

Review of Nigeria's Effort to Stop Gas Flaring by 2020

¹Abdulkadir, Sarauta, ²Abdullahi, Ahmed Chinade &
³Hajara Salihu Bawa

^{1,2&3}Department of Environmental Management Technology,
Abubakar Tafawa Balewa University, Bauchi, Nigeria

Abstract

Gas flaring has been theoretically banned since 1979 in Nigeria however, the deadlines have been extended several times and as a result Nigeria still remains a top gas flaring nation as 7th position in 2016 with only 10% flared gas remains. Nigeria has achieved additional 1% flared gas reduction in 2018 is now left with only 9%. Nigeria is also exploring unconventional petroleum resources in the country such as Coal and Shale resources massive gas industry (as proposed in PIB) therefore, gas flaring has to be stopped. Nigeria is committed to stopping gas flaring by the year 2020, as part of the effort the establishment of gas development industries, legislative measures to regulate the oil and gas industry and a pipeline to transport gas to Europe and some neighbouring African countries. The strategic method and steps involved in this review are: Legislation effort to stop gas flaring from 1969-2012, current situation to end gas flaring, future strategies to end flaring by 2020, benefit of stopping gas flaring and the way forward. The result shows that series of attempts were made to stop gas flaring from 1969 to 2012 without success. The key policies Nigeria relies upon to end gas flaring include: Petroleum Industry Bill (PIB), National Strategies to stop gas flaring, INDC, National oil policy, National gas policy, downstream policy, and Fiscal reform policy. However, despite formulation of these policies, the country's is yet to end gas flaring.

Keywords: *Gas Flaring, Greenhouse Gas, Emission Reduction, Nigeria*

Corresponding Author: Abdulkadir, Sarauta

Background to the Study

Gas flaring has been theoretically prohibited in Nigeria since 1979. However, the deadlines set for this prohibition to come to effect have been extended several times and Nigeria still remains as gas flaring as a result (Otiotio, 2013). A study suggested that underground injection of flared gas is the best choice to quit gas flaring in oil production field (Lawal et al., 2017). The problem of gas flaring in Nigeria can also be reduced through the Federal Government policy of increasing of flared natural gas utilization in Nigeria (Giwa et al., 2017).

Another study indicated that expansion of gas distribution facilities is the key to mitigating gas flaring activities and achieving sustainable development in the sector. This will also stimulate the development of gas market in the country (Agbonifo, 2016). In addition, a study on flared gas recovery and its application to electricity generation in Nigeria shows that energy generation can eliminate flaring activities (Adekomaya, *et al.*, 2016).

To mitigate gas flaring, natural gas vehicles (CNG) should be adopted in Nigeria as Strategic Fuel Substitution Initiative (SFSI) intervention to reduce Greenhouse gases (GHGs) contribution from road transport in Nigeria. The result revealed that the successful implementation of SFSI appears to be a sustainable means of reducing flared gas (Giwa and Odufuwa 2017). Another study suggested that the partnership through public-private and external fund source, with political will through advance policy reform is a key to reducing flare emission. Expansion of domestic gas utilization locally would also ensure gas flare-out in the country as stated by Sonibare and Akeredolu (2006)..

In Nigeria almost seventy one millions m³/day of gas is being flared while the domestic gas demand is more than half of that value (Farina, 2010). It has been estimated that Nigeria has 182 trillion cubic feet of gas reserves with a projected growth rate of over 70% by 2025, the application of cutting edge technologies such as Gas-to-liquids (GTL) diesel and synfuels, Gas-to-Methanol, Compressed Natural Gas (CNG), Gas-to-hydrates, etc. would stop gas flaring in Nigeria (Odumugbo, 2010).

One of the strategic measures to mitigate GHGs (by 18 MM tons annually) in the country is to generate sufficient electric power (Kristin, 2018). It has also been reported that, in order to end gas flaring in Nigeria, natural gas utilization and the Nigerian gas-to-liquid project must be prioritized (Ahmed, 2012). The challenge of ending gas flaring in Nigeria can be linked to oil revenue as one of the main contributor to GDP (Chiudo, 2016).

According to Adaji et al. (2018) gas utilisation in Nigeria is associated with poor and low technical know-how in the sector ranging from obsolete facilities, weak policies and regulatory frameworks. The result of the prediction analysis shows that there would be a significant increase in domestic gas use from 2015 to 2020. To support this growth therefore, there is a need for more investment in the sector to ensure stable gas development (Adaji et al., 2018).

Nigeria had introduced several mechanisms in order to control gas flaring in the country over the last ten years. This has resulted into reduction of gas flaring by 26% from 36% ten years ago. This achievement has pushed the country to 7th largest gas flaring nation from the 2nd position within the last ten years (2006 to 2016). A further 1% reduction of flared gas was further achieved between 2016 to 2018 (Ladan, 2018).

Nigeria emits about 2.5 BScf in 2006 where as only 300 mscf of gas is utilised daily (Ughamadu, 2017). This means there is huge opportunity of boosting domestic utilization. Nigeria is committed to reducing gas flaring by the year 2020 (Ughamadu, 2017), as part of the efforts put in place to achieve this, a liquefied natural gas plant was commissioned, legislative measures to regulate the oil and gas industry were taken and a pipeline to transport gas to Europe and some African countries was laid (Emam, 2015). Nigeria, ratified the Paris Agreement in 2016 and has pledged to end gas flaring before 2030 as part of its nationally determined contribution (NDC) (Federal Ministry of Environment, 2016; Roser and Kurdziel, 2016 and Ehirim, 2016). To meet the set goals, Nigeria must have transition effort in governments at all levels willing to implement the national and other policies on INDCs.

It is quite possible to end gas flaring in Nigeria as a number of countries have achieved similar feat in the past, Some of these countries include Norway, Netherland, UAE, Chad, Equador, Muzambique, Egypt, Tunisia and Qatar among others. Lack of reliable data on the actual amount and sources of flared gas constitute a major obstacle in planning how to regulate the practice (Andah, T). Also, this prevents regulatory agencies from selecting the best technological and natural methods to reduce emissions emanating from the flare (Chiudo, 2016).

Effort to End Gas Flaring through Regulations and legislative Framework in Nigeria from 1969-2020

Gas flaring started in 1956 in Nigeria after oil boom at Oloibiri in the present Bayelsa State. Gas flaring continues unstopped because it is the cheapest way of separating associate gas from crude oil (Otiotio, 2013).

First Nigerian laws on oil and gas to stop gas flaring in 1969

The Nigerian government's first legislation on oil and gas industries is the the Petroleum Act of 1969. After manifestation of the impact of the oil and gas activities on human health and environment, the Federal Government of Nigeria promulgated laws and policies aimed at stopping gas flaring in 1969. Unfortunately, these laws were not very effective. The laws and regulation were included in the Petroleum Drilling and Production Regulations of Decree No. 51 of 1969 under the Petroleum Act (Otiotio, 2013).

A Solid Step to Control Gas Flaring in 1979

A solid step to control gas flaring in 1979 was reached after the enactment of the Associated Gas Re-Injection Act (AGRA), it is a legal and regulatory framework for gas utilization for both land and the Exclusive Economic Zones. The Act directs all oil and gas companies to

submit, preliminary ways for the viable utilization of all associated gas produced from a field and develop projects to re-inject all non-utilized associated gas (flared gas) in an industrial project, not later than April 1st, 1980, notwithstanding the provisions of the Regulation 42 transformed provision to be mandatory. The Act makes it illegal for any producer of oil and Gas Company to flare gas after January 1st 1984, without being authorised by the Minister (Sonibare and Akeredolu, 2006).

Continues gasflaring regulation on January 1st, 1985

The Act give right to Nigerian Government to utilize any gas at flare point free of cost. The large amount of money required for gas re-injection as well as inability of the Federal Government to satisfy their financial agreement with joint venture partners, lack of infrastructural facilities, coupled with the inability of foreign oil and gas companies to meet the 1984 deadline led to the promulgation or establishment of the Associated Gas Re-Injection (That is Continued Flaring of Gas) Regulation in 1985 (Otiotio, 2013).

Gas continued to be flared in the country up to January 1st, 1985 after (Continued Flaring of Gas Regulation take effect on January 1st, 1985), but it gave enormous powers to the Minister of Petroleum resource to issue a certificate on some situations to oil and gas companies under section 3(2) of the Associated Gas Re-Injection Act (Amended) for continue flaring of gas. From then on gas flaring continued unrestricted in the country. The Nigerian government later tried to apply economic instruments to amend the Act (Otiotio, 2013).

Gas Flaring Penalties from 1988 -2008

The Associated Gas Re-Injection (Amendment) Act, put a penalty of two kobo per 1000scf of gas flared in areas where gas flaring ermissions were not granted. Later, the fine was increased to fifty (50) kobo per 1000scf of gas in 1990. S further increase of the penalty was made in 1998 to ten (10) Naira per 1000scf of gas. Then lastly the fine was increased to \$3.50 per 1000scf in April 2008. Most of the oil and gas companies prefer to pay the fine because it is cheaper than utilizing the gas. It was realised that after the 2008 penalty increase all the oil companies failed to pay the fine. The Introduced of the Associated Gas Framework Agreement (AGFA), which provide broad based fiscal incentive for gas utilization in regard to its production, processing, transmission, and supply to NLNG and other Nigerian facilities mad we them to comply (Otiotio, 2013).

Government Established NLNG to Reduce Gas Flaring

However, the federal government also enacted the NLNG (Fiscal Incentive Guarantee and Assurances) Decree (FIGAD), the incentive is to encourage and facilitate the development of the NLGN project as a way of reducing gas flaring. Furthermore, the Act grants ten years tax free to the NLNG companies and exempts the companies involved in the NLNG project from import duties and certain taxes.

In order to facilitate huge utilization of gas, the government entered into a treaty with three African countries i.e Benin, Togo and Ghana in January 31, 2003, for the West African gas Pipeline Project (WAGP) and the National Assembly passed it to law by Treaty on West African Gas Pipeline Project (Ratification and Enforcement) Act (Otiotio, 2013).

The WAGP Authority established an international institution with legal personality, financial autonomy and autonomous powers to implement WAGP project on behalf of member states. The Petroleum Profit Tax Act also provides some tax incentives to any company engaged in gas utilization projects (Otiotio, 2013).

Multi-national Company's Effort to stop Gas Flaring

Shell Petroleum Development Company (SPDC) of Nigeria began an ongoing multiyear program to install equipment to capture gas from its facilities. In total SPDC flaring dropped by more than 60 % between 2002 and 2011 from over 0.6 billion ft³/day to about 0.2 billion ft³/day (Emam, 2015).

No associated gas flaring after 31st December 2012

In 2010, National Assembly amended the Associated Gas Re-Injection Act that, "No oil or gas company engaged in production to flare associated gas after 31st December 2012, rather than such minimum allowed by the Minister. Therefore, the amendment Act set December 31, 2012 as the deadline for the cut of gas flaring. But a new section in the provision that permitted companies to flare gas temporary on the payment of a penalty charge of \$5.00 per 1000scf of gas flared. However, the President at the time has not signed that amendment into law.

The Petroleum Industry Bill, 2012

The Petroleum Industry Bill, 2012 was enriched with abatement measures to combat gas flaring in the country. This bill seeks to consolidate all the existing oil and gas laws in the country into one piece of legislation. The fundamental objectives of the bill included amongst others, the prudent management and allocation of petroleum resources and their derivatives in accordance with the Cap. 354 L.F.N. 1990; Cap. P14 L.F.N. 2010. S 10A & 11. Associated Gas Re-Injection Amendment Act of 2010. Id. S 3(1). S 3(2). Id. S 3(2)(b).

The Bill was presented to the National Assembly by the Nigerian President in July 19, 2012. The bill provide that natural gas shall not be flared or vented in any oil and gas production operation, block or field after the flare out date to be prescribed by the Minister in regulations to be made pursuant to the Act (Otiotio, 2013).

The PIB stated that any lessee or licensee who vents or flares gas without a written permit from the Minister are liable to pay a fine, equal to the value of the gas flared. However, the bill prohibits the license or lease awarded for the production of oil and gas to any new applicant without an approval of comprehensive program for natural gas utilization or reinjection. It mandates all operators in Nigeria to install metering equipment of gas within three months of the Act coming into force to know the exact volume of gas flared.

A Criminal Offence Gas Flaring without a Permit

The PIB provisions provide that it is a criminal offence to flare gas without a permit, and also required that any group of people, community, or individual to lodge any gas flaring or venting complain to the nearest office of the Inspectorate. If there is any lodged complain of

gas flared, an inspection would be carried out by an officer of the inspectorate to the facility within two days of receiving the complaint. The officer would submit a verification report to the Inspectorate within seven days to look at the situation and if satisfied impose a fine or sanction the facility as appropriate (Otiotio, 2013).

Nigerian government has established institutional framework to regulating gas flaring in the country, these include: The Federal Ministry of Environment (FMEnv), the Department of Petroleum Resources (DPR) in 1975, and the Nigerian National Petroleum Corporation (NNPC). Under the FME nether are some departments and parastatals charged with the responsibility of its supervisions and control these are: The Department of Environmental Assessment (DEA) and NESREA. The DEA is responsible for implementation of the EIA Act No. 86 of 1992 while, the NESREA is saddled with the responsibility of enforcement. The Department of Petroleum Resources (DPR) was charged with the responsibility of regulating all the affairs of the petroleum industry in Nigeria. It is also responsible for enforcing environmental regulations, safety and advice the federal government and relevant government agencies on policies on administration and control of petroleum as well as technical matters.

After the establishment and implementation of the Nigerian National Domestic Gas Supply and Pricing Policy in order to reduce gas flaring, the Ministry of Petroleum Resources commenced implementation of zero flaring policy for new oil and gas fields and no permission is granted for gas flaring in new projects. The ministry began the installation of pilot gas flare meters to measure the value of flarde gas flow accurately and the actual penalty fine to be paid. The Escravos Gas Project, the NLNG project, and other gas in joint venture partners had utilized a large volume of hitherto flared gas. The gas supply to domestic and international markets enormously reduced the quantity of gas flared in the country (Otiotio, 2013). The Nigerian government also intends to harness unconventional petroleum resources in the country as it contains in the Petroleum Industry Bill such as Coal and Shale resources (Nwaoha & Wood, 2014). This would boost massive gas development and revenue generation from foreign investors and export Nwaoha & Wood, (2014). But the Nigerian government is currently in conflict over the non passage of the PIB into law (Nwaoha & Wood, 2014). The Nigerian government intends to pass a new legislation on gas sector to address issues, adjust the anomaly as well as to distinguish gas activity at the upstream, mid and downstream. (Adeniji, 2017)

Gas Flaring and Gas Demand in Nigeria

Gas Flaring in Nigeria

Gas flaring activity by oil and gas industries contribute significantly to climate change, global warming, ozone depletion, acid rain, eutrophication, photochemical smog, terrestrial toxicity and aquatic toxicity via catalyst such as SO₂, NO₂, CFCs, CH₄, CO₂, VOCs (Ojijiagwo, Chike & Emekwuru, 2017). The table below shows the volume of gas flared and its reduction between 2007 to 2016.

Table1: Gas Production, Utilization and Flared in Nigeria 2007 - 2016

Years	Gas Production (mscf)	Gas Utilization (mscf)	Gas Flared (mscf)	% Flared
2007	2,415,649,041	1,655,960,315	759,688,726	31.34
2008	2,287,547,344	1,668,143,489	609,398,854	27.08
2009	1,837,278,307	1,327,925,402	509,351,905	27.32
2010	2,392,838,898	1,811,270,545	581,568,354	24.30
2011	2,400,402,880	1,781,370,022	609,032,858	25.79
2012	2,580,165,626	1,991,498,902	588,666,724	22.82
2013	2,235,137,449	1,916,531,001	409,311,430	17.60
2014	2,485,645,730	2,199,884,130	285,761,600	11.50
2015	2,929,852,323	2,588,480,059	341,372,264	11.65
2016	2,777,791,236	2,465,343,183	312,448,053	11.25

Source: (NNPC, 2016)

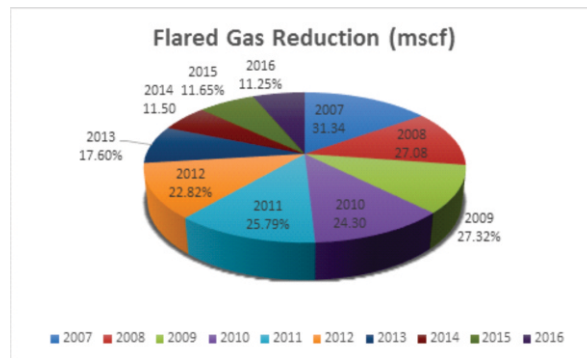


Figure1: How gas flaring drastically decrease from 2007 to 2016 (NNPC, 2016)

Gas Demand in Nigeria

There is high gas demand in Nigeria as shown in figure 2 and 3. Gas consumption in eria rising from the 2002 level to about 25% growth in 2020

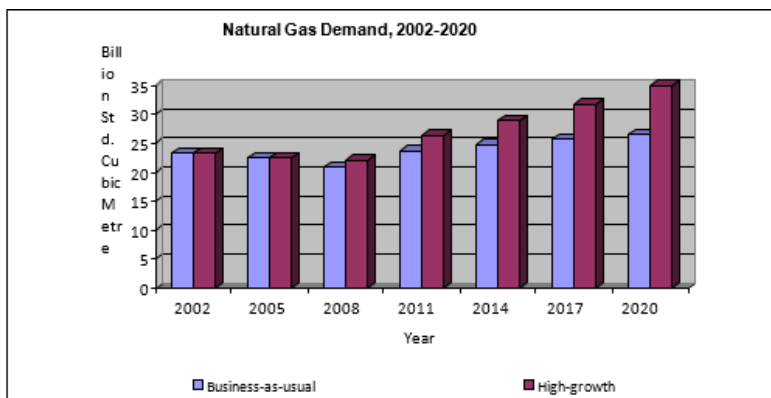


Figure2: Natural Gas Demand (Consulting, 2006)

Current Situation to End Gas Flaring in Nigeria

Nigeria has taken loudable steps stop gas flaring in the country. As stated by the chief operational officer(COO) of the Nigerian National Petroleum Corporation(NNPC),the country has developed a National Gas Policy in order to stop gas flaring completely in the country by 2020(Ughamadu, 2017)

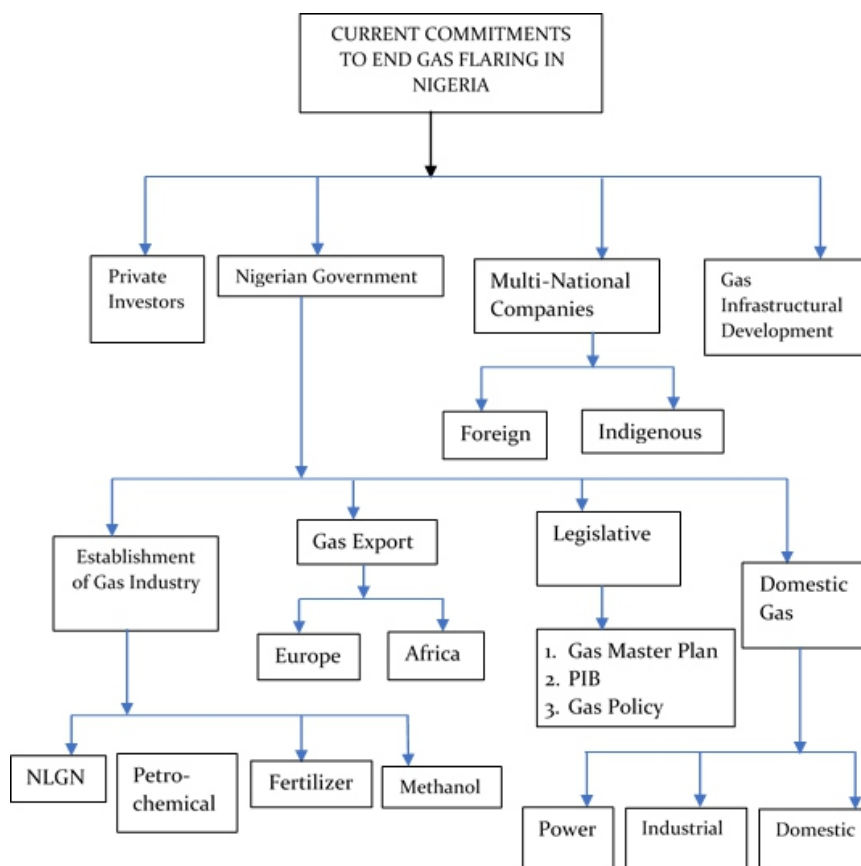


Figure 3: Flow Diagram Showing Nigerian Commitments to End Gas Flaring (Author data, 2018)

Sevent gent project is to provide 20,000 MW by 2020.Domestic gas-to-power supply have successfully increase electricity power generation from700MMscfd in 2016 to 1,220MMscfd in 2017.3.5billion scf/d of gas projects are anticipated to supply Nigerian gas domestic market by 2020 toward gas flaring reduction(Mai Kanti Kacalla Baru, 2017).

Ongoing Gas Utilization Projects in Nigeria

Gas resources utilisation projects in Nigeria include: NLNG trains 1 - 3, 4 & 5. GTL Plant - NNPC/Chevron/Sasol, NGL Extraction -Oso NGL recovery & Chevron EGP, WAGP - Gas supplies to West Africa.

The domestic utilisation projects comprises: Power generation- 4 PHCN stations (Geregu, Papalanto, and Omotosho & Alaoji), New NEPA Plants and NAOC Kwale, Mobil & Ibom I, Steel and aluminium, Fertilizer and Cement Manufacturing.

Renowned Finished Projects (about \$1.0Billion) include:

1. Gas Supply to Abeokuta (\$50Million)
2. Gas supply to Oyo state (\$160Million)
3. ELP – Jebba Trunk pipeline - supplies to Osun, Ekiti, Kwara etc. (\$400Million) – Gas supply to Geregu, Omotosho, Papalanto and Alaoja (\$384Million)
4. These include the Ajaokuta–Abuja pipeline that will supply Northern and Central
5. Aba–Enugu–Gboko that will supply Eastern Nigeria

Equatorial Guinea Gas Plan

Gas supply to Equatorial Guinea pipeline project it is monetizing Nigeria's gas sector and reducing flaring in the process. The gas supply to the Bioko LNG plant in Equatorial Guinea is up to 600 MMscf/d of natural gas to train 2 (Odumugbo, 2010).

Nigerian Gas Supply to Ogun State

Nigerian Gas Company presently operates eight gas supply systems in the country. The current plant capacity is 2 Bcf/d and connected 30 firms in the Agbara/Ota industrial area of Ogun State to gas supplies. (Odumugbo, 2010).

Escravos Gas-to-liquids Project

Developed by Chevron Nigeria Limited, NNPC and Sasol, the plant when completed will use part of the gas currently being flared with a production capacity of 34,000 bpd from two trains, the feed gas required to support the production capacity of the plant is around 340 MMcf/d (Odumugbo, 2010).

Ogidigben Gas Based Industry

The Africa Largest Gas industry - Ogidigben Gas Based Company aims to produce Methanol, Fertilizer, and Power projects.

Ongoing work on gas infrastructures development

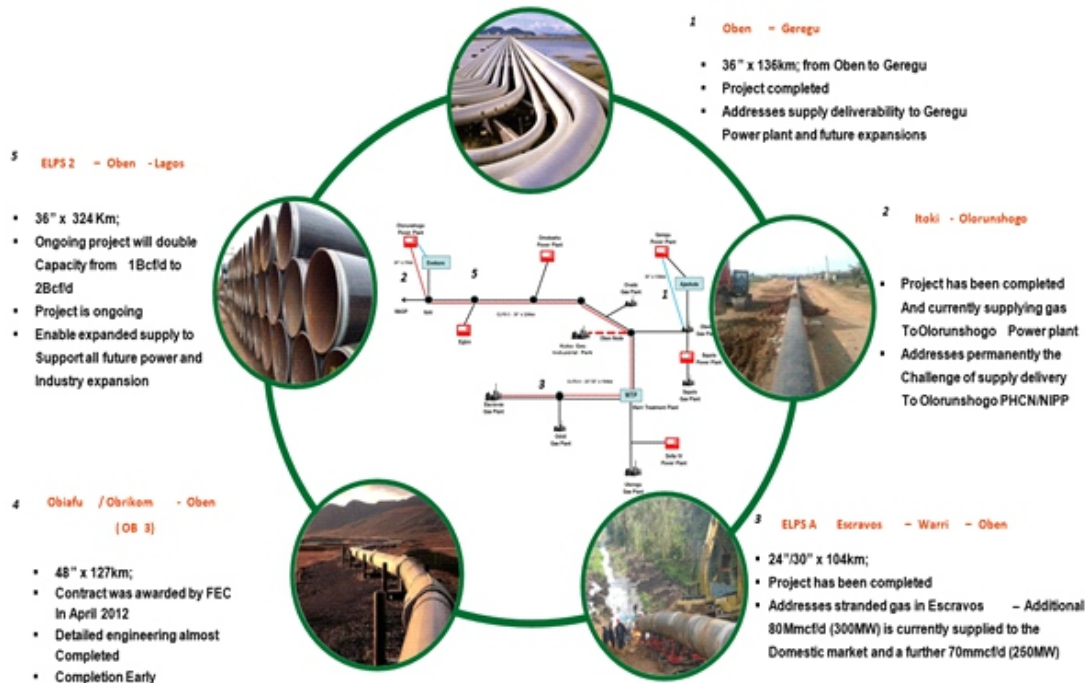


Figure 4: Ongoing Gas Infrastructural Expansion in Nigeria to Stop Gas Flaring

Future Strategies on Gas Development to End Gas Flaring by 2020 and Beyond

Trans - Sahara - To Algeria & Europe, The New LNG Programmes, NLNG Train 6, New promoters of Brass LNG, OK LNG, Exxon Mobil FLNG, Nwadoro LNG. As well as Trans Nigerian Pipeline System Power generation - Abuja IPP, Others - State govt. plan IPP's e.t.c and others - Methanol, Gas to Olefins & CNG

Future projects

1. Ajaokuta - Abuja - Kaduna and to entire northern part of the country Pipeline System
2. Aba - Enugu - Gboko Pipeline system
3. East - West Link Pipeline System

Domestic Gas Pipeline Network throughout the Country

The transport of natural gas throughout the country by interconnected pipelines, gathering pipelines, transmission pipelines, and distribution pipelines to each state of the federation is being planned by the Nigerian Government. As shown in the figure below

Nigerian future plans to network gas pipeline all over the country

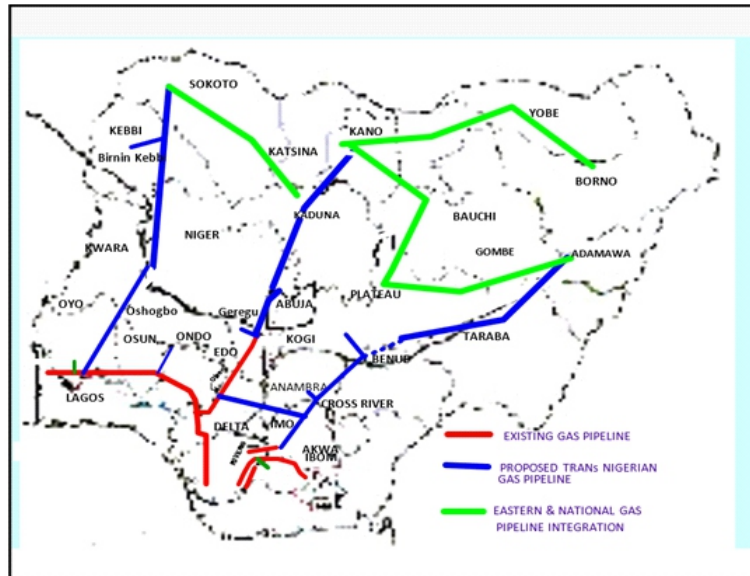


Figure 5: Domestic Gas Pipeline Project for Nigeria State (Ige, 2013)

African Sahara Regional Gas Pipeline Project

Nigeria will supply gas to Algeria by laying a pipeline which will pass through number of countries. The proposed 4500 km pipeline natural gas transportation is to provide gas energy security for African countries. The project's cost is estimated to be \$13 billion with a gas supply volume of 30 BSCF/yr. (Nwaoha and Wood, 2014) as shown in the figure below.

West African Gas Pipeline Project

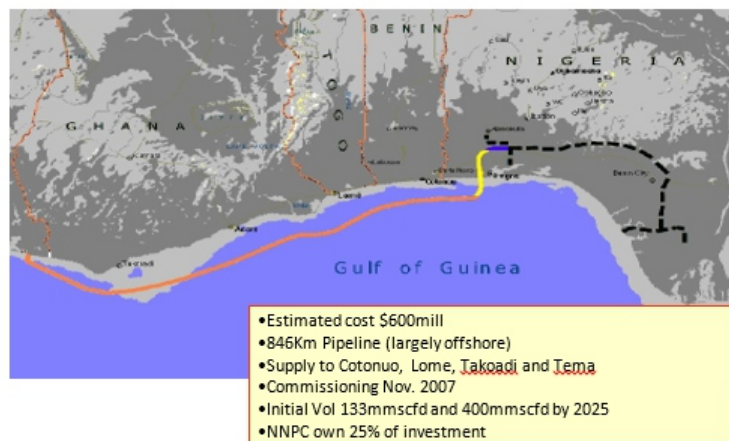


Figure 6: Gas Pipeline Project from Nigeria to West African Countries (Ige, 2013)

Gas Pipeline Project from Nigeria to Europe

A Collaborative effort by Nigeria and Algeria to Supply Nigerian Gas to Europe. Feasibility Study phase completed, definitional stage being pursued: Estimated 4188km of 56" pipeline at 100barg to be laid across Nigeria, Niger and Algeria with 18 compressor units to boost pressure, Gas to be sourced from gas fields operated by CNL and MOBIL, Estimated cost \$12.2Billion. Over 2.0Bscfd to be supplied to Europe from 2016. Project viable and bankable. Netback price of pipeline gas competitive with that of NLNG transport. Current sponsors are NNPC and SONOTRACH (Algeria) will consolidate regional co-operation and diversify World's Energy Supply Sources. This is shown in the figure below (Nwaoha and Wood, 2014).

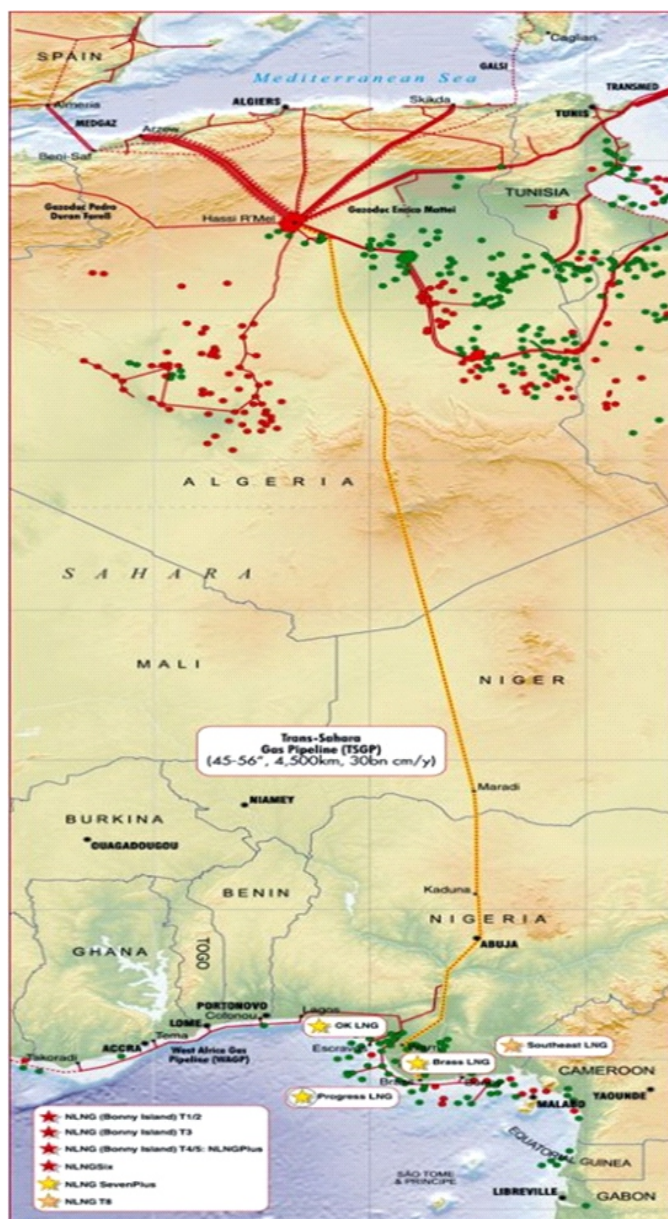


Figure7: Gas Pipeline Project from Nigeria to Europe (Nwaoha and Wood, 2014)

National Strategies to End Gas Flaring in Nigeria

Nigeria need to implement existing policies and strategies to end gas flaring. These include: The National Gas Master Plan, Petroleum Industry Bill and new gas policies. However, there is need for advance development of gas market and infrastructure, strengthening of regulatory framework, legal, investment, and conducive operating environments (Kristin, 2018). The Key National Strategies are: (1) Ensured implementation of existing abatement pledges; (2) Flare-out gas flaring by 2020 to 2030; (3) Generation of sufficient electric power for all and improvement in the efficiency of transmission and distribution

Nigerian Gas Master Plan

Nigerian Gas Master Plan was developed and approved in 2008 as part of Nigeria's effort of becoming a key player in the international gas market with a solid foundation for gas infrastructural expansion within the domestic market. The Gas Master Plan is a regulation governing the exploitation and management of the gas sector.

It aims at developing Nigeria's gas economy by following the three key strategies which are:

1. Ensure the multiplier effect of gas development in the domestic economy
2. Place Nigeria competitively in gas high development value export markets
3. Assure the long-term gas energy security of Nigeria

Petroleum Industry Bill (PIB)

Petroleum Industry Bill (PIB) 2012. The proposed provisions are an innovation to the previous provisions of the AGRA Act. The PIB in addition to provisions of the Ministry of Petroleum Resources, provide for the establishment of three agencies, two regulatory agencies, three companies and one support bureau namely; Downstream Petroleum Regulatory Agency, Upstream Petroleum Inspectorate, Petroleum Technology Development Fund, Petroleum Host Communities Fund, Petroleum Equalisation Fund, National Oil Co., National Gas Co., Petroleum Technical Bureau., and National Petroleum Assets Management Co.

Four New Policies on Oil and Gas

After the PIB successful approval, the federal government would also focus on four new gas policies as follows:

1. National Gas Policy,
2. National Oil Policy,
3. Downstream Policy and
4. Fiscal Reform Policy

National gas Policy

The government is already working on the New Gas Policy that is more effective. The aim of the policy is to stimulate the growth of gas-based industries in the country. The features of the Nigerian Gas Policy are:

1. Establish gas to be as stand - alone product
2. Developed midstream activity for the gas sector
3. Give priority on domestic gas supply.

4. Stress on gas industry structure for ensuring sustainable growth.
5. Provide new reforms to boost efficiency of multi-national gas operation companies
6. Focus on gas sector improvement, infrastructure, and resource as well as building gas markets.
7. Lay a solid foundation for transparency in policy, regulation, procurement licence, lease, awards and renewals.

Fundamentally, the objectives of the gas policy include:

- (a) Encourage increased participation of private investors in the gas sector
- (b) Remove barriers to investment in the gas sector
- (c) Diversify the domestic gas supply options to ensure energy security in the country.
- (d) Expand gas penetration within Nigerian market in order to facilitate the growth of the industries, electricity, and agricultural sectors
- (e) Gain acceptability of Nigerian gas in domestic and international markets
- (f) Introduce standard in health, safety and environment.
- (g) End gas flaring and protect the environment.

LPG development is one of the critical areas of the gas policy with vast applications for the industrial, domestic, agricultural, power as well as transport sectors. It will also stimulate the development of local gas cylinder manufacturers.. The existing oil industry legislation focuses more on the oil sector while laying little emphasis on gas development. It has become necessary, therefore, to regulate the gas industries in order to improve domestic markets(Adeniji, 2017).

Challenges to Ending Gas Flaring Nigerian Government

One of the major challenges faced in ending gas flaring in Nigeria is the government's role as a regulator and owner. Most importantly, since the government takes majority of the oil revenues, a stringent enforcement of gas flaring regulations will adversely affect the revenues that will accrue to the government, so the legislature and the agencies relax the rules to allow for a continuous production of oil and gas.

A major challenge for the effective enforcement of gas flaring regulations is the lack of autonomy and independence of the regulatory agencies. Lack of political will to implement policies that will eliminate gas flaring. Another challenge in the enforcement of gas flaring regulation is the fact that only federal agencies are empowered to regulate and enforce the laws on gas flaring.

National Assembly

The second challenge is enactment of weak legislations by the National Assembly that are not effective in addressing the issue. The 1984 amendments of the AGRA were done to allow for continued flaring of associated gas under permit issued by the Minister, subject to the payment of penalties which is small compared to the cost of gas re-injection or utilization. This was a great drawback to the government.

However, several amendments have continuously led to the postponement of the abatement date with the payment of penalty considered meagre and does not pose constitute deterrence to oil and gas companies, which find it easier to pay the penalty than utilize the gas. The amendments repeatedly push back the deadline to end gas flaring. This demonstrates the complete lack of seriousness and political will on the part of the legislature to end gas flaring.

Multi-national oil and Gas Companies

Multi-national companies have so far failed to implement available technology of ending gas flaring in their respective industries. They are also after exploitation of national resource without any concern to environment, human health and function of ecosystem, however, they are not ready to comply with any set of regulation to end gas flaring in the country, as well as to pay the exact penalty fine loaded on them, what they are after is to have free and cheaper resource exploitation in the country.

Corruption

Another key challenge that derives the failure to end gas flaring in the country is pervasive corruption among officials in the industry politicians as well as multi-national oil and gas companies.

Investment opportunities in Nigeria

Key areas of high investments opportunities in the gas sector include: Gas transmission pipelines, upstream gas development, LNG and LPG plant, Gas processing facilities and manufacturing industries, Gas infrastructures, Pipe milling and fabrication and financial services. It is the time to invest in the gas sector of Nigeria as shown in the figure below. However, Nigerian Government is willing to also harness unconventional petroleum resources in the country as contained in the Petroleum Industry Bill such as Coal and Shale resources.



Figure 8: Investment opportunities (\$16 Billion) in Nigerian gas sector

Benefit of Stopping Gas Flaring

Environmental and economic aspect would be improved by stopping gas flaring. Some of the environmental benefits include: reduction in noise and thermal radiation, reduction in operational and maintenance costs, elimination of air pollution and gas emission, elimination of wastage in gas consumption. Other benefits include:

1. Meeting and satisfying Paris Agreement
2. Curtailing direct threat to human health and environment
3. Additional source of revenue to the government
4. Acquisition of Certified Emission Reduction Credit card
5. Improvement in electricity access for all
6. Ending the emission of estimated Million tonnes of CO₂e into atmosphere

Conclusion

In conclusion, it appears that there is no any concerted effort of ending gas flaring in national petroleum refineries despite the large gas emission contribution from it flare stack with a high volume of gas flared daily. However, there is huge investment opportunities in the Nigerian gas sector, oppose to some views, now the country is favourable to business and it is the high time to invest in Nigeria's gas sector for the fruitful return of the investment.

Ending gas flaring in Nigeria by 2020 is possible with the present government commitments, and number of gas development projects put in place. A number of countries and industries have succeeded in stopping gas flaring, some of these countries include Netherland, Qatar, UAE, Muzembique, Chad, Equador, Tunisia, Egypt, Norway, Abu Dhabi, etc.

As reforms are being put in place with so much improvement and government commitments to end gas flaring in the country with massive expansion plans in gas development and various effort have been put in place into the sector (such as domestic, regional, national, int'l, within refineries, commercial ling, privatising, power, GTL, NLGN, Recycling, polices, govt commitment, private sector, technologies, networking to end gas flaring.

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