nigeria relies on foreign nations for the supply of refined products including gasoline, diesel, kerosene, and even LPG. Nigeria planned to reverse this trend by investing in bioenergy. Nigeria biofuel policy and incentives was released in 2007 with the aim of spurring a vibrant bioenergy sector. This article reviewed the Nigerian policy and incentives and found some policy conflicts, gaps and inconsistencies. The Nigerian biofuel policy narrowly classified biofuel to include only bioethanol and biodiesel neglecting other biofuels and energy carriers that are obtainable from biomass. The Nigerian biofuel policy classified the biofuel enterprise as belonging to agro-allied industry, yet the policy mandated the petroleum industry to play a leading role in the establishment of the biofuel sector. The policy inadvertently refer to food crops such as cassava, sweat potato, and maize as cellulosic bio-ethanol feedstocks. These feedstocks are food crops, though are also feedstock for the production of first generation bio-ethanol. Cellulosic (second generation) ethanol is typically produced from non-food crops such as grasses (elephant grass, miscanthus, switch grass), fast rotation crops, wood wastes, etc. The policy did not address the potential food versus fuel conflicts that could arise from the use of food crops as biofuel feedstock. The policy considered the development of transgenic varieties of cassava, sugarcane, sweet potato, and maize without considering the environmental impacts and agronomic impacts of transgenic crops to native species. The Nigerian biofuel policy did not adequately address issues pertaining to technology transfer. In view of the policy gaps and conflict we suggest an upgrade of the policy.

Contents

1. Introduction/background

Nigeria is blessed with abundant natural and energy resources. In terms of fossil fuel resources, Nigeria has a large reserve of crude oil, natural gas, tar sand, coal and lignite. The country has a proven crude oil reserve of over 36 billion barrels. Crude oil is the major source of transportation and cooking fuel in Nigeria. Petrol (gasoline) and diesel are the major liquid transportation fuels obtained from crude oil. Others include aviation fuel for air transportation and kerosene for domestic/household cooking. Nigeria also has a proven reserve of 187 trillion scf of natural gas, which is used to fuel thermal gas power plants and as household cooking fuel, while the rest is flared at the oilfield locations because of inadequate gas gathering and storage infrastructure. Nigeria also has extensive deposits of sub-bituminous coal and lignite [1] with a reserve of 2.7 billion tonnes [2]. Adenikinju [3] estimated that Nigeria has

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4.0 billion tonnes of coal and lignite. Coal used to be the major source of fossil fuel in Nigeria in the early 1900s. Coal, which was discovered in commercial quantities in Nigeria in 1916, was used as fuel for railway transportation, electricity generation, and industrial heating in cement production lines. Due to the conversion of railway fuel systems to diesel and closure of coal power plants during the civil war (1967–1970), the current use of coal for energy is now insignificant [1]. Tar sands, which are estimated as 31 billion barrel of oil equivalent, have remained untapped in Nigeria. Nearly 65% of electricity supplied to the Nigerian national grid comes currently from natural gas fired power plants, while the rest is supplied by large hydropower plants.

Nigeria has a large capacity of renewable energy resources including hydropower, wind, solar, geothermal, and biomass [4]. Nigeria has a capacity of 11,250 MW of large hydropower and 3500 MW of small hydropower. Currently, only 1938 MW of large hydropower is being produced from 3 power plants in Jebba, Kainji and Shiroro, while about 30 MW of small-scale hydropower is generated by NESCO [2]. Beside fuel wood, petroleum (crude oil and gas) accounts for 83.88% of primary energy consumption (liquid fuel and electricity) in Nigeria, while hydropower accounted for the rest 16%.

Several reports suggest that there are radioactive elements in Nigeria including uranium and thorium [5,6]. Thus far, nuclear energy has remained untapped in Nigeria. However, the country planned to construct and commission the first 1000 MW nuclear power plant in 2017, which will be expanded to 5000 MW in 2027. Nuclear energy is beneficial, producing electricity while recycling radioactive elements, but the risk associated with radiation leaks and the management of nuclear wastes, especially spent fuel, is a cause for concern. Experiences from Chernobyl and Japan are still fresh in our minds. Japan is a major victim of nuclear energy. The first and only time nuclear bombs were used was against Japan during the Second World War. Now as a result of the Tsunami of March 2011, nuclear power plants in Japan lost control, melting down and releasing radioactive substances into the environment. Radioactivity levels of over a million times higher than background levels have been reported in the soil, food and water in Japan. If this could happen in Japan, which is one of the most technological advanced nations on earth, then it will be more disastrous if it happens in Nigeria. Nigeria has no experience in nuclear energy; the maintenance culture is generally very poor and the country would therefore be unable to respond effectively in the event of a nuclear disaster.

The non-hydro renewable energy in Nigeria is relatively undeveloped. Wind speed in Nigeria is generally reported as 2–4 m/s at 10 m height [2]. Adekoya and Adewale [7] measured wind speed for 30 locations in Nigeria and reported wind speeds of 1.5–4.1 m/s and power density varying from 5.7 to 22.5 W/m^2, with the northern areas having higher wind speeds than the south. A similar trend was reported by Ojosu and Salawu [8] showing that wind speeds range from 1.0 to 4.1 m/s measured at different heights ranging from 4.56 to 15.2 m. Ngala et al. [9] measured the average monthly wind speeds over 12 months from 1995 to 2004. They reported wind speed in the range of 2.84 m/s (September) to 5.11 m/s (June), while the power density was 13.3–77.66 W/m^2. Although, Adekoya and Adewale [7] consider these speed regimes as being generally weak, Ajayi [10] considers it as great potential with a huge prospect. According to Sambo [11], wind electricity has not been significantly harnessed in Nigeria despite the great potentials. Thus far the only functional wind turbine installed and operated in Nigeria is the 5 kW Sayya Gidan Gada. Nigeria is currently constructing a 10 MW wind power farm in Katsina State which is scheduled for commissioning in 2012. Beside this, engineering design is currently ongoing to install four other 10 MW wind farms in Sokoto, Kebbi, Taraba, and Kaduna states. Nigeria planned to install a total of 200 MW wind power plants [12]. Solar radiation is considered high in Nigeria, ranging from 3.5 to 7.0 kW h/m^2/day but has not been commercially exploited except to power a few devices like street lights and bore holes. The total solar power installed in Nigeria, thus far, is estimated to be <1.0 MW.

Despite all these abundant and diverse energy resources, the energy situation in Nigeria is in crisis. Electricity generation has recently risen to 4000 MW for a population of over 150 million people. Only 40% of the people are connected to the national grid. Because of the insufficient power generation in the country, the power holding company of Nigeria (PHCN), a Federal Government company tasked with the sole responsibility of distributing power in Nigeria, is now embarking on load shedding. The Nigeria electricity performance record is among the worst in the world. The country has the lowest generating capacity factor (20%), the highest rate of distribution losses (33%), the lowest revenue (1.56 cents/kW h), and the lowest rate of return (-8%) among a group of 20 low income and upper income countries [3]. Electricity supply in Nigeria is of low quantity and relatively unstable. In the period 2004–2005, Nigeria recorded 1059 unplanned outages/year, which is about 30 times more than what is obtained in middle income countries. As a result many people rely on self-generated electricity using either gasoline or diesel powered generators. The share of self generated electricity to total electricity generated in Nigeria is 52% compared to <1.0% in middle income countries and 10% in low income countries [3].

Liquid transportation and cooking fuels are similarly constrained by production/refining inefficiencies and product shortages. Nigeria has four refineries, with two located in Port Harcourt while the other two are located in Warri and Kaduna. These four refineries are all operating far below capacities. For instance, in 2008 the capacity utilization for Kaduna was 19.56%, with 38.52% at Warri, and 17.84% at Port Harcourt (old and new) refineries [13]. As a result poor refining capacity, the country is currently importing gasoline, diesel, and kerosene and cooking gas for domestic use. And because of logistical constraints, these products are often in short supply. In order to overcome the constraints of liquid transportation fuels and energy in Nigeria, the country now wishes to invest in biofuels and to create conducive environment for the commencement of a vibrant biofuel industry. Pursuant to an August 2005 government directive on an Automotive Biomass Programme for Nigeria, the NNPC has been given the mandate to create an environment for the take-off of a domestic fuel ethanol industry. The Nigerian Biofuel Policy and Incentives came into effect on 24th July, 2007. The aim is to gradually reduce the nation's dependence on imported gasoline, reduce environmental pollution while at the same time creating a commercially viable industry that can generate sustainable domestic jobs. The aim of this study is to review and appraise the Nigeria biofuel policy (2007), identifying important gaps and suggesting how to improve the policy.

2. Materials and methods

The Nigerian Biofuel Policy and Incentives document [14] was thoroughly reviewed and summarized into tables (Tables 1–10) containing the various themes covered by the policy. The remaining part of the paper is focused on an in-depth analysis of the themes covered by the policy.

3. Results and discussion

Table 1 presents the definition of terms as used in the Nigeria biofuel policy and incentives (2007) document. In this policy,