



Nigeria

Associated Gas Utilization Study

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Thanks to Albert Bressand and Thomas Mitro for their thorough peer-review



Columbia Center
on Sustainable Investment

A JOINT CENTER OF COLUMBIA LAW SCHOOL
AND THE EARTH INSTITUTE, COLUMBIA UNIVERSITY

Summary of findings

Fiscal and legal regulation for APG use and outlet

APG projects: NLNG

Pipelines: non-integrated and not maintained

Unattractive gas and power pricing

Underdeveloped domestic market

Deficient governance



Endorsement of the zero routine flaring by 2030 initiative

- ◆ Nigeria has an extensive regulatory and fiscal framework surrounding flaring and Associated Petroleum Gas (APG) use, as well as networks of domestic and international pipelines (such as the West African Gas Pipeline).
- ◆ This has spurred a few APG use projects in the country including the landmark NLNG project using APG for LNG production for export.
- ◆ However, deficient maintenance of non-integrated gas pipelines and unattractive gas and power pricing act as disincentives for APG use and investment in the domestic economy, particularly the power sector.
- ◆ Deficient governance of the oil sector marked by the lack of an independent regulator and a history of payment defaults on the part of the NNPC and the power utility, combined with some unstructured regulation like the 2014 directive by the MPR urging oil companies to give flared gas to 3rd party investors for APG utilization projects has sparked much controversy among oil majors operating in the country.
- ◆ Nigeria's most recent endorsement of the World Bank's Zero Routine Flaring by 2030 might give the impetus for a deep reform of the legal framework and investment climate necessary to enable APG use. In fact, Nigeria just set its own flaring out date as being 2020.



The statistics of APG flaring in Nigeria: How bad is it?

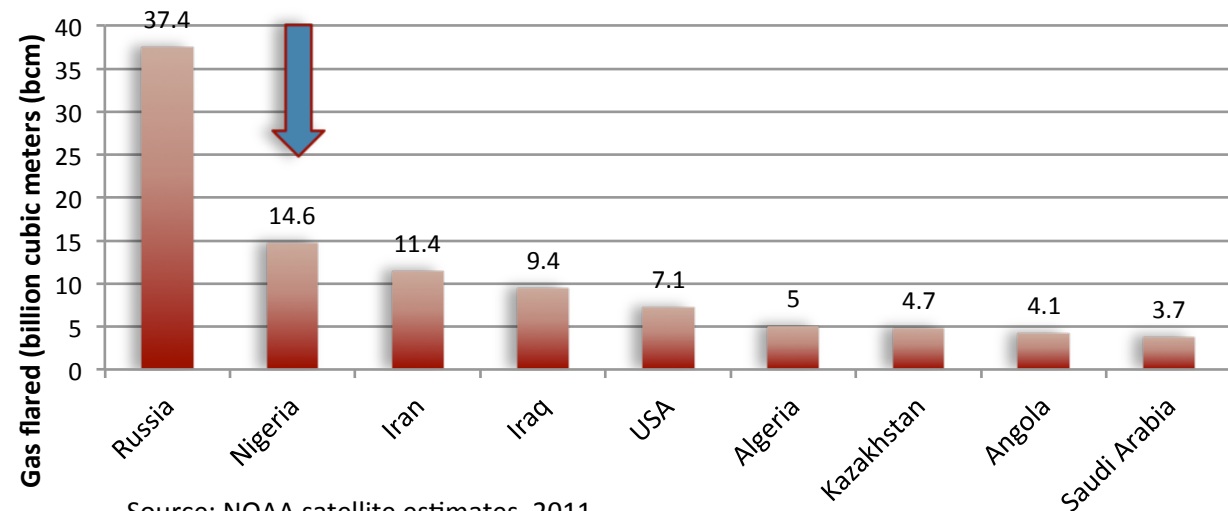
Overview stats on
APG flaring

On the companies
involved

Over the last
decade

And their flaring
trend over time

Top 10 Gas Flaring Countries 2011



Source: NOAA satellite estimates, 2011

- ◆ Nigeria accounts for just over 2% of global oil production and about 10% of gas flared globally in 2011.
- ◆ Economic cost of flaring has been assessed at about \$72bn from 1970-2006 = about \$2.5bn/year in revenue losses.
- ◆ According to the 2015 statistical report of the Organization of Petroleum Exporting Countries (OPEC) Nigeria produced 86.3 bcm of gas and flared 10.7 bcm in 2014. According to NNPC, gas flaring represented a loss of up to \$868.8 million, about N173.76 billion in 2014.



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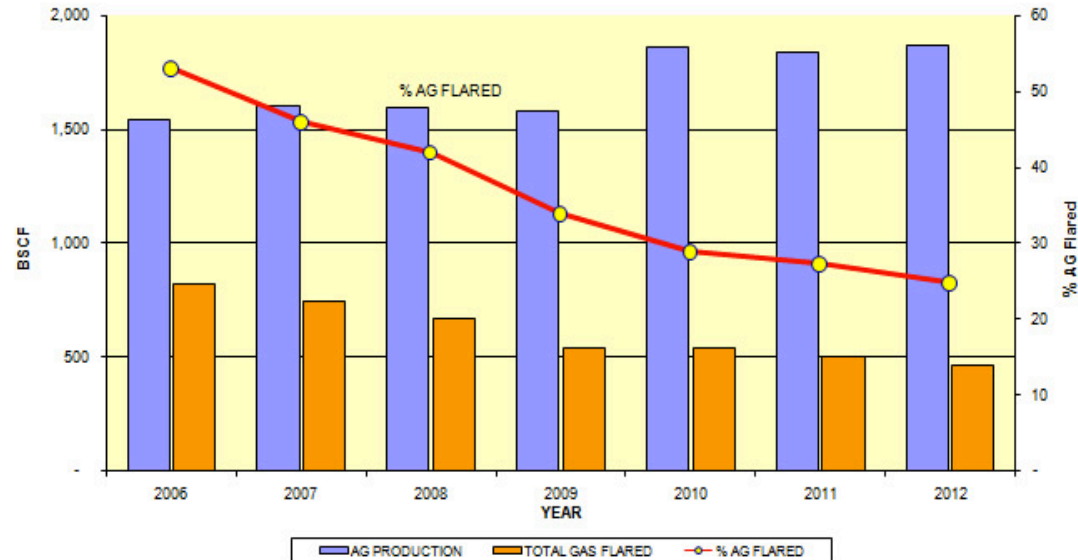
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Trend: APG Produced and Flared since 2006



Source: Department of Petroleum Resources (DPR) Nigeria, 2011

- ◆ Of the 2400 billion standard cubic feet (bscf) of gas produced in 2011, 1800 bscf or about 75% was APG. About 28% of this APG was flared in a decreasing trend from 2006 continuing today. About 12% of APG was flared in 2014 according to NNPC.
- ◆ As of 2008, Nigeria was exporting about 3 billion standard cubic feet per day (bscf/d) of gas in LNG form, while flaring about 2.5 bscf/d and providing only 0.5 bscf/d to the domestic power sector which accounted for about 70% of domestic gas consumption.



The statistics of APG flaring in Nigeria: Who is involved?

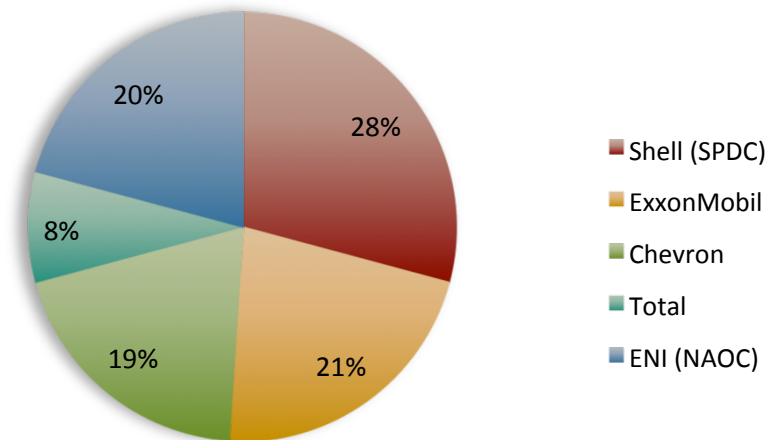
Overview stats on APG flaring

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2000-2008 % share of gas flared by Company in Nigeria



Source: Oni, 2011, Madueme, 2010

- Shell has been the top flarer on a cumulative basis over almost a decade, followed closely by Exxon, ENI and Chevron.



The statistics of APG flaring in Nigeria: Who is involved?

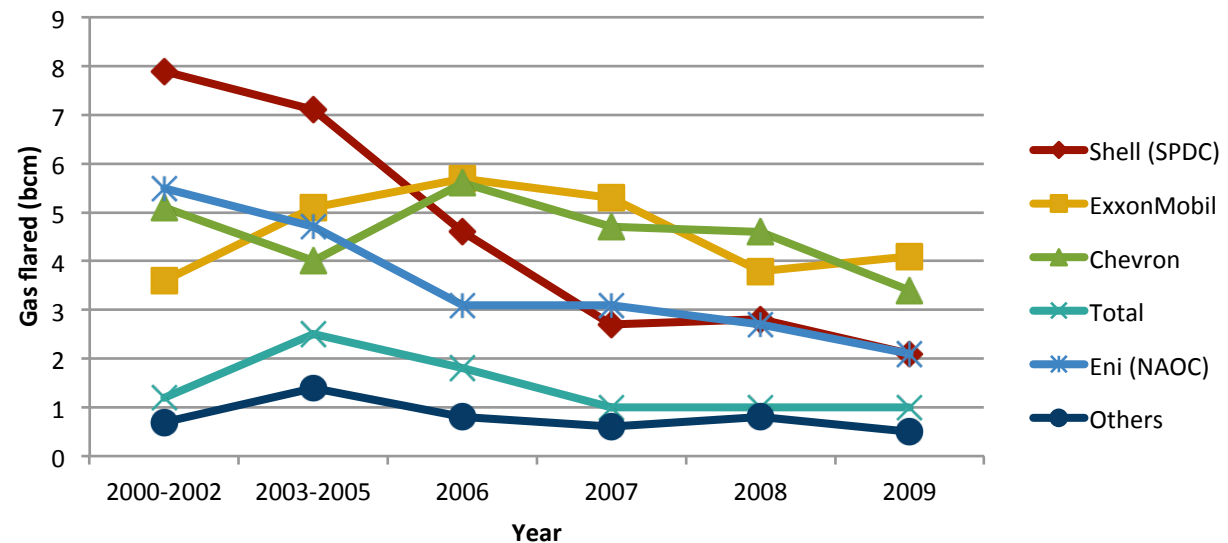
Overview stats on APG flaring

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Gas flared by Company in Nigeria from years 2000-2009



Source: GE, 2011

- Shell has seen the most dramatic decrease in gas flared over the past decade spurred presumably by a combination of attractive fiscal incentives and public opprobrium concerning their actions in the Niger Delta region of the country.
- However in 2014, according to NNPC Shell's increased levels of oil production resulted in an augmentation of the volumes of flared gas by 12% over the year, and of 9% in flaring intensity. Shell is however claiming that in 2015 they reduced flaring by 28% as compared to 2014 and flaring intensity by 15%.



The statistics of APG flaring in Nigeria: Who is involved?

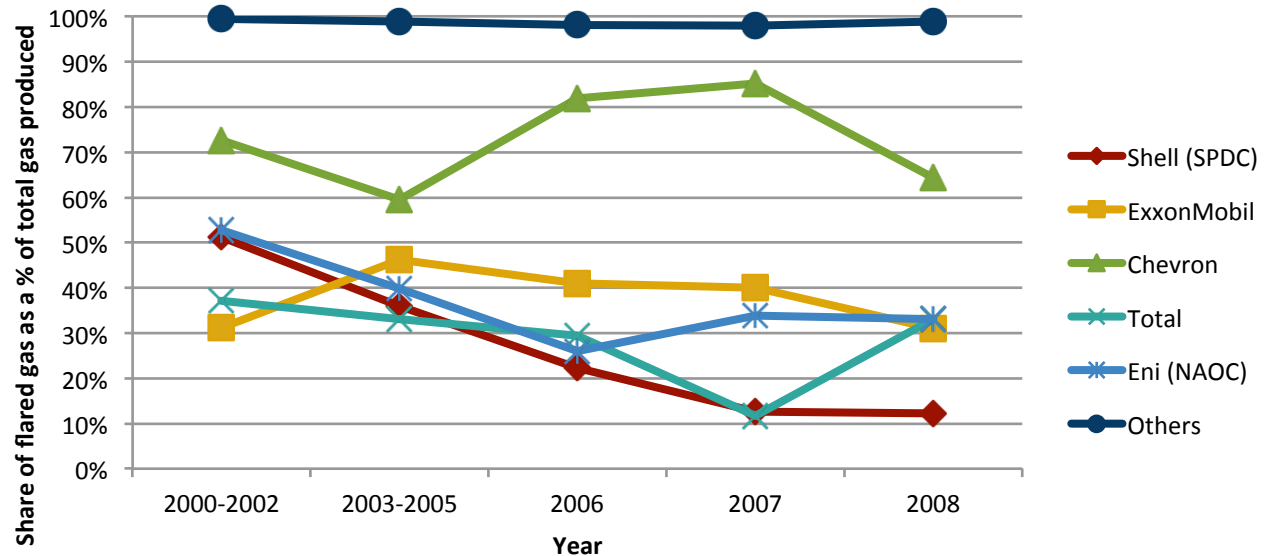
Overview stats on APG flaring

On the companies involved

Over the last decade

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Flared gas as a % of total gas produced by company from years 2000-2008



Source: Madueme, 2010

- Of the major IOCs, Chevron has flared the greatest share of its total gas produced for the last decade, with flared gas making up as much as 64% of total gas produced as of 2008; in comparison Shell has flared 12% of total gas produced as of 2008.
- According to NNPC, in 2014 Chevron (CNL) was still the biggest offender among companies with 53.6 bscf of gas burnt. Shell followed with 51.92 bscf, Exxon with 42.86 bscf and Nigeria Agip Oil Company (NAOC) with 35.79 billion SCF.
- The smaller offenders are: Addax Petroleum Development Company which burnt 35.6 bscf, Total Exploration and Production, 22.78 bscf, Total Upstream Nigeria 18.73 bscf, Esso 4.517 bscf, Chevron Texaco 4.43 bscf and Amni Petroleum 3.87 bscf.



What is the legal and fiscal framework in place to stop flaring and incentivize APG use?

Regulation:
Agencies and
analysis

Regulation: Legal
framework and
analysis

Regulation: Fiscal
framework and
analysis

Government institutions involved in regulation of oil production/flaring	Description
Federal Ministry of Petroleum Resources (MPR)	Headed by the Minister. In charge of formulating oil and gas policies and regulating Exploration & Production (E&P) activities by granting flaring allowances and monitoring E&P activities. Controls the NNPC and DPR
Department of Petroleum Resources (DPR)	Originally the first legal agency created to regulate the petroleum sector in Nigeria; is currently the enforcement arm of the MPR
Nigerian National Petroleum Corporation (NNPC)	Government oil corporation, exerts Nigeria's interests in the petroleum industry. The Nigerian Gas Company (NGC) is one of about 11 subsidiaries of the NNPC and is responsible for the development of an efficient gas industry. NNPC has generally 60% state equity share in the projects that it has trouble honoring
Federal Ministry of Environment (FMENV)	Federal ministry responsible for protection and improvement of water, air, land, forest and wildlife in Nigeria (note: except oil and gas)
The National Environmental Standards and Regulations Enforcement Agency (NESREA)	Subsidiary of FMENV, created to enforce environmental laws, policies and regulations in Nigeria. Acts as the regulatory arm of FMNEV



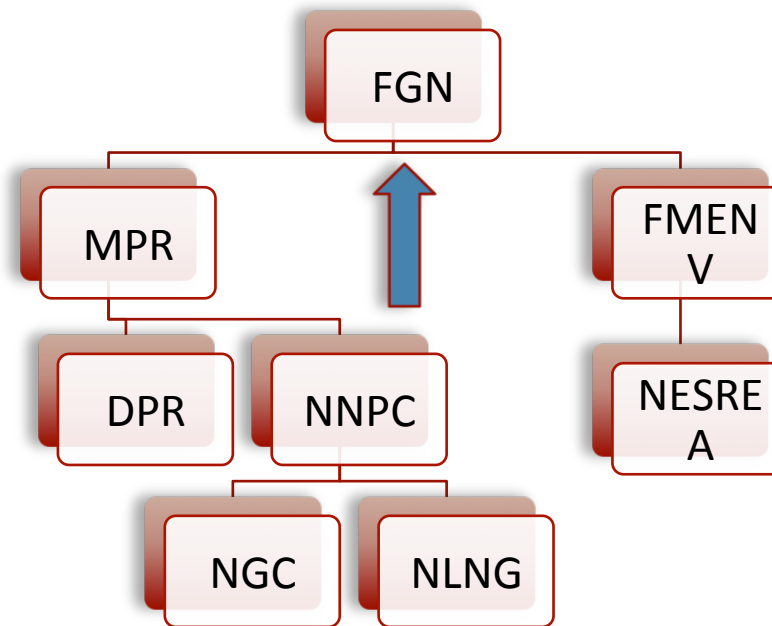
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Government institutions regulating oil production and flaring



- 70% of FGN revenue comes from NNPC earnings
- The Federal Government of Nigeria (FGN), through NNPC, holds about 55-60% interests in most of these IOCs involved in gas flaring which impedes independent regulation and good governance .



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Regulation/Policies on Gas Flaring/ APG use	Description
1969 Petroleum Act and Regulations	Encouraged use of APG, exempted multinational oil companies from paying royalties
1979 Associated Gas Re-injection Act (APGRA)	Forbade flaring of APG after Jan 1,1984 without permission from Minister of Petroleum (<i>not met</i>)
1985 Associated Gas Reinjection Act Amendment Decree 7	Insignificant fine (about \$0.46 per 1000 scf flared by 1998)
1992 Associated Gas Framework Agreement (APGFA)	Fiscal incentives for companies involved in APG utilization
2004 Associated Gas Reinjection Act and Associated Gas Reinjection Amendment Act	Prohibited flaring without permission from Minister of Petroleum. Obligated all oil producing companies in country to submit detailed plans for gas utilization (<i>not met</i>)
2008 Nigeria Gas Master Plan	Invited foreign IOCs to assist in construction of gas gathering plants and pipelines to supply weak power sector. Also included a flare out target date for companies to stop gas flaring by 2008 (<i>not met</i>)
2008 National Domestic Gas Supply and Pricing Policy and Regulations	Established a domestic gas supply obligation arrangement that guaranteed the supply of a sufficient amount of gas by oil and gas producers to all active power plants in the country. Policy would also regulate the price of gas used in the downstream gas sector



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- ◆ 2010 Associated Gas Reinjection (Amendment) Bill
 - Proposed bill was setting a new deadline for flare out at Dec. 31, 2012 with allowance for a Temporary Gas Flaring permit from the MPR with payment of a fee.
 - The Bill, never passed, also stipulated that companies without facilities for APG use would not be permitted to engage in oil production.

- ◆ 2010 FGN Accelerated Flared Gas Development program
 - Controversial directive from the FGN to IOCs mandating the companies to allow 13 third party investors access to oil fields, flow stations or well heads to get gas that would otherwise be flared and employ it in power generation and other APG use projects. A MoU was signed between the MPR and the private investors but directive has faced considerable opposition from many IOCs.
 - Some companies like Shell's SPDC are reporting compliance with the directive : for 10% of its sites, Shell has been looking for third party investors (with Shell/ NNPC joint-venture building itself the gas gathering facilities for 90% of the sites).
 - As part of a broader Gas Development program, NNPC is also seeking to attract private investment for larger backbone pipelines, in particular the 395-km Calabar-Ajaokuta pipeline and the 740-km Ajaokuta-Kaduna-Kano pipeline, due for completion in 2017.

- ◆ A controversial 2012 Petroleum Industry Bill
 - Would completely overhaul most of the above acts and raise taxes on IOCs, creating a comprehensive legal framework for the exploitation of gas and petroleum resources in the country. Currently being debated.



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- ◆ 2012 Petroleum Industry Bill
As part of its aims, the PIB is expected to:
 - “Enhance exploration and exploitation of petroleum and particularly gas resources in Nigeria and for Nigerian people
 - Optimize domestic gas supplies, especially for power generation and industrial developments
 - Deregulate and liberalize the downstream petroleum sector
 - Create efficient and effective regulatory agencies”
- ◆ The PIB also includes provisions like:
 - The creation of 2 regulatory entities- 1 for technical and commercial matters related to upstream and named the Upstream Petroleum Inspectorate, and one for downstream responsibilities and named the Downstream Petroleum Regulatory Agency
 - Provisions for breaking up the NNPC into 3 parts (including a national oil and national gas company) and privatizing 2 parts
 - An emphasis on the Domestic Supply Obligation (DSO) for gas created in the 2008 Domestic Gas pricing policy
 - However, the penalties instituted if the IOC fails to meet the DSO are weak
- ◆ As well as provisions for a possible transitional gas pricing. There is currently nothing concrete regarding gas pricing in the Bill.



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- Definition and boundaries not followed
 - Flare out dates are repeatedly shifted forward and not met
 - Weak monitoring and enforcement of regulation
 - No significant penalties for flaring over the last decade, and feeble enforcement of penalties is an issue
- No independent regulator
 - MPR is both a participant in, through the NNPC, and regulator of, through the DPR, oil and gas activities in Nigeria, creating conflicts of interests reflected in the lax enforcement of flaring regulation. At the same time, as a joint-venture partner at a very high level (around 60%), NNPC has been more than 1 -2 years late in paying its equity share of cash calls. Both problems have created a lot of mistrust among the community of investors.



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- ◆ High Petroleum Profits Tax Act (PPTA) rates (up to 85% of profits) (instituted in 1959) acted as a disincentive to gas utilization and spurred the introduction of an incentive regime (PPPTA - Section 10A amended by Decree No. 30 of 1999):
 - Any amount invested in the separation of gas and crude oil from a reservoir as well as any amount associated with gas delivery, is 'Allowable expense for upstream operations'
 - Gas produced and transferred from the natural gas liquid facility to the gas-to-liquids facilities taxed at 0% tax and 0% royalty
 - Capital expenditure associated with gas-to liquid facility is cost-recoverable
 - Condensates that are re-injected will not lead to incentives
 - Those incentives are also applicable to non-associated gas
- ◆ As of 1998, all downstream gas utilization project-associated profits are taxed under the Companies Income Tax Act (30%) and benefit from the incentives specified by its Section 28 G:
 - Options: Companies eligible for a 3-year tax holiday or a 35% capital allowance
 - Tax deductible interest on any interest payable on any loan taken for a gas project
 - VAT exemption on any plant and equipment bought for gas utilization
 - Tax-free dividends under certain conditions (downstream investment made in foreign currency or goods imports during the tax-free period account for min. 30% of the company's equity; not applicable if the company chose the 35% capital allowance)
 - Accelerated capital allowance post tax holiday - 90% (+ 15% if company opted for tax holiday)
- ◆ Pricing policy of gas supply and power seen as a disincentive:
 - Below market-prices for domestic gas (as of 2009 \$0.12/mmbtu domestically vs. \$0.50/mmbtu on export markets), denominated in local currency, coupled with the terrible credit rating of the PHCN, former power public utility as well as highly unreliable gas pipelines



What are some current APG use projects that could serve as a blueprint for future projects?

Power Generation (IPP)

Liquefied Natural Gas (LNG)

Natural Gas Liquids (NGL)

Gas to Liquid Conversion (GTL)



- ◆ Notable APG use projects: the Nigeria LNG (NLNG) project with NNPC and Shell as primary shareholders and some GTL, NGL and IPP projects.
- ◆ Some additional LNG project (Olokola LNG (OK-LNG) and Brass LNG) as well as power plants are tremendously delayed.
- ◆ Given their distrust of the governance of the oil and gas sector, IOCs currently prefer high return export options like LNG and GTL projects to necessary IPP projects for the country. That said, 1) a PIB Gas pricing policy shifting towards market prices for gas and obligating IOCs to allocate a specified amount of gas to the domestic market along with 2) the 2013 PHCN privatization and power tariff hikes (due to withdrawal of subsidies) may shift this trend. However some IOCs now state that they have already committed their gas reserves into long term Gas Sales and Purchase Agreements in the export markets.

What power needs could the flared gas satisfy?

Power
Generation (IPP)

Liquefied Natural
Gas (LNG)

Natural Gas
Liquids (NGL)

Gas to Liquid
Conversion (GTL)

- Significant gas reserves often referred to as a “gas country with some oil in it”
 - Proven reserves at 180.5 trillion cubic feet (tcf) as of 2011
- The power sector makes up over 70% of the total domestic gas demand.
- With an electricity access rate of 51% and operational installed capacity of only 3500 MW there is significant potential in the use of flared APG to meet the country’s electricity needs.



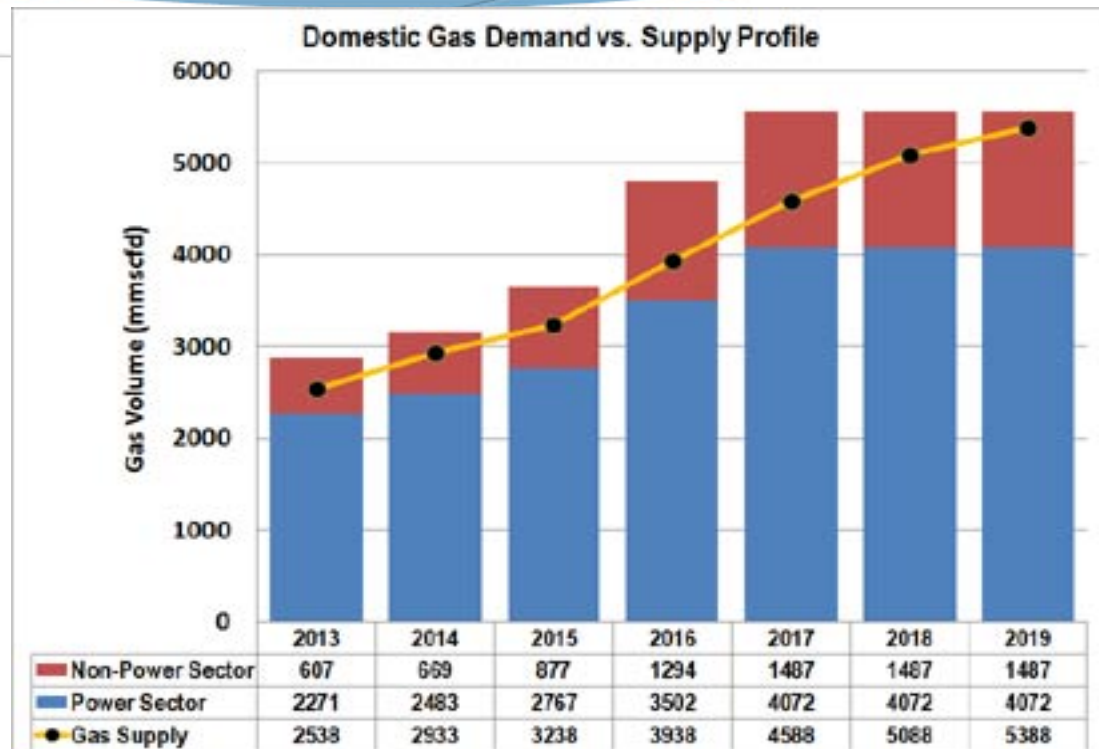
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Source: Nwachukwu and Eboh, 2013

◆ Demand in the power sector is expected to grow significantly in coming years with more gas power plants being built/renovated following the privatization of PHCN.

◆ APG can be utilized to meet this demand.



So why is APG not being used primarily for power generation?

Power Generation (IPP)

Liquefied Natural Gas (LNG)

Natural Gas Liquids (NGL)

Gas to Liquid Conversion (GTL)

- ◆ Unattractive gas pricing and electricity tariff regimes in the country (as described previously)
- ◆ Unreliable gas pipeline networks because of poor maintenance on the part of NGC
- ◆ By one DPR source, some previous APG for power generation projects from IOCs spurred by the directive to meet the Gas Plan's 2008 flare out deadline were:
 - A 350 MW plant in Bonny by Mobil
 - A 900 MW, two-part construction plant in Okpai by Agip
 - The takeover of the Afam and Sapele plants by Shell and the addition of 700 MW
- ◆ These efforts failed largely (except for part 1 of the Okpai plant by Agip and part of the Afam plant by Shell presented after) due to:
 - Refusal of the FGN to guarantee steady payments to the IOCs for any power generated and sold to the PHCN
 - Associated wariness of IOCs due to PHCN's terrible credit rating (it was owing over \$60 million to the NNPC for gas supplied as of 2009)
- ◆ The 2013 PHCN privatization efforts and the new PIB Gas Pricing policy might make APG use for the domestic power sector more attractive for oil companies.



APG use company case study: Eni Okpai power plant (IPP)

Power Generation (IPP)

Liquefied Natural Gas (LNG)

Natural Gas Liquids (NGL)

Gas to Liquid Conversion (GTL)

◆ Project Participants:

- NAOC - a joint venture of NNPC (60%), Eni (20% and project operator) and Conoco Philips (20%)

◆ Project Description and Motivation:

- Nigeria's 1st IPP, completed in 2005 by ENI.
- Part of Eni's 2008 "Zero Gas Flaring" policy and to adhere to 2008 FGN Flare out deadline, also a CDM project. It was originally intended as a two-part 900 MW construction but scaled back due to factors mentioned in preceding slide.
- Generates 480 MW of power. 450 MW of this electricity is transferred for consumption by Nigeria's eastern region, while 30 MW are used by Eni.

◆ Project Location:

- Near the NAOC's Oil and Gas Processing Plant (OGPP) in the Kwale region in Delta state in southeastern Nigeria

◆ Associated Gas Use:

- Uses about 80 million cubic feet per day (mmcf/d)
- Uses formerly flared APG at Kwale's OGPP operated by NAOC
- Also uses gas extracted from its oil areas in the Delta states

◆ Project Technology:

- Integrated cycled plant with 2 gas turbines and 1 steam turbine
- 14 km pipeline for transporting fuel gas from NAOC system to power plant, commissioned by NAOC
- Overhead transmission line of 130 kv, 54kms in length, joins plant to national grid in Onitsha, Anambra in Eastern Nigeria



APG use company case study: Eni Okpai power plant (IPP)

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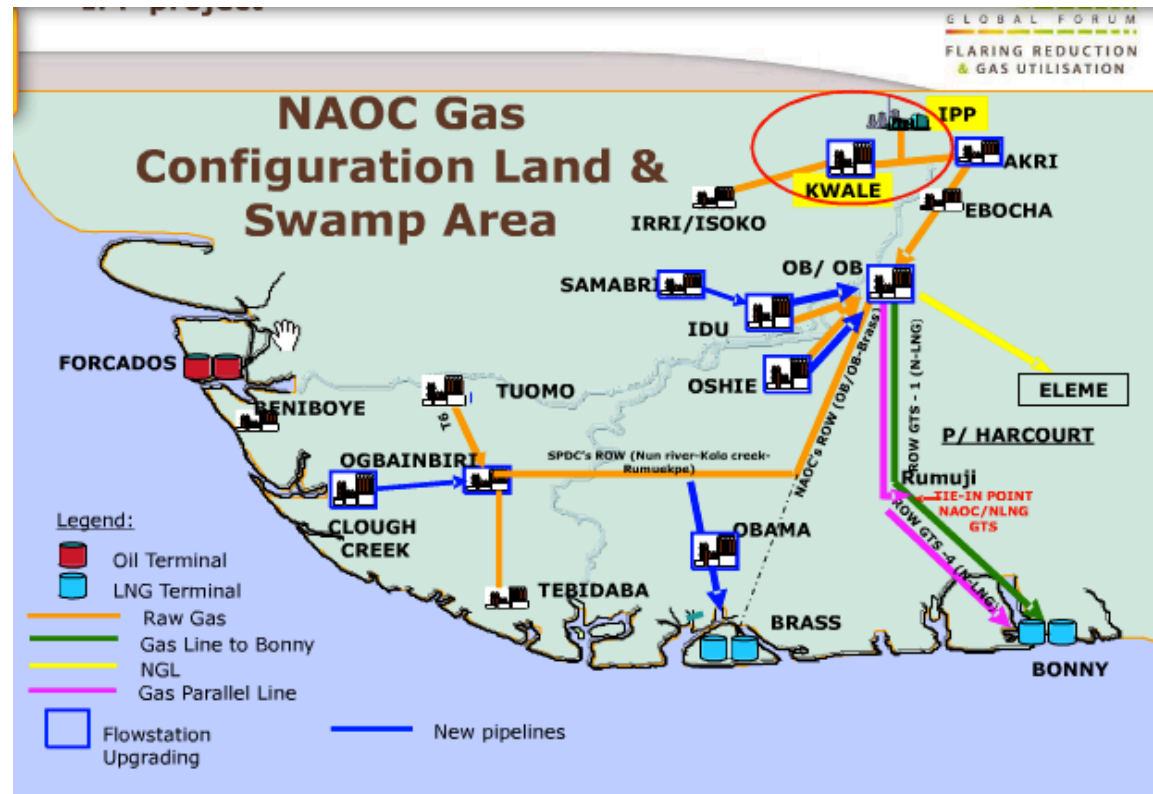


Figure: Eni (NAOC) Okpai IPP APG project schematic.

Source: Linzi, Eni



APG use company case study: Shell Afam power plant (IPP)

Power Generation (IPP)

Liquefied Natural Gas (LNG)

Natural Gas Liquids (NGL)

Gas to Liquid Conversion (GTL)

Project Participants:

- The Shell Petroleum Development Company of Nigeria Limited (SPDC)(JV including NNPC(55%), Shell(30%), TEPNG(10%), NAOC(5%)), Shell is the operator

Project Description and Motivation:

- Motivated in part by 2008 Gas Master plan which stipulated a flare out deadline of 2008
- A CDM project, the Afam VI power plant generates grid electricity from a high efficiency plant utilizing low carbon intensity gas with some allowance for the system to absorb APG.
- Operational in 2008 - investment costs by its JV partners of up to \$1.3 billion.
- Generating 650 MW the power plants contributes 14% of Nigeria's grid-connected power generating capacity in 2015.
- Due to reported gas shortages, the plant has suffered numerous shutdowns since it became operational.

Project Location:

- Power station located in Rivers State, in the Niger Delta region

Associated Gas Use:

- Gas supply is mainly from the Okoloma gas plant, with gas from the Afam NAPG field, a production capacity of 240 mmscfd of non-associated gas but allowing the system the capacity to absorb APG through the NGC regional gas network.

Project Technology:

- Installation of new combined cycle gas turbines in a plant fitted with air-cooled condensers and 40m high stacks
- Additionally, the Afam VI plant replaces existing Afam I-IV units, which had not been operational for some time.



APG use company case study: Shell Afam power plant (IPP)

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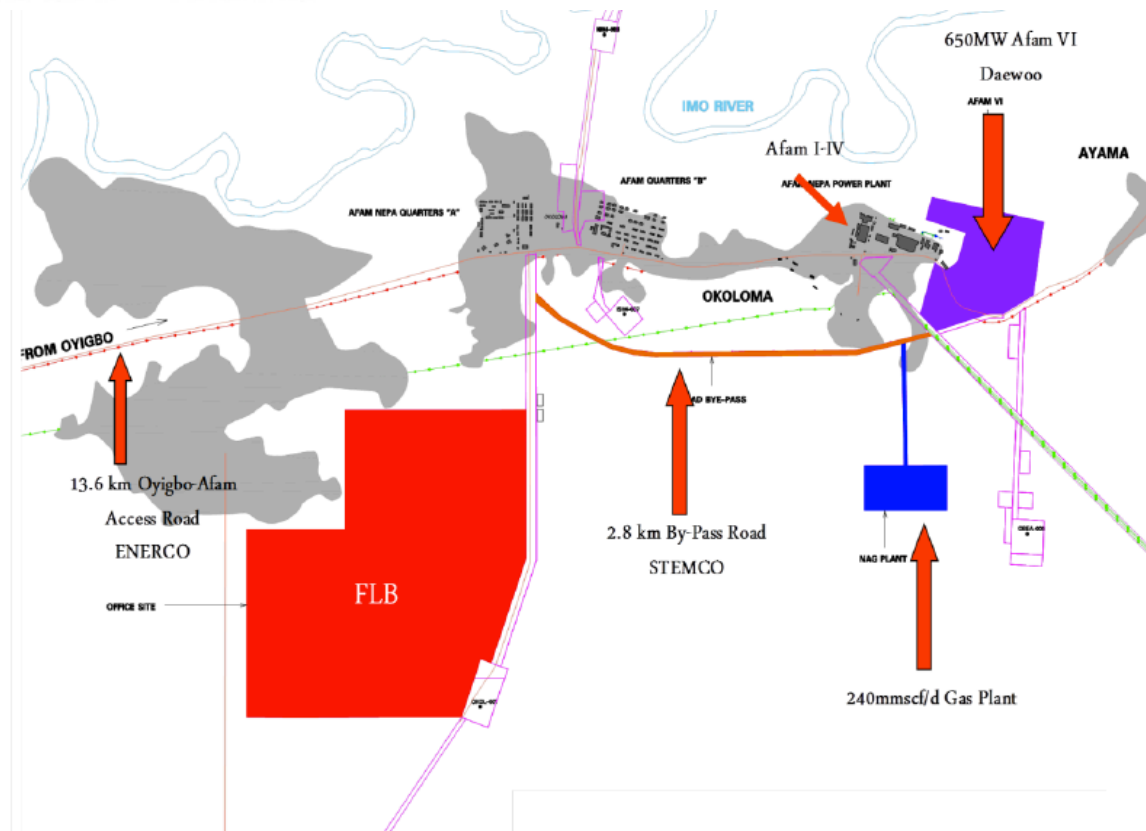


Figure: Shell Afam VI (in purple) IPP APG project schematic.

Source: UNFCC, CDM



APG use company case study: NLNG (LNG)

Power
Generation (IPP)

Liquefied Natural
Gas (LNG)

Natural Gas
Liquids (NGL)

Gas to Liquid
Conversion (GTL)

◆ Project Participants:

- NLNG: NNPC (49%) and Shell (25.6%), Total LNG (15%), Eni (10.4%)
- NLNG In long-term gas supply agreements with 3 joint ventures: SPDC (Shell), TEPNG (former EPNL) and NAOC (Eni)

◆ Project Description and Motivation:

- One of the most significant APG use projects in Nigeria
- Early motivation was a desire to utilize country's significant natural gas reserves and meet rising international demand and attractive prices for LNG
- 6 liquefaction units or trains possessing a production capacity of 22 mtpa of LNG; First production of LNG in 1999
- Cost of the first 2 trains was about \$3.6 bn and financed by NLNG's shareholders (with NNGC's share carried by Shell). The 3rd train's cost of about \$1.8 billion was financed by 3rd party investors with loans in 2002. The next 2 trains, 4 and 5, cost around \$2.2 billion and were financed by a mix of revenue generated in-house and 3rd party loans in the amount of about \$1.06 billion. Train 6 cost \$1.7 billion and was financed by the shareholders.
- Currently manages 16 long-term LNG sales contracts (these buyers include Enel, Repsol Gas Natural LNG (Stream), Botas, GDF Suez, GALP GN, BG LNG, Endesa, ENI, Iberdrola, Shell Western LNG BV and Total Gas and Power Ltd.)

◆ Project Location:

- Constructed on 2.27 square km of mostly reclaimed land in Finima, Bonny Island in Rivers State in Southern Nigeria

◆ Associated Gas Use:

- As of today, NLNG has converted some 119 bcm or 4.2 tcf of APG to LNG/NGL products for export
- Gas collected by the 3 joint ventures in supply agreements with NLNG from their oil fields
- NLNG has signed Sales and Purchase Agreements (SPAs) with off-takers (all Nigerian companies) to deliver 250,000 tons of LPG into the Nigerian market annually. The first delivery was in 2007.



APG use company case study: NLNG (LNG)

Power Generation (IPP)

Liquefied Natural Gas (LNG)

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Gas to Liquid Conversion (GTL)

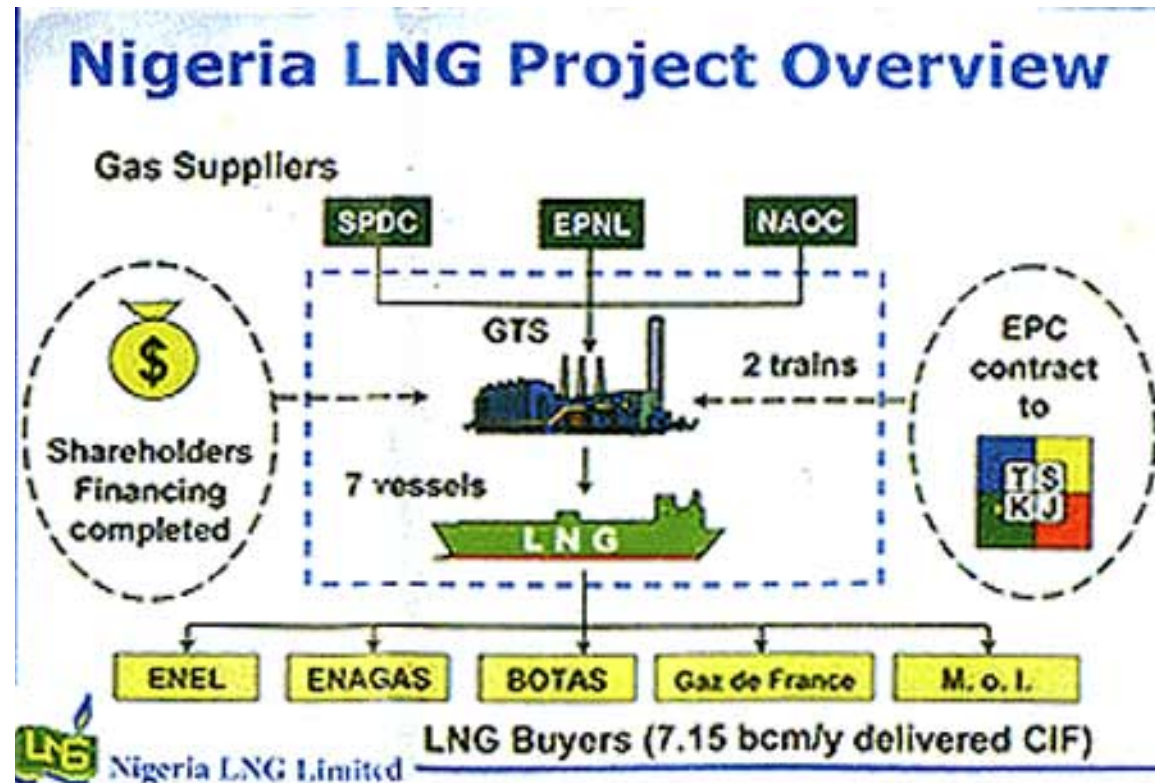


Figure: Overview of Nigeria LNG project.

Source: <http://www.hydrocarbons-technology.com/projects/bonny/bonny1.html>



APG use company case study: Total's Ofon (OML 102)

Power
Generation (IPP)

Liquefied Natural
Gas (LNG)

Natural Gas
Liquids (NGL)

Gas to Liquid
Conversion (GTL)

◆ Project Participants:

- Total E&P Nigeria operates OML 102 with a 40% interest, with NNPC holding 60%.

◆ Project Description and Motivation:

- Routine flaring was completely halted in December 2014 which represented a 10% reduction in the overall flaring of Total
- Most of the APG from the Ofon field is exported via a new 70 km pipeline to the Amenam offshore gas hub, and is then brought to the NLNG facility
- Some of the gas is also re-injected to enhance oil recovery
- A very small part is also used for own-site power generation
- At the Global Forum of the Global Gas Flaring Reduction Partnership (GGFR), of September 9, 2015, Total's Nigerian subsidiary received a GGFR Excellence Award, recognizing the elimination of routine flaring on the Ofon field.

◆ Project Location:

- The Ofon field is located 65 kms offshore in water depths of 40 meters. Production started in 1997 and is currently at 25,000 barrels of oil equivalent a day.

◆ Associated Gas Use:

- 1 million cubic meter per day of gas are monetized
- In phase 2 of the project, Total has been drilling 24 new wells. When these are completed, 3 million cubic meters per day of APG will be monetized.



APG use company case study: Exxon Mobil Oso condensate project (NGL)

Power
Generation (IPP)

Liquefied Natural
Gas (LNG)

Natural Gas
Liquids (NGL)

Gas to Liquid
Conversion (GTL)

Project Participants:

- Exxon Mobil: 35%, NNPC: 65%

Project Description and Motivation:

- APG used for reinjection to recover NGLs. Producing 110,000 barrels per day (bpd) Natural Gas Liquid (NGL) for the export market.
- Expected, at its inception in 1998, to recover 350 million barrels of NGL from Exxon's Oso condensate field over its 20+ year lifespan
- Cost of project reported to be between \$218 - \$900 million. Mobil fronting 35% of the total cost of the project in equity, NNPC's 65% share in the project cost is covered by a loan from the World Bank, the International Finance Corporation (IFC), among others - first upstream petroleum project to be sponsored by the World Bank in Nigeria.

Project Location:

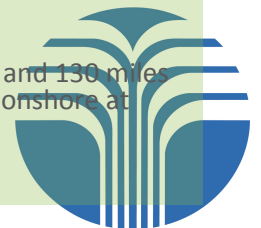
- Proceeds from an offshore location at the Oso field and an onshore one at the Bonny River Oil Terminal linked by pipelines
- Oil Mining Lease No. 70, about 35 miles offshore from Mobil's Qua Iboe oil terminal in Ibeno, Akwa-Ibom state in southeast Nigeria

Associated Gas Use:

- Monetize NGLs that are produced together with the natural gas flow from the Oso condensate field and 'other associated gas production'
- APG is re-injected as an important NGL recovery system, thereby minimizing flaring.

Project Technology:

- The project consists of 21 oil/condensate wells, 8 platforms, 1 point mooring, and 130 miles of offshore pipelines. It also has 3 primary storage tanks and loading facilities onshore at Qua Iboe terminal.



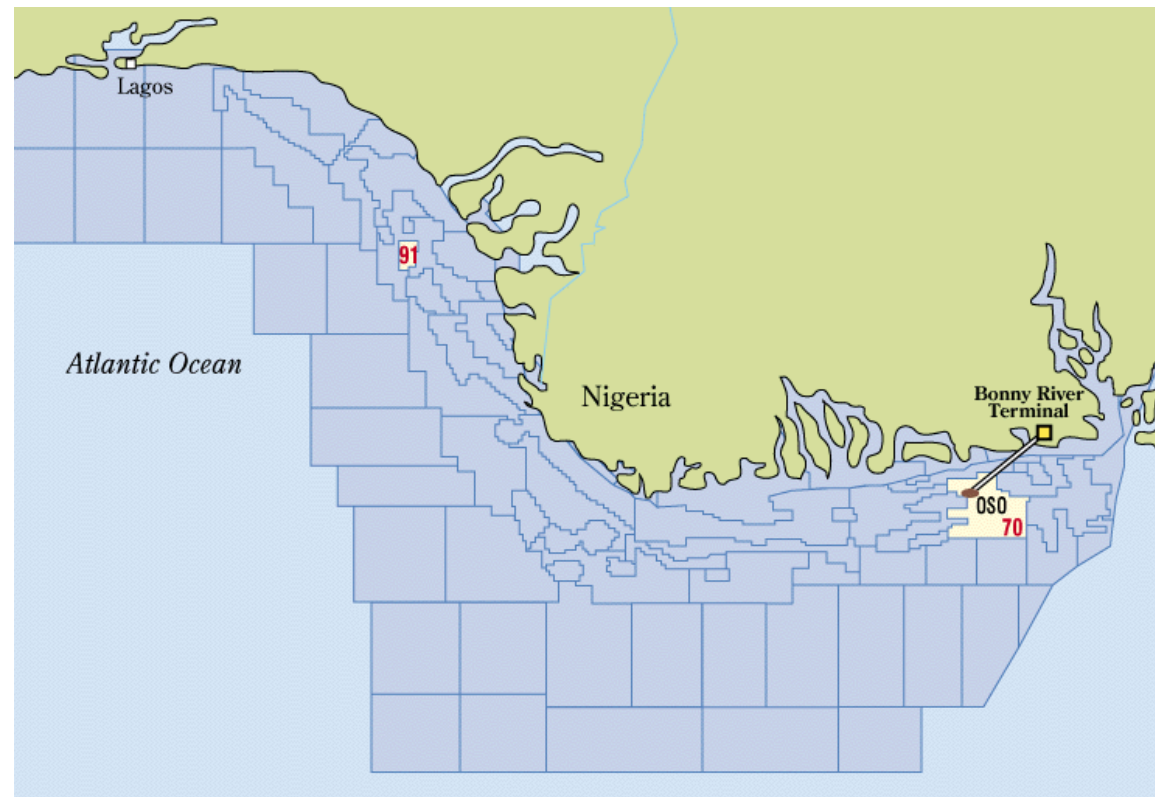
APG use company case study: Exxon Mobil Oso condensate project (NGL)

Power
Generation (IPP)

Liquefied Natural
Gas (LNG)

Natural Gas
Liquids (NGL)

Gas to Liquid
Conversion (GTL)



Source: Offshore Magazine Vol 58 Issue 10

Figure: Exxon Mobil APG use: Oso NGL project location



APG use company case study: Chevron Escravos project (GTL)

Power Generation (IPP)

Liquefied Natural Gas (LNG)

Natural Gas Liquids (NGL)

Gas to Liquid Conversion (GTL)

Project Participants:

- 75% Chevron (CNL) 15% NNPC and 10% Sasol
- Sasol bringing here its Fischer–Tropsch process technology

Project Description and Motivation:

- Converts APG to GTL diesel and GTL naphtha
- Project's motivations included the establishment of incentives by the Nigerian National Gas Policy of March 1995 (materialized by the incentives of PPTA and CITA established in 98-99).
- Motivations also included the creation of agreement with NGC to accept and deliver lean (dry) gas from APG to domestic markets .
- The project has a capacity of 34,000 bpd with anticipated expansion to 120,000 bpd.
- Construction started in 2005 and the project came online in 2014.

Project Location:

- Located in the Escravos region in the Niger Delta region of Nigeria

Associated Gas Use:

- Associated gas from the Okan and Mefa oil fields in the Oil Mining Lease 49, Delta region of Nigeria

Project Technology:

- The technology used consists of an offshore gas gathering and compression platform (GSCP), a gas plant onshore, and a floating storage and offloading vessel.
- After the liquids are extracted from the associated gas, the left-over lean gas would be compressed and delivered into a 16-in gas pipeline to the NGC.
- The West African Gas pipeline links to Chevron's existing Escravos-Lagos gas pipeline



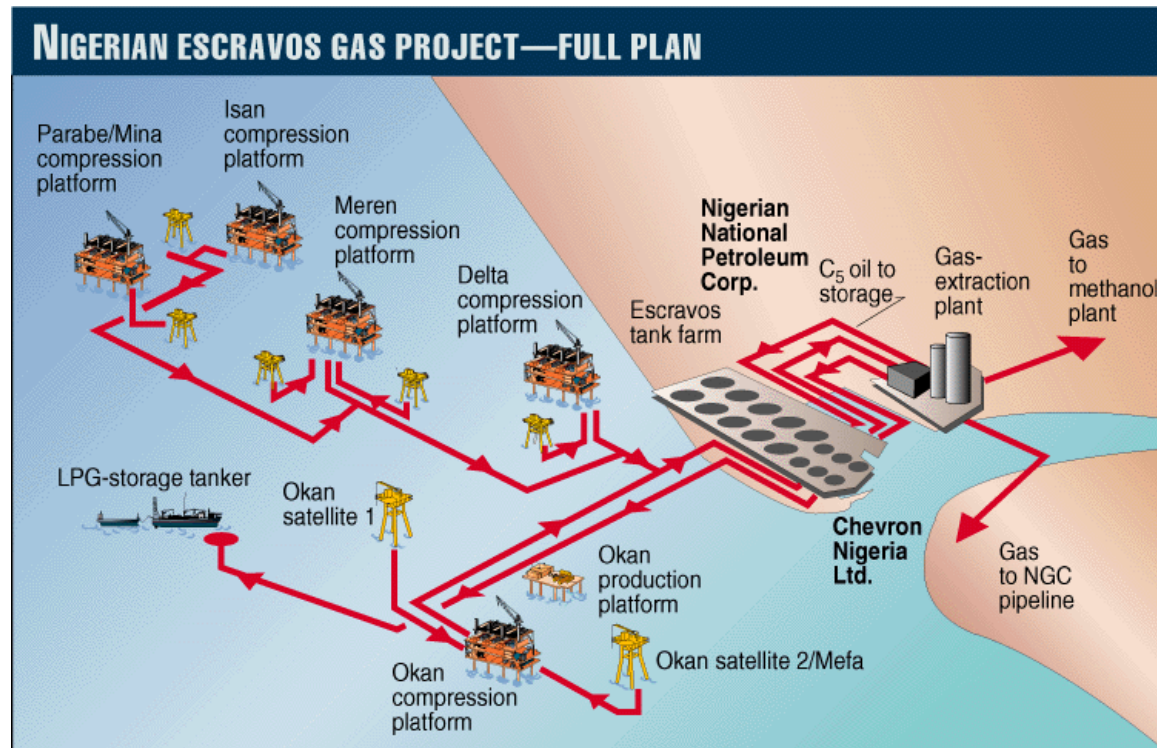
APG use company case study: Chevron Escravos project (GTL)

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Source: Oil and Gas Journal Vol. 96 Issue 16

Figure: Chevron Escravos GTL project schematic



Potential future projects

Power
Generation (IPP)

Liquefied Natural
Gas (LNG)

Natural Gas
Liquids (NGL)

Gas to Liquid
Conversion (GTL)

Some potential APG-unlocking infrastructure projects:

- *Power Plants:* The government is requiring all IOCs to build at least one IPP as part of the 2008 Gas Master plan. As a result, Total has planned to develop a 400MW IPP on OML 58 in Rivers State and Exxon is planning to construct a 500MW IPP at its Qua Iboe Terminal. The projects were slated to go online a few years ago. They are currently delayed by to non-availability of upstream projects to supply gas feedstock to the plants.
- *Gas Gathering Facilities:* Shell through its SPDC is investing \$2bn in two projects to extend gas-gathering facilities to 90% of its operations: the Southern Swamp Associated Gas Solution (SSAPGS) and the shallow-water Forcados-Yokri projects, with a combined capacity of 185,000 barrels of oil equivalent a day at its peak. It is also intended to produce gas for domestic power consumption. Once completed, it should reduce Shell's gas flaring by 95%. The report is however delayed by a lack of funding.
- *Additional pipelines:* NNPC has been trying to attract funding for larger backbone pipeline (395-km Calabar-Ajaokuta pipeline and the 740-km Ajaokuta-Kaduna-Kano pipeline). Nigeria has also the ambition to build a trans-Saharan gas pipeline (first proposed in 2002) that would travel through Niger and Algeria, and link Delta gas reserves to European markets. Total and Russia's Gazprom have shown interest in the project but the hefty cost estimates (of above \$30bn) and an unstable security situation in the Delta and Sahara regions have stalled the project.



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