*Global demand for affordable, reliable energy will continue to grow for the foreseeable future, but there is a new longer-term backdrop as the world transitions to a low carbon system. Companies in the oil and gas sector need to reconsider their portfolio and related capabilities to not only survive, but thrive, in this new future.*

# ***New Energy Futures***
# Perspectives on the transformation of the oil and gas sector

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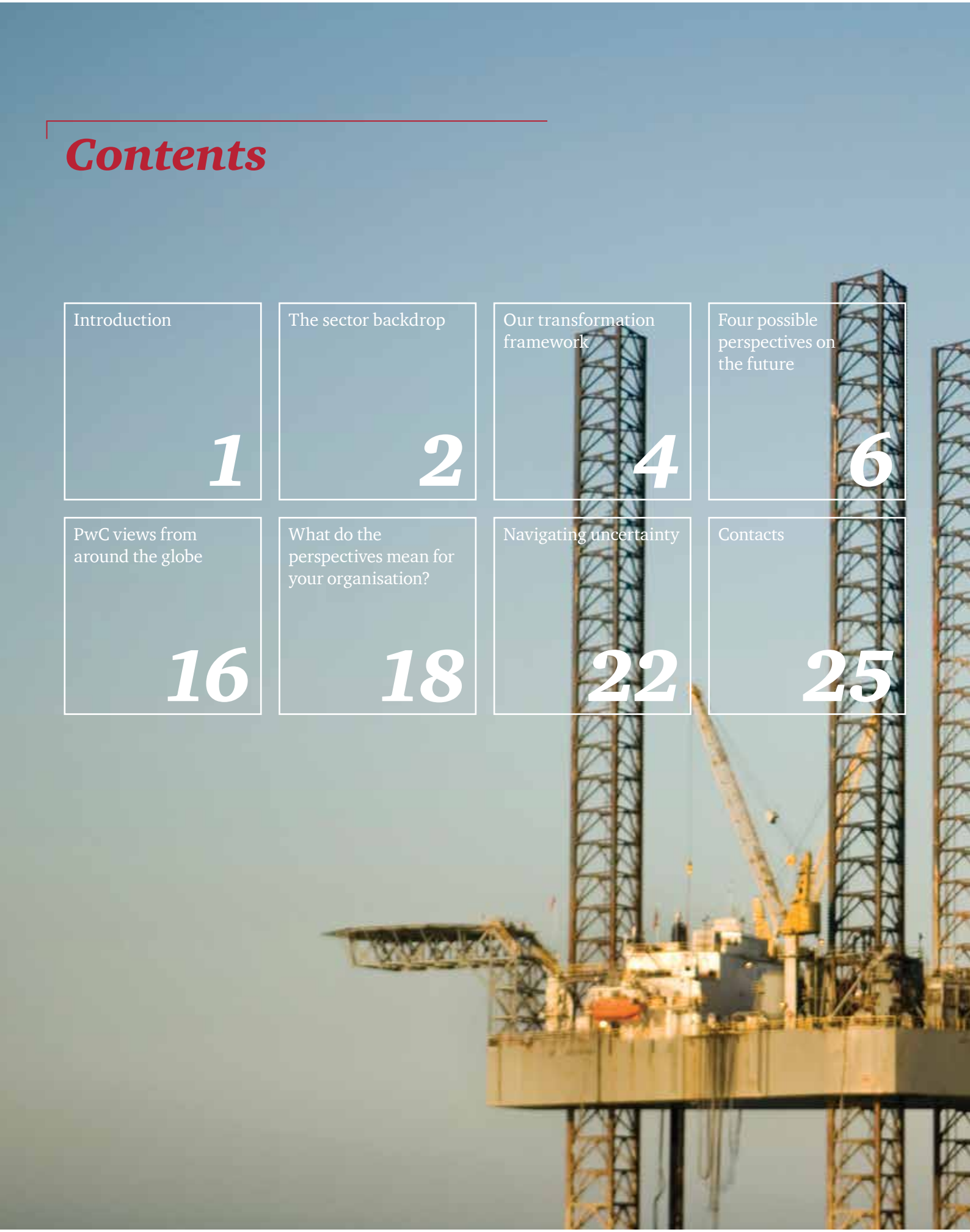
# Contents





# Introduction

The oil and gas sector is no stranger to recurring upheaval, volatility and shifting geopolitical landscapes. Successful players have proven an ability to take a long term view and manage through such challenges by innovating and adapting. However, navigating the future is increasingly challenging in a more complex global market, and the longer-term backdrop has changed.

Whilst global demand for affordable, reliable energy will continue to grow for the foreseeable future, the world is transitioning to a low carbon energy system. Peak demand for oil and gas may well be on the horizon, with fossil fuels representing a declining proportion of the energy mix. Market dynamics have also changed; OPEC is focused on protecting market share and US shale represents a substantial source of new, and flexible, supply. Given these rapidly evolving industry dynamics, looking beyond the near term has become much harder, but this has never been more important.

To support you in this challenge, we've developed a framework for considering potential futures. In this paper, we'll look at four perspectives, highlighting some of the fundamental trends reshaping the oil and gas sector, and viewed through a medium term lens of five to fifteen years. We recognize that some of these trends may take considerably longer for the full effects to take hold, but we believe these trends in the medium term will already have significant implications for the sector and its long term prospects. In two of the perspectives, market forces play a defining role, while the other two perspectives are driven more by government action and geopolitics. Each teases out some possible effects on supply, demand and market dynamics.

These possible futures look very different. Some aspects of each of the four perspectives represents a significant move away from the current position, while others continue current trends. In practice, of course, no single perspective is neatly 'ring fenced'. Nevertheless, by thinking carefully about and expanding upon these different perspectives, companies will be able to evaluate their current strategy and plans, as well as consider the implications for their operating model, partnering strategies, resourcing and technical capabilities.

Regardless of which perspective resonates most, the future is uncertain. Companies will need to be agile and resilient, underpinned by a fundamentally sustainable business model.

Please get in touch if you would like to discuss these themes with us. We look forward to an on-going dialogue about the oil and gas sector's, and your company's, future.

February 2016

**Ross Hunter**
Global Oil and Gas Leader

**Jan Willem Velthuijsen**
Chief Economist

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Global Oil and Gas Strategy& Leader

# The sector backdrop

The perspectives in this paper take a look at how dynamics in the oil and gas sector may evolve over the next five to fifteen years by considering the potential disruptors to the sector. To provide some context, we need to take a brief look at the sector's current position.

**World primary energy demand by fuel**

2013 New policies scenario

| 31% | 29% | 22% | 10% | 5% | 2% | 1% |
|---|---|---|---|---|---|---|
| Oil | Coal | Gas | Bioenergy | Nuclear | Hydro | Other Renewables |

**Source:** IEA World Energy Outlook 2015

### *Fossil fuels dominate the energy mix*

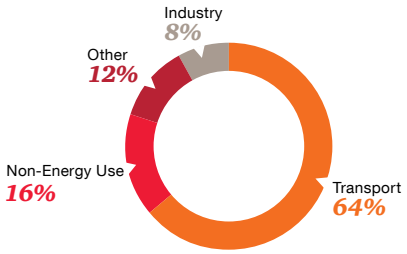
From a global energy point of view the world remains heavily reliant on fossil fuels. According to the IEA, oil, gas and coal represent about 80% of primary energy demand.

Our reliance on oil in particular is further underpinned by demand from the transport sector, where a commercially viable alternative to the fossil fuelled internal combustion engine remains elusive.

Transport still accounts for over 60% of global oil product demand (based on IEA data).

Current sector forecasts for energy demand from the IEA suggest that renewables and nuclear will grow the fastest between 2013 and 2040 (6.7% and 2.3% CAGR respectively). Nevertheless, fossil fuels will still dominate energy demand in 2040 with a 75% share (about 80% in 2013).

**Total oil final consumption by sector**




**Note:** Other includes agriculture, commercial and public services, residential, and non-specified other
**Source:** IEA Key World Energy Statistics 2015

## *The low carbon agenda will increasingly shape our energy future*

In the aftermath of COP21 and against a backdrop of heightened public concern about climate change, the long term outlook for fossil fuels as a whole is to play a proportionally diminishing role in the world's fuel mix. COP21 set some historic milestones, with countries committing to targets aimed at keeping global temperature rises below 2C with a mandatory review every five years. There was also a significant commitment from developed countries to invest US$100 billion per annum in climate finance for developing countries by 2020.

Whilst this is in itself unlikely to impact oil and gas companies in the short term, and the rhetoric needs to be acted upon, the clock is ticking and it is clear the momentum to replace fossil fuels with cleaner energy sources, sooner rather than later, is gathering pace. Consequently, oil and gas companies would be well served to review their long term strategies, recognising the possibility that oil could suffer a similar fate to coal in the coming decades.

## *Low oil prices challenge company priorities*

The oil and gas sector is currently going through a challenging period. At the time of writing, oil prices have declined by more than 60% since the US$100/bbl+ highs in 2014 and are now hovering in the US$30/bbl range. The forces of oversupply, triggered partly by the US shale oil revolution, and OPEC's decision to maintain market share, combined with weakening global demand, have converged to push global oil prices dramatically lower. How long this downward pressure on oil prices will hold is hard to predict.

Given the high capital costs of this sector and the long term investment cycle, oil and gas producers have little alternative but to relentlessly focus on cost. Layoffs, reduced capital expenditure budgets, and aggressive discounting across the supply chain reflect a sector trying to adjust to a new reality. While the much heralded wave of consolidation across the sector has yet to be realised, it is clear that more transactions may well follow a period of financial distress.

There are of course other trends shaping the oil and gas sector. With the ongoing emphasis on cost reduction, demand for innovation in technology will grow. Whether it is the more widespread application of the digital oilfield or use of drones to undertake offshore inspections of pipelines, technology is key to reducing cost and improving operational efficiency. Witness the dramatic revival and transformation of US oil production due to innovation in horizontal drilling and fracking.

Investment in the oil and gas sector is likely to become a more critical issue in coming years. The low oil price has led operators to defer FIDs (Final Investment Decisions) on over US$300bn of projects. With a persistently low oil price predicted for the immediate future, it raises the question of when producers will begin investing again in sources of new production to meet forecast demand.

These are a few key characteristics illustrating current developments within the oil and gas market. Just how these trends will evolve is uncertain, but will depend on how the combination of megatrends and disruptive factors impact both the supply of, and demand for, oil and gas.

# Our transformation framework

Megatrends and disruptors impacting markets and businesses are not new, but are increasingly testing the sector's ability to plan for the future. We use PwC's sector transformation framework to take a closer look.

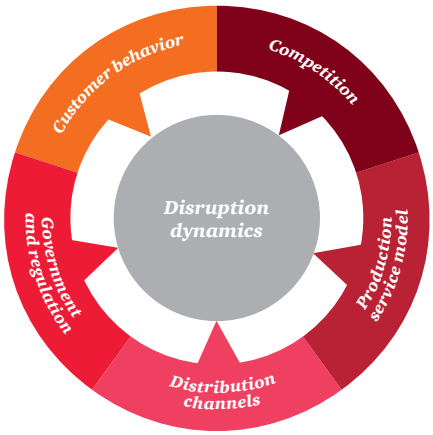
### *Mapping the megatrends*


In developing our four possible perspectives on the future, we looked at five megatrends and the collision between them:

1. Technology breakthroughs and innovation – leading to efficiency improvements and the deployment of low carbon solutions such as the electrification of the car fleet
2. Climate change and resource scarcity – encouraging growth in renewable energy and energy storage solutions.
3. Demographic change – shifting energy consumption patterns with energy consumers becoming more discerning
4. Shift in economic power – impacting the relative balance of demand between current established markets and developing markets.
5. Rapid urbanisation – accelerating the growth of mass mobility solutions.

### *Discussing disruption and uncertainty*

We further tested the impact of these megatrends across five categories of disruption: customer behaviour, competition, technologies of production/service models, distribution channels and finally government and regulation.

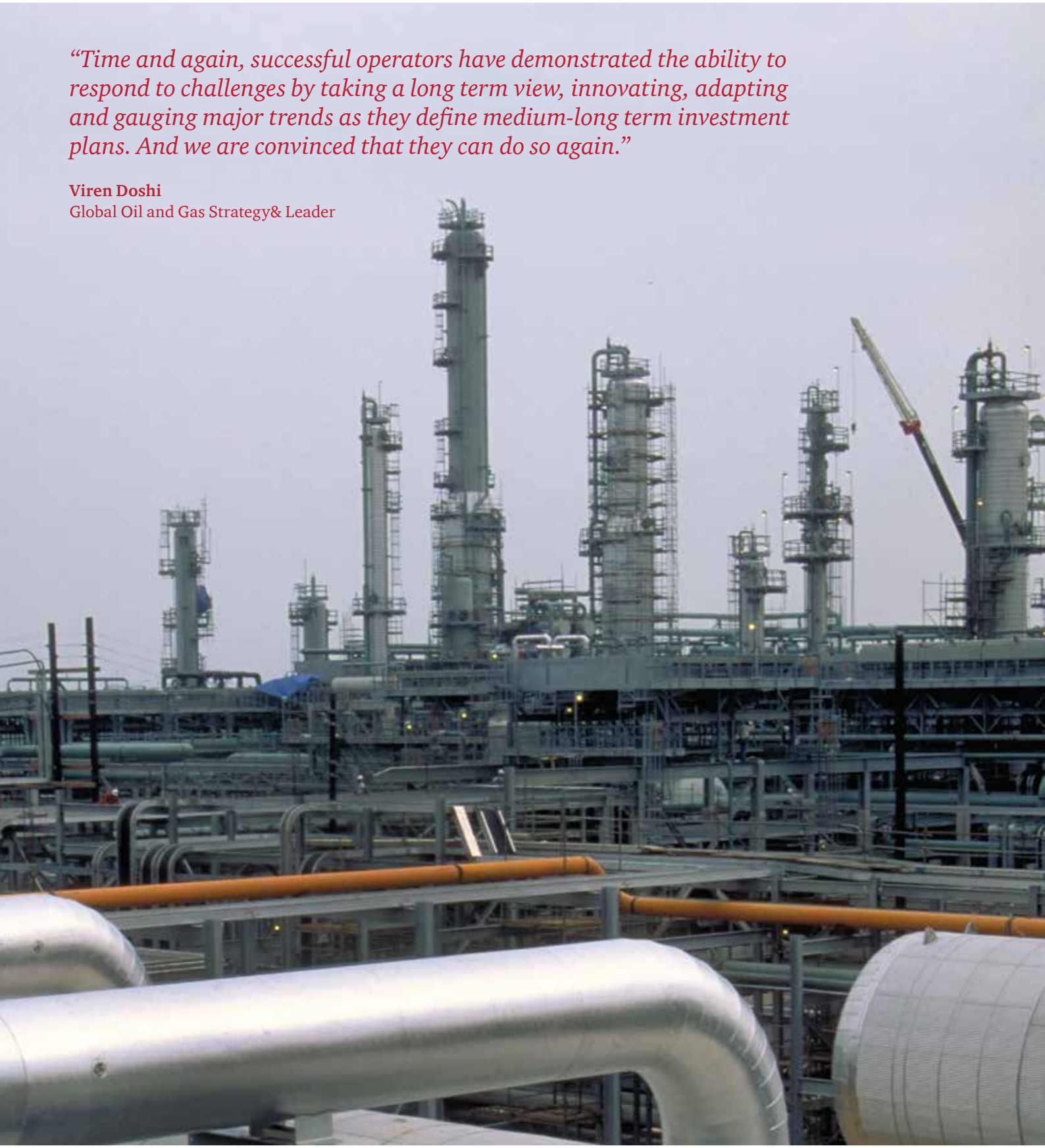



Some key questions were considered:

- How will **energy supply evolve** over the coming years and what will be the key influences on supply?
- How will **demand for oil and gas evolve** in light of the transition to a low carbon economy and the rise of renewables?
- How will the **price for oil and gas respond** to variations in supply and demand, and how volatile will oil prices be?
- What will be the **key focus areas for investment in technology**, and what disruptive technologies might influence supply and demand?
- How **disruptive will the forthcoming changes** be for oil and gas companies as compared to business as usual?
- What will be the **pace of change** in the oil and gas sector and how should this influence company strategies and their operating models?

*"Time and again, successful operators have demonstrated the ability to respond to challenges by taking a long term view, innovating, adapting and gauging major trends as they define medium-long term investment plans. And we are convinced that they can do so again."*

**Viren Doshi**
Global Oil and Gas Strategy& Leader



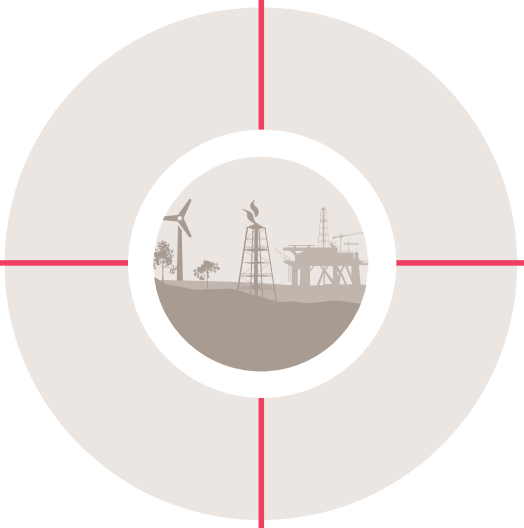
# Four possible perspectives on the future

## The drivers of change

To provide a framework for consideration of the potential sources of disruption and uncertainty we have mapped four key drivers along two axes. These drivers have the greatest impact on the extent of change in the perspectives on the future.

***Market-led***
Marked by an environment of free market forces where actions by companies and individual consumers, in aggregate, influence market patterns significantly.

***Supply driven***
Marked by significant changes to the sector's supply dynamics, including factors constraining supply by making certain resources inaccessible.



***Demand driven***
Marked by shifts in fundamental demand trends, notably consumer demand (retail and commercial) for cleaner energy.

***Government / Geopolitical intervention***
Marked by an environment where the actions of governments, or changes in government /geopolitical circumstances, dictate the activities of businesses and consumers.

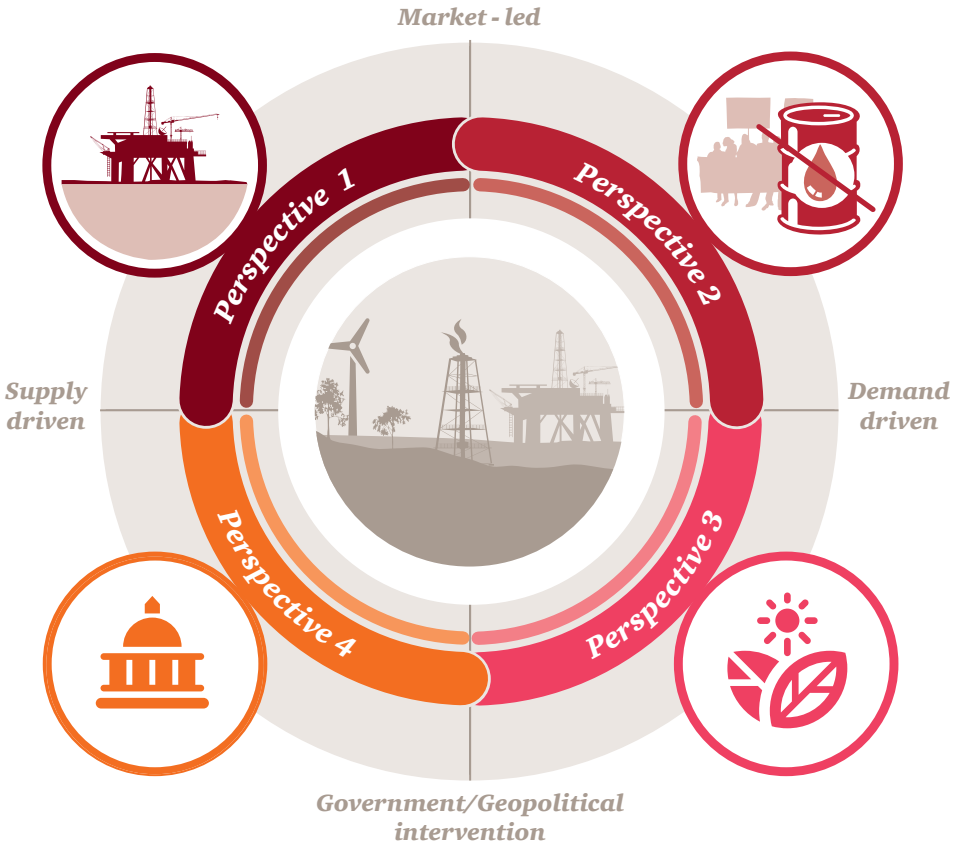
## The perspectives

### 1. Oil and gas sector evolves along current lines. Ongoing price volatility presents investment challenges

Against a backdrop of limited government intervention and price led investment cycles, the oil and gas sector swings between surplus and deficit of supply, with associated price volatility. Pressure for, and investment in, alternative energy sources is also cyclical. The oil and gas sector responds gradually to a 'greener' world, however, security of supply and affordability remain key drivers of demand.

### 2. Energy consumers, retail and commercial, drive the transition to low carbon world and more efficient energy system

Retail and commercial consumers in key markets actively seek to reduce their environmental impact and turn away from use of fossil fuels, reducing demand ahead of supply. Energy efficiency, and a move to alternative fuels for power and transport, de-link economic growth and energy intensity as compared to historical norms. Significant private investment in new low carbon technologies as the onset of a low carbon world is accelerated.




### 4. Government actions and / or geopolitical events trigger supply constraints

Supply constraints apply either through direct government action such as implementing carbon legislation affecting supply, or constraints over permitting and licences (e.g. Shale, Arctic). Geopolitical disruption also contributes on a periodic and regional basis. This leads to volatile prices and significant variations in the producing environment. The focus on security of supply is addressed alongside an accelerated transition to a low carbon world.

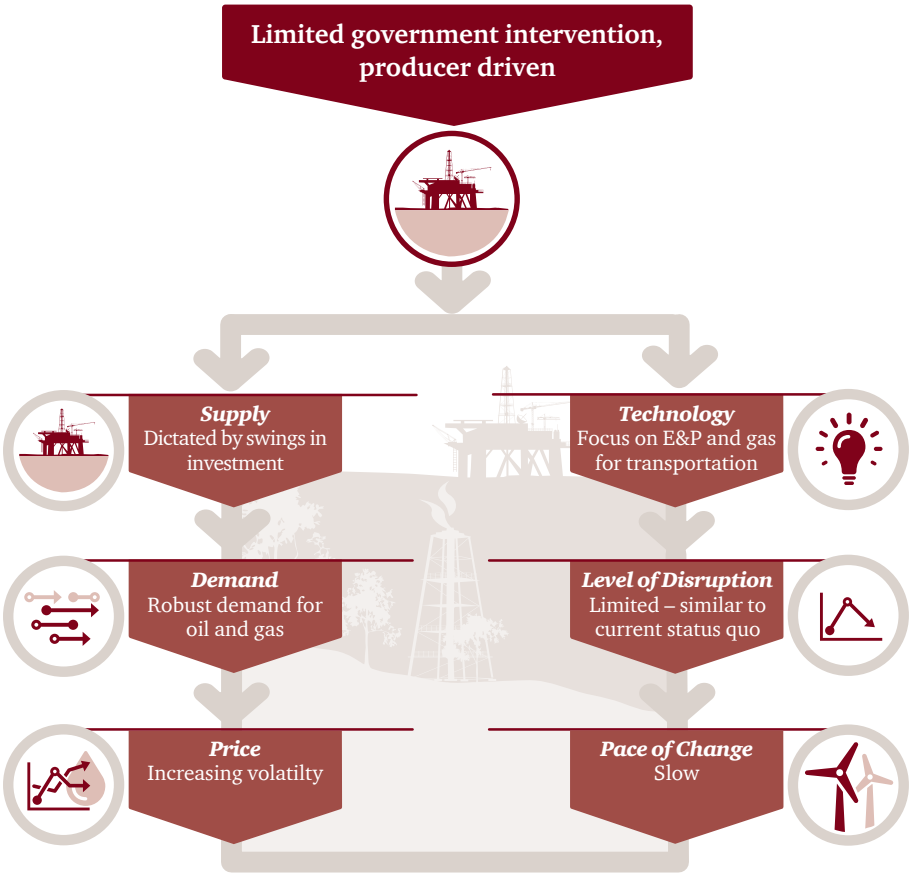
### 3. Governments stimulate a broad and accelerated 'green' demand environment

Governments follow through on climate conference commitments and drive a greener demand environment through a combination of regulations, incentives and direct investments that balance affordability and low carbon objectives. This stimulates increased energy efficiency, expansion of renewable energy demand and an accelerated development of disruptive technologies, particularly in transport.

# 1.

# *Oil and gas sector evolves along current lines. Ongoing price volatility presents investment challenges*

***Perspective 1:*** Against a backdrop of **limited government intervention and price led investment cycles**, the oil and gas sector swings between surplus and deficit of supply, with associated price volatility. Pressure for, and investment in, alternative energy sources is also cyclical, but progressively grows. The oil and gas sector responds gradually to a 'greener' world, however, security of supply and affordability remain key drivers of demand.




***What other features might we see in this environment?***

The key driver in this perspective is the highs and lows of the investment cycle and the effect on supply.

Whilst demand for oil remains relatively robust, and grows for gas, periods of low prices cut off investment in the oil and gas sector and affect confidence for the future. Gas is promoted and accepted as the transition fuel. New oil and gas discoveries are increasingly frontier, high cost and technically challenging plays.

Investor appetite for the oil and gas sector is reduced and becomes more selective due to volatile pricing, risky projects and the continuing move towards a low carbon economy.

These factors, along with rising depletion rates, lead to supply squeezes and price spikes, providing periods of strong returns for those who survive the cycle. Relatively low-cost producers, notably many national oil companies (NOCs), will aim to produce at a maximum rate, whilst international oil companies (IOCs) will need to make difficult choices weighing up higher cost investment projects with capital allocation priorities across their portfolios.

As consumers experience higher and more volatile prices, momentum builds for alternative energy solutions, with the oil and gas sector gradually responding to this with increased investments in low carbon technologies.

### *Demand declines relatively slowly*

Economic growth in developing economies continues apace, compensating for slow growth in mature markets, and energy demand increases accordingly. With inconsistent follow up to agreements reached at global climate conferences, oil continues to be recognized as an indispensable part of the overall energy mix, and gas becomes accepted as a critical transition fuel. Price, affordability and convenience continue to be the dominant factors influencing the use of oil and gas, and primary modes of transportation continue to rely on oil and gas as their main fuel source.

Demand in mature markets declines more slowly than currently expected. The focus on smart city and transport system developments, as well as energy efficiency measures, fail to take hold immediately and extensively.

### *Good news for gas producers*

Gas suppliers will be relatively well placed, as gas is recognised as a 'bridge' fuel in the transition to a low carbon economy. In addition to becoming the preferred fuel for power generation, gas will increase its share in transportation fuels as well. Liquefied natural gas (LNG) becomes the dominant fuel for long-distance shipping and both LNG and liquified petroleum gas (LPG) increase their share of the rail market. Compressed natural gas (CNG) also gains market share in commercial vehicles, especially in long-distance trucking and municipal buses.

### *Investment is needed to find and develop new reserves*

High levels of capital investment are required to find and develop new oil and gas reserves. Equally, expanding renewable resources will require significant investments. Oil and gas companies will need to make a persuasive risk-based case for the sustainability of their plans. Investors and shareholders are wary of funding long term or frontier fossil fuel developments, as competing renewable resources expand and as they respond to societal concerns about the environment.

Companies need to invest in maintaining their licence to operate and compete to gain sufficient financial support from concerned investors. Capital discipline will continue to be the sector mantra. Countries also need to compete to attract investors and technology to realise the benefits from their resources and support economic growth, local content and other social programmes.

### *Need for collaboration to increase resilience*

Sector participants with control over long-term access to resources (such as NOCs) are at significant advantage in this perspective, provided they are operating in a region that is politically stable.

For IOCs, collaboration that ensures access to resources in return for knowledge and capabilities will continue to be key, and companies will need active portfolio management.

In this perspective we might witness far greater collaboration between operators and service providers to pool resources and deliver more widespread standardisation to reduce cost. With the supply of engineering talent declining, exacerbated by headcount rationalisation during cyclical downturns, there will be a greater imperative to consider new partnerships as a way to drive forward both innovation and efficiency. Mergers and acquisitions may also become an increasingly preferred option for building technical capabilities, scale and resilience in this environment.

### *Rewards for the winners*

With periods of tight supply, volatility increases. Energy producing countries with a stable political environment and a flexible resource base, in particular, reap the benefits. Resilient international producers with a strong portfolio of accessible resources are also rewarded. Energy import dependent countries and companies, on the other hand, seek alternatives to limit their exposure to volatile costs.

### *Disruptor spotlight: Gas and its role as a transition fuel to a low carbon economy*

Gas is increasingly being positioned by the industry as a 'bridging' fuel to a lower carbon world. Some oil companies have directly targeted coal when promoting gas as a replacement in power generation. The IEA recently predicted a 'golden age' for natural gas and the Paris Agreement at COP21 is expected to boost the switch from coal to gas-fired power generation over the next 15 years (as gas is roughly half the CO2 emissions of coal per MWh).

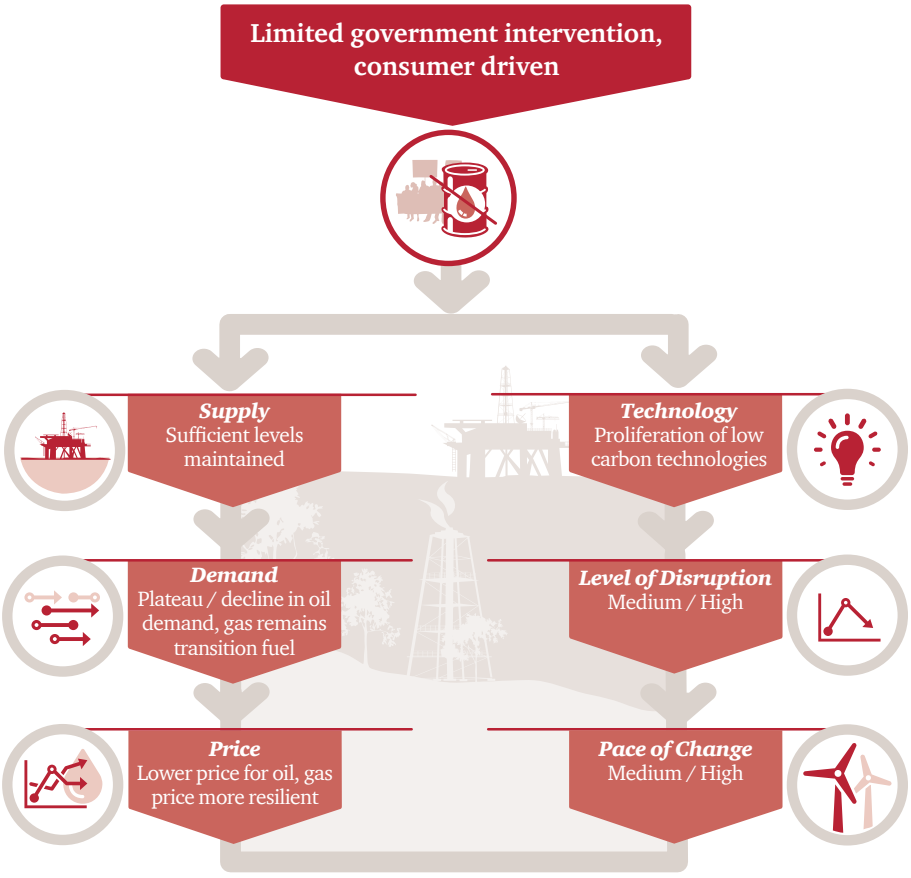
According to the IEA World Energy Outlook 2015, cumulative investment in the gas sector will total US$9.9 trillion between 2015 and 2040. The major share of this investment will focus on developing the upstream sector, totaling US$6.9 trillion.

However, there are also some concerns about the environmental impact of greater gas usage. Some studies have suggested that even if the gas fracking revolution goes global, this will have little impact on total global CO2 emissions. While lower cost gas would displace higher carbon coal generation, it would also displace zero carbon renewables and nuclear. Moreover, abundant availability of gas would lower the cost of energy and so stimulate more demand.

# 2.

## *Energy consumers, retail and commercial, drive the transition to low carbon world and more efficient energy system*

***Perspective 2:*** Retail and commercial **consumers** in key markets actively seek to **reduce their environmental impact** and turn away from the use of fossil fuels, especially oil, **reducing demand ahead of supply**. Energy efficiency, and a move to alternative fuels for power and transport, de-link economic growth and energy intensity as compared to historical norms. Significant private i**nvestment in new technologies** as the onset of a low carbon world is accelerated.




### *What other features might we see in this environment?*

In many mature economies, and some developing economies, residential and industrial energy users are no longer content to consume energy passively. Instead, they empower themselves to change the way energy is produced and consumed. In particular, consumers limit their carbon footprint by reducing energy demand through adoption of renewable technologies and promotion of energy efficiency. Developing markets may also leap to a more efficient and sustainable energy future rather than following the past journey of the mature markets.

The overall impact is that even if economic growth picks up again, the link with growth in energy demand becomes much weaker. Gas has a role as a transition fuel, but demand for oil reaches a plateau and begins to decline and there are sustained periods of surplus supply and low prices.

### *Green economy is finding its momentum*

Shared consumption is becoming more and more common. Car-sharing increases in popularity, in part due to increasing urbanisation, and individuals choose to make greater use of other low impact transport options, leading to a substantial reduction in the fuel needed for transport. Affordable mass-scale storage solutions also increase the attractiveness of electric vehicles, which experience a sharp surge in sales.

Informed and connected consumers, including a growing number of the middle classes in developing countries, demand more information on the carbon footprint of products, influencing the energy choices made by the producing companies. Consumers apply even more pressure by using social media campaigns to 'name and shame' energy companies that are viewed as environmentally damaging. For those consumers with the economic wherewithal, they actively choose to purchase 'green energy' for residential use or to generate their own energy. As economies of scale drive down the costs of 'green energy', affordability improves, further increasing adoption rates by consumers.

Energy-intensive industries focus on innovation to further reduce energy consumption and improve process performances. New integrated and biomimetic, nature imitating systems, emerge which facilitate re-use of materials, creating further declines in energy demand.

### *Technology will be a major determinant in the pace of change*

Increasingly, private and institutional investors channel capital that was formerly directed at carbon-based technologies (for example, to fund oil exploration) to alternative energy solutions. The Breakthrough Energy Coalition fund sets the funding template for clean technology investments, and is emulated by others across the sector.[1]

The role of gas as a transition fuel would be further sustained through investment in Carbon Capture Storage (CCS) technology to prolong its position as back-up for intermittent renewable power, albeit diminishing as battery and other balancing technologies improve.

Investment in fuels technology, including biofuels, will also continue to improve efficiency and extend the acceptability of fossil fuels in transport.

### *Companies compete for consumers*

In a surplus supply environment, where prices are low, and demand for oil in particular is waning, sector margins will come under pressure. Both national and international producers will need to evolve their operating model to meet the needs of a world that is weening itself off oil and gas and transitioning to a low carbon economy.

For integrated players for example, this may translate into greater focus on a particular part of the value chain. Alternatively, this evolution may manifest itself in new investments and capabilities related to low carbon technologies.

Consumers are also more selective when choosing their energy providers and buying products and services. Costs and convenience are no longer the primary deciding factor. The carbon-footprint and the way a company does business are equally important. Companies with a strong reputation for sustainable practices have a competitive advantage. Carbon-based companies may need to reposition their brand to compete with new entrants and retain investors' and consumers' trust.

### *Disruption spotlight: Commercial customers shift focus to clean technology*

Congestion and urban air pollution are driving smarter and cleaner distribution systems in many major cities. UPS has rapidly adopted alternative vehicles into its distribution fleet. The number of 'alternative' miles driven has grown from zero in 2000 to 505 million miles in 2014 – UPS aims to reach 1 billion miles by 2017.

Alternatives, that will erode the market share of traditional diesel and petrol (gasoline) models, include: compressed natural gas (CNG), propane, liquefied natural gas (LNG), hybrid electric, hybrid hydraulic, biomethane, ethanol, and full electric vehicles (EV).

Companies such as UPS are working on both the development of these vehicles and their roll out – and they are encountering challenges along the way, such as the ability of the local electricity grid to cope with the extra demand. The adoption of EV in commercial fleets will be critical to the widespread roll-out of the technology.

These companies are helping to drive the innovations in the EV market that will ultimately become mainstream among consumers.

Google is another commercial consumer driving change. In December 2015 Google announced a significant renewable energy purchase as it seeks to increase the amount of green energy powering its facilities. The company signed contracts to buy power from wind and solar plants in the US, Sweden and Chile for between 10 and 20 years. This move will help the company reach its goal of powering 100% of its operations with clean energy by 2025. Prior to this deal some 37% of power used to supply its data centres was sourced from renewable energy in 2014.

According to Michael Terrell, Google's director of energy and infrastructure: "We're really trying to lead this transition to a cleaner energy economy. It's transforming anyone who touches the energy space. It's not just about data centers or tech companies."[2]

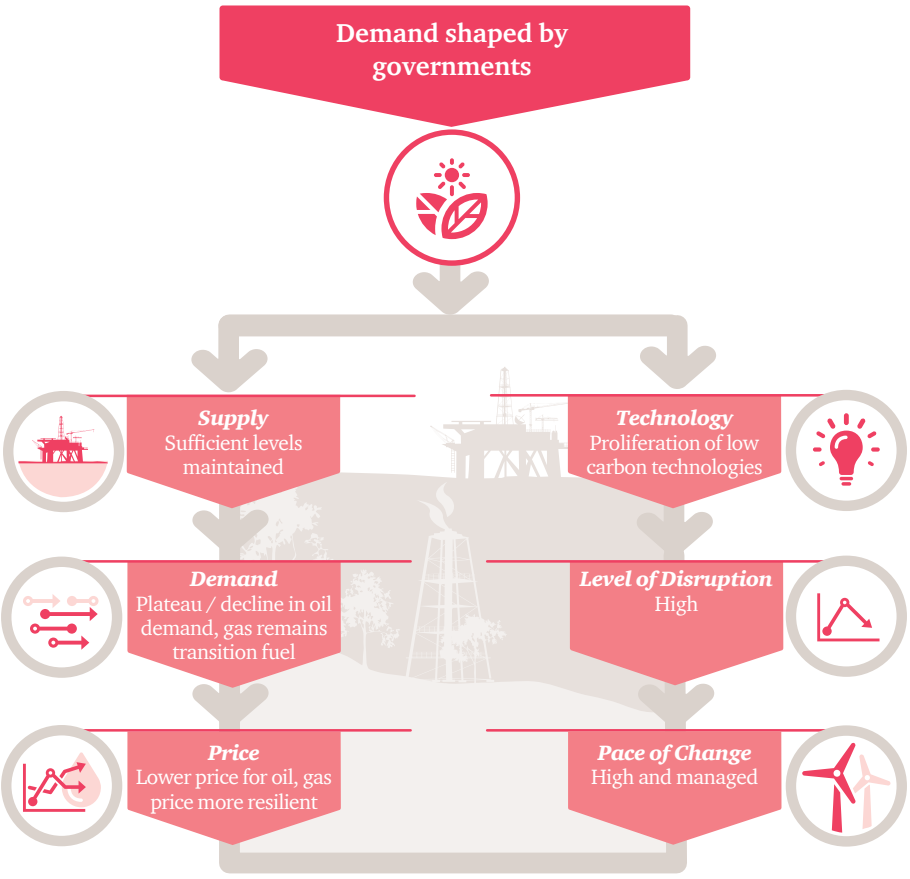
2 'Google steps up its purchases of renewable energy', Financial Times, December 2015

1 At the Paris climate conference 29 billionaires, led by Bill Gates, pledged to invest in research through their Breakthrough Energy Coalition fund. If this commitment is followed through, or emulated and supported more broadly, particularly in the field of transport, the implications could be significant.

# 3.

# *Governments stimulate a broad and accelerated 'green' demand environment*

***Perspective 3:*** **Governments** follow through on climate conference commitments and **drive a greener demand environment** through a combination of regulation, incentives and direct investments that balance affordability and low carbon objectives. This stimulates increased energy efficiency, expansion of renewable energy demand and accelerated development of **disruptive technologies**.




***What other features* might *we see in this environment?***

Overall, in this perspective we witness a more 'managed' transition as governments drive change. The pace of change is more accelerated as states set the parameters for the transition to a low carbon world, rather than leaving it to a disparate set of consumers to decide. Governments reached an unprecedented accord at the COP21 climate change conference in Paris. Follow up actions are taken, including investing close to US$100 billion per annum in climate finance for developing countries, leading to significant changes in the global energy system, with fundamental implications for the oil and gas sector.

Governments employ both the carrot and the stick. They invest significantly in energy efficiency and promote renewables, influencing consumer choices.

In some cases, carbon taxes are also implemented on consumption, where goods and services are taxed according to the carbon emitted in their production and during use. End-of-life regulations promote a circular economy where recycling is mandatory, creating new challenges for downstream operators.

Demand for fossil fuels peaks and declines ahead of supply, leading to persistent low prices. Consumption of oil is more strongly affected than for gas, which is recognised as a transition fuel.

### *Growth economies look to address pollution and achieve energy security*

Governments in major developing economies respond to growing concerns regarding urban pollution levels and focus significant efforts on improving energy efficiency and promoting demand for domestic based renewable energy. Mechanisms include, for example, subsidising home improvements and providing low-carbon R&D credits for industrial consumers.

China, for example, builds an extensive network of electric vehicle charging stations, which encourages uptake, particularly in growing urban environments. As China increases its use of both nuclear and coal-fired electricity generation with carbon abatement technology, and expands its use of solar and wind power, demand for oil imports is suppressed. Other countries also increase their energy security by focusing on use of local resources, with Africa, in particular, increasing the use of domestic gas for power generation and India promoting extensive deployment of wind and solar technology.

### *Technological advances in renewable energy and mobility*

The strong government push towards clean energy leads to technological advances in renewable technologies, environmentally friendly devices and greater energy efficiency. While government subsidies may lead the charge on driving down costs for battery technology, the renewables sector will also reach new levels of efficiency through economies of scale, improved chemistry, and supply chain optimization.

Significant breakthroughs in battery technology leads to the wholesale electrification of the car fleet, with governments leading by example, progressively displacing the use of fossil fuels. Moreover, growing urbanization, with the rising need of mass transit and improved transport efficiencies, will accelerate the electrification trend.

### *Pressure on fossil fuel suppliers*

Oil and gas supply exceeds demand, which has declined faster than anticipated. Gas demand remains more robust than oil demand, as its environmental profile is better.

Oil and gas companies will need to find new ways of working in an era of persistent low prices, including the deployment of low carbon technologies. In this perspective, governments establish a framework of incentives to support the sector's transition, in a relatively managed manner. Those companies reluctant to change may face more punitive fiscal measures, as governments more proactively influence who will be the winners and losers in the new world.

Equally, shifting consumer attitudes will vary across time and between regions according to the local environment and there will be opportunities for companies able to respond accordingly. Similarly, their position in meeting transient fossil fuel demand will be strengthened by differentiating themselves in specific parts of the value chain where they bring particular capabilities.

### *Disruptor spotlight: China's alternative energy investment appetite*

China is making great strides in promoting the deployment of clean technology. In 2014 China published the Energy Development Strategy Action plan (2014-2020) which promised more efficient, self-sufficient, green and innovative energy production and consumption.

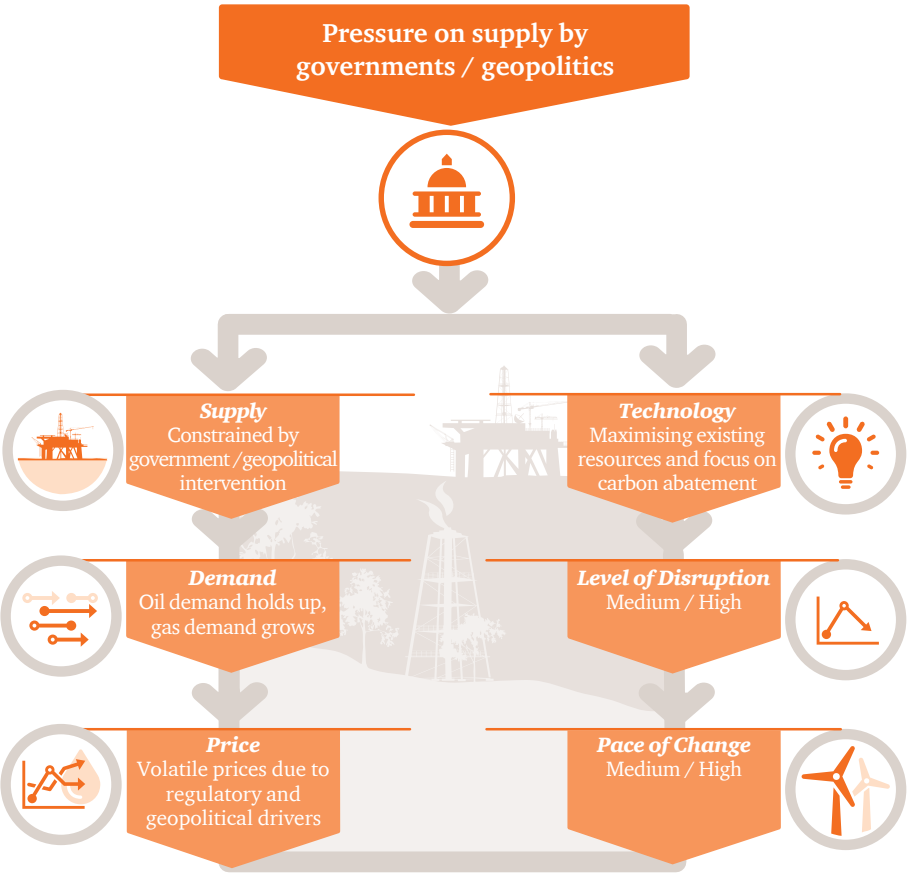
Growth in electric vehicles is stimulated by the Chinese government through regional investment subsidies for EV manufacturers, and through tax exemptions on the purchases of EV.

These subsidies and tax exemption are part of a larger economic plan to boost alternative energy and reduce China's environmental impact. The scale of this investment is staggering. In 2014, the largest renewable energy investments were in China– a record of US$83.3 billion, which is nearly a third (31%) of global renewable energy investments. Moreover, China's government invests more than any other government in R&D for renewable energy, committing US$1.7 billion in 2014 compared to US$1.4 billion invested by Europe and US$788 million invested by the US.

# 4.

# *Government actions and / or geopolitical events trigger supply constraints*

***Perspective 4:* Supply constraints apply** either through direct government action such as implementing carbon legislation affecting supply, or constraints over permitting and licences. Geopolitical disruption also contributes on a periodic and regional basis. This leads to volatile prices and significant variations in the supply environment. Security of supply is addressed alongside an accelerated transition to a low carbon world.




***What other features* might *we see in this environment?***

Government attitudes and circumstances are dictating the supply environment in this perspective.

This may reflect a relatively managed environment, in which governments apply constraints in response to climate change commitments or societal expectations, or unmanaged, for example where geopolitical upheavals disrupt the supply chain.

The investment environment is biased in favour of supply from renewables and 'greener' sources such as gas and biofuels. Gas will be recognised and supported as a transition fuel. In this perspective governments may actively seek the rise of new players to challenge the oil majors and provide little support to the latter group in this transition period.

This leads to a highly fragmented landscape in supply terms, both over time and regionally, and leads to supply squeezes and increased prices and volatility.

Portfolio, and stability through the cycle, will be key ingredients for success.

### *Legislation and regulatory constraints take hold*

As a result of global climate change agreements, governments in a number of countries, led by mature economies and growing economies that are not oil and gas exporters, institute carbon pricing schemes or other types of emission legislation.

Governments are also likely to sharpen other aspects of environmental protection driven in part, by social considerations particularly in the more mature economies. Bans on fracking of onshore oil and gas resources, for example, may become more widespread, or subject to much stricter regulations. Permits and licences to develop fossil fuel resources in environmentally sensitive areas will also become more difficult to secure, further constraining the range of accessible resources.

### *Major oil producing states face competing demands*

In many oil exporting countries, governments will juggle the need to be seen as good global citizens with the competing need to finance social programmes through monetising oil and gas reserves. This applies particularly in regions where there is scope for political turmoil affecting continuity of supply.

There will be increasing pressure on NOCs to adapt to a lower carbon economy and issues such as gas flaring will attract greater international scrutiny.

There might be an explicit shift towards gas production over oil in some states and OPEC may be superseded by a gas equivalent, with significant implications for market dynamics.

Some of the oil exporters will also channel export revenues to grow their domestic low carbon economies, investing in renewables and carbon abatement technology. However, the focus of this investment will be secondary to monetising revenue from oil and gas reserves and NOCs, with a relatively low cost of supply, may increase their market share.

### *Prices react to periods of tight supply*

Supply squeezes, combined with increased regulatory costs and taxes will tend to increase both volatility and overall oil prices. Gas prices will also rise driven by increased demand relative to oil and a need to recoup additional costs necessitated by regulatory compliance.

In this perspective, there will be opportunities for oil and gas companies with portfolios that are best placed to withstand the periodic and regional forces described above. International companies with assets weighted towards oil in less stable environments will face the greater likelihood of having to deal with inaccessible resources. Generally, there will also be a need to manage carbon footprints more actively by investing in carbon abatement technologies.

### *Disruptor spotlight: A fragmenting world*

Geopolitical order has been steadily unwinding in recent years, leading to an increasingly fragmented world where countries are motivated more by self-interest than global alliances. This phenomenon was coined by Ian Bremmer, President of Eurasia Group, as G-zero. We see the effects of this trend playing out in the medium term, with increased volatility and uncertainty in global markets.

For the sector, this is brought into sharp focus when considering the aftermath of the 2011 Arab Spring with, for example, Libya emerging as a divided state, Iraq remaining politically unstable and the conflict in Syria causing turmoil across the region and also within Europe. More broadly, Iran is returning to the international fold and looking to regain market share in oil and gas production, as well as exercising its diplomatic muscle in the region. Russia is operating under sanctions, but has also signed bi-lateral supply agreements with China, whose relationship with the US is still adjusting to a new world order.

In a future where oil supply and demand are more evenly balanced, it is not difficult to envisage how a major geopolitical event which disrupts supply, may have significant, direct and disproportionate repercussions across the global energy market.

In this scenario, spare capacity would not be able to plug the gap in the short term, with the shortfall in supply sending prices sharply higher with potentially broader ramifications across the financial markets.

This more fragmented and self-centered world of the future is the backdrop against which oil and gas companies will be making major capital investment decisions.

# *PwC views from around the globe*

We asked PwC's sector team from around the globe what's happening in the oil and gas sector locally and what our future perspectives mean to them. Here's what they told us:

*"Oil and gas producers are focused on lowering their cost structures, introducing technological innovations and maintaining stability in the changing energy world. In the midst of the uncertainty, there are good reasons to be positive about drawing on Canada's strong gas resource base when considering future perspectives."*

Canada Oil and Gas Leader – Reynold Tetzlaff

*"The unconventional shale plays in the US sparked a technological renaissance which continues to spur innovation in an increasingly complex and data driven marketplace."*

US Oil and Gas Leader – Niloufar Molavi

*"South America is moving ahead: one of the largest reserves of shale gas and shale oil in Argentina will have global implications, along with the development of deep water assets in Brazil once the country emerges from the current difficulties."*

Argentina Energy Leader – Jorge Bacher

*"As the North Sea becomes increasingly mature and increasingly uncompetitive in the face of rising costs, it is essential that the industry finds new ways of working. There are opportunities to learn from other sectors in developing a collaborative, sustainable future in the basin."*

UK Oil and Gas Leader – Alison Baker

"Limited access to foreign investments and technologies along with the decline in oil prices is forcing local oil and gas players to re-prioritize their long-term investment projects. The region is likely to be a follower rather than a leader on transition to alternative energy sources"

Russian Oil and Gas Leader – Maxim Timchencko

*"Transition across the Middle East will undoubtedly require strong government intervention given their need to secure alternative sources of revenues to balance budgets and the fact that the market players consist largely of quasi-Government entities."*

Middle East Oil and Gas Leader – Neil O'Keeffe

*"China will see massive structural changes in the energy market driven by the shift away from coal into gas and renewables, the very large and aggressive investments in nuclear, solar, wind and hydro power will continue. This will be accompanied by major energy market reforms, starting in the natural gas market and more aggressive promotion of unconventional shale and coal seam gas exploration and development. Oil will remain largely static as demand growth driven by increasing vehicle population will be balanced by vehicle energy efficiency improvements (EV's and Hybrids)."*

China Oil and Gas Advisory Leader – Kirk Williams

*"Future economic development depends on solving Africa's energy challenges. The role that oil and gas will play in these solutions will be informed by a wide range of drivers, as well as clarity on the relative priority for governments in the competition between oil and gas and renewable energy solutions."*

Africa Oil and Gas Advisory Leader – Chris Bredenhann

*"Australian energy companies have placed some big bets on LNG export facilities, renewables and new business models. All are under major market pressure to perform. Have they created sufficient agility as they have done this? We wait to see which companies will dive, survive or thrive and only time will tell."*

Australia Oil and Gas Leader – Mark Coughlin

# What do the perspectives mean for your organisation?

Businesses need to address fundamental challenges over the next five to fifteen years, regardless of which perspective comes to pass or where they sit in the value chain.

### *Upstream*

For upstream producers, there remain significant opportunities but the perspectives present several distinct types of challenge.

Where government related interventions dominate, upstream companies will need to address whether their portfolio balances different levels of risk exposure to increased regulation or political instability, and they will face a tough balancing act. In these perspectives, in particular, it will be important to evaluate whether the company is able to generate a risk – commensurate return from specific basins and geographies and even entire resource types, to maintain stakeholder support through periods of volatility.

Rapid changes in consumer behaviour feature in some of the perspectives on the future. In these cases, the share of renewables in the energy mix increases more rapidly and upstream companies will need to take a strategic decision on whether or not to enter these markets. Social media magnifies the potential for consumer action to damage a company's reputation, so active "social listening" is essential for companies to address concerns at an early stage.

Innovation will be vital for upstream companies in every perspective, but the focus may need to shift over time. If governments impose higher taxes on emissions, technologies to reduce emissions should take priority, while investments in new types of exploration may become somewhat less important. When supply constraints lead, continuing the current focus on technologies to improve production efficiency, from mobile devices in the field and predictive data analysis (mining 'big data') to automated solutions for maintenance, will become even more important. These investments need to be a priority even when prices are low, in order to ensure future competitiveness.

Collaboration can help upstream companies to navigate the future, extending beyond the current arrangements to focus more on sector-wide efficiencies and also on innovation. For example, upstream companies may work together to standardize major types of equipment, such as portions of offshore platforms. This could lead to a modular approach that saves significant resources.

In all the perspectives there are either periods of, or persistent, low prices and upstream businesses will need to ensure that they manage their financial resources to withstand these challenges.

### *Midstream and trading*

Midstream and trading businesses will be deeply impacted by the resulting oil and gas flows under the different perspectives.

Midstream already plays an important role in bridging demand and supply. With oil and gas produced typically in countries where there is relatively low demand, and larger consuming nations, such as in Asia, needing this supply, there is a clear strategic opportunity for midstream companies. The capacity utilisation through the combination of conversion (liquefaction/gasification), shipping, pipeline and storage facilities will be directly dependent on the size and direction of these hydrocarbon flows. How these flows evolve in the medium term will dictate the future success of midstream participants.

Equally, in each perspective, new midstream projects such as pipelines and LNG terminals may face significant headwinds, either from stricter government regulations or consumer objections to fossil fuel projects. Working to gain trust and support from governments, local communities and the media will be an important prerequisite to any investments.

Regulators have tried in the past and will continue in the future to ensure that midstream assets do not become toll gates to extract extraordinary profits for the owners. It is worth noting that governments are increasingly interested in the activities of traders and potential market price distortions and, particularly in the mature economies, are looking to extend the net of regulators to include the activities of commodity trading businesses.

The traders therefore need to make sure that they are operating on a basis that will withstand this additional scrutiny. Nevertheless, the changing dynamics of supply and demand will continue to present opportunities to profit from bridging over bottlenecks.

Uncertainty as to which perspective is being realised at any point in time leads to volatility in prices. This daily volatility in crude prices has often been higher than the gross margin of the entire downstream value chain during the past five years. It is not surprising that trading companies with capabilities to manage and profit from risks associated with price volatility have emerged as the most profitable players in the sector. These trading companies see value from asset-backed trading and have moved on to integrate into refining, logistics and marketing operations across the world. Given price volatility will likely continue in multiple perspectives, trading opportunities will proliferate against this backdrop of uncertainty.

For the large oil and gas companies, having trader-like capabilities, albeit in a risk managed way, has become essential. Supply demand perspectives vary almost daily. As a consequence, much value can be lost through poorly managed inventory holding or pricing arrangements that are misaligned to rapidly moving market indices. These trading capabilities will become even more valuable as uncertainty accompanies the transition to a low carbon economy.

### *Downstream*

The outlook for downstream companies will hinge on how demand for transport fuel products (mainly gasoline, diesel and jet) will evolve. This will be heavily influenced by evolving trends in mobility, engine efficiency and substitution of oil-based fuels (such as electric vehicles, biofuels and gas).

Flexibility in terms of adjusting to different feedstock sources and also to changes in product demand is critical in an environment of high uncertainty and increasingly stringent compliance requirements. The need for increased efficiency is a constant. Innovation plays a vital role here, as well as in the future development of enhanced products, such as biofuels and lubricants which promote energy efficiency.

By incorporating renewable feedstocks into their product mix, downstream companies can seize new opportunities created by concerned consumers.

They'll need to have access to the market for their refineries or run the risk of losing out to competitive intermediaries.

Business models may need to change, too. For example, downstream operators may want to consider further enriching or tailoring their offering with post sales value added products or services, including energy efficiency services, to strengthen and retain their trusted relationships with customers.

Finally, with a potential shift in value from access to supply (upstream) to access to demand (markets in downstream), companies will need to adapt. In this context for example, a different set of capabilities in fuel marketing will be required in order to succeed. In the same way supermarket chains transformed the landscape in fuel marketing, market players will need to innovate to maintain their competitive edge.

### *Oilfield Service (OFS) providers*

Oilfield service providers will also need to adapt their businesses to compete. In some of the perspectives, OFS companies may want to consider changing their business model. For example, if governments are taxing carbon emissions at a high rate, some assets may no longer be economically attractive, making the decommissioning market potentially more lucrative. Carbon constraining regulation might also provide impetus to newer technologies around CCS and downhole hydrocarbon separation. Divesting non-core businesses may also help OFS companies manage costs and focus on areas where their core capabilities are really differentiating.

Where government intervention plays a strong role, OFS companies should assess their portfolio to make sure that clients which are more exposed to potential regulatory interventions are balanced by those in less sensitive regions or resource areas.

The traditional strength of many OFS players in innovation will prove to be a differentiating factor for winning companies, particularly where demand for oil and gas remains robust, but supplies are constrained by government intervention or other factors. Innovative OFS players can help upstream companies make the most of mature basins through superior enhanced oil recovery (EOR), for example. They can also enhance their position with their customers through improved technology and driving standardisation across the sector.

In some regions where NOCs are dominant, the latter group may team up with national governments to develop their own OFS champions to support the localisation agenda.

### *Summing it up*

In defining measures to be taken or developing future business models, companies need to align on several essential strategic questions. These fundamentals, supported by certain necessary characteristics of an organization, can provide a basis on which, in this uncertain future, oil and gas companies are able to adapt, survive and thrive. This is explored further in the next chapter.

# Navigating uncertainty

The oil and gas sector will be operating in a more volatile world as we transition to a lower carbon energy system. The perspectives show that the range of plausible futures is broad. And while oil and gas will represent a reducing proportion of the overall energy mix, the timing of the peak and pace of the decline is still very uncertain, and the sector will play a critical role in the transition.

In this paper we've sketched out some of the possible futures that may emerge, including where the market environment may be subject to significant shocks, or where there may be a more gradual progression towards plateau and decline.

Looking across the sector's own forecasts, there is no consensus, reflecting the broad range of viewpoints and commercial interests of the market participants. In practice, various elements of the perspectives can be expected to apply in distinct ways in different regions.

In every perspective it is important to:

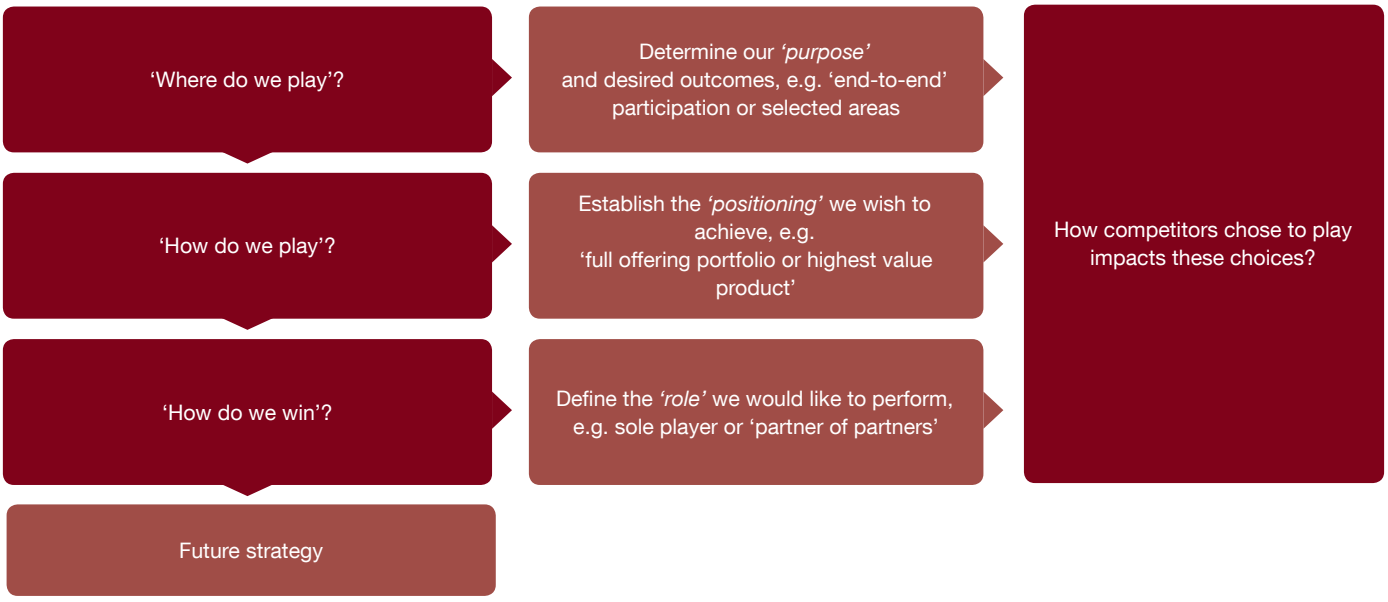
### *Develop a clear strategic underpinning*

As illustrated below, companies need to 'blueprint the future' and ask themselves some key questions, such as: where do they want to play (for example across many parts of or selected parts of the value chain)?; how do they want to play and what will be the go-to-market strategy?

Each way to play has implications for company business models, and the associated operating model, asset portfolio and capabilities.

The skills and capabilities needed to make the most of shale gas reserves are very different from those needed for success in ultra deepwater. This is also highly pertinent if the strategic choice is to develop a complementary low carbon business. Success depends, ultimately, upon aligning distinctive capabilities with business strategy and applying them consistently and coherently so that strategy is executed successfully (our publication 'Strategy That Works' examines this theme more closely).

**'Blueprinting the future'**



### *Focus on agility and resilience*

**Agility** will be critical. This means recognizing the signals of change and responding promptly and appropriately. In a dynamic pricing environment, for example, agility will help companies take advantage of price spikes. Companies that aren't sufficiently nimble will be outflanked and outpaced by more able competitors.

Another key characteristic, **resilience**, goes hand in hand with agility. Resilient companies have strategies that lessen the impact of shocks to the business environment, especially important in the light of geopolitical and regulatory uncertainty. Equally, in a persistent low price environment it will be about resilience and being able to reduce costs through innovation.

### *Leverage key enablers*

**Innovation**, driven through strong use of technology, will be essential for both agility and resilience. Whether it's mobile devices in the field, predictive data analysis, or drones for maintenance, **technology** will help companies respond to disruptive change.

Equally vital will be **collaboration** across the value chain. The sector already has a strong history of upstream joint ventures, but in the future the focus will need to shift further towards gaining efficiency, rather than cost and risk sharing. That will be especially true for perspectives where oil and gas prices look likely to drop. Focus matters, and a very different set of capabilities distinguish successful players in particular parts of the value chain, so teaming up may be critical to access all the skills you need. That's especially likely to be true in perspectives where a sharp growth in the application of renewables technologies is likely to disaggregate the sector's value chain.

### *Ensure you have the trust and support of your stakeholders*

A **trusted business model** is also essential, not only to secure the continued investment from investors and lenders for medium and longer term investment plans in the face of recognised risks, but also in maintaining the social licence to operate. In a number of the perspectives, consumer choices are becoming a larger determining factor and reputation will be key.

# *Final thoughts*

In conclusion, the oil and gas sector has entered a period of transition, as it faces the onset of a low carbon world. Against this backdrop, there are many other trends that will impact the oil and gas sector. Some of these are ongoing themes such as geopolitical instability and acquiring and retaining talent, while others have more recent momentum such as growing consumer activism. None of the perspectives pretend to predict the future. However, they do highlight how some current and emerging themes may converge in the future and the potential consequences for the oil and gas sector.

For all the uncertainty that may cloud the sector's future, one thing is certain. Time and again the oil and gas sector has demonstrated resilience and innovation to adapt to a dramatically changing world. Whatever the future may hold, the oil and gas sector will continue to play a vital role in meeting our changing energy needs.

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***Further reading on the oil and gas sector:***

- Industry Perspectives – Oil & Gas Trends 2016
- Sail, not rail
- Fit for $50 oil: is your company in shape?

***Further reading on industry transformation:***

- The road ahead: gaining momentum from energy transformation
- Re-inventing the wheel: scenarios for the transformation of the automotive industry
- Glimpsing the future(s): Transformation in the chemicals industry
- Strategy That Works

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