

Review Article

Drivers for Nuclear Energy Inclusion in Ghana's Energy Mix

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Received 21 July 2020; Revised 23 October 2020; Accepted 27 October 2020; Published 25 November 2020

Academic Editor: Hao Wu

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Energy has become the driving force for national infrastructure development, including the socioeconomic development of every society. Ghana, like many other African countries, formulated developmental policies to attain middle-income status in the medium term. Socioeconomic growth comes with an upsurge in electricity consumption. Ghana seeks to use industrialization to achieve its middle-income target. To achieve this target, there is a need to develop a reliable, sustainable and affordable energy supply in a benign environment. The entry point for Ghana to become a middle-income economy is a cost-effective and reliable electricity supply. Ghana is endowed with fossil fuel, hydro and renewable resources to drive its industrial ambitions, but the indigenous gas fields feeding some thermal plants for electricity production are decreasing and could run out by early 2030 unless new fields are discovered and may also be affected by price volatility. The untapped hydro resources are also small and unreliable if the country seeks to become a middle-income country. Despite the abundant renewable resources, they are intermittent and do not present a baseload option. In safeguarding Ghana's energy security, the country seeks to include nuclear energy into her energy mix. This research paper discusses the major drivers for nuclear energy inclusion.

1. Introduction

Socioeconomic development coupled with industrialisation and energy demand increase is positively correlated, requiring reliable and sustainable energy supply [1, 2]. Electricity distinguishes the developed countries from the nondeveloped ones [2–5]. Castellano et al. [2] asserted that globally, countries that have their electrification rates less than 80% consistently suffer reduced gross domestic product (GDP) per capita [6]. In this regard, countries that provide affordable and reliable electricity grow their economies and create wealth for national development [5, 7, 8]. Hence, many countries are looking to secure a sustainable energy supply as a result of the combination of increasing population growth, socioeconomic development, and international environmental obligations [7]. For most countries, the best energy strategy encompasses the combination of different energy sources to attain a robust diversity.

Ghana is not new to the effects of insufficient energy and has faced its share of challenges arising from it [9, 10]. However, the availability and affordability of energy in a sustainable manner and, in particular, the electricity supply is an indispensable condition for the working of modern society [11]. Ghana's ambition to fulfil higher economic growth requires an abundant and affordable supply of electricity through a diverse generation mix [12].

Ghana's electricity generation went through numerous stages. The first was diesel generators and stand-alone electricity supply systems owned by industrial mines and factories. This was followed by hydropower leading to the construction of the Akosombo Dam in 1966, and the current addition of thermal-powered technologies that use either gas or light crude oil [13]. In the recent past, renewable energy, mainly in the form of solar energy, has been included in the generation mix, with new projects being developed [14]. The country has also decided to include nuclear power into

the energy mix and this is reflected in the new energy policy as well as the state of the nuclear power programme of the country [15, 16].

This paper thus seeks to bring to fore, the key drivers that encourage Ghana to forge ahead with its nuclear power programme. The general conception of the drivers is based on the backdrop of limited available hydropower resources, the projected decline of available local gas reserves in the early 2030s, and the projected growth in energy demand, especially due to Ghana's industrialization that is driven by the government industrial policy.

2. Nuclear Power Programme in Ghana

2.1. Nuclear Power Journey. Ghana, like many other countries worldwide, has decided to include nuclear power into its energy mix for baseload electricity [17–19]. Ghana's quest to utilize nuclear energy for electricity generation dates back to the early 1960s when the country's first reactor project was almost launched in 1963 involving the proposed construction of a 2 MW Soviet research reactor [20, 21]. Besides, the country has suffered three major nationwide power crises and rationing exercises in the periods: 1993/1984, 1997/1998, and 2006/2007 to 2015 [10]. In 2007, when Ghana's third major energy crisis occurred [22], a presidential commission was set up and their report submitted in 2008 led to a cabinet decision to include nuclear energy in Ghana's National Energy Policy and Strategy in 2010 [23]. The government of Ghana then declared its intention to pursue a nuclear power programme for peaceful purposes through a letter submitted to the International Atomic Energy Agency (IAEA) in 2008 [18]. The Nuclear Regulatory Authority (NRA) bill was passed into Act 2015 (Act 895) by the Parliament of Ghana in August 2015, but the Authority was fully established in January 2016 as an effective independent Nuclear Regulatory Body [24]. Ghana further applied for an International Atomic Energy Agency (IAEA) Integrated Nuclear Infrastructure Review (INIR) Mission for Phase 1 of the Programme development in 2015 based on a self-assessment report. The IAEA INIR mission report in 2017 stated that the country has made significant progress in its nuclear power programme. It concluded the report review with eight suggestions and recommendations while it recognized three best practices that other countries can also learn from [18]. Based on the IAEA INIR mission recommendations and suggestions, the country has continuously worked towards the achievement of milestone one of the IAEA milestone approach, leading to the follow-up INIR mission in 2019 [16]. Currently, Ghana's Programme Comprehensive Report (PCR) has been submitted to the Government, ensuring Ghana's knowledgeable commitment to a nuclear power programme.

3. Factors driving Ghana's Nuclear Energy Inclusion

Major factors influencing Ghana's nuclear energy option drive are long-term vision outlined in Ghana's development plan, increasing electricity demand, and limited hydro as well

as gas resources. Others include energy diversification, climate change mitigation, and industrialization (economic diversification and transformation) in Ghana.

3.1. Long-term vision outlined in Ghana's Development Plan. Ghana as a lower middle-income economy in 2018 has a population of 30.28 million with a GDP per capita of 2,214 dollars [25]. The country's electricity consumption per capita stands at 461.7 kWh with an installed grid capacity of 5,171.6 MW and electricity access at 85 percent as of 2019 [26]. The benefits of long-term development plan that lead to sufficient electricity for a country [9] are already evident in developed countries. These countries include Japan, Sweden, South Korea, America, and Australia that have an electricity supply plan of 30 years and beyond [3, 27–29]. The increasing interest in long-term energy planning for periods beyond 30 years [27, 30] has shifted the development agenda of such countries far ahead of Ghana [31]. The Ghana National Development Planning Commission (NDPC) has envisaged a 40-year long-term development plan that is based on the high aspirations for the Ghanaian economy [12]. The long-term plan is expected to guide the formulation and implementation of the country's national development. It is therefore projected that, the development plan period for Ghana when successfully executed would rank the country among upper-middle or high-income countries of the world. This comes with a projected GDP per capita of about \$12,736, with an industrialized, diversified and export-oriented economy that is resilient to high electricity demand requirements [32, 33]. The electricity demand requirement for the 40-year long-term economic growth projected by the NDPC is shown in Figure 1.

From Figure 1, it is observed that the country's aspirational projection to achieve high-income level per capita for long-term growth will require about 35,000 MW installed capacity. The country's long-term projections are expected to drive an economic infrastructure that would require a strong baseload electricity source [15]. However, nuclear energy does provide such energy density and comes with a zero short-run marginal cost that serves well as a strong baseload [34, 35] for the NDPC projections [12]. Estimates by Lane [36], indicate that the energy released in a nuclear fission reaction is ten million times greater than the amount released when burning fossil fuels. Moreover, the spin-off of nuclear energy in the country has the potential of job creation in diverse areas feeding into the economic diversity that the NDPC envisages in Ghana's long-term development [37].

3.2. Increasing Electricity demand. The NDPC of Ghana projected Ghana's population to increase from 30 million in 2018 to 50 million by 2057 [12]. The increase in the country's population is expected to expand the economy leading to the expansion of social amenities and infrastructure [14].

Various projections from various government organizations have projected the country's electricity demand to increase in the short, medium, to long term [14, 38]. Although the projected margin of increase is different considering the projections, it is apparent that the increase is imminent and Ghana must prepare itself to supply the

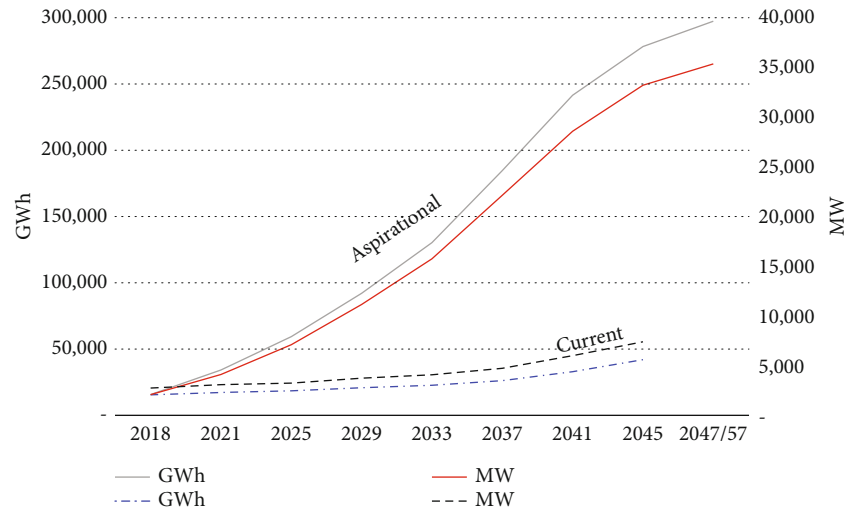


FIGURE 1: Electricity demand requirements for 40-year long-term economic growth [32].

corresponding demand. Figure 2 shows the energy demand and supply output by the Energy Commission (EC) of Ghana.

From Figure 2, which represents the short-term projection, it is noted that Ghana would need about 1,200 MW additional installed capacity by the year 2021 to attain electricity sufficiency. From the same figure, it can be observed that the demand curve also corresponds to the growth of the total installed capacity until 2021. This shows that there is a need for the country to acquire electricity-producing plants to meet the ever-growing demand.

The contribution of nuclear power to meet the increasing electricity demand is invaluable to Ghana [39]. Besides, the rising electricity demand, along with concerns about resilient, affordable, clean, and abundant energy makes nuclear power an important source to the generation mix [40].

3.3. Limited Hydro Resources. Ghana’s Akosombo Hydroelectric Power project was a comprehensively planned industrial, agricultural, and service “take-off” initiative for the fast-track development of Ghana in harmony with the vision of a long-term development plan in the electricity sector [9].

The country’s total hydropower potential has been estimated to be about 2,420 MW, of which 65.3 percent (i.e., 1,580 MW) has been exploited [41]. This includes the 1,020 MW Akosombo Hydropower Plant with a dependable capacity of 900 MW and the 160 MW Kpong Hydropower Plant with a dependable capacity of 148 MW. The third is the 400 MW Bui Hydropower Plant with a dependable capacity of 342 MW [26]. The remaining 840 MW that is yet to be exploited to yield a dependable capacity of about 500 MW. These are untapped hydroresources with capacities below 100 MW [41]. Figure 3 shows a map of hydropower sites, tapped and untapped hydropower potentials in Ghana.

Considering the electricity demand increase [14], the pollution, and degradation of various water bodies combined with climate change effects [42], it is envisaged that the untapped hydroresource of 840 MW would even dwindle. Ghana cannot continuously rely on hydropower as was done

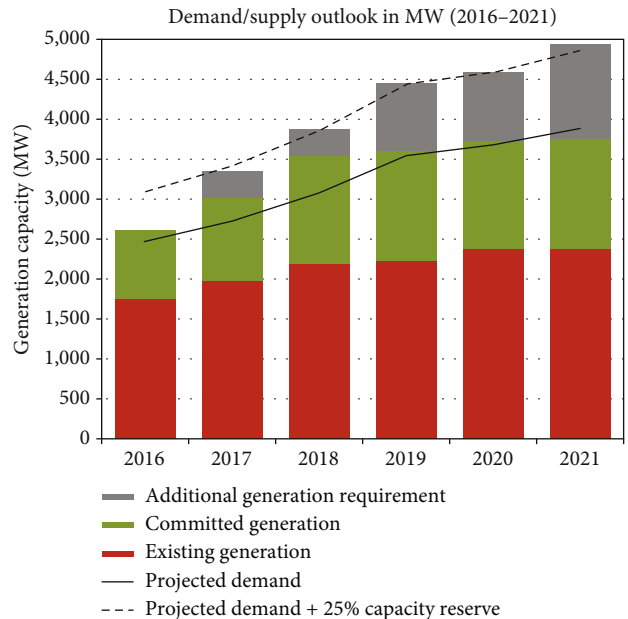


FIGURE 2: Energy Commission demand-supply projections, 2016.

in the postindependence era but must explore other base-load options that are reliable [15], affordable, and sustainable as described in the sustainable development goal (SDG) 7 [43]. Nuclear power is one energy source that is currently under serious consideration in Ghana [16] because nuclear technology has been recognised as an alternative energy source that can generate high-capacity base-load electricity at an affordable price and enhance energy security for Ghana [15].

3.4. Local Natural Gas Resources. In 2007, crude oil-associated natural gas was discovered in the Jubilee Field, offshore Cape-Three Points in Ghana’s sedimentary basin. Natural gas was again discovered in the Tweneboa, Enyenra, and Ntomme (TEN) and Sankofa-Gye Nyame (SGN) fields [44].

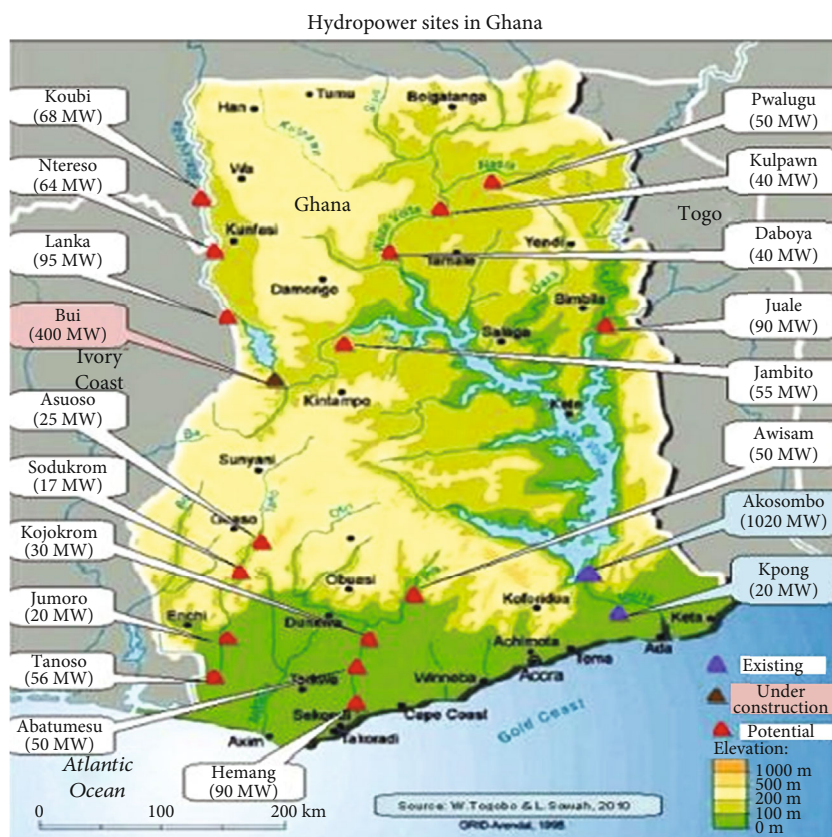


FIGURE 3: Existing and potential hydropower sites in Ghana [41].

TABLE 1: Natural gas discoveries and reserves [44].

Natural gas fields	Associated gas in-place (BCF)	Nonassociated gas-in-place (BCF)	Year of discovery	Year of start production	Year of the end of production	Expected peak daily production (mmscf/day)
Jubilee	568	0	2007	2015	2022	100
TEN	294	59	2009 – 2012	2016	2027	85
SGN	287	1071	2009 -2012	2016	2038	180

The total associated and non-associated natural gas reserves in-place discovered increased from 0.57 trillion cubic feet (tcf) in 2010 to about 2.38 Tcf in 2014. Table 1 shows the reserves and other features of the associated and non-associated natural gas fields discovered in Ghana.

The indication is that if 80% of Ghana's natural gas reserves in-place would be recovered for electricity generation that would be adequate to generate electricity for 25 years from a 1,200 MW combined cycle power plant with a heat rate of 7,800 BTU/kWh. This implies that Ghana must seek to identify more gas fields after 25 years or diversify its energy sources.

The projected time frame of 25 years for gas reserve usage brings to notice the numerous challenges that accompany Ghana's reliance on domestic gas, which must be addressed through diversification of fuel and technology options. As represented in Figure 4, the natural gas supply from the Jubilee field is expected to peak in 2019 and then start a terminal decline from 2030 to 2036 for all case scenarios.

Despite TEN and SGN fields coming online in 2016 and 2018, as represented in Figures 5 and 6, the long-term supply of domestic natural gas for electricity generation is uncertain unless intense exploration activities are undertaken to discover new fields, if any.

The two fields are all expected to dwindle by 2036 in all case scenarios. Based on all projections, it has been projected that domestic demand for natural gas will outstrip supply from domestic fields and imports through the West African Gas Pipeline (WAGP) by 2025 [41, 45]. The dwindling projections by the GNPC coupled with the price volatility of the gas resource must encourage Ghana to find other sources of energy to replace the gas supplies, especially for electricity generation.

The new field HESS, as represented in Figure 7, is expected to start exploitation in 2021 and then peak at 2027, even before the TEN, Sankofa and Gye Nyame gas production fields, as projected by Ghana National Petroleum Commission (GNPC).

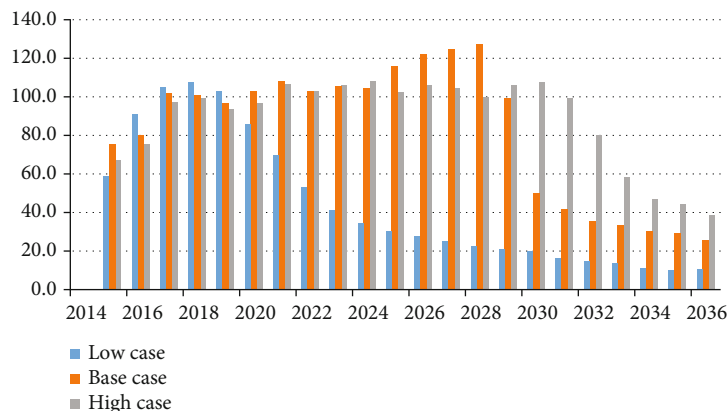


FIGURE 4: Greater Jubilee full field gas production, mmscfd.

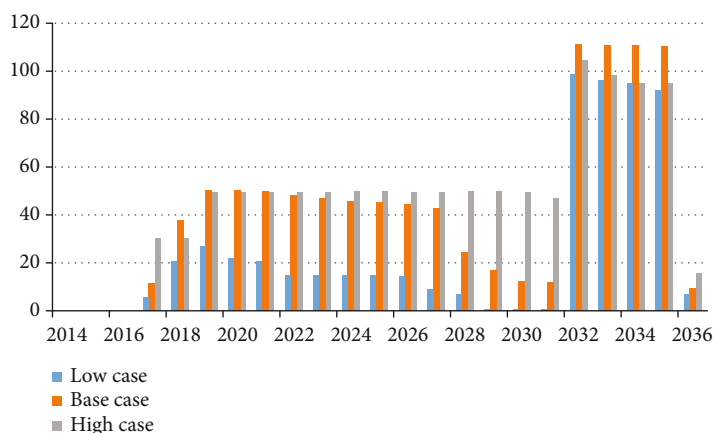


FIGURE 5: TEN gas production mmscfd.

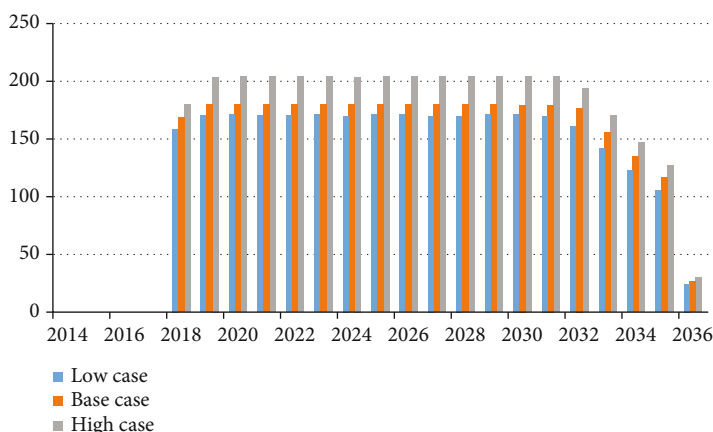


FIGURE 6: Sankofa and Gye Nyame gas production mmscfd.

3.5. *Natural Gas Imports and Their Prices.* Ghana has depended on fossil fuel imports before the discovery of the Jubilee field in 2008 and subsequently the discovery of other fields. The Country imports natural gas from Nigeria for electricity generation through the WAGP [46]. The N-Gas, a subsidiary of Nigeria National Petroleum Corporation

(NNPC), is expected by contract to supply an initial amount of 170 MMscf/day of natural gas through the 678 km WAGP. The capacity of WAGP can, however, accommodate future growth in gas demand up to 474 MMscf/day maximum with compression additions. In case the gas volume increases to 474 MMscf/day, this would suffice for a 3,000 MW combined

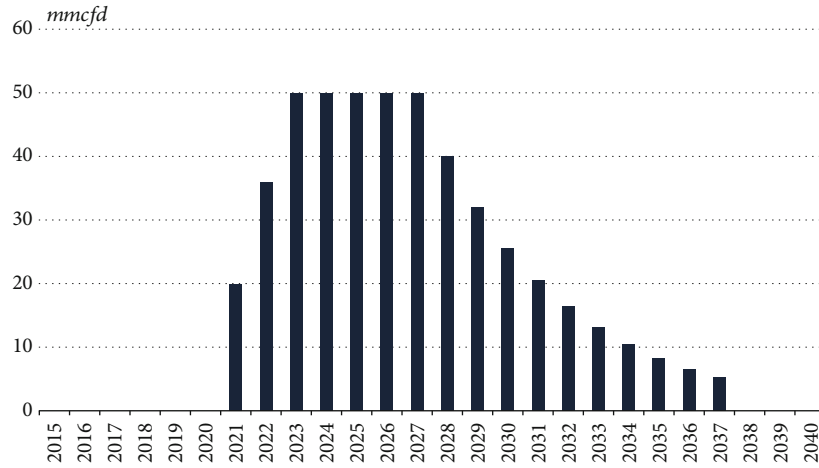


FIGURE 7: Hess gas production forecast, mmscf.

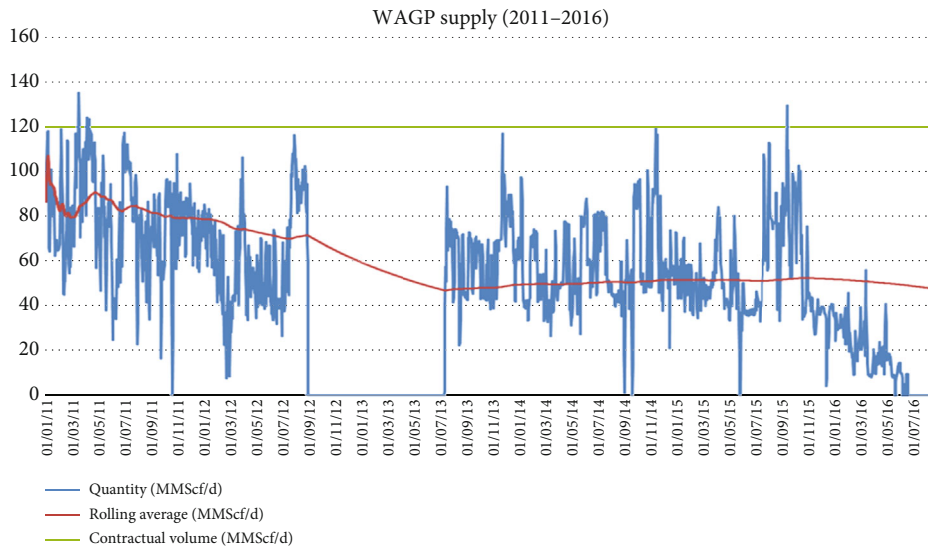


FIGURE 8: Erratic nature of gas supply from WAGP.

cycle power plant. However, since the commissioning of the pipeline in 2009, it has operated on average below the contracted volume of 120 MMScf/day, as shown in Figure 8.

In addition to the erratic gas supply from Nigeria, there have been accidental damages to the pipeline on two occasions which affected the supply.

Additionally, the price volatility of natural gas has necessitated “artificial” shortages in gas supply in Nigeria and other neighbouring countries, leading to power shortages in the country. Figure 9 shows the international natural gas prices from 2009 to 2018 [47].

There were several key issues regarding the purchase of fuels for electricity generation in Ghana from 2000 to 2016 [13]. These developmental issues exerted upward pressure on electricity tariffs and the cost of goods and services in Ghana.

Unlike natural gas, there exists greater insurance against future price exposure on nuclear fuel. In comparison, nuclear fuel prices are low and stable as shown in Figure 10 [48].

The small contribution (5% of uranium) to the total cost of nuclear power is an advantage over fossil fuels [17, 49–51]. The nonresponsiveness of nuclear fuel to price fluctuations offers a way to stabilize power prices in deregulated markets [17]. On average, nuclear power plants require low fuel supply; the fuel can also be stockpiled up to 10 years. These aspects of nuclear fuel significantly reduce the risks associated with fuel supply and price instability [22, 52].

3.6. Energy Diversification. Since independence to date, Ghana has relied on hydropower, fossil (oil and gas) thermal power plants as a major source of electricity [26]. Recently, renewable energy, mainly solar energy, has been added to the energy mix, with new projects being developed [26]. However, renewable energy does not provide the needed baseload energy option and it is challenged with intermit- tencies [15]. Based on the backdrop of limited available hydropower; the projected decline of available local gas reserves in the early 2030s and; fossil fuel price volatility,



FIGURE 9: Historical natural gas price chart is shown in U.S. dollars [47].

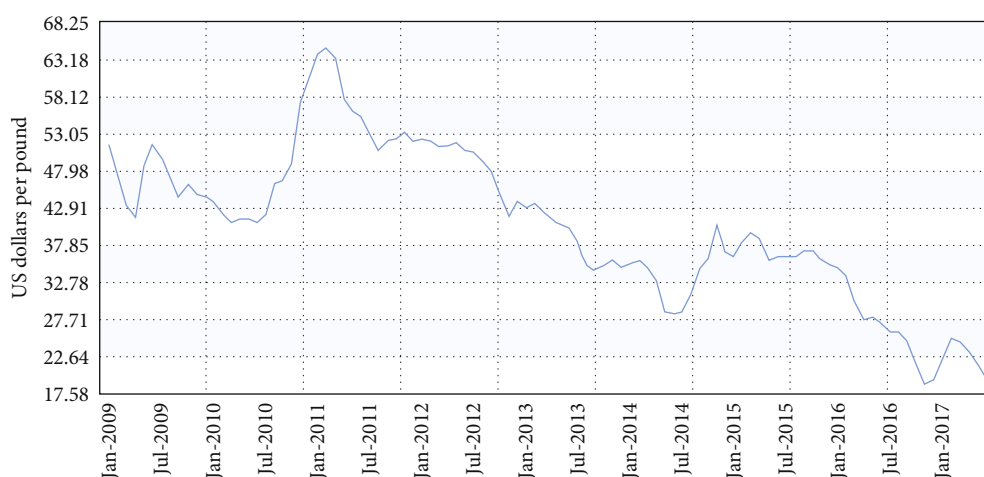


FIGURE 10: Historical nuclear fuel chart.

the national energy policy recommends diversification of Ghana's energy mix to include nuclear and coal, while increasing the penetration of renewable energy [15]. The country's current diversified generation mix consists of 1,580 MW from hydro-power, 3,549 MW from thermal, and 42.6 MW from renewables, mainly solar [26]. Figure 11 shows a clear drift from the heavy dependence of hydro sources to thermal sources.

As at the first quarter of 2019, the electricity generation mix stood at approximately 68.62 percent of thermal against 30.55 percent and 0.82 percent of hydro and renewable sources, respectively [26].

The diversification of energy sources for a country like Ghana allows for the absorption of shocks in one energy input by increasing the use of another. The inclusion of nuclear power in Ghana will mean a well-diversified energy mix that will contribute to stabilizing the nation's energy grid, in addition to providing reliable and affordable electricity [40].

3.7. Climate Change Mitigation and Environmental Concerns. Climate change has become a greater threat to economies worldwide. Its related hazards and some disasters triggered by weather in 2017 alone cost the global economy some US\$320 billion in losses [53]. The economic losses are expected to increase and even exert greater impacts on the lives and livelihoods of the poorest and most vulnerable shortly.

The country's energy emissions profile has been on the increase following electricity demand growth at an estimated rate of 10 to 12 percent per year [54]. The country's current Greenhouse Gas Inventory Report estimated the total greenhouse gas (GHG) emissions stand at 42.15 million tonnes (Mt) CO₂-equivalent (CO₂e), with the energy sector contributing the second-largest emissions of 15.02 MtCO₂e [42]. The emissions from the following four economic sectors were analyzed to ascertain the growing nature of Ghana's emission trends shown in Figure 12.

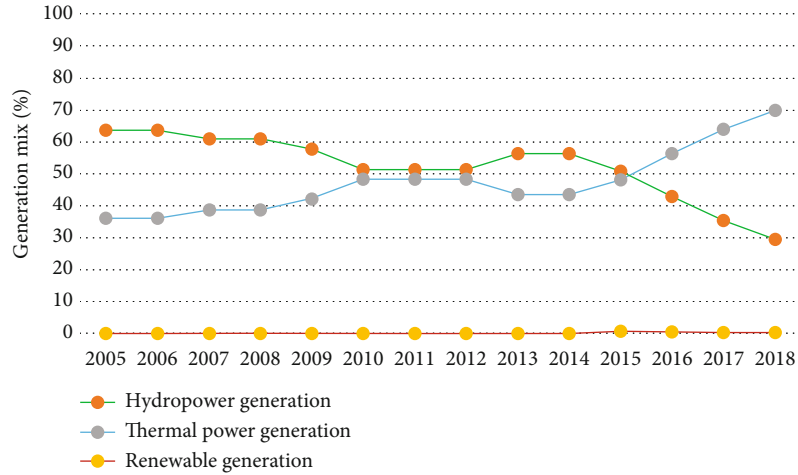


FIGURE 11: Installed electricity generation mix from 2005 to 2019.

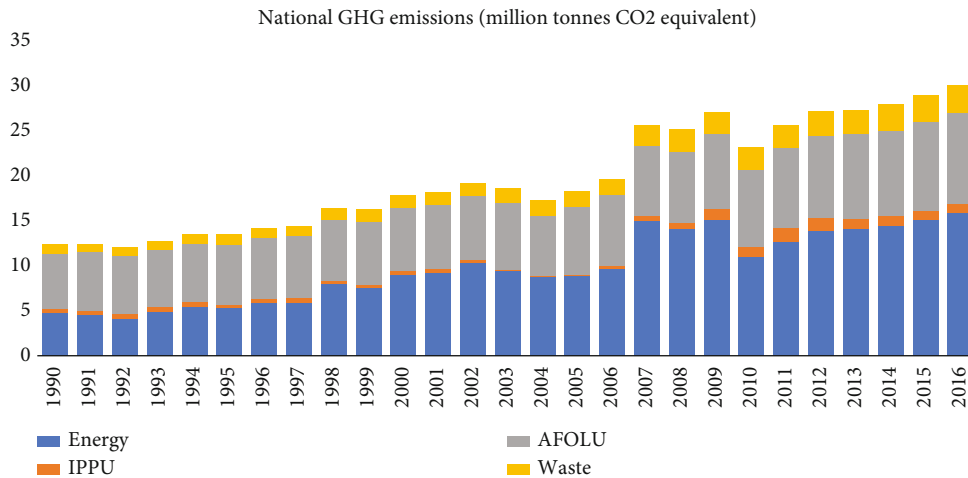


FIGURE 12: Contribution of GHG emissions from four economic sectors [42].

These emissions can potentially increase with time as Ghana pursues a high-income economy [15, 55]. Therefore, as a country, the energy, especially from electricity to achieve a high-income economy in the future must be reliable and clean [15, 55, 56]. Recently, Nyasapoh and Debrah [56] asserted that a long-term commitment to the integration of nuclear power and renewables could lead to low-carbon energy for Ghana’s industrial and economic aspirations.

The economic transformation programme has resulted in a notable rise in emissions from energy-related activities (such as electricity generation from gas and crude-fired thermal plants). USAID [57] indicated that 19% of the energy sector emissions in Ghana are attributed to electricity generation.

Nuclear power has the potential to make an important contribution to reducing greenhouse gas emissions while delivering reliable dense energy needed for national development [58], [59], with 12 g/kWh median lifecycle emissions, similar to wind energy [60]. Moreover, the entire nuclear power generation cycle produces only about 2.5 to

5.7 gCeq/kWh as compared to 105-366 gCeq/kWh to that of fossil fuel and 2.5-7.6 gCeq/kWh from renewable energy resources such as hydro and wind [22].

Nevertheless, in adding renewables to the electricity grid, it is imperative to consider the unstable effect of renewable energy sources, mainly solar and wind. For instance, Ghana’s wind capacity is around a speed of 6 m/s at 50 m above sea level and this happens intermittently [61]. The intermittent nature of the wind energy causes instability of the grid and the end thereof is a flicker, observed from the receiving end (consumers) [62].

The only emissions-free energy source that is widely scalable and serves as a baseload is nuclear, with the power plants providing excellent habitats for wildlife and plants in addition to preserved environmentally rich wetlands [40]. Hence, electricity from nuclear technology occupies a distinctive position in the deliberation over global climate change as one of the few carbon-free energy sources during its operational period; and as such, is already contributing to the world energy supply on a large scale [17].

Finally, despite the environmental concerns associated with fuel management, the world of nuclear technology is in the hunt for a panacea to handling spent nuclear fuel. This consists of conventional ways used in storing spent fuel safely and that has been reliable to some extent over several decades [63]. In on-going studies, researchers in the field have found a dimension in nuclear fuel management that is very promising. This has to do with making the spent fuel reusable by breeding it in a reactor facility. This is well known as the fast breeder reactor [64] and in effect, this technology will make the nuclear power environmentally friendly.

3.8. Economic Growth and Industrial Development. Despite early investments in Ghana's electricity infrastructure in 1966, the country has lost some significant amount of economic opportunity in the past decade, leading to a considerable economic growth impact [65]. The World Bank ranked the country's electricity situation as the second relevant limitation to economic activity, hence losing an estimated 1.8 percent of GDP during the 2007 power crisis [45]. Besides, Ackah [65] estimated in 2015 that Ghana, on the average, loses production worth of about US \$2.1 million each day (or US \$55.8 million per month) through the power crisis alone. Indicating that the country lost about US \$680 million (2 percent of GDP) in 2014 due to the power crisis [65]. A major factor that has accounted for Ghana's power crisis for the past decades is the overdependence on thermal and hydro sources for electricity generation. This has mainly been coupled with lower levels of reservoirs, shortage of oil, and higher prices [9, 13, 66].

The ambitions of increasing economic growth and meeting projected electricity demand as well as industrial development make nuclear power the solution [39]. It is imperative, therefore, that if Ghana is to develop to achieve economic growth, the country must seek to provide a sustainable, reliable, clean and economically competitively priced electricity supply. This kind of electricity should be available to industry, social services, and households. The increased focus on nuclear energy is motivated by the above factors and a wide range of other factors including economic growth and industrial development.

4. Conclusions

Sustainable development will require a mix of energy technologies. Energy technology implementation in Ghana will depend on resource availability, economics, geography, demography, and social preferences. No single energy source or technology can form an exclusive basis for future electricity generation. Ghana needs to develop the right energy mix to propel its developmental agenda while fulfilling its international commitments.

There is a need for Ghana to diversify its energy mix and update its policy framework to open up the full range of low-carbon options. There is no taint of doubt that those options should include nuclear power.

The long-term vision outlined in Ghana's development plan; the projected growth in demand for electricity; the limitation of future hydroelectric power projects in the country;

the projected decline of oil and gas reserves; the need to diversify generation to ensure robustness and security of supply, the negative effects of fossil-fuelled plants on the environment and; industrial transformation agenda, provide a strong justification for the choice of nuclear power as a long term energy option for Ghana's electricity sector. Nuclear power will provide a sustainable, affordable, and reliable baseload option for electricity generation to boost economic growth and industrial transformation. The reason is that nuclear has low operation cost; relatively stable fuel price over a long period; long plant operational duration; longer plant life and; can operate at full power with high capacity factor.

Considering the urgency imposed by the threat of climate change to Ghana's hydropower, the projected increase in energy demand; the uncertainty over oil and gas prices worldwide; the attention to resolving the threat of climate change by the introduction of carbon-free energy sources worldwide and; concerns of energy security, calls for serious attention to develop and implement a nuclear power programme to meet future electricity demand.

Response measures to mitigate the negative effects of climate change must address issues of just transition and economic diversification while creating decent jobs as indicated by the Paris Agreement. Nuclear presents an opportunity to decarbonize the environment while providing decent jobs to the people of Ghana. It is established that nuclear is one of the highest-paid jobs in the electricity sector, thus presenting the opportunity of decent jobs being sought by the Paris Agreement.

It is a well-known fact that one of the largest GHG emitters includes fossil power plants. Fossil power plants utilise conventional technologies in generating the required electricity. As the fossils may gradually be phased out to enable Ghana to achieve its Nationally Determined Contributions (NDC's), there is an opportunity for the workforce in the fossil to transition to the nuclear conventional islands. Thus, eliminate the unjust layoff of fossil workers and provide a solution to the Paris Agreement just transition issue.

Nuclear energy has been used by many advanced countries around the world to diversify their economic environment. Ghana can take the opportunity of introducing nuclear energy to also do the same.

Ghana stands the chance to fulfil its industrial agenda with cost-effective, reliable and resilient electricity by developing the necessary infrastructure for the inclusion of nuclear energy in the country's energy mix. It is important to note, however, that developing a nuclear power programme is a major undertaking requiring strong national leadership to ensure coordination, broad political and popular support, and should be owned and promoted by the government. Ghana is systematically following the IAEA laid-down procedures, and in January 2017 hosted a Phase 1 IAEA-led INIR Mission. The review noted that Ghana had made considerable progress in the development of its Phase 1 nuclear infrastructure, but still had key studies outstanding. The deployment of nuclear energy in the energy mix will not only secure electricity supply in the country but also bring other benefits such as high-

tech industry promotion; development of a more safety-oriented society; industrialization and; employment (both direct and indirect).

Nuclear energy research and development is key to ensuring a viable future for nuclear power as a prime component of Ghana's energy mix. It requires that the government align to drive a culture of innovation and agility to flex the changing circumstances and environment; mitigate construction complexity challenges; keep conversations open to improve economic efficiency; acquire the right talent and skillsets to operate the next-generation power plants and; safeguard the environmental as well as energy needs of the country.

Additional Points

Highlights. Ghana's ambition to fulfil higher economic growth requires an abundant and affordable supply of electricity through a diverse energy mix. Nuclear power is recognised as an alternative energy source that can generate high-capacity baseload electricity at an affordable price and enhance energy security for Ghana. Factors influencing Ghana's nuclear energy drive include long-term vision, increasing electricity demand, limited hydropower potential, and local gas reserves. Securing a sustainable energy supply following high population growth, socioeconomic development, and international environmental obligations is imperative. Ensuring a viable future for nuclear power is a key component of Ghana's energy mix. Ghana has worked towards the achievement of milestone one as part of the International Atomic Energy Agency (IAEA) Milestone Approach.

Conflicts of Interest

None of the authors have any conflicts of interest.

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