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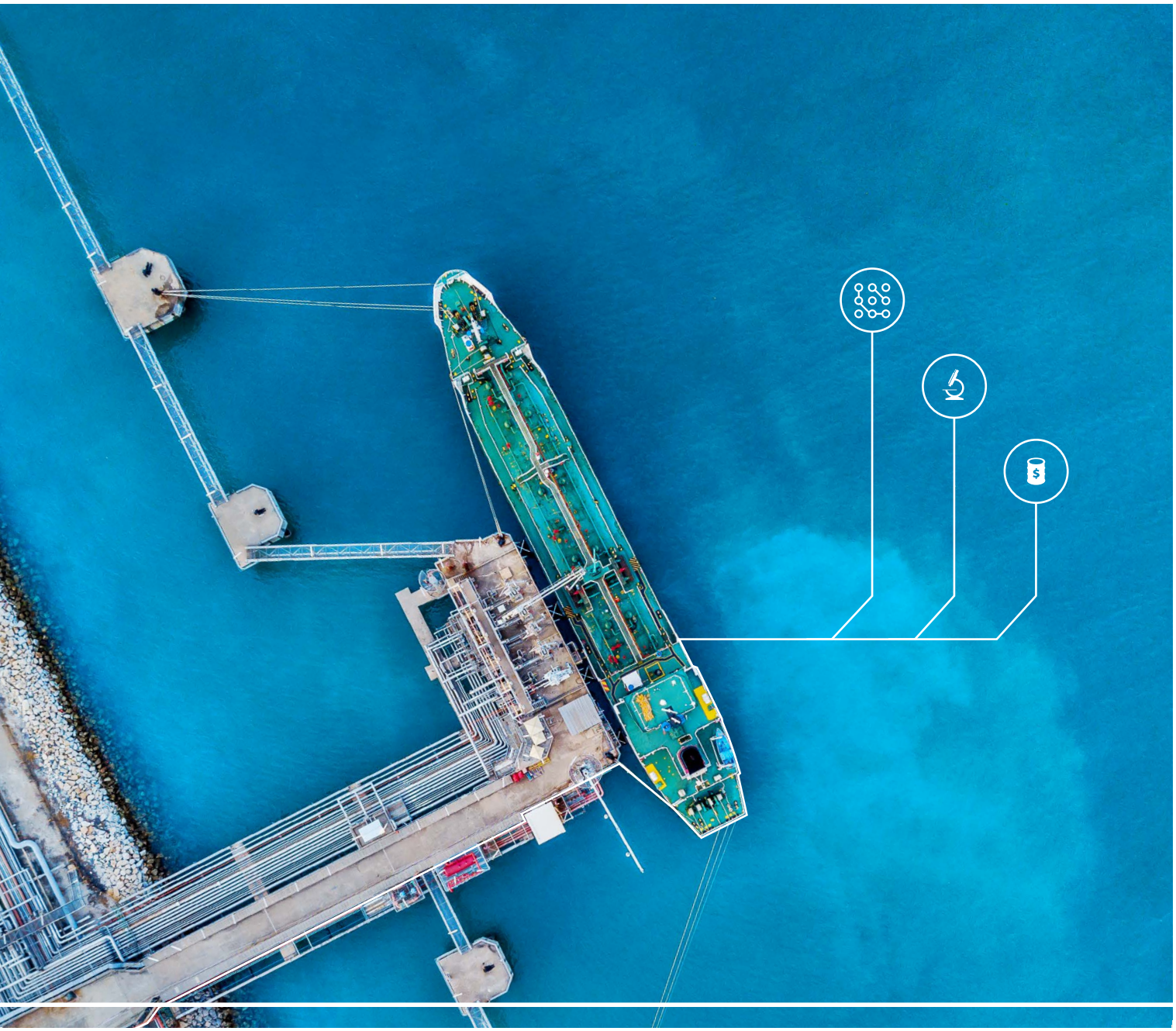

CONFIDENCE AND CONTROL

The outlook for the oil and gas industry in 2018

SAFER, SMARTER, GREENER

ABOUT THE RESEARCH

Confidence and Control is an industry benchmark study on the outlook for the oil and gas industry in 2018, published by DNV GL, the technical advisor to the sector. The study was launched in 2011 and is now in its eighth year; each edition builds on the findings of previous research.

The report assesses industry sentiment, confidence and priorities, and provides expert analysis of the key pressures facing the industry in the year ahead. It is based on a global survey of 813 senior industry professionals and executives, along with 15 in-depth interviews with a range of experts, business leaders and analysts, conducted during October and November 2017. The research was carried out on behalf of DNV GL by Longitude and Kantar TNS.

The companies surveyed vary in size: 44% had annual revenue of USD500 million or less, while 21% had annual revenue in excess of USD5 billion (bn).

Respondents were drawn from across the oil and gas value chain, including publicly-listed companies and privately-held firms. They represent a range of functions within the industry, from board-level executives to senior engineers.

The findings and views expressed in the report do not necessarily reflect the views of DNV GL.

813
Senior industry professionals were surveyed

33%
of respondents work for publicly-listed companies

13%
of respondents came from integrated oil and gas companies

18%
of respondents work for a fully or partially state-owned company

21%
of respondents work for companies with annual revenues in excess of USD5bn

Acknowledgements

We would like to extend our thanks to all participants, and in particular to the following interviewees for sharing their time and insights with us:

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Mark Gainsborough, executive vice president, New Energies, Shell

Maria Moræus Hanssen, CEO and chairman of the management board, DEA Deutsche Erdoel AG

Liv Hovem, CEO, DNV GL – Oil & Gas

Frank Ketelaars, regional manager, Americas, DNV GL – Oil & Gas

Kidong Kim, principal researcher, KOGAS R&D Institute

Thore Kristiansen, chief operating officer E&P, executive director, Galp

Edward Morse, global head of commodities research, Citigroup

Lu Nianming, secretary general, China Chemical Safety Association (CCSA)

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Brian Sullivan, executive director, IPIECA

Trude Sundset, CEO, Gassnova

Eirik Wærness, senior vice president and chief economist, Statoil

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01

GREEN SHOOTS: A SHARP RISE IN INDUSTRY CONFIDENCE

A fresh sense of optimism has emerged in the oil and gas industry over the past year. Looking ahead to 2018, 63% of the senior oil and gas professionals we surveyed are confident about growth in the industry.

This is a long way off the 88% we recorded ahead of 2014, but it is nearly double the 32% we reported just one year ago.

There have been similar surges in respondents' confidence about their own organizations' prospects for reaching revenue and profit targets in the year ahead. As we explore later in this report, a significant proportion of the industry intends to increase investment – not only in its core business, but also in diversification opportunities, R&D and digitalization.

A margin mindset

"A combination of two things have brought confidence back to the industry," says Maria Moræus Hanssen, newly appointed CEO and chairman of the management board of DEA Deutsche Erdoel AG (DEA), an international exploration and production (E&P) company based in Hamburg, Germany. "The first, of course, is oil and gas prices. Short-term prices seem to drive a lot of sentiment about longer-term perspectives for the industry – it's always been like that. And second, costs have come down, both running costs and investment costs."

Much of our research suggests this second factor is key to current sentiment. The successful cost cutting and newly-built efficiencies we have seen over recent years appear to be driving a new optimism for success. This takes place in an environment where the oil price is widely expected to stay lower for much longer, rather than an expectation that the industry is returning to historical highs.

"The big change in industry confidence is not because of a belief that the oil price is going to rise to previous levels," says Graham Bennett, vice president of DNV GL – Oil & Gas. "But instead because industry participants now have their cost levels under control and can make a reasonable margin, even at USD55 or USD65 oil."

Many industry leaders share this view, including Thore Kristiansen, chief operating officer E&P, and executive director at Galp. "It seems to be that we are perhaps beyond the bottom of this cycle and that we are slowly heading up," he says. "But we are preparing for lower-for-longer prices. We do not believe that we will go up towards the past highs, but that we will stay at the levels around where we are currently for many years to come."

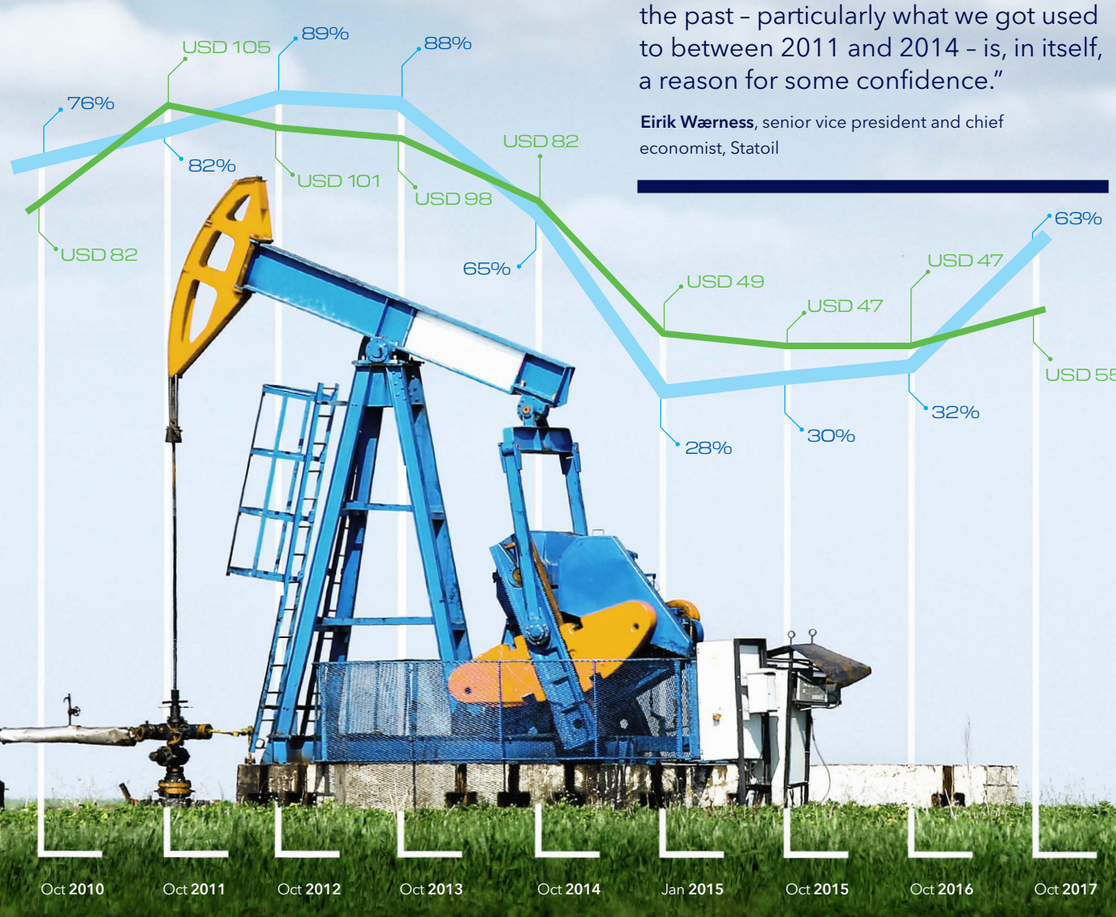
Oil price volatility has fallen

Much of the industry's new confidence is driven by stronger, and perhaps more importantly, less volatile, oil prices in 2017. The Cboe Global Markets Crude Oil ETF Volatility Index (OVX),[1] which had a monthly average of 46 OVX units in 2015 and 44 in 2016, averaged just 28 in 2017. It is now around its lowest level since September 2014.[2]

"I think one of the main reasons why there is generally more optimism in the industry is that the oil price has stabilized." says Frank Ketelaars, regional manager, Americas, DNV GL – Oil & Gas. "When prices are volatile there is more uncertainty about strategy, leaders don't know what kind of adjustments to make, deals are harder to agree – stability allows some predictability to return."

Many expect these conditions to continue through 2018. Just 37% of our survey respondents name the oil price as an expected barrier to growth for 2018, compared with 64% a year ago. There has also been a fall – from 42% two years ago to just 16% this year – in those who expect the global economy to hold back growth.

Oil price vs. overall industry confidence



"The ability of the industry to reduce costs and prepare for something different to the past – particularly what we got used to between 2011 and 2014 – is, in itself, a reason for some confidence."

Eirik Wærness, senior vice president and chief economist, Statoil

1. The Cboe Crude Oil ETF Volatility Index measures the market's expectation of 30-day volatility of crude oil prices: http://bit.ly/2DS0OQU
2. As at 10 January 2018: http://bit.ly/2DwFKC2

Industry confidence change vs. oil price change

Confidence has increased much faster than the oil price

The industry's new confidence appears to be underpinned by lower costs, stable oil prices and fewer concerns about global economic headwinds.

Interestingly, however, the magnitude of the increase in confidence is dramatically greater than the increase in the oil price. When we look at the eight years since we started surveying the industry (see chart, left), the two numbers have been closely correlated (with a coefficient of 0.93 over the past eight surveys), and typically show much closer rates of change from year to year.[3]

This buoyancy of industry confidence relative to the oil price raises interesting questions. For instance, how much is the industry encouraged by a strong belief in the impact and sustainability of new cost models and discipline? Is optimism partly driven by diversification investments beyond oil and gas? Some industry participants believe that there could simply be overconfidence in the stability of prices at current levels:

"The confidence and stability we are seeing are deceptive," says Edward Morse, global head of commodities research at Citigroup. "The most significant response to the higher oil price outlook has been an increase in capital spending, which will turn into a supply surplus much quicker than the market thinks. We think the optimism is not going to last very long, and that by 2019 – particularly if OPEC producers and Russia want to bring production back into the market to avoid losing market share – we will be back in a USD40 to USD45 price environment."

"I'm starting to see companies across the industry feeling confident about operating at USD50 per barrel."

Maria Moræus Hanssen, CEO and chairman of the management board, DEA Deutsche Erdoel AG

3. For instance, between October 2014 and October 2015 the oil price fell by 16% while confidence fell by 26%. Three months later, in January 2015, the oil price had fallen another 41% and confidence had dropped by 57%.

Many believe prices need to rise further

The World Bank and the US Energy Information Administration (EIA) expect crude to average USD55 a barrel[4] to USD56 a barrel[5] respectively in 2018. For our respondents, meanwhile, the average expectation is that the oil price[6] will be USD63 a barrel by the end of December 2018.

Even if our respondents are proven right, that price is still too low to revive some parts of the industry. "The current price level is not comfortably high," says Eirik Wærness, senior vice president and chief economist at Statoil. "There are still pockets of the supplier industry that cannot make money at the moment, and we have seen debt levels come up in parts of the chain."

Another factor is that many in the supply chain are still struggling, not because of the oil price directly, but because operators are on a seemingly relentless drive to improve their margins. This has both reduced the number of available projects and put downward pressure on fees.[7]

Indeed, for many in the industry, the hard times are not over. While 51% of respondents to our survey say that overall prospects for their organization improved in 2017, 24% have the opposite view. Another 24% are neutral, with neither improvement nor decline expected in 2018.[8]

Many of the less confident respondents are from smaller companies (see page 12), which suggests a divide between the sector's behemoths and the rest of the industry.

Indeed, Goldman Sachs expects 2018 to be a bumper year in oil and gas, but not for the whole industry. Its analysis predicts that the super majors will again develop a 1990s-like domination, because cost cutting and low prices are keeping smaller players out of the biggest projects. Over the past three years, the seven largest oil and gas companies have initiated 90% of mega-projects, compared with 50 companies that shared the largest projects over the 10 years before that.[9]

Preparing for future challenges

This year's research shows that many companies in the oil and gas industry continue to expect significant challenges ahead. The difference for 2018 is that they appear to be better prepared for them.

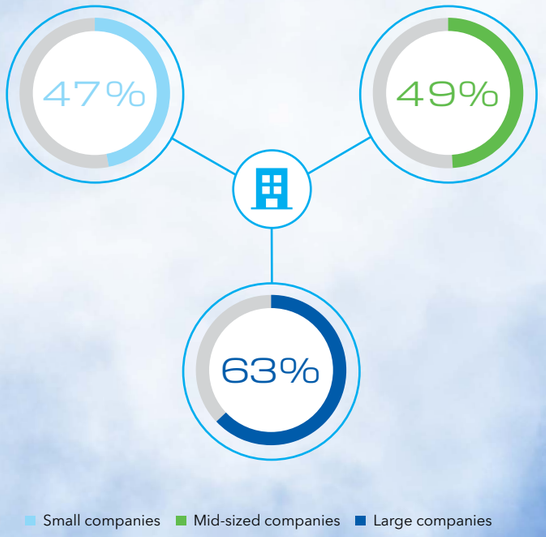
When Shell announced in November 2017 that it had joined BP and Statoil in resuming dividend payments to shareholders, CEO Ben van Beurden explained that the company had successfully shifted its culture from "engineering wonders" to "financial outcomes", citing a "deep transformation in our ways of working".[10]

Galp, meanwhile, is working on becoming more agile. "In our company we are continually preparing ourselves for changes in prices – that's number one," says Thore Kristiansen, "and it's why we are adamant about keeping unit costs low."

Although confidence is returning, it seems most likely that the industry of old is not. Leaders who expect prices to remain lower, or more volatile, are actively evolving their organizations – shifting from an expansion mindset to margin mindset – and implementing new models and technologies to improve operational efficiency.

> "I think it is noteworthy that large integrated companies have resumed deepwater exploration activity. This is a sign that they are content that prevailing prices and lower structural costs will persist."
>
> **Edward Morse**, global head of commodities research, Citigroup

Respondents who agreed that overall prospects improved for their organization in 2017



Top three barriers to industry growth, by year

4. Average of Brent and West Texas Intermediate forecasts: http://bit.ly/2DS7nD2
5. Average price of Brent, Dubai Fateh and West Texas Intermediate: http://bit.ly/2BfVljX
6. Average of Brent and West Texas Intermediate.
7. For Oilfield Suppliers, It's Adapt or Die - OilVoice: http://bit.ly/2EW3Enk
8. 1% of respondents selected "don't know/not applicable"
9. Goldman says oil giants poised for best year in decades: http://bit.ly/2BgjcjC
10. Shell to Pay Its Dividend in Cash in Latest Sign of Health for Big Oil - WSJ: http://on.wsj.com/2DPVGNq

Large organizations are more optimistic

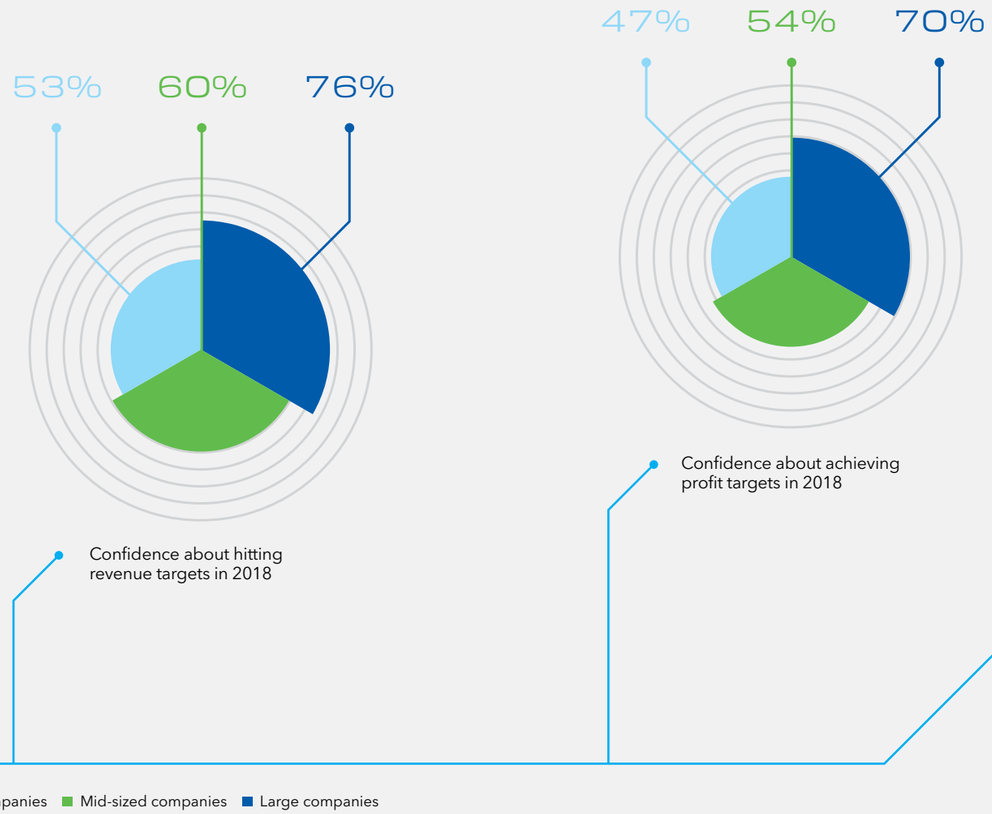
Respondents from large companies have significantly stronger confidence in both industry growth and the prospects for their organizations, compared with those from medium-sized and small companies.[11]

For instance, three-quarters (76%) of those from large companies expect to reach their revenue targets in 2018, and 70% expect to meet profit targets. At small companies, meanwhile, only 53% and 47% respectively expect to achieve their profit targets in 2018.

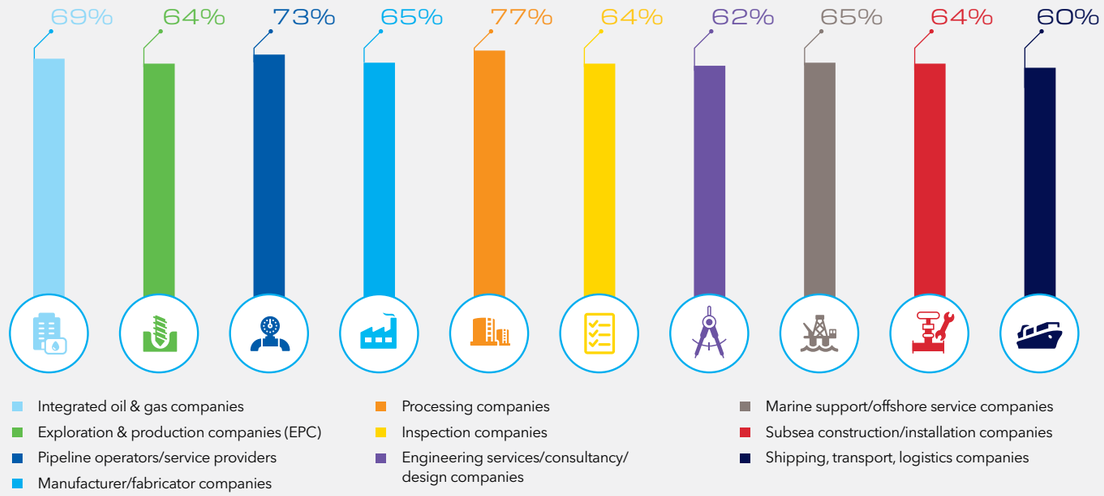
"We're starting to see the larger companies looking more optimistic, but the smaller players are still battling to get their organizations under control."

Brian Sullivan, executive director, IPIECA

Confidence in hitting revenue and profit targets, by company size



Respondents who agree that prospects for their organization will improve in 2018, by company type



Downstream confidence is high

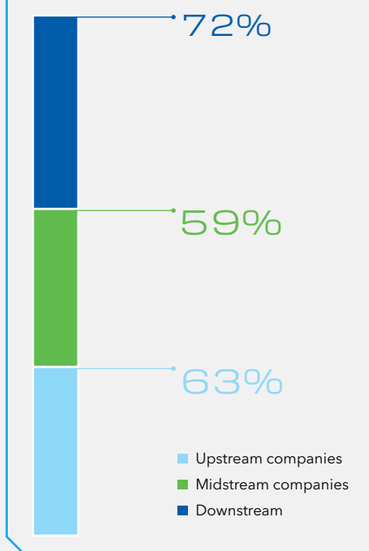
Respondents from downstream-focused organizations are more confident than those from other parts of the industry. Oil-refining and gas-processing respondents report the strongest optimism, with 82% confident about the industry's growth prospects in 2018.

Upstream companies have significantly lower confidence in achieving their profit targets for 2018 (49%) than those with operations throughout the chain (61%), while downstream (65%) and midstream (54%) are also more confident about their profit targets.

"In 2018, I think we will see some of the smaller upstream operators exploiting smaller fields, doing tie-backs or extracting from smaller pools that were already explored. I don't really see a big rebound in activity level for the major E&P players or the drilling companies."

Graham Bennett, vice president, DNV GL – Oil & Gas

Confidence about industry growth prospects, by sector



11. For the purposes of this report, we have defined company sizes by annual revenue according to the following bands: small (USD500m or less), medium (USD500m to USD5bn) and large (USD5bn+).

Reforms drive resurgence in Latin America

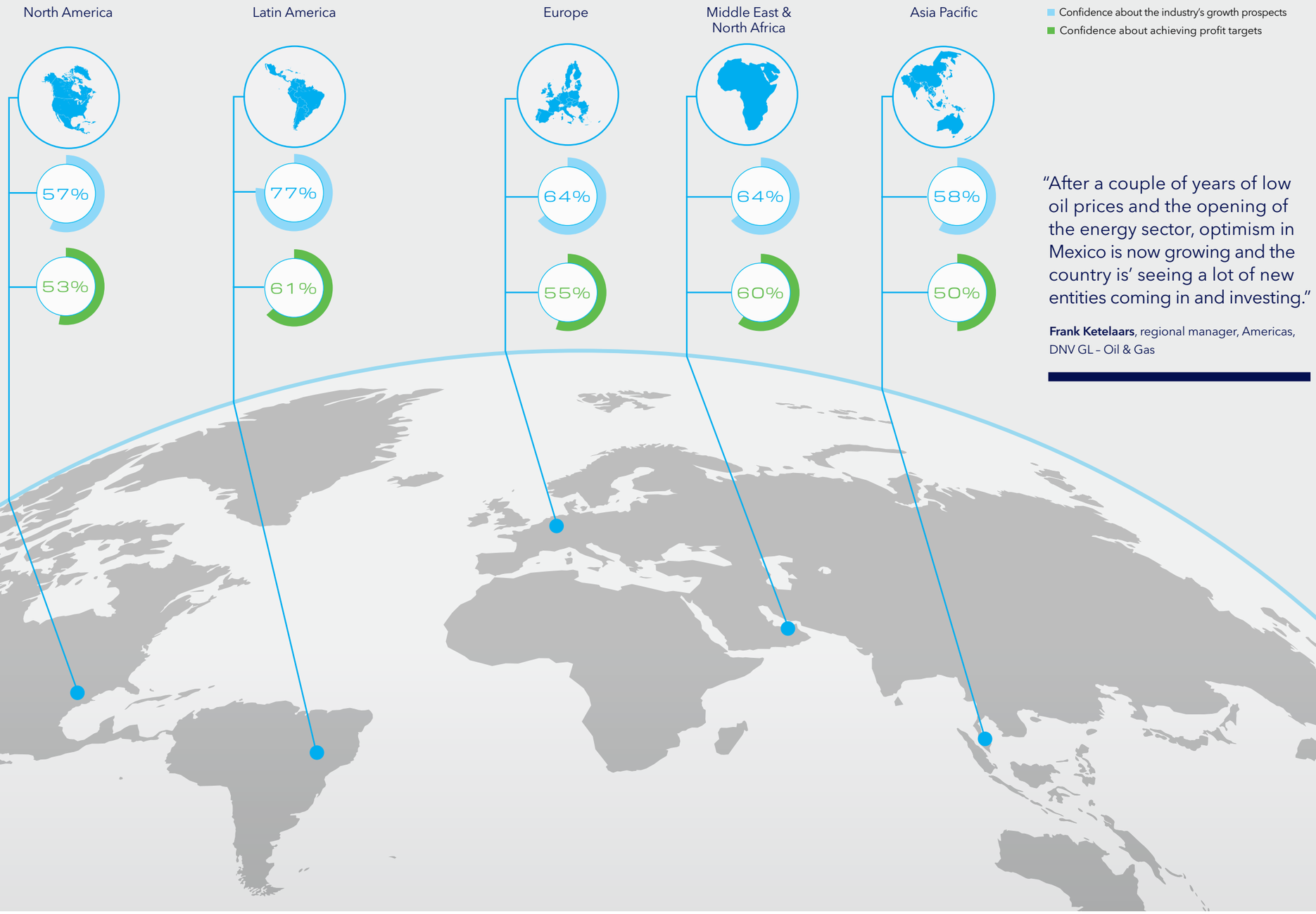
Confidence in the industry's growth prospects are lower for respondents from North America (57%) and Asia Pacific (57%), particularly compared with Latin America (77%) – the region with the brightest outlook.

Just two years ago, when confidence was at rock bottom, Latin America was the least confident region (17%) and Asia Pacific was the most confident (34%). Despite this ranking reversal, confidence clearly improved in all regions during 2017.

"In Brazil, the anti-corruption campaign and the erosion of the national content provisions have opened a bottleneck and reduced prices. The majors are coming back in in a vigorous way."

Edward Morse, global head of commodities research, Citigroup

Industry confidence for 2018, by region



"After a couple of years of low oil prices and the opening of the energy sector, optimism in Mexico is now growing and the country is' seeing a lot of new entities coming in and investing."

Frank Ketelaars, regional manager, Americas, DNV GL – Oil & Gas

02

OVERHAUL FOR THE LONG HAUL: SMART INVESTING, AGILITY AND LONG-TERM DISCIPLINE

With a more confident industry emerging, our survey gives clear signs that the sector plans to invest in R&D, digitalization, diversification and, to some extent, in new exploration and expansion activities around existing fields in 2018.

Two-thirds of those we surveyed (66%) plan to maintain or increase capital expenditure (capex) in 2018 – the first increase in that measure in three years and a considerable jump from the 39% that intended the same for 2017. The areas of the industry most likely to increase capex are oil refining and gas processing, integrated companies and E&P companies.

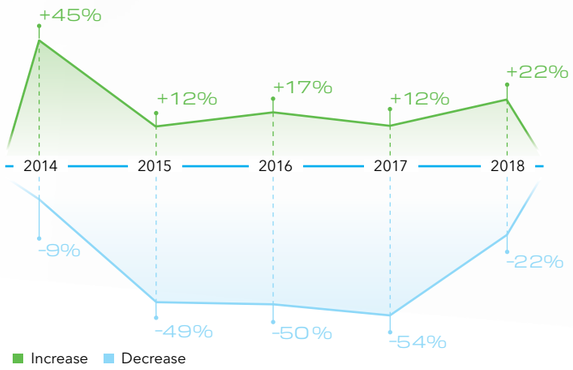
We saw signs in 2017 of an increasing appetite for investment. Saudi Aramco, for example, approved plans to spend USD20 bn building the world's largest petrochemicals plant[12] (and the first in Saudi Arabia), while Exxon Mobil confirmed it will invest the same amount over the next five years in chemical and refining plants along the US's Gulf Coast.[13] These developments highlight the attractiveness of the downstream segment.

A return to deepwater

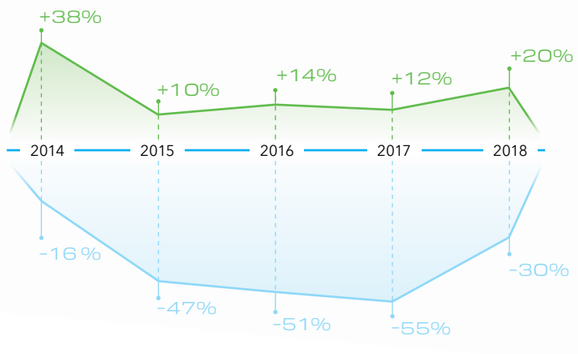
Some major offshore projects also got the green light in 2017. In mid-2017, Exxon Mobil announced it will spend USD4.4bn on the initial phase of the Liza development in offshore Guyana, within a block that is expected to hold between 2 and 2.5bn barrels of oil equivalent. In December, Statoil announced the largest offshore project to be approved in 2017: the USD5.89bn development of the Johan Castberg field, which will be the northern most development ever on the Norwegian Continental Shelf.[14]

Eirik Wærness of Statoil explains that after three years of significant cutbacks in investment, the industry has accumulated many potential projects, most of which have lower break-even points than before. "These projects have been run through the mill several times, in terms of cost reductions," he says. "Some of them will certainly come to investment soon." The Johan Castberg development is a prime example: originally tabled before the price fall in 2014, the project was significantly redesigned and new solutions had to be developed to achieve profitability.[15]

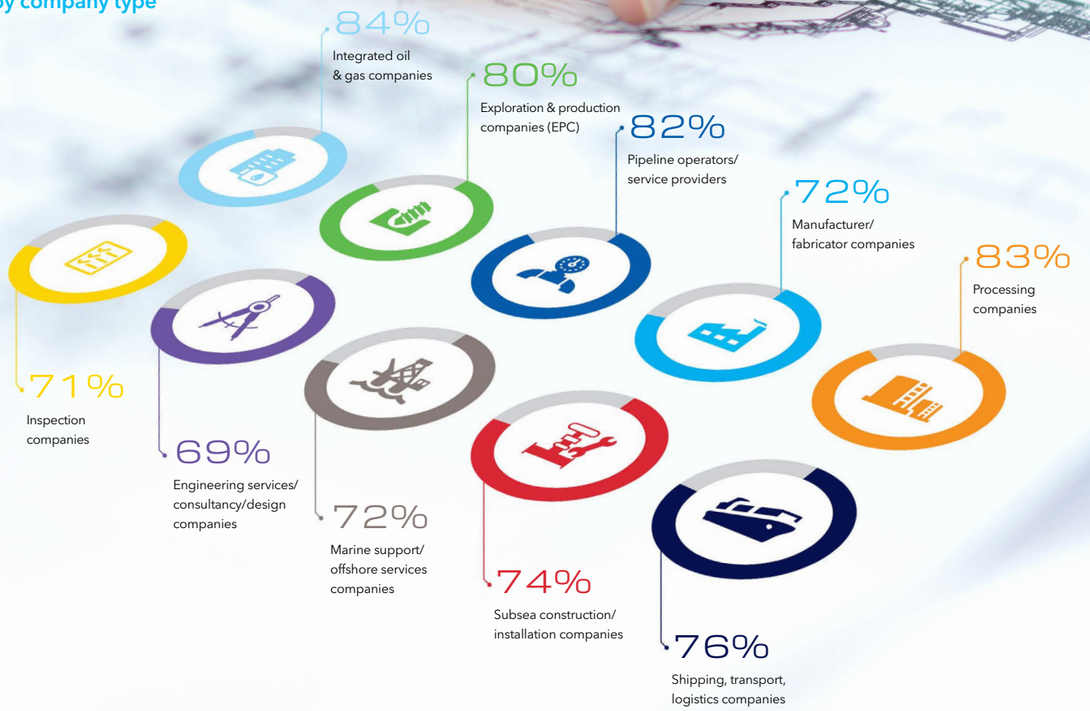
Respondents' expectations for changes to their companies' capital expenditure, by year



Respondents' expectations for headcount changes in their companies, by year



Respondents who said their company reached its cost efficiency targets in 2017, by company type



Standardization has been key to getting some new projects off the ground, and will continue to be a focus: 87% of survey respondents will increase (48%) or maintain (39%) their spending on standardizing operations in 2018. "We are now seeing examples of both super majors and smaller entrants developing fields in the Gulf of Mexico effectively as carbon copies; design one, build two," says DNV GL's Ketelaars.

"We expect volatility in commodity prices to remain. That's why we need to be relentless in our pursuit to make sure our unit costs stay low."

Thore Kristiansen, chief operating officer E&P, executive director, Galp

12. Saudi Aramco, SABIC plan to build $20 bln oil-to-chemicals complex - Reuters: http://reut.rs/2DmZHf8
13. Exxon to invest $20 billion on U.S. Gulf Coast refining projects – Reuters: http://reut.rs/2mV4D0E
14. Statoil Plans $6B Development At Huge Arctic Oil Field – OilPrice.com: http://bit.ly/2EWS2k6
15. Johan Castberg - statoil.com: http://bit.ly/2DOtOsS

Greater agility for shorter cycles

This fits the pattern developed over the past few years of companies developing new levels of discipline in spending, project selection, and collaboration, while pioneering new models and innovations that achieve more with less. Over eight in ten (84%) of the respondents that are increasing their capital expenditure in 2018 are doing so following successful cost cutting in 2017.

Our survey also highlights an increasing focus on being nimble, with 60% of respondents reporting that their organization is favouring investments in more agile, shorter-term projects – an increase from 52% a year ago.

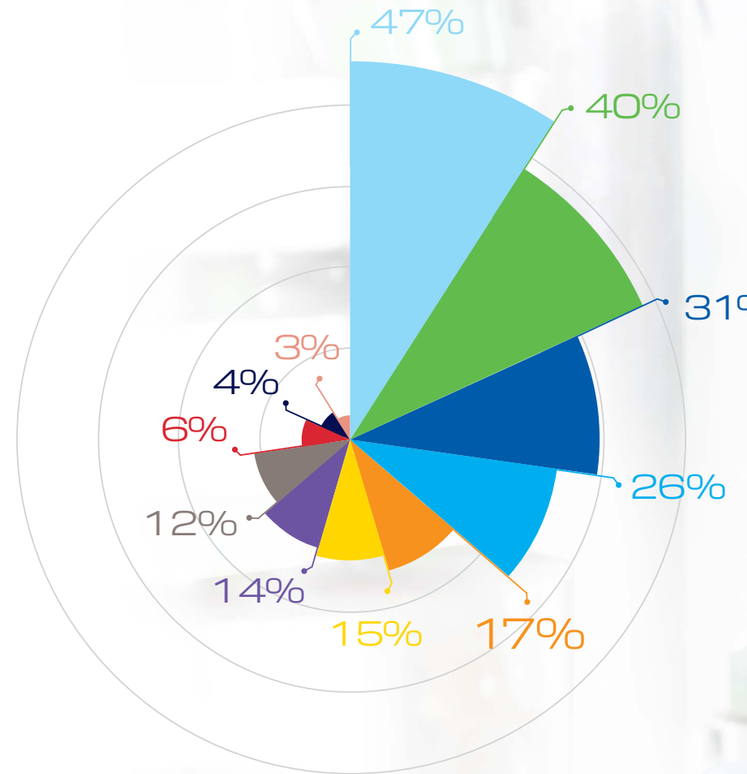
"New projects are likely to have a quicker return on investment," says Liv Hovem, CEO of DNV GL – Oil & Gas. "We see the majors driving a much quicker turnaround on mega-projects compared with a few years ago." This shift is becoming a necessity in gas markets, where buyers now push for shorter contracts based on natural gas indices, rather than the long-term, oil-price-pegged contracts of the past.[16]

The industry may have to adapt to shorter investment and price cycles. "We know that the shale-oil cycle is a short one – a nine-month cycle, both when prices go up and go down," says Edward Morse of Citigroup. "But the fact is that the deepwater cycle has also shortened. It is no longer a 10-year cycle. Now that infrastructure is in place and so widespread, it really is five or fewer years from the time you decide to develop a project to getting it completed."

More companies expect to increase their operating expenditure (19%) and headcount (20%) in 2018 than they did ahead of 2017 (11% and 12% respectively). But this is not the start of a return to pre-2014 norms; instead, the suggestion is that these increases are to support leaner, smarter projects. Half of companies in the survey (50%) are steadfast in their efforts to increase cost-control measures in 2018, which is consistent with last year's result (51%). And while this is not as high as two years ago (70%), it does suggest that a new discipline is here to stay.

Top priorities for cutting costs in 2018

Negative effects of cost cutting



- Reduced company morale
- Fewer available skills
- Less innovation
- Less internal collaboration and knowledge sharing
- Weaker customer relationships
- Cost cutting had no negative effects
- Fewer supplier relationships
- Increase health and safety
- Weaker environmental and climate performance
- Increased cyber security risk
- Other

"We see the majors driving a much quicker turnaround on mega-projects compared with a few years ago."

Liv Hovem, CEO, DNV GL - Oil & Gas

16. 2018 outlook on oil and gas - Deloitte: http://bit.ly/2rnJcKg

03

TOUGH QUESTIONS FOR OIL AND GAS LEADERS: CAPITAL ALLOCATION IN THE ENERGY TRANSITION

Apart from an increased focus on margins, there are also other trends emerging that suggest we have entered a new era for oil and gas. Many are connected to the notion that we have entered a long-term energy transition, towards a diverse mix of ever-lower-carbon solutions.

The energy transition is seen by many as a gradual process, but already 44% of respondents to our survey say their organization is actively preparing for a transition to a less carbon-intensive energy mix, against just 27% who say they are not preparing; 29% are unsure or neutral.

"I think there's an increasing feeling that we are facing the start of an energy transition," says Statoil's Wærness. "That makes decision-makers and the industry more cautious than they would be if this had been a normal boom-bust type of cycle." Many leaders know they need to focus on doing things differently in the near-term, while also reassessing their long-term strategies, and this creates a new set of hard choices.

Gas seen as critical to the energy transition

Some organizations have responded by directing their investments towards natural gas and liquefied natural gas (LNG) – ahead of crude oil. For example, Shell became the world's largest LNG exporter after acquiring BG Group in 2016,[17] Total invested heavily in Iranian gas in 2017,[18] and Japanese trading company Mitsui & Co has shifted its focus from crude oil to LNG as demand surges in the Asia Pacific region.[19] BP, meanwhile, completed seven major projects in 2017, six of which were focused solely on gas.[20]

Our survey suggests some industry consensus on the priority of gas in the short and medium term. The vast majority (86%) expect gas to become an increasingly important part of the global energy mix over the next 10 years – up from 77% a year ago. More respondents than last year (55% to 45%) now expect oil and gas prices to decouple, which highlights a growing expectation of divergence in the supply and demand patterns of the two fuels.

Modelling supports the case for gas

The case for gas is supported by its availability and cleaner-burning profile relative to other fossil fuels. This makes it an ideal energy source for lowering carbon emissions in the near-term, while complementing the gradual development of renewable energy and zero-carbon technologies, that will in the long-term, take an increasing share of the global energy mix.

A new determination in Asia to fight air pollution is a major driver in the shift towards gas. "Environmental regulations will be the biggest driver of change in demand for natural gas and LNG," says Kidong Kim, principal researcher at Korea's KOGAS R&D Institute. "Air pollution in Korea, China and northeast Asia is stirring public interest and leading to new emissions regulations from governments. As a result, I expect gas to expand much faster than coal or oil."

DNV GL's 2017 *Energy Transition Outlook*, an independent forecast of the future of energy, lends support to the gas-first strategy pursued by the likes of Shell and BP.

It predicts a relatively swift energy transition, with oil demand peaking within the next 10 years and gas expected to remain the world's biggest single source of energy through to 2050.[21]

Diversification into renewables

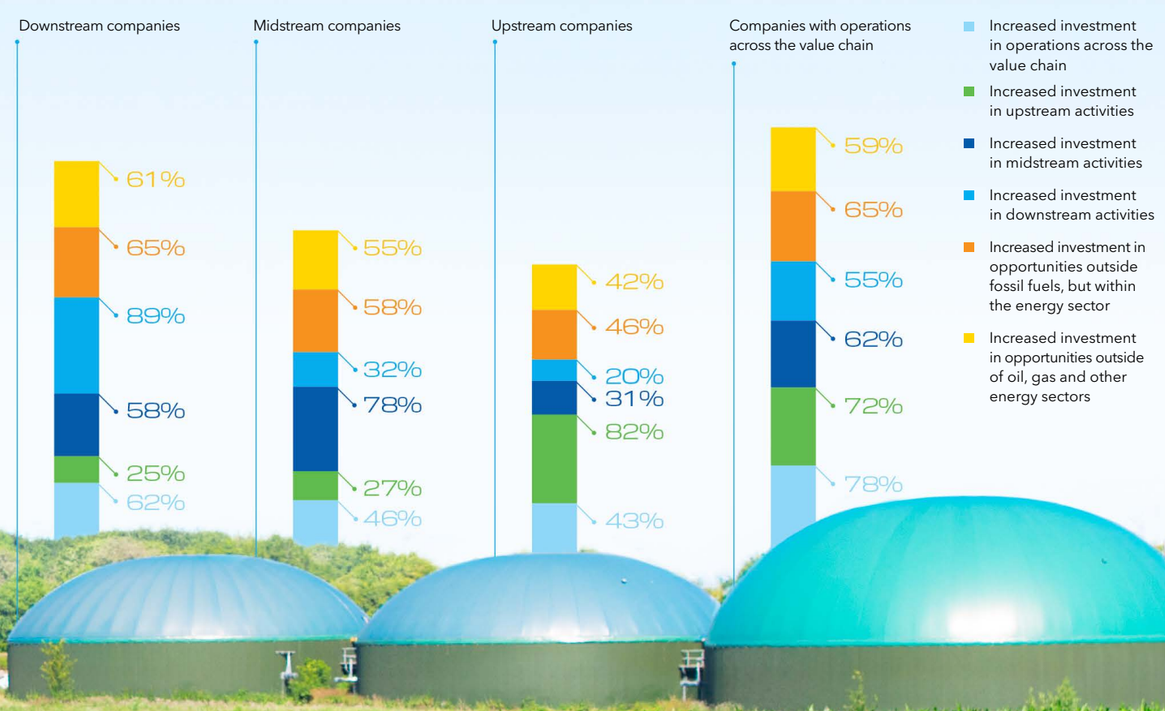
Our survey results also highlight an ever-growing share of renewable energy sources within the portfolios of oil and gas companies: 38% of respondents expect to increase their renewable energy investments in 2018, up from 27% a year ago.

"The business case is proving increasingly attractive," says Brian Sullivan, executive director of IPIECA, the global oil and gas industry association for environmental and social issues.

"Some companies clearly have the remit to diversify beyond oil and gas. They are all looking at what they expect the future market to be and are working out whether it's an area they can invest in."

It is not difficult to justify such investments. The consultancy Wood Mackenzie, for instance, has outlined scenarios that see solar and wind alone constituting 23% of the global power market by 2035 (and 6% of the total energy market).[22] The debate is no longer over whether renewables will grow during the coming decades and take an ever-increasing share of the energy mix. It is over when exactly to enter the market, which specific renewables to invest in, and how to balance these investments with those in fossil fuels

Respondents' expectations for their companies' diversification in 2018, by sector



17. Oil Majors Are Leading The Recovery Race – OilPrice.com: http://bit.ly/2mPu7Mb
18. What Total's $4.8 billion investment means for Iran: http://cnb.cx/2rnO8yM
19. Financial Times: http://on.ft.com/2DkhnUR
20. Shifting towards gas: http://on.bp.com/2mTOg3N
21. 'Energy transition outlook 2017: oil and gas use – forecast to 2050', DNV GL, September 2017: http://bit.ly/2Dw3rug
22. Global Oil Majors Are Poised for a Resurgence in Solar and Wind – Greentech Media: http://bit.ly/2BgbxBN

The capital allocation challenge

Our 2018 survey reveals where different parts of the industry intend to invest during the coming year. Unsurprisingly, all categories of company within our sample remain most likely to maintain or increase investment in the areas of the value chain that are already core to their business – rather than in any other part of the value chain.

However, integrated and downstream organizations appear to be diversifying more than upstream and midstream companies. Upstream companies have the narrowest investment focus, with low proportions likely to venture downstream or beyond the oil and gas industry (see chart on page 21).

Interestingly, 65% of both integrated and downstream companies are likely to invest in opportunities outside of fossil fuels, but still within energy.[23] These opportunities include renewable energy generation, electric vehicle charging networks and biofuel synthesis. French utility Engie, for example, is moving away from the upstream oil and gas business entirely. It sold its upstream LNG assets to Total in November 2017,[24] following the sale of its E&P business to Neptune Oil & Gas earlier in the year.[25] Denmark's DONG Energy, meanwhile, made a dramatic shift out of oil and gas to focus almost entirely on renewables.[26]

An industry of diverse strategies

Some companies are moving against the tide. This includes Ineos, a privately-held chemicals company, which began moving upstream in 2015 and continued strongly over the past year. In 2017, Ineos purchased oil and gas fields in the North Sea from Siccar Point Energy and notably, given its opposing strategy, DONG Energy.[27] The company has also picked up midstream assets, taking over the Forties pipeline from BP in October 2017.[28]

"These deals were part of a bumper year of M&A activity on the UK continental shelf, with numerous deals announced," says Andy Samuel, CEO, UK Oil and Gas Authority (OGA), in reference to Ineos's Forties pipeline deal and Chrysaor's acquisition from Shell of several North Sea interests.[29] "We enjoy a diverse mix of players, and new entrants are recognizing the substantial remaining potential of the basin and bringing new investment and ideas."

Even more significant, perhaps, is that close to 60% of respondents from both integrated and downstream organizations report that they are likely to invest in opportunities outside of energy entirely. This could include anything from waste-water management to industrial biotechnology.[30]

Shell, for instance, has one of the world's biggest retail networks through its fuel stations, with more sites than either Starbucks or McDonald's.[31] "We deal with 30 million customers a day," says Mark Gainsborough, the firm's executive vice president for new energies. "I can see us doing more things with those customers in the future, as well as meeting a bigger part of their total energy needs."

The diversification of revenue streams and strategies looks set to continue across the oil and gas industry in 2018. But investments in traditional oil and gas projects and innovative variants will go on attracting the most industry capital. "I think we'll see continued strong investment in the oil and gas sector in 2018," says Gainsborough. "Oil and gas are going to be a very important part of the energy mix for the coming decades."

Respondents who agree that their company is actively preparing for the energy transition in 2018, by region

Respondents who agree that their organizations will favour investment in projects that are adaptable within shorter time frames, by year

> "We see the future for cost-effective, low-carbon power generation as really about renewables plus gas."
>
> **Mark Gainsborough**, executive vice president, New Energies, Shell

23. Respondents were given three examples – renewables, biogas, and hydrogen – to help describe what the survey meant by "opportunities outside of fossil fuels, but within energy"
24. Financial Times: http://on.ft.com/2Djmrso
25. Financial Times: http://on.ft.com/2mTHMBA
26. Danish giants pull out of the oil industry - Offshore Technology: http://bit.ly/2DwIQGg
27. Ineos expands into North Sea oil and gas exploration - BBC News: http://bbc.in/2riEBZM
28. BP's Sale Of North Sea Forties Pipeline: http://bit.ly/2DjgNGB
29. Chrysaor completes acquisition of Shell package pdf: http://bit.ly/2DwJHqs
30. New research highlights billions of pounds of diversification opportunities: http://bit.ly/2Dou9FG
31. What the future of the petrol station looks like: http://bit.ly/2Dw6bI4

04

FRESH IMPETUS FOR INNOVATION AS DIGITALIZATION REACHES A TIPPING POINT

Over a third (36%) of senior oil and gas professionals expect to increase spending on R&D and innovation in 2018 – the highest level in the four years since we started tracking this indicator. In the past two years, only 15% (2016) and 14% (2017) respectively were planning increases. This suggests an imminent turnaround after three years of cuts and freezes.

For some, investment is urgent. One in five respondents (19%) cite a lack of investment in innovation as a key barrier to growth in 2018 – on a par with oversupply of oil and gas (19%), operating costs (18%), reduced exploration activity (19%) and competitive pressure (22%). Only the oil price (37%) is seen as a significantly higher barrier.

What kind of R&D projects are likely to go ahead in 2018? Digitalization (37%) and its prerequisite, cyber security (36%), are by far the leading areas for our survey respondents. Looking at the next five years, 76% of respondents say they will invest in digitalization and 68% in cyber security. Only one of the 15 other technologies we asked about will be developed by more than 50% of respondents over the next five years (subsea, by 54%).

The potential of digitalization

Commentators often point out that the oil and gas industry has been slow to reap the benefits of digitalization. "We are probably decades behind the automotive industry or the aerospace industry, for example, in using vibration monitoring on some of our higher-pressure equipment," says David Parkin, director of safety and network strategy at Cadent, the UK gas network operator. "There's a lot we can do with smart technology to better inform our maintenance procedures."

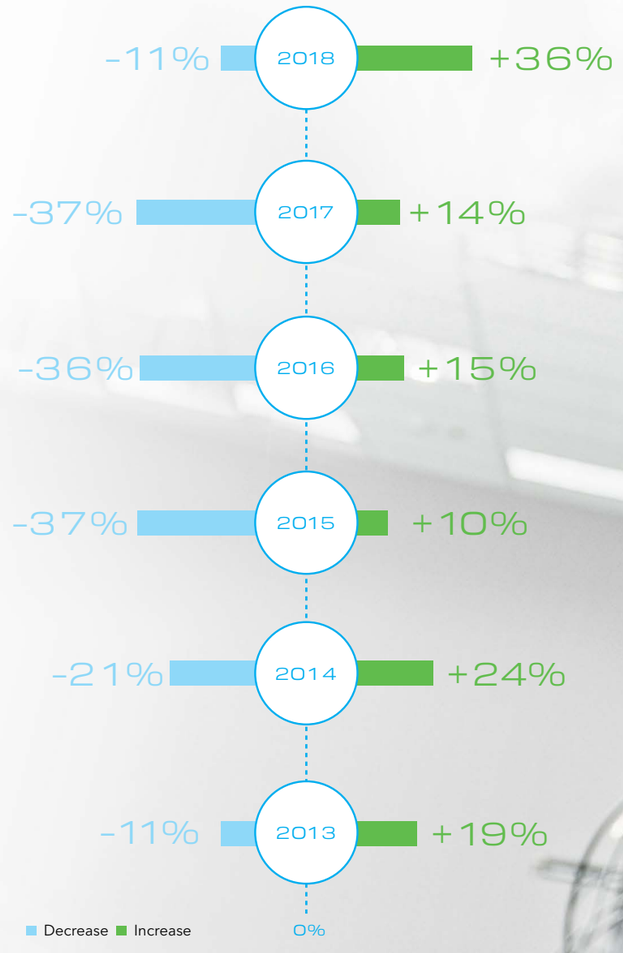
Today's increased focus on digitalization is linked to the industry's drive towards greater cost efficiency. Last year 49% of respondents to our survey said that they needed to embrace digitalization to increase profitability at their organization. This year that figure has leapt up to 70%. "Digitalization will be very important," says Galp's Thore Kristiansen. "It will make us more competitive and faster, and will contribute to lower unit costs."

Maria Moræus Hanssen of DEA agrees, and expects R&D spending to be reprioritized as a result. "We will see more R&D going into digital, artificial intelligence and automation, which is really about costs, about other ways of doing our business," she says. "R&D is now less likely to be focused on ultra-deepwater, the Arctic or other extreme environments. It will be more about rationalizing the business – making the industry more profitable, more productive, modernized."

In terms of implementation, there has been a significant increase in the proportion of respondents (54%) who intend to boost spending on digitalization in 2018 – up from 39% expected for the previous year.

> "The last decade was a period of record cost levels. This is a decade of rapid technological development and cost deflation, which doesn't look like it will end any time soon."
>
> **Edward Morse**, global head of commodities research, Citigroup

Respondents' expectations for changes to their companies' R&D and innovation spending, by year



Many of the majors see enormous potential in digitalization. "We've been digital for decades, but it has had limited impact beyond becoming more energy efficient," says Statoil's Wærness. "What we see now is that the different types of technology development come together at an increasingly rapid speed. That means we can make large changes more quickly. Things like blockchain, artificial intelligence, robotics – they allow for different operational models."

Throughout the value chain, there are examples of digitalization's potential. In the upstream segment, the IEA estimates that digital technologies could decrease production costs by 10–20% with more advanced use of sensors, seismic data, and reservoir modelling. The research also concludes that digitalization could increase technically recoverable oil and gas resources by 5% globally.[32]

With its history of narrow margins, the downstream sector is digitalizing operations faster than its upstream counterparts. Modern refineries are highly automated, with sensors allowing small teams to monitor and control operations in real time.[33] The midstream, meanwhile, is catching up, with increasingly automated, digitally monitored facilities, predictive analytics and robotic pipeline inspectors.[34]

The market for digitalization in the energy sector – including things like sensors, data collection and analytics – is expected to grow to USD64 (bn) by 2025, according to Bloomberg New Energy Finance, with the biggest share being used to "to improve the bottom line of fossil fuel generators".[35]

Bridging the digital skills gap

The industry is catching up on innovation investment, but realizing the benefits of digitalization depends on more than simply increasing the budget allocation.

Our survey finds that a lack of required skills is the biggest barrier to greater digitalization. This reflects the shift in the industry's focus: last year, the top barrier was a lack of funding, and access to the right skills was fourth. This year, funding has fallen to fifth.

This suggests that funds are increasingly available for digitalization initiatives, but that the challenge is now more in the implementation. With such strong investment on the way, we could see a battle for digitalization skills – not only among traditional rivals, but also with parallel industries where these sought-after skill sets overlap.

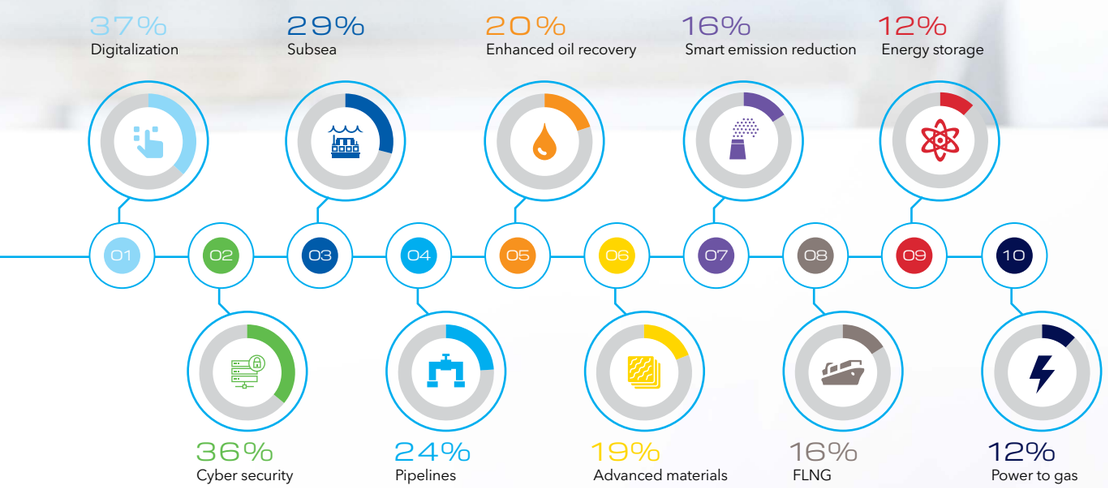
A lack of digital skills can introduce new, complex and serious risks, from safety accidents to environmental disasters. It is crucial then, that digitalization in high-risk areas are, not just installed by temporary experts, but managed and maintained by leaders and teams with the requisite knowledge.

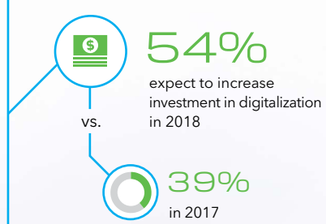
These kinds of digital skills gaps need to be closed urgently, no matter how challenging the labour market may be. This can require innovative approaches to defining individual roles and team responsibilities. "We need the right combination of industry experience, subject matter experts and digital competencies, but not always in the same person" says DNV GL's Liv Hovem. "As digitalization advances we need to be clever about designing teams and finding new ways to collaborate to ensure the ideal skills are available at all the right moments."

Recruitment and skills development are not the only routes companies can – and should – be taking to build available skills, particularly when the need is urgent. Research by EY has found that while 41% of oil and gas companies intend to develop in-house digitalization capabilities, 33% are "buying, forming alliances or creating [joint ventures] with digital companies".[36]

Galp's Kristiansen backs up the partnership approach. "In addition to building our internal resources, we are reaching out to world leaders within each of our key digitalization areas – finding the right partners to work with," he says. "We look for companies that have clearly had success within each area, but not necessarily within oil and gas. We look outside, to other industries where we can learn new things."

Top priorities for R&D and innovation in 2018





32. Digitalization and Energy: http://bit.ly/2Bgev9p
33. For Now, NOC Refiners Winning the Digital Maturity Race – Rigzone: http://bit.ly/2Djg7RU
34. Digital Transformation Initiative - White Paper: http://bit.ly/2EWZqw3
35. Market for Digitalization in Energy Sector – Bloomberg New Energy Finance: http://bit.ly/2mRC17F

36. Oil & Gas Capital Confidence Barometer – EY Global Oil & Gas: https://go.ey.com/2DmRG68

Securing digital transformation

One of the key areas where oil and gas companies may need to build their capabilities in this way is cyber security, and 43% of our survey respondents expect to increase their spending in this area in 2018.

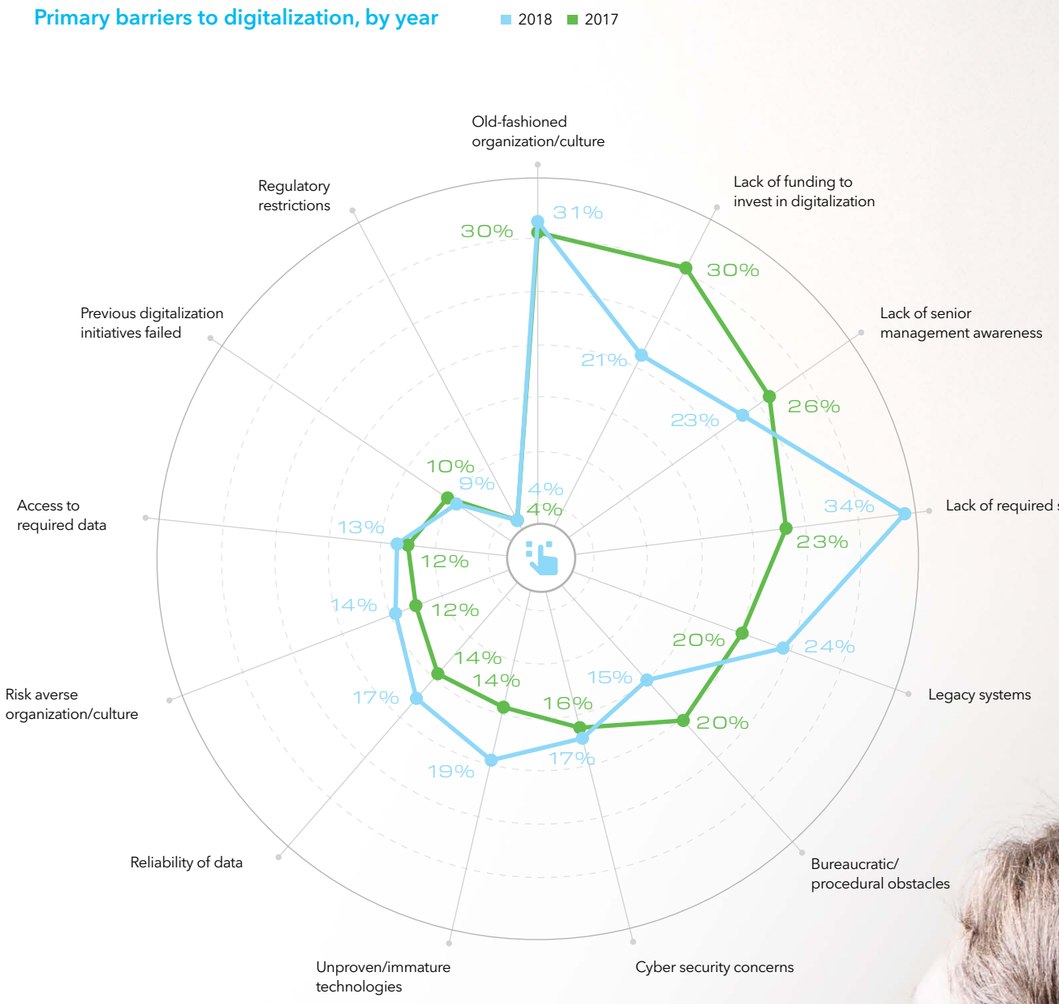
"Certainly we see the increase in risk from cyber threats," says Graham Bennett of DNV GL – Oil & Gas. "There is a lot of complexity in IT systems, control systems, safety systems and shutdown systems – all of those can be exposed to cyber risk. Complex supply chains then multiply these risks and require careful management".

Sometimes existing, ageing technologies and infrastructure are comparatively low risk. As David Parkin explains, parts of Cadent's gas network are essentially "Victorian, analogue systems which have a relatively low risk profile from a cyber-security perspective."

He says that Cadent has to weigh the benefits of digital technologies against the loss of a system that "can go through a complete cyber blackout, lose all automated control to the network, but still run perfectly well without any digital control systems in place." Despite this, Cadent, like so many in the industry, is prioritizing digitalization to improve operational efficiency over the next decade.

> "The industry's operational and safety systems have become much more complicated as the sector continues to digitalize. As a result, we are seeing a significant increase in companies' exposure to cyber threats and attacks."
>
> **Graham Bennett**, vice president, DNV GL - Oil & Gas

Primary barriers to digitalization, by year



05

THE POWER OF CLEANER PROFITS: A GROWING BUSINESS CASE FOR DECARBONIZATION

Last year marked the 20th anniversary of the Global Reporting Initiative (GRI), one of the pioneering organizations behind the development of sustainability reporting. Currently, 74% of the world's largest 250 companies use GRI's Sustainability Reporting Standards to communicate their impact on "climate change, human rights, governance and social well-being".[37]

More than 9,700 companies, across 161 countries, have also joined the UN Global Compact since it was established in 2000 – another major achievement in the movement towards more responsible business.[38]

More recently, efforts are underway to ensure companies do more to demonstrate the links between climate risk and financial performance. This is being driven by the Financial Stability Board's Task Force on Climate-Related Financial Disclosures (TCFD), which published recommendations in 2017 for companies to use to provide climate-related financial risk information to investors, lenders and insurance underwriters.[39]

Oil and gas companies have been important to this reporting and disclosure movement. Most are well-accustomed to having environmental and social factors as part of their licences to operate. "Issues of sustainability, climate and social responsibility are becoming increasingly important to a larger number of players in the oil and gas industry," says IPIECA's Brian Sullivan.

Our survey supports this, with 56% of respondents stating that sustainability (including environment, climate, corporate social responsibility and workplace environment) is a top or high priority for their organization. Another third (33%) see it as a moderate priority, which means that very few have it as a low (6%) or non-existent (5%) priority.

Where profits meet principles

Our survey also finds that commitments to sustainability are linked to the growth prospects of organizations in the oil and gas sector. For instance, sustainability is a high or top priority for more respondents from companies that expect to meet their profit targets (64%) as opposed to those that do not (35%).

Successful businesses certainly have more resources to devote to sustainability. But might sustainability initiatives actually drive greater profitability? This thesis has strong support. The Business and Sustainable Development Commission was launched at the 2016 World Economic Forum and has found that companies could gain USD12 trillion in business savings and revenue by developing sustainable business models.[40]

The senior oil and gas professionals responding to our survey appear to recognize the opportunity. When we asked respondents to choose the biggest drivers of sustainability initiatives in their organizations from a long, diverse list, the top three choices were all related to commercial success: business opportunities (40%), reputation and brand (39%) and competitive advantage (36%). The Paris Agreement on climate change readiness (10%) and the UN Sustainable Development Goals (7%) feature much less prominently.

Yet the top three barriers to sustainability initiatives are similarly financial: the capital investment required (39%), operational costs (34%) and low short-term profitability (31%). This suggests that some companies are in a sustainability catch-22: they want to invest to improve profits, but lack the funds to do so.

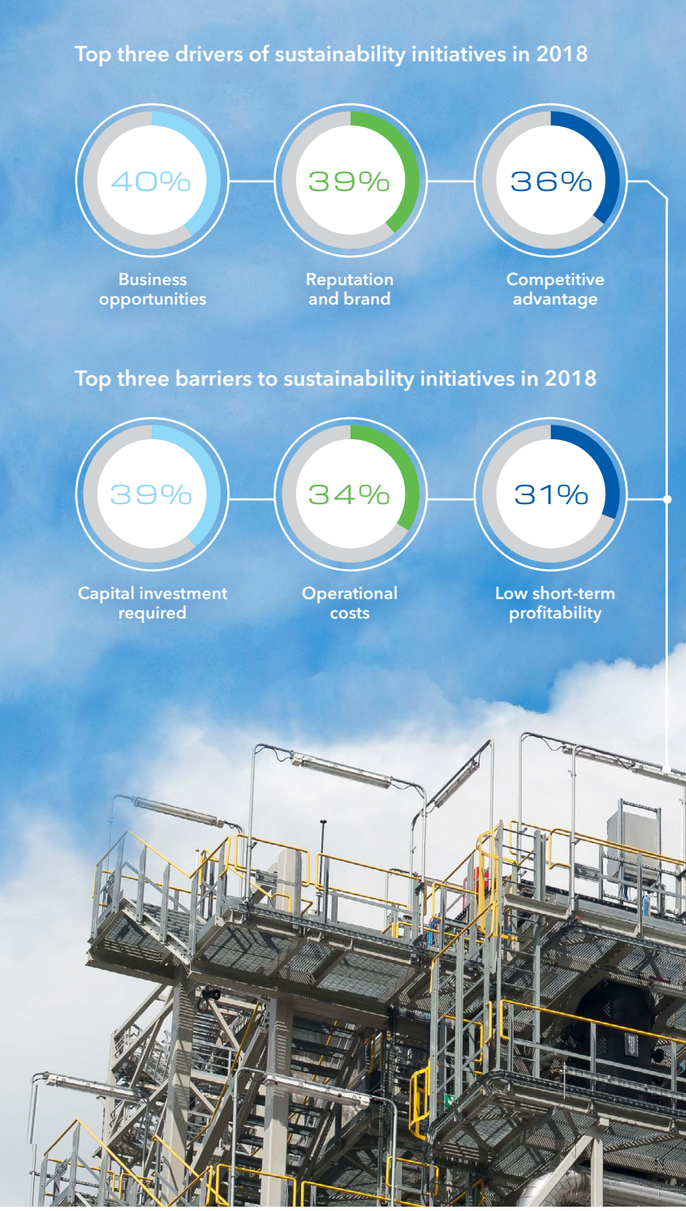
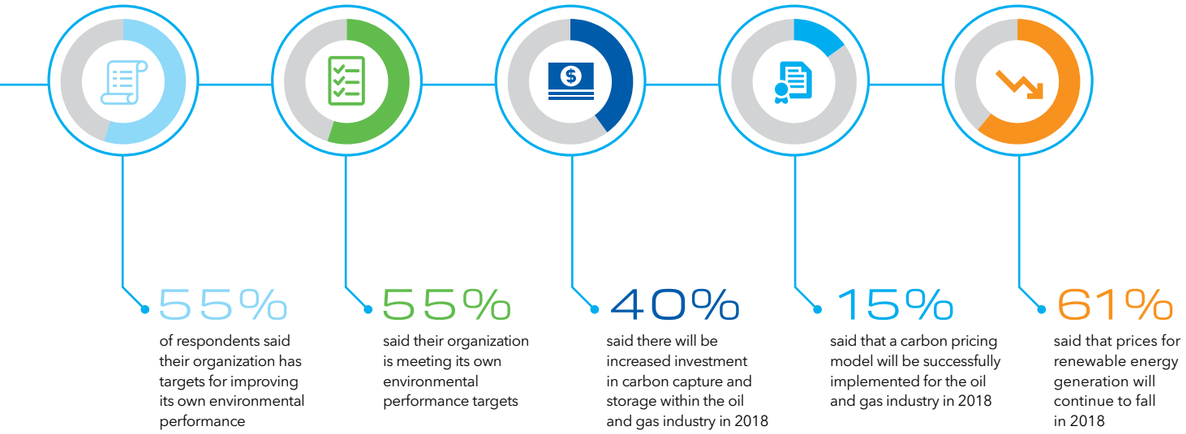


Image courtesy Helge Hansen, TCM

37. Global reporting: http://bit.ly/2mVuLIR
38. UN Global Compact: http://bit.ly/2EWcMsk
39. Task Force on Climate-related Financial Disclosures – TCFD - Publications Landing: http://bit.ly/2EXCgW1
40. Better Business, Better World – BSDC: http://bit.ly/2DslYIN



55%
of respondents said their organization has targets for improving its own environmental performance

55%
said their organization is meeting its own environmental performance targets

40%
said there will be increased investment in carbon capture and storage within the oil and gas industry in 2018

15%
said that a carbon pricing model will be successfully implemented for the oil and gas industry in 2018

61%
said that prices for renewable energy generation will continue to fall in 2018

The challenge of carbon capture

Carbon capture and storage (CCS) technology is a case in point, demonstrating the inextricable relationship between profitability and responsibility.[41] "I can't see how we will achieve the goals of the Paris Agreement without CCS. It's scalable, and can become a cost-effective way to reduce the emissions associated with power generation and industry," says IPIECA's Brian Sullivan.

CCS is attractive because it allows for fossil fuels to be used without the detrimental emission of greenhouse gases. Captured CO_2 can also be used to support enhanced oil recovery by injecting it into reservoirs to help extract gas and oil, as has been demonstrated by the Petra Nova project in Texas.[42]

And the technology is proven. "CO_2 injection has been used for enhanced oil recovery for a long time," says Sullivan. "There are about 20 demonstration projects for CCS around the world – the engineering and technology are there. The main need is to create the environment that will enable support, investment at commercial levels, and scale."

What would that environment look like? It would need to guarantee the financial merit of CCS over the long-term. "The biggest challenge is that it costs too little to emit carbon," says Trude Sundset, CEO of Norwegian state enterprise Gassnova, which is developing a full-scale CCS project in Norway. "That makes the business case for CCS challenging."

"Carbon pricing is probably one of the most important measures we have for addressing emissions," says Bente Pretlove, programme director for climate change at DNV GL. "It's technology neutral, flexible and transparent. If we get it right, it will send important long-term signals and encourage the innovation and investment required to support a better energy transition."

DNV GL's *Energy Transition Outlook*[43] predicts that average prices for emitting carbon will not rise enough to cover the costs of CCS for several years. Assuming a gradual or limited uptake of CCS, the Outlook forecasts that the cost of CCS per tonne of CO_2 will decrease from USD115 in 2020 to USD110 by 2030, USD90 by 2040, and USD74 by 2050. At the same time, the model predicts that average carbon prices will increase across all regions, but only to a top of USD60/ton in Europe by 2050. The numbers do not yet add up, so without higher carbon prices or government financing we are unlikely to see large-scale CCS in the near future.

Just 10% of survey respondents expect to make investments in CCS within 12 months, and only 15% of think a carbon pricing model will be successfully implemented in 2018. As Pretlove says: "It's going to take time, 2018 is too soon because the carbon price in current markets is basically too low to incentivize CCS."

> "Profitability is easily measured and communicated to shareholders. But companies are increasingly aware of broader issues that affect their licences to operate. No company can operate long term if society fails around them."
>
> **Bente Pretlove**, programme director, climate change, DNV GL

Market forces flourish in the right conditions

So for CCS to take off, it needs to make business sense. But for it to do so, the political, social and regulatory conditions need to align.

"If you look at CO_2 mitigation strategies, politically it's a lot more acceptable to invest in renewables than CCS – despite the fact that CCS is often cheaper and more effective at reducing CO_2," says Sullivan. "There are wider challenges than the cost, including social and political acceptance, and the fact that there are some locations around the world that are more and less suitable, for regulatory, economic and geological reasons."

It is certainly possible for the right conditions to be created. Gassnova is demonstrating this in Norway by leading the development of what will become Europe's first full-scale CCS project to capture CO_2 from industrial emission sites. The project will capture and move CO_2 from factories to storage sites in the oil and gas fields of the North Sea. In October 2017, Statoil, Shell and Total signed a contract to jointly develop the storage component of the project. The first phase will be capable of sequestering 1.5 million tons per year, and the project will ultimately be the first storage site in the world that can receive CO_2 from several different countries.[44]

"This project shows that large companies do see CCS as a business opportunity in the long-term, which is key because to grow globally you need the oil majors," says Sundset. "We have to think of the CCS market like we did renewables some years ago: wind and solar were too expensive in the beginning – they needed incentives and frameworks until the market grew big enough. The way to get the prices down is to create a big enough market. That's when you'll see the prices of CCS dropping."

DNV GL's *Energy Transition Outlook* model bears this out: in a scenario where the carbon cost is increased by 50%, CCS uptake grows tenfold and plays a much more important role in curbing emissions.[45]

The business of decarbonization

For the 89% of survey respondents that prioritize sustainability, environmental issues are the most important area, which reflects the fact that oil and gas companies recognize their unique position in relation to decarbonization and the fight against climate change.

DNV GL's Graham Bennett cites the example of Statoil, which is increasingly incorporating carbon costs into its price calculations for developing oilfields. "Within conventional oil and gas, some projects are 'cleaner' than others," he says. "And we may also see more diversification away from oil sands, or other developments that are seen to be carbon intensive, towards developments – still within oil and gas – that have a lower carbon intensity."

As we have seen, the industry is increasingly focused on gas, which is the least carbon intensive of the hydrocarbons.

But within gas, midstream and downstream companies are exploring the use of biogases, which are derived from renewable sources such as biomethane, to decarbonize gas.

Cadent is using biomethane demonstration projects to justify the ongoing use of gas networks in future decades. "Our long-term interest, for our shareholders, is to essentially preserve, and if possible grow, the gas distribution network in the UK," says Cadent's David Parkin. "It's very difficult to see our asset base continuing to thrive unless we can demonstrate that there are viable decarbonization technologies out there."

Other UK gas networks have similar priorities. For example, Northern Gas Networks has launched an initiative to convert the gas grid in Leeds from natural gas to zero-carbon hydrogen. The project aims to demonstrate the potential hydrogen has to help the UK meet 2050 climate change obligations, while making use of existing gas network infrastructure.

Overall, there are encouraging signs of acceleration in the sustainability agendas of oil and gas companies. In our survey, we have tracked intended spending on emission controls, which is up from 16% for 2017 to 26% for 2018, and environmental impact reduction, which is up from 17% for 2017 to 31% for 2018.

However, like with many aspects of the industry in 2018, there are a number of possible directions this acceleration could go in. As Citigroup's Edward Morse puts it: "Momentum is gradually building towards making decarbonization of the energy system a higher priority, but there is still a lot of uncertainty about how we will get to that desired outcome."

41. CCS is a technology that captures CO_2 emissions from the burning of fossil fuels in electricity generation and industrial processes, and prevents them from entering the atmosphere – typically by injecting the captured CO2 into suitable geological formations deep underground.
42. Petra Nova Project – NRG Energy: http://bit.ly/2DjHH1c
43. 'Energy transition outlook 2017: oil and gas use – forecast to 2050', DNV GL, September 2017: http://bit.ly/2Dw3rug
44. Statoil, Shell, Total partner on Norway CCS project: http://bit.ly/2rmYhvM
45. 'Energy transition outlook 2017: oil and gas use – forecast to 2050', DNV GL, September 2017: http://bit.ly/2Dw3rug

CONCLUSION: CHALLENGING CHOICES IN A WORLD OF TRANSITION

Oil companies enter 2018 with a more positive outlook than recent years. This sentiment, while not universal, is built on more than the prices of oil or gas. For many, it is built on a belief that their organization has evolved enough in recent years to cope, and even thrive, against a backdrop of lower-for-longer prices, the rise of unconventional oil, growing demand for LNG and the long-term energy transition.

It also looks likely that this evolution has only just begun. "The majors will turn into energy companies – they will broaden their portfolios," says Maria Moræus Hanssen of DEA. "Partly because there are strong investment opportunities outside oil and gas, and partly to position themselves for a changing future."

That changing future is likely to be on the mind of many leaders in 2018, particularly as they analyse scenarios that could affect their longer-term investments. "The greatest looming challenge for oil and gas companies is how they adapt to the energy transition," says DNV GL's Bente Pretlove. "There will likely be greater regulatory and social pressure forcing the industry towards decarbonization. To succeed, the industry will need to make the right investments and harness technology and innovation more than ever."

A new platform for growth

A near-term risk is that an increase in profitability lulls the industry back into old spending and investing habits, unravelling hard-fought cost-tightening and strategic recalibration. Along with two-thirds of survey respondents, Statoil's Eirik Wærness believes that new operating models will last. "I think the industry has, for now at least, learned a lesson that will have lasting impact," he says. "Many changes will remain in place because it makes no sense to go backwards now that we have found smarter ways to operate."

Despite the shifts in confidence and investment intentions over the year, the title of DNV GL's 2017 industry outlook report, 'Short-term agility, long-term resilience', remains appropriate for 2018.

As companies adapt to immediate opportunities, they must invest now to prepare for various phases of energy transition. "A challenge going forward will be to invest more consistently, to maintain our purpose over time, and not be too disrupted by short-term changes," says Shell's Mark Gainsborough.

Over the next three decades, climate change, the energy transition, digitalization and technology innovation will cause unprecedented disruption across the oil and gas industry. Companies are already reacting to the risks and opportunities this presents, while balancing short-term priorities. This strategic challenge looks set to remain for several years, but as 2018 begins, many leaders will meet it with greater control over their enterprises and a new confidence for the future of the industry.

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"The winners in our industry this year are those who can continue to make a clear shift from an expansion mindset to a margin mindset, and recognize the importance of implementing new models and technologies to improve operational efficiency."

Liv Hovem, CEO, DNV GL – Oil & Gas

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