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# The decline in gas flaring in Nigeria has not led to a decrease in greenhouse gas emissions

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**ABSTRACT:** The Global Gas Flaring Tracker Report 2023 highlights Nigeria'sstrides in decreasing gas flaring, yet recent data reveals a continuous rise in the country's greenhouse gas (GHG) emissions. This raises uncertainty about whether the reported reduction in gas flaring can effectively lower Nigeria's GHG emission targets.Therefore, this article scrutinizes the Nigerian government's initiatives to curb gas flaring nationwide and delves into the ramifications of this reduction on the country's overall GHG emissions. The findings of this study reveal that despite the decline in gas flaring, it has not significantly curbed GHG emissions in Nigeria. Consequently, the article concludes that solely reducing gas flaring may not sufficiently mitigate climate-related adverse effects nor substantially decrease overall GHG emissions, as gas flaring represents only a fraction of the country's GHG emissions.

***KEYWORDS***: *Clean Development Mechanism, Nigeria, GHG Emissions, Gas Flaring, Gas Flaring Policies in Nigeria.*

## I. INTRODUCTION

The Nigerian government launched significant gas utilization projects on a national scale, with the primary goals of reducing gas flaring and mitigating greenhouse gas emissions.[1] Similarly, the Kyoto Protocol introduced the Clean Development Mechanism (CDM) to aid developing countries in their efforts to decrease GHG emissions.[2] Nigeria has witnessed the registration of numerous CDM programs, primarily targeting the phasing out of gas flaring and the reduction of GHG emissions. While initial reports suggest positive progress, with Nigeria's transition from being the second-highest gas flaring country in 2008 to the ninth largest in 2023.[3] Both the gas utilization projects and the CDM program purportedly contributed to a reduction in GHG emissions, as indicated by the Biennial Report estimating a decrease of approximately 6,967 GHG emissions in Nigeria.[4] However, a detailed investigation reveals that GHG emissions in Nigeria have remained consistently steady and are on a continuous upward trend.[5] Therefore, this study examines both the gas utilization projects and registered CDM initiatives in Nigeria, questioning whether the reported reduction in gas flaring genuinely corresponds to an overall decrease in GHG emissions in the country.

Firstly, this article begins by examining the current status of gas flaring in Nigeria. Secondly, it delves into the connection between gas flaring and GHG emissions, elucidating the correlation between the two. Thirdly, it explores Nigeria's key policies aimed at promoting gas utilization over flaring, highlighting the establishment of pivotal gas utilization projects as a result of these policies, which have contributed to the decrease in gas flaring. The fourth section of the article focuses on the CDM program and the registered gas utilization projects within Nigeria's energy sector. It evaluates these projects and concludes that while they claim

[1] H A Sharif and I B Garba, Gas Flaring: When Will Nigeria Decarbonise Its Oil and Gas Industry (2016) 1(3) International Journal of Economy, Energy and Environment, 40-54, 46; Federal Republic Of Nigeria, National Energy Policy [Draft Revised Edition (Energy Commission Of Nigeria 2018) 12-14 <http://www.energy.gov.ng/Energy_Policies_Plan/National%20Energy%20Policy.pdf> accessed 1 November 2023 ; The Government Of The Federal Republic Of Nigeria 'Nigeria National Gas Policy' (2017) 61-62 available >http://www.petroleumindustrybill.com/wp-content/uploads/2017/06/National-Gas-Policy-Approved-By-FEC-in-June-2017.pdf> accessed 15thDecember 2023 ; Nigerian Gas Flare Commercialization Programme <http://www.ngfcp.gov.ng/> accessed 13th December 2023 ; Nigeria Gas Master Plan (NGMP) 2008 ; NationalDomesticGasSupplyandPricingRegulation2007.

[2] M.R., Singh and N Naik, 'Role of the Clean Development Mechanism (CDM) in the Development of National Energy Industries' 2014 25(2) Energy & Environment, pp.325-342; W Broere, the elusive goal to stop flares 2008 Shell World.

[3]Global Gas Flaring Tracker Report 2023, GGFR available at 2023-Global-Gas-Flaring-Tracker-Report.pdf (worldbank.org) accessed 23 February 2024.

[4]Ibid, Federal Republic of Nigeria (2018) First Biennial Update Report (BUR1) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC) 133-134.

[5]EDGAR - Emissions Database for Global Atmospheric Research, GHG emissions of all world countries
2023 report available at EDGAR - The Emissions Database for Global Atmospheric Research (europa.eu) accessed 12 January 2024.

to reduce gas flaring and emissions, this reduction does not translate into an overall decrease inGHG emissions in Nigeria, as GHG emissions continue to rise. Finally, the fifth section briefly examines why the reduction in gas flaring has not resulted in an overall decrease in GHG emissions in Nigeria.

## II. THE CURRENT SITUATION OF GAS FLARING IN NIGERIA

One of Nigeria's objectives outlined in its Nationally Determined Contributions (NDC) under the Paris Agreement is to cease gas flaring by the year 2030.[6] NDCs represent the actions that nations commit to taking under the Paris Agreement to combat climate change on a national scale.[7]Ending gas flaring entails that International Oil Corporations (IOCs) engaged in flaring associated gas in Nigeria must cease this practice. Associated gas refers to natural gas present in oil wells alongside crude oil.[8]When this associated gas surfaces with crude oil during production, operators typically have three primary options for handling it: firstly, re-injecting the gas into an underground reservoir; secondly, utilizing the gas for domestic and commercial purposes; and thirdly, disposing of the gas through flaring (burning it off).[9]

Among the three primary options, re-injecting gas into an underground reservoir presents significant challenges due to the expensive infrastructure and complex machinery required.[10]Similarly, harnessing the gas for domestic and commercial use demands costly facilities and equipment, such as pipelines for transportation from oil wells to processing centers.[11] In contrast, the option of disposing of the gas through flaring is comparatively less expensive, imposing a less substantial financial burden than re-injection or utilization for domestic and commercial purposes.[12] Evidence suggests that operators in Nigeria's oil and gas industry predominantly opt for the third option, flaring the associated gas, due to its affordability and convenience. For instance, Chevron, one of the IOCs operating in Nigeria, stated that gas flaring would cost the company $1 million while transitioning from water to gas injection would incur a cost of $56 million.[13] Statistics reveal that approximately 17% of Nigeria's total daily gas production is re-injected, 33% is utilized commercially, and the remaining 50% is wasted through flaring.[14]Studies indicate that Nigeria flared 10.73 billion cubic meters of its associated gas production, accounting for 12% of its gross production.[15] According to the Global Gas Flaring Reduction Initiative, Nigeria flared about 17.2 billion cubic meters in 2000.[16]Nigeria was consistently rated among the second-highest gas flaring countries between 2007 and 2011.[17]

Copied from enormous energy.[18]

[6]Nigeria's Intended Nationally Determined Contribution (Submitted by The Federal Government of Nigeria Being a Requirement by Conference of Parties to the United Nations Framework Convention on Climate change (COP-UNFCCC) in Preparation for the Adoption of Climate Change Agreement at the Paris Conference on Climate change coming up in December 2015 Prepared by the Federal Ministry of Environment. 2-3 and 14

[7] F-Z Taibi and S Konrad, Pocket Guide to NDCs under the UNFCCC (ecbi 2018) 1-2.

[8] M Thurber M. Gas Flaring: Why does it happen and what can stop it? (2019) Sandford University 1; B Buzco-Guven and R Harriss, 'Gas flaring and venting: extent, impacts, and remedies' 2010 Energy Forum 1-72 at 8.

[9]B Buzco-Guven and R Harriss, 'Gas flaring and venting: extent, impacts, and remedies' 2010 Energy Forum 1-72 at 1-9; J U Orji, 'Moving from gas flaring to gas conservation and utilisation in Nigeria: a review of the legal and policy regime' (2014) 38(2) OPEC Energy Review 149-183; 150.

[10] J U Orji, 'Moving from gas flaring to gas conservation and utilisation in Nigeria: a review of the legal and policy regime' (2014) 38(2) OPEC Energy Review 149-183; 150.

[11] Ibid.

[12] B Buzco-Guven and R Harriss, 'Gas flaring and venting: extent, impacts, and remedies' 2010 Energy Forum 1-72; 1-9; J U Orji, 'Moving from gas flaring to gas conservation and utilisation in Nigeria: a review of the legal and policy regime' (2014) 38(2) OPEC Energy Review 149-183; 150.

[13] J U Orji, 'Moving from gas flaring to gas conservation and utilisation in Nigeria: a review of the legal and policy regime' (2014) 38(2) OPEC Energy Review 149-183; 154

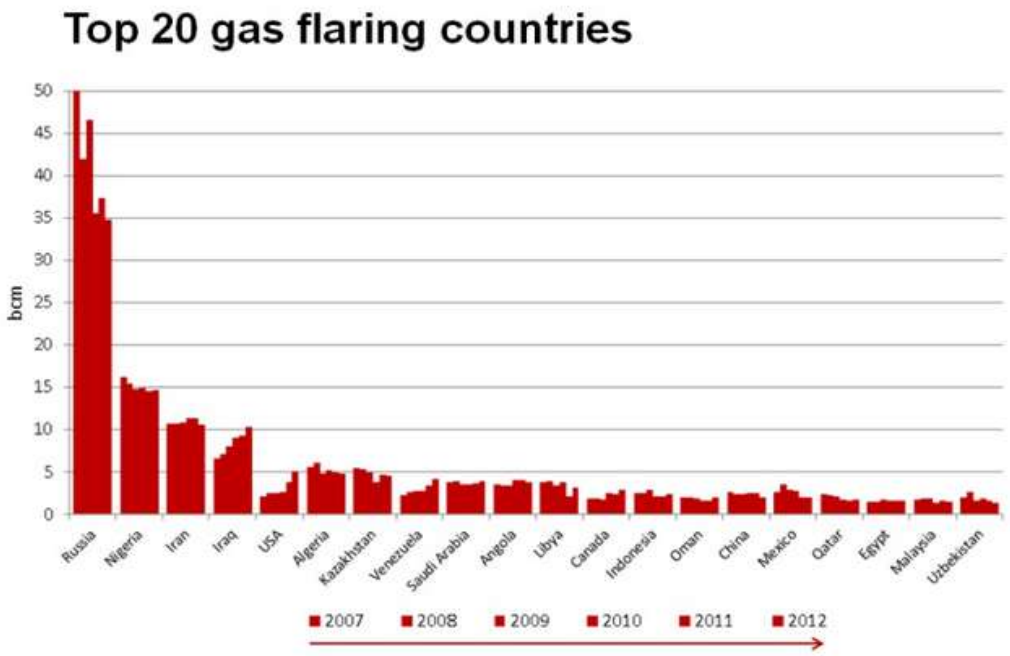
[14]B Buzco-Guven and R Harriss, 'Gas flaring and venting: extent, impacts, and remedies' 2010 Energy Forum 1-72 44.

[15]Federal Republic of Nigeria (2018) First Biennial Update Report (BUR1) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC)
Biennial 27-29;Energy Information Administration (EIA), Country Analysis Brief: Nigeria (2016) <https://www.eia.gov/beta/international/analysis_includes/countries_long/Nigeria/nigeria.pdf>accessed 5th March 2024.

[16]Global Gas Flaring Reduction Initiative available at World Bank Document at pp 34 and 15 accessed 5th March 2024.

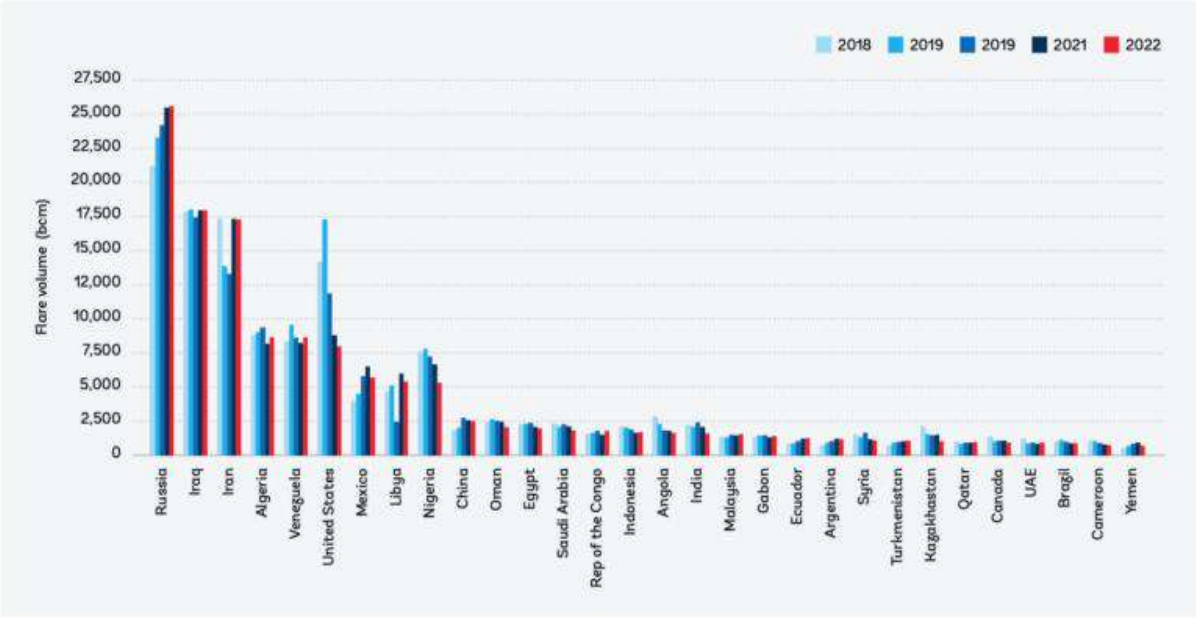
[17]CElvidge andM Zhizhin,'A fifteen-year record of global natural gas flaring derived from satellite data'(2009) 2 (3) Energies, 2(3), pp.595-622. at 607.

[18]Flaring and Its Environmental Aspects: Vanity, Economics, And Carbon Emissions available at FLARING AND ITS ENVIRONMENTAL ASPECTS: VANITY, ECONOMICS, AND CARBON EMISSIONS (energy-techno.blogspot.com)> accessed 5th March 2024.




However, the current situation in Nigeria tells a different story. According to the Global Gas Flaring Tracker Report 2021, Nigeria has made considerable progress over 15 years in reducing gas flaring.[19] The latest Global Gas Flaring Tracker Report from 2023 indicates that Nigeria has now moved to the ninth-largest flaring country. The report states: "Nigeria contributed the most to the overall global reduction, reducing its flare volumes by 1.3 billion cubic meters in 2022, a 20% reduction from 2021 levels." [20]Therefore, Nigeria's current position in terms of gas flaring is ninth, signifying a significant reduction from previous years.

Figure 3 Flare volumes for the top 30 flaring countries from 2018 to 2022 (sorted by 2022 flare volume)[21]




[19]Global Gas Flaring Tracker Report APRIL 2021, available at WB-GGFR-Report-Design-05a.pdf (developmentaid.org)>accessed 5th March 2024.
[20]Global Gas Flaring Tracker Report March 2023 available at 2023-Global-Gas-Flaring-Tracker-Report.pdf (worldbank.org) accessed 5th March 2024.

[21]Global Gas Flaring Tracker Report March 2023 available at 2023-Global-Gas-Flaring-Tracker-Report.pdf (worldbank.org) accessed 5th March 2024.

## III. THE CORRELATION BETWEEN GAS FLARING AND GHG EMISSIONS

The flaring of associated gas is a significant source of carbon dioxide (CO2) emissions.[22]This is primarily because natural gas, which constitutes the majority of associated gas, contains methane (CH4) and ethane (C2H6), both of which contain carbon.[23] During the process of gas flaring, the hydrocarbons present in natural gas are not completely combusted, resulting in the production of CO2.[24] CO2 is a GHG that contributes to the greenhouse effect by trapping heat in the Earth's atmosphere, thereby leading to global warming and climate change.[25] Additionally, methane, another GHG emitted during gas flaring, is particularly potent with a higher global warming potential than CO2 over a 20-year timeframe.[26] Although gas flaring is primarily intended to burn off methane, there is a possibility that some methane may escape unburned during the process.[27] The release of methane exacerbates climate change by trapping heat more efficiently than CO2, albeit over a shorter period, before eventually degrading into CO2.[28] Therefore, the process of gas flaring contributes significantly to GHG emissions and further exacerbates the challenges posed by climate change.

Moreover, gas flaring is also responsible for releasing other GHGs such as nitrous oxide (N2O), notwithstanding in smaller quantities.[29] Additionally, the process of flaring can emit particulate matter and black carbon, which contribute to atmospheric warming by absorbing sunlight and altering cloud formation processes.[30] Gas flaring not only contributes to climate change but also poses direct environmental and health risks to nearby communities.[31] The release of pollutants like Sulfur Dioxide (SO2), Nitrogen Oxides (NOx), and Volatile Organic Compounds (VOCs) from flaring can lead to air pollution, respiratory issues, and other adverse health effects.[32] To sum up, gas flaring serves as a significant source of GHG emissions, primarily CO2 and methane, which exacerbate climate change and its associated impacts on the environment and human health.

It is important to note that GHG emissions extend beyond gas flaring. Numerous human activities contribute to the release of GHGs, such as the burning of coal, waste disposal, deforestation, and many others.[33]These activities, categorized by the Intergovernmental Panel on Climate Change (IPCC) as drivers of climate change, collectively impact the Earth's climate system. For the scope of this article, we will refocus on gas flaring and the reduction of GHG emissions in Nigeria. However, we will revisit the broader context of GHG emissions drivers later in this discussion.

## IV.NIGERIA'S DOMESTIC STRATEGIES FOR ELIMINATING GAS FLARING

Currently, the Nigerian government is actively promoting projects aimed at utilizing natural gas to eliminate the flaring of associated gas.[34]This initiative entails operators harnessing the gas and utilizing it for electricity generation or other domestic purposes instead of simply burning it off.[35] The overarching goal is twofold: to reduce gas flaring and stimulate economic growth.[36] The concept of utilizing gas to reduce emissions and foster economic development is enshrined in the National Energy Policy (NEP). For instance, one of the specific

[22] B Buzco-Guven and R Harriss, 'Gas flaring and venting: extent, impacts, and remedies' 2010 Energy Forum 1-72; 10.
[23] Le Corre, Olivier, and Khaled Loubar. 'Natural gas: physical properties and combustion features.' (2010) In *Natural Gas*. IntechOpen,
[24]O Ismail and G Ezaina Umukoro, 'Modelling combustion reactions for gas flaring and its resulting emissions' (2016) 24(2) *Journal of King Saud University-Engineering Sciences* 130-140.
[25]P C Jain, 'Greenhouse effect and climate change: scientific basis and overview. (1993) 3 (4-5) *Renewable energy*, pp.403-420.
[26]R W Howarth, 'Methane emissions and climatic warming risk from hydraulic fracturing and shale gas development: implications for policy' (2015). *Energy and Emission Control Technologies*, pp.45-54.
[27] Ibid.
[28]J Donald and H Katharine, 'Atmospheric methane and global change' (2002) 3 (4) *Earth-Science Reviews* pp.177-210.
[29] J Roosenbrandand P Levelt, 'Nitrogen oxide emissions from US oil and gas production: Recent trends and source attribution.' (2020) 47 (1) *Geophysical Research Letters*, p, 20.
[30]ND James and R Matthew, 'Black carbon particulate matter emission factors for buoyancy-driven associated gas flares. (2012) 62(3) *Journal of the Air & Waste Management Association* pp, 307-321.
[31]DBernard andM Lisa, 'Potential public health hazards, exposures and health effects from unconventional natural gas development' (2014) 48 (15) (*Environmental science &pp*, 8307-8320.
[32] Ibid.
[33] G R Blanco and P. Zhou, 2014: Drivers, Trends and Mitigation. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (eds.)] Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA at 380-385
[34]Federal Republic Of Nigeria, National Energy Policy [Draft Revised Edition (Energy Commission Of Nigeria 2018) 12-14 <http://www.energy.gov.ng/Energy_Policies_Plan/National%20Energy%20Policy.pdf> accessed 1 November 2023 ; The Government Of The Federal Republic Of Nigeria 'Nigeria National Gas Policy' (2017) 61-62 available >http://www.petroleumindustrybill.com/wp-content/uploads/2017/06/National-Gas-Policy-Approved-By-FEC-in-June-2017.pdf> accessed 15th March 2024 ; Nigerian Gas Flare Commercialization Programme <http://www.ngfcp.gov.ng/> accessed 13th February 2024 ; Nigeria Gas Master Plan (NGMP) 2008 ; NationalDomesticGasSupplyandPricingRegulation2007.
[35] Ibid.
[36] The aim of Nigeria Gas Master Plan (NGMP) 2008 'is to ensure natural gas is supplied at affordable prices to all domestic sectors, mainly power and other sectors that have a significant multiplier effect on the nation's economy.' See E. T Ukpohor, 2009, October. 'Nigerian gas master plan: strengthening the Nigeria Gas Infrastructure Blueprint as a base for expanding the regional gas market. (2009) In World Gas Conference Technical Paper, 11.

objectives of the NEP is to "expand the utilization of natural gas as an industrial and domestic fuel, as well as for power generation."[37]This commitment is further evidenced by the approval of the National Gas Policy 2017, which emphasizes the preference for utilizing flared gas in various downstream sectors rather than burning it off or re-injecting it without valid technical justification.[38] According to the government, "It is the policy that gas utilization will be a priority consideration over other considerations for handling of associated gas."[39] The Nigerian government aims to curb the unnecessary re-injection of associated gas, leading to the establishment of the Nigerian Gas Flare Commercialisation Programme (NGFCP), approved by the Federal Executive Council in December 2016.[40] The objective of the NGFCP is to eradicate gas flaring by implementing technically and commercially sustainable gas utilization projects developed by competent third-party investors.[41] These investors will be invited to participate in a competitive and transparent bid process, aligning with the government's commitment to reducing gas flaring while fostering economic growth.

However, translating these plans into tangible actions presents significant challenges. Utilizing gas for domestic and power generation purposes necessitates the establishment of production plants, transmission systems, local distribution pipelines, storage tanks, and more.[42]To address these challenges, the Nigerian government, with the assistance of the international community, initiated the Nigeria Gas Master Plan (NGMP) in 2008. The NGMP aims to bolster the development of gas utilization infrastructure and attract investments in the gas industry.[43]A key strategic objective of the NGMP is to tackle barriers hindering the growth of the domestic gas market in Nigeria, thereby leveraging the domestic gas industry for national economic development.[44] Central to the NGMP is the development of gas infrastructure, particularly pipelines for gas transmission. Additionally, the NGMP imposes domestic gas supply obligations on producers, mandating them to prioritize supplying gas to meet domestic demand before exporting it.[45] Moreover, the implementation of a gas pricing policy was initiated to ensure the affordability of natural gas across various domestic sectors, particularly power generation and other sectors with significant economic impacts.[46]This policy establishes minimum gas prices that producers can charge. To enforce this policy, the Minister of Petroleum issued the National Gas Supply and Pricing Regulation in 2008. [47]This regulation aims to promote the utilization of gas domestically, such as for power generation, fertilizer production, methanol production, and manufacturing industries.[48] Furthermore, the National Gas Supply and Pricing Regulation reinforces the gas pricing policy's objectives and requires producers to allocate a specific volume of gas for domestic consumption. The Minister of Energy is empowered to periodically determine the required volume of gas for domestic use. Failure by gas producers to meet the required volume for domestic use may result in fines for undersupply or restrictions on gas exportation, as determined by the Minister of Energy.[49] Overall, the primary goal of the Nigerian government's interventions is to reduce associated gas flaring by harnessing the gas for electricity generation and other beneficial uses within the domestic market.

## V.IMPORTANT DOMESTIC PROJECTS IN NIGERIA AIMED AT ELIMINATING GAS FLARING

The Federal government, in collaboration with International Oil Corporations, has initiated several key projects as part of efforts to reduce gas flaring. Notable examples include the Nigeria Liquified Natural Gas (NLNG) project, the West African Gas Pipeline (WAGP), and others. The NLNG, operational since 1999, boasts six units (trains) dedicated to harnessing natural gas.[50] The WAGP, on the other hand, is a 617 km pipeline designed to transport natural gas from Nigeria to Benin, Togo, and Ghana.[51] According to the World Bank, this project is

[37] Federal Republic Of Nigeria, National Energy Policy [Draft Revised Edition (Energy Commission Of Nigeria 2018) 12-14 <http://www.energy.gov.ng/Energy_Policies_Plan/National%20Energy%20Policy.pdf> accessed 1 November 2023.

[38]The Government Of The Federal Republic Of Nigeria 'Nigeria National Gas Policy' (2017) 61-62 available >http://www.petroleumindustrybill.com/wp-content/uploads/2017/06/National-Gas-Policy-Approved-By-FEC-in-June-2017.pdf> accessed 15th March 2024.

[39] Ibid.

[40] Nigerian Gas Flare Commercialization Programme <http://www.ngfcp.gov.ng/> accessed 13th April 2023.

[41] Ibid.

[42]R Sims and van Hulle, Integration of Renewable Energy into Present and Future Energy Systems. In IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation (2011 eds), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 647.

[43] Nigeria Gas Master Plan (NGMP) 2008.

[44] Ibid.

[45] Ibid.

[46] E. T Ukpohor, 'Nigerian gas master plan: strengthening the Nigeria Gas Infrastructure Blueprint as a base for expanding regional gas market. (2009) In World Gas Conference Technical Paper, 11.

[47] National Domestic Gas Supply and Pricing Regulation2007.

[48] Ibid.

[49] Ibid.

[50] Nigeria LNG <http://nlng.com/Our-Company/Pages/Profile.aspx> accessed 5th April 2023.

[51]G I Malumfashi, 'Phase-out of gas flaring in Nigeria by 2008: The prospects of a multi-win project. Centre for Energy Petroleum and Mineral Law and Policy (CEPMLP) (2007) University of Dundee, Scotland, United Kingdom 31- 33.

expected to mitigate 78 million tons of carbon dioxide equivalent (tCO2e) emissions.[52] In addition to the NLNG and WAGP, other projects such as the Escravos Gas-to-Liquid Projects (EGP) and the OSO NGL Recovery Project are focused on converting gas into synthetic fuels. These initiatives collectively represent significant strides towards reducing gas flaring and harnessing natural gas for beneficial purposes.[53]

These projects, along with numerous others, have made significant contributions. Firstly, they have effectively reduced the flaring of associated gas, a point that will be further discussed below. Secondly, through initiatives like NLNG and the WAGP, Nigeria has emerged as the world's fourth-largest exporter of Liquified Natural Gas (LNG) to both European and African countries.[54]According to the Nigeria National Petroleum Corporation, there was a notable increase in the commercialization of gas. In 2018, 62.61% of the average daily gas produced was commercialized,[55] compared to 60.89% in 2017.[56] This indicates an expanding market for natural gas, with more industries gaining access to it.[57]Furthermore, natural gas is predominantly used for power generation, with approximately 80% of electricity in Nigeria being generated from natural gas (thermal).[58]These gas utilization projects have played a pivotal role in stimulating the gas market in Nigeria, facilitating greater commercialization and utilization of this valuable resource.[59]

## VI.THE CONTRIBUTION OF CDM PROJECTS TO THE REDUCTION OF GAS FLARING IN NIGERIA

The Kyoto Protocol implements market-based mechanisms to assist developed countries in achieving their emission reduction targets. These mechanisms include the Clean Development Mechanism (CDM)[60] and Joint Implementation (JI).[61] This article focuses on the CDM specifically.[62] It is worth noting that Article 6 of the Paris Agreement also promotes market-based mechanisms similar to those in the Kyoto Protocol. However, under the Paris Agreement, these mechanisms are referred to as the Sustainable Development Mechanism (SDM) instead of the CDM.[63]

The key point is that the implementation of the CDM by member states under the climate change regime over the past two decades has played a crucial role in helping the Nigerian government reduce the flaring of associated gas in the country. This is because the CDM, as established under the Kyoto Protocol, enables industrialized (Annex-I) countries to invest in or finance projects in developing nations aimed at reducing GHG emissions.[64] The CDM serves as a valuable tool in achieving the goal of reducing the flaring of associated gas, as it offers additional incentives for emissions reduction by providing credits for carbon reduction that can be traded on the emissions trading market.[65] Since its adoption in 2005 as part of the Kyoto Protocol, the CDM has become an indispensable tool for financing projects and delivering sustainable development benefits to member

[52] H A Sharif and I B Garba, Gas Flaring: When Will Nigeria Decarbonise Its Oil and Gas Industry (2016) 1(3) International Journal of Economy, Energy and Environment, 40-54, 46.

[53] Ibid. 40-54; C A Odumugbo, 'Natural gas utilisation in Nigeria: Challenges and opportunities (2010) 2(6) Journal of Natural Gas Science and Engineering, 2(6) 310-316 at 313

[54] Energy Information Administration (EIA), Country Analysis Brief: Nigeria, 2016 at 15,<https://www.eia.gov/beta/international/analysis_includes/countries_long/Nigeria/nigeria.pdf> Accessed 9th November 2023.

[55] NNPC Monthly report Financial and Operations Report December 2018; <https://www.nnpcgroup.com/NNPCDocuments/Performance%20Data/FullReports/NNPC%20Monthly%20Financial%20%20Operations%20Report%20for%20the%20Month%20of%20December%202018.pdf> accessed 5th May 2023.

[56]NNPC Monthly report Financial and Operations Report December 2017 <https://www.nnpcgroup.com/NNPCDocuments/Performance%20Data/FullReports/NNPC%20Monthly%20Financial%20%20Operations%20Report%20for%20the%20Month%20of%20December%202017.pdf> accessed 5th May 2023.

[57] K Ifesinachi, and E Aniche, 'The Nigerian National Petroleum Corporation (NNPC) and Enforcement of Zero Gas Flaring Regime in Nigeria (2015) 4(1), ANSU Journal of Arts and Social Sciences 13-14.

[58] G Occhiali and G Falchetta, (2018): 'The Changing Role of Natural Gas in Nigeria: A policy outlook for energy security and sustainable development, Working Paper, No. 010.2018, (2018) Fondazione Eni Enrico Mattei (FEEM Milano 7.

[59]P E Agbonifo, 'Natural gas distribution infrastructure and the quest for environmental sustainability in the Niger Delta: The prospect of natural gas utilization in Nigeria (2016) 6(3) International Journal of Energy Economics and Policy.442-448; 448 and 443; B Henry, 'Gas Production and Utilization in Nigeria: A Long-Term Perspective' (2019) 6 (5) international journal of engineering technology management Research 58-72 at 63.

[60] Article 12 of the Kyoto Protocol.

[61] Article 6 of the Kyoto Protocol.

[62] Since The Clean Development Mechanism (CDM) focuses on investments in emission reduction projects in developing countries, whereas Joint Implementation (JI) entails emission reduction initiatives in developed countries. See M.R., Singh and N Naik, 'Role of the Clean Development Mechanism (CDM) in the Development of National Energy Industries' 2014 25(2) Energy & Environment, pp.325-342.

[63]United Nation Climate Change, available at <https://unfccc.int/news/cdm-can-inspire-inform-outfit-any-new-mechanism-under-paris-agreement, Accessed 2nd March 2024 ; United Nation Climate Change, 'Achievements Of The Clean Development Mechanism Harnessing Incentive for Climate Action (2001-2018).

[64]M Singh and N Naik, 'Role of the Clean Development Mechanism (CDM) in the Development of National Energy Industries' 2014 25(2) Energy & Environment 325-342.

[65]W Broere, the elusive goal to stop flares 2008 Shell World.

states.[66] Several CDM projects in Nigeria are specifically designed to reduce the flaring of associated gas, further demonstrating the effectiveness of the mechanism in addressing this environmental challenge.[67]
The Department of Climate Change, serving as the Designated National Authority for CDM in Nigeria, has registered several CDM projects, some of which are related to gas flaring mitigation.[68]One such project, the Recovery and Utilization of Associated Gas from the Obodugwa and neighboring oil fields in Nigeria, was registered in December 2012 and is scheduled to conclude in 2024. This initiative aims to reduce approximately 288 GHG emissions.[69]Similarly, the Recovery and Marketing of Gas at the Asuokpu/Umutu Marginal Field targets a reduction of 257 GHG emissions.[70] Another project, the Recovery of Associated Gas at the Kwale oil-gas processing plant, was registered in November 2006 with an initial end date in 2015.[71] However, it is unclear if this project has been completed. Additionally, the Pan Ocean Gas Utilization Project, registered in February 2009, concluded in 2020.[72] This project was anticipated to reduce approximately 2627 GHG emissions.[73]
These CDM projects, implemented under the climate change regime, have significantly aided the Nigerian government in reducing associated gas flaring and promoting domestic utilization of this valuable resource. In 2008, Nigeria ranked alongside Russia as one of the top two highest gas flaring countries.[74] However, there has been notable improvement since then, attributed to various programs and projects aimed at reducing the flaring of associated gas.[75]By 2020, Nigeria had made considerable progress, moving from the second-highest gas flaring country in 2008[76] to the sixth position in 2018.[77]Furthermore, according to the Global Gas Flaring Tracker Report of 2023, Nigeria has now moved to the ninth position.[78] This demonstrates a significant decline in gas flaring activities over the years. The impact of these efforts is underscored by the First Biennial Update Report, which claims that the aforementioned CDM projects have contributed to an annual reduction of about 6,967 GHG emissions.[79] This highlights the effectiveness of targeted interventions and initiatives in reducing associated gas flaring and mitigating greenhouse gas emissions in Nigeria.

However, despite their positive contributions, CDM projects have faced criticism on several fronts. One major concern revolves around their effectiveness in reducing GHG emissions. It is important to note that CDM projects operate as offset mechanisms rather than direct emission reduction strategies.[80]This means that while a CDM project may reduce emissions in one location, emissions may increase elsewhere, a phenomenon known as carbon leakage.[81] Carbon leakage occurs when strict climate policies in one country lead to increased emissions in another country.[82]Critics argue that this undermines the overall goal of reducing global GHG emissions.[83] Additionally, there are concerns that CDM projects may not significantly contribute to the sustainable development goals outlined by the United Nations Framework Convention on Climate Change (UNFCCC), particularly in non-Annex 1 Parties (developing countries). Critics contend that the impact of CDM

[66]R Spalding-Fecher and P Parks, Gas Flaring Reduction Projects Framework for Clean Development Mechanism (CDM) Baseline Methodologies Revised Printing April 2005, The World Bank.
[67] Table 3 mentioned the number of CDM projects in Nigeria. See Federal Republic of Nigeria (2018) First Biennial Update Report (BUR1) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC) 121-125.
[68]Department of Climate Change available at <https://climatechange.gov.ng/division/mitigation/cdm/registered-cdm-projects-in-nigeria/> Accessed 12 April 2023.
[69]Federal Republic of Nigeria (2018) First Biennial Update Report (BUR1) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC) 121-125.
[70] Ibid, It was registered on the 16 Oct 2010, ended 01 May 2021.
[71] Federal Republic of Nigeria (2018) First Biennial Update Report (BUR1) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC) 121-125.
[72] Ibid.
[73] Ibid.
[74] C Elvidge and M Zhizhin, M., 2009. A fifteen-year record of global natural gas flaring derived from satellite data (2009) 2(3) Energies 595-622.
[75] R U Onolemhemhen and A Adenikinju, 'An evaluation of domestic gas utilization on the Nigerian economy (2017) Journal of Economics, Management and Trade 1-13.
[76]C Elvidgeand M Zhizhin, 'A fifteen-year record of global natural gas flaring derived from satellite data' (2009) 2(3) Energies, pp.595-622. at 607.
[77] The World Bank 'Global Gas Flaring Reduction Partnership (GGFR)' available >http://www.worldbank.org/en/programs/gasflaringreduction#7> accessed 28th April 2023.
[78] Global Gas Flaring Tracker Report March 2023 available at 2023-Global-Gas-Flaring-Tracker-Report.pdf (worldbank.org) accessed 5th March 2024.
[79]Federal Republic of Nigeria (2018) First Biennial Update Report (BUR1) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC) at 12.
[80]K E Rosendahl and J Strand, 'Carbon leakage from the clean development mechanism (2011) The Energy Journal, 1-33, 3.
[81] Earth Journalism Network, Clean Development Mechanism <https://earthjournalism.net/resources/clean-development-mechanism> accessed 2nd November 2023; J Buen, CDM Criticisms: Don't Throw the Baby out with the Bathwater (2013) 8 FridtjofNansen Institute Climate Policy Perspectives, 3 and 4.
[82]C Andrés, 'Emissions Loophole Stays Open in EU' (The New York Times 2014) available at https://www.nytimes.com/2014/11/19/business/energy-environment/emissions-loophole-stays-open-in-eu.html> Accessed 12 March 2024.
[83] Ibid.

projects on the development trajectories of developing countries is limited.[84] They argue that the benefits derived from these projects often do not align with the broader objectives of sustainable development.[85] These criticisms underscore the need for ongoing evaluation and refinement of CDM mechanisms to ensure their effectiveness in addressing both climate change and development challenges.

A specific criticism directed at CDM projects in Nigeria is their uneven distribution across sectors. The allocation of CDM projects in Nigeria is heavily skewed towards the energy sector, particularly oil and gas, while other sectors receive minimal attention.[86]The Biennial Report of Nigeria underscores this point, as out of the 11 highlighted CDM projects, approximately 9 are focused on the energy sector.[87]This unequal distribution of CDM projects across sectors has led to concerns raised by experts like Pillay, who argue that the distribution of CDM projects by region in Nigeria is uneven and heavily favors GHG reductions.[88] Consequently, sectors such as transportation, waste management, agriculture, forestry, and other land use receive minimal attention.[89] Moreover, despite the implementation of CDM projects, tangible economic and social benefits are yet to materialize in Nigeria.[90] Critics argue that these projects have not significantly contributed to economic development, as unemployment rates among Nigerian youth remain high.[91] In summary, criticisms of CDM projects in Nigeria highlight their disproportionate distribution across sectors, with a heavy emphasis on the energy sector, and their failure to deliver expected economic and social benefits, particularly in terms of employment opportunities for the country's youth.

## VII.CDM AND GAS UTILIZATION PROJECTS IN NIGERIA HAVE FAILED TO DECREASE GHG EMISSIONS

Both the CDM and domestic gas utilization projects have played significant roles in aiding the Nigerian government to develop the domestic gas market, capitalize on its potential, and transition from being the second-largest gas flaring country to the ninth within a reasonable period. This progress bodes well for Nigeria's National Determined Contributions (NDC) gas phasing out target, promising a positive trajectory for the future. However, despite the advancements made by these initiatives, there remains a stark disparity between the envisioned outcomes and the reality on the ground. For instance, the Federal Government of Nigeria has identified approximately 178 locations across oil-producing areas where associated gas is still being flared.[92]These flares collectively emit more than one billion standard cubic feet per day (1Bscfd) of gas, highlighting the ongoing challenges and the need for further action to fully address the issue of gas flaring in Nigeria.[93]Once again, these projects fail to contribute to the reduction of overall GHG emissions in Nigeria, a key criticism leveled against both the CDM projects and the activities of the Nigeria Liquified Natural Gas (NLNG) company.[94] Critics argue that these projects do not effectively reduce the country's overall GHG emissions.[95] Specifically, NLNG has faced criticism for primarily utilizing non-associated gas in its early years, which has little impact on reducing the flaring of associated gas in the country.[96]

Similarly, CDM projects have been faulted for their limited effectiveness in curbing GHG emissions on a national scale. This criticism is further underscored by Nigeria's GHG emission trends, which have shown a continuous and steady increase from 1990 to 2023. For instance, emissions were recorded at **287.31**Mton

[84]C Voigt, 'Is the Clean Development Mechanism Sustainable? Some Critical Aspects. (2010) 8 (2) Sustainable Development Law & Policy, 615-21 20.

[85] Ibid.

[86]S Pillay, 'An assessment of Clean Development Mechanism project contribution to sustainable development in Nigeria 2016 (15) 6 International Business & Economics Research Journal (IBER), 315-328 at 321.

[87]Federal Republic of Nigeria (2018) First Biennial Update Report (BUR1) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC) 133-134.

[88]S Pillay, 'An assessment of Clean Development Mechanism project contribution to sustainable development in Nigeria 2016 (15) 6 International Business & Economics Research Journal (IBER), 315-328 at 321.

[89] Ibid.

[90]P Agbonifo, 'The Pursuit of Climate Protection and The Uneven Global Distribution of Clean Development Mechanism (CDM) Projects: Lesson from Least Developed Countries (LDCS) (2017) 6 (1) European Journal of Sustainable Development, 139-139 at 149.

[91]D O Akinyele and W k Seah, 'Clean development mechanism projects for developing countries: Potential for carbon emissions mitigation and sustainable development' In 2014 Eighteenth National Power Systems Conference (IEEE 2014) 1-6 at 4.

[92] Major Waves Energy Report <https://majorwavesenergyreport.com/gas-flare-commercialisation-set-to-attract-3-5bn-investments-to-nigeria-fg/> accessed 5th April 2023.

[93]K Ebiri, 'Ending gas flare in 2020, another promise amid scepticism' (The Guardian 2018) <https://guardian.ng/saturday-magazine/cover/ending-gas-flare-in-2020-another-promise-amid-scepticism/> accessed 23rd April 2023.

[94] C. Streck, Expectations and Reality of the Clean Development Mechanism. Climate Finance (2009), p.67. at 68; Zhang, J. and Wang, Co-benefits and additionality of the clean development mechanism: An empirical analysis. Journal of Environmental Economics and Management, (2011) 62(2), pp.140-154. At 145; Buen, J., 2013. CDM Criticisms: Don't Throw the Baby out with the Bathwater. FridtjofNansen Institute Climate Policy Perspectives, (8). At 3; Earth Journalism Network, Clean Development Mechanism <https://earthjournalism.net/resources/clean-development-mechanism> accessed 2nd November 2023.

[95] J U Orji, 'Moving from gas flaring to gas conservation and utilisation in Nigeria: a review of the legal and policy regime' (2014) 38(2) OPEC Energy Review 149-183; 156.

[96] Ibid.

CO2eq in 1990, **419.54**Mton CO2eq in 2000, **399.98** in 2005, **404.08**Mton CO2eq in 2015, **408.25**Mton CO2eq in 2020, and **409.45**Mton CO2eq in 2021.[97] These figures demonstrate that despite the purported reduction of 6,967 GHG emissions annually by CDM projects, Nigeria's overall GHG emissions have continued to rise steadily over the years. In summary, the lack of significant impact on overall GHG emissions reduction in Nigeria casts doubt on the effectiveness of both CDM projects and NLNG activities in addressing the country's environmental challenges.

## VIII.CDM AND GAS UTILIZATION PROJECTS IN NIGERIA HAVE NOT REDUCED THE ADVERSE IMPACTS OF CLIMATE CHANGE

Although strides have been made in reducing gas flaring in Nigeria, these efforts have not led to a substantial decrease in the impacts of climate change within the country. A clear indicator of this is the ongoing trend of rising temperatures experienced across Nigeria. Despite initiatives to curtail gas flaring and mitigate its associated GHG emissions, the overall warming trend persists.[98] The escalating temperatures in Nigeria have resulted in a myriad of challenges associated with climate change. These challenges include disruptions in weather patterns, heightened frequency and severity of extreme weather events such as droughts, floods, and heat waves.[99] Additionally, ecosystems are experiencing disturbances, and agricultural productivity is being negatively affected.[100] In essence, while efforts to reduce gas flaring are commendable and contribute to environmental sustainability, they have not yet been sufficient to counteract the broader impacts of climate change in Nigeria. Addressing these challenges requires a comprehensive approach that goes beyond gas flaring reduction and encompasses strategies to adapt to and mitigate the effects of climate change across various sectors of the economy.

## IX.WHY THE CDM AND GAS UTILIZATION PROJECTS HAVE NOT REDUCED GHG EMISSIONS?

While gas flaring is a significant source of GHG emissions in Nigeria, it is not the sole contributor to climate change. Other sectors, such as energy production, transportation, agriculture, and industrial processes, also emit GHGs.[101]These emissions collectively contribute to the overall impact of climate change in the country**.** See the table below:

Table 2:1 National emissions for the year 2015 in Nigeria.[102]

| No. | Categories of total national emission from Nigeria | Total Gg CO2-eq | Percentage |
|---|---|---|---|
| **1** | Agriculture, Forestry and Other Land Use emits | 476,949 Gg CO2-eq | 66.9% |
| **2** | Energy | 201,319 Gg CO2-eq | 28.2% |
| **3** | Waste | 21,103 Gg CO2-eq | 3.0% |
| **4** | Industrial Processes and Product | 13,267 Gg CO2-eq | 1.9% |
| **5** | Other | 0 | - |
| **7** | Total | 712,638 Gg CO2-eq | - |

Based on the data presented in the table, Agriculture, Forestry, and Other Land Use emerge as the sectors with the highest GHG emissions. Various activities within this sector contribute to increased GHG emissions, including landscape modification, land conversion[103](such as deforestation and conversion of forests, croplands, and grasslands), wood harvesting, and management of manure from livestock.[104] Following closely, the energy sector ranks as the second-largest emitter of GHGs.[105] Emissions from this sector primarily stem from activities

[97] EDGAR - Emissions Database for Global Atmospheric Research, GHG emissions of all world countries2023 report available at EDGAR - The Emissions Database for Global Atmospheric Research (europa.eu) accessed 12 January 2024.
[98] Ibid.
[99]H U Agbebaku, 'Environmental challenges and climate change: Nigeria experience' (2015) 2 (4) Journal *of Research in Environmental and Earth Science*, pp.01-12.
[100]B J Abiodunand AA Abatan, 'Potential influences of global warming on future climate and extreme events in Nigeria.' 92013) 13 *Regional Environmental Change*, pp.477-491.
[101] Federal Republic of Nigeria (2018) First Biennial Update Report (BUR1) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC). Biennial Reports are reports. Prepared by developing countries to the UNFCCC containing updates of national GHG inventories, including action taken to reduce the emission of GHG.
[102] Total net national emissions (Table 2.51), including removals, amounted to 712,638 Gg CO2-eq Copied from the First Biennial Update Report (BUR1) of the Federal Republic of Nigeria at page 8.
[103] Federal Republic of Nigeria (2018) First Biennial Update Report (BUR1) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC); 93-101.
[104]Ibid 98.
[105]Ibid 93.

like gas flaring during oil and gas production. [106]The waste sector occupies the third position in terms of GHG emissions. Emissions in this sector predominantly result from the indiscriminate disposal of solid wastes through landfilling, dumping, incineration, open burning, and the treatment of domestic and industrial liquid wastes.[107] Lastly, the industrial processes and production sector rank fourth in the table. Emissions in this sector stem from by-products generated during various industrial processes, such as cement production in the mineral industry, ammonia production in the chemical industry, and iron and steel production in the metal industry.[108] This breakdown underscores the multifaceted nature of GHG emissions in Nigeria and highlights the need for comprehensive strategies to address emissions across various sectors effectively.

The sectors highlighted above as major contributors to GHG emissions underscore the complexity of addressing emissions solely through reduction in gas flaring. While reducing gas flaring is beneficial and comes with various advantages, such as mitigating health risks in local communities and promoting a cleaner environment, it alone may not suffice to significantly reduce overall GHG emissions in Nigeria. To fulfill its climate change commitments effectively, the Nigerian government, International Oil Corporations, and international climate change agencies must collectively address emissions across all five sectors with potential GHG emissions in the country. This requires comprehensive strategies that extend beyond the scope of gas flaring reduction. In essence, achieving Nigeria's climate change obligations demands holistic approaches that encompass initiatives targeting the following sectors:

- Renewable Energy Transition: Invest in and promote renewable energy sources such as solar, wind, and hydroelectric power. Develop supportive policies and incentives to encourage the adoption of renewable energy technologies. Expand renewable energy infrastructure and enhance grid integration to ensure a reliable and sustainable energy supply.
- Energy Efficiency Improvements: Implement energy efficiency measures across industries, buildings, and transportation to reduce energy consumption and associated emissions. Upgrade infrastructure and equipment to meet energy efficiency standards and promote energy-saving practices. Provide training and capacity-building programs to enhance energy management skills.
- Sustainable Transportation: Encourage the use of cleaner and more efficient transportation modes such as electric vehicles, public transit, and non-motorized transport. Invest in public transportation infrastructure and prioritize low-emission vehicles in urban planning and development. Promote sustainable mobility solutions through policies supporting alternative fuels and reducing vehicle emissions.
- Afforestation and Reforestation: Expand Forest cover through afforestation and reforestation initiatives to sequester carbon dioxide and enhance biodiversity. Protect existing forests from deforestation and degradation by implementing sustainable land management practices and enforcing conservation measures. Engage local communities in forest conservation efforts through participatory approaches and incentives for sustainable land use.
- Climate-Smart Agriculture: Promote climate-resilient agricultural practices that enhance soil health, water management, and crop diversity. Support smallholder farmers with training, resources, and access to climate-smart technologies to increase productivity and adapt to changing climatic conditions. Implement agroforestry and conservation agriculture techniques to sequester carbon and improve ecosystem resilience.
- Waste Management and Circular Economy: Implement integrated waste management systems that prioritize waste reduction, recycling, and resource recovery. Invest in waste-to-energy technologies to capture methane emissions from landfills and generate renewable energy. Promote sustainable consumption and production patterns through public awareness campaigns and incentives for eco-friendly practices.
- Policy and Institutional Strengthening: Develop and enforce policies, regulations, and standards that support climate change mitigation and adaptation efforts. Strengthen institutional capacities and coordination mechanisms for climate action planning, implementation, and monitoring. Enhance collaboration with international partners, civil society organizations, and the private sector to mobilize resources and expertise for climate action. By adopting these comprehensive solutions, Nigeria can effectively fulfill its climate change obligations and contribute to global efforts to mitigate climate change while promoting sustainable development and resilience.

## X.CONCLUSION

[106] Ibid 56.
[107] Ibid
[108] Ibid 85.

This paper has assessed the impact of gas phasing out projects and CDM initiatives in Nigeria. It has demonstrated that both domestic gas utilization projects and CDM programs have played significant roles in improving gas commercialization and reducing the flaring of associated gas in the country. The remarkable reduction of Nigeria from being the second-highest gas flaring nation to the ninth largest can be largely attributed to the implementation of various gas utilization projects nationwide. Furthermore, the Biennial Report highlights the substantial contribution of CDM projects under the climate change regime, indicating a reduction of approximately 6,967 emissions of GHGs. Despite these achievements, it is evident that these efforts have not yet translated into an overall reduction of GHG emissions in Nigeria. On the contrary, GHG emissions in the country continue to rise annually, presenting a significant challenge.

This discrepancy underscores a fundamental contradiction between the reduction of gas flaring and the reduction of overall GHG emissions in Nigeria. It indicates that while strides have been made in curbing the direct emissions associated with gas flaring, other sources of GHG emissions across various sectors remain largely unabated. Addressing this contradiction requires a comprehensive approach that goes beyond the singular focus on gas flaring reduction. It necessitates concerted efforts from the Nigerian government, International Oil Corporations, and international climate change agencies to address emissions across all sectors contributing to GHG emissions in the country. Moving forward, it is imperative to prioritize holistic strategies that encompass initiatives targeting agriculture, forestry, energy, waste management, industrial processes, and policy interventions. By adopting such comprehensive measures and fostering collaboration among stakeholders, Nigeria can effectively mitigate its GHG emissions and fulfill its climate change commitments, paving the way for a more sustainable and resilient future.