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OFFICIAL PUBLICATION OF THE 22ND WORLD PETROLEUM CONGRESS

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Meet demand for energy or reduce its impact?

Technology can help us do both.

Our industry is changing faster than at any time in our lifetime. Demand for energy is set to increase 30% over the next 20 years as the global population rises to nearly 9 billion people. At the same time the world is looking to address climate change by transitioning to lower carbon energy. And it’s never been more important to provide it safely and reliably.

So how do we do this? Technology holds many of the answers. From seismic imaging and enhanced oil recovery, through to advanced fuels and lubricants, and pioneering robotic technology in our operations.

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Welcome to the Official 22nd WPC Congress Publication!

By Dr József Toth, President, World Petroleum Council

Every three years the World Petroleum Congress draws together all areas of the oil and gas sector. We all currently face a very challenging but interesting period for our industry, and the nonpolitical and neutral platform our Congress provides is essential. For the 22nd WPC we appreciate the hospitality provided by our Turkish hosts and value this exceptional situation whereby the President of our Host Country has extended invitations to other Heads of States, providing them with the opportunity to share their world views with our congress delegates.

We look forward to welcoming over 5,000 participants and over 600 speakers to the Congress, including ministers and CEOs of NOCs and IOCs, the heads of international organisations and senior experts from around the globe. In nearly 100 sessions they will share their knowledge and expectations for the future of the oil and gas industry with you. The Plenaries, CEO Panels, Strategic Sessions, Forums and more will address a wide spectrum of issues across the whole sector. Every aspect of our industry is covered including: upstream challenges in a low oil price environment, the increasing importance of petrochemicals in the downstream, the rise of natural gas, climate change strategies, engaging and retaining talent in our industry and how to manage all these issues through better governance, leading to a sustainable future.

The Congress will be accompanied by one of the largest strategic oil and gas exhibitions, the World Petroleum Exhibition and the Global Business Opportunities Centre (GBOC), featuring our 65 member countries. In addition, we have many special stands showcasing for example the industry’s involvement in social responsibility and young professionals.

The Official Publication of the 22nd World Petroleum Congress supports the Congress Programme through in-depth articles which consider global, strategic and technical issues. The 22nd edition of the World Petroleum Congress will address these industry issues under the theme ‘Bridges To Our Energy Future’.

The current challenges faced by the industry are substantial and strong management is needed to address them – responsibility, cooperation and sustainability are the ongoing goals we must keep our focus on.

As the world population increases, access to affordable, safe and reliable sources of energy is a key factor in promoting economic development and well-being for mankind. Oil and natural gas will continue to be the world’s leading energy resource for the foreseeable future. Meeting subsequent demand in a safe, sustainable and socially responsible manner will require massive investments, leading edge technologies and the highest skilled human resources. Producers, consumers, governments and societies need to cooperate responsibly to develop energy resources and we will need all types of energy resources in the future to meet the ever growing demand.

The energy map in general, and the oil production and consumption map in particular, are changing around the world, with a shift towards emerging countries becoming key consumers. New producers will appear due to technical advances in exploration and production, and due to this innovation, traditional consumer countries are now becoming not only producers but also net exporters.

Good leadership, together with high standards and ethical business practices, are required to ensure the sustainable supply and efficient use of the world’s oil and gas resources for the benefit of all. Industry leaders must be trusted to act responsibly to use the best available technology and practices that ensure we minimise all adverse impacts and risks to the people and environments in which we operate around the world.

The WPC is the largest international organisation representing the interests of the global oil and gas community. One of the main goals of this organisation is building a dialogue between stakeholders to share experiences and knowledge, to enhance the development of solutions to key challenges in the oil and gas sector and the articles included in this latest publication are one of the ways we can share this knowledge.

As I finish my last term as President of the WPC, I would like to take this opportunity to thank the WPC “family” of countries for their support and to wish you all a very enjoyable and valuable time at the 22nd World Petroleum Congress.

Dr József Toth
President, World Petroleum Council
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Shaping the industry’s future: Certainty and uncertainty

By Dr Pierce Riemer
Director General, World Petroleum Council

The oil and gas industry is facing many complex challenges and issues in the new global context. However, the major challenge for the oil and gas industry is to provide energy security in a world with increasing complex challenges and uncertainties.

Let us first look at what is CERTAIN

- We know that NO other industry works on time horizons like we do.
- We must understand ALL factors involved.
- We need to know the certainties.
- We know that the world population is increasing.
- We are also helping to bring vast populations out of poverty.
- We know a larger population will need long term energy supplies.

The United Nations Population Models indicate that the world’s population could possibly exceed 16 billion by the end of the century. Based on more conservative growth assumptions, a global population of around 9 billion is likely by 2050, and growing to 11 billion by 2100. According to the UN’s Population Division, China and India will remain the two largest countries of the world, representing 30 per cent of the world’s projected population. It is certain that economic expansion and population growth will continue to drive increased global oil demand, with the main regions of growth being non-OECD countries in Asia, the Middle East and Africa. These factors alone will ensure the long-term future of the oil and gas industry.

Our Meta-Analysis – which combines research from the IEA, OPEC, IEF and EIA – indicates that, despite international efforts to slow global climate change, oil in 2050, along with other fossil fuels, is likely to remain in a leading position in the global energy mix. However, I need to highlight a word of caution here. As major emerging economies (such as India and China) mature, more efficient technologies will be introduced and, as environmental concerns become more prominent, global oil growth may be constrained to some limited extent. The principal challenges for long-term supply are: which countries and what types of oil production are most likely to increase demand growth?

Non-OPEC supply from unconventional sources has increased significantly in recent years, often encouraged by government policy directives and various incentives. However, there is very little agreement on where this future supply may peak or start to decline. To meet long-term demand growth, OPEC will continue to provide a key role in global oil supply.

Another area of CERTAINTY concerns the Sustainable Development Goals. These are a universal call to action to end poverty, to protect the planet and to ensure that all people experience peace and prosperity.

The World Petroleum Council fully supports these global goals and these subjects are addressed in our triennial Congresses, alongside the various technical and managerial programmes. Every goal involves the energy industry in some way. The oil and gas industry, in conjunction with key industry associations and other stakeholders, has embraced these initiatives and, today, many privately funded sustainability projects are being developed, or have been completed, in many developing countries.

I would now like to touch on another area of CERTAINTY which addresses the need for large investment over the next 20 years. Although total investment in the oil and gas sector has declined over the past five years – reflecting the drop in upstream oil and gas spending, and cost deflation in many areas – long-term investment requirements will remain high to meet global energy demand. We are all aware that, according to the IEA and OPEC, over the next 20 years investments of more than US$25 trillion will be required. The most recent IEA report demonstrates that the energy system is undergoing a gradual re-orientation towards low carbon energy and efficiency, but it also points out that the investment in key clean carbon technologies needs to be further ramped up to put the world economy on track for climate stabilisation.

Against the CERTAIN background of increasing growth in global population, increasing energy intensity, the pressing need to bring vast populations out of poverty – including pressures of urbanisation, and the continuing demand for long term investment, the outlook for the oil and gas industry seems well assured. However, in the new global context, the range, scope and impact of UNCERTAINTIES are taking risk management to a new level and to the very top of managements’ agendas. Apart from the effects of continued sluggish global economic growth, such uncertainties include:

- Heightened Geo-political Risks
- Volatile Commodity Price Risks, and
- Complex Geological and Technical Challenges

Against the backdrop of the range of challenges and uncertainties facing the global oil and gas industry, in May 2015, the World Petroleum Council organised a Leadership Conference in Tromso, Norway. The purpose of the Conference was to bring together industry leaders to discuss and demonstrate best available technology and practices to minimise the impacts and risks to the people and environments where companies operate around the world. By highlighting the industry’s strategies in locations such as the Arctic and other frontier areas, the industry can contribute to raising the standards across the sector. Given
the complexity and uncertainties that the petroleum business will face in delivering energy for the sustainable development of the world, a responsible culture needs to be incorporated at all levels, from the small communities where we operate and throughout our global businesses. We intend to hold a similar conference again in the near future.

Oil price determination

We cannot escape the important subject of highly volatile energy commodity prices which continue to generate great uncertainty in risk management and in financial management. Over the past 50 years the oil price has been highly volatile compared to the steady increase in production. The correlation between demand and supply is not straightforward and is influenced mainly by market sentiment and geo-political factors.

Unlike other products, oil prices are NOT determined completely by supply, demand and market sentiment. Instead, supply, demand and sentiment towards oil futures contracts, which are heavily traded by speculators, play a key role in determining the oil price. In recent years, geo-political events have also played an increasing role in determining oil prices. It is interesting to note, that while we have seen the oil price decline, world demand has remained relatively stable, even during the global economic downturn in 2008/9. So, where are we heading? Oil prices remain relatively stable at present, settling around the US$50 mark, while global demand continues to slowly increase by 2mbbl/d towards 100mbkb/d. Given the recent OPEC Production Agreements, reserve depletion is estimated to exceed the forecast increase in global production by 5mbbl/d. To maintain the current reserve and production balance, an estimated 7mbbl/d will be required just to meet current demand, especially in the emerging markets of Asia, the Middle East and Africa.

Over the past 20 years, demand for natural gas has increased significantly as many countries have been switching from other sources such as coal and oil to fuel their economies. For most of this period, gas prices in the various regions of the world, were highly correlated, often linked to oil prices, and prices generally moved in unison reflecting regional demand and supply.

Progress is also being achieved in reducing gas flaring which has been a major environmental issue. The Global Gas Flaring Reduction Initiative - which is a public-private partnership - was launched at the World Summit on Sustainable Development in 2002. The World Petroleum Council has been active in encouraging all our members to join the World Bank Initiative on the reduction of non-essential gas flaring. The objective is to achieve zero routine flaring by 2030. We are pleased to report that many members of the World Petroleum Council have already signed up to this initiative.

Turning to the future management of the industry, it is imperative that the oil and gas industry attracts and develops the highest quality, professional skills that will be needed in the new global context. In this important area, the World Petroleum Council has been active in organising events for young professionals around the world. We have an international Young Professionals Committee which has been active over the past 20 years in organising various conferences, seminars and leadership programmes, including active participation in our triennial Congresses. This has greatly stimulated the interest of young professionals in the industry and has helped to ensure that we attract the brightest and best qualified people to meet the challenges of the new global context.

In conclusion

• The Industry has its critics and we all know we are not perfect, BUT:
• We are unbelievably good at what we do – unique time horizons
• We are essential for modern life – there is no escaping it
• We are essential for economic growth
• Have been for over 150 years
• Will be for the next 100
• No energy = no growth = no advancement = no social progress
• This fact is often forgotten in many consuming countries
• The Industry supplies an efficient, economic and regular supply to consumers
• Commodity cycle – we know there are ups and downs, increased political risks.
• There is still energy poverty – which we must help deal with
• Need a level global playing field, fair taxes and fair regulation
• Governments need to recognise the great job that we do – the vital job that we do
• High-tech and capital-intensive industry requires significant skilled human and financial resources to succeed
• But we must do this in a responsible and sustainable manner.

Dr Pierce Riemer
Director General, World Petroleum Council
Saudi Aramco is a world leader in integrated energy and chemicals. We are driven by the core belief that energy is opportunity. From producing approximately one in every eight barrels of the world’s crude oil supply to developing new energy technologies, our global team is dedicated to creating positive impact in all that we do.

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From the Istanbul Congress, held in what was once the crossroads of the world, the path ahead for the petroleum industry itself is to meet the dual challenge of satisfying rising demand and of addressing climate change, argues Robert Dudley of BP. More energy, greater efficiency, fewer emissions. This will involve applying common sense at scale, in terms of exploiting big data to revolutionise big oil, and of recognising the huge decarbonisation from cleaner fossil fuels, especially natural gas that is of increasing relevance to suppliers like BP and customers like Turkey. For the industry to achieve all this, Alexander Novak, Russia’s energy minister, sees the need for a stable framework for what he calls the unregulated and speculative oil market. This could be provided by the production restraints agreed by OPEC and non-OPEC suppliers like Russia, a breakthrough event that could lead to greater cooperation in oil technology as well as in the oil market. India, for which Dharmendra Pradhan is the minister for petroleum and natural gas, is already the world’s third largest energy consuming country, and has the potential to consume much more, given its huge population and low per capita consumption of its citizens. India is seeking to minimise imports, boost domestic oil and gas output, develop alternative bio-fuels; and to avoid the waste common to many other energy subsidy schemes, it is tackling fuel poverty with a scheme that transfers money directly to 170m poor consumers. Dr Fatih Birol of the International Energy Agency cautions against assumptions that the Paris climate agreement will lead to any early fall in oil demand. Rather, it will likely cross the 100 million barrel a day threshold in 2019 and continue to expand for many years to come – not only as fuel for cars but as core inputs for shipping, aviation, trucks, and plastics where few alternatives exist. On the supply side, the period of US$100 oil lulled the industry into a sense of security that proved false when the price collapsed and capital expenditure, outside the US, dried up. However, some of the recent cost cuts appear structural, and should therefore provide a solid base for efficient expansion. Mohammad Sanusi Barkindo of OPEC warns that the oil price gyrations have led to a boom and subsequent bust in upstream oil and gas investment, which could lead to a decline in medium-term supply growth. Therefore recent output restraints agreed by OPEC and partner suppliers may be also necessary for the longer term, even though OPEC does not envisage any peaking of oil demand in the foreseeable future. Dr Sun Xiansheng of the International Energy Forum argues for a wider dialogue between producers and consumers that goes beyond everyone’s natural interest in near-term market developments to embrace new technologies and energy efficiency. Government policies to deploy a wide range of new technologies, and consumer response to them, are making the outlook for energy demand more uncertain and provide issues for dialogue, especially in transport. Lorenzo Simonelli of GE Oil & Gas highlights ways in which a new hi-tech breed of service company can bring an Industrial Internet of Things approach, developed in many other areas of the economy, to the petroleum sector, linking machines, data and people. Use of asset performance management software can, for instance, reduce unplanned downtime, create regular flows of data about machine maintenance, and thereby take the guesswork out of checks. A final form of leadership is that exercised by Pedro Parente in helping Petrobras recover from the financial and reputational damage it has recently suffered. Although still heavily indebted, the performance of Brazil’s largest company has improved, greatly helped by much needed regulatory changes. The government has relaxed the obligation for Petrobras to be the operator of all Brazil’s pre-salt fields, and at the same time adjusted local content rules to local capabilities.
Istanbul, through the ages, has often been called the crossroads of the world. It is where East meets West, and where cultures mix and goods are exchanged – along with ideas.

The city is therefore an apt location for this gathering of an industry which finds itself at a crossroads, contemplating its future direction as it faces the dual challenge of meeting rising demand competitively while addressing the risk of climate change.

Turkey also reminds us of the pace of change. Demand for energy here grew by more than 35 per cent in the decade to 2015, more than twice as fast as the global average.

Fast-growing countries such as Turkey are driving the growth in demand for energy globally, which we forecast to go up by around 30 per cent over the next two decades in the BP Energy Outlook.

In meeting this demand, our industry plays a vital role in powering economic growth as well as raising living standards for families and individuals. However, the way in which we deliver heat, light and mobility now needs to be adapted to changing economic and environmental circumstances.

The lesson of the last three years has been that the unlocking of so much new resource has changed the economics of the industry. Abundant supply is now a fact of life, with more than half a century’s worth of oil and gas in the ground and technology constantly increasing the proportion that can be economically produced.

The longer-term environmental lesson from the last 30 years is that it is possible to create a more sustainable energy mix. The rate of growth in carbon emissions has slowed, but we need to move faster. Momentum has built behind the ambition to limit the global temperature rise to no more than 2°C – and as energy providers, we have a responsibility to help drive the transition to a low-carbon economy.

So, our industry faces a complex task: to provide more energy than ever before and reduce carbon emissions more than ever before – in a world that is more competitive than ever before.

The good news is that we have taken on momentous challenges before, and succeeded. There may be no easy, overnight solutions, but we can solve this current challenge with the right approach: more efficient production and products alongside advances in lower-carbon energy of all forms, including a continuing shift towards gas.

In times of change it is more important than ever to remember that safety comes before everything else. Whatever we do to reduce costs, streamline processes and develop new products, safety remains the top priority and first call on investment. Safe businesses also tend to be efficient businesses, because safety and efficiency have common roots in disciplined operations.

Operational efficiency has become paramount in a cyclical commodity industry where the successful companies and countries are those that bring their products to the market most competitively, particularly at the bottom of the cycle. In BP, our efforts to make our business resilient to a low-price environment have included learning from other industries, from manufacturing to IT. And sometimes, change has meant doing less, not more, simplifying the way we work, reducing interfaces and eliminating duplication.

These gains can be accelerated by innovation and we are fortunate to have a wave of technological advances converging on the industry that can enable a step change in performance. In particular, big data is revolutionising oil and gas production. Having transformed exploration through seismic processing, digital technology is now transforming production through data lakes, real-time feeds and predictive software that enable us to maximise production and minimise downtime. A BP engineer anywhere in the world can now get real-time alerts on wells based on the processing of almost a billion data points per second.

Such developments rely on partnerships with expert suppliers, and underline the fact that good relationships are needed more than ever in today’s complex and fast-changing world.

We see this, for example, in the work now underway to boost efficiency industry-wide by extending standardisation in areas such as procurement specifications.

**Applying common sense at scale**

When talking with BP colleagues, I often refer to simplification, efficiency and innovation as ‘common sense at scale’, which also needs to be applied to the advancing of lower-carbon energy.

Common sense tells us that the ambition to reduce emissions cannot be achieved with only some of the tools in the toolbox – it will need all of them. It is critical to invest in renewable energy to maintain its long-term growth. However, we must also recognise that the vision of a fully renewable world is unlikely to be fulfilled in the required
time when non-hydroelectric renewables such as wind, solar and tidal power represent only 3 per cent of today’s energy supply.

Fortunately, there are other massive game-changers at hand. One is energy efficiency – where our industry has another huge part to play, not only through more efficient upstream production but in the downstream, by supplying advanced fuels and lubricants for cars, trucks, aeroplanes and other forms of transport, as well as producing petrochemicals in increasingly hi-tech, low-emission plants.

Another big lever for rapid and large-scale emissions reduction quickly and at scale is natural gas. It has been estimated that if all existing coal-fired power stations were switched to state-of-the-art gas-fired plants, we could avoid around 10 per cent of total energy-related greenhouse gas emissions.

Our industry can drive this process forward. In BP, for example, we expect gas to make up an increasing share of our upstream production as major projects come onstream in the next few years in places such as Oman, Indonesia, Azerbaijan, Egypt and Trinidad and Tobago.

This trend is also very relevant in Turkey, where gas accounts for 30 per cent of all energy used. One of BP’s largest partnership projects, the Southern Gas Corridor, will bring a further six billion cubic metres a year (bcma) of gas from the giant Shah Deniz field in the Caspian to industrial customers across Turkey, as well as supplying an extra 10 bcma to EU markets. Of the 3,500 kilometres of pipeline, 1,850 are being laid in Turkey.

Meanwhile, many companies, BP included, are also investing in renewables, building for the longer term. Today, renewable energy is at an inflection point where it has become competitive with hydrocarbons in many situations – and costs are likely to go only one way. We see that directly in BP as our Brazilian biofuels business becomes increasingly efficient and as new developments in turbine technology benefit our large wind power business in the US. In BP, our venturing arm is investing in technology companies with the potential to advance both low-carbon energy and industrial efficiency, from biojet fuel to desalination and solar thermal power to refrigerants.

Partnership is critical in the endeavour to reduce emissions, as is demonstrated by the range of major companies working together in the Oil and Gas Climate Initiative (OGCI). The OGCI is investing US$1 billion to bring promising low-carbon technologies to the market, looking initially at methane emission reduction, carbon capture use and storage, industrial efficiency and transportation.

Partnerships between countries and companies are also important because trusting relationships lead to long-term agreements. In Turkey we have a relationship that goes back over a century, and has led not only to the construction of strategic pipelines but a network of approaching 700 retail stations.

Many complex problems have been solved over many years by businesses and governments working together. We need to drive for greater efficiency throughout our industry and advance all forms of lower-carbon options. If we do so through partnerships, and with a shared sense of purpose, I believe we can meet today’s challenges and deliver energy competitively and sustainably over the decades ahead.
The cooperative way to reduce price volatility

By H.E. Alexander Novak
Minister of Energy, The Russian Federation

Technological progress, globalisation and an unprecedented accessibility of financing are increasingly speeding up economic and historical processes. Each year brings new evidence corroborating this thesis. Just ten years ago we could speculate about 7-10 year cycles and forecast trends but only tectonic shifts like the 2008 crisis or the birth of the Russian Energy Agency (REA) could temporarily reverse long-term trends.

During the 1980s a huge reserve of production capacities was built up in a period of high prices. Then, the decade of stagnation in the oil sector in the 1990s was followed by a new cycle of price growth in the 2000s accompanied by the rapid rise of Asian economies, especially in China and India. Despite considerable production reserves, there was concern in the market about the onset of the so-called peak oil production, after which the industry would no longer be able to meet the growing global demand for oil. At the time it seemed that this is what happened to deposits in the US in the 1980s.

However, in 2008 the deepest financial crisis of the modern era took hold and caught many off-guard. A challenge on such a scale required non-standard decisions. Quantitative easing programmes in the US and the European Union, unprecedented in their scale, ensured the flow of available money, which was meant to help economies avoid deep recessions and prevent assets from depreciating.

The plan paid off, but one of the side effects of this monetary policy was the emergence of financial bubbles in many markets, including resources, renewable energy and technology companies. Appetite for risk grew rapidly. This factor became key in the rapid recovery of the global financial markets and also contributed to the sharp rise of the speculative component in commodity markets. Cheap financing led to the emergence of a whole cluster of new innovation companies such as Uber, Tesla, Airbnb, Salesforce and others, but also became an additional and largely defining driver of technological progress in oil and gas production as it made possible the financing of high-risk projects.

The collapse of the oil market commenced in 2014: despite the continuing growth of demand and limited free capacities, oil prices dropped by over 66 per cent. Investors’ perception changed with the appearance of shale oil producers, strong and adaptable new players that came to the fore in a region with highly developed infrastructure, access to cheap financing and focus on efficiency due to high competition. Moreover, shale oil producers’ response time to macroeconomic changes did not exceed 6-12 months. Today, shale oil producers play a decisive role in meeting excess demand on the oil market and will continue to do so until the moment when their growth potential is exhausted or the rise in demand for oil will exceed the excessive supply and the output growth potential of shale oil operators.

In addition, a cumulative effect from the investments made over the past years started manifesting itself in the market. In the period of high prices, oil companies both from the OPEC countries and those outside the cartel, invested heavily not only in existing deposits but also in the development of new deposits with huge resource potential. During the fall of the oil prices in 2014-2016, companies optimised their expenses and production processes, which caused a steady decline of the breakeven cost point for many projects, by 30-50 per cent on average, and the potential to increase output was preserved due to the investments made earlier.

In early 2016, the competition for market share reached its peak. The market participants were ready to sharply push down the prices, thus generating additional volatility. At a certain point, the unhealthy state of the market, further exacerbated by speculators, caused oil prices to fall below US$30 per barrel.

These market conditions had a devastating effect on the investment attractiveness of the global oil and gas market. Over the two-year period, the production sector received US$500 billion less in investments than expected. Companies were not able to finance expensive projects and no longer approved major new projects. In these conditions, the global oil industry could continue moving forward for another 3-4 years through inertia, increasing output on projects which had already been launched or projects that were ready to be launched, thus compensating for the falling output at traditional deposits. However, if the natural decline in production at traditional deposits remains within the limits of 3-5 per cent, then in five years the world will be short of around 20 million barrels per day (mb/d) to satisfy the demand, which, according to the forecasts, will be growing by 1.1-1.3 mb/d annually.

Amidst the low oil prices which have set in since early 2016, such a task seems impossible especially considering the fact that the industry launched more complicated and capital-intensive projects, while the oil companies’ investment programmes shrank by more than 50 per cent. Preserving prices at a level of under US$40 per barrel creates substantial risks for future oil supply, which will have negative consequences both for producers and consumers.
The 24 country initiative

In this situation, responsible producers made the only decision that could guarantee the industry’s progressive and stable development and global supply of energy resources – to voluntarily limit production temporarily to stabilise the market and reduce the excess of commercial reserves in the world. For the first time in history, not only the 13 OPEC countries participated in the initiative, but also 11 countries outside the organisation, making a total of 24 countries responsible for around half of the world oil output. Following the talks, a decision was made to reduce the group’s output by 1.7-1.8 mb/d compared to the level of October 2016. Despite the criticism and scepticism a number of experts expressed at the time of the talks, the level of compliance with the agreement reached nearly 100 per cent by the mid-term of the initiative, which is unprecedented for the global oil industry.

This factor, as well as growing demand, largely contributed to stabilising the market and restoring the sector’s investment attractiveness. Stock reserves started declining, which is confirmed by statistics on two floating storage facilities and oil reserves in OECD countries. Since the start of 2017, reserves in tankers have declined by approximately 50 per cent. In the mid-term perspective, this trend is expected to accelerate due to the seasonal growth in demand.

However, the growth of shale oil production remains the main risk to achieving balance in the oil market. In the past two years, US producers have doubled the output of new wells and reduced service costs thanks to a rapid fall in demand for these services. But it is important to consider the overall situation: these growth rates exceed the potential growth of shale oil production in the current conditions. We are already seeing a slowdown in the productivity growth rate and an emerging trend of rising prices for oilfield services, which can eventually slow the shale oil production rate.

Cooperation between the OPEC countries and the 11 others became a breakthrough event in an absolutely non-regulated, highly speculative market. This created a new mechanism in the market that may serve to mitigate the market’s inefficiency in a critical situation.

Producers and consumers must join efforts and think about the future and ways to satisfy the growing demand, make energy more accessible for more than 1.3 billion people who are currently deprived of this commodity and ensure sufficient returns on investment in new projects to avoid periods of shortfall. This is the only way to reduce price volatility, which affects all market participants: it is vital to prevent a shortage of energy resources, which are an irreplaceable fuel for the growth of the global economy.

Free trade and competition are the main prerequisites for the development of the global economy. The agreement reached at the end of last year opens a new page in cooperation between the participating countries. All countries taking part in the initiative depend on imported equipment for many of their high-tech industries. However, the new experience of cooperation will help these countries move forward in building up their own technological know-how. Thus, the agreement to stabilise the oil market may be just the first step on the long path of cooperation and mutual understanding for the benefit of the global economy and our countries.

Rosneft Oil Terminal in the port of Nakhodka
Today, India is one of the world’s fastest-growing large economies and the third largest energy consumer, after the US and China. However, per capita consumption of energy in India is one of the lowest in the world. India is home to 18 per cent of the world’s population but uses only 5 per cent of its energy. There is vast scope for future growth.

Over the past decade, India’s primary energy mix has not changed much. The country continues to depend on fossil fuels, for most of its energy needs, on coal (over 55 per cent), oil and natural gas (together around 35 per cent). Natural gas is emerging as a preferred source of energy as it is cleaner than other fossil fuels. However, currently it accounts for 6.5 per cent of India’s primary energy consumption. There is high dependence on imported crude oil and natural gas.

With the economy expected to sustain its current momentum and annual growth rate of over 7-8 per cent in the coming years, India needs to have a multipronged approach to ensure energy security, including diversifying energy sources.

To strengthen the country’s energy security, the government is encouraging the domestic oil and gas companies to become global energy players and to pursue interests in hydrocarbons assets overseas. To date, our oil and gas companies have established footholds in over 25 countries.

India’s energy security is primarily about ensuring continuous availability of commercial energy at competitive prices to support its economic growth and meet the energy needs of households with safe, clean and affordable forms of energy. Several policy initiatives have been taken for increasing production and exploitation of all domestic petroleum resources.

Prime Minister Narendra Modi has outlined a vision for a 10 per cent reduction in the import of crude oil by 2021–22, coinciding with the 75th anniversary of our independence. Many policy initiatives have been undertaken to increase production of oil and gas, promote energy efficiency and conservation measures, give a thrust to demand substitution, capitalise on the untapped potential of biofuels and other alternative fuels and renewable energy sources, and improve refining processes.

Our government is committed to implementing an operational framework that will incentivise domestic exploration and production. India recently concluded bidding rounds for Discovered Small Fields (DSF) and launched the new Hydrocarbon Exploration and Licensing Policy (HELP). Given its pro-investor policy features HELP is expected to attract foreign direct investment and technology. It has attractive elements such as pricing freedom and marketing freedom, a single licence for oil and gas, a shift from profit sharing to revenue sharing, and an open acreage policy.

We have to tap and monetise every possible source of energy in unconventional hydrocarbons. The Directorate General of Hydrocarbons has estimated some 92 trillion cubic feet (tcf) of coal-bed methane resources, while India’s shale gas reserves could be anywhere between 300 and 2,100 tcf. While coal bed methane production is underway, under the current agreement, exploration of shale gas is being carried out by the Oil and Natural Gas Corporation (ONGC) alongside Oil India. There is a national gas hydrate programme to collect more data on hydrates to encourage exploitation.

India has emerged today as a global refining hub. Today, our refiners have the capability to process the most complex and diverse crudes at the most competitive refining margins. We have added major refining capacity such as state-of-the-art refinery at Paradip, on India’s east coast. Domestic demand for petroleum products is expected to grow at a compound annual growth rate of 7.5 per cent during the next five years. The projected expansion of existing refining capacity from 230 to 300 million metric tones per annum (MMTPA) by 2023 is in line with India’s aspiration to become a global refining hub.

There have been two recent important developments in India’s refining sector. First, our public sector companies, as consortium partners, are planning to set up a 60 MMTPA mega-refinery on the west coast of the country at an estimated investment of about US$28 billion. Several global petroleum majors have evinced interest in joining this ambitious project. Second, a new 9 MMTPA greenfield refinery is being set up in the western state of Rajasthan by HPCL, one of our public sector companies, at an estimated investment of around US$7 billion. These two projects along with many other brownfield refinery expansion and modernisation projects currently underway will further boost and strengthen India’s refining sector.

The government is attaching increased emphasis to biofuels. Through oil marketing companies, the government is implementing an ethanol blended petrol programme under...
which they sell petrol blended with ethanol up to 10 per cent. Further, ethanol produced from other non-food feedstocks, such as cellulosic and lingo-cellulosic materials, are also allowed. With regard to bio-diesel, the government in 2015 has allowed sale of Bio-diesel (B100) by private manufacturers to bulk consumers such as the railways, state transport corporations and other large consumers. The government has also started the retailing of diesel blended with bio-diesel by oil marketing companies.

The world’s biggest direct energy subsidy scheme
No energy policy is complete or comprehensive unless we reach out to the most underprivileged members of society. In order to provide clean cooking fuel at an affordable price, the government initiated the ‘PAHAL’ subsidy scheme. This is the world’s largest direct benefit transfer scheme, in which the subsidy is directly transferred to the registered account of the consumer without involving any intermediary. More than 170 million consumers are registered to avail themselves of this subsidy. More than Rs. 47,961 crore (US$7.5 billion) of subsidy has been transferred to the 172.2 million users of LPG.

Further, to empower the rural poor, the government launched the PMUY plan. With a vision of a smoke-free rural India, this scheme aims to benefit 50 million families by 2019 especially the women living below the poverty line by providing concessional connections to supplies of LPG. This will increase the usage of LPG and would help in reducing health disorders (caused by use of traditional sources of cooking fuel such as biomass), air pollution and deforestation. This will in turn enhance the productivity of woman, raise their quality of life by removing the drudgery associated with collection of wood and ensure constant availability of cooking fuel. We have been able to create over 20 million new LPG connections under the PMUY programme in just one year. Our target is for 50 million connections by 2019.

The government has announced the implementation of the BS-IV standard for auto fuels across the entire country by April 2017. Further, it has been decided that the country will leapfrog directly from BS-IV to BS-VI fuel standards. The BS-VI standards will be implemented in the country from April 2020.

Natural gas: fuel of the future
India has decided to take action to enable an increase in the share of gas in the country’s energy basket, which is expected to reduce our present emissions rate. The government is working towards boosting domestic production of gas and buying competitively-priced LNG from diverse supply sources. India looking to make substantial investments in its gas infrastructure. Prime Minister Narendra Modi attaches top priority to the formation of a national gas grid through the addition of 15,000 kilometres of gas pipelines. The expansion of the gas grid will also provide the necessary infrastructure for further investment in enhanced production of domestic gas and a higher volume of LNG imports. Infrastructure to import greater volumes of LNG is also being built, including setting up new LNG terminals, enhancing existing terminal capacity and expanding gas grids. LNG terminals have been proposed on both the east and west coasts of India.

To meet the energy needs of the country, the government is following up several mega infrastructure projects in the oil and gas sector. Immediate investment opportunities exist in the upstream, midstream and downstream sectors. Potential investment areas include exploration and production, refinery and petrochemical projects. There are also opportunities for conventional and unconventional oil and gas, such as coal bed methane, shale gas and underground coal gasification. The government will soon invite bids for a fresh round of exploration and production licences. Many foreign players such as BP, Shell, Rosneft have a business presence in India’s oil and gas sector.

India, today, is standing at the cusp of change in the national hydrocarbon landscape. The investor-friendly policy initiatives of the government and emphasis on maximum governance and minimum government are some important steps that are here to stay. As a Minister for energy, it is my responsibility to ensure the supply of accessible and affordable energy to all, for both domestic and industrial sectors. We are working towards meeting energy needs, while being cognizant of climate change by advocating sustainable management of fossil fuels and adopting ambitious targets for reducing greenhouse gas emissions through climate change policies.

We are working towards fulfilling our developmental priorities and delivering energy justice to all our citizens. Our target is to provide energy access, energy efficiency, energy sustainability and energy security to all. In this process, the importance of hydrocarbons will continue to grow. As responsible global citizens and at the same time meeting our national priorities, we are committed to provide energy justice for all.
The future of oil rests on Investment and innovation

By Dr Fatih Birol
Executive Director, International Energy Agency

Oil markets have had an exciting two years. Prices collapsed dramatically following a half-decade of sitting at historically high levels, then recovered sharply. Investments were curtailed, costs went into free-fall, and efficiency ruled the day.

Meanwhile, the signature of the Paris climate agreement led many to question the future of fossil fuels. From drilling costs to divestment movements, the industry is facing an unprecedented range of uncertainty as it charts its strategy forward.

Now with increasingly fuel-efficient engines, and the rise of electric vehicles, it would be easy to assume that oil demand is set to fall. But this ignores the significant potential for growth in emerging economies, and from those sectors outside of passenger transport that will continue to rely heavily on oil. In short, we can expect to see continued growth in oil demand for many years to come.

In 2016, oil demand grew by a robust 1.6 million barrels per day (mb/d), down from the 2.0 mb/d in 2015 – the largest year-on-year growth since the exceptional post financial crisis recovery year of 2010. The IEA’s latest market forecast is for demand to continue to rise in the next five years, passing the symbolic 100 mb/d threshold in 2019 and reaching about 104 mb/d by 2022. Developing countries account for all of the growth and Asia dominates, with about seven out of every 10 extra barrels consumed globally.

At least in the medium term, much of this growth will be fuelled by gasoline, and low prices have certainly contributed to growing demand in recent years. From SUV sales in China to increased driving in the US, there are numerous examples of consumers taking advantage of cheaper fuel.

But looking forward, the picture is more complex. Despite global oil demand (excluding biofuels) growing by more than 11 mb/d between 2015 and 2040, the IEA’s World Energy Outlook 2016 shows oil demand associated with passenger cars actually declining in the next 25 years. This might seem like a surprising projection considering that the global car fleet is expected to add a billion vehicles in the next quarter century. Some of these vehicles will be electric, but the bulk will have increasingly efficient combustion engines.

Electric cars have made significant progress in recent years, and they certainly have the potential to grow further. The cleanliness and efficiency of the electric engine, coupled with consumer excitement, is creating a compelling combination for growth. But, despite the recent enthusiasm, for now electric cars only displace 0.01 per cent of global oil demand. This highlights a fact too often ignored: passenger cars represent only a relatively minor share of global oil demand growth.

Rather it is shipping, aviation and heavy duty trucking that are expected to grow robustly as emerging markets experience rising incomes and increasing integration to the world economy. Manufacturing of modern consumer goods – everything from televisions to refrigerators to electric cars as well – generally has supply chains spanning several continents, all being shuffled around by internal combustion engines.

The other major driver of oil demand growth in coming years comes from plastics. In fact, the growth in petrochemical demand alone is larger than the reduction we currently expect to see from adding more electric cars. Taken together, this explains why without further changes in policies, we can expect to see robust oil demand growth for many years to come.

However, with the dramatic declines in global oil industry investment over the last two years, and only modest signs of recovery in 2017, it is far from clear that enough projects will enter the pipeline in the next few years to avoid a potentially tight market by 2020 and with it, the possibility of a new period of price volatility. As the current overhang of surplus stocks is eroded, will investment recover? Will governments and companies have sufficient confidence in market conditions to commit to bringing forward new projects?

Perhaps unavoidably, several years of prices averaging upwards of US$100 per barrel lulled the oil industry into a sense of security. It had never had it so good, but below the surface its vulnerabilities were also growing. Ironically, it was not climate policy or electric cars that ended that cycle and led to the price collapse. Rather, it was thanks to the oil industry’s own innovations and technical ingenuity, namely US light, tight oil (LTO). Even though it is widely discussed, the scale and importance of the turnaround in the prospects of domestic production in the US is still hard to grasp.

In the first half of this decade, more capital was committed to oil and gas upstream projects in the US than in Russia and the Middle East combined. Even before 2015, rapid learning by doing and technological progress kept US LTO overall costs stable in a high oil-price world while the rest of the industry struggled with cost inflation. In the end, the rapid upswing of production was possibly the single most important reason for the oil price collapse.
The last two years will likely prove to be a valuable experience for the industry. Investment cuts of more than 20 per cent two years in a row were unprecedented in the industry’s history. A decade of cost inflation was wiped out by a relentless focus on efficiency and reengineering projects. And just as it had during the production ramp-up, the US LTO industry led this change as well: in two years, the cost of LTO project development was cut nearly in half.

Globally, across the industry there are legitimate concerns that costs may creep up once more as investment recovers, but there is no doubt that a considerable share of the cost savings is structural and can be maintained. For example, digitalisation of the oil industry has enabled better targeting of drilling, higher recovery rates as well as lower outage rates and higher capacity utilisation. Perhaps as important as hard technology are the softer, managerial changes such as a relentless focus on re-engineering, streamlining and standardising projects. In the meantime, major oil producing governments are acting with a new sense of purpose in reforming energy subsidies as well as investing into the non-oil growth potential of their countries.

The oil industry prospered through the ups and downs of the 20th century thanks to its commitment to innovation and its perseverance in the face of challenges. To prosper in this next century, it will need to continue to invest in the future, maintain its efficiency and discipline, drive innovation and increase its strategic commitment to new sustainable technologies.

*This hydraulic fracturing rig in Colorado is part of the technical ingenuity that has reshaped world energy markets*
OPEC has long played an important role in contributing to, and supporting, oil market stability. The history of our organisation is one of repeated efforts to ensure equity, fairness and stability – for the benefit of consumers, producers, the industry and the world at large. It is, in fact, a statutory responsibility for OPEC.

Although the oil market has changed in many ways, some of its most basic features have not. While there have been significant technological advances along the entire oil supply chain, the fundamental factors that influence the price of crude on the world’s markets have not really changed. Consumer expectations, economic uncertainties, geopolitical instability, international trade: all these continue to drive the underlying supply and demand dynamics.

Such factors have increasingly been joined by additional ones that have significantly affected the market – such as financial innovations and speculative investment flows. In fact, given their growing importance, these have been the focus of much of our research and dialogue work over the years.

The fact remains that the central role of prices has not changed. While attempts have been made over the years to apply quantitative techniques to the forecasting of future price levels, they remain unpredictable, at times even volatile – and over the past four decades, there have been six volatile oil market cycles.

The challenge of market volatility
In the past ten years, we have seen oil prices go from a staggering level of nearly US$148/barrel to the low $20s. Such price extremes have not been good for anyone. The low price extremes have led to a drop in upstream investments in the short-term – and, ultimately, a decline in medium-term supply growth.

During such circumstances, OPEC has always tried to step into the breach – either by taking direct action or by cooperating with non-OPEC producers to find collective ways to respond to such challenges.

Between the middle of 2014 and the start of 2016, the market – driven primarily by supply factors – faced a sharp inventory build-up worldwide, and both OPEC and non-OPEC oil stock levels reached historic highs.

This growing imbalance in the oil market was reflected in a resulting price decline, which was observed between June 2014 and January 2016. During this period, crude prices fell by an unprecedented 80 per cent.

This was the largest percentage drop of the last 40 years. The depth and duration of this downturn was alarming – and, as time passed, its adverse impacts began to be manifested across the supply chain.

At the same time, the oil industry witnessed a significant contraction in investments in both 2015 and 2016. Spending on global oil and gas exploration and production fell by around 26 per cent in 2015 and by 22 per cent in 2016. This equated to a loss of more than US$300 billion, which impacted both

### Episodes in OPEC Reference Crude Oil Price

<table>
<thead>
<tr>
<th>Date</th>
<th>High US$/b</th>
<th>Low US$/b</th>
<th>Change US$/b (%)</th>
<th>Recovery</th>
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<tbody>
<tr>
<td>1985-1987</td>
<td>28.7</td>
<td>20.9</td>
<td>-11.8 -56</td>
<td>7 Sep 99 10 Months</td>
</tr>
<tr>
<td>1990-1991</td>
<td>20.9</td>
<td>15.9</td>
<td>-5.0 -29</td>
<td>7 Sep 99 10 Months</td>
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<tr>
<td>1997-1999</td>
<td>15.9</td>
<td>28 Jul 86</td>
<td>-20.4 -71</td>
<td>30 Jul 08 30 Months</td>
</tr>
<tr>
<td>2000-2001</td>
<td>15.9</td>
<td>33.8</td>
<td>-18.0 -53</td>
<td>30 Apr 04 30 Months</td>
</tr>
<tr>
<td>2008-2009</td>
<td>33.8</td>
<td>110.5</td>
<td>-76</td>
<td>13 Mar 12 51 months</td>
</tr>
<tr>
<td>2014-2016</td>
<td>110.5</td>
<td>22.5</td>
<td>-88.0 180</td>
<td>4 Sep 90 50 Months</td>
</tr>
</tbody>
</table>
new projects coming onstream as well as new discoveries. The industry also saw significant job losses during this period. Not surprisingly, financial and operational stress increased for many companies – and it became increasingly apparent that the industry could not continue to operate under such conditions.

Producers and consumers everywhere had begun to comprehend the gravity of the situation, and there was broad acknowledgement that it was necessary to get the industry back on a path of stability.

The historic decision among producing countries
These dire concerns led to OPEC embarking on one of the most extensive and determined consultation processes in the organisation’s history. This involved OPEC member countries, as well as non-OPEC producing nations, in a collective effort to build broad consensus regarding the strategic urgency of restoring market stability.

This effort – which has since been widely acclaimed – resulted in a series of historic decisions: on September 28 in Algiers at the 170th (Extraordinary) Meeting of the OPEC Conference; on November 30 in Vienna at the 171st Meeting of the OPEC Conference; and on December 10 again in Vienna with the ‘Declaration of Cooperation’ with 11 non-OPEC producers.

These landmark decisions reflected OPEC’s commitment to its core mission to strive always for market stability. They also served to demonstrate the organisation’s readiness to work exhaustively with both producers and consumers, for the good of the industry and the global economy at large.

The focus is currently on the implementation of these decisions. Cooperative work with non-OPEC producing countries therefore continues – most notably through the Joint Ministerial Monitoring Committee (JMMC). This was established to oversee conformity, and full and timely implementation of the decisions based on the underlying principles of equity, fairness and transparency.

The decisions had several important and positive outcomes, which helped bring back confidence to the industry. They also served to demonstrate the organisation’s readiness to work exhaustively with both producers and consumers, for the good of the industry and the global economy at large.

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The decisions had several important and positive outcomes, which helped bring back confidence to the industry. There were, for example, early signs of realignment in the fundamentals, especially with regard to an easing of the OECD stock overhang. In addition, increasingly favourable industry conditions appeared in the renewal of some upstream investments in the first quarter of the year.

Longer-term energy prospects
It is important to make sure that the recent historic decisions not be viewed only as short-term measures. They were also vital to the long-term stability of the oil market and to the future of global energy. Such a long-term perspective is included in the tenth edition of our World Oil Outlook (WOO), launched in November 2016.

In general, the WOO considers the increasingly complex nature of the oil industry, and explores the links between security of supply and security of demand, with the aim of improving overall understanding of the challenges and uncertainties facing the oil market.

Among its findings, the WOO sees oil demand reaching more than 109 million b/d by 2040, representing an increase of more than 16 million b/d from 2015 levels. This will be driven mainly by trends in developing countries, particularly in Asia, as well as an expanding global transportation sector.

In fact, according to our data, more than one-third of the total increase in oil demand is expected to come from the road transportation sector, in addition to the petrochemical sector.

Thus, in our estimation, there is no future ‘demand peak’ foreseen. According to the findings of various scenarios, oil will remain the fuel of choice for at least the next several decades.

Needless to say, any expected or actual expansion in oil demand requires significant investments – not only so production may increase but to accommodate for fast decline rates from many existing fields. With this in mind, we see overall investment requirements of around US$10 trillion in the oil sector over the period to 2040.

There is broad recognition that the industry needs such investments – ones that are timely, adequate, and sustainable – to guarantee future supply. However, the industry needs other elements as well – from infrastructure upgrades to a healthy, vibrant economic environment.

Thus, OPEC will continue to emphasise the importance of having a broad enabling environment that facilitates and supports these ongoing investments and associated upstream projects.

We should remember that the closely linked and increasingly complex nature of oil and other energy markets calls for strengthened collaboration among the world’s producers – so that they may continue to meet their obligations as reliable and dependable suppliers of oil to the world markets.

As such, we are confident that OPEC and non-OPEC producers will continue their efforts to strive for sustainable market stability – for the benefit of all.
Producers and consumers share views to deliver joint goals

Dr Sun Xiansheng
Secretary General, International Energy Forum

The producer-consumer dialogue pays close attention to the growing interdependence between short, and medium-term investment cycles in both unconventional and conventional oil and gas production, as well as to what the successful deployment of new energy technologies in fulfilment of shared goals will mean for the way we produce and consume energy in the longer term. To strengthen global energy security, and ensure our collective energy market performance reaches milestones further down the road as efficiently as possible, energy ministers have called for an enhanced role of the producer-consumer dialogue on the platform that the International Energy Forum uniquely provides and it is my great privilege to host.

Although energy markets may appear well supplied today, there is little room for complacency. Close to 3 billion people still lack access to energy networks or modern and reliable energy services in households. Producing and consuming countries face increasing uncertainties when balancing demographic trends and economic performance with requirements for greater sustainability in already volatile oil and gas markets. The risks and opportunities flowing from today’s policy and technology choices merit careful consideration and continuing cooperation. Connecting producer and consumer perspectives to illuminate energy markets and stimulate timely investment is fundamental to market stability and the realisation of shared goals for a secure, affordable, healthy, and equitable energy future.

The dialogue has been particularly vibrant and enriching in terms of engagement and substance over the past year. Algeria hosted the 15th International Energy Forum Ministerial under the theme “Global Energy Transition: An enhanced role for the dialogue” in September 2016. Ministers exchanged views on the enduring stability challenge in oil markets and debated how natural gas markets will accommodate more abundant and diverse Liquefied Natural Gas (LNG) supplies.

Taken together, these market trends have chilled oil and gas sector investments over the past three years. Notwithstanding natural interest in near-term market developments, the dialogue process helps to maintain focus on long-term investment requirements key to global energy security. Policy discussions emphasised the role that new energy technologies and greater energy efficiency and resilience in energy supply chains will play to overcome short-term market volatility and stay within new greenhouse gas emission thresholds on longer-term horizons. Since fossil fuels will remain the mainstay of energy markets for the foreseeable future, technology advances and energy efficiency gains must feature more prominently in energy policy and business orientations if energy is to remain reliable and affordable to both the poor and the affluent, while at the same time all sustainable development goals are to be reached.

India hosted the Fifth IEF-IGU Ministerial Gas Forum under the theme “Gas for Growth: Improving economic prosperity and living standards” on 6 December 2016. Ministers discussed the new opportunities for gas trade and integration among the three major regional gas markets in Asia, Europe and North America. They noted that natural gas can be a driving force in achieving orderly energy transitions, because it is projected to make a larger contribution than other sources. Given the abundance of upstream natural gas resources, and greater flexibility in global LNG markets, ministers acknowledged that in-depth dialogue on the evolution of gas markets will help producers and consumers to seize this opportunity, overcome market hurdles in downstream markets, and maintain gas market security in the longer-term.

Looking forward, the dialogue promises to pick up further momentum in the months ahead. IEF Ministers have agreed to support the launch of the IEF energy efficiency knowledge-sharing framework and work on new energy technologies, as well as enhanced engagement with Africa and other regions, as we have established in Asia. They also encourage us to build on our success in enhancing market transparency through the long-standing IEF trilateral programme of work with the International Energy Agency (IEA) and the Organisation of the Petroleum Exporting Countries (OPEC) including implementation of the Joint Organisations Data Initiative (JODI) 5-year plan in close collaboration with JODI partner organisations that also include Asia Pacific Economic Cooperation, Eurostat, the Gas Exporting Countries Forum, the Latin American Energy Organisation, and the UN Statistics Division. Here the IEF and its partners have set an international standard for inter-institutional collaboration that has strengthened global energy market governance.

The Joint Symposia on Energy Outlooks that the IEF hosts in close collaboration with the IEA and OPEC each year in Riyadh permits review of projections, underlying data, methodologies and assumptions. Alongside the Joint Workshops on Physical and Financial Energy Market Interactions, and the Symposium on Gas and Coal Market Outlooks hosted by OPEC and IEA respectively, the Symposium serves to help drive improvements in the comparability of energy outlooks. It is...
one of the pillars of the producer-consumer dialogue upon which better-informed decision-making rests.

Lessons learned so far

So, what have we learned? In the upstream the role of “swing supplier” is recast among a wider range of producer profiles. US shale producers have demonstrated remarkable levels of innovation and resilience in response to short-term market fluctuations, but their ability to help balance markets in the longer term is yet to be tested. Recent agreements between OPEC and non-OPEC countries to restore supply demand equilibrium will also stimulate investment in new conventional production necessary to compensate for depletion rates and three consecutive years of deferred investment. Recent dialogue findings show that market rebalancing on a supply-side correction may accelerate when financial support and regulations tighten.

In the meantime, inventory levels midstream remain persistently high. Greater transparency of non-OECD stock data would help to inform decisions in both physical and financial energy markets, and help to moderate oil market volatility, aligning price signals with new market realities. Mainstream forecasts continue to project robust demand for oil in the medium, and longer term, especially in Asian growth markets. Inventories are likely to play a pivotal role in physical and financial energy market interactions, as well as in the management of risk in oil supply chains that are shifting rapidly in the new energy market landscape.

Further downstream, consumers are responding to the availability of a wider range of energy sources. Preferences and expectations are also changing due to generational shifts and new approaches to urban planning. More determined policies to deploy a wider range of new technology options are likely to change well established demand patterns in already competitive energy markets. This will add uncertainty to outlooks beyond the present investment cycle and provide fuel for dialogue especially on developments in the transport sector.

To help improve communication and manage expectations in a period when energy markets are exposed to unprecedented change and more deeply-rooted cyclical developments, the IEF stands ready to take the dialogue forward. Highlights include the 1st Asian Energy Efficiency Conference and Exposition that the Kingdom of Saudi Arabia and Japan will co-host from 30 October to 2 November in Riyadh, followed by the 7th Asian Ministerial Energy Roundtable that Thailand will host together with the United Arab Emirates to discuss global energy markets in transition and move from vision to action on 1-3 November 2017 in Bangkok. We will take stock of these and other meetings at the 16th IEF Ministerial Energy Forum that India will host on 10-12 April 2018 in New Delhi, along with China and Korea as co-hosts.

The International Energy Forum carried the producer-consumer dialogue forward at its meeting in Algiers in September 2016
EXPERIENCE COUNTS

Woodside is Australia’s largest independent oil and gas company with a global portfolio, recognised for our world-class capabilities – as an explorer, a developer, a producer and supplier of energy.

Our assets are renowned for their safety, reliability and efficiency, and we are Australia’s most experienced LNG operator.
In oil and gas, as with other industries, companies need to stand out. To be truly innovative, they need to demonstrate they have unique offerings for customers that cannot be found elsewhere in the competitive space. Companies need to be strong. They need to be brave. And, above all, they need to disrupt the traditional ways of working.

The theme of disruption has been a constant at GE Oil & Gas as we examine the different ways in which we can disrupt how we work within the oil and gas industry, and so provide tangible benefits to the world's biggest operators. Disruption comes in many forms, including human and industrial, and we have learned we can bring the greatest benefits by fully harnessing the power of digital technology.

**Putting data to work for our industry**

The world is fast getting more complex, and the pace of change has revolutionised not only the way customers do business, but also the type of solutions they seek and the standards of performance they expect. Business models are changing, and software is affecting every industry, from the consumer world to heavy industry. In the oil and gas industry, we are blurring the lines between digital and physical and today the possibilities to enhance performance and productivity, driven by advanced digital capabilities, are monumental.

Digital transformation is much more than an IT change or the adoption of a new software programme. Digital transformation takes time. It’s a fundamental shift in the way organisations engage, work and act. By breaking down silos and connecting assets, people, processes, systems and ecosystems through the cloud, our industry will benefit from reduced non-productive time, improved efficiency, increases in reliability, and better enterprise-wide visibility.

The oil and gas industry is facing a productivity conundrum. Prior to 2011, global industrial productivity held steady at 4 per cent a year for more than 20 years. Since 2011, that productivity declined to 1 per cent or less. Today, we have the opportunity to unleash 3-5 per cent in annual productivity gains back into the oil and gas market leveraging a cloud-based technology solution, an agile mindset and adoption of advanced data analytics and machine learning. It’s time to put data to work for our industry.

GE has embraced disruption in order to transform itself into the world’s leading digital industrial company. We know the right systems are needed to scale. And we know we must transform together.

One of the hallmarks that enables industrial digital transformation is Predix, the cloud-based platform for the Industrial Internet, connecting machines, data and people to power the digital industrial companies of the future. Predix is the foundation for the most aggressive advancement in customer innovation, productivity and operations optimisation offering the strength, scale and security operators need to succeed in a new industrial era. It is at the core of all digital industrial transformation, securely harnessing massive volumes of data and delivering advanced analytics for any industry.

The Predix platform provides a single, standard way for companies to connect machines, data and people, while balancing the scale, complexity and security requirements necessary for the oil and gas industry. Powerful microservices and applications built on Predix then enable endless opportunities to make any machine an intelligent asset and to bring visibility, control and analytic insights to every part of industrial infrastructure and operations.

**Using digital to predict the future**

Creating and evolving efficient machinery is imperative for oilfield companies, but having the ability to capture, analyse, learn from and then make proactive decisions based on the data to ensure ongoing sustainability and efficiency... that’s the game-changer, and a real example of disrupting the industry norm.

Operators want to have access to the right information at the right time in order to make smart, informed decisions about how to operate efficiently, and when maintenance is required on their equipment. In real terms, the volume of data available to operators is endless, yet we’ve found fewer than 24 per cent of oilfield companies describe their maintenance approach as a “predictive” one, based on data and analytics. The potential for improved decision-making is immense, and Predix and similar technologies can provide the access they seek.

Machine learning – the ability to teach computers to mimic human decision making on data-driven workflows – is a cornerstone of digital scalability. By building “smart machines” that can infer a complex and continuously improving set of business rules based on past behaviour and outcomes, GE Oil & Gas is building a robust, scalable, and fault-tolerant way to improve operations.
The key to successful production-grade machine learning is to approach it from a system engineering perspective. Importantly, because industrial systems are the heart of our business, we recognise that these systems must not only be accurate, but also transparent (i.e. interpretable) and fault-tolerant (i.e. recognise that not every decision has the same cost to being wrong). By automating repetitive tasks, we are creating a seamless transition between automation and augmentation of human decision making. Machine learning empowers your workforce to do what people can do uniquely well: to be creative in applying data-based insights, innovating and solving the hardest problems you face.

Key to this idea is a Digital Twin – a digital replica of a physical asset built with artificial intelligence algorithms that allows the twin to interact with humans to help them better manage the performance and service of individual assets. Bridging physical and digital worlds, Digital Twins provide an in-depth understanding of each unique asset over time, combining sensor data with analytics, models and material science to provide a detailed and constantly evolving picture of machine operations.

GE’s twins are powered by Predix, which makes it easier for developers to incorporate Digital Twins into industrial apps by making it simpler to connect assets, ingest and normalise data for analysis. A truly disruptive technology, we believe that in the future, every product will have a Digital Twin with the ability to connect a system of twins easily, increasing the power of data and analytics.

At GE, we have used Digital Twins across industries – aviation, transport, healthcare – to reduce costs and improve quality. We have used models of our Evolution Locomotive to minimise fuel consumption, within our 6FA Turbine Combined Cycle Plant to increase efficiencies and on our GE90 Engine, we have used flight data from Digital Twins to save millions of dollars in unnecessary service overhauls. Across oil and gas, we are successfully using Digital Twins for artificial lift projects and are working toward further advances in this technology.

**Intelligent asset strategies**

Asset performance management (APM) software solutions help oil and gas companies face challenges to achieve new and sustainable efficiencies and optimisations to reduce unplanned downtime, improve maintenance processes, extend asset and equipment life and reduce costs. APM technology uses continuous inspection data and cloud-based analytics and has already proven beneficial to companies on a global scale.

As with many parts of the oil industry, maintenance issues can be performed in a silo. With so many available software solutions and a lack of integration among them, it is difficult to create and maintain a regular flow of data about the maintenance of machines. Removing the guesswork of checks and only intervening when necessary can save companies invaluable time and many millions of dollars, and modern APM solutions are able to deliver this. Consider the bottom line benefits of increasing productivity by even 1 per cent.

We are continually adapting these solutions, and have recently announced a new suite of digital inspection technologies to monitor, manage and prevent corrosion. An immense challenge for the industry, corrosion is estimated to cost US$2.2 trillion globally, and organisations spend billions of dollars on scheduled, manual inspection services. GE’s Predictive Corrosion Management is an APM solution that combines Predix with sensors and advisory services to continuously monitor corrosion-related risk and proactively make decisions to alleviate the pressures of corrosion and allow for continuous operation with full and real-time visibility of potential issues.

**Keeping the focus on the customer**

This focus on embracing digitalisation and disrupting traditional ways of working provides a host of benefits to customers, but it also underlines the enormous value of working more closely with them to co-create solutions that meet the customers’ specific needs. It involves testing, failing and learning together, deepening the relationship between all parties, and replacing the traditional, transactional relationship between customer and vendor with a long-term partnership that is built on mutual trust. Nowhere is this more important than in the digital space, where advanced and innovative measures can bring huge benefits, but only if trust exists on both sides to implement new ideas.

In all of our customer matters, preserving security is vital and as the Industrial Internet expands, security must evolve too. The security and reliability of the technology that operates much of the world’s critical infrastructure is a top priority, and we build digital and cybersecurity solutions in a secure and scalable environment with our customers to strengthen this security and develop best industry practices.
Growing with Responsibility

Embracing responsibility, increasing efficiency and sustainable growth – these are the ingredients of DEA’s success story. The Mittelplate Drilling and Production Island at the edge of the Wadden Sea National Park in Germany is a good example of DEA’s approach towards the environment. DEA is currently producing more than 50% of Germany’s domestic crude oil from Mittelplate and has been operating the field without any harmful influence on the nature reserve for 29 years now. DEA takes responsibility towards humankind and the environment in all its upstream activities – in countries like Germany, Norway, Denmark, Egypt and Algeria – every day.
Markets transform expectations into prices, and when we look at Petrobras’ recent market performance, this has been a rather positive trend. Since the beginning of 2016, the company’s market cap has risen by 99 per cent, providing an unmistakable sign that shareholders and analysts are seeing consistent progress in management and results.

After the immense financial and reputational losses the company faced after it was engulfed by a major corruption scandal, Petrobras is already being recognised by the authorities as a victim of a scheme in which contractors, a small number of executives and politicians colluded to get overpriced contracts from the company. However, the financial statements from the first quarter, released in May, highlight the progress towards increasingly better operational and financial results.

The company registered an operating income of US$ 4.3 billion. In addition, efforts to reduce costs and improve productivity are showing in our results. The most prominent example being that the company cut its investments by 8 per cent in US dollar terms in relation to the same quarter of 2016, while at the same time production increased. Technological advances help reduce average drilling times and keep Petrobras’ average lifting costs low at US$ 10.6 per barrel of oil equivalent a day (boed) and below US$ 8/boed in the pre-salt fields, where wells are achieving production levels nearly 30 per cent higher than originally forecast.

Although improvements are being achieved and priced by the markets, Petrobras is still one of the most indebted oil companies in the world. Its net debt stood at US$ 95 billion at the end of the first quarter, still much higher than its peer group. Deleveraging is our main strategic target alongside safety. The company will continue to reduce the net debt/EBITIDA ratio and have it under 2.5 times by the end of next year, while at the same time lowering the total recordable injury rate by 3.6%. The metrics show financial goals will not be met at the expense of safety.

Adding to tight cost control and increased capex productivity, this ambitious goal will be reached through a competitive pricing policy and a robust partnership and divestment programme. After achieving US$ 13.6 billion in completed transactions between 2015 and 2016, the company is committed to sell an additional US$ 21 billion dollars in assets over the next two years. This target includes upstream assets and partnerships in the downstream, a market in which Petrobras still holds a 98 per cent market share.

Significant changes in the Brazilian regulatory framework have taken place since last year, also contributing to Petrobras’ future and current performance. The government reviewed Petrobras’ obligation to participate as the sole operator in all pre-salt fields. This requirement of a single operator limited the development and production pace of these areas to Petrobras’ financial capabilities, thus affecting the volume and speed at which pre-salt fields could be explored and transformed into government revenues. For Petrobras, the change in the law allows the company to focus on exploring assets with the highest return and the lowest risk for its portfolio. Ending this obligation is an example of a change in regulation that can be of benefit to all.

Another important change is the new bidding rounds already announced by the Brazilian regulatory agency. Four bidding rounds are scheduled for 2017, three for 2018 and three for 2019. The acreage offered means there are opportunities for companies of all sizes and profiles, and Petrobras will look at those bidding opportunities focusing on rebuilding its exploration portfolio.

Local content = local capability
Local content policy was also adjusted to match the local industries’ capabilities, thereby reducing a major source of uncertainty for operating companies and for investors. Local content requirements, for example, are no longer criteria for winning bids, the percentages of locally produced equipment was lowered to what is already being met by the industry and the overall policy was simplified in order to avoid litigation over policy compliance. Last but not least, Petrobras continues on its journey to strengthen its governance and compliance rules. Much focus has been put on these issues due to the corruption scandal, and much was changed in the company. Its decision-making process was redesigned, so that investment decisions are made collectively. Several statutory committees have been created, increasing accountability in decision-making. An independent and specialised company is operating the whistleblower channel. Candidates for leadership positions and supplier companies undergo rigorous integrity testing. All employees must adhere to the Code of Ethics and the Code of Conduct.

Looking at all the changes and results achieved so far, we are comfortable today that Petrobras is tackling its challenges. The company has a robust business plan and will continue to deliver results throughout 2017 allowing us to recover credibility and to rebuild Brazil’s largest company.
ENERGIZING BY TECHNOLOGY
The Upstream: Exploration and Production

Exploration has suffered more from a low oil price than production. It is easier to justify saving money by drilling fewer wells than cutting back on existing production. More fundamentally, the very concept of exploring for conventional resources, especially offshore, has been challenged. Tim Dodson of Statoil acknowledges the challenges – the temptation to go for unconventional projects that cost less and pay back quicker; the prospect that new finds may lie in such inhospitable regions that they will struggle to be profitable; and the climate rationale that more than enough fossil fuels have been discovered than can ever be responsibly developed. And he addresses the challenges. On cost, Statoil has more than halved the average production cost of oil in its portfolio. On climate change, the company accepts and acts on it. Emissions will gradually come with a price tag, and ‘carbon efficiency’ will increasingly be a competitive advantage. And because not all hydrocarbons are created equal, the exploration guideline should be to aim for those that are high-value and relatively low-carbon.

As the world’s third largest oil and gas consumer, India needs to boost its own upstream supply in order to achieve its ambitions to increase manufacturing and reduce import dependence, according to Atanu Chakraborty, the Indian petroleum ministry’s chief of hydrocarbons. Key to this is the new Hydrocarbon Exploration and Licensing Policy (HELP). A benefit of this new policy is to allow companies to choose exploration blocks by accessing the national geological data base directly, instead of having their choice restricted to blocks offered by the government in sporadic formal bid rounds. Another advantage is the introduction of a uniform licence for all forms of hydrocarbons, meaning that companies do not have to seek fresh permission if they come across something unconventional such as shale or coal-bed methane deposits. Well-placed to serve Asian gas markets is Australia, which is on its way to become the world’s largest supplier of LNG, able to supply one third of global LNG demand. The long lead time for LNG projects can lead to periodic mismatches of supply and demand. Peter Coleman of Woodside Energy does not expect the current period of abundance to last, which is why his company is taking advantage of fairly low prices to make acquisitions. The 2020s may see a global shortfall in LNG supply. A major beneficiary of any such global gap in gas supply would be Iran. The country’s has the world’s largest gas reserves, but is so far a relatively minor gas exporter. Dr Amir Hossein Zamaninia, deputy petroleum minister, and Dr Gholam-Reza Manouchehri, deputy head of engineering at the National Iranian Oil Company, set out plans to change this by boosting exports to Iran’s neighbours, and eventually developing LNG to reach more distant markets. Despite years of sanctions, Iran has increased its oil output to a level of 4 million barrels a day, making it OPEC’s second biggest producer. To sustain this, the Iranian oil sector needs to copy the enhanced recovery techniques that have worked in its gas sector. Alastair Harris and David Renwick examine the changing fortunes of Trinidad and Tobago, one of the oldest petroleum provinces in the western hemisphere and an early adopter of LNG technology, in the face of low oil and gas prices and the nearby shale revolution in its former main market of the US. Meanwhile in Peru, Rafael Zoeger, President of State hydrocarbons agency, Perupetro, discusses the recent overhaul of the country’s oil and gas licencing framework, and the prospects for new discoveries in Peru’s many un- and under-explored sedimentary basins.
The world of energy has been facing fundamental changes and tough challenges since the 21st World Petroleum Congress took place in Moscow, three years ago.

Crude oil prices fell sharply in the autumn of 2014 and have generally remained at half the price level we saw in summer, when Brent Blend traded at up to US$110 per barrel. In December 2015, world leaders gathered in Paris for the United Nations Climate Change Conference (COP 21) agreed on an ambitious plan to address climate change, setting the course for a low carbon future. At the same time, the incredible success of unconventional oil and gas production is continuing to reshape the industry and market dynamics.

Against this backdrop, it may not be surprising that conventional oil and gas exploration has suffered, both in terms of activity and success rate. The total volume discovered last year was the lowest in more than 60 years.

Easier to save money on exploration than production

Obviously, the cash flow effect of plunging commodity prices has made its mark on activity and spend levels in oil companies, and it is generally easier to save money on reduced exploration than on producing fields and field developments that are under execution.

More fundamentally, the concept of conventional exploration – specifically offshore – has been challenged in some quarters. Exploring for, and exploiting, unconventional resources is less capital intensive, and could come with lower sub-surface risk and potentially quicker pay-back.

Moreover, the industry’s ability to unlock new basins capable of creating material value has been questioned – and some of the yet-to-find volumes are in such inhospitable environments or require such complex development solutions, that they just do not complete against the current industry backdrop.

From a climate perspective, some argue that exploration should be stopped altogether, as there is already more discovered resources than can be responsibly developed without dangerous climate change effects.

We respectfully beg to differ.

Earlier this year, Statoil launched its sharpened corporate strategy. At its core is our strategic motto: always safe, high value, low carbon.

Acknowledging many of the dilemmas and challenges that our industry is facing, the strategy is addressing the need to be cash generating at all times, to have capital expenditure flexibility, to capture value from cycles and prepare for a low-carbon future.

The downturn has been painful. But it has also presented the industry with maybe a once-in-a-generation opportunity to strengthen our competitiveness.

In Statoil, we have reworked solutions, all the way from the reservoir to market. And we have brought the break-even cost of what we call our “next generation portfolio” – more than 3 billion new barrels which will go into production from 2018 to 2022 – down from around US$70 to well below US$30 per barrel.

In the exploration area, Statoil, like many of our peers, has reduced activity and spend. But we have also kept a determined focus on replenishing our portfolio through the cycle, positioning ourselves for the long term by acquiring acreage and seismic data at competitive terms.

And we are now reaping benefits from improvement programmes, efficiency gains and market effects. We can do more for less.

In 2017, Statoil plans to complete approximately 30 exploration wells and the total capital expenditure on exploration is forecasted at US$1.5 billion. The drilling activity is around 30 per cent up on the 2016 exploration programme, while the spend level stays the same.

Our sharpened exploration strategy builds on three strategic pillars:

- Exploit prolific basins
- Test impact opportunities
- Access at scale

The prolific basins continue to deliver. Where oil has been found, there is more to be had. For Statoil, the Norwegian continental shelf (NCS) is clearly the best example. We have been working this basin for some 50 years, and still we were as recently as 2010/2011 able to uncover world class discoveries like the Johan Sverdrup field, with reserves estimated at 1.9-3.0 billion barrels currently under development and now part of our Next Generation portfolio.

We also continue to believe in frontier exploration, with impact opportunities. Several frontier, high-impact prospects are included in our 2017 drilling programme.

We have frontier prospects in several countries, but the wells that for various reasons are subject to most attention, are probably some of our prospects in the Norwegian part of the Barents Sea. Our 2017 Barents Sea campaign, kicked off in May, could provide us with crucial information about the long-term future of the NCS.
Access is the primary vehicle for shaping, replenishing and maintaining optionality in our portfolio. Our aim is to pursue assets with multiple options and scale to capture potential for transformational geological breakthroughs.

**Low-carbon opportunities and high-value resources**

The low-carbon future will reshape the energy space. Some see this as a threat to our industry, but in Statoil we look for the opportunities it offers.

Statoil doesn’t debate climate change. We act on it.

Besides our investments in renewables and carbon capture, we are shaping our oil and gas portfolio to be robust in a low-carbon future. We know that demand for oil and gas continues to grow, in tandem with a growing world population and improved living standards in the developing world. Even with exponential growth in renewables, oil and gas will remain a large part of the global energy mix for many decades ahead.

We think it is necessary to respond to the challenge of climate change – reducing emissions, from CO₂ and methane. In Statoil, we believe that such emissions should – and gradually will – come with a price tag. Our perspective is that carbon efficiency will increasingly be a competitive advantage. So how we run our industry matters, and will do so more and more.

Exploration shapes our future portfolio, beyo. As we have shifted focus from volume to value, we also have a clear view as to what areas we prioritise for exploration, and what resources we are looking for.

Not all hydrocarbons are created equal. Our future carbon footprint will be impacted by the discoveries we make. Emphasis is therefore increasingly on high-quality resources; light hydrocarbons with good subsurface characteristics such as good reservoir properties and high resource density. Those discoveries offer the ideal combination of high value and relatively low carbon footprint in the production phase.

On natural gas, we have stated that we will prefer exploration prospects that offer the potential for pipeline options to undersupplied markets. Our position in Turkey has a perfect strategic fit in that respect. Statoil has farmed into two licences operated by Valeura Energy in the West Thrace region in the north-western part of the country. If we find what we hope for, infrastructure and market will be right on our doorstep.

Statoil’s statement of purpose is to turn natural resources into energy for people and progress for society.

The oil and gas industry is global by its nature. Geology rules geography. We sell commodities to global markets. And we depend on talent, innovation and suppliers from around the world.

Global collaboration and integrated markets has been, and will remain, key to making our industry prosper. Global collaboration is also essential if we want to tackle the climate challenge. As a long-term industry, we are heavily invested in the communities where we operate.

When turning natural resources into energy for people, and progress for society, doing it in a sustainable way is in our common interest. Working together is therefore more important than ever. The World Petroleum Congress in Istanbul is a great arena for doing just that.

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**Norway’s Johan Sverdrup field, one of the biggest recent finds**

© Statoil ASA
The oil and gas industry has a crucial role to play in meeting the energy needs of a fast-growing economy like India. This is evident from the scale of growth witnessed in the demand for oil and gas in the past decade. Currently, India is the third largest consumer of oil and gas in the world. However, its oil and gas demand has outpaced domestic supply significantly and it is largely dependent on imports for its consumption, importing about 75-80 per cent of its crude oil and 45-50 per cent of its gas requirement. Our Prime Minister has mandated that India should reduce its import dependence by 10 per cent by 2022.

As the country is set to become the fastest growing economy in the world, the energy demand is likely to see a substantial growth in future. Moreover, as the government

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**A HELPing hand to accelerate India’s oil and gas output**

By Atanu Chakraborty  
Director General of Hydrocarbons, Government of India

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**India’s Oil and Gas Consumption – Production Snapshot**

![Chart showing India’s Oil and Gas Consumption and Production]

*Source: BP Statistical Review 2016.*

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**India’s increasing crude oil imports**

![Chart showing increase in crude oil imports]

*Source: Petroleum Planning & Analysis Cell*
is focusing on increasing the share of manufacturing in GDP from about 16 per cent currently to 25 per cent, by introducing a series of proactive and transformative policy reforms, energy demand is likely to increase further. In the International Energy Agency’s view, India’s energy demand is estimated to grow by more than any other country up to 2040, accounting for a quarter of the global rise in energy demand over that period. Hence, the swift growth of the energy sector has become the need of the hour. With nearly half the country’s sedimentary are yet to be appraised, it is of utmost importance to unlock India’s true hydrocarbon potential.

Driven by the goal of reducing import dependence on oil and gas to improve energy security, a new policy framework has been introduced called Hydrocarbon Exploration and Licensing Policy (HELP). It is a major reform in the Indian upstream sector, introduced with the objective of addressing certain deficiencies and challenges related to cost recovery, work programming, and operational, administrative and regulatory inflexibility, which were faced in the previous regime. The salient features of HELP are:

- Uniform licensing for exploration and production for all forms of hydrocarbons
- Open Acreage Licensing Policy (OALP)
- Easy-to-administer revenue sharing model
- Marketing and pricing freedom for both crude oil and natural gas
- Exploration phase of 8 years for onshore and shallow water blocks and 10 years for ultra-deepwater/frontier areas.

HELP is a progressive and business-friendly policy which opens up India’s entire sedimentary basin for investment by domestic and foreign players under a simplified, transparent and investor-friendly fiscal and administrative regime. This policy not only facilitates the objective of making India a business – and investor-friendly destination, but also aims at accelerating exploration and production (E&P) activities in India in a very significant manner. HELP has also taken into consideration the higher risks and costs involved in E&P from offshore areas.

One of the key advantages for investors under the OALP plan is the ability to select the exploration blocks after accessing geological, geophysical and historic data of India through the National Data Repository (NDR). Previously, companies had to wait for formal bid rounds by the government and E&P activity was restricted to only those blocks offered for bidding by the government. But OALP now would allow companies to approach the government at any time and seek permission to explore any block by submitting an Expression of Interest. Blocks so identified would be taken up for bidding every six months.

Henceforth, OALP enabled by the NDR will be providing seamless access to India’s entire E&P data process, through a digital medium, to all investors, and should encourage upstream investment and improve productivity.

Moreover, OALP now gives investors the flexibility to carve

Declining domestic gas availability and rising LNG dependency

Source: Petroleum Planning & Analysis Cell
out exploration acreages and carry out petroleum operations through a uniform license for exploration and production of all forms of hydrocarbons. This should also boost unconventional exploration, as it permits oil and gas firms to explore whatever source of fuel they can discover in the area contracted out to them without seeking fresh permission from the administration for each kind of fuel, be it coal-bed methane, shale oil or gas, or any other condensate.

The recently concluded ‘Discovered Small Fields’ (DSF) bid round of 2016 is testimony to the acceptance of oil and gas investors of the new policy framework introduced by government. The bid round drew great interest and participation from various private and international companies, mostly new entrants to India’s E&P sector. A total of 134 bids were received for 34 contract areas from 47 companies.

Two types of contracts are envisaged under the HELP regime. The Petroleum Operations Contract (under the revenue sharing regime) will be for the entire life cycle of the field, covering exploration, appraisal, development and production. In addition, in order to encourage survey and exploration activities in India, a variant of the exploration contract with the objective of carrying out surveys and exploration has been created, termed the Reconnaissance Contract. This would allow bidders to seek out blocks (again with the help of NDR) and carry out survey and exploration activities in the area. The party would have 12 years to lease the data at a commercial rate. The operator of such Reconnaissance Contracts is also provided the “right of first refusal” to shift to a full Petroleum Operations Contract by submitting its intention to the government to match the bids once the block is taken up for bidding.

The government is also in the process of finalising a policy framework to encourage technology and investment in maturing fields. Such ‘Production Enhancement Contracts’ would be implemented through varying schemes of private sector participation where the objective would be to provide an opportunity to earn returns from enhanced production.

Given these significant reforms the Indian E&P industry is poised for major growth with increased inflow of international capital and technology for exploration and production. The untapped potential of the less explored sedimentary basins of India would be opened up, and survey and exploration activity in the frontier basins and deep and ultra-deepwater basins is also expected to pick up.

Sedimentary Basins of India

Source: Ministry of Petroleum and Natural Gas.
A vision for the Nation cannot be limited by its borders

Across 4 continents in 17 countries with 38 projects, ONGC Videsh reflects international integration and cooperation.
Natural gas from down under rises to the top

By Peter Coleman
Chief Executive Officer, Woodside Energy

The Australian Liquefied Natural Gas industry has experienced exponential growth since the last World Petroleum Congress and is just two to three years from taking its place as the world’s biggest supplier of LNG.

When the WPC last met three years ago, Australia was host to three projects producing nearly 25 million tonnes per annum (mtpa) of LNG.

Since then, we have seen dramatic growth in production in Australia and new producers entering the market. There are now seven operating LNG developments in Australia and three more under construction. In what has become an extremely vibrant LNG sector, Woodside has emerged as the most experienced Australian producer and exporter.

We are renowned for our operational excellence but also acclaimed for the prudent financial management that has allowed us to continue to invest in new assets, even when oil prices were low, thereby positioning ourselves well for future growth.

As we look to the future, Woodside has led the way for major industrial companies in pioneering the application of artificial intelligence and data analytics to remote operations. This is driving a cultural change in our company and saving us time and money by connecting our highly qualified people to decades of accumulated corporate knowledge.

Woodside’s two most established projects, the North West Shelf and Pluto in the state of Western Australia, account for 8 per cent of global supply. The North West Shelf was Australia’s first LNG project, delivering its first gas in 1984 and its first export cargoes to Japan in 1989. Since then, it has grown to include five production units (or trains) with an average annualised capacity of 16.9 mtpa. Pluto LNG has one production train with an average annualised capacity of 4.7 mtpa.

Our assets are renowned for their safety, reliability and efficiency. As an operator, Woodside has always focused on performance excellence, and in the past three years we have delivered capacity and reliability improvements, which today see our two plants producing nearly 6 per cent more than in 2014 and at a considerably lower operating cost. In 2016, our plants achieved world-class reliability of 98.7 per cent and at Pluto LNG we achieved a 40 per cent reduction in unit production costs.

Last year, Woodside reported its second-highest annual output of 94.9 million barrels of oil equivalent (MMboe), of which LNG accounted for a record 63.7 MMboe.

This will increase soon, when the Chevron-operated Wheatstone project begins production. Wheatstone comprises two production trains and is a key component of Woodside’s near-term growth strategy. When fully operational, it will contribute more than 13 million barrels of oil equivalent (MMboe) to our annual production.

All in all, it’s been an extraordinary couple of years for Australia, with LNG production and export capacity worth around A$200 billion either delivered or developed to within a line of sight. That investment is set to boost Australia’s total capacity beyond 85 mtpa, more than any other producer of LNG and accounting for around one-third of current global demand.

The Australian industry did not arrive at this position by chance. Its success has been built on hard work, innovation, and strong partnerships with Asian joint venture partners and customers, as well as the support of state and federal governments and our communities.

That has been particularly so in Western Australia, where the LNG export industry has developed in cooperation with the state government and in a way that guaranteed that it also provided secure and affordable supplies of gas to domestic consumers.

By virtue of geography, Western Australia is disconnected from the energy grid that supplies Australia’s more populous eastern states and has been able to successfully chart its own course. In contrast, the remarkable growth of the LNG export industry in Queensland has posed transitional challenges for eastern Australia as the domestic gas market adjusts.

In Australia, as in the rest of the world, gas is taking on an increasingly important role in the energy mix, as the world strives to reduce emissions while demand for energy continues to grow. Renewables are making progress and we consider there is much scope for complementarity, with gas able to deliver energy of a scale and reliability needed to power Asian mega-cities and major industrial users.

Well-placed to serve Asian markets

From Australia, we are well-placed to deliver gas into Asian markets, where the rapid emergence of regasification capacity, combined with the availability of relatively low-priced supply, is stimulating new demand and changing trading patterns. LNG has long been a crucial part of the energy mix in Japan and is now emerging as the fuel of choice across Asia more broadly.

This demand growth is occurring at the same time that economic circumstances and the reluctance of buyers to commit to long-term contracts have made it challenging to sanction large-scale new LNG projects.
The current period of abundance will not last. At Woodside, we have been taking advantage of market conditions to acquire promising new assets at favourable prices. Since the last World Petroleum Congress in 2014, we have diversified our portfolio by making significant acquisitions, including in Senegal, Australia and Myanmar.

We are a leading LNG supplier globally, and we are also progressing oil opportunities in Senegal and are executing the Greater Enfield development in northern Western Australia. Our interest in the SNE deepwater oil discovery in Senegal presents the opportunity for first oil production from 2021 to 2023.

In our LNG production, we are aiming to be strongly placed to compete with potential projects in existing producing regions, as well as new entrants including the US, Canada and East Africa.

We have also been preparing for an expected global LNG supply shortfall in the 2020s by progressing plans to grow production from our existing facilities.

At Pluto LNG we are evaluating opportunities to maximise our investment by undertaking further capacity enhancements and mid-scale to large-scale expansion. That process would accelerate development time frames and production from unallocated Woodside and third-party gas resources in several fields in the Carnarvon and Browse basins off northwest Australia.

Woodside has also been working for some years, as operator, to find the right development concept for the world-class but remote Browse Joint Venture resources, which comprise 16 trillion cubic feet (Tcf) of dry gas and 466 million barrels of condensate.

Today, conditions are aligning for us to look closely at an opportunity to bring the Browse resource into the North West Shelf gas processing and export infrastructure. This option would basically double the life of the project, which now represents a combined investment by the joint venture partners of around A$34 billion.

The concept Woodside is currently pursuing has the dual advantage of ensuring the most efficient use of capital while minimising risk by relying on proven technologies to develop the offshore Browse resource and pipe it to the existing North West Shelf joint venture facilities.

As operator of both Browse and the North West Shelf, Woodside is ideally placed to play a leadership role in realising this vision and we are currently talking to our joint venture partners about the next steps. It is still early in the process but we think this is a compelling option and could be achieved at a competitive price and in a time frame that could see Browse gas enter the North West Shelf plant from the mid-2020s, coinciding with the forecast supply crunch.

But Woodside is not just waiting for demand to emerge. We are already working to grow markets for LNG as a low-emissions transport fuel, starting in Western Australia’s Pilbara region. This region in the state’s north is home to our North West Shelf and Pluto LNG operations, and is also the world’s largest iron ore production and export hub.

The proximity of fuel-intensive industry to world-class gas supplies makes the Pilbara the perfect place for Woodside to start driving the transition from diesel to LNG as a clean transport fuel. We are collaborating with the mining and shipping industries and equipment manufacturers to deliver LNG as a fuel for locomotives and mine-haul trucks and as a marine fuel on busy trade routes.

As Australia’s biggest independent oil and gas company, we are proud of what our industry has achieved and the contribution we make to our nation’s social and economic prosperity and its energy security. We are also looking forward to realising the near-term opportunities to cement our role as a reliable supplier of affordable, low-emissions energy to the world’s growing gas markets.
WPC AND ITN PRODUCTIONS PROUDLY PRESENT

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Putting the world’s largest gas reserves to work

By Dr Amir Hossein Zamaninia, Deputy of Trade and International Affairs, Petroleum Ministry, Islamic Republic of Iran and Dr Gholam-Reza Manouchehri, Deputy of Engineering and Development Affairs, NIOC

As the country with the world’s largest gas reserves, Iran is bound to play a significant role in international gas markets starting in 2020. We have 18 per cent of the global total, of which a third is associated with oil and two-thirds in non-associated gas fields. We view gas as a clean and abundant energy source that will facilitate sustainable development. Natural gas’ environmental premium should lead to a fair and reasonable value for it, which would allow for sufficient investment in gas projects. Iran plans to boost output capacity, particularly by developing the remaining phases of the South Pars gas field.

By March 2017, we were producing one billion cubic metres of gas a day, putting us in a position to supply more than 100 million cubic metres of gas per day to neighbouring countries. By pipeline, Iran is already exporting gas to Turkey and can expand the capacity of this gas link to ramp up its supplies to the Turkish gas market or European countries through Turkey. There is a gas pipeline to Armenia. The Iran-Iraq gas pipeline has been ready to use since the beginning of April 2016.

Construction of the subsea pipeline to Oman can start very soon and should be completed in the coming three years. This gas could supply Oman’s domestic gas market or be liquefied in spare Omani LNG production capacity to reach international gas markets.

The pipeline project to Pakistan is 50 per cent completed, and only the Pakistani part is still pending. This route could later on reach the Indian market, which also could be targeted through a subsea pipeline from Iran.

As regards LNG, Iranian officials indicate LNG export plants could be ready to use in four to five years, but if we were to choose the floating LNG option this might be sooner – two to three years. The preferred destinations for this gas would be markets in Asia and western Europe.

Iran plans to boost natural gas production and increase its presence in regional and international gas market present various opportunities for foreign companies to invest and participate in Iran’s gas and LNG projects. Foreign investments can be targeted to upstream and midstream sectors of the natural gas industry, including exploration, production and implementation of natural gas pipelines, both offshore and onshore, as well as the infrastructure required for transporting the gas in the form of LNG and CNG.

Moreover, one of Iran’s main objectives for inviting international companies is to utilise the latest know-how in Iran’s gas industry, and to obtain the knowledge and technology in order to enhance local capacity and experience.

Iran is also the second largest OPEC producer of oil and its proved oil reserves rank fourth largest in the world at approximately 157.8 billion barrels of conventional oil, or roughly 10 per cent of the world’s total proven reserves. Based on these estimates, Iran can draw on its oil and natural gas reservoirs for at least 50 and 80 years, respectively, without making any new discoveries.

Iran’s production of oil has reached around 4 million barrels per day which is an indication that the country is regaining its crude production capacity after many years of sanctions. Further recovery would be expedited through the development of several key projects.

Ramping up oil recovery

Within the next few years. A growing number of energy firms, including Total, Royal Dutch Shell, China National Petroleum Corporation, Inpex Corporation of Japan and Petronas of Malaysia have signed provisional agreements to study Iran’s massive underground oil and gas reservoirs in a bid to eventually develop the fields.

Oil and gas development in Iran is attractive to foreign companies because of the relatively low costs of exploration and production in the country. A barrel of Iranian crude costs less than US$10 to produce, making Iran one of the world’s most attractive places for exploration and production, after Saudi Arabia but ahead of Iraq.

Development of the South Azadegan Field is a crucial project over which we are negotiating with several global energy companies. We expect Chinese companies to team up with European majors on this project. We would also have to bring an Iranian company on board, under the regulations for the new format of Iranian oil sector contracts. South Azadegan was discovered in 2001, and was described at the time as the world’s biggest oil finds in decades, with recoverable reserves of about 2 billion barrels. Iran has already signed five heads of agreement with companies including Shell, Total and Inpex for the development of this field.

The National Iranian Oil Company has plans to employ enhanced and improved oil recovery methods in order to ramp up the country’s average recovery rate, currently around 26 per cent, to a level of 60 per cent within the next 30 years. Over the past two decades there has been a new wave of increased recovery in the gas sector, which has brought economic benefit to Iran during the past years of sanctions, and a similar wave of enhanced recovery is now needed in the oil sector.
After more than a century in the oil business, and several decades as a highly successful exponent of the LNG and petrochemical-led economic model, Trinidad and Tobago’s world-class energy sector was hit by a “perfect storm” in the form of a global fall in oil and natural gas prices in 2014, followed by a sharp decline in production of both commodities. This in turn lead to a curtailment of gas supplies to its critically important downstream sector industries, combined with a significant shortfall in government revenues.

After three years of the sector being in the doldrums, however, the country’s energy Minister, Franklin Khan – who, as a former geologist, is better qualified than most to assess such matters – is cautiously optimistic about the country’s medium-term prospects. He cites a revival in exploration activity, a promising pipeline of new production due to come on-stream in the next 2 years, progress in the commercialisation of formerly uneconomic marginal fields, and an apparent breakthrough in the long-awaited monetisation of Venezuelan gas in T&T.

“As of today, there are four rigs off the East Coast, and Shell is planning to bring in two more rigs by the end of this year, so 2018 will see the highest level of activity in more than a decade. We hope that we will be adding significant new resources in the next 3-5 years based on the investment profile of the major players”, he explains.

One can tell a lot about a person – or indeed a country – by the company they keep, and Trinidad and Tobago boasts three of the largest oil companies in the world in its ‘social circle’ – namely BP, Shell and BHP Billiton – together with the more low-key EOG Resources. The big three alone are set to invest around US$10 billion in the country over the next five years.

“To succeed in exploration you need deep pockets,” the minister points out, “and we are fortunate to have three of those with the deepest in the business”.

In addition to BP’s recent significant gas discoveries with its Savannah and Macadamia wells, which have unlocked approximately 2 trillion cubic feet (tcf) of gas, and BHP Billiton’s ongoing deepwater drilling programme, which has already yielded one gas discovery, Shell and its partners are in the process of bringing to fruition one of the longest-standing ‘great white hopes’ of the T&T energy sector – namely, the monetisation of Venezuelan gas through T&T’s LNG and petrochemical facilities at Point Fortin and Point Lisas, respectively.

“We expect first gas from [Venezuela’s] Dragon field in the first quarter of 2019”, says Minister Khan. “We have not agreed on price as yet – those negotiations are ongoing – but we have a Heads of Agreement between [Trinidad and Tobago’s National Gas Company] NGC, Shell and [Venezuelan National Oil Company] PDVSA, and we plan to conclude the gas sales agreement by the end of July this year, looking at volumes of around 500 million cubic feet per day (mmcf/d)”.

An even bigger prize, in the form of the cross-border Loran-Manatee gas field, remains a longer-term prospect, due to the added complexity of unitising its gas between Venezuela and T&T, although the recent announcement of Shell’s acquisition of Chevron’s stake in the field (along with the company’s other Trinidad assets) looks set to simplify matters.

In the meantime, BP’s Juniper platform is due to come on stream by September this year, adding 590 mmcf to the grid, whilst its Sercan project with EOG, and Trinidad Onshore Compression project (TROC) will also bring much needed additional gas to market.

This will come in the nick of time, since gas production, Minister Khan notes, “is now around 3.1-3.2 billion cubic feet a day (bnmcf/d), compared
with demand of about 4.2 bncfd from Point Lisas and Point Fortin, which gives us a shortfall of almost one billion cubic feet a day.

**Bringing more gas into the grid**

Things should improve in 2017, however, with Minister Khan predicting that the above-mentioned projects should “bring the gas deficit to almost zero by the first quarter of 2019”, although he qualifies this by saying that “I don’t want to commit to saying it will be wiped out, because in a sense we are ‘walking up the down escalator’, due to the natural decline of the wells – around 20 per cent per year – and other factors.”

The recent return of Shell to Trinidad and Tobago following its acquisition of BG Group marks a significant twist in the company’s long history in the country. Shell enjoyed a dominant position over many decades in pre-independence Trinidad, operating one of the island’s two main refineries at Point Fortin, now the site of the Atlantic LNG facility. It was also a major crude producer, although whether it will want to go back into that business remains to be seen.

In addition to simplifying cross-border developments with Venezuela, where the company has a significant and long-standing presence, its acquisition of Repsol’s LNG assets has streamlined the decision making process at Atlantic, according to Thackwray (Dax) Driver, CEO of Trinidad and Tobago’s Energy Chamber.

Both BP and Shell, together with ExxonMobil and EOG Resources, were the recipients of a visit by Trinidad and Tobago’s Prime Minister, Dr Keith Rowley to their respective regional headquarters in Houston, Texas earlier this year, a move widely credited with persuading BP to sanction its long-awaited Angelin project, and to sign a long-overdue new supply contract with NGC.

Whilst gas remains the lifeblood of T&T’s petroleum sector, increasing oil production is equally, if not more important, due to oil’s transparent global price, more robust taxation system, and its higher employment generation potential, according to Franklin Khan. “The acquisition of the Teak, Samaan and Poui (TSP) fields by the French company Perenco will inevitably lead to an increase in oil production,” he believes. According to the Minister, current output of the TSP field is a mere 15,000 bpd, although he is convinced Perenco is the “right fit” for these assets, and could raise production to 20,000-25,000 bpd in the near future.

“As we speak, oil production is around 75,000 bpd. It is my intention as Minister of Energy to attempt to get that production to at least 100,000 bpd.” Other potential boosters of oil output include Petrotrin, particularly in its Trimar acreage and, of course, BHPBilliton, “should it find oil as well as gas, in its deepwater blocks.”

**Potential bonanza from Guyana**

As luck would have it, some of the biggest oil discoveries in the world over the past two years have taken place on Trinidad’s doorstep, in Guyana, where ExxonMobil has made...
three major discoveries at its Liza, Payara and Snoek wells. This offers the tantalising prospect of a bonanza for T&T’s oil services companies, together with a new source of crude for Petrotrin’s Pointe-à-Pierre refinery – although the latter would require US dollars to purchase, which might preclude such an outcome, unless some sort of ‘payment in kind’ arrangement or and Under Processing Agreement (UPA) can be negotiated.

Dax Driver, for one, believes that Guyana is crucial to the future of Trinidad and Tobago’s oil and gas industry. “Obviously, for the service companies based in Trinidad, the opportunities in Guyana are pretty certain. The Liza Phase 1 FPSO development is happening and you’ve got three big contracts there, and then Liza 2 will almost certainly follow straight afterwards.”

He is at pains to point out that the going will not be easy for T&T’s indigenous players, however. “To be frank, it’s the international companies based in Trinidad who are going to get the bulk of that work. Having said that, there is a local company here called Ramps Logistics who are running the port facilities in Georgetown, and another local outfit, Tiger Tanks, have also got a facility there.”

At the forefront of T&T’s adaptation to the ‘new normal’ of low gas prices and constrained supply – as well as the country’s drive to seize opportunities across the entire value chain, particularly internationally – is the National Gas Company, NGC. “This requires a wholesale reconfiguration of NGC’s functions, which would amount to an NGC 2.0; if one can put it that way,” says the company’s President and sometime steelpan orchestra composer Mark Loquan, a veteran of the petrochemicals business in Africa and elsewhere. “And the way we are positioning the 2.0 version is to look at the value chain both upstream and downstream, both locally and internationally.”

This determination to reinvent the company is echoed by its Chairman, Gerry Brooks: “Success in the new and emerging business environment requires the NGC Group to adopt and execute transformative business strategies in pursuit of a sustainable future for the local energy sector,” he explains.

“We see ourselves as a transporter, aggregator, and a merchant marketer,” continues Mr Loquan. “We can earn value for Trinidad and Tobago without even using our own gas – potentially using swaps, for example.”

According to Mr Loquan, discussion around the ‘new’ NGC must focus on “the Strategic Plan, which was rolled out to employees in March this year and incorporated the findings of the Gas Master Plan, authored by consultancy firm Poten & Partners, centred around NGC’s role in the new environment. This must be more than that of a transport or pipeline company, and the way we are positioning the company is to look at the value chain, upstream, midstream and downstream and decide what is best for the country. You lose sight of the value chain if you are just a transport or pipeline company.”

“Another feature of our approach to expansion will be to leverage state-to-state collaboration. We will be partnering with the government and other state enterprises, both in trinidad and tobago and the target markets in a number of instances,” adds Mr Brooks.

Looking at the whole value chain

“NGC must be a catalyst for industrial development,” adds Dr Vernon Paltoo, President of the wholly-owned NGC Group subsidiary National Energy, “moving upstream with DeNovo, downstream into polyolefins from methanol, and even a drive into renewables, both as a means of freeing-up gas for higher-value purposes than electricity generation, and the creation of an industrial cluster to manufacture solar PV cells.” NGC will lead the way and set the framework for the Group’s internationalisation drive, particularly when focusing on energy markets in Africa, such as Mozambique. National Energy, for its part, will play a major role in pursing business opportunities in its Caribbean ‘backyard’ in jurisdictions such as Guyana and Suriname. It also has its hands full locally, with its investment promotion function and management of the energy ports at Point Lisas, Brighton and Galeota.

Its vessel fleet already services offshore activity in Trinidad and Tobago and has now begun to service Guyana as well, while its industrial estate management function includes Point Lisas North and South, and the Union estate, where the Mitsubishi-led Caribbean Gas Chemical project will be sited. Dr Paltoo regards the latter as a good indicator of the country’s ability to “do more with less” in gas terms, while still attracting world-class companies to invest.

“In order to maintain a ‘progressive’ energy sector and an industrial sector, we have to think outside the box and develop projects that are less reliant on gas, but yet still provide the benefits that we are accustomed to from a gas industry,” he concludes.

Whilst Trinidad and Tobago’s long and fascinating energy saga has taken many surprising twists and turns over the past century – with the likes of both BP and Shell having quit the country only to return many years later, as new opportunities have presented themselves – history suggests that many more chapters still remain to be written.

●
PERU´S HYDROCARBON REFORM IS UNDERWAY

New Contracting Framework:

- Direct Negotiation
- Simplified Bidding Processes
- Improved Contract Model and TEA
Adapting to a dynamic E&P environment

Interview with Rafael Zoeger
President, Perupetro

The fall in oil and gas prices since 2014 has hit many Latin American producers hard. How has Peru weathered the storm in comparison to its regional neighbours and competitors?

It is true that global exploration activity and the development of hydrocarbon exploitation projects have been severely reduced during this cycle of low oil prices.

We are not immune to this situation in Peru; however, as all crises bring opportunities, this new scenario has led us to rethink the way in which we go about attracting investment. With this in mind, we are working on a reform that includes the modification of the contract model, legal framework and the Organic Law of Hydrocarbons, in order to be more competitive in our fiscal and contractual terms.

We have good reason to believe that this year we will see significant achievements in increasing our area under exploration, with new contracts and with the participation of important oil companies which guarantee the use of state-of-the-art technology, with the possibility of more intensive exploration activity in the medium term.

What were the main outcomes of this process, and what impact do you expect the new regime to have on Peru’s competitiveness as a destination for oil and gas sector investment?

The industry is highly dynamic and evolving. We have to adapt ourselves to the current environment in which the supply of available areas for hydrocarbon exploration exceeds to the demand for new areas by oil companies.

Perupetro has committed itself to enacting reforms to encourage the sustainable reinforcement of the country’s upstream hydrocarbons sector. The main goal of the reform is to provide our country with energy security, sustainable economic growth and a significant contribution to the improvement of our people’s quality of life.

The reform consists of three ‘pillars’: first, a new regulatory framework, more competitive with worldwide trends, that allows us to attract new sustainable investments, with wide entrepreneurial, technological, social and environmental support.

Second, we have strengthened and redefined Perupetro’s role. Perupetro needs to be an active investment promoter, leading the interaction with oil and gas companies and the development of sector policies, with full capacity and autonomy for the fulfillment of its new responsibilities as mandated by MINEM and Congress.

Third, we are drawing up a National Hydrocarbons Exploration and Exploitation Plan, to establish medium- and long-term production and reserves goals.

At the moment, while developing the first ‘pillar’, we have prepared a new qualification indicators procedure for oil companies and a new contracting policy through a process of direct negotiation and bidding, with the purpose of attracting investment with more competitive contracting conditions and according to the new contracting trends in the industry.

At the same time, we now have a new Technical Evaluation Agreements policy which will allow oil companies to proceed with the evaluation of the requested area while the State moves forward with the Previous Consultation Process, in order to continue with the subscription of a Licence Contract without wasting time in desk reviews, etc, moving immediately to exploration activities.

Also being prepared is a new, much more flexible royalty scheme, according to oil price variation, production, well depth and type of area. This new scheme will shortly be approved by the Minister of Energy and Mines, and will apply to all new contracts signed.

Another important aspect is the modification of the Organic Law of Hydrocarbons, where we are proposing the extension of the exploration and exploitation terms to the economic limit, considering the necessary control to ensure that the Contractor makes optimal and efficient use of the hydrocarbon resources which are the property of the State.

When we talk about competitiveness, the scope is not only limited to contracting and fiscal conditions but also to prospectivity. We understand that prospectivity is a ‘must’ in order to attract investors, but it must always be accompanied by an attractive contracting and fiscal framework.

It is also part of the country’s competitiveness that authorisations, licences and approvals from the relevant authorities are granted in a reasonable timeframe. Over the last decade these processes have been delayed, resulting in the postponement of investments. In this respect, we are making our best efforts to support the performance of industry activities, with the commitment that these will be executed fulfilling the environmental and social standards in force. To this end, the government has established the Vice Ministry of Territorial Governance, to strengthen the management of social conflicts, and we are confident we will have good results.

With respect to social conflicts, we understand the concerns of the population living close to those areas where upstream projects are being developed, and many of these conflicts occur because the benefits do not reach them directly. For this reason, Perupetro is proposing the modification of the Oil Fees Law so that the funds collected from hydrocarbons extraction benefit them directly.
How will the changes affect the government’s overall hydrocarbons strategy, in particular its stated aim of making Peru a net oil exporter?

Since 2011, Peru has been an important exporter of natural gas and natural gas liquids in South America. However, the country is also a growing importer of the most widely consumed hydrocarbon: oil.

During the first half of 2014, Peru was in the process of increasing oil production, on a sustained basis, with the contribution of northern jungle heavy oil, but the fall in oil prices affected this process.

With the discovery of heavy oil and two other oil discoveries in the northern jungle, future additional production capacity in the northern jungle is expected to be in the region of 150,000 bbl/d (bpd), giving us a total oil production capacity, in theory, of approximately 200,000 bpd.

On the other hand, consumption of oil derivatives in the country is around 250,000 bpd, and is continuously increasing, so we need at least two new important commercial discoveries to reach equilibrium between oil production and derivatives demand in the next 10 years. We are confident that exploration in our deep water areas, which will begin next year in the north of Peru, will yield positive results.

The most significant Peruvian hydrocarbon discovery in recent years has been not oil but gas, namely the Camisea reservoir, which has provided a major boost to Peru’s economy since coming on-stream in 2004, diversifying the country’s energy mix and making Peru an LNG exporter. What is the government’s strategy with respect to the further development of the country’s natural gas sub-sector?

The discoveries of our two giant gas and condensate fields date back to 1984 and 1986. Production from the first field discovered began in 2004, and the second in 2009, which remains the biggest hydrocarbons field discovered in Peru to date.

There was always a strong possibility of new discoveries around Block 88 (Camisea) where the other discoveries I just mentioned are located. In 1998, an important discovery of natural gas and condensate was made in Block 56, with two further important finds in Block 57 in 2007 and 2010. Between 2009 and 2013, four natural gas and condensate discoveries were made in Block 58. Blocks 56, 57 and 58 are adjacent to Block 88.

In block 58 only the northern area has so far been explored, and there exist at least two additional prospects for exploratory drilling. In the southern area of this block, after seismic was shot in 2016, possible additional prospects have also been identified. So, the likelihood is that new discoveries will be made.

At the moment, Block 88 is enough to satisfy the growing domestic demand for natural gas, and we expect it to continue to do so for at least the next fifteen years.

To date, natural gas is used exclusively as a fuel in Peru, and we need to encourage new uses for its diversification, such as petro-chemistry, as the demand for fertilisers, which are made using natural gas as a feedstock is currently met solely by imports. The same is true of plastics. CNPC of China has plans to develop a petrochemical project in the country, which would be an important step in the right direction.

Despite a long history of oil and gas exploration dating back to the 19th century, Peru’s 18 sedimentary basins remain largely under-explored, with some 98 of the country’s wells drilled in just four of them. What is the government’s strategy to encourage more widespread exploration, and which areas offer the greatest potential, in your view?

It is true that most of our sedimentary basins remain either unexplored or underexplored. This is why we are paying particular attention to the drilling of the two first exploratory wells in deep waters of Tumbes-Progreso Basin which we hope will begin in the next few months.

At the same time, there are are least also two unexplored offshore basins in which we are monitoring the exploration interest from major oil companies. As I mentioned earlier, companies’ exploration approach is constantly changing, and recently we have detected a renewed interest. In the southern jungle, the Madre de Dios Basin is underexplored and we have good reason to believe that it has the possibility to yield significant hydrocarbon resources.

An important aspect we are proposing as part of the reform to improve the country’s competitiveness, is that Perupetro should have the capability to generate technical information on our various sedimentary basins, as other agencies around the world do, which will allow us to offer updated information to investors.

The oil companies that have been operating in the country since 1993 are the best evidence that Peru has always complied with its contractual commitments. We invite all companies which still have not had the experience of operating in Peru to contact us, so we can put disposal all the information that could be of interest to them regarding hydrocarbon exploration and production activities in our country.
More than thirty years after it last held the event, in 2020 Houston is to host the World Petroleum Congress (WPC) once more. And the Texan city which prides itself on being “the energy capital of the world”, in the words of Mayor Sylvester Turner, wants the world to know that anyone who thinks they know Houston needs to think again. Still the beating heart of the US oil and gas industry, Houston has undergone a remarkable transformation in the 21st century to become America’s most diverse city – a cosmopolitan conurbation with an open heart and a warm welcome at the ready for all-comers.

“It’s important for us to be recognised, not just as an oil and gas city, but as a diverse global destination with a warm soul,” says Mayor Turner of Houston’s victory in the bid for the 23rd WPC, after being pipped to the post in the two previous processes by Moscow and Istanbul.

“This is huge for us; now we can proudly say we are the world energy capital. But we did not want to come across as arrogant or cocky, and, in some ways, we had to change that perception of a sense of entitlement. People want to know that a city has a real personality and that we are warm, friendly and embracing. People will find that old southern hospitality when they visit Houston,” says Turner, Houston’s second African-American mayor, who took over from one of the United States’ first openly gay city mayors, Annise Parker, in 2016.

“We are oil and gas, and so much more,” Mayor Turner continues, admitting that he was no industry insider when he got involved in the bid team that brought together sector leaders based in the city such as Halliburton, Houston’s political representatives and development agencies. “We are a city of hopes, dreams and inspiration. With me, people can see the diversity of Houston from top down. I am not an oil and gas person; I am a representative of the whole community and that includes the energy industry, which played a big part in making this city what it is.”

Houston is home to more than 5,000 energy-related organisations, including 500 oil and gas exploration firms, 150 pipeline transformation establishments and nine refineries, as well as renewables enterprises and research and development institutions. Half of all Houstonians are employed in the energy sector. The recent rise of the Permian Basin shale oil region in western Texas, home to some of the lowest-cost sources of new oil anywhere in the world, according to the research company Wood Mackenzie, Houston is more than ever a metropolis that is marking out the beat of the energy sector’s future.

As the United States’ primary energy hub, Houston plays host to a range of leading industry events, including the annual Offshore Technology Conference (OTC) and CERAWeek, but the long absence of the WPC was a thorn in the Texan city’s side, a wound to its civic pride which has finally been healed.

Paradoxically, the city’s unquestionable pedigree almost became its chief problem as far as landing WPC 2020 was concerned.

Galen Cobb, Vice President of Industry Relations at Halliburton and Chairman of the WPC’s US National Committee, admits to the challenge of bringing energy sector people back to a city they have most likely visited either on many occasions, or a few decades
back when downtown was a starkly business-only environment. “We’re so excited about the WPC, which has a different feel and a different mix to the other events. Being once every three years, it’s a step change every time and there is a level of thought leadership that is just on another level. We will be raising the bar even higher in 2020,” Mr Cobb says.

The Halliburton veteran congratulates the mayor and, in particular, the Houston First Corporation for bringing key local figures together behind a drive to show the world what it may have missed regarding the city’s spectacular metamorphosis over recent years. The local government corporation scored a major success in bringing the 2017 Super Bowl American football event to the city, where it became the biggest NFL final of all time, attended by 1.3 million people and with 118 million watching live on television. The event capped a fine year for the city, with a record 20 million visitors arriving in Houston during 2016.

“The fantastic support, professionalism and expertise we have had from Houston First gives us confidence we can deliver three years from now,” enthuses Mr Cobb, adding that Houston’s energy sector put its weight behind the hosting of the 51st Super Bowl, with the likes of Halliburton, Shell, Hess, ConocoPhillips, Noble and Anadarko, among others, prominent on the event host committee.

“The Super Bowl was another opportunity to tell our story on the global stage and establish our brand. All partners came together in a great collaborative effort, from the host committee down to the police, and, especially, the more than 10,000 Super Bowl volunteers,” says Mayor Turner. “Those 10,000 didn’t just go the airports to welcome people, they also went and saw them off again on the Monday,” recalls Mr Cobb.

But the city once associated with oilmen wearing boots and cowboy hats has a lot more to offer than just charming old-school manners. “We are the cultural and culinary capital of the south,” asserts the Senior Vice President of Tourism for visit Houston Jorge Franz, who has a message for anyone who remembers WPC 1987 in the city amidst a sterile downtown area with nothing much to do once the oil and gas talk was done. Recent years have seen the rise of what Houston calls its Midtown district, south of downtown with some 50 bars and clubs mushrooming in what was previously an area for people just passing through. Around the George R. Brown Convention Center itself, which has doubled in size since it was opened in 1987, there are now more than 20

The writing’s on the wall: Houston’s annual HUE street art festival makes its mark on the city
refreshment establishments, filling a previous gap.

The Hilton Americas-Downtown spearheaded a significant boost to the amount of quality accommodation in the area, located right by the convention centre and equidistant from Minute Maid Park, the Toyota Center, BBVA Compass Stadium and Discovery Green, Houston’s cluster of monuments that are now better linked by a light-rail Metro system.

“You don’t need a car here anymore. You can go and do a lot in a day in the new Houston,” says Mr Franz.

“This is going to be a walkable Congress,” affirms Mayor Turner.

And delegates who walk up an appetite can enjoy a world of diverse flavours from Houston’s more than 10,000 restaurants. The growth in the gastronomic scene is beautifully illustrated by the story of Mexican-born chef Hugo Ortega, a former goatherd whose journey to success started after he arrived as an illegal migrant in 1982. From Backstreet Café to Hugo’s, Origen and Caracol, Mr Ortega continues his culinary odyssey, offering Houstonians Mexican classics but also the country’s under-appreciated seafood, and, now, in his most recently opened restaurant, Xochi, the herby, delicate tastes of his grandmother’s native Oaxaca region. “The city and myself have been feeding each other with pure energy and the gastronomical experience of Mexico. It is a love affair,” the chef comments from a table in Xochi, a must-visit for food freaks.

Meanwhile, Jorge Franz reels off some of the things visitors will see, and hear, as they roam around the city in 2020, including Houston’s lively jazz scene that locals will tell you is just as authentic as the sounds of New Orleans, not so far away along the Gulf of Mexico coast. Near the convention centre, the House of Blues hosts nightly shows featuring hugely talented musicians. Houston has an impressive 19 museums and is one of only five cities in the US that offer full-time ballet, theatre, symphony and opera companies, Houston Ballet and Houston Grand Opera.

Houston, Mr Waterman notes, has been described as the most philanthropic city in the United States, allowing, among other things, the Museum of Fine Arts to have received Mark Rothko’s personal collection of his own paintings in 1986.

Perhaps even more remarkable is the Rothko Chapel, a sacred space open to all which contains 14 site-specific murals by the abstract master, housed within an octagonal structure based on the Greek cross. As well as home to the work of greats from the past such as Rothko and Vincent Van Gogh, Houston is eagerly positioning itself as a vibrant location for up-and-coming talent, with a penchant for street art, showcased in the HUE week-long annual mural festival that has left its colourful mark on the city’s walls and vacant lots.

The Houston Art Car Parade each spring is a mind-blowing display of human invention with automobiles styled as anything from sharks to cupcakes chasing each other through the streets. But, if you really want to see something quirky in America’s oil and gas capital, visit the Beer Can House. As it says on the tin, the building is made of empty beer containers; but this is no rusty, pungent heap, but rather a delicate, shimmering space refracting the Texan sunshine in different ways according to the time of day. Equally surprising are the art installations in the Cistern, an underground space that was once a water-storage facility under what is now the sculpted, leafy parkland of the 160-acre Buffalo Bayou. Strolling with a different purpose can be done in Houston’s central River Oaks district; “it’s our Rodeo Drive for a truly high-end shopping experience,” notes Mr Franz.

“I heard from delegates and their connections things like ‘we don’t want to come back to Houston; we were there 20 years ago and you have freeways, tunnels and it’s so hot,’” recalls Halliburton’s Galen Cobb of the bidding process. “And what I had to say to them was: ‘But have you seen Houston lately?’ A billion and half dollars were spent improving the city for the Super Bowl. People will be pleasantly surprised. We are solving the traffic, and this will be a walkable Congress in our pleasant December climate.”

Houston 2020 organisers hope people will stick around and make a vacation out of their visit before jetting elsewhere from one of the city’s two international airports. Beyond the revamped city itself, there are scores of daytrip options, including the beach at Galveston and the nearby Kemah Boardwalk amusement park, oil heritage at Beaumont, where
the first gushers of the early 20th-century Texas oil boom burst forth, and, of course, Space Center Houston. From the Saturn V rocket and the historic mission control room to the original shuttle carrier, NASA 905, with a space shuttle replica on its back, NASA’s history is right here.

“On any given day, we can take you into space and we can take you all around the globe,” says Mayor Turner to sum up modern Houston’s variety. And the Texas of cowboys and rodeos is still alive, with a number of attractions based around the frontier era, including The George Ranch Historical Park, where actors take visitors through 200 years of history and cowboys display their wrangling skills.

But cowboy culture is not merely a picturesque vision of the past; one company has found a desire among modern-day corporate staff to improve their teambuilding and leadership skills by offering them the wisdom acquired ‘on the range’. The Cowboy Solution welcomes groups to its ranch an hour outside of Houston, taking them back to basics and examining the essence of partnership through man and horse. “Organisations are not as effective as they could be, and this is nothing to do with technology or competencies, but everything to do with getting a person to want to do the job. Communication is about being understood. We can have a group here for just half a day sometimes, and then they go into the barn for a meeting and it’s powerful. The experience has really ploughed the field, and they express themselves with no agenda,” The Cowboy Solution’s Don Hutson explains.

The path for Houston to host the WPC was arduous, missing out twice before striking success. The city’s representatives developed a strong sense of team spirit and humility along the way. “Losing hurt but we are going to learn from the events in Moscow and Istanbul and then try to improve on them,” says Mr Cobb. “We want to make sure people walk away with some real value from Houston 2020. When people see the concentration of energy and technology companies we have here, and the inspiring speakers from our own back yard, we feel confident they will walk away feeling inspired.”

Houston’s host committee also has high hopes for the WPC 2020 legacy fund, a key pillar of the winning bid under which all net profits will be distributed evenly around the six regions of the world, primarily to be used in education programmes and overseen by the World Petroleum Council Secretariat in London.

Above all, Houston has learnt a lot about itself during the third-time-lucky bidding process, especially the way it pulls together in adversity. “This is the largest city that acts like a small town. If you have an idea to do something, you can get the right players in the room. No one cares what your title is or what your daddy did; if you come to improve Houston, people will get behind you. It’s intoxicating, and it reminds you that this place was built on wildcat prospecting – a proposition that either ends in wild success or death with nothing in between,” says Mike Waterman. “There is something in the DNA of Houston that says ‘we’re never gonna give up, we’re gonna do it the right way, roll our sleeves up and when we’re down is when we’re at our best.’”

Weird and wonderful: The car’s the star at the Houston Art Car Parade
Turkey and the Caspian region

A rising regional power, Turkey will continue to work towards cooperative solutions in order to normalise politics in its neighbourhood, says Berat Albayrak, Turkey’s minister of energy and natural resources. Turkey’s position as a geographical bridge is reinforced with ‘energy bridges’ spanning East and West. Given the political turbulence affecting many of its neighbours, Turkey underpins regional energy security with the network of energy supply and transport routes crossing its territory and territorial waters. Beşim Şişman of Turkish Petroleum emphasises the same strategic location of Turkey between the resource-rich CIS and Middle East regions and the large energy consumer markets of Europe. Energy flows between these regions by ship through the Turkish Straits and via eight oil and gas pipelines from Russia, Iraq, Iran and Azerbaijan. Turkish Petroleum, which aims to transform itself into ‘an international national oil company’, is pursuing exploration in the Black Sea and the Mediterranean, while at home the Turkish gas market is being transformed through liberalisation. However, John Roberts of the Methinks consultancy cautions that this liberalisation has effectively stalled since it was introduced by law in 2001, because BOTAŞ, the state gas company, still commands some 80 per cent of the market, and its planned unbundling into transmission, storage and trading has yet to happen. There is a distinction between a geographical hub, where import and export pipes meet, and a market hub, where traders actively want to buy and sell gas. Full liberalisation would benefit Turkey by ensuring that Turkey’s main gas suppliers – Russia, Azerbaijan, Iran and various LNG producers and marketers – would have to compete against each other. Rovnag Abdullayev of SOCAR explains how Azerbaijan is building on its 200-year history of oil production to expand its gas exports to Turkey and beyond through the Trans Anatolian Pipeline, his company’s largest ever overseas investment. Azerbaijan has also become a major downstream investor in petrochemicals and refining in Turkey, while at home it is boosting the industrial local content of petroleum projects by carrying out, for the first time, design and construction of steel jackets and topside platforms. Jambulat Sarsenov of KAZENERGY sets out how expansion of Kazakhstan’s oil production stands on the three legs of the launch or re-launch of the huge Kashagan field, increased output of the Tengiz field, and maintained production of the Karachaganak field. In parallel with this is the modernisation of domestic refineries and production of petrochemicals such as benzene that had not been previously produced in Kazakhstan. Later this year Astana, the Kazakh capital, will host EXPO-2017 a major international exhibition, on the theme of future energy sources that will include renewables.
World political history has taken its new form as a result of several key turning points. We are now at the beginning of a new era in which global power balances and their regional reflections are being reconstructed. It is not possible to comment on today’s world with the concepts and ideologies from previous eras, or construct the dynamics of tomorrow with the memories of past centuries.

In this structural transformation process, we witness that the spheres of influence of traditional superpowers are becoming narrower and the presence of new regional and global actors are being felt more strongly. In this process, in which the balances are recalibrated, the actors who can read political and economical parameters shrewdly will be the prominent game-setters in the new landscape.

Turkey, with its geostrategic location, is at the very centre of this change facing the world. In particular, given the political turbulence affecting many of its regional neighbours, Turkey plays a vital and critical role with its strong, reliable and sustainable energy policies regarding the supply and transportation of energy to international markets, thereby ensuring regional energy supply security.

Our region is strongly impacted by developments such as the easing of sanctions on Iran, the arrival of new and existing resources from Azerbaijan on international markets, the growing role of Iraq in the oil and gas markets, and the emergence of East Mediterranean gas as an important factor.

Turkey continues to act in the interests of peace and stability, aware that energy will contribute to this process more than that it used to. In this regard, we believe that a better future can only be ensured if multidimensional, long-term, well-defined and fair policies are achieved.

Our energy diplomacy
The basis of the energy diplomacy which Turkey conducts today is built on the paradigm which states that energy sources should not be a source of disputes and conflict. On the contrary, energy sources can be used for enhancing social welfare by improving collaboration and unity among countries. We have not only mobilised our energy diplomacy to ensure a strong economy and enhance national security in Turkey, but we also emphasise the repairing and peace-making potential of energy. Our approach stresses the role of energy as a tool and an incentive for countries to collaborate for peace and prosperity, rather than generating conflict and poverty. In this context, Turkey, as a game-setter and the most significant partner for regional energy projects, is one of the most important actors in the region.

The problems facing the energy hinterland located at the centre of the global terror threat reveal the importance of this collaboration and unity once again. We are not interested in the agenda of any individual or institution, but we are interested in the essence of the subject. No matter what its name or origin may be, the subject we have to take into consideration is elimination of all kinds of terrorist activities. Turkey will continue to work with great determination so that the region’s politics may be normalised, and reach a level which meets the requirements of the modern world.

More than a geographical bridge
At this point, Turkey is making great efforts to establish a solution-oriented structure which supports cooperation. In addition to being a geographical bridge, Turkey connects East and West by energy bridges so that this understanding can be settled by energy sources.

With its political stability and strong financial system, Turkey has always been a reliable counterpart in energy projects. Beyond its borders, having a rich cultural and historical influence on the region, from the Middle East to the Balkans, from the Caucasus to Central Asia, Turkey continues to be a trustworthy partner.

Turkey has achieved great success in recent years due to its strong economic system, political stability and maturing democratic culture. With its infrastructure investments over the last 15 years, a young and qualified work force, its dynamic and bold entrepreneurs, and tight financial discipline and monetary policy, Turkey has made rapid progress towards becoming a regional and global hub.

Turkey is ahead of many countries with its competitive economic environment, its legal regulations providing investment incentives, accessibility to new markets, improved transportation infrastructure, a young and growing population, and easy access to raw materials and intermediate inputs.

We consider all international companies which intend to grow in Turkey and open up to the world through Turkey as our partners. New reforms which will pave the way
for new investors will be implemented rapidly in the coming years. Investors in Turkey never lose, and now we are entering a period in which investors will gain more.

The new government structure adopted after the April referendum will provide a great opportunity for the implementation of strong, long-term and investor-friendly energy policies. Long-term energy policies will present a predictable energy market for investors.

Turkey will move forward without retreating from democracy, the rule of law, the free market economy and universal values. Turkey will continue to be the conscience of the world, with its multilateral foreign policy based on humanitarian values, collaboration and unity.

That is why last year our motto for the 23rd World Energy Congress was “Share for Peace”. Everything we wish for ourselves we also wish for our region. In this regard, all stakeholders a great responsibility to take a rational perspective.

All of our discussions and decisions at the 22nd World Petroleum Congress will, in a sense, also be the milestones for our activities aimed at achieving global peace.

In this regard, I am delighted to welcome you to Istanbul, to the 22nd World Petroleum Congress. In such a new global business environment, where cooperation is the key word, the 22nd WPC will provide a suitable platform for our discussions.

Istanbul, with its beauty derived over centuries, its extensive history and cultural heritage, rich Turkish cuisine, beautiful Bosphorus and world-famous hospitality is the right place for this Congress.
The Turkish centre of a regional energy network

By Beşim Şişman,
President and CEO, Turkish Petroleum

With its rapidly expanding economy, Turkey has become one of the fastest growing energy markets in the world. It has significant demand growth in nearly all segments of the energy sector for several decades and the growth trend seems set to continue. At the same time, Turkey is not a resource-rich country. Oil and gas together, accounting for some 60 per cent of Turkey’s primary energy consumption and more than 90 per cent of hydrocarbon consumption, is imported. In addition, nearly half of natural gas supply is used for power generation, resulting in an additional increase in energy dependence. Thus, Turkey’s primary aim is to realise its energy security by diversifying primary energy sources and supplier countries.

Thanks to its geographic location, Turkey is located at the crossroads between the resource-rich CIS and Middle East regions, and the large European consumer countries. The Turkish Straits are already home to one of the world’s busiest chokepoints, through which more than 2 million barrels per day of crude oil flowed last year. In total, three gas and five oil pipelines from Russia, Iraq, Iran and Azerbaijan operate to meet both Turkey’s and Europe’s demand. Another six pipelines are under construction or in the planning phase to sustain that in the future.

In the case of the Turkish energy market, we are experiencing a transformation: the liberalisation of the Turkish gas market boosting private companies’ investments and shares in the projects. For instance, BOTAŞ has signed important agreements that enhance Turkish energy security. The agreement on the Trans Anatolian Pipeline (TANAP) will deliver 6 billion cubic metres a year (bcm/a) of Azerbaijani gas to Turkey and 10 bcm/a to Europe, contributing to the EU’s energy security. Moreover, the TurkStream project is another major project that will help diversify supply routes from Russia to Turkey and Europe. When fully operational, it is planned that 31.5 bcm/a of Russian gas will be delivered to Europe via Turkey.

The Turkish energy market has certain unique features. Among European OECD countries Turkey is the only country with an increasing demand for refined products. A new refinery under construction will help to meet the demand in the future. Natural gas also has a significant share in Turkish energy consumption. Despite stalling gas demand for the last two years, Turkey needs the aforementioned pipeline projects to meet increasing future gas demand. On the other hand, each pipeline project enhances Turkey’s position in its region. In this respect, energy relations further improve with each pipeline and energy project in the region. As gas starts to flow through the ‘Southern Gas Corridor’ to Europe, Turkey will become a focal point of attraction for investors who have already invested in regional gas projects.

With over 60 years’ experience, Turkish Petroleum (TP) pursues business activities – exploration, drilling, production and distribution – in six different countries: Turkey, the Turkish Republic of Northern Cyprus (TRNC), Afghanistan, Azerbaijan, Iraq and the Russian Federation.

Between 2002 and 2015, Turkey increased domestic exploration and production activities by drilling 1,667 wells. In this aggressive upstream process, Turkish Petroleum has played a leading role in both onshore and offshore fields, drilling 77 per cent of total wells in 2015. As a result, the total oil and gas production of TP reached 110,000 barrels of oil equivalent per day in 2016.

Prospective plays offshore

Turkish Petroleum is determined to follow its ambitious exploration programme in the coming years. TP and Turkish policy-makers attach great importance to the offshore potential of the country, and detailed exploration plans have been developed for prospective plays in the Black Sea and the Mediterranean. We have a close cooperation with international players like Royal Dutch Shell in the Black Sea and Turkish Petroleum is open to develop further cooperative models and businesses, both domestically and internationally.

Turkish Petroleum is keen to participate in international projects as well. The company is the second largest stakeholder of the Shah Deniz Project with a 19.5 per cent share. Azeri-Chirag-Guneshli in Azerbaijan, Baitugan in Russia and the Badra, Missan, Mansuria and Siba projects in Iraq constitute the remainder of our international portfolio.

In coming years, Turkish Petroleum will transform itself into an international national oil company which is dynamic and resilient enough to do business in different parts of the world. In addition to this transformation programme aims to increase the efficiency and resilience of Turkish Petroleum so as to enhance its structure against today’s volatile market and operational conditions.

As an active player, Turkish Petroleum aims to contribute to Turkish energy security. We believe that both TP’s transformation programme and its international projects will bring prosperity to Turkey and its surrounding region.
So far, US$40 billion has been invested in India’s Oil and Gas sector, resulting in around 236 oil and gas discoveries. A number of these have already come on stream and account for approximately 30% of the country’s oil production and 25% of its natural gas production.

To learn more, please visit the India Pavilion at the 22nd World Petroleum Congress Exhibition, stand number B125

www.dghindia.gov.in
Turning a geographical hub into a hub of market activity

By John Roberts
Energy Security Specialist, Methinks Ltd

Turkey enjoys a magnificent geographical position which should enable it to become one of the world’s foremost gas hubs. It has pipelines that bring in gas from Russia, Azerbaijan and Iran and LNG import facilities that ensure supplies from such diverse producers as the United States, Algeria and Qatar.

In addition, it is helping to develop the US$40bn Southern Gas Corridor which will bring gas both to and through Turkey, ensuring connections between the Caspian and a range of recipient nations in the Balkans and western Europe.

However, it is still finding its way towards developing a clear strategy to transform these physical and geographical advantages into a market hub where competition can flourish between and amongst suppliers and consumers.

This is the distinction between being a geographical hub – a crossroads where import and export pipes meet – and a market hub, a location where traders actively want to buy and sell gas. Turkey certainly has the capacity to develop a market hub, not least because legislation passed in 2001 to liberalise the gas market sets out a road map for the transformation of the state gas company, BOTAŞ, into a cluster of companies and whose trading arm would account for no more than 20 per cent of the country’s internal gas sales.

Implementation, however, has been somewhat slow, with BOTAŞ today still commanding around 80 per cent of the market.

But reform is once again in the air, fuelled by several major developments.

• The first is an era of financial constraints so that, even with relatively low gas prices, there is an increasing emphasis in Turkey on energy efficiency – and on alternative energy sources – in order to reduce the country’s energy bill. Turkey itself produces only a tiny fraction of the gas it consumes, meaning that in 2015, the first full year of comparatively low international gas prices, it paid out around US$17.5bn for some 45 billion cubic metres (bcm) of gas imports.

• The second is the concurrence of several major developments in the regional gas market in the next few years. The Southern Gas Corridor should start bringing Azerbaijani gas to Turkey via the South Caucasus and Trans-Anatolian (TANAP) pipelines from the middle of next year and, a year or so later, it should start carrying further volumes of Azerbaijani gas to southeastern Europe and Italy. By around 2021–2, it should be delivering some 6 bcm a year to Turkey and 10 bcm/y to southern and western Europe.

• The third concerns gas from Russia. Sometime in late 2018 or early 2019, Turkey will start receiving gas from Gazprom’s new 15.75 bcm/y capacity TurkStream pipeline across the Black Sea. In essence, this will replace the flow of gas, currently running at around 12–14 bcm/y, received via Ukraine and the Trans-Balkan Pipeline and which is expected to cease when Russia’s current transit contract with Ukraine terminates at the end of 2019.

One immediate question is whether Russian gas delivered via TurkStream will be sold on the same long-term contract (LTC) basis as current supplies delivered via the Trans-Balkan line. In addition, an LTC concerning around 6.5 bcm of annual imports from Azerbaijan is due to end in 2021, and one governing the import of up to 10 bcm/y from Iran is due to end in 2026.

Moreover, Turkey has started receiving gas from the US in the form of LNG and has, indeed, added to its LNG import capacity with the installation in 2016 of a new floating regasification and storage unit (FRSU) and with preparation for a second FRSU currently under way.

Missing element in the marketplace
All this means that both the hardware and the product are in place for Turkey to become a hub. What’s missing, however, is much of the software required for Turkey to become a true marketplace. Market liberalisation is the key and, indeed, Turkey has been officially committed to opening its market ever since April 2001, when it passed Law 4646 which aimed to ensure the supply of stable volumes of gas at competitive prices. Law 4646 envisaged the eventual unbundling of BOTAŞ and the creation of an autonomous transmission system operator to own and operate the extensive national gas transmission system developed by BOTAŞ and thus ensure full third party access in a regulated tariff environment.

But the dominant role played by BOTAŞ is still hampering market liberalisation. Draft legislation first prepared in 2009 was supposed to have ensured that by the start of 2015 BOTAŞ would be split into three separate entities handling transmission, storage and trading. This has yet to happen.

There should also be increased diversity regarding importers, with BOTAŞ’ share of the market reduced to 20 per cent. In practice, the company was still handling 84 per cent in 2015, although this seems to have fallen to around 78 per cent in 2016. This dominance, which has ensured the failure to implement a requirement in Law 4646 that distribution companies should only purchase 50 per cent of their supply from a single source,
does, however, mean that BOTAS can fulfil a key strategic role in a country that is overwhelmingly dependent on imports, acting as a supplier of last resort.

BOTAS’s role as supplier of last resort requires it to develop gas storage to meet seasonal variations in demand. BOTAS is actively working on this, not least by commissioning Chinese constructors to develop a US$700m underground storage facility at Lake Tuz which, when it is completed in 2019, should be able to hold more than one bcm of gas and to release some 44 million cubic metres a day to the national distribution system.

While BOTAS’s role can be defended as a strategic safeguard for an import dependent country, it runs counter to the development of the kind of fully liberalised market necessary for the development of a trading hub in which companies voluntarily wish to trade. This is particularly true when it comes to pricing, since BOTAS is still presiding over a system which involves varying degrees of subsidy, thus raising questions that it is not only distorting competition but may be undermining its own financial position.

At the same time, there are concerns that the Energy Market Regulatory Authority, which is entrusted with establishing the principles under which licensed operators can trade, is in practice moving to develop a tight set of regulations in which it is effectively instructing operators how to trade, rather than allowing them to develop their own arrangements that would reflect changing market conditions.

The long road to liberalisation

Government policy does favour the development of a natural gas spot market to be operated by the Energy Markets Operation Company (EPİAŞ), which already operates an electricity market. So, although Law 4646 has yet to be formally amended, the government has not only set targets for increased storage but ordered studies for the development of a natural gas spot market to be operational by the end of 2017.

This would clearly be a major step on Turkey’s long road to full gas market liberalisation. Turkish officials, stressing progress made to date, argue that Turkey is generally following EU regulatory precedents. And, of course, in Europe the development of spot markets and gas trading hubs has contributed significantly to increased competition and the consequent convergence of prices throughout the continent that generally reflect, in practice if not always in theory, the gas-on-gas pricing found in major gas hubs.

Such a development would certainly benefit Turkey, not least by ensuring that Turkey’s major gas suppliers – Russia, Azerbaijan, Iran and various LNG producers and marketers – would have to compete against each other. But to achieve this, and to develop a market in which both foreign and domestic companies actively wish to trade, Turkey still needs to resolve key issues concerning BOTAS’ dominance, the provision of subsidies that can help the poorest but not distort the market, and full third party access to the country’s transmission and distribution systems.

A tanker threads its way through the Bosphorus near Istanbul
Azerbaijan diversifies into a regional energy network

By Rovnag Abdullayev
President, SOCAR

Our energy strategy forms the cornerstone of sustainable development in Azerbaijan, and provides a solid foundation for regional and global projects. The development of the Azeri, Chirag and the deep-water part of the Guneshli fields with huge hydrocarbon reserves has been the largest oil project in the Azerbaijani sector of the Caspian Sea. Some 416.5 million tonnes of oil and 128.2 billion cubic metres (bcm) of gas had been produced by the start of this year, and we plan to extract 5 billion barrels of oil from the fields by the end of the project contract. Azerbaijan, with its 200-year history of oil production, is approaching the point of having produced 2 billion tonnes of oil.

The important steps have been taken through the long-term agreements for the supply of Azerbaijani gas to the countries of the European Union. At the moment, we are implementing Southern Gas Corridor (SGC), one of the world’s largest infrastructure projects, extending to 3,500 kilometres.

Taking into account the increasing demand for natural gas in the world, our main task is to increase gas production. We are looking forward to the second phase of development of the Shah Deniz field with the estimated total reserves of 1.2 trillion cubic metres of gas and 240 million tonnes of condensate.

It is the first time that subsea design and the construction of steel jackets, as well as of topside platforms, have been carried out in Azerbaijan. These works are being implemented at the ATA yard (involving AMEC, Tekfen and Azfen) and by the Bos Shelf joint venture at the Baku Deepwater Jackets Factory, owned by SOCAR and our partners.

An additional volume of 16 bcm of natural gas per year is planned to be produced for the second stage of the development of Shah Deniz field. Of this volume 6 bcm will be exported to Turkey, through the TANAP (Trans Anatolian Pipeline). This is the largest overseas investment project carried out by SOCAR. This pipeline, the foundation of which was laid in March 2015 in Kars with the participation of heads of state of Azerbaijan, Georgia and Turkey, is one of the world’s largest natural gas pipeline projects in terms of pipe diameter and length of the line.

Another 10 bcm a year will be exported to Greece, Bulgaria and Italy via Georgia and Turkey through the TAP pipeline. The groundbreaking ceremony of TAP (Trans Adriatic Pipeline), the final segment of SGC, was held in May last year. The pipeline will carry natural gas from the Turkish-Greek border across Greece, Albania and the Adriatic Sea, coming ashore in southern Italy. We are currently reviewing the opportunities to increase this volume up to 31 bcm through the existing pipelines in the future.

Today, the hydrocarbon reserves of the country are transported through seven oil and gas export pipelines on different routes. The Baku-Novorossiysk, Baku-Supsa, and Baku-Tbilisi-Ceyhan pipelines have been successfully operated as key elements of global energy security for many years.

We continue to expand production in various fields in the Caspian Sea. Geological studies show that the production from Umid is connected to the nearby Babak structure, and development of the Absheron field – another major source of gas condensate – is in progress with the projected production date in late 2019.

Investment projects in other countries can serve the development of our country, as SOCAR has effectively demonstrated with its decision a few years ago to diversify its investment portfolio. We decided to direct our investments to different areas at times when the crude oil price was high. At those times oil companies often preferred to make investments, mainly in production, and exploitation of fields with high development costs. However, in order to reduce risks and increase efficiency along with the production, we have been implementing various investment projects in gas processing and petrochemical, transportation and trading with the purpose of diversifying and trying to enter new markets.

Re-investing profits in infrastructure
The profitability of refining and petrochemical products increased as crude oil prices declined. We can see this in the example of Petkim Petrochemical Holding, our largest activity in Turkey. In 2016, the company achieved a net profit of 732 million Turkish lira in exporting to nearly 40 countries. This profit is being re-invested in projects such as the STAR oil refinery, the Petlim port, and a container terminal. The purpose of the construction of the STAR oil refinery with the proposed annual processing capacity of 10 million tonnes is to supply Petkim with naptha as a raw material and to meet the demand for a number of other oil products imported into the Turkish market. The Petlim port built in the Petkim peninsula has been put into operation and the Petkim container terminal will be Turkey’s third largest terminal, and the largest one in the Aegean region.

The concept implemented by SOCAR’s subsidiary, SOCAR Turkey Energy Inc, is a great contribution to the strengthening
of bilateral relations between our two countries. It is worth mentioning that our business in Turkey is being closely followed and appraised by international financial institutions. In 2015, the purchase of 13 per cent of the shares of SOCAR Turkey Energy by Goldman Sachs and JP Morgan at a price of US$ 1.3 billion demonstrates the increase in the value of these assets. We are also implementing telecommunications projects in Turkey, such as SOCAR Fiber-Optic, as well as SOCAR Gas Trade. We believe SOCAR Turkey Energy will become one of the largest petrochemicals, logistics, container, port and distribution companies both in Turkey and in the region. 

Our neighbouring country, Georgia, is a large part of our gas supply and petroleum products market. SOCAR Energy Georgia is the biggest tax payer in Georgia and now, with the exception of Tbilisi, controls 95 per cent of the Georgian regional gas distribution network.

Since 2008, SOCAR Trading in Geneva has been selling Azerbaijani crude oil and gas in the world market, as well as oil products. SOCAR Trading sells oil and gas products in the retail and wholesale markets of Switzerland through SOCAR Energy Switzerland, and also retails oil products in Romania and Ukraine. 

In conclusion, the evident success of these current projects creates confidence in the implementation of future projects in the diverse fields of application for oil and gas, particularly in petrochemicals.

The SOCAR Turkey Aegean Refinery on the Petkim peninsula near Izmir
Developing the Kazakh downstream as well as oil and gas upstream

By Jambulat Sarsenov
Vice Chairman, KAZENERGY Association

Despite low oil prices, the measures Kazakhstan has taken to support its oil and gas industry as well as the launch, or re-launch, of the giant oilfield Kashagan in the Kazakh zone of the Caspian Sea increased oil production to 77 million tonnes last year. The energy ministry is forecasting that oil output will reach 80 million tonnes this year, and rise to 102 million by 2030.

The expected growth of oil production is related to the development of three projects crucial for the economy and the future of the country: the launch of Kashagan, increased production at the Tengiz field and maintaining the current level of production at the Karachaganak field.

Thus, at Kashagan, Kazakhstan is going to maintain the commercial production rate at more than the 75,000 per day achieved in November last year. At Tengiz, which accounts for almost a third of national oil output, the milestone is the ‘Future Growth Project’, worth US$37 billion, which will enable an increase in annual production to 39 million tonnes by 2022. At the peak of construction, this will create some 20,000 jobs. At Karachaganak, engineering work to maintain production level at 11-12 million tonnes a year is expected to start this year.

Production will also be boosted by new oil fields in the Caspian Sea coming on stream from 2025, as well as – in the long term – by the implementation of the huge International Project ‘Eurasia’, which involves drilling super-deep wells in the ‘Pre-Caspian Oil Basin’, which may hold up to 40 billion tonnes of hydrocarbon resources. This project, presented at the KAZENERGY Eurasian Forum over two years ago, has stirred interest among global oil corporations willing to invest in the new potential of the Pre-Caspian area.

These large oil and gas projects in Kazakhstan will create a multi-layered multiplier effect, leading to the development of oilfield services, expansion of oil and gas exports, more jobs, and an increase in the share of local goods and services. With the ongoing modernisation and reconstruction of the three domestic oil refineries, the volume of oil refining will increase from 14.5 million to 17.5 million tonnes after 2019. There will be an increase in the production of light types of petroleum products – gasoline, diesel fuel, jet fuel – and the import dependence of the domestic market will be eliminated.

In the Petrochemical industry, a number of large facilities producing oil bitumen, benzene and paraxylene has been launched over the recent years. The country is no longer dependent on the import of bitumen, with the total capacity of domestic plants reaching 1 million tonnes, in comparison with internal consumption of 400,000–450,000 tonnes a year. The Atyrau refinery has, in addition to increased output of high-octane gasolines, produced 5,000 tonnes of benzene, which had not been previously produced in Kazakhstan. Within the operation of the Special Economic Zone for petrochemicals in the Atyrau Region, construction of a 310 MW gas turbine power plant has started with the creation of over 700 jobs.

Despite Kazakhstan’s place in the top 20 world league of primary energy producers, our country faces a number of problems and threats. We must pay special attention to ensuring energy security, increasing competitiveness through energy and resource conservation, energy efficiency, environmental protection and water and energy issues. Kazakhstan clearly understands the role of alternative energy sources, including renewable energy sources and involving more of such projects in the energy balance.

Securing the future of energy

For Kazakhstan, sustainable energy is of utmost importance. The energy ministry and the KAZENERGY Association of oil/gas and energy sector organisations are actively fostering and implementing government initiatives to promote “green” strategies.

Over the recent years, Kazakhstan has adopted the concept of transition to the green economy, ratified the Paris climate agreement, and created a national system for greenhouse gas emissions regulation. President Nazarbayev initiated the Green Bridge Partnership Programme, which aims at strengthening green economic growth in Central Asia through international cooperation and promotion of technology transfer, knowledge sharing and financial support. The president has proposed to open the International Centre for Green Technologies Development and Investment Projects under UN auspices in Astana.

Local legislation seeks to provide a high level of stability for investment in renewable energy, first of all, in the development of solar, wind and river energy. The law on energy efficiency and saving is aimed at reducing the energy intensity of economy by 25 per cent by the end of the current decade.

In 2016, the amount of renewable energy amounted to 928 million kWh, exceeding the target volume by 16 per cent, although the share of renewable energy reached just one per cent of total electricity. Today, the country has 50 renewable energy facilities with a total capacity of 296 MW. At the same time, investors’ interest in implementing renewable energy
projects continues to grow. In order to avoid over-saturation and uncontrolled development of renewable energy in the country, specific target indicators have been adopted: to achieve a three per cent renewable share in electricity production by 2020, and 10 per cent by 2030.

In 2017, Astana hosts the EXPO 2017 international exhibition, the theme of which is “Future Energy”. This unique project aims to collect the best know-how in green technologies for the energy sector in order to demonstrate not only what will be the energy of the future, but also the problems of developing countries’ energy needs.

One key event of EXPO-2017 will be the XI KAZENERGY Eurasian Forum on September 7-8, 2017. Its organiser is the KAZENERGY Association with the support of the government. The forum traditionally attracts the attention of governments, international energy organisations and corporations, diplomatic missions, and academics. Its success and credibility are largely related to the participation of influential political figures and well-known experts with a worldwide reputation.

The partners of the Forum are major international organisations such as the World Petroleum Council (WPC), the International Energy Agency (IEA), the International Energy Charter, the International Energy Forum (IEF), the Gas Exporting Countries Forum (GECF), the International Renewable Energy Agency (IRENA) as well as international energy companies. For discussion at KAZENERGY Forum are issues and problems related to the effective management of sustainable energy sources, control over production, conservation and use of energy, universal access to energy, climate change and reduction of carbon dioxide emissions, encouragement of alternative energy sources, and implementation of energy efficiency programmes.

Part of Kazakhstan’s huge Kashagan oil field in the north Caspian
WITH CONFIDENCE TO THE FUTURE
Forecasting oil and gas demand, and therefore prices, gets harder. The traditional assumption of an inexorable rise in oil prices, due to higher costs and growing demand, has been shaken by US shale productivity. As John Mitchell of Chatham House puts it, the price machine has changed from escalator to treadmill. This is largely because of the breaking of one of the ‘great planning handholds’ – the assumed decline of US output – on which forecasters could steady themselves in a volatile world. Estimates of oil and gas demand are lower than they were five years ago, while discussion is about when demand peaks, at what level, and thereafter how quickly. As for policy, the Paris climate agreement provides a framework – but not so far any pressure – to lower demand for fossil fuels.

Spencer Dale and Armine Thompson of BP ask how this likelihood of some technically-recoverable barrels of oil never being produced might affect the long-term behaviour of low-cost producers, such as in OPEC. If the latter can no longer assume a barrel left in the ground today can always be pumped tomorrow, they might cease rationing supply. Moreover, the BP economists do not see any increase in oil output being significantly offset, on the demand side, by the rise of the electric vehicle (EV). They foresee an extra 100m EVs only reducing oil demand by 1-1.5 million barrels a day, unless digital and behavioural changes lead to really intensive use of these extra EVs. Oil demand is the crucial determinant of the refining industry, which will be changing its product mix and geographic location, according to Bakheet Al-Rashidi of Kuwait Petroleum International. The transport sector will continue to lead oil demand, but though growing it is slowing, in contrast to oil demand in petrochemicals that is expected to rise by 50 per cent in the next decade. Two-thirds of the petrochemical demand growth will be in Asia, where China will continue to be the world’s second biggest consumer of oil, and rising car ownership there and in India will boost gasoline demand. As for the refining business itself, the refineries will succeed if they are big enough to capture economies of scale, sophisticated enough to create complex products, and near enough regions of high oil demand growth.

Didier Houssin of IFP Energies Nouvelles examines the pros and cons of EVs powered by electric batteries or fuels cells using hydrogen, setting out the infrastructure and cost obstacles that need to be overcome before either power system can go mainstream. He sees an upturn in biofuel investment, due to Asian concerns about urban pollution, competitive South American supply and a transition in Europe to non-food based biofuels. Chris Le Fevre of the Oxford Institute for Energy Studies focuses on the potential of LNG to replace marine bunker fuel in shipping, and explains that one large ferry would consume in a year as much LNG as 130 fishing boats or 11,000 taxis. New international sulphur limits and gas/oil price spreads are driving the general advance of LNG as a marine fuel, with the best regional prospects being in North America, Europe and China.
The outlook for global oil markets over the next 20 years or so is dominated by two key questions: how might the growth of electric cars and the broader mobility revolution impact the demand for oil; and how might the combination of slowing oil demand and abundant oil resources affect the behaviour of oil producers? This article considers these two questions based on the analysis in the 2017 BP Energy Outlook which considers the “most likely” path for global energy markets to 2035 and explores key uncertainties.

Oil Demand

Oil and other liquids demand is expected to increase throughout the Outlook, driven by increasing prosperity in fast-growing emerging economies. Transport demand is projected to account for around two-thirds of that growth, but the impetus from transport is likely to slow over the Outlook period. A consequence of this slowing growth in transport demand is that the non-combusted use of oil, particularly within the petrochemicals sector, is expected to take over as the main driver of growth by 2030. This suggests that the most important source of growth in oil demand in the 2030s won’t be to power cars or trucks or planes, but rather it will be the use of oil as an input into other products, like plastics and fabrics. This would be quite a change from the past.

Focusing on the car sector, the global car fleet is expected to roughly double from 0.9 billion cars in 2015 to 1.8 billion by 2035. The vast majority of this growth stems from the growing middle class within emerging economies, with the number of cars in the developing world projected to triple.

Estimating the amount of electric cars in the global car fleet by 2035 is very uncertain. Our best guess is that the number of electric cars will increase from a little over 1 million in 2015 to around 100 million by 2035: a rapid increase, but with electric cars still accounting for only a small fraction of the total car fleet by 2035. Estimating the growth of electric cars is of course highly uncertain and depends on a whole range of unknowns, including developments in fuel economy standards, battery costs, government support for electric cars, oil prices, efficiency gains in conventional cars, and perhaps most important, consumer preferences.

We can breakdown our projection of oil demand for cars, which account for around 19 million barrels a day (mb/d) or 20 per cent of total oil demand in 2015. Other things equal, the doubling in the number of cars, should lead to roughly a doubling in oil demand (+23 mb/d). But this is significantly offset by projected gains in fuel efficiency as manufacturers respond to projected gains in fuel efficiency as manufacturers respond to tightening vehicle emission standards (-17mb/d). The increase in electric cars also dampens the growth in oil demand, but the scale of the offset is relatively modest.
Overall, liquid fuel demand for cars increases by around 4mb/d by 2035 in our central case, accounting for around a quarter of the total projected increase in oil demand.

A key message from this analysis is that the impact of electric vehicles on oil demand over the next 20 years is likely to be relatively limited: an additional 100 million electric cars equates to somewhere between 1 and 1.5mb/d of reduced oil demand. Even if electric cars were to grow far more rapidly than expected, say two or three times more quickly, this would reduce oil demand only by around 3 or 4mb/d in a market which is expected to expand by around 15mb/d to 110mb/d by 2035. Even a very rapid penetration of electric cars doesn’t seem likely to be a game changer for oil demand over the next 20 years, at least on its own.

Indeed, the implications for oil demand of the expected gains in the efficiency of conventional cars are many times more important than the growth of electric cars. This reflects the simple fact that, under most scenarios, conventional cars are likely to account for the majority of the global car fleet over the next 20 years, so small improvements in their efficiency can have substantial benefits. It is important that we do not lose sight of the potential importance of efficiency gains when considering policies to reduce carbon emissions from the transport sector.

But electric cars are only part of a broader mobility revolution that might affect the car market and oil demand over the next 20 years. When considering the potential changes to the car market, there are at least three other features which should be considered:

- **Autonomous driving** – which increase the efficiency with which cars are driven and thus reduces energy demand.
- **Car sharing** – where technology makes it easier for people to share cars rather than own their own (think Uber or Lyft). Car sharing doesn’t directly affect energy demand; it just means some cars are used more intensely. However, the important point here is that if, as seems likely, the cars which are used more intensely embody one of the new technologies – such as electric cars or autonomous driving – this will act to amplify the impact of the new technology since more miles are travelled in new-technology cars and less in conventional cars.
- **Ride pooling** – where technology allows journeys to be shared more easily, reducing total miles driven.

Trying to look into the future and calibrate how these different technologies and behaviours might evolve is clearly very difficult. Our view so far is that, if electric cars increase broadly in line with our central view, a rapid adoption of these other technologies (autonomous driving, car sharing and...
ride pooling) are unlikely to have a very significant impact on oil demand. But the impacts could be more substantial if the growth of electric cars is significantly stronger than we expect and the other aspects of the mobility revolution are all concentrated within electric cars. More details are given in BP’s Energy Outlook 2017.

**Oil Supply**
The second question concerns how oil producers might react to the prospect of slowing growth in oil demand, given the growing availability of oil resources.

The simple point here is that there is an abundance of oil. We estimate that technically recoverable oil resources, a measure which aims to capture those resources which can be extracted using current technology, are over 2.5 trillion barrels. In comparison with oil demand, that is more than enough to meet the world’s likely entire consumption of oil out to 2050, twice over. It seems increasingly likely that some technically-recoverable barrels of oil will never be produced.

Given this, the strategy that many low-cost producers have followed up to now, of effectively rationing their oil supplies with the expectation that a barrel not produced today can be produced in the future, may start to become less compelling. In the Outlook, we assume that low-cost producers, particularly Middle-East OPEC, Russia and US tight oil, respond by using their competitive advantage to increase gradually their market share, at the expense of higher-cost producers. This would represent a radical change in the oil market, with implications for both the composition of supply and longer-term price trends.

Given the abundance of oil resources, some movement in this direction seems likely, but how much and how quickly is hard to know and will depend on at least three issues: the cost and feasibility of low-cost producers increasing their production levels in the short-to-medium run; the impact a change of strategy towards selling more oil at a lower price would have on their economies; and, the ability of high-cost producers to compete by varying their tax and royalty regimes.

These two issues: the impact of electric cars and the mobility revolution; and the extent to which low-cost producers respond to the growing abundance of oil, are likely to have a significant bearing on the development of the oil market over the next 20 years.
SAVE THE DATE

23rd World Petroleum Congress December 6-10, 2020

HOUSTON
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DOWNTOWN HOUSTON’S CENTER OF ENTERTAINMENT

Avenida Houston is a walkable, pedestrian plaza featuring restaurant offerings, programmed events and unique art installations while also connecting visitors to surrounding attractions including three professional sports stadiums: Minute Maid Park (baseball), Toyota Center (basketball), BBVA Compass Bank (soccer) near the convention campus. In addition to the George R. Brown Convention Center, the new Marriott Marquis hotel, Discovery Green park and the Hilton Americas-Houston hotel.

energy API

VISITHOUSTON
The demand for oil and gas is continually evolving. There are mismatches between policies, industry strategies, and the changing possibilities of technology.

First, experts and investors have lost confidence in the traditional forecasts which suggested that oil prices would rise inevitably as a result of the higher cost and difficulty of meeting demand growing at historical rates. The phase of USD$100 plus prices between 2011 and 2014 looks anomalous given lower demand growth and more ample supply, and the US$40-$60 range is an acceptable (though rather vague) range for forward-looking endeavours. The price machine has changed from escalator to treadmill. One of the great planning handholds – that US production will inevitably decline – has broken. US production, driven by shale productivity, rose despite much lower prices in 2015 and 2016 caused by OPEC. The factors that caused shale production to rise may in the future be replicated in other countries.

Secondly, the industry is migrating to the Eastern Hemisphere. This is not a new trend. Asian demand has continued to grow, except in Japan, while it has stagnated or even fallen in some Atlantic countries. The figure below shows the oil deficits of Asian consuming countries now exceed the exports of the Middle East producers. Asian oil importers must now and for the foreseeable future compete for supplies from Africa, Russia, Central Asia, and South America.

Natural gas demand in Asian countries (except Japan) is a lower proportion of the energy mix than in countries where domestic natural gas is available. The cost of transporting LNG and investing in treatment plants constitute a barrier to developing new markets in Asia based on imports, even from within the Asian region. There, a pricing structure is needed which is high enough to support development for export in Australia and East Africa, but low enough to support the expansion of demand in Asia. The main market for LNG is the power sector, where government policy on nuclear industry and renewables defines the residual demand for gas.

Third, the Paris climate agreement of 2015 brings these trends together in a framework that will lower the demand for fossil fuels. It was approved by 140 countries including China, India, and the US and, in a diplomatic coup, it abandoned previous attempts to limit all individual country emissions by reference to an historic baseline (though this remains for developed counties). In contrast to the developed countries’ intentions to restrict and reduce carbon emissions, and accordingly the use of fossil fuels, the developing countries intend to reduce the energy intensity of their economies: the economies will continue to grow at their desired rates, but the energy input will not grow so fast and fossil fuel use will decline in the long run.

Both groups of countries are committed in their different ways to an objective of limiting global average temperature increase to well below 2°C. Individual countries have signified their “Intended Nationally Determined Contributions” (INDCs) towards this objective, but in combination they imply a temperature rise of 2.7°C (in a range of 2.2 to 3.4°C) by the end of the century. This fails to meet the objective but is an improvement on what might have been a 3.7°C increase under “business as usual”.

Next year the Paris signatories will begin to prepare for a 2020 renewal of the treaty in which pressure will be put on all countries to improve their targets and to reduce the mismatch between the objectives and the reality of the policies so far indicated.

Of course the US commitment to the objective of “2°C or less” is now seriously in doubt, although the US has not formally withdrawn from the Paris climate accord.

Much, however, will depend on the relative prices of gas and coal in the US. The Obama plan had envisaged an important shift towards gas and away from coal in the American power sector: coal demand would fall by 15 to 21 per cent in 2020...
and 16 to 38 per cent in 2040. Without this additional use of gas its price would be lower in gas-rich states, to the benefit of other consumers, such as the chemical industry. The high cost of exporting LNG may leave the US competing in foreign markets with cheap chemicals rather than with cheap gas.

In the EU, the demand for gas is also restricted by the reservation of part of the national power markets for renewables, (with different systems of support). Gas and oil demand will also be affected by a stricter emissions trading system.

In China and India current policy is to promote the use of gas over coal, and the use of renewables over both. Renewables costs have reduced drastically and consumption (especially of wind energy in China) has increased. These trends are likely to continue. In China, policies are focused on reducing the energy intensity of the economy, largely achieved by structural shifts away from energy intensive industries.

In the rapidly growing markets of the Middle East oil producers, there are measures to substitute gas for oil in power generation, to increase the efficiency with which electricity is used, and, in the case of Saudi Arabia, to diversify the economy.

Transport accounts for 60-70 per cent of oil consumption (higher in some countries) and is under pressure from tightening efficiency standards such as the CAFE standards in the US (which are at some risk under the new administration) and the EU. Automobile manufacturers are competing for leadership in electric vehicles, assisted driving and automated driving models: the effect of the latter two on oil demand and particularly on emissions is not yet clear.

It is difficult to estimate the trend of current policies, let alone future policies, on the demand side: reductions in demand for oil and gas increase demand for goods and services which enable consumers to avoid using oil, gas (or coal). These are business opportunities for the technologists of consumption, and a loss of business for the fuel suppliers.

Estimates of oil and gas demand are lower than they were five years ago and the discussion is about when demand peaks, at what level and the trajectory of subsequent decline.

One of the successes claimed for the Paris agreement is that it commits countries to review emission trends, in 2020 and then every five years, and exposes them to criticism of individual policies. It remains to be seen how this process works, but if the expected results of current policies continue to fail the aspirations for limiting warming to 2°C or less, then policies will be strengthened further. We cannot say exactly where or when this next seismic shift will occur but the trend seems inexorable. Close observation of trends on the demand side may introduce some certainty into an outlook already beyond the imagination of policymakers of ten or even five years ago.

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Wind farm on the top of Jiugong Mountain, Hubei Province, China
OIL IN THE GLOBAL ENERGY MIX

A vital question – strategic as well as technical: how long will oil continue to lead in the global energy mix, and how will oil demand be influenced by competition from other energy sources such as natural gas, electric battery vehicles and renewables?

The fuel mix continues to adjust. Although oil, natural gas and coal remain the dominant sources of energy, low-carbon energy – renewables, together with nuclear and hydro energy – will provide half the additional energy required beyond 2035. Natural gas is expected to grow faster than oil or coal, helped by the rapid growth of liquefied natural gas increasing the accessibility of gas across the globe.

The most likely pathway sees carbon emissions from energy continuing to increase, indicating the need for further policy action and raising important choices and opportunities for our industry.

Faster gains in energy efficiency combined with the gradual changes in the fuel mix mean the growth of carbon emissions from energy is expected to slow down relative to the past 20 years. Oil demand continues to increase, although the pace of growth is likely to slow as vehicles become more efficient and technological improvements, such as electric batteries, autonomous driving and car sharing, potentially herald a mobility revolution.

Transport will continue to be the world’s largest single demand sector for oil, accounting for just over half of global oil demand for the next 20 years or so.

In the developing world, China remains dominant, while India and Brazil will show strong growth in gasoline demand, as car ownership increases, in addition to rapid industrialisation. China will continue to be the world’s second largest consumer of oil, consuming around 15 million barrels per day (mb/d) by 2035, but its exceptional pace of growth, driven by rapid industrialisation, is likely to slow down.

The GCC region is fostering renewable energy, thereby diverting valuable natural gas to industrial use, mitigating greenhouse gas emissions and boosting the economy through job creation and investments in the private sector.

Examples of ambitious renewable projects include:

• Saudi Arabia’s Farasan solar power plant, the world’s largest solar park project
• The North Park project located in Dhahran, with the target of supplying 14 per cent of the country’s current power generating capacity by 2030
• Abu Dhabi’s Masdar City Solar project to produce the world’s cheapest electricity by 2020
• Kuwait’s Shagaya Renewable Energy Park – aimed at producing 15 per cent of the country’s electric power needs by 2030.

Keeping Q8 on Europe’s highways
A major area of continuing decline in demand for gasoline, and therefore low gasoline prices, is Europe, where many small-scale, low-conversion refineries have permanently closed or being converted to terminals. Europe has seen more than 2 mb/d in refining capacity shut over the past six years, with more closures forecast up to 2020, as gasoline demand continues to decline. Our strategy has been to divest small, simple refineries and to build bigger, more complex integrated ones and to locate them close to where the demand is growing.

It is anticipated that European demand may not pick up to any great extent due to environmental regulations and emissions reduction requirements, as well as to car manufacturers opting for smaller, more efficient engines.

Europe exports gasoline to the US east coast and imports distillates from the Middle East and Russia. Its refined product prices and refining margins are set by these trade flows rather than local economics. Even though Europe today consumes, at more than 12 mb/d, almost as much as the major Asian economies, growth is heading east. In Asia, we are progressing well with the commissioning of a US$9 billion greenfield project to build an integrated refinery and petrochemicals plant of 200,000 barrels per day (bpd) in Vietnam, along with our partners.

Nonetheless, Europe is still a strong and mature market, and it is extremely important for Kuwait Petroleum International (KPI) to maintain a strong retail outlet presence along Europe’s highways. These sites are the major strength of our network and play a vital role in building the Q8 brand awareness, which helps to boost sales elsewhere on the network.

The company’s new Antwerp lube blending plant enables Q8Oils to meet growing demand from customers quicker and more efficiently. This state-of-the-art blending plant is one of the largest and most technically advanced lubricant production facilities in Europe. KPI is proud to be operating this state-of-the-art, environmentally responsible blending plant with a current capacity of 125 million litres of lubricants, scalable up to 250 million litres per annum.
Downstream and future demand

Adding value to Kuwait’s upstream
KPI is the international downstream arm of Kuwait Petroleum Corporation with a focus on refining and marketing abroad. Europe has been our key market, and it is our plan to strengthen our position there by improving the efficiency of our operations and increase our presence.

Our growth in Europe during the past year was 15 per cent, which is a very high percentage if you consider the decline in European demand for petroleum products of 11 per cent in 2015, and of 16 per cent in 2016. Yet we have been able to increase our market share by concentrating on countries where we have major operations: Italy, the Netherlands, Belgium and Spain. In 2016 we completed our acquisition of all Shell stations in Italy, including four product storage facilities and about 830 filling stations, making us the second-largest player in Italy.

At our network of more than 5,000 retail fuel stations across Europe, KPI has also taken steps to provide cleaner fuel to ensure our competitiveness and to work with the communities where we operate on minimising damage to the environment. Our service stations are characterised by innovation and environmental sensitivity, including the offer of Compressed Natural Gas (CNG).

Closer to home for us is our new joint venture with the Oman Oil Company (OOC), the Sultanate’s investment arm in the energy sector, to develop the Duqm Refinery and Petrochemical Complex, with capacity of 230,000 bpd. The project is sited in the special economic zone in the Al Wusta region, and will provide a significant long-term outlet for Kuwaiti and Omani hydrocarbons.

In brief summary, we see three main keys to refining success: capacity large enough to provide competitive economies of scale; complexity and sophistication in configuring refineries; and geographical presence in regions of high growth.

### Average annual growth in oil demand (%)

<table>
<thead>
<tr>
<th>Region</th>
<th>2005-2015</th>
<th>2016-35</th>
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<tbody>
<tr>
<td>World</td>
<td>1.1</td>
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<td>India</td>
<td>4.8</td>
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</tr>
</tbody>
</table>

**Source:** KPI in-house analysis, BP Statistical Review 2016, Wood Mackenzie 2016 Forecast

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**Regional evolution of refining: Global Refining Capacity**

- **North America:** 19.96 MM B/D (138 148)
- **Europe:** 19.83 MM B/D (111 142)
- **CIS:** 7.33 MM B/D (124)
- **Middle East:** 9.23 MM B/D (52 78)
- **Africa:** 3.49 MM B/D (64 118)
- **India:** 6.42 MM B/D (23 151)
- **Japan:** 3.84 MM B/D (15 133)
- **Asia Pacific:** 32.73 MM B/D (175 188)

**World Crude Capacity: 95.97MM B/D**

- No. of Refineries: 144

*Asia Pacific includes China, India, Japan and Others*
Achievements and commitments

- A recognized experience in oil and gas industry
- An international oriented development
- A global pioneer in LNG industry
- A socially responsible company
- A committed human resource

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Today 56 per cent of oil production is consumed in the transport sector and the share of oil products in the final energy consumption for transport reaches 93 per cent, making this sector among the least diversified. Thanks to a high energy density (~12 kWh/kg), well-established infrastructure and abundant supplies, liquid petroleum-based fuels are massively used in transport.

The transport sector is also, after the power sector, the second largest contributor to energy-related greenhouse gas (GHG) emissions, with 23 per cent of current world CO₂ emissions.

Demand for passenger mobility and freight is growing fast, with the need for oil rapidly increasing. Moreover, options to reduce the sector’s overwhelming oil dependence are not yet available and there are still large possibilities to optimise the thermal engine. Nevertheless, efforts are being made to overturn this apparently stable situation, and alternative visions for the energy mix in the transport sector are taking shape.

The need for a transition in the mobility sector

The Paris agreement will steer the world towards a low carbon economy by the end of the century. In the meantime, pollutant emissions in the cities (NOx and particles) have become a significant public health hazard. But while the development and utilisation of Renewable Energy Technologies in the power sector continue to progress, the deployment rate of most clean energy technologies in the transport sector is still rather slow.

How long could it take to transition away from our current energy system in this sector? Are we considering a smooth transformation, or are we at the eve of a disruption leading to the quick decrease in oil consumption?

Building medium-term and long-term scenarios and being able to anticipate technological breakthroughs, radical political changes or sudden modifications in social behaviour remain a challenge. What are the current possible game-changers and the technological breakthroughs that could trigger the energy mix change and decrease oil demand in the transport sector?

Efforts are well under way to find alternatives to oil. With an increase in environmental pressure, the solutions could be new models for mobility demand, new technologies and also the development of alternative fuels.

Biofuels: A relative growth under constraints

After three years of contraction, world biofuel investments are expected to recover in 2017 due to the following growth drivers: (i) strong commitments from Asian countries on energy security and air quality, (ii) opportunity for an expansion of competitive biomass supply in South America, (iii) a transition toward non-food-based pathways in the European Union and (iv) boosted interest in export markets in the US.

In a mid-term perspective, second generation technologies from lingo-cellulosic biomass could emerge rapidly. Several projects have been announced in America, Europe and Asia, some of them cost-competitive with current pathways, but investors still need public support and a clearer policy outlook.

On the demand side, liquid fuels for road transport still have significant prospects for growth in developing countries. Moreover, considerable perspectives could emerge in the aviation and maritime sectors, as environmental concerns are strong and growing in these sectors. Indeed, a greenhouse gas reduction objective in the aviation sector could imply a worldwide and large demand increase in liquid biofuels (nearly 3 million barrels of oil equivalent per day in 2040 according to the International Energy Agency), as the aviation sector has few options other than biofuels when it comes to replacing petroleum jet fuel.

However, a number of uncertainties remain that could slow down the biofuels market expansion. Post-2020 regulatory constraints and goals for the incorporation of biofuels into the transport sector in the US and EU will be determining factors. The reduction of capital expenditure for future biofuel technologies, and their relative competitiveness, will govern the evolution of the respective market shares in the sector.

Electricity for transport: Evolution or revolution?

Electric vehicles (EVs) are regarded as one way to reduce the environmental impact of transport. The EV market is still developing and the mid-term perspectives are promising. The gradual electrification of an automobile fleet enables governments to address existing challenges, i.e. reducing GHG emissions (if the electricity used is low-carbon), reducing urban pollution, and decreasing domestic consumption of petroleum products.

The light-duty EV market (including battery electric vehicles and plug-in hybrid electric vehicles) has consistently grown since the arrival of the first mass-market models. While only 50,000 vehicles were sold worldwide in 2011, the market reached 775,000 vehicles last year (placing the global plug-in share at some 0.85 per cent).
Even though the current range of EVs can cover most day-to-day journeys, range limitations remain one of the key concerns for buyers, as well as do the cost of EVs without any purchasing subsidy. Nevertheless, there are real technical improvements, and manufacturers continue to invest in expanding battery range as well as reducing their weight, by improving energy density. The cost of batteries has fallen fourfold since 2008, reaching approximately US$265/kWh in 2016 according to the US Department of Energy. Simultaneously, investment in recharging infrastructure is still developing in many countries.

High purchase prices, the need to establish incentive-based public policies to significantly increase sales, and vehicle range (including charging time) are challenges to overcome before EVs become a sustainable part of the world’s automobile fleet. Although important progress is made, a breakthrough leading to mainstream applications of fully-fledged EVs does not appear likely in the near future.

Hydrogen: An option for the future?

Hydrogen and fuel cells which offer zero tail-pipe emissions could play a significant role in reducing air pollution from transport. However, it remains in our view an option for the longer term as part of the electrification of transport. As for the EV, its potential to mitigate climate change will depend on the hydrogen production process.

The main advantage compared to battery electric vehicles is expected to be the driving range (up to 500 km) and the refueling time (similar to liquid fuels). The main obstacles to growth are related to current costs of fuel cells and electrolysers, the development of a hydrogen transport, distribution and retail network, and the cost-efficient generation of hydrogen with a low-carbon footprint.

Innovation and technical progress are underway. To meet the Paris agreement on climate change and to limit the urban pollution due to transport, actions should be taken in two directions – improve the efficiency of vehicles, and diversify the energy pathways for the transport sector.

Alternative solutions, like EVs, biofuels, or hydrogen can achieve low-carbon forms of individual transport and contribute to decarbonising the transport sector. However, most of these new technologies are still in their early stages of commercialisation. The emergence of second generation technologies of biofuels (widely developed at IFPEN) and the development of mobility services could be the ground-breaking factors.

Forecasting energy demand and supply for mobility (persons and goods) is a difficult exercise. Various scenarios can be applied, ranging from a strong development of electric vehicles in the short-term and a rise of biofuel demand, to a “business as usual” case.

While we recognise the necessity of the development of alternative fuels to tackle climate change and environmental issues, we believe that oil will still maintain a dominant share in the energy mix of the mobility sector in the next decades. Indeed, even an optimistic scenario for alternative solutions to fossil fuels could only result in a saving of up to 15 million barrels a day (15 per cent of today’s oil consumption) in 2040. It would represent a significant part of oil consumption, but it would not represent a radical change in the transport energy mix.
The use of natural gas as a transport fuel (primarily in the form of compressed natural gas – CNG) has failed to make significant inroads in most markets. Liquefied Natural Gas provides two and a half times the energy of an equivalent volume of CNG and the consequent greater range and efficiency makes it a practical fuel for heavy road vehicles and ships, particularly where it can also provide cost and environmental advantages over existing fuels. The market is still in its early stages, though the long-term potential could be significant. This article focuses primarily on the prospects for LNG in shipping.

There are both demand pull and supply push factors. From a demand perspective, the attractions of LNG arise from its financial and environmental advantages in comparison to other fuels.

- The financial case for LNG is dependent on the price differential with diesel in road transport and with heavy fuel oil in marine markets (marine gasoil is also important in some marine markets). Comparative taxation rates can also play an important role in inland markets.
- The environmental advantage of LNG arises from lower emissions of carbon dioxide (CO2) and of virtually no nitrogen oxides (NOx), particulate matter (PM), or sulphur oxides (SOx). The latter pollutant is a concern in maritime transport where fuel oil use still dominates; the International Maritime Organization (IMO) has introduced restrictions on sulphur content in fuel oil in mandated emission control areas in North America and Europe. From 2020 global sulphur limits will be applied to all shipping fuel.

Supply side factors include the increased availability of LNG and of LNG terminals (many of which have spare capacity), the growth of small scale transport of LNG and the presence in some markets of an existing off-grid sector supplied by LNG.

The volumes consumed by different vessels or vehicles can vary widely – for example, the annual LNG consumption of a large ferry is approximately equivalent to the combined consumption of 130 fishing boats, or of nearly 11,000 taxis. The relative scale makes large marine vessels the most prospective market for LNG sales.

Obstacles to be overcome
There are a number of barriers that can hinder the uptake of LNG in the various market sectors. The most important obstacles are:

- comparative prices,
- cost and availability of appropriate vehicles/vessels and of refuelling infrastructure, and
- regulatory inconsistency.

Fuel costs are a critical consideration for any transport operator. In shipping for example the cost of fuel can account for 60-80 per cent of a vessel’s operating expenses. The commodity price of LNG has been well below that of oil products.
in non-Asian markets for many years, though the gap has decreased since 2015 with the fall in oil prices. This narrowing of differentials is illustrated in the chart which shows the differential with gasoil in the emission control areas of North America and Europe, and with fuel oil in Asian markets. This chart shows that natural gas has generally been cheaper than gasoil in Europe and the US, whereas the differential between LNG and fuel oil in Japan is generally narrower, which is to be expected given that the price of most Japanese LNG is still linked to crude oil prices.

The benefits of LNG in terms of reduced fuel costs have to be considered against the higher capital charges for a new or converted LNG-fuelled vessel. These relate primarily to the higher costs of an LNG-fuelled engine and of the storage and delivery system. Studies suggest that a discount of US$2-4 per million British thermal units (MMBtu) to the equivalent fuel is required for most vessel types, while very large bulk carriers require a discount of around US$6/MMBtu. There is a further obstacle, however, that is specific to the shipping market. Ship owners usually charter their vessels to operators under long-term contracts. The owners do not, therefore, reap the fuel cost savings associated with the higher investment cost. This makes retrofitting a vessel for LNG particularly challenging.

In the road market, the financial case is often heavily impacted by the relative taxation rates at the point of sale. In most EU countries, taxation accounts for around two-thirds of the retail price of diesel (though discounts can confuse the picture) while in the US the equivalent taxation figure is only around 13 per cent. Retail LNG is generally taxed at lower rates, though the price differential is much greater in Europe than in the US.

The second barrier to overcome is the availability of appropriate vehicles/vessels and refuelling infrastructure. LNG bunkering capacity is being developed most rapidly in Europe, though North American ports are not far behind, with Singapore also making good progress.

The third obstacle concerns the regulatory framework. The uncertainty over the timing and extent of the restrictions on sulphur in fuel oil being extended globally has now been removed. There is, however, regulatory inconsistency between (and sometimes within) countries regarding the control and regulation of LNG re-fuelling.

**Key regional markets for LNG**

The prospects are greatest in the three major markets of North America, Europe, and China. These markets share some common characteristics: large long-haul road freight and coastal/inland shipping sectors and existing LNG infrastructure (including storage facilities, coastal import terminals, and a growing number of refuelling/bunkering facilities).

The North American market also has the advantage of low-cost indigenous gas production, an innovative LNG vehicle and engine sector with a number of players, and the North American Emission Control Area (extending 200 miles out to sea from the coast) which encourages the use of LNG in shipping. The main barriers to uptake have been the fall in oil prices, LNG taxation, and gaps in the refuelling network.

In Europe differential taxation means that LNG prices for road hauliers are much lower than diesel, and the Baltic and North Sea Emission Control Areas have boosted the LNG marine fuel market – most notably in Norway. The EU Alternative Fuel Infrastructure Directive and the LNG Blue Corridors project are encouraging the use of LNG, though take-up is still relatively slow.

In China growing concern over air quality has resulted in a government target of 10 per cent of total inland transport fuel consumption to be of natural gas by 2020. There is already an extensive LNG supply chain in China and at the end of 2013 the country had an estimated 100,000 LNG vehicles, making it by far the largest LNG-fuelled fleet in the world.

It is not yet clear whether LNG will break out from its current, relatively minor niche role in some regional markets to become a significant global transport fuel. The key determinant is likely to be whether LNG prices remain competitive, both with existing fuels and new alternatives.

The narrowing of the oil/gas price spread since 2015 has reduced growth expectations for LNG in transport, but the combination of legislation limiting sulphur in marine fuels and growing concerns over particulate emissions from diesel in urban areas means that demand growth in the sector is expected to be positive. Most forecasts expect global volumes in the sector to grow to between 25 and 50 million tons per annum (mtpa) by 2030; this compares with global LNG production of around 260 million tons in 2016, forecast to increase to 375 mtpa by 2021.

Developments in the maritime sector are likely to be key, as this will provide a platform of significant scale to allow road-based usage to develop in a relatively risk-free economic environment. Timescales could, however, be extended by the fact that retrofitting to LNG is difficult and expensive and the switch to the new fuel is most likely to occur at the point of vehicle/vessel renewal.
If there is one aspect of the petroleum industry’s sustainability that everyone has a stake in, it is the energy sector’s carbon emissions, the largest contributor to man-made climate change. Rachel Notley, premier of Alberta, has taken a bold approach. She has imposed an economy-wide carbon levy and set emission limits on exploitation of the oil sands that give the Canadian province the world’s third largest oil reserves. Part of the carbon tax proceeds goes to reducing energy emissions, as well as to renewable energy and efficiency, in order to make Alberta higher-tech and lower-carbon.

Molly Walton of the IEA tackles the energy-water nexus – how the energy and water sectors need each other. China and India need water to cool their nuclear and coal-fired plants, many of which are sited in areas of water stress, while Middle East and North African desert regions will need far more energy for desalination to meet their water demand. Saving energy and water helps both sectors.

Malcolm Dickson of Wood Mackenzie addresses the emerging issue of decommissioning oil and gas rigs in maturing offshore oil provinces like the Gulf of Mexico and the North Sea. Governments need to be prescriptive enough for operators and contractors to plan the phasing out and dismantling of equipment, but to avoid over-regulation that would stifle innovation in new techniques. Decommissioning is proving an obstacle to merger and acquisition activity, with sellers as well as buyers of assets wary about liability risk. Nonetheless, Ian Catterall of the Bank of Tokyo-Mitsubishi reports that good transactions – able to show compelling economics even in the low part of the oil price cycle – are able to get financed. Private equity investors have drawn many bank lenders back into upstream projects, though financing of downstream projects like refineries and petrochemical plants has slowed down.

Laszlo Varro of the IEA reminds us that energy is the world’s most capital-intensive industry, accounting for a tenth of total global investment. The most important factor for investment has been the halving of the crude oil and LNG prices since the WPC met in Moscow three years ago, and the consequent fall, outside of North America, in conventional oil investment. However, with stricter management controls and some structural cuts in costs, the industry is in better shape than it has ever been. Moreover, the low level of activity on the supply side means it is nearly impossible to see oil or gas assets being stranded for lack of demand. However, the oil and gas industry faces the growing risk of cyber attacks, a threat explained by Leo Simonovich of Siemens. Cyber security has not kept pace with digitalisation, and piecemeal solutions will not work. Isolating systems does not reduce risk, because connectivity, while often making systems vulnerable, also provides the very transparency needed to detect and take action. More use of machine learning and artificial intelligence are good options for companies to build up their cyber threat monitoring capability.
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Controlling emissions key to Alberta’s energy future

By Hon Rachel Notley
Premier, Government of Alberta

Our world is transitioning to cleaner energy. Yet, even as the proportion of renewables grows, the world will continue to rely on hydrocarbons to fuel much of its power, heat, light and transportation for years to come.

In Alberta, we are proving that good jobs in oil and gas go hand-in-hand with reducing emissions. Through close co-operation with leading international energy companies, environmental leaders and Indigenous communities, we are reducing emissions, getting new pipelines approved, and helping to position our energy industry for a low-carbon future.

With the world’s third largest energy reserves, and some of the largest gas formations, Alberta can meet the continuing need. Production is growing, with 600,000 barrels a day coming on line over the next two years.

But our land-locked geography limits sales to North America. A pipeline to the Pacific coast has been a long-sought goal of producers and successive Alberta governments. Previous governments failed to make it happen, in large part, because they didn’t take climate change seriously. Our government was elected to change that.

To develop a made-in-Alberta approach to climate change, broad consultations were held with energy, environmental and business leaders, and with indigenous communities and the Alberta public. More than 25,000 people shared their opinions online or in-person.

The result is an Alberta Climate Leadership Plan that puts an economy-wide price on carbon and sets limits on emissions. Oil sands emissions are capped at 100 megatonnes a year. By 2025, methane emissions will be cut by 45 per cent from 2014 levels.

A portion of carbon levy revenues will be invested in helping to reduce energy industry emissions, as well as in renewable energy projects, green infrastructure and energy efficiency programmes.

Advanced technology is Alberta’s third-largest value-added industry by value added, with more than 1,300 companies generating C$3 billion in revenue. Much of Alberta’s advanced technology brain power and research infrastructure are working on lowering emissions, including from oil, gas and the oil sands.

The future of Alberta’s energy sector will be high-tech and lower-carbon. It also will be more innovative and more sustainable. Oil and gas from Alberta’s dependable supplies will be a more responsible choice for a greener-minded world, and will help get it there.

Alberta’s energy and climate leadership also provides the credentials that are gaining access to a more diversified market via a pipeline to the Pacific tidewater.

Prime Minister Justin Trudeau credited Alberta’s climate leadership in his government’s decision to approve the Trans Mountain Pipeline to the Pacific coast. It is the pipeline we have been working for—one that will bring Alberta energy to tidewater and to international markets.

A greener and competitive energy industry that has access to tidewater is an attractive investment opportunity—as are the technologies that lower emissions. And a higher value-added energy industry, for example through petrochemicals, offers further investment potential.

Backed by the lowest overall tax regime in Canada, Alberta is an exciting place to invest. Business development, export support and investment attraction programmes help business and investors meet their own business goals, and create jobs for Albertans. It is a message that Alberta has carried to investment forums and trading partners around the world.

Alberta has come this far by seeking advice and input from a broad range of interests. Taking an inclusive approach helped the Climate Leadership Plan win praise from the energy industry and environmental advocates alike. By working together, Alberta is building a healthy energy industry that produces fewer emissions, offers greener alternatives to coal, supports the development of clean technology, attracts investment, and continues to provide a reliable source of energy over the long term.

The consultation and collaboration continue. We are gathering information on the best way to implement our pledge to limit annual oil sands emissions. Other consultations are underway with industry as we develop a carbon competitiveness system that rewards top-performing facilities and provides output-based emissions allocations to emissions-intensive, trade-exposed industries.

It is a key part of how this made-in-Alberta plan protects great energy jobs and our province’s key industry. Not only will output-based allocations reduce the average cost of compliance for some, it will also help to drive best-in-class performance, support comparability with international jurisdictions, and maintain Alberta’s global competitiveness.

An Energy Efficiency Advisory Panel is also consulting widely to learn how government should evaluate new technologies, deliver effective programmes and measure outcomes, as we encourage Albertans to lower their energy usage and save money.

We also seek advice more broadly, through agreements, Memorandums of Understanding, formal partnerships and investment opportunities around the world. The World Petroleum Congress is one such event. Expect to hear more from Alberta, and expect to be excited by the potential.
Managing the interdependence of energy and water

By Molly A. Walton
World Energy Outlook, International Energy Agency

Effectively managing the interdependence of water and energy supply is fundamental to the economic and social prospects of millions around the world. The provision of water services, such as clean drinking water and sanitation, depends on reliable supplies of energy. The ready availability of water is a key factor in the viability of many energy projects. Almost all of the weaknesses in the global energy system, whether they are related to energy access, energy security or the response to climate change, can be exacerbated by changes in water availability. And almost all of the fault lines in global water supply can be widened by failures on the energy side.

With both energy and water demand on the rise, and with a large share of the world’s population remaining without adequate access to reliable energy and water services, it has become ever more important to understand the linkages between the two, to anticipate future stress points and to implement policies, technologies and practices that soundly address the associated risks.

The current status of the nexus between water and energy and how the complex interdependencies will deepen in the next decades was examined in the 2016 edition of the World Energy Outlook, the International Energy Agency’s flagship publication.

Water for energy
Recognition by the energy community of the critical importance of water to the energy sector and the impact that the sector can have on water quality and quantity has grown in recent years. Today, the power sector is by far the largest source of freshwater withdrawals by the energy sector, accounting for almost 90 per cent, while primary energy production (coal, oil, natural gas and biofuels) accounts for almost two-thirds of the energy sector’s total water consumption.

The energy sector is set to become thirstier over the next decades. In our main scenario, while global freshwater withdrawals from the energy sector rise by less than 2 per cent to 2040 to reach over 400 billion cubic metres (bcm), the amount of water consumed increases by almost 60 per cent to over 75 bcm (see Figure 1). The shift towards higher efficiency power plants with advanced cooling systems lowers withdrawals (and tempers or moderates consumption) while a rise in nuclear power generation and in biofuels production increases both.

While a lower carbon pathway offers significant environmental benefits, the suite of technologies and fuels used to achieve this reduction can, if not properly managed, exacerbate or be limited by water stress. Technologies, such as

Figure 1: Global water requirements for the energy sector, Main Scenario

Notes: Biofuels refers to irrigated crops grown as feedstock. Renewables includes solar photovoltaics (PV), concentrating solar power (CSP), wind, geothermal and bioenergy. Hydropower is not included in the estimates presented here as a majority of the water withdrawn is returned to the river; however hydropower’s water consumption is highly site-specific and the measurement methodology is not agreed upon.
as wind and solar PV, require very little water, but others like biofuels production, concentrating solar power, carbon capture and storage (CCS) and nuclear power can have more significant water demands. As a result, our analysis shows that in a 2 Degree scenario, though water withdrawals for the energy sector are 12 per cent lower than they are in our main scenario in 2040, consumption is 2 per cent higher (see Figure 2).

Water will increasingly affect the physical, economic and environmental viability of energy projects, even low-carbon ones. The availability of water, particularly for emerging economies, could become an increasingly important issue. For instance, demand for water from many end users is increasing in China and India, which both rely on nuclear and coal-fired power plants, many of which are located in areas of water stress. As a result, policymakers must account for water when making decisions, and assess the current and future water availability when choosing the energy mix, the location of energy projects and the cooling technologies.

Energy for water
The other part of the nexus, how much energy the water sector uses, is less well understood but just as critical. To this end, the WEO-2016 analysis provided the first systematic global estimate for the amount of energy used to provide water services to consumers.

Today, the amount of energy used in the water sector is almost equivalent to the entire energy demand of Australia. Most of this is in the form of electricity. In 2014, 4 per cent of global electricity consumption was used to extract, distribute and treat water and wastewater, along with 50 million tonnes of oil equivalent of thermal energy, mostly diesel for irrigation pumps and natural gas in desalination plants.

Our analysis shows that over the next 25 years, the amount of energy used in the water sector will more than double, as desalination capacity rises sharply in the Middle East and North Africa, as more water is moved to satisfy demand in water-stressed areas and as demand for wastewater treatment (and higher levels of treatment) grows, especially in emerging economies (see Figure 3).

The rising dependence on desalination in the Middle East, which is home to several of the countries with the lowest renewable water resources, to help close the water gap comes with a cost: by 2040, desalination will account for over 10 per cent of the Middle East’s total final energy consumption. Similarly, in many countries, a large
percentage of wastewater is not collected or treated, posing a threat to human health as well as being a hazard to the environment. Achieving the United Nation’s Sustainable Development Goal (SDG) to ensure access to water and sanitation for all will also require energy: by 2040, more wastewater will be treated and will need 60 per cent more electricity than it did in 2014.

There exists significant untapped potential to save energy. Exploiting the economically available energy efficiency and energy recovery potential (wastewater contains significant amounts of embedded energy that can be recovered in the form of heat and/or electricity from biogas production) could reduce energy consumption in the water sector by 15 per cent in 2040. At a local level, water services account for a large share of municipal energy bills; investing in efficiency and energy recovery could allow municipal wastewater facilities to move towards ‘energy neutrality’, where energy needs are entirely satisfied with own generation. Capitalising on energy recovery alone could cover more than half of the electricity needs of municipal wastewater utilities by 2040, but without greater attention from policymakers and municipalities this potential risks being unfulfilled. Additionally, reducing water losses — which occur through leaks or theft — can save water and energy. If all countries were able to reduce their losses to levels seen in advanced countries, the equivalent of the entire electricity needs of Poland could be saved today.

The Bottom Line

Many of the challenges we face, including the realisation of the Sustainable Development Goals on water and energy, urbanisation and the fulfillment of the Nationally Determined Contributions made at the UN Climate Change Conference in Paris in 2015, hinge on understanding the linkages between these two resources. Policies and technologies already exist that can help reduce water and energy demand, and ease potential chokepoints in the water-energy nexus. Taking advantage of these opportunities will require an integrated approach to energy and water issues from policymakers and industry — without it there is a risk that the development of one sector will have negative consequences for the other, undercutting the chance to reach policy and development goals effectively, or in some cases to reach them at all.


Figure 3: Total energy consumption in the water sector by process

Notes: Supply includes water extraction from groundwater and surface water, as well as water treatment. Transfer refers to large-scale inter-basin transfer projects.
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Smart Applications for Onshore & Offshore Pipelines
Decommissioning (decom) of oil and gas projects is fast becoming a pivotal issue for the industry. As we head into a critical mass of decom work, the size of the challenge facing operators, governments and supply chain is huge. It is worth focusing offshore, as this represents a task of a higher magnitude to onshore – in terms of complexity of operations, size of supply chain, and cost.

Decom activity tends to be clustered around the end of field life, and globally, on average 140 offshore fields are expected to cease production every year for the next 10 years. This is up from only 40 annually over the past five years. To give an idea of the scale of the task offshore over the next decade: 3,000 platforms, 550 subsea manifolds and templates, 84,000 kilometres of pipelines and control lines and more than 16,700 wells are expected to be decommissioned.

Questions abound. Is the supply chain ready? Are fiscal and regulatory frameworks fit for purpose? What will it cost? And how will it mesh with corporate strategies? Likewise, there is a host of corresponding opportunities, most clearly on the supply chain side.

To consider decom worldwide, it is important to look at the three provinces with the most activity – the US Gulf of Mexico (GoM), the UK, and Asia Pacific (APAC) – each of which is at a different point in the journey.

Compared to the rest of the world, decom is a mature activity in the US GoM. Regulations are in place and over 25,000 wells and 2,500 platforms have been abandoned and decommissioned so far. Even so, plenty of ‘idle iron’ remains. With more than 150 fields expected to cease production in the next 10 years, the backlog will only grow. Recently, we have seen an uptick in decom activity as the low oil price has rendered marginal producing fields uneconomic. But with service costs at rock bottom and oil price sentiment improving, the challenge now will be to balance decom with project investment.

In the UK, decom is a huge issue, especially as the total cost will be US$66 billion from 2017. Indeed, it is expected to reach a watershed in 2022, outpacing development capex for the first time. For that reason, it weighs heavily on the minds of operators, oilfield service providers and prospective asset buyers and sellers.

But the UK has developed strict regulations on removal and corporate liability, plus a clear tax policy for liable parties. We estimate the government will need to meet 45 per cent of the total decom bill through tax relief. The problem is that, given the maturity of the sector, expected future income from North Sea taxes is minimal. This means there is a mutual interest for companies and the government to bring costs down. There is also a big effort to maximise economic

The Brent Delta platform, as high as the London Eye, arrives in Hartlepool for decommissioning
recovery offshore, avoiding a ‘domino effect’ – that is, when critical infrastructure shuts down, causing production from dependent fields to cease early.

By contrast, decom in APAC is still in its infancy. For many years, it has been the elephant in the room that regulators and operators tried to avoid. Only a couple of small scale projects have been decommissioned in the region. But with over 410 projects expected to cease production in the next 10 years, decom can no longer be delayed and all the stakeholders must take responsibility. However, because of their lack of clear regulatory frameworks, most of the APAC countries appear unprepared to face this challenge today. Countries like Australia and Thailand are furthest ahead in planning. Now pressure is building on Indonesia, China and Malaysia in particular, as they all have a host of offshore fields to decommission over the coming decade.

Obstacles and opportunities

So what are the common lessons that we can draw from these provinces? Three clear themes emerge: regulatory environment, supply chain, and deal flow.

Fiscal terms and regulations will be pivotal: These need to be prescriptive enough for the operators to plan and budget confidently. Yet over-regulation is a risk too, as it can stifle innovation and erode markets by creating barriers. A balance needs to be struck between enforcing minimum standards and allowing the flexibility for companies to develop new techniques. In the GoM and the UK, regulations are stringent, while allowing decom activities to be run successfully and competitively. But most other regions are only starting to look into setting up frameworks – heaping uncertainty on operators, suppliers and the governments themselves. Meanwhile, the clock is ticking, with a massive wave of field cessations due to hit these regions in the next 10 years.

Is the supply chain ready? Despite the fact that decom is ongoing, the global supply chain is still a considerable way off establishing a large-scale business. The value of potential business is mouth-watering, but uncertainty over timing has held back many potential players. Understanding demand is the key. It is not only defined by the number of facilities to be removed or wells to be plugged, but also the methods used, which are continually developing.

Outside of shallow water GoM, the supply chain is under-developed. In the UK, a great deal of knowledge has been built from previous projects, but the lack of consistent demand has hindered capacity growth. Some ports and harbours have scaled up in anticipation of greater activity but contracts have been awarded overseas, frustrating local suppliers. In the APAC region, a sustainable supply chain is yet to be established. Indeed, local contractors appear reticent to invest in an industry they perceive as lower margin than their core construction offering. The common theme, recurrent across all regions, is that until demand is proven, contractors will be reluctant to invest in decom.

However, it is clear that the opportunities are substantial for all aspects of decom, from safe removal to onshore recycling. The biggest prizes are in well plugging and abandonment (P&A), which makes up the vast majority of the cost. In the near term, companies will continue to charter rigs for ad-hoc P&A work, thereby taking advantage of the down cycle in the drilling market.

In the longer term the most attractive solutions will be those that minimise or eliminate rig time. There will also be opportunities for companies that can offer integrated solutions to clients taking duty holder responsibility for projects. Doing things cheaper and quicker will be the competitive edge that the supply chain, and even some opportunistic oil companies, can use to create value.

 Blocking deals: For oil and gas companies, decom is proving to be a real hindrance to mergers and acquisition activity. Buyers see liabilities as a deterrent, while for sellers, the continued liability risk from disposed assets is also off-putting. In the GoM and the UK, statutes exist to protect the government from defaults by ensuring the partnership has sufficient financial strength to cover abandonment liabilities. In the APAC region, the lack of regulations has dampened the asset market. Buyers are interested, but the uncertainty surrounding decom has curbed appetites. Recent deals across all three regions have included creative clauses that either protect the seller from future liabilities or split the decom burden between both parties.

In conclusion, it is clear large-scale decom is coming, and that not everyone is ready. Even the GoM, which has the most experienced practitioners, has further to go in regulation, deal making and the supply chain. For every oil and gas producing country, understanding the demand outlook is vital. For those on the supply side, this will help build a scalable business around decom. For those paying for it, planning and cost control will be made easier.

Written in collaboration with Jean-Baptiste Berchoteau, Gordon Loy and Luke Davis.
Debt funding still possible in a low commodity price cycle

By Ian Catterall
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The oil and gas financing market has clearly been going through some challenging times. As represented by the Project Finance (PF) market, the volume figures for the first quarter of 2017 at US$8.7bn show a 19 per cent fall, compared to the corresponding period in 2016. Furthermore, when the debt for the National Grid sale in the UK is excluded, this reduction increases to a shade under 40 per cent. However, when looked at in the context of the overall market, the reduction is not quite so dramatic, being consistent with the overall global decline of 19.4 per cent from the comparable time period in 2016.

So what is the real picture for sources of debt available to the industry in the context of the current phase of the commodity price cycle? Has the oil price stabilised sufficiently for the International Oil Companies (IOCs) to start taking final investment decisions (FIDs) on a range of major projects? Or is the ability of the US shale producers to ramp up production relatively quickly and efficiently placing an effective cap on the price of oil? Anecdotal evidence would seem to suggest that there will be an increase in FIDs in 2017, with three major deepwater projects, Mad Dog Phase 2 and Kaikias in the Gulf of Mexico and Leviathan in the eastern Mediterranean, already approved. There is also the potential for two Floating LNG (FLNG) projects, Coral offshore Mozambique and Fortuna offshore Equatorial Guinea, to achieve FID this year.

The leading US and European IOCs have recently produced strong first quarter results reflecting the impact of higher crude prices combined with the beneficial impact of reduced costs. Reflecting the improved performance, Royal Dutch Shell, ExxonMobil and Total were all able to cover capital expenditure and dividends from operating cash flows. However, the recent dip in oil prices to below US$50/bbl will remind the IOCs that they are still operating in a challenged sector. Indeed, notwithstanding the probable continuation of the voluntary reductions in capacity by OPEC and other countries, most notably Russia, it is likely to be the response of the US tight oil industry that has a more significant impact on prices. The recent 2017 first quarter results of Halliburton and Schlumberger seem to suggest that the US$50/bbl price is an important driver in attracting more rigs back to work in the shale plays and thereby putting a de facto cap on the price of oil, at least in the short term.

So what does this do for the financing of upstream oil? Historically the Reserve Base Lending (RBL) structure has been a key debt instrument in the financing of the upstream sector. The combination of low interest rates after the 2008 financial crisis, coupled with oil prices at or above US$100/bbl, encouraged the financial markets to pour billions of dollars into shale production in the US and financings in the UK and Norwegian North Sea as well as sub-Saharan Africa. Companies such as Tullow and Lundin were able to use the benign market conditions to finance their development activities. In the North American market the aggregate of net debt of E&P companies was approximately US$200bn compared to approximately $50bn in 2005.

Private equity and banks acting together
With the collapse of the oil price in 2014 the stage was set for an increase in the involvement of the Private Equity (PE) sector. That this did not happen immediately was a reflection of ultra-low interest rates combined with a willingness of lenders to take a long term approach and not rush to push borrowers into default and ultimately liquidation. Upstream companies such as Enquest and Premier have benefited from this approach. There are signs, however, that the PE investors are now becoming more active and bringing with them the traditional RBL structure. The Chrysaor acquisition of the Shell assets in the UK North Sea was backed by EIG Global Energy Partners, but also attracted a US$1.5bn 6 year RBL initially underwritten by Bank of Montreal, BNP Paribas, Citigroup, DNB of Norway and ING. This demonstrates that traditional RBL is alive and that the banking market is prepared to support an appropriately structured transaction. The US$3.9bn acquisition by Neptune Oil and Gas – which is backed by Carlyle Group and CVC Capital Partners – of Engie’s exploration and production assets also demonstrates the increasing involvement of Private Equity.

Innovative equity structures have also played their part in helping lenders to become more comfortable with existing borrowers and therefore provide support for the RBL structure. For example, the combination of Det Norske and BP Norway to form Aker BP has arguably produced a stronger individual entity. Again Statoil’s investment in Lundin has arguably produced a stronger company.

In the downstream sector there has been a slowdown in the financing of oil refineries and petrochemical projects. A number of projects are potentially seeking financing including the Duqm refinery in Oman sponsored by Oman Oil Company and Kuwait Petroleum. Elsewhere, in Malaysia a joint venture between Petronas and Saudi Aramco may also be approaching the financing market for bridge financing to be
refinanced through a traditional long term project financing. The involvement of export credit agencies and development agencies to provide liquidity and longer tenors is likely to remain a feature of these financings.

Debt Capital Markets (DCM) also have a role to play. The recent financing of the Tengizchevroil expansion development in Kazakhstan has in part been financed through an initial DCM issue alongside short term bank debt with the potential for further DCM activity in the future. Tengizchevroil has clearly benefitted from an investment grade credit rating that has allowed it to access the DCM market. But with interest rates remaining at historically low levels, there is also a considerable volume of liquidity looking for yield that is increasingly focusing on emerging markets.

Institutions such as the World Bank group’s International Finance Corporation and the Multilateral Investment Guarantee Agency also have a role to play in financing oil and gas in emerging markets. This was evident in the financing for Vitol’s participation in the OCTP gas and liquids project offshore Ghana. The World Bank Group provided a total package in excess of US$1bn through a combination of direct lending and the provision of guarantees and letters of credit to support the contractual structure.

In conclusion, the picture is varied across both debt instruments and geography. In North America the high yield market is well and truly open and arguably is comparable to that seen when oil was last at US$100/bbl in the third quarter of 2014. More traditional finance is still available through the RBL market, but only for the better credits or to support existing clients through the current commodity price cycles. Some borrowers who had moved from the traditional Pre-export Finance (PXF) market to the unsecured market are now finding that they are making the journey back, as lenders are reluctant to provide support without appropriate security. For the more structured long term financings in emerging markets we are seeing the increased involvement of development finance institutions and the continued involvement of export credit agencies.

The bottom line is that good transactions will be able to source financing. To be good a transaction needs to be able to demonstrate compelling economics, even in the low part of the commodity price cycle. The financing may not necessarily be on the terms hoped for and may require more equity than anticipated, but for the well-structured transaction there is liquidity available.

Shell’s Everest platform is part of a US $1.5bn North Sea asset package to be sold to Chrysaor
Keep a steady flow of capital into the energy transition

By Laszlo Varro
Chief Economist, International Energy Agency

In the three years since the last World Petroleum Congress, the energy sector’s business, technology and policy environment has shifted tremendously. The market conditions prevailing at the time of the 2014 Congress seem an echo of a bygone age when oil was expensive and projections of ever-increasing demand were little questioned. But in that short timespan, market and technology changes have had a profound impact on investment, the lifeblood of the energy system.

Energy is the world’s most capital-intensive industry, accounting for around a tenth of total global investment. Investments play a crucial role for economic development, energy security, energy access and achieving global sustainability objectives. Countries don’t lack for creative policy ideas, but rather their success or failure is determined by their ability to mobilise investment to meet policy goals.

In this light, WPC 2017 is a timely forum to launch the latest World Energy Investment, a flagship publication by the International Energy Agency offering a comprehensive assessment of energy investments.

From the oil and gas industry’s point of view, the most important factor shaping investment is the stabilisation of crude oil and LNG prices at about half of where they were when the WPC last met. It is important to emphasise that this is primarily due to the industry’s own technology and investment successes. Climate policy, electric vehicles and self-driving cars might have a big impact on oil demand in the future. But today, the largest electric-car manufacturer has about the same impact on the oil supply-demand balance as a single modern horizontal rig drilling in the Permian formation in the US.

Structural and sustainable cost cutting

The transformation of the market environment has been the result of developments in oil supplies, capital availability for technology and the ability of companies to adjust their approach and culture. In fact, the transformation of the oil and gas industry will be a major challenge for clean energy investment. While electric cars have continued to grow more popular, so have big SUVs and pick-up trucks. Similarly, falling technology costs for wind and solar power are driving a race to the bottom with ever-lower prices for LNG and gas-fired power generation. As a result, continuous policy support for renewables remains essential for their growth.

If the past few years were challenging for new energy technologies, they provided a litmus test for the North American shale industry. As with every new technology, from the railroad to the Internet, some investors got carried away, some operators promised too much and some bankers regretted their generosity. Nevertheless, the industry passed the test and is now in better shape than it has ever been. A combination of strict management controls and impressive technological progress cut the cost of shale development. This probably earned the industry the title of most-radically improved energy technology, along with other more fashionable technologies such as solar panels and electric car batteries, at least for 2016.

As investment picked up in 2017, there are signs of cost inflation reappearing. Nevertheless we estimate that an impressive share of the cost decline observed in the past two years is structural and sustainable.

However, one should keep in mind that while the US shale industry has proven its resilience, it alone cannot shoulder all the growth in global oil supply. Outside of North America, the investment picture is bleak for conventional oil. Despite management efforts that have delivered a cost deflation almost as impressive as that of shale, investment activity remains very weak. In fact, the industry is currently not reinvesting to replace its inheritance. In 2016, the world consumed 25 billion barrels of conventional oil. If a very strong post-Paris climate policy were to put oil demand on a declining path, and the industry ran down its reserves, then by the late 2020s only 10 billion barrels of resources would be needed to start field development. By contrast, last year, the actual number was 4.7 billion barrels. The good news for the industry is that it is nearly impossible to have a stranded asset problem associated with oil and gas with this level of activity. Thanks to current excess capacity, oil and LNG security of supplies are adequate.

While oil and gas is still the largest piece of the investment cake, electricity is the fastest-growing part of the energy system with both technology and regulation reshaping investment. Wind and solar investment has a robust momentum, benefitting from technological progress as well as a policy design in many countries that is conducive to a low cost of capital financing. However, wind and solar alone are currently insufficient to achieve the transformation needed for climate stabilisation. This decade, the fast growth of wind and solar broadly offset declining investments in hydro and nuclear, leaving the annual expansion of low-carbon sources at around 1.2 percent of global power generation compared to an almost 2
per cent average growth rate of global electricity demand.

Electricity systems are getting smarter and smarter in managing the variability of wind and sunshine by mobilising flexibility resources. However, the overwhelming majority of this flexibility is not the result of investment into new technologies like batteries, but is due to old workhorses like gas turbines, hydro plants and transmission lines. Investments in these assets were often made decades ago, and they face increasing uncertainty. The old utility business model of buying primary energy, burning it in centralised power plants and selling electricity by the kilowatt-hour is being disrupted in a number of markets. And yet, new flexibility sources often have difficulty attracting finance, amid a lack of clear and adequate price signals for investment. To remedy this, regulatory reforms will need to deliver new market designs that incorporate new technological possibilities and create proper investment signals for both renewables and flexibility sources. Electricity networks remain essential and absorb a quarter trillion dollars capital investment annually, most of which is based on regulated markets.

The digital revolution also has a potential to transform the energy system. As of today, digital investment in energy is around half what is spent on video games each year, and still represents a minor proportion of the investment spending on energy infrastructure. Nevertheless, modern IT has already contributed to oil and gas upstream cost reductions. In electricity, its biggest promise is to unlock flexibility from consumers and networks in a decentralised fashion, and thus enhance the performance of existing systems and ease physical investment needs that might be expensive and difficult. There is little doubt that the big disruptive impact of digital energy is still yet to come, and will require a comprehensive response both from corporate leaders and regulators.

Overall, energy investment spending has been declining for the last two years. There are some good reasons for this, most importantly management and financial discipline as well as technological progress. Nevertheless, there are clouds on the horizon. Even under a strong climate policy, oil and gas field development will be needed beyond US shale. Moreover, that strong climate policy will have to be translated into investment by ramping up the growth of low carbon production by at least a factor of two, with all the accompanying transformation in market design and infrastructure operation. Energy is, and will remain, a cornerstone of growth and prosperity as well as the vortex of most environmental challenges. The industry and policymakers will need to make sure to keep the flow of capital steady.

A streamlined North American shale industry is now in better shape than it has ever been.
Our world is more connected than ever. Billions of intelligent devices from sensors to robots, generate, collect and store massive amounts of data. Companies are increasingly recognising that the ability to tap into this data can help them improve their own operations and performance. In fact, a company’s recognition of how to turn its data into business value is a key factor in its market success.

At the same time, a company’s greater connectivity also makes its systems more vulnerable to a myriad of cyber threats. According to a recent study by the Ponemon Institute that surveyed the world’s largest oil companies, 68 per cent of respondents said their operations experienced at least one security compromise within the past year. Attacks against digitalised operational technology (OT) now comprise 30 per cent of all cyber attacks.

Clearly, security is not keeping pace with digitalisation. To protect the oil and gas industry from the growing OT threat, companies must think and act strategically so they can gain visibility into their systems and secure their operating environments. The question the leadership of any oil and gas company must ask is not if it will be attacked. Rather, it must fully understand, when an attack does occur, the degree of visibility into its field and control room environment so that it can quickly respond and recover.

Isolation does not equal security

The relationship between connectivity and security is not always well understood. Companies often feel that isolating their systems reduces their attack surface and therefore their vulnerability. But this misunderstands the origins of many cyber threats. The Ponemon study found that 69 per cent of all attacks come from inside the company. For example, malicious code can be delivered via an unsuspecting vendor or rogue employee. In these circumstances, isolating systems from each other wouldn’t work. Isolation does not equal risk reduction. In fact, connectivity provides the very transparency that is required to detect and take action. Connectivity makes a system vulnerable but it also makes it safe.

That is why we advocate a holistic view of the cyber threat with our customers. This means taking a risk-based approach to managing cyber security and building connectivity in blocks. Having a robust cyber vendor risk management, dedicated approaches to transient assets and most importantly a robust monitoring approach is essential.

Industry is not fully prepared to address the risk

The industry remains largely unprepared to deal simultaneously with first-line-of-defence measures while building up internal advanced connectivity and monitoring capabilities. To be cyber secure, the imperative is to do both. Barely a third of oil and gas organisations surveyed in the Ponemon study rated their OT cyber readiness as high. At the same time, while 63 per cent of respondents identify analytics as an important tool for strengthening their cyber defences, only 20 per cent say they have that capability today.

It speaks well for many petroleum companies that their shared concern over a lack of preparedness has led them to begin collaborating. For example, in the US, the Oil & Gas Information Sharing and Analysis Center collects information provided by US oil and gas companies, synthesises this information and turns it into actionable data about common threats. American oil and gas companies are also working with regulatory leaders to develop effective national cyber security policies for critical infrastructure. These collective actions are important. But they are not sufficient. Individual companies must take the lead on protecting their own critical assets. Standards can provide a general framework, but the heavy lifting belongs to the asset owners.

More good news is the recognition at the corporate board level to address this imperative. Budgets for cyber continue to increase. Our customers already recognise the cyber threat and they understand the need to put financial resources against this threat. Where customers often need our help is in understanding what is mission critical and what to do about it on a practical level. This is where we can really support our customers, by helping them develop a baseline understanding of their connected asset base and its vulnerabilities. This informs how and where they should allocate resources to implement defensive technologies and adopt risk management strategies.

Getting the basics right is important but not enough

A simple list can help a company know if it is doing the right thing. Network segmentation, identify and access management, two factor authentication, life cycle management and basic monitoring – these are foundational capabilities for every industrial company. To go beyond these basics, though, companies must transform their network topology and build dedicated network requirements into their greenfield projects. We work with our customers to
define what those blueprints should look like. We draw from our significant experience from other industries so that we can adapt these best practices without disrupting the business.

Options exist for companies to build up their cyber threat monitoring capability, even if they lack an in-house cyber capability and are not in the position to add cyber-skilled staff. Machine learning and artificial intelligence are excellent options. AI-enhanced monitoring enables detection at much greater speeds, reducing the potential for significant damage. These solutions both detect anomalies and store data about operating environments to enable a smarter response for the future.

In addition to monitoring solutions, incident response programmes are critical to mitigating damage and minimising costs from cyber attacks. When an organisation has programmes and policies in place to effectively respond to the threat, it can quickly move into action based on cues from network monitoring. Wargaming with ‘red teams’ can be used to test organisations’ response capabilities within a protected environment. Response plans can then orchestrate resources.

Response as well as prevention

For Siemens, cyber security is an essential component of our vision for digitalisation and intelligent infrastructure. Over the last 10 years, we have invested over US$8.5 billion to make digitalisation a core part of our own business transformation. We make this internal capability and its complimentary external offerings – like Mindsphere, our industrial operating platforms – available to our customers.

Given that the probability of a cyber attack for any company is nearly 100 per cent, the question becomes not whether to act, but how. Holistic cyber security emphasises not only how to prevent but also respond to an attack. We take our customers on a cyber security journey that brings maturity to their cyber enterprise. This means starting with a strategy that deals in fundamentals, transforms an organisation’s response to the environment, and most importantly, builds their capacity to monitor and respond, from the oilfields to the control centres to the enterprise networks. This agility is essential to dealing effectively with the growing cyber threat. Those oil and gas companies that move proactively to build their capability to detect and respond will be best positioned to meet this growing threat.

Cyber security is essential to digitalisation and intelligent infrastructure
Ten of the UN’s 17 Sustainable Development Goals (SDGs) depend on achieving SDG 7 – universal access to modern energy by 2030. Malcolm Cosgrove-Davies and Yann Tanvez of the World Bank argue progress will be made chiefly through electrification, but gains in electricity will enable solutions more broadly across the energy mix. Moreover, natural gas and liquefied petroleum gas (LPG) have a major role in replacing traditional cooking fuels such as wood or dung which, burnt indoors, can seriously damage human health. Suleiman Al-Herbish of the Opec Fund for International Development is working with the World Petroleum Council to establish ‘the Oil and Gas Industry Energy Access Platform’, in order to leverage the industry’s capabilities in widening access to energy. Most people without modern energy live in developing countries where international oil and gas companies have long operated and know the local challenges; such companies can help meet domestic energy needs as well as export demand. In contrast to these developmental issues that are external to the oil and gas sector is the industry’s need to improve, and widen, its capacity for internal regeneration. Jean-Marie Rousset and Aleek Datta of Accenture warn many of the nearly half a million people who left the industry over the 2014-16 period will never return, and that at the present slow rate of recovery and hiring, there will be a serious shortage of petro-technical professionals (PTPs) by the mid-2020s. Many of these PTPs will not want to come back, and some of those who do will no longer have the right hi-tech skillsets. Nor is the industry’s image that appealing to many new graduates. Solutions lie in companies giving employees longer-term career perspectives, in emphasising new technologies to woo digitally curious recruits, and if necessary outsourcing more to contractors. Part of the answer must be to make full use of a potentially sizeable and critical pool of talent – women – by redressing the gender imbalance in personnel that is highlighted by Katharina Rick and Ivan Marten of the Boston Consulting Group and Ulrike von Lonski of the World Petroleum Council. The survey carried out by BCG and WPC shows that while women’s representation in office jobs can be as high as 40 per cent, it drops to only 15 per cent in the critical technical area. A number of improvements are suggested at the levels of entry, mid-career and senior leadership. With leadership commitment, especially from CEOs, most survey respondents believed that women’s representation could reach or surpass the 35 per cent mark within five years.
While access to modern energy is fundamental to development, more than one billion people still lack access to electricity, and about three billion are cooking with 19th century fuels. These tend to be wood, charcoal or dung which, burnt indoors, can seriously damage human health. In replacing them, there is a significant transition role for natural gas and liquid petroleum gas (LPG) which, though hardly zero carbon, are less smoky and deadly, as well as being suited to off-grid cooking.

Governments and their development partners have been the traditional financiers and implementers of access expansion programmes, but their action alone is insufficient to reach the United Nations Sustainable Development Goal (SDG) 7 on universal access by 2030. The private sector is increasingly finding financially viable solutions, and their accelerated participation is critical to reaching the 2030 goal. Improved governance and better coordination between governments, the private sector, development partners, and civil society organisations will be paramount.

Energy access is a prerequisite to development. Recognising that lack of access to electricity and modern cooking fuels is a key barrier to human development, the UN SDGs include a specific target for ensuring access to affordable, reliable, sustainable and modern energy for all. Unsurprisingly, progress on the 16 other SDGs is tightly linked to SDG7 on energy. Specifically, achieving 10 of the SDGs hinges on meeting SDG7, and of the 169 SDG sub-targets, 125 are closely linked to energy.

Coordination between all stakeholders will be critical towards achieving universal energy access and ensuring steady and inclusive growth in emerging markets. Across the energy value chains, governments will be responsible to ensure policies, regulations and laws are aligned so that investors (and customers) have a high degree of certainty to make investment decisions on energy supply and associated infrastructure. Immediate gains can be made in the electricity sub-sector that will enable energy solutions more broadly across the energy mix.

Current electrification rates are too low to achieve universal access by 2030. Globally, 1.06 billion people still do not have access to electricity, a number that will grow to 2.3 billion by 2030 if we maintain a business as usual approach. This means annual electricity access growth will need to increase grow by 66 per cent from the current rate of 86.5 million people to 144 million to reach the goal.

Sub-Saharan Africa’s electricity access challenge is particularly acute, and progress is slowing. South Asia and sub-Saharan Africa have the greatest number of people without access to power. While South Asia is making progress, the number of people getting access for the first time in sub-Saharan Africa is not keeping pace with population growth. A look at rural vs. urban access trends between 2012-2014 reveals that 92 per cent of new users were in urban areas. This means rural populations, which account for 62 per cent and 67 per cent of Sub-Saharan Africa and South Asia populations respectively, are far less likely to receive service.
Electricity access solutions are multifaceted, ranging from solar lanterns and small solar kits to ‘mini-grids’ to ‘unlimited’ 24/7 grid systems. While most customers consider 24/7 grid service to be the best solution, it is often not financially viable to extend grid services to remote and sparse populations. This is due to numerous factors including the high cost of extending grid networks, low electricity demand which limits revenue potential, and inability to pay for service. Fortunately, the market has responded with alternative ‘off-grid’ supply options such as mini-grids – for towns and villages – and individual solar systems – for household, commercial, and institutional applications. The off-grid solar individual systems’ market is the most dynamic, and has recently grown from offering basic services such as lighting and cell phone charging, to providing services that rival (and sometimes surpass) service from the main grid network, including energy for rural productive uses such as grinding and welding. Pico-solar products (mainly portable lights), have seen explosive market growth in the past five years, with more than 100 companies having sold about 20 million branded products by 2015.

Providing sustainable, affordable, safe, high quality service requires more than just the ‘last mile’ connections. All delivery channels (grid, mini-grid, individual systems) require a fully functioning value chain for sustainable service. For the grid, this means generation, transmission, distribution and retail elements must be financially viable, efficient, and suitably regulated to ensure quality service to customers. Likewise, the off-grid systems need adequate equipment supply chains, qualified operators and sales and service teams, and a regulatory environment which allows sufficient de-risking to offer a competitive and affordable service.

Governments are always in the forefront of their energy access programmes which, in the past have been primarily the role of the national power utility. More recently, governments have invited the private sector to play a role. Of the 111 countries included in the Regulatory Indicators for Sustainable Energy (RISE) database, 84 countries have enacted legislation aimed at encouraging private participation in energy access. The role of the private sector
rangen from full private operation of utility distribution networks, such as in Delhi, to the private operation of mini-grids (Tanzania) and distribution and servicing of solar PV systems (Bangladesh). In most cases, development partners, including multilateral institutions such as the World Bank, bilateral agencies, and non-governmental organisations also play important roles in helping to build the enabling environment to expand access. This includes financial and technical support, as well as international experience that can be adapted to the national context.

Private Sector funding is needed to plug the access gap. The International Energy Agency estimates a total annual investment of US$45 billion to meet Sustainable Energy for All’s goal of universal access by 2030, compared to today’s investments of about US$9 billion per year. This leaves a wide gap in the funding needed to reach the universal access target, a gap which cannot be closed without the private sector. In addition to financing, the private sector brings much needed human capacity to the access task as well as commercial disciplines. To date, the private sector’s role in electricity markets in emerging economies has largely focused on generation, although there are notable examples of private electricity distribution system operations such as in Cameroon, Uganda, Gabon, and Cote d’Ivoire. Privately operated ‘mini-grid’ systems are also becoming more common, including extending service from a private industry, such as a mine, to the surrounding community. The renewable off-grid market is also a vibrant and growing area for the private sector, including both individual systems (solar lanterns and home systems) and mini grids. For instance, it is estimated that the individual systems’ market alone represents a US$ 3.1 billion market opportunity for the private sector between now and 2020, when a third of today’s off-grid households may be using such technologies.

A role for gas in crowded cities
Following the Paris climate accord, natural gas and LPG will play an important role in securing affordable, reliable, and sustainable energy. As the lowest carbon alternative among carbon-based fuels, natural gas is well suited to provide energy solutions in densely-populated, urban areas and industrial hubs where energy needs remain either unmet or are being supplied with higher-carbon coal, diesel, heavy fuel oil; together with air pollution resulting from burning charcoal, wood and dung. The need to provide gas in crowded urban areas is guided by an understanding that the impact of climate change and air pollution is undercutting broader development opportunities. Across Asia and sub-Saharan Africa, the penetration of natural gas into coastal urban centres and industrial hubs will improve energy access for millions. In rural areas, LPG will play a significant role in the transition from traditional biomass to cleaner energy. LPG has been very successful in expanding its market share as a cleaner fuel where biomass is otherwise contributing to air pollution, sickness and premature death. To realise the above opportunities, coordination across government agencies, private parties and customers continues to be a major hurdle.

The potential for exploiting new technology is only starting to be tapped. Developments such as Pay-As-You-Go, mobile money, and smart metering technologies have sparked a revolution in the way companies do business. These technology-enabled business models allow entrepreneurs to remotely control and receive payments for their services, significantly reducing transaction costs, and open the door for follow-on sales such as system upgrades, appliance purchase, and even non-energy products such as insurance. These business models are evolving quickly, and the end point is still not in sight. For the private sector looking for the next world energy markets, it also represents an enormous opportunity. Large corporations, including from the petroleum industry, have played a modest role until now, with relatively small and localised investments. However, their placement at the economic heart of many countries means their focus on the energy access agenda could help achieve development impact, and new market development at scale tomorrow.
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Leading the way towards universal energy access

By Suleiman Jasir Al-Herbish
Director-General, OPEC Fund for International Development

In 2015, the world’s governments adopted the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs), and a few months later, signed the Paris Agreement, which came into force in November 2016. These landmark agreements aim to address some of the world’s most pressing economic, social and environmental issues.

UN member states are expected to use the SDGs to frame their development agendas, and there is a recognition that the private sector – including the oil and gas industry – will play an important role in achieving them. Therefore, the implementation of the SDGs should no longer just be part of corporate social responsibility of the private sector, but part of their core business.

At the root of the 2030 Agenda is the placement of energy at its centre as SDG 7, something that the OPEC Fund for International Development (OFID) and like-minded institutions had achieved by diligently working together under the umbrella of Sustainable Energy for All (SE4ALL). SDG 7 calls for universal access to modern energy services (including a shift away from biomass for cooking fuels and other heavily-polluting sources of energy) a substantial increase in the use of renewable energy sources, and increasing energy efficiency.

Indeed, energy is a key driver of sustainable development, without which most of the other SDGs cannot be achieved. Access to affordable, reliable, sustainable and modern energy is essential for economic growth, employment, education, poverty reduction, and health and safety. Yet in 2015, about 1.1 billion people had no access to electricity. Additionally in 2015, an estimated 3 billion people globally – 41 per cent of the world’s population – had no access to clean cooking and instead relied on solid fuels such as wood, charcoal and animal dung for cooking and heating. Meeting the needs of these billions through modern energy services can help mitigate the impacts of climate change and reduce the health risks associated with the use of traditional biomass.

Integrate SDG 7 into the industry’s core business

The oil and gas industry is already undertaking a range of actions to both address climate change and provide access to modern energy services. Some leading companies, for instance, supplemented their use of fossil fuels with renewable energy sources, particularly solar energy and biomass. Others have focused their efforts on the use of technology in Carbon Capture and Storage (CCS) initiatives for cleaner energy and have committed to end gas flaring as well as provide financial and technical support to foster the adoption of clean cooking stoves and fuels.

Oil and gas companies have critical and notable opportunities to help meet the world’s targets for access to safe, reliable, and modern energy, both within their own business models and together with partners. They can help operationalise SDG 7 in their core business practices by incorporating it into their corporate systems, policies and processes.

Many of those without modern energy access are located in developing countries where oil and gas companies have a long history of operating, giving them familiarity with local challenges. Companies can improve energy access by working with governments and local communities to determine how to best align their investments in a project with the country’s and community’s needs as well as to take advantage of opportunities to develop shared-use energy infrastructure.

For instance, if gas projects are developed with a view to service international markets, companies should work closely with the host government to maximise the opportunities for domestic gas allocation. Taking advantage of favourable circumstances to develop shared-use energy infrastructure could also increase electrification around the project site. In this respect, Nigeria LNG Limited (a joint venture between the Government of Nigeria, Shell, Total and Eni) established the Bonny Utility Company to supply affordable, reliable and cleaner electricity to around 93,000 people at economical prices.

Furthermore, oil and gas companies may find it advantageous to explore opportunities for research and development as well as commercial investment in deploying alternative energy technologies. In some cases, renewables may provide off-grid or micro-grid energy access in a more cost-effective manner than via the extension of energy grids to these areas. At the same time, this strategy also supports better health and environmental outcomes than the traditional use of biomass fuels. Total recently acquired an interest in two companies that offer solar-powered energy solutions for rural areas with limited or no access to conventional energy grids. They provide 10,000 new customers a month in Tanzania with home and battery storage systems powered by solar energy, and will launch a project that will install 100 micro-grids to supply electricity for 90,000 homes in Kenya.

OFID and Energy Access

These and similar actions are integral to addressing the...
challenges of sustainable development since they tackle universal access to sustainable energy, which is a cause that OFID has championed for many years. To address the challenges of energy access, OFID derived a strategy based on three pillars:

- First, advocacy, building awareness and momentum.
- Second, consolidating and expanding action and projects on the ground, and
- Third, effective partnerships and collaboration with other stakeholders, including the oil and gas industry.

With regard to the first pillar, OFID worked hard in international fora to include combating energy poverty in the post-2015 Development Agenda, and was among those whose efforts culminated in placing energy as SDG 7 in the 2030 Agenda.

Regarding the second pillar – activities on the ground – energy access has been the central theme of OFID’s work since 2007, when it received a mandate from the Riyadh Declaration of the 3rd OPEC Summit. OFID has taken up this call as a special mandate and has intensified its energy poverty eradication programmes, with the Declaration on Energy Poverty, issued in 2012 by OFID’s Ministerial Council, providing the strategic guidance for OFID’s work.

Since 2008, with the goal of alleviating energy poverty, OFID has delivered a total of US$3.4 billion in energy financing through governments, private companies, small and medium-sized enterprises, non-governmental organisations and through entrepreneurs. This sum leverages 91 projects worldwide, with a combined total value of over US$23.8 billion.

Effective partnerships and collaboration

But clearly, the scale of the task is much bigger than any single institution can overcome individually. It requires the coordinated efforts of a range of partners across many different sectors. This is the basis of the third pillar of OFID’s energy access strategy: effective partnerships and collaboration with other stakeholders.

A solid example of this partnership is OFID’s collaboration with the World Petroleum Council to leverage the oil and gas industry’s capabilities. In this connection, they launched last year the “Oil and Gas Industry Energy Access Platform (EAP)”, a collaboration between OFID, the WPC, Total, Shell, Schlumberger, OMV, IGU, GLPGP, BCG and other strategic partners such as the Shell Foundation. The membership of the EAP is open to all companies in the oil and gas industry, as well as to other stakeholders, including development funds and business developers.

The EAP Executive Committee (EC) unanimously elected Total as the Chair and Shell as the Vice-Chair and agreed to launch the EAP website on July 11 at the 22nd World Petroleum Congress.

Designed within the context of the UN multi-stakeholder initiative SE4ALL, the EAP will directly support the achievement of the SDGs, in particular SDG7 on universal access to sustainable energy. This strategic partnership is intended to leverage the knowledge, experience and technology of its members to provide a platform for collaboration on energy access solutions, improved energy efficiency and increased deployment of modern energy.
Fauna & Flora International (FFI) is the world’s longest established international conservation body, founded in 1903. We protect threatened species and ecosystems worldwide, choosing solutions that are sustainable, based on sound science and take account of human needs.

FFI works directly with businesses and the influencers of business across a range of sectors to bring about change for the protection of biodiversity in all its forms. Ultimately, we are working to create an environment where business has a long-term positive impact on biodiversity conservation.

If you or your company are interested in engaging in the urgent need to save our natural world and the species that inhabit it, please contact me to discuss how you can work with us to secure a future for our planet. In addition, I would be delighted if you are interested in joining our Conservation Circle: an exclusive Club for forward-thinking individuals who commit to making a significant investment in FFI and help us deliver the best conservation outcomes to wildlife and wild places.
FAUNA & FLORA INTERNATIONAL WORKS ON MORE THAN 140 PROJECTS, IN OVER 40 COUNTRIES ACROSS FIVE CONTINENTS.

FEATURED PROJECT:

CONSERVATION AND SUSTAINABLE DEVELOPMENT IN KENYA

In 2003, FFI, with the help of the Arcus Foundation, protected 90,000 acres at the foot of Mount Kenya. Ol Pejeta Conservancy, now owned and managed by a Kenyan non-profit, safeguards critical migration corridors and diverse wildlife using a novel business model that features wildlife conservation, livestock grazing, eco-tourism and community outreach. Today FFI supports the conservancy’s community development programme and conservation initiatives, including protecting its rapidly growing populations of white and black rhinos.

www.fauna-flora.org/olpejeta
Supply curve changes, fueled largely by technical innovation, have created an unprecedented downturn in oil and gas markets, leading to massive workforce reductions and laying the groundwork for significant talent gaps in the future. As a result, when the market rebounds, oil and gas companies may not have the in-house petrotechnical skills they need to scale up investments. Compounding their dilemma, the approaches used to manage talent shortages in the past will no longer work. To avoid the looming talent crisis that could cripple business, it is critical for companies to devise new talent strategies today.

The talent pipeline has ruptured

During the 2014 – 2016 crisis, oil and gas companies focused on containing costs, including downsizing their workforces. Through layoffs or job cuts, they shed some 440,000 jobs globally since 2014. Accelerated retirements among workers who started their careers in the 1970s winnowed tens of thousands more out of the workforce.

Despite initial efforts to protect them, upstream petrotechnical professionals (PTPs) have been hard-hit. This workforce—which includes geologists and geophysicists and engineering professionals in a variety of disciplines such as reservoir, drilling, completion, production and maintenance—is the lifeblood of exploration and production operations. Given present levels of hiring, we predict a deficit of 12,500 to 25,000 PTP professionals by 2025.

This time it’s different.

The oil and gas industry has navigated boom-and-bust cycles in the past. But the workforce challenges accompanying today’s structural changes are different.

• Entirely new skillsets are needed. Digital technologies and automation have changed how upstream work will be performed. For example, sensors are making wells “intelligent,” enabling them to gather, analyse and transmit production data in real-time. Visualisation tools and pattern-recognition software identify production anomalies, diagnose well conditions, and request help, all without human intervention. Drones provide remote surveillance and even drop off robotic tech support.

• PTP talent won’t come back. During previous rebounds, managers re-hired PTPs who had separated from their companies during the preceding downturn. Because of industry demographics, many PTPs have retired or accepted early retirement packages. Even if they were invited back, they have little incentive to answer the call. At the same time,
technology advances have accelerated and portfolios have been reshuffled. This means the skills of PTP professionals who would rejoin the industry are not the most needed ones.

- Millennials won’t readily close the gap. Companies facing a professional talent crunch can usually rely on recent college graduates to fill vacancies. That is not the case for oil and gas companies. Despite evidence to the contrary, many millennials believe the sector is lacking innovation, agility and creativity, as well as opportunities to engage in meaningful work. In fact, only two percent of US college grads consider the oil and gas industry their top choice for employment, our 2016 survey of US university graduates revealed. This means oil and gas companies are in the unenviable position of competing with other, nimbler, more appealing industries for scarce talent.

**Thriving in volatility**

To position themselves for the upturn, and thrive over the long term, oil and gas companies need to adopt new approaches to recruiting, hiring, developing and retaining their future workforces. They must start now by rethinking four main elements of their talent strategy,

- **Pivot from firing to hiring.** As oil prices plummeted, reducing the workforce size was a logical response, including cutting back hiring of “fresh-outs.” But the lack of jobs has led to fewer students enrolling in PTP-related university programmes. Oil and gas leaders need to think beyond the immediate talent gap, investing in new talent strategies, developing resilient, digitally enabled operating models, and transforming the organisational culture to attract and retain the best and brightest for years to come, in good times and in bad.

- **Use digital to attract and develop talent.** New technologies can play an essential role in attracting and developing digitally curious talent. Digital platforms, cloud-based collaboration tools, and peer-developed training that is delivered via streaming video can create more engaging, satisfying work environments and accelerate workforce productivity. Remote “over-the-shoulder” coaching and augmented reality—which overcome limitations of time and distance and enable real-time collaboration and guidance—can also be used to shorten time-to-competency for new hires and multiply the skills of the experienced workforce.

- **Work smarter to do more with fewer PTPs.** Leaders need to identify and build new capabilities and roles that will allow them to hit the ground running when the market turns. Digital must be an integral component of new operating models and talent strategies as it will accelerate productivity improvements by enabling PTPs to focus on value-added tasks. Moreover, digital innovations, coupled with new asset portfolios, will also require oil and gas companies to create new PTP roles or refine existing ones. For example, remote operation engineers with backgrounds in such disciplines as operational geology or directional drilling will be in high demand. Production engineers will likely transition their focus from addressing issues that are ongoing or have already occurred—e.g., foaming, liquid loading, electric submersible pump failure—to predicting that an issue is likely to happen and choosing the best avoidance or mitigation approach from a pre-defined set of solutions. Finally, data scientists who can develop complex algorithms and analyse the petabytes of information pouring in from field sensors will be required. Accenture Strategy estimates that 12,000 data scientists are needed immediately to support the upstream oil industry.

- **Make “agility” your guiding star.** The oil and gas future belongs to those companies who can manoeuvre seamlessly through periods of high volatility. To achieve the agility that is required, talent strategies must be designed to fully leverage the extended workforce, including employees, contractors and service companies. As a first step, leaders should determine which roles employees should fill, in what proportion, and which can be delegated to contractors. Increasing the ratio of contractors to full-time employees and partnering more closely with suppliers are two ways to inject elasticity into the talent pool.

**Ready. Set. Go.**

At first blush, right-sizing an organisation is not a bad business strategy. But it can be disastrous if it translates into a shortage of skills that stifles a company’s agility and growth in the future. That is precisely the scenario that is unfolding for many oil and gas companies. It may seem counter-intuitive to invest in acquiring and training PTPs when the oil and gas industry is in such a difficult and volatile state. But in this instance, it is a wise move. Companies that implement resilient talent strategies will be ready to capitalise when the market rebounds.

Since 2005, Accenture Strategy and Schlumberger Business Consulting (acquired by Accenture in 2019) have been studying the upstream and technical talent pools of approximately 40 oil and gas companies representing more than 30 percent of world production. We have assembled a unique database and toolset designed to provide insights into the size, characteristics and productivity of this talent pool, and its future evolution. Please visit [http://www.accenture.com/TalentWell](http://www.accenture.com/TalentWell).

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Gender balance in oil and gas: An important – and attainable – goal

By Katharina Rick, Partner and MD and Iván Martén, Senior Partner, MD and Vice Chairman (Energy) of The Boston Consulting Group, and Ulrike von Lonski, Director of Communication, WPC

Representing roughly a fifth of the oil and gas sector’s employees, women account for a significantly smaller share of the industry’s workforce than they do in almost all other industries. The industry’s women also work disproportionately in business and commercial roles – they have a very limited presence in technical posts, which are often considered prerequisites for career advancement, and upper management roles. The upshot: oil and gas companies are failing to fully leverage a potentially sizable and critical pool of talent.

The loss to the industry is threefold. First, oil and gas companies have a smaller number of highly qualified candidates to choose from when filling positions, especially among the industry’s middle and higher ranks, as many talented women either never join the industry or drop out prematurely. Second, the industry misses out on the greater quality of teamwork, diversity of perspectives, and level of creativity in solving technical and business problems that characterise more gender-diverse companies. Third, the industry’s relative lack of gender diversity, particularly in the senior ranks, hurts its reputation among women as a career destination. This could create a vicious circle, one in which the industry finds it progressively harder to recruit women across the board.

The effects could weigh heavily on oil and gas companies’ ability to increase the productivity of human and other capital. Increased capital productivity will be vital to these companies going forward as they wrestle with the challenges posed by (a) the industry’s pending generational “crew change,” (b) the ongoing “lower for (much) longer” oil-price environment, and (c) advances in robotics and artificial intelligence that could reshape the industry in a host of ways.

Attracting and retaining greater numbers of women, particularly those with optimal backgrounds, will pose challenges for the industry. The hurdles include the limited number of girls and women pursuing technical education; structural barriers within the industry that make it difficult for women to advance and/or balance work and family; and an established, male-centric culture that remains prevalent throughout much of the industry. The industry can and must surmount these challenges and close the gender gap, however, if it hopes to position itself optimally for the future.

The report’s key findings include the following:

- The percentage of women in the industry’s workforce drops over time and falls particularly sharply between the mid-career and senior leadership levels. The trend won’t change unless CEOs make gender diversity a greater strategic priority. Although 56 per cent of men believe that their CEO cares about gender diversity, only 36 per cent of women do. CEO commitment matters because many employees, especially men, take their lead from the CEO. When men believe that the CEO considers gender diversity “very unimportant,” only 34 per cent view it as important. But when they believe that the CEO considers it “very important,” 86 per cent deem it important, too.
- While men and women start out on an equal footing, women hardly ever reach the top of the organisation. This isn’t due to lack of ambition among women – women are just as ambitious as men, our research revealed. So, what’s the reason? Men, especially those in senior positions, attribute much of it to a shortage of qualified female candidates. This assessment is probably accurate: among women who have spent many years in the industry and might otherwise be considered suitable candidates for promotion to senior management, many have failed to accumulate the critical experiences – and connections – that their male colleagues have. This accounts for much of the fact that, among women who are still working in the industry after 15–20 years, most have a less than 20 per cent chance of landing a senior executive job.
- There are wide gaps in perception between men and women regarding the gender-diversity challenges that women face. Men believe, for example, that women are generally less flexible than men and therefore less suited to specific types of roles, including many expatriate jobs and positions in the
field. But women are actually prepared to be as, or even more, flexible than men in their jobs, our survey indicated. Many men also believe that they provide the same level of career support to women as they do to men – but women disagree. At least half of the women we interviewed felt that they had no visibility into many career opportunities; 60 per cent felt that they had been overlooked for senior positions. Women cite lack of support and sponsorship as the main reason for their lack of advancement.

- Without developing a critical mass of women across all types of roles, the industry will not make a meaningful difference in its gender balance. Many oil and gas companies have made a genuine effort to improve gender diversity – by improving recruiting practices, instituting work-life balance policies, and other means. One of the major reasons that this has not produced the desired results, however, is that the approach is too “hands-off” and does not focus on attaining meaningful quantitative targets broadly. The industry might reference having 22 per cent of its jobs, on average, filled by women. Looking across individual departments, however, a different picture emerges. While women’s representation in office-based roles can be as high as 40 per cent, their representation in the critical technical arena is only 15 per cent. This comes at a sizable cost to women in technical roles, who often find themselves talked over in meetings and otherwise struggling to command the same attention and respect that men get. Over time, this can erode these women’s self-confidence and enthusiasm substantially.

- There are many actions the industry can take to increase its percentage of female employees and accelerate progress toward gender equality. The industry must look holistically at the various functions – especially technical ones – and establish targets for boosting women’s presence. The industry should also take specific actions centered on the three critical career stages that Untapped Reserves: Promoting Gender Balance in Oil and Gas focuses on:

  - At the entry level, the industry can increase the size of the talent pool it draws from by taking steps to boost women’s participation in STEM programmes. It can increase its attractiveness to women as a career choice by promoting the industry’s wide range of jobs and increasing job flexibility; working with governments to remove structural barriers that make it difficult for women to work in the industry; and making senior female role models in the industry more visible. The inflow of women can be boosted by instituting aspirational gender-balance recruitment targets, such as a 50/50 male-female ratio for new hires.

  - At the mid-career level, the industry can work to ensure that women have the same career opportunities as men; that each woman has a sponsor who proactively supports her and can offer career guidance; and that work-life balance policies are available and applied equally across genders.

  - At the senior leadership level, the industry can provide “stretch” goals for women and the necessary support to help them succeed; broaden the range of career paths from which senior leaders are picked; and ensure that decision standards for promotions are applied equally to men and women.

Greater gender diversity is a worthwhile and attainable goal for the industry, one that it has the means to achieve. Provided that leadership commitment, especially from CEOs, remains sufficiently strong, the industry could boost women’s representation steadily and materially over time, certainly reaching or surpassing the 35 per cent threshold that most survey respondents said they consider possible by 2022. And the industry could reap a host of benefits – including improved organisational performance, creativity, decision-making, and likely morale – for its efforts.
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