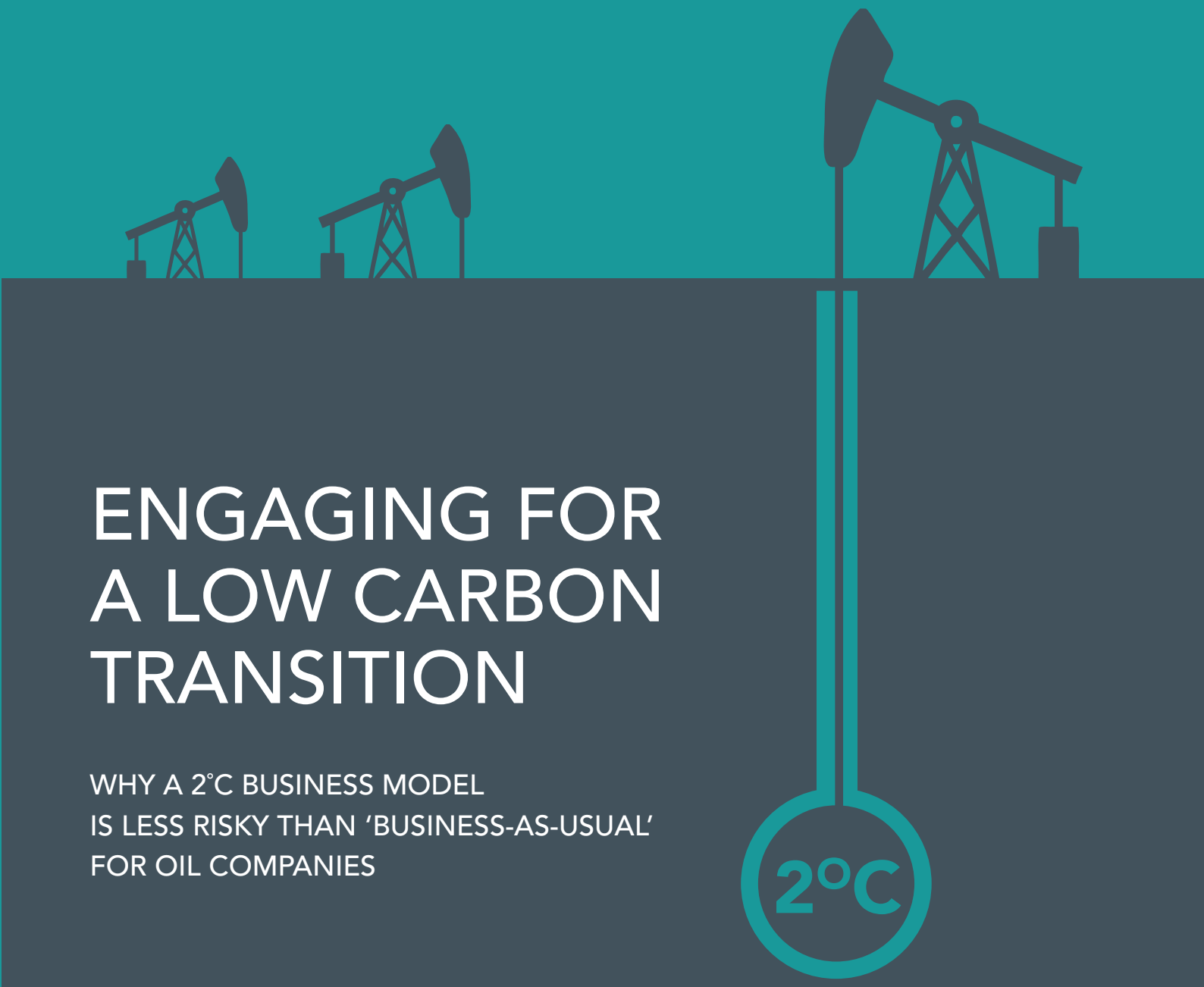
Local Authority Pension Fund Forum

Carbon Tracker Initiative



ENGAGING FOR A LOW CARBON TRANSITION

WHY A 2°C BUSINESS MODEL IS LESS RISKY THAN 'BUSINESS-AS-USUAL' FOR OIL COMPANIES

- Over the past decade, demand for fossil fuels has risen by around 2% annually. That trend needs to be reversed if the rise in global temperatures is to be limited to 2 degrees and efforts made for a 1.5-degree limit in line with the aspirations of COP21.
- The business model for many in the fossil fuel industry seems to assume that demand will follow past trends, rising steadily for the foreseeable future. LAPFF and Carbon Tracker Initiative believe that planning on this outcome risks over-investment, potentially destroying shareholder value.
- This report focuses on the oil and gas industry because there is still time to adopt a 2-degree compliant business model. For coal, it is already getting too late. Some continued investment is necessary for oil and gas due to the decline in existing fields. But the amount of capital needed is less than the industry's 'business-as-usual' assumption implies.
- A 2-degree compliant business model would, by definition, deliver less growth in production. But this need not be negative for shareholders. Indeed, the oil and gas industry's past pursuit of growth appears to have delivered little value for shareholders over the past five years.
- The problem with the industry's growth agenda was that it involved investing in high cost assets which lowered its return on capital, hurting shareholder returns. Had the industry embraced capital discipline, focusing on low cost assets, shareholder returns might well have been improved and some of the multi-billion dollar write-offs of the past two years avoided.
- This report shows that a 2-degree business model is less risky than 'business-as-usual'. It also destroys less shareholder value during periods of low oil prices. And if the greater risk of a 'business-as-usual' approach is taken in to account, the 2-degree model would deliver superior value for shareholders unless oil prices were to match or beat historic highs.
- Shareholders need to be able to identify the risks that an energy transition poses to their investments by engaging with management. Key issues are whether company planning assumptions are prudent, where its assets are on the industry cost curve and how sensitive assets are to movements in oil prices.

Contents

Context

The report looks at how moves to limit the rise in global temperature to two degrees might affect demand for fossil fuels, energy company business models and investors. It touches on aspects of the measures needed to achieve this (such as efficiency gains, renewables, electric vehicles) but not in great detail. It assumes that the energy transition needed is delivered rather than how it might occur. For more information on how demand destruction for fossil fuels may occur, we suggest you read 'Lost in Transition' by Carbon Tracker.[1] The report does not deal with other issues relevant to shareholders, such as divestment, but does indicate financial scenarios where such action might well be financially prudent.

Summary

Under the International Energy Agency's 450 scenario (IEA two-degree compliant), the cumulative amount of coal needed between 2015 and 2040 is 25% below the New Policies Scenario (NPS) which is the IEA's central scenario; oil and gas are 15% and 13% below NPS respectively. By 2040, oil and gas demand will be 30% and 23% below NPS levels. The divergence will continue to widen thereafter. For the majors, oil provides the greater short term challenge as demand needs to start declining from 2020. In contrast, gas demand continues to rise until 2030 and plateaus thereafter. So capital investment in oil will need to be curtailed earlier than for gas. Coal needs no additional expenditure on new mines.

In this paper, we will compare a notional company with a portfolio of projects that are required in order to meet a two-degree global demand profile (decided on the basis of relative positioning on a global cost curve), and a similar notional company that presses ahead with the projects available to it under the base case scenario in Rystad's UCube database[6]. The two-degree company could be described as being in 'harvest' or 'managed decline' mode, the latter in 'growth' mode.

Under a two-degree scenario, lower demand is likely to mean lower prices than under a New Policies or BAU demand scenario. This is because the lower level of demand can be met with fewer, lower cost projects. For a given year, the price needed to make the marginal barrel economic will be lower for a two-degree demand profile. The divergence in demand between the two scenarios is gradual so the same is likely to be the case with prices. For oil, a material differential in demand does not emerge until after 2025. Nevertheless, given lead times for oil and gas projects are often five to ten years, it is important that oil companies stress test future projects by using a low oil price scenario in addition to their central planning assumptions.

Most oil companies follow an 'invest-for-growth' business model aiming to grow production steadily. Ironically, in many cases, this model has failed to deliver top-line growth. Even more concerning for shareholders, it has delivered deteriorating returns over the past five years. The current model has clearly not delivered. A 'managed decline' or 'harvest' business model – reducing investment to match a two-degree demand scenario – would likely lower business risks, reducing the likelihood of destroying shareholder value. It would do so because such a company would be investing in lower cost assets, reducing the volatility in earnings caused by oil price movements. Reducing capital expenditure by focusing only on lower cost assets could enable companies to return more capital to shareholders over the next five to ten years. This is a strategy that LAPFF has recognised and promoted in voting alerts in 2015 and 2016 to members for the Chevron AGM[7].

Carbon Tracker believes that the difference in potential valuations for 'growth' and two-degree companies is modest. Indeed, the two-degree model could be superior in a low oil price environment. This is because a two-degree company's projects will have a lower average cost per barrel. Also some 'growth' projects could destroy value in a two-degree, low price scenario. A key additional factor is risk. A growth model will be higher risk because it involves investing in oil projects further up the cost curve. This is likely to lead to greater volatility in earnings and valuations for a given move in oil prices. On a risk-adjusted basis, Carbon Tracker found that the notional two-degree company could be worth more than the growth company unless oil prices were at or above historical highs.

This report includes a checklist that investors might wish to use when engaging management. Some companies may not be willing to answer some of the questions posed as they regard the answers as commercially sensitive. That is a possible danger signal for investors. The degree of openness displayed by management along with the answers to these questions should enable investors to assess the degree to which their investments are aligned with a two-degree future. Key questions:

Price: What are your oil and gas planning assumptions? Do you include a downside scenario for prices and what prices do you assume?
Carbon content: What is the split of undeveloped projects between oil and gas? What proportion of new projects are LNG and oil sands?
How robust/risky are your future projects? Where do your future projects sit on the cost curve? What is the sensitivity of your company to oil and gas prices?

Introduction

LAPFF, together with other investors concerned about the risks from climate change, has achieved notable success in requesting corporate disclosures on carbon asset risk. Following sustained engagement, the BP[2] and Shell[3] boards supported successful resolutions filed by shareholders on strategic resilience at their 2015 AGMs. These called upon the companies to provide additional disclosure on emissions, portfolio resilience to post 2035 demand scenarios, investment in and research into low carbon technologies, executive incentives and key performance indicators (KPIs).[4] Carbon Tracker has been developing its carbon supply cost curves, which highlight the relationship between keeping emissions over the next couple of decades within a particular carbon budget, and the levels of production and investment in coal, oil and gas supply that fit with that scenario.[5] These global analyses show how fossil fuel supply and demand may start to decline in the future, creating a downside risk for the producers.

However, most oil companies still seem to plan their businesses on the assumption that the action on climate change needed to deliver a two-degree scenario (which equates to around 450 parts per million (ppm) of CO2 in the atmosphere) will not emerge in the foreseeable future. The risk to businesses is that under an energy transition, volumes and prices are likely to be lower than oil companies assume in their 'business-as-usual' (BAU) or 'growth' planning scenarios. This risks future and current investments delivering sub-commercial returns. LAPFF considers that companies pursuing growth models are at greater risk of destroying shareholder value than those that take into account two-degree compliant scenarios.

For that reason, it is important for investors to use the increased disclosure by the fossil fuel industry to identify the degree to which their investments are 'two-degree' compliant. Where compliance is poor – or non-existent – investors need to engage so that management understand their concerns. That engagement will need to consider many issues including:

1. What does a two-degree world mean for fossil fuel demand?

2. What does a two-degree world mean for oil prices?

3. What might a two-degree business model look like?

4. Does a two-degree business deliver less value?

5. A corporate checklist for fossil fuel investments

6. Oil industry shibboleths

By engaging with management, shareholders should be able to gain a better understanding of the relative risks that climate change pose to their investments. Low cost companies which take in to account climate change issues are likely to fare better under a two-degree demand scenario. Those in denial could prove to be high risk companies. Indeed, unless oil prices return to historic highs, a growth business model could well destroy value.

What does a two-degree world mean for fossil fuel demand?

Summary

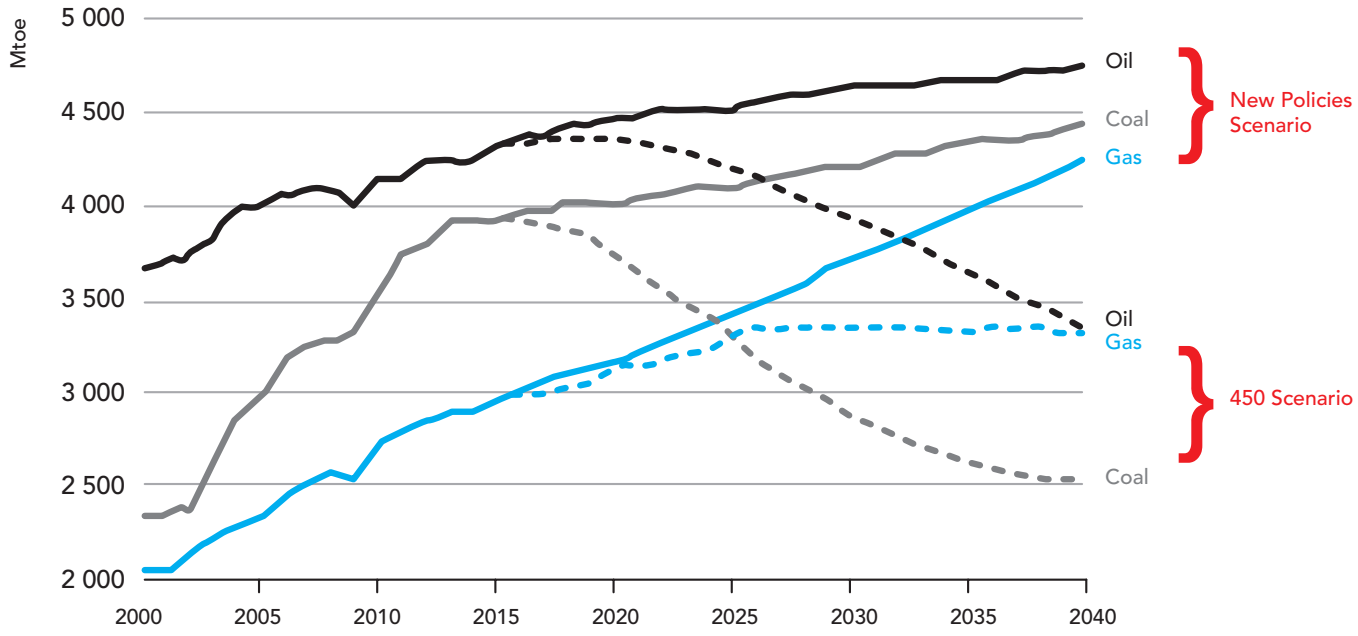
Under the IEA's 450 scenario, the cumulative amount of coal needed between 2015 and 2040 is 25% below the NPS. For oil and gas, the amounts are 15% and 13% below NPS respectively. Oil provides the greater short term challenge to the industry as demand needs to start declining after 2020. In contrast, gas demand continues to rise until 2030 and plateaus thereafter. So capital investment in oil will need to be curtailed earlier than for gas – and coal needs no additional expenditure.

Carbon dioxide levels have been rising since the beginning of the industrial revolution causing global temperatures to rise. Organisations, including the IEA, estimate the concentration of carbon dioxide in the atmosphere needs to be limited to 450 ppm in order to give a 50% chance of limiting the rise in global temperature to two degrees by 2100. To achieve this, the use of fossil fuels, especially coal, needs to be curtailed. The IEA has several scenarios for demand but only two are referred to in this report.

The NPS takes in to account climate change policies that have been announced but not yet implemented. NPS is a possible version of business as usual (BAU) where demand for fossil fuels and carbon emissions continue to grow. It takes into account possible future measures and technologies including an OECD carbon price, greater use of renewables, energy storage, commercial carbon storage and materially improved energy efficiency.

Under the 450 scenario, demand for all fossil fuels will be below the demand scenarios most fossil fuel companies currently appear to plan around. Coal will see the biggest shift in demand but oil demand will also start to fall from 2020. Only gas will continue to see demand growth but at a slower rate and only out till 2030.

Global fossil-fuel demand in the 450 Scenario relative to the New Policies Scenario (from 2015 World Energy Outlook)



Note: MTOE is million tons of oil equivalent. Source: IEA

As time goes on, the divergence between the two scenarios steadily widens for all fossil fuels. Under a two-degree scenario (450), coal consumption in 2040 is around 45% below the New Policies level. For oil and gas, the equivalent figures are around 30% and 23% lower. Those gaps will continue to widen post 2040. The oil majors have little if any exposure to coal anymore so it is only the demand outlook for oil and gas that directly matters for them. (Ironically, BP and Shell used to be important coal producers in the 1980s but chose to divest.)

The outlook for demand for fossil fuels shifts from continued growth for all fuels under NPS to falling demand for coal and oil and a plateauing of gas demand under the 450 scenario. So with gas, the majors have more time in which to act. For oil, the need for action is nearer, with demand, already weak, set to start declining after 2020.

The implication of these demand trends is that, should the fossil fuel industry continue with a business-as-usual approach, supplies of oil and gas could outpace demand. Companies will then face the choice between shutting in capacity or starting a price war to force others to do so. Both choices lead to stranded assets: the first leads to physical stranding, the latter to financial stranding. A Carbon Tracker Initiative report in 2015[8] estimated that the fossil fuel industry could waste investments of $2 trillion by 2035 if it continued to invest under a growth model. It is already too late for coal – no new projects are needed under a two-degree demand scenario. But the oil and gas industry has time to avoid the massive value destruction seen in the coal industry but only by curtailing capital expenditure and returning any additional cash generated to shareholders.

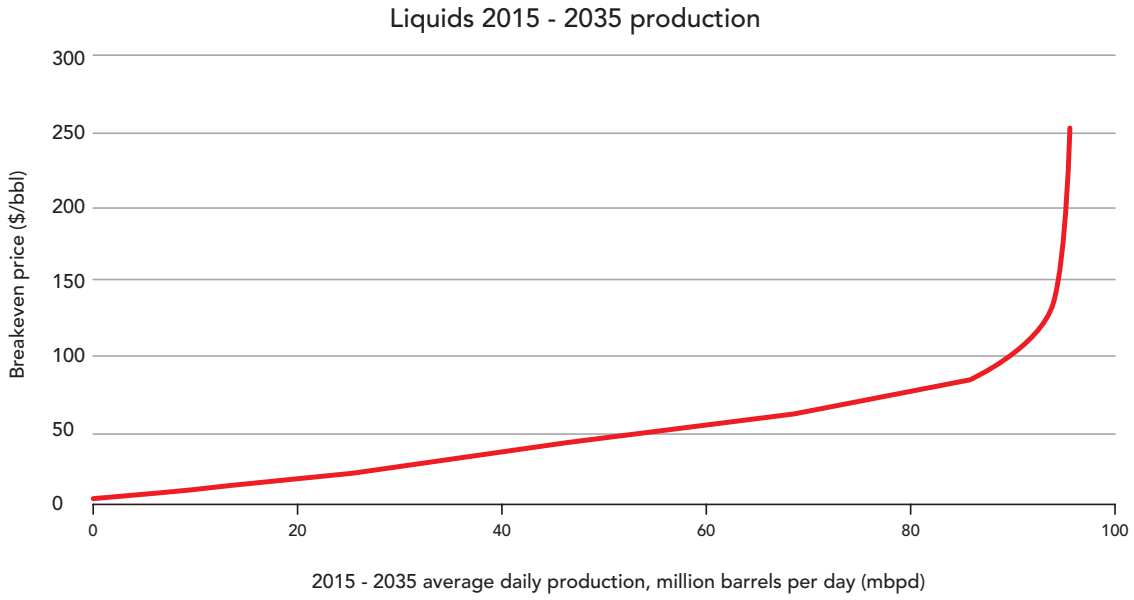
What does a two-degree scenario mean for oil prices?

Summary

Forecasting oil prices is complex. Indeed, history shows few observers, including oil industry management, have consistently anticipated price movements. But it is fair to conclude that weak or falling demand for any commodity increases the likelihood of pressure on prices. But the divergence in oil prices should be gradual and is unlikely to be material until beyond 2025. However, much depends on the industry's behaviour. Continuing with a 'growth' model in the face of a two-degree demand profile risks a price war. Moving to two-degree or 'managed decline' model would lead to more orderly price behaviour.

This section focuses on the oil price as oil is the most important commodity price for most majors as much of their gas production has prices linked to oil. Forecasting commodity prices is very complex. Estimating a demand profile may be relatively easy but assessing future supply is incredibly difficult. It means judging the likely investment behaviour of hundreds of companies, anticipating changes in technology (such as fracking), assessing project lead times and understanding the politics of major producers such as OPEC (especially Saudi Arabia) and Russia. It is therefore not surprising that even the experts, including oil industry management, often get it wrong.

What we can look at with some degree of certainty is the breakeven prices needed for future potential developments. The breakeven price is the oil price needed for a given project to generate a commercial return. This gives a picture of the level of prices needed to deliver a given amount of supply. Carbon Tracker has used cost curves to assess the capital at risk for all three fossil fuels should demand fail to meet the industry's 'business as usual' assumptions. For oil, Carbon Tracker used the Rystad UCube model and database which includes existing production as well as potential future developments. The projects in the database are sufficient to meet Rystad's base case for demand which can be regarded as 'business as usual'.



The database's breakeven prices range from a few dollars a barrel to hundreds of dollars a barrel. The higher the level of demand, the greater the number of high cost projects would be needed. In theory, this would mean the price needed to allow economic development of sufficient projects to meet a NPS demand profile will be higher than for two-degree. In a perfect market, both scenarios would see rising prices as the necessary projects move up the cost curve. But prices should rise slightly faster under the NPS scenario. It is important to note that higher NPS prices do not necessarily mean higher overall industry margins. Prices are only higher under NPS because costs are higher.

The demand profiles for the two scenarios (NPS and two-degree) only diverge gradually meaning that over the next decade, there is unlikely to be a material price gap. Beyond 2025, however, the rate of decline in oil demand accelerates. The demand gap steadily widens suggesting that the divergence in price could also accelerate.

In theory, this divergence should be gradual but that assumes the industry is rational. Should it continue to invest for growth beyond 2025, there would be growing oversupply, potentially leading to a price war – similar to those which OPEC initiated in 2014 and 1986. In that situation, prices could be driven down towards cash costs – as opposed to breakeven (or full cycle) costs. But such a collapse would have more to do with supply side behaviour than the demand outlook. It is when the balance between supply and demand is out of kilter that prices can prove volatile as the industry learned to its cost in 2014. The scale of such price movements can be material. In 1986 and 2014, oil prices fell by around three quarters.

The Carbon Tracker cost curve suggests that under a two-degree scenario, future demand out till 2035 could be met with projects having a breakeven price of $80 or lower (real prices). This does not mean that we need $80 over that whole period. That is the maximum theoretical price that is needed. In theory, prior to developing that last marginal project, prices would be lower. Given that much of the cost curve is below $50, prices could be much lower under either scenario. But we stress again that much depends on the industry's behaviour. Should OPEC withhold oil from the market, prices could rise. And should the industry over-invest on the assumption that prices will recover, prices could remain depressed. We reiterate – forecasting oil prices is complex.

Turning briefly to gas, it is fair to assume that gas prices would also be lower under two-degree than under New Policies. However, the smaller demand gap means that the difference between the two scenarios would likely be smaller. Indeed, in Carbon Tracker's analysis of the Liquefied Natural Gas[9] (LNG) market, the difference between the two-degree scenario and its Low Demand Scenario was not significant. As the two demand scenarios for gas are fairly close to each other until 2030, this is to be expected. We note, however, that much of the world's Australian, Middle Eastern and Asian LNG and European piped gas is sold under oil-linked prices and so could be affected by a two-degree oil price scenario.

What might a two-degree business model look like?

Summary

Most oil companies follow an 'invest-to-grow' business model aiming to grow production steadily. In most cases, this model has failed to deliver top-line growth. Even more concerning for shareholders, it has generated deteriorating returns. The current model has clearly not delivered. A managed decline business model – investing to match a 450 demand scenario – would likely lower business risks, boost returns and avoid destroying shareholder value. This would involve investing less and returning more capital to shareholders.

Why is looking at a two-degree business model important?

Some oil majors, predominantly European, accept the science behind climate change. However, most – if not all – believe that the action needed to limit the rise in global temperature to two degrees will not be delivered in time. A number of European majors and NOCs have formed the Oil & Gas Climate Initiative (OGCI). It "aims to catalyse practical action on climate change in focus areas such as the role of natural gas, carbon reduction instruments and tools, and long-term energy solutions". Many CEOs made supportive noises in the run up to the Paris COP in 2015. However, there is a transatlantic divide with the US majors, who do not publicly back measures such as a global carbon price, unlike their European counterparts. That said, there is little detail from the companies on how such a measure would work in practice, or why their significant lobbying power has yet to deliver any noticeable progress towards this objective.

Despite the formation of OGCI, virtually all the oil majors in Europe (and the US) continue to plan on rising demand for both oil and gas and have planning scenarios that reflect this. Two-degree demand scenarios appear to be largely ignored. The five-to-ten-year lead time for most oil and gas projects means that the industry risks delivering a rising supply profile into a market where gas demand is likely to plateau and oil demand fall. This oversupply could push oil prices down towards cash operating costs, much as happened in 1986 and 2014/15.

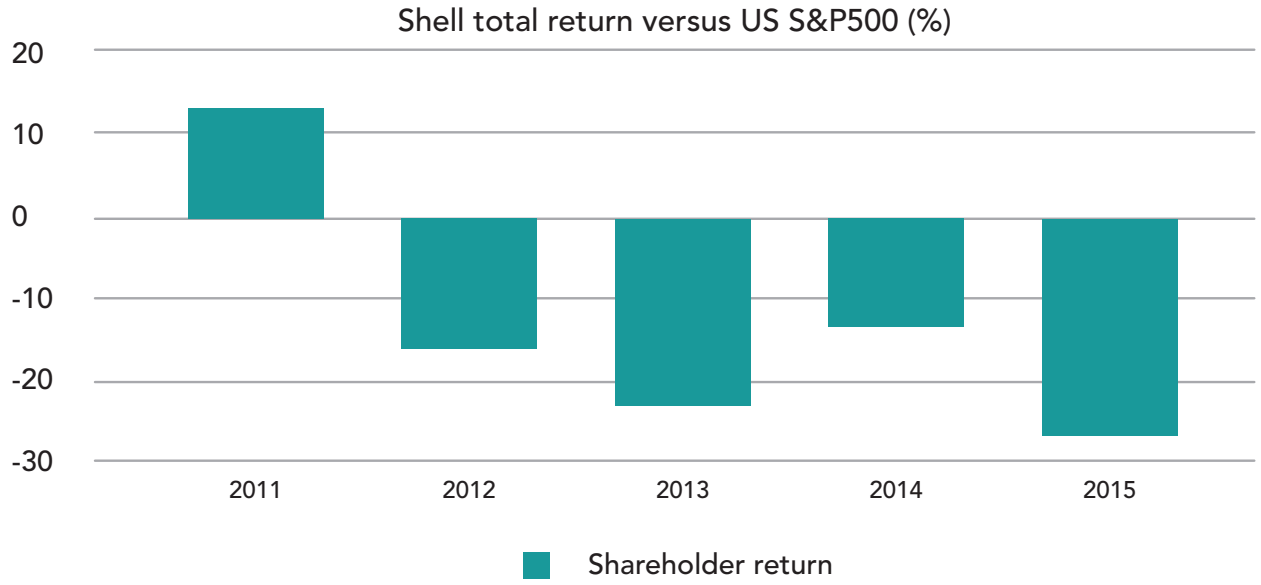
It is only by looking at the financial difference between a two-degree and business-as-usual model that investors can judge the risk that climate change poses to their investments. High risk (high cost) investments may well end up destroying shareholder value should management fail to consider a two-degree scenario in their planning.

Business as usual had already failed even before the oil price crash

Before looking at a two-degree or 'managed decline' model, it is worth looking at the current, 'invest-to-grow' model. In the past, this approach had delivered market beating returns – but only up until 2012. Around that time, the growth model started to fail, with the industry seeing falling returns and poor share price performance. And this deterioration started well before the oil price collapse of 2014.

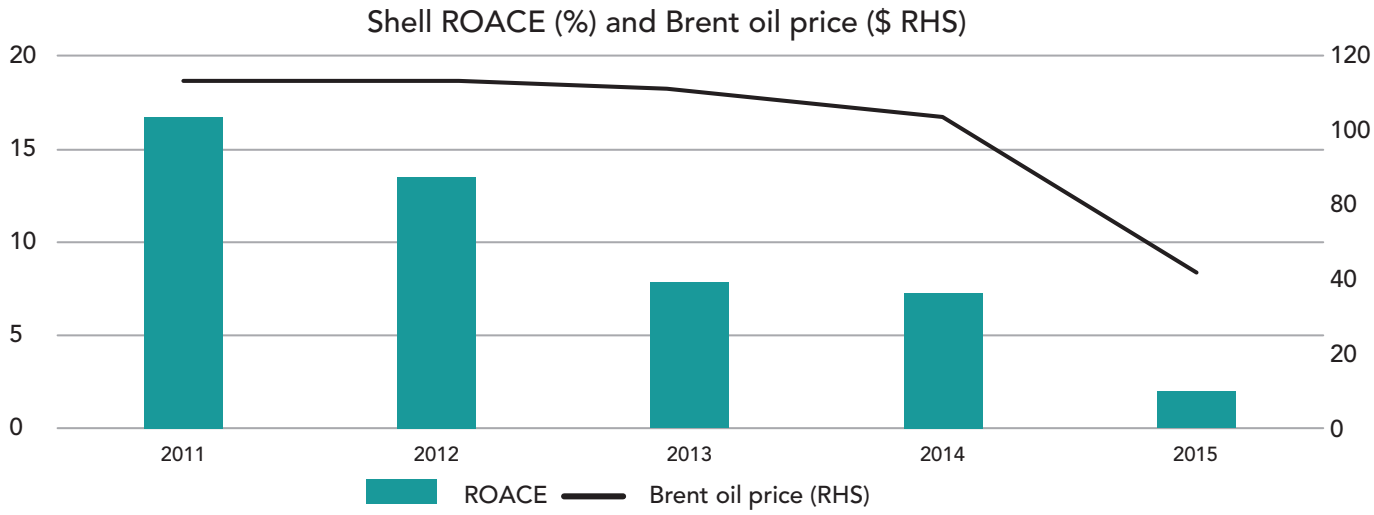
We use Shell, a surrogate for the industry, as our example. Over the ten years prior to 2012, Royal Dutch Shell (Shell) outperformed the S&P 500 by roughly 3% annually[10], an impressive performance. But since then, its performance has lagged the wider market – underperforming in 2012, 2013, 2014 and 2015 by 17%, 24%, 14.5% and 27% respectively.

A thousand dollars invested in Shell at the beginning of 2012 would have fallen to under $800 by the end of 2015. Invested in the S&P 500, it would have risen to over $1,700. This order of underperformance is typical of that for most of the oil majors in Europe and the US. This is hardly surprising given that they tend to follow similar business models.



Carbon Tracker considers that a possible factor behind this underperformance is the deterioration in one of Shell's key performance measures, return on capital employed. Return on capital is post tax profit excluding finance costs divided by the company's shareholders' funds plus debt. It is an important measure of the level of profitability being delivered by a company's asset base.

As would be expected, delivering a high return on capital is normally good for a company's rating. Indeed, one study has shown that there is a reasonable correlation between the oil sector's valuation and its return on capital.[11]



ROACE: Return On Average Capital Employed

We believe that much of the deterioration in returns for Shell (and the rest of the industry) is because it invested too much capital in the pursuit of growth. In order to try and deliver growth, it developed ever-more expensive, capital intensive projects. For example, between 2010 and 2014 (before the oil price crash), Shell's capital investment on oil and gas rose by 22% and its capital employed (a measure of the size of the asset base) rose by 35%. Its return on capital more than halved between 2011 and 2014. Focusing on lower cost assets and reducing levels of capital expenditure would probably have resulted in a further fall in production. However, its capital employed and capital expenditure would have been lower, probably delivering better returns. The capital investment saved could have been returned to shareholders.

A two-degree model (managed decline)

A two-degree strategy could mean investing at a level that delivers a production profile that matches the 450 demand profile. That means a very modest rise in oil production till 2020 with a decline thereafter of around 1.5% annually. For gas, production needs to rise by around 1% annually for the next decade and plateau thereafter. Given that existing conventional oil production declines by 2-5% annually, the industry will still need to invest in new assets as the world transitions to a carbon neutral scenario. But the overall level of capital expenditure would be lower. As the gap between the 450 and NPS demand profiles widens, the scale of reduction in capex would also increase.

Looking at our two hypothetical companies, 'two-degree' and 'growth', we can draw some important distinctions. A two-degree supply model would deliver lower revenues than the growth model. But it would also invest less capital and its projects would have lower average production costs. This is because most companies have a portfolio of future projects from which they can pick and choose. These projects will have a range of costs as we saw in the Carbon Tracker cost curve. A two-degree company will have fewer projects and they will be lower cost than those for a growth model. The two-degree company will therefore have higher average margins. Its earnings and valuation would be less sensitive to price movements meaning lower volatility. This implies lower risk which in turn should mean a lower cost of capital.

For the next ten or so years, there will be very little difference between the revenues of the two notional companies because the two oil demand scenarios only start to see material divergence after 2025. But oil projects typically have lead times of five to ten years, with the notable exception of US shale. That means that the investment needed to deliver a 2025 barrel could be needed before 2020. So the two-degree company's capital investment programme might well be below that of the growth company but it would still see 'growth' style cash-flows for the next five years or so. So its free cash flow, revenue less all costs including capital expenditure, could be higher in the medium term than for the growth company.

That additional cash flow could be returned to investors as higher dividends or through share-buy backs. The other option would be to use the cash to diversify by investing in renewable energy, mirroring the likely trend in energy use. However, the oil majors' past diversification efforts have been notoriously poor, often destroying value and resulting in asset write-downs. Such efforts have included fish-farming, pet food, coal mining and high street retailing and are rarely talked about nowadays. Many of their efforts in alternative energy have also proved relatively short lived.

Turning to the growth company again, it might eventually deliver superior production in the longer term – but with greater risk. If it misreads the supply demand outlook, oil prices might fall below project break-even prices by the time the high-cost growth projects start production. Such investments would destroy value and returning cash to investors would have been a better option. Indeed, many of the projects the industry sanctioned prior to 2014 are not delivering the returns the industry planned on. Many are probably destroying value due to a collapse in oil prices that management failed to anticipate and failed to plan for.

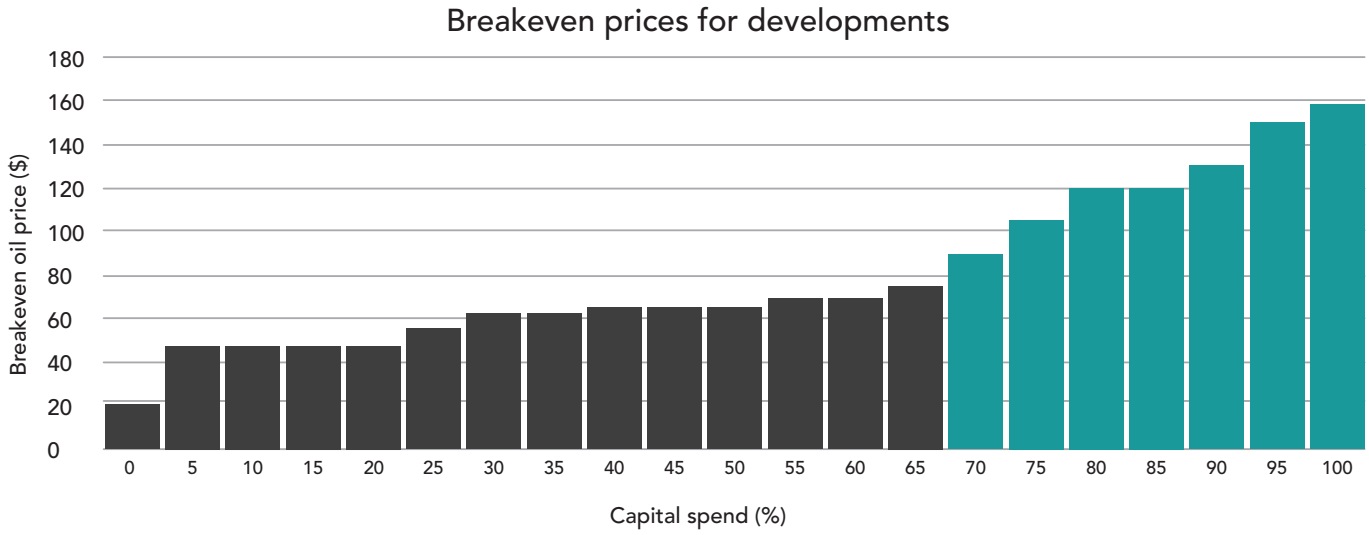
So, a two-degree model does not necessarily create less value than an invest-for-growth model. Indeed, under certain scenarios, such as a weak demand leading to low oil prices, it may well create more value at lower risk to shareholders. Under the same scenario, the growth company risks oil prices falling below the breakeven levels needed for its projects to deliver commercial returns.

What does a two-degree business model mean for shareholder value?

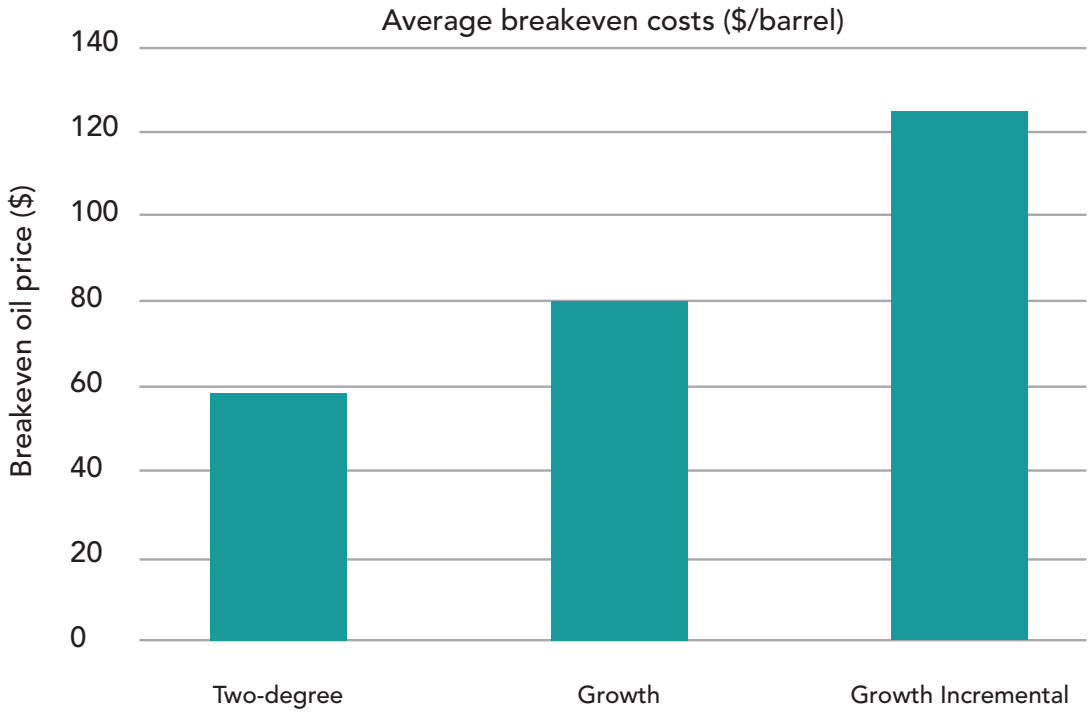
Summary

Carbon Tracker believes that the difference in potential valuations for growth and two-degree companies is modest. Indeed, the two-degree model could be superior at low oil prices. This is because it will be lower cost. Also, some of the growth company's projects could destroy value in a two-degree demand scenario. A key additional factor is risk. A growth model will be higher risk because it is higher cost leading to greater volatility in valuations for a given move in oil prices. On a risk-adjusted basis, Carbon Tracker believes that the two-degree company could be worth more than a growth company unless the oil price were to recover to or above historic highs.

Looking at valuations, it is obvious that for a given oil price, the existing producing assets will have the same value in a growth company as in a two-degree company. The difference emerges when we look at how the cash flow from these assets is reinvested. All companies have a portfolio of development assets with a range of breakeven costs. The following is an illustrative chart for a possible range of break-even prices for a development portfolio consisting of one hundred projects.



The breakeven prices range from $20 to $160, the darker coloured bars being the projects with break-evens below $80. These would typically be the projects a two-degree company might develop. The lighter coloured bars are the additional projects a growth company might need to develop.



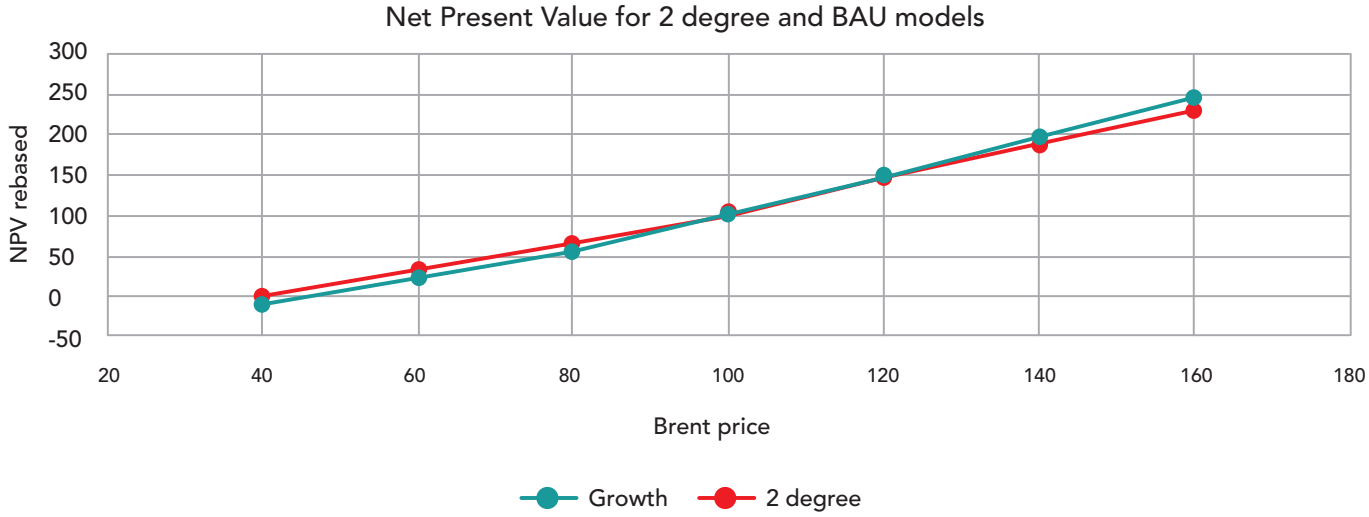
The cost base for the two-degree company will be lower as it is not chasing growth. Assuming it only develops the sub $80 projects on our hypothetical cost curve, the two-degree company would have an average breakeven of around $60. That for the growth company would be $80. This would mean that for a given oil price, the growth company will have lower margins and hence its value will be more sensitive to the oil price.

But the most important conclusion is that the incremental projects needed to deliver the 'growth' have far higher costs. They have an average breakeven of around $120. In this example, the incremental 'growth' only delivers value at oil prices close to historic highs. It is more likely that the company would deliver growth in volumes but destroy value in the process. This is exactly what has happened over the past five years with some majors investing in projects with breakeven prices in excess of $80. With the collapse in oil prices in 2014/15, those projects are now subject to multi-billion dollar asset write-downs.

A more complex approach to illustrate this effect is to use a cash flow model to work out the net present value of oil companies following the two different business models. We have assumed that the growth company develops sufficient projects to meet a rising demand curve (this is Rystad's base case for demand). In contrast, the two-degree company develops fewer projects as it plans on a two-degree demand profile – ie it assumes declining demand for demand after 2020. The Carbon Tracker cost curve shows that the two-degree company would develop projects with breakeven prices up to $80 a barrel. The growth company would develop projects with breakeven prices of well over $100.

Some may feel that we should value a 'growth' company using higher oil prices given the higher demand outlook. But our valuations are looking at two different business models not two different oil price scenarios. We are interested in supply because that is where the two business models differ. Both can exist in either demand scenario. Our interest is to assess how the valuations of the two business models differ under a range of oil prices. The oil price does not care what business model a company is following: it is impartial. Should demand remain high, leading to a recovery in oil prices, the two-degree company will still benefit even though it is delivering a falling supply profile. As companies often note, the wider supply and price picture is beyond their control.

This chart, which uses the Rystad UCube database, shows how the net present values for each type of company might change for a range of oil price assumptions.



Source: Carbon Tracker Initiative using Rystad data

It might surprise some that the two-degree company's theoretical value is little different to that of the growth company. Indeed, in this example, the two-degree model delivers superior value unless Brent averages above $100/barrel in real terms. This is because it is spending less capital and so has a lower average cost per barrel. Also, many of the new projects developed by the growth company are uneconomic at prices below $100.

But this analysis ignores the issue of risk. From the chart, it can be seen that the slope of the net present value (NPV) chart is gentler for the two-degree company meaning that its net present value is less sensitive to movements in the oil price. From the slope of the NPV curve, we can see that it has around 10% less sensitivity to the oil price meaning its valuation will be less volatile and hence carry less risk.

Our calculations for this example suggest the two-degree company has a cost of capital around 0.6% lower than the BAU company. More details of our calculations are given in the following text box.

Cost of capital

The Capital Asset Pricing model (CAPM) describes one way of calculating cost of capital and how it is affected by risk or volatility. Using the simplest version of CAPM, a company's cost of capital is made up of its cost of debt and its cost of equity. Its cost of debt is its long term cost of borrowing – for example, Shell's cost of debt is around 4.5% currently. Cost of equity is more complex and is defined as:
Risk Free Rate + Beta (or volatility relative to the market) x Excess return (Market return less risk free rate)

The risk free rate is defined as the return on long term government bonds – currently around 2.5% for US treasuries. The market return for the S&P500 has been around 9% (since records began in 1871). This gives an excess return of 6.5%, for which investors have accepted higher risk.

We will assume that our BAU company has a beta of 1 meaning the volatility in its share price is the same as the market's. We know from the earlier Net Present Value curves that the valuation of the two-degree company is around 10% less volatile than that for the BAU company– all other things being equal, apart from the oil price. If a company's share price tracks its asset valuation (which it should), the two-degree company's share price will be 10% less volatile. Share price volatility is the key determinant of beta (a measure of volatility) and so one would expect the two-degree company to have a beta of around 0.9 which compares to our assumed growth company beta of 1.0.

Combined, these factors give a cost of equity (CoE) for our BAU company of 9% [2.5%+1x(9%-2.5%)]. Our two-degree company has a cost of equity of 8.3%. [2.5% + 0.9x(9%-2.5%)]

Shell's long term dollar debt is currently yielding around 4.5%, which we will use as its cost of debt (CoD).

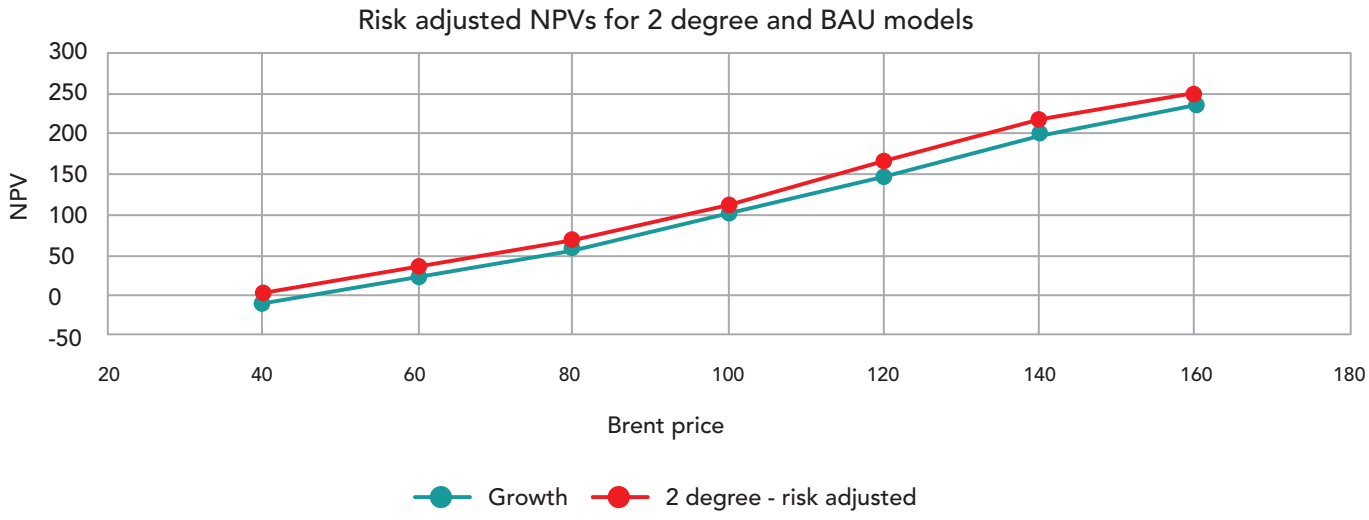
The total cost of capital is a blend of a company's cost of debt and its cost of equity. It depends on the proportion of the company that is funded from debt. At the end 2015, Shell was around 15% funded from debt and we will use that as our template.

This gives an overall cost of capital of 8.3% [15% x 4.5% CoD plus 85% x 9% CoE] for our BAU company and 7.7% [15% x 4.5% plus 85% x 8.3%] for the two-degree company. The actual cost of capital is less important than the gap between the two (because all of the component measures can change over time). The key conclusion is that the two-degree company has a lower cost of capital which is 0.6% below that of the BAU company. It is lower because of the two-degree company's lower risk.

This calculation might seem somewhat theoretical. However, we believe it is highly relevant to the real world because cost of capital is a key input to the discount rate used to value future cash flows. We know that the market prices lower risk assets at higher ratings – i.e. it accepts a lower return from them in return for greater security. For example, this is why government bonds yield around 2.5% but riskier corporate bonds yield 4.5%. The consequence of this is that the cash-flows from a government bond should be valued using a 2.5% discount rate whereas those from a corporate bond should be discounted at 4.5%.

When valuing oil assets, this means that we should use a lower discount rate to value a lower risk, two-degree company than when valuing a higher risk, BAU company. This is because the high cost company has lower margins and so is at greater risk of defaulting on dividend payments or going bankrupt should oil prices collapse.

The following chart shows the valuations adjusted to take risk in to account. We do this by using a lower discount rate when valuing the two-degree company's cash flow.



We can see that the two-degree model delivers superior value for oil prices up to $160/barrel. We estimate that oil prices would need to be over $180/barrel for the BAU model to beat the two-degree model on a risk-adjusted basis. Under a two-degree demand scenario, we believe the oil price could be lower than the planning assumptions used by the oil industry. That suggests that the prices needed for the growth model to deliver superior returns may well not materialise. A capital disciplined approach to business is not only climate friendly, it might well also deliver superior returns to shareholders. It would certainly have destroyed less value during the oil price crash of 2014/15.

A corporate checklist for fossil fuel investments

Summary

Some companies may not be willing to answer some of the questions posed as they regard the answers as commercially sensitive. That is a possible danger signal as shareholders need to be able to assess the risks climate change may pose to their investment. The degree of openness displayed by management along with the answers to these questions should enable investors to assess the degree to which their investments are aligned with a two-degree future. We include several charts from industry publications that illustrate the type of information that could prove useful – and also demonstrate that this kind of information has been provided on previous occasions.

What is the company's planning assumption for oil and gas prices?

As we have already commented, forecasting oil prices is complex. But all companies have planning assumptions, which often include different scenarios for oil and gas prices. By comparing company oil price assumptions, they can be graded: those with more conservative oil price assumptions are more likely to invest cautiously and so prove more climate friendly. They will also tend to be lower cost companies, lowering investor risk. Shareholders should also ask whether the company has a 'downside' price scenario – something that could emerge under a two-degree demand scenario. Again, these assumptions can be ranked. The more conservative, the better.

Key questions

What are your planning assumptions for oil and gas prices?
Do you include a downside scenario for prices and what prices do you assume?

What is the make-up of the company's undeveloped reserves?

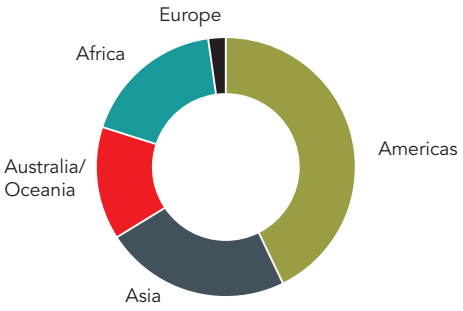
All quoted companies produce reserve statements showing the level of proven reserves. These are split between oil and gas. Helpfully, some companies also break out the amount of oil sands and LNG (high cost assets) included in reserves. The reserves are also split between developed and undeveloped – and it is the latter that is crucial for investors to discuss as they are more at risk of becoming financially stranded. If possible, investors also need to determine the make-up of a company's probable reserves and contingent resources, not just its proven reserves. (We include a discussion of the definitions behind reserves and resources at the end of this chapter.)

Given the demand outlook under a two-degree scenario, gas reserves are likely to be lower risk than oil – in theory. We say 'in theory' because one form of gas, liquefied natural gas or LNG, is far from climate friendly. Nor is it investor friendly. This is because LNG projects are very capital intensive and so tend to be high cost, low return assets (similar to oil sands). Also, fugitive emissions of methane from LNG plants can more than outweigh the gains from lower carbon dioxide emissions. Knowing the make-up of future development projects can be useful in gauging risk. For example, a portfolio that is heavy on high cost projects (such as oil sands, heavy oil or LNG) could well be higher risk than one based on conventional projects.

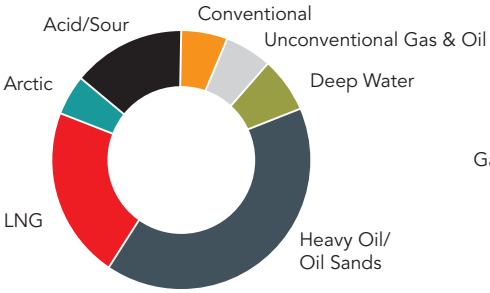
The sort of information that could be useful to investors is shown in this chart from ExxonMobil's 2015 Financial and Operating Review (see page 22)12 which provides some of this information in graphic form. It shows upstream projects that have been approved for development or are already underway ('Upstream Charts'). We can see, for example, that at the end of 2015, Exxon's future developments were biased to liquids (green segment in the right hand Upstream Chart) and contain a relatively high proportion of heavy oil/oil sands (grey segment, middle Upstream Chart), which could prove to be high cost.

Upstream Charts

Upstream projects
By geographic region
(Percent, oil-equivalent barrels)



By development type
(Percent, oil-equivalent barrels)



By hydrocarbon type
(Percent, oil-equivalent barrels)

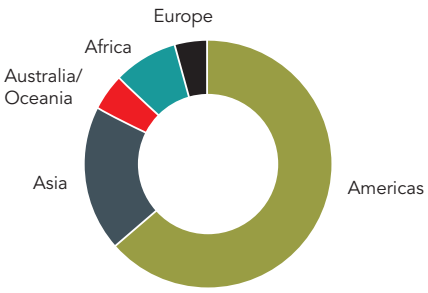
Source: ExxonMobil 2015 F&O Review

The Resource Charts below, which are from the same report, show the split of 'resources', which Exxon defines as discoveries likely to become reserves in the future. These are discoveries where a development decision has yet to be taken - unlike those in the first set of pie charts which have already been approved for development. The two left-most Resource Charts show the split of the overall resource base by type and by geography whereas the right hand chart shows the incremental change to the resource base over the year.

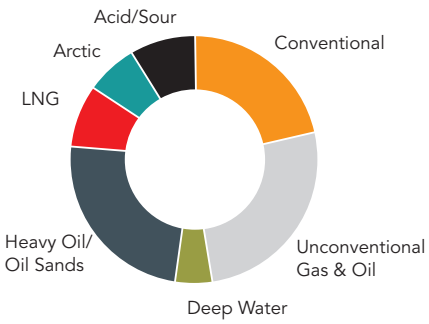
The middle Resource Chart shows that Exxon's overall resource base has reasonably high exposure to LNG, heavy oil, oil sands, and the Arctic. These will tend to be high cost. The Additions" chart to the right shows that Exxon is increasing its relative exposure to unconventional (grey segment) and deep-water (green) plays.

Resource Charts

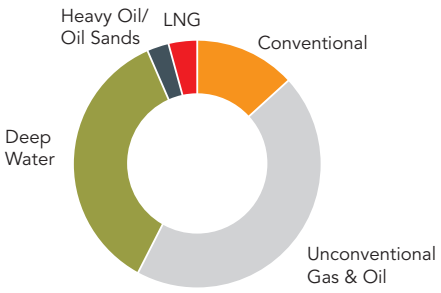
Resource Base Distribution
By geographic region
(Percent, oil-equivalent barrels)



By development type
(Percent, oil-equivalent barrels)



Resource Additions/Acquisitions
By hydrocarbon type
(Percent, oil-equivalent barrels)



Source: ExxonMobil 2015 F&O Review

The Upstream Charts are the more important as they show projects where Exxon has already committed – or is about to commit – capital. The Resource Charts give an indication of the longer term shape of the business. It is these resources that could feed in to Exxon's projects over the next few decades.

Key questions

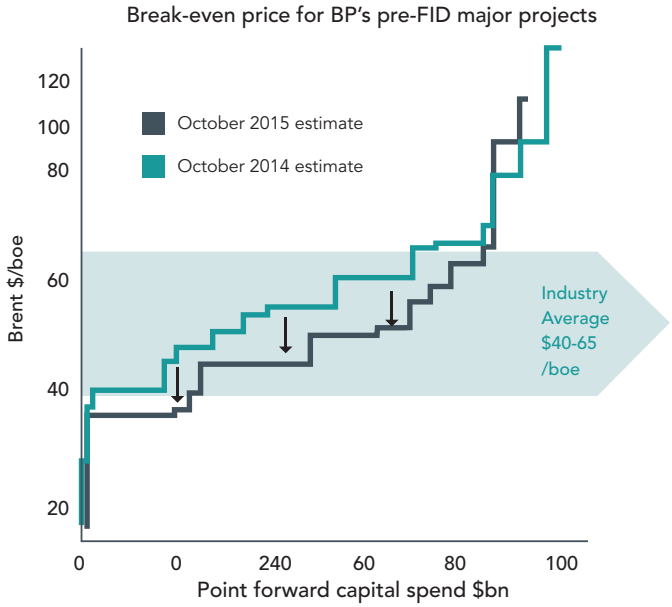
What is the split of undeveloped (proven and probable) reserves between oil and gas?
What proportion of oil reserves (and resources) are high cost – such as oil sands, arctic or heavy oil?
What proportion of gas reserves (and resources) are LNG? These also tend to be high cost.

How robust are future projects?

Oil companies are not required to produce cost curves showing breakeven prices but many do. A breakeven price is the oil or gas price that a future project needs to meet a given cost of capital. At prices below the breakeven price, a project destroys value and is on its way to becoming financially stranded. This is a slide BP provided with its third quarter results in 2015.

Improving quality of future investments

- Progression only when value thresholds are met
- Delivering value improvements
  - Renegotiate supply chain contracts
  - Standardisation
  - Using industry led solutions
  - Optimising scope and phasing
  - Focus on front-end loading
- Focus on value growth versis volume



Source: BP 3rd quarter results and update. 27 October, 2015. Page 24
(The title and comments on this slide are BP's not LAPFF's or CTI's).

This shows BP's potential projects have breakeven prices ranging from under $20 to over $100/barrel. Under current oil prices, around half of BP's potential investment would destroy value. Under current oil prices, around half of BP's potential investment would destroy value, although it is noted that BP's assumptions may be different from those used by Carbon Tracker to derive its cost curve. From a shareholder perspective, it is important that only low cost projects are pursued as this reduces the risk of financial stranding. It is difficult to cross-compare this measure for different companies as they may use different planning assumptions and hurdle rates. Nevertheless, it is valid for shareholders to ask companies to provide such information in a manner which assists comparison. Although cross comparison of company-provided data may be difficult, other sources such as Carbon Tracker Initiative, many energy consultants and some investment banks provide this type of analysis on a consistent basis.

Of note is that some companies have high cost assets in joint ventures and associates where disclosure is far less detailed. It is important that these assets, if material, are included in the cost curve discussion. Such analysis would enable shareholders to identify high cost companies which are at most risk of destroying value. It would also enable shareholders to check development decisions as they are taken. If a company consistently proceeds with high cost assets, such as oil sands and LNG projects, this should be taken as a danger signal.

In terms of shareholder risk, a useful measure is price sensitivity. The higher the sensitivity of earnings and cash-flow to moves in oil and gas prices, the greater the risk. Some in the oil industry have a vision of steadily rising demand and hence prices. Under this scenario, taking greater risks may deliver more value. But under a lower oil price scenario, that greater risk may well end up destroying shareholder value. Companies quoted in the US already provide a simple valuation of their oil and gas assets although they caution that it should not be used for valuation purposes. The following is Shell's from 2015.

Standardised measure of discounted future cash flows relating to proved reserves at December 31

2015 - SHELL Subsidiaries								£ Million
					North America			
	Europe	Asia	Oceania	Africa	USA	Canada	South America	TOTAL
Future cash inflows	46,910	83,549	36,644	35,856	28,755	81,957	2,264	315,935
Future production costs	21,526	25,494	11,690	17,470	21,480	60,449	1,728	159,837
Future development costs	12,003	12,730	12,987	6,344	10,930	17,983	898	73,875
Future tax expenses	7,660	15,926	1,407	6,357	864	1,099	86	33,399
Future net cash flows	5,721	29,399	10,560	5,685	(4,519)	2,426	(448)	48,824
Effect of discounting cash flows at 10%	1,870	14,181	5,894	1,372	(2,394)	2,241	(221)	22,943
Standardised measure of discounted future net cash flows	3,851	15,218	4,666	4,313	(2,125)[A]	185	(227)[A]	25,881
Noncontrolling interest included	-	(1)	-	(149)[A]	-	-	-	(150)

[A] While proved reserves are economically producible at the 2015 yearly average price, the standard measure of discounted future net cash flows is negative for those proved reserves at December 31, 2015, due to addition of the overhead, tax and abandonment costs.

This shows that the industry can give an indication of the value of its reserves for a given price scenario. Some indication of the sensitivity of these values to the oil and gas price could be very useful as a measure of risk.

Key questions

Where do future projects you are considering for development sit on a cost curve (oil and gas), including those in joint ventures and associates?

What were the breakeven prices for projects that you decided to approve last year?

What is the sensitivity of the value of your oil and gas reserves to movements in oil and gas prices?

Definitions: reserves and resources

Some in the industry use the term 'reserves' as a catch-all description. But the issue of how much oil and gas a company has is more complicated than that.

Companies have two types of volume measures, reserves and resources. Reserves have been discovered and are commercial – meaning the industry has the technology needed to develop them and the project is economic under its planning assumptions. Resources are more complicated – there are two classes, contingent and prospective. Contingent resources have been discovered but cannot be regarded as reserves because they are not commercial. The 'contingencies' preventing them being classified as reserves can be economic, technical or practical. For example, the technology needed to safely develop an ultra-deep, high pressure, high temperature oil field may not exist. The discovery exists but does not count as reserves. But as technology develops, such a resource could move in to the reserve category.

The second type of resources are prospective. These are volumes of oil and gas that geologists believe are present but have yet to be discovered. They may be there but have not been explored for. In terms of falling quality, the order of these measures is reserves, contingent resources and prospective resources.

Oil companies also rank these volume measures by probability. All oil fields have a range of potential volumes. When an oil field is discovered, geologists make an estimate of how much oil it may contain. This can be quite a large range at the point of discovery but as more work is undertaken and production history is gained, that range is likely to narrow.

Let us assume that our oil field contains between 500 and 1000 million barrels. The industry uses the terms 'proven', 'probable' and 'possible' to refer to degree of certainty over these volumes. For example, 'proven' means that management are 90% certain that the eventual volumes will be at or above that level. Some companies use the term P90 rather than 'proven' to refer to the 90%. In this case, the 'proven' reserves might be 600 million barrels. 'Probable' means a 50% certainty and is also the most likely outcome. In this case, the 'probable' reserves could be 750 million barrels. 'Possible' has only a 10% chance of being met and is often described as 'blue sky'. That could be 900 million barrels.

Oil companies are only required to disclose data about the level of proven reserves in their filings. However, these can often account for only half of the 'most likely' or 'proven and probable' reserves. Also, the percentage of undeveloped projects is likely to be higher in the 'probable' category. By definition, all of a company's resources are undeveloped.

Oil industry shibboleths

Denial: "Action on climate change is unlikely", "A global carbon price is unlikely."

Action is already being taken on climate change and it does not need a carbon price to be successful. European carbon emissions were lower in 2014 than they were in 1978 and US carbon emissions have been falling since 2007. Globally energy-related carbon emissions did not rise in 2014, despite global economic growth and all carbon emissions rose less than 0.1 percent in 2015 even as economic output expanded[13]. This has been achieved without a global carbon price. Instead, governments have set efficiency targets for automobiles, domestic boilers and many household appliances. Technology has also led to improved efficiency; the current generation of LED lightbulbs is a good example. Such changes are likely to continue. For example, battery technology is making incredible steps and renewable costs are likely to continue falling relative to those for fossil fuels. Ignoring the possibility of action on climate change risks oil and gas companies being blind-sided in much the same way as the coal industry was.

"We are a gas company"

Very few companies are pure gas plays. Nearly all have oil reserves in addition to their gas reserves, and the economics are often conjoined. But at its simplest, this statement is true. Gas is a lower carbon fuel and does not face the same demand destruction as oil and coal. However, we have two caveats. The first is that projects still need to pass the return or breakeven cost test. Does the project deliver acceptable returns to shareholders? LNG projects, although gas, are traditionally very high cost and so often deliver below average returns. Many that were approved prior to 2013 will now be destroying value. The second caveat is fugitive emissions which is especially an issue for LNG projects and some tight gas plays (fracking). Methane (natural gas) is a far more potent greenhouse gas than carbon dioxide – although it is not as persistent in the atmosphere. Valid questions for a company claiming to be a 'gas' company are "What percentage of production from your gas projects is lost as fugitive emissions?" and "What proportion of your gas projects is LNG?". Investors should therefore try to ensure that data for these are disclosed.

"The world will always need oil and gas so we have to keep investing"

The world is not going to stop using oil and gas overnight, but the amount of gas and especially oil needed to meet a two-degree scenario is lower than for NPS for example. Under a two-degree scenario, cumulative oil and gas demand till 2040 is likely to be 15% and 13% lower than under NPS. Much of that demand can be met from existing production and so the shift in the amount of capital needed will be even lower than these demand forecasts imply.

"We are only a small part of global supply reserves so our actions don't matter"

It is true that state oil companies, especially those in OPEC, own a far greater amount of oil reserves than the major oil companies. BP estimates that OPEC owns around 70% of the world's oil and roughly half of the world's gas reserves. But, listed oil companies (including the majors) have far shorter reserve lives than OPEC. This means they make up a far greater proportion of production over the next 15 years than the 'state oil' reserve comment implies. Carbon Tracker estimates that private sector oil companies, including the majors, could make up around 44% of the world's oil production over the next 20 years. Further, due to the relatively higher cost nature of the private sector's projects, they account for 55% of total capital expenditure on oil projects. It is this high cost capital expenditure that is at risk of financial stranding.

"It is very unlikely that our proven reserves will be stranded"

This is the defence that many companies use. It is true that it is harder to 'strand' existing production because development costs have already been sunk. An existing field will tend to have a much lower costs than future assets that are yet to be developed. But that has not stopped the oil majors taking multi-billion dollar write-downs on their existing production as a result of the 2014 oil price collapse. Clearly, existing production can be 'stranded' if the oil price falls low enough.

In addition, not all proven reserves are developed – typically around 20% of proven reserves are undeveloped and these can become stranded far more easily than existing production. An excellent example of this is Shell's Carmon Creek project where development was halted with a $2 billion write-down.

Further, a key issue that this defence ignores is reinvestment risk. The cash flow from existing production is only hard to strand if it is returned to shareholders. If it is reinvested, this rolls the stranding risk forward by five to ten years, possibly longer. Oil companies do reinvest material amounts of the 'unstrandable' cash-flows from existing assets. For example, in 2014, Shell reinvested two-and-a-half times as much as it paid in dividends. It doesn't matter if low risk, low cost proven reserves are hard to strand if the resulting cash-flow is reinvested in future high cost, high risk assets.

Conclusion

The world is already taking measures to limit future carbon emissions. We are still some way from a two-degree demand profile but are moving in that direction. The oil and gas industry seems to plan on the assumption that demand for oil and gas will continue to grow because governments will not take the necessary action. Of course, the world will still need investment in new oil and gas projects even under the IEA's 450 scenario, just materially less than the industry is planning for. Demand for gas could plateau after 2030 but that for oil could start to decline after 2020. Given that investment lead times on most oil projects are five to ten years, the industry should already be considering a reduction in its oil investment programmes.

There is a future for the oil and gas industry under the 450 scenario but it involves moving away from the current 'invest-to-grow' model to 'managed decline' or 'harvest'. Many industries have had to make such a transition in the past. Some, such as the tobacco industry, did so more successfully than others, such as coal. The winners tended to be those that had proactive rather than reactive business models.

One threat to the industry's performance is the pursuit of a growth agenda in the face of a 450-demand scenario. That would lead to oversupply, possibly causing oil and prices to fall below 'growth' planning assumptions, depressing project returns and possibly destroying shareholder value.

An oil and gas company that manages a decline in production will tend to have a lower cost base because it will cherry pick the most attractive, low cost projects from its portfolio. It will also have a lower capital budget, boosting its free cash-flow generation over the medium term. In contrast, a growth company will have lower cash flow generation and a higher proportion of high cost projects. The former company's valuation would be less sensitive to movements to fossil fuel prices, meaning lower volatility and hence less risk. Indeed, such a business model may well deliver superior risk-adjusted returns to shareholders should commodity prices fail to return to historic highs.
Shareholders concerned about the effect an energy transition might have on their investments need to engage. Valid questions for management are price planning assumptions, breakeven prices for future projects and sensitivity of valuations to movements in the oil and gas prices. The answers to such questions should put shareholders in a position to gauge the risk profile of their investment. There is a financial argument that those that can't reassure investors could be considered as divestment candidates.

About the Local Authority Pension Fund Forum (LAPFF)

LAPFF represents the interests of 70 public sector pension fund members with combined assets of approximately £175 billion. The Forum has long been concerned about climate and carbon-related risks to the underlying investment portfolios of member funds. LAPFF members are interested in investment opportunities afforded by a low-carbon future which increase asset diversification and provide long-term returns. When engaging, LAPFF encourages companies to align their business models with a 2°C scenario to push for an orderly carbon transition.

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About Carbon Tracker

The Carbon Tracker Initiative is a team of financial specialists making climate risk real in today's financial markets. Our research to date on unburnable carbon and stranded assets has started a new debate on how to align the financial system with the energy transition to a low carbon future.

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Endnotes

[1] http://www.carbontracker.org/report/lost_in_transition/
[2] http://www.lapfforum.org/news/files/LAPFFWelcomesBPAGMClimateDecision5thFeb2015.pdf
[3] http://www.lapfforum.org/news/lapff-welcomes-shell-support-for-2018aiming-for-a2019-climate-resolution
[4] http://www.lapfforum.org/news/files/ShellPlcBoardResponsetoAimingforAAGMResolution29Jan.pdf
[5] http://www.carbontracker.org/report/stranded-assets-danger-zone/
[6] http://www.rystadenergy.com/Databases/UCube. Rystad is an energy consultant and its UCube database provides economic models of oil and gas projects. Carbon Tracker uses these to create cost curves and calculate valuations
[7] http://www.lapfforum.org/members-folder/voting-alerts-1/2015/copy_of_2015_Chevron_Voting_Alert.pdf
[8] http://www.carbontracker.org/report/stranded-assets-danger-zone/
[9] LNG is gas that has been super-cooled and compressed so it can be transported by tanker rather than pipeline. It needs to be regasified at its final destination.
[10] We use Royal Dutch Shell rather than BP due to the latter's collapse following the Macondo disaster. The S&P 500 was used rather than the FTSE 100 due to the latter's heavy weighting to the oil and financial sectors.
[11] http://www.guinnessfunds.com/wp-content/uploads/2014/06/2014.06-Return-of-returns.pdf
[12] http://cdn.exxonmobil.com/~/media/global/files/financial-review/2015_exxonmobil_financial_and_operating_review.pdf
[13] Bloomberg,http://newsletters.briefs.blpprofessional.com/document/WGzNMHmbu8tHi5vcseIzJQ--_9ez1nawflmtz90epbc

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