Chapter 3
Integrated Resource Planning for Efficient Power Supply in Nigeria by 2050:
Future Scenario Approach

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ABSTRACT

Power supply in Nigeria has been epileptic due to low capacity for electricity generation, transmission, and distribution. The country's peak dispatch power stands at 5,552.8 MW against estimated demand of about 98,000MW thus stifling socio-economic activities with attendant adverse effect on economic growth. The absence of effective integrated resource planning was identified as a major cause of the low level of power supply in Nigeria as available energy resources have not been optimally harnessed. Using a future scenario approach, this chapter developed plausible scenarios for Nigeria's power supply by the Year 2050 based on a predictive model of seven per cent (moderate growth), ten per cent (high growth) and 13 per cent (optimistic growth) used in analyzing the impact of energy growth on Nigeria's economy. This led to the generation of scenario-based strategies including the optimal diversification of electricity generation mix and restructuring of the power grid system in Nigeria.

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INTRODUCTION

The efficient supply of power is a major stimulant of socio-economic activities for improved productivity and development of nations. The major productive sectors of a nation's economy depend on power supply from one or more sources of energy for efficient operation. The sources of power supply could be fossil fuels such as coal that facilitated mechanisation through steam engines which characterised the First Industrial Revolution of 1764-1840 (Onifade, 2020). In contemporary times, the major source of power supply is electricity which was developed during the Second Industrial Revolution (2IR) between 1870 and the early 1900s. In the 2IR era, electricity was mainly produced from fossil fuels such as coal and crude oil. In the Third Industrial Revolution (1969-1984), renewable sources of energy such as hydropower, solar and wind energies began to gain prominence. Contemporary power supply has also witnessed the incorporation of mini and micro grids to the conventional national grid systems. Consequently, Integrated Resource Planning (IRP) has been proven as a sustainable means of power supply for economic growth and development.

In Brazil, hydropower was the main source of power supply, providing about 8,930 Megawatts (MW) constituting 77 per cent of 11,600 MW of electricity to the national grid as at 2000 (Food and Agriculture Organisation, 2018). Low rainfall in 2001-2002 however led to power supply shortages thus impinging on the efficiency of power supply to industries with adverse effect on the country's economy (Jardini et al., 2012). Consequently, the government conducted the 2003-2004 energy sector reforms based on Integrated Energy Options (IEO) (Griebenow, 2019). By 2016, Brazil had built about 290 power plants from 4 energy sources: gas, hydro, solar and nuclear sources. Consequently, power supply increased by 191 per cent, from 21,202MW in 2008 to 61,708MW in 2020 (BNamericas, 2020). The improvement in power supply facilitated industrial growth, particularly steel production that rose from 13 million tons to 422.8 million tons, representing an increment of 3,152 per cent, between 2009 and 2019 respectively. As a result, the country's steel industry contributed about US$1.6 billion to the economy in 2019 (Fonseca, 2020). Thus, Integrated Resource Planning constituted a major enabler of improved industrialisation for economic growth in Brazil.

In 2010, South Africa formulated the Integrated Resource Plan (IRP) to diversify the electricity generation sources for its power supply system that was hitherto largely based on coal. Coal had constituted about 85 per cent of the country's 45,700 MW capacity for power supply as at 2014 (Craig, 2018). Consequently, the country began to integrate renewable and other

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