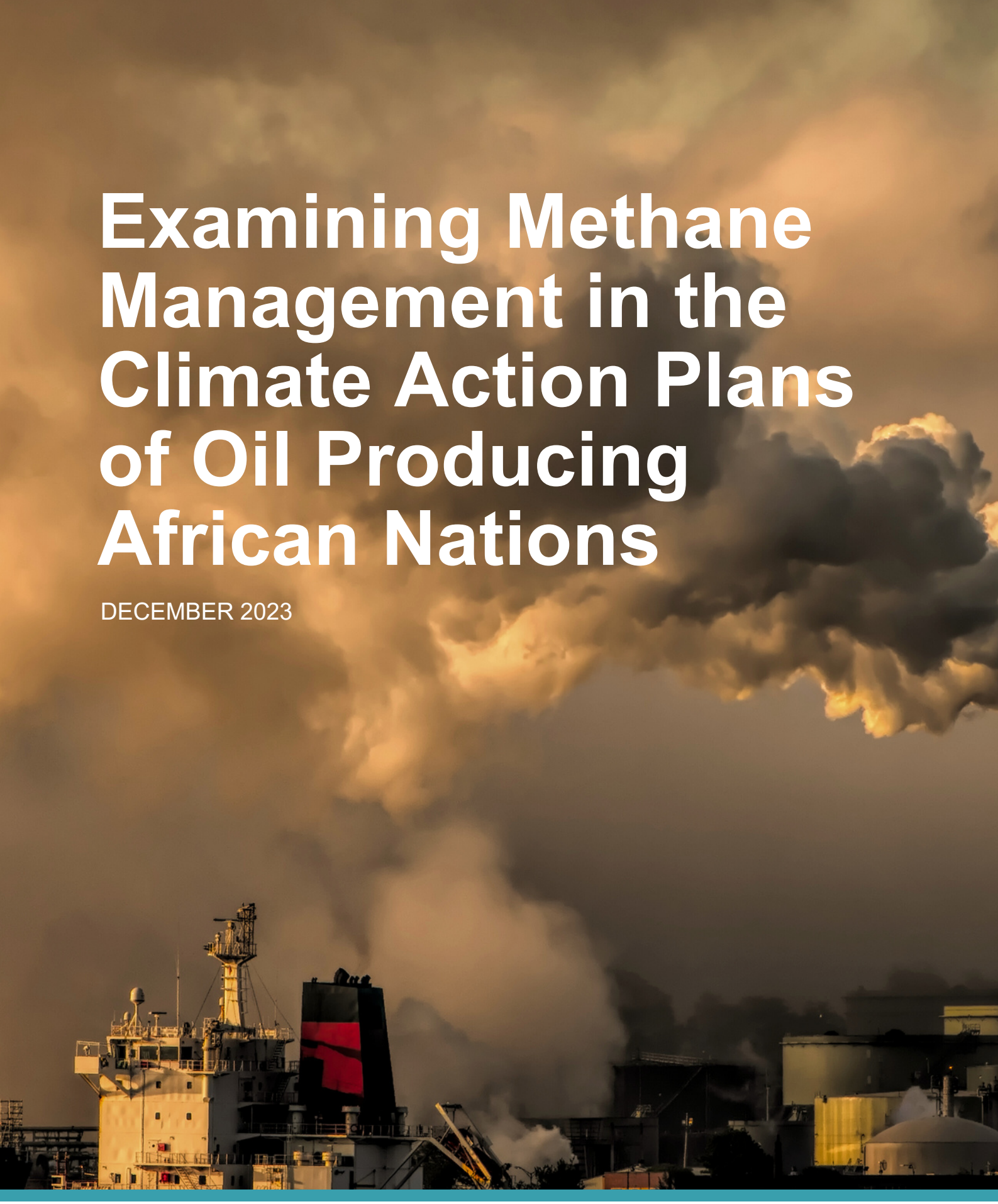
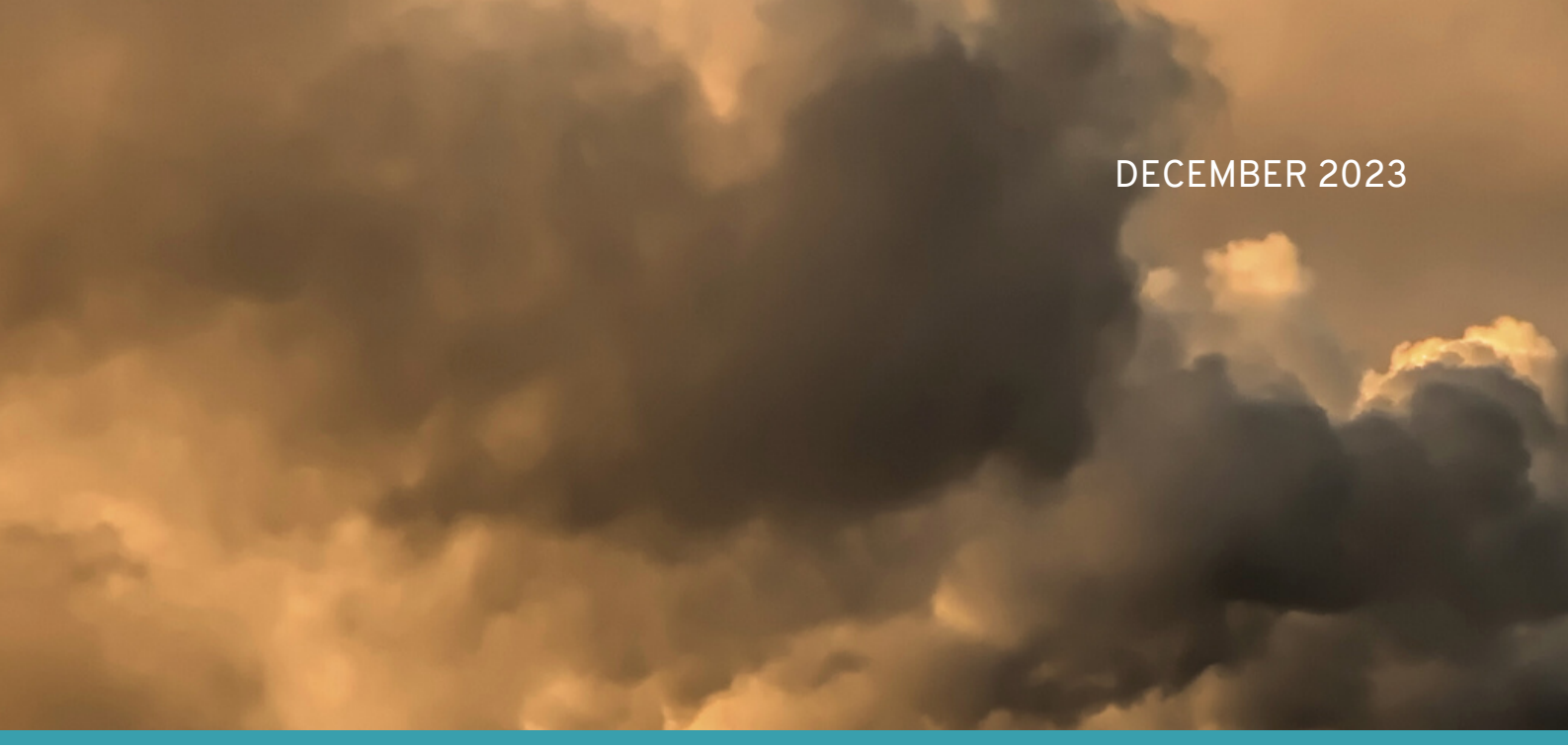
Examining Methane Management in the Climate Action Plans of Oil Producing African Nations

DECEMBER 2023



Africa
Centre for
Energy Policy



DECEMBER 2023

Examining Methane Management in the Climate Action Plans of Oil Producing African Nations

Benjamin Boakye
Charles Gyamfi Ofori
Kodzo Yaotse

ACEP
Africa Centre for Energy Policy

ACKNOWLEDGEMENT

This work was undertaken by the Africa Centre for Energy Policy (ACEP), with invaluable support from the Global Methane Hub. We express our appreciation to the contributors whose dedication and expertise have significantly enriched the content of this report:

- Mr. Benjamin Boakye – Executive Director, ACEP
- Dr. Charles Gyamfi Ofori – Policy Lead, Climate Change and Energy Transition, ACEP
- Mr. Kodzo Yaotse – Policy Lead, Petroleum and Conventional Energy, ACEP

We also thank the stakeholders in Ghana, Nigeria, Angola, Senegal, and Mozambique for their unwavering support and invaluable contributions. Their insights have played a pivotal role in shaping the analysis presented in this report.

Table of Content

List of Tables

List of figures

List of Abbreviations

Abbreviation	Meaning
AfDB	African Development Bank
ALNG	Angola Liquified Natural Gas
ANPG	National Agency for Petroleum, Gas and Biofuels
AQUA	National Agency for Environmental Quality Control
BAU	Business-As-Usual
CCAC	Climate and Clean Air Coalition
CNG	Compressed Natural Gas
CNPC	China National Petroleum Corporation
CoMAT	Country Methane Abatement Tool
DFI	Development Finance Institutions
ECOWAS	Economic Community of West African States
EIA	Environmental Impact Assessments
EITI	Extractive Industry Transparency Initiative
ENAMMC	National Strategy for Adaptation and Mitigation of Climate Change
EPA	Environmental Protection Agency
ESG	Environmental, Social and Governance

Abbreviation	Meaning
EU	European Union
FLNG	Floating Liquified Natural Gas
FMENV	Federal Ministry of Environment
GACMO	Greenhouse Gas Abatement Model
GCARP	Ghana Climate Ambitious Reporting Program
GGFR	Global Gas Flaring Reduction Partnership
GHG	Greenhouse Gas
GMI	Global Methane Initiative
GTA	Grand Tortue Ahmeyim
GWP	Global Warming Potential
ICAT	Initiative for Climate Action and Transparency
IEA	International Energy Agency
INP	National Petroleum Institute
IOC	International Oil Company
IPCC	International Panel for Climate Change
LDAR	Leak Detection and Repair
LNG	Liquified Natural Gas
MCTA	Ministry of Culture, Tourism and Environment
MESTI	Ministry of Environment, Science, Technology and Innovation
MIREME	Ministry of Mineral Resources and Energy
MIREMPET	Ministry for Mineral Resources and Petroleum
MMBTU	Million British Thermal Units

Abbreviation	Meaning
MMSCF	Million Standard Cubic Feet
MPR	Minstry of Petroleum Resources
MRV	Measurement, Reporting and Verification
MTA	Ministry of Land and Environment
MW	Megawatts
NDC	Nationally Determined Contributions
NESREA	National Environmental Standards and Regulations Enforcement Agency
NMDPRA	Nigeria Midstream and Downstream Petroleum Regulatory Authority
NOC	National Oil Company
NOSDRA	National Oil Spill and Detection Regulatory Agency
NUPRC	Nigerian Upstream Regulatory Commission
OGMP	Oil and Gas Methane Partnership
PIA	Petroleum Industry Act
PIAC	Public Interest and Accountability Committee
SLCP	Short-Lived Climate Pollutants
TEN	Tweneboa Enyerra Ntomme
UNEP	United Nations Environmental Program
USA	United States of America
WHO	World Health Organisation

Executive Summary

- Methane is a potent GHG with a global warming potential 28 to 36 times higher than carbon dioxide. Therefore, targeted efforts to reduce methane emissions are imperative.

- The energy sector contributes about 40% of anthropogenic emissions. Emissions have steadily increased over the past decade, and projections suggest a potential rise of 3% to 17% between 2020 and 2030 if robust reduction measures are not implemented.

- The oil and gas sector constitutes about 62% of the methane emissions within the energy sector, primarily through venting, incomplete combustion of flared gas, and equipment and pipeline leaks. Given this substantial contribution, the sector is crucial in shaping methane emissions reduction efforts.

- Beyond environmental benefits, mitigating methane emissions presents economic opportunities through gas commercialisation, offsetting implementation costs.

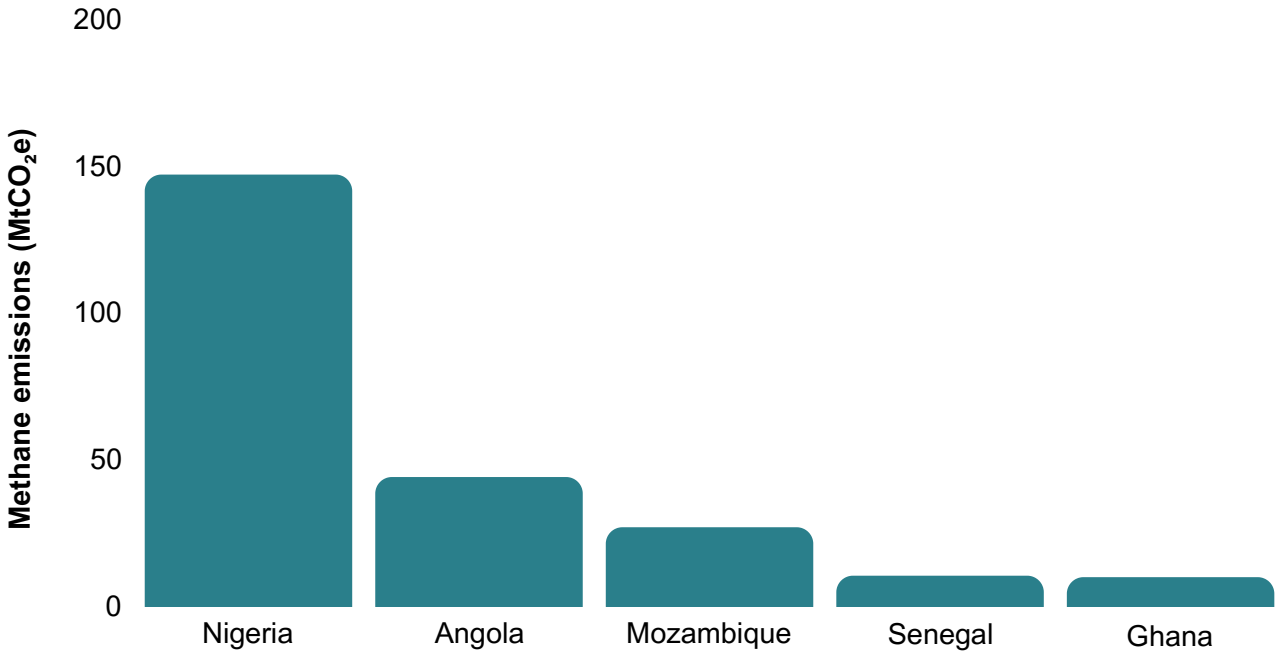
- Africa’s oil and gas sector accounts for about 68% of methane emissions in the energy sector, with the potential for an increase due to anticipated industrial growth. This accentuates the critical need for heightened commitments to methane management in Africa's oil and gas sector, particularly given the region's vulnerability to climate change.

- This study examines the role of methane management in the climate action plans of mature and frontier oil-producing African countries: Nigeria, Angola, Ghana, Mozambique, and Senegal. It also identifies opportunities and barriers that support or impede actions on methane emission reduction in Africa.

Methane Emissions

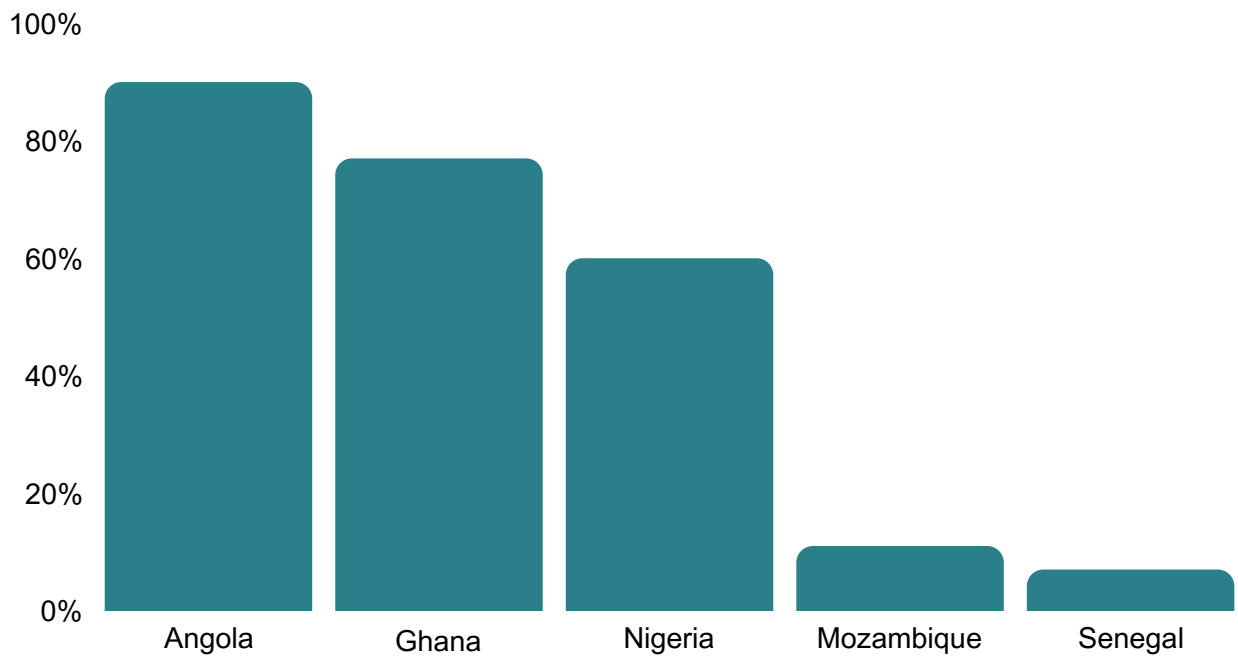
- Nigeria, the largest oil producer in Sub-Saharan Africa, mirrors its status with the highest methane emissions, with an average contribution of about 147 MtCO2e between 2010 and 2020. Among the study countries, Angola, Mozambique, Senegal and Ghana follow, respectively.

ES 1: Average methane emissions among study countries (2010-2020)

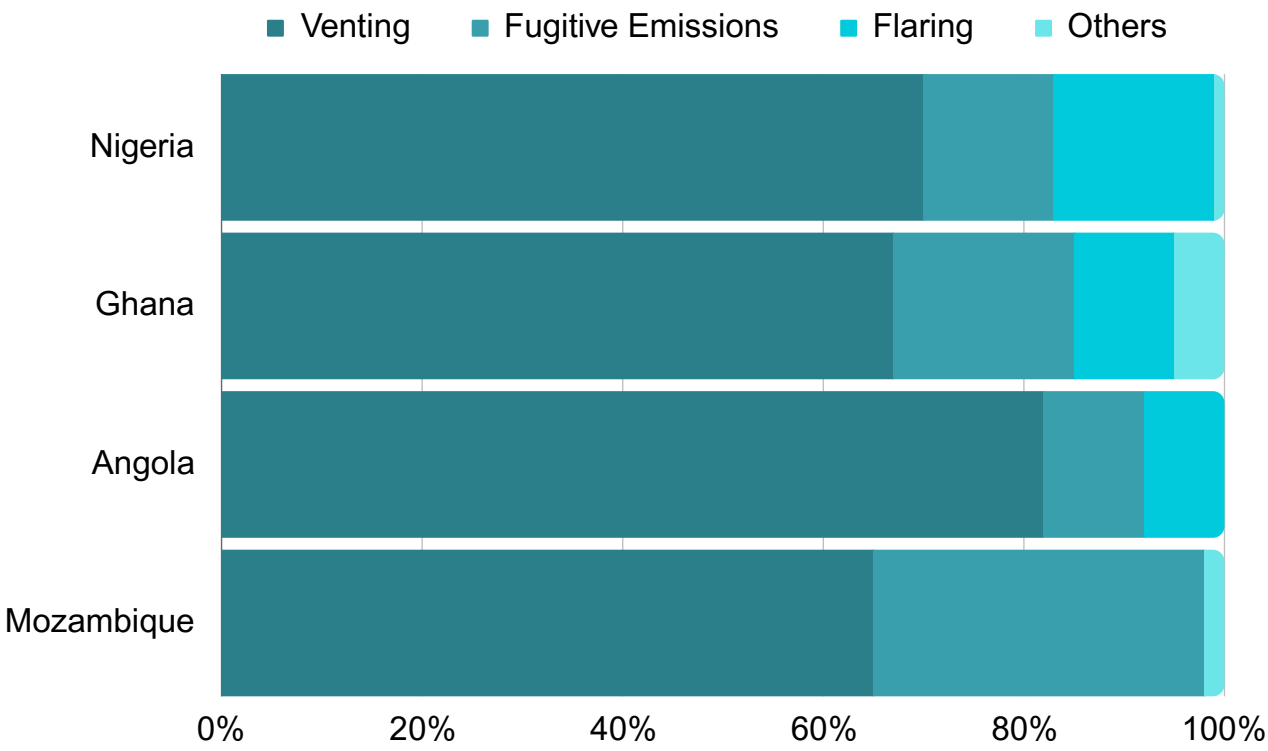


- While the energy sector significantly contributes to methane emissions in Nigeria and Angola, it is comparatively less significant in Ghana, Mozambique, and Senegal. However, it still warrants attention as oil and gas activities are likely to increase in these countries.
- Oil and gas activities contribute significantly to methane emissions in the energy sectors of Angola, Ghana and Nigeria, with respective contributions of 90%, 77% and 60%.
- Venting emerges as a primary source of methane emissions in oil and gas activities. It forms about 65% to 83% of methane emissions, followed by flaring and fugitive emissions.

ES 2: Methane emissions from oil and gas activities within the energy sector



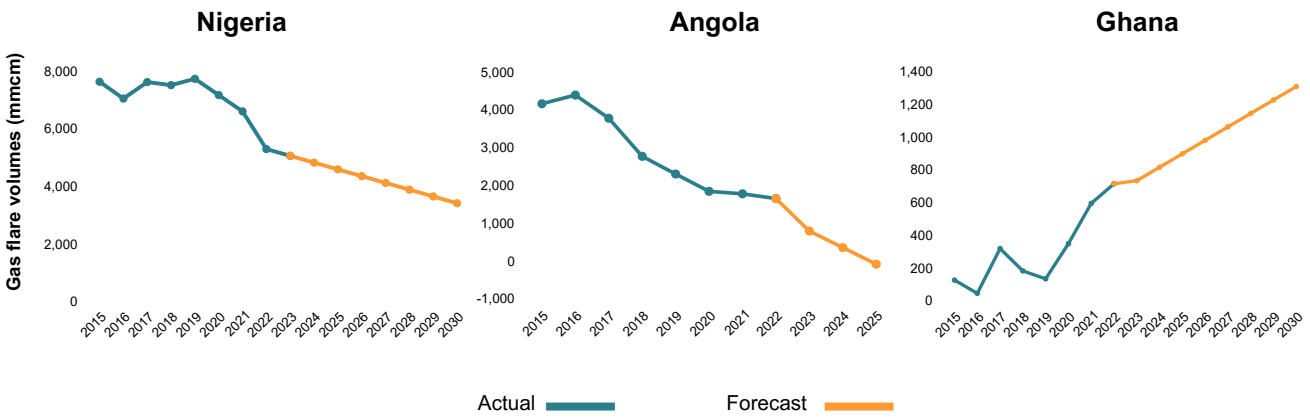
ES 3: Sources of methane emissions in the oil and gas sector



Methane abatement efforts

- The study countries exhibit varying levels of commitment towards methane management. Nigeria and Ghana have explicitly incorporated methane emission targets in specific national policies. Methane abatement efforts in Angola, Mozambique and Senegal are evidenced in their overall strategies on GHG emissions reduction.
- All five countries demonstrate enormous efforts to reduce methane emissions through zero-gas flaring policies and gas commercialisation efforts. Projections show that Angola is on track to meeting its zero-flaring targets. Again, given the current trend, Nigeria can reduce flaring by 50% by 2030 (relative to 2020).
- Ghana's gas flaring trend is increasing, largely attributed to the limited infrastructure to accommodate associated gas from its producing fields.

ES 4: Actual and projected gas flaring in Nigeria, Angola and Ghana



Measurement, Reporting and Verification (MRV) systems

- Nigeria has established specific MRV frameworks for methane abatement using the Country Methane Abatement Tool (CoMAT). Additionally, the Nigeria Gas Flare Tracker uses satellite imagery to track gas flares on its offshore and onshore sites.
- Ghana utilises the Ghana Climate Ambitious Reporting Program (GCARP) and the Greenhouse Gas Abatement Model (GACMO) to monitor emissions across various sectors of the economy. Angola, Senegal, and Mozambique have yet to provide thorough MRV frameworks for methane management.
- A common theme running through the MRV systems for each study country is the issue of voluntary reporting. This approach to reporting undermines the accuracy of emissions reporting, especially in areas where regulatory oversight is inadequate.

Best practices in methane management

- Nigeria, Ghana and Angola have taken a leading role in methane reduction initiatives, exemplifying the significance of gas commercialisation in reducing flares.
- Ghana and Nigeria's existing MRV systems present further development and enhancement opportunities.
- Support from development finance institutions could be a benchmark to ensure new fields comply with standards to avoid methane emissions.

Gaps in methane management

- Despite its significant contribution to methane emissions, efforts in addressing venting remain limited, reflecting a gap in comprehensive strategies for emission reduction. This challenge in methane oversight is compounded by a lack of political will and inadequate regulatory capacities. These challenges undermine the development of robust policies necessary to control methane emissions in the oil and gas sector.
- National Oil Companies (NOCs) have yet to fully commit to global initiatives on methane management, highlighting a challenge in aligning industry practices with broader environmental goals. This lack of commitment may impede progress in achieving substantial reductions in methane emissions.
- MRV frameworks in methane management heavily rely on voluntary disclosures, which raise questions about the accuracy of reported emissions data. Further, the absence of a clear consensus on who bears responsibility for emission reduction investments hinders resource allocation for effective methane management.
- Weak coordination among government agencies and inadequate awareness among other stakeholders, including civil society, contribute to knowledge gaps and limited advocacy on methane management in Africa.

Measures required for effective methane management

- Effective methane management requires a tailored approach for matured and frontier oil producers. Matured producers should take responsibility for their emissions, devising realistic plans to eliminate methane releases.
- Governments and companies must clarify institutional roles for methane management in the short term to ensure a cohesive strategy for emission reduction. Achieving this requires a shared commitment between the government and companies to invest in methane abatement technologies.
- National Oil Companies must demonstrate leadership in implementing methane management strategies. They must strengthen institutional collaborations, invest in capacity building, promote transparent reporting, and explore innovative approaches to reduce methane emissions in the oil and gas sector.
- For new producers, aligning gas commercialisation infrastructure with oil and gas production is imperative. These countries should integrate strict provisions on methane emissions management into their legal frameworks to establish a foundation for sustainable practices from the outset.
- Governments and regulatory agencies must prioritise methane reduction efforts within the oil and gas sector, emphasising the importance of a coordinated and stringent approach.
- Institutional collaboration is paramount, necessitating a holistic strategy for methane management. These institutions must be deliberate in providing specific policies to address methane emissions in Africa's oil and gas sector.
- Philanthropy organisations and development partners should integrate methane management into their strategies to support global environmental goals. Lastly, development finance institutions, as part of their ESG strategies, must make methane management a precondition for financing new oil and gas field developments. This approach would ensure that financial support aligns with sustainable practices.

Introduction

Chapter Summary

- Methane is a potent greenhouse gas and the second most significant contributor to human-induced climate change. Therefore, reducing methane emissions is central to climate change mitigation.
- Methane emissions originate from both natural processes and human or anthropogenic activities. Anthropogenic sources are responsible for approximately 60% of the total methane emissions.
- The energy sector significantly contributes to anthropogenic methane emissions accounting for about 40% of global methane emissions. The oil and gas industry accounts for about 62% of the methane emissions from the energy sector. Consequently, efforts to reduce methane emissions in oil and gas can substantially impact methane emissions reduction and bolster climate action.
- Besides the environmental benefits of emissions reduction, methane abatement offers economic advantages through utilising and commercialising captured methane gas. Existing technologies can potentially reduce methane emissions by about 70%, and the gains from gas commercialisation can largely offset the costs associated with these technologies.
- Africa's oil and gas sector accounts for about 68% of methane emissions from the energy sector, with a potential increase in emissions considering the anticipated growth in oil and gas activities. This emphasises the importance of increased commitments to methane management within the continent's oil and gas sector.
- Methane emissions from oil and gas result from venting, fugitive emissions and incomplete combustion of flared gas. In 2022, venting formed about 63% of the sector’s emissions, followed by fugitive emissions and flaring, accounting for 21% and 9% respectively.

Methane is a potent greenhouse gas with significant impacts on global climate change

Methane is a major greenhouse gas, accounting for about 16% of global greenhouse gas emissions.[1] It is the second largest contributor to human-caused climate change after carbon dioxide but has a comparably shorter atmospheric lifetime and a higher Global Warming Potential (GWP). Over a 100-year timescale, the GWP of methane is estimated to be 28 to 36 times that of carbon dioxide.[2] When assessed over a 20-year timeframe, the GWP escalates to 84 to 86 times, contributing to climate change with its devastating environmental impacts.

Methane's influence on human health is indirect yet consequential. It plays a central role in the formation of tropospheric ozone, a notorious component of smog linked to various respiratory ailments, including bronchitis, asthma, and other lung diseases. [3] Globally, mortality from tropospheric ozone was estimated to increase by 46% between 2000 and 2019.[4] Thus, addressing methane emissions through effective management strategies holds the potential to mitigate the prevalence of respiratory diseases associated with tropospheric ozone. The World Health Organisation (WHO) also estimates that abating Short-Lived Climate Pollutants (SLCP) such as methane could prevent about 3.5 million deaths annually by 2030.[5]

Methane emissions result from both natural processes and human activities. Natural methane sources include wetlands, termites, wildfires, and geological seepage. In contrast, anthropogenic or human-induced methane emissions result from various activities such as agriculture (e.g., livestock and manure management), oil and gas production and distribution, coal mining, and waste management. The Global Carbon Project estimates that about 60% of global methane emissions are attributed to anthropogenic sources,[6] underscoring the urgency of tackling methane emissions from human activities.

1 IPCC. (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

2 US Environmental Protection Agency. (2021). Methane Emissions. Retrieved from https://www.epa.gov/ghgemissions/methane-emissions

3 Climate & Clean Air Coalition (n.d.). Tropospheric Ozone. Retrieved from https://www.ccacoalition.org/short-lived-climate-pollutants/tropospheric-ozone

4 Malashock, D. A., Delang, M. N., Becker, J. S., Serre, M. L., West, J. J., Chang, K. L., ... & Anenberg, S. C. (2022). Global trends in ozone concentration and attributable mortality for urban, peri-urban, and rural areas between 2000 and 2019: a modelling study. The Lancet Planetary Health, 6(12), e958-e967.

5 World Health Organization (2015, October 22). New report identifies four ways to reduce health risks from climate pollutants. Retrieved from https://www.who.int/news/item/22-10-2015-new-report-identifies-four-ways-to-reduce-health-risks-from-climate-pollutants

6 Global Carbon Project. (2021). Global Methane Budget. Retrieved from https://www.globalcarbonproject.org/methanebudget/20/historical.htm

Methane emissions management requires collaboration and collective action among national and international stakeholders. Governments, companies, regional economic blocs, and other stakeholders must demonstrate their commitment to mitigate methane emissions through compliance with global initiatives, such as the Paris Agreement and the Global Methane Pledge. Stakeholders must also actively uphold the targets and measures outlined in these initiatives and prioritise actions that contribute to reducing methane emissions.

Table 1: Natural and human-induced causes of methane emissions

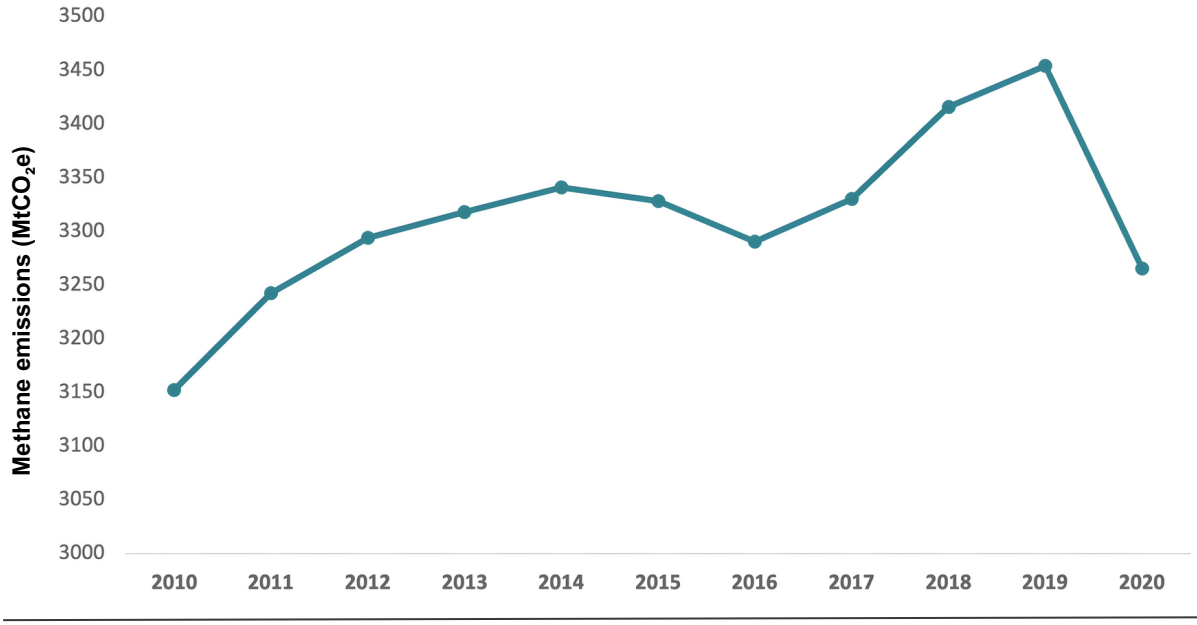
Source	Mode of emission
Natural sources	
Wetlands	Breakdown of organic matter, such as plant material and animal waste, by microbes in waterlogged soil.
Termites	Digestive processes
Oceans	Methane is produced by microbes in the water and released into the atmosphere.
Geological sources	Natural gas seeps, mud volcanoes, and geothermal activity, such as volcanic eruptions
Human-induced sources	
Oil and gas production	• Intentional venting • Fugitive emissions from pipelines, storage and transport of fossil fuels • Incomplete combustion of gas flares
Agriculture	Livestock production and manure management
Landfills and wastewater	Decomposition of organic waste
Coal mining	• Coal mining-related activities such as extraction, crushing and distribution of coal. • Active underground and surface mines • Abandoned mines and undeveloped coal seams
Bioenergy	• Anaerobic decomposition of agricultural residues and biogas digesters • Incomplete combustion of biomass for energy production • Leakages during storage/transportation of biogas

Reducing methane emissions from the oil and gas sector can significantly reduce global methane emissions

The energy sector formed about 40% of global methane emissions between 2010 and 2020. The sector's contribution to methane emissions increased from 3,152 MtCO2e in 2010 to 3,453 MtCO2e in 2019. Methane emissions declined by 5% in 2020, primarily attributed to the drop in oil and gas activity caused by the Covid 19 pandemic.

Despite the temporary reduction in 2020, the long-term trend shows a rising concern with methane emissions from the energy sector. The United Nations Environment Programme (UNEP) and the Climate and Clean Air Coalition (CCAC) project that by 2030, global methane emissions from the energy sector will increase between 3% and 17% relative to 2020 levels if no serious reduction efforts exist.[7] This increase is anticipated to be driven by continued growth in oil and gas production and use, particularly in developing countries.

Figure 1: Global methane emissions from the energy sector (2010-2020)



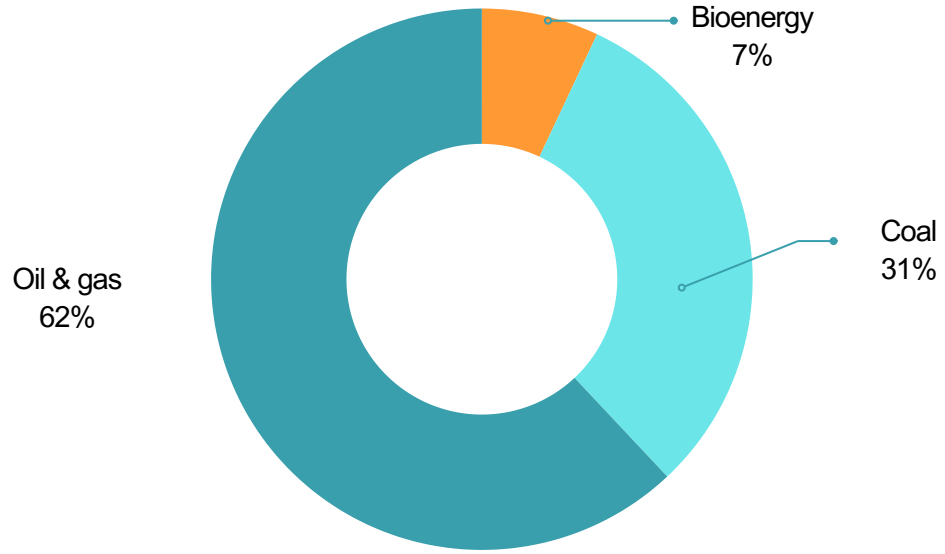
Source: World Resources Institute

Oil and gas activities account for a more significant proportion of methane emissions from the energy sector. Statistics from the IEA indicate that in 2022, the oil and gas sector contributed to about 62% of methane emissions, followed by coal and bioenergy, with 31% and 7% respectively. Methane emissions from oil and gas emerge from venting, incomplete combustion of flared gas, and leaks from equipment and pipelines.

7 United Nations Environment Programme / Climate and Clean Air Coalition (2022). Global Methane Assessment: 2030 Baseline Report Summary for Policymakers. Nairobi. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/41108/methane_2030_SPM.pdf?sequence=1&isAllowed=y

- **Venting** is the deliberate release of methane at various oil and gas development phases. It is the primary contributor to methane emissions in the oil and gas sector, accounting for about 63% of methane emissions from the sector in 2022.
- **Fugitive emissions** refer to the unintended release of gas, including methane, into the atmosphere. These emissions occur due to leakages, malfunctioning, and improper equipment maintenance. Fugitive emissions accounted for about 21% of methane emissions from the oil and gas sector in 2022.
- **Gas flaring** is the controlled activity of burning natural gas in oil and gas production. While complete combustion releases CO_2 and water, incomplete combustion leads to the release of methane and other compounds. The amount of methane released primarily depends on the level of combustion. The World Bank estimates that globally, methane formed about 12% of total emissions from gas flaring. About 9% of methane emissions from the oil and gas sector were attributed to gas flaring in 2022.

Figure 2: Global Methane emissions from the energy sector, 2022 (kt)



Source: International Energy Agency (2023), Methane Tracker Database, IEA, Paris. License: Creative Commons Attribution CC BY-SA 4.0.

Existing technologies can cut 70%+ of methane emissions from oil and gas, a viable methane mitigation strategy

[k]

Reducing emissions from fossil fuel production and consumption is an effective approach to mitigating methane emissions. The IEA estimates that utilizing existing technologies can potentially prevent about 62.4Mt of methane emissions (about 70% of current emissions). Methane abatement measures can yield economic value which extends beyond emissions reduction. Additional potential exists for utilizing the conserved gas to offset the cost associated with the employed technologies.

The IEA estimates that about 31.1Mt of the savings are achievable at zero net cost.[8] Again, new investments worth about $13 billion will be required to abate the remaining methane emissions.

However, the benefits of commercializing the captured methane would outweigh its costs. Various technologies and methods exist for methane reduction, each differing in cost and mode of operation. Examples of such technologies include vapour recovery units, plungers, the substitution of pneumatic devices with low-emission alternatives, and robust systems for detecting and repairing leaks. Interactions with IOCs and local companies show various efforts at methane abatement using technologies in new fields and their commitment to reducing flaring and venting in existing fields.

Box 1: Methane abatement technologies and methods

Pneumatic units in oil and gas systems can significantly reduce methane emissions. Pneumatic devices, such as controllers and pumps, which utilize natural gas as their power source, often release methane through venting and leakages. The following approaches are effective in mitigating emissions through pneumatic units:

- Substituting pneumatic devices with electric pumps or controllers (e.g. pumps powered by solar generators)
- Swapping high-bleed pneumatic devices (which allow gas to escape faster) with lower-bleed alternatives.

Capturing and utilizing methane to curb emissions and enhance value. Methane accumulation in specific areas of oil and gas equipment, such as storage tanks and well heads, can be captured for economically beneficial applications. Technologies like Vapour Recovery Units (VRUs), blowdown capture devices, and plungers can capture these methane volumes. Once obtained, methane from oil and gas production can be utilized as a transportation fuel, either in the form of compressed natural gas (CNG) or liquefied natural gas (LNG).

Methane Leak Detection and Repair (LDAR). Identifying fugitive emissions from pipelines, wells (including abandoned wells), and storage tanks is crucial in the oil and gas industry. Regularly monitoring and using leak detection devices like optical gas imaging cameras and optical spectroscopy instruments are effective strategies to promptly repair leaks and reduce emissions.

8 IEA (2023), Methane Tracker, IEA, Paris. Retrieved from https://www.iea.org/data-and-statistics/data-tools/methane-tracker

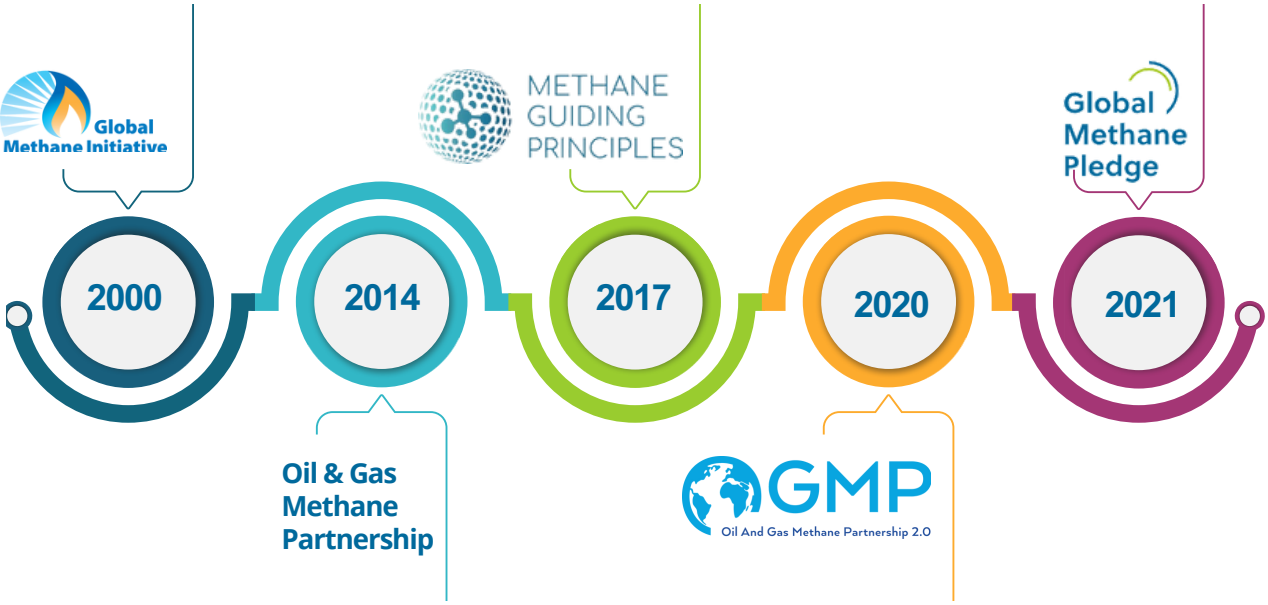
Global Commitments to Methane Management from the Energy Sector are gaining momentum

Many countries have pledged to reduce greenhouse gas emissions, including methane emissions, through established Nationally Determined Contributions (NDCs) under the Paris Agreement. Given the importance of methane management in mitigating global warming and climate change, there are several global initiatives that elicit commitments and action from multiple stakeholders.

In the 21st century, one of the pioneering initiatives by oil and gas companies is the Global Methane Partnership, founded in 2004 as an international coalition of oil and gas companies. Its primary objective is to promote cost-effective and immediate measures for methane abatement, recovery, and utilization as a clean energy source. The Oil and Gas Methane Partnership (OGMP) was established in 2014 to boost methane management commitments in the oil and gas sector. In 2020, OGMP transformed to OGMP 2.0, with a comprehensive reporting framework covering the entire oil and gas value chain.

As companies commit to reducing methane emissions, governments and non-state actors have also become involved in this commitment. Methane Guiding Principles was established as a coalition of industry players and civil society organizations with a collective aim to actively engage in methane management efforts. In 2021, the Global Methane Pledge emerged, with country commitments to reduce global methane emissions by at least 30% and ensure effective management through enhanced measurement and monitoring mechanisms.

Figure 3: Global initiatives on methane emissions reduction



Box 2: The Global Methane Pledge

The Global Methane Pledge was established at the United Nations Climate Change Conference (COP26) in Glasgow in 2021. The pledge was led by the United States and the European Union and included major methane emitters such as China, India, and Russia. As of July 2023, the GMP had 150 participating countries, including 39 African countries, to reduce global methane emissions by at least 30% from 2020 levels by 2030.

The Global Methane Pledge also includes commitments to improve methane measurement and monitoring and reduce methane emissions from the oil and gas sector. The pledge also commits to support existing international methane emission reduction initiatives, such as those of the Climate and Clean Air Coalition, the Global Methane Initiative, and the relevant work of the United Nations Environment Programme towards methane emissions management.

Participating African countries under the Global Methane Pledge

Member countries in Africa

1. Benin
2. Burkina Faso
3. Cabo Verde
4. Cameroon
5. Central African Republic
6. Chad
7. Comoros
8. Congo DRC
9. Congo Republic
10. Cote d'Ivoire
11. Djibouti
12. Egypt
13. Equatorial Guinea
14. Eswatini
15. Ethiopia
16. Gabon
17. Gambia
18. Ghana
19. Lesotho
20. Liberia
21. Libya
22. Malawi
23. Mali
24. Mauritania
25. Morocco
26. Mozambique
27. Namibia
28. Niger
29. Nigeria
30. Rwanda
31. São Tomé and Príncipe
32. Senegal
33. Seychelles
34. Sierra Leone
35. Somalia
36. Sudan
37. Togo
38. Tunisia
39. Zambia

Box 3: Methane Guiding Principles

The Methane Guiding Principles (MGP) was launched in 2017 as a voluntary initiative by a coalition of industry and civil society organisations that brings together companies and NGOs committed to reducing methane emissions across the natural gas supply chain to actively share knowledge on the best practices and effective methane management strategies. Over 50 companies, including major producers such as BP, Chevron, and ExxonMobil, have committed to implementing the principles, which include reducing venting and flaring, improving leak detection and repair, and reporting emissions data. The MGP's five Principles include:

- Continually reduce emissions
- Advance strong performance across the gas supply chain
- Improve the accuracy of methane emissions data
- Advocate sound policy and regulations on methane emissions
- Increase transparency

The Methane Guiding Principles have developed best practice guides on varied natural gas supply chain processes to help signatories effectively reduce methane emissions.

Box 4: The Global Methane Initiative (GMI)

The GMI is an international partnership of over 45 countries and organizations that works to reduce methane emissions across four key sectors: oil and gas, coal, agriculture, and waste management. GMI members have committed to developing and implementing methane reduction strategies, sharing best practices and technologies, and promoting the use of natural gas as a cleaner fuel. The initiative has set a target to reduce global methane emissions by 15% by 2030. There are about 13 company members that have operations in Africa

GMI participating companies operating in Africa

Box 5: Oil and Gas Methane Partnership

The inception of the Oil and Gas Methane Partnership dates back to 2014. OGMP's primary objective is to assist oil and gas companies in gaining a deeper comprehension of methane emissions management and setting priorities within their operations. It aims to facilitate the development of action plans for achieving immediate reductions. Companies involved in OGMP as partners are dedicated to methodically recognizing, measuring, controlling, and mitigating methane emissions resulting from leaks and specific equipment and processes. In 2020, OGMP was transformed into OGMP2.0 within additional reporting guidelines to improve accuracy and reliability from the oil and gas companies by providing members with a comprehensive measurement-based reporting framework. OGMP 2.0 currently has 95 company members (including operators of natural gas transmission and distribution pipelines, gas storage capacity and LNG terminals) and five non-company members.There are 12 company members that have operations in Africa.

OGMP 2.0 participating members operating in Africa

Box 7: Specific methane commitments of some IOCs operating in Africa

Royal Dutch Shell – In 2018, Shell set a target to keep methane emissions intensity for its oil and gas business below 0.2 percent by 2025. This target covers all upstream and integrated oil and gas facilities for which Shell is the operator. Shell is also involved in international partnerships for methane emissions management initiatives, including the Methane Guiding Principles, Oil and Gas Climate Initiative, Oil and Gas Methane Partnership 2.0 (OGMP 2.0) and the Global Gas Flaring Reduction Partnership.

BP – Targeting methane emissions intensity of 0.2 percent from its operations and holding it below 0.3 percent. The company is pursuing this target by upgrading mature productions and employing new designs and technologies in green fields. BP is also a member of Methane Guiding Principles, Oil and Gas Climate Initiative, Oil and Gas Methane Partnership 2.0 (OGMP 2.0) and the Global Gas Flaring Reduction Partnership.

Total Energies – Total has also set its methane emissions intensity at below 0.2 percent of commercial gas produced at all of its operated upstream oil and gas installations. In 2022, Total launched a worldwide drone-based emissions detection and quantification campaign across its upstream oil and gas-operated sites. Total is also a member of the Methane Guiding Principles, Oil and Gas Climate Initiative, Oil and Gas Methane Partnership 2.0 (OGMP 2.0) and the Global Gas Flaring Reduction Partnership.

Eni – The company is one of the first in the industry to set an absolute reduction target for fugitive methane emissions as early as 2016 and confirms its commitment to further reduce methane emissions from its upstream businesses in line with the Global Methane Pledge. Eni is also a signatory to the Methane Guiding Principles and a member of the Oil and Gas Climate Initiative and the Oil and Gas Methane Partnership 2.0 (OGMP 2.0). The company confirmed that its new fields employ state-of-the-art technologies in managing methane emission from new fields, and investing to reduce emissions from existing fields.

Many countries have integrated their methane reduction targets within their broader national net zero pledges encompassing multiple greenhouse gases. This comprehensive approach acknowledges the importance of reducing methane emissions alongside other pollutants to achieve climate targets.

Beyond the broad frameworks that capture methane emissions with other greenhouse gases, countries are developing specific emissions reduction targets. This momentum is expected to accelerate, particularly among oil-producing countries, contributed by their commitment to various global treaties focused on methane abatement actions. Table 2 outlines some oil and gas producing countries and regional bodies with specific methane emissions reduction targets.

Table 2: Specific methane emission reduction strategies from some oil and gas producing jurisdictions

Country	Policy/Strategy	Methane Emission Targets
Canada	Canada's Strengthened Plan[9]	• Reduce methane emissions from the oil and gas sector by 40-45% by 2025. • Review and set new targets for 2030 and 2035
USA	Methane Emissions Reduction Action Plan 2022[10]	Reduce harmful methane emissions and energy waste from covered sources by 87% below 2005 levels in 2030.
European Union	EU Methane Action Plan[11]	Reduce overall methane emissions by about 23% between 2020 and 2030, leading to an overall methane reduction of just over 50% between 1990 and 2030
Vietnam	Action Plan for Methane Emissions Reduction[12]	• Reduce overall methane emissions by at least 13.34% below 2020 levels by 2025. • Reduce overall emissions by at least 30% below 2020 levels by 2030.
Vietnam	Guidelines for Management of Fugitive Methane and Greenhouse Gases Emissions in the Upstream Oil and Gas Operations in Nigeria	• Reduce fugitive methane emissions/leakages from oil and gas by 60% by 2031 • Eliminate (100%) routine gas flaring by 2030

9 Government of Canada (2021). A Healthy Environment and A Healthy Economy: Canada's strengthened climate plan to create jobs and support people, communities and the planet. Retrieved from: https://bit.ly/3ZNsnEh

10 US Methane Emissions Reduction Plan. Retrieved from: https://www.whitehouse.gov/wp-content/uploads/2022/11/US-Methane-Emissions-Reduction-Action-Plan-Update.pdf

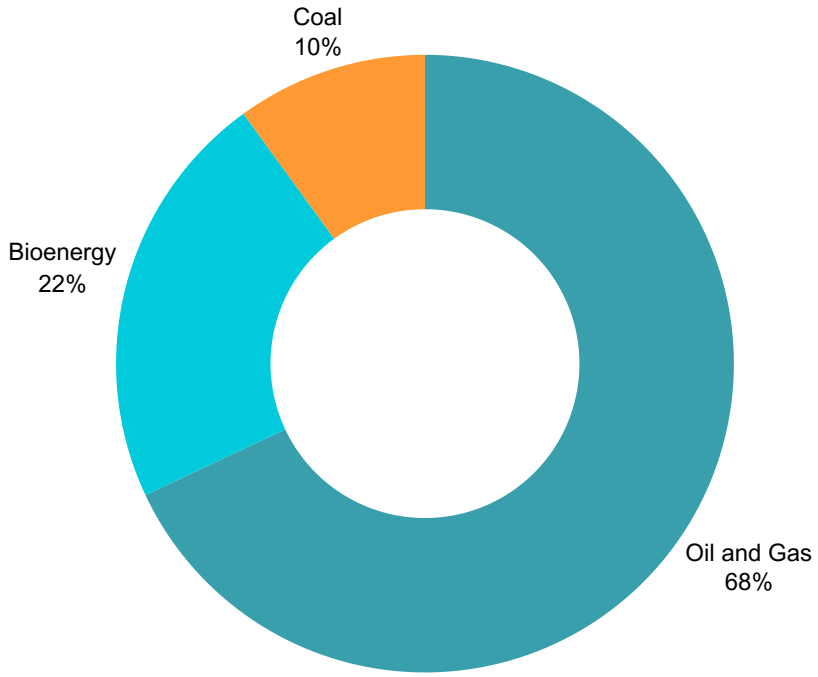
11 EU Methane Action Plan. Retrieved from: https://www.iea.org/policies/17024-european-union-methane-action-plan

12 International Energy Agency (2022). Viet Nam Action Plan for Methane Emissions Reduction by 2030. Available at https://www.iea.org/policies/17026-viet-nam-action-plan-for-methane-emissions-reduction-by-2030

Africa's increasing oil and gas projects require improved methane management for sustainable development

The oil and gas sector is Africa's highest contributor to methane emissions, emitting about 68% of the energy sector's methane emissions. A report by the African Development Bank (AfDB) identifies Egypt, Nigeria, Algeria, South Africa and Angola as responsible for three-quarters of total methane emissions from Africa, with Algeria and Nigeria being the largest methane emitters from the oil and gas sector. [13]

Figure 4: Methane emissions from Africa's energy sector, 2022 (%)



Source: International Energy Agency (2023), *Methane Tracker Database*, IEA, Paris. License: Creative Commons Attribution CC BY-SA 4.0.

The statistics on methane emissions from Africa could increase significantly under a business-as-usual scenario of little to no action on methane abatement, especially with the increasing role of natural gas for electrification, export and industrialization. Several big-ticket gas projects on the continent have already advanced towards production. These include the Mauritania/Senegal Greater Tortue Ahmeyim FLNG project, Angola's Sanha Lean Gas project, Congo's Marine XII Fast LNG Project, Mozambique's Rovuma LNG project and Ivory Coast's Baleine Phase 1 project.

13 Africa Development Bank (2020). Methane In Africa: A high-level assessment of anthropogenic methane emissions in Africa with case studies on potential evolution and abatement. Available at https://www.afdb.org/en/documents/methane-africa-high-level-assessment-anthropogenic-methane-emissions-africa-case-studies-potential-evolution-and-abatement

These oil and gas initiatives align with Africa's commitment to utilising its abundant energy resources to combat energy poverty, as outlined in the continent's shared stance on energy access and a just transition.[14] This position emphasizes the significance of natural gas in addressing energy security and ensuring universal access to energy. However, to increase Africa's oil and gas production while minimizing environmental impact, effective strategies must be implemented to manage potential methane emissions arising from venting, fugitive emissions, and incomplete combustion of gas flaring.

About 75% of African nations have committed to reducing methane emissions under the Global Methane Pledge, showcasing the continent's dedication to curbing methane emissions. However, achieving these goals necessitates collaboration among various stakeholders, including governments, corporations, civil society and academia, to establish robust mechanisms for monitoring and reducing emissions. It also requires fostering an understanding of best practices through peer learning, sustained engagement, and advocacy. An examination of methane abatement strategies reveals that African countries and its regional organizations have not fully adopted deliberate and comprehensive approaches to methane management, resulting in a limited emphasis on this crucial aspect. Therefore, a study that explores how methane considerations are incorporated into the energy and development plans among African countries becomes imperative.

Research objectives and scope

This research seeks to understand the place of methane management in the energy and developmental plans of some selected African countries. It also aims to explore opportunities and barriers that support or militate against action on methane emission reduction in Africa.

Specifically, the study seeks to:

1. Explore existing national, regional, and continental frameworks influencing energy transitions, particularly methane emissions, in each selected country.
2. Identify the political drivers of action or inaction around energy transitions and their impact on commitments to methane emissions reduction.
3. Identify areas of advocacy for methane emission reductions.
4. Identify major public (state-owned enterprises and regulatory agencies), private, and civil actors involved in the governance and implementation of methane emissions reduction.

14 Africa Union (2022). Africa Speaks with Unified Voice as AU Executive Council Adopts African Common Position on Energy Access and Just Energy Transition. https://au.int/sites/default/files/pressreleases/42071-pr-PR-The_Executive_Council_Adopted_African_Common_Position_on_Energy_Access_and_Transition.pdf

The study covers existing and new oil and gas producers in five African countries: Angola, Ghana, Mozambique, Nigeria and Senegal. These five countries represent matured and frontier oil and gas producers. Nigeria and Angola are two of the most mature African oil and gas producers, with each country producing over 1 million barrels per day. They have long-standing experience in oil and gas exploration and production in Africa. Mozambique has been a gas producer for the past two decades, producing about 280 mmscf per day. Recent discoveries and production are set to make Mozambique a significant gas exporter on the continent.

On the other hand, Ghana is fairly new, having produced oil for about 13 years. Senegal has also made significant oil and gas discoveries, positioning the country as an oil producer in less than one year. The ensuing chapters present the different country case studies, which provide detailed accounts of the experiences of the selected nations included in the research.

Country Case I: Nigeria

Country Summary

- Nigeria is the largest producer of oil in sub–Saharan Africa. In 2022, it recorded an average production of 1.3 million barrels of crude oil and condensates per day.
- Methane emissions in Nigeria are on an upward trend. Nigeria is the leading methane emitter in the sub-region, accounting for about 16% of Sub-Saharan Africa's methane emissions between 2010 and 2020. The energy sector averagely contributes about 62% of total methane emissions, of which the oil and gas sector accounts for about 60%.
- Venting in onshore and offshore oil and gas fields is the primary cause of methane emissions in Nigeria's oil and gas sector. It constitutes about 70% of the sector's emissions. Gas flaring and fugitive emissions account for 16% and 13%, respectively.
- Nigeria has specific targets and mechanisms to reduce methane emissions from the oil and gas sector. The country aims to eliminate gas flaring and reduce fugitive emissions and leakages by 50% by 2030.
- Nigeria has aligned policy, regulation, and guidelines towards achieving its methane management targets. Such laws include the Petroleum Industry Act 2021, Flare Gas (Prevention of Waste and Pollution) Regulations, 2018 and Guidelines for Management of Fugitive Methane and GHG emissions in Nigeria's upstream oil and gas operations.
- Gas commercialisation and flare reduction are central to Nigeria's methane emission reduction efforts. The country has already reduced flaring by 30% since 2015 and is projected to reduce flaring by 55% by 2030. To achieve zero flaring by 2030, Nigeria will need to strengthen its regulatory measures.
- The Country Methane Abatement Tool (CoMAT) is the primary MRV primary tool for emissions monitoring. Additionally, Nigeria has a gas flare tracker that operates using satellite imagery. While these are essential for monitoring, successful implementation depends on the accuracy of emissions data from major equipment used in oil and gas production.

Introduction

Nigeria is the largest producer of oil in sub–Saharan Africa. In 2022, it produced about 1.3 million barrels of oil per day (equivalent) of crude oil and condensates. There are currently 323 developed fields in Nigeria from which crude oil, condensates and natural gas are extracted.[15]

Nigeria is the largest emitter of methane in Sub-Saharan Africa, contributing about 16% of the region's methane emissions between 2010 and 2020. Within the period, Nigeria emitted a yearly average of about 147MtCO2e of methane (See Table 3). Again, Methane emissions from Nigeria increased between 2010 and 2020. As shown in Figure 5, methane emissions have increased by about 6%, from 143MtCO2e to 151.56MtCO2e.

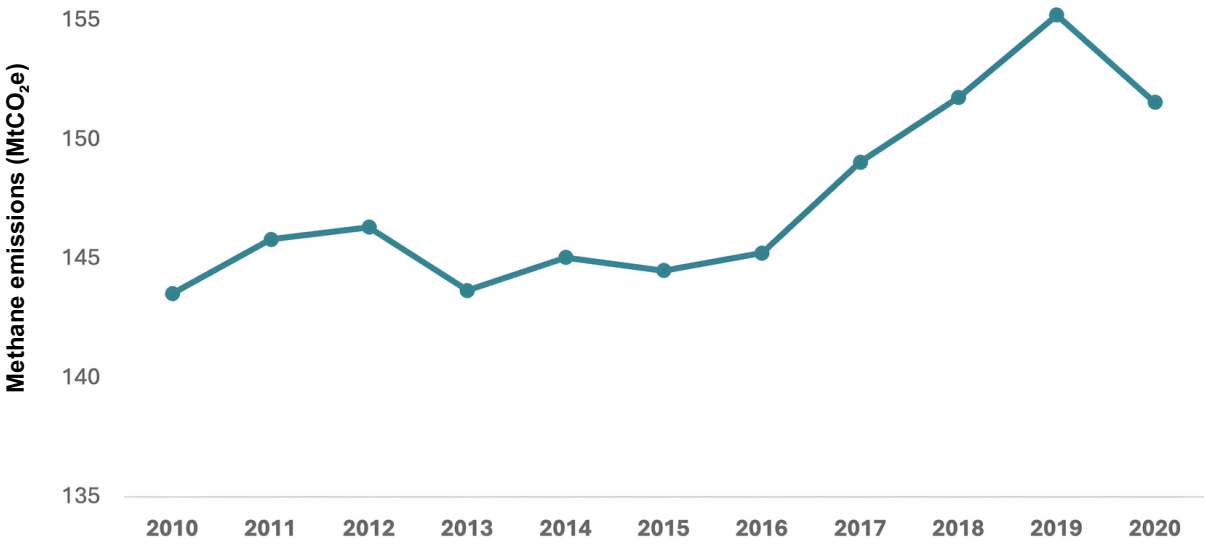
Table 3: Average Methane Emissions in Sub-Saharan Africa (2010-2020)

Country	Methane Emissions (MtCO2e)	Percentage
Nigeria	**147.43**	**16%**
Ethiopia	80.36	9%
South Africa	73.16	8%
Sudan	54.45	6%
DRC	48.00	5%
Chad	47.65	5%
Tanzania	45.36	5%
Angola	44.00	5%
South Sudan	33.62	4%
Kenya	31.79	3%

Source: World Resources Institute

15 Nigerian Upstream Petroleum Regulatory Commission. Oil Production Status Report. Retrieved from https://www.nuprc.gov.ng/oil-production-status-report/

Figure 5: Global methane emissions from the energy sector (2010-2020)

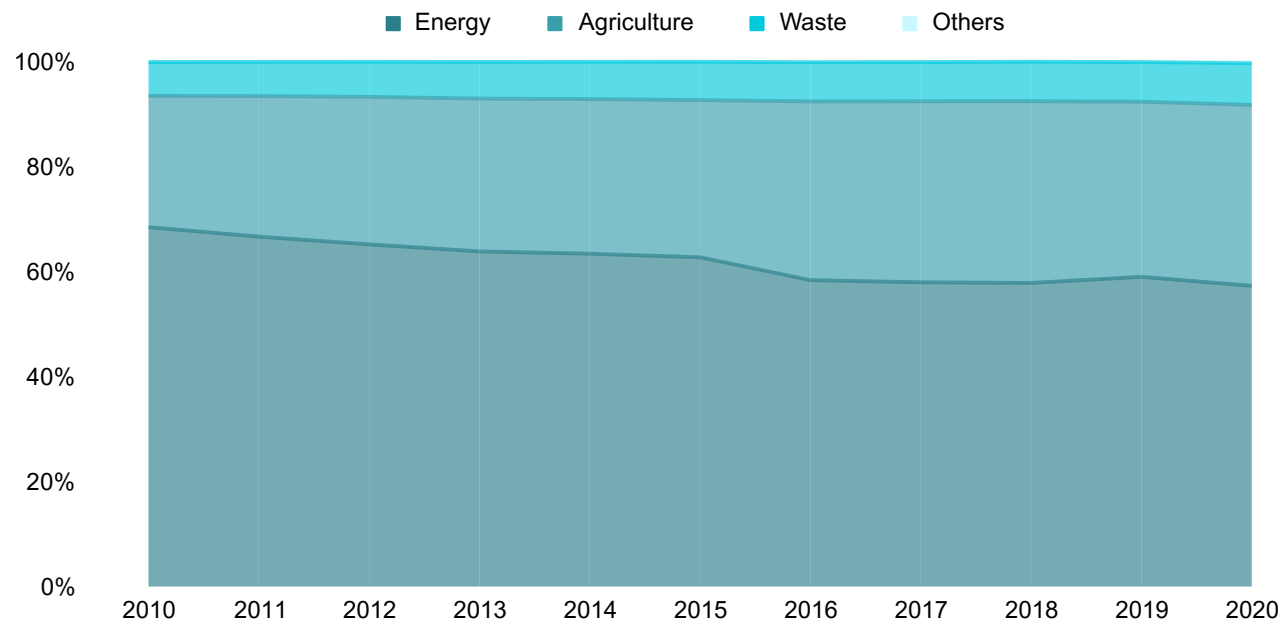


Source: Authors' construct with data from World Resources Institute

The energy sector has consistently been Nigeria's largest source of GHG emissions.[16] Figure 6 shows that the energy sector contributed more than 50% of methane emissions in Nigeria between 2010 and 2020. The energy sector has contributed an average of 91MtCO2e (about 62% of total methane emissions) between 2010 and 2020. The agriculture and the waste sectors follow with average contributions of 31% and 7%, respectively.

16 Federal Republic of Nigeria (2021). Nigeria's Nationally Determined Contribution – 2021 Update

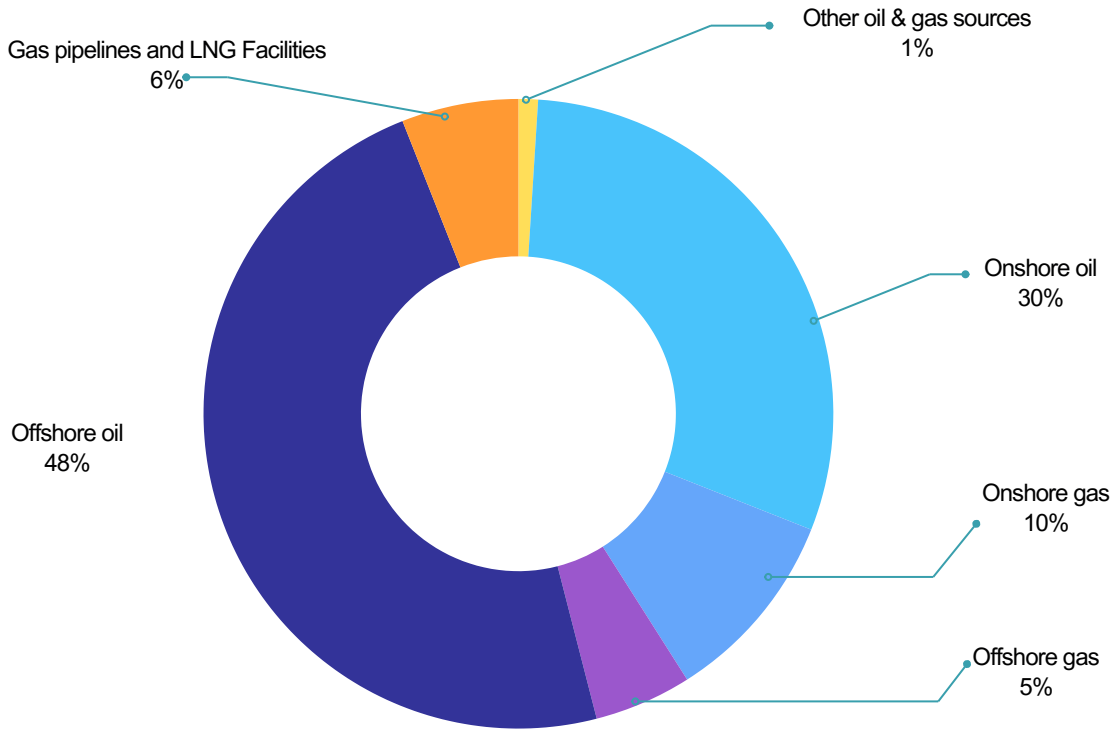
Figure 6: Sources of methane emissions in Nigeria (2010-2020)



Source: Authors' construct with data from World Resources Institute

The oil and gas sector accounts for about 60% of the energy sector's methane emissions, mainly from onshore and offshore oil production. The IEA estimates that offshore and onshore oil production contributed about 78% of total methane emissions from the oil and gas sector (48% from onshore and 30% from onshore oil production) in 2022. Onshore gas is the third main emission source, contributing about 10% of emissions from the oil and gas sector, followed by emissions through gas pipelines and LNG facilities (6% of emissions). Figure 7 describes the various sources of methane emissions from Nigeria's oil and gas sources.

Figure 7: Methane emissions from Nigeria's oil and gas sector (2022)



Source: International Energy Agency (2023), Methane Tracker Database, IEA, Paris. License: Creative Commons Attribution CC BY-SA 4.0.

Venting is the primary cause of methane emissions in the oil and gas sector, constituting approximately 70% of emissions from oil and gas. Onshore and offshore oil production are the two key emission sources for methane venting. Flaring is the next prominent contributor, accounting for about 16% of methane emissions. The sector's remaining methane emissions originate from fugitive emissions at 13% and other minor sources at 1% (see Table 4).

Table 4: Methane emissions (in kt) profile from Nigeria's oil and gas sector (2022)

	Activity			
Emission source	**Venting**	**Fugitive emissions**	**Flaring**	**Others**
Gas pipelines and LNG facilities	41.09	77.07		
Offshore gas	64.59	29.77		
Offshore oil	689.98	50.93	203.02	
Onshore gas	138.26	63.72		
Onshore oil	458.35	33.83	103.51	20.17
Grand Total	**1392.27**	**255.32**	**306.54**	**20.17**

Source: International Energy Agency

Relevant agencies responsible for methane management in Nigeria

Methane management in Nigeria is the responsibility of various institutions, including Federal Ministries, regulatory authorities, national oil companies and other stakeholders. Table 5 details the key institutions responsible for methane management in Nigeria.

Table 5: Institutional framework for methane management in Nigeria

Body	Function
Ministries	
Ministry of Petroleum Resources (MPR)	MPR is responsible for the formulation and implementation of policies in the oil and gas sector
Federal Ministry of Environment (FMENV):)	The mandate of the Federal Ministry of Environment is to ensure environmental protection, natural resources conservation and sustainable development

Body	Function
Regulatory Agencies	
Nigerian Upstream Regulatory Commission (NUPRC)	• Regulator for the upstream oil and gas sector. • Ensure that upstream operators comply with relevant laws that govern the sector. • NUPRC operates under the Ministry of Petroleum Resources
Nigeria Midstream and Downstream Petroleum Regulatory Authority (NMDPRA)	• NMDPRA regulates and monitors the midstream and downstream petroleum sector, including bulk storage, distribution, marketing and transportation pipelines in the oil and gas sector. • The authority operates under the Ministry of Petroleum Resources
National Oil Spill and Detection Regulatory Agency (NOSDRA)	• NOSDRA ensures preparedness, detection and response to all oil spillages in Nigeria. • It is tasked to enforce all environmental laws and standards that govern the petroleum industry. • The agency operates under the Federal Ministry of Environment
National Environmental Standards and Regulations Enforcement Agency (NESREA)	• NESREA is mandated to ensure environmental protection and development, biodiversity conservation and sustainable development of Nigeria's Natural resources • Provides regulations for control of emissions from various sources (industrial, vehicular, power generation, mining and processing of industrial minerals, waste management) except the oil and gas sector. • NESREA operates under the Federal Ministry of Environment

Nigeria has set targets for methane emissions reduction

The focal points of action for Nigeria's commitment to methane emissions reduction are enshrined in its Short-Lived Climate Pollutants (SLCP) plan and the updated Nationally Determined Contributions (NDCs). The SLCP plan acknowledges methane as a major SLCP and establishes explicit targets for its reduction in Nigeria. It encompasses various measures to curb methane emissions, including the elimination of gas flaring, effective control of fugitive emissions, and efforts to reduce leakages. Similarly, Nigeria's NDCs have specific targets for methane emissions reduction, with a primary focus on eliminating gas flaring and curtailing fugitive emissions (see Table 6).

Table 6: Nigeria's methane abatement measures under the SLCP plan and NDCs

Abatement Measure	Description	Target
Elimination of gas flaring	Eliminating gas flaring and the recovery and utilisation of vented associated gas	**SLCP target:** eliminate gas flaring by 100% by 2020
		NDC target: eliminate gas flaring by 100% by 2030
Control of fugitive emissions	Control of unintended fugitive emissions/ leakages from oil production and processing	**SLCP target:** 50% fugitive emission reduction by 2030
		NDC target: 60% fugitive emission reduction by 2031
Methane leakage reduction	Reduction of methane emission from leakage of lateral gas transportation and distribution	**SLCP target:** 50% reduction of methane emissions by 2030

To achieve these targets, the government has other policies and actions, the implementation of which are supposed to guide methane emission reductions. Below is a summary of such laws and policies;

- **The Petroleum Industry Act (PIA):** The Petroleum Industry Act 2021 establishes the governance, fiscal, environmental, and regulatory framework for the Nigerian petroleum industry. It prohibits gas flaring and venting during oil and gas production, except in emergencies, where NUPRC can grant an exception. Furthermore, the Act defines the functions of the key regulatory bodies within the sector and makes legal provisions for licensing and the general operation of oil and gas fields.
- **Flare Gas (Prevention of Waste and Pollution) Regulations, 2018:** The objectives of the flare gas regulations include the reduction of the environmental and social impacts caused by gas flaring, environmental protection, and creating social and economic benefits from gas flare capture. The regulations also vest ownership of flared gas to the state at no cost (Regulation 2 (1)).
- **Guidelines for management of fugitive methane and GHG emissions in the upstream oil and gas operations in Nigeria:** These guidelines, established by NUPRC, provide the necessary guidelines for controlling and mitigating methane emissions. For example, it provides standards for Leak Detection and Repair (LDAR) systems in the oil and gas business. The regulations stipulate that operators must undertake LDAR assessments using optical glass imaging technologies or any other technologies approved by the Commission.

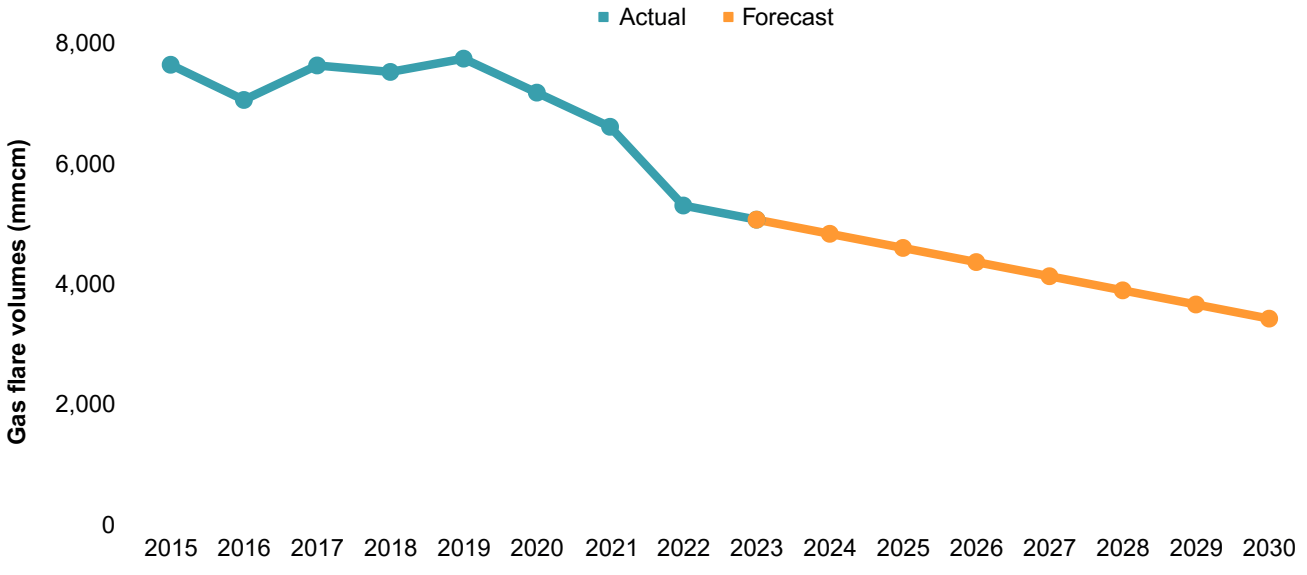
Gas commercialisation and flare reduction are central to Nigeria's methane abatement efforts

Interactions with stakeholders show that Nigeria significantly emphasises reducing gas flaring to address SLCPs. Beyond the climate concerns associated with gas flaring, financial losses are occasioned by the non-commercialisation of flared gas. PricewaterhouseCoopers (PwC) Nigeria estimates that over five years (2014-2018), Nigeria had lost about $4.17 billion of revenue due to gas flaring.[17] The Nigerian Gas Commercialisation Document and the SLCP plan set an ambitious objective of achieving zero gas flaring by 2020. However, this target could not be realized within the given timeframe. Subsequently, Nigeria's revised NDCs extended the timeline to 2030.

Nigeria has significantly reduced gas flaring between 2019 and 2022, with a decline of approximately 31%. The volume of gas flared decreased from 7,759 million cubic meters (mmcm) in 2019 to about 5,318 mmcm in 2022. These positive advancements can be attributed to implementing initiatives to curb flaring and promote the commercial utilization of gas resources.

Although the current trajectory suggests a continuous decline in gas flaring, achieving the set target may prove challenging. At the prevailing trend, it is projected that by 2030, gas flares will further decrease to approximately 3,400 mmcm, representing a 50% reduction compared to the levels recorded in 2020. Nigeria will have to intensify its efforts to achieve its zero-flare target. Nigeria can accelerate its journey towards achieving this goal by focusing on utilising and monetising gas resources. The study identified two critical efforts the country is making to reduce gas flares - introducing penalties for gas flaring and the National Gas Flaring Commercialization Program.

Figure 8: Forecast of gas flaring in Nigeria by 2030



17 PwC Nigeria (2019). Assessing the impact of gas on the Nigerian economy. https://www.pwc.com/ng/en/assets/pdf/gas-flaring-impact1.pdf

Nigeria institutes a penalty for gas flaring and subsequently promotes commercialization for sustainability

The laws on gas flaring aim to address the negative environmental and economic impacts associated with the practice. **The Flare Gas (Prevention of Waste and Pollution) Regulations prescribe penalties for gas flaring. Operators with a daily production threshold of 10,000 barrels are required to pay a penalty of $2 for every thousand standard cubic feet (mscf) of flared gas, while those producing less than 10,000 barrels per day face a penalty of 50 cents per mscf.** These penalties are intended to discourage gas flaring and encourage more sustainable oil and gas operations practices.

However, interactions with stakeholders have revealed **weaknesses in monitoring and enforcement mechanisms, leading to limited compliance and the failure to derive the full economic benefits of gas commercialization. Insufficient oversight, ineffective penalties, and a lack of comprehensive data on gas flaring have all contributed to the inadequate enforcement of the regulations.**

In addition to imposing fines, Nigeria has initiated a Gas Flare Commercialization Program that allows third-party investors equipped with the necessary technology and investments to obtain permits to access and capture flare gas, which can be converted into profitable ventures. The program was initially introduced in 2016 and gained significant interest. As of 2019, about 800 companies had expressed their intention to participate, of which 226 companies submitted bids for 176 gas flare sites.[18]

The program was suspended due to the emergence of the COVID-19 pandemic and the implementation of the new Petroleum Industry Act. The program was relaunched in 2022, and the government has earmarked 47 flaring sites for prospective bidders to apply. In January 2023, following an evaluation of the requests for qualification, the government announced the selection of 139 bidders to proceed to the next stage of the process (i.e. request for proposals).[19] Discussions with stakeholders indicate delays in evaluating proposals, which was expected to be completed by the first quarter of 2023. Consequently, the government continues to receive penalties for gas flares by oil producers.

18 Agency Report (2019). 800 companies bid for 176 Nigeria's gas flare sites — Kachikwu. Premium Times Nigeria. Available at https://www.premiumtimesng.com/news/more-news/325051-800-companies-bid-for-176-nigerias-gas-flare-sites-kachikwu.html?tztc=1

19 Nigeria Upstream Regulatory Commission (2023). Announcement of successful applicants for the request for qualification (RfQ) phase of the Nigerian Gas Flare Commercialisation Programme (NGFCP) 2022. Available at https://ngfcp.nuprc.gov.ng/successful-applicants/

Measurement, Reporting and Verification (MRV) systems for methane management in Nigeria

The Global Methane Pledge emphasizes the commitment of member states to adopt the most advanced approaches recommended by the IPCC to enhance the precision of emission measurement and estimation. This commitment underscores the significance of robust Measurement, Reporting, and Verification (MRV) systems. Implementing MRV systems also plays a crucial role in identifying and pinpointing sources of methane emissions. Therefore, governments must ensure that companies employ the necessary technologies to measure and report methane emissions precisely. The evaluation of MRV systems in Nigeria reveals two approaches: the Country Methane Abatement Tool (COMAT) and the Nigeria Gas Flare Tracker.

Nigeria has signed up to the Country Methane Abatement Tool (CoMAT) as an MRV framework

The Country Methane Abatement Tool (CoMAT), developed by the Clean Air Task Force, is an online tool which estimates methane emissions and formulates mitigation strategies. It comprehensively evaluates methane emission sources associated with diverse equipment, considering their respective emission factors. The tool provides default assumptions for emission factors, which can be adjusted to align with the specific circumstances of each country.

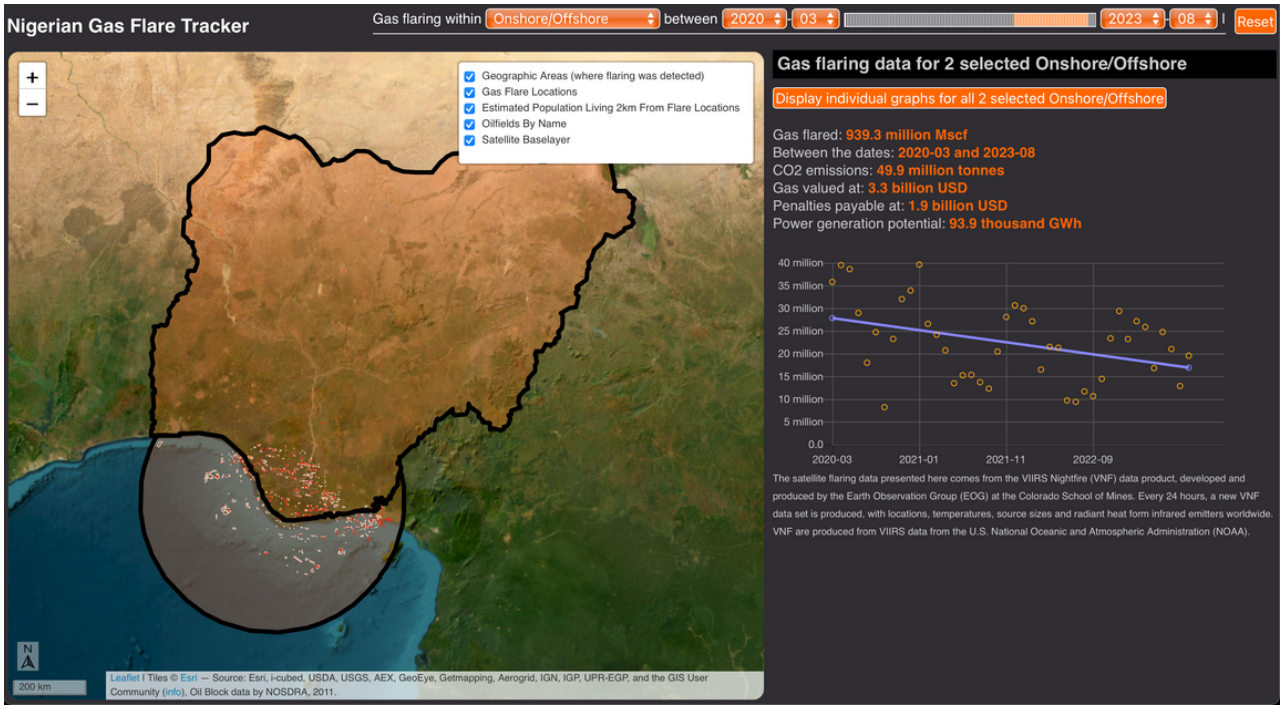
Before adopting CoMAT, consultations with stakeholders revealed that companies voluntarily reported the majority of emissions. Generally, International Oil Companies report on emissions to regulatory bodies. However, challenges arise when verifying these emissions. Stakeholder interactions highlighted the difficulties regulators face in validating the accuracy of emissions reported by companies.

The implementation of CoMAT, therefore, introduces a significant improvement in the accuracy of emission determination. However, the successful implementation of CoMAT depends on the government's ability to obtain detailed and precise data on emissions from major equipment. This necessitates conducting extensive and periodic surveys on such equipment to effectively verify their emissions using accurate emission factors.

A satellite imaging system to detect flares

The Nigeria Gas Flare Tracker is an advanced geospatial platform designed to monitor and record the volume of gas flared in both onshore and offshore fields. This system effectively identifies gas flares occurring at production sites using satellite imagery. It employs specialized heat and light sensors to detect the distinct illumination emitted by these flares. The tracker also calculates the amount of Greenhouse gases released and estimates the potential value of the flared gas if it were commercially utilized. It also determines the flared gas potential power generation capacity (Figure 9).

Figure 9: Nigeria gas flare tracker interface showing gas flare volumes for onshore and offshore fields



Source: NOSDRA (2023)

Voluntary reporting relies on the willingness of operators to provide information about their gas flaring activities and may lack standardized measurement methods, which are subject to variations in reporting practices or biases. The Nigeria Gas Flare Tracker offers a standardized and technologically advanced approach to tracking and monitoring gas flares, ensuring greater accuracy and transparency in assessing the extent and impact of gas flaring activities. Therefore, it increases data reliability and reduces the potential for underreporting through voluntary reporting mechanisms.

Country Case II: Angola

Country Summary

- Angola accounts for about 5% of methane emissions in sub-Saharan Africa. The country's energy sector accounts for about 49% of methane emissions, of which the oil and gas sector makes up about 90%.

- Venting is the primary cause of methane emissions, constituting about 83% of methane emissions from the oil and gas sector. On the other hand, fugitive emissions and flaring account for 9.5% and 11% of methane emissions from the sector, respectively.

- Angola has limited specific regulations on methane emission reduction in the oil and gas sector. The primary laws governing Angola's oil and gas sector include the Petroleum Activities Law (Law No. 10/04) and the Regulation on Petroleum Operations, 2009, which detail the country's flaring policies and guide the development and utilization of the gas resources.

- Angola's gas commercialization efforts have led to a substantial reduction in gas flare volumes. Consequently, the country is on course to achieve zero flaring by 2030.

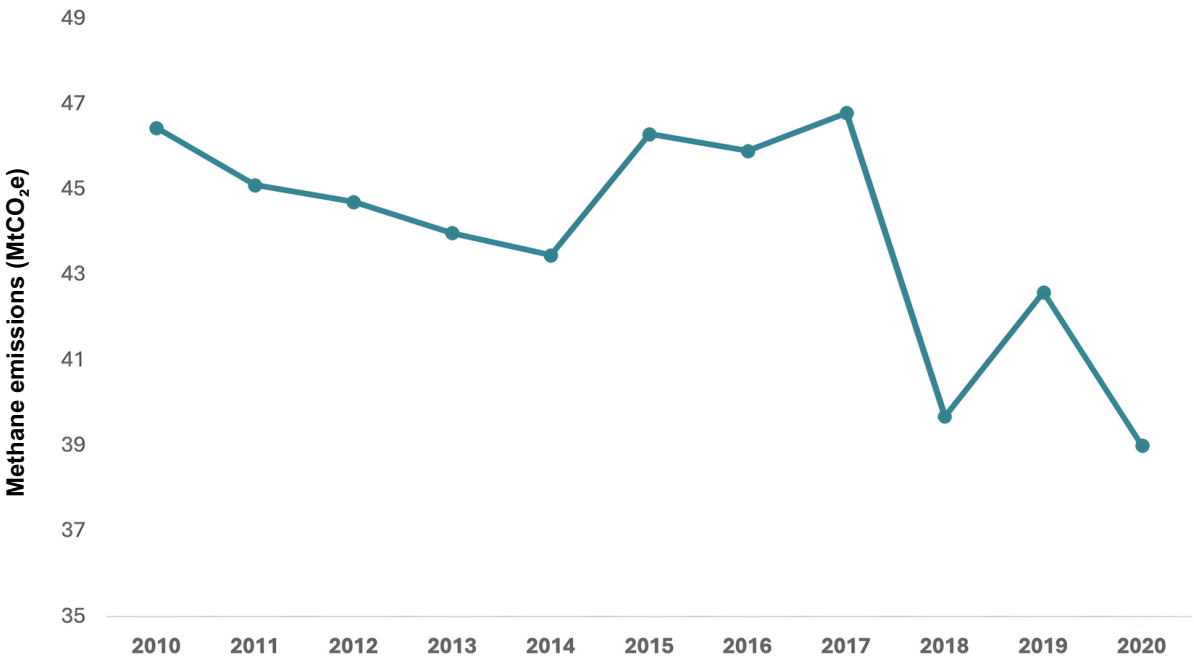
- There is limited attention to venting in Angola's methane management efforts, even though it accounts for about 90% of the country's methane emissions from the oil and gas sector. Considering the significant contribution venting to methane emissions, it is essential to prioritize abatement measures to reduce methane emissions from the sector.

- Angola's oil and gas regulations require companies to establish metering, recording, and reporting procedures that adhere to international standards and best practices. However, it relies on voluntary disclosures, which may be prone to inaccuracies that reduce data reliability.

Introduction

Angola is the second largest producer of oil in sub-Sahara Africa, producing about 1.12 million barrels of oil per day. Angola exported its first natural gas in 2013, which was either reinjected or flared. The country continues to seek for more investments to increase its natural gas production. Angola contributes about 5% of emissions in sub-Saharan Africa. Between 2010 and 2020, the country's yearly average methane emissions was about 44 MtCO2e. Methane emissions in Angola have been on a decreasing trend. Between 2017 and 2020, methane emissions have reduced from 46MtCO2e to 39MtCO2e.

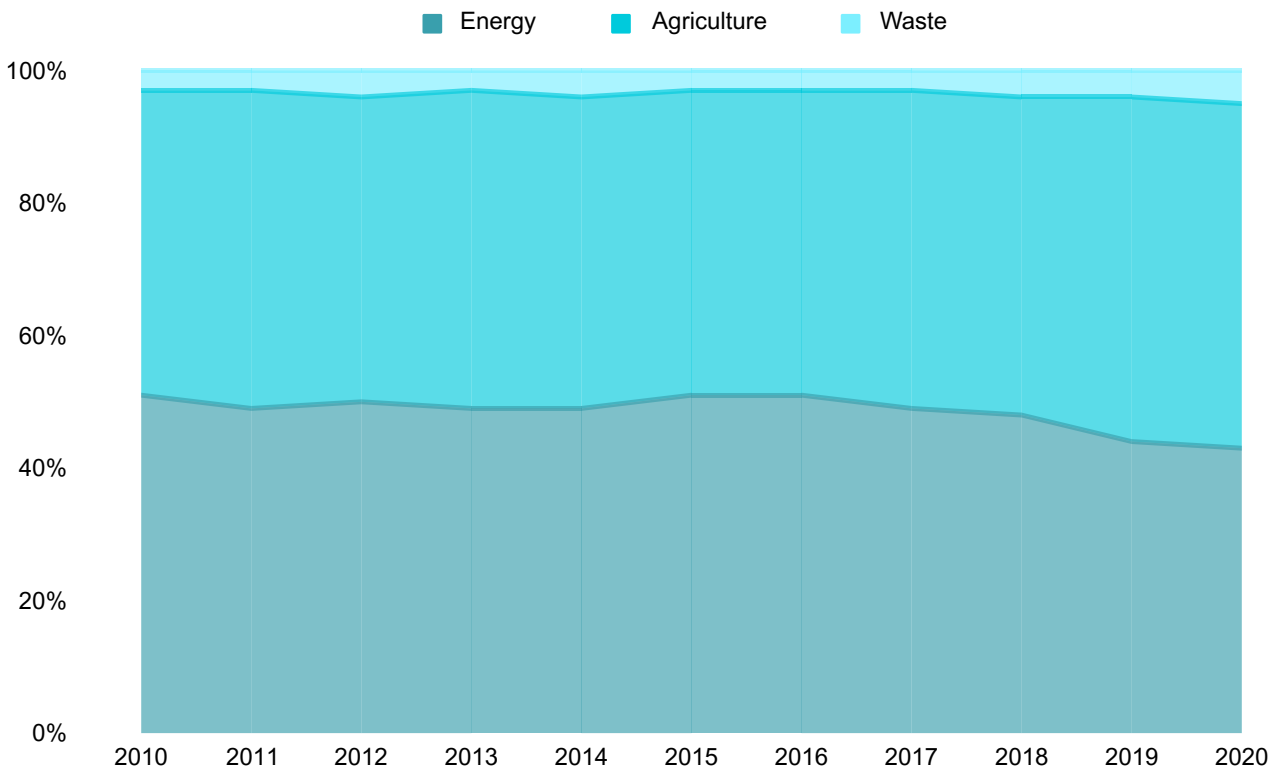
Figure 10: Methane emissions in Angola (2010-2020)



Source: Authors' construct with data from World Resources Institute

The primary sources of methane emissions in Angola are the energy and agriculture sectors. Between 2010 and 2020, the energy sector contributed about 49% of emissions, followed by the agriculture sector with 48%. The waste sector emits the least, contributing about 3% of emissions.

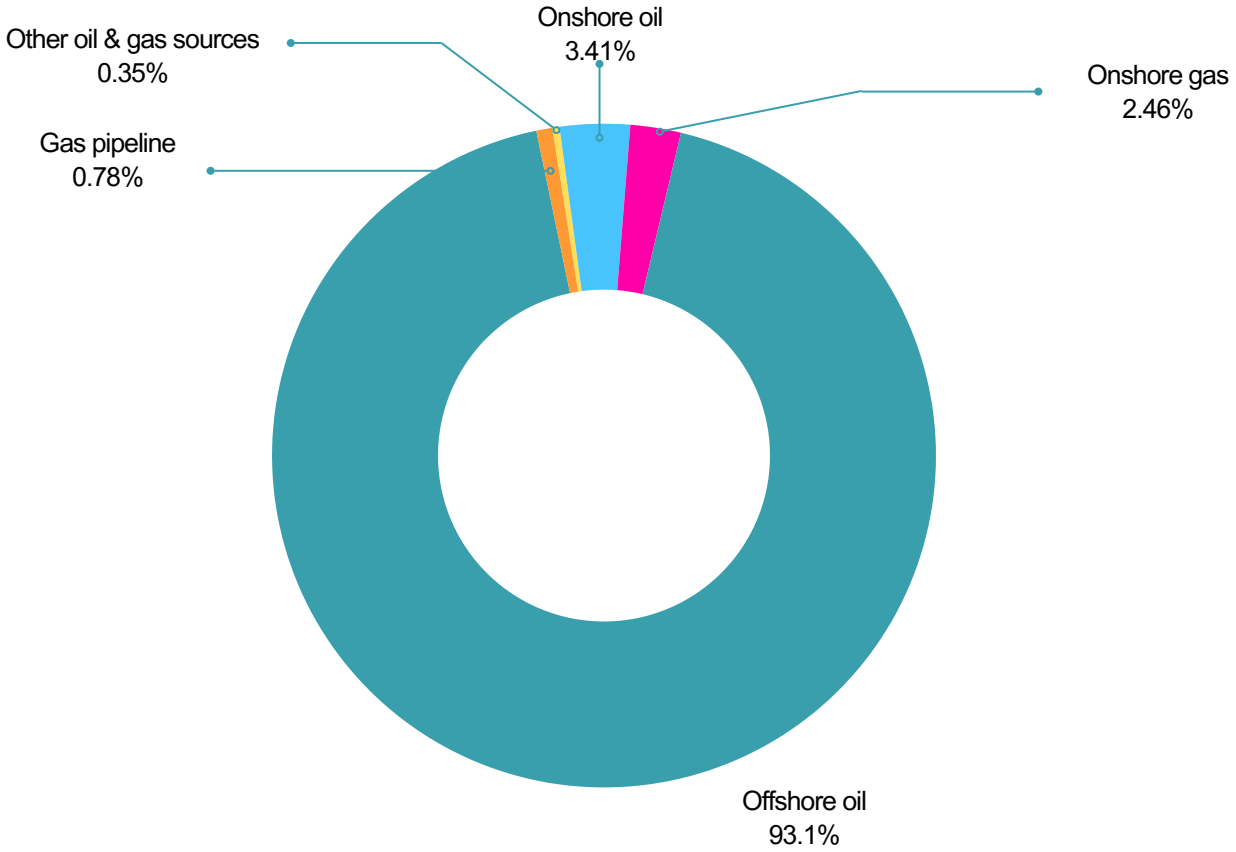
Figure 11: Trend of methane emission sources in Angola (2010-2020)



Source: Authors' construct with data from World Resources Institute

The oil and gas sector dominates methane emissions from the energy sector, accounting for about 90% of total emissions. These emissions can largely be attributed to offshore oil production activities, which form about 93% of methane emissions from the oil and gas sector. Other areas responsible for the oil and gas sector's emissions include onshore oil (3.41%), onshore gas (2.46%), gas pipelines and LNG facilities (0.78%) and others (0.35%). Venting is a significant cause of methane emissions from the oil and gas sector. In 2022, it contributed about 83% of methane emissions from oil and gas activities. Flaring and fugitive emissions follow with respective contributions of 9.5% and 7.6% (see Table 7).

Figure 12: Methane emissions from Angola's oil and gas sector (2022)



Source: International Energy Agency (2023), Methane Tracker Database, IEA, Paris. License: Creative Commons Attribution CC BY-SA 4.0.

Table 7: Methane emissions (in kt) profile from Angola's oil and gas sector (2022)

Row Labels	Flared	Fugitive	Vented	Other Sources	Grand Total
Offshore oil	47.64	29.42	398.60		475.67
Onshore gas		3.96	8.60		12.56
Onshore oil	0.96	1.13	15.33		17.42
Other from oil and gas				1.78	1.78
Grand Total	**48.60**	**34.52**	**422.53**	**1.78**	**507.42**

Source: International Energy Agency (2023), Methane Tracker Database, IEA, Paris. License: Creative Commons Attribution CC BY-SA 4.0.

Relevant agencies responsible for methane management in Angola

The regulation of Angola's oil and gas sector, including environmental concerns such as methane management, is the responsibility of particular ministries and regulatory bodies. The responsibilities of these institutions include policy formulation, implementation, and enforcement (See Table 8)

Table 8: Angola's agencies responsible for methane management

Body	Function
Ministries	
Ministry for Mineral Resources and Petroleum (MIREMPET)	• Responsible for the formulation, execution, monitoring, and reviewing of all upstream, midstream, and downstream oil and gas policies. • Ensures that petroleum exploration, development, production, distribution and storage are done in an environmentally friendly manner.
Ministry of Culture, Tourism and Environment (MCTA)	• Responsible for formulating and implementing environmental policies and regulations across all sectors of the country. • Conduct Environmental Impact Assessments (EIAs) for projects and for issuing environmental licenses to these companies.
Regulatory Agencies	
National Agency for Petroleum, Gas and Biofuels (ANPG)	• The primary regulator of petroleum activities in Angola. • Responsible for the protection of the environment, holding operators accountable through the review of environmental impact studies as well as management and environmental auditing plans

Angola's methane emissions strategies are embedded in its oil and gas legal frameworks

Angola has committed to several international initiatives on climate change and methane management. It ratified the Paris Agreement and has since prepared its Nationally Determined Contributions (NDCs). Although Angola's NDC does not contain specific methane emissions reduction targets, it seeks to reduce GHG emissions unconditionally by 14% (15.4 MtCO2e) relative to 2015 levels and a further reduction of 10% (11.1MtCO2e) conditioned on support.[20] The country plans to reduce fugitive emissions from oil and natural gas exploration and production through energy efficiency measures. Additionally, Angola has targeted to stop routine flaring of natural gas with an unconditional target of reducing flaring by 295mmscf/day (See Table 9). Angola is also a member of the World Bank's Global Gas Flaring Reduction Partnership (GGFR), which seeks to achieve zero routine flaring from oil-producing countries by 2030. The Bank supports governments in formulating, enacting and enforcing the necessary policies and regulations to end venting while utilizing conserved gas for productive purposes.[21]

Table 9: Angola's methane abatement targets

Abatement Measure	Description	Action/Target
Control of fugitive emissions	Reduction of fugitive emissions from oil and natural gas exploration and production	• Implementing energy efficiency measures in industrial processes of extraction and production of hydrocarbons • Reduce the flaring process by making efforts to stop the routine burning of natural gas in the long term, in line with the World Bank initiative
Emissions Flaring	Reduction of flaring from oil ad gas fields.	• Unconditional target: Reduce flaring – 295 MMSCF/day • Conditional target: Reduce flaring – 370 MMSCF/day

Source: Nationally Determined Contributions of Angola

20 Republic of Angola (2021). Nationally Determined Contributions of Angola.
21 Global Gas Flare Reduction Partnership (n.d.) Global Flaring and Venting Regulations. https://flaringventingregulations.worldbank.org/about

Angola's actions on methane management are mainly targeted at reducing venting, flaring and fugitive emissions across the petroleum value chain. The Angolan government has made some provisions in its petroleum laws to manage and reduce methane emissions.

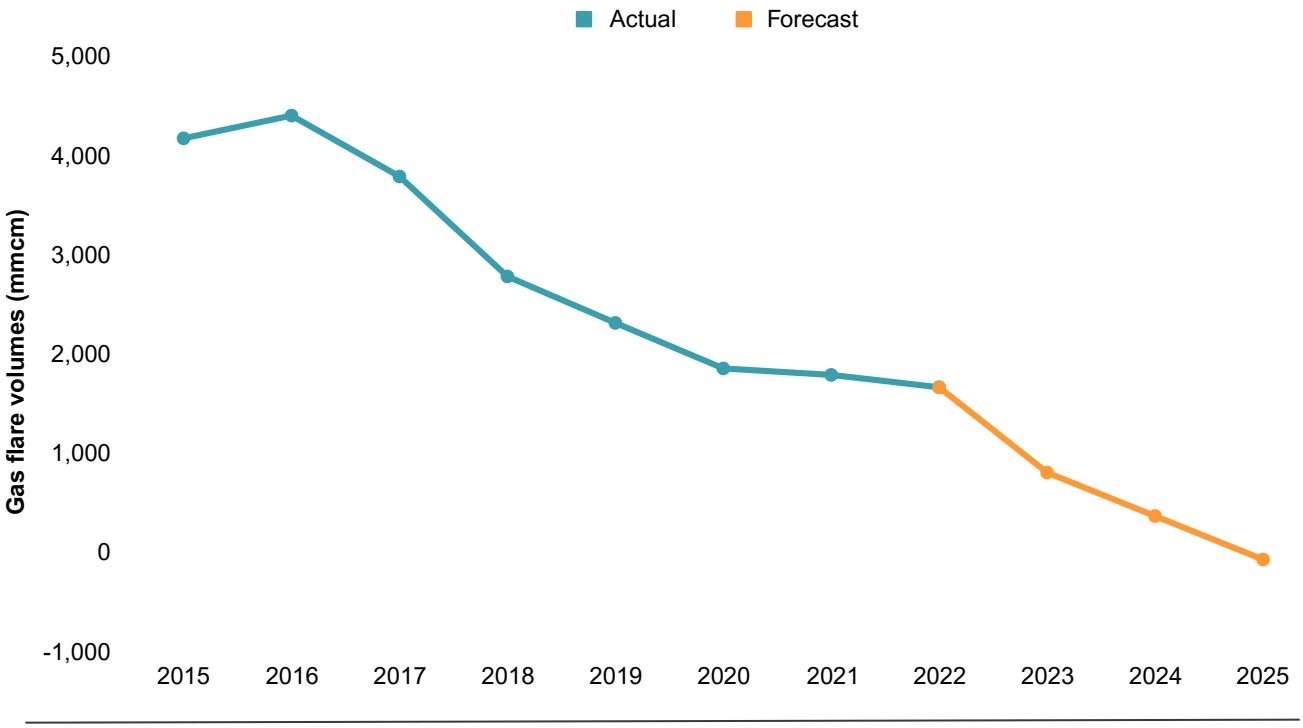
- **The Petroleum Activities Law (Law No. 10/04)** establishes the overall structure for oil operations in Angola. It regulates various activities associated with oil exploration, concessions, surveys, evaluations, development, and decommissioning. The petroleum law prohibits gas flaring, except for short periods of testing or other reasons which the Ministry of Petroleum must authorize. The law also imposes a fee based on the quantity of flared gas, which is determined by the supervising ministry.
- **The Regulation on Petroleum Operations, 2009** provides a framework for governing and managing petroleum operations in Angola. It provides operational guidelines for implementing the Petroleum Activities Law (Law No.10/04). Article 22 of the Regulations stipulates that the overall development and production plan must incorporate a specific strategy for utilizing the associated natural gas.
- **The Presidential Legislative Decree No. 7/18** establishes a comprehensive legal and fiscal framework for the gas business in Angola. Under this decree, oil and gas companies can explore, research, evaluate, develop, produce, and trade natural gas domestically and internationally. However, while this law offers a structure for gas utilization, it does not explicitly address methane management or gas flaring reduction.

Angola is projected to meet its zero-flaring target before 2030

Angola has changed its perspective on gas, previously regarded merely as a by-product of lucrative oil production. Currently, the country is exploring opportunities to exploit and utilise natural gas. The Angola Liquefied Natural Gas Project (ALNG) was established in 2013 to commercialize the country's natural gas resources. The ALNG project is pivotal in reducing gas flaring and associated greenhouse gas (GHG) emissions by utilising associated natural gas.[22] Notably, Angola has made significant strides in reducing flaring volumes, achieving a 60% reduction between 2015 and 2022. At the current pace, it is estimated that Angola can reach a zero-flaring target by 2025.

22 World Bank (2023). Global Gas Flaring Tracker Report. Available at https://thedocs.worldbank.org/en/doc/5d5c5c8b0f451b472e858ceb97624a18-0400072023/original/2023-Global-Gas-Flaring-Tracker-Report.pdf

Figure 13: Forecast of gas flaring in Angola by 2030



Source: Authors' construct using data from the World Bank

Angola is yet to create robust MRV systems for methane management

Stakeholder interactions reveal that Angola largely relies on reporting by companies to determine the extent of GHG emissions, including methane, which is prone to risks of underreporting. Angola has yet to establish a robust framework to measure emissions from various sectors adequately. The country's NDCs capture its intention to establish an MRV system that consists of four subsystems:

- **GHG Inventory:** To systematically track and report greenhouse gas emissions.
- **Mitigation Measures:** To monitor the implementation of mitigation actions and their impact on emissions.
- **Adaptation Measures:** To monitor the implementation of adaptation actions and their effectiveness in addressing climate change impacts.
- **Financial, Technical and Technological Support:** To track the financial, technical, and technological support received by Angola to support its climate action efforts.

In the short term, Angola aims to develop and implement the MRV system as part of its NDC tracking process by 2025. Angola's proposed MRV framework does not explicitly mention its reliance on voluntary reporting. However, it emphasises knowledge management, capacity development, quality control and the integration of legal frameworks into the system. Angola can strengthen its MRV systems by leveraging technological advancements for data collection, monitoring, and reporting to reduce errors and enhance the accuracy of reported information.

Country Case III: Ghana

Country Summary

- Ghana ranks 24th in methane emissions in Sub-Saharan Africa between 2010 and 2020; despite its relatively lower emission values, the country has experienced a consistent upward trend in methane emissions, showing about a 50% rise between 2010 and 2020.

- The energy sector ranks third in methane emissions after the agriculture and waste sectors. However, methane emissions from the energy sector have increased by about 237% between 2010 and 2020, compared to the respective increments in agriculture and waste emissions, which were 36% and 28%. The significant increase necessitates targeted measures for emissions reduction from the energy sector.

- The oil and gas sector contributes about 77% of the energy sector's methane emissions. Within the oil and gas sector, venting accounts for about 68% of methane emissions, followed by fugitive emissions and gas flaring contributing 17.5% and 9.5%, respectively.

- Ghana operates a no flaring policy; however, gas flare volumes are on an increasing trend. The country's gas processing facility does not have sufficient capacity to process the entire associated gas produced from its Jubilee and TEN oil fields.

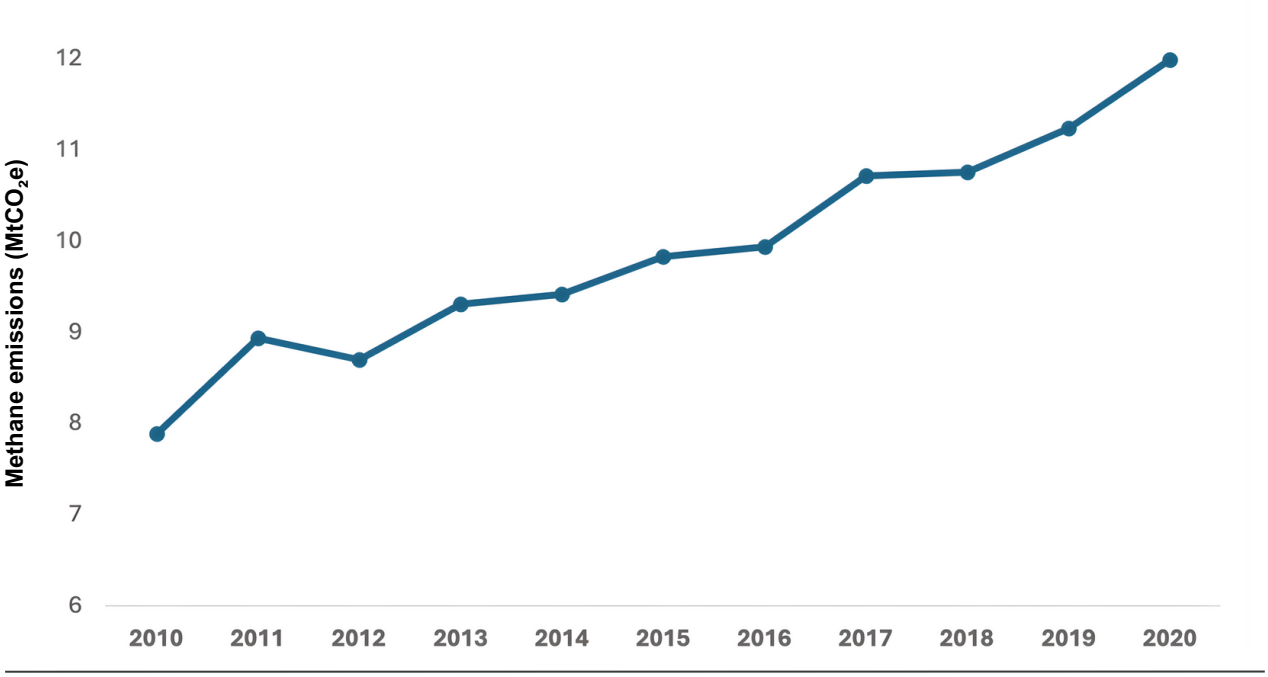
- Ghana uses the Ghana Climate Ambitious Reporting Program (GCARP) and the Greenhouse Gas Abatement Model (GACMO) as its MRV frameworks. While these frameworks provide a platform for consolidating emissions from various sectors, accuracy in emissions reporting relies on the accuracy of data obtained from producers.

Introduction

Ghana has three major oil-producing fields: Jubilee, TEN and Sankofa Gye Nyame. In 2022, the country produced about 51.8 billion barrels of oil (about 142 thousand barrels per day) and about 235.6 bcf (about 645mmscfd) of gas.

Ghana had an average annual methane emission of approximately 9.9MtCO2e, positioning the country as the 24th highest emitter of methane in Sub-Saharan Africa between 2010 and 2020. Despite having relatively lower emissions, Ghana has experienced a consistent upward trend in methane emissions. In 2020, Ghana's methane emissions reached 12 MtCO2e, indicating a significant increase of about 50% compared to the emission levels in 2010 (see Figure 14). With the increasing potential for oil and gas production in Ghana, it is imperative to implement advanced technologies and establish robust regulatory frameworks essential for effective methane management.

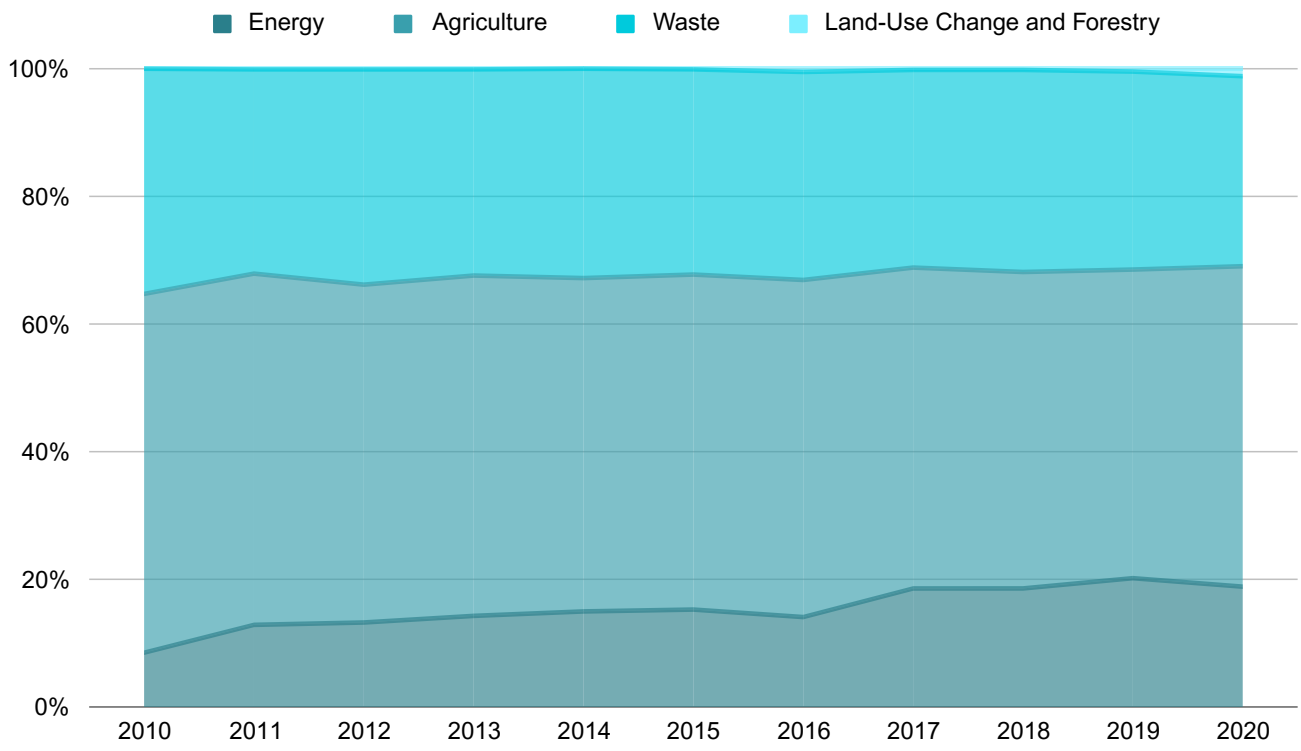
Figure 14: Ghana's methane emissions (2010-2020)



Source: Author's construct based on data from World Resources Institute

Although agriculture is Ghana's largest contributor to methane emissions, the energy sector is a growing concern. Between 2010 and 2020, methane emissions from the energy sector increased by 237%, while emissions from agriculture and waste increased by 36% and 28%, respectively. Considering the notable rise in methane emissions from the energy sector, it is essential to implement specific actions for methane reduction in the energy sector.

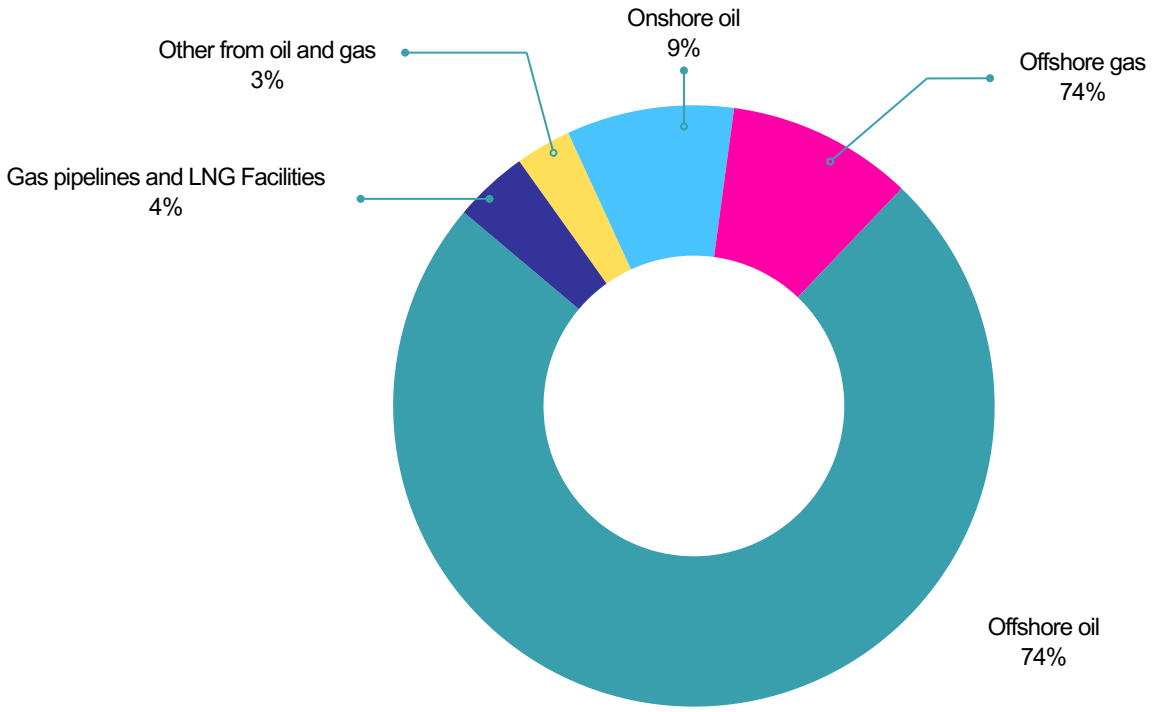
Figure 15: Sectoral contributions to Ghana's methane emissions (2010-2020)



Source: Author's construct based on data from World Resources Institute

The oil and gas sector contributes about 77% of methane emissions from the energy sector. In 2022, methane emissions from the oil and gas sector were about 93.1kt. Offshore oil production formed about 74% of methane emissions from the oil and gas sector. Offshore gas follows with about 10% of emissions (see Figure 16). Like Nigeria and Angola, methane emissions in Ghana's oil and gas sector are contributed mainly by venting. Statistics from the IEA show that about 68% of methane emissions from Ghana's oil and gas sector are a result of venting. Gas flaring and fugitive emissions follow with respective contributions of 17.5% and 9.7% (see Table 10).

Figure 16: Sources of methane emissions in Ghana's oil and gas sector



Source: International Energy Agency (2023), *Methane Tracker Database*, IEA, Paris. License: Creative Commons Attribution CC BY-SA 4.0.

Table 10: Methane emissions (in kt) profile from Ghana's oil and gas sector (2022)

	Activity		
Emission source	**Flared**	**Fugitive Emissions**	**Venting**
Offshore oil	16.48	3.60	48.73
Onshore oil	1.09	0.48	6.47
Gas pipelines and LNG facilities		2.66	1.42
Offshore gas		3.00	6.51
Grand Total	**17.57**	**9.73**	**63.12**

Source: Author's construct based on data from World Resources Institute

Relevant agencies responsible for methane management in Ghana

Various government agencies responsible for providing policy direction and regulation undertake methane management in Ghana. Table 11 provides an overview of Ghana's primary institutions responsible for methane management.

Table 11: Agencies responsible for methane management in Ghana

Body	Function
Ministries	
Ministry of Energy	The Ministry of Energy is responsible for energy sector policy formulation, implementation and enhancement.
Ministry of Environment, Science, Technology and Innovation (MESTI)	MESTI is responsible for policy formulation to promote science and technology application in the country and to create the enabling environment for environmental innovations
Regulatory Agencies	
Petroleum Commission	• The Commission is the primary regulatory body overseeing Ghana's upstream oil and gas activities. • The commission collaborates closely with the Environmental Protection Agency to establish and enforce regulations and guidelines concerning environmental protection and the management of greenhouse gas (GHG) emissions in the petroleum sector. • Operates under the Ministry of Energy
Environmental Protection Agency	• The main regulatory body responsible for environmental protection across all sectors in Ghana. • EPA Develops and enforces regulations, monitors and reports methane emissions, and ensures compliance within various industries. • The EPA also promotes best practices, builds capacity, and fosters collaboration to reduce methane emissions, contributing to climate change mitigation in Ghana • Operates under MESTI

Methane emissions strategies are embedded in oil and gas legal frameworks

The National Action Plan to Mitigate SLCPs (2018) presents an elaborate framework for the abatement of SLCPs, including methane. The action plan has specific targets for methane emissions; however, these are mainly targeted at waste management. For example, the SLCP action plan targets the recovery of about 350kt per year of methane from well-engineered landfills by 2030. Various climate change policies and plans mention the elimination of gas flaring, venting and fugitive emissions from the oil and gas sector (See Table 12). Out of the various policies and measures, the revised Nationally Determined Contributions (NDCs) explicitly provide a specific target for reducing fugitive methane emissions from oil and gas infrastructure.

Table 12: Ghana's methane abatement measures in the oil and gas sector

Policy	Abatement measure	Description
National Energy Policy (2010)	Eliminating gas flaring and venting	Maximise the utilisation of natural gas reserves by prohibiting flaring or venting of natural gas produced within Ghana unless necessary in operations
National Climate Change Policy (2013)	Eliminating gas flaring	Establish efficient infrastructures and mechanisms for processing and use of by-products from oil fields to prevent gas flaring
National Action Plan to Mitigate Short-Lived Climate Pollutants (2018)	Zero gas flaring and venting	Monitoring of environmental conditions, including ensuring zero or allowable flaring or venting.
Revised Nationally Determined Contributions (2021)	Reducing fugitive methane emissions	Decarbonising Oil and gas production. **Target:** 20% reduction in fugitive methane from oil and gas infrastructure by 2030

Beyond the policies, specific laws and regulations provide some prescriptions for methane management:

- **The Petroleum (Exploration and Production) Act 2016** regulates exploration and production activities. Its purpose is to ensure safe, sustainable, and efficient petroleum operations for the benefit of the Ghanaian people. Section 33 of the Act focuses on environmental protection and emissions management. It restricts gas flaring and venting unless authorized by the Environmental Protection Agency. However, the Act does not specify penalties for violating these provisions, although there are penalties for general contraventions with the Act.
- **The Environmental Protection Agency (EPA) Act** establishes the Environmental Protection Agency and consolidates laws relating to environmental protection, pesticide control and regulation. The agency issues environmental permits and pollution abatement notices for controlling emissions and other climate pollutants.
- **The Petroleum (Exploration and Production) (Measurement) Regulations 2016** provide guidelines and standards for the design, calibration, and operation of metering equipment used in oil and gas operations. **While the explicit mention of methane abatement technologies is absent within the regulations, it can be inferred that these technologies are inherently included within the scope of the law.** This inference is based on the understanding that the effective measurement and monitoring of methane emissions necessitate accurate and reliable metering equipment.

Ghana operates a no-flaring policy but flared gas increase yearly

Ghana's legislation clearly states a no-flaring policy, as already highlighted. Recognising the significance of gas in Ghana's power sector, the country has prioritised domestic gas utilisation for power generation, necessitating the establishment of a dedicated gas processing plant to capture and utilise the associated gas produced at the Jubilee and TEN fields.

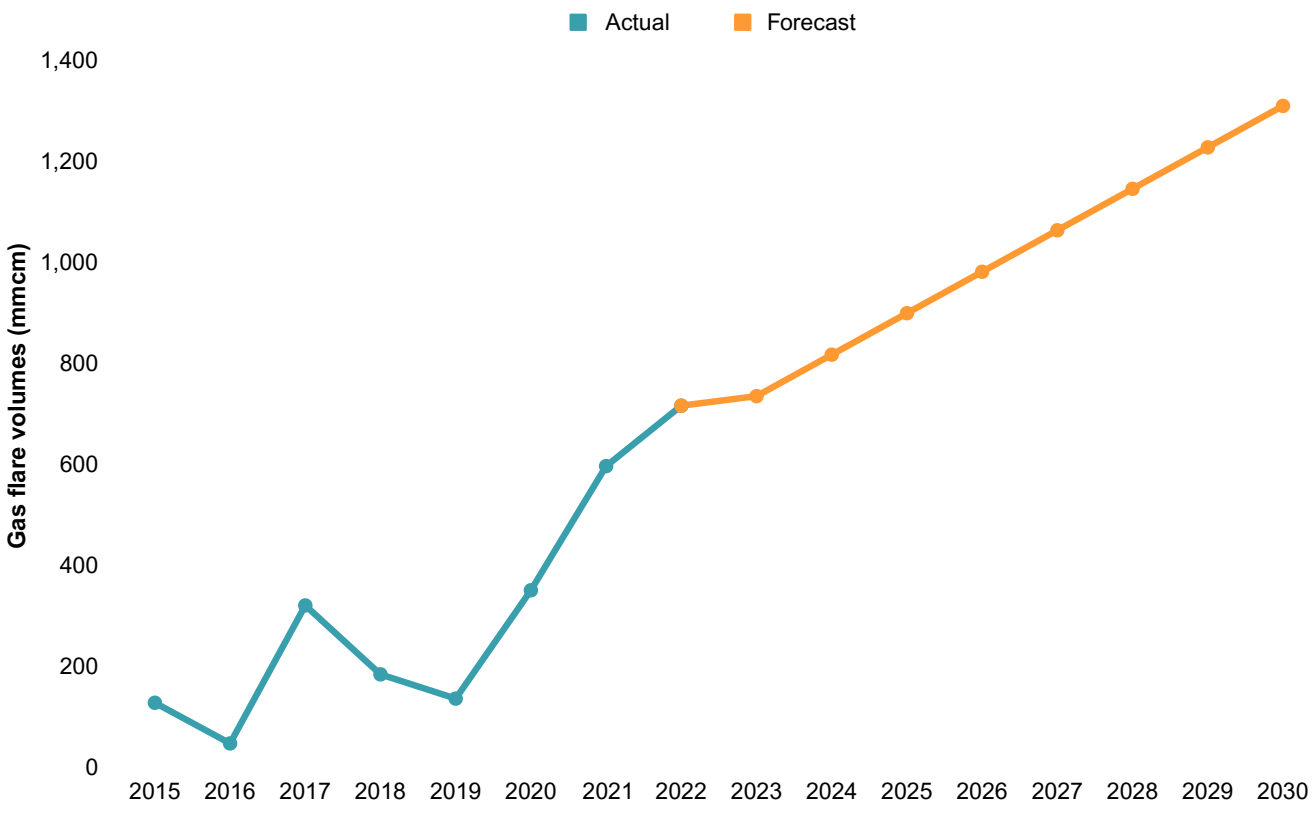
However, the facility's current capacity is insufficient to handle the gas produced from the Jubilee/TEN fields, resulting in a consistent increase in flared volumes. As a result, the amount of gas flared has consistently increased. Between 2019 and 2022, gas flare volumes have increased by about 400%, from 139 mmcm to approximately 719 mmcm (See Figure 17). Gas flare volumes are projected to increase to about 1300mmcm by 2030 if there are no adequate measures to reduce flaring.

The consequences of Ghana's inability to commercialize flared gas are twofold, posing environmental and economic challenges. Firstly, the elevated gas flaring levels lead to a substantial increase in CO2 and other associated gases, including methane, through poor combustion, worsening the country's GHG footprint. Specifically, the 2022 volume of 719 mmcm of flared gas contributes to an estimated 2MtCO2e of GHG released into the atmosphere.

The EPA has projected that Ghana has a GHG abatement potential of about 2.7 MtCO2e, contingent on the successful recovery of approximately 120 mmscfd of natural gas from its oil fields. [23] However, this abatement potential appears increasingly unattainable given the high gas flaring volumes.

Secondly, the failure to capitalize on the commercialization of flared gas has resulted in substantial revenue losses. With an estimated gas price of approximately $2.5 per MMBTU, [24] the significant volume of flared gas in 2022 translates to an approximate loss of $82 million in potential gross sales. Thus, urgent measures are required to convert the growing flared gas volumes into commercial opportunities.

Figure 17: Forecast of gas flaring in Ghana by 2030



Source: Author's construct using data from World Bank and the Public Interest and Accountability Committee (PIAC)

23 EPA. (2019). Ghana's Fourth National Communication to the United Nations Framework Convention on Climate Change.
24 World Bank. Global gas Flaring Tracker. Available at https://www.worldbank.org/en/programs/gasflaringreduction/global-flaring-data

Ghana uses the GCARP model to measure and report on methane emissions

Ghana has recognized the importance of robust data collection and reporting in tracking emissions and meeting its climate reporting obligations. The country has adopted the Ghana Climate Ambitious Reporting Program (GCARP) as its data collection and analysis framework. In 2013, GCARP was designed to establish an integrated reporting system enabling Ghana to fulfil its reporting requirements. [25] The GCARP framework consists of four interconnected components that work together to ensure comprehensive and accurate reporting:

- **Institutional Arrangements:** This component identifies the relevant institutions responsible for reporting emissions data. Through MoUs among these institutions, clear roles and responsibilities are established, streamlining the reporting process.

- **Data Handling:** This component outlines specific data requirements for reporting. It includes identifying and monitoring data sources and defining relevant templates and formats. The standardisation of data collection and handling procedure ensure consistency and comparability across different sectors.

- **Methods, Tools, and Protocols:** The methodologies used for emissions computations within the GCARP framework are based on internationally recognized guidelines, such as those provided by the IPCC and the GHG inventory manual. These established methods and protocols enable accurate and consistent emissions calculations across sectors, ensuring the reliability of reported data.

- **Skills Development:** This component focuses on enhancing the skills and knowledge of the individuals involved in the reporting process. Continuous training programs are implemented to strengthen the capacity of stakeholders, including government officials, technical experts, and reporting entities.

Ghana relies on energy production and consumption information reported by the Energy Commission. Source documents such as the Energy Outlook, Energy Statistics, and the Energy Information Database serve as essential references. Once compiled, the data is transferred to the Environmental Protection Agency (EPA), which is inputted into the Greenhouse Gas Abatement Cost Model (GACMO model). This model helps determine various emission volumes to comprehensively assess the sector's environmental impact.

25 International Partnership on Mitigation and MRV (2017). Ghana Climate Ambitious Reporting Program. Available at https://transparency-partnership.net/system/files/document/Good%20Practice-Ghana-Climate%20Ambitious%20Reporting%20Program.pdf

Ghana can strengthen its capacity to accurately track emissions across sectors as it integrates the GCARP framework and utilise the GACMO model. However, it is essential to note that the accuracy of the reported volumes relies on the quality of the source of information. Stakeholder interactions reveal challenges of poor data quality, undermining the accuracy of reported emissions. These findings are corroborated by Ghana's report on the MRV scheme, which highlights the challenges of poor data systems, limited capacity, institutional inertia, and lack of political will. [26] Addressing the underlying data quality challenges remains crucial for ensuring reliable and accurate emissions reporting. Concerted efforts are required to strengthen data systems, build capacity, ensure institutional collaboration, and foster political commitment to data quality and transparency.

26 Benefoh, D. T., Antwi-Boasiako, A. (2017). Status of Monitoring Reporting Verification Scheme in Ghana. Initiative for Climate Action Transparency. Available at https://climateactiontransparency.org/wp-content/uploads/2021/07/Status-of-Ghanas-MRV-System.pdf

Country Case IV: Mozambique

Country Summary

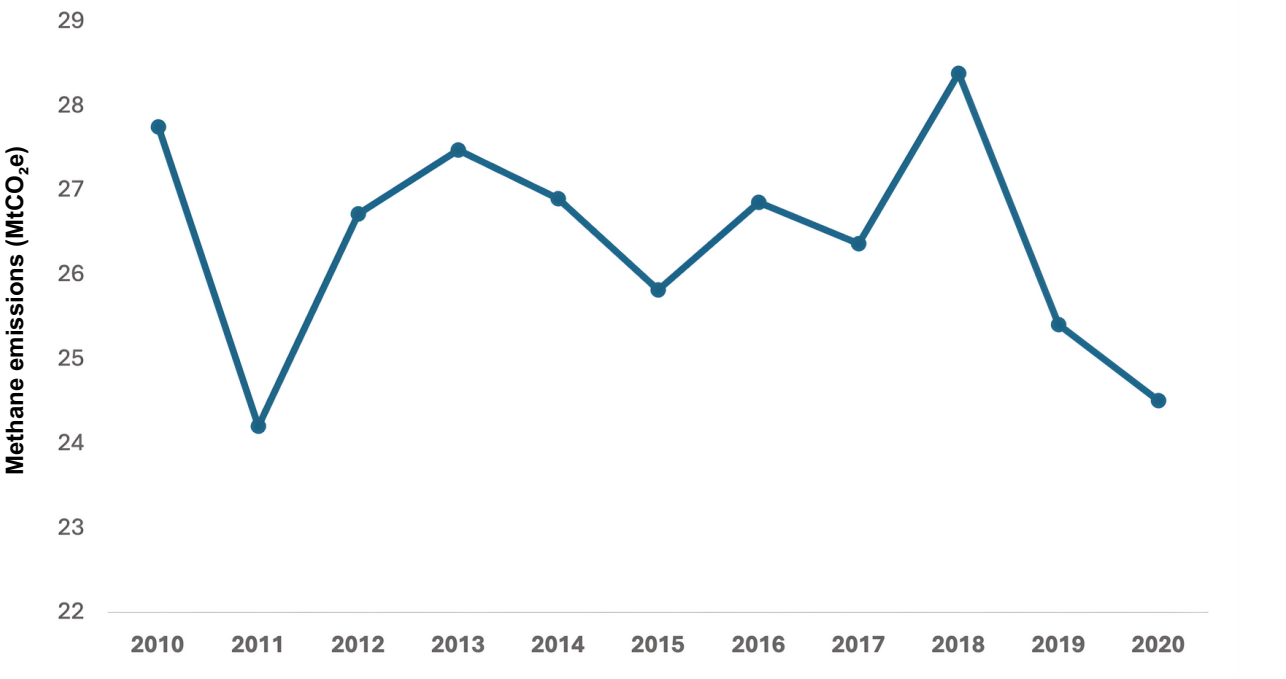
- Mozambique ranked as the 13th highest methane emitter in Sub-Saharan Africa between 2010 and 2020.
- The oil and gas sub-sector is the least contributor to the energy sector methane emissions after coal and bioenergy, contributing approximately 11% of emissions. However, new discoveries and diversification from coal can increase the sector's contribution to methane emissions.
- Onshore gas is the leading source of methane emissions from the oil and gas sector, representing about 67% of emissions.
- Mozambique's petroleum and environmental policies are quite generalized in addressing greenhouse gas emissions. There are no specific goals for methane emission reductions from the country's oil and gas industry that target methane emissions from venting, fugitive emissions or flaring.
- Mozambique's successful history of low gas flaring ended abruptly in 2022, coinciding with Eni's first LNG shipment from the Coral South Field.
- The ENAMMC in Mozambique has established a National MRV System, outlining responsibilities for emissions data collection and processing, aligned with international standards. However, there is a gap in specific MRV systems for methane management in the oil and gas sector within the country's NDC framework.
- The current MRV regime relies on consultants, leading to delays and incomplete data. The Initiative for Climate Action and Transparency (ICAT) proposes a standardized approach, incorporating common reporting frameworks and expert training to improve data collection efficiency and enhance the overall quality of climate reporting, particularly in managing GHGs, including methane.

Introduction

Sasol operates the current natural gas production in Mozambique's Pambe and Temane gas fields, which have proven reserves of approximately 2.6 tcf. Most of Mozambique's gas is exported to South Africa through an 865km pipeline, with a portion set aside for domestic use. In 2010, significant gas reserves of about 180 tcf were discovered in the Rovuma basin, leading to the initiation of three LNG projects: the Coral FLNG Project (jointly operated by ENI and ExxonMobil), the Mozambique LNG Project, Area 1 (Total, formerly Anadarko), and the Rovuma LNG Project, Area 4 (ExxonMobil, ENI, and CNPC). The first phase of the Coral FLNG Project has been completed, and Mozambique successfully exported its first LNG cargo in 2022. The other projects are currently in various stages of development.

Between 2010 and 2020, Mozambique's average annual methane emissions was 26.9MtCO2e. In 2020, Mozambique ranked as the 13th highest methane emitter in Sub-Saharan Africa. **Over the same period, there has been a downward trend in methane emissions in Mozambique, with a reduction of about 11%. However, the recent gas discoveries and the revitalization of gas operations in Mozambique can potentially increase the country's methane emissions.**

Figure 18: Mozambique's methane emissions (2010-2020)

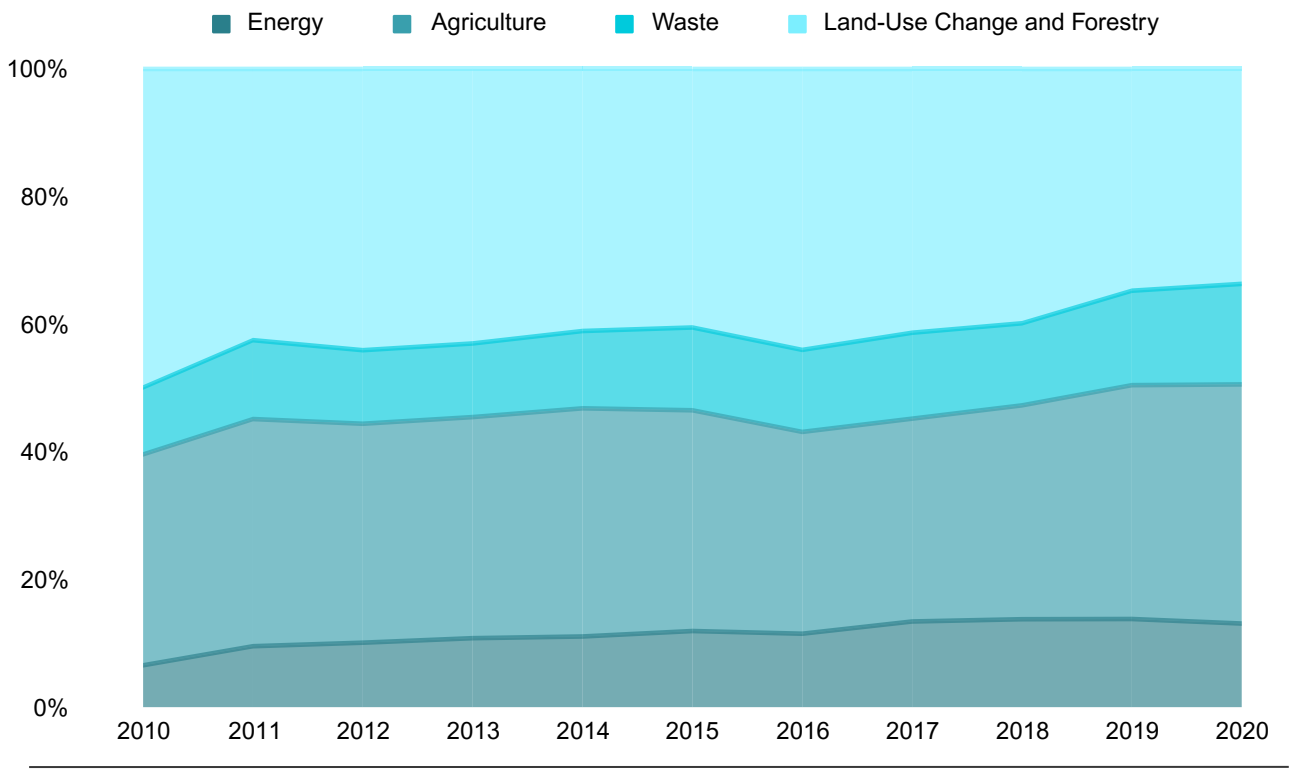


Source: Author's construct based on data from World Resources Institute

The energy sector occupies the fourth position in methane emissions in Mozambique, following land use, agriculture, and waste sectors. From 2010 to 2020, the energy sector accounted for approximately 11.4% of the country's total methane emissions (see Figure

19). While the energy sector contributes the least to methane emissions, evaluating the country's efforts to reduce emissions in this sector is crucial, especially considering the upcoming gas developments.

Figure 19: Sectoral contributions to Mozambique's methane emissions (2010-2020)

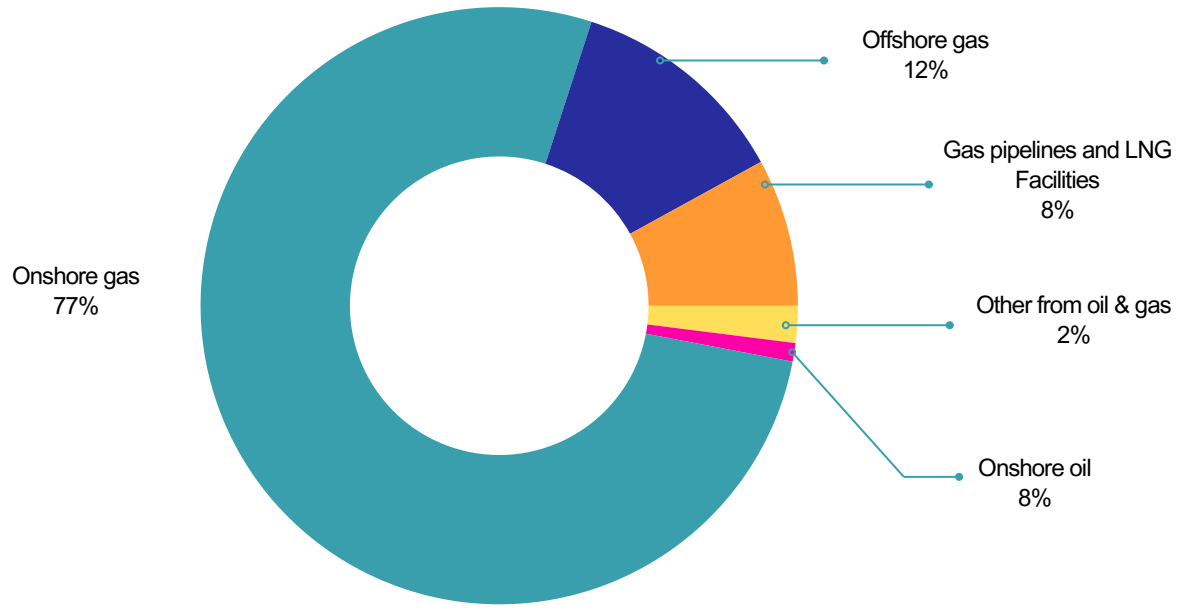


Source: Author's construct based on data from World Resources Institute

A breakdown of Mozambique's energy sector emissions shows that oil and gas operations contribute the least to the energy sector emissions, accounting for approximately 11% of emissions. The coal and bioenergy sub-sectors contributed to about 28% and 53% of emissions, respectively, in 2022. Notwithstanding, there is a case for methane reduction from the oil and gas sub-sector, considering the country's plans to leverage its natural gas resource to replace traditional fuels like coal and charcoal.

The primary origin of methane emissions in the oil and gas sector is onshore gas operations, constituting approximately 77% of emissions in the sub-sector. The offshore gas sector follows, contributing around 12% of the emissions (See Figure 20). These emissions are sourced primarily from venting and fugitive emissions.

Figure 20: Sources of methane emissions in Mozambique's oil and gas sector



Source: International Energy Agency (2023), *Methane Tracker Database*, IEA, Paris. License: Creative Commons Attribution CC BY-SA 4.0.

Table 13: Methane emissions (in kt) profile from Mozambique's oil and gas sector (2022)

	Activity	
Emission source	**Fugitive Emissions**	**Vented**
Onshore gas	10.59	22.97
Offshore gas	1.60	3.46
Gas pipelines and LNG facilities	2.41	1.28
Other from oil and gas		
Onshore oil	0.02	0.23
Grand Total	**14.61**	**27.95**

Source: International Energy Agency (2023), *Methane Tracker Database*, IEA, Paris. License: Creative Commons Attribution CC BY-SA 4.0.

Relevant agencies responsible for methane management in Mozambique

Table 14 below provides a comprehensive overview of Mozambique's primary institutions responsible for methane management.

Table 14: Agencies responsible for methane management in Mozambique

Body	Function
Ministries	
Ministry of Land and Environment (MTA)	MTA plans, coordinates, and ensures the implementation of policies concerning land administration, geomatics, natural resources management, environmental management, and conservation areas.
Ministry of Mineral Resources and Energy (MIREME)	MIREME is responsible for implementing government policy regarding geological research, mineral and energy resource exploitation, and the development and expansion of infrastructure to supply electricity, natural gas and petroleum products.
Regulatory Agencies	
National Petroleum Institute (INP)	INP regulates the administration and promotion of Petroleum Operations, ensuring the highest standards of competence, technical capability, and impartiality.
National Agency for Environmental Quality Control (AQUA)	AQUA operates under the MTA and is responsible for adopting and implementing measures to improve environmental quality monitoring capacity. The institution is also responsible for completing the National Inventory of Atmospheric, Land, Marine, and Coastal Pollution Sources.

Mozambique's legal frameworks generally focus on GHG emissions reduction

Mozambique's climate change mitigation efforts have been widely targeted at reducing GHG emissions with limited attention to methane management, especially in the energy sector. The only provision in the country's updated NDCs concerns agriculture. Mozambique has a conditional commitment to reduce GHG emissions from industry by encouraging the measurement of GHG emissions.

Table 15: Mozambique's methane abatement measures

Policy	Abatement measure	Description
Updated Nationally Determined Contributions (2021)[27]	Reducing GHG emissions from industry	Encouraging investors to evaluate GHG emissions in investment projects

A summary of policies to guide the implementation of methane management is given below:

Decree No. 56/2010: The decree approves the Environmental Regulation for oil operations. It also provides guidelines for environmental impact assessments and measures to protect the environment from the negative environmental impacts of the oil sector.

Petroleum Law No. 21/2014: This provides the legal framework for the Mozambican petroleum sector, emphasizing the preservation of transparency and the safeguarding of national interests. The Law has several articles dedicated to environmental safety and protection, as well as other noteworthy mentions to that effect, which include the prohibition of petroleum flaring unless it has been established that all alternative methods are unsuitable.

Methane management strategies in Mozambique are embedded in no-gas-flaring policies

The policy document highlighting methane management in Mozambique is the National Strategy for Adaptation and Mitigation of Climate Change (abbreviated in Portuguese as ENAMMC), a 12-year strategy covering 2013 to 2025. According to the ENAMMC, Mozambique intends to recover methane while extracting hydrocarbons.[28]

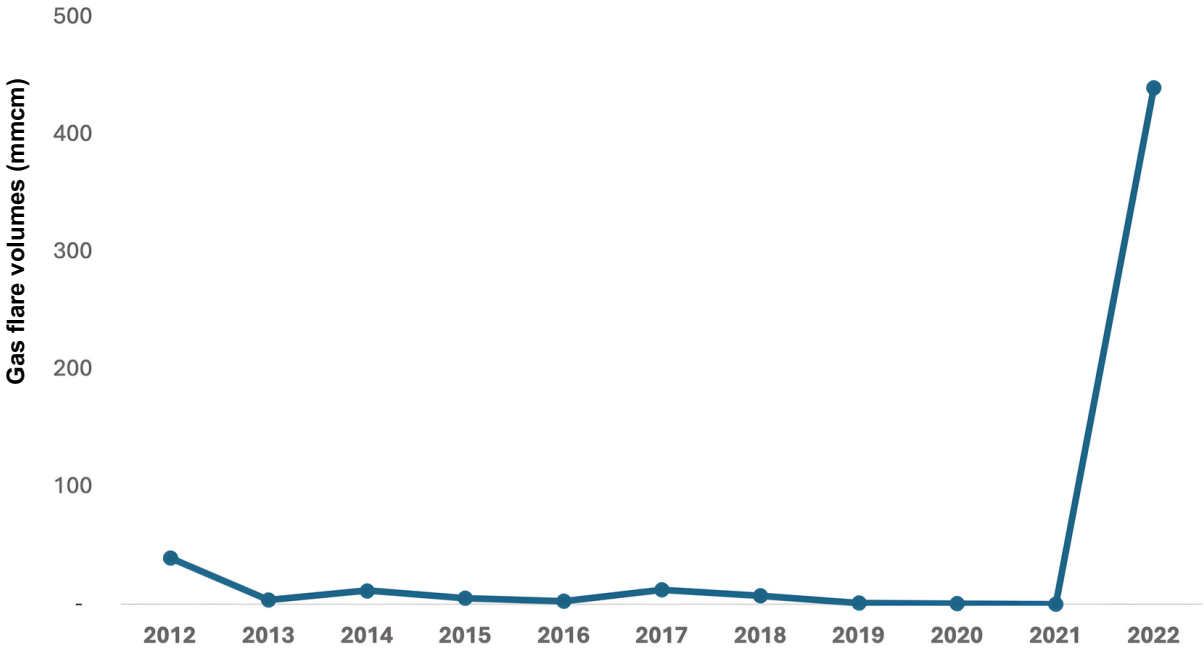
Regarding gas commercialization, the Mozambique Natural Gas Master Plan, introduced in 2014, outlines a comprehensive strategy for developing and utilising the country's vast natural gas resources.[29] The master plan focuses on utilising domestic gas for power and industry and facilitating gas monetization through liquefied natural gas (LNG) projects. The master plan also emphasizes the importance of environmental and social sustainability, ensuring that gas development is conducted in an environmentally responsible and socially inclusive manner. Eni, the operator of the Coral South project, began LNG shipments from Mozambique in November 2022.[30] To some extent, this

27 Government of Mozambique (2021). Update of the First Nationally Determined Contribution to the United Nations Framework Convention on Climate Change. available at https://unfccc.int/sites/default/files/NDC/2022-06/NDC_EN_Final.pdf
28 Ministério Para A Coordenação Da Acção Ambiental. (2012). Estratégia Nacional de Adaptação e Mitigação de Mudanças Climáticas. Republic of Mozambique
29 Cabinet Council. (2014). Natural Gas Master Plan. Republic of Mozambique
30 Eni (2022). Mozambique's first LNG cargo departs from Coral Sul FLNG, offshore the Rovuma basin.

effort contributes to methane management through gas commercialisation in Mozambique.

Mozambique's methane management is also linked to its no-flaring policy. A scan of flaring data from the World Bank shows low flaring volumes between 2012 and 2021. However, there was a dramatic rise in flared volumes in 2022, the same year Eni exported its first LNG cargo from the Coral South Field. Previous studies have revealed Mozambique's challenges in documenting gas flares and their respective emissions,[31] corroborated through stakeholder interactions.

Figure 21: Gas flaring in Mozambique (2012-2022)



MRV systems for methane management in Mozambique

The ENAMMC established a National MRV System, which would define clear responsibilities for data collection, processing, and information management in emissions reporting that correspond to international standards. Mozambique's NDCs also outline a framework for measuring, reporting and verifying GHGs and national adaptation and mitigation actions. Under this framework, key operators in the energy, waste, and transport sectors measure and report emissions to respective regulatory and coordinating institutions, which is verified by the Inter-Institutional Group for Climate Change, Academia, the Statistical Service, and the Council of Ministers. However, these plans do not provide specific MRV systems for methane management in the oil and gas sector.

31 United Nations Environmental Program. (2018). Institutional Capacity Needs Assessment for Strengthening Environmental Management in the Oil and Gas Sector in Mozambique.

An assessment of Mozambique's MRV regime reveals that the system lacks the required inter-institutional arrangements for primary data on emissions information from key operators. Instead, consultants are hired to collect data, which leads to delays, incomplete data and a lack of continuity when consultants are replaced for subsequent data collection and reporting.[32] The current approach hampers collaboration and hinders the effectiveness of managing GHGs, including methane. It makes it challenging to monitor and assess the impact of climate-related initiatives.

The Initiative for Climate Action and Transparency (ICAT) [33] has introduced a uniform data collection approach by incorporating common reporting frameworks, expert training and direct integration of IPCC recommendations for GHG emissions data. Implementing this updated system is designed to enhance the efficiency, comprehensiveness, and consistency of data collection, thereby improving the overall quality of climate reporting.

32 Initiative for Climate Action and Transparency. (2021). Institutional Arrangements for the National MRV System for Mozambique.
33 The ICAT supports developing countries to build transparency frameworks required for effective climate action and advancing national sustainable development priorities (https://climateactiontransparency.org/our-work/

Country Case V: Senegal

Country Summary

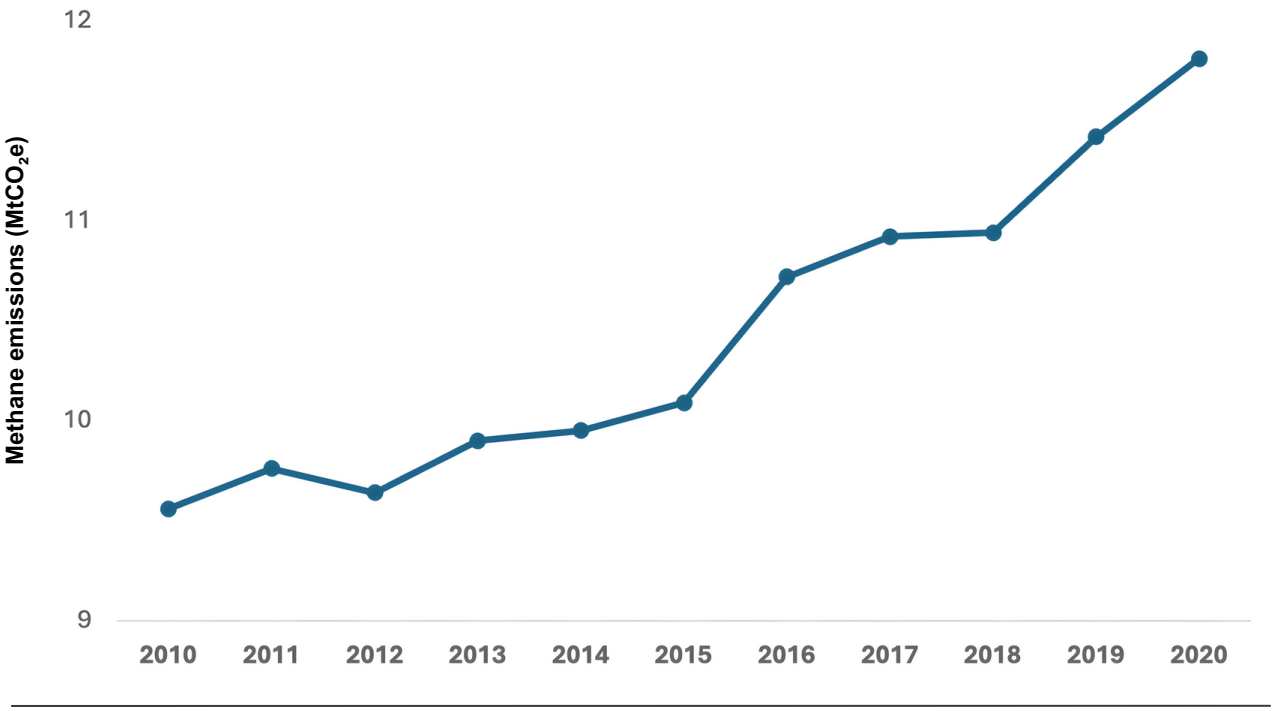
- Senegal's methane emissions have been on an upward trend, recording an increase of about 21% between 2010 and 2020. The agriculture and waste sectors are the primary contributors to these emissions, responsible for about 95% of the country's total methane emissions.
- Senegal's energy sector's contribution to methane emissions is less than 4%. Within the energy sector, bioenergy is the main contributor to methane emissions, accounting for about 92%, whereas oil and gas contribute about 6%.
- Despite the marginal contribution of the gas sub-sector to methane emissions, relative to other oil-producing countries, the recent discovery of oil and gas reserves necessitates methane abatement measures, as commercial petroleum production can substantially increase methane emissions.
- Senegal's NDCs do not include explicit methane emissions reduction goals for the oil and gas sector. Nonetheless, the country has committed to unconditional GHG emissions reduction targets of 5% by 2025 and 10% by 2030, relative to the business-as-usual (BAU) scenarios.
- Senegal is leveraging partnerships with international institutions such as the World Bank, International Energy Agency and the New Producers Group to align its oil and gas sector's policies and regulations towards methane management and implement monitoring specifications, including the use of satellites and sensors to track emissions.
- Senegal also seeks to leverage its gas resources to achieve universal electrification. The country aims to utilize its associated and non-associated gas resources for power generation and industrial use, thus, reducing emissions through flaring and venting.
- Senegal is in the process of developing systems for effective Measurement, Reporting and Verification of methane emissions in the oil and gas sectors, targeting satellite imagery technologies to effectively determine and measure emissions.

Introduction

Senegal has made significant commercial discoveries of oil and gas reserves: the Grand Tortue Ahmeyim (GTA) field, the Yaakar-Teranga project, and the Sangomar project. These fields hold substantial natural gas reserves, with the GTA, Yaakar-Teranga, and Sangomar projects estimated to have 15 tcf, 20 tcf, and 2.4 tcf of proven reserves, respectively. Additionally, the Sangomar project has reserves estimate of 630 million barrels of oil. Although these fields are at different stages of development, first gas from GTA is expected by the end of 2023.

Between 2010 and 2020, Senegal witnessed a consistent upward trend in methane emissions. Over this period, emissions have risen from approximately 9.5 million metric tons of CO2 equivalent (MtCO2e) in 2010 to about 12 MtCO2e in 2020.

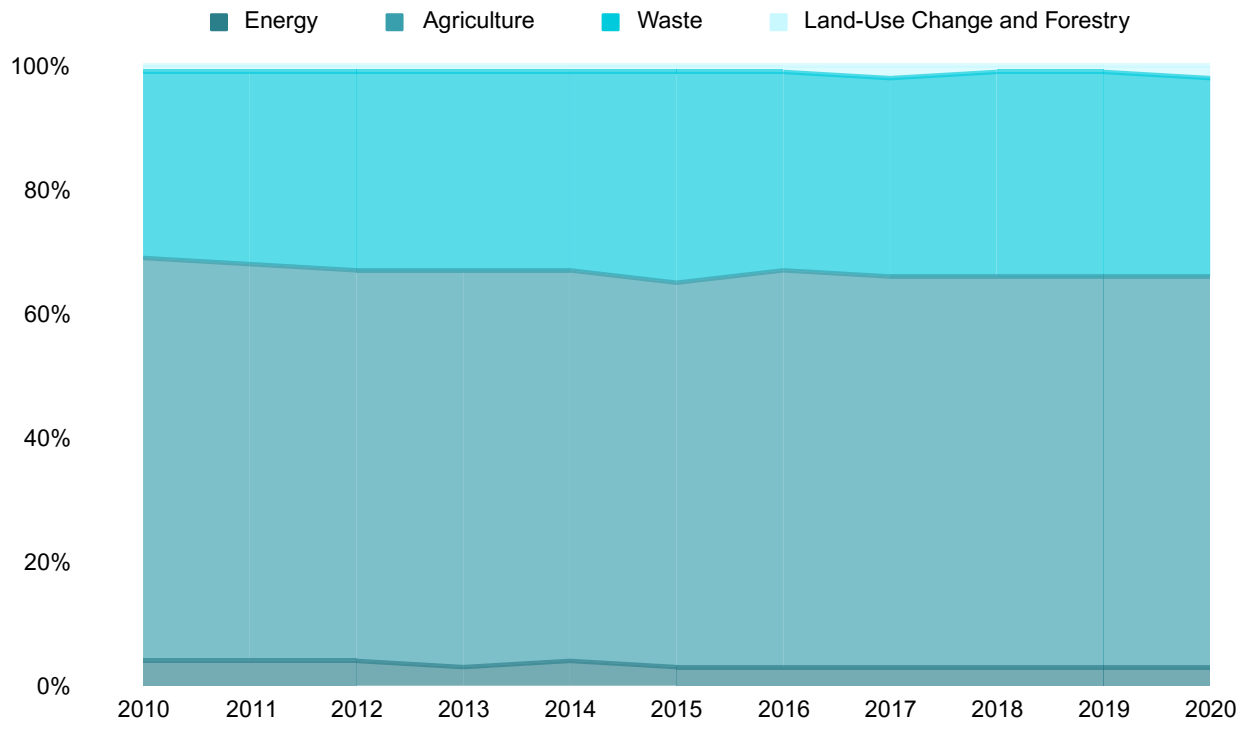
Figure 22: Senegal's methane emissions (2010-2020)



Source: Authors' construct with data from World Resources Institute

The agriculture and waste sectors have consistently constituted more than 95% of methane emissions between 2010 and 2020. The energy sector accounts for an average of 3.28% of emissions within the period. **Senegal's energy sector contribution to methane emissions is relatively lower compared to other oil-producing African countries. However, with the recent discovery of oil and gas, there is a possibility of a substantial increase in methane emissions if no significant abatement measures exist.**

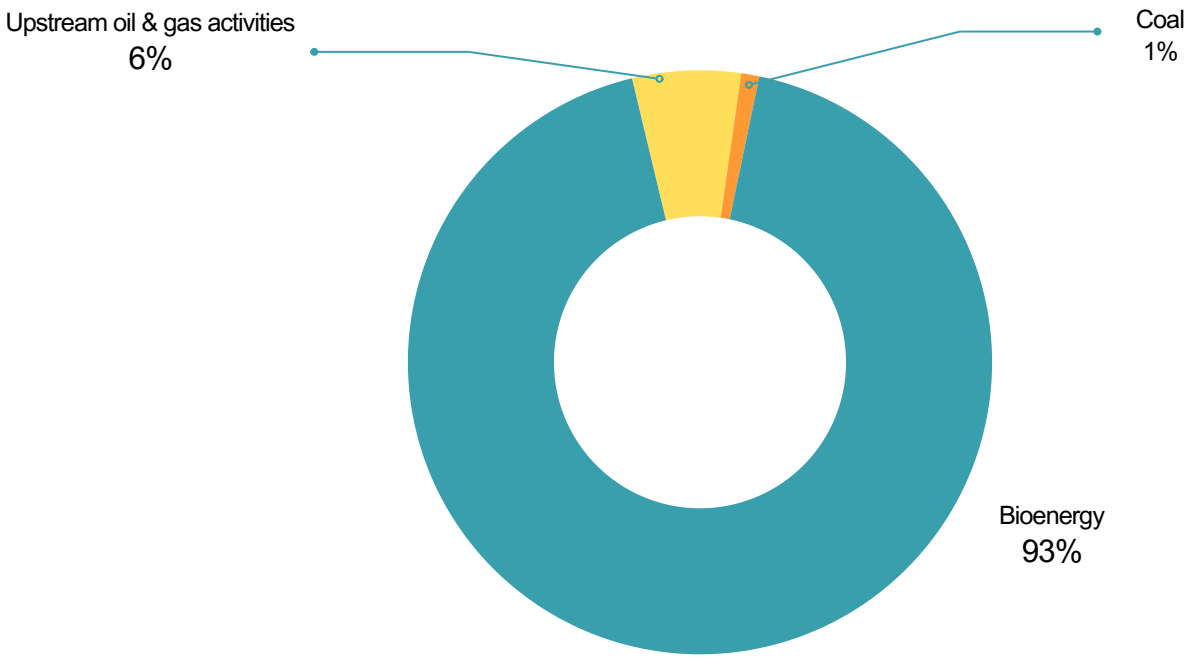
Figure 23: Sources of methane emissions in Senegal (2010-2020)



Source: Authors' construct with data from World Resources Institute

Bioenergy is the primary source of methane emissions from the energy sector, contributing about 92%. Upstream oil and gas activities and coal follow with respective contributions of 6% and 1%.

Figure 24: Methane emissions from Senegal's energy sector (2022)



Source: Authors' construct with data from IEA

Table 16: Methane emissions (in kt) profile from Senegal's oil and gas sector (2022)

	Activity			
Emission source	**Fugitive Emissions**	**Vented**	**Flaring**	**Other sources**
Gas pipelines and LNG facilities	0.060	0.032		0.092
Onshore gas	0.026	0.057		0.084
Others from oil and gas				0.661
Grand Total	**0.086**	**0.089**		**0.837**

Source: International Energy Agency (2023), Methane Tracker Database, IEA, Paris. License: Creative Commons Attribution CC BY-SA 4.0.

Relevant agencies responsible for methane management in Senegal

Table 17 shows the institutions responsible for methane management in Senegal's oil and gas sector.

Table 17: Institutions responsible for methane management in Senegal

Body	Function
Ministries	
The Ministry of Petroleum and Energies	• The Ministry is the authority tasked with implementing and overseeing the governmental policies related to the hydrocarbons sector.
Ministry of Environment and Sustainable Development	• The Ministry is responsible for formulating and implementing environmental monitoring and pollution prevention policies across all sectors.

Methane emissions strategies in Senegal are embedded in NDC targets and legal frameworks

Senegal's NDCs do not have any specific methane emissions reduction targets in the oil and gas sector. However, it has unconditional GHG emissions reduction targets of 5% by 2025 and 10% by 2030, relative to the Business-as-usual (BAU) scenarios. In the energy sector, the country has a target to unconditionally reduce GHG emissions by 1.4MtCO_2e and 2.4MtCO_2e by 2025 and 2030, respectively. The government of Senegal acknowledges the need for methane emission management within the oil and gas sector and has taken actions to promote methane management in developing its oil and gas fields. These actions include environmental protection provisions in its petroleum code,[34] gas commercialization efforts and monitoring reporting and verification requirements.

- **Gas Code, Law No. 2020-06:** The primary purpose of the Gas Code is to regulate activities in the midstream and downstream gas sectors. It provides a legal framework for the transportation, storage, processing, importation, and exportation of natural gas, LNG, and Compressed Natural Gas (CNG). Generally, the gas code mandates license and concession holders to implement measures to prevent and control pollution, ensuring no release of polluting substances into the environment. The Gas Code also provides guidelines for monitoring and outlines applicable sanctions and penalties to ensure compliance with these regulations.
- **Petroleum Code 2019, Law no. 2019-03:** The Petroleum Code in Senegal serves as a regulatory framework for the hydrocarbon sector. It establishes rules and guidelines for various petroleum activities, including prospecting, exploration, development, transport, storage, and natural gas liquefaction. While it does not explicitly address methane emissions, it mandates that oil and gas companies must adopt necessary measures to prevent and mitigate pollution in accordance with international industry standards and national legislation.

Senegal has received immense support from international partners

The discovery of commercial quantities of oil and gas in Senegal has engendered conversations on reducing emissions from oil and gas activities. Subsequently, Senegal has received support from development partners such as the World Bank, the New Producers Group, the IEA, and the Climate and Clean Air Coalition. The aid from development partners focuses on shaping policies, developing technical skills, and implementing efficient emissions management practices.

World Bank: Following the discovery of oil and gas resources in Senegal, the World Bank has supported Senegal with capacity building and creating a favourable environment for private sector investment.[35]

34 Senegal Petroleum Code, 2019. Available at https://itie.sn/reglementation/
35 World Bank (2017). World Bank to Help Senegal Negotiate Complex Oil & Gas Projects. available at https://www.worldbank.org/en/news/press-release/2017/05/31/world-bank-to-help-senegal-negotiate-complex-oil-gas-projects

Specifically on environmental protection, the Bank is supporting the country to track emissions from its oil and gas fields using sensors and satellites. Senegal is also receiving technical support to formulate new legislation on GHG monitoring and respective sanctions for non-compliance.

New Producers Group: The New Producers Group (NPG) supports sustainable development for emerging oil and gas producers like Senegal. They facilitate knowledge sharing among member countries to manage resources effectively. NPG's training in Senegal aims to equip stakeholders with the skills to develop emissions reduction plans for the oil and gas sector.

International Energy Agency (IEA): The IEA has extended support to Senegal to secure sustainable energy for its citizens. The Agency provides technical knowledge and capacity building on controlling emissions from the oil and gas sector.

Climate and Clean Air Coalition (CCAC): The Senegalese government is receiving support from the CCAC to develop a National Methane Roadmap, which would feed into an update of its NDCs. These roadmaps will utilize emerging data and techniques to improve emissions inventories, identify effective abatement strategies, and establish methane-related policies, programs, and funding sources for implementation.

Gas commercialisation is central to Senegal's emissions reduction and economic growth as a new producer

Senegal is committed to increasing the generation and utilisation of clean energy through its gas-to-power strategy. Diesel accounts for approximately 80% of Senegal's electricity generation mix, while natural gas contributes less than 1%.[36] The strategy seeks to increase natural gas-generated electricity towards achieving universal access by 2025.[37] Senegal's NDCs pledge to replace fossil fuels with gas thermal power plants, reaching 600 MW of installed capacity by 2030.

Senegal seeks to leverage its natural gas fields to achieve its universal access to electricity target. It intends to utilize a share of its domestic gas from the Sangomar and GTA to fuel its gas-to-power projects. Beside gas reserved for domestic use, all the gas from these fields would be converted to LNG and exported using tankers. Senegal is currently developing a gas master plan to guide the utilization of its domestic gas resources. The master plan would include refinery upgrades, gas pipeline networks, CNG and LNG Fuelling stations, and gas-to-power and fertilizer plants.[38]

36 IEA. World Energy Balances 2022. Available at https://www.iea.org/data-and-statistics/data-product/world-energy-statistics-and-balances

37 Sarr, S. & Fall, S. (2022). Just energy transitions and partnerships in Africa: a Senegal case study. Enda Energie

38 Seydou, T (n.d.) Investment opportunities in the Senegalese Oil and Gas sector. Available at https://ambassadesenegal.be/wp-content/uploads/2022/07/Presentation_to_Investors_Investment_Opportinuties_Oil_Gas_rf.pdf

Senegal is developing standards for MRV systems

Stakeholder interactions reveal a lack of robust MRV frameworks for tracking emissions, which is also confirmed by the country's assessment of MRV systems in response to its NDCs. The report highlights that monitoring and evaluation systems primarily focus on measuring the performance of sectoral policies but neglect the necessary data for NDC tracking. Consequently, there is a need to improve and enhance MRV frameworks to effectively capture the data required for monitoring NDC progress.

In collaboration with development partners, the government of Senegal aims to enhance MRV systems, particularly in the oil and gas sector. These enhancements involve utilising remote sensors and satellite imaging technologies to improve the accuracy of emissions data acquisition in the oil and gas fields.

7.0 Best practices, gaps and solutions

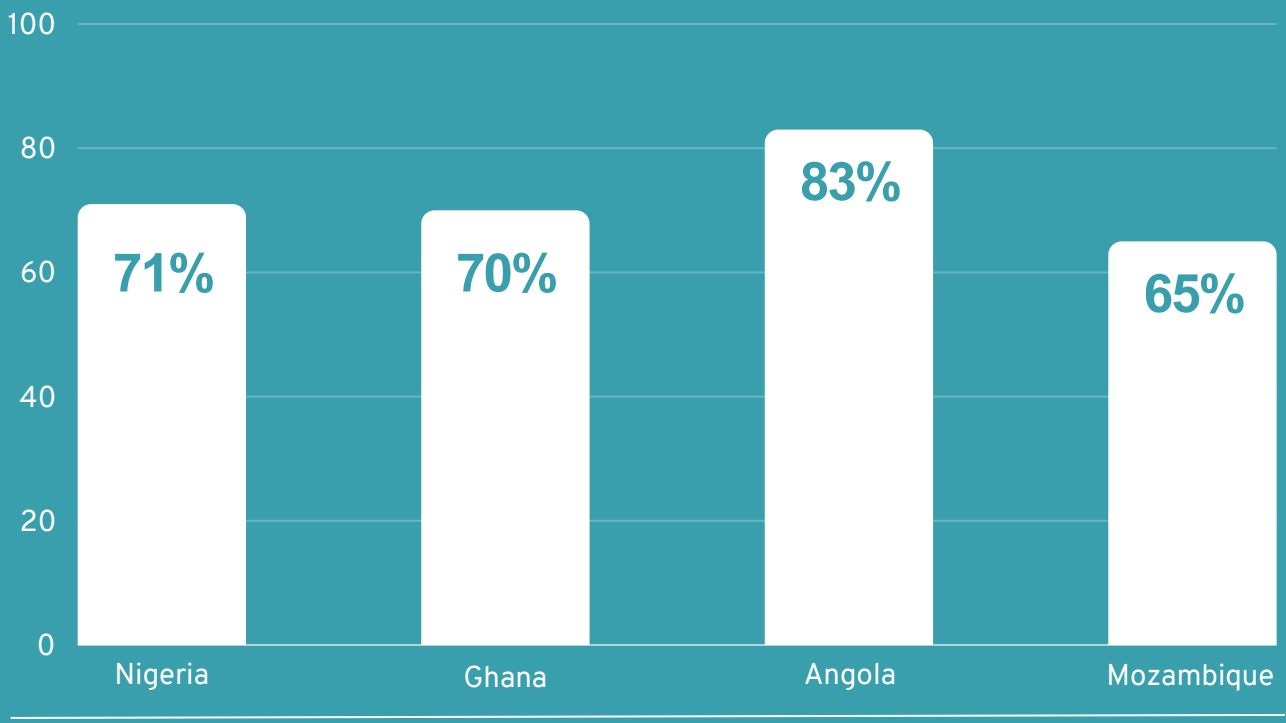
Methane management is paramount in averting a global catastrophe caused by its potent greenhouse effect. Industrialized nations often receive attention as major methane emitters compared to Africa. The notion of Africa's minimal contribution permeates the thinking around the continent's decision to aggressively explore its oil and gas resources. However, Africa must acknowledge the necessity for proactive measures within the region.

Despite being disproportionately impacted by climate change disasters, African nations can lead in mitigating climate change by spearheading efforts to reduce methane emissions. This leadership could give them a powerful voice in urging major emitters to take more decisive actions. Again, abating methane emissions, particularly from the oil and gas sector, can generate economic value by utilising existing technologies. The IEA estimates that the benefits of investing in methane abatement measures outweigh the costs of investments in appropriate technologies to commercialise the gas.

This study sought to understand the place of methane management in the energy transition plans of five selected African countries. The study examined the diverse approaches to methane management policies and actions implemented by African governments and companies. It aimed to understand the roles and responsibilities of various stakeholders in mitigating methane emissions. Furthermore, the research assessed the compliance of these measures with international protocols and agreements that countries have subscribed to for effective methane management. The study provided insights into the comprehensive landscape of methane management efforts in Africa by considering governmental and corporate actions.

Venting stands out as the dominant source of methane emissions in the oil and gas industry. In Nigeria, Ghana, Angola and Mozambique, over 65% of methane emissions from the oil and gas sector is caused by venting, despite policies instituted by some of the study countries to prevent venting. Venting can be averted through gas commercialisation or re-injection. Where commercialisation or re-injection is not possible, the installation of flares to convert methane into CO2 will be an appropriate short-term measure.

Figure 25: Proportion of methane emissions caused by venting in study countries



Best Practices

1. **Nigeria emerges as a frontrunner in implementing measures for methane management.** The country has demonstrated its commitment by establishing specific targets and policies to reduce methane emissions. Notably, the SLCP action plan in Nigeria includes dedicated targets for methane abatement, which serve as a standard measure to assess progress on methane emissions reduction. Additionally, it has developed regulations and guidelines to govern fugitive methane emissions. Nigeria's example sets the clarity of standards and targets for other countries to emulate.
2. **The instances of Nigeria, Angola and Ghana exemplify how gas commercialization can effectively decrease gas flaring.** Commercialization efforts for exports through LNG, power generation, and the petrochemical industry have reduced gas flaring in Nigeria, Angola and Ghana. These examples provide lessons for new producers to consider commercialization efforts and ensure that gas utilization infrastructure coincides with production.
3. **The current emission monitoring systems offer room for further growth and advancement.** Ghana's GCARP model and Nigeria's CoMAT tool are essential in monitoring and consolidating methane emissions data from diverse sources. While GCARP covers all forms of GHG emissions, CoMAT specifically focuses on methane emissions. Additionally, Nigeria has made advancements in its monitoring systems

by implementing satellite imagery technology to track gas flares in both onshore and offshore fields. As a new producer, Senegal also plans to utilize satellite imagery to monitor overall GHG emissions from its oil and gas sector.

4. Development finance institutions ensure the development of advanced systems to govern the oil and gas sector. Senegal is receiving support from the World Bank to ensure that the GTA field has advanced technologies to prevent and track emissions. These forms of support could be a benchmark for other DFIs to ensure new fields comply with standards to avoid methane emissions.

Gaps in methane management

1. **The lack of strong political will hinders the effective implementation and enforcement of policies and regulations.** Political leaders are committing to global methane initiatives and actions. However, these commitments have not translated into domestic political actions to monitor compliance by state institutions. For example, Mozambique has not paid much attention to methane management in its oil and gas sector. Angola does not have adequate systems to monitor and verify emissions from oil and gas operations. Interactions with stakeholders in Nigeria also reveal similar challenges in monitoring offshore operations. Ghana has also delayed aligning infrastructure development with oil and gas operations, contributing to significant flare volumes. These examples are essential lessons for an emerging gas producer like Senegal.
2. **Unlike Nigeria, the other study countries do not have separate policy documents highlighting methane management.** These countries do not have specific methane management provisions in their legal frameworks that guide oil and gas operations. Instead, they have provisions in various laws, regulations and international commitments that guide general GHG emissions. However, it is best for countries to have specific targets and guidelines on methane emissions to facilitate effective monitoring.
3. **National Oil Companies are yet to commit to any global initiative on methane management.** Global initiatives like the Global Methane Initiative (GMI) and Oil and Gas Methane Partnership 2.0 (OGMP 2.0) have membership from many IOCs. However, none of the NOCs in the study countries has joined these initiatives, reflecting the broader reality in Africa. While participation is not legally binding, it signifies a commitment to methane reduction. The NOCs are key players in developing resource-rich developing countries' oil and gas sectors. Therefore, participating in methane emissions reduction initiatives will be an important signal demonstrating commitment to emissions reduction.
4. MRV frameworks in study countries rely on voluntary disclosures from companies. Although Ghana and Nigeria have MRV frameworks that track emissions data from various sources, they rely on voluntary disclosures from companies for primary level data. These voluntary disclosures may require regular tracking to verify the data

presented, which is not done in study countries. The remaining study countries do not have comprehensive MRV reporting systems and thus depend on companies and lower-tier methodologies to determine emissions.

5. **The challenge of getting approval for additional investment in methane abatement efforts.** While companies are willing to invest in new technologies to abate emissions at a cost to the project, getting governments' consent remains a challenge. These additional investments for mitigation are not a priority to governments, especially when they impact revenue. This challenge is particularly evident in fields where further investments are necessary to retrofit equipment. Regrettably, in some instances, the required investments are not significant, which governments would discover if they examined the requirements.
6. **Weak coordination among government agencies undermines effective regulatory oversight.** Interactions with stakeholders reveal a disconnect among regulatory institutions, creating a gap that allows non-compliance to go unnoticed. Policy decisions and interventions may be based on incomplete or misleading information, potentially leading to suboptimal outcomes or ineffective measures to address environmental challenges.
7. **There is inadequate awareness among civil society, think tanks and academics on the need to track methane emissions and their impact on the climate.** The few who share some understanding do not programme methane emission reduction into their core activities, necessitating deeper conversation and capacity development for these actors to research, monitor and engage in various country commitments to methane emissions.
8. **The concept of methane programming is continuously evolving within the philanthropy space.** Interaction with some organisations demonstrates a fair understanding of the challenges associated with methane abatement. However, these organizations have not fully integrated methane management concerns into their strategies. This finding suggests that there may be a gap between recognizing the importance of addressing methane emissions and actively supporting initiatives targeting methane reduction. The conversation about methane emissions is subsumed within the broader framework of climate action and GHG emission reduction, which de-emphasises the critical conversations to target specific actions required for methane emissions reduction.

Short-term and long-term measures required for effective methane management

1. Matured oil and gas producing countries must take responsibility for their emissions, with realistic plans to eliminate methane emissions. An immediate cessation of methane emissions could be challenging; however, matured producers should take ownership of the impact of methane emissions. By internalizing this responsibility, they can develop suitable strategies to effectively address all forms of methane emissions within a realistic and achievable timeframe. This approach reflects a proactive stance, emphasizing the need for responsible actions to mitigate methane emissions while considering the industry's complexities.
2. In the short term, matured producing countries must develop and clarify institutional roles for methane management. These institutional roles must define responsibilities among stakeholders to monitor, report, and implement methane reduction strategies effectively. This coordinated approach ensures accountability and enhances their leadership in addressing environmental sustainability and climate change.
3. National Oil Companies must demonstrate leadership in implementing methane management strategies. Given their strategic positioning, NOCs possess significant influence to drive their partners' compliance with methane management strategies. NOCS must strengthen institutional collaborations, invest in capacity building, promote transparent reporting, and explore innovative approaches to reduce methane emissions in the oil and gas sector.
4. Investments in methane abatement technologies require a shared commitment between the government and companies. This commitment will clarify respective responsibilities in funding and implementing methane abatement measures. This is important, particularly when it is noted that methane abatement can generate returns to cover investment costs.
5. Matured producers must consistently publish emissions reduction achievements. These achievements will showcase producing countries' environmental responsibility, foster transparency, and inspire global efforts in combating climate change.

Measures for new producers

1. **New producing countries like Senegal and Mozambique must ensure that gas commercialisation infrastructure aligns with new oil and gas production.** The successful development of such infrastructure is vital for the efficient utilization and monetization of natural gas resources. New producers should resist the temptation to postpone gas commercialization efforts to evade the challenge of mitigating methane emissions in the future.
2. **New producing countries must integrate strict provisions on methane emissions management into their legal frameworks.** They must establish a robust regulatory environment that prioritizes methane reduction measures which align with global climate goals. Embedding such provisions ensures that all relevant stakeholders, including companies and government entities, are bound by clear and enforceable guidelines for methane emissions control.

General measures

1. **Governments and regulatory agencies must prioritize methane management efforts within the oil and gas sector.** Governments must consider the environmental and economic importance of effective methane management. These must drive political action on capacity building, regulatory enforcement, institutional collaborations and promoting investments for gas commercialization.
2. **Governments, companies, and other stakeholders must take a holistic approach towards methane management.** Methane management efforts in the oil and gas sector must consider all sources of methane emissions, including venting, fugitive emissions, and flaring. A broad focus will yield optimum emission reductions.
3. **Governments and companies must design specific policies to deal with methane abatement.** These deliberate efforts would enable efficient tracking and performance assessment of methane emissions. Again, recognizing the different efforts required to mitigate the various GHGs, methane emissions management must not be lumped up with other GHGs.
4. **Philanthropy organisations and development partners must integrate methane management into their strategies.** These efforts would facilitate critical conversations and advocacies that drive action towards methane management.
5. **Financing institutions, as part of their Environmental, Social and Governance (ESG) strategies, must make methane management a precondition for financing new oil and gas field developments.** This would ensure the prioritization of methane abatement efforts in new oil and gas fields, thus promoting methane emission reduction from the oil and gas sector. Development Finance Institutions should spearhead strategy considering their roles as financiers for oil and gas projects.

Limitations and suggestions for further research

The research centred on five oil-producing and frontier African countries, which may not offer a comprehensive evaluation of methane management efforts throughout the continent. While the study reveals similarities in approaches among the countries examined, it is crucial to consider that distinct approaches and contextual differences may require cautious interpretation and generalization. Conducting further assessments in specific contexts would be beneficial in applying the findings of this study to countries that were not included in the research.

Moreover, the focus of the study on understanding the policy landscape limited the participants to government officials, business representatives, civil society actors, and academics involved in or affected by methane emissions policies. Consequently, the research did not directly investigate the specific impacts on communities or engage with individuals directly affected by methane emissions. Including a broader range of perspectives would enhance the overall understanding of the challenges and opportunities related to methane management.

List of organisations

Group	Ghana	Mozambique	Angola	Senegal	Nigeria
International Oil Companies	• Eni • Kosmos Ghana • West Africa Gas Pipeline Company • Ghana National Gas Company	• Eni • Sasol	• Eni • SLB	• Kosmos Energy	• Nigeria LNG • West Africa E&P • Chevron
National Oil Companies	• Ghana National Petroleum Corporation	• Empresa Nacional de Hidrocarbonetos (ENH)	• Sonangol Group	• Petrosen	
Government institutions	• Petroleum Commission • Environmental Protection Agency • Energy Commission • Ministry of Energy • Ministry of Sanitation	• Instituto Nacional de Petróleo (INP) • National Agency for Environmental Quality Control	• National Agency for Petroleum, Gas and Biofuels • Ministry of Energy and Water	• Ministry of Petroleum and Energy	• Federal Ministry of Environment • National Environmental Standards and Regulations Enforcement Agency (NESREA) • National Oil Spill Detection and Response Agency • National Midstream and Downstream Regulatory Agency
Research / Civil Society Organisations	• Mountain Research Institute • A Rocha Ghana • Strategic Youth for National Development • Ghana Upstream Chamber	• Natural Justice • Centro Terra Viva (CTV) • Centre for Democratic Development (CDD Mozambique) • CPI Maputo	• Action for Rural Development and Environment • Angola EITI	• EITI Senegal • NRGI Senegal • Oxfam Senegal	• Facility for Oil Sector Transparency and Reform in Nigeria • Spaces for Change • Teno Energy Services
Cross-cutting	• British High Commission • New Producers Group • Energy Transition Fund • Ford Foundation • Open Society Foundation				

Africa Centre for Energy Policy

26 Lemming St. || North Legon || GM-058-1968
P. O. Box CT 2121 || Cantonments || Accra
+233 (0) 302 900 730
info@acep.africa
acep.africa

ACEP is a thought leader in Africa's energy and extractives governance space, working towards improving economic transformation and inclusive sustainable development. We contribute to developing alternative and innovative policy interventions through high-quality research, analysis, and advocacy in Africa's energy and extractives sector.