PETROLEUM REVIEW

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February 2017

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Magazine of the energy institute

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PETROLEUM
REVIEW

VOLUME 71 | NUMBER 840

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Abbreviations
The following are used throughout *Petroleum Review:*

mn = million (10^6)
bn = billion (10^9)
tn = trillion (10^{12})
cf = cubic feet
cm = cubic metres
b/d = barrels/day
boe = barrels of oil equivalent
t/y = tonnes/year
t/d = tonnes/day
kW = kilowatts (10^3)
MW = megawatts (10^6)
GW = gigawatts (10^9)
kWh = kilowatt hour
km = kilometre
sq km = square kilometres

No single letter abbreviations are used. Abbreviations go together
eg 100mn cf/y = 100 million cubic feet per year.

Printed by Geerings Print Ltd

Magazine of the energy institute

61 New Cavendish Street, London W1G 7AR, UK

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Terms of control: Petroleum Review is circulated free of charge to all paid-up members of the Energy Institute. To libraries, organisations and persons not in membership, it is available on a single subscription of £310 for 11 issues in the UK and £480 for overseas subscribers. Single issue £30 (UK), £45 (overseas). Agency Commission – 10%. ISSN 0020-3076.
Energy Institute Registered Charity No.1097899, 61 New Cavendish Street, London W1G 7AR, UK.

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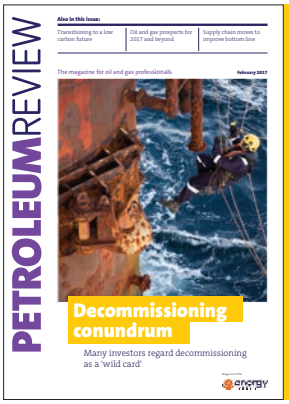


Front cover: Fairfield Energy is focusing attention on the decommissioning of its North Sea Dunlin field

Source: Fairfield Energy

Update & regulars

IN THIS ISSUE...

This month's issue of *Petroleum Review* begins with a look at how the international oil and gas sector is looking to transition to a low carbon future. We assess how central banks are positioning themselves to regulate the process, and highlight a call for fossil fuel companies to disclose potential greenhouse gas emissions from their reserves as investors look to more accurately determine possible downside risks. We also review some of the strategies, innovations and technologies being adopted by key players in the drive to decarbonise.

Ahead of his keynote presentation at IP Week on 21–23 February 2017, OPEC Secretary General Mohammed Sanusi Barkindo provides his view of the role of OPEC and fossil fuels in the future energy mix.

We also look at the impact of shifting oil prices on the markets, and outline some of the reasons producers can begin to be hopeful of better times ahead. That said, decommissioning is seen to remain a 'vexing' issue despite a partial recovery in the oil price.

Meanwhile, make sure to visit our website to view two online features looking at the role of gas in decarbonising Europe's energy markets, and how sources of financing will help electricity network companies evolve to embrace new and disruptive technologies.

Kim Jackson, Editor

Features

See also online...

Future of gas in decarbonising European energy markets
Professor Jonathan Stern
Visit **bit.ly/2k4Vte4**

The role of capital in facing disruption
Matt Rennie
Visit **bit.ly/2jDfzze**

PERSPECTIVE

As much about oil as solar

Louise Kingham OBE FEI, Chief Executive, Energy Institute

Nothing symbolised the shifting tectonic plates in energy technology more in 2016 than CEO Elon Musk unveiling Tesla's solar roof tiles on the former set of TV show *Desperate Housewives*.

The cost of manufacturing one watt of solar PV cell capacity fell from a staggering $77 in 1977 to an equally staggering 36 cents in 2014 (according to Bloomberg New Energy Finance). Indeed, costs are forecast to fall even further, between 40% to 70% by 2040 (*IEA World Energy Outlook, 2016*).

Factor in a similarly rapid drop in the cost of storage and it is easy to see why smart innovators are piling into the territory, putting integrated, zero carbon lifestyle solutions into a price bracket accessible to mainstream consumers.

But tectonic plates move slowly; this is no overnight transition. The IEA's *World Energy Outlook* is clear – even in a post-Paris world aiming to limit global average temperature rises to 2°C, and despite the current challenging oil price – fossil fuels will continue to be 'a bedrock of the global energy system for many decades to come'.

Some 60% of the investment needed globally in energy by 2040 will still be in fossil fuels. Gas consumption in particular is projected to increase, with investment in LNG leading to the creation of a global market. Consumption of oil in freight, aviation and petrochemicals, where there are as yet few alternatives, will also continue to grow.

The journey ahead

So, contrary to the often polarised public debate around energy, the co-existence of high and low carbon is inevitable for the foreseeable future. While Paris sealed the discussion about the destination, the journey there is as much about using hydrocarbons wisely and efficiently as it is about renewables, nuclear and disruptive technologies.

Furthermore, many of the people whose skills and ingenuity have successfully harnessed oil and gas from some of the most inhospitable environments on the planet will be among those who will drive the development of the alternatives we now need for our future low carbon existence.

Reach, influence and relevance

This context puts a premium on an organisation that has international reach and influence in the policy making arena and expertise and knowledge that spans the entirety of the energy system – what the IEA describes as the 'trade-offs, co-benefits and competing priorities that need to be untangled across the energy sector'.

The Energy Institute intends to position itself as that organisation, with a new strategic programme over the next three years aimed at growing internationally, engaging actively in the policy debate and supporting the low carbon transition.

More specifically, by 2020 we will aim to have expanded our international reach into four regions we are currently developing and a further four new ones globally to support hundreds, if not thousands, of energy professionals we don't currently reach.

We will be a recognised body of expertise valued for its objectivity and ability to be a safe, honest place to ask – and look to answer – the difficult questions. We will also support members and partners to identify the skills, knowledge and good practice needed to make the low carbon transition and address these issues in those sectors where we don't currently work within the next three years.

All of this will be founded on the knowledge, skills and good practice on which professionals across the industry already rely. We will continue to deliver on familiar, valued work such as the Energy Barometer, the Energy Systems conference and our annual awards and other key events – but it will also mean doing things differently, including a significant shift to online learning.

Strong values in a 'post-truth' world

The *Oxford Dictionaries*' word of the year in 2016 was 'post-truth', an adjective defined as 'relating to or denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief'.

This reference to global politics might seem a million miles away from our day jobs, but we have seen empirical evidence distorted and proven expertise called into question closer to our own field. Witness the alarmism that has surrounded technologies such as onshore wind, shale gas, deepsea oil production, as well as attempts to discredit climate science.

This is why I believe we are vital, as individuals and, through the Energy Institute, as a professional and learned group right across the energy sector. In this age of 140 character communication via Twitter, we must have pride and confidence in ourselves, of what we know, what we do and how we do it.

The public deserves an energy debate that is evidence based, not headline grabbing. We must do what we can to enlighten the debate, to replace opacity with clarity and to call out opinion where it is masquerading as fact.

This underscores the importance of the values newly adopted by all of us at the Energy Institute, which will come to the fore in delivering our strategy. We will act with integrity, objectivity and professionalism; our work will be forward-thinking and creative; we will seek to demonstrate our knowledge and competence; and we will do so collaboratively.

At the EI Awards last November President, Jim Skea CBE FEI said: 'Energy fuels human progress and is delivered by highly skilled people whose dedication helps to develop and sustain society, often with little visibility to those that benefit.' I believe it is our job to improve that visibility and celebrate the work energy professionals do, now so more than ever. ●

Sudanese oil agreement renewed

Landlocked South Sudan has renewed a contract allowing it to continue using a Sudanese pipeline to export oil

Sudan and South Sudan recently agreed to extend an oil deal originally negotiated in 2012, which will enable landlocked and troubled South Sudan to continue utilising a Sudanese pipeline to export its crude, reports *Andrew Green*. 'We have agreed to extend it for another three years,' Sudan's Petroleum and Gas Minister Mohamed Zayed Awad told local news agencies after signing the deal.

Under the renewed deal, Juba (the capital of South Sudan) has to pay to use the pipeline, in addition to paying transit and transportation fees – the original agreement included a $3bn transitional financial arrangement (TFA). In total, Juba originally paid Khartoum (the capital of Sudan) about $25/b. As global crude oil prices fell, Khartoum agreed in early 2016 to float that fee.

Details on the renewed arrangement are still scarce, including how much money South Sudan still owes toward the TFA. South Sudan's only official statement came after the signing, when its Petroleum Minister Ezekiel Lol Gatkuoth pledged cooperation with Khartoum.

The deal comes as South Sudan, mired in a three-year internal civil conflict, has struggled to maintain production levels. The fighting has forced cuts from 220,000 b/d to an estimated 130,000 b/d.


Source: Isaac Billy / UN Photo

Sudan President Omar al-Bashir (left) arrives in South Sudan ahead of that country's official independence in 2011 and greets his southern counterpart, Salva Kiir (right)

'In the last two years, we've seen repeated statements from the South Sudanese government that production will increase again,' says Luke Patey, a senior researcher at the Danish Institute for International Studies, who authored a book on the oil industry in the two countries. 'I'm not confident that it will actually occur this year.' If production figures remain low, Patey does not expect South Sudan's oil to have a significant impact on global markets.

Oil has been a flashpoint since South Sudan seceded from Sudan in 2011. It took with it 75% of the former united Sudan's oil reserves, although it had no means of export aside from the pipeline through the successor state of (northern) Sudan. The two states were initially unable to reach an agreement and in January 2012 South Sudan abruptly stopped oil production. The September 2012 agreement ended that stalemate.

Exploration and production

OGA publishes EOR delivery programme

The UK Oil and Gas Authority (OGA) recently published its Enhanced Oil Recovery (EOR) Delivery Programme, which expands on its earlier announced EOR Strategy. According to the OGA, there is still a 'significant prize' to be gained by increasing recovery from existing UKCS oil fields. However, the average recovery factor is projected to be around 46% at the end of field life. Through advocating and facilitating the use of tertiary EOR techniques, OGA seeks to support the extraction of up to 250mn boe.

The Delivery Programme describes eight areas of focus:

- *Existing EOR projects* – ensuring current polymer and low salinity EOR projects are progressed in line with their field development plans (FDPs).
- *Maximising economic recovery (MER) for future EOR projects* – ensuring EOR opportunities are identified early enough in the field life cycle to maximise economic recovery.
- *Workgroups and industry partnerships* – ensuring that EOR technology and implementation lessons are shared.
- *Technology development and deployment* – gaining additional buy-in from EOR technology providers and operators to develop and then deploy economical EOR technology.
- *Creating value – improving economics* – ensuring the economics of marginal EOR projects do not stifle investment.
- *Advance next EOR and support CO_2 storage* – ensuring that, while prioritising polymer and low salinity EOR, other EOR technologies are not neglected.
- *Knowledge management* – ensuring EOR knowledge is widely available, improving awareness and knowledge transfer.
- *Communication and stakeholder plans* – ensuring investment in EOR projects is not limited by lack of senior industry leadership buy-in to the deployment of EOR technology.

Exploration and production

Cypriot well could be transformative for Eastern Med

Driven by the success of Eni's major Zohr feld gas discovery offshore Egypt in 2015, companies are rethinking the Eastern Mediterranean region's gas potential, according to new analysis from IHS Markit. Furthermore, Total's announcement that it will drill a 2017 exploration well in its deepwater block 11 located offshore Cyprus indicates the growing interest in the wider region.

Indeed, the market analyst company believes that Total's Cypriot well will be one of the 'most critical wells drilled globally in 2017 for the E&P industry, especially given the slowdown in exploration drilling worldwide'.

Total's offshore Cyprus block 11 is located to the north of Zohr's Egyptian Shorouk offshore block, which, according to Graham Bliss, Senior Director of Plays and Basins Research, IHS Markit, is the first time in the region that a carbonate, rather than a sand, reservoir has been targeted. 'The carbonate reservoir that comprises Zohr is of particularly high quality,' he said. 'As such, it will likely enable development using a minimum number of wells and, therefore, reduce costs and enhance project economics.'

The Zohr Field is one of the largest conventional gas discoveries of recent years. It has in-place resources of 32tn cf of dry gas, with possible recoverable resources of about 20tn cf, according to Eni statements. Phase 1 of the field development is due to come onstream in 2017.

'The existence of a carbonate reef play, which Zohr has proven to be, is very different from the turbidite sand-play discoveries in the Israeli Levantine Basin and the Egyptian Nile Delta Basin,' Bliss said. 'If the Zohr carbonate play extends northward into Total's block 11, then the potential for a significant discovery in block 11 exists, resulting in profound implications for the region. A major find would provide competition with offshore Israel gas fields to fulfill Egypt's rising gas demand, and within the complex jigsaw puzzle of gas supply and demand in the Eastern Mediterranean, could even potentially lead to gas exports to Turkey,'

IHS Markit research has also concluded that direct pipeline exports from the Eastern Mediterranean to Greece are potentially commercially viable.

The competitive landscape in the region has already begun to change in anticipation of the potential. In November 2016, BP purchased a 10% equity stake in the Shorouk offshore block (including Zohr) from Eni, with the option to acquire a further 5% stake.

Meanwhile, the December 2016 announcement of results from Cyprus's Third Offshore Licensing Round confirmed the interest of established and new companies in the Eastern Mediterranean region's growing gas potential. Eni extended its key role in the region with its award of offshore Cyprus block 6 (north-west of block 11) with partner Total, as well as offshore block 8 (north-east of block 11). ExxonMobil won the bid for offshore block 10 (which Total had previously relinquished). The ranks of larger companies in the region have now swelled to include Total, ExxonMobil and Rosneft, in addition to the established players Eni, Shell and BP.

While gas is the primary target for the Total Cyprus block 11, the IHS Markit analysis suggests there is some potential for a deeper, but unproven, Cretaceous target, which could have oil potential.

IN BRIEF

ADNOC has awarded BP a 10% interest in Abu Dhabi's onshore oil concession operated by ADCO, the Abu Dhabi Company for Onshore Petroleum Operations. As part of BP's interest in the concession, it will become asset leader for the Bab integrated asset group within ADCO. It is hoped the new partnership model will bring technology, expertise and financing aimed at maximising the value of the resources and supporting the transfer of knowledge. BP joins Total of France, Inpex Corporation of Japan, and GS Energy of South Korea as shareholders of ADCO and the onshore concession, who each own a 10%, 5% and 3% interest respectively. ADNOC will continue to explore opportunities with potential partners for the remaining 12% stake of the 40% earmarked for foreign partners.

Nigerian National Petroleum Corporation (NNPC) has awarded contracts to 39 companies for crude oil offtake in 2017–2018. According to *Global Energy Research*, 18 Nigerian companies secured contracts, 11 traders, five foreign refiners, three government-backed companies and two trading units of NNPC. All of the contracts are for 32,000 b/d, apart from NNPC's Panama-registered Duke Oil unit, which won a deal for 90,000 b/d. Meanwhile, NNPC has reiterated its intent to proceed with two new LNG projects in Nigeria – Brass LNG and OK LNG – describing both as 'priority ventures'.

Ashurst is advising Tullow Oil on a substantial farm-down of its assets in Uganda to Total E&P Uganda. Under the terms of the agreement, Total will acquire 21.57% in the Lake Albert development project in Uganda, with Tullow retaining a 11.76% interest in the upstream project and pipeline, which would reduce to 10% when the government of Uganda formally exercises its right to back-in. The Lake Albert project is expected to achieve around 230,000 b/d when it reaches plateau.

The Veolia and Peterson partnership has been awarded two platform decommissioning contracts for recycling at its facility in Great Yarmouth (see pic below). With an aim of reaching 96% recycling rates the work to recycle materials and assets is expected to begin in spring 2017 when the platforms arrive onshore.

Source: Veolia

Ghanaian power generation shift

Investment support from the World Bank Group is to help Ghana transition to a low carbon future

IFC and MIGA, members of the World Bank Group, have committed $517mn in debt and guarantees to support Ghana's Sankofa gas project, an integrated offshore oil and natural gas project that will provide a source of reliable, affordable energy in the West African country. The project will fuel up to 1,000 MW of power generation, helping Ghana meet its growing energy needs and displace oil-fired power generation with a clean-burning alternative.

The $7.7 bn Sankofa project will be developed by Vitol Ghana and Eni Ghana, in partnership with Ghana's National Petroleum Corporation. IFC has committed a loan of $235mn to Vitol Ghana and is arranging another $65mn in debt from the Managed Co-Lending Portfolio Program, a loan-syndications initiative that enables third-party investors to participate passively in IFC's senior loan portfolio. The IFC financing is part of a $1.35bn loan facility provided by commercial banks, including HSBC, Société Générale, ING, Standard Chartered Bank, UKEF, among others. MIGA has committed these commercial lenders with up to $217mn in political risk guarantees.

Ghana's government has identified the Sankofa project as a transformational project that will help the country achieve its COP21 commitments for climate mitigation. Once it starts to produce gas in early 2018, the project is expected to reduce carbon emissions in Ghana by an estimated 1.6mn t/y as gas displaces heavy fuel oil – equivalent to taking 1.2mn cars off the road each year or planting 152mn trees.

The Sankofa project involves the development of multiple subsea wells tied back to a FPSO which will be connected to shore via a gas export line

Sankofa is expected to generate $2.3bn in revenues for Ghana's government and provide a stable, long-term source of domestic gas that will help solve the country's chronic gas supply constraints.

Phlippe Le Houérou, IFC Executive Vice President and CEO, said: 'Ghana will require significant power generation and infrastructure to meet the growing needs of its young and expanding population. This project demonstrates that private capital can be mobilised on a large scale to contribute to the country's energy security. Developing Ghana's domestic natural gas resources will help the country reduce carbon emissions and provide a clean source of power for generations.' MIGA Executive Vice President and CEO Keiko Honda, added: 'The natural gas from the Sankofa project underpins the nation's transition to a low carbon future.'

With this announcement, IFC and MIGA support brings World Bank Group financing for the Sankofa gas project to approximately $1.217bn, building on a $700mn guarantee package from the World Bank announced last year that will help Ghana's National Petroleum Corporation ensure timely payments for gas purchases and that has enabled the project to secure financing from its private sponsors.

Fuel retailing

BP and Woolworths agree fuel retail partnership

BP is to establish a strategic partnership with Woolworths, one of Australia's largest supermarket retailers. The deal includes BP acquiring, rebranding and operating Woolworths' existing 527 fuel and convenience sites, as well as an additional 16 sites currently under construction, across Australia for a total consideration of $1.3bn.

A new fuel and convenience offer, Metro at BP, will be the first of its kind for Australia's growing convenience sector, bringing together BP's quality fuels, Woolworths' Everyday Rewards, fuel discount dockets and a new range of high-quality, ready-to-eat and take home fresh food products, reports the oil major.

Initially, the partners will launch a Metro at BP pilot programmes across 16 BP fuel and convenience sites and phase two of the programme will expand the Metro at BP format across more than 200 sites.

The acquisition of Woolworths' fuel and convenience sites will add to BP's existing network of 350 company-owned retail sites across Australia. BP also supplies fuel and branding to a further 1,000 sites owned by independent business partners.

Gas distribution

Ukraine lifts regulatory restrictions on gas exports

Ukraine has amended legislation that previously restricted exports of natural gas and anthracite. 'This represents an unexpected move for a country which is a net importer of natural gas,' comments international law firm CMS. 'If it achieves its desired aims the Resolution will mark a significant step towards the liberalisation of the natural gas market in Ukraine, enabling the flow of natural gas from European Union countries with which Ukraine has interconnectors, and also from Ukraine to them.'

Since 2006, the export of gas of Ukrainian origin has been heavily restricted by regulatory obstacles such as licensing (issued by the Ministry of Economy) and quotas (such quotas being determined on the basis of the Annual Gas Balance, usually equal to zero), explains CMS. As a result, Ukrainian gas producing companies (both state-owned and private ones) have not exported natural gas from Ukraine since 2011.

It should be noted, however, that due to Ukraine's recent switch to a system of tariffs for entry/exit capacity at Ukraine's gas interconnectors with neighbouring EU countries, exporters of natural gas from Ukraine are now required to pay the tariffs for using Ukraine's gas system exit capacity at those interconnectors. Such tariffs are calculated and approved by the Ukrainian energy regulator (the National Commission on the State Regulation of the Energy and Public Utilities Sector) for each particular exit point in $/1,000 cm. 'At present, the relevant exit tariffs are only established for a number of exit points and vary from $16.74 to $32.8/1,000 cm depending on the exit point in question,' notes CMS.

IN BRIEF

BP and PTT have entered into a sales and purchase agreement under which BP will provide PTT with approximately 1mn t/y of LNG. The term of the agreement is 20 years. LNG supply will commence in 2017 and will be sourced from BP's diverse portfolio of LNG, including the Freeport LNG project in the US. Commercial terms of the agreement have not been disclosed.

In line with the pricing policy announced by Petrobras in October 2016, the company raised the price of diesel sold at its refineries by 6.1% on average, in January 2017. The price of gasoline sold at its refineries remains unchanged. The decision is mainly due to the effect of the continued, although modest, rise in oil prices in international markets, the strengthening of the Brazilian real since the last price review, and adjustments to Petrobras' competitiveness in the domestic gasoline and diesel markets. The price changes also reflect seasonal movements in international oil product prices, as diesel prices have responded to higher demand during the Northern Hemisphere winter. As Brazilian law guarantees pricing freedom in the market for fuels and oil products, the refinery price changes made by Petrobras may or may not be reflected in consumers' end prices. This will depend on price changes made by other players in the fuel chain, especially distributors and gas stations. If the adjustments made are fully passed on and no changes take place in the other elements that make up the end price for consumers, diesel prices could increase by 3.8% or around R$0.12 per litre on average, notes Petrobras.

Helios Investment Partners and Vitol have agreed the acquisition of Shell's 20% shareholding in Vivo Energy for $250mn. On completion in 1H2017, Vivo will be owned 100% by Vitol and Helios. At the same time, a long-term brand licence agreement has been renewed with Shell soVivo Energy will continue to operate under the Shell brand. Vivo Energy, the company behind the Shell brand in Africa, was created by Helios, Vitol and Shell in 2011 when Shell divested its majority share in its downstream operations in 14 African markets. Since then, its shareholders have made significant investments in people and assets, expanding the retail network from 1,300 to 1,700+ stations and its presence to 16 countries. Vivo Energy plans an additional $300mn of investment over the next three years.

Energy UK recently reported that overall in 2016, some 4,822,885 UK consumers switched electricity supplier, an increase of 26% compared to 2015.

Fossil fuels aren't going away soon

Fossil fuels will provide nearly 80% of global energy demand in 2040, according to ExxonMobil's latest *Energy Outlook*

Global population growth of nearly 2bn, a doubling of worldwide economic output and rapid expansion of the middle class in emerging economies are all expected to contribute to energy demand growth of about 25% from 2015 to 2040, according to ExxonMobil's 2017 *Outlook for energy: A view to 2040*.

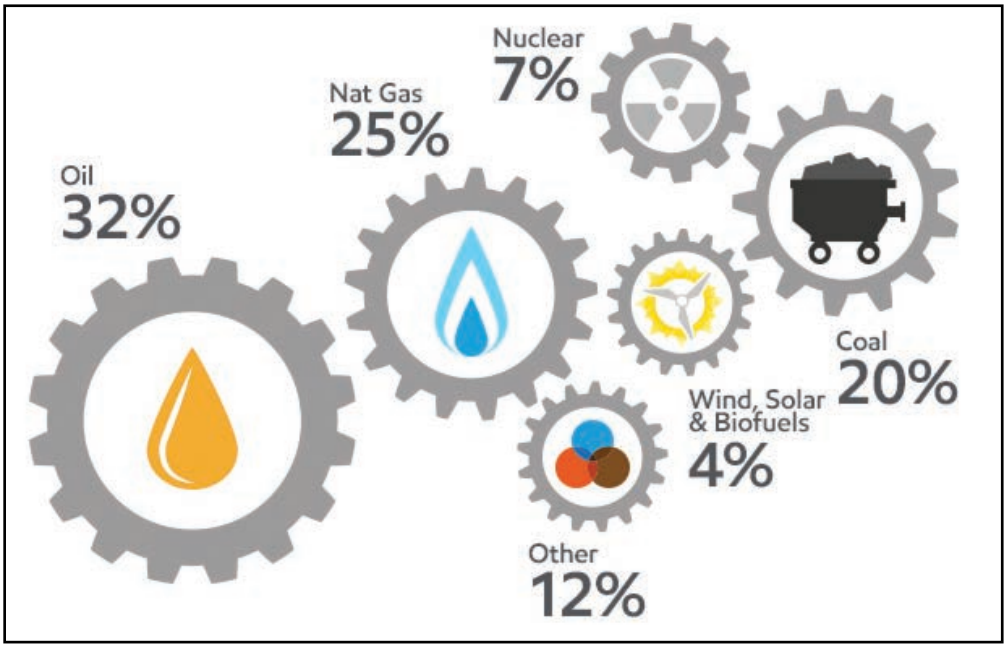
Efficiency gains across economies worldwide are expected to play a significant role in limiting the growth in energy needs. Energy demand in member nations of the Organisation for Economic Co-operation and Development (OECD) is likely to be flat to 2040, while demand in non-OECD nations is expected to increase 40% as prosperity expands and access to modern energy increases.

Growth in global energy demand will be led by greater electrification of the global economy. Some 55% of the energy demand growth over the next quarter century will be tied to power generation needed to support the increasingly digital and plugged-in lives of society, according to the company's annual long-range supply-and-demand energy forecast.

Average electricity use per household will rise about 30% between 2015 and 2040. The share of the world's electricity generated by coal is expected to fall to about 30%, from approximately 40% in 2015 as the use of lower-emission energy sources including natural gas, nuclear and renewables increases.

'As economies expand around the world, energy demand will increase as more people seek higher standards of living,' said William Colton, ExxonMobil's Vice President of Corporate Strategic Planning. 'Humanity's dual challenge is to meet growing energy demand while managing the risk of climate change. Our *Outlook for energy* can help people understand factors influencing future energy supply and demand and inform industries and governments as they consider future energy policy.'

With the global middle class more than doubling to about 5bn, the number of cars, sport-utility vehicles and pickups are expected to increase about 80% to 1.8bn vehicles by 2040. During the same period, average new car fuel economy will improve from about 30 miles per gallon (m/g) to nearly 50 m/g, reflecting significant strides in efficiency of conventional vehicles and a shift in the fleet mix favouring hybrid vehicles, the report shows.



It will take all energy types to meet demand in 2040 – oil, natural gas and coal are expected to account for 77% of the energy mix at this time

Source: ExxonMobil Energy Outlook 2017

Global energy-related carbon dioxide (CO_2) emissions are expected to peak during the 2030s and then gradually decline. This is supported by an increasing shift to less carbon-intensive energy for power generation and higher energy efficiency across all sectors.

Key findings of the ExxonMobil report include:

- From 2015 to 2040, global demand for energy is expected to increase by about 25% – roughly equivalent to the total energy used today in North America and Latin America.
- In 2040, oil and natural gas are expected to make up nearly 60% of global supplies, while nuclear and renewables will be approaching 25%.
- Natural gas demand will expand significantly, accounting for about 40% of the projected growth in global energy demand.
- Nuclear and renewable energy sources – including bio-energy, hydro, geothermal, wind, and solar – are also likely to account for 40% of the growth in global energy demand to 2040.
- Oil will provide about one-third of the world's energy in 2040, remaining the No. 1 source of fuel, with growth driven by commercial transportation and chemicals demand. Average global fuel economy for new light-duty vehicles is expected to improve by about two-thirds.
- Carbon intensity of the global economy is likely to be reduced by 45% through 2040, reflecting significant gains in the energy efficiency of economies worldwide and a gradual transition to lower carbon-intensive energy types.
- Global energy-related CO_2 emissions are likely to peak during the 2030s and begin to decline, even as global economic output doubles from 2015 to 2040.
- North America, which for decades had been an oil importer, is likely to become a significant net exporter by 2025.
- India is likely to surpass China as the world's most populous nation by 2025. The two countries are expected to account for about 45% of the growth in global energy demand.

Finance and investment

France launches more than €20bn in green bonds

France has announced it is launching more than €20bn of green bonds, in a move that follows hot on the heels of Poland, which became the first country to do so as 2016 drew to a close, writes *Robert Follie* of law firm Holman Fenwick Willan.

According to France's debt agency, the country will issue the green bonds over two to three years, including 2017 – with an initial offer at the start of January raising at least €2.5bn. At the close of 2016, the Polish government issued €750mn of sovereign bonds.

Green bonds are distinctive in that their proceeds are earmarked for use in financing projects or initiatives that have environmental and climate benefits. Indeed, according to *Bloomberg*, French Finance Minister Michel Sapin emphasised in early January 2017 that the government expected the green bond market to promote 'climate awareness by all actors, bankers, companies and states'.

France and Poland are making their first forays into the green bond markets against the backdrop of the Paris Agreement on climate change, which came into force in November 2016. The agreement obliges 195 countries to hold global warming to no more than 2°C above pre-industrial levels.

The global market is currently dominated by development banks, businesses and local authorities, and it is hoped the entrance of powerful state bodies could build momentum in this area – even as noted climate change sceptic Donald Trump becomes US President.

However, there are legal challenges and obstacles to overcome if sovereign green bonds are to take off and thrive. These challenges are mainly caused by a lack of common definition and legal framework; for instance, no monitoring mechanism is in place to ensure that the funds raised are actually used to finance environmentally friendly projects.

The French government has tried to address these issues and avoid 'greenwashing' criticisms by implementing two innovative mechanisms:

- an ex-ante control based on the intervention of an independent rating agency (Vigeo Eiris) and the issuance of an annual report by the French government on the allocations of the funds invested; and
- an ex-post control based on the opinion of a committee of experts in environmental issues.

However, some uncertainties remain and the committee members selection process is yet to be determined. Moreover, these monitoring measures are limited to France and will have little impact globally.

Another consequence of the lack of common definition is standardisation might be more difficult to achieve. This may discourage investors from investing as they perceive the bonds as being less liquid than other assets.


Source: Pixabay

To tackle this issue, France has developed the Transition Energétique et Ecologique pour le Climat (TEEC) label. It comes in addition to the Green Bonds Principles (GBP) or the Climate Bond Initiative (CBI), the two main international voluntary frameworks used to label green bonds.

Finally, it must be noted that most of the green bonds are held by institutional investors. A way forward could be to ease individual investors' access to the market.

For these reasons, with hope that developments in France and Poland represent a new era, there is more progress to be made in terms of bringing legal certainty on a global perspective.

IN BRIEF

Wood Group has secured a five-year, multi-million dollar framework agreement to continue to provide engineering and project management services to Saudi Aramco's onshore capital programmes in the Kingdom of Saudi Arabia. Effective immediately, the contract also includes three, one-year extension options and will be delivered locally in Saudi Arabia.

Energy Intelligence has released its annual ranking of the world's 100 largest oil and gas companies, which compares private sector firms with national oil companies (NOCs). The Top 10 companies in this year's rankings are 1 – Saudi Aramco; 2 – NIOC; =3 – CNPC and ExxonMobil; 5 – PDVSA; =6 – BP and Rosneft; 8 – Shell; 9 – Gazprom and 10 – Total. Some mid-tier NOCs appear to be struggling, with Mexico's Pemex down three places to 18th and Libya's National Oil Corporation sliding two to 33rd. Spain's Repsol jumped seven places following its acquisition of Canada's Talisman. Meanwhile, headwinds in shale hit US independents, with Anadarko dropping five places and Chesapeake three.

A new publication to help guide the growing use offshore of unmanned aerial systems (UAS) – also known as drones – has been published by Oil & Gas UK. According to Mick Borwell, Health, Safety and Environment Director with Oil & Gas UK: 'A small but increasing number of oil and gas operators are using UAS for inspections predominantly, but also for aerial photography, surveying and security. The technology is particularly attractive for its use in improving safety. For example, sending unmanned aircraft instead of people into confined spaces to conduct inspections reduces risk, and is also effective and efficient. We expect their usage to grow.' The new guidelines aim to achieve consistency with the high safety and operating standards already adopted on the UKCS for offshore oil and gas production and helicopter flight operations. 'The intention is to encourage offshore operators planning on using this emerging technology to think about the whole operating and safety system offshore and not just the air vehicle,' concluded Borwell.

EI Awards

Hosted by energy institute

Showcase your excellence in 2017

The annual EI Awards competition is now open for entries. The Awards celebrate teams and individuals across the global energy sector who have demonstrated excellence in areas such as:

- Communication
- Community Initiative
- Energy Champion
- Energy Excellence
- Efficiency
- Environment
- Innovation
- Safety
- Technology
- Young Energy Professional of the Year

If you or someone you know has done something outstanding to shape our energy future, please enter the EI Awards in 2017 to gain the recognition you deserve.

Deadline for entries is 26 May 2017
For information on how to enter please visit: **energyinst.org/ei-awards**

Knowledge

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Energy Barometer 2017

Your chance to inform energy policy and make your voice heard

energy Barometer

"The Energy Barometer zones in on the biggest challenges facing our sector, and society, over the next few years. The issues highlighted by people working at the heart of the energy industry will resonate as a timely contribution to the policy debate."

Brent Cheshire
UK Country Chairman, DONG Energy

"Very thought provoking. Thank you."
2016 Survey respondent

"A very well constructed survey and a privilege to have been asked to participate."
2016 Survey respondent

Watch your inbox in January for an invitation to share your views. The survey will follow in February.

knowledge.energyinst.org/barometer

energy institute

IP Week 2017 to assess impact of eventful past year on industry future

In the wake of the UK vote to leave the European Union, the ratification of the Paris Agreement on climate change, Donald Trump's election to the US presidency; and with further political and economic milestones ahead, International Petroleum (IP) Week – hosted by the EI in London from 21 to 23 February – will offer a timely forum to assess the future impact of these events on the global oil and gas sector. It will also debate the effect of industry-specific issues such as the challenging oil price environment and OPEC's production cuts.

Over the three days of conferences, roundtables and social events, delegates will receive insights from distinguished figures including Mohammad Sanusi Barkindo, OPEC's Secretary General, Dr Hoesung Lee, Chair of the Intergovernmental Panel on Climate Change (IPCC), H.E. Dr Mohammed Bin Saleh Al-Sada, Minister for Energy and Industry, State of Qatar, alongside leaders from many major oil and gas operators, including Igor Sechin, CEO of Rosneft. Those attending the prestigious IP Week dinner on 23 February will also hear from Patrick Pouyanné, Chairman and CEO of Total.

'Over the years, IP Week has become an unmissable event for oil and gas industry executives as a global platform for thought-leadership on the issues affecting the sector,' says Louise Kingham OBE FEI, Chief Executive, Energy Institute. 'This year will be of particular interest considering the significant events of the past few months. We are entering a new era in international relations and trade, and IP Week 2017 will represent a particularly valuable opportunity to gauge the mood and expectations of the oil and gas industry in these challenging times.'

To find out more about this year's event and register, visit **ipweek.co.uk**

IN YOUR AREA

North East YPN visit Drax Power Station

In October, the EI North East Young Professionals Network (NEYPN) organised a visit for 25 members to the Drax Power Station in Selby, North Yorkshire, which supplies around 7% of the UK's power at any one time. Having been welcomed by Phillip Batty of Haven Power, the delegates were given a summary of operations at the power station, from the supply chain behind the fuels used on site (coal and biomass), to Drax work towards cleaner power generation.

They then toured the facilities, including the national grid HV infrastructure, cooling towers, biomass storage systems and control room. The turbine sheds were particularly awe-inspiring for the visitors. The branch would like to thank Drax Power Station and Haven Power for helping organise the event, Newcastle University for their financial help, and Marcelo Calispa Aguilar for the photography.

For more detailed reports from the EI branches network, including speaker presentations, and further information about forthcoming activities and events in your area, visit **energyinst.org/branches**

Queen's Honour for EI Vice-President Dr Bernie Bulkin FEI

Many congratulations to the EI's Vice-President Dr Bernie Bulkin FEI who has been made an OBE in the Queen's New Year Honours List for services to the energy industry.

Dr Bulkin has been an eminent and influential voice in the energy world for many years, having served across industry, policy and academic circles. He has had an extensive portfolio of roles ranging from Chief Technology Officer of BP Oil and then as Chief Scientist of BP to Member of the DTI Energy Board (2006 – 2009) and Chair of the Office of Renewable Energy in Department of Energy and Climate Change (2010 – 2013).

As an academic, Dr Bulkin has been Honorary Professor at the University of York and Professorial Fellow at Cambridge, where he co-founded the 'Environment on the Edge' lecture series. Some of the lectures were published by the UN Environment Programme and programmes on the theme were broadcast on *Voice America*.

Dr Bulkin has also worked as a venture capitalist, first as a partner in US firm Vantage Point, and more recently for Ludgate Investments Limited. He has been a Non-executive Director of Severn Trent and currently serves as a Non-executive Director of US firm ATN International. He chaired UK public companies AEA Technology and Pursuit Dynamics.

Following the publication of his book *Crash Course* in 2015, he currently coaches companies in leadership techniques as a senior partner of UK consultancy Refresch.

Dr Bulkin joined the EI Council in 2012 and was appointed Vice-President at the latest AGM in June 2016. We are honoured and grateful to enjoy the support of such a respected figure toward our work.

IN BRIEF

Certificate of Appreciation for EI Aviation Committee Chairman

Dr Anthony Kitson-Smith (right) receives certificate of appreciation from Martin Hunnybun MEI, Technical Team Manager, Energy Institute

The EI has presented Dr Anthony Kitson-Smith with a Certificate of Appreciation in recognition of his much valued services as Chairman of the Aviation Committee, 2015 – 2016, and significant contribution to the field of aviation fuel quality and handling.

During his tenure, Anthony has demonstrated considerable leadership, been responsible for significantly progressing key projects, represented the EI at a number of stakeholder events and devoted a lot of his time to committee activities. Highlights include establishing the committee's highest priority items and focusing available resources on their completion; updating the committee on IATA Fuel Forums, UK MoD Aviation Fuels Committee meetings, a National Institute of Storage Tank Management conference (Orlando) and Joint Inspection Group workshops, representing the EI as part of an IATA technical mission to Beijing (April 2015), supervising the production of seven publications, hosting technical seminars for international stakeholders and resolving feedback from stakeholder review.

2017 Energy Barometer

The 2017 Energy Barometer survey will be emailed to EI College members this month. If you accepted your invitation this year, or completed the survey for the first time last year, you will receive a link to complete the 2017 questionnaire online. The survey enables a number of EI members to share their insights and concerns about the future of the UK energy system with policymakers. In a recent blog (**blog.energyinst.org**), Dr Joanne Wade FEI, Chair of the EI Energy Advisory Panel, reflects on the impact of last year's report and how the EI was able to build on its findings to further inform energy policy. The 2017 report will be published in June.
knowledge.energyinst.org/barometer

Energy Efficiency conference and workshop 29 – 30 March 2017

The EI's popular Energy Efficiency conference returns next month with an additional workshop taking place the following day. Under the theme 'Embedding behaviour change to unlock efficiency potential', the conference will discuss how to reduce carbon emissions and lower operational costs, and explore the issue at the heart of effective energy management: people. Topics will include behaviour change, management strategy and performance monitoring. The workshop will build on the conference outcomes and focus on the latest behaviour change techniques and solutions. Find out more at **energyinst.org/events**

New EI eLibrary titles

The following titles have been recently added to the EI's extensive eLibrary collection – one of the most valuable resources from the EI Knowledge Service, alongside the Energy Matrix, Information sheets and access to periodicals.

Dodson, Jago, et al. *Planning after petroleum: preparing cities for the age beyond oil*. 2017.

FitzRoy, Felix; Papyrakis, Elissaios. *An introduction to climate change economics*. 2016.

Navanietha Krishnaraj, R.; Yu, Jong-Sung. *Bioenergy: opportunities and challenges*. 2016.

Newton, David E. *Fracking: a reference handbook*. 2015

Henderson, Harry. *Nuclear power: a reference handbook*. 2nd ed. 2014

Adaramola, Muyiwa. *Wind resources and future energy resources: environment, social and economic issues*. 2015

Visit **knowledge.energyinst.org** to explore energy information and data, and access the e-Library.

Sadly, we have been notified, over the past few months, of the deaths of the following members:

	Born
Mr G Cardinal FEI	1947
Mr T M Jensen FEI	1938
Mr K Gladstone-Millar FEI	1921
Mr C H D Lamb MEI	1945
Mr N A Osbourn CEng FEI	1924
Mr G G Pyett MEI	1932
Mr S P Redgrave MEI	1948
Dr W Stockdale FEI	1945
Mr G Williams CBE FEI	1917

Help inspire the next generation of scientists and engineers: join the Big Bang Crew

The organisers of the 2017 Big Bang UK Young Scientists & Engineers Fair are calling for volunteers to join the 'Big Bang Crew' and help inspire school children into studying STEM disciplines. The Fair, which takes place in Birmingham on 15 – 18 March, is the largest celebration of science, technology, engineering and maths for young people in the UK, with over 70,000 young people, teachers and parents expected to attend and enjoy theatre shows, engage in interactive workshops, discover science and engineering projects and collect extensive careers information. Entry is free and the Crew's role is to ensure that the exhibition is accessible to visitors of all ages – but especially the very many young ones.

Roles available include helping with events, activities, career information and the judging of projects (the latter requires STEM career experience).

Further details on how to get involved can be found at **thebigbangfair.co.uk/play-your-part/volunteering**. The official deadline for applications is 29 January 2017 but the EI has secured a few days' extension to enable its members to apply.

2017 Hawley Award open for entries

A prestigious annual engineering award supported by the Engineering Council has launched its 2017 campaign to recognise the most outstanding engineering innovation that delivers demonstrable benefit to the environment.

The Hawley Award is open to individuals who have undertaken after graduate or post-graduate degree work and have at least reached a stage where a prototype or a proof of concept has been developed, with the expectation of commercial implementation. Candidates must be members of a professional engineering institution and within ten years of starting a professional career as an engineer or scientist in either academia or industry. Individuals can put themselves forward for the award but must have the support of a supervisor. The winner's cash prize is £5,000.

The entry deadline is 18 April 2017. Interviews for shortlisted candidates will be held on 3 or 4 May 2017. Full details can be found at **engc.org.uk**

FINANCE

Systemic risk or greenwashing?

Central banks are poised to regulate both the transition to a low carbon economy and the environment, writes *Maria Kielmas*.

'Climate change is the tragedy on the horizon,' warned Bank of England Governor Mark Carney in September 2015 when addressing members of the Lloyds of London insurance market. His aim was to highlight how climate change is a risk to global financial markets. His speech followed one by Paul Fisher, Bank of England Executive Director of Insurance Supervision, that the insurance sector faces major losses if it continues to invest in fossil fuel-based assets should governments take action to cut greenhouse gas emissions in line with recommendations from the United Nation's Intergovernmental Panel on Climate Change (IPCC). Speaking in Berlin one year later, Carney said that 'climate transition and green finance can help resolve' this looming tragedy.

Reactions to the Bank of England statements ranged from positive from the insurance and reinsurance industries to vitriolic from capital markets players who blamed central bank policies of quantitative easing since the 2008 financial crisis for suppressing market interest rates, artificially inflating asset prices, contributing to wealth inequality and creating a new financial powder keg. Carney in particular has come under fire since Britain's June 2016 vote to leave the European Union for 'overreach', straying into the political arena and claiming a say in environmental regulation.

Underpinning the central bankers' concern about climate risks is the 'carbon bubble' thesis. First proposed in 2011 by London-based environmental advocacy group Carbon Tracker, this states that the world must keep within a 'carbon budget'– the CO_2 volume that may be emitted to avoid global mean temperature from rising 2°C above pre-industrial levels by 2050 – to avoid a catastrophic climate change. This benchmark was recommended by the IPCC and endorsed by the 2016 Paris Agreement. If this logic is followed, then up to 80% of world proven oil, gas and coal reserves would be unproduceable without expensive carbon capture technology, left 'stranded', and lead to a collapse in the market value of all fossil fuel-based companies. Proponents of this thesis claim that this is comparable, but worse, than the housing and sub-prime mortgage bubble whose collapse was one of the causes of the 2008 financial crisis.

Underpinning central bankers' concern about climate risks is the 'carbon bubble' thesis, which states that the world must keep within a 'carbon budget'– the CO_2 volume that may be emitted to avoid global mean temperature from rising 2°C above pre-industrial levels by 2050 – to avoid a catastrophic climate change

Source: Shutterstock

Market awareness

Richard Tol, Professor of the Economics of Climate Change at Sussex University, disagrees. 'Do we really believe that governments are secretly preparing a climate policy and the suckers on Wall Street are not aware of this? There is no bubble.' Government energy and climate policies affect companies, he adds. This was seen when the ExxonMobil share price rose when the market anticipated that with former ExxonMobil CEO Rex Tillerson at the State Department, the US may lift sanctions against Russia, thus enabling growth in ExxonMobil's Russian investments. But Tol does not believe that there is a risk of climate policy causing mayhem. 'Sensible governments won't do this,' he said. Although noting that 'Germany is the exception,' referring to Germany's *energiewende*, the transition to renewables that has had profound effects on utilities such as RWE and E.ON. These companies were left with stranded hard coal, though not lignite, and gas-fired power generation plants and laid off thousands of workers. But the combination of state subsidies and unlimited access to the power grid for renewable producers irrespective of demand has led at times to negative wholesale electricity prices. The surplus passed free to neighbouring Austria and Switzerland, but Germany had to pay for its disposal and consumers face ever increasing domestic retail power prices.

Slow transition

London-based consultancy group IHS Markit is another critic of the carbon bubble thesis. In a series of reports addressing the Bank of England comments, Vice Chairman Daniel Yergin and Analyst Elena Praventoni noted that there is little risk of oil and gas companies being overvalued by any potential climate policy restrictions. Barring some as yet unrealised technological breakthrough, no one expects oil to be a minority source of energy before 2050.

Energy transitions unfold over decades and do not constitute a systemic risk to the financial system. In any case, they argue, some 82 global oil companies burned off 42% of their value between June 2014 and December 2015, or about $1.4tn in market capitalisation. In addition, the Dow Jones Industrial Average has risen 6% since the oil price dipped below $100/b.

It was puzzling, Yergin said, that a central bank would identify this sector as a systemic risk when there are more immediate and obvious risks such as mounting Asian debt, disruption of global trade and cybersecurity. In addition, not all financial regulators agree.

In a February 2016 report on climate risks by Finansinspektionen, the Swedish financial supervisory authority noted that the experts' view of climate risks diverges widely and that taking action to reduce climate risks creates risks of its own. Faced with the prospect of successful climate change mitigation policies on the part of government, fossil fuel companies may be encouraged to exploit their resources faster so that they do not remain stranded. In such an eventuality, fossil fuel prices will fall but there is no certainty that alternative low carbon energy supplies will be available at a low enough cost to make any transition economically feasible. Realistically, the transition risk to a low carbon future could resemble that of demographic and technological changes which can be significant but do not usually lead to a crisis. Human-induced climate change and its mitigation are fraught with uncertainty, the report concluded.

Richard Tol agrees, stressing that the magnitude of human influence on the climate is a hotly disputed subject, the instrumental record does not contain enough information for reliable risk estimates and that things can be manipulated to a fraudulent degree. 'The impacts of climate change are strongly exaggerated,' he adds, 'they are decades in the future and have been discounted in the stock markets.' He believes that companies should be preparing for weather, not climate, risks.

Renewable investment drive

Nevertheless, a combination of shareholder pressure and sensitivity to consumers and reputations is driving oil and gas companies to invest in renewable energy. Total hopes that within 20 years some 20% of its portfolio will be renewable or low carbon business. Shell and Statoil are investing heavily in wind power. China plans that 15% of its power mix will come from renewables by 2020 and hopes to invest $361bn to that purpose. Even the Trump administration in Washington is unlikely to halt plans to expand renewables in many states where the industry is supported by the local Republican Party, and federal subsidies for renewables are scheduled to end over the next five years. The most likely change by a Trump administration would be a withdrawal of the US from the Paris Agreement.

Task Force report

Central bankers are not shifting from their view, although their statements conflate climate, weather and the atmosphere. 'Once climate change becomes a clear and present danger to financial stability, it may be already too late to stabilise the atmosphere at 2°C,' Carney said in September 2016 in Berlin. Climate related catastrophes are increasing in frequency, the past is not prologue, and 'the catastrophic norms of the future are the tail risks of today'.

The solution, he said, is to build a market in climate related financial risk to enable a smooth adjustment to a low carbon economy, as well as corporate disclosure of climate related financial risks. This was laid out in a December 2016 report by the Task Force on Climate-Related Financial Disclosure, a division of the Financial Stability Board (FSB) that is a forum for central bankers and governments of the G20 group of major economies. It called on companies to mainstream quantified climate risks in obligatory financial statements. These would include not just current carbon footprints but also how these impact on existing and future business lines, their governance, management and corporate mitigation strategy, financial planning, R&D, and capital expenditure. All of these could be illustrated by a series of scenario analyses for different levels of global temperature rise and emissions. These should include political and technical development as well as evolving physical and liability risks.

IHS Markit was concerned that this new disclosure framework would be a preface to more regulatory action and that the unintended consequences of the disclosure framework are high. Risk analysts emphasise that any kind of scenario modelling depends on the initial assumptions made by the researcher, usually on the basis of past trends and information as well as personal prejudice. If the past is no guide to the future, as Carney points out, future climate trends can be anything the analyst wants them to be. The upshot could be that climate risk disclosure becomes a work of fiction.

But Andreas Spiegel, Head of Group Sustainability Risk at the Zurich-based Swiss Reinsurance Company, and a member of the Task Force, refuted this, saying that the disclosure requirements are not prescriptive. 'The disclosures are voluntary and have nothing to do with regulation.' It is important to think in the long term. He views scenario assessments as valuable tools in dealing with decision making uncertainty but the scientific discussion about attributing climate change to human activity is over.

Tol believes that the whole move towards climate risk disclosure is another form of 'greenwashing' – appearing more environmentally friendly than reality – and a way of producing job opportunities for consultants. In his view, most impacts of climate change fall on poor people in poor countries not rich people in rich countries. Today's climate policies are about the enrichment of the 'happy few', he says, adding: 'It's a kind of low level nepotism. The concept of systemic risk opens up job possibilities. Over 20–25 years of European climate policy there has been no structural change, no fall in emissions but has created a big diesel emission falsification scandal.' The final FSB Task Force report on climate risk disclosure will be presented at the G20 heads of government summit this year in Germany. It means that the central bankers' move into environmental regulation and its politics has begun. ●

FOSSIL FUELS

What's at risk?

Stephen Russell, from the World Resources Institute, explains why fossil fuel companies should disclose the potential greenhouse gas emissions from their reserves as investors look to determine potential downside risks.

To help prevent global warming it is estimated that over 80% of current coal reserves will need to remain unused through 2050

Source: Parolan Harahap

Because the value of fossil fuel companies is based on the size of their reserves, it may seem counter-intuitive to see some of these assets as potential risks. But changes in market or economic conditions can make some reserves too expensive to tap, leaving them stranded – and their owners more vulnerable than the size of their reserves would indicate. Even majors such as ExxonMobil are not immune – the company recently announced that it no longer considers 20%, or 4.5bn barrels, of its proved oil reserves to be extractable. This reduction applies mostly to the company's oil sands deposits in Canada, which are expensive to extract and use, and therefore particularly sensitive to dips in oil prices. The write-down could be the largest single-company revision in the history of the industry.

However, the high cost of extraction is only one factor that can create stranded fossil fuel assets. Another is the worldwide accepted goal to curb emissions to keep global temperatures from rising more than 2°C above pre-industrial levels. To realise this goal, an estimated one-third of all oil reserves, half of all gas reserves and over 80% of current coal reserves need to remain unused through 2050. If fossil fuel companies are required to leave a significant bulk of their reserves untapped, their valuations could decline steeply – that is, unless these companies preemptively adjust their businesses strategies to avoid these risks, for example by diversifying holdings to include more low or zero carbon energy sources like wind, solar and geothermal.

Risk assessment

If prices of alternative energy, including wind and solar power, continue to drop as expected, the financial incentives for extracting existing fossil fuel reserves shrinks. Given the popularity of clean energy across the political spectrum, and the need for $90tn worth of infrastructure investment over the next 15 years, it makes sense to aim that investment toward low carbon projects. One way to encourage this kind of enlightened self-interest in investing is to help shareholders and other stakeholders understand the risk of potential emissions to fossil fuel reserves.

The connection between potential emissions from fossil fuel reserves and climate change is substantial, with enough carbon stored in untapped reserves to bust the carbon budget, which is the amount of emissions allowed before the 2°C goal is exceeded. Preliminary analyses show that the 200 publicly traded companies with the largest reserves of oil, gas and coal have enough carbon in their proved and probable reserves to equal 156% of the carbon budget. This figure is based only on fuel burning and doesn't count the considerable emissions from fuel production and processing. These upstream sources account for between 5% and 37% (an average of 15%) of fossil fuels' total emissions, from exploration to consumption. As the world's conventional fields get depleted and companies turn to fields that require more energy to extract, such as oil sands, upstream emissions are expected to increase. Measuring and breaking down upstream emissions as a percentage of overall life cycle emissions indicates which reserves are the most energy-intensive to produce, and provides a clue as to which reserves are likely to be stranded. Furthermore, when combined with data on reserve size, potential emissions can act as an indicator of the carbon intensity of future production.

Moving to disclosure

Currently there is no requirement that companies report on factors that could contribute to stranded assets and, as a result, individual shareholders could unwittingly be at risk. However, voluntary disclosure of these potential challenges is on the rise as investors demand more information about downside risk in their investments, especially fossil fuels. New analysis by *Reuters* shows that 48% of the world's 4,400 largest companies report their emissions to investors and other stakeholders.

This trend toward disclosure is likely to continue as part of the push for socially responsible investing that has grown 10-fold since the 1990s and continues to outpace other strategies. Investors are most concerned about the future performance of companies, and data on potential emissions from reserves offer valuable information about a company's future prospects. Climate protection policies, like Canada's carbon tax, could affect the value of their assets and eventually profits, so it is essential for investors to know the potential emissions so that they can calculate the expected liability. And now that climate change has secured a permanent slot on the world's priority list, policies to curb emissions are destined to propagate and strengthen.

Investors have already collaborated on a number of initiatives to standardise the disclosure of carbon-related data and make data more readily available in the fossil fuel industry – and these initiatives are now likely to include potential emissions. By reporting potential emissions from their reserves, companies can reassure their investors that they are acknowledging the emergence of climate protection policies and market signals driving the world towards a low carbon future.

Alarmingly for investors, not a single fossil fuel company currently discloses potential

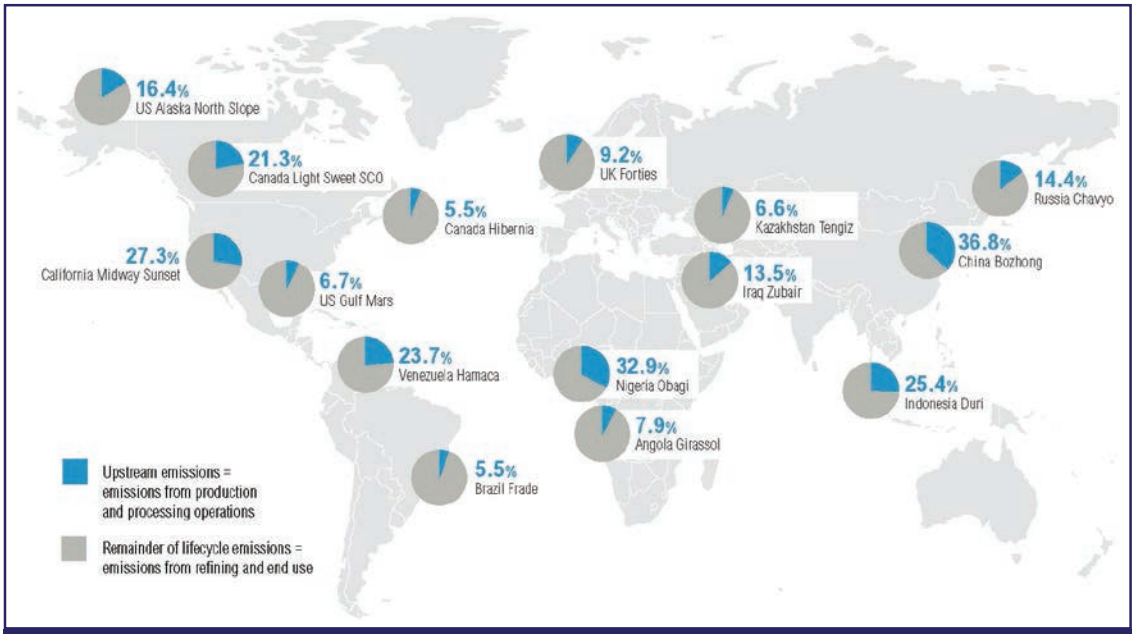

Figure 1: Upstream emissions are expected to increase as the world's conventional fields become depleted and companies turn to more energy-intensive fields. Upstream emissions account for 5–37% of fossil fuels' overall greenhouse gas emissions – to date, analyses of potential GHG emissions have not taken this into account

Source: http://oci.carnegieendowment.org/

emissions from reserves. But that could change. The Financial Stability Board – made up of the 20 most powerful central bankers and finance ministries in the world – recently called for companies to disclose climate-related risks, both financial and physical.

Part of the challenge is that until now there hasn't been a consistent, credible methodology for them to calculate their potential emissions. To address this challenge, the World Resources Institute (WRI) recently launched the first comprehensive methodology to measure and report potential emissions from oil, gas and coal reserves.

These trends are occurring against a backdrop of dramatic political change and a shifting international landscape. As part of the Paris Agreement on climate change, which entered into force in November 2016, nearly 200 countries committed to significantly cut their greenhouse gas emissions and take other actions necessary to avoid the worst consequences of climate change. Although US President Donald J Trump has hinted he is less than committed to the pact, the rest of the world has shown steely determination to push forward. California Governor Jerry Brown, who oversees the sixth largest economy in the world (it surpassed that of France last year), has vowed that the state will not back down from its aggressive efforts to lower emissions and tackle climate change. Other US states and major cities have reaffirmed their resolve to push forward as well.

The private sector has heeded the regulatory and physical risks related to climate change and has made significant strides to address it. For example, more than 200 companies have committed to set science-based targets to curb emissions in line with the global effort to keep temperature rise under 2°C – including NRG Energy, Wal-Mart, DuPont and other heavy hitters. In addition, 640 companies and investors have committed to climate action through the 'We Mean Business' coalition.

Despite a decline in the price of oil and gas, the shift to cleaner, zero emissions energy is underway and seems destined to continue. Clean energy investment broke new records in 2015 and is now seeing twice as much global funding as fossil fuels. The desire to bring back US jobs to heartland states is already being realised in states like Florida, Kansas and Colorado, where over 21,000 factory workers are making the majority of domestic wind farm components. The number one fast growing job in America this decade? Wind turbine service technician. The solar industry is growing fast as well, creating jobs at a pace 12 times faster than the rest of the US job market.

So, how can a company measure and report potential emissions from their reserves? The WRI methodology mentioned earlier is based on industry standards for estimating and disclosing the size of reserves, ensuring companies will already have much of the data they need. First, you start with reported reserve quantities, which represent the amount of hydrocarbons available for sale or transfer to downstream operations. Then you adjust these quantities to reflect losses or usage in upstream production and processing operations, or activities that can store carbon and reduce potential emissions. This data offers all you need to convert to potential emissions, which then can be reported in using a standardised template for disclosure to investors and other external users.

At a nexus

Fossil fuel companies are at the nexus of two major trends. Governments around the world are committing to ever more aggressive targets for curbing carbon emissions, presenting risks that some reserves will become stranded. And investors are demanding increasingly more information on emissions to support risk analyses and investment decisions. Being open about potential emissions is central to how fossil fuel companies respond. We expect that potential emissions data will become part of standard disclosure practices, not only through government mandates, but mainly because corporations will realise the benefits of less business risk, happier investors and a more sustainable world. ●

INNOVATION

Big Oil plans for a low carbon future

Big Oil is under pressure to prepare for a low carbon future. What are the risks and opportunities, and what initiatives are underway? *Brian Davis* reports.

The Oil and Gas Climate Initiative (OGCI)*, including several of the world's biggest oil companies, announced plans last November to invest $1bn over the next 10 years to develop low carbon technologies to capture and store greenhouse gases, reduce emissions and improve energy efficiency (see *Petroleum Review* Dec 2016/Jan 2017). But this is only part of the picture. What is the reality, given that each company has its own agenda and initiatives underway?

In a recent report (November 2016) on how oil majors are responding to the transition to low carbon energy, Wood Mackenzie suggests that up to 50% of the production of oil majors could be hit by carbon costs in the next decade if legislators extend carbon pricing policy to the upstream sector. Indeed, new greenhouse gas emission-limiting policies are being considered across the world following the COP21 agreements.

Wood Mackenzie anticipates that natural gas and zero carbon fuels will satisfy at least 60% of the rise in global energy demand to 2035. Renewables could grow nearly 500% in the next 20 years, while coal and oil demand could peak before 2035.

Paul McConnell, Research Director of Global Trends for Wood Mackenzie, says: 'The majors are under pressure to de-risk their existing business models and diversify into low carbon strategies. However, diversification into renewables will be challenging as returns from low carbon energies lag far behind those in the upstream sector.' He maintains: 'It will be difficult to justify allocating already scarce capital into low-returning projects, and transformation of existing business models will not be easy.' McConnell stresses the need for new skills to be developed by the majors, mostly through joint ventures or acquisitions.

Gas is seen as the prime transitional fuel strategy. Notably, BP achieved the biggest increase in its share over the past year (2016), with its strategy to diversify into gas value chains. While Shell acquired BG.

Strategies for success

Three different strategies are emerging – 'decarbonise', 'capitalise' and 'grow'. 'Decarbonise' is about looking at legacy oil and gas operations but doing it in a low carbon way by investing in technologies like carbon capture and storage (CCS). 'Capitalise' is about using the expertise developed in the upstream sector and moving that into different business opportunities, such as offshore wind. 'Grow' calls for investment in renewables by investing in companies involved in solar power, energy storage and new technologies which sit far outside usual oil and gas business competencies.

For the most part, the majors have embarked on different routes to achieve their chosen strategy or strategies.

Total is the most ambitious (so far) and aims to have 20% of its assets in low carbon businesses by 2035. Statoil has increased its exposure in offshore wind energy but it is still relatively small scale, with Shell on a similar path. The remaining majors are focusing on decarbonisation or using venture capital to spread their bets – which underlines the challenge of picking the winning technology.

'US companies are moving more reluctantly towards decarbonisation, believing rightly that oil and gas will be a significant component of the energy mix for the foreseeable future,' notes McConnell. 'Whereas, the Europeans are moving more aggressively into this new market.'

> ***'The majors are under pressure to de-risk their existing business models and diversify into low carbon strategies. However diversification into renewables will be challenging as returns from low carbon energies lag far behind those in the upstream sector.'***
>
> **Paul McConnell, Research Director of Global Trends for Wood Mackenzie**

Historically, the majors have made similar moves in the past with varying degrees of success. BP's 'Beyond Petroleum' campaign was launched with big fanfare then quietly dropped. McConnell recognises there are risks on both sides of this pathway. 'On the one hand there is the risk of moving too quickly or aggressively into a new marketplace, which is traditionally not a comfortable place for oil and gas companies. On the other hand, moving too slowly could miss an important window of opportunity. However, the biggest risk is to do nothing, and be left exposed to investors that make up their own minds.'

If oil prices recover and the switch to a lower carbon demand phase doesn't materialise as quickly as anticipated, 'there is a risk of destroying shareholder value and going down the wrong path', warns McConnell. Investment in renewables by the majors is still less than 2% of upstream capital expenditure. He reflects: 'It's very small change compared to core oil and gas activities – none [of the majors] has invested more than $2bn in this space in recent years, which reflects a level of caution.'

While there is strong rhetoric on diversification into renewables, the majors are yet to follow it up with an appropriate scale of investment. Total is the exception, with the acquisition of SunPower, a solar panel manufacturer and a battery storage company called Saft.

The drivers for change are government policy and technology. 'The policy component is arguably less important than in the past, but technology (like electric vehicles) has matured much faster than 20 years ago,' says McConnell.

At present only 15% of global emissions are covered by carbon pricing. The oil companies are mostly using a shadow carbon price to help value their assets internally, which ranges from $6–$80/t. 'That's not to say that all assets will be subject to carbon pricing, but they are certainly being risked as if they will be under some scenarios,' says McConnell. 'It remains to be seen how policymakers will expand the role of carbon pricing to cover upstream assets of the future.'

Meanwhile, CCS projects are not moving ahead as fast as anticipated. Shell has invested in

'Remuneration of chief executives in the oil majors is still orchestrated around production levels or reserve replacement metrics. Perhaps if they had some climate metrics or reserve-energy replacement ratio taken into account on their energy assets as well as hydrocarbons, that would give more incentive to transform.'

Tarek Soliman, CDP Senior Analyst

CCS, but it has not yet been proven commercially and the cost will remain high for the foreseeable future. McConnell says it is difficult to see CCS as a large-scale solution to excess emissions in the short term. 'Generally, we see strong growth in renewables but from a very low base, and the growth won't be big enough or soon enough to offset the need for gas in countries where the move away from coal is a priority.'

In the pipeline

In its latest report *In the pipeline*, CDP (formerly Carbon Disclosure Project) introduces a league table for oil and gas company performance linking emissions-related metrics to earnings. The report highlights those companies best preparing for transition to a low carbon economy. The highest ranked companies are Statoil, Eni and Total, while the lowest ranked are ExxonMobil, Suncor and Chevron.

The report shows a clear transatlantic divide, with European majors coming out on top across most key areas. European majors' portfolios have a higher percentage of gas relative to their American peers. Differing exposure levels to 'risky' oil sands is further evidence. There is also a divide in terms of climate governance and strategy.

European companies are more active investors in alternative energy and low carbon technology, like battery development and carbon capture, use and storage (CCUS). But low carbon spend is dwarfed by upstream capital expenditure. For the 11 companies in the report with total capex for 2016 of about $160bn, only about 1.5% is linked to low carbon investment.

Current business models continue to rely heavily on finding and proving reserves. The report argues: 'This resource-ownership focus is unsustainable and will need to adapt for low carbon transition. Traditional industry performance metrics such as reserve-replacement-ratio and reserve-life are potentially outdated; with peak oil demand expected to occur in the coming decade investors might reconsider their importance.'

Furthermore, the oil and gas majors face key short- and long-term strategic decisions to secure their future business models, rebalancing portfolios in coming years and considering wider diversification or managed decline over the coming decades.

Operational efficiency also remains an issue, with the 11 companies in the study losing an average 6% of their natural gas production through flaring, methane venting and leakages. 'Responsible resource management will affect demand for the sector's products in their downstream use,' says the report. In addition, 40% of onshore oil and gas upstream production is currently located in areas of medium or high water stress, which could have implications for future financial performance.

There are three broad areas which impact how companies are lining up for a low carbon future, explains CDP Senior Analyst Tarek Soliman. 'First is how much gas companies have relative to oil in their portfolios, and how much oil sands.' European companies are significantly stronger in gas versus oil than US operators. Another area is spend on low carbon assets or alternative energy. 'Here again there is a noticeable outperformance by European companies relative to US, from solar and wind power to biofuels and battery technology. European companies are diversifying and accumulating more assets in this space,' says Soliman.

Thirdly, there is performance around climate change governance and strategy. European companies are outperforming North Americans in climate policy engagement to the extent that they integrate climate consideration into management remuneration, internal use of carbon price and other initiatives.

CDP analyst Luke Fletcher also sees the oil major's capex on low carbon initiatives as 'a drop in the ocean' compared to E&P expenditure upstream. But there are signs of light.

Key company focus

Statoil has the highest percentage of gas in its proved reserve base and has increased gas production in recent years. The Norwegian company has the lowest upstream emissions intensity, and has also made recent commitments on low carbon energy, focused on offshore wind projects.

Meanwhile, Eni's future potential production is dominated by conventional resources, but it has no oil sands production. Eni also has large gas projects on the horizon, such as Zohr in Egypt, which is due to come onstream later this year (see p4). Eni is also committed to eradicate routine flaring.

Total aims to have '20% low carbon assets in 20 years' and recently acquired solar panel producer Sunpower and battery maker Saft. The company aims to have 60% gas in its hydrocarbon portfolio by 2035 and has set up business units to address low carbon investment.

Shell's acquisition of BG makes it the only company listed to produce more gas than oil. Shell has also published pathways to net zero emissions and recently set up a 'New Energies' division. It has wind energy operations in the US, invests in biofuels, small hydrogen-fuel initiatives and CCS projects. Shell has committed to spend $200mn/y on energy alternative solutions.

BP has the second highest gas production, and has released a 'Faster Transition' scenario for world energy use which details global peak emissions in the late 2020s. It has the largest alternative energy business, including onshore wind in the US.

Occidental performs best in capital flexibility because of a bias towards unconventionals. Although it has no alternative energy assets, the company is involved in a number of CCUS projects for enhanced oil recovery.

The big question

'A lot of people might question whether oil and gas companies have the expertise to transform themselves faced with a low carbon future,' remarks Fletcher. 'But they have this option with their huge balance sheets that enable an acquisitive strategy like Total, for example. Others may like to see managed decline of their fossil fuel production, returning capital back to their shareholders. There's a huge scope of options available. In the past the majors had a view of growth based on things like reserve replacement. That mentality will be questioned more and more.'

This also touches another issue mentioned in the CDP report, remarks Soliman: 'Remuneration of chief executives in the oil majors is still orchestrated around production levels or reserve replacement metrics. Perhaps if they had some climate metrics or reserve-energy replacement ratio taken into account on their energy assets as well as hydrocarbons, that would give more incentive to transform.' ●

*The 10 member companies that comprise the OGCI are BP, China National Petroleum Corporation (CPNC), Eni, Pemex, Reliance Industries, Repsol, Shell, Saudi Aramco, Statoil and Total. Together, they represent one fifth of the world's oil and gas production.

INNOVATION

On the radar

Low carbon power generation technologies will continue to see major investment and innovation – but more standardisation is needed, according to new research, writes *Nova Garabetian*, Marketing Lead, Low Carbon Power Generation, Lloyd's Register.

In the wake of COP21, and despite suggestions of wavering political commitment in some regions, low carbon energy continues to attract record levels of investment. The latest *Lloyd's Register Technology Radar – Low Carbon* report finds that a low carbon future is looking increasingly viable thanks to technological advances and growing confidence across the sector.

Lloyd's Register's (LR) Energy Director Alasdair Buchanan says: 'The research demonstrates the progress that has been made in recent years towards a diverse energy mix that includes low carbon sources as well as innovative fossil fuel technology. Through this combination, communities across the globe can enjoy security of supply whilst striving towards a low carbon future.'

Research demonstrates the progress that has been made in recent years towards a diverse energy mix that includes low carbon sources as well as innovative fossil fuel technology. Through this combination, communities across the globe can enjoy security of supply whilst striving towards a low carbon future

Source: Lloyd's Register

LR's report is based on the insights of the nearly 600 executives and experts surveyed across the low carbon industry, from energy utilities and distributors, through to equipment manufacturers. Respondents were asked to rate a number of technologies in terms of their potential impact on the low carbon sector, the amount of time it would take for these technologies to hit the market, and how likely they are to be adopted once they do.

According to the findings, the innovations likely to have the largest impact in the short term include:

- Renewables – solar cell technology
- Energy storage – software and (in the longer term) electrical technology advances
- Transmission and distribution – smart grid software
- Nuclear – waste recycling innovation

The innovation context

According to those polled for the research, innovation is gathering pace across the sector and there is a large appetite for new and emerging technology in both nuclear and renewables. This can partly be seen as an effect of COP21, which nearly two-thirds of respondents believe has had a major impact by not only bringing about carbon reduction objectives but also highlighting the growing urgency around climate change.

However, after cost, deployment continues to be seen as the major barrier to the implementation of both nuclear and renewable technologies. Most respondents identified themselves as 'fast followers' rather than 'early adopters', which reflects typical project economics. Indeed, few players can afford to take on the risks that come with testing new and emerging technologies, while securing sufficiently low borrowing rates.

Who's driving innovation?

According to LR's research, manufacturing companies are the richest seam of innovation at present. Contributing to the report, Brent Cheshire, UK Country Chairman of DONG Energy, agrees and credits DONG Energy's relationship with OEMs (original equipment manufacturers) as a key success factor. 'If you are a first implementer, you have to

work closely with OEMs because the technology investment is not yours but theirs. So we have many iterative conversations with them around costs, market and pipeline size, in order to drive that investment.'

Policymakers and regulators did not feature highly as drivers of innovation for any sub-sector. Interestingly, renewables respondents highly rated utilities as innovators, unlike nuclear respondents, perhaps reflecting the infrastructural challenges that have been tackled to make renewables sources viable.

Energy storage is another area with a strong innovation agenda. Players throughout the value chain have an interest in seeing storage technologies reach maturity in order to harness the potential of low carbon sources. Governments have begun to recognise this, and encourage growth through investment and policy. LR's research highlights that energy storage is seen across the sector as a major innovative force and one that is likely to have impact sooner as well as later.

Although many energy storage technologies have yet to reach maturity, what is unquestionable is that the increasing mix of power generation technologies has and will continue to drive the growing need for large and small scale energy storage technologies, which are essential for the emergence of a more dynamic and smarter controlled distribution. To support this, we are now seeing the emergence of an increasingly complex array of technologies, some of which will have profound impacts on the energy landscape and society as a whole.

In the short term, according to the research, it is likely to be software advances that drive forward innovation in energy storage, with opportunities to quickly enhance the performance of existing systems and infrastructure. Electrochemical storage technologies are felt to be close to maturity, but are less likely to have as much impact as innovations that have the potential to improve economies of scale of existing batteries. In fact, the storage technology that respondents believe will have the biggest impact is electrical technology such as supercapacitors, which will rapidly speed up charging times for large batteries. Amongst the technologies that are felt to be least likely to have impact are thermal storage innovations and mechanical storage innovations.

A question of affordability

As an emerging field, energy storage technologies are receiving significant government support to drive investment, development and adoption. But this is not a long-term solution and any successful technology must eventually be self-sustaining. For example, after years of debate about subsidies and policy support, there appears to be growing consensus that renewables are starting to pay their own way. LR's research largely reflects this, with 70% agreeing that renewables are reaching cost parity with fossil fuels. At the same time, nuclear, despite its cost premium, is seen by the majority as a necessary and long-term source of energy supply.

Development costs, however, are still seen as the main barrier to low carbon generation – 74% of renewables respondents and 61% of nuclear respondents are of this opinion. On the renewables side, this is more strongly felt in the Asia-Pacific (85%) and North America (84%) than in Europe (61%). The Middle East is the region least likely to consider cost a significant barrier. Instead, Middle East respondents cite stringent regulations as the leading obstacle.

In Europe, cost is felt to be much less of an issue for implementing nuclear technology than in North America. Only 47% of respondents in Europe consider it to be the main barrier, compared with 80% in North America, 69% in the Middle East, and 58% in the Asia-Pacific. Instead, the research indicates, European respondents feel that the biggest barriers to progress are public opinion (17%), too-stringent regulations (17%) and deployment challenges (16%).

Government role

LR's research suggests that many across the sector believe there is more that governments and regulators could do to accelerate progress towards low carbon energy – and it is not limited to subsidies, policy and investment. For renewables, standardisation has driven down the cost curve, and facilitated the growth of solar and wind technologies. But according to the research, this has yet to happen to the same extent in the nuclear sector, which has held back deployment of innovative technology and, by extension, cost reduction.

In the report, David Scott, Executive Director of Economic and Energy Affairs at the Abu Dhabi Executive Affairs Authority, says: 'There's been a cry for a long time from people saying, "If we could just standardise, we could drive down cost per unit." The challenge is that you have opposing regulatory regimes in different parts of the world that operate against standardisation.'

Serge Gorlin, Head of Industry Cooperation at the World Nuclear Association (WNA), agrees: 'For almost a decade now, the WNA has advocated a more harmonised regulatory system, so that the whole process of reactor design evaluation, for example, in one country does not have to be repeated in another country.' Similarly, as power markets continue to move towards decentralised generation, governments need to encourage innovation in grid infrastructure, to facilitate a pathway for alternative suppliers.

The research demonstrates that there are still major roles for government to play. Moreover, to step back too soon could easily damage investor confidence and reverse the progress that has been made to date.

What's next?

LR's research highlights that, although there is huge global appetite for decarbonisation, this will only be translated into outcomes if that appetite is nurtured by innovation and investment. Renewable energy sources, particularly solar and wind, have achieved vast efficiency improvements in recent years – enough to compete with fossil fuels and, in an increasing number of cases, reach grid parity. The races to capture new offshore energy capacity and to build the next generation of solar panels have inspired several new technological breakthroughs. However, increased innovation around market structures, regulatory frameworks, transmission and distribution infrastructure, and energy storage systems is still sorely needed to integrate the new supply that has been created.

LR's Buchanan concludes: 'We are really encouraged by the research, but it also shows that none of us can afford to be complacent. Clearly, there is no single answer to the economic, environmental, technical and social challenges facing today's global communities but, as the *Technology Radar – Low Carbon* research shows, the combination of solutions presented by low carbon technologies and fossil fuels provides opportunities for real and sustainable change.' ●

For the full LR report visit
info.lr.org/techradarlowcarbon

OPEC and the future


Source: OPEC

Mohammed Sanusi Barkindo, OPEC Secretary General, provides insight into the role of OPEC and fossil fuels in the future energy mix ahead of IP Week on 21–23 February 2017, at which he will be giving a keynote presentation.

How do you see the role of OPEC in a rapidly changing mixed energy environment?

For more than half a century, OPEC has remained steadfast in delivering on its original mission of acting as a consistent, stabilising force in the energy industry, while acknowledging the interrelated issues of providing oil, promoting prosperity and protecting the environment.

Looking towards the future, oil and gas will continue to play a very important role in supplying the world's energy needs, making up an estimated 53% of the global energy mix by 2040, according to our recently published *World Oil Outlook*.

The outlook on global oil demand is also positive. It is estimated to increase from roughly 93mn b/d in 2015 to over 109mn b/d by 2040. In relation to natural gas, demand is set to rise from around 350bn cf/d in 2015 to 590bn cf/d in 2040.

This positive outlook, of course, hinges on huge investments being made to not only increase production from new areas, but also to compensate for existing fields on the decline. Between now and 2040, an estimated $10tn in oil-related investments will be required, and for gas, roughly $6tn.

OPEC's member countries are ready to make the required investments in production, as well as research and development (R&D), so as to ensure that the future requirements of consumers are met in a timely and sustainable manner. Over the past two years, though, the industry has seen dramatic drops in investment due to the fallout from the price crash that hit the industry in mid-2014. Spending on global oil and gas exploration and production declined by around 26% in 2015, and an additional 22% decrease is forecast for 2016.

Some have suggested that it is possible that we may see a third year of investment cutbacks, which would be unprecedented in the history of the oil industry.

This is one record we do not want to see broken. The fact is our industry needs a steady flow of ongoing investments to ensure the required supply gets to consumers in both the medium and long term, and OPEC will be instrumental in making this happen. This was readily apparent in the decisions taken at the end of last year by OPEC member countries, as well as some non-OPEC producers, to adjust their production in order to achieve oil market stability in the interest of both producers and consumers.

What are the key challenges for OPEC in the coming years given the rise of US shale gas and potential production from the Arctic and other sources, coupled with moves towards decarbonisation due to climate change?

We see a future energy environment that is sure to have its fair share of challenges, but it will also present many opportunities.

One thing that you can count on, though, is that the world will need more energy in the coming years to fuel a global economy that is expected to more than double between now and 2040. Add to that the exponential growth in the world's population, which is forecast to expand by 1.7bn to reach a staggering 9bn by 2040, and it is clear that our work is cut out for us.

To meet this demand, all forms of energy will be required, including a significant and increased contribution from renewables, such as wind and solar. According to our *World Oil Outlook*, the share of non-fossil fuel sources in the overall energy mix is expected to grow from approximately 18% in 2015 to 22% by 2040. OPEC's member countries support this development, and many of them are already benefiting from their own bountiful renewable resources. This also supports their transitions to more diversified economies.

As far as non-OPEC supply goes, we see a decline during 2016 and 2017 due to recent lower oil price levels, but then a gradual increase to 2021. From the long-term perspective, we expect non-OPEC supply to continue to rise steadily, reaching a high of 61.4mn b/d in 2027, before dropping to 58.9mn b/d in 2040.

This all points to the fact that OPEC will be needed to fulfill most of the additional long-term oil demand. For crude, this means an estimated 8.9mn b/d between 2015 and 2040, and for all liquids, 12.6mn b/d. The share of OPEC crude in the global liquids supply is forecast to increase from approximately 34% today to 37% by 2040.

At the same time, OPEC recognises the issue of climate change and its potential threat to the environment. We welcome the COP21 agreement made in Paris in 2015 where our member countries played a valuable role in drafting the agreement. OPEC remains committed to this process, which can be viewed in its member countries playing a full role at the recent COP22 meeting in Marrakesh, and it will continue to support the successful and comprehensive implementation of the Paris Agreement to ensure a 'win-win' outcome for all.

In this regard, we should also remind ourselves that the Paris Agreement is under the UNFCCC and should continue to be guided by its principles and provisions. In particular, the unique situation of developing countries should be given the top priority it deserves.

How long do you see the oil price remaining an effective tool for change? And how has OPEC helped return stability to prices and balance to the market?

In January of last year, the OPEC Reference Basket price dropped to $22.48/b, a decline of 80% over the period since the oil price crash hit in June 2014. It is the largest

percentage fall in the five cycles of sharp price declines we have observed over the past three decades. This oil price decline exerted a severe blow on the industry, resulting in hundreds of thousands of jobs being cut, investments being deferred or cancelled, and R&D, in some cases, coming to a halt.

With this in mind, it is important to consider the crucial relationship between prices, demand and supply. If these three factors are in balance, we will see the industry regain its footing and begin to invest at adequate and necessary levels again to ensure that future energy needs are met.

However, if these factors remain out of equilibrium, then we could see further negative consequences for jobs, investments and R&D. No one in the industry likes to see severe boom and bust cycles. These are undesirable for all stakeholders. In this respect, both oil prices levels and the volatility of prices are important factors.

Given that oil and gas will continue to play a vital role in providing energy in the years to come, we must continually focus on providing balance and stability in the market. Achieving market stability is one of the main reasons OPEC was founded, and it will continue to be the central aspect of our strategy going forward.

This was evident during the second half of 2016 when it became evident that producers, as well as most consumers, began to fully comprehend the gravity of the current oil cycle that began in mid-2014. We saw extensive consultations with many OPEC ministers and non-OPEC ministers, as well as some heads of state and governments engaging in the process of rebalancing the oil market, and expressing their views on the need to see sustainable stability return.

From OPEC's perspective, this led to the landmark Algiers Accord that was agreed by all OPEC member countries at the 170th (Extraordinary) Meeting of the OPEC Conference in Algeria on 28 September 2016 and the historic Vienna Agreement, adopted on 30 November 2016. The agreement focused on the urgent need to stimulate the acceleration of the drawdown of the stock overhang, to bring the market rebalancing forward and ensure that much needed investments return to the industry. It all underscores OPEC's continued commitment to stable markets, in the interests of both producers and consumers.

What followed soon after was a pledge from some non-OPEC producers to adjust their production at a joint ministerial-level meeting between OPEC and a number of non-OPEC producers in Vienna on 10 December. This underlined a shared and deep resolve to return much needed stability to the market, and the industry, as a whole.

What are the key opportunities going forward?

Given the developments at the end of last year, we will continue to work closely with our fellow industry stakeholders. This includes further strengthening the consultations between OPEC and non-OPEC oil-producing countries, as well as evolving existing and developing new dialogues to help better understand the challenges and opportunities we face. In this regard, let me stress that it is vital that we have open channels of communication so that we are able to take timely and pro-active measures to ensure a balanced oil market on a sustainable basis.

It is evident that the current oil market has presented our industry with tremendous challenges, but we should remember that 'tough times' are nothing new for the industry. The story of our industry is one of many cycles, both up and down, but it has always recovered and come back stronger.

I believe there are many reasons why we should be optimistic about the industry's future. Firstly, it is clear that oil and gas will continue to be fuels of choice. And secondly, I have no doubt that through innovation, human ingenuity and technology, the industry will become more efficient, more resilient and more nimble. This will enable it to continually transform itself to overcome the challenges it faces, and unlock the many opportunities before it in the years ahead.

For example, many of OPEC's member countries are embracing new opportunities to boost efficiency and innovation in their operations through environmentally friendly carbon capture and storage initiatives, as well as enhanced oil recovery efforts to optimise extraction of valuable resources.

This is a great example of a negative being turned into a positive. The cyclical challenges we are experiencing at the moment have presented us with new opportunities to improve as an industry, and we are optimistic that a bright future lies ahead.

OILFIELD SERVICES

Anticipating sea change

How will the oilfield service sector emerge from the latest downturn to position itself for future success in a new world? ask *Adrian Del Maestro*, Director of Research, and *Craig Stevens*, Senior Manager in Oil & Gas, at PwC.

Oscar Wilde once said: 'We are all in the gutter, but some of us are looking at the stars.' And to some extent that sentiment must resonate with many oilfield service (OFS) companies. The past two years have been a torrid time for the sector. With operators across the global oil patch scaling back dramatically on upstream capex spend and deferring major projects, the OFS sector has responded by pulling the traditional cost reduction levers in a downturn – cutting capex and headcount massively, while minimising operating expenditure. Margins have been eroded and many OFS companies are still in financial distress. The outlook looked grim.

Now, however, there appears to be light at the end of the tunnel. With supply and demand seeking a gradual equilibrium, the oil price has recovered a little. Among some companies there is a growing confidence that perhaps we have reached the trough. That said, if we are poised for a potential recovery, it is likely to be uneven.

A brave new world beckons

As companies emerge from this period of distress, the world they operate in has changed dramatically since June 2014, as illustrated in **Figure 1**. Oil prices no longer have a mythical 'structural floor' of $100/b, with Brent hitting a low of $28/b in January 2016. Operators are less 'bullish' and we see some retreating from those challenging technical frontier plays, as well as reduced exploration activity. Saudi Arabia's role as the traditional swing producer is being challenged by US tight oil, a segment that has proved to be extraordinarily resilient.

Meanwhile, the lifting of sanctions in January 2016 paved the way for the return of Iran, as it grew production. There is also the renewed momentum for a lower carbon world and a greater sense of urgency post COP21 for the need to decarbonise our energy system. Finally, we see a relentless focus on cost reduction across the whole oil and gas sector.

Preparing for a recovery

So, while OFS companies may still feel their feet are firmly planted in the 'gutter' what should they do to prepare for the 'stars'? Here are just a few thoughts to consider:

Double down on innovation – Innovation and R&D are at the core of the OFS business. Yet due to financial distress triggered by the oil price decline some of the major OFS companies are scaling back R&D spend. Compared to 2014 all the big four OFS companies saw R&D spend shrink, as shown in **Figure 2**. Given the importance of innovation, it is essential OFS companies protect investment levels in this core area. Moreover, the technology demands of players in this environment will also influence the type of technology being sought. It is unlikely advances in seismic technology will have the scale of impact in the market given the drop in exploration spend and reduced activity compared to growing demand for improved production technology.

Explore partnerships to aggressively push 'big data' analytics – The innovation theme is broader than R&D spend. The sector has an opportunity to really push on data analytics. If we look at the digital oilfield for example, there are some pioneers in the industry but digital oilfields have yet to take off. This is partly because the sector has been slow to adopt and deploy these new technologies at scale. One industry player described the sector's conservative approach to technology as 'glacial'. To be fair to the oil and gas sector, the risk of catastrophic failure is a major reason why companies are wary of rapid adoption.

Nevertheless, with the industry's relentless focus on cost reduction and the impact of headcount attrition and loss of capability, technology has the opportunity to succeed.

There are now new entrants in the sector not traditionally seen as OFS companies, such as Siemens and GE Oil and Gas, who are competing with the likes of Halliburton and Schlumberger. These technology companies use their experience in other industries and versatility to leverage digital technologies to address remote operations and collaboration. Some OFS companies may do well to consider strategic partnerships with these new entrants to deliver a whole new set of capabilities to operators (the proposed merger between GE Oil and Gas and Baker Hughes is a case in point).

Bridging the capability gap – The human cost of this downturn cannot be over-estimated. According to some industry estimates between 230,000 and 350,000 jobs have been lost in the oil and gas sector globally since 2015. Moreover, the ability to retain and recruit new talent to the sector will be rendered much more difficult. In our conversations with the sector, some respondents noted their biggest concern was the lack of people and capabilities available to OFS once the upturn materialises and this may stoke the next cost escalation cycle.

Facing this significant capability gap, what should OFS do? Clearly there is no single silver bullet but companies will need to consider a range of strategies ranging from the application of technology, to pursuing partnerships with selected providers to outsourcing services and operations and improving workforce diversity.

Reduce complexity of operations – Companies should review their business structure and operations to reduce complexity. The value of digitisation has long been heralded but little real progress has been made in this area. Baker Hughes is one exception, exploring the application of artificial intelligence to manage back office invoicing.

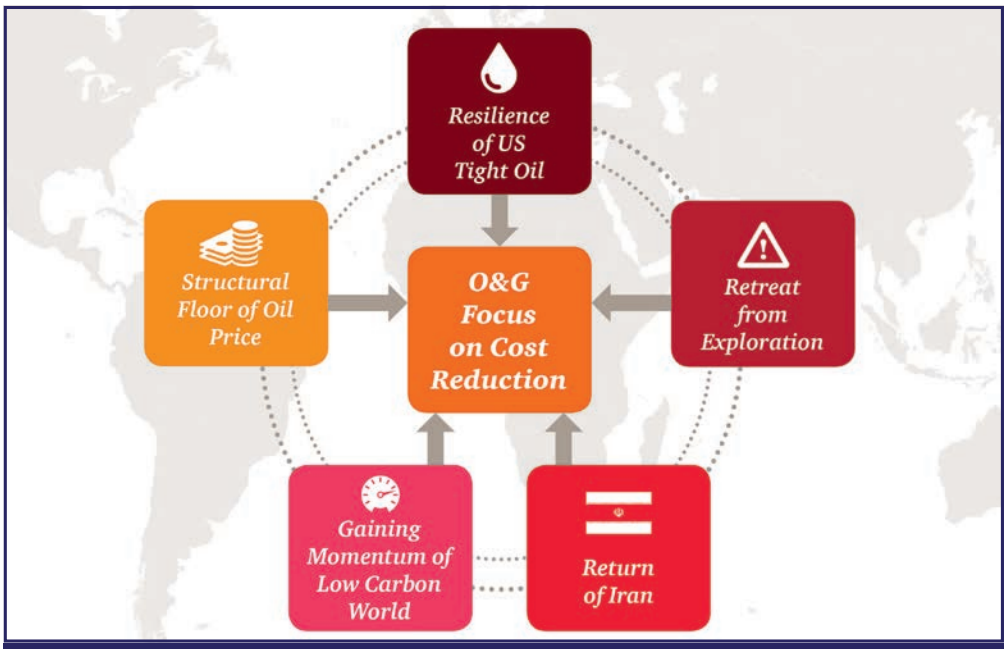

Figure 1: Evolution of the global oil market – selected drivers *Source: PwC Strategy& research*

Aside from digitisation, OFS companies might consider business models where they share pools of resources more effectively. In the same way Premier floated the concept of pooling back office functions across some operators in the UK North Sea, OFS might be able to replicate a similar approach. Schlumberger and Halliburton already pioneer services and solutions that manage assets on behalf of operators (respectively called Production Management and Integrated Asset Management). This enables service companies to optimise operations and innovate, while creating flexibility for the operator to release its own talent and capital to redeploy to newer and more prolific basins.

Be mindful of M&A deals and know your future client portfolio – The risk of any major M&A transaction is that they distract management focus, are costly to execute and may add complexity to the business. However, the upside from well thought through and planned M&A can be significant. For larger players a major M&A transaction can be the means by which they can differentiate themselves quickly. Alternatively, companies can explore limited 'bolt on' acquisitions that deliver value added services and capabilities in a region or technology. But given the complexity of executing an M&A deal successfully, there are other options. Pursuing partnerships and alliances with other companies to develop capabilities is a cost-effective way to deliver added services and perhaps may serve as a precursor to a targeted M&A deal.

This focus on portfolio optimisation should not only be viewed through the M&A lens. OFS companies will also need to decide their optimal portfolio through the lens of their client base. As oil and gas activity picks up, OFS companies will need to have a view on the plays they will focus their efforts on going forward. This may have a number of dimensions ranging from geography, offshore versus onshore, asset type from gas to oil, and conventional versus unconventional, to potentially the type of corporate client from national oil companies to independents.

Working smarter – As we head towards a future, particularly in mature basins, dominated more by late life and decommissioning, it is clear that innovative solutions will play a greater role as upstream companies seek to minimise their decommissioning spend. Consortia of service companies providing packaged solutions through aggregation of skillsets could be the way forward. These solutions need only be 'good enough' to ensure that the job gets done and the inherent risk transfer from operator to service company is minimised through intelligent 'demolition' protecting both the asset and people.

Looking ahead

There is a sense that a balancing of industry fundamentals is approaching which should support a limited oil price recovery. And while we are unlikely to see $100/b prices returning in the near to medium term at least, a more robust price in the $60 to $70/b range should be realised in the next few years. This will trigger an increase in upstream capex spending and broader activity levels which, in turn, will improve the fortunes of the OFS sector.

But this recovery will be uneven. Moreover, we are unlikely to witness a return to the boom period as prices recover. Operators are in cost reduction mode and are embedding a culture that ensures the business model is more resilient at lower prices. This will mean the OFS sector has to adapt its own business to this new reality. It is essential, therefore, that OFS companies maintain their focus on cost reduction, but with one eye on the future. Those players that can operate efficiently and profitably in the current environment, while investing in core business areas for future growth, will be the fittest to emerge from the turmoil and most likely to reach for the stars. ●

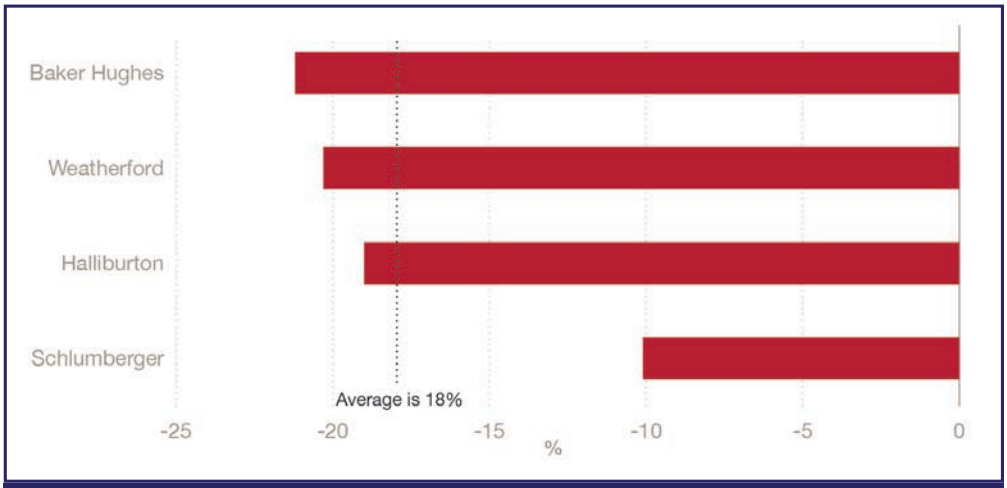

Figure 2: Decline in R&D spend for selected players, 2015 vs 2014 *Source: Bloomberg; PwC Strategy& research*

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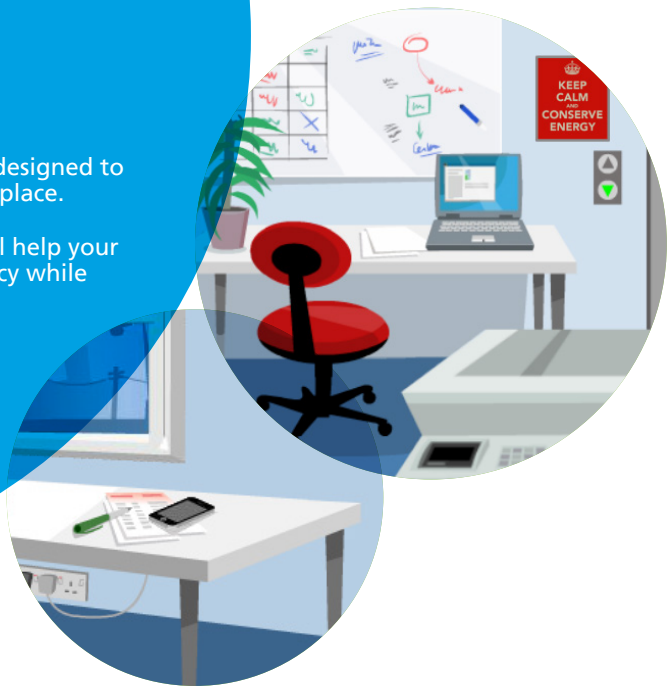

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FINANCE

Lower pressure on the Gulf

Shifting oil prices in 2017 should reduce pressures on Gulf governments and producers. S&P Global Ratings' Associate Director, *Karim Nassif*, explains.

Last year, 2016, was tough for the global oil and gas industry. The Gulf Cooperation Council (GCC) region – comprising Saudi Arabia, Qatar, Oman, Kuwait, Bahrain, and the United Arab Emirates – has been particularly affected by low oil prices and lost revenue, given that it holds nearly 40% of the world's oil reserves. Indeed, government deficits are expected to average about 10% of GDP annually in Bahrain, Kuwait, Oman, and Saudi Arabia between 2016 and 2019.

In response, GCC governments have had to make rigorous efforts to control expenditures and address growing fiscal challenges through increasing sector-specific taxes, implementing cost-reflective tariffs, and cutting energy subsidies. At the same time, governments have been forced to source new creative methods of financing the region's large infrastructure projects.

Oil and gas companies have also felt the effects, although GCC government related entities (GREs) and national giants that are backed by government support have been better placed to weather low oil prices better than smaller private oil companies.

Looking ahead to this year, 2017, and the outlook for oil prices is more positive – which may bring some relief for GCC governments and producers that rely on its revenue.

Oil price repercussions

GCC oil and gas companies have certainly felt the repercussions of the low oil price, including a decrease in financial support for energy producers and delays or cancelations of many of the region's infrastructure projects, previously a major driver of local economic growth.

In 2016, S&P Global Ratings took negative credit rating actions on one third of the corporate and infrastructure companies that it rates in the GCC region. Energy subsidy reform across the GCC, placed to deal with lower commodity prices and fiscal deficits, has weakened the operating performance of downstream oil and gas companies to varying degrees, depending on existing contractual feedstock arrangements.

Smaller and midsize private operators especially, have been highly exposed in the weak operating environment. Dubai-based oilfield services company Shelf Drilling Holdings Ltd, for example, was downgraded twice in 2016 to 'CCC' from 'B'.

Unlike the smaller private players, large government related entities have, without doubt, been better positioned to withstand low oil prices – state-owned companies like Qatar Petroleum, Industries Qatar QSC and International Petroleum Investment Company have all seen their stable credit ratings maintained in line with their sovereign's rating.

Yet even large enterprises in the oil sector have begun consolidating in order to reduce costs and improve efficiency. Most importantly for credit quality, there has not yet been a trend for GREs to increase shareholder distribution – which is key to underpinning credit rating performance strength.

Shifting financial markets

Fiscal tie-backs, as a result of low oil prices, have also led to a shift in financing markets. While low-priced bank loans continue to be an attractive option for corporate and infrastructure financing (loans as a proportion of total corporate and infrastructure funding rose to 90% for the first eight months of 2016 from 74% in 2013), it is likely that access to affordable long-term funding is set to reverse as bank liquidity in the region tightens. Indeed, corporate loan rates from the days of stronger oil prices and large deposit inflows have not yet been repriced, contributing to competitive lending prices in the bank and corporate loan market.

Moreover, with bank liquidity drying up, sovereign governments in the region have begun issuing large syndicated loans via international lenders to combat rising deficits. In 2016, Saudi Arabia issued $10bn in the capital markets, with Qatar issuing $9bn and Abu Dhabi a further $5bn. **Figure 1** shows how GCC bond issues grew in 2016 compared to 2015 – most of this can be attributed to sovereign governments' bond issues.

Over the longer term, S&P Global Ratings recognises that GCC administrations may have to

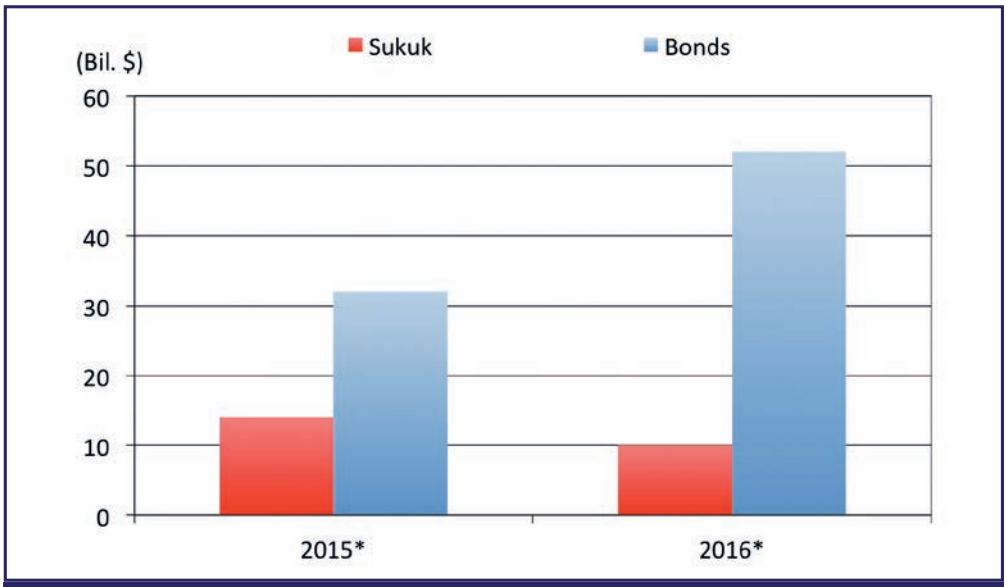

Figure 1: GCC capital market issuance, 2015 vs 2016. *year to 30 September *Source: Standard & Poor's Financial Services*

increasingly rely on more creative methods of raising funds for infrastructure and utilities financing due to still-low oil revenue income. This may come in the form of public-private partnerships, and bonds known as 'sukuk' – bonds that are structured to generate returns to investors without interest and, thus, are compliant with Islamic law. Indeed, total GCC sukuk issuance (including corporate and infrastructure, financial institutions, and sovereigns) expanded to $9bn for the first eight months of 2016.

More recently, Saudi Arabia-based International Company for Water and Power Projects (ACWA Power) issued its first senior secured sukuk for $1bn, to which S&P Global Ratings assigned a preliminary 'BBB-' rating. This is the first senior secured sukuk rating we have in our global portfolio.

However, as a relatively new financing tool, sukuk will require further standardisation to limit issuance costs which remain higher than those associated with conventional bonds.

Rising global prices

Although oil companies and governments continue to brace against oil price headwinds, S&P Global Ratings expects a slight rebound in 2017. OPEC's recent decision to cut production by 1.2mn b/d in tandem with a reduction of 558,000 b/d by non-OPEC members, should bring the market closer to a balanced position and support higher prices. This is also in the context of expected oil demand growth projections of about 1.3mn b/d for 2017, as reported by the International Energy Agency (IEA).

Accounting for these factors, S&P Global Ratings has increased its average oil price expectations for 2017. Both Brent and West Texas Intermediate (WTI) are expected to average at $50/b in 2017.

However, because the OPEC agreement only lasts for six months – and given that OPEC's members have not always complied with its agreements – the oil price rise may curve and later slope back downwards. Nigeria and Libya, which are exempt from the agreement, have already raised output since October, and will probably continue to post higher average production rates in the future, which will ultimately counter-attack OPEC's cutbacks.

A price increase may also encourage US shale production to pick up. Even at $50/b, shale production in the US is economical, as demonstrated by the increasing rig count and increase in hedge volumes this past year.

Significant production cost deflation currently taking place in the industry represents another factor in the coming year's price assumptions. A decade of cost inflation is drawing to a close thanks to engineering optimisation, improved drilling efficiencies, and production cost reductions – especially in the once high-cost US shale industry. Drillers, forced to improve production costs due to low prices, have introduced new drilling and fracking techniques that have resulted in more permanent production cost reductions.

Because oil prices are expected to rise as we move into 2017, the financial performance of oil and gas companies is expected to stabilise. However, the continuation of rising prices and hope for smaller private oil companies will depend on producers' continued commitment to mutually cutting supply in the long-term. ●

Reasons to be cheerful

After a torrid few years which have hit investment levels, there are reasons to believe that oil producers have better times ahead, says *Maarten van Wesemael*, Head of Oil and Gas at Lloyds Bank Commercial Banking.

'The general thinking is that prices can't collapse, prices can touch $60 or a bit lower for some months, then come back to an acceptable level, which is $80/b.' This comment, from an OPEC source quoted by *Reuters* in December 2014, exemplifies how producers, buyers and corporates were caught somewhat off-guard by the oil price slump. The price, which had already dropped from nearly $100/b earlier in 2014 to $60/b, was about to experience an even more dramatic fall. By early 2016 the price had plummeted to below $30/b, while Goldman Sachs was warning that barrels could soon be selling for as little as $20/b.

While this near-apocalyptic prediction ultimately didn't materialise, there is no doubting the colossal impact the low oil price has had on how the sector operates globally and in high-cost, less efficient regions like the North Sea.

The actions taken by producers to adjust to the new 'lower for longer' environment – as BP Chief Executive Bob Dudley has memorably described it – are well-documented but have generally entailed reducing costs by cutting investment and making redundancies. In the North Sea, investment, which was a record £14.8bn in 2014, was expected to be about £9bn in 2016, according to Oil & Gas UK (see **Figure 1**).

The Shell-BG deal, meanwhile, which was seen by some as a vote of confidence in the sector, nevertheless led to a rationalisation of investment. According to Shell, its capital spending was expected to be $29bn in 2016 – a vast sum but, around 40% less than Shell and BG combined invested two years earlier.

Nevertheless, after the tumult of the past two years – which has even pushed some lenders out of the sector – the oil industry can at least take some solace in being more insulated than most others following the UK's vote to leave the European Union. Oil being traded in US dollars has shielded – and in some cases helped – London-headquartered majors.

Meanwhile, in the UK, the decision by new Prime Minister Theresa May to move energy policy into the business department – resulting in the new Department for Business, Energy and Industrial Strategy – is seen by some commentators as welcome recognition of the strategic role the oil and gas industry plays in the country's economy.

Silver lining

Compared to the drama of the past two years, therefore, the current environment can be viewed as relatively stable, with the oil price settling somewhat in 2016. Most significantly in recent months, after an OPEC deal to cut production in member countries, struck at the very end of November, oil reached near 18-month highs of $55/b in a boon for producers (see *Petroleum Review*, December 2016/January 2017 issue, and this issue p20).

Despite this the price remains well below the highs of early 2014, although in operating terms the low price has had one positive impact, the redundancies notwithstanding. While the North Sea was previously seen as one of the least efficient operating areas in the world, the requirement to adjust to a lower price has pushed producers and explorers to become leaner and more efficient. This can only be beneficial in the long-term, particularly from the perspective of attracting investment to the UKCS.

Attracting investment

In fact, in our view there are currently a number of other reasons to be optimistic about the sector's ability to continue to attract investment from both international majors and smaller, newer players alike.

The first and most fundamental reason is the world's ongoing and growing thirst for energy. We welcome the increasing focus of energy firms on renewables, particularly given the need to help combat climate change and the increasing scarcity of fossil fuels. This is reflected in Lloyds Bank's commitment to funding renewable energy across the UK alongside our ongoing support of the UK oil and gas sector.

Nevertheless, as nations continue to embrace renewables and increase the share of energy produced by greener sources, oil demand is expected to grow to help support the rising global

Now may be an appropriate time for firms to review their options and investment strategies and, for some, to raise finance

Source: Pixabay

demand for energy, driven in the main by emerging nations like the BRICS countries (Brazil, Russia, India, China and South Africa). Indeed, the International Energy Agency (IEA) predicts that demand for oil will continue to grow and may not peak until 2040, suggesting producers have up to a quarter of a century of robust prices to look forward to.

With that in mind, oil firms are likely to remain an attractive 'defensive' stock for investors, particularly if the very largest continue their commitment to generous dividends; most commentators do not expect this to change. Meanwhile, those operators which look to increase their share of revenue from renewable sources are also likely to be favoured investors, who view diversified income streams as a hedge against the potential of future shocks – such as another oil price drop.

Secondly, the monetary environment in most rich economies, such as the UK and US, is particularly conducive to raising finance. Interest rates remain at historical lows, making borrowing cheaper than the long-run average. Inevitably, larger, savvy players are taking advantage of this – BP, Shell and Total have all issued bonds (denominated in US dollars or euros) during 2016. These have proved popular and attractive to investors hunting reliable, long-term yields. More bonds are likely to be issued by oil majors in 2017.

In the UK market, demand has also been boosted by the Bank of England's decision to include assets from the oil and gas sector in its bond-buying via its quantitative easing programme. This is further, welcome recognition of the strategic role played by the industry – and particularly the North Sea – in the UK economy.

New kids on the block

There is also increasing evidence that non-traditional investors continue to eye up oil and gas assets, especially in the North Sea. As mentioned earlier, the region is still seen as less efficient than international counterparts, with high costs offering the potential to make operators leaner – and therefore more profitable.

These 'alternative investors' have been present in the North Sea for a number of years now (and we have previously written about them in the pages of *Petroleum Review*). Yet they have increased in number in recent years following the oil price slide. They include both private equity firms with experience in the sector and bespoke companies with the backing of funds in the hunt for North Sea assets.

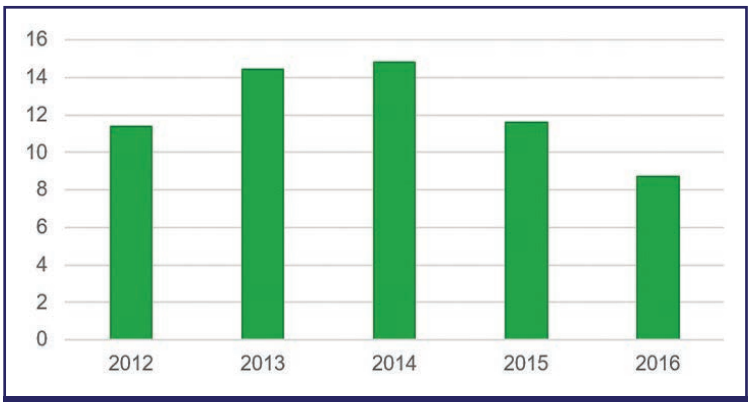

Figure 1: Investment in offshore UKCS, in $bn *Source: Oil & Gas UK*

For example, Neptune Oil & Gas, an acquisition firm backed by Carlyle Group and CVC Capital Partners and headed by former Centrica Chief Executive Sam Laidlaw, was created to invest in assets in key energy locations worldwide, the North Sea included.

This market is fuelled by a number of factors. For one, as already highlighted, these investors are attracted by the strong fundamentals of oil and gas – robust demand underpinning reliable returns. However, this is also a buyer's market, with many of the oil majors putting assets up for sale, either to raise cash, shed non-core assets or pay down debt. This creates an environment in which the key groups driving the alternative investments – private equity firms – can cut deals and prosper.

Some questions, some answers

The wildcard in oil and gas investment – and, again, particularly in the North Sea – is decommissioning. According to figures from Oil & Gas UK's *Decommissioning Insight* report, decommissioning is a growing market in the UKCS, now accounting for 5% of investment, up from 2% in 2010. Yet there are still some questions to be answered about who ultimately foots the bill for decommissioning, creating some uncertainty and, potentially, stymieing investment. (See also p30.)

That said, there are encouraging signs which should act as incentives to investment in even maturing assets over the next decade or so. For example, Lloyds and other banks have worked closely over recent years to develop tailored financial products aimed at pulling funding into North Sea decommissioning. The UK's decommissioning relief deeds, introduced by the Treasury in 2013, have also proven to be effective in encouraging operators to invest in maturing assets, while offering a degree of comfort to new investors who may be considering entering the North Sea market.

Risks remain but outlook optimistic

After more than two years of oil price instability and uncertainty, the global industry is now a very different place. This has inevitably affected the behaviour of explorers and producers and changed how investors view the sector.

Yet while risks remain – principally the oil price and, in particular, how it is impacted by the actions of OPEC – there is a view that the industry is now more stable and, certainly, more efficient. The high oil price enjoyed for so long before 2014 arguably resulted in complacency among some producers, leaving them ill-equipped to cope in the 'lower for longer' environment. That complacent inclination has been shaken, resulting in generally leaner, wiser oil and gas businesses.

Now, therefore, feels like an appropriate time for firms to review their options and investment strategies and, for some, to raise finance. With evidence that the oil price is settling and a benign backdrop in which to raise funding, it may be the optimum moment for producers and those in the supply chain to invest in new areas and push for growth.

There is every reason to believe – and hope – that 2017 will be a turning point for the global oil and gas industry. ●

DECOMMISSIONING

The decommissioning conundrum

Fairfield Energy has taken the unusual step of reinventing itself as a decommissioning operator, entirely focused on winding up its North Sea Dunlin field and associated structures but also potentially looking at opportunities to work with other operators in the future

Source: Fairfield Energy

A partial recovery in the oil price during 4Q2016 did little to ease industry concerns over the vexing issue of decommissioning, writes *Nick Cottam*.

A report by the Nasdaq-listed information company IHS Markit predicts that spending on decommissioning projects will increase from around $2.4bn in 2015 to $13bn/y by 2040. What's more, Oil & Gas UK's *Decommissioning Insights 2016* report notes that the decommissioning market in both the UK and the Norwegian continental shelves has expanded from 2% of total industry spend in 2010 to 5% in 2015 – and the market is likely to exceed 12% of spend in 2017.

In other words, what has been a trickle of decommissioning spend has every chance of becoming a ripple and then a wave of activity. No wonder the issue is attracting industry attention, not to mention a burgeoning portfolio of special reports, meetings and conferences. According to the IHS Markit report, an extra 2,000 projects will be commissioned between 2021 and 2040. And as the wave keeps gathering momentum, operators recognise that cost, timing and overall approach will all be important factors to securing future success.

Investing in P&A

'It's an evolving market because so much is new,' says Bjorn Hem, a senior analyst with IHS Markit and one of the authors of the report. 'One area in which we see very high costs is P&A (plugging and abandonment). If you look at some of the big projects like Brent Delta, typically around half the costs are associated with [P&A of] the wells.'

Innovation, according to Hem and others across the industry, is essential in order to drive down project costs and make the task of plugging wells and dealing with associated structures a less daunting one. 'There will be a need for more efficiency and more specialist equipment,' says Hem. 'This is the way to bring costs down.'

Increasingly cost-conscious operators agree with him. 'The downturn has been so long and so severe that operators are now thinking about decommissioning in a different way,' comments Graeme Fergusson, Managing Director of the North Sea company Decom Energy, the parent company of wholly owned subsidiary late-life operator Fairfield Energy. 'They want to understand their liabilities and they want to plan for them differently.'

While the North Sea will present a challenging environment for decommissioning over the next 20 years, so too will other parts of the world such as the Gulf of Mexico, Africa and Asia-Pacific. 'Decommissioning has been going on for a while, for example in the shallower waters of the Gulf of Mexico,' notes Hem. 'But it is deeper water installations and harsher weather conditions, such as in the North Sea, which will throw up the most significant challenges in the future.'

Higher North Sea costs

This is in part a symptom of the way the oil and gas industry has developed over the past 40 years or so. First came easier pickings in a region like the Gulf of Mexico, where around 4,000 mainly shallow-water platforms have been decommissioned over the past 10 years. Many of the remaining 1,000 or so Gulf of Mexico installations will prove more challenging – and more costly – according to Hem and his team. Historical decommissioning costs for rigs in the region have been in the $500,000 to $4mn range, while in the North Sea where costs are typically higher, decommissioning budgets at the top end of the scale are likely to reach $2bn and more.

'While North America is the largest market for decommissioning, the European region has the highest level of offshore decommissioning spending, based on size and volume of the structures being commissioned in the North Sea, including concrete gravity-based structures (GBSs),' says Grigorij Serscikov, Senior Manager for Upstream Oil Gas at IHS Markit.

Decommissioning operator

For its part Fairfield Energy has taken the unusual step of reinventing itself as a decommissioning operator, entirely focused on winding up its North Sea Dunlin field and associated structures but

also potentially looking at opportunities to work with other operators in the future. 'We're a new type of operator,' says Graeme Fergusson, who leads Decom Energy but also sits on the board of its Fairfield Energy subsidiary. 'The next phase for me is building a commercial model around what is already a strong technical model.'

Chairman Ian Sharp agrees that the company has an opportunity by harnessing expertise and know-how as a decommissioning operator. 'We set out to make this a vibrant, exciting, committed organisation to get this job done as successfully as we could,' he says. 'Having made the decision to do this there have been no competing priorities and we have been able to demonstrate to the relevant authorities that this has been the right decision for all parties.'

What sets Fairfield apart, certainly for the moment, is its sole decommissioning focus. When the oil price started to fall back in 2014, the company moved quickly to cease production from its 45 platform wells plus a further 16 subsea wells and associated infrastructure. The prime aim, says Sharp, was to turn decommissioning into a positive move, keeping a confident organisaton together and garnering new skills as they were needed. At this stage neither Sharp nor Fergusson are prepared to put a price tag on the work involved – suffice to say that they will be working in line with the UK Oil & Gas Authority's (OGA) strategy to reduce individual project costs by up to 35%.

'You start, you get in, you learn and you apply new technologies as appropriate,' says Sharp. 'The unit costs are starting to come down but this particular phase of the industry needs substantial investment from an innovation and from an R&D perspective.' This is born out by the IHS Markit report which sees decommissioning as a significant operational challenge in a whole range of areas.

Finding the right security

'This is quickly becoming a business priority for offshore operators,' says Hem. 'Rig rates have come down over the last few years (from $700,000/d to around $300,000/d) but you are still talking about very high costs – and the more difficult the environment, the higher the cost.'

Glenn Legge of the US law firm Legge Farrow puts decommissioning into the 'perfect storm' of increased regulatory compliance and the lower oil and gas price – plus the need to sort and manage assets in some of the world's deepest waters. 'This means more investment and more security to acquire assets,' he says, noting that in contrast to the North Sea: 'There's no tax payer bail-out in the US. You must provide the right security assurances to government agencies.' One option, he believes, could be tapping into the London insurance market with presumably an insurance product introduced to cover excessive decommissioning costs.

Tom Walters of the international law firm HFW believes that standardising the different types of contract between different parties would help to drive down costs – going some way towards meeting the OGA target for the North Sea. 'There needs to be better risk allocation,' he says, 'between the operator, the contractors and the marine salvage operators.' Cost pressures should ensure this starts to happen as the market gathers pace over the coming years.

Net environmental benefit

A key risk and potential cost as Shell and others will testify is HSE (health, safety and environment) – protecting the environment and keeping people healthy and safe as you start to dismantle these end of life structures. The OSPAR convention, which has 13 signatory states, puts the onus on the operator to dismantle and remove platforms and associated structures – although pipelines are exempt. 'In the UK a clean sea bed is the base case,' explains Will Hazel, a Partner in charge of the Aberdeen office of international consultancy ERM. 'There's a lot of industry talk around net environmental benefit, although what that actually means for different projects can be open to debate.'

What it has meant in parts of the Gulf of Mexico is turning certain rigs into artificial reefs which can benefit the environment with the formation of a new ecosystem and avoid the cost of wholesale dismantling and disposal. While this may appear to run counter to OSPAR in terms of total clean-up and removal, Ian Watts of Forum for the Future asks the question: 'What is the natural environment when a region such as the North Sea is already totally transformed by human activity?' Another factor, he says, is whether some of the money saved by turning rigs into reefs could be used for conservation and to help communities which are going to lose out once the oil activity ceases.

A new mindset

Beyond North America and Europe, we must look to countries such as Angola, Nigeria, Australia, Brazil and Mexico for a sharp rise in future decommissioning spend, notes the IHS Markit report. In facing up to the decommissioning issue a country such as Brazil, for example, has yet to put the appropriate regulatory structure in place.

Operators must prepare themselves without knowing quite what will be required of them. Even in the North Sea, where cost and approach are now an urgent focus, 'we need to change the technology we use and we need to bring a new mindset to the market', says Fairfield Energy's Sharp. Changing your company into a decommissioning operator might well be a step in the right direction. ●

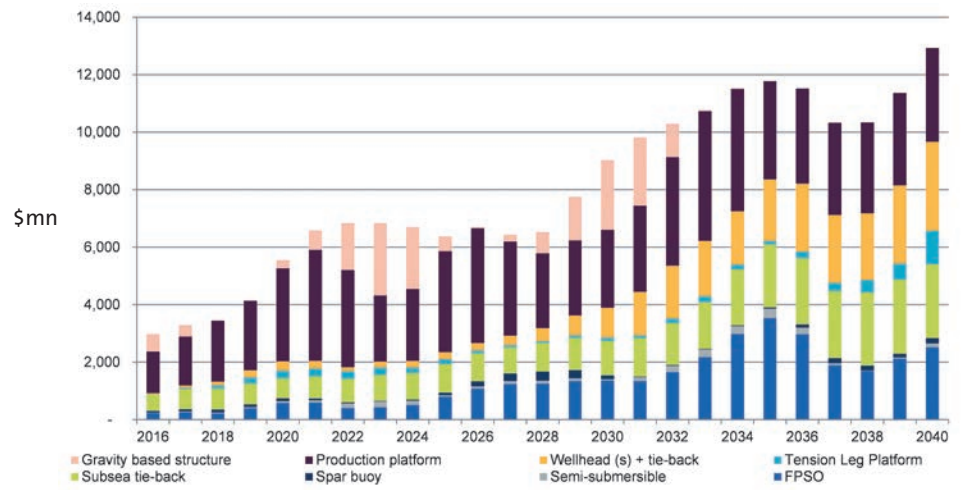

Figure 1: Decommissioning spending by project type *Source: IHS*

TECHNOLOGY

Oil price slump boosts logistics innovation

Companies are increasingly looking to supply chain management processes to improve their bottom line. *Nnamdi Anyadike* reports.

Global oil prices are now well on their way to recovery, having ended 2016 above $50/b for the first time in two years. There is also every prospect of a sustained $70/b oil price level being achieved in 2017. The oil price decline that began in 2014 forced many oil companies to reconsider the way in which they organised and managed their supply chain and to adopt enhanced logistics. However, the oil price recovery is unlikely to mean that supply chain and logistics restructuring by the oil industry will be rolled back or placed on the back burner. On the contrary, supply chain innovation is arguably more important now than ever before.

Last year, 2016, proved to be a critical year for the oil industry. It was the year when all sectors, from the upstream through to the downstream and retail, finally began to look in earnest at other similar sized industries for examples of where it should be heading. Comparable industries such as retail and defence all take advantage of technologies such as the internet of things (IoT), automated asset tracking, 3D printing and predictive analysis. They are now reaping the rewards of standardisation, simpler processes, more efficient operations and tighter cost control.

But for the oil and gas industry, which is still a decade or more behind these other industries when it comes to the supply chain, there is much catching up to do.

The oil and gas industry's supply chain – which links exploration, production, refining, marketing and the consumer – is a global one. It includes both domestic and international transportation, as well as ordering and inventory visibility and control, materials handling, import/export facilitation and information technology (IT). Inevitably, there are several strategies for improving supply chains in the oil and gas sector. For example, companies may choose to become fully integrated and own all the value adding steps in the production of their product. Or as an alternative they may plump for outsourcing, whereby some aspects of the product-service bundle are contracted out to third parties. Whatever the strategy, the goal of supply chain management (SCM) must be to provide maximum customer service at the lowest cost possible. Because cost is the common issue facing all the complex links that involve shipments of widely diverse equipment from pipes, valves, cranes, chemicals, cement and steel to drilling rigs.

Cost-cutting strategies

Moves that were begun in 2016 have largely been positive. Research carried out by DNV GL showed that cost reduction, including in the supply chain, was the top priority for oil and gas companies. The supply chain is understood to have accounted for 10–15% of the total 20–30% average costs reductions for operators in 2016. This continues the trend from the previous year when almost three quarters of companies in the sector said that they had had some success in reaching their cost cutting targets. This year, cost pressures will continue to force greater collaboration within the industry to maintain innovation. Almost half of upstream companies are understood to have increased standardisation. This is an area where the DNV study has identified 'vast' opportunities across the value chain, from data collection to design, drilling and IT.

Getting to grips with the various supply chain management challenges within the oil industry, in what is still a fairly low price environment compared with five years ago, is difficult. Bank of Scotland (BoS) research suggests that a worrying number of North Sea oil and gas companies appear to be looking towards implementing staff layoffs and other short-term cutbacks as the preferred means of reducing their costs in 2017, rather than introducing greater supply chain efficiencies. In response to a query on how they plan to meet the cost challenges in the North Sea over the next 12 months, 'making day-to-day operational efficiencies' such as staff cuts came ahead of 'rationalisation of the supply chain' in the BoS survey of 141 firms. Among the report's key findings, over half of the companies surveyed have already cut jobs.

However, investing in the supply chain is a far more cost-effective strategy when operating in a period of price uncertainty, rather than simply slashing the company payroll. At the recent 'Intelligent Energy' conference in Aberdeen, speakers from Shell, ConocoPhillips, Chevron, BP and IHS Cera's Upstream Group, spoke of the growing realisation within the industry about the important role of digital tools in achieving cost-effective results and enhancing supply chain performance. Greg Hickey, Digital Technology Operations Advisor, BP Upstream Technology, said that BP is now on a journey to 'transform and modernise' its upstream business. This involves 'pursuing a

LNG tanker at the Karratha gas plant loading terminal, Western Australia
Source: Woodside Energy

manufacturing ethos more than we have in the past', he noted. He added that it also means 'driving down costs, standardising the way work is done, and eliminating non-value adding activity'.

One area where BP is expecting to make supply chain efficiencies is with the use of innovative process technologies. Today, BP uses platforms like GE Predix to process data that is sent every few seconds from the 50,000 offshore sensors that are fitted on platforms – an example of industrial IoT in action. ConocoPhillips' priority, meanwhile, is to move towards 'lean manufacturing', with the elimination of waste and the development of 'integrated operations'. David Boyle, UK Operations Manager, ConocoPhillips, said the company's integrated operations project has already led to big improvements in production efficiency and equipment uptime. As a result of better planning, the company can now make more efficient use of its vessels, and through savings it has managed to remove one supply vessel from its fleet. Unplanned shutdowns have also been reduced from about once a week to every four to five weeks. Recently, the company sent a team to visit the UK F1 car manufacturer McLaren and to Vodafone's office in the Netherlands to get cost-cutting ideas from different industries.

For Shell, the focus is on making sure that it has adequate measures in place to enable its supply chain to provide logistics efficiencies even during a period of an extended oil price downturn. Shell VP Production Excellence Producing Assets, Johan Atema, said that the company is now preparing for a 'lower for longer' scenario to make sure it can be profitable at $20/b or $40/b oil prices. Two years ago, he said, the company was making business plans around a $60/b to $80/b oil price, 'now we just don't know'. Shell is looking to take a leaf out of other companies' supply chain successes. Among the companies it is looking to is Amazon, from which Shell is hoping to learn lessons about maintaining continuous improvement and providing effective tracking information materials. Shell's upstream sector is also learning from the group's downstream operations, which have always been run on much tighter margins. Another oil major, Chevron, is concentrating on improving workflow and the way it works with suppliers. It has restructured the way that it leases helicopters and moved to a system of booking slots rather than hiring them for long-term periods.

Enhanced software is key

But for a SCM overhaul to be truly effective enhanced software is the key. An example of a company that has managed to overhaul its supply chain through a new software implementation is the Arkansas-headquartered Murphy Oil Corporation. The company carried out a software implementation covering ERP (purchasing and supply chain), accounting and business management, in less than six months. The implementation commenced in July 2015 and went live in January 2016. The software included cloud-based Accenture Upstream Direct on the SAP HANA platform, and SAP Ariba and SAP 'Success Factors solutions'. The roll-out covered its worldwide operations. Commenting on why Murphy elected to undertake this expense at such a challenging time for the industry, Mike Orr, IT Director of Strategy and Planning at Murphy Oil Corporation, said: 'We were in quite a bit of pain as an organisation. We had 64 different software systems and each country had its own ERP system. We were doing consolidation gymnastics at the end of each month trying to get that into a core reporting platform.' The effect on Murphy's SCM is already transformational with respect to its upstream operations management – forecasting, planning, production allocations, procurement and maintenance.

An immediate benefit has been helping purchasing managers identify ways to reduce inventory, without cutting it back to the point where there are expensive service interruptions. The inventory can now been seen by company staff on a global basis, thereby allowing them to look for more ways to optimise it. As a result, Murphy now has something similar to a manufacturing 'just in time' system for upstream. Orr says that typically, if a company can save 5–10% of its purchasing costs from the software, this is sufficient to cover the costs of the software implementation.

Over the next 10 years, the oil industry's supply chain will benefit from having fewer people and more technology. The more routine transactions will be automated and employees will be spending a bigger proportion of their time working to reduce inventory, optimise spending, and working on the more complex transactions, which Orr says 'will probably run on the cloud'. ●

FUELS

Diesel filterability issues


Source: Pixabay

The Energy Institute (EI) has published a new test method to predict filterability issues in diesel – IP 618 *Cold Filter Blocking Tendency (CFBT)*. *Ian Mylrea*, Chair, EI Cold FBT Task Group, reports.

Previously in *Petroleum Review* (January 2014), the Energy Institute Test Methods Standardisation Sub-Committee B reported on the proposed test method Cold Soak Filter Blocking Tendency (CSFBT) designated IP PM-EA/13, which had been developed in response to filterability issues experienced in the field. It is well known that when diesel fuels, containing fatty acid methyl esters (FAME), are cooled for extended periods solids may form. These are typically saturated mono-glycerides (SMG) and sterol glucosides (SG), which do not dissolve when the fuel is warmed.

The standardisation of IP PM-EA, which was for B100 (biodiesel) and BX blends (where 'X' represents the percentage of biodiesel in the fuel blend), has been difficult due to variability in precision during multiple European pilot studies carried out by the CEN Total Contamination Working Group (CEN TC19/WG31). Winter issues have continued and there have been an abnormal number of light duty diesel vehicle breakdowns, specifically due to fuel filter blocking. Many experts consider this to be a complex issue, which is not only related to the fuel, but also to the design of vehicle filtration systems.

In 2014 the FBT test method (IP 387) was introduced with a maximum ratio limit of 2.52, as a voluntary measure over the winter period, to provide further quality assurance. In 2015 this limit was formally introduced into the national annex of BS EN 590 and applied during the winter. The year-on-year figures for breakdowns due to filter blocking appear to have reduced as a result, although other variables, such as differences in winter temperature conditions, have also played a part. However, despite this positive outcome, the number of breakdowns is still above the norm experienced during previous winters and summer months.

Raising awareness

To raise awareness and focus current thinking, the CEN Distillate Fuels Specification Working Group (CEN TC19/WG 24), the group responsible for the European diesel specification (EN 590), organised a filter blocking workshop, which took place in London in June 2015. In the introductory remarks it was stated that 'a wide range of vehicles' was 'being affected in several European countries', and that 'there is a possible link with base diesel quality, FAME composition, cold flow additives and oxidation stability effects'. The workshop discussion went on to describe experiences in the UK, Sweden and Italy, and offered some technical insights into the work done so far to try and understand the issues. In particular, a clear correlation was shown between cold days in the UK and the number of vehicle breakdowns, with overnight minimum temperatures below 3°C causing a significant rise.

The technical report put together after the workshop, CEN/TR 16982:2016 (E) *Diesel blends and fuels – Cold filterability issues*, was published in September 2016. During the proceedings Cold Filter Blocking Tendency (CFBT) was introduced, where tests similar to IP 387 *Filter Blocking Tendency* were carried out at a reduced temperature. Amongst other data presented, CFBT results from various fuels from UK service stations containing FAME from 0.7% (V/V) to 3.7% (V/V) showed good differentiation between fuels over a range of temperatures from –1°C to +20°C.

Other fuel data demonstrated correlation with the BSI Filter Blocking Task Force Freezer Rig experiments in most cases, and whilst preliminary, there was cautious optimism that a rapid small scale cold FBT test might be feasible as a standardised method.

At the conclusion of the workshop it was agreed that the CEN Distillate Fuels Specification Working Group should support the formation of the EI Cold FBT Task Group in developing a new low temperature filterability performance test. The EI Task Group met for the first time in July 2015.

Proposed test method

A proposed test method, IP PM-ES, was published in January 2016. The procedure uses 750 ml of fuel which is prepared at ambient temperature. The CFBT apparatus pumps the fuel sample through a heat exchanger which cools it to +3°C, before it passes through a filter which is also held at +3°C. The differential pressure is measured between the filter and

the atmosphere and if particulates build up on the filter, the pressure increases. When the final pressure reaches 105 kPa the test stops, or if the pressure never reaches 105 kPa then the test is deemed to be complete after 300 ml of fuel has passed through the filter. The result is calculated for CFBT(3).

The temperature is adjusted to –1°C and the process repeated on a fresh portion of the same sample, to give a result for CFBT(–1°C). As such the two results provide a useful insight into the filterability behaviour of the fuel at lower temperatures. If both results are high and similar then the fuel may contain elevated levels of particulates. If both results are low, then fuel is clean. If the –1°C result is much greater than the +3°C result, then it shows some temperature dependence of the fuel – eg to generate particulates upon cooling between these temperatures.

Initially published online, the IP proposed method included preliminary precision gained during a pilot study using three sets of apparatus and 10 samples, for CFBT, and contained an additional procedure on how to cold soak the fuel, if required. The initial precision was similar to IP 387 (the ambient FBT test) and it was agreed to schedule an inter-laboratory study (ILS) in 2016. Discussion regarding the need for the cold soak step was finely balanced.

One objective was to try to reflect real world conditions to the greatest extent possible, whilst appreciating obvious practicalities in the supply chain for a test which would take over 20 hours, if a cold soak was included. As such it was decided to include both CFBT and CSCFBT in the proposed ILS. A call to industry was made, via UKPIA and the BSI Liquid Fuels Committee, which resulted in nine companies agreeing to take part. The apparatus was supplied to participants in April and May 2016, and an Energy Institute SC B-5 CFBT Task Group Workshop was held at Essar Stanlow Refinery/SGS Thornton Lab on 26 May 2016. The EI workshop was deemed a big success and was very well attended by ILS participants, industry stakeholders, the Department for Transport, TMS Panel Members and the convener for CEN TC 19 Working Group 24. Presentations were made on the background to the development and the key issues. The meeting was a final opportunity to comment on the test method and protocol in advance of the ILS. Hands-on training was provided by Stanhope-Seta, the manufacturer of the test apparatus. The revised IP PM-ES/16a was published online, with feedback provided from the workshop.

The ILS took place during July and August 2016, consisting of a number of winter grade base diesels from different UK sources, and included imports from the US and Europe, mixed with FAME derived from soya, rapeseed, tallow and used cooking oil (distilled and non-distilled). Saturated monoglycerides were added to one sample to the maximum allowed UK winter level of 55 mg/l and from the ILS data the EI statistician calculated the precision for both Cold FBT (CFBT) and Cold Soak Cold FBT (CSCFBT) at –1°C and +3°C.

IP 618 *Cold Filter Blocking Tendency* was published in October 2016, a little over one year from the first meeting of the EI Cold FBT Task Group and can be downloaded from the EI website **http://publishing.energyinst.org/ip-test-methods**

The groups' work, however is not over and is now being directed towards developing a test procedure for B100. In the meantime, industry has another tool in the box to try to understand winter filterability issues.