

Learning to leapfrog Africa oil & gas review



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Methodology

The project team, based in Cape Town, South Africa, developed a questionnaire that was utilised by Infomineo in order to conduct primary research via telephone and email throughout Africa. Respondents totalled 79 individuals from across 11 countries and included upstream, midstream, downstream and oilfield service companies, among other industry stakeholders.

The project team utilised the information gathered via the questionnaire together with their own knowledge of the industry, which they have gained by

working with clients throughout the oil & gas value chain across Africa. In addition, the team attends industry events and holds regular interactions with industry players.

Additional research was also conducted by the team. The result is another piece of PwC thought leadership that represents the PwC point-of-view on the oil & gas industry in Africa.

Acknowledgements

PwC Africa would like to thank those who took time from their busy schedules to respond to our questionnaire. We would also like to thank Infomineo for their assistance in driving the survey effort.



Foreword

This review of activity and developments in the African oil & gas industry is our seventh in a series on the sector

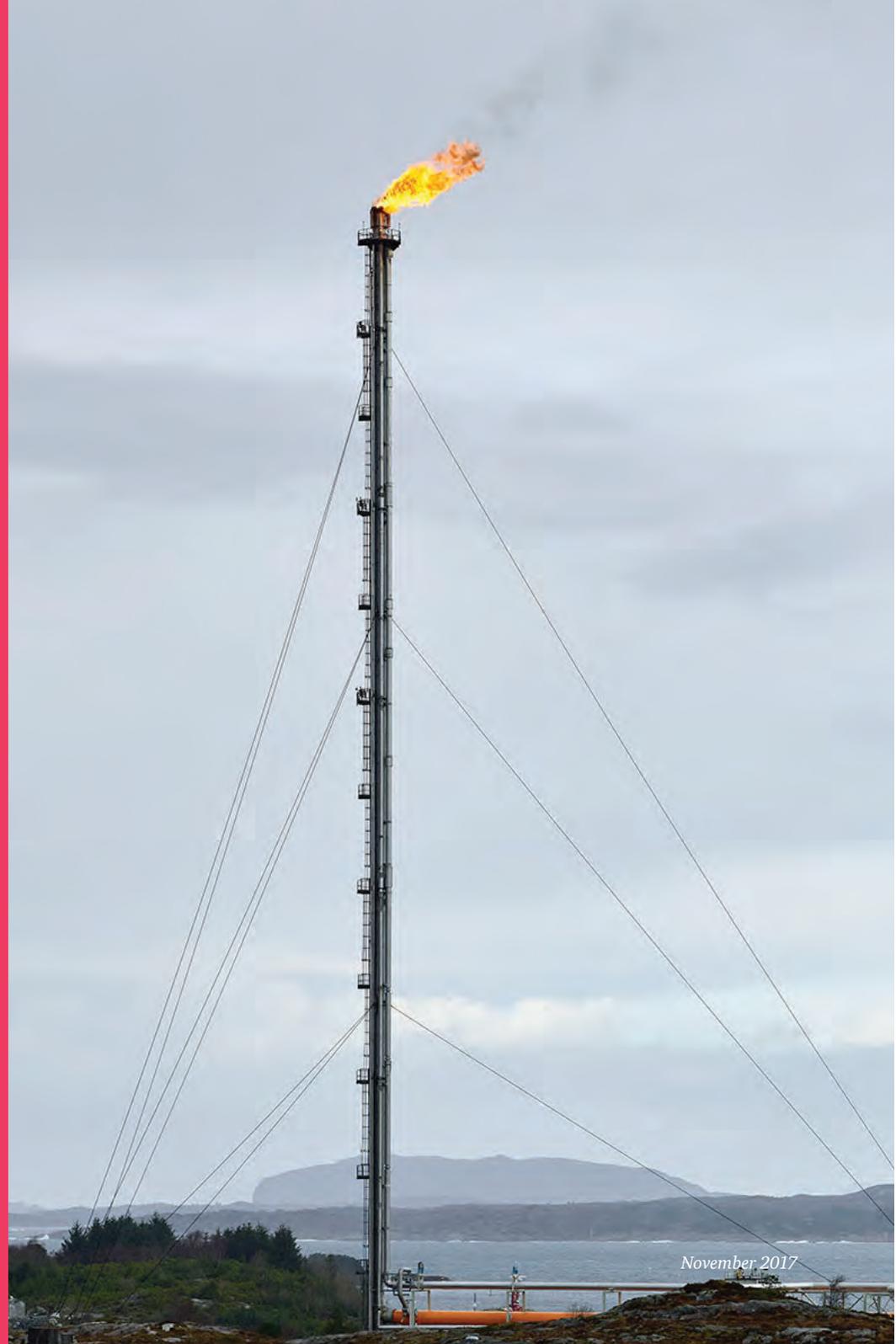
This review factors in the views of oil & gas industry participants operating in Africa and includes the experiences of international oil companies, national oil companies, oilfield service companies, independent oil companies and other industry stakeholders, to shed light on the key challenges and opportunities facing the sector.

In this edition, we consider events that have taken place in the past year within burgeoning and established hydrocarbon provinces throughout the continent. With a constantly changing competitive environment and significant pressure on cutting costs, the industry continues to face significant challenges. However, there continue to be opportunities too.

The sustained lower price of oil has largely been accepted as the new normal, and companies are putting plans in place to enable a more dynamic and

nimble response to commodity price fluctuations in the future. For some, this means a **diversification of portfolio**, and many are considering moves to an energy mix that includes some form of renewables and other alternatives. As low carbon continues to feature high on government agendas, renewables will continue to gain momentum—and they will present more competition to traditional hydrocarbon solutions.

In addition to balancing portfolios, oil & gas companies are also reconsidering their overall **strategies** to ensure that they are aligned and poised to evolve in the future energy market. Key to this are the capabilities that can differentiate them in the market, cost structures that make them competitive in the industry and organisational designs that allow for resilience in a changing world.



Africa continues to offer abundant opportunities to explore for hydrocarbons in a frontier market. New hydrocarbon provinces are popping up regularly; Mauritania and Senegal are good examples of countries where hydrocarbons have recently been discovered.

To date, the African oil & gas industry continues to play catch-up with the rest of the world. But what if there is another way? What if African oil & gas companies could sidestep the competition by doing things differently? There are new technologies that can enable a profound transformation to the way operations and business are conducted in the industry.

At PwC, we believe that African oil & gas companies should be ‘**learning to leapfrog**’. Challenges will persist, but given new technologies and ways of working, companies could learn to leap over them rather than going through them. Take for example the lack of infrastructure that plagues the industry in Africa. If there are no roads to get parts and equipment to remote work sites, why not utilise drones? Imagine when the need for a small replacement is produced by 3D printers and delivered to a drilling location via drone—reducing downtime to a fraction of what it would have been with traditional sourcing strategies.

Likewise, oil & gas organisations need to rethink the way they embrace change to their benefit. Industry leaders have often been accused of being laggards when it comes to tech adoption. On the surface it comes as a surprise considering the level of innovation and new technology that has been developed by the industry to explore for and produce hydrocarbons. But when it comes to the structure and functioning of the organisation itself, more visionaries are needed in Africa to ensure that they don’t find themselves on the bottom of the hierarchy when it comes to the diffusion of innovations.

One such call to action is the need to pay attention and do something about **cyber security**. The threat is real. Cyber security must become a matter of national security, and pretending that it does not exist or threaten your organisation is a sure-fire way to get your fingers burned. The more we embrace new technology, the more critical cyber security will become.

PwC follows and analyses developments in the market in order to advise and guide our clients with innovative and market-leading solutions in a world of uncertainty. We feel that this is critical to the fulfilment of our purpose: ‘To build trust in society and solve important problems’.

Our industry experts take up the call of duty to maintain a wide-ranging knowledge base on the energy value chain that can be tapped by our clients to drive transformational change. As we move into the future of energy, we encourage the African oil & gas industry to take up the challenge in ‘learning to leapfrog’!

Pedro Omontuemhen

Africa Oil & Gas Industry Leader

Chris Bredenhann

Africa Oil & Gas Advisory Leader

Ayesha Bedwei

Africa Oil & Gas Tax Leader

Oil reserves

128.0 billion barrels

7.5% of the world's proven reserves

Gas reserves

503.3 Tcf, **86.8 billion** BoE

7.6% of the world's proven reserves up 0.1% from prior year

Shale oil potential

Libya 5th globally

26 billion barrels

Shale gas potential

Algeria 3rd globally

121.9 billion BoE

Bidding rounds in 2017 include: Gabon, Congo-Brazzaville, Egypt, Equatorial Guinea, Namibia, Nigeria, Seychelles, Somalia, South Sudan and Tunisia

By 2050, Africa's oil & gas is set to increase by **74%** and global consumption by 45%. Africa's share of global consumption will increase from 4.3% to **5.1%**

Refinery capacity as % of global:

3.5%

Actual throughput 2016:

2.6% or **2.1 million** bbl/day

LNG exports from Nigeria, Algeria, Egypt and Equatorial

Guinea were 1.61 Tcf, **13.1%** of global, down 6.6%



Global LNG nominal liquefaction capacity 339.7 MTPA at December 2016. Africa capacity 68.3 MTPA,

20.2% of global capacity, a decline of 4% over the past 2 years

LNG operating capacity in Africa in 2016 **51%**, average world operating capacity 82%

Average excluding Africa **90%**

Gas pipeline exports were 45.6 bcm, 6.2% of the world's export. Africa exports increased by 8.3% in 2016

Global oil discoveries were down to 174, the lowest level for 60 years.

Africa only had **3** major discoveries in 2016 and H1 of 2017, down from 11 in 2015

Global oil discoveries declined to 2.4 billion barrels in 2016 compared to an average of **9** billion barrels p.a. over the past 15 years

Oil production as % of global:

8.6%, down 0.5% from prior year

Oil consumption as % of global same as prior year at **4.2%**, although it grew regionally by **1.5%**

Gas consumption **13.3** Bcf per day, grew by 1.4% in 2016

Executive summary

Reserves and production

Africa's share of global oil production has continued its downward trend from the past four years, dropping sharply, moving it from 9.1% of global output last year to 8.6%.

Proven oil reserves in the region are estimated at 7.5% of global, a 0.1% drop from 2016 totals. As exploration activity has waned, this result was foreseeable. Despite this reduction, recent large finds include: Owowo in Nigeria with a potential of one billion barrels of oil, Cayar in offshore Senegal/Mauritania with approximately 15 Tcf of gas and Block 20/21 in Angola with around 313 million barrels of condensate and 2.8 Tcf of gas. Globally, the oil discovery count was down to 174, the lowest level for 60 years.

With a total of 128 billion barrels of oil reserves, Africa's daily production dropped to 7.9 million barrels of crude oil per day (bbl/d) in 2016—a total year-on-year reduction of 4.9% as compared to 2015. As was the case in our previous review, over 77% came from Nigeria, Angola, Algeria and Egypt.

The drop in African production was sizeable in many jurisdictions with production in Nigeria and Congo dropping 11.9% and 7.6% respectively. In South Sudan, despite it being one of the most oil dependent countries in the world, there was a 20% drop in production between 2015 and 2016. This is due to the continued disruption from civil war in the territory as well as ageing production facilities. There are only two notable countries where production increased with Algeria growing by 1.4% and Chad increasing by a mere 0.6%.

At the end of 2016, Africa is reported to have had proven natural gas reserves of 503.3 Tcf. This marks an increase of around 1% in total gas reserves on the continent. Ninety percent of African gas production continues to come from Algeria, Nigeria, Egypt and Libya though the overall quantity produced in 2016 reduced by 1.1% down to 208.3 bcm. As a result of the decrease in production and some additional discoveries, we have seen the years of available natural gas production go up from 66.4 to 68.4.

Source: BP Statistical Review 2017



Growth and development

As industry activity continues to wane globally, industry participants are focusing investment on a very few select projects. Cost cutbacks continue, and exploration activity is at a historic low despite lower costs associated with rig day rates. We have seen a handful of discoveries in offshore Africa over the last year, but most of those prospects have been in the pipeline for quite some time. We don't expect to see exploration activity ramp up substantially until the oil price starts to show some form of a sustainable increase.

The focus on the continent tends to be quite wide at the moment. Players are going where the geology looks promising and where the fiscal terms are most attractive. The promise that was once shown in East Africa seems to have lost some momentum though the fact that project sanction has now been given on Eni's Coral FLNG project bodes well for the region.

While we are seeing a reduction in upstream activity across the board, midstream and downstream activities are picking up some pace. There are several countries or regions looking at opportunities to develop storage or transport facilities in order to take advantage of market needs. Several small independent companies have been conducting market and feasibility studies to enter downstream distribution in various parts of Africa as well.

In addition, independent power producers (IPPs) are regularly eyeing African markets for entry opportunities. Many of them offer gas-fired power solutions. This aligns with the expected overall growth agenda for a lower carbon future as gas is expected to be used as a bridging fuel as we move to more renewable alternatives.

The hope is that additional gas usage could result in reduced flaring on the continent with additional facilities providing alternative uses for the gas. Although overall gas flaring has increased globally, the World Bank reports that Nigeria has made significant progress, reducing flaring by 18% since 2013, to less than 8 bcm in 2015.



Costs continue to be at the top of the oil & gas CEO agenda. While mass layoffs are largely behind us, operators in the upstream space continue in their attempts to cut operating costs. They have also shelved or cancelled some projects in an effort to cut capital expenditure. Given the cost reduction efforts and pressures that have been placed on service providers, we might soon see a slight uptick in project sanction—both globally and in Africa.

Oil & gas companies are also looking at their strategies in an effort to make themselves more resilient. Whereas in previous downturns, we might have witnessed mass layoffs followed by a hiring surge in the upswing, now players are realising that they must design their organisations in order to be dynamic and nimble.

From a human resource aspect, this means that more individuals need to have broad knowledge across the business so that they can be deployed in areas where they are needed, which may vary from cycle to cycle. Specialist individuals who can only fulfil specialist roles will likely become less attractive as companies reinvent themselves.

Technology and innovation obviously present a great growth opportunity for industry players in Africa. Because of the frontier nature of the territory, companies working here feel as though the region needs to catch up with the rest of the world when it comes to the energy sector. We believe, instead, that the industry should be ‘learning to leapfrog’ in order to jump past the competition by harnessing innovation and technology.

Other industries in Africa have done just the same—the telecommunications sector in Africa, for example, is very advanced. Instead of rolling out copper wire for communications, many African countries went straight to mobile solutions. This was borne out of the challenges that the African market faced. Instead of simply trying to go through the challenge, they innovatively went around it, offering cutting-edge products to the market.

There is also still a promise of growth and urbanisation on the African continent. As we make a move to become a more interconnected and globalised world, there will always be opportunities on the horizon. The African people must embrace these opportunities while also

demonstrating patience and resilience to weather the storm and come through the turbulence to create a strong and prosperous future—and that includes the oil business.



The challenges

For the fourth year in a row, uncertain regulatory frameworks come top of the list of challenges cited by our respondents. While not surprising, it is a bit disheartening that governments are still not taking up the plea from oil & gas companies to actually do something about ensuring certainty to players who are looking to invest in hydrocarbon plays in various African countries. Likely, it's largely due to the political nature of such a challenge. No one person or entity has direct control over regulatory frameworks, and many of the stakeholders don't realise or appreciate how important they are in creating an attractive investment environment for potential entrants.

Corruption moved up slightly on the agenda this year, moving from third place to second place. This could be due to some of the news that we have been hearing in certain markets, ranging from state capture accusations in South Africa through to potential election fraud in Kenya. Transparency must continue to be promoted throughout Africa if we are to see progress in this regard, and every individual must choose to make moral and ethical decisions to ensure a level playing field and a fair market.

While it dropped in importance for the past two years, financing costs has popped back into the top-three challenges cited this year. This is largely due to wariness from financial institutions stemming from some of the other challenges like fraud and corruption concerns as well as foreign currency volatility (which came fourth on the list of challenges noted by respondents this year).

The fifth challenge listed this year is taxation requirements, dropping from second position in 2016. While taxation remains an important challenge. This move is likely related to the relative upward movement of other challenges.

In addition to the top-five challenges, PwC continues to see oil & gas clients focus on cost cutting. Players continue to be more discerning in choosing the projects they wish to take forward, and operational excellence continues to factor high on the agenda.



Turning obstacles into opportunity

There is also a need to rebalance portfolios, and renewable and other alternative energy solutions are being tabled more often by oil & gas players than ever before. Diversification continues to be key to weathering the commodity cycles.

The lack of skills development is a persistent problem in Africa, and it is becoming a global challenge in the oil & gas industry overall. As a large portion of skilled individuals in the industry is set to retire soon, there is still a need to grow and develop the next generation of industry leaders in an effort to ensure succession planning.

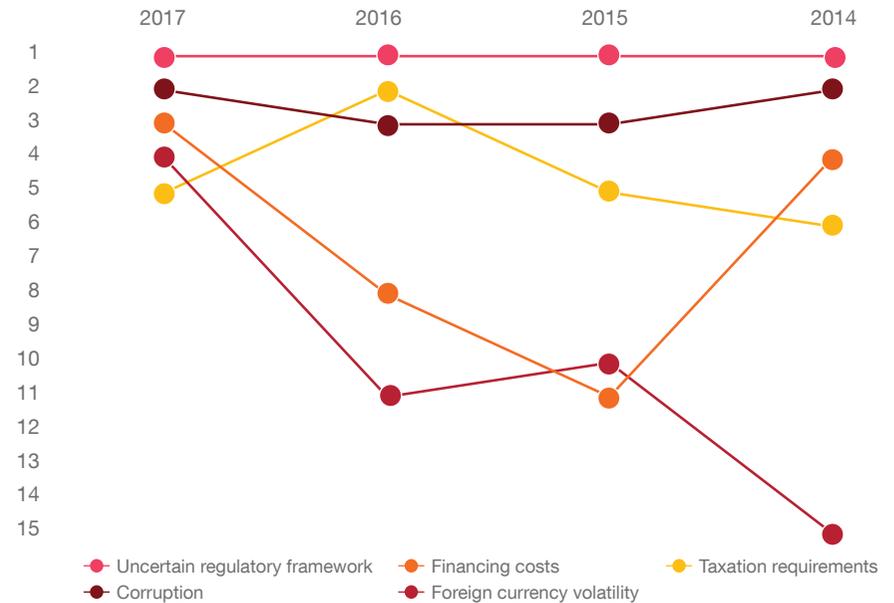
Lastly, the industry in Africa needs to take up and utilise technology as an enabler in meeting other challenges being faced. Instead of simply catching up to the rest of the world, this strategic effort will enable industry players on the continent to ‘leapfrog’ the rest. Challenges will be ever-present, but they also pose the opportunity to ‘reimagine the possible’, which is fundamental to operating an oil & gas business in the low-price oil world of today and in the potentially volatile energy future.

As in the rest of the global industry, the African oil & gas market has been adjusting to the realities of a US\$50-60/bbl oil price landscape. However, aside from this particular ‘new normal’, there has been consistency in the specific regional challenges facing oil & gas companies over the years. The challenges of operating in Africa are numerous and interrelated.

This year, we see that the top challenges have remained similar to those in previous years—with uncertain regulatory frameworks, corruption and taxation requirements remaining in the top six for the past four years. We also see that financing costs and foreign currency volatility have both become more critical challenges since 2015 when they were being ranked 11th and 10th respectively.

Figure 1: Top five challenges over time

Q What do you see as the five biggest external challenges in developing an African oil & gas business in your country? Please rate on a scale of 1-5 with 1 being the highest priority and 5 the lowest.



Source: PwC analysis

Regulatory issues a critical challenge across the continent

The uncertain regulatory frameworks in oil & gas across Africa have been the primary challenge for four consecutive years and continue to severely inhibit sector development across the continent.



Uncertain regulatory frameworks in oil & gas across Africa have been the primary challenge for four consecutive years

Nigeria finally making progress

The Petroleum Industry Bill (PIB) in Nigeria is legislation proposed in order to redefine the legal framework and regulate the petroleum sector. The Bill, lagging in the National Assembly since 2008, is yet to be passed in its entirety, with various stakeholders opposing it to varying degrees, creating significant uncertainty in the industry.

The government has broken the Bill into four parts to enable easier passage into law—with the aim for passage by the end of 2017. This strategy has achieved some success, as the Petroleum Industry Governance Bill (PIGB), which focuses on regulation of the petroleum industry, has been passed. While the remainder may take longer than this year to pass, this marks a significant milestone for the Bill, and there is hope that this will bring some certainty to the industry.

South Africa dragging its feet

Upstream regulation in South Africa remains uncertain, with separation of oil & gas from mining still not achieved in the Mineral and Petroleum Resources Development Act (MPRDA). In a largely under-explored region, regulatory certainty will be required in order to develop the industry.

Several amendments have been suggested to the Act, with the main amendments calling for the establishment of two new entities to take responsibility for promoting petroleum exploration and production as well as dealing with petroleum rights applications. These two entities would take the place of the Petroleum Agency of South Africa (PASA).

The MPRDA also proposes the state be provided with a 20% free-carried interest in all new exploration and production rights, with further state participation in the form of acquisition at an agreed price, or production sharing agreements and joint operating agreements.

However, in August 2017, legal experts warned that the amendments were still not aligned to the constitution, prompting further delays.

Other key markets in Africa are also experiencing regulatory issues

Tanzania

Tanzania passed two laws in July 2017 allowing the government to forcibly renegotiate contracts with mining and energy companies. It is unclear if any of the outstanding petroleum contracts will be renegotiated, but this has potential to significantly undermine investor confidence.

Mozambique

The country approved the New Gas and Petroleum Law 2014 in August of that year. The framework has reduced uncertainty, but issues remain for (potential) investors. These include the state's ability to participate at any lifecycle phase (creating planning uncertainties), local participation requirements (preferred at up to 100% premium over internationally sourced goods and services)) which will lead to higher costs and potential supplier risk, and requirements for resources to be used domestically (potentially challenging in early years of production given an immature market).

Uganda

The legal framework that currently governs the operations of the petroleum industry includes the Petroleum (Exploration, Development and Production) Act, 2013, the Petroleum (Refining, Conversion, Transmission and Midstream Storage) Act, 2013 and The Public Finance Management (Amendment) Act 2015.

The legislation has been criticised for granting too much authority to the Energy Ministry. Additionally, the local content laws and regulations have caused some excitement with varying interpretations from different players and prospective investors. Despite this, developments are ongoing with the oil pipeline line route agreed and the FEED study as well as the land acquisition and resettlement planning underway. Concurrent FEED studies are taking place for upstream oilfield development and PSAs for the new exploration licences which are being negotiated.

Angola

Presidential decrees are leading to changes limiting Sonangol's role more, for example with the intended creation of a new petroleum sector agency. However, some newly-enacted fiscal revisions are not having the desired impact, such as a decree to allow further

exploration on development licences intended to prove more reserves, which remains unused; and a marginal field terms decree to incentivise investment in smaller discoveries, which is seen as ambiguous—Sonangol has announced it will be revised. In short, while the changes look to bring some certainty, they will take time to cement.

Corruption continues to plague the industry

Corruption has remained among the top three challenges over the last four years, with numerous instances occurring across the continent. Despite the existence of anti-corruption programmes at government and corporate levels, the effectiveness of such programmes is questionable as corruption remains prevalent.



Despite the existence of anti-corruption programmes at government and corporate levels, the effectiveness of such programmes is questionable

The motivation for corrupt activity varies. Paying bribes or facilitation fees can often be to bypass bureaucratic inefficiencies and the related cost of delays to companies. Other reasons include:

- Perceived challenges in dealing with public institutions;
- Government employees who are often poorly paid;
- A belief that bribes are required to do business in certain areas;
- Difficulty with monitoring in remote locations;
- Large tender and bid margin possibilities;
- Supplier kickbacks; and
- Government nepotism to promote their own political agendas.

A positive sign is that companies are prioritising and spending money on prevention of fraud and corruption with more ethics training and senior management locally and globally encouraging companies to be legally compliant in all countries in which they operate.

Further indication of attempts to drive change is that the Extractive Industries Transparency Initiative (EITI), which promotes transparency, good governance and accountability in the use of oil, gas and mining resources, has more African country participants by number and percentage than the rest of the world. African governments are therefore aiming to become compliant, primarily so that they can attract more foreign investment.

Despite some regional producers (such as Nigeria) being identified as having made satisfactory progress towards meeting the 2016 EITI Standard, some issues still exist. As an example, assets in Nigeria worth US\$1.2bn from Shell and Eni were seized in January 2017, due to alleged fraud. The US Department of Justice has also filed a lawsuit against Nigeria's former oil minister relating to alleged illegal awarding of oil contracts.

Difficulty accessing affordable finance

In the context of corruption issues, it is perhaps not surprising that costs of finance have risen to third among major challenges for African players. It is likely that the regional issues and uncertainties, combined with a constrained wider industry, have led banks and other institutions to be wary of offering favourable financing terms.

Indeed, in Nigeria, we've seen banks express difficulties in providing loans to the industry. Dr Ibe Kachikwu, the Minister of State for Petroleum Resources summarised the issue:

Over the years, Nigerian companies have found it difficult competing with their counterparts from jurisdictions where funding is accessible for five percent or less as compared to our market where bank lending rates hover around 20 percent.¹

¹ Onwuemenyi, Oscarline. "How ageing pipelines impacted crude production in July – Kachikwu" Sweet Crude Reports. 25 August 2017. <http://sweetcrudereports.com/2017/08/25/how-ageing-pipelines-impacted-crude-production-in-july-kachikwu/>

For national banks in Nigeria, this will have been driven in part by high inflation rates, which averaged 16% in 2016.

Of course, with international lenders, part of this difficulty is driven by volatile and/or depreciating currencies.

Continued exchange rate volatility

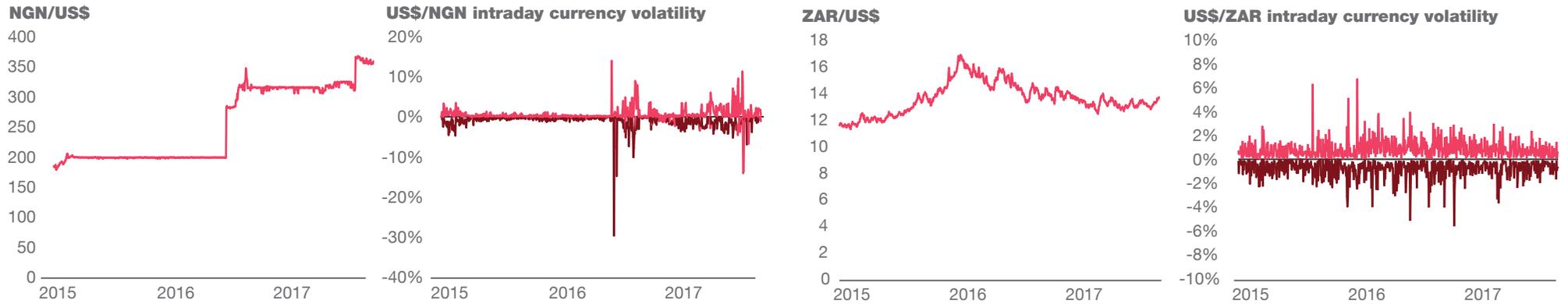
As most respondents operate multinationally, foreign currency volatility is a key issue. When compared to the United States dollar (US\$), we can see volatility across most major currencies. However, we can also see that many currencies across the continent have devalued over the period, which is likely the more pressing issue.

Nigeria's naira lost about a third of its value against the dollar in 2016. While the devaluation of the currency has posed issues, Nigeria has tightened its currency controls since 2014, creating a complex environment, which may have further deterred investment. While the Central Bank of Nigeria has eased some trading restrictions this year, the use of multiple exchange rates has resulted in spreads stretching almost 20%.

The figures on the next page show the intraday currency volatility and US\$ exchange rate of the Nigerian naira (NGN), South African rand (ZAR) and the Tanzanian shilling (TZS). These demonstrate the extent of currency challenges faced by African countries, with a mixture of volatility and/or devaluation.



Figure 2: US\$ exchange rates and intraday currency volatility, 2015–29 September 2017



Source: Bloomberg

Lower forever?

Aside from those challenges highlighted by companies, adjusting to the new normal of lower oil prices remains a key ongoing challenge for businesses. By recent historical standards, the oil price has been relatively 'stable' through 2017. Having recovered since the January 2016 low, it has typically been trading in the US\$50-60/bbl range.



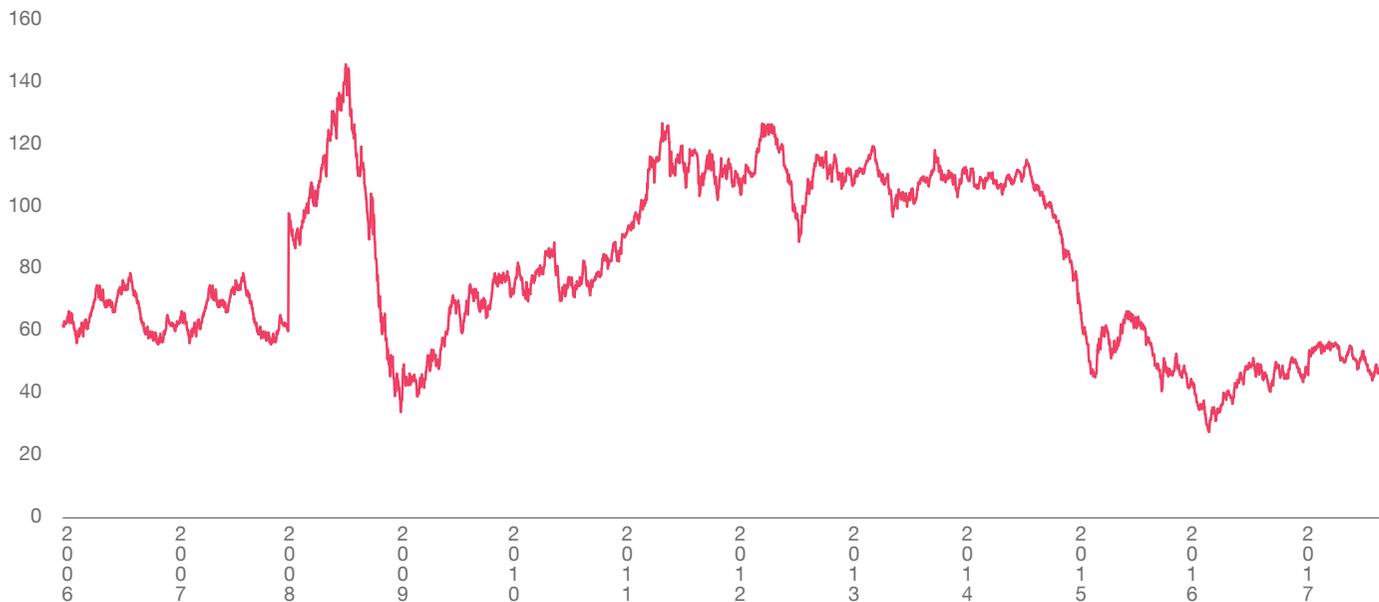
As the Brent oil price reached close to US\$60/bbl in September 2017, market chatter began asking whether ‘lower for longer’ may be over. Certainly, oil demand is picking up, and supply is easing off, suggesting a market rebalancing is under way.

Prices are being propped-up further by geopolitical issues such as increasing civil strife in Venezuela, an uncertain future for the nuclear deal with Iran, threats from Turkey to close pipelines for exports from Iraqi Kurdistan due to the regions secession push, and increasingly bellicose rhetoric between the US and North Korea.

However, global crude inventory levels remain high (approximately 3bn bbls of OECD oil and other liquids inventory in June 2017), and the US tight oil producers’ role as swing producer is likely to cap price rises going forward.

Combining this with an apparent ‘price floor’ driven by OPEC’s continued cuts (a 1.8m bbls/d cut, $\pm 2\%$ of global demand, agreed in November 2016 was extended from June 2017 to the end of Q1 2018), creating a nominally stable range of US\$50-60/bbl. However, as we have often seen with global oil prices, nothing is ever certain.

Figure 3: Brent Crude daily price, January 2006-September 2017



Source: Bloomberg

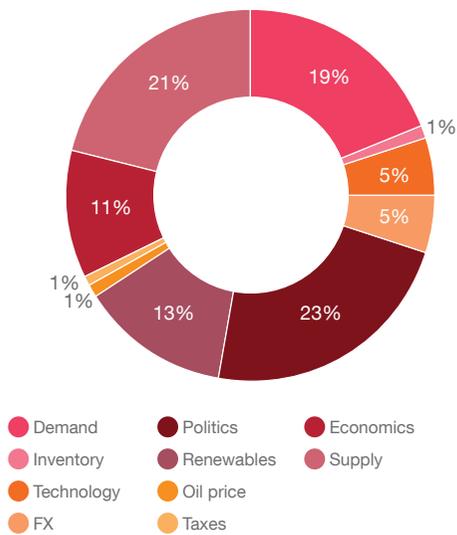
There are geopolitical tensions across some OPEC and non-OPEC members that create risks to the sustainability of production cuts. Notably, there have been tensions between Saudi Arabia and Iran over proxy wars in Yemen and Syria. Moreover, supply from Nigeria and Libya, who are exempt from OPEC cuts, are already seen as risks to market rebalancing.

Survey respondents generally agree with a conservative view, citing geopolitics, supply and demand as the three major reasons for the current oil price environment. Renewable technology proliferation is also seen as having a significant impact on the oil price. However, the skew towards the top three responses suggest that the current low prices are perceived to be very much a function of oil market fundamentals, with an appreciation of the increasing impact of renewables.

Looking ahead (or perhaps into their crystal balls), respondents broadly agree to an expectation of modest price increases over the next two years—with 65% and 52% expecting price to be in the US\$51-60/bbl range for 2018 and 2019 respectively.

Figure 4: Drivers of commodity prices

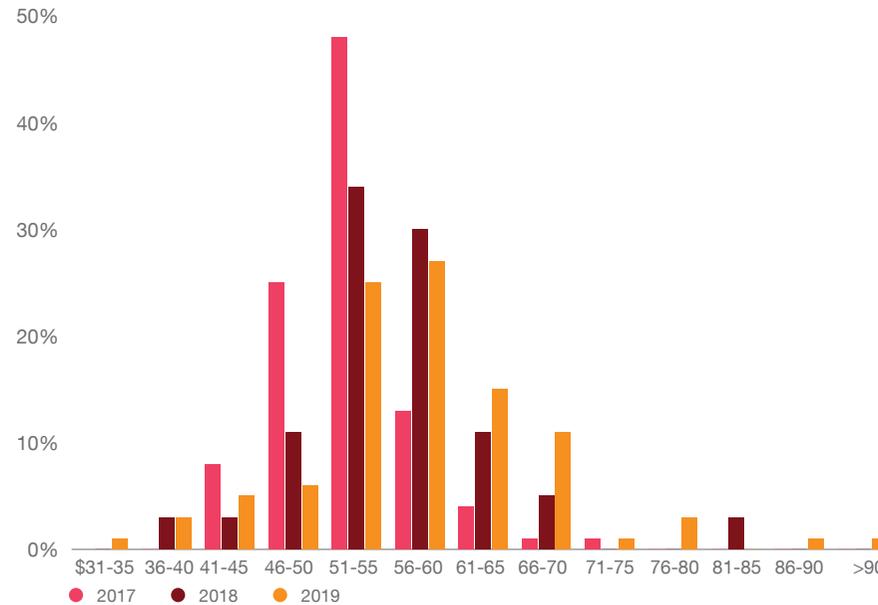
Q What factors do you think are impacting commodity prices most?



Source: PwC analysis

Figure 5: Expectations of future oil prices (US\$/barrel)

Q What oil price do you expect at the end of the next three consecutive years?



Source: PwC analysis

Acreage costs

With oil prices being somewhat sustained, this year marks the end of decreasing acreage cost expectations. After a period of decreasing capex spend, there have been some early indicators of a recovery. Approximately 32% of survey respondents said they expected somewhat of an increase in acreage costs.



As activity and capex in the region increases, acreage costs may do the same

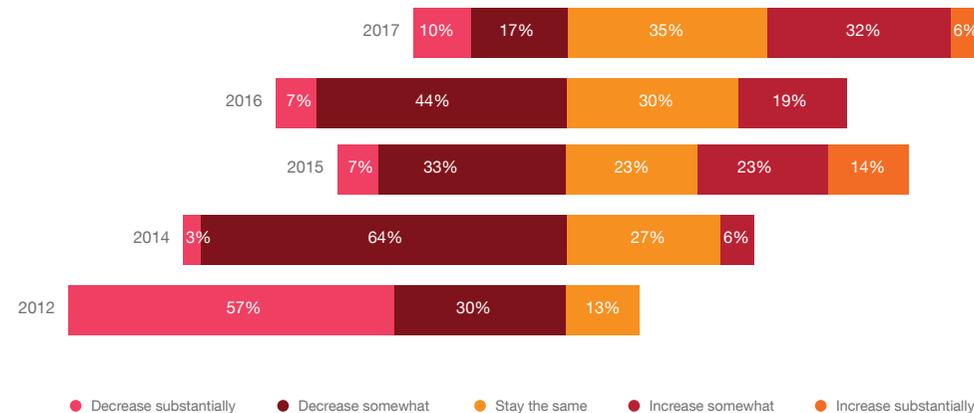
Between July 2016 and January 2017, the rig count in Africa increased from 79 to 89. This increase may continue given average rig day rates in sub-Saharan Africa have declined by $\pm 60\%$ since 2014.²

² Baker Hughes, PwC Analysis

Oil & gas industry capex is expected to increase further in the near future, from US\$46bn spend in 2017 to US\$58bn in 2020.³ Such an increase would support a perceived increase in acreage costs.

Figure 6: Expectations of acreage costs

Q Over the next year, what do you expect to happen to acreage/licence acquisition costs in your country?



Source: PwC analysis

³ Rystad, PwC analysis

Nature of discoveries

While spend might be increasing now, global trends suggest that capex allocation and related discoveries may change. Although recent discoveries in Africa have been offshore, with some being deepwater, this may not continue to be the case with investment tendencies likely to shift if oil prices remain as they are.

According to the 2017 Barclays Upstream Spending Survey, IOCs will be more focused on shorter cycle opportunities (e.g. shale, shallow water, brownfield, tiebacks) over major deepwater projects.

In North America, offshore markets remain in a state of continued decline versus recovery in onshore, which we could also see happen in Africa if prices remain in a US\$50-55/bbl range over the longer term. There are already indications of this trend, with all types of discoveries declining between 2013 and 2016 (expected given the extent of capex declines), but offshore and unconventional declines are much greater than onshore and conventional, at -70% and -100% vs -37% and -41% respectively.

Furthermore, operators in Nigeria are expected to increase focus of drilling spend on low-cost workovers in the near-term. Eni, which has invested in Africa throughout the low-price period, is more likely to focus on projects with lower cost per BoE, such as offshore projects in Mozambique and Congo in 2019 and beyond.

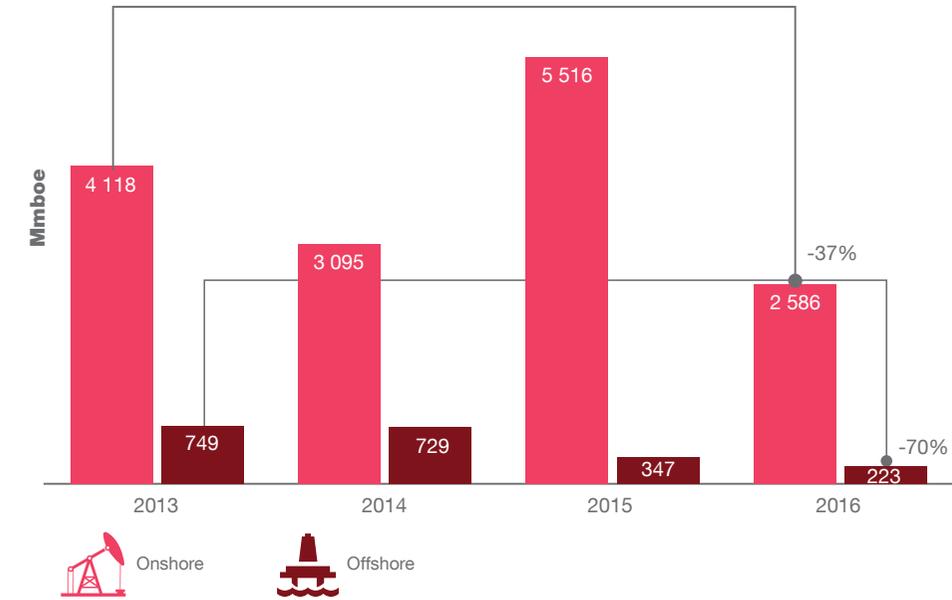
This may change with higher and more stable oil prices. In this outcome, it would likely stimulate the economics of more expensive plays (e.g. deepwater). However, major players such as IOCs may look to maintain low break-even portfolios, even in the instance of higher prices, in order to ensure profitability against a backdrop of market volatility.

Top 10 oil & gas discoveries in 2016

Asset	Country	Region	Operator	Type	On/ Offshore	Resources (Mbbbl)
Woodford & Barnett Shale (Alpine High) – Permian Delaware	United States	North America	Apache	Gas	Onshore	944
Katambi	Angola	West Africa	BP	Gas	Offshore	699
Woodford & Barnett Shale (Alpine High) – Permian Delaware	United States	North America	Apache	Liquids	Onshore	629
Teranga	Senegal	West Africa	Kosmos Energy	Gas	Offshore	529
Al-Jathatheel	Kuwait	Middle East	Kuwait Petroleum Corp (KPC)	Liquids	Onshore	419
Ahmeyim	Senegal	West Africa	BP	Gas	Offshore	417
Golfinho	Angola	West Africa	Cobalt International Energy	Liquids	Offshore	272
Jerun	Malaysia	Southeast Asia	Sapurakencana Petroleum	Gas	Offshore	250
Zalophus	Angola	West Africa	Cobalt International Energy	Gas	Offshore	245
Anye Shale	China	East Asia	Sinopec	Gas	Onshore	244

Source: Rystad Energy

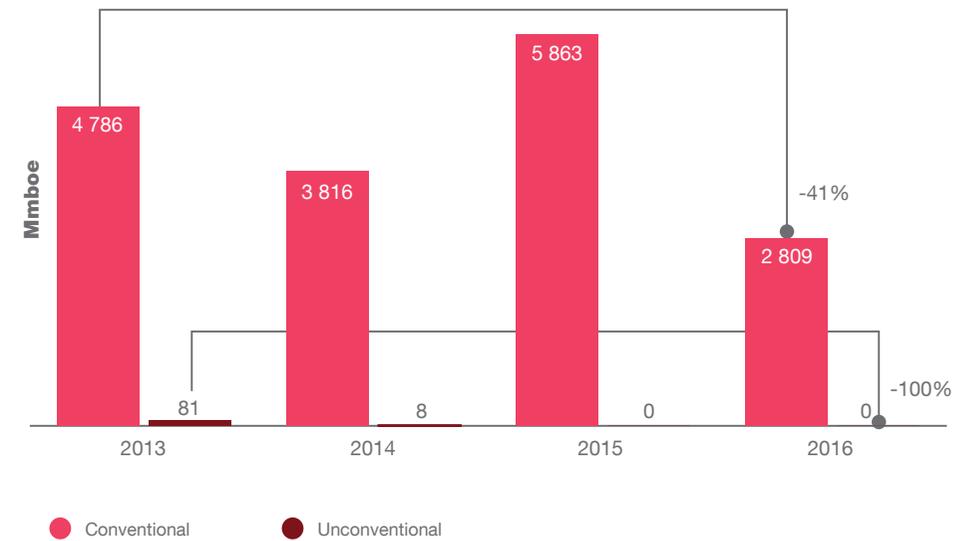
Figure 7: Onshore vs offshore discoveries (Africa)



Source: Rystad Energy



Figure 8: Conventional vs unconventional discoveries (Africa)



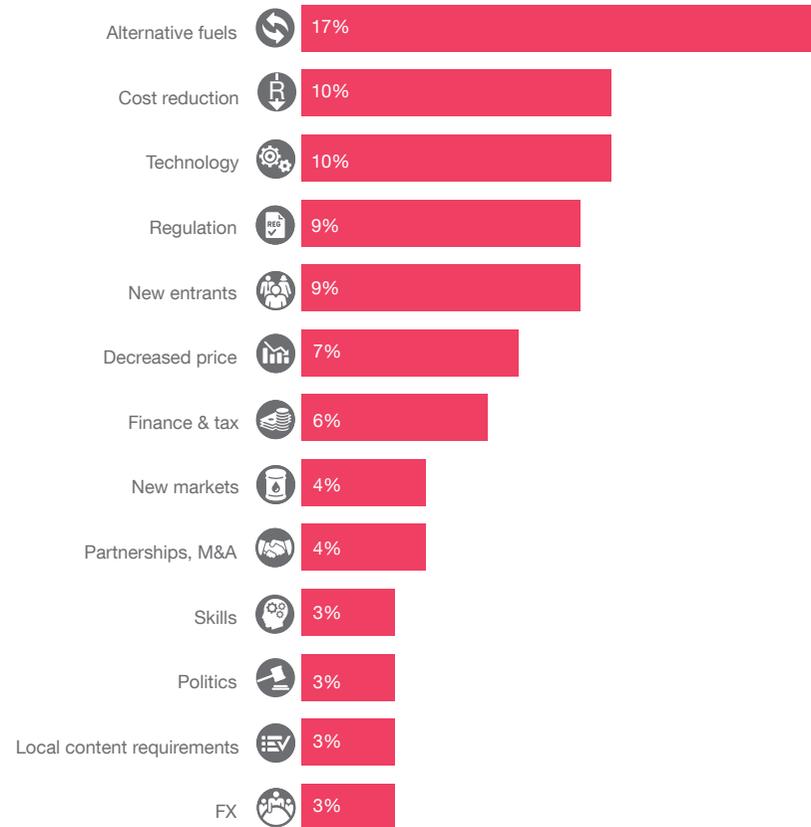
Source: Rystad Energy

Changing competitor landscape

In response to many of these challenges, companies are looking to alter their strategies and operating models, which has changed the competitive landscape. Respondents report that major changes anticipated or recently experienced in the competitive environment are driven by the growth in alternative fuels, the impact of regulation, technology-driven disruption and the need for cost reduction. We're also seeing that new entrants and partnerships are having an effect as peripheral drivers. Other factors were raised, but to a lesser degree.

Figure 9: Changes anticipated or recently experienced in the competitive environment

Q What changes do you anticipate, or have you recently experienced, in the competitive environment?



Source: PwC analysis

Alternative fuels

Alternative fuels are viewed as the biggest driver, likely due to the growth of the liquefied natural gas (LNG) industry over oil and the potential for the development of unconventional gas as well as the expansion in renewables.

Gas and LNG are transforming the energy landscape across Africa. Of the largest 10 discoveries globally in 2016, five are gas discoveries in West Africa. Of the recent final investment decisions (FID) in the industry, one was the significant Coral South FLNG in Area 4 of Mozambique (on track for first LNG production in 2022), led by Eni in May 2017. This will mark the first FLNG unit in Africa and the third globally.



With low-carbon commitments increasing demand for green energy, it is also certain that renewables will become an ever-important part of energy companies' portfolios

IOCs have been altering their portfolios, but there is no ideal energy mix being pursued.

Significantly, there are examples of companies looking to utilise their current capabilities to best enter the renewables market. Examples include utilising offshore technologies (particularly anchoring) to secure offshore wind plants as well as Shell stating that its expertise in managing financial, political and project-development risk positions it will to take part in clean-energy plays. Statoil and Ørsted (formerly known as DONG Energy), on the other hand, are leveraging their offshore oil & gas experience (logistics services, operating in harsh environments, etc.) to the development of renewable technologies such as offshore wind.^{4,5}

Regulations

As mentioned, regulatory uncertainty continues to delay development of the industry in a number of regions. Companies are, understandably, delaying FIDs (and even exploration) until they can plan accordingly. Similarly, complex regulation can also lead to organisations exiting markets.

Few companies seem able to derive a competitive advantage from this, as regulations tend to impact the whole industry. However, regulation can raise barriers to new entrants, which can allow the national incumbents, namely NOCs and experienced IOCs, to dominate the markets.

Technology

In PwC's 2017 Annual Global CEO Survey, we asked executives to what extent technology will change competition over the next five years. Only 1% of energy CEOs believed there would be no impact—28% moderate impact, 52% significant impact, and 18% believe it will completely reshape competition.

Many organisations are looking at technologies to enhance their business models (e.g. cutting costs and improving operational efficiency by making use of technologies such data analytics, the Internet of Things (IoT), drones and blockchain).

While disruptive innovation in the capital-intensive and highly-regulated oil & gas industry might seem unlikely, innovation thrives on constraints. The industry should not believe it is insulated from the rapid change of business in other industries. In today's business landscape, industries can change rapidly, and organisations need to plan accordingly.

Cost reduction

We've seen that the top strategic priority for oil & gas companies remains operational excellence, with nearly three-quarters of respondents looking at some formal cost-reduction initiative.

To achieve these savings, companies have altered their operating models and focus, which has significant implications for the competitive landscape. This might be most noticeable in the upstream sector, where companies have drastically decreased their risk appetite. They are now focusing on low-risk initiatives such as appraising existing regions with shorter lead times and low above-ground risk over new explorations with higher-cost marginal plays, etc. Companies have also looked to de-risk activity and expand operations through new partnerships to access capabilities while incurring lower costs.

New entrants and partnerships

While the majority of respondents do not believe that new entrants and partnerships are driving changes in the competitive landscape, we believe that this will become an increasingly important factor.

The oil & gas industry has evolved from being dominated by large, generalist companies, to a myriad of specialists focused on narrower aspects of the operating environment. We will see fewer single, integrated companies discover, develop and operate a field, and more alliances of partners or changes in ownerships throughout the lifecycle, maximising value extraction.

In Africa, NOCs are playing an important role which is often delivered through partnerships, and companies will need to ensure they have the right capabilities to build value in these partnerships.

In order to compete in this world, companies will need to consider appropriate collaboration and partnership models, which may not come easily for some. One noteworthy example is the alliance between BP and Kosmos in West Africa, where the oil giant is looking to leverage the technical exploration capabilities of a smaller firm.

⁴ Hirstenstein, Anna. "Shell Sees Ability to Manage Risk as Benefit in Offshore Wind Development". *Renewable Energy World*. www.renewableenergyworld.com/articles/2017/06/shell-sees-ability-to-manage-risk-as-benefit-in-offshore-wind-development.html

⁵ "Oil companies position for emerging offshore wind sector". *Offshore*. 10 August 2017. www.offshore-mag.com/articles/2017/08/oil-companies-position-for-emerging-offshore-wind-sector.html

With all of these challenges, companies need to focus

To respond to such a myriad of challenges, organisations need to craft their strategies and ensure that they focus on key initiatives. Following a challenging few years, oil & gas CEOs' short-term confidence about company growth has risen compared to last year and is on a par with 2014 and 2015. They are less confident than in other sectors about their company's growth prospects, but are more optimistic about overall economic growth: 34% are confident that global economic growth will improve (up from 28% in 2016); 29% are very confident of growth internally (up from 27% the previous year).

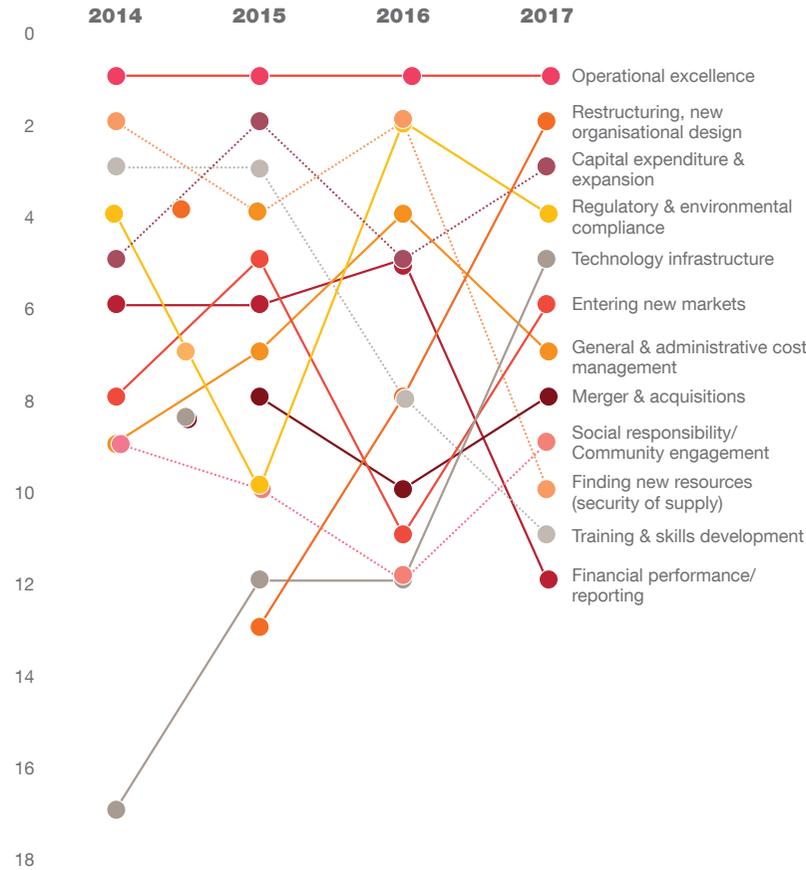
Survey results indicate that African oil & gas companies are continuing their focus on operational excellence and capital expenditure & expansion, as in the previous year. However, we're also seeing more focus on restructuring their organisations and improving technology infrastructure.



We're seeing more focus on organisational restructuring and improving technology infrastructure

Figure 10: Top three strategic focus areas

Q Please select the top strategic focus areas for your company over the next three years



Source: PwC analysis

Operational excellence

Operational excellence remains the top strategic focus area—not surprising given falling revenues tied to low oil prices. Of course, operational excellence goes beyond cost-cutting; it enables safe, reliable and efficient operations, which are business imperatives at any oil price.

Restructuring

Restructuring/new organisational design has increased from 6th place to 2nd place over the past year—the highest leap among all factors. This could be driven by two things:

- Restructuring forms part of new operating models, which can be key to driving efficiencies and cutting costs. In the same way that operational excellence has remained a key challenge, we expect restructuring to be another initiative to control costs in a low oil-price environment.
- Companies are looking to alter their energy portfolios, which they may do through the development of new departments, such as renewables and alternative energy solutions.

Capital expenditure & expansion

Companies are increasingly concerned with capital expenditure and expansion, as seen in its move from 5th to 3rd. Globally, we're seeing some early indicators of a recovery—Rystad is forecasting steady recovery, with 9.8% CAGR from 2017-2020 globally, largely being driven by North America.

Significant growth is also expected in Africa, forecast at 7.5% CAGR over the same period with the most notable investment being Eni and Galp's decision to invest US\$7bn in Mozambique's Area 4 consortium for the Coral South FLNG project.



Take-aways

- The sustained low oil price means organisations need to continue to manage costs/spend efficiently. This is made more important as we begin to see capex increases return.
- In a changing competitive landscape, driven by alternative fuels, technology, cost-cutting and partnerships, companies need to review their strategic portfolio of activities to ensure appropriate positioning as the competitive landscape changes.
- With financing costs, FX and currency devaluation continuing as key issues for the industry, organisations should consider developing more sophisticated finance capabilities.
- As corruption continues to be a key factor in the industry, businesses need to ensure that strong, ethical leadership drives the right behaviours across the organisation.

Tough questions: Strategy and capabilities



- Do you have a regulatory strategy, with intentions to build good government relations and play a proactive role in any uncertain regulatory frameworks?
- In an increasingly risky business environment, how can you factor both agility and resilience into your growth strategy?
- What is your organisation doing to prepare itself to respond to and recover from a crisis?
- How is your organisation building trust by better understanding stakeholders' views?

Are companies in Africa's oil and gas industry Fit for Growth?

Internal hurdles to growth

When asked to choose from a list of options of what the top internal hurdles to growth, most respondents identified 'too little investment in developing capabilities' as their most significant impediment. This was followed by weak strategy and leadership, which suggests a realisation that setting an organisation up for success means the strategy has to be right, the leaders have to be strong and money must be spent strategically in developing the right capabilities to be successful. The results resonate with what PwC has experienced elsewhere.

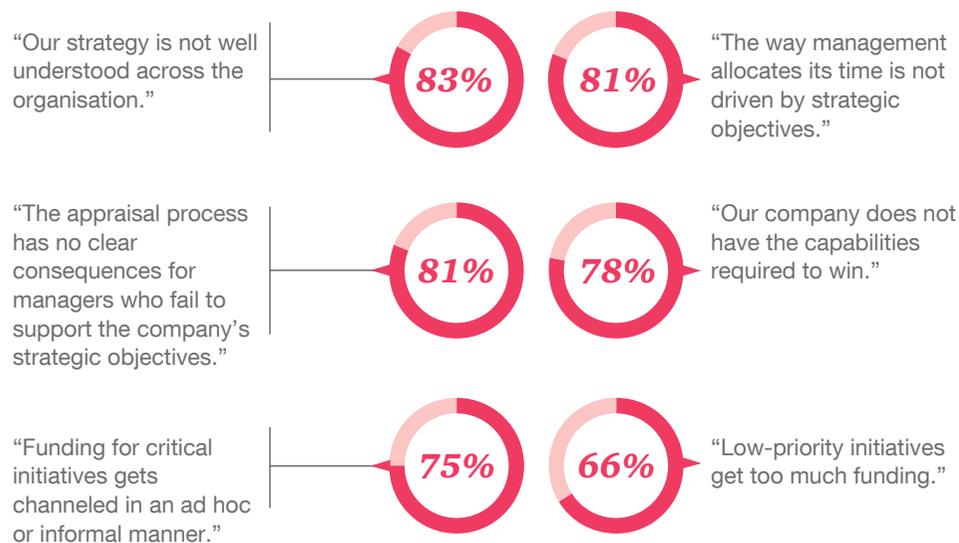
Top internal hurdles to growth

- 1 Too little investment in developing capabilities
- 2 Weak/incoherent strategy
- 3 Weak leadership
- 4 The strategy does not reflect in day-to-day business
- 5 Inefficient organisation
- 6 Weak culture
- 7 No differentiating capabilities
- 8 Product offerings are too complex
- 9 Have not entered the right markets



Too many companies do not put their money where their strategy is

Client interactions have shown that most often an organisation's strategy is vaguely defined, does not make clear choices to invest, and the leadership team is unclear where and how to get started.



The PwC Fit for Growth offering provides a strategic approach to set up companies for sustainable growth and long-term profitability. It argues that companies that are Fit for Growth have the right amount of resources in the right places to compete effectively, ‘no more, no less’.

Source: PwC Strategy&

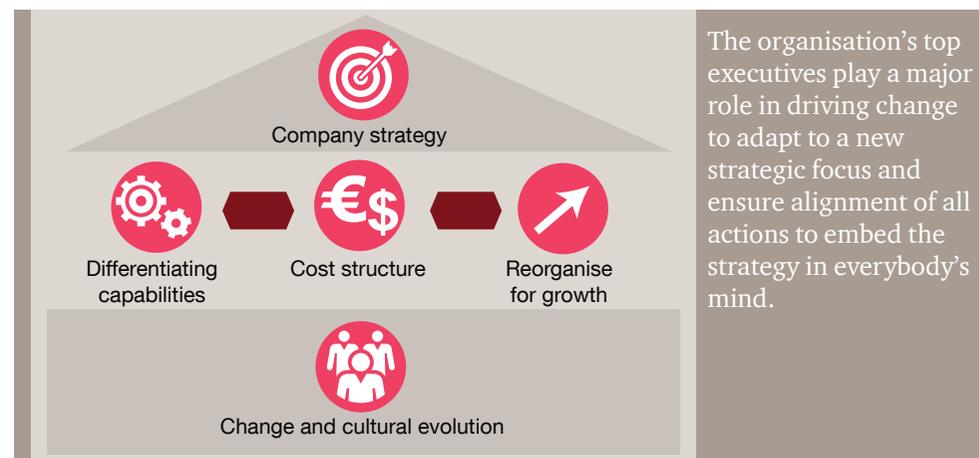
PwC's Fit for Growth approach requires leaders to clearly pin down their identity and develop a capability-driven strategy that is clearly articulated and communicated among staff. This will need to not only address what the companies should be doing, but also needs to define what the company should stop doing to make sure it does not spread itself too thinly and focuses on its differentiating value proposition to the market.

Once the strategy is set out, the leaders need to do three things consistently and continuously.

- Focus on a few differentiating capabilities;
- Align their cost structure to those capabilities; and
- Organise (internally and externally) for growth.

For the transformation to succeed and to be sustainable, the leadership team needs to advance and leverage the existing culture of the organisation.

Fit for growth is a strategic approach to cost management



Source: PwC Strategy&

Strategy in Africa

In our review, 75% of participants stated that they have reviewed their Africa strategy in the last three years to confirm its adequacy, but they also acknowledge that there are issues with incoherence and a problem with executing it in day-to-day business.



75%
of survey participants reviewed
their Africa strategy in the last
three years

Investment in capabilities

PwC's Fit for Growth approach emphasises that investment in capabilities that enable the organisation to create unique value for customers is key for sustainable growth.

It practically means identifying three to six things your company does better than anyone else and that enable you to compete most effectively in the areas

where you choose to do business. These capabilities require investment that can be funded by the improvements in the cost structure of the business.

It is important to understand that capabilities need to be looked at as a combination of processes, tools, knowledge, skills and organisational structure rather than, for example, a skill set or a core competency on its own.

Identifying the differentiating capabilities of an organisation is a strategic exercise that requires consensus on the part of the senior management team. The capabilities identified should be distinctive, powerful and mutually enforcing and form a capabilities system that is unique and will be almost impossible to replicate.

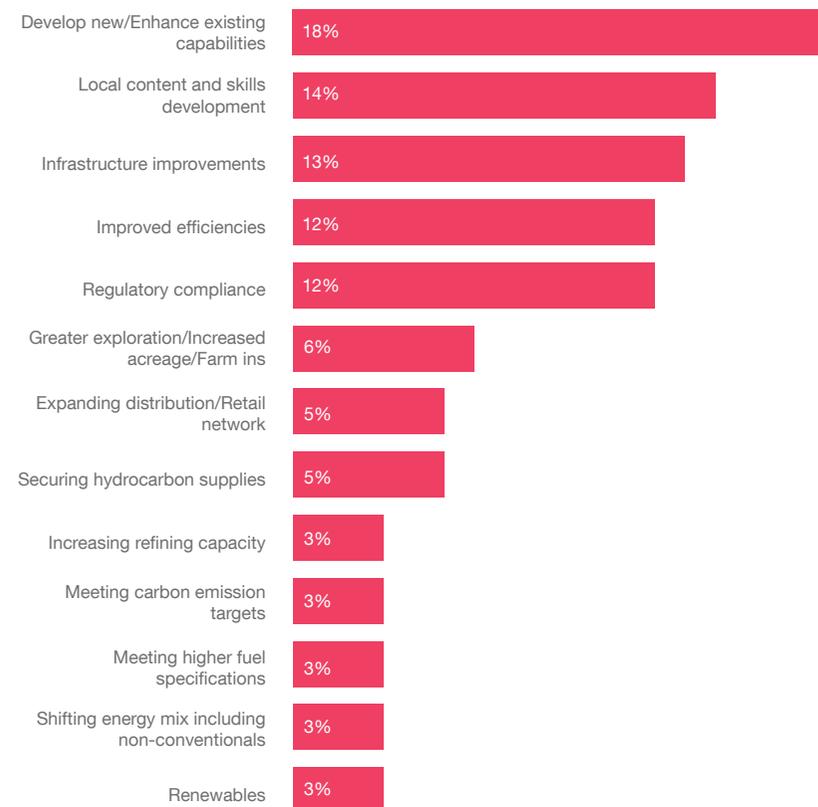
Expenditure over the next three years

While investment in regulatory compliance, local content and skills development remains high on the agenda for African operations, development of new or enhancement of existing capabilities received the highest responses from our survey participants, closely followed by improved efficiencies as a target for expenditure.

This suggests that organisations are aiming to strengthen their organisations following the turmoil of the past few years in order to weather further challenges ahead and set up the organisation for growth.

Figure 11: Expenditure: Companies are investing in themselves (capabilities, infrastructure, efficiencies), but compliance and local content remain priorities

Q In what key areas will you focus your expenditure over the next three years?



Cost management and cost-cutting in African operations

The best-run companies think of cost management as a way to support their strategy and of cost as a precious investment that will fuel their growth. They put their money where their strategy is and continually cut bad costs and redirect resources toward good costs.

This means that if an activity, process or person advances a differentiating capability, they make sure it is adequately resourced and set up for success. And from non-priority capability, remove as much cost as possible.

For participants in our review, cost management as a strategic focus has fallen in importance, which might indicate that overheads and non-core operations have been addressed in the previous difficult years and the work is considered done.

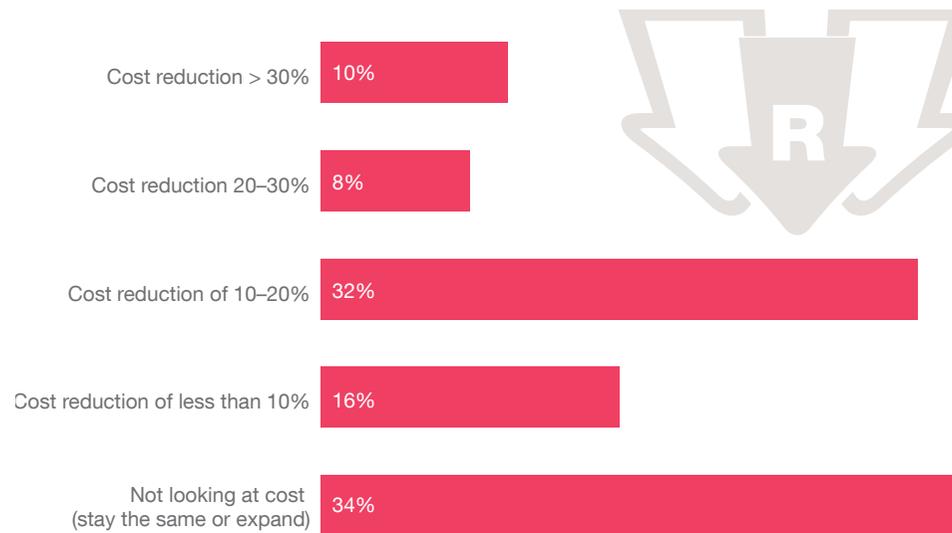
However, for a new cost structure to be maintained, focus should not divert from ways to maintain frugal, cost-conscious behaviour. Avoiding that, the organisation reverts to past behaviours and spending habits will start with

behaviour changes modelled at the top. It could also include building a continuous improvement capability, transferring the ownership of end-to-end budgets to cross-functional teams and rewarding cost-conscious behaviour.

One-third of respondents indicated they had no cost-cutting intentions.

Figure 12: Intention to reduce costs

Q Are you looking at formal cost reduction measures for your Africa operations in the next three years, and if so by how much?



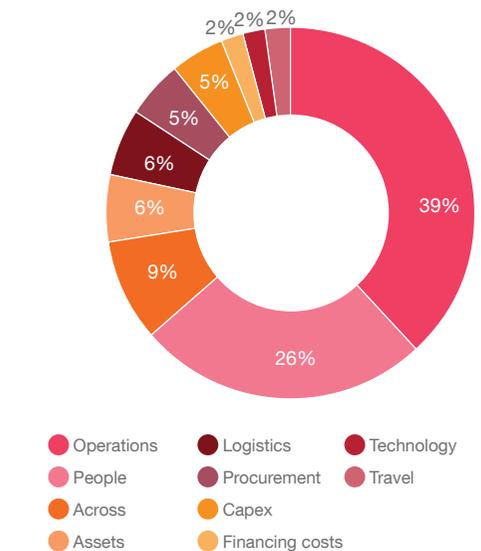
Source: PwC analysis

Just under half of respondents intend to reduce costs by up to 20%.

Those that intend to pursue cost-cutting plan to do so mainly by optimising their operations (36%) and reducing headcount (26%), while 9% want to cut costs across the organisation.

Figure 13: Cost-cutting areas

Q What areas of your business are you considering for cost-cutting?



Source: PwC analysis

Fit for Growth proposes cost-cutting measures be undertaken strategically, using a combination of cost reduction levers to free up resources to build your unique capabilities. They include:

- Portfolio rationalisation to reduce complexity;
- Zero-basing to justify all costs based on strategic priority, value add and business necessity;
- Restructuring of the business operating model to align with strategy, determining how critical work gets done, how organisational units are structured and how people work together;
- Outsourcing considerations to hand off necessary but non-differentiating business processes to external providers;
- Footprint optimisation to improve effectiveness of your location network;
- Process excellence review to identify true sources of customer value and to simplify work and minimise bureaucracy;
- Addressing spans and layers to flatten and empower the organisation;
- Strategic supply management to extract more value from your purchases; and
- Digitisation of the organisation to make technology a game changer.

Tough questions: **Your organisation's fitness for growth**



- Does your organisation have a well-defined African strategy and a clear statement of where it's heading? How well is it communicated and understood in your organisation?
- Have you identified the right capabilities to execute your strategy successfully?
- Have you considered how you can target investment more precisely to maximise strategic advantage? Have you also looked at how you can cut out the low-performing business and inefficient operations that waste resources and hold back returns?
- Has your organisation clearly defined the value it is creating for customers, its value proposition (e.g. offering low-price products, or providing innovative solutions)? How relevant do you feel your organisation's value proposition is in the market?

Achieving sustainability

Low carbon

Low carbon is an agenda that has been building for some time, brought to a peak of global alignment on the issue with the COP 21 Paris Agreement in which nations agreed to reducing carbon emissions in order to limit the rise in temperatures to ‘well below’ 2°C. This agenda continues to be a global focal point—even President Donald Trump’s decision to withdraw the US from the agreement (a decision which may yet be changed), has seemingly only resolved to strengthen commitment to

the agreement by the remaining global signatories.

Growing decarbonisation is therefore a medium- to long-term challenge that will continue to have significant implications for the sector. As such, key stakeholders impacted by the agenda, from regulatory bodies to governments and businesses, have been taking significant actions to support and align themselves to the agenda.



Selected examples of major developments in low carbon in recent years

Government/Regulatory	Countries	Business	Other
G7 supported cutting greenhouse gases by 40% to 70% by 2050 from 2010 levels	Saudi Arabia’s Vision 2030 Plan, aims to reduce dependence on hydrocarbons to a point where they could “live without oil by 2020”	Shell/Statoil created new low-carbon business units in 2016. Eni partnering with GE on low-carbon projects	Fitch ratings warns of ‘investor death spiral’ if electric vehicles gain momentum
COP21 in Paris resulted in a deal to attempt to limit rise in global temperatures to ‘well below’ 2°C and pursue efforts to limit it to 1.5°C	UAE announced it intends to invest US\$163bn in projects to generate 50% of the nation’s power needs from renewables by 2050	CEOs of 10 large oil companies to create fund to address CO ₂ emissions, spending US\$1bn over next 10 years on carbon capture & storage and energy efficiency	Wood Mackenzie says the oil & gas industry is not investing enough in green technology
Norway’s sovereign wealth fund resolved to withdraw investments from mining or energy groups deriving more than 30% of sales or activities from coal business	Chinese authorities looking to improve air quality in Beijing by mandating every new taxi in the city must be electric or gas-fuelled	Google announced plans to buy enough renewable energy in 2017 to meet power needs of its data centres and offices around world	Shell CEO warns peak oil demand may arrive in next decade

Source: PwC Strategy & analysis



A significant example of government initiative occurred in September 2017 when France announced it was planning to pass legislation to phase out oil & gas E&P in its mainland and overseas territories by 2040. As stated under a draft bill, no exploration permits would be granted, and concessions to extensions would be limited and phased out by 2040, which will spell the end of their shale gas potential, which is currently banned. They are the first country in the world to pursue this path but will unlikely be the last.



Oil & gas companies must have a long-term strategy to be sustainable as we move inexorably to a low-carbon environment

Some IOCs (including BP, Shell, Total and Statoil) are adapting to this change by establishing dedicated new business units focused on low-carbon energy while also investing in wind and solar.

France's Total is implementing a plan that requires one-fifth of its asset base to be focused on low-carbon technologies and acquiring a battery manufacturer to spearhead its efforts in electricity storage. In May, Ørsted sold its upstream oil & gas business to British petrochemicals group Ineos in a deal worth more than US\$1.1 billion as the Danish group refocused on renewable energy.

Some are following similar pursuits in Africa. The Central Energy Fund, holding company of PetroSA (South Africa's NOC), has established an energy projects division to pursue commercially viable renewables investments. Sonatrach, Algeria's NOC, is also investing significantly in renewables as part of its diversification strategy. Having already begun construction of a 10MW solar facility in southern Algeria, it will also play a key role in the upcoming tender for 4GW of solar capacity, taking 40% equity in all projects.

In many instances, gas may provide the answer as a bridging fuel to move to a 'cleaner' energy source. Gas has been discovered in abundance around the continent, and some NOCs, with significant investment from IOCs, are already exploiting it.

Nigeria's NNPC has a division focused on LNG, for example. The group is also investing in renewables, with divisions looking at biofuels among other cleaner energy sources. In Ghana, where domestic gas exists, GNPC has been mandated by government as the gas aggregator to support the growth of the gas industry. The gas will be used to serve the country's power needs through proliferation of gas-to-power.

Small-scale liquefied natural gas (SSLNG), may also develop across the region as the LNG industry grows. SSLNG is the direct use of LNG in its liquid form, as opposed to the traditional model of regasification and subsequent introduction into the gas transmission grid. Small-scale liquefaction plants are usually developed to serve specific markets, providing supply to end-users in places where traditional infrastructure does not reach or to consumers needing liquid fuel.

SSLNG is well suited to meet growing demand from the shipping and trucking industries, for fuels that are more environmentally friendly than oil and diesel and has advantages in addressing off-grid power generation for industrial and residential needs in remote locations. As an example, although the delivery of first gas is delayed, Norwegian ship owner IM Skaugen has

been contracted for long-term charters for delivery of LNG for two existing small-scale LNG-to-power operations in Africa.

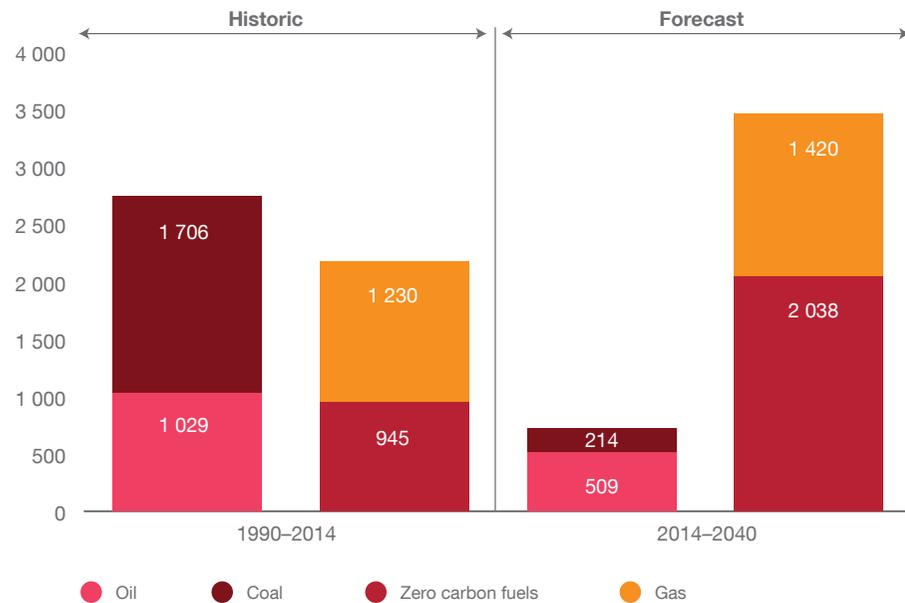


Almost half the growth in electricity generation up to 2040 in Africa is set to come from renewables

While Africa only accounted for 3% of all new investment in renewable energy totalling US\$7.2bn, the sector has promise. Almost half the growth in electricity generation up to 2040 on the continent is set to come from renewables, according to the International Energy Agency (IEA). An era of rapid technological change is coming at a pivotal time in the expansion of African power infrastructure, opening up the prospect of more affordable off-grid energy solutions in rural areas.

It is no surprise then that, looking ahead, forecast global energy demand growth will be driven by gas and zero-carbon fuels, as shown in figure 14 (on the following page).

Figure 14: Change in global energy demand growth by fuel (new policies scenario) (Mtoe)



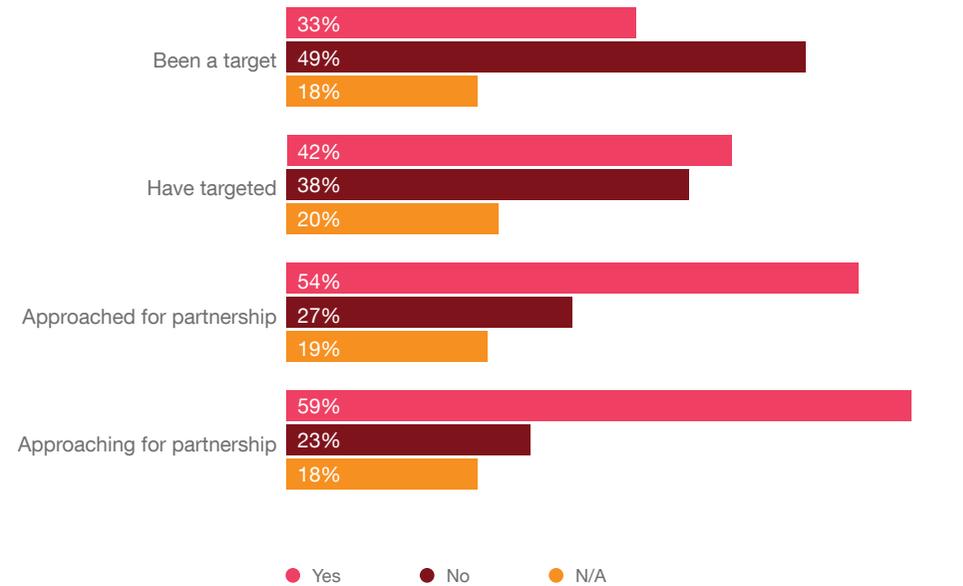
Source: IEA WEO 2016

The need to strategically assess the portfolio of activities oil & gas companies in Africa pursue in order to be sustainable in the drive towards a low-carbon world is necessary, but to deliver on potential portfolio changes and the related investments (i.e. developing and pursuing low-carbon activities), may be a challenge in a cash constrained region and market environment. A key approach to reposition companies and portfolios is therefore through M&A and, in particular, partnerships.

Survey results support our view that partnerships are key to delivering the intended and repositioned strategies and growth. The minority of respondents were related to an M&A proposition to drive growth, with approximately 30% of respondents being targeted for acquisition and approximately 40% having targeted an entity themselves.

The majority of respondents referred to a partnership proposition with nearly 60% having both been approached or approaching another entity for partnership.

Figure 15: Proportion of companies related to M&A or partnership opportunities

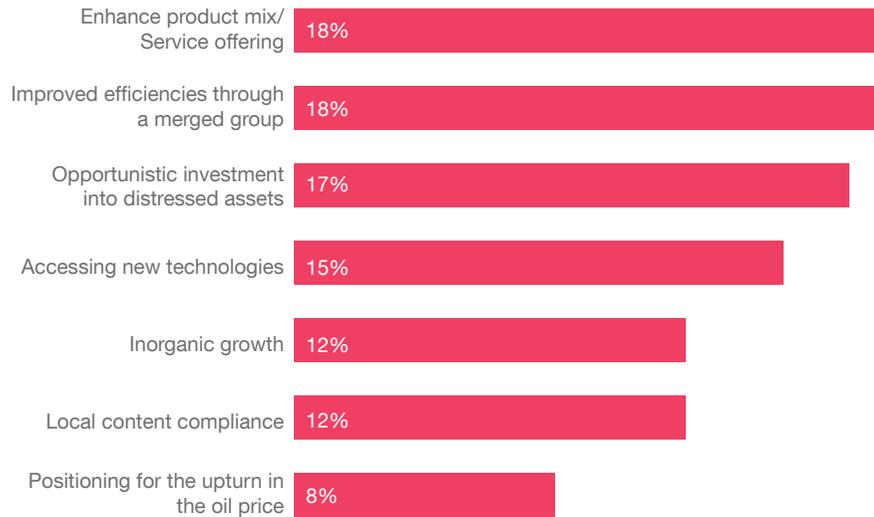


Source: PwC analysis

There are broad reasons for companies looking at M&A and partnerships, as shown in figure 16. The primary reasons for considering such an option is to enhance the company's product mix/service offering and to improve efficiencies through a merged group. There is both a strategic revenue growth purpose and a strategic cost reduction purpose driving these responses. This aligns to the perspective that the market is still very much cost conscious in a low oil price environment but is also now looking at opportunities for growth.

Figure 16: Reasons for M&A or partnership pursuit

Q What was the reason to pursue M&A or partnership?

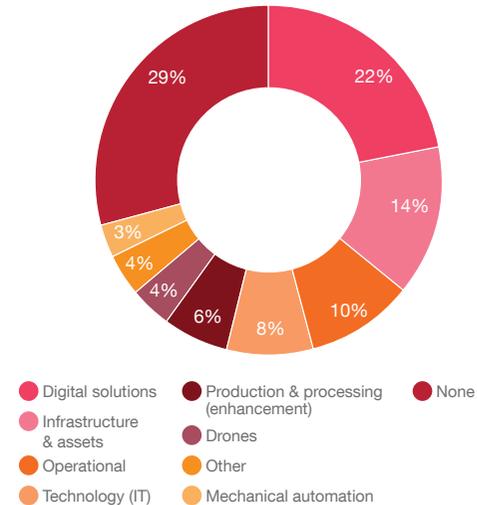


Source: PwC analysis

Technology

Figure 17: Innovative technologies implemented

Q Which innovative technologies have you implemented to surpass your competitors?



Source: PwC analysis

While some oil & gas companies continue to explore opportunities for cost reduction and improved efficiency in the low oil price environment, consideration is now being given to how they will stay ahead of the competition. This focus is being borne out in some of the innovations that are being implemented across businesses in the industry in Africa.

The fact that cost reduction is still a priority can be deduced with the majority of those that responded stating that they were doing nothing innovative to stay ahead of the competition; innovation can be seen as superfluous when simply looking to keep the business afloat in such a downturn.

Perhaps surprisingly, given the perception of slow uptake of digital solutions in oil & gas, nearly a quarter of those that responded to the question stated that they had implemented some form of digital solution, from production and drilling to mobile solutions.

More technical innovations relating to operational process and efficiency, as well as other technology-based innovations (such as ERP), were also cited. Drone use was cited by 4% of respondents, indicating the growth in use of a technology highlighted as having significant potential to the industry.

Survey results indicate the application of digital, which is an important step in achieving sustainable operational efficiency. The industry has been slower than other sectors to adopt digital solutions and has had a tendency to be focused on increasing production, recovery and throughput for years. However, with lower oil prices likely for the foreseeable future, digital technologies connecting equipment and field operations through IoT, the tasks of automating processes and access to data, as well as helping with cost-cutting, will be essential if the industry is to improve productivity while curbing costs.



Digitally-enabled systems are expected to significantly reduce the cost of future hydrocarbon resource exploitation

Digitally-enabled technology systems are expected to significantly reduce the cost-per-barrel of future hydrocarbon resource exploitation. So-called digitisation involves physical devices communicating directly with each other—machine-to-machine—with little or no human intervention.

To the upstream oil & gas business, digital includes smart elements such as sensors, measuring devices and actuators embedded in drills or wellheads exchanging data in real time. The use of IoT sensors can help oil companies have real-time control that could increase the safety, reliability and yield of thousands of wells around the globe.

Such exchange enables expansive monitoring, integrated operations, remote configuration and optimisation, and even self-management. Wireless networking connects these elements, and through the use of purpose-built applications, sends their combined and integrated data to servers for processing, storage and analytics.

A single drilling rig, for example, can generate one terabyte of data each day. In a control room, personnel see and interact with an accurate virtual representation of the field and all its components. Field data can be processed continuously in real time,

with applications automating decision-making, performing predictive analyses, reacting to alarms, and monitoring and controlling production process—with or without human intervention.

Drones also have a place in the digital oilfield—from safety inspections to parts delivery. Drones can be utilised to complete costly (and sometimes dangerous) activities, including those of a routine nature. An end-to-end solution combines drones, digital analytics and machine learning to power transformation, with activities including:

- Drilling site inspection, selection and planning;
- 2D and 3D geodetic-grade surveys used in exploration phases;
- Integrated data from the field, with waste ponds monitoring and measurements in 2D;
- Equipment and materials surveys in 3D, automating inventory with machine learning;
- Construction progress monitoring; and
- Storage tank and pipeline inspections.

If digital innovation is really put to use, we could even see 3D printing of spare parts and drone delivery to the remote oilfield.



There are demonstrable quantifiable benefits to such transformation through drone use. Research conducted by PwC's global Drone Powered Solutions team found that construction surveys were accelerated by up to 20 times, monitored projects completed on time, decrease of life-threatening accidents by 91%, savings of 68% of claims settlements, reduction of environmental penalties by 52%, and accelerated time of acceptance by 29% and decreased staff involvement.

The downstream sector is also fertile ground for digitisation given its direct interaction with end users. In addition to the growth of electric vehicles (EVs), more broadly, vehicles are becoming more digitally-enabled. So much so that

technology companies (such as Google and Apple) and industrial product innovators (such as Dyson) are known to be at various stages of developing their own vehicles.

The retail forecourt is now in the early stages of accommodating electric vehicles. Shell, for example, is beginning to roll-out charging points at retail sites in the UK and has already stated an intention to test the market in South Africa in the coming years. Digitising the retail station provides various opportunities for top-line growth:

- Lead customers to a retail station: Real-time customer segmentation of individuals into local and en route clients; digitalise the experience using mobile devices to lead customers to a station by providing upfront information.
- Digital loyalty programmes: Design loyalty programmes that involve mobility; design the incentive structure to stimulate revenue from high-margin products.
- Stimulate shop sales: Stimulate customer product purchasing interest before they enter the shop or even before they stop at the retail station.

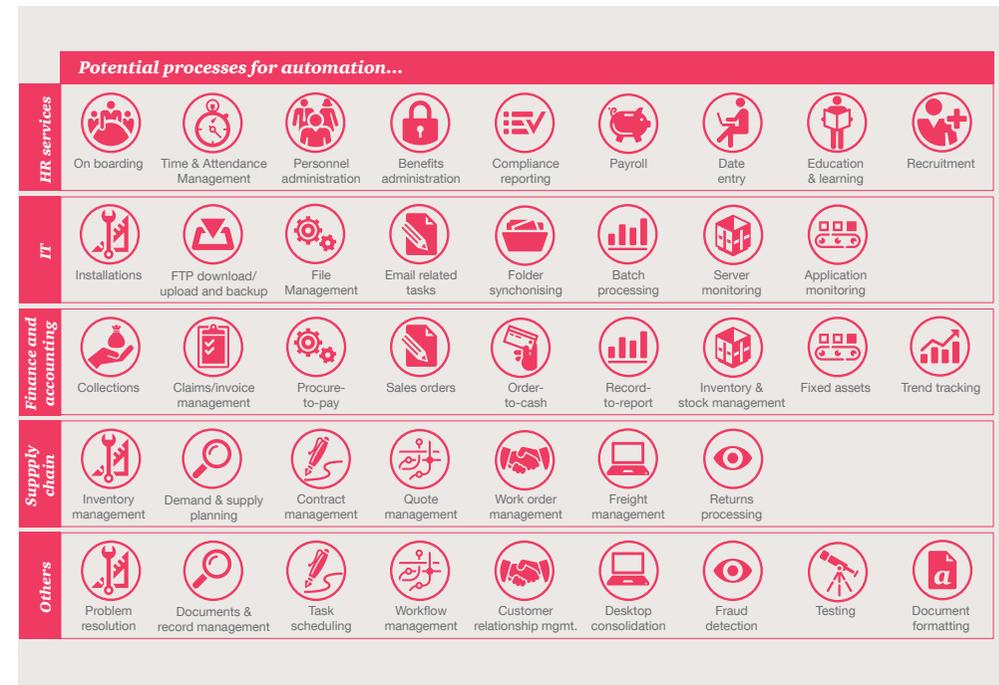
Robotic process automation (RPA) is another application of technology that should be considered by oil & gas companies seeking efficiencies and a cost-based competitive advantage. RPA allows a company to configure computer software, a ‘robot’, that sits on top of existing systems and interprets existing applications to perform tasks normally performed by a human, using rule-based processes.

The application of RPA enables:

- Cost-effective automation of rule-based tasks, replacing manual processes;
- Operating on a 24x7 basis at about one-third of the cost of offshore operators or one-ninth the cost of an onshore operator;
- Strong governance and auditability, facilitating detailed and real-time traceability;
- Implementation with relative ease within a complex IT landscape; and
- Rapid incremental benefits and standardisation of processes.

RPA can be applied to a multitude of processes across multiple functions.

Potential applications for robotic process automation



Blockchain is also a technology that is beginning to penetrate the broader energy market. Blockchain is a technology for peer-to-peer transaction platforms that uses a distributed ledger system to record all transaction data. Blockchain technology changes the way transactions are made, with the underlying transaction model shifting away from a centralised structure (banks, exchanges, energy companies) towards a decentralised system (end customer, energy consumers). Third-party intermediaries are no longer needed in this system as transactions are carried out directly from peer to peer. This can cut costs and speed up processes, and so the entire system becomes more flexible as manual work is carried out automatically.

The application of blockchain technology in the energy industry has predominantly been seen in the power sector, with potential use in executing energy supply transactions, metering billing and clearing processes, documentation of ownership, asset management, emission allowances and renewable energy certificates. But with many oil & gas companies entering the renewables space, it is valuable to consider blockchain usability not only in power, but with a consideration as to how it may apply directly in oil & gas (for example in trading and downstream).

Tough questions: Sustainability



- Do you have the right mix to win in the African oil & gas market? Should you alter your investment portfolio to include (more) renewable/alternative sources of energy?
- Have you considered how the application of digital will help you create competitive advantage through sustainable operational efficiency in your key markets?
- With the possibility of competition emerging from a variety of industries, and emerging business models often enabled by new technologies, how do you ensure your future in the energy sector of tomorrow?

Leveraging local content

The GDP growth rate of sub-Saharan Africa is predicted to recover from 1.4% in 2016 to 2.6% in 2017 by the International Monetary Fund. For the years to come, a growth rate of just above 3.5% is predicted.

The powerhouses of the region, South Africa and Nigeria, are seeing their lowest growth rates in years. Nigeria is forecasted to leave its decline of -1.5% with a 0.7% growth rate for this year and then level out short of 2% for the years to come. South Africa is expected to recover from a 0.3% decline rate in 2016 to just under 2% from 2020. The decline in the region's GDP growth is a reflection of the challenging global macroeconomic climate and political uncertainty.

According to Rystad, total expenditure in the oil & gas industry in Africa follows the same pattern. The spend decline between 2014 and 2018 amounts to more than US\$30 billion, a reduction of more than 35%. An increase in spend is expected from 2019. Global spend is projected to already be showing recovery this year, largely driven by North America and Russia.⁶

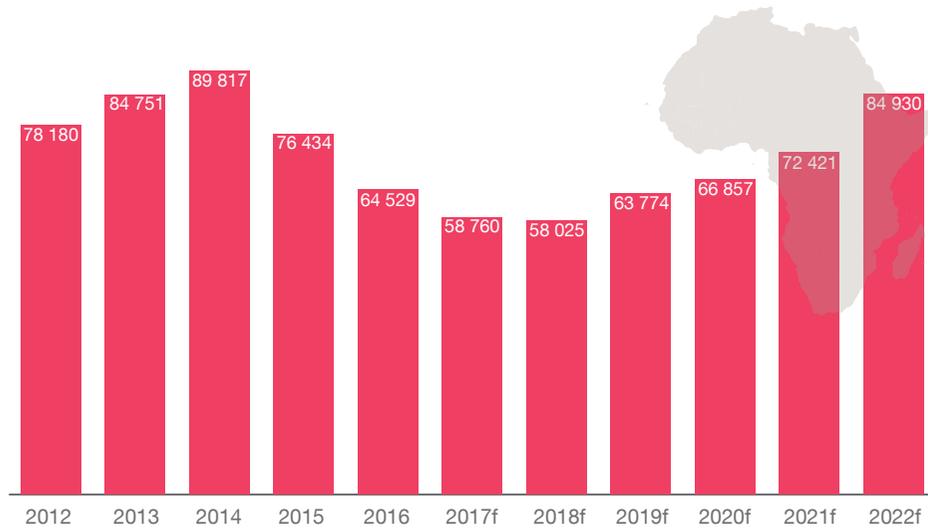
The capital required to restart activity in the oil & gas industry largely originates from foreign countries. This calls for an investor-friendly environment with regulatory stability and, as in prior years, this needs to be balanced with the requirements for local content in the industry.

Respondents in our survey again confirmed the importance of local content and skills development, which remained the second-highest recipient of company expenditure. When asked for the biggest external challenges, local content does not feature among the top six, but regulatory uncertainty remains the principal challenge for respondents. This reinforces the view that local content is an integral part of doing business in Africa but that governments need to work on realistic and reliable regulatory frameworks to be attractive for investment.

⁶ Rystad DCube. <https://www.rystadenergy.com/Products>

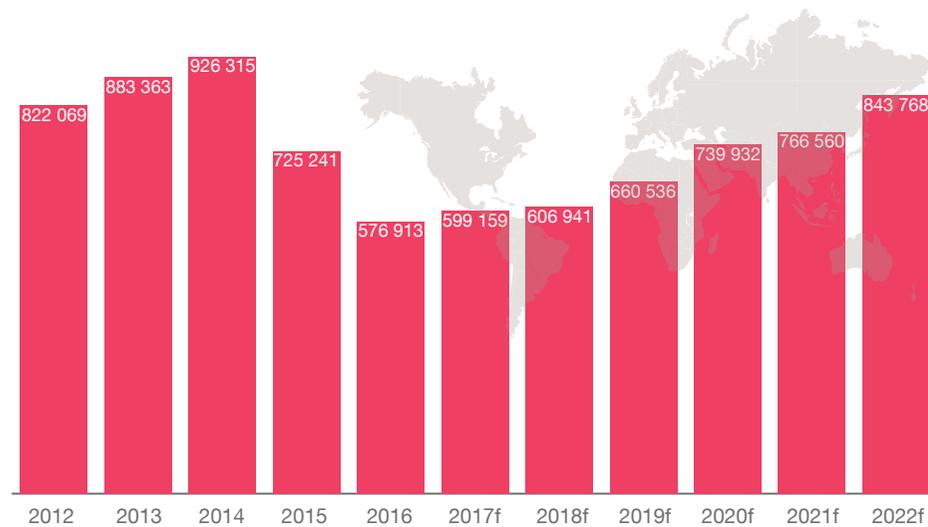


Figure 11: Oil & gas spend: Africa (US\$ millions)



Source: Rystad DCube

Figure 12: Oil & gas spend: Global (US\$ millions)



Source: Rystad DCube

Learning to leapfrog – Africa oil & gas review

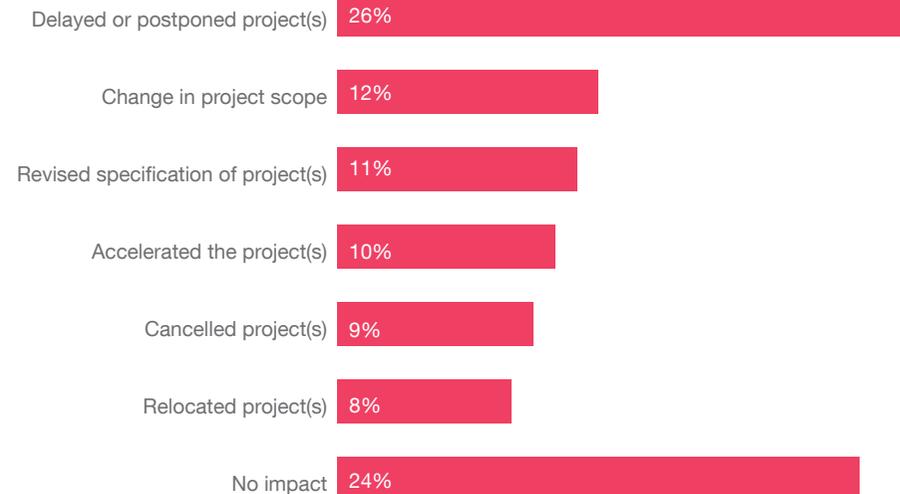
How have current/proposed local content and regulatory policies affected your investment decisions?

More than 25% of respondents said that projects have been postponed or delayed by local content policies, and approximately 15% have relocated or cancelled projects in response to local regulations. About 10% indicated an acceleration of their projects. This could reflect the positive effect of less onerous local content compliance requirements in some jurisdictions, combined with strong relationships with the host governments.

There has been no significant change to last year's results which, considering the general number of projects executed over the past 12 months, does not come as a surprise.

Figure 13: A quarter of respondents find that local content delays projects, 9% have cancelled, 10% accelerated

Q How have current / proposed local content and regulatory policies affected your investment decisions?

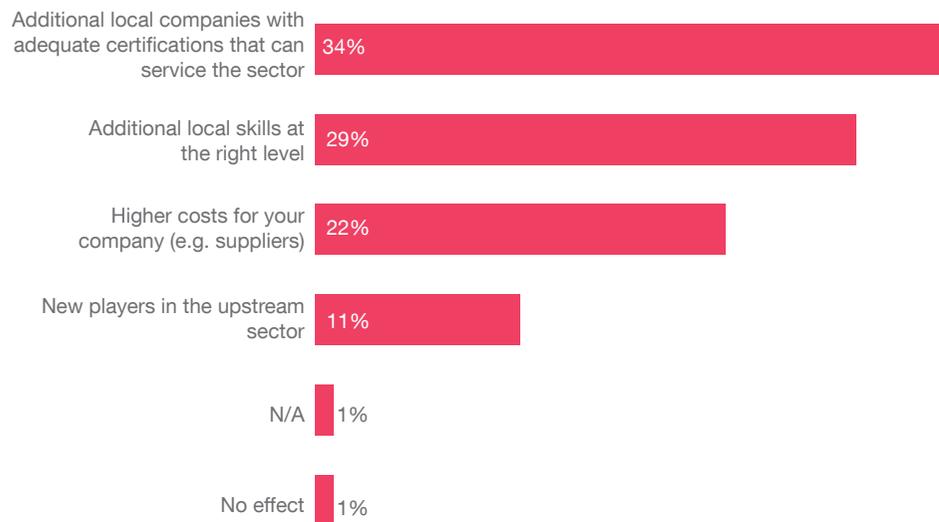


Source: PwC analysis

Local content regulations appear to bear results, but is it enough and is it adequately monitored and tracked?

Figure 14: Increasing costs, but creating local capability

Q Which of the following have local content regulations in your country resulted in?



Source: PwC analysis

It is difficult to assess the impact of local content regulations in oil & gas countries. This can partly be attributed to a lack of empirical evidence and also to very different departure points for respective countries. These include the quality and spread of the education system; the qualification of the local industry; the presence of parallel industries that allow skills transfer due to similar qualification requirements; the maturity of the industry and presence of international companies; the size, type and location of resources; the technical complexity of extractive operations; the infrastructure maturity of a location; the regulatory framework and enforcement thereof; and the combination of quantitative and qualitative measures used, amongst others.

There is little transparency and information on a country's achievements in local content available in the public domain. This is likely due to a lack of capacity to implement, manage and monitor regulations and the effects thereof.

One-third of respondents in our survey think that there are more local companies today that can serve the sector. Just under one-third acknowledge that local skills at the right level are available in their country and 11% said that new players have emerged in upstream as a result of the regulations.

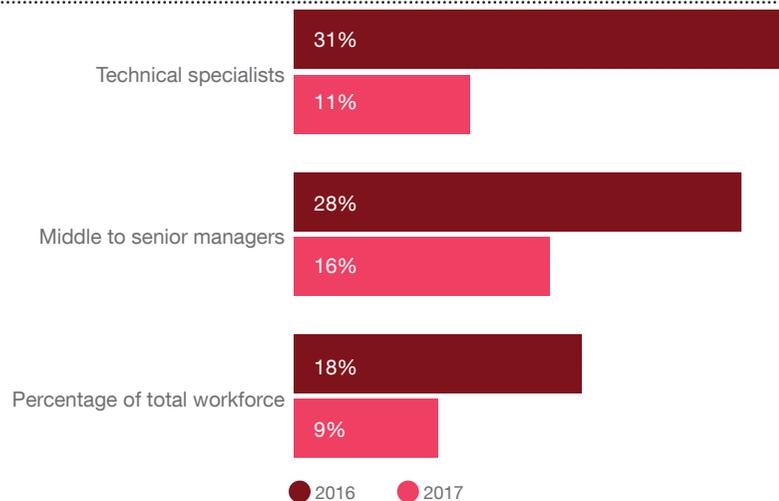
Considering that the early stages of local content regulations have been too ambitious in most African countries (partly because of insufficient domestic capacity to meet targets), this looks positive. However, the results do not indicate that we have nearly enough local people and companies with the right qualifications and adequate certifications to fulfil the stringent requirements of the oil & gas industry.

Percentage of the workforce comprised of expatriates

By the end of 2016, more than 440 000 oil & gas employees had lost their jobs globally. The assumption that in low to no activity regions expatriates would be affected due to their comparatively high cost and focus on local content development, would explain the significant drop in the proportion of expatriates employed reported by respondents.

Figure 15: Proportion of workforce expatriates, 2016 vs 2017

Q Approximately what percentage of your workforce is expatriate?

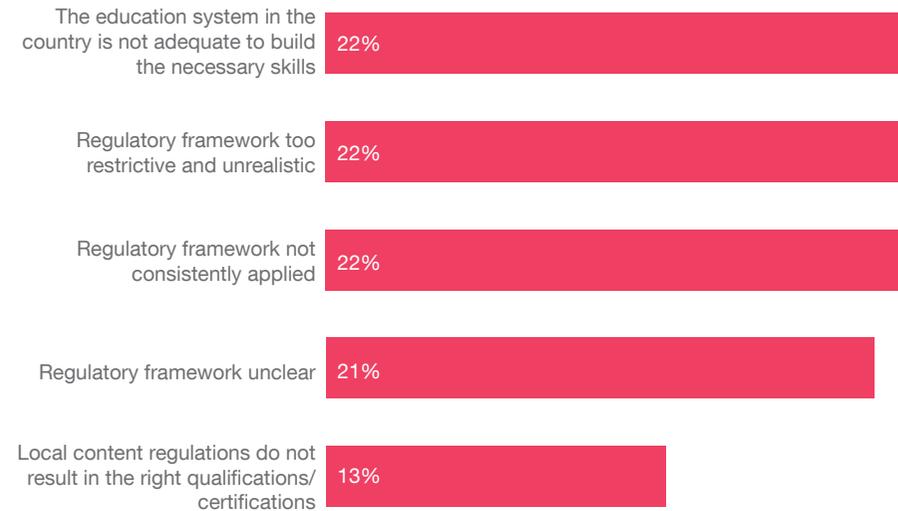


Source: PwC analysis

Challenges in establishing local content

Figure 16: Challenges to establishing local content

Q Where do you see the challenges in establishing national content in your country?



Source: PwC analysis

Respondents highlight issues with the regulatory framework for local content, which is to be expected considering that the monitoring and tracking of local content compliance is inconsistent and difficult to obtain. Few countries have a specific entity that concentrates on this function.

In most African countries, the inadequacy of the education system is alarming, and it seems to have made little headway in recent years. But with little upstream activity, combined with low activity in the combined industry, education programmes do not receive the same attention they did before oil prices crashed.

Local content development continues to require a highly collaborative approach between government, local industry, international firms, communities and the education system. The desired outcomes will only be achieved by clearly articulating requirements from all sides and an appropriate partnering strategy.

Transparency in the administration of any programme should be a base provision to make sure everyone is well-informed on progress and achievements as well as challenges. Transparency will most likely foster support from all parties, with meaningful contributions, monetary or otherwise, being allocated accordingly.

Criteria for an ideal local partner

Figure 17: Criteria for selecting a local partner

Q What are your criteria for an ideal local partner?



Source: PwC analysis

Over one-third of respondents selected technical skills as the most important criteria for a local partner. Financial resources and stability as well as values and a culture that resemble those of the international organisation follow behind. In other words, the local partner of tomorrow should fulfil an onerous set of criteria and local content regulations that result in an increase in the right skills in a country and also provide a funding pool to local companies to set up in the industry.

Tough questions: Skills and local content

- How are you getting the visibility that you need to ensure that skills are being deployed effectively in your organisation?
- What strategies do you have in place to ensure you're looking as widely as possible for talent?
- What re-training programmes have you added to your company's learning and development plans to bridge the existing talent gap and to ensure a workforce that is fit for the future?
- How are you building a future portfolio of transformation leaders that fits what is required for your next wave of change and your future organisation?
- How are you working with government to create better outcomes for customers and employees?

Building a firewall around your barrels

The mismatch of supply and demand and lower commodity prices aren't the only serious challenges facing the African oil & gas industry.

With the industry going through a wrenching period of change in which operational efficiency through digitisation is the name of the game, opportunities for cyber criminals are multiplying. Unsurprisingly, in recent years, the oil & gas industry has been targeted by a number of high-profile cyber attacks.

“There are two types of companies: those that have been hacked, and those who don't know they have been hacked.”

– John Chambers, former CEO of Cisco Systems

As stated by John Chambers, former CEO of Cisco Systems, “There are two types of companies: those that have been hacked, and those who don't know they have been hacked.” In fact, PwC's *Global State of Information Security Survey 2017* found that globally, oil & gas respondents detected an average of 7 432 cyber security incidents in the past twelve months.

What is cyber security?

At PwC, we know that cyber security isn't just about technology—it also involves protecting people, information, systems, processes, culture and physical surroundings.

Cyber security aims to create a secure environment where businesses can remain resilient in the event of a cyber attack.

Cyber security risks have dramatically increased, but the approach oil & gas industry players use to manage them has not kept pace. With this in mind, the legacy information security models—technologically-focused, compliance-based and perimeter-oriented—do not address the realities of today.



Overall, an investment in cyber security can foster innovation, enhance agility, facilitate business growth, build trust and *fuel* competitive advantage.

Cyber security in oil & gas

The dark side of connectivity

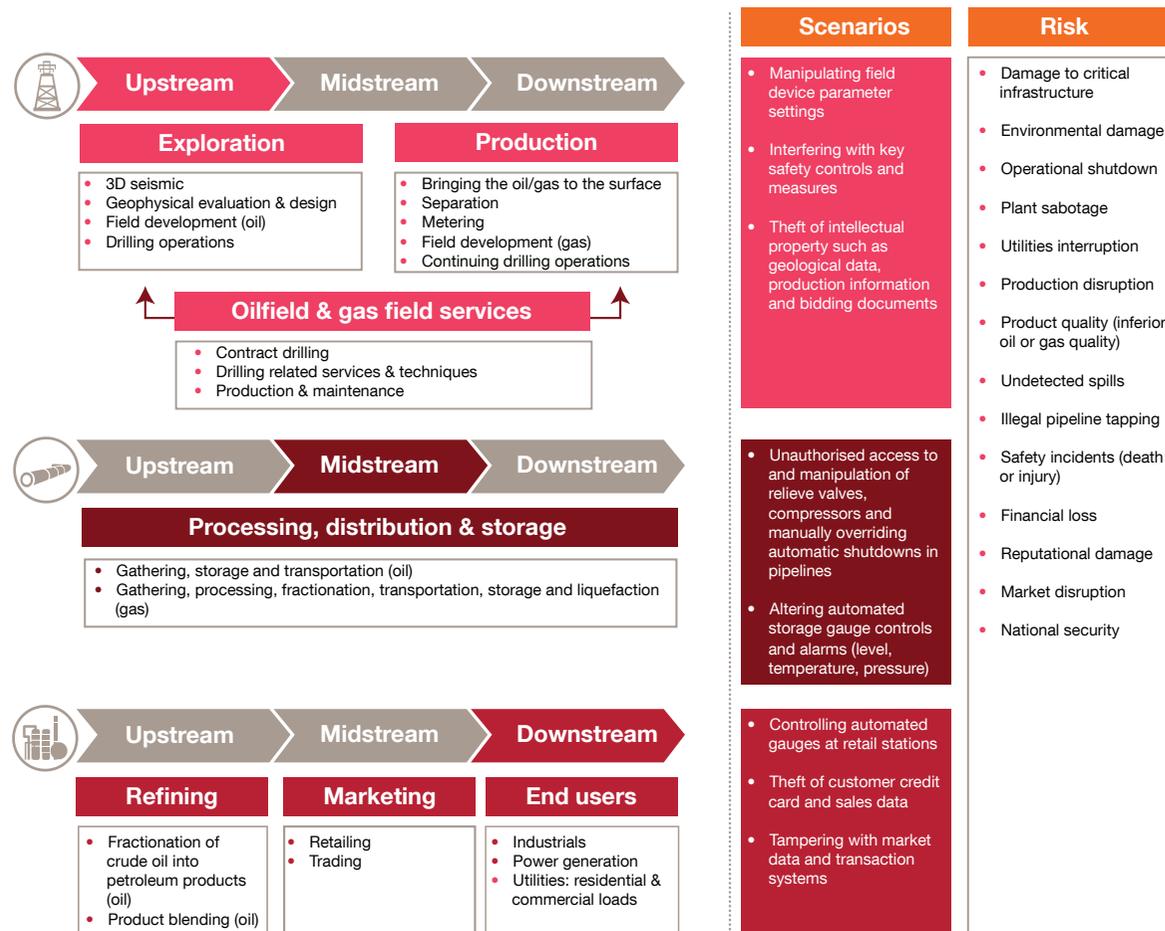
Today's oil & gas industry is increasingly complex from a technological standpoint, and it relies heavily on industrial control systems (ICS) and supervisory control and data acquisition (SCADA) that leverage IT to control physical machinery and supervisory management, respectively. This may lead to more efficiency, but it also makes systems more vulnerable to cyber attacks.

Research has shown that oil & gas companies acknowledge the repercussions of a cyber breach or attack. For example, in PwC's *20th Annual Global CEO Survey* oil & gas companies recognised cyber security breaches as a top area of concern.

On average, 46% of cyber attacks are believed to go undetected, and nearly 70% of oil & gas companies were hacked in the past 12 months, according to a recent study by the Ponemon Institute.

The motive behind cyber attacks on the oil & gas industry can range from being malicious, economically disruptive and profit motivated to being politically driven.

How and where cyber breaches impact the oil & gas value chain



Source: South African Oil & Gas Alliance (SAOGA); ERPScan; PwC Analysis

The *Cisco 2017 Security Capabilities Benchmark Study* found that two-thirds of organisations that have been subject to a breach saw up to eight hours of system downtime. In addition, the study also saw 11% of organisations identifying revenue losses of 20% or more as a result of cyber security breaches.

Considering the substantial impact and costs of cyber attacks, we believe that all organisations in the oil & gas value chain need to consider their cyber security exposures and be prepared for a potential incident.

Are you ready?

At PwC, we consider six lenses of confidence as essential to embedding cyber security into the culture, operations and decision-making of an organisation.

Cyber security at the heart of your business



Confidence in your people

People make critical security decisions every day.

Disappearing organisational boundaries mean that you can no longer rely on technology alone.

You need to make sure your people understand security and act securely.



Confidence in your technology

Technology underpins your business.

As your business changes so should your technology. While embracing the new, you still need to protect legacy technology and information against cyber threats.



Confidence in your priorities

Addressing cyber threats helps you prioritise what matters most.

Being prepared for changes in the digital era will help you get your priorities straight. A 'cyber savvy' governance and management structure means you can prioritise opportunities and know where you can afford to take risks.



Confidence to take risks

Digital opportunities cannot be realised without managing the inherent risks.

Some risks are worth taking, but if you're struggling to manage the downside, you won't be able to take advantage of the upside.



Confidence during a crisis

Cyber attacks are now commonplace.

Resilience means being able to react quickly and effectively when compromised. Being aware of and prepared for threats will help you prevent incidents and react to them quickly enough to reduce their impact, and prevent them becoming a crisis.



Confidence in your connections

Organisations exist in an increasingly complex digital ecosystem.

We share information and transact digitally more than ever before.

Your digital relationships with customers, suppliers and others expose you to new areas of risk that need to be managed.

Source: PwC

Ultimately, organisations that integrate cyber security with digital strategies will be better poised to build trust into everything they do and be well-positioned to win in the market.

Tough questions: Cyber security



- Does your organisation have a cyber-response plan in the event of an attack?
- Do you know what your cyber vulnerabilities and threats are across your people, systems, processes and operations?
- Have you instituted effective training programmes that instruct employees on the appropriate handling and protection of sensitive data?
- How often do you discuss and review your cyber security defences and policies?



Conclusion

Oil & gas in Africa continues to be one of the burgeoning and frontier plays for the industry. It is riddled with complex challenges and adversity, but with challenge comes opportunity. The opportunity is there for players who are willing to ‘reimagine the possible’ in a future that looks very different to our present.

The future outlook should include a strategy that is dynamic and fluid to market and situational changes. While portfolios should be diversified, African oil & gas companies need to ‘learn to leapfrog’ so that they are not only ahead of disruption—they actually cause it. This will enable them to meet traditional challenges head-on.

While there are some challenges that can be ‘leapfrogged’, others will continue to plague the industry. For some, like foreign exchange rate volatility, contingency plans can be made. For others, like uncertain regulatory frameworks, there is very little control. Contingency plans are still possible, and working to influence and motivate these political decisions through lobbying would be highly recommended.

In addition, industry players should be open to work more directly with government departments in order to share and transform industry knowledge.

In addition to being disruptors, oil & gas companies in Africa need to carefully consider strategic partnerships. This strategy will work hand in hand with portfolio diversification as it leads to risk diversification as well. There is no need to be everything to everyone; utilising a partnership model allows companies to take advantage of potential upside while hedging against potential downside.

The future of energy as we know it is changing. The dramatic oil price shift at the end of 2014 marked a significant shift and shows that change can happen at any time. As Steve Jobs, former CEO of Apple, said “the mark of an innovative company is not only that it comes up with new ideas first, but also that it knows how to leapfrog when it finds itself behind”. It is evident that African oil players must ‘learn to leapfrog’ to remain competitive in the new energy future.



Acronyms

bbl	Barrels
bbl/d	Barrels per day
Bcm	Billion cubic metres
BoE	Barrels of oil equivalent
CCS	Carbon capture and storage
CAGR	Compound annual growth rate
COP21	21st annual conference of the parties of the UN Framework Convention on Climate Change
E&P	Exploration and production
EIA	Energy Information Administration (USA)
EITI	Extractive Industries Transparency Initiative
ERP	Enterprise resource planning
EV	Electric vehicle
FID	Final investment decision
FLNG	Floating liquefied natural gas
FTP	File transfer protocol
FX	Forex
G7	Group of Seven
GDP	Gross domestic product
GNPC	Ghana National Petroleum Company
GW	Gigawatt
ICS	Industrial control systems
IEA	International Energy Agency

IOC	International oil company
IoT	Internet of Things
IPPs	Independent Power Producers
ISO	International Organization for Standardization
LNG	Liquefied natural gas
M&A	Mergers and acquisitions
Mmboe	Million barrels of oil equivalent
MPRDA	Mineral and Petroleum Resources Development Act (South Africa)
Mtoe	Million tonnes of oil equivalent
MTPA	Metric tonnes per annum
MW	Megawatt
NNPC	Nigerian National Petroleum Corporation
NOC	National oil company
OECD	Organisation for Economic Co-operation and Development
OPEC	Organisation of the Petroleum Exporting Countries
PASA	Petroleum Agency South Africa
PIB	Petroleum Industry Bill (Nigeria)
PIGB	Petroleum Industry Governance Bill (Nigeria)
RPA	Robotic process automation
SCADA	Supervisory control and data acquisition
SSLNG	Small-scale liquefied natural gas
Tcf	Trillion cubic feet
UNCTAD	UN Conference on Trade and Development

Contacts

Pedro Omontuemhen

Africa Oil & Gas Industry Leader

+234 (1) 2711700

+234 (0) 8058021576

pedro.omontuemhen@pwc.com



Chris Bredenhann

PwC Africa Oil & Gas Advisory Leader

+27 (0) 21 529 2005

+27 (0) 82 373 2680

chris.bredenhann@pwc.com



Ayesha Bedwei

PwC Africa Oil & Gas Tax Leader

+233 (0) 302 761 500

+233 (0) 244 813 956

ayesha.a.bedwei@pwc.com



Project team

Derek Boulware

+27 (0) 21 529 2353
derek.boulware@pwc.com



Wessel van Wyk

+27 (0) 21 529 2279
wessel.van.wyk@pwc.com



Ulrike Finckh

+27 (0) 21 529 2780
ulrike.finckh@pwc.com



David Baron

+27 (0) 21 529 0359
david.baron@pwc.com



Taz Rashid

+27 (0) 21 529 2017
rashid.tazik@pwc.com



Infomineo contacts

Martin Tronquit

Managing Partner
martin.tronquit@infomineo.com



Marwane Najimi

Analyst
marwane.najimi@infomineo.com



Llewelyn Buys

South Africa Country Manager
llewelyn.buys@infomineo.com



Hinde Adjar

Analyst
hinde.adjar@infomineo.com



Youssef Taik

Research Manager
youssef.taik@infomineo.com





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