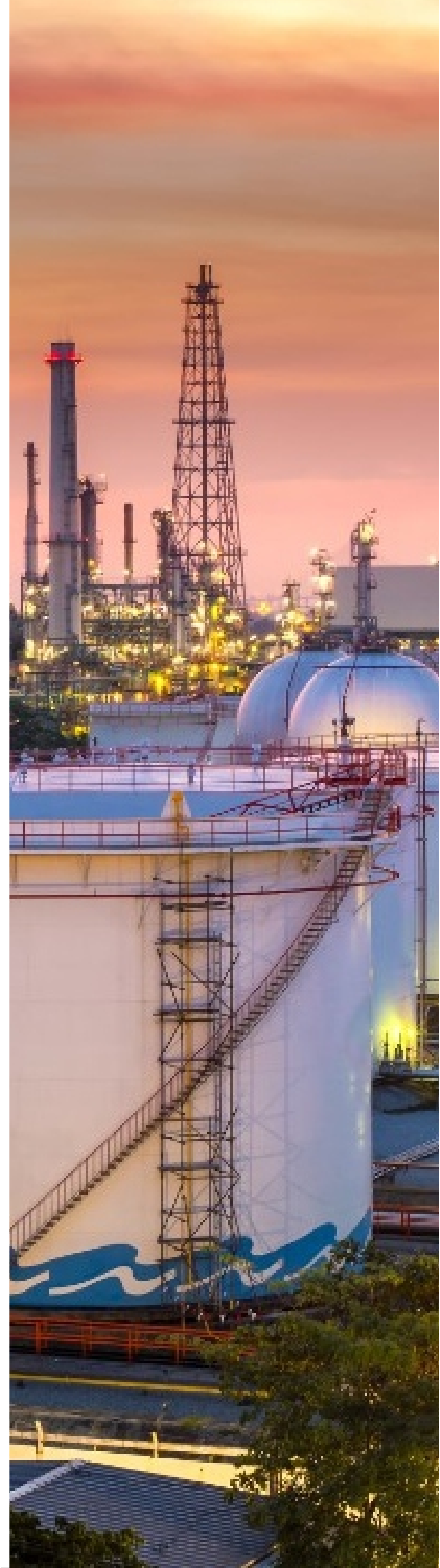


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# Evaluating Nigeria's Gas Value Chain

The second of a three-part gas series



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This publication is the second of a three-part series on the Nigerian Gas sector. The series aims to highlight the industry issues and challenges, as well as assess the opportunities across the value chain, in addition to providing an outlook for the sector.

In the first part, we assessed the impact of gas flaring on the Nigerian economy by estimating in monetary terms, the economic and environmental impacts of gas flaring, as well as the revenue potential lost to flaring. In this second part, we assess the potential economic impact of Nigeria's untapped proven gas reserves in monetary terms.

In the third part, we will explore the opportunities for private investment in the sector.

## Executive summary



Natural gas is estimated to be the fastest growing fossil fuel in the world, and is projected to overtake coal by 2030, as the second largest source of energy after oil.<sup>1</sup>

Globally, 64% of the top 10 global petroleum discoveries in 2018 was natural gas. According to the International Energy Agency (IEA), global demand for natural gas grew by 4.6% in 2018, driven by strong economic growth and the transition from coal-fired electric power due to climate change strategies, among others. Gas accounted for nearly half of the world's growth in energy demand, with China and the United States leading the consumption trend.

In 2020, slowdown in global industrial activities due to COVID-19, coupled with the mandated lockdown and restrictions across the world, have dampened the outlook for the gas sector in the medium-term. Prior to the pandemic, a global gas supply glut amid fears of weakening demand was already pushing gas prices downward toward the end of 2019.

The pandemic coupled with the oil price shocks could prolong the recent supply-demand imbalance in gas exporting markets, thereby resulting in the continued downward trend in gas prices.

In Africa, gas reserves and production were increasing with several LNG projects being developed across the continent.

Nigeria, a major contributor to Africa's oil and gas potential, accounted for 29% and 21% of total oil and gas reserves respectively in 2018. Although, the country

has the ninth (9th) largest proven reserves globally, the sector is largely underdeveloped as production-to-reserves is approximately 1%. According to NNPC, Nigeria has 202 trillion cubic feet (tcf) of untapped proven gas reserves. The estimated recoverable gas is 139.4 tcf.

With dampened outlook in the global gas sector, focusing on Nigeria's domestic markets by harnessing the potential productivity of the country's domestic gas sector and enhancing the country's local value chain could provide much-needed economic returns.

PwC estimates that harnessing Nigeria's proven gas reserves can stimulate an estimated Gross Value Added (GVA) of US\$18.3 billion annually to the domestic economy. In addition, optimizing the domestic utilisation of gas could support 6.5 million Full Time Equivalent (FTE) jobs for the local economy.

Total gas produced in 2018 stood at approximately 1.74 tcf, making Nigeria the seventeenth (17th) largest producer in the world, despite being one of the top 10 holders of the largest reserves in the world, as well as the foremost in Africa.

Nigeria holds more of non-associated gas (NAG) in its reserves than associated gas (AG), yet the latter accounts for more than half of the total gas produced every year. Associated gas (AG) accounted for about two-third (66%) of the total gas produced in the last eighteen years with NAG making up the balance of 34%.

1. International Energy Agency

# Introduction



At the core of most countries' environmental policies is the deliberate shift toward low-carbon energy sources such as natural gas. The growing appeal for natural Gas as an alternative energy source to oil and coal is because of the unique qualities outlined below:

- ☒ Natural gas is relatively clean i.e. when combusted, it generates 45% and 30% less CO<sub>2</sub> emissions than Coal and oil respectively.
- ☒ Natural gas is cheaper and available in abundance. As at end of 2019, global proven reserves of gross natural gas stood at 7,019 trillion cubic feet (tcf).<sup>2</sup>
- ☒ The versatility and efficiency of natural gas is another reason for its increasing preference as an energy source.

## Gas as the future of fossil energy

Natural gas has been projected to be the fastest growing fossil fuel over the next two (2) decades. The fundamentals for gas as the future of energy is potentially strong across key sectors that depend on energy for consumption and production. In addition, the crucial role gas will play in driving industrial growth in the future becomes particularly appealing in view of its low-carbon emission quality.

Globally, in the industrial sector, the need to replace oil and coal with gas to meet up with industrial emission standards has led to the rise of the petrochemical industries that use gas as feedstocks. This further underscored the growing demand for gas in the industrial sector.

In the power sector for example, gas and other renewable energy sources have been sought for, as gradual replacement for coal and oil in the energy mix across key regions. As a result, many coal-fired and nuclear-fired power plants are giving way to gas-fired power plants, as well as other renewable energy sources such as solar and wind.

In the transportation sector, the new policy by the International Maritime Organisation (IMO), which puts a 0.5% cap on the sulphur content of bunker fuel used in the maritime industry has resulted in the search for alternative energy sources such as low-sulphur diesel oil and Liquefied Natural Gas (LNG) that meets the international requirements.

This is plausible given the current investments in gas infrastructures and heightened gas exploration & production activities, which is pushing up supply. Also, government policies and technological advancements have led to focus on increasing the output of electric cars and natural gas vehicles (NGVs).

There are less NGVs in Nigeria compared to other countries with similar demography such as Brazil, China, etc. However, interest in Compressed Natural Gas (CNG)-powered cars have started gaining momentum in the country because of increased awareness about its efficiency and affordability compared to traditional fuels such as Diesel and Premium Motor Spirit (PMS).

It is estimated that Nigeria has about 5,000 fuel-powered (petrol and diesel) vehicles that have been converted to CNG over the past ten years.<sup>3</sup> Official statistics estimate that Nigeria could potentially save over N10 trillion every year, if all the vehicles in Lagos, Port-Harcourt and Abuja are converted to use CNG instead of the conventional petroleum products.

Other factors driving the shift to gas includes the volatility of the global crude oil markets caused by frequent geopolitical tensions, policy changes by major oil importers due to emissions control, increased emphasis on renewable energy sources, among others. Overall, the sectoral drivers of gas consumption and/or demand clearly differ across countries and regions. For instance, in the Middle East, prior to the pandemic and the oil price shocks, the power sector is anticipated to drive demand for gas.

2. <https://www.eia.gov/tools/faqs/faq.php?id=52&t=8>

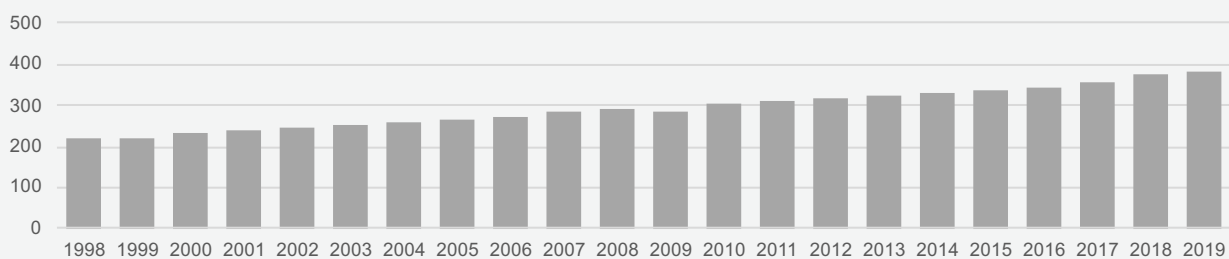
3. Nigerian Independent Petroleum Company (NIPCO) Plc

# Global gas production



Global gas production grew over the past two decades at an average of 3.1% per annum from 217.3 billion cubic feet (bcf) per day in 1998 to about 386 bcf per day by 2019 bolstered by stellar growth in Asia and the Middle East. While gas production accounted for 23% of the total energy production in 2019, analysts predicted that by 2030, the figure is expected to account for more than 45%.

Global gas production trends (in bcf)



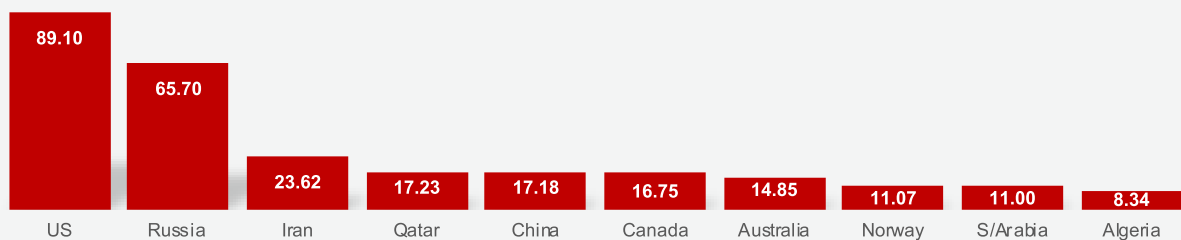
Source: BP Statistical Review, PwC analysis

\*\*Note that natural gas production as used here excludes gas flared or recycled but includes natural gas produced for Gas-to-Liquids transformation.

The United States, Russia and Iran are the biggest gas producers worldwide, accounting for nearly half (46%) of total global production of about 390 bcf per day in 2019. Nigeria is

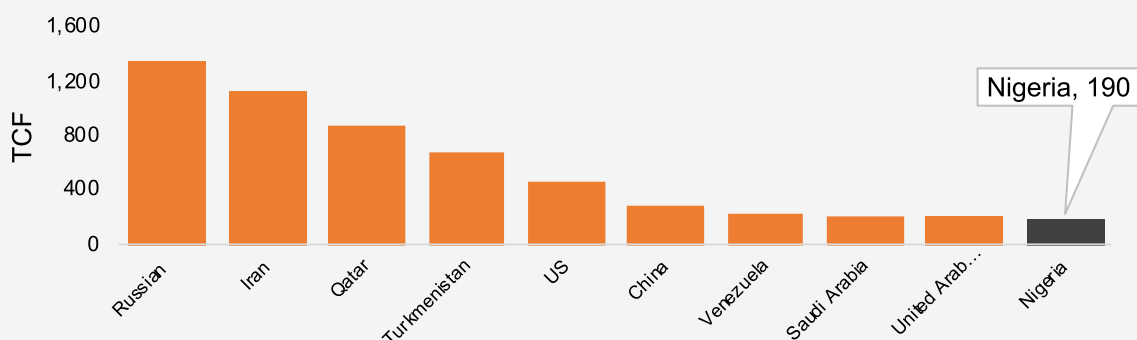
conspicuously absent on the top ten list, despite holding the largest gas reserves in Africa and the ninth (9th) largest in the world.

Top ten natural gas producers in the world (bcf per day), 2019



Source: BP Statistical Review, PwC analysis

Top Ten Natural Gas Reserves in the World, 2019



Source: BP Statistical Review

Meanwhile, global gas consumption increased by 2% to 380.2bcf per day in 2019 from 372.2 bcf per day recorded in the preceding year. According to the Gas Exporting Countries Forum (GECF), gas consumption is expected to increase by 37% in 2040 with Asia Pacific, Middle East and North America leading the growth. Gas is equally expected to account for 26% (2018:23%) of the global electricity mix by 2040.

The global industrial sector was also expected to witness significant growth with demand for gas estimated to rise by about 62% between 2017 and 2023<sup>4</sup> bolstered by its use in production processes and as feedstock in chemicals. Consequently, the industrial sector will displace the power generation sector as the main driver of growth in the global demand for gas.

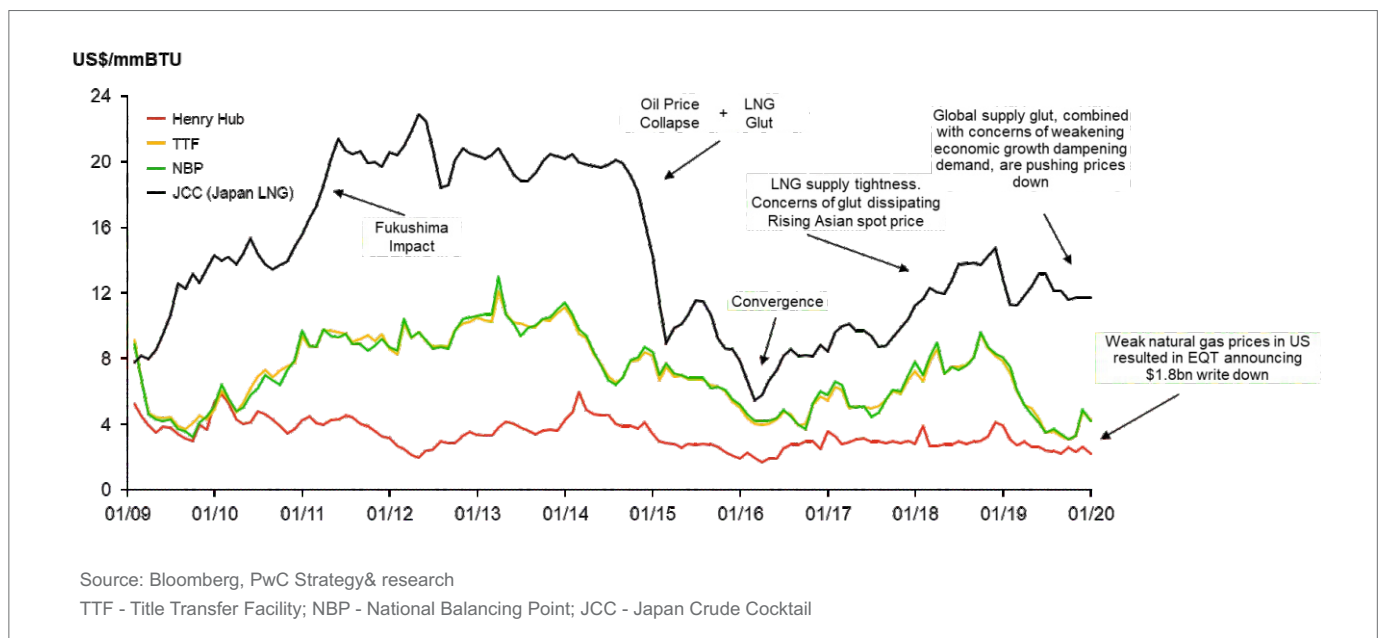
All the above projections were prior to the Coronavirus pandemic, which has caused a global economic slowdown and consequently, a significant decline in the global demand for gas, in the short to medium-term.

The slowdown has resulted in a low-price environment for gas, which in turn, has impacted investment in gas projects for exports and local production. Many oil & gas (upstream and midstream) companies globally and in Africa, have had to reconsider their capital expenditure plans in the interim.

Summarily, the slowdown of industrial activities across major developed countries, due to the coronavirus outbreak, and the subsequent lockdown measures, have dampened the actualisation of these projections.

The coronavirus outbreak, which started at the last quarter of 2019, flustered the global energy market and created ripple negative effects across diverse economic segments of major energy-exporting countries. Oil price in the petroleum market plummeted below US\$30 per barrel in March and April 2020, partly due, on one hand, to the pandemic outbreak, which led to demand slump and, on the other hand, by the crude oil price shocks in the global market.

### Monthly Gas Price Selected Markets (January 2009 – December 2020)



Meanwhile, the spot price of natural gas across Europe, Asia and the United States started weakening from the start of 2019 driven by weaker demand, resumption of Japanese nuclear power plant, increased export by the U.S. and Australia etc.<sup>5</sup>

As at 7 February 2020, U.S. natural gas traded at US\$1.86 per million British thermal units (MMBtu) while spot price for the Japan-Korea-Marker (JKM), Asia natural gas benchmark, traded at a historic low of US\$3 per MMBtu. The outbreak of COVID-19 further exacerbated the weakened demand position of gas, as China, the world's largest importer of liquefied natural gas (LNG), declared force majeure on some contracts.<sup>6</sup>

The Centre for Strategic and International Studies (CSIS) had earlier stated that the most obvious impact of COVID-19 on the gas market would be through demand. The decline in gas

demand (2%) during the 2009 global recession was more than the decline in overall energy demand (1.4%). However, 2020 will look very different and much improved from 2009.<sup>7</sup> Social distancing, as a measure to check the spread of the viral pandemic, and the sit-at-home order in most countries will help to keep stable, or increase household demand, for gas and electricity.

In Nigeria, crude oil accounts for over half of total government revenue and more than three-quarters of aggregate export. The dependence of the Nigerian economy on crude oil export has had an adverse impact whenever oil prices fall.

Gas as the future of Nigeria's energy, industrial and economic development has become more pressing, given the country's growing population and rising urbanisation.

4. International Energy Agency

5. <https://blogs.worldbank.org/developmenttalk/natural-gas-and-coal-plunging-prices>

6. <https://www.cnbc.com/2020/02/07/coronavirus-natural-gas-prices-falls-to-historic-low-amid-outbreak.html>

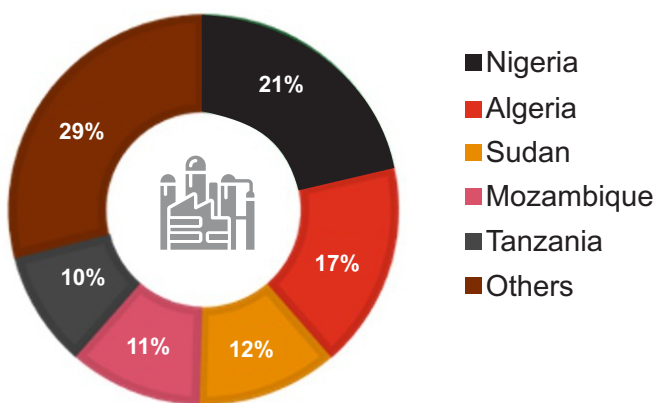
7. <https://www.csis.org/analysis/how-covid-19-will-reshape-global-gas>

# Africa's growing gas reserves and production

Africa's proven reserves at 527 tcf accounted for 7.5% of the world's total proven reserves. Gas production in Africa increased marginally by 0.7% to 8.4 tcf (or 23 bcf per day) in 2019, which represented 6% of global production. Gas

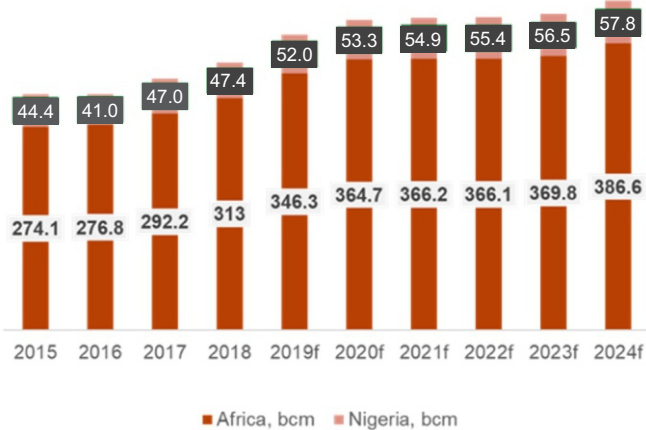
consumption in the continent also increased to 5.3 tcf (or 14.5 bcf per day) in 2019, an increase of nearly 1% from the previous year. Africa's gas consumption in 2019 represented 3.8% of global consumption value.

Distribution of Africa's Gas Reserves (2018)



Source: NBS, Fitch Solutions, PwC analysis

Natural Gas Production

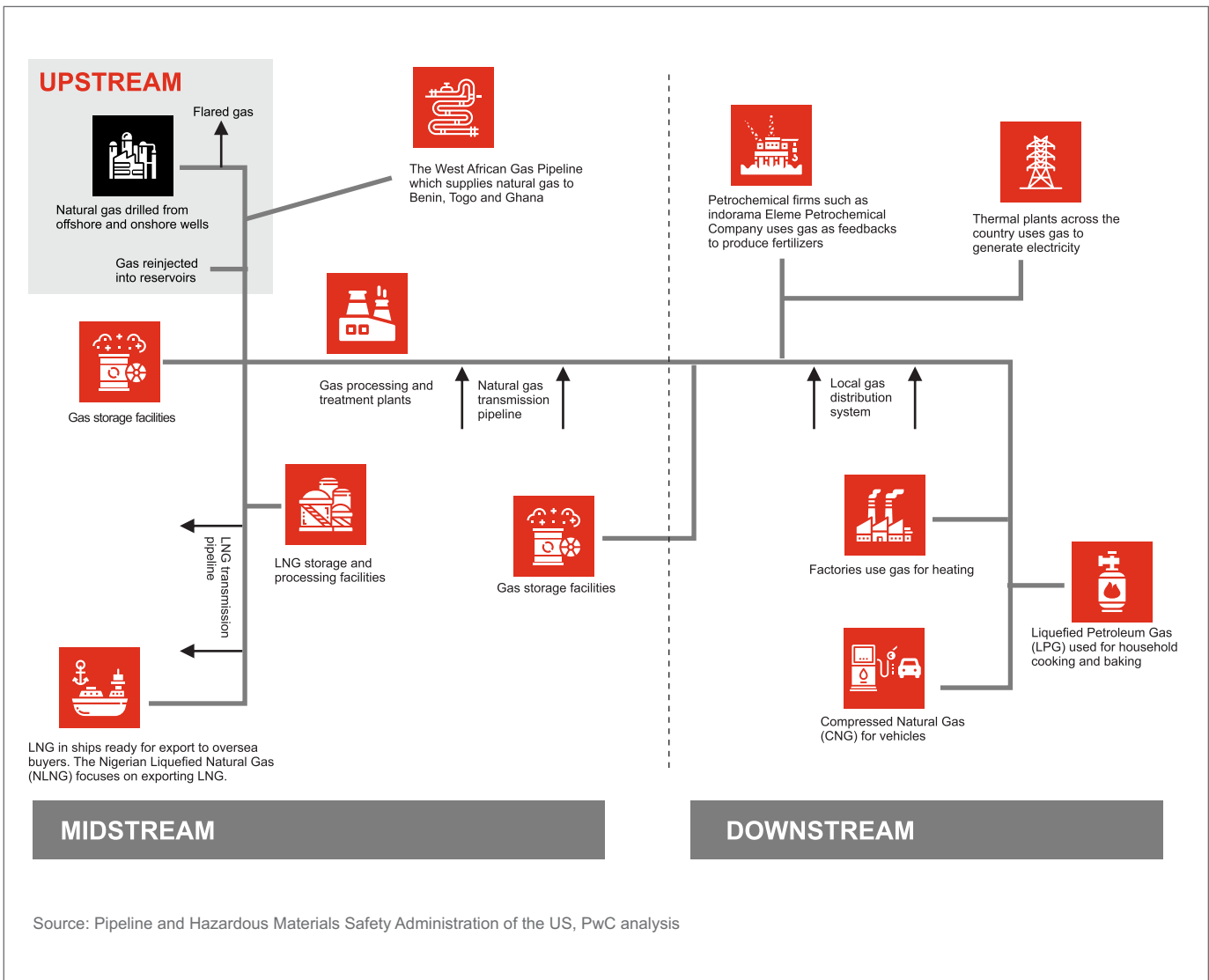


# Nigeria's gas value chain



Nigeria's gas value chain cuts across the three core segments of the gas sector (upstream, midstream and downstream). Various players operating along the value chain range from oil companies that extract gas during oil production, to natural gas producers, petrochemical firms, power generation companies, regulatory agencies, as well as industrial and household consumers.

Below is a diagrammatical representation of the Nigerian gas value chain.



Source: Pipeline and Hazardous Materials Safety Administration of the US, PwC analysis



## Government regulations and policy timeline

The Associated Gas Re-injection Act	The Associated Gas Framework Agreement	National Domestic Gas Supply and Pricing Regulations	Gas Master Plan	Nigerian Oil and Gas Industry Content Development Act (NCDA)	Nigerian Gas Flare Commercialisation Programme	National Gas Policy	Flare Gas (Prevention of Waste and Pollution) Regulation
1979	1992	2008	2008	2010	2016	2017	2018
<p>Promulgated to compel international oil companies to submit a plan on their gas utilisation and reinjection programme by the following year(1980).</p>	<p>Introduced a package of fiscal incentives for the utilisation of natural gas, which was subsequently incorporated into the Petroleum Profit Tax Act of 2004 (PPTA).</p>	<p>Segmented the domestic gas market into three divisions (gas-to-power, gas-as-feedstock and gas-as-alternative fuel and prescribed an applicable pricing regime for each segment.</p>	<p>Approved to address the challenges in the Nigerian Gas Sector. It was poised to make Nigeria become a major international player in the international gas market as well as to lay a solid framework gas infrastructure expansion within the domestic market.</p>	<p>Indigenous Nigerian operators will be given first consideration for the award of oil and gas licenses and contracts and that preference should be given to goods manufactured in Nigeria.</p>	<p>Designed to eliminate gas flaring through technically and commercially sustainable gas utilisation projects developed by competent third party investors.</p>	<p>Seeks to unlock a new policy direction, and introduce an institutional and governance framework for the country, geared towards driving industrial growth through gas utilisation strategies.</p>	<p>Released to specify the means for the implementation of the gas policy. The regulation provides a legal framework to support the government's plan to reduce greenhouse gas (GHG) emissions through the flaring of gas.</p>

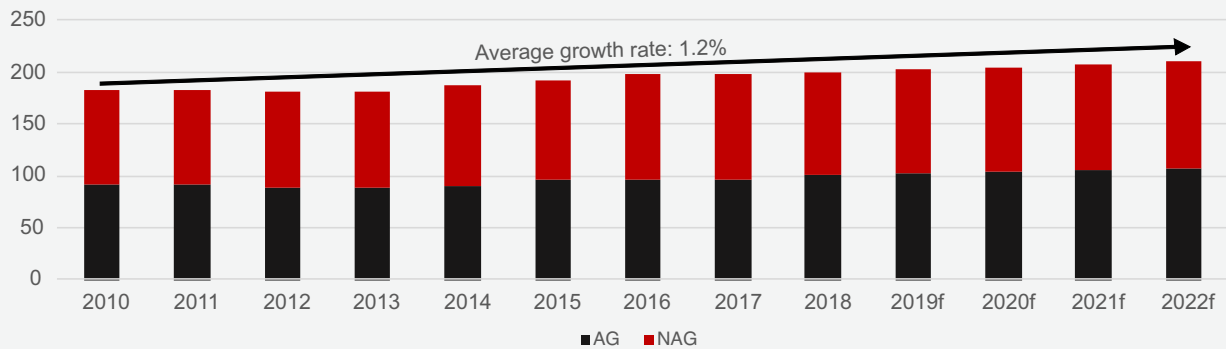


# Trends in the Nigerian gas sector

Nigeria's gas reserve is estimated to rise to 210.8 tcf by 2022.<sup>8</sup> With adequate investment in gas exploration, Nigeria could become the gas powerhouse of Africa.

Notwithstanding the significant gas reserves the country holds, only a small portion is extracted annually. Gas production stood at an average of 2.53 tcf in nearly two decades, which is less than 1% of the nation's reserve.

**Nigeria gas reserve split between associated and non-associated gas (trillion cubic feet)**

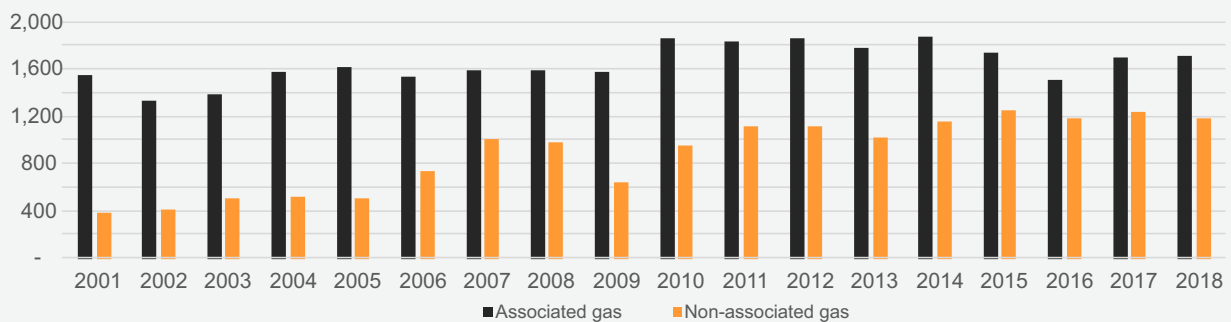


Source: DPR, PwC analysis

Associated gas (AG) accounted for about two-third (66%) of the total gas produced in the last eighteen years, with NAG making up the balance of 34%.

The large AG relative to NAG is attributable to the activities of multinational oil companies, whose primary purpose is oil exploration and production.

**Associated and non-associated gas production in Nigeria from 2001 to 2018 (in billion cubic feet)**



Source: NNPC, DPR, PwC analysis

8. <https://www.dpr.gov.ng/nigerias-gas-reserves-rise-to-200-79-trillion-cubic-feet-dpr/>

Gas production began to increase rapidly in the 1990s spurred by a growing domestic market.

Key growth drivers included the development of deep offshore fields containing reserves of associated gas, increased

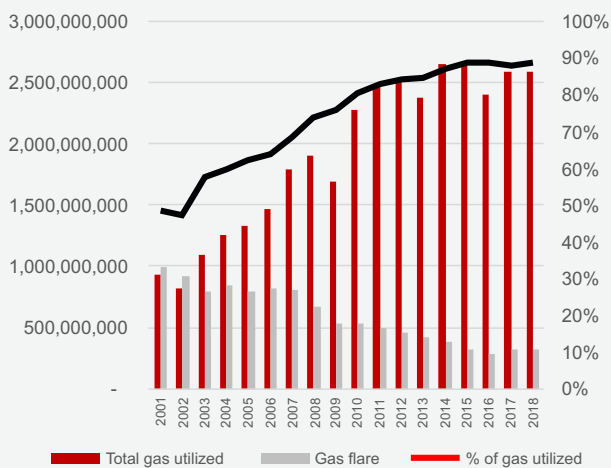
electricity demand, which necessitated the development of gas power plants; local demand for liquefied petroleum gas (LPG) for household use; growth of the gas export business led by the Nigeria Liquefied Natural Gas (NLNG) company, among others.

### Gas utilisation and consumption in Nigeria

Gas produced in Nigeria is either exported or used domestically for power generation, as feedstock for gas-based industries (such as petrochemicals and fertiliser

production), industrial heating, and as fuel for natural gas vehicles. Liquefied Petroleum Gas (LPG) derived from gas processing is also used for cooking and power generation.

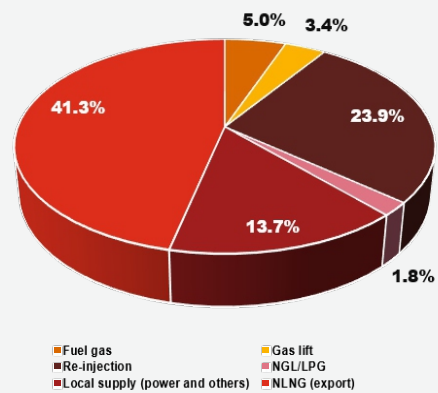
**Gas utilized vs flared between 2001 and 2018 (bscf)**



Source: DPR, PwC analysis

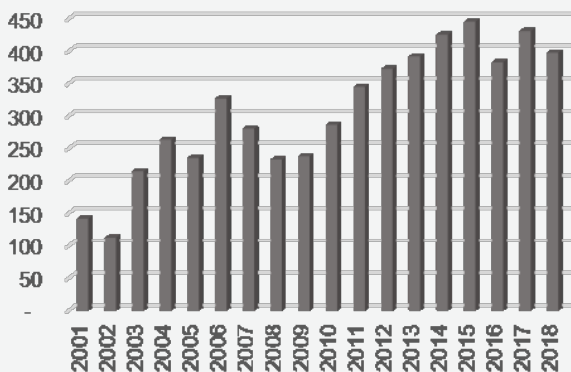
Increase in domestic gas consumption in the country, according to the Nigerian National Petroleum Corporation (NNPC), is driven by power sector reforms and the prioritisation of gas-powered generation plants. In addition, government-led reforms have also resulted in the paradigm shift from kerosene stoves and firewood to LPGs for cooking purposes.

**Gas utilisation in Nigeria, 2018**



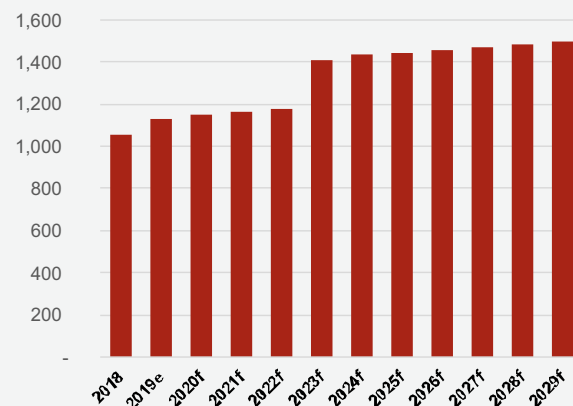
Through the Nigeria Liquefied Natural Gas (NLNG) Company, Nigeria has been able to export over 13 tcf of Liquefied Natural Gas (LNG) between 2001 and 2017. Nigeria ranked fourth place globally in natural gas exports and controlled about 7% of the total global export of natural gas as at 2017.

**Nigeria domestic gas sales (bcf)**



Source: DPR, Fitch Solutions, PwC analysis

**Nigeria's dry gas net exports (bcf)**

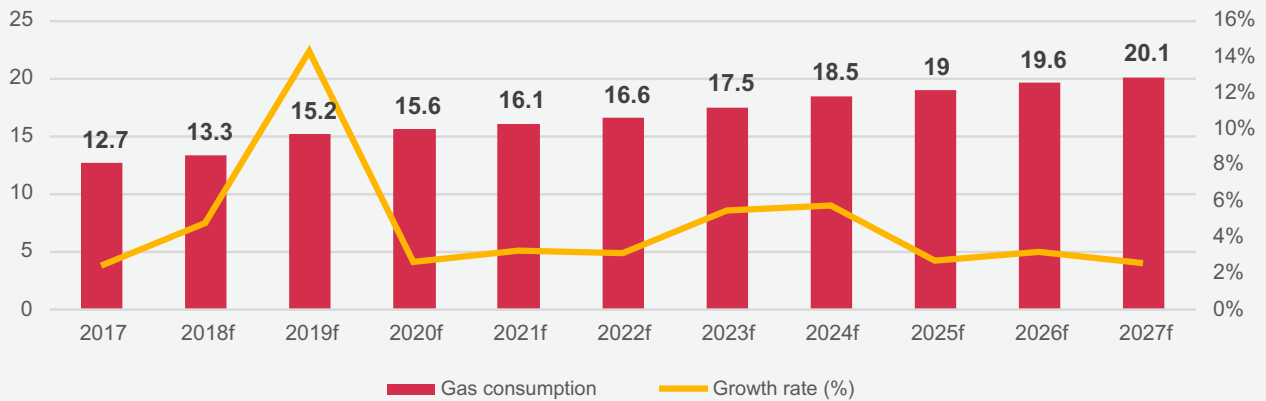


9. <https://punchng.com/lpg-consumption-grew-by-600-in-two-years-fg/>

Fitch Solutions predicted that gas consumption will accelerate steadily to 20.1 bcm till 2027 due to greater availability of gas which will support more use of natural gas in the power sector. As a result, there will be greater electricity generation. Fitch however hinted that gas will remain below the government's desired targets due to lack of accelerated

investment in vital infrastructure. Specifically, the outbreak of COVID-19 which has led to the delay in the completion for the Obiafu-Obrikom-Oben (OB3) gas pipeline, a critical infrastructure that is expected to boost gas supply to thermal power plants, would further dampen the projected delivery of natural gas to power sector and industry.

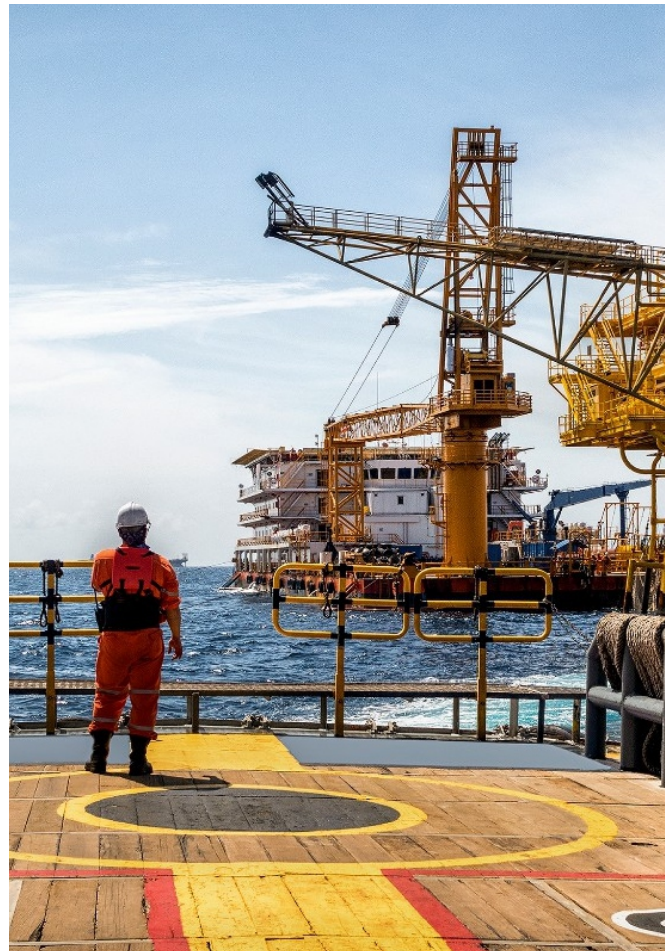
### Dry natural gas consumption in Nigeria (bcm)



Source: Fitch Solutions, PwC analysis

The outbreak of COVID-19 will have a significant impact on domestic gas utilisation in Nigeria. The lockdown which started in March 2020 and the subsequent easing in some parts of the country— Lagos, Ogun and Abuja – sparked demand for cooking gas. In addition, there was need to increase power generation to satisfy the electricity requirement of Nigerians due to the home-stay restriction. While there was considerable decline in electricity demand by commercial and industrial users, the overall effect was compensated for as residential demand, which was on the increase, accounts for 70% of electricity demand in the country. Nevertheless, the extent of gas consumption by the power sector would depend on the existing operational capacity of the gas powerplants and the current nature of gas infrastructure that would transport gas to power plants.

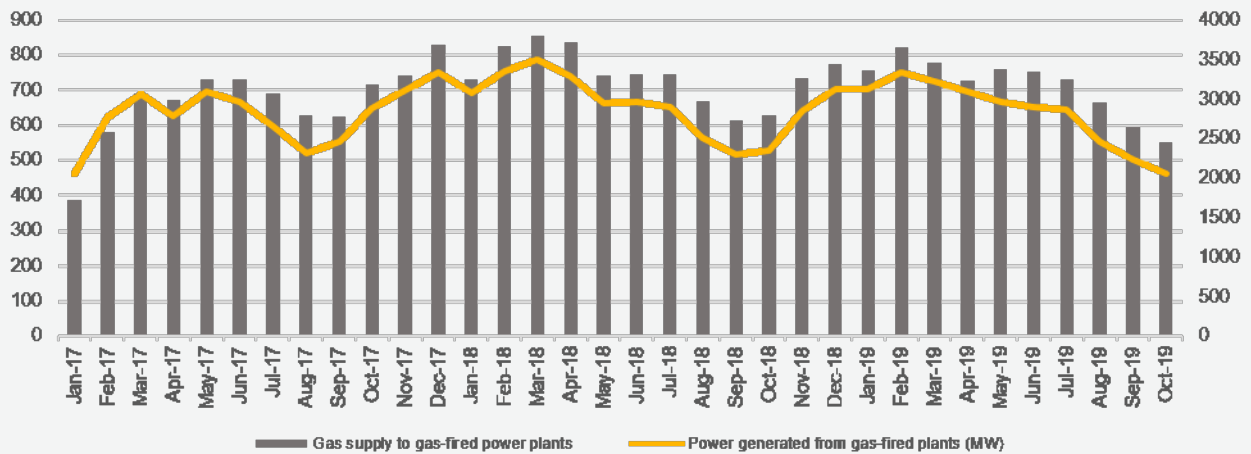
Although Nigeria is ranked as one of the top ten largest exporters of natural gas globally, the receipts from gas export is small relative to the proceeds from oil exports. Nevertheless, the falling gas prices as a result of the coronavirus pandemic will have measurable impact on the country's fiscal receipts and forex reserves.



## Gas to power

Nigeria faces a serious energy crisis; power supply is not only epileptic but grossly insufficient to stimulate massive industrial growth.

### Gas supply to thermal power plants in Nigeria (mmscfd)



Source: Fitch Solutions, PwC analysis

Nigeria's energy mix is dominated by thermal/fossil fuel plants (non-renewable sources), which accounted for 65% of electricity generation in 2017, followed by hydropower (a renewable energy source), which accounted for about 17% power generation, according to Fitch Solutions. Nigeria has over 10 thermal power plants with combined installed capacity of over 8,000 megawatts (MW). Yet, peak power generation still hovers around 4,900MW per day.<sup>9</sup> Gas-fired power plants is increasingly dominating the energy mix.

Fuel used in power generation is expected to decrease over the coming years, as gas supply grows, and delivery becomes more consistent<sup>10</sup> even though the COVID-19 outbreak has led to set back in the completion of critical gas pipeline infrastructure projects such as OB3.

In 2018, an average of 739 mmscf of gas was sent out to the various thermal plants across the country. This generated about 2,915 megawatts (MW) of electricity daily compared to 668 mmscf supplied to gas-fired power plants that generated 2,790 MW of electricity daily in 2017.



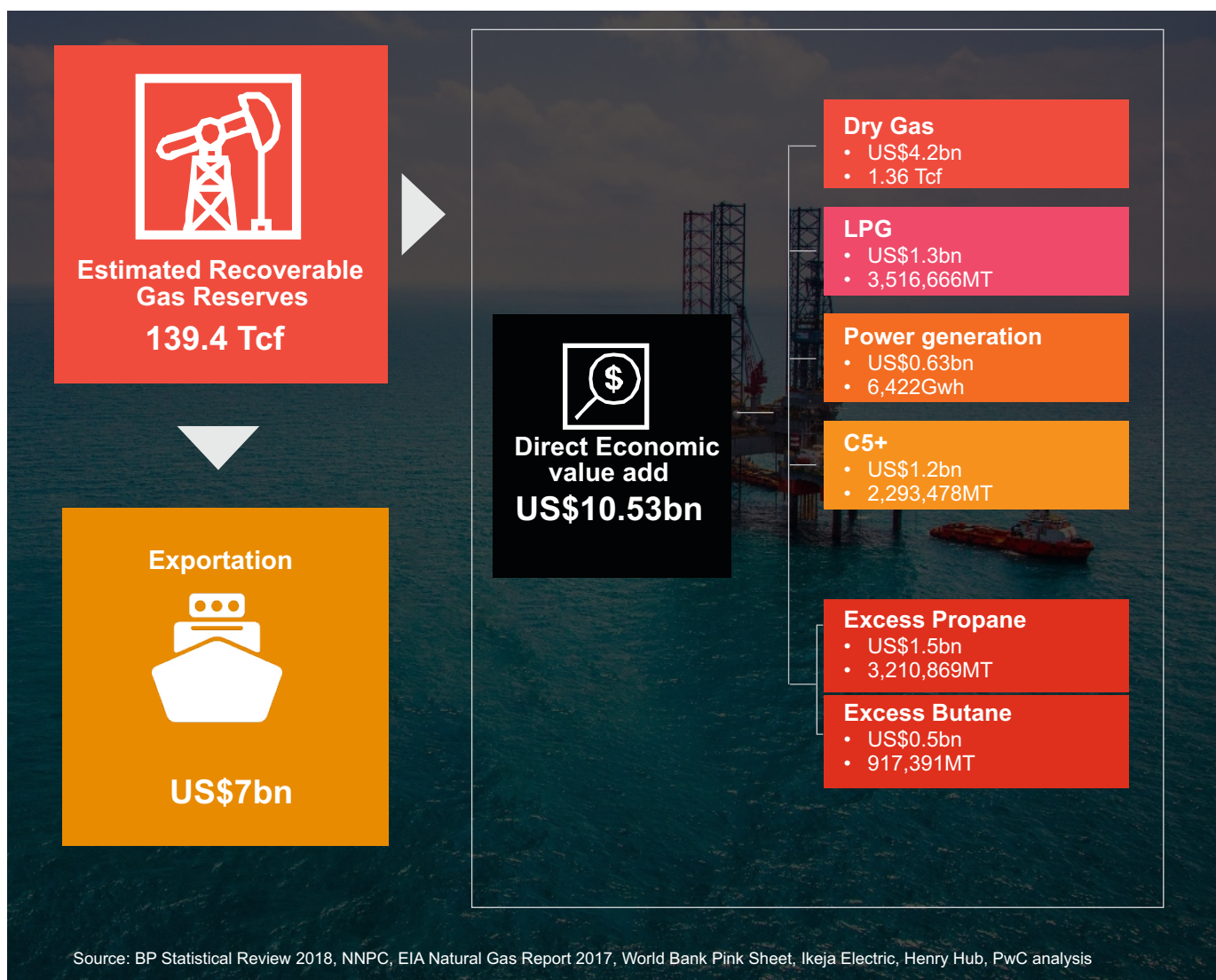
9. Peak power generation data is as August 2019 presented by the Nigerian Electricity System Operator.  
10. Nigeria Oil and Gas Report, Q1 2019.

# The economic importance of Nigeria's gas potential



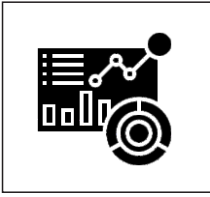
PwC estimates that economic activities stimulated by the domestic utilisation of Nigeria's recoverable proven gas reserves has the potential to generate a Gross Value Add (GVA)<sup>11</sup> of US\$ 18.3 billion yearly to the domestic economy through direct economic value addition of US\$10.5 billion;

indirect value addition of US\$3.4 billion and induced value addition of US\$4.4 billion. This is in comparison to generating annual export value of US\$7 billion. Harnessing the country's proven reserves for domestic utilisation can also support 6.5 million full-time equivalent jobs yearly.

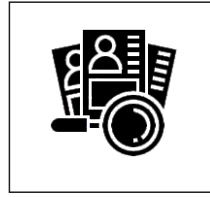


11. Gross Value Added (GVA) is a measure of economic activity which can be viewed as the incremental contribution to Gross Domestic Product (GDP).

## Economic Impact of Domestic Gas Utilisation

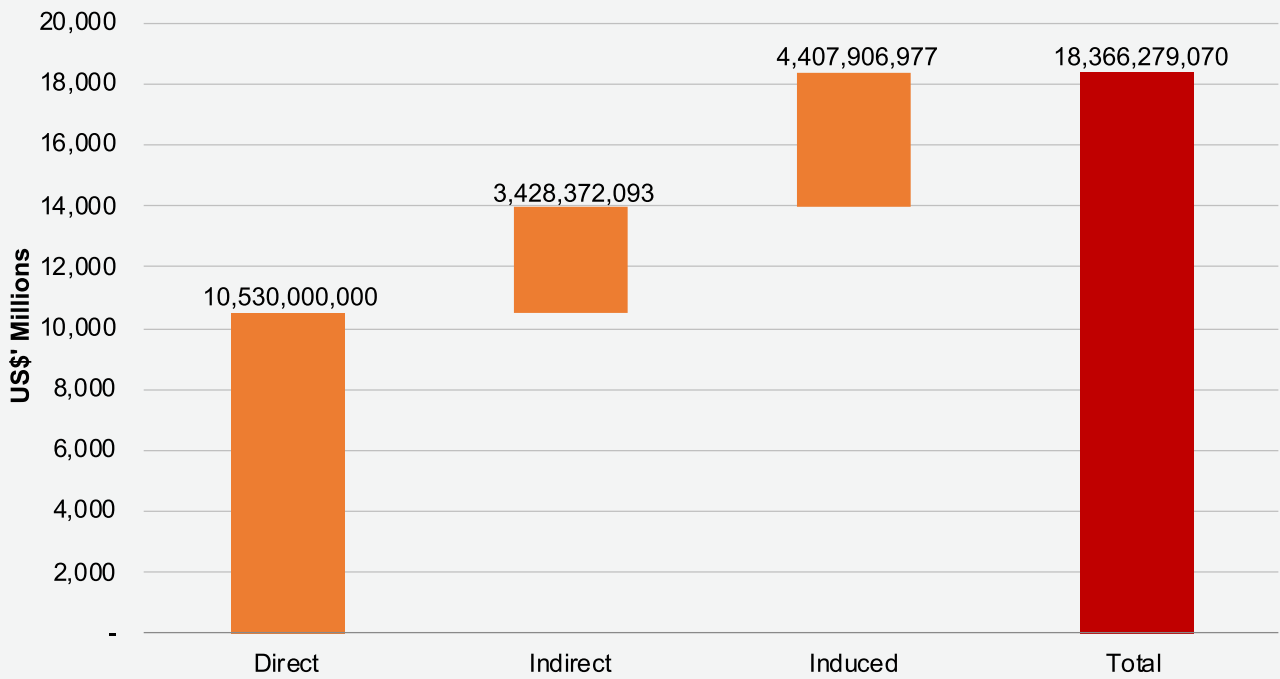


**\*US\$ 18.3B**  
Gross economic  
value added



**6.5 million**  
Full Time Equivalent  
(FTE) jobs supported

### Potential Annual Gross Economic Value Addition of Nigeria's Untaped Gas



Source: PwC analysis

# Nigeria's gas value chain: Challenges




The challenges in the Nigerian gas value chain differ. Structural and institutional constraints that impede gas exploration and production in the upstream segment might not necessarily be the same challenges facing players in the

midstream or downstream segment. To reap meaningful results from developmental initiatives taken by players across the value chain, some key challenges highlighted hereunder must be properly addressed.

Gas exploration/ production	Gas distribution	Gas consumption	Gas pricing
<ul style="list-style-type: none"> <li>Majority of gas exploration and production activities is geared toward associated gas, even though Nigeria holds more reserves in non-associated gas. This is due to dearth of investment needed to pursue exploration of non-associated gas sites.</li> <li>High concentration of activities in the Niger Delta, which makes gas exploration and production highly susceptible to security challenges in the region.</li> </ul>	<ul style="list-style-type: none"> <li>Existence of huge gaps in gas infrastructure. The implication is a shortfall in the domestic gas supply obligations (DGSO). As at 2017, the shortfall was 1,307 mmscfd which is about 52% of the total DGSO.</li> <li>New investments are required in gas distribution infrastructure as many of the existing gas infrastructures are old and inefficient.</li> <li>Gas infrastructures are increasingly threatened by pipeline vandals.</li> </ul>	<ul style="list-style-type: none"> <li>Irregular supply of LPGs across retail outlets, which sometimes make the gas prices unstable.</li> <li>Low awareness about the cost-effectiveness of gas usage especially for transportation and household consumption.</li> <li>Gas consumption in the power sector is hampered by low capacity of our transmission network. Development of regional power transmission infrastructure and/or increase in the capacity of the existing national transmission infrastructure to enable evacuation of more power from the existing power plant.</li> </ul>	<p>The government still regulates domestic price of natural gas, an act which many industry players says promotes inefficiency as price pegged might not be reflective of actual cost of gas despite the position of the National Domestic Gas Supply and Pricing Regulations issued in 2008 which enunciated different price regimes for each of the three demand-segments in the country – a regulated price for the strategic domestic sector (e.g. power sector) and the strategic industrial sector (petrochemical firms). The commercial sector (industries that use fuel for production) was to be based on market-determined price.</p>



# Recommendations



In view of the immense potential of Nigeria's gas resources to stimulate industrialisation and economic growth, some recommendations to address the challenges across the gas value chain and spur the needed investment in the sector include:

1

Commitment to the implementation of the national gas policy should be of priority to the government. Efforts should be doubled towards ensuring that the long-term action plans enshrined in the policy document are achieved.

2

Boost institutional capacity and training for regulatory stakeholders.

3

The National Assembly should expedite action on providing legislative backing for the national gas policy document particularly the provision seeking to separate the Nigerian Gas Company Limited (NGC) from the NNPC. This will ensure greater coherence and efficiency in coordinating industry players in the gas value chain.

4

We recognize government's effort in transiting to a market-based pricing structure, as spelt out in the various policy documents and regulations such as the National Domestic Gas Supply and Pricing Regulations. Proper gas pricing methodologies that consider the current and future dynamics of the gas market, as enshrined in the national gas policy must be vigorously executed to optimise benefits from gas across the value chain.

5

Put in place measures that would shield gas players in Nigeria from the adverse shock to the sector caused by the COVID-19. One measure is to include short-term financial support and debt relief.

6

Gas infrastructure should be rehabilitated through concessions (Public Private Partnerships) and improved to be more automated and equipped with the technology for better monitoring

7

Investments in power transmission infrastructure will enable evacuation of more power and increase gas utilisation for power generation.

8

Digitise operations of gas assets to optimize infrastructure and ensure security of assets and improved return on investment for industry players

# Key Contacts



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