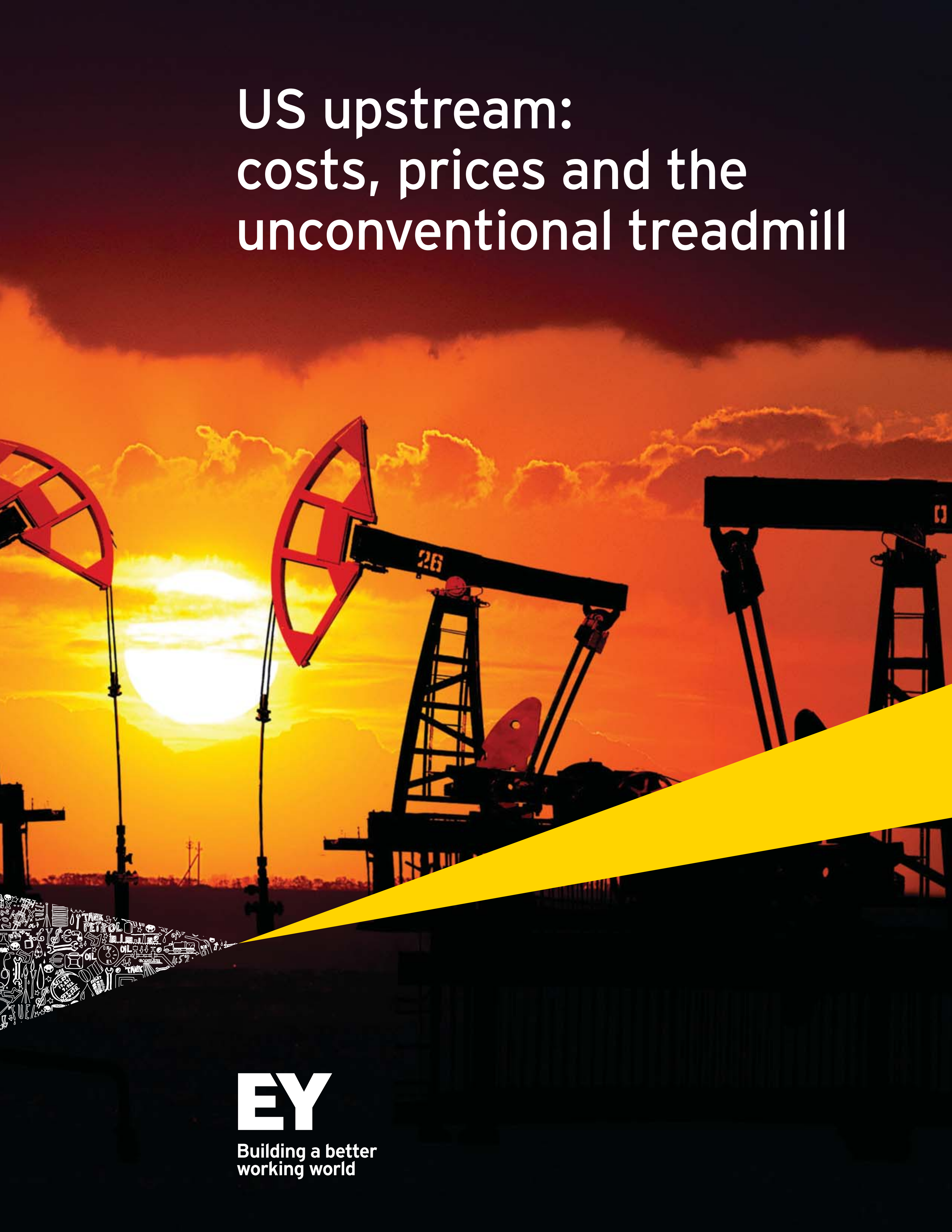
# US upstream: costs, prices and the unconventional treadmill



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# Introduction

This analysis builds on the data collected, compiled and published by EY in its *US oil and gas reserves study*. That annual study, last released in June 2014, looks at US exploration and production results for the 50 largest oil and gas companies, based on year-end oil and gas reserves. In 2013, these 50 companies accounted for about 50% of the country's oil production (crude oil and natural gas liquids) and about 55% of its natural gas production. This analysis focuses on the reported costs and upstream financial results of those companies. In particular, we will focus on what the data might tell us about full-cycle upstream costs and the implications for oil and gas companies in the current and prospective price environment.

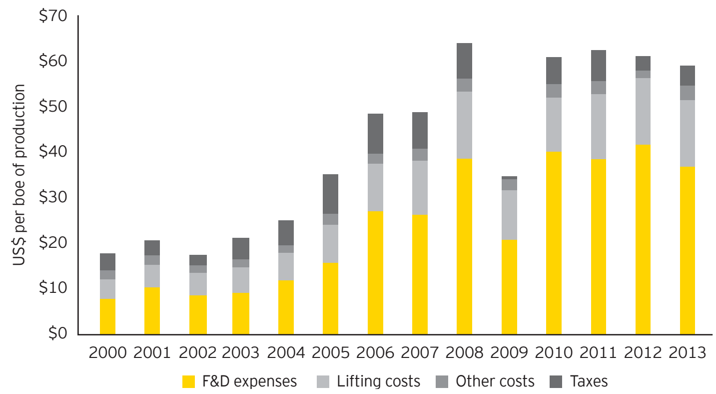
# US upstream performance: spending, costs and cash flows

As was reported in our US reserves studies, US upstream oil and gas spending has been increasing rapidly with the onset of the so-called "shale" or "unconventional revolution," beginning in the middle of the last decade. Notably, US upstream finding and development (F&D) spending (i.e., total upstream spending, excluding spending on the acquisition of proved reserves) increased by an average of 13% per year between 2004 and 2013. Operating/production or "lifting" costs have also been rising rather sharply, increasing by an average of 10% per year between 2004 and 2013.

We can also use the related reported data to estimate costs on a full-cycle basis, noting that notional full-cycle costs have surged (along with global oil prices) from an average of around US$20 per barrel of oil equivalent (boe) before 2004 to more than US$60 per boe as of 2013. As shown in Figure 1, apart from the distortions related to the global financial collapse in 2009, notional full-cycle costs have averaged over US$60 per boe since 2008.

**Figure 1. US full-cycle upstream costs**

(per flowing boe of production)

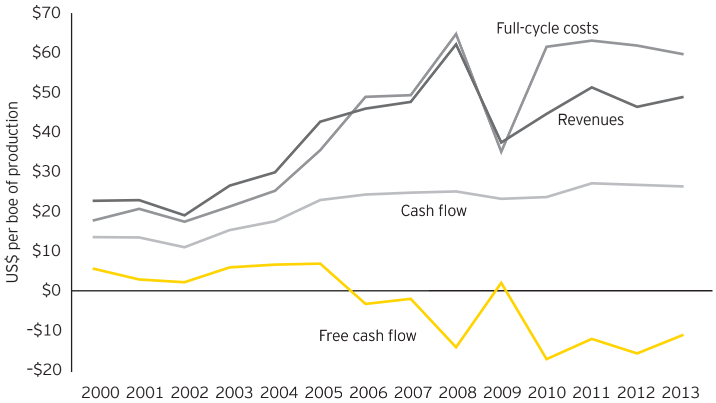



Source: EY analysis of company data

As is shown in Figure 2 below, full-cycle costs have exceeded average revenues since 2006 (again, apart from the distortions in 2009), while average upstream operating cash flows have been broadly flat since 2005. Critically, however, free cash flows (i.e., operating cash flows less capital expenditures — defined as F&D spending in this case) have been trending downward since the start of the shale boom and have been generally negative since 2005. As is shown in Figure 2, companies have been largely financing their US upstream development activities through increased debt, asset sales and, if available, from cash-on-hand.

### Figure 2. US upstream performance

(per boe of production)




Source: EY analysis of company data

With the step change in oil prices over the last decade, the industry has arguably lost some of its focus on cost and cost efficiency. More critically, though, the downward trend in free cash flow and the recent negative levels are inherently unsustainable, and they represent a shock to the industry. While the biggest companies may have the balance sheets to weather the free-cash-flow storm in the short term, they are nevertheless increasingly feeling shareholder pressure as upstream project economics have deteriorated. Oil prices are either too low or costs are too high — a clear stimulus for change. Clearly small and midsize independents whose pockets aren't as deep have even more constraints and pressures.

## Unconventional economics

Over the past decade, the "unconventional revolution" has transformed the US from a mature oil and gas province in terminal decline to the world's largest source of growth in oil and gas production. Unconventional production — primarily shale gas and its geological counterpart, tight oil — from the six primary US shale basins[1] accounted for 50% of US crude oil production in 2013 and 52% of US natural gas production. And importantly, it provided almost all of the growth in production for both crude oil and natural gas.[2] There are, however, some key differences to conventional oil and gas development.

### Maturity phases of unconventional development[3]

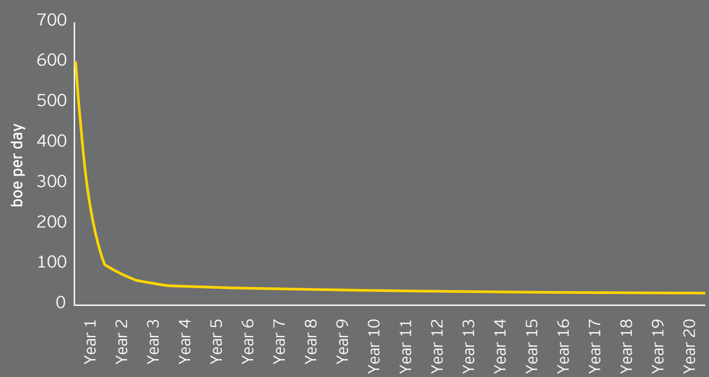
- **Evaluation:** While the location of shale deposits is generally well-known, the recoverability of reserves depends on multiple factors, including geological content, natural fractures and hydrocarbon content. Once a potential field has been identified, it is generally then followed by what is termed a "land grab," whereby operators rush to lease as much contingent acreage as possible and then drill test wells, where core samples are taken and analyzed and initial flow rates are assessed.
- **Optimization:** Once the operator is convinced that the field will produce, the next phase involves determining the right "recipe" to provide maximum results. Thus, operators will adjust variables such as the lateral length of the horizontal well, the type of proppant to be used (e.g., sand, ceramics or resin-coated) and the completion design (e.g., plug-and-perf versus sliding sleeve). When the maximum production is achieved, the operator will then try to reduce well costs by further adjusting some of the above variables. Notably, the optimization phase may last three to four years.
- **Manufacturing:** Once the well and completion design has been optimized, the field will then enter true development, characterized by high well density and essentially becoming a manufacturing operation where production results should be broadly consistent while costs move lower through improved efficiency. The only unconventional plays that are thought to be fully in the manufacturing phase are the Barnett Shale in Texas and the Fayetteville Shale in Arkansas, both of which are shale gas plays. The Bakken Shale tight oil play is generally considered the furthest along on the unconventional oil side and is thought to be close to true development.

1. The six basins are the Bakken in North Dakota and Montana; the Eagle Ford in South Texas; the Haynesville in East Texas and northern Louisiana; the Marcellus in Virginia, West Virginia, Ohio and Pennsylvania; the Niobrara in Colorado and Wyoming; and the Permian in West Texas/eastern New Mexico.
2. "Drilling Activity Report," U.S. Energy Information Administration, April 2014.
3. "Global Unconventional Oil & Gas," J.P. Morgan Cazenove, 10 January 2014.

## Production curves and investment and cash flow pressures

Unconventional oil and gas wells are typically characterized by very high initial production (IP) rates, followed by extremely sharp decline rates, and then a long, relatively flat production "tail." A nominal production profile of an unconventional well, such as might be developed in the Bakken Shale, is depicted in Figure 3.

### Figure 3. Single unconventional well production profile

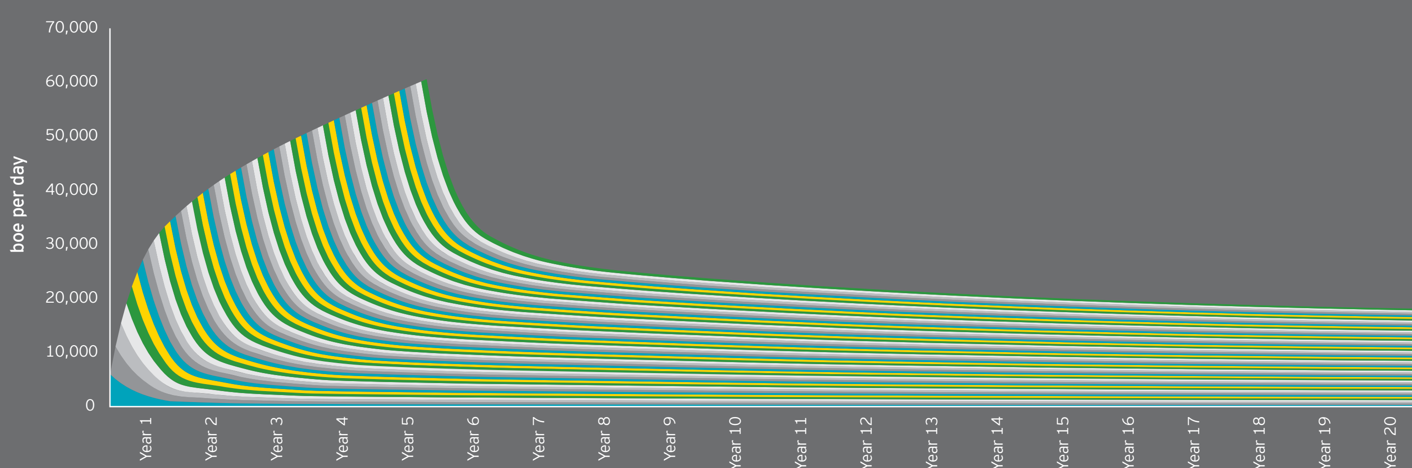



Source: EY analysis of data from J.P. Morgan Cazenove

A relatively aggressive, but yet fairly typical, unconventional development program — that is, to drill 10 new wells per month for 5 years — would yield relatively strong short- to medium-term production growth and long-lived returns from the long, flat production tail. A notional production profile for such a development is shown in Figure 4.

### Figure 4. Monthly unconventional production profile

(drilling 10 wells per month for 5 years)




Source: EY analysis of data from J.P. Morgan Cazenove

But that production growth and those long-term returns will come at a steep price, given the investment requirements[4] over the initial five years, compounded by the high rates of decline in the early years, which will reduce flexibility and increase capital intensity. As a result, growth and future returns will be at the expense of negative free cash flow during the first three to four years of the development program.

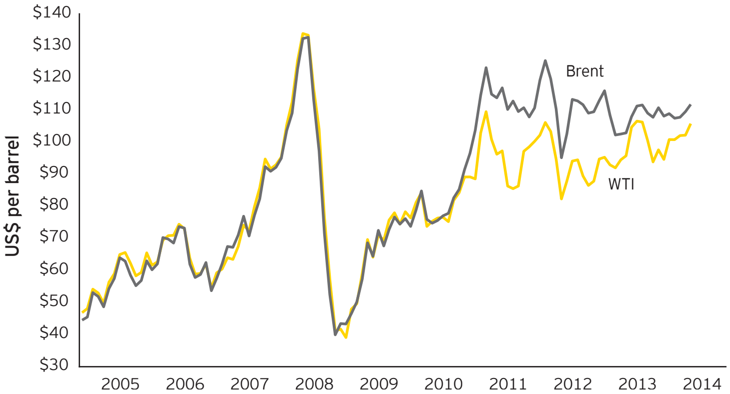
It should be noted that a negative outlook in free cash flow in the initial years of an unconventional oil and gas development project is not notably different from what is generally seen in most conventional oil and gas development projects. However, what differentiates unconventional developments is the fact that in these initial years, essentially all cash flows generated by the project will need to be immediately reinvested to fund the drilling that will in turn deliver the subsequent period's production growth and cash flow — what can only be described as the unconventional "treadmill." This high reinvestment requirement thus makes these unconventional developments highly vulnerable to declines in commodity prices. Such a drop would impact current-period revenues and cash flow, as well as subsequent-period production if reinvestment is reduced or delayed.

4. A typical unconventional well will cost US$5 million to US$10 million, depending on the specific geology and local conditions. Anecdotal evidence points to wells in the Bakken and Eagle Ford Basins tending to cost more than those in the Permian or Marcellus Basins. Further evidence, however, indicates that per-well costs are gradually declining with improving drilling and completion efficiencies.

# The price retrenchment threat: what happens at US$75 to US$80 per barrel of oil?

Following the financial system's near collapse in 2008–09, the global economy recovered quite strongly, boosting oil demand and prices as supply struggled to keep up. But even as the global recovery faltered and oil demand moderated, a series of crude supply issues — some localized, like North Sea loading problems or Nigerian sabotage, but others more widespread, like the Libyan civil war and the Iranian sanctions — kept global oil prices relatively high yet volatile. As is shown in Figure 5 below, prices for the global benchmark Brent crude have averaged about US$110 per barrel for each of the last three years.

### Figure 5. Average monthly spot crude oil prices




Source: EY analysis of data from the Energy Information Administration (EIA)

US benchmark crude oil prices had surged along with global prices after the financial collapse, but as US unconventional development shifted from shale gas to tight oil, US oil production rose sharply, creating logistical bottlenecks and simple supply/demand imbalances. As a result, US prices essentially "disconnected" from their global counterparts, creating notable price differentials. US oil production growth has remained strong, but some of the logistical constraints have eased as new pipeline and rail capacity has been built to move the increased production to market. As a result, these differentials have narrowed somewhat. However, US benchmark crude prices have likewise stayed very volatile but nonetheless averaged around US$95 per barrel in each of the last three years.

The relatively high oil prices of the last four years have certainly underpinned the massive investment surge into unconventional/tight oil development. But given the expected continued growth in US oil production (with the vast majority of that growth coming from unconventional development), two questions have arisen:

- Could increasing US oil supply, along with other global fundamentals, push global oil prices down significantly, possibly as low as US$75 to US$80 per barrel?
- Given the recent trends in US upstream performance, is the sustainability of the "revolution" at risk if oil prices were to retreat to such levels?

The answer to the first question is a qualified yes — but it will, as usual, depend on the fundamentals. The nearby sidebar considers some of these fundamental pressures. That said, current conditions and short-term expectations would seem to make a price retreat to the US$75 to US$80 range less likely. The second question, however, deserves a bit more comment.

## Global and US oil price pressures

### Upward global price pressures

- Improving global economy with rising oil demand, particularly in the US, Europe and China
- Non-OPEC/non-North American supply issues (e.g., Kazakhstan, North Sea)
- OPEC supply issues (e.g., Libya, Iran, Iraq, Venezuela, Nigeria)
- Saudi production discipline
- Moderately low commercial inventories

### Downward global price pressures

- Sluggish/stagnant global economic recovery, particularly in the US, Europe and China, with minimal global oil demand growth
- Strong non-OPEC production gains, led by North American production
- Minimal OPEC supply issues (e.g., strong production gains in Libya, Iran and Iraq)
- Rising Saudi market share ambitions
- High/rising commercial inventories

### US price considerations

- Corporate actions (e.g., building new pipeline, processing and/or rail capacity) that address the supply pressures and/or infrastructure bottlenecks that have contributed to the abnormal price differentials over and above those expected due to normal transportation and quality considerations will typically cause these differentials to narrow.
- Similarly, political actions (e.g., expedited pipeline approvals, the easing of some of the Jones Act requirements or the lifting of the crude oil export ban) would also cause those differentials to narrow.
- In particular, lifting the crude oil export ban (although unlikely in the short term) would have a dampening effect on global oil prices but would (at least in relative terms) boost US crude oil prices.
- Refining crude quality concerns will result in some downward pressures on light, sweet crude oil prices. Refiners will need an incentive to run suboptimal volumes of light, sweet feedstock.

## Full-cycle cost pressures/constraints

Many analysts and industry-focused organizations will estimate marginal or break-even prices for various types of oil and gas development.[5] While such estimates vary, the consensus is that with the exception of Canadian oil sands and potentially some future Arctic development, just about all North American projects (both conventional and unconventional, including deepwater) would have average after-tax break-even costs of US$75 per barrel or less. However, our analysis of the performance and full-cycle cost data leads us to believe that such break-even estimates understate actual costs, while actual realizations or revenues run well below apparent "market" levels.

As we noted earlier, full-cycle US upstream costs have exceeded US$60 per boe since 2008 (again, apart from the distortions in 2009). But we must keep in mind that this is a blended cost, including both oil and natural gas. If we assume that the theoretical break-even cost for gas development in 2013 was between US$4 and US$6 per million BTU or roughly US$24 to US$36 per boe, and given that the US gas/oil production split was 55%/45%, the break-even cost for oil would have been US$80 to US$90 per barrel in order for the blended rate to be around US$60 per boe — a good bit higher than the typical estimates of under US$75 per barrel.

### Room for some optimism in the full-cycle cost data?

As shown in Figure 1 on page 1, full-cycle costs may have peaked. The data for the 50 companies in our sample indicate a slight downward trend over the past few years. And as more and more unconventional projects move into the third phase of development — manufacturing — we can expect costs to decline further as a result of increasing efficiencies.

## How might companies respond?

The corporate levers to address these upstream performance issues include, most obviously, cutbacks to capital spending, but in the case of unconventional development, these cutbacks can have quick impacts on both production and revenues. In the event that prices did move sharply down, we would expect that most companies would move quite quickly to restrain capital spending, most likely by slowing or postponing drilling programs.

Other levers include:

- Better overall capital allocation (e.g., better project evaluation, project re-scoping if appropriate, capital optimization) — the upstream industry has gradually moved from being opportunity-constrained to being capital-constrained. Notably, our recent *Oil and Gas Capital Confidence Barometer* reported an emphatic shift in companies' capital agendas toward optimizing, away from investing.[6]
- Operating-cost focus — upstream operators are looking not just at their own operations but are also passing some of the pressure on returns and free cash flow down/up the value chain to the oilfield service companies. Similarly, our recent *Barometer* also reported that cost-cutting and operational efficiency have supplanted growth as the primary strategic driver for oil and gas companies.[6]
- Accelerated disposal of underperforming or non-producing assets — while oil and gas divestiture activity has recently slowed, a sharp price retreat could trigger another round of activity.
- Better hedging (e.g., systematic rather than episodic) — given the challenges of managing both basis risk (i.e., differentials) as well as volatility, hedging is critical.

5. These are usually depicted as a "cost curve," where the cheapest barrels (say, from onshore Middle East) are at the far lower-left of the chart, with incrementally higher-cost barrels added along the horizontal axis and gradually up in cost in a stairstep fashion.

6. *Oil and Gas Capital Confidence Barometer*, EY, April 2014.

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