

Exploring Alternative Sources of Energy in Kenya

By: *Kariuki Muigua**

Abstract

The Kenyan Government has been preparing to set up nuclear reactors in the country as an alternative source of energy to add to the national grid as part of the plans to meet the country's development blueprint, Vision 2030 and the Big Four Agenda. Nuclear energy, while a plausible source of energy, comes with its good share of challenges. This paper critically evaluates the viability of different sources of energy including nuclear energy by drawing lessons from other countries where these sources have been explored and either succeeded or failed. The paper also offers recommendations on the possible sources of energy that are worth exploring in the Kenyan context.

1. Introduction

With the ever growing population, advanced technological developments and climate change, the world continues to face challenges as far as energy needs are concerned.¹ In order to meet its energy requirements, the Government of Kenya set out to install nuclear energy reactors as an alternative source of renewable energy in addition to hydropower, wind and geothermal power, among others, in the country.² The country's energy needs are expected to rise due to population increase as well as the country's development blueprint,

* *PhD in Law (Nrb), FCIArb (Chartered Arbitrator), LL. B (Hons) Nrb, LL.M (Environmental Law) Nrb; Dip. In Law (KSL); FCPS (K); Dip. In Arbitration (UK); MKIM; Mediator; Consultant: Lead expert EIA/EA NEMA; BSI ISO/IEC 27001:2005 ISMS Lead Auditor/ Implementer; Advocate of the High Court of Kenya; Senior Lecturer at the University of Nairobi, School of Law; CASELAP.*

¹ David Bodansky, 'Nuclear Energy: Principles, Practices, and Prospects' (CERN Document Server, 2008) <<https://cds.cern.ch/record/1109377>> accessed 19 August 2020.

² Republic of Kenya, *National Energy Policy*, October, 2018 <https://kplc.co.ke/img/full/BL4PdOqKtxFT_National%20Energy%20Policy%20October%202018.pdf> accessed 30 September 2020.

Vision 2030 and the Big Four Agenda.³ Kenya expects peak demand to top 22,000 megawatts by 2031, partly due to industrial expansion, a component in Kenyatta's Big Four Agenda.⁴

Currently, it is estimated that hydropower accounts for 35 percent of Kenya's electricity generation, with the rest coming from geothermal, wind and diesel powered plants.⁵ Notably, Kenya is not the only African country that is on the journey towards establishing their first nuclear plant, as way of diversifying the countries' energy mix to improve their electricity generation capacity.⁶ However, while Kenya is at an advanced stage with the nuclear power plant establishment, there have been serious concerns relating to the technical issues associated with storage, transportation and the disposal of radioactive material and waste.⁷ This is in view of the nuclear disasters that have occurred in the past and recently across the globe.⁸ There is a need for the Government

³ Kiprop, Eliud, Kenichi Matsui, and Nicholas Maundu. "Can Kenya supply energy with 100% renewable sources?." In *5th International Conference on Environment and Renewable Energy*, pp. 18-19. 2017 <https://www.researchgate.net/publication/328925970_Can_Kenya_Supply_Energy_With_100_Renewable_Sources> accessed 30 September 2020.

⁴ 'Kenya on Course for \$5 Billion Nuclear Plant to Power Industry' *Bloomberg.com* (4 August 2020) <<https://www.bloomberg.com/news/articles/2020-08-04/kenya-on-course-for-5-billion-nuclear-plant-to-power-industry>> accessed 19 August 2020.

⁵ Republic of Kenya, *National Energy Policy*, October, 2018.

⁶ 'A Case for Nuclear Energy in Kenya' (*The Star*) <<https://www.the-star.co.ke/opinion/columnists/2019-04-05-a-case-for-nuclear-energy-in-kenya/>> accessed 19 August 2020.

⁷ 'A Case for Nuclear Energy in Kenya' (*The Star*) <<https://www.the-star.co.ke/opinion/columnists/2019-04-05-a-case-for-nuclear-energy-in-kenya/>> accessed 19 August 2020.

⁸ 'A Brief History of Nuclear Accidents Worldwide | Union of Concerned Scientists' <<https://www.ucsusa.org/resources/brief-history-nuclear-accidents-worldwide>> accessed 6 October 2020; Daniel Bukszpan, '11 Nuclear Meltdowns and Disasters' (*CNBC*, 16 March 2011) <<https://www.cnbc.com/2011/03/16/11-Nuclear-Meltdowns-and-Disasters.html>> accessed 6 October 2020; 'Nuclear Reactor Accidents - History and Legacies' (*Atomic Heritage Foundation*) <<https://www.atomicheritage.org/history/nuclear-reactor-accidents-history-and-legacies>> accessed 6 October 2020; 'Chernobyl Was the World's Worst Nuclear Power Plant Accident. Here's How It Compares to Fukushima and Three Mile Island.'

of Kenya and other stakeholders to be wary of the same even as the country ventures into nuclear energy production.

2. Energy Sources in Kenya: the Challenges

The Ministry of Energy observes that energy is one of the key enablers of Kenya's Vision 2030 and the Big 4 Agenda development programs and thus, Kenya treats energy security as a matter of national priority.⁹ This is based on the fact that the Third Medium Plan 2017-2022 identifies energy as the country's driver into "a newly-industrializing, middle-income economy, providing a high quality of life to all its citizens in a clean and secure environment," and as a result, Kenya considers access to competitively-priced, reliable, quality, safe and sustainable energy as an essential ingredient for the country's social – economic development.¹⁰

It has rightly been pointed out that in the past decade the country has grappled with the challenge of unreliable, expensive and unsustainable energy use supporting a stagnating industrial and manufacturing base. This is due to aging energy infrastructure that can no longer meet the modern day requirements as envisaged in the country's economic blueprint, the Kenya Vision 2030.¹¹

As Kenya seeks to realize the national blueprint for development and the sustainable development agenda as far as energy generation is concerned, there has been efforts to diversify energy sources in the

(*Business Insider Africa*, 12:20 200AD)
<<https://africa.businessinsider.com/tech/chernobyl-was-the-worlds-worst-nuclear-power-plant-accident-heres-how-it-compares-to/1x12t91>> accessed 6 October 2020.

⁹ kawi, 'Background' (*Ministry of Energy*) <https://energy.go.ke/?page_id=439> accessed 28 September 2020.

¹⁰ Ibid.

¹¹ Owiro, D., G. Poquillon, K. S. Njonjo, and C. Oduor. "Situational analysis of energy industry, policy and strategy for Kenya." *Institute of Economic Affairs* (2015) <https://media.africaportal.org/documents/Situational-Analysis-of-Energy-Industry-Policy-and--Strategy-for-Kenya_1.pdf> accessed 28 September 2020, p.5.

country. It has been observed that Kenya is moving towards procuring more of its additional power from wind and solar and with the substantial growth in hydro, wind and solar energy in the recent years, this has led to a decline in generation from oil, gas and coal sources and electricity imports.¹²

Indeed, Kenya is considered the world's 8th largest geothermal power producer, has the continent's largest wind farm, a vibrant off grid energy market, and an aggressive last mile campaign to connect every citizen.¹³ As at 2015, it was estimated that the energy sector relies on three main sources of energy, biomass, petroleum and electricity, at 68%, 21% and 9% of total energy consumption in Kenya, with biomass constituting the largest source of energy consumed in Kenya in the form of wood fuel and charcoal, extensively used in the rural areas by mostly poor households for cooking and heating purposes, as well as small business, principally kiosks and restaurants within urban centres.¹⁴

Some reports show that Kenya has had one of the fastest increases in electrification rates within sub-Saharan Africa since 2013: by 2018, 75% of the population had access, with the Government aiming to reach full access by 2022.¹⁵ Notably, Government's Kenya Vision 2030 aspires to transform Kenya from low income status into a middle-income country and a key element to this vision is a lower cost of power

¹² Research and Markets, 'Insights on the Energy Requirements of Kenya to 2050 - Moving Towards Procuring More Power from Wind and Solar' (*GlobeNewswire News Room*, 11 September 2020) <<http://www.globenewswire.com/news-release/2020/09/11/2092394/0/en/Insights-on-the-Energy-Requirements-of-Kenya-to-2050-Moving-Towards-Procuring-more-Power-from-Wind-and-Solar.html>> accessed 24 September 2020.

¹³ 'Our Latest Thoughts on Kenya's Power Sector Challenges' (*Energy For Growth*) <<https://www.energyforgrowth.org/blog/our-latest-thoughts-on-kenyas-power-sector-challenges/>> accessed 21 September 2020.

¹⁴ Owiro, D., G. Poquillon, K. S. Njonjo, and C. Oduor. "Situational analysis of energy industry, policy and strategy for Kenya." *Institute of Economic Affairs* (2015), p.7.

¹⁵ 'Kenya Energy Outlook – Analysis' (*IEA*) <<https://www.iea.org/articles/kenya-energy-outlook>> accessed 21 September 2020.

reaching more broadly across the population.¹⁶ As the African Continent seeks to invest in infrastructural development, including the power sector, Kenya is touted as one of the countries that have made notable progress. For instance, it is noted that the Programme for Infrastructure Development in Africa is forecasting an additional 140,000 MW of power over for the East African Power Pool where Kenya's share of this is 13,852 MW of planned peak demand by 2038 or an increase of just over 11,000 MW over this 20-year period.¹⁷

Despite this positive report, Kenya's energy sector is faced by a myriad of challenges. As far as the use of clean energy is concerned, it is estimated that two-thirds of Kenya's energy currently comes from bioenergy.¹⁸ It has been observed that as Kenya seeks to move from non-renewable energy sources to renewable energy sources, moving an economy which relies heavily on wood fuel and biomass as its largest energy source, to achieve sustainable energy use through the gradual increase in the use of renewable energy sources that are often expensive due to the technology deployed, in the face of oil and coal discoveries that could be more readily accessible in spite of its known effects on the environment is a great challenge.¹⁹

While independent power producers have made considerable efforts to produce enough power to run the country, there have been challenges

¹⁶ Research and Markets ltd, 'Kenyan Energy Requirements Forecasted to 2050 - Research and Markets' <<https://www.researchandmarkets.com/reports/5136031/kenyan-energy-requirements-forecasted-to-2050>> accessed 24 September 2020.

¹⁷ Research and Markets, 'Insights on the Energy Requirements of Kenya to 2050 - Moving Towards Procuring More Power from Wind and Solar' (*GlobeNewswire News Room*, 11 September 2020) <<http://www.globenewswire.com/news-release/2020/09/11/2092394/0/en/Insights-on-the-Energy-Requirements-of-Kenya-to-2050-Moving-Towards-Procuring-more-Power-from-Wind-and-Solar.html>> accessed 24 September 2020.

¹⁸ 'Kenya Energy Outlook – Analysis' (*IEA*) <<https://www.iea.org/articles/kenya-energy-outlook>> accessed 21 September 2020.

¹⁹ Owiro, D., G. Poquillon, K. S. Njonjo, and C. Oduor. "Situational analysis of energy industry, policy and strategy for Kenya." *Institute of Economic Affairs* (2015), p. 7.

with uptake of the same by the Kenya Power and Lighting Company Plc (KPLC). For instance, in the recent times and partly due to the Corona Virus (Covid-19) pandemic, there have been reports that measures to contain the pandemic have led to reduced demand for power especially among the commercial consumers who account for over 65% of the power use in the country.²⁰ Reports also indicate that KPLC has prioritized the uptake of geothermal at 39.5 per cent, hydro at 33.9 per cent, wind at 14 per cent, diesel at 9.7 per cent with other sources like solar, imports from Uganda and co-generation accounting for about three per cent.²¹ This has thus left some of the producers with excess power.²² This shows that Kenya's main consumers of electricity are commercial businesses and when these run into problems, the independent power producers are left stranded. This happens while there are still reports that there are homes still not connected to the grid despite the Government's best efforts to do so. Thus, even as the Government looks for ways to produce cleaner power, there is also a need to address the disconnect between production and take up of the power.

It is estimated that Kenya's Lake Turkana wind farm and its 365 turbines make for a generating capacity of more than 300MW, creating one of the most productive projects anywhere in the world.²³ Wind power has become a key contributor to the national grid to the extent that where

²⁰ 'Consumers Pay the Price as Covid Electricity Cuts Hit Turkana Project - The East African' Monday September 14 2020
<<https://www.theeastafrican.co.ke/tea/business/consumers-pay-the-price-as-covid-electricity-cuts-hit-turkana-project-1939124>> accessed 1 October 2020.

²¹ 'Consumers Pay the Price as Covid Electricity Cuts Hit Turkana Project - The East African' Monday September 14 2020
<<https://www.theeastafrican.co.ke/tea/business/consumers-pay-the-price-as-covid-electricity-cuts-hit-turkana-project-1939124>> accessed 1 October 2020.

²² Ibid.

²³ 'What's Driving Wind Power in Kenya and What Challenges Lie in Wait?'
<<https://www.nsenerybusiness.com/features/wind-power-kenya-challenges/>>
accessed 24 September 2020.

there is interruption in its production, consumers have ended paying more for electricity in the country.²⁴

Notably, the Lake Turkana Wind Power (LTWP) has been allocated a maximum production quota of 210MW, against an installed capacity of 310MW.²⁵ While this has been attributed to the Covid-19 pandemic that afflicted almost the whole world in 2020, it raises a concern as to whether the power producers' major customers are only the commercial users. This is because, it has already been pointed out that there are households that still mainly rely on kerosene and biomass as their main source of energy for their inability to afford electricity. Thus, even as we vouch for increased transition to renewable energy by way of increased production, this scenario points out the fact that there is more than availability of the renewable energy: the same must not only be made available but must also be made affordable to the local 'mwananchi' (citizen).

3. Nuclear Power as a Substitute for Fossil Fuels

It has been noted that many countries are reconsidering the role of nuclear energy in their energy mix, as a means to alleviate the concerns over climate change, security of energy supply and the price and price volatility of fossil fuels.²⁶

Thus, the need for alternative sources of energy has been fueled by the combination of climate change fears and a continued growth in energy

²⁴ 'Consumers Pay the Price as Covid Electricity Cuts Hit Turkana Project - The East African' <<https://www.theeastafrican.co.ke/tea/business/consumers-pay-the-price-as-covid-electricity-cuts-hit-turkana-project-1939124>> accessed 1 October 2020.

²⁵ 'Consumers Pay the Price as Covid Electricity Cuts Hit Turkana Project - The East African' <<https://www.theeastafrican.co.ke/tea/business/consumers-pay-the-price-as-covid-electricity-cuts-hit-turkana-project-1939124>> accessed 1 October 2020.

²⁶ Gordelier, Stan, and Ron Cameron. "Comparing nuclear accident risks with those from other energy sources." *Nucl Dev* (2010): 33-40, p.9; Strupczewski, A. "Accident risks in nuclear-power plants." *Applied Energy* 75 (2003): 79-86.

demand as a way of moving away from the global fossil fuel addiction.²⁷ Currently, it is estimated that nuclear fission as one such alternative accounts for 14% of global electricity generation and has the potential to generate significantly more.²⁸ The proponents of use of nuclear energy argue that it has the potential to reduce pollution, cut greenhouse gas emissions, and help countries attain more energy independence.²⁹ The global legal framework on production and use of nuclear energy governs key issues relating to the use and safety of nuclear energy and all countries venturing into this territory are expected to abide by the same. Specifically, the existing international nuclear liability regime is based on the Convention on Third Party Liability in the Field of Nuclear Energy of 29 July 1960, as amended by the Additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982 (1960 Paris Convention) and the Vienna Convention on Civil Liability for Nuclear Damage (1963 Vienna Convention), which set forth the basic principles of nuclear liability law.³⁰ These principles include: the operator of a nuclear installation is exclusively liable for nuclear damage; strict (no fault) liability is imposed on the operator; exclusive jurisdiction is granted to the courts of one State, to the exclusion of the courts in other States; and liability may be limited in amount and in time.³¹ The International Atomic Energy Agency is the main institution that oversees the implementation of these legal instruments among other functions.³² Countries such as France have

²⁷ 'Nuclear Power: The Good, the Bad and the Ugly' <<https://sites.google.com/site/asaksdfuyhlaku/>> accessed 8 September 2020.

²⁸ Ibid.

²⁹ 'International Politics - Nuclear Energy' <<https://sites.google.com/a/ncsu.edu/nuclear-energy/politics/foreign>> accessed 8 September 2020.

³⁰ Gioia, Andrea, "The 1997 Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Convention on Supplementary Compensation. Explanatory Texts." (2007): 5-99 <https://www-pub.iaea.org/MTCD/Publications/PDF/P1768_web.pdf> accessed 8 September 2020.

³¹ Ibid, pp. 1-2.

³² 'International Atomic Energy Agency | Nuclear Energy for Peaceful Uses | NTI' <<https://www.nti.org/learn/treaties-and-regimes/international-atomic-energy->

been using nuclear energy as their biggest contributor to domestic electricity needs.³³ However, it should be noted that even such countries as France and Germany that have far much advanced technology and regulatory frameworks in place for nuclear energy are also cutting down on their use of nuclear energy for its potential negative effects if not well handled.³⁴

4. Nuclear Energy in Kenya: Legal and Institutional Framework

The preferred site for the nuclear plant in the country is Tana River County, near the Kenyan coast which was preferred after studies across three regions. The plant will be developed with a concessionaire under a build, operate and transfer model.³⁵ It is noteworthy that Kenya is still at a nascent stage in its plans to set up nuclear reactors, especially as far as regulatory frameworks are concerned.

4.1 Nuclear Power and Energy Agency (NuPEA)

The Nuclear Power and Energy Agency, formerly Kenya Nuclear Electricity Board (KNEB), is a State Corporation established under the Energy Act 2019.³⁶ The Agency is charged with, inter alia: being the nuclear energy programme implementing organization and promoting the development of nuclear electricity generation in Kenya; and

agency/> accessed 6 October 2020; See also Convention on Third Party Liability in the Field of Nuclear Energy and the Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Convention on Supplementary Compensation for Nuclear Damage.

³³ 'Nuclear Power in France | French Nuclear Energy - World Nuclear Association' <<https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/france.aspx>> accessed 6 October 2020; Velasquez, Carlos E., Fidellis BGL e Estanislau, Antonella L. Costa, and Claubia Pereira. "Assessment of the French nuclear energy system—A case study." *Energy Strategy Reviews* 30 (2020): 100513.

³⁴ • Nuclear Reactors: Permanent Shutdowns by Country Worldwide 2020 | Statista' <<https://www.statista.com/statistics/513639/number-of-permanent-nuclear-reactor-shutdowns-worldwide/>> accessed 6 October 2020.

³⁵ 'Kenya on Course for \$5 Billion Nuclear Plant to Power Industry' *Bloomberg.com* (4 August 2020) <<https://www.bloomberg.com/news/articles/2020-08-04/kenya-on-course-for-5-billion-nuclear-plant-to-power-industry>> accessed 19 August 2020.

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carrying out research, development and dissemination activities in the energy and nuclear power sector.³⁷ The Agency is therefore expected to work closely with the other stakeholders in the energy sector to oversee the setting up and successful running of nuclear energy production projects in the country.

4.2 Nuclear Regulatory Act 2019

The Nuclear Regulatory Bill 2018 was first published by Parliament on November 19, 2018.³⁸ The Bill has since been enacted as law under *Nuclear Regulatory Act, 2019*³⁹ which was enacted to provide for a comprehensive framework for the regulation of safe, secure and peaceful utilization of atomic energy and nuclear technology; the production and use of radiation sources and the management of radioactive waste; the repeal of the Radiation Protection Act and for connected purposes.⁴⁰ While the Act is quite comprehensive, there will be need for constant review as the stakeholders identify what works and what challenges arise in the course of its implementation.

5. Nuclear Energy in Kenya: Getting it Right

Some commentators on the issue have highlighted some of the issues that have made the general public uncomfortable with the idea of Kenya turning to nuclear energy including: lack of properly trained manpower, the overall cost of the project, suitability of the sites where nuclear plants are to be built and nuclear disaster management.⁴¹ However, even as the Government proceeds with the project, there is a need to consider and continually address the issues discussed hereunder to minimize the

³⁷ Sec. 56, Energy Act, No. 1 of 2019, Laws of Kenya.

³⁸ Nuclear Regulatory Bill 2018, Kenya Gazette Supplement No.143 (National Assembly Bills No.27).

³⁹ Nuclear Regulatory Act, No. 29 of 2019, Laws of Kenya.

⁴⁰ *Ibid*, Preamble.

⁴¹ 'A Case for Nuclear Energy in Kenya' (*The Star*) <<https://www.the-star.co.ke/opinion/columnists/2019-04-05-a-case-for-nuclear-energy-in-kenya/>> accessed 19 August 2020.

risk of coming face to face with the potential ugly consequences of mishandling the nuclear reactors.

5.1 Capacity Building

Considering that there are hardly any nuclear engineers currently working for the Nuclear Power and Energy Agency, and despite it doing a lot to ensure the existing engineers are trained and mentored abroad, the Government of Kenya through the agency has been rolling out annual training programmes targeting Kenyans in various fields to build adequate capacity for the country's nuclear power programme.⁴² The training mostly comprises of short and long term programmes in partnership with local and international institutions.⁴³ In the long run, the Government needs to invest in local institutions to enhance their capacity for training.

5.2 Public Awareness

Considering that nuclear energy is a completely new concept among the Kenyan people, there is a need for authorities to sensitise the public on the same. It is commendable that there have been efforts by the relevant authorities to not only organise public forums but also organise primary and secondary schools' writing competitions on nuclear energy.⁴⁴ This should continue in order to address any concerns that the public may have and also for ensuring that there is clear communication among all stakeholders. A well informed public can process and appreciate any information that is disseminated and it also makes it easier for the

⁴² 'A Case for Nuclear Energy in Kenya' (*The Star*) <<https://www.the-star.co.ke/opinion/columnists/2019-04-05-a-case-for-nuclear-energy-in-kenya/>> accessed 19 August 2020.

⁴³ 'A Case for Nuclear Energy in Kenya' (*The Star*) <<https://www.the-star.co.ke/opinion/columnists/2019-04-05-a-case-for-nuclear-energy-in-kenya/>> accessed 19 August 2020.

⁴⁴ 'NuPEA 2020 Essay Contest' <<https://nuclear.co.ke/index.php/en/nupea-2020-essay-contest>> accessed 20 August 2020; 'Library' <<https://nuclear.co.ke/index.php/en/library>> accessed 20 August 2020.

Government to tap into any potential talents out there seeking to pursue knowledge and expertise in the area of nuclear energy production.

6. Lessons from Elsewhere: Making the Best of Nuclear Power

It is estimated that currently, over thirty countries produce and use nuclear energy, with some, like France, producing large portions of their electricity from nuclear power, and others like Brazil and the Netherlands producing small percentages of electricity by nuclear power.⁴⁵ Notably, some countries like China are investing heavily into construction of new plants and others like Germany have long term plans to phase out their plants.⁴⁶ However, a few of the major players as highlighted below demonstrate that even as Kenya seeks to start nuclear power project, the Government should consider moving more towards other sources of renewable energy. Kenya is already hailed as one of the notable producers of renewable energy such as wind power and geothermal power. There is a need to explore these at a higher scale because while they are not cheap to produce, nuclear energy may even prove more expensive and complicated to run due to the potential risks.

6.1 France

As at September 2020, it was estimated that France derives about 75% of its electricity from nuclear energy, due to a long-standing policy based on energy security, making France one of the world's largest net exporter of electricity due to its very low cost of generation, and gains over €3 billion per year from this.⁴⁷ In addition, the country has been very active in developing nuclear technology such as reactors and especially fuel products and services have been a significant export.⁴⁸

⁴⁵ 'International Politics - Nuclear Energy'

<<https://sites.google.com/a/ncsu.edu/nuclear-energy/politics/foreign>> accessed 8 September 2020.

⁴⁶ Ibid.

⁴⁷ 'Nuclear Power in France | French Nuclear Energy - World Nuclear Association'

<<https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/france.aspx>> accessed 4 October 2020.

⁴⁸ Ibid.

According to the available data, the total country's electricity generation in 2017 was 562 TWh broken down as follows: nuclear 398TWh (71%); hydro 55.1 TWh (10%); natural gas 40.4 TWh (7%); wind 24.7 TWh (4%); coal 15.1 TWh (3%); biofuels & waste 10.2 TWh; (2%); solar 10.2 TWh (2%); oil 7.4 TWh (1%).⁴⁹ Despite this success in generation of nuclear power, reports from as recent as January 2020 indicate that the Government of France policy is to reduce reliance on nuclear energy from 75% to 50% of the country's electricity by 2035 by bringing in more renewable power.⁵⁰ In addition, some of the challenges that have led to the closure of some of the reactors include but are not limited to safety-related issues reported at some plants over the past several years, including non-lethal radioactive contamination of workers, electrical fault, cracks in a reactor cover, a chemistry error, water pollution, and a fuel leak.⁵¹ France has also been reacting to pressure from its neighbours including Germany which has been arguing that "nuclear power is not a climate savior. It is risky, expensive and leaves behind radioactive waste for thousands of generations."⁵²

Kenya should therefore anticipate and address similar concerns in time and periodic review of the country's performance is critical.

⁴⁹ Ibid.

⁵⁰ 'France to Cut Nuclear Energy Reliance by 2035: Minister | Reuters' <<https://www.reuters.com/article/us-france-nuclearpower/france-to-cut-nuclear-energy-reliance-by-2035-minister-idUSKCN1NN0OK>> accessed 4 October 2020; Darrell Proctor, 'Last Reactor at Oldest French Nuclear Plant Going Offline' (*POWER Magazine*, 28 June 2020) <<https://www.powermag.com/last-reactor-at-oldest-french-nuclear-plant-going-offline/>> accessed 4 October 2020; Jake Stones, 'French Strategy Boasts Largest 2030 Electrolyser Hydrogen Capacity' (*ICIS Explore*) <<https://www.icis.com/explore/resources/news/2020/09/11/10551839/french-strategy-boasts-largest-2030-electrolyser-hydrogen-capacity>> accessed 4 October 2020.

⁵¹ Darrell Proctor, 'Last Reactor at Oldest French Nuclear Plant Going Offline' (*POWER Magazine*, 28 June 2020) <<https://www.powermag.com/last-reactor-at-oldest-french-nuclear-plant-going-offline/>> accessed 4 October 2020.

⁵² Deutsche Welle (www.dw.com), 'France Shuts down First Reactor of Fessenheim Nuclear Plant near German Border | DW | 22.02.2020' (*DW.COM*) <<https://www.dw.com/en/france-shuts-down-first-reactor-of-fessenheim-nuclear-plant-near-german-border/a-52466064>> accessed 4 October 2020.

6.2 Germany

Germany itself currently has six nuclear power plants operating all of which are all scheduled to be shut down by the end of 2022.⁵³ The 2011 Fukushima nuclear disaster in Japan led to widespread anti-atomic-power protests across Germany after which it is reported that German Chancellor Angela Merkel announced that all plants would be closed over the next decade, making Germany the second country after Italy to shut down all of its atomic energy stations.⁵⁴ This is a pointer that nuclear energy may not always be the answer and there is a need to tap into more renewable sources of energy in the country.

6.3 Sweden

The construction of Sweden's first commercial nuclear power plant started on 1 August 1966 and grid connection was carried out on 19 August 1971, namely Oskarshamn-1, which was retired in 2017 after an estimated generation of total of 110 TWh over its lifetime.⁵⁵ The shutdown of O1 left eight reactors operating in Sweden, one at Oskarshamn (O3), four at Ringhals and three at Forsmark where

⁵³ Deutsche Welle (www.dw.com), 'France Shuts down First Reactor of Fessenheim Nuclear Plant near German Border | DW | 22.02.2020' (DW.COM) <<https://www.dw.com/en/france-shuts-down-first-reactor-of-fessenheim-nuclear-plant-near-german-border/a-52466064>> accessed 4 October 2020; 'Germany Shuts down Atomic Plant as Nuclear Phase-out Enters Final Stretch | News | DW | 31.12.2019' <<https://www.dw.com/en/germany-shuts-down-atomic-plant-as-nuclear-phase-out-enters-final-stretch/a-51845616>> accessed 4 October 2020.

⁵⁴ Deutsche Welle (www.dw.com), 'Germany Shuts down Atomic Plant as Nuclear Phase-out Enters Final Stretch | DW | 31.12.2019' (DW.COM) <<https://www.dw.com/en/germany-shuts-down-atomic-plant-as-nuclear-phase-out-enters-final-stretch/a-51845616>> accessed 4 October 2020; 'Germany Demolishes Cooling Tower of Former Nuclear Power Plant | News | DW | 09.08.2019' <<https://www.dw.com/en/germany-demolishes-cooling-tower-of-former-nuclear-power-plant/a-49967279>> accessed 4 October 2020.

⁵⁵ Ihédate and ihédate, 'Sweden Retires First Commercial Nuclear Reactor (Oskarshamn-1)' (World Nuclear Industry Status Report, 20 June 2017) <<https://www.worldnuclearreport.org/Sweden-Retires-First-Commercial-Nuclear-Reactor-Oskarshamn-1.html>> accessed 5 October 2020.

Ringhals-2 was scheduled to shut down in 2019, with Ringhals-1 to follow in 2020.⁵⁶ The closure decision was taken for commercial reasons, and although the price of electricity has recovered since 2015, the assessment was that it would not be possible to continue operation of either of the two reactors, for both economic and practical reasons.⁵⁷

7. Realizing the Right to Clean and Sustainable Energy for all

It has been argued that since energy cannot be created or destroyed, one of the best ways of ensuring that all Kenyans have access to clean energy is promoting energy efficiency.⁵⁸

Goal 7 of the Sustainable Development Goals (SDGs) seeks to ensure that there is access to affordable, reliable, sustainable and modern energy for all.⁵⁹ Particularly, countries are expected to ensure that by 2030, there is universal access to affordable, reliable and modern energy services; substantial increase in the share of renewable energy in the global energy mix and doubling the global rate of improvement in energy efficiency.⁶⁰ Thus, away from nuclear energy, the Government

⁵⁶ Ibid; 'Ringhals 2 Nuclear Plant Shuts Down' (*Vattenfall*) <<https://group.vattenfall.com/press-and-media/news--press-releases/newsroom/2019/ringhals-2-nuclear-plant-shuts-down>> accessed 5 October 2020; 'Ringhals 2 Enters Retirement: Corporate - World Nuclear News' <<https://world-nuclear-news.org/Articles/Ringhals-2-enters-retirement>> accessed 5 October 2020; 'Sweden Closes Nuclear Reactor after over 40 Yrs of Operation' (*AP NEWS*, 30 December 2019) <<https://apnews.com/article/a08facfe81523e85083e21ffe1ded681>> accessed 5 October 2020.

⁵⁷ 'Ringhals 2 Nuclear Plant Shuts Down' (*Vattenfall*) <<https://group.vattenfall.com/press-and-media/news--press-releases/newsroom/2019/ringhals-2-nuclear-plant-shuts-down>> accessed 5 October 2020.

⁵⁸ Munene, Martin Brown, Janes Ouma Odongo, and Anne Nyambane. "Energy Efficiency in Kenya." (2019). Available at <https://ke.boell.org/sites/default/files/energy_efficiency_in_kenya_study_.pdf> Accessed on 1 September 2020.

⁵⁹ UN General Assembly, *Transforming our world: the 2030 Agenda for Sustainable Development*, 21 October 2015, A/RES/70/1, SDG Goal 7.

⁶⁰ Ibid.

of Kenya needs to put in place other measures to enhance the efficiency of the available sources of renewable energy as well nonrenewable sources while minimizing any negative effects that these may have on the environment or the public's health.

7.1 Expanding infrastructure and upgrading technology for supplying modern and sustainable energy services

SDG Goal 7.b seeks to ensure that by 2030, countries expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all especially in developing countries, in particular least developed countries, Small Island developing States and landlocked developing countries, in accordance with their respective programmes of support.

In line with the 'Last Mile Project', there is a need for the Government of Kenya to continually invest in infrastructure as well as upgrading energy technology to ensure that all Kenyans have access to modern and sustainable energy. As things stand, there is a huge number of Kenyans who still rely of non-renewable energy such as kerosene, wood and charcoal (biomass), thus making it difficult to achieve the minimum 10% tree cover as provided for under Article 69 of the Constitution of Kenya 2010.⁶¹

Under Kenya's Vision 2030 and specifically the National Renewable Energy Master Plan, the Government of Kenya hopes to 'promote development of renewable energy as an alternative source of energy which will include generation of energy from solar, wind, biogas, development of bio-energy including bio-ethanol and diesel value

⁶¹ 'How Kenya Can Transform the Charcoal Sector and Create New Opportunities for Low-Carbon Rural Development on JSTOR' <https://www.jstor.org/stable/resrep02811?seq=1#metadata_info_tab_contents> accessed 21 September 2020.

chains and promotion of the use of improved cooking stoves and charcoal kilns, and re-afforestation of water towers.⁶²

While these aspirations come with social, economic and political challenges, if achieved, they can go a long way in achieving the right to affordable and sustainable energy for all.

7.2 Mainstreaming Gender Issues in Energy and Addressing Poverty

Some authors have argued that if the right to energy for all Kenyans is to be realized, then gender issues ought to be tackled. This is because of the important role that women play when it comes to meeting the energy needs of families especially in the rural setting.⁶³ Facilitating access to clean energy for women not only contributes to strengthening families and their health but also creates business opportunities for them.⁶⁴

There is also a need to address poverty levels in the country. An economically empowered household is likely to have more choices when it comes to energy use for their domestic needs. Enhancing energy production in the country without addressing the socioeconomic factors that make energy unavailable to most households in the first place may not achieve much as far as adoption of cleaner sources of energy is concerned.

7.3 Promoting Energy Efficiency in Kenya

A number of studies have been carried out on factors that affect energy efficiency practices and how the stakeholders in the Kenyan energy sector can enhance energy efficiency in the country. Some of the energy

⁶² 'Development of New and Renewable Sources of Energy | Kenya Vision 2030' <<https://vision2030.go.ke/project/development-of-new-and-renewable-sources-of-energy/>> accessed 30 September 2020.

⁶³ 'Women in Energy Means More Clean Energy for All across Africa' <<https://www.esi-africa.com/industry-sectors/future-energy/women-in-energy-means-more-clean-energy-for-all-across-africa/>> accessed 28 September 2020.

⁶⁴ Ibid.

demand and consumption aspects that influence the adoption of energy efficiency practices in the country that have been identified include: the different types of energy being used domestically in the household level; the respondents' knowledge of energy efficiency; household energy consumption monitoring/tracking trends; respondents' perception of energy efficiency; knowledge on the potential energy efficiency practices; benefits associated with energy efficiency; and their knowledge regarding climate change dynamics and how these compare with domestic energy use.⁶⁵

Promoting energy efficiency practices has been hailed not only as a way to ensure that there is enough energy for all but also as a climate mitigation measure.⁶⁶ As a result, Kenya's Climate Change Action Plan 2018–2022 has prioritized enhancement of energy efficiency as one of the priority actions to mitigate climate change in the country.⁶⁷ It is important to point out that producing power without promoting efficient consumption of the same will mean that it may be counterproductive as it may never be enough for everyone. There is need for continued promotion of diverse methods of enhancing efficiency across use of all

⁶⁵ Munene, Martin Brown, Janes Ouma Odongo, And Anne Nyambane, 'Energy Efficiency in Kenya: Public Awareness, Strategies, Challenges & Opportunities | Heinrich Böll Stiftung | Nairobi Office Kenya, Uganda, Tanzania, Somalia/Somaliland' (Heinrich-Böll-Stiftung)

<<https://ke.boell.org/en/2019/09/16/energy-efficiency-kenya-public-awareness-strategies-challenges-opportunities>> accessed 3 October 2020; Zaharia, Alina, Maria Claudia Diaconeasa, Laura Brad, Georgiana-Raluca Lădaru, and Corina Ioanăș. "Factors Influencing Energy Consumption in the Context of Sustainable Development." *Sustainability* 11, no. 15 (2019): 4147; Temiz Dinç, Dilek, and Ece C. Akdoğan. "Renewable energy production, energy consumption and sustainable economic growth in Turkey: A VECM Approach." *Sustainability* 11, no. 5 (2019): 1273; Jian, Jianhui, Xiaojie Fan, Pinglin He, Hao Xiong, and Huayu Shen. "The effects of energy consumption, economic growth and financial development on CO2 emissions in China: A VECM Approach." *Sustainability* 11, no. 18 (2019): 4850.

⁶⁶ 'Promoting Energy Efficiency as a Climate Change Mitigation Action in Kenya | UNDP in Kenya' (UNDP) <<https://www.ke.undp.org/content/kenya/en/home/stories/2019/lecrd-promoting-energy-efficiency.html>> accessed 4 October 2020.

⁶⁷ Ibid.

sources of energy and in all sectors such as through ensuring that energy efficient appliances are not only available but also affordable, there is a wider use of efficient technology to take advantage of the available sources of energy such as biomass to come up with the most efficient and less polluting forms of the same and even use of biogas in villages for lighting and cooking. As already pointed out, biomass provides about 69% of the country's overall energy requirements while petroleum accounts for about 22% and electricity about 9% and as at June, 2017, 65.6% of the electricity component was generated using renewable energy sources with fossil fuels providing the balance of 34.4%.⁶⁸ There is a need to expand the use of these sources to generate more electricity.

Private persons may also be considered for funding to come up with larger scale biogas production projects to light villages.⁶⁹ This will not only create employment for more people but will also promote cleaner energy technologies and climate change mitigation.

7.4 Capacity Building for Adoption of Nuclear Power

It is commendable that the Government of Kenya already put in place the Nuclear Power and Energy Agency as envisaged under the Energy Act, 2019 and also enacted the Nuclear Regulatory Act 2019. However, it is true that the Agency requires to work closely with other stakeholders across the board. While the Government has shown some efforts towards training of personnel to create expertise in nuclear power, there is a need for sustained and long term efforts for capacity building through training of engineers in industry and consultants as well as developing localized university and polytechnic level training in the country.

⁶⁸ Republic of Kenya, *National Energy Policy*, October, 2018, para. 3.

⁶⁹ Huber, Sebastian. "Small-scale biogas production from organic waste and application in mid-income countries—a case study of a Lebanese community." (2019) < <http://www.diva-portal.org/smash/get/diva2:1334609/FULLTEXT01.pdf>> accessed 4 October 2020.

8. Conclusion

Some of the existing studies have concluded that although the government of Kenya has done so much to turn around energy use practices in the country, and the take up of these is increasing, most citizens still use crude energy sources basically wood, charcoal and crude fuels. There also seems to be a disconnect between the reported government efforts and achievements vis-à-vis actual public energy use practices pointing to both a communication gap and inability of the citizens to quickly take up these projects. Thus, while this paper supports the government's efforts to diversify the available sources of renewable energy in Kenya, there is also a need for continued public awareness campaigns to sensitize the public on the need for practicing energy efficiency regardless of the energy source in question. It is not just about affordability and availability of energy but also how efficiently the same is utilized.

Such energy sources as nuclear power, while viable in the country require continued consultations, creating public awareness and immense investment in radioactive waste handling and disposal for the sake of public health and environmental protection. Indeed, some commentators have argued that African countries looking to invest in nuclear energy as a source of clean electricity should consider Europe's struggles with disposing of radioactive waste.⁷⁰ It is therefore important that the Government expands its choices while trying to meet the current and future energy needs of the country by investing more in the already available renewable sources of energy, enhance efficiency and also ensure affordability by a wider group. Exploring alternative sources of energy is a worthwhile exercise in line with Kenya's quest for Sustainable Development.

⁷⁰ Deutsche Welle (www.dw.com), 'What Happens to Nuclear Waste from Power Plants? | DW | 13.11.2019' (*DW.COM*) <<https://www.dw.com/en/what-happens-to-nuclear-waste-from-power-plants/a-51216359>> accessed 4 October 2020.

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