**FUSION TECHNOLOGY AN ANTIDOTE TO NUCLEAR ENERGY DEPLOYMENT IN AFRICA: A CASE STUDY OF NIGERIA**

*Ini Godwin[1], O.N Ofodile[2]*
*Nigeria Atomic Energy Commission[1], Nigerian Army Simulation Center[2]*
*inigodwin7777@gmail.com*

## 1.0 Introduction

Fusion, a process in stars, generates energy from light nuclei forming heavier nuclei. On Earth, hydrogen gases are heated to over 100 million degrees Celsius, creating a plasma with millions of reactions. This plasma can generate a large amount of energy from small fuel amounts. The tokamak, a ring-shaped magnetic chamber, is used to control the intensely hot plasma. CCFE aims to develop fusion reactors using this concept. This study shows an analysis focused on the potential of fusion technology in Africa; Nigeria as a case study, using advocacy, detailing the overwhelming benefits of fusion technology over other technology, and recommendations [1].

## 1.1 The Importance of Public Engagement in Nuclear Energy

South Africa, the only operational nuclear power plant in Africa, has actively engaged with the public to address safety concerns. The National Nuclear Regulator and Eskom hold public hearings and Public Safety Information Forums, involving local communities, industry stakeholders, media, and NGOs. The Department of Energy holds seminars and offers media training programs. Recurring polls provide valuable data on public attitudes towards nuclear energy [2]. Climate change is a significant global challenge, with the energy sector contributing to over two-thirds of global greenhouse gas emissions. Mitigation and adaptation strategies are needed to combat this issue. Technological advancements are needed to support low-carbon options and transition towards a cleaner, more sustainable energy system. Renewable energy technologies are being developed, particularly in electricity generation, which has experienced a peak in GHG emissions in 2018 [3].


Figure 1. Geographic position of African countries that have pursued integrated Nuclear Infrastructure Review (INIR) mission to kick-start or extend their nuclear programs

Table 1.0 Status of intended African countries towards nuclear energy program (Kofi, 2020)

| **Country** | **Electricity per capital (kwh)** | **Current Energy Source (%)** | **Potential Vendor** | **Grid Capacity (Mwe)** | **Intended NPP capacity (Mwe)** | **Population density (people/km$^2$)** |
|---|---|---|---|---|---|---|
| Egypt | 1,792 | Oil (38), Gas (53), Coal (1), Hydro (4), Renewables (4) | Russia | 58,051 | 4,800 | 103 |
| Ghana | 496 | Oil (43), Gas (25), Hydro (16), Renewables (16) | Russia | 4,577 | 1,000 | 140.34 |
| **Nigeria** | **151** | **Oil (53), Gas (40), Hydro (4), Renewables (3)** | **Russia, China** | **12,522** | **4.800** | **242.27** |
| South Africa | 3,936 | Oil (14), Coal (72), Gas (3), Renewables (9), Nuclear (2) | France, China, USA, Russia | 51,309 | >20,000 | 49.58 |
| Sudan | 223 | Oil (67), Biomass (33) | Russia, China | 3,015 | 1,200 | 24.96 |
| Uganda | 85 | Oil (4), Biomass (88), Hydro (7), Renewables (1) | Russia, China | 1,268 | 2,000 | 201.13 |

IEA, 2022: Our world in data, 2023 [4].

### 1.3 Nigeria

Nigeria has been exploring the possibility of nuclear power as a solution to its energy deficit since the creation of the Nigeria Atomic Energy Commission (NAEC) in 1976 via the NAEC Act. However, the implementation of the NPP project has been delayed due to political instability, opposition from civil society organizations, and concerns over technical and security risks associated with nuclear energy. However, in the last eight years, the NPP programme has been revamped with Nigeria attaining the IAEA milestone two in NPP programme development. It is necessary to say that Nigeria is currently carrying out research in fusion technology. This it has made one of her core mandates to explore fusion technology and its possible applications. Fusion technology holds significant promise for Nigeria and the Africa continent at large, as it could play a transformative role in addressing the continent's energy challenges, economic growth, and environmental sustainability. It is true that most African leaders and players in the energy diocese in Nigeria are skeptical about nuclear [5].

### 1.4 Strategies for advancing nuclear fission technology in Nigeria and the African sub-region

The strategies for advancing nuclear fission technology in Africa, is been focused on policy and regulatory reforms. Three effective strategies include stakeholder engagement, evidence-based approaches, and investment in capacity building. Stakeholder engagement encourages diverse perspectives, while evidence-based approaches ensure rigorous analysis and desired outcomes. Investment and financing mechanisms are crucial for the deployment of nuclear fission technology in Africa. High capital costs and lack of affordable financing hinder NPPs' development, human capacity, research, and infrastructure, making them difficult to finance without external assistance [6].

### 1.5 The need to embrace fusion technology

Fusion technology holds significant promise for Nigeria and the Africa continent at large, as it could play a transformative role in addressing the continent's energy challenges, economic growth, and environmental sustainability. It is true that most African leaders and players in the energy diocese in Nigeria are skeptical about nuclear. The quotation known as Not-in-my-backyard-syndrome has eaten deep into hampering the progress of nuclear energy development in Nigeria. Fusion technology has potentials to address those fears in the mind of these government officials and captain of industries. Fusion technology as taken care of questions that could arise from nuclear waste, safety, clean and sustainable energy, environmental benefits, minimized nuclear waste, decentralized energy solution, technology innovation and leadership, building research capacity, availability of fusion fuel and long-term sustainability [7].

### 1.6 Conclusion

Fusion technology could play a transformative role in Nigeria's energy future, offering sustainable, reliable, and environmentally friendly energy solutions. By strategically investing in fusion research and aligning it with national interests, Nigeria could enhance its energy security, drive economic development, and position itself as a leader in advanced energy technologies within Africa and beyond. However, careful planning, investment, and consideration of challenges are essential to realize this potential. Fusion technology could be a game-changer for Africa, offering a sustainable, clean, and virtually limitless energy source to fuel economic growth, combat energy poverty, and contribute to global efforts against climate change. The long-term benefits make fusion technology a worthy investment for Africa’s future energy security and prosperity. Embracing fusion technology today could set Africa on a path toward becoming a leader in clean energy in the coming decades.

### References


[1] J.H.B. Opschoor, Fighting climate change - human solidarity in a divided world, Dev. Change 39 (6) (2008) 1193–1202, https://doi.org/10.1111/j.1467- 7660.2008.00515.x.

[2] International Energy Agency, If the energy sector is to tackle climate change, it must also think about water, IEA (2020). https://www.iea.org/commentaries/i f-the-energy-sector-is-to-tackle-climate-change-it-must-also-think-about-water. (Accessed 28 July 2022).

[3] Intergovernmental Panel on Climate Change, Climate Change 2022 - Mitigation of Climate Change - Summary for Policymakers, SPM, 2022 no. 1.

[4] United Nations, Framework Convention on Climate Change, Paris Agreement, Paris, 2015.

[5] International Renewable Energy Agency, Accelerating the Energy Transition through Innovation, UAE, Dubai, 2017.

[6] International Renewable Energy Agency, Global Renewables Outlook: Energy Transformation 2050, UAE, Dubai, 2020.

[7] International Energy Agency, Tracking Power 2021 (2021).