

Fourth Quarter 2015

Energy Outlook

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What Next?



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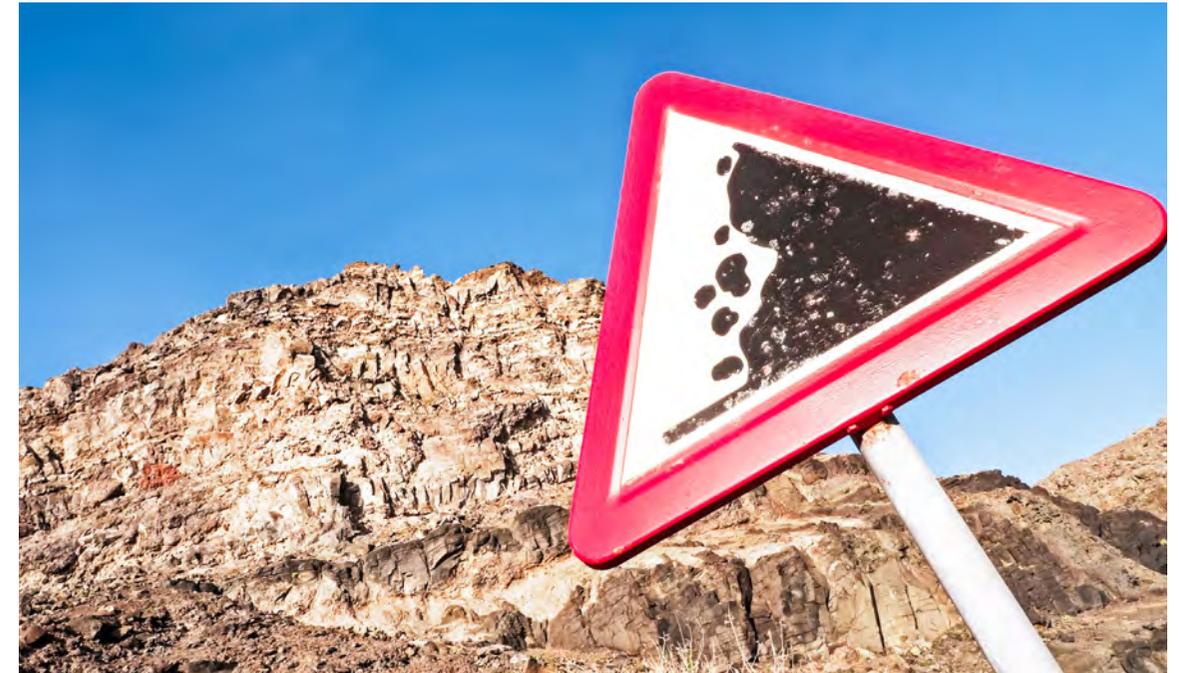
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What a Year – What's Next...?

WELCOME to the end of a year that felt like a tumble down a rocky hill, with the odd dead cat bounce off a boulder of defiant optimism, but the weight of gravity propelled all economic sentiment and geo-political expectation down towards even greater unknown unknowns. Feeling dizzy with concussion, we are left facing 2016 with a repeated bad record festive carol screeching off the turntable over and over asking – what's next?

But the one constant graph that kept moving up against economic gravity and logic was the monetary easing generosity juggernaut extended to the financial markets for yet another year. Like UFC cage fighters slamming on a cliff edge, the European and the Chinese central bankers landed bigger and bigger blows to salvage an economic system caught in an endless Greek tragedy, while the Fed essentially kept the punch bowl filled and the Chinese-demand slumber party going.

The only answer that the swarms of PhDs packing the globe's leading financial institutions can offer the world is we must keep printing free money – give everyone more credit cards on zero interest rates to pay for the last credit card bills! All these brains, so little wisdom...

Governments and central banks risk tipping the world into a fresh financial crisis, the International Monetary Fund warned in its Global Financial Stability Report released in October. Emerging market companies

have “over-borrowed” by \$3 trillion in the last decade, reflecting a quadrupling of private sector debt between 2004 and 2014, the IMF Report said. Now they face a Fed rate-rising cycle – ouch!

Despite the endless government interventions, China's economic slowdown continues to surprise on the downside heading to 5%, and perhaps beyond. While most keep waiting for the hidden TV cameras to pop out from behind the couch to say that it was all a joke and China is still enjoying double-digit growth. We need to all wake up – It's not! It's over!

The Bloomberg Commodity Index, the gauge tracking the performance of 22 natural resources, has plunged two-thirds from its peak in 2011, to the lowest level since 1999. That shows it's back to square one for the so-called commodity super cycle, an appetite for coal, oil and metals from Chinese manufacturers that powered a bull market for about a decade.

Anglo American, one of the world's biggest mining companies, said in early December it would cut around 85,000 employees, or 63% of its workforce. And I haven't even mentioned the 60% collapse in oil prices facing-off against a global stockpile of 3 billion barrels...

Suffice to ask – What's Next?

Sean Evers
Managing Partner, Gulf Intelligence



UAE Energy Industry Outlook

**ADIPEC 2015 Feature Interview:
H.E. Suhail Al Mazrouei, UAE Minister of Energy**

Sean Evers (SE): Your Excellency, do you foresee a new era of cooperation between OPEC and non-OPEC?

H.E. Suhail Al Mazrouei: OPEC has always welcomed cooperation and invited everyone to join the dialogue. Oil prices are not the problem of just one producer – this is an industry-wide problem and we need everyone to do their part. Common sense must prevail, which means that lower cost production should go to the market first. Then, the more expensive production should be the filler and the swing producer. Whatever price is good for sustainable production should be good for us. We have a vested interest to keep oil prices as stable as possible – we too have invested in building infrastructure and capacity.

SE: Do you see any recovery in the oil price next year? If so, do you see this being triggered by a specific action, or just a gradual tightening of the supply-demand outlook?

H.E. Suhail Al Mazrouei: We need a healthy recovery and I think oil prices will gradually rise. People are quoting \$20/bl and others say \$130/bl – both are too extreme. We need to slow down the production of the most expensive oil, to take a part of, or all of the glut from the market. This is primarily going to be dictated by the U.S.’ shale oil production. Oil prices will recover and we will come out of this cycle stronger than ever before.

SE: Have you been surprised by the resilience of the unconventional producers in the U.S.? They have maintained and even increased production despite lower oil prices.

H.E. Suhail Al Mazrouei: Over the last year, shale oil producers have increased and decreased production, with a recent focus on the sweet spots – but these will not be enough. Unconventionals are part of the game and we need them. We need prices that are good for unconventional, good for sour production and good for the ultra deep production. Everyone must have a share in the market.

SE: It has been a big year for the UAE, especially with the removal of subsidies on transport fuels from 1 August, potentially saving the UAE’s economy millions of

dirhams per year. Have the subsidy cuts had the impact that you anticipated and will there be more reforms in 2016?

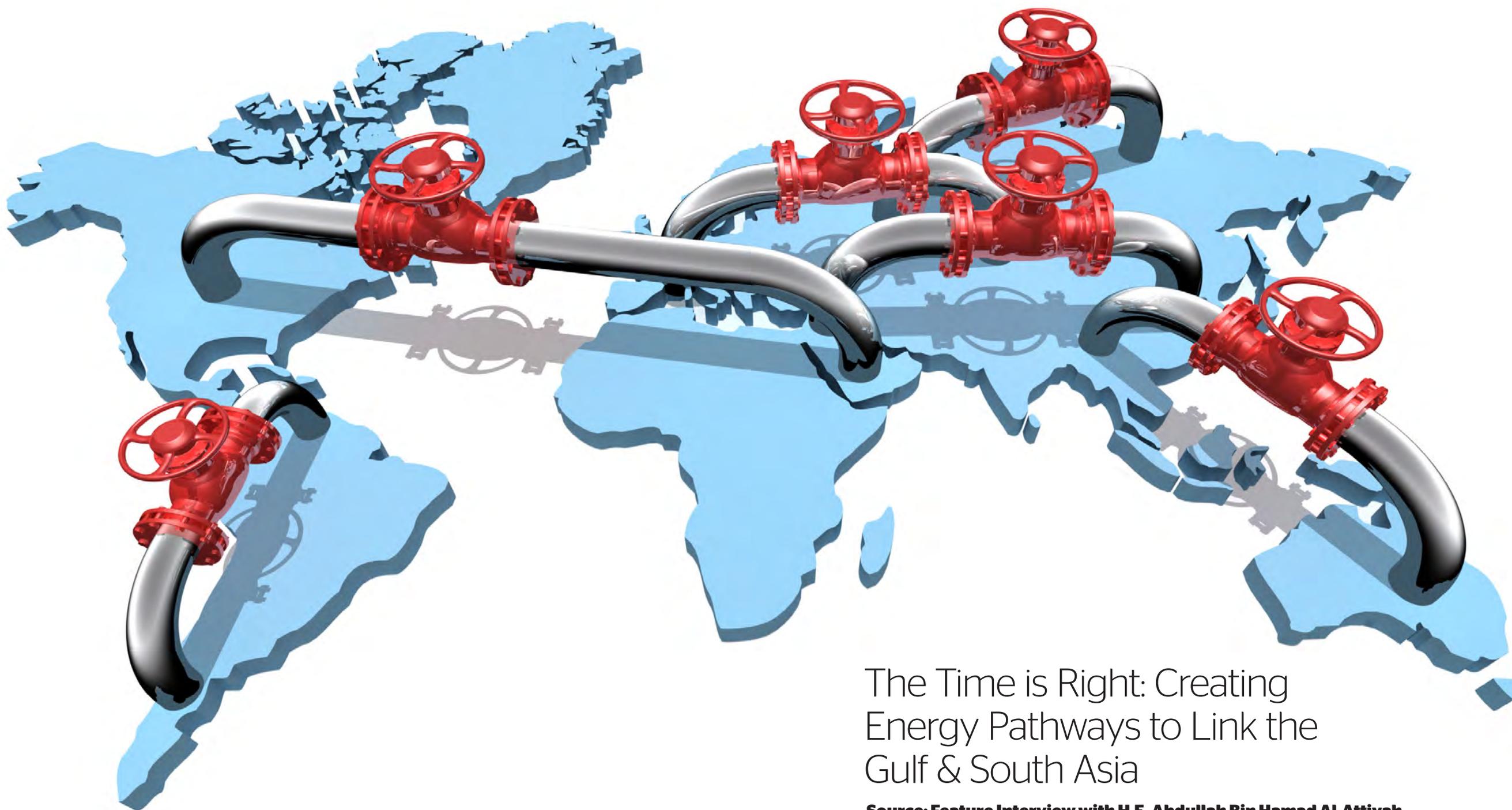
H.E. Suhail Al Mazrouei: We would have been just like everyone else if this cycle of lower oil prices had come and gone without action – we do not want to be just like everyone else. It was a difficult decision, but the trust between the leadership and the nationals and expats made it successful. The public knows that a more sustainable economy in the UAE is better for them and their children. This marked one of our steps to making sure we are always strengthening the country’s economy. Along these lines, we are also expanding our petrochemical and refining industry, which has proven to be a wise investment.

SE: Introducing subsidy reforms remains a sensitive topic across the region. What is the wisest lesson you’ve learnt since August?

H.E. Suhail Al Mazrouei: A government needs to create a system that is transparent and that is fair. We did not change subsidies for nationals only, for example. Each country will have their own system. We are still learning from this experience and collecting data that we will share with the public. We will tell the UAE public how many people have converted their vehicles from V8 four-wheel drives to six cylinders, or how many more electrical cars we have now. We are not going to force people to change. It is their choice if they want to drive a car with a V12 engine – you’ll just pay for it.

SE: Diversification is a buzz word across the Gulf. The UAE has made a big push to diversify its economy, such as pioneering renewable energy projects and strengthening its financial hub. Are these efforts paying off?

H.E. Suhail Al Mazrouei: As a general rule, the UAE’s leadership very wisely diversifies the economy, especially through international investments. Oil is not going to be here forever. His Highness Sheikh Mohammed bin Zayed Al Nahyan said last year that the UAE would like to celebrate the last barrel of oil with talented young people who can make money in other ways. We are proud of what we have achieved, but we have a long way to go.



The Time is Right: Creating Energy Pathways to Link the Gulf & South Asia

**Source: Feature Interview with H.E. Abdullah Bin Hamad Al-Attiyah
Chairman of The Abdullah Bin Hamad Al-Attiyah Foundation for
Energy & Sustainable Development.**

OIL AND GAS markets are heralded as the beating heart of the Gulf's flourishing economies, but carving out a united infrastructure has always proven more complicated. The outlook is set to become even more convoluted as China and India seek deeper integration with South Asia – incorporating the Gulf, Iran, Pakistan and even Afghanistan and Bangladesh. Despite the multifarious geopolitical hurdles, the negative impact of lower oil prices and long-term rising energy demand forecasts means an integrated framework looks more likely than ever.

Asian Game Changers

Dynamic new players from South Asia are entering the already competitive mix, with China, India, Pakistan and a possibly sanctions-free Iran leading the charge. India's determination in the race for energy supply security from South Asia and the Gulf is reflected by Prime Minister Modi's perpetual visits to any country with commodities to sell and a recent 8-day tour across Central Asia.

It has not been a smooth road for India, with a recent UN resolution dashing the country's hopes for a natural gas pipeline from the Gulf because the route traversed Pakistan's territorial waters. Meanwhile, plans for a 2,700km Iran-Pakistan-India pipeline are frequently stalled by political complications.

India's concerns are rising around the fact that Asia's emerging hegemon, China, will position its economic and political might to strangle India's energy supplies from the Gulf. India has earmarked the UAE as its gateway to the entire Middle East and total trade between India and the GCC is at around \$270 million. India is also inviting GCC investors to build refineries, pipelines and wider energy infrastructure on Indian soil to support its long-term goal of becoming a 'refining superpower' by 2025.

Meanwhile, eyes are on China's push into South Asia, especially following its large investment in Pakistan's deep-sea port in Gwadar. The site puts China within a stone's throw of Iran's border and in turn, some of the world's largest energy reserves. Only time will tell if China, the world's second largest importer of oil and petroleum products, is locking in more supply routes, or if Beijing hopes to use its energy and related infrastructure in South Asia to influence the Middle East's energy policy.

Others argue that economic drivers are the sole reason behind China's push, as Beijing

tries to build an 'Economic Corridor' that encompasses a wide array of businesses outside the energy spectrum. Pakistan simply marks the first pit stop; its geographical position between the Middle East, Iran, India and China places it as a strategic emerging hub.

Next door, there is budding appetite to build energy infrastructure – pipelines, specifically – in Afghanistan's stable regions. But all these objectives require considerable financial and political backing; China's integral involvement is inevitable.

Iran's Bold Ambitions

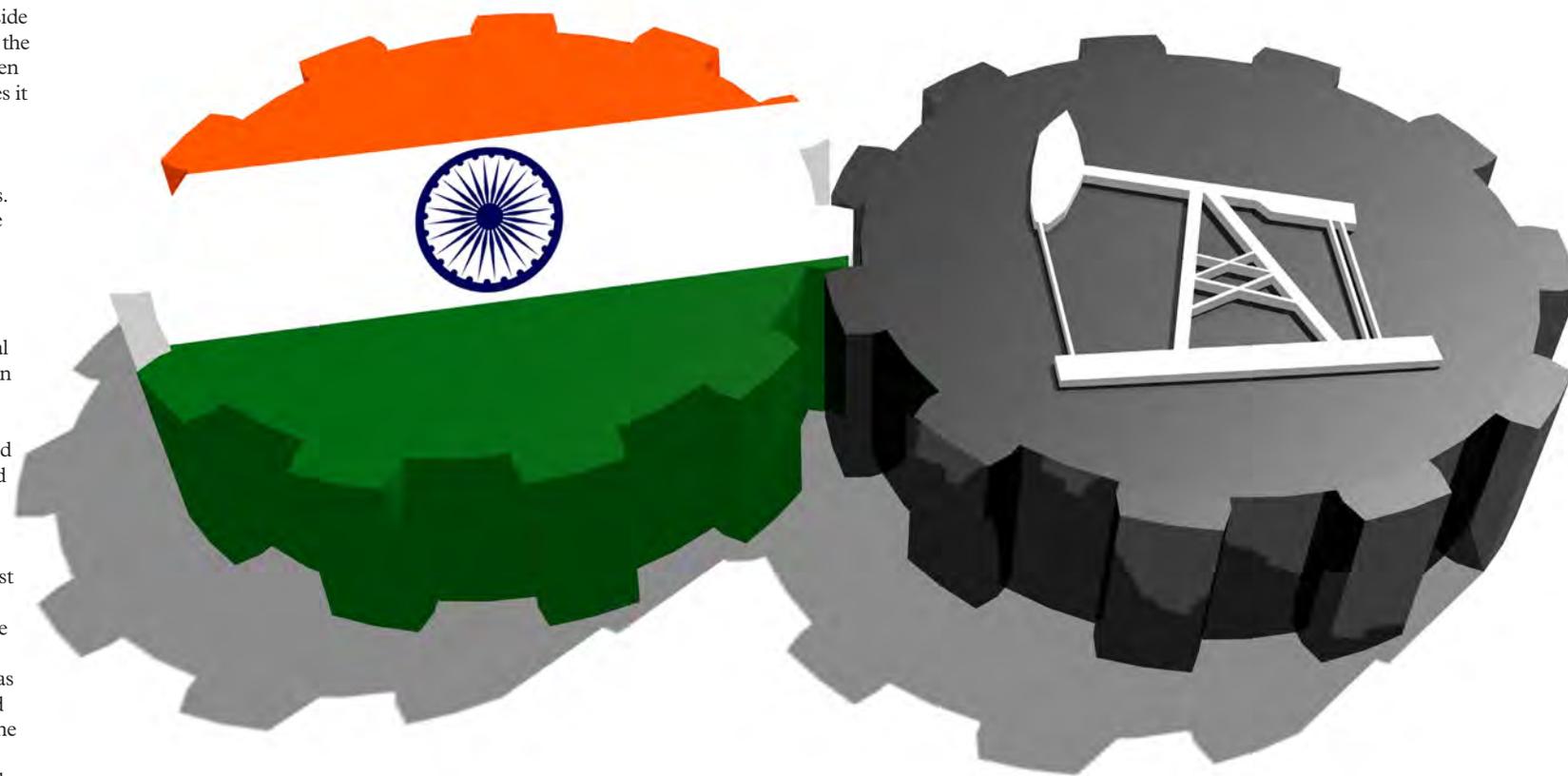
Iran's pending re-emergence onto the global energy stage could shift the dynamic. Tehran has made it clear through global headlines that the country hopes to boost current oil production from around 3.1m b/d to 4m b/d almost immediately after sanctions are lifted and then to 5.7m b/d shortly thereafter.

But Tehran's vague schedule means it remains to be seen whether either target is realistic. Sitting on the world's second largest natural gas reserves, Iran could also play a pivotal role in a united energy infrastructure as a supplier and as a conduit for India's access. But this will take considerable time as Iran has consistently had to import gas, and the development of the South Pars field – the world's largest gas field – is often delayed. Tehran must first establish itself as a credible LNG exporter before it can expect to widen its client base, as Qatar did in the nineties.

It also has to reverse the damage caused by its failure to deliver on particular projects, such as its dispute with Dana Gas over a supply agreement that ended up in an international tribunal last year. There should be more clarity over whether Iran can reliably supply the pending gas agreements with Pakistan, Iraq, Oman and others when sanctions are fully lifted.

Step-by-Step

Geopolitics are oft the cause of stagnating oil and gas projects in the GCC and beyond. But some ideas have successfully navigated the political minefield. This is most clearly highlighted by the modern infrastructure at Fujairah. It has leveraged its strategic location on the South-South energy corridor to become a trading hub that could soon rival behemoth trading hubs like Singapore and Rotterdam. Other success stories include the launch of the Dolphin pipeline in 2007, which connects Qatar, Oman and the UAE in a bid



to tackle the GCC's chronic gas shortage – the region's first cross-border refined gas transmission project.

The popularity of LNG imports and the war to ring fence market share will continue to rise as the high fiscal costs are offset by the political flexibility it offers. 'Floating pipelines' are generally a safer alternative to multi-billion dollar attempts to lay pipelines across many borders. Supply in what is a volatile region can easily be redirected to peaceful ports. For example, embattled Yemen's access to a gas supply lasted months longer than supply from the beleaguered oil fields, as Yemen LNG stored an urgent supply offshore its port city of Aden.

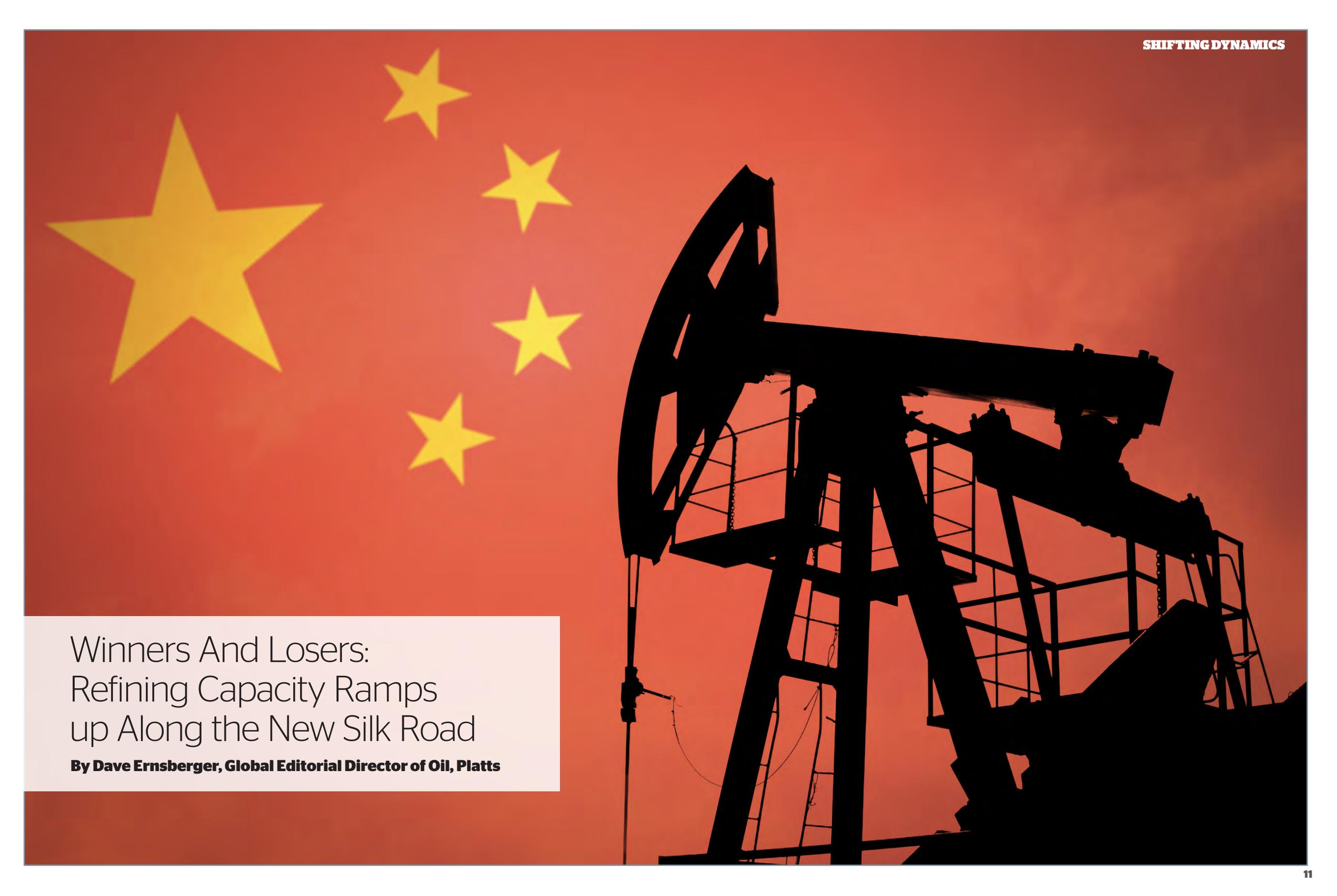
Qatar, the world's biggest LNG exporter, is still building regional trade ties, having signed export contracts with Kuwait, and potential long-term deals are brewing in Pakistan and Jordan. Many more Gulf countries are on Qatar's hit list; Oman and Bahrain, plus Saudi Arabia if the oil giant opts to preserve its oil and use gas instead for power generation.

But India, like all countries in the South

“Proposals are still only ideas, words scribbled on pieces of paper circulating energy ministries across the Gulf and South Asia. Action is the missing ingredient.”

Asian belt, says LNG is only one piece of the energy jigsaw and it must be complemented by land-based pipelines and facilities. India proposes a pipeline to serve its northern population could track from the Middle East to India, from Central Asia to India, even Russia or Myanmar to India.

But proposals are still only ideas, words scribbled on pieces of paper circulating energy ministries across the Gulf and South Asia. Action is the missing ingredient. ■

The background of the entire page is a sunset sky in shades of orange and red. On the left side, there are five yellow stars of varying sizes, arranged in a pattern similar to the Chinese national flag. On the right side, there is a large, dark silhouette of an oil pumpjack, a piece of machinery used for extracting oil from the ground. The pumpjack is positioned in the foreground, with its complex structure of beams and pulleys clearly visible against the bright sky.

Winners And Losers: Refining Capacity Ramps up Along the New Silk Road

By Dave Ernsberger, Global Editorial Director of Oil, Platts



THE GLOBAL refining industry is in the midst of a major transition, triggered principally by a shift in demand centers away from developed nations – dominated by the US – towards developing countries. Gasoline and diesel prices, long dependent on demand from the West, now fluctuate on the back of a soaring thirst for crude oil and fuels in the Middle East, Asia, Africa and Latin America. The long-standing link between global crude prices, US gasoline prices and Gulf Coast marginal refining economics has been broken, creating a more challenging refining industry structure.

Gasoline demand in the US and Europe faces further declines in the future as more hybrids and electric vehicles enter the market and bio fuels become more competitive. Oil price volatility and environmental concerns and costs are also pressuring margins, leading to refining asset restructurings and sales, and even bankruptcies as in the case of Europe's Petroplus Holdings, which shut down in 2012.

In Asia, Australia, having shut three refineries down in recent years, is now a net importer of refined products, and has another refinery closing later this year. And Japan has a structured plan to consolidate its four remaining refineries over the coming five to seven years.

In the midst of these refinery reductions, and yet while the global market remains oversupplied, national oil companies in the Middle East and Asia are planning to ramp up refining capacity, encouraged by rising domestic demand and potential new export markets. Per capita demand in China and South Asia is currently about 6 barrels a year.

By comparison, in Western Europe it is closer to 16 and in the U.S. around 20. It is unlikely that South Asia and China will hit U.S. levels of per capita consumption but as urbanization continues and as demographics change, they could edge closer to the European level. An expected doubling of demand over the next 10 or 15 years seems encouraging for refiners in the Middle East and Asia.

Taking one country's demographics: about 70% of Pakistan's 200,000 plus population is young and just entering the earning phase so future demand for cars, petrol and plastics seems secure. Looking more broadly, if one

considers that 2.2 billion people in today's world are living below the "hydrocarbon" poverty line, the potential for refined product demand growth is rendered huge potentially.

In the past three years, approximately 4 million barrels a day (b/d) of additional refining capacity has been added to the East of Suez market. Around 2.5 million b/d is expected to come on stream sometime in the next five years in the GCC - from the likes of refineries being built in Duqm, Oman; Jazan in Saudi Arabia; Alzore in Kuwait and Fujairah in the UAE. Iran has said that post-sanctions, it could boost its oil refining capacity to 3 million b/d by 2018 from the current 1.9 million. And a further 4.5 million b/d is expected to come on stream in South Asia, Far East Asia and Southeast Asia by 2020.

While world demand is growing quickly and can accommodate another couple of million barrels a day of refining capacity beyond what's on board today, how all of these planned capacity additions will in fact be absorbed longer term and what impact they will have on the sector's economics remains to be seen.

Which industry stakeholders, countries or regions will be most challenged in coping with the current change? Will it be investors or refinery owners themselves with excess capacity looking for a home? Do any of the new refineries currently in the planning stage have a particular advantage over others?

India is at present comfortable with its refining capacity, but when one looks at domestic demand projections for the next 15 years, one would certainly say it seems justified to be planning three more refineries. The country is also looking to expand its exports of refined products, being strategically well placed to supply lucrative markets in Africa and Asia. Modern refineries in India like Essar and Reliance have also proven that if run and managed efficiently, refineries can make a profit even if they need to source crude from further afield.

And surely it makes more sense to build a refinery in Saudi Arabia for example, than for it to export its crude to Singapore and then export refined diesel back? The same could be said for Pakistan and West Africa. On the other hand, there are sometimes of course net cost advantages that come with certain trade flows of crude and product.

Without a doubt, the business model for refineries has changed. For example, refineries producing less than 100,000 b/d are no longer considered competitive, at least on an IRR



“Without a doubt, the business model for refineries has changed.”

basis. A case in point is Pakistan where most refineries are producing below this level and as such need to be supported by public funds to remain operational. That having been said, the country is planning for its new 600,000 b/d refinery in Gwadar port to be operational by 2020.

Economies of scale, adoption of new technologies and forming partnerships when needed with feedstock suppliers, will have a significant impact on refinery operators' economic survival going forward. ■



Dave Ernsberger,
Global Editorial Director
of Oil, Platts

OPEC Producers Shouldn't Panic Yet About Slowdown in China

By Thangapandian Srinivasalu, Executive Director, Gulf Petrochem Group





CONCERNS THAT the slowdown in China's economic growth will curb Asia's energy demand from the Middle East and beyond could be premature. Yes, any hint of weakness in the world's largest net importer of crude and its second largest economy rings alarm bells in OPEC capitals and in boardrooms across the globe. India and Southeast Asian economies are also flourishing hubs of energy demand, respectively, but China is front and centre.

China's crude imports in the first six months of the year grew by 7.5%, yes, slower than the 10% pace in the same period of 2014, according to customs data, but still a healthy increase with OPEC forecasting demand for its oil to rise by 1mn b/d in 2016.

The devaluation of China's currency, the yuan in mid-August fueled fears in the global markets that China's debt-driven burst onto the global stage over the last decade could crumble and take the bulk of Asia's energy demand down with it. But while China overtook the

U.S. as the largest crude importer in April for the first time this year and no longer posts 10% annual gross domestic product growth, its fiscal future is hardly bleak.

The International Monetary Fund (IMF) expects China to report 6.8% growth this year, down from 7.4% last year, with 6.3% anticipated in 2016. While the forecasts mark China's slowest economic growth in a quarter of a century, the data has also triggered Beijing's plans to start switching to more sophisticated market reforms. If all goes to plan, China's fiscal discomfort today will transform its rather wild economic prowess into a steady and safe consumer-based economy within a few years.

China's energy demands are not expected to weaken in the meantime. Beijing-based General Administration of Customs estimates that the country's import of Middle Eastern crude climbed by 273,000 barrels a day (b/d) in the first half of this year on the same period in 2014, to a rough average this year of 3.5mn b/d

— just below half of China's total crude imports. China's total imports for 2014 rose by 9% on 2013 to an average of 6.2mn b/d, and in the first half of this year surpassed 7mbpd.

The US' Energy Information Administration (EIA) expects China's oil consumption to grow at a moderate pace to approximately 11.3mn b/d by 2016. In short, China's energy needs will ensure it is amongst the world's top importers for a long while yet.

China's import appetite has partly been driven by an ambitious plan to build strategic petroleum reserve capacity to around 500 million barrels (bls) by 2020 to safeguard domestic supply. China's current stockpile is likely to be around 130mn bls, but the exact figure is closely guarded. What is clear is that Beijing wants to have enough stored to equal at least 90 days of net oil imports by 2020, which amounts to and there is no doubt that the collapse in oil prices over the last year has created a perfect storm that has inadvertently

lent China a helping fiscal hand to bolster storage.

China's expanding middle class is also expected to ramp up consumer-based growth, driving demand for gasoline and jet fuel. The tentative forecasts that oil prices will strengthen towards mid of next year means that China will probably also increase its imports during that time of the year to lock in additional refining supply sooner rather than later.

Kuwait is particularly keen to push deeper into the Asia's downstream sector and is pursuing joint ventures with local counterparts to build integrated refineries as investors shun Europe's dying refining sector. But Kuwait has had mixed success. There has been significant progress on Kuwait's investment in Vietnam's 200,000 b/d Nghi Son refinery, but efforts to take a stake in China's state-controlled Sinopec's new 300,000 b/d Zhanjiang refinery have stagnated.

But there is no doubt that China's robust and dual relationship with a handful of partners in the Middle East will continue, spearheaded by regional hegemon, Saudi Arabia. The Kingdom, the world's largest exporter, accounted for the biggest portion of China's crude imports last year, at 16%, followed by Angola and Russia with 13% and 11% respectively.

China's historical trade link to the Middle East that has endured for over two millennia, plus Beijing's aversion to wade into regional politics, continues to charm trade partners like Oman, the UAE and Iraq. But such close ties can also risk leading to overreliance, which could be said of Oman's recent export portfolio. China accounted for around 90% of the Sultanate's crude exports in June.

Meanwhile, China has kept a distance from Iran to appease the US and Europe during the economic sanctions on Tehran. But the historic Sino-Iran trade accord is expected to regain momentum following the testy nuclear agreement between Iran and the P5+1. Consultancy Facts Global Energy's data shows that Iran accounted for 9% of China's total crude imports in 2014, on par with Iraqi imports and a touch below Omani crude imports.

So should energy producers be rushing to safeguard investments against shaky Asian demand? Not quite, but they should heed the cautious undertone that has long accompanied China's bullish story. There must be an appreciation of China's changing economic framework and that the Asian heavyweight's energy strategy will shift as it hits milestones in its quest for vast strategic petroleum reserves. ■



Thangapandian Srinivasalu, Executive Director, Gulf Petrochem Group



Promise of Riches: Iran Hopes to Attract International Companies Back with New Oil Contract

By Gulf Intelligence

THE NEED for Iran to invest in its oil and gas sector to maintain and boost output is obvious. In a bid to create an environment more conducive to attracting foreign investment, the oil ministry has started working on a new contract model for international companies seeking to become involved in domestic oil field developments which will be unveiled in London in December.

The terms of the new Iran Petroleum Contract (IPC), as it has been called, have been leaking out in recent months to whet the appetite of potential investors. It is set to

replace the traditional buyback scheme, which was first introduced in the 1990s in an attempt to bridge the gap between the country's need to attract foreign oil and gas companies, and a ban on private and foreign ownership of natural resources under the Islamic republic's constitution.

The scope of Iran's buyback contracts covers both field exploration and development. They are essentially risk service contracts, under which the contractor is paid back by being allocated a portion of the hydrocarbons produced as a result of providing services. The pay-back period

tends to be short, ranging between five to seven years, after which a developed field will be handed over to the National Iranian Oil Company (NIOC). Buyback schemes are based upon a defined scope of work, a capital cost ceiling, a fixed remuneration fee and a defined cost recovery period.

Although Iran has updated the buyback model twice since it was first introduced the contracts have been widely unpopular with International Oil Companies (IOCs) due to their inflexibility and limited returns. The IOCs have in the past expressed their concerns about the buyback model as being prone to huge potential losses because it didn't include many options to put a ceiling on its capital costs. Additionally, the way that the contracts are structured means that at the time of signing, long term pre-defined operating targets are set that do not take account of prevailing market conditions, new drilling plans, reserve estimates, financing costs, etc.

The new IPC is expected to do away with many of these criticisms as it varies markedly from the existing buyback schemes in that it proposes the establishment of a joint venture between NIOC (or one of its subsidiaries) and a foreign partner for field exploration, appraisal, development and – for the first time since 1979 – production.

There will also be a provision for the IPC to extend into enhanced oil recovery (EOR) phases. According to the US Energy Information Agency, "this modification aims to rectify issues with field decline rates by including the IOC in the production and recovery phases, while optimizing technology and knowledge transfers."

Unlike the short nature of the buybacks, the IPC model will offer extended contract duration of 20-25 years, allowing for much longer cost recovery after first production. On top of this, there will be a risk-reward element linked to the complexity of fields that pays companies higher fees for 'very high risk' on- and offshore fields compared with 'low-risk onshore' fields.

The IPC is also designed to take advantage of foreign companies' marketing expertise and give Iran access to their supply network to find an export market, in particular at a time when the Islamic republic has lost some market share.

While IOCs won't be able to book oil and gas reserves on their balance sheet under Iranian law, it is understood that the IPC will make some provisions allowing investors to incorporate revenues generated

“There can be little doubt that interest among international firms in developing Iran's hydrocarbon resources post sanctions is enormous.”

from Iranian oil and gas resources in their financial reporting, which for stock market-listed companies in particular would be an important incentive when mulling involvement in the country.

Other significant amendments versus the buyback model include an 'annual work program and budget' to be approved by a joint venture development committee (JDC) made up of officials from the partner companies. This is an important change as the fixed cost approach under the buyback model meant that cost for projects going above budget couldn't be recovered, thus eroding profitability.

Overall, the increased flexibility and improved terms offered under the IPC will provide some incentive for foreign investors to consider a return to Iran's oil and gas sector if and when sanctions are lifted. However, challenges remain. Continental Energy's Shoar says, among other issues, IOCs may be concerned over too much interference into operations by the local joint-venture party, in particular when the foreign partner shoulders all project-related risk.

There can be little doubt that interest among international firms in developing Iran's hydrocarbon resources post sanctions is enormous. A reopening of the country's energy sector would likely lead to a bonanza for oil companies not seen since the opening of Iraq in the post-Saddam Hussein era. The difference would be that the Islamic republic in many ways is a safer bet than Iraq given its politically stable environment and more diversified economy.

To be sure, the risks and challenges associated with becoming involved in Iran's energy sector would still be large – but likely to offer sufficient upside to attract international interest. In some way, Iran's new contract model resembles the one that has been successfully applied by the Kurdish Regional Government (KRG) in neighboring Iraq. ■

The background image shows a large excavator on the left, its arm extending towards the center. In the foreground, three workers wearing hard hats are silhouetted against the bright sunset. The sky is a mix of orange, yellow, and blue, with several high-voltage power lines and towers stretching across the scene.

Oman's Industry-Academia Must Tackle Skills Mismatch Before Issue Becomes Insurmountable

By H.E. Salim Al Afi, Undersecretary, Ministry of Oil & Gas, Oman

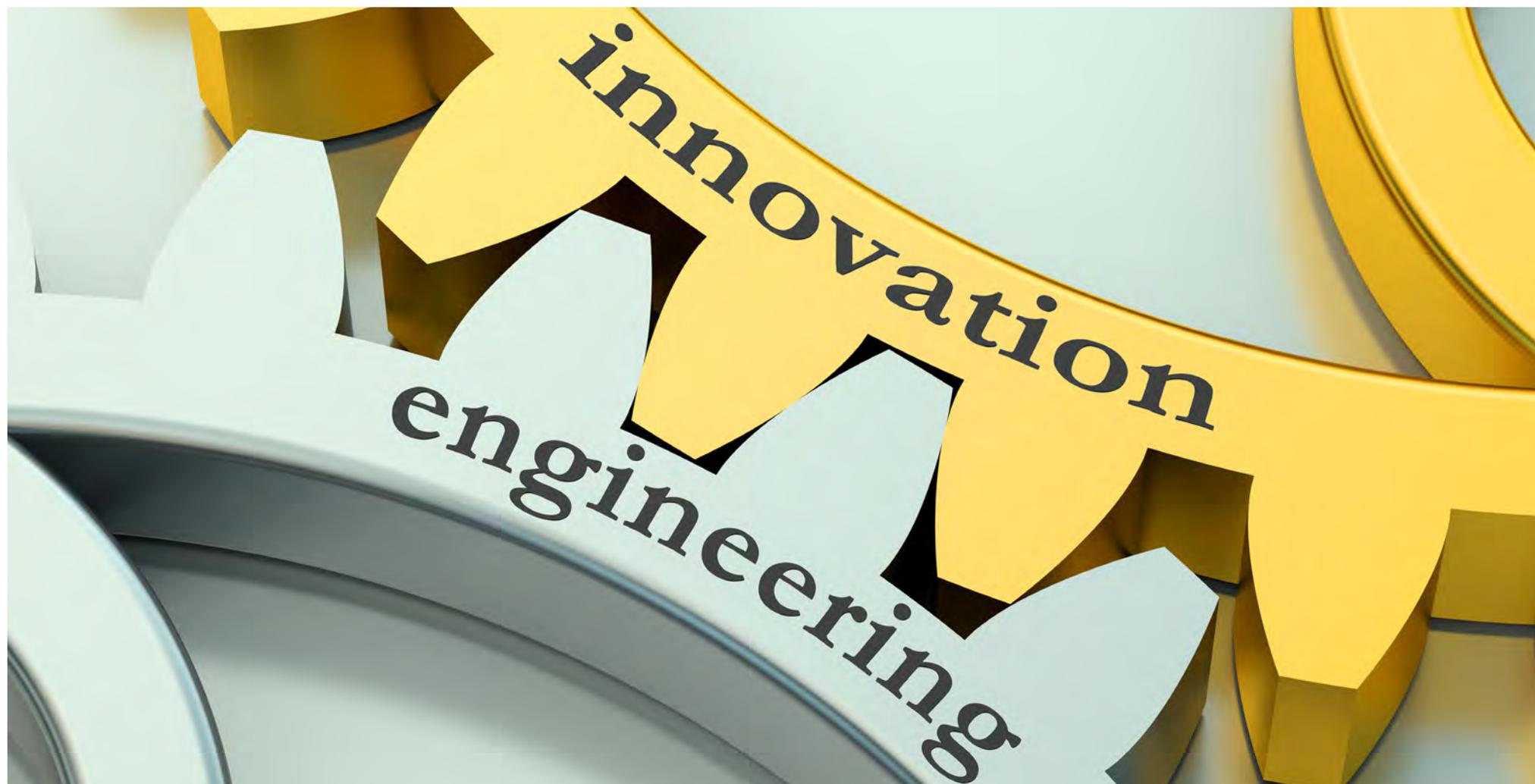
AS THE major contributor to Oman's national GDP, the oil and gas industry and the energy sector in general are uniquely placed to drive innovation in all sectors of the country's economy. To achieve this, there will have to be a much greater focus on producing an indigenous skilled and expert work force that can drive and sustain an expanding private sector.

As the world continues to make advancements in areas like technology or science, new jobs are also continuously materialising but they are proving more difficult to fill since they require particular skills that academic institutions or potential employees haven't developed yet. It can be difficult for academia to focus their programs on developing all the skills one could need in the future if they don't even know what all of those skills will be. But even for today's jobs that already exist, university graduates are not necessarily equipped with the skills and degrees those employers in Oman's energy sector need.

One of the biggest challenges is to ensure a steady flow of students into science-related subjects to be able to then choose careers as petroleum engineers and researchers. And the question is becoming even more pressing in today's interconnected and technology-driven world in which companies not only seek graduates equipped with the right knowledge base but also 21st century accomplishments such as critical thinking, communication, collaboration and creativity.

When it comes to human capital, we face a lot of challenges in Oman. One is identifying the caliber of skills we need and how to recruit the right people. The second is retaining good quality individuals and keeping them incentivized by continuously developing and expanding their skills, knowledge and expertise while they advance inside an organization. Lastly, in the event that employees are let go, what process should we follow to redirect them into areas which they're not necessarily qualified for in an immediate sense?

All of these questions and others require a significant interface between industry and academia to ensure that we actually match supply with demand, but there's very little discussion, if any, taking place between what the industry really needs today, or even in 5 or 15 years from now, and what academic institutes are capable of producing. We seem to be working in completely different universes, so government and industry end



up wasting a lot of resources, for example on re-training.

Individual companies have specific requirements and sometimes they develop their own training programs to ensure that their staff are qualified to do the job well, but these courses tend to be generally ad hoc and often on a small scale. I think there is still an element of mistrust between the industry and the training bodies that exist and that could be because they are not very well governed. Companies may not be sure if the programs that the institutes are running are accredited or whether its instructors are actually qualified. So instead, they find a solution in house; that's what's been happening.

PDO set up its welding program to create skills instead of going to an educational

institute and asking it to train its employees to the standards it needed. Similarly, BP is setting up its own training institute for its 2018 operational program, as opposed to going to an existing training institute.

In order for this existing dynamic to change, industry needs to work on communicating and defining very specifically what it needs from academia. We need to get much better at researching and identifying exactly what skills we need our staff to have. Only then can we go to academia with a case for them to invest and develop new programs. From academia's standpoint, it also doesn't always make economic sense for it to invest in developing and teaching a particular course, for just a select few who may need it.

In conclusion, from a government

policy point of view, I believe the priority through to 2040 should be to improve the quality of education in general. If this is not addressed properly, the energy sector and other key sectors for Oman's economy like manufacturing and tourism, will not witness an improvement of choice in the labor pool.

As part of this initiative, the government should continue to be the regulator of education and ensure that no school, university or vocational institute is set up unless it meets certain criteria and standards, but it should not act as the service provider; this should be left to the institutions themselves, to develop curricula and courses - and when appropriate in conjunction with industry - that will equip people with the required knowledge and skills for the 21st century. ■



H.E. Salim Al Afi,
Undersecretary,
Ministry of Oil & Gas,
Oman



R&D: The Glue That Will Unite Industry-Academia

Source: Maersk Oil Industry Roundtable, Adipec 2015



THE UAE'S energy industry has made strides over the last decade to build the foundations for a world-class energy R&D ecosystem in Abu Dhabi, which holds close to 10% of the world's proven oil reserves. Now, research is emerging as the engine that will unite the country's sometimes disjointed worlds of industry and academia. Abu Dhabi's new goal to hit a 70% recovery rate from its oil reservoirs - double the world average - and become a hub of innovation by 2023 sits at the heart of the country's recent ramp up in R&D. The Year 2015 was declared the 'Year of Innovation', illustrating the UAE's appetite for novel thinkers.

Abu Dhabi has gotten off to a strong start. The Petroleum Institute was established with foreign partners in 2001, followed by the launch of Masdar as an alternative energy research hub in 2006 and the Takreer Research Center in 2009. Next on Abu Dhabi's R&D agenda is the opening of the Petroleum Institute Research Center, which will use its annual budget of over \$30m to primarily develop Enhanced Oil Recovery (EOR) in carbonate reservoirs.

But the UAE still has a long way to go. The gap in collaboration between industry and academia is still too wide and the country came 47th on the Global Innovation Index 2015, in between Saudi Arabia (43rd) and Qatar (50th).

There are also strong doubts within the oil industry that the 70% target will fail unless Abu Dhabi immediately boosts its domestic R&D ecosystem and recruits more foreign help. Carving out clearer communication channels means academia could tweak the curriculum throughout the education cycle to create students that are more aligned to the energy industry's needs. In turn, oil and gas leaders could provide mentors, organize internships and help students' define their career paths through a sector that is oft considered archaic.

Greater collaboration requires bright minds; a lack of which has emerged as one of the top hurdles that industry and academia need to tackle together. There is an ever-growing shortage of graduates with skills in science, technology, engineering and mathematics (STEM) and almost half of the

world's petroleum engineers are scheduled to retire over the next decade. Investing in human resources is vital. Expecting a researcher who has come up with a novel idea to also market that concept commercially does not work. Each profession along the value chain plays a unique role in global R&D and bringing fresh ideas to boost cost and production efficiency in the energy market.

Academia, industry and government need to pin down their common goals and Abu Dhabi's highly publicized 70% target is at the very least a positive and accountable step in that direction. The road to achieving the 70% target could stretch over the next five decades, but the value in even a 1% increase holds significant monetary value to Abu Dhabi.

Many lessons can be learned from abroad, including the astronomical and unexpected success of the fracking industry in the U.S. where companies deliver R&D and solutions for production issues along the spectrum.

Norway's 'Goodwill Agreement' see preferential access offered to new concession blocks for oil companies that invest more heavily in Norwegian researchers in local institutions. In Brazil, a monetary amount equal to 1% of a field's gross production income is channeled into R&D projects if production hits a specified level.

In the Gulf, the 20-year old semi-private chartered, non-profit organization Qatar Foundation started the Qatar Science and Technology Park; international and national oil companies work together under the same umbrella in a tax free environment. Oman's particularly challenging oil and gas fields forced Muscat to pioneer EOR technologies over a decade ago. Other industries are also taking action; the world's largest chemical producer BASF funnels up to 10% of its sales revenue into the company's R&D, for example.

The Abu Dhabi Education Council (ADEC) recently held a competition for a grants program that generated almost 250 proposals, despite the tight submission window of four weeks - the cycle typically takes six months. Many of the applications came from major research institutions, like the Petroleum Institute and Masdar. The significant appetite highlighted the pent up interest for funding research in the UAE and the untapped potential. Many of the projects can either be plugged into existing industry operations to improve efficiency, or they propose a fresh approach.

“ There is huge hunger for more innovation in the UAE, which can only be realized by tighter partnerships between industry and academia.

Relative newcomers to R&D, such as Abu Dhabi benefit from a combination of top-down and bottom-up approaches. A framework where the government provides infrastructure, a regulatory framework and national goals can be complemented by the energy industry's know-how and academia. An added value of the UAE's 70% target for recovery rates is that it will encourage companies to brainstorm internally for solutions along the value chain, thus boosting bottom-up thinking.

The need for applied research - research that answers specific queries with a practical solution - tops the agenda for the UAE and the wider Gulf, especially in Saudi Arabia, Oman and Qatar. Applied research adopts the thinking that study can largely not be done for the sake of study. ADEC, for example, doesn't plan to shy away from risky projects, acknowledging that also funding offbeat ideas is how disruptive technologies are born. But the industry in the Gulf and beyond need to prioritize field experiments and pilot projects in the exploratory process; realizing the academic theory out in the field as soon as possible.

This raises the question of whether the UAE and wider Gulf should be registering their patents locally. The UAE has three patents versus 47,000 in the U.S., with one or two of those three patents also registered in the U.S. There is also a growing push in the UAE to send students to train abroad to learn about how to actually work within a company, with the hope that they will have the tools and confidence to build their own small and medium-sized enterprise (SME).

There is huge hunger for more innovation in the UAE, which can only be realized by tighter partnerships between industry and academia. Now, it's a case of squeezing that potential to put the country higher on the global podium of innovation by 2023. ■

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Four students who are excelling in their fields will be selected in recognition of their unique achievements and contribution to Qatar's future. The dissertation advisors for each of the winning students will be publicly recognized.

The students will be presented with their Awards at the Qatar Energy & Industry R&D Forum on April 25th 2016 at Qatar University's New Research Complex. Stakeholders from industry and academia as well as students are invited to nominate top individuals for either category.

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PhD Award Criteria:

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- Demonstrate the intention of working in Qatar
- PhD dissertation should be relevant to Qatar
- Extra weight given to doctorate research that would have a clear impact on the advancement of industry
- Demonstrates potential to be a future thought leader in the energy industry in Qatar

Masters Award Criteria:

- Qatar National or Qatar-based and Qatar-educated
- Have completed Masters Degree, or be near completion
- Demonstrate the intention of working in Qatar
- Current or planned involvement in energy-related research in Qatar
- Demonstrates potential to be a future thought leader in the energy industry in Qatar
- Extra weight will be given to those with intent to pursue a PhD

Please Submit Nominations to Brian Cozzolino at: briancozzolino@gulfintelligence.com



Getting Ready to Join the Oil & Gas Industry: An Academic Perspective

**Dr. Mahmoud Abdulwahed and Dr. Rashid Alammari,
College of Engineering, Qatar University**

THE OIL and gas sector will play a major role in transforming Qatar into a knowledge based economy as per the country's National Vision 2030, with STEM (science, technology, engineering & mathematics) highlighted as the most critical fields.

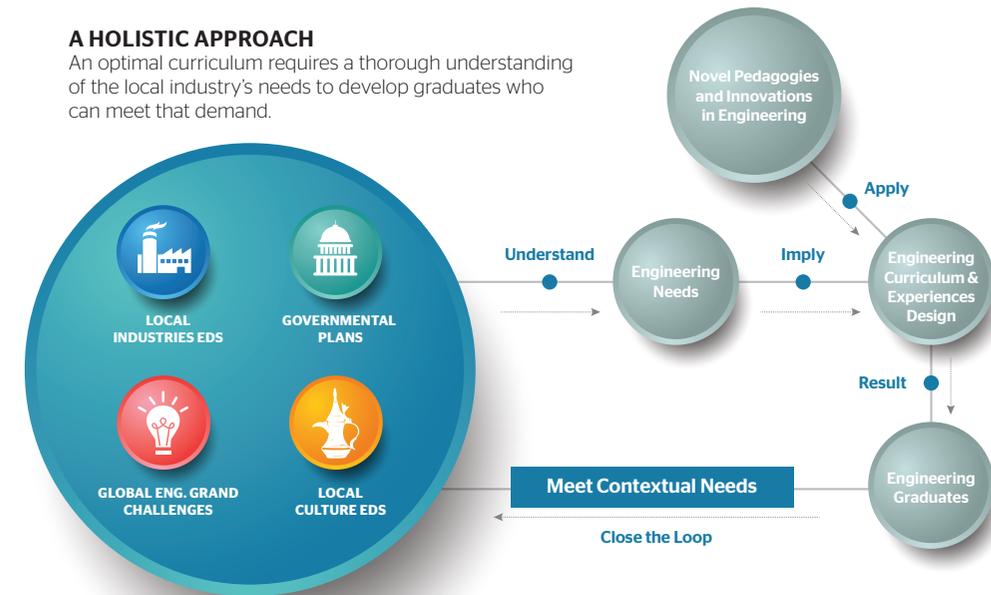
The energy industry can contribute via multiple routes, such as increasing and implementing effective internal research and development (R&D) divisions that tackle

applied research – research that aims to answer a specific question. Industry leaders could also build stronger collaborations with existing academic institutions in Qatar that focus on technology and engineering to facilitate knowledge sharing and technology transfers.

Thirdly, industry can help kick start and groom new ideas to add high-value technology and engineering small and medium enterprises (SMEs).

A HOLISTIC APPROACH

An optimal curriculum requires a thorough understanding of the local industry's needs to develop graduates who can meet that demand.



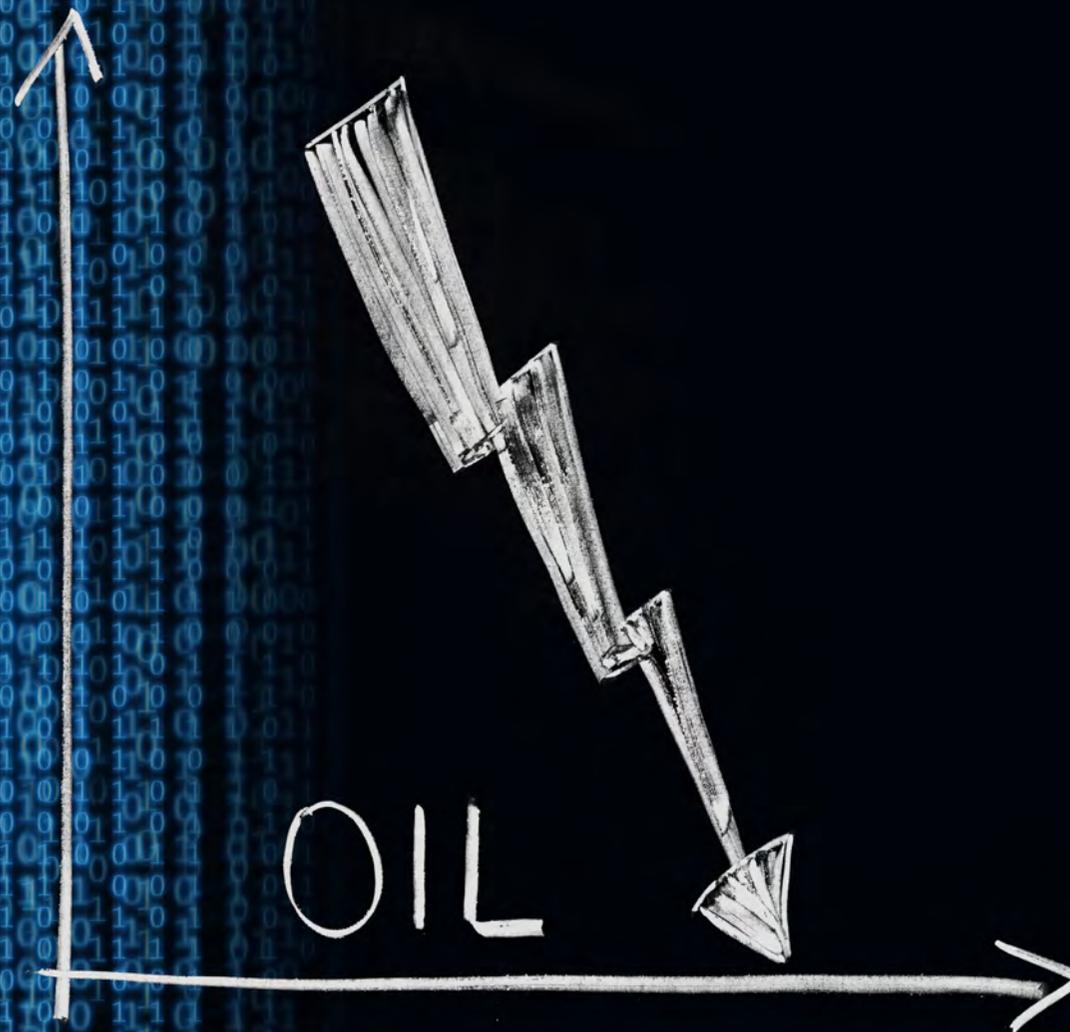
Qatar University: Leading the Way

The College of Engineering (CENG) at Qatar University (QU) is the largest provider of engineering and computing education in Qatar. CENG provides eight undergraduate programs, seven Masters programs and the first established PhD program in Qatar. The College is currently one of the largest attractors of research funds from both the government and local industries, with current total funded projects of more than \$150m. CENG contributes to about 20% of total indexed publications in the State of Qatar. The CENG is progressively embracing the elements of the closed-loop model; designed to match up curriculum and experiences for contextual fit within the energy sector. In this context, feedback collected from industrial advisory boards – be it college-wide or departmentally focused – with robust research projects to feed into the curriculum are key to pinpoint current, short and long-term needs that all culminate in meeting Qatar's 2030 goals.

Qatar University's dealings with the oil and gas sector have revealed several useful inputs into the university's curricular designs. The industry is currently content with the level of technical and engineering theory of our graduates, but there is also a growing emphasis on the need for practical skills and soft competencies. Soft skills require students and employees to have strong leadership, communication and teamwork skills.

CENG is continuously responding with a number of curricular and experiences that are aimed at enhancing the skill sets of engineering graduates, including establishing a competition for plant design. The annual competition is run as part of CENG's curriculum and evaluated by industrial experts. CENG also hosts the Gasna competition, which aims to attract K-12 students to the study of engineering disciplines related to the oil and gas industry.

CENG's Gas Processing Center was established to provide an institutional platform to link R&D with the gas industry sector, while the Office of the Associate Dean for Industrial Relations and Development focuses on enhancing linkages with industry. CENG also facilitates mandatory internships for engineering programs and Project Based Learning (PBL), which uses engineering courses as a platform to develop students' soft competencies. Qatar's ambitious academic development plans also open up opportunities for existing academic and industrial entities as the benefits of having higher quality graduates loops back into the energy sector. Accordingly, Qatar University envisages a unique opportunity for mutual collaborations between the academia and oil and gas sector in matters of technology and knowledge transfer. Start-ups of high value technologies presents another opportunity, especially as small and medium enterprises (SMEs) already significantly contribute to Qatar's goal to be a knowledge economy by 2030. ■



Unlocking the Value of Crossover Technologies

By Ghassan Barghouth, VP Oil & Gas and Industrial Segments ME, Schneider Electric



CROSSOVER TECHNOLOGIES are emerging as a priority in energy companies' fiscal defence against low oil prices. The elongated wave of higher prices pre-June 2014 stalled the deployment of much-needed innovations aimed at curbing costs and boosting operational efficiency. Now, companies' stressed budgets and rising energy demand must herald a new era of cutting-edge technology, especially as the oil glut looks set to continue. Saudi Arabia, OPEC's linchpin, is shrugged off global pressure to lower the group's 30mn b/d production ceiling in Vienna. Sub \$50/bl oil has already trimmed many companies' revenues by two thirds, but creating innovative technologies from scratch is expensive and time-consuming – time and excess cash are distant luxuries.

Crossover technologies provide a middle ground; energy companies need new ideas and adapting innovations from other sectors for oil and gas operations saves considerable time and money. Exploring this alternative could mark a turning point for companies looking to pull back their investments in novel initiatives. Lower oil prices have already

slowed or halted many firms' innovative plans, according to 76% of survey respondents to Lloyd's Register Energy's 2015 Oil and Gas Technology Radar research report titled 'Innovating in a New Environment'.

The Middle East has an abundance of energy waiting at its drill bits, but the industry needs to enhance its tool kit. Energy equipment faces a tough balancing act; it must be easy to maintain and repair while also being able to withstand harsh conditions.

A single technology holds potential for many industries. Automated image analysis can be used by security forces for facial recognition, by doctors for digital pathology and in the oil and gas sector to determine drill bit damage. Directional control can happily straddle medicine and energy with steerable needles and geosteering, respectively. Novice oil rig workers can be protected from hazardous environments by using simulators for training, as done in aviation by professional pilots. Determining when an oil pump may fail is similar to checking when a commuter train could stutter to a halt during rush hour, as is the risk analysis of an energy

geologist's view of a rock formation before drilling and sailors' gauge of a meteorological threat.

Yet, a number of obstacles mean energy companies' actual application of crossover technologies has dragged. The need to safeguard their squeezed budgets has formed the crux of companies' defense; especially as today's volatile pricing has put balance sheets under the spotlight.

A new breed of thinkers who can carry over established ideas from other industries to transform the archaic methods in oil and gas are urgently needed. Nearly half of the world's petroleum engineers will reach retirement age within the coming decade, accelerating the dash for new talent. Companies can also look for untapped thinkers internally, which could be helped by creating an innovative culture in-house. Gulf countries are also increasingly reappraising school and university curricula to galvanize students' critical thinking and appetite for science, technology, engineering and maths (STEM).

The industry is still treading too carefully around the topic of collaboration as they fear that sharing too much could jeopardise their intellectual property. But ring-fencing sacred information and sharing the rest is essential in seeking out new channels to transfer technologies into the oil and gas industry – medicine and aviation remain firm favourites. Boosting the level of standardization is also key. A transparent set of best practices for crossover technologies could help initiate change in oil and gas – an industry deeply entrenched in aged practices – and ease shareholders' reluctance to explore new territory.

Energy companies eyeing crossover technologies also need to make sure they finish the job. Lessons on how best to use digital platforms in oil and gas have partly been gleaned from other industries. But there is an inconsistency in application – digital information from oil fields is still passed through the operational chain on PDFs and paper.

Companies must first overcome their fear of first-mover disadvantage and seek strategic guidance from the many success stories worldwide. The Canada Oil Sands Innovation Alliance (COSIA) was launched in 2012 and is a strong example of how a joint approach was used to improve the sector's environmental impact, with over 800 distinct technologies and innovations shared so far. Lower oil prices need not dampen companies'



“ Companies must first overcome their fear of first-mover disadvantage and seek strategic guidance from the many success stories worldwide.

hunger for innovation, as illustrated by Shell when it established GameChanger during a down cycle in 1996. GameChanger is based upon the exploratory thinking of Silicon Valley and has engaged 1,700 innovators and turned more than one hundred ideas into reality.

The energy industry has already embraced the concept of crossover technologies, especially the significant savings in research and development. But a theory means little without real-life application and the industry cannot afford to wait. ■



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Energy Industry Must Overcome
Low Oil Price Challenge to Maintain
Innovation & Technology Deployment

By **LR Energy**

WITH THE collapse of the oil price over the last year, companies' revenues have fallen by around two thirds. What is more, exploration is getting trickier and more hazardous, yet demand for energy will only rise. These are undoubtedly challenging times for the industry, but downturns, as we know, historically throw up opportunities.

The industry has for decades lived in a bubble of high prices, which has stifled innovation. Those days are gone for now, opening the door to a new era where disruptive technologies can transform an industry in need of modernization. Some technologies are already in use, others are in the embryonic stages of development. Digital oil fields, drones, unmanned underwater vehicles (UUV) and the Internet of Things can all play a part in helping the industry develop and meet its goals of reliability, cost reduction and safety.

Which of these are most deployable in the short term? Remote-controlled aerial drones with high-resolution cameras are already simplifying and reducing inspection times on offshore oil rigs, an otherwise dangerous business. A flood of new start-ups specializing in this work are entering the market and a host of oil majors are already using the technology.

Still largely in development is the work being done on autonomous drones that require no human input. These will be able to operate in very hazardous areas like separators, tanks that separate oil and gas, and can be sent underwater to explore for oil, drilling through rock and sending back information. It may not be too far away that companies are presented with an opportunity to a replace a very expensive exploration well with a much cheaper robot.

Total's open competition to design an autonomous robot to work at onshore and offshore oil and gas sites will announce its winner in 2017. But these technologies also then present further challenges in assessing the safety of operation, and to what guidelines and standards they should be operated.

Other technology like the Internet of Things is changing how data is analyzed in real time at oil drilling platforms. Electrical pumps operating at variable speeds are connected to the cloud so they can be monitored hundreds of miles away from a control room. Data is collected via sensors where it is fed to engineers, providing real time information on pressure, temperature and flow rates. What is more, they will be alerted instantly to when a problem is detected.



Real time analytics are also being used in Enhanced Oil Recovery technology allowing output to be maximized at ageing fields. Already the industry is moving away from data mining because it simulates historical information about a field rather than building a scenario based on what something might look like in the future. The challenge is using this data to create a tool that people can navigate and use.

More uncertain is how technologies that require an internet connection would be deployed. Cost and safety issues have so far meant there is a reluctance to install Wi-Fi on the some of the most hazardous offshore platforms. While there is a perception that Wi-Fi wouldn't work in a big steel facility, this has proven not to be the case.

It is true, though, that deployment presents big innovation challenges for upstream companies. Firms recognize this. Nearly three quarters of companies say the challenges

of utilizing technology is a key barrier to innovation, according to the Lloyd's Register Oil and Gas Technology Radar 2015 survey. While most firms rate themselves as better than their peers at conceptualizing and developing new technologies, over half rate themselves as no better than or below average at deploying them.

Why is this? Oil and gas firms must meet ever ambitious objectives in a tighter cost environment, making the price of innovation failure very high. Indeed, this risk means that there isn't yet the collective will in the industry to move forward because companies don't want to be first to use new technologies in case they go wrong.

The industry also needs more time to adjust to a low price era. With prices only having fallen in the last year, this is hardly enough time for any great shift in innovation to take place. With oil sitting under \$50/bl, there has never been a greater need for the industry

to collaborate not just among itself but with other sectors. Collaboration between upstream companies has been limited. This must change.

Crossover technologies must also flourish from aerospace, defense and even the automobile, IT and telecoms sectors. Aerospace is of particular interest to oil and gas firms because both industries require equipment that can withstand huge pressure and extreme climatic conditions.

Upstream companies have only scratched the surface when it comes to innovation and they must adapt to and embrace cost-effective technology that will streamline operations, improve safety and maximize returns. It is not however as straightforward as that: the industry needs, in tandem, to develop new ways of interpreting and integrating data to drive quicker and more accurate decisions. This will lead to myriad benefits, not least finding resources at time when it's getting harder to do so. ■

Water Management Innovation Must Lead, Not Follow, Shale Revolution

By Dr. Samer Adham, Manager, Water Solutions Group, ConocoPhillips



UNCONVENTIONAL OIL and natural gas have transformed the energy industry in the last decade. Hydraulic fracturing and horizontal drilling techniques have revolutionized how we extract oil and gas from geological formations considered of little interest and potential only a few years ago. But alongside this significant opportunity has come new challenges.

One key challenge is water management; how it is sourced, how it is used, how it is disposed of safely and increasingly how it is recycled. Sourcing and managing water in a cost-effective and sustainable manner is a vital issue that must be addressed. Technology advancement in fracturing has been meteoric, and innovation surrounding water management continues to hold much promise.

Fracturing requires a mixture of water, sand and additives. This mix is then forced under high pressure into impermeable shale rock formations to unlock potentially vast reserves of oil and natural gas. Around two to five million gallons of this mix – or 50,000 to 120,000 barrels – is required to fracture a typical horizontal well. Water sourcing can be an acute challenge, especially in regions experiencing water stress. Fracturing requires only a few days during the well completion phase and allows for many years of production.

Companies are actively working to address the environmental aspects of water disposal and transport. Increased focus on water sustainability and environmental stewardship, as well as a tightening regulatory landscape, all contribute to driving changes in water management practices. In some regions, between 10 to 80% of the fracture fluid mix returns to the surface as produced water. The management alternatives include temporary storage in tanks or engineered pits, injection into disposal wells, off-site disposal and reuse/recycle, which means the scale of the water management challenge can be considerable.

The industry strives to reuse water when technically and economically feasible in additional fracturing operations. The advantages are clear. Reusing water reduces i) the reliance on fresh water sources, ii) surface storage requirements; iii) transport costs and road traffic because less water must be transported; and iv) reduces the volume of wastewater injected into underground wells.

Schemes to reuse 100% of the water produced from fracturing have been successfully piloted in the United States. However, local or regional produced water composition may prevent or significantly limit reuse potential and challenges for reusing water include fracture fluid compatibility, treatment feasibility and costs and environmental trade-offs including energy use and waste generation.

Investing and deploying an economic water recycling program will require collaborative effort from engineers, technicians and operation specialists. Companies are discovering that a fully integrated process is a good foundation of an effective water management strategy, which incorporates the complete life cycle of water from sourcing, transfer, storage, reuse and disposal.

There are recycling options available and, based on produced water composition,

“Investing and deploying an economic water recycling program will require collaborative effort from engineers, technicians and operation specialists.”

companies are working to understand if and how water can be recycled and the technologies required. Produced water can be reused without treatment if its composition is compatible with fracturing fluids, and some companies are exploring the use of moderately saline water instead of freshwater in the well stimulation process.

A large-scale framework could use centralized water treatment plants that are connected to wellheads by pipelines. Wastewater can be identified from a certain well and then processed and piped back to suit the requirements of that operation.

Managing shale water can be both environmentally beneficial and cost-effective. Some equipment vendors are promising a “silver bullet” that incorporates cost-effective and sustainable water management, but the challenges of managing water are often unique to the well and geological site. A solution for one field may not work in another. Water-free fracturing may ultimately emerge as an answer, when the technology matures and costs decrease.

The costs associated with water management will be a dominant economic factor for shale operators for years to come, particularly if the crude oil price remains at current levels. This highlights the importance of an integrated approach, where a complete water management team is armed with water resource and process engineers, geologists, hydro geologists and water sustainability specialists who can deliver cost reduction, boost operational efficiency, and develop a water management approach that takes into consideration local water resource availability including potential water stress, water source alternatives including moderately saline water and produced water reuse/recycling. ■



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