Deloitte.

Short of capital?

Risk of underinvestment in oil and gas is amplified by competing cash priorities

Deloitte Center *for* Energy Solutions

Table of contents

Introduction

A low oil price environment and the resulting stress on the exploration and production (E&P) industry continues for the third year in a row. Although there is some cause for optimism—oil prices have recovered from the lows of $26/bbl in February 2016 to $50/bbl in early June—the final outcome of the degradation of oil and gas companies´ balance sheets and the future direction of oil prices continue to remain uncertain.[1]

With more than 77 E&P companies having already filed for Chapter 7 and 11 (North America, as of May 15, 2016) and several on the brink of debt default, companies in general are finding it tough to navigate through troubled waters (read *The crude downturn for E&Ps: One situation, diverse responses*, February 2016).[2] Because of the cash crunch, E&P companies are reducing their capital expenditures (capex) significantly. In fact, after cutting capex by about 25 percent in 2015, the global upstream industry (excluding the Middle East and North Africa, or ex-MENA) has announced further cuts of 27 percent in 2016.[3]

These cuts have reduced spending to below the minimum required levels to offset resource depletion, let alone meet any expected growth. Oil and gas is a depleting resource with average annual production decline rates from existing wells of approximately 7-9 percent (including shales).[4] This mismatch, or underinvestment, points toward a looming problem of sustaining current production levels and adding new capacity, which will likely be apparent three to five years from now.

Even in the case of nonlinear demand growth, reserves, and cost outlooks, the industry needs a minimum investment of about $3 trillion (ex-MENA capex of $2.7 trillion, real 2015 dollars) during 2016-2020 to ensure its long-term sustainability. At a commodity level, natural gas (gas) will likely need more investments than oil due to large exploitation of reserves in the past, a switch in investments from gas to oil, and large unmet demand potential, particularly in Asia Pacific.

But will the industry have enough operating cash flows to fund even these lower capex levels? One should consider that capex may not have the first call on the cash available with oil and gas companies. Balance sheet focus and maintaining the already reduced payouts may command higher priority for many companies, at least in the initial few years. So, what is the size of the capital gap we may see over the next five years?

These are some of the questions this third report of our capital trail series will explore and address with factual and strategic perspectives. Underinvestment will likely be the reality, but E&P companies should at least enter the next decade with a much improved financial health to take the industry forward.

John W. England
US and Americas Oil & Gas Leader, Deloitte LLP

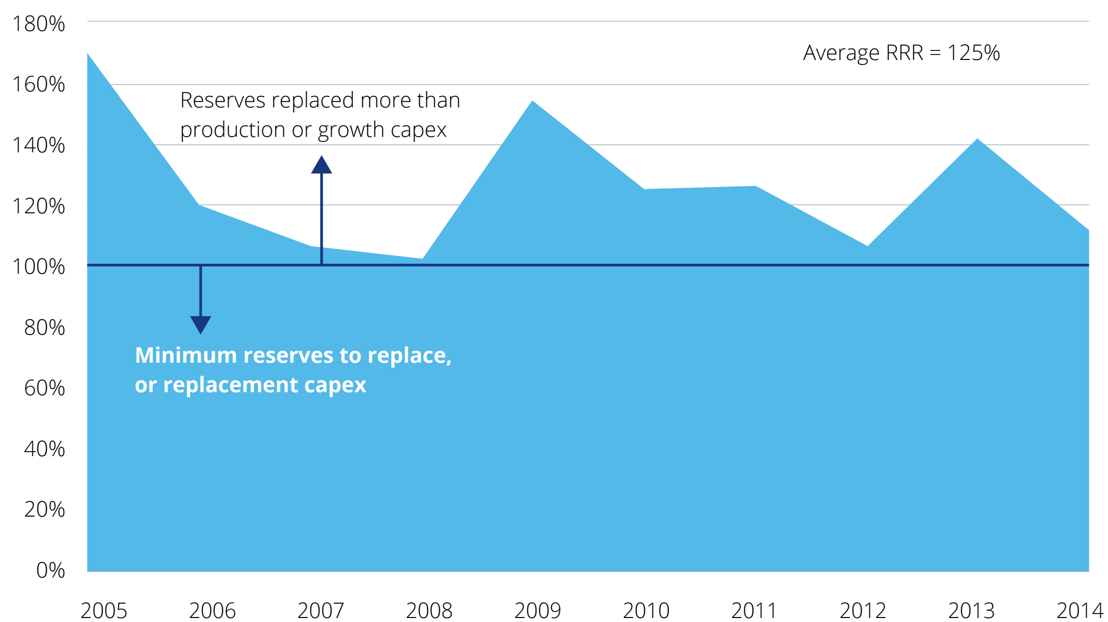
The oil and gas industry's capital needs are high—about 80 percent of its capex goes into keeping its reserve replacement and developed resource share flat

Oil and gas is a depleting resource, with high reserve replacement needs. The industry needs to replenish drawdown in reserves to serve base annual demand of about 33.5 billion barrels for oil and 120.5 trillion cubic feet (Tcf) for gas, and it has to also meet annual demand growth of 1-2 percent along with overcoming natural field declines of nearly 7-9 percent annually.[5,6,7]

Despite record investments, major resource-seeking oil and gas companies were able to replace only 125 percent of their production over the past 10 years. And, the share of their proved developed reserves fell from 62 percent to 58 percent.[8] A reserve replacement rate (RRR) of less than 100 percent means negative to no reserve growth for companies, and the decline in proved developed reserves means less cushion to enable an increase in production in the near term.

Stated in capex terms, replacement capex (that is, capex for maintaining RRR of 100 percent and developed reserves share, or staying flat) of major oil and gas companies constituted about 80 percent of their total spending, while growth capex was only about 20 percent in the past 10 years. Simply put, it takes a lot for the industry to just stay flat.

Figure 1. Oil and gas reserve replacement rate (major oil and gas companies)



Note: Major oil and gas companies consist of top 50 resource-seeking oil and gas companies listed worldwide, which constitute 27 percent of global oil and gas production.

Sources: Deloitte Market Insights, Capital IQ, Bloomberg, SEC filings

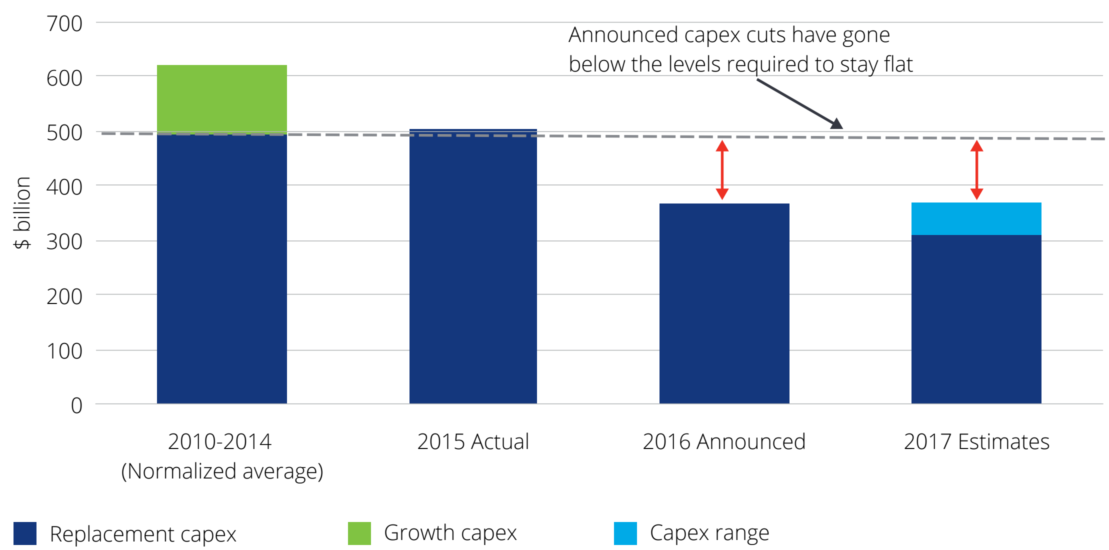
Announced capex cuts suggest even remaining flat could be a challenge for the industry

Since the industry's replacement capex is about 80 percent of total spending, then broadly speaking, the industry could reduce its overall capex by a maximum of 20 percent to remain flat. After making capex cuts of 25 percent in 2015, E&P companies have announced further capex cuts of 27 percent in 2016 and expect a flat 2017, taking future spending far below the levels required to stay flat.[9]

Even if the upstream capital cost deflation of 15-18 percent is considered, the industry's capex levels have gone below the minimum required levels to offset depletion, let alone meet any expected growth.[10]

The impact of these actual and projected capex cuts over three years in row will likely start reflecting in the future availability of reserves and production. In 2015, conventional discoveries of oil and gas outside North America dropped to the lowest level since 1952.[11]

Figure 2. Global upstream spending (ex-MENA, $ billion)



Notes:
- Normalized annual capex during 2010-2014 is adjusted for upstream capital cost inflation until 2014.
- Analysts (as of early March 2016) expect a fall of 10 percent to no growth in the industry's 2017 capital spending.

Sources: Deloitte Market Insights, Barclays, J.P. Morgan

Changing trends suggest lower capex requirements in the near term

Figure 3. Factors impacting future capex requirements

OECD commercial crude stocks are at an all-time high of 1544 million barrels, or 215 million barrels higher than the latest five-year average as of March 2016.[12] Apart from offsetting demand growth, it also delays the investment decisions of companies seeing the excess supply in the market.

A carbon-constrained world, economic weakness in emerging markets (particularly China and Brazil), and removal of fuel subsidies stir up fears of demand growth slowdown. IEA expects oil demand to grow by about 1 percent CAGR over the next five years, as against 1.25 percent during 2010-2015.[16] Lower demand reduces reserve replacement and development need.

OPEC's strategy to maintain, and even gain, production share limits investment needs for private players to develop costlier projects outside MENA. Finding and development costs in MENA, primarily in onshore fields, is 30-50 percent less than the (F&D) costs in other regions.[17]

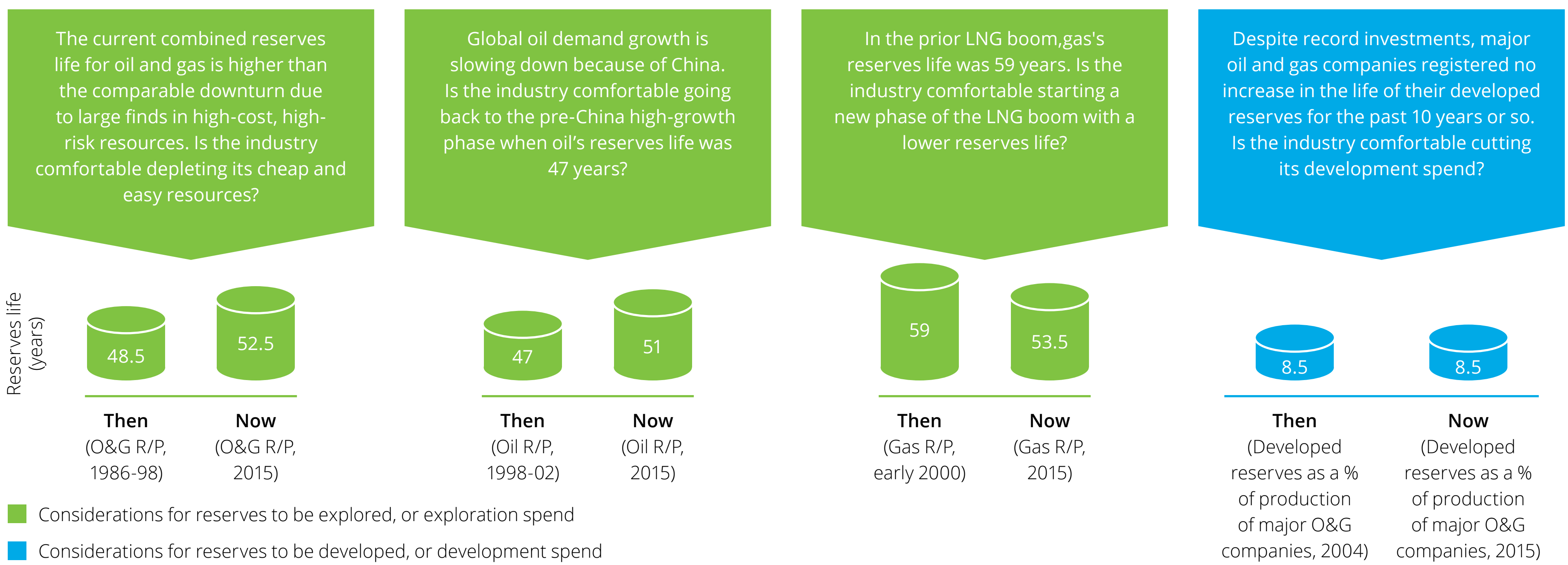
Close to 10 percent of the world's oil and gas production now comes from shales, which have lower capex intensity (F&D costs/boe of niche tight oil producers is lower by over 30 percent than companies with a conventional projects portfolio; and capex per well have dropped to $5-7 million) and produce 50 percent of total recoverable production in the first year itself. Falling capital costs also reduce capex requirements.[13, 14, 15]

Long-cycle, mega projects led to a sharp increase in pre-productive capital of the industry, depressing the return on capital employed (ROCE) of major players (40 percent of supermajors' capital is reported to be pre-productive as of 2015).[18] A large part of this pre-productive capital will start producing in 2-3 years, especially in LNG, which would likely reduce future development spend in gas over the next few years.

Past downturns can provide a basis for estimating future exploration and development capital spending

The industry's future capex requirement depends on how much reserves it adds by exploring (exploration spend) and how much reserves it develops (development spend). Past phases and comparable downturns can provide some basis or act as scenarios for estimating future reserves requirement and thus the capex. Oil and gas have different demand, supply, and reserves position, thus their capex needs should be studied separately.

Figure 4. Oil and gas reserves life, past vs. current



Note: R/P refers to reserves to production ratio, or remaining amount of recoverable reserves at current production rate, expressed in years.

Sources: Deloitte Market Insights, BP Statistical Review of World Energy (2015)

In the case of oil, companies can exploit proved reserves, but likely need to maintain development spend over the next five years

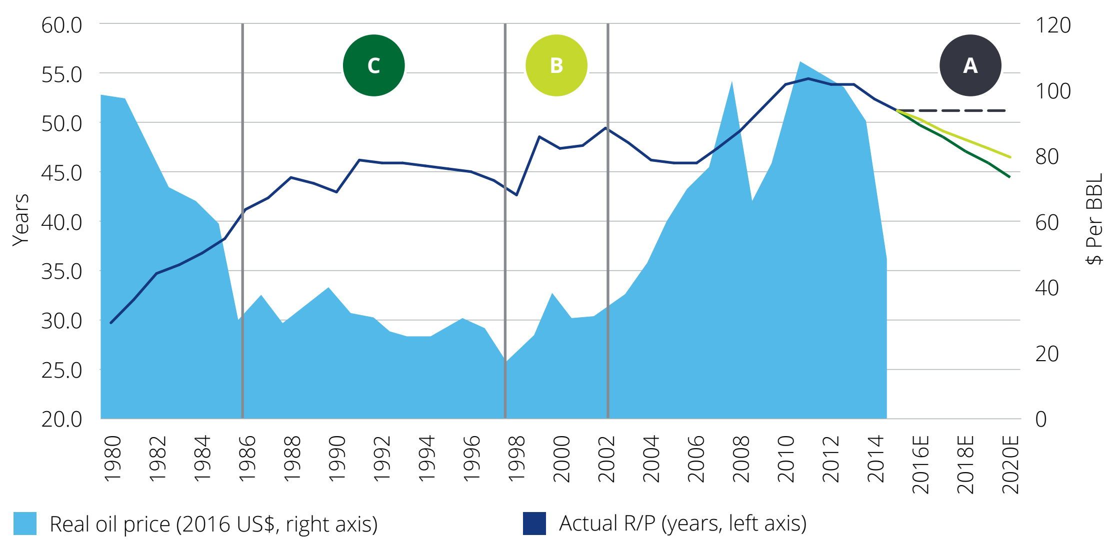
Significant oil reserve additions in Iran, Iraq, Canada, Venezuela, and tight oil prospects in the United States drove oil's proved reserves-to-production (R/P) ratio to its highest level: 54 years in 2013. Although the ratio fell marginally in recent years due to a fall in investments, it is still 8-10 years higher than the pre-China high-growth phase (1998-2002) and the late 1980s-early 1990s downturn.

Ruling out an increase in exploration or R/P due to weak prices, the best case for the industry would be to maintain its R/P at current levels of 52 years (case A, high). Alternatively, the industry can drop its R/P to the pre-China high-growth phase of 47 years seeing recent weakness in China's oil demand (case B, moderate).

At a minimum, the industry can look at the comparable 1980s-90s downturn, when its R/P was 45 years (case C, low). Knowing discoveries of new oil dipped to a 60-year low in 2015, this case may not be that conservative.[19] However, this case would likely mean dipping into low-cost, low-risk reserves base in the near term and increasing reliance on riskier resources in the long term.

On developed reserves or development capex, however, the industry has little cushion. Over the years, the industry's developed reserves share has fallen, so the industry should aim to at least maintain these low levels.

Figure 5. Crude oil: Reserves by production (low, moderate, high case)



A **High case:** Maintain R/P at current levels

B **Moderate case:** Drop to pre-China high growth days

C **Low case:** Drop to the comparable 1980s/1990s downturn

Crude oil: Proved developed reserves share (major oil and gas companies)					
2007	2009	2011	2013	2015	2016-2020E
65.0%	63.8%	60.5%	58.2%	59.3%	Flat (low case)

Sources: Deloitte Market Insights, BP Statistical Review of World Energy (2015), GlobalData

On the other hand, the E&P industry needs to replenish natural gas reserves life, which is at a 25-year low, but it could go slower on the development front

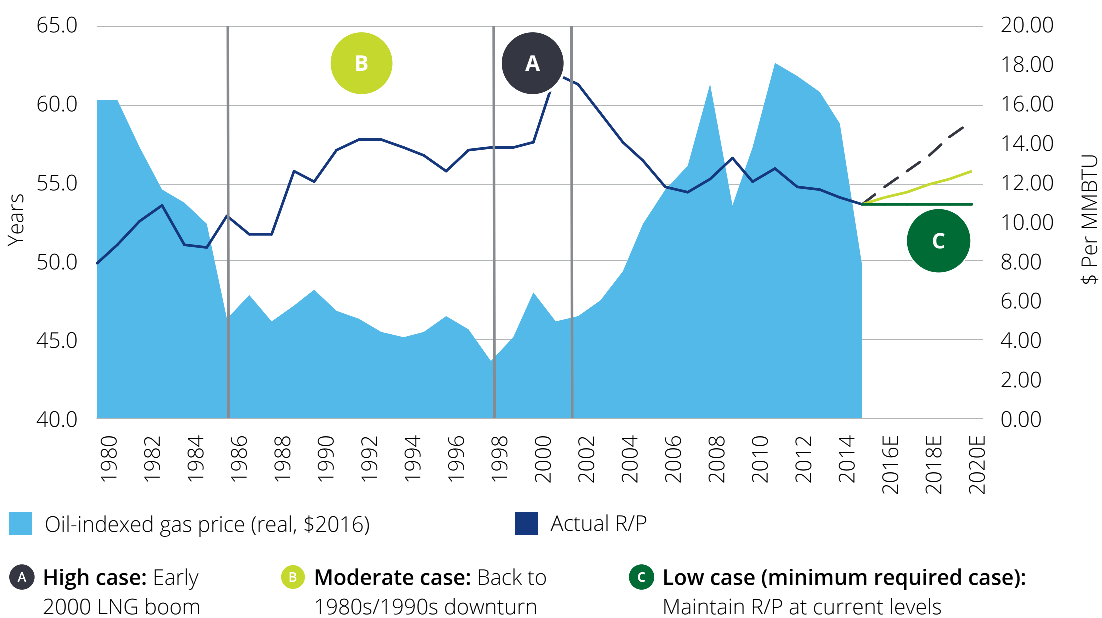
Over the past 15 years, the world R/P level of natural gas has fallen by 10 years. The fall is explained by limited proved reserves additions (except the large 525-700 Tcf find in Turkmenistan), high demand-led production growth, and a shift in investments toward oil.[20]

Considering gas's current R/P is already at a 25-year low and assuming large, unmet demand potential in Asia Pacific, the industry, at a minimum, should maintain its R/P at current levels (case C, low). Current R/P levels are far lower than early 2000 levels, when major LNG projects in Qatar, Angola, and Trinidad were about to start (case A, high).[21]

On having developed resources for the future the natural gas market has a cushion due to large investments by companies in developing resources for LNG exports recently. This is reflected in the rise in developed reserves in 2015 as major LNG projects near completion.

Knowing many large under-construction LNG projects will likely enter the market in 2016 and 2017 and the mega-capex commitment associated with LNG projects, the industry might go slower on LNG development spend over the next few years.

Figure 6. Natural gas: Reserves by production (low, moderate, high case)



Natural gas: Proved developed reserves share (major oil and gas companies)					
2007	2009	2011	2013	2015	2016-2020E
57.9%	58.2%	58.9%	56.1%	59.7%	Decline (low case)

Sources: Deloitte Market Insights, BP Statistical Review of World Energy (2015), GlobalData

At a minimum, the industry requires an investment of about $3 trillion during 2016 to 2020 for maintaining its long-term health

Even under our low R/P and development cases for both crude oil and natural gas (case C), the industry needs an investment of about $3 trillion over the next five years. This comes up to about $600 billion every year or about 40 percent higher than 2016 expected levels. Under high (case A) and moderate case (case B) cases, investment needs rise to over $6 and 4 trillion, respectively (see page 20 for methodology).

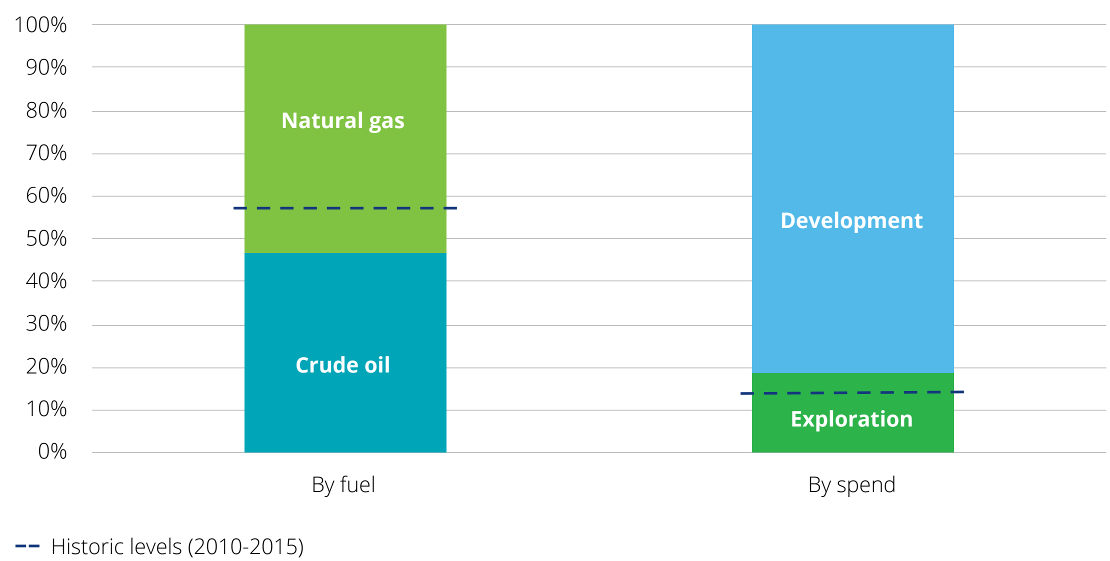
If we look at how the $3 trillion would be allocated between oil and gas, oil, after adjusting for excess inventories, slowing demand, and higher decline rates, likely needs an investment of about $1.4 trillion, while gas, after taking into account a higher demand growth outlook, likely needs an investment of about $1.6 trillion.

Despite gas having lower annual production drawdown of about 60 MMboed to replace, future investments in gas will likely need to exceed investments in oil. (Historically, oil has dominated the capex spend share at about 57 percent).[22] This is because of gas's high annual demand growth of two percent and the need to have the necessary capacity for meeting future growth.[23]

Prioritization of development over exploration—share of exploration spend fell from 18 percent to 14 percent during 2010-2015, and thus the resultant fall in the discoveries of new resources—call for an increase in exploration spend share to about 20 percent by 2020. The E&P industry will likely go slow on gas development over the next few years as major LNG projects start production in 2016 and 2017.[24]

$3 Trillion
(Low case, 2016-2020)

Figure 7. Global upstream capex by fuel & spend (low case, $3 trillion, 2016-2020)



Note: For capex methodology and assumptions, see page 20.

Source: Deloitte Market Insights

Cash flow availability

Will the industry have enough cash flow to fund this capex of $3 trillion?

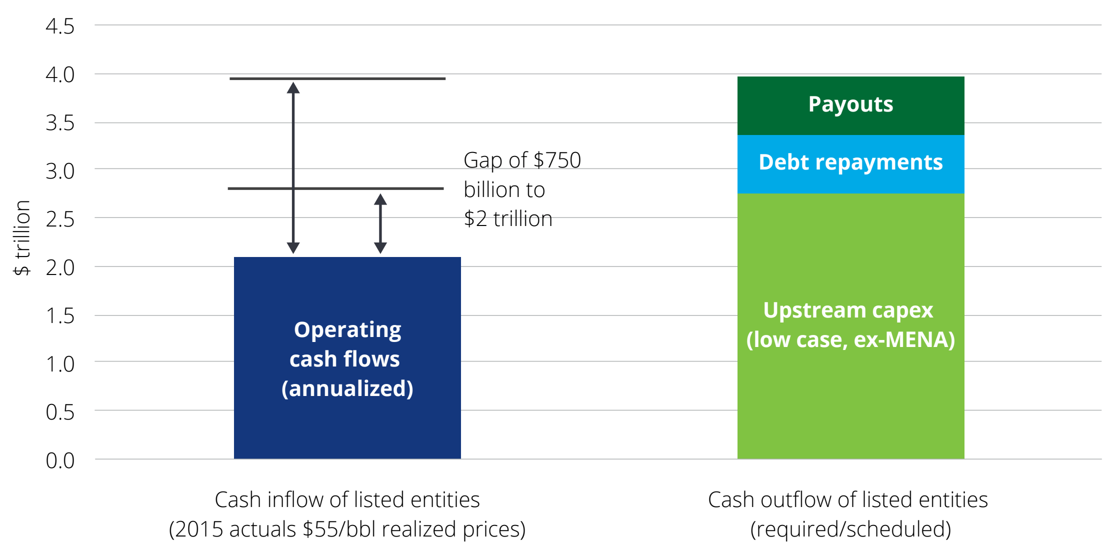
Apart from capex, the upstream industry has two major outflows—debt repayments and shareholder payouts (dividends and profit-sharing duty paid to governments, excluding share buybacks as they have been nearly reduced to zero).

Listed entities worldwide have $590 billion of maturing debt and about $600 billion in already reduced payouts (2015 values annualized for five years) to pay over the next five years.[25] This takes total cash outflows to about $4 trillion for 2016-2020.

Such huge outflows raise a question as to whether there will be enough cash flows in the system. If operating cash flows of the industry in 2015 are annualized for the next five years—Deloitte MarketPoint expects oil prices to average about $55/bbl (real) during 2016-2020, the average realized oil price of companies in 2015—we see a gap of up to $2 trillion.[26,27]

Capex on a standalone basis has a minimum gap of about $750 billion if no debt repayments or investor payouts occur. But, it will not likely have first call on a company's cash flow as a focus on balance sheets and maintaining the already reduced payouts may get higher priority, at least in the initial few years.

Figure 8. Cash inflows vs. outflows of the industry (listed E&Ps, IOCs, NOCs; 2016-2020)



Notes:
- More than 900 listed E&Ps, IOCs, and NOCs are considered for estimating the industry's operating cash flows
- Operating cash flows of IOCs and NOCs also include midstream and downstream cash flows
- The chart assumes average oil prices (real) of $55/bbl during 2016-2020, which was 2015 realized prices for entities
- Operating cash flows of listed E&Ps, IOCs, and NOCs were $415 billion in 2015, which is annualized for 5 years
- Upstream capex in the above graph = required capex of $3 T minus MENA capex (unlisted) of $340 billion
- Debt repayments are maturities due between 2016-2020, as of March 31, 2016
- Payouts are annualized and include dividends and profit-sharing duty paid by select NOCs (Pemex and PDVSA)
- Share buybacks are not considered under payouts, as the majority of the companies have reduced it to zero

Source: Deloitte Market Insights

Every dollar increase in oil prices will help the industry to bridge the gap, assuming no commensurate increase in costs

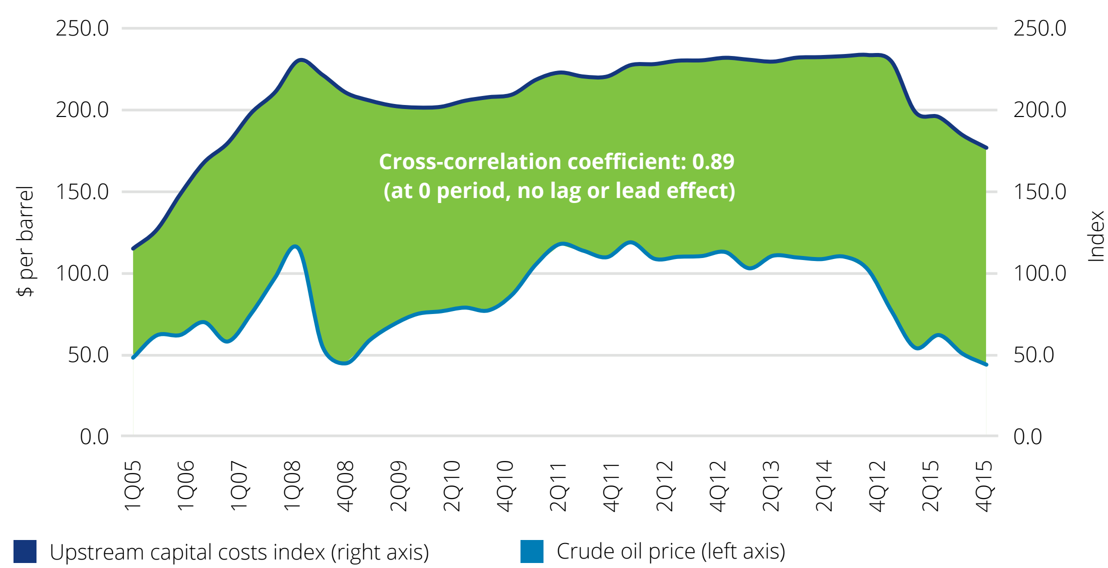
Any increase in oil prices would theoretically help bridge the capital gap. However, upstream costs usually track oil price changes.

Crude oil prices and upstream capital costs have strong correlation and cross-correlation. Typically, costs follow upward movements in prices, then costs take the lead and drive prices further up, and at the end, prices fall first.

Given the significant cuts oilfield drilling and service (OFS) companies are making to their expansion plans and workforce strength (24 percent fall in US OFS employment between June 2014 and September 2015), there is a high possibility of cost inflation beating price recovery in the future.[28] Rebuilding the supply chain will not be fast and cheap.

Consequently, a recovery in prices may not bridge the $750 billion to $2 trillion gap between operating cash flows and capex. In fact, it could widen the gap, as capex requirements may rise faster than cash flows.

Figure 9. Crude oil prices and upstream capital costs (cross-correlation, 2005-2015)



Note:
• Cross-correlation is a measure of similarity of two series as a function of the lag of one relative to the other
• At 0 period means, both move in the same direction immediately, here a quarter

Sources: CERA, Upstream Capital Costs Index (UCCI), US DOE/EIA

Any further reduction in reserves position over the low case could reduce the gap, but it would come with significant risks

Figure 10. Oil and gas capex sensitivity analysis (2016-2020)

Oil and gas industry's R/P (change over case C)

Oil and gas developed reserves share (change over case C)

$ Trillion	-1.5 yrs.	-1 yrs.	-0.5 yrs.	Case C	+0.5 yrs.	+1 yrs.	+1.5 yrs.
-1.5%	1.7	2.0	2.3	2.6	2.9	3.2	3.5
-1.0%	1.9	2.2	2.5	2.8	3.1	3.4	3.7
-0.5%	2.0	2.3	2.6	2.9	3.3	3.6	3.9
Case C	2.2	2.7	2.7	**3.0**			
+0.5%	2.4	2.7	3.0				
+1.0%	2.6	2.9	3.2				
+1.5%	2.7	3.0	3.4				

Note: For methodology and assumptions, see page 20

- **Greater dependence on OPEC and heavy oil:** Reduced capex, or dipping into existing low-cost resources, would likely mean the industry will start the next decade with a lower quality reserves base and a greater reliance on OPEC, heightening supply risks and price volatility.

- **Short-term cash flows at the expense of long-term sustainability:** Developing undeveloped reserves and reducing exploration spend is beneficial as it reduces their pre-productive capital and thus supports their near-term cash flows and returns matrices. But, this would come at the expense of their resource base for the future (which then would require large acquisitions to achieve RRR of 100 percent or more).

- **Unprepared for black swan events:** Reduction of development spend, or the fall in spare production capacity, may leave the industry highly vulnerable to "black swan" events, such as production disruptions or a war.

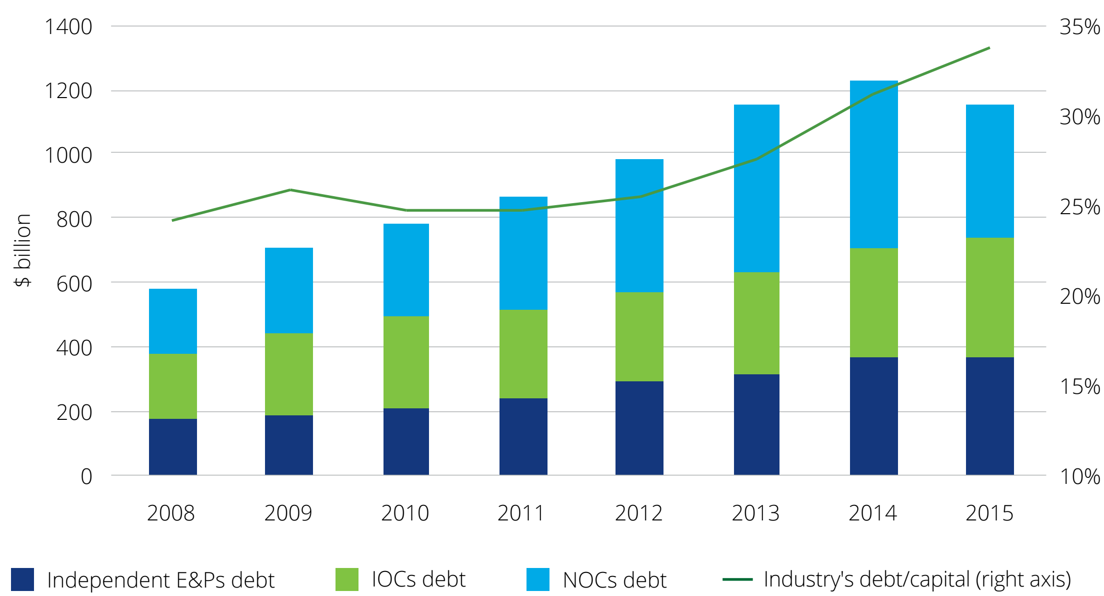
Source: Deloitte Market Insights

Repaying past high debt and sustaining dividends may lower capex priority

The industry has nearly doubled its debt since 2008, and its leverage ratio is at a record high of 34 percent.[29] Among the companies, pure-play E&Ps and NOCs (listed) have increased their debt significantly. About 50 percent of the industry's debt is maturing in the next five years.[30]

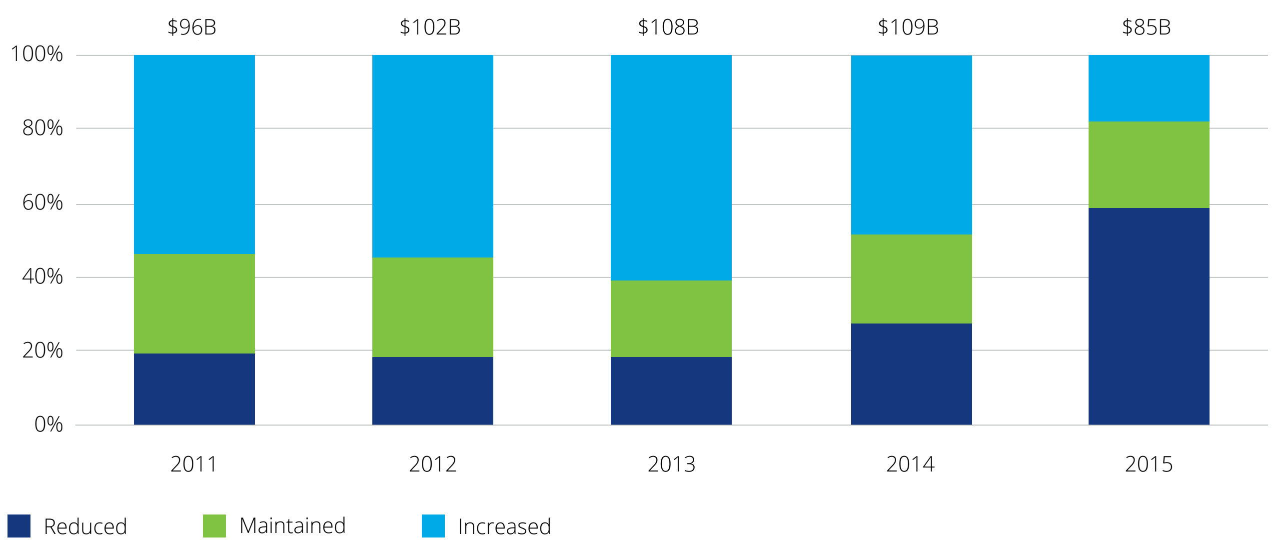
The industry, on the other hand, maintained, and even increased its dividends to shareholders. In 2012, even when US gas prices fell below $2/MMBtu, about 80 percent of top 100 regular dividend payers maintained/increased their dividends.[31, 32] Although many companies slashed their dividends in 2015, about 40 percent (primarily the large companies) still did not cut dividends.[33]

Figure 11. Total debt and leverage (2008-2015)



Sources: Deloitte Market Insights, CapitalIQ

Figure 12. Dividend trend of companies YoY (proportion of top 100 consistent payers)



Note: Consistent payers means companies with a history of paying dividends regularly, at least until 2014.

Source: Deloitte Market Insights, CapitalIQ

Capex may not be the highest priority use of many companies' cash flows over the next five years

Figure 13: Cash priority order by company type (high to low priority)

Pure-play E&Ps	
Debt	Pure-play E&Ps would most likely prioritize strengthening their balance sheets over everything else. These E&Ps doubled their debt to $370 billion during 2008-2015 and have about $175 billion in debt maturities to service over the next five years.[34]
Capex	E&Ps high capex requirements have an immediate, circular relation with debt, especially for short-cycled shale producers. In a low oil price scenario, this cross-relation will likely make it difficult for them to repay debt and maintain cash flows at the same time.
Payouts	Pure-play E&Ps, however, benefit from a lower-dividends legacy and minimal expectations from shareholders, which slightly relieves the pressure on their cash flows.

IOCs	
Payouts	Payouts, here dividends, are somewhat sacrosanct for IOCs. In fact, the majority of them curtailed capex and increased their debt by $50 billion in order to maintain or boost dividends in 2014 and 2015.[35]
Capex	IOCs outspent their cash flows during 2005-2015 and still barely achieved an RRR of above 100%. Thus, high capex is a necessity for them to replace fast-falling production from their aging or high-decline fields.[36]
Debt	Although IOCs currently have record levels of debt, the majority of them have a leverage ratio below 30% and continue to maintain a solid credit rating.[37] Unlike pure-play E&Ps, IOCs have majorly sourced past capital through bonds, which have a longer debt maturity.

R-R	R-P	NOCs
Payouts	**Capex**	Even in a weak year of 2015, resource-rich NOCs (R-R, listed) paid 43% of their operating cash flows to their respective governments in dividends and profit-sharing duty.[38] On the other hand, R-P NOCs reduced their payouts even after reduction in the fuel subsidy burden.
Debt	**Payouts**	Negative free cash flows and continued high payouts have taken the debts of Latin American R-R NOCs to all-time highs, calling for higher prioritization of debt management over growth.
Capex	**Debt**	Asian resource-poor NOCs (R-P, listed) will likely continue to access new oil and gas resources supported by their strong downstream, moderate payouts, and manageable debt levels.

Note:
- Resource-rich NOCs (R-R NOCs) primarily consist of Middle East, African, and Latin American NOCs.
- Resource-poor NOCs (R-P NOCs) primarily consist of Asian NOCs scouting for reserves worldwide.

Meeting other priorities leaves a capex funding gap of $1-1.3 trillion by 2020

Only 65 percent of the industry's (ex-MENA) cash flows will likely be available for future capex, or there could be a **c**apex gap of about $1.3 trillion during 2016-2020. Even if the industry refinances 50 percent of its maturing debt, the gap would likely still be more than $1 trillion (relative to capex in conservative case, ex-MENA).

Figure 14. Capex funding gap by company type

	Pure-play E&Ps	IOCs	R-R NOCs (listed)	R-P NOCs (listed)
Operating Cash Flows (OCF) (2015 values @ $55/bbl annualized for 2016-2020)	**100%**	**100%**	**100%**	**100%**
Other outflows prioritized over capex (see figure 13)				
• Annualized payouts (dividends/profit-sharing duty)	–	(29%)	(43%)	–
• Scheduled debt repayments (assumed no refinancing)	(38%)	–	(31%)	–
OCF available for capex (%, 2016-2020)	**62%**	**71%**	**26%**	**100%**
Aggregate OCF available for capex (%, 2016-2020)	**65%**			

As against 65% for future, the industry's capex by cash flows was 98% during 2011-2015.

Considerations to narrow the gap

Pure-play E&Ps
Restructure debt to more sustainable levels. Explore contingent debt-to-equity conversions.

- Proactive renegotiation around grace periods (delayed amortization) and covenant terms.
- Explore new financing structures such as 1.5 lien debt swap.
- Consider project financing route for advantaged undeveloped properties.
- Discuss future growth potential of undeveloped reserves with bankers.

IOCs
Prioritize key metrics, and link to explicit shareholder value proposition.

- Accelerate short-cycle projects for quick cash flows and maintaining production growth.
- Reduce capital intensity through farm-ins, subsea, and brownfield expansions.
- Strengthen the power/value of diversification for capturing margin shifts across the value chain.
- Consider "bolt-on" or near-field acquisitions to deliver progressive growth at minimum risk.

Resource-rich NOCs
Tackle unique challenges through liberalization, diversification, or non-debt capital-raising mediums.

- Tap overseas equity market by listing a portion of state-owned companies (Middle East NOCs).
- Reorganization/monetization of midstream assets/stakes.
- Greater liberalization of the sector, with competitive government takes (Latin American NOCs).
- Weigh gas-centric investments (both upstream and downstream) for fuel diversification.
- Greater diversification toward midstream and downstream.

Resource-poor NOCs
Stay the course and seize new resource-access opportunities in this downturn.

- Pick up quality producing assets from rationalizing IOCs for early cash flows.
- Build international acreage through farm-ins with cash-strapped international E&Ps/ NOCs.
- Seize the opportunity of downstream divestments by IOCs.
- Strengthen the power/value of diversification for capturing margin shifts across value chain.

Planning for a capital-constrained future

Underinvestment will likely be the reality over the next few years. Sustaining production over the next few years will likely be a challenge for the industry, but the bigger concern is the quantity and quality of reserves at which it enters the next decade. Exploiting more of non-OPEC conventional and cheap resources to save cash in the near term could leave high-cost and riskier resources for the future. Although technology and innovation might come to the rescue, how upstream companies manage their capital and tailor their business models will be key.

- **Proactive debt management:**
  Considering the funding gap of more than $1 trillion, the industry's dependence on a continual supply of external finance appears inevitable. The companies, however, can reduce their burden by exploring new financial instruments that consider the interests of stakeholders and by proactively working with lenders in developing flexible loan covenants that reflect the sustainable growth profile of a company.

- **De-risking the capital structure:**
  Although the significant pre-productive capital in the system will likely begin to produce over the next few years, especially that of supermajors, de-risking the overall capital structure further through infill drilling, brownfield expansions, bolt-on acquisitions, farm-ins/outs, or incremental investments in existing assets could help companies balance both operational (RRR, production growth, etc.) and financial metrics (ROCE dividend per share, etc.)

- **Investment optionality and internal capital market benefits:**
  The current downturn reiterates the power and value of diversification, whether by fuel type, resource type, geography, market, or business. On one hand, it provides investment optionality and opportunity to maximize the portfolio, but on the other hand, it provides stability to cash flows and internal capital market benefits.

- **Supplementary role of shale plays:**
  Although oil and gas production from US shales is five percent below its peak level, its merits in terms of short production and cash flow lags, and the ever-growing scope for companies to optimize operations through open learning, make shales all the more important and attractive. This resource has the closest correspondence between investment and production, which is the need of the hour from cash's point of view.

- **Big oil playing a bigger role:**
  Bigger and stronger companies, particularly IOCs, will likely have to play a much bigger role by finding more to cut from operational costs than capital spending; by sharpening their core competency of planning, delivering and starting projects on time and budget; by upholding their relationship with governments and suppliers; and by seizing new resource-access opportunities in this downturn. They might be the biggest safeguards in a riskier and costlier future.

Endnotes

1. EIA, Oil Spot Prices, May 25, 2016.
2. Haynes and Boone, LLP, ***"Oil Patch Bankruptcy Monitor,"*** May 16, 2016.
3. J.P. Morgan, ***"Global E&P Capex Survey,"*** March 09, 2016.
4. Estimated using shale production declines by EIA and mature field decline rate estimates by IEA and HIS, http://www.eia.gov/todayinenergy/detail.cfm?id=25472, http://www.oilgasmonitor.com/oil-demand-and-well-decline-rates-ensure-strong-outlook-for-oil-industry/.
5. George Given and Jeff Suchadoll, ***"The balancing act: A look at oil market fundamentals over the next 5 years,"*** Deloitte Market Point, February 15, 2015, http://www2.deloitte.com/us/en/pages/energy-and-resources/articles/future-of-oil-markets-next-five-years-marketpoint.html.
6. IEA, ***"Natural gas: Fast facts,"*** 2015, http://www.iea.org/topics/naturalgas/.
7. BP, ***"Statistical review of world energy,"*** 2015, http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html.
8. S&P Capital IQ and Global Data, "Oil industry database."
9. J.P. Morgan, ***"Global E&P capex survey,"*** March 09, 2016.
10. IHS, "IHS Upstream Capital Costs Index (UCCI)," 2016, https://www.ihs.com/info/cera/ihsindexes/.
11. IHS, ***"Conventional Discoveries Outside North America Continue Their Decline; 2015 Marked Lowest Year for Discovered Oil and Gas Volumes Since 1952,"*** May 23, 2016, http://press.ihs.com/press-release/energy-power-media/conventional-discoveries-outside-north-america-continue-their-decli.
12. OPEC, "Monthly Oil Market Report," March 2016 Release.
13. EIA, ***"Drilling productivity report,"*** April 2016 Edition.
14. Estimated using declines for major plays by EIA, February 11, 2016 http://www.eia.gov/todayinenergy/detail.cfm?id=24932.
15. Global Data, "Oil industry database."
16. IEA, "Oil market report," March 2016 Release.
17. OPEC, "Oil Market Report"; The World Bank Group, ***"The Petroleum Sector Value Chain,"*** June 2009.
18. Pzena Investment Management, ***"Fourth Quarter 2015 Commentary."*** http://www.pzena.com/Cache/1001205837.PDF?O=PDF&T=&Y=&D=&FID=1001205837&iid=4162576.
19. Financial Times, ***"Oil Discoveries Slump to 60 Year low,"*** May 08, 2016.
20. BP, ***"Statistical review of world energy,"*** 2015, http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html.

21. International Gas Union, "World LNG report," 2015 Edition, http://www.igu.org/sites/default/files/node-page-field_file/IGU-World%20LNG%20Report-2015%20Edition.pdf.
22. S&P Capital IQ and Global Data, "Oil industry database."
23. IEA, "Natural gas: Fast facts," 2015, http://www.iea.org/topics/naturalgas/.
24. International Gas Union, "World LNG report," 2015 Edition, http://www.igu.org/sites/default/files/node-page-field_file/IGU-World%20LNG%20Report-2015%20Edition.pdf.
25. S&P Capital IQ.
26. George Given and Jeff Suchadoll, ***"The balancing act: A look at oil market fundamentals over the next 5 years,"*** Deloitte Market Point, February 15, 2015, http://www2.deloitte.com/us/en/pages/energy-and-resources/articles/future-of-oil-markets-next-five-years-marketpoint.html.
27. S&P Capital IQ and Bloomberg.
28. Bureau of Labor Statistic Database, http://data.bls.gov/pdq/querytool.jsp?survey=en.
29. S&P Capital IQ and Bloomberg.
30. S&P Capital IQ.
31. EIA, ***"Short Term Energy Outlook,"*** April 2016 release.
32. S&P Capital IQ.
33. S&P Capital IQ.
34. S&P Capital IQ and Bloomberg.
35. S&P Capital IQ.
36. S&P Capital IQ and Global Data, "Oil industry database."
37. S&P Capital IQ.
38. S&P Capital IQ and Bloomberg.

Appendix: Capex methodology

Production to be replaced

- Considers annual oil and gas demand growth of 1 percent and 2 percent, respectively
- Adjusted for excess OECD oil inventories and US natural gas inventories over the past 5-year average

Reserves to be explored

- Ascertained R/P with no new exploration
- Used required R/P under various scenarios
- Required R/P minus actual R/P yields reserves to be explored
- Used 2015 finding costs of top 50 oil and gas companies with production spread across regions

Reserves to be developed

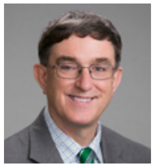
- Ascertained developed reserves with no new development
- Used required developed reserves under various scenarios
- Required developed reserves minus actual yields reserves to be developed
- Used 2015 development costs of top 50 oil and gas companies with production spread across regions

Field decline adjustment

- Assumes 70 percent of production comes from mature conventional fields
- Used 5-6 percent production decline for mature conventional fields
- Estimated shale production decline using average decline rates of major shale basins

Let's talk

John England
US and Americas Oil & Gas Leader
Deloitte LLP
jengland@deloitte.com
+1 713 982 2556
@JohnWEngland



Andrew Slaughter
Executive Director
Deloitte Center for Energy Solutions
Deloitte Services LP
anslaughter@deloitte.com
+1 713 982 3526

Key contributors

Anshu Mittal
Executive Manager
Market Development
Deloitte Support Services India Pvt. Ltd.

- Gary Adams, Principal, Deloitte Consulting LLP
- Vivek Bansal, Analyst, Market Development, Deloitte Support Services India Pvt. Ltd.
- George Given, Senior Manager, Deloitte MarketPoint LLC
- Ramani Moses, Assistant Manager, Deloitte Support Services India Pvt. Ltd
- Deepak Vasantlal Shah, Senior Analyst, Market Development, Deloitte Support Services India Pvt. Ltd.
- Jeffrey Suchadoll, Senior Manager, Deloitte MarketPoint LLC

We want your feedback
In an effort to capture your feedback, so we can continue to provide you with the most relevant and valuable publication material, we have created this brief survey to better understand your needs. Thank you for your participation.

www.deloitte.com/us/er-tl/survey

Deloitte Center *for* Energy Solutions

The Deloitte Center for Energy Solutions (the "Center") provides a forum for innovation, thought leadership, groundbreaking research, and industry collaboration to help companies solve the most complex energy challenges.

Through the Center, Deloitte's Energy & Resources group leads the debate on critical topics on the minds of executives–from the impact of legislative and regulatory policy, to operational efficiency, to sustainable and profitable growth. We provide comprehensive solutions through a global network of specialists and thought leaders.

With locations in Houston and Washington, DC, the Center offers interaction through seminars, roundtables, and other forms of engagement, where established and growing companies can come together to learn, discuss, and debate.

www.deloitte.com/us/energysolutions

@Deloitte4Energy

Deloitte.