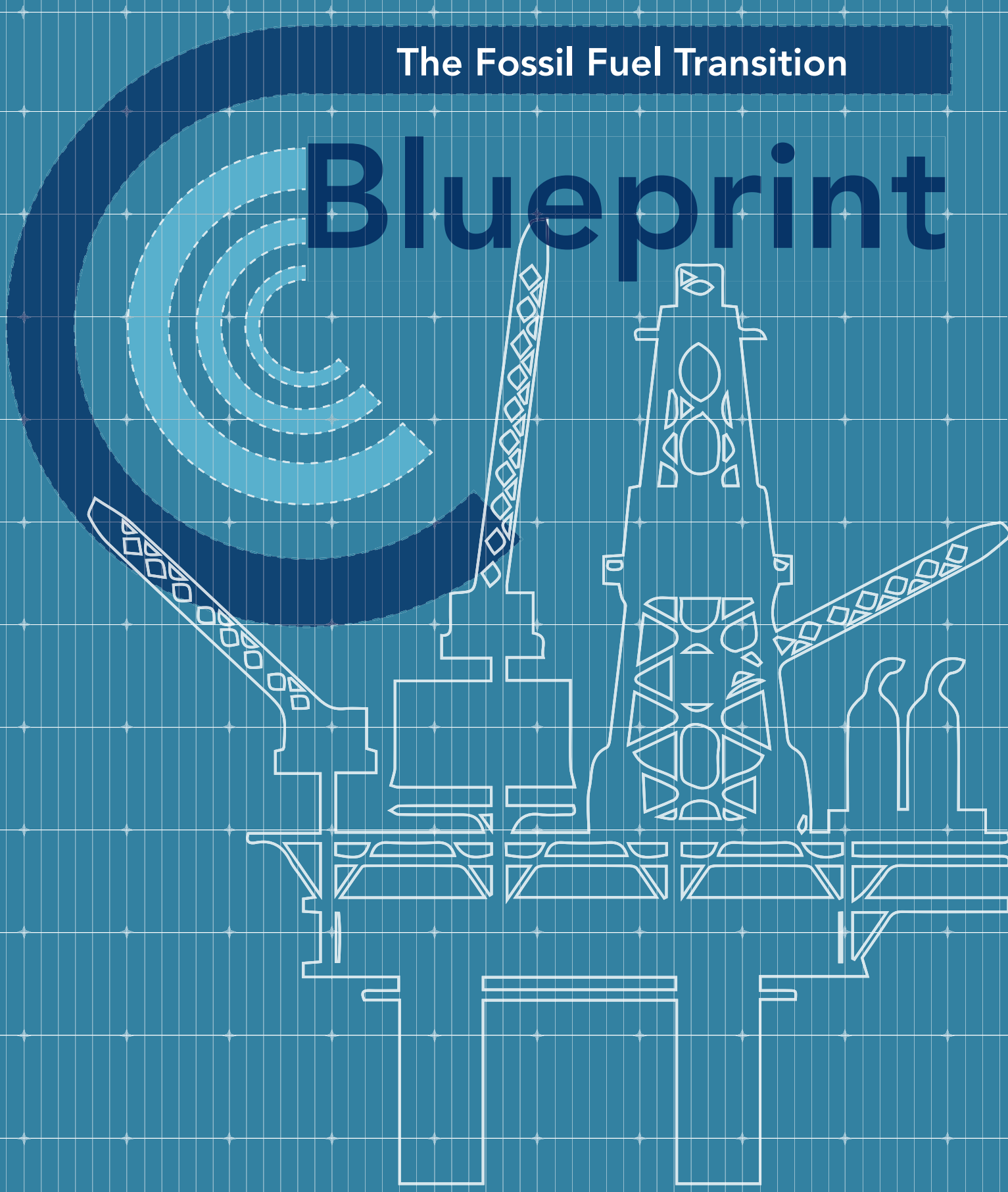
The Fossil Fuel Transition

Blueprint



Carbon Tracker Initiative

Energy Transition Advisors
ETA

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.

You can download this report from:

http://www.carbontracker.org/report/companyblueprint/

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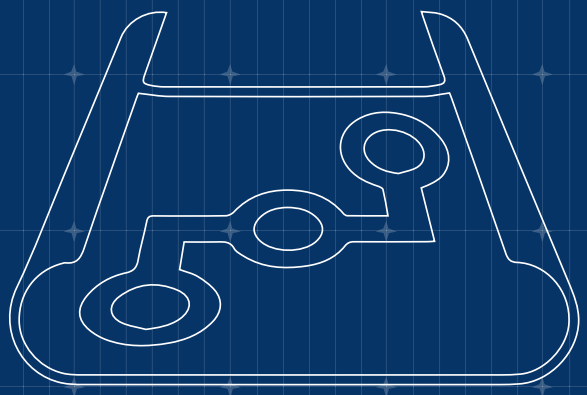
Context: The Blueprint Series

The Fossil Fuel Transition Blueprint Series



Carbon Tracker is developing a transition road map for the fossil fuel industry (the "Blueprint Series"). This will outline the steps we believe that the industry and individual companies will need to take to adapt their business practices and models to move down a trajectory consistent with an energy transition that delivers a climate secure global energy system.

We launch this series with a document looking at the framework for hard wiring the necessary risk management and associated governance procedures into the decision making processes of companies to manage climate risk, preserve value and manage the transition. Our focus is primarily on how demand could be disrupted by climate regulation, emerging clean technologies, efficiency and economic assumptions and flow on to commodity prices. These changes could manifest themselves in either an orderly or a disorderly manner. Governance processes within companies need to be fit for purpose to manage these risks however they manifest.

Further documents in the series will also be designed specifically for investors and regulators concerned with transparency. These will help them understand more fully these risks and the specific steps they should be requiring the companies they own or regulate to incorporate into their governance structure to manage risks.

The goal of the series is to provide a signposted roadmap to test the progress of companies towards being able to cope with a more climate secure global energy system consistent with the 2°C budget. This will be a critical tool for shareholders in their engagement with companies around climate risk.

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Content

Managing corporate risk from an energy transition: an oil and gas focus

Focusing on higher internal rates of return (IRR) - lower cost projects reduces risk for companies and shareholders. It might also create additional value by improving stock ratings should historic return/rating relationships persist.

In our view, fossil fuel companies and their shareholders are exposed to the following key risks associated with climate change.

- **Commodity Price risk:**
  What is the risk to the value of existing company reserves in a 'low carbon' scenario for demand where commodity prices are likely to be lower but certainly more volatile?

- **Demand/Volume risk:**
  What is the relative exposure to future high cost, high carbon developments that may prove unnecessary and hence sub-commercial in a 'lower carbon' scenario?

- **Capital allocation risk:**
  Is there sufficient flexibility within existing capital budgets to avoid pressure on shareholder dividends and employee levels in a 'lower carbon', low price scenario?

- **Management risk:**
  Are management and shareholder interests aligned correctly for a 'low carbon' scenario, which would likely require a low/no growth investment strategy?

Carbon Tracker believes that fossil fuel management are overly focused on demand and price scenarios that assume business as usual and so there may be a risk assessment 'gap' between a management's view of the future and that which would result from action on climate change, technology developments and changing economic assumptions.

Critically, the greatest impact will likely be felt not in reduced volumes in the short term, but in the consequent pressure on commodity prices caused by lower-than-anticipated demand.

The major fossil fuel companies need a risk assessment approach that encompasses the risks from an energy transition. This should include:

- Scenarios that look at demand pathways that differ from Business As Usual, including the IEA New Policies Scenario and 450PPM/2Degrees Scenario.
- Planning assumptions including commodity price assumptions/scenarios and hurdle rates. These can differ from IEA price assumptions even if based upon the IEA's demand scenarios, depending on supply assumptions.
- Key indicators for the future project portfolio such as net present value (NPV), internal rates of return (IRR) and breakeven price curves.
- An indication of cash flow at risk from commodity price changes, expressed as an NPV for example.
- A discussion of the degree of flexibility within the group's committed and uncommitted capital investment program over the next five years.

Providing disclosure of these elements would then allow investors to determine whether they were comfortable with the company's energy transition risk assessment.

Bringing these aspects together, we set out a "checklist" to consider when evaluating whether a company can respond well to an energy transition:

☑ **Does management accept climate science?** Most fossil fuel companies do, but some disclosures imply continued debate on this issue - that alone is a red flag. Companies should assess whether mitigation action could occur within their planning timeframe and utilized current information regarding changes in low-carbon technologies and the potential for energy efficiency.

☑ **Has management assessed the probability and scale of risks?** Here, risk-weighted probability analysis is essential - revealing those probabilities is critical for investors.

☑ **Is the company strategy able to cope with an energy transition?** A focus on climate-related regulation is too narrow; companies must consider the combined implications of energy efficiency, technological change, and the robustness of their economic assumptions as well.

☑ **Are company hurdle rates commensurate with the risks faced?** An energy transition poses greater risks to fossil fuel companies - hurdle rates should reflect that risk premium and companies should identify those rates so investors can get a sense of the level of risk being taken on. We believe this metric, more than any other, is critical for investors to understand.

☑ **Is the board's compensation policy aligned with shareholder value?** We believe that compensation performance metrics should de-emphasise any form of volume related metrics (including 'stealth' volume measures) and emphasise those that matter most to shareholders. We would include Total Shareholder Return (TSR) relative to peers, relative Return on Capital Employed (ROCE), and other metrics that value lower costs. (These are all found in many current compensation policies.) Such metrics would enable companies to compensate managers even in a low-growth context.

☑ **Is the company planning process and governance structure fit for purpose?** Companies must ensure they follow both a top-down and bottom-up approach to addressing risks. It's the interaction of these governance and business processes in relation to the energy transition that is crucial to our blueprint.

☑ **Are energy transition risks considered by all relevant committees and business units?** Planning and strategy, development and investment groups must be familiar with the company's risk weighted scenario analysis and its implications for project sanction. Here we highlight the role of the Chief Finance Officer (CFO). When put in the context of capital management as discussed below, we believe the CFO should play an important role – if not deciding – in the final investment/capital expenditure decision.

☑ **Does the company's risk management approach flow from the board through the investment planning process?** Energy transition risks must be properly considered by every committee - not just the public policy committee. Just as audit committee members need the proper expertise to perform their functions, boards should ensure that they have the necessary expertise to consider climate-related risks. Nominating committees should consider this when selecting new board members, non executives and executives.

Shareholders will only be protected from the business effects of an energy transition if management address the risks from climate change and take action to mitigate them. In this respect, climate change should be treated no differently from other industry risks including such as safety, cost overruns, project delays, potential political change and fiscal uncertainty.

Such an approach would give investors (and the board) a better indication of how well placed a company's business model and project portfolio is to cope with an energy transition. Indeed, investors are already calling for this information. The Institutional Investors Group on Climate Change (IIGCC), Ceres' Investor Network on Climate Risk (INCR), the Investor Group on Climate Change, (IGCC) and the Asia Investor Group on Climate Change (AIGCC) have published investor expectations on fossil fuel company strategy in the face of these risks (the "Investor Expectations" document[1]).

Taking these steps will help put any company on a more climate-secure footing and likely result in one of two types of business responses.

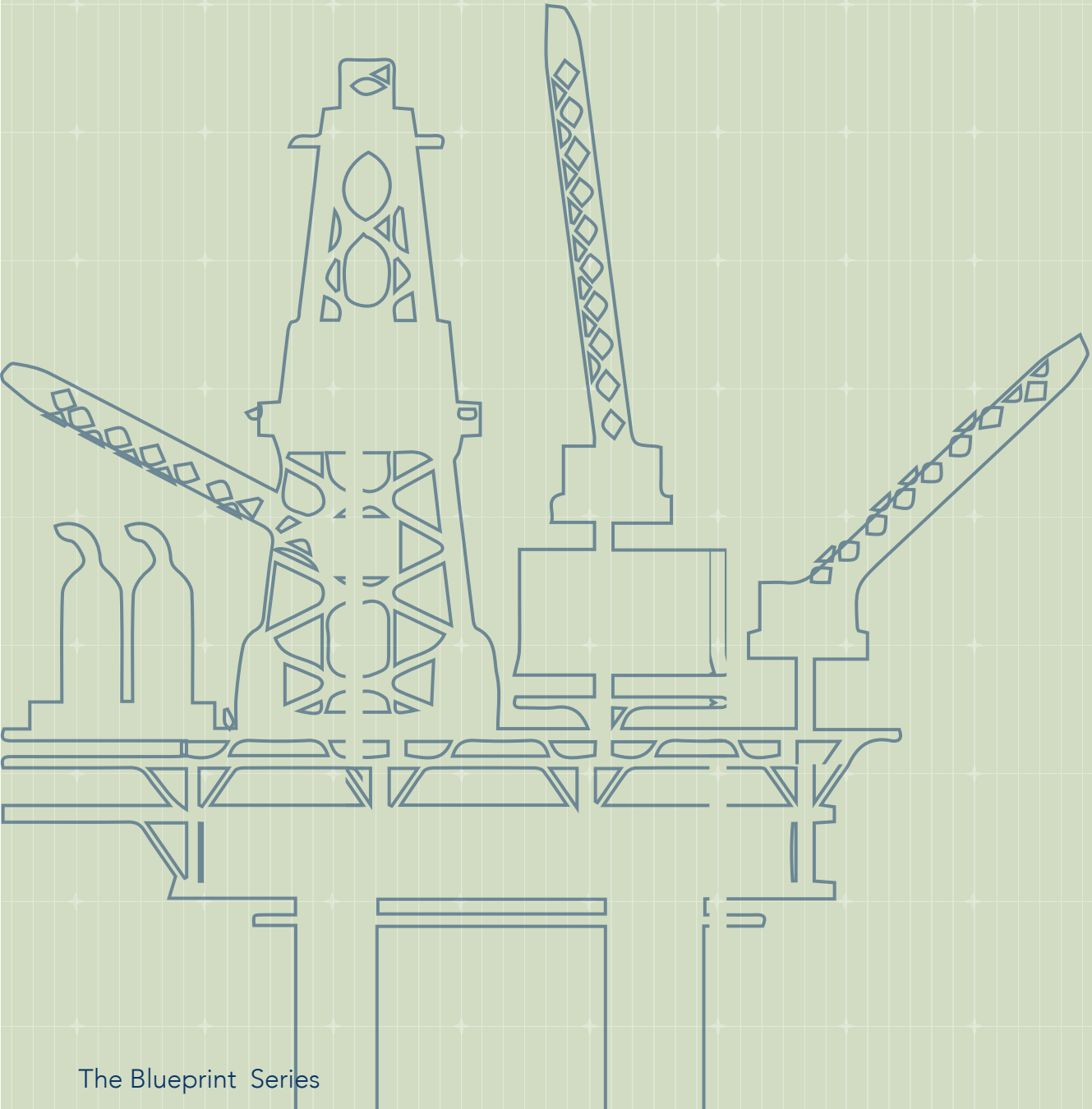
1 See, http://www.iigcc.org/files/publication-files/2014_Investor_Expectations_Oil_and_Gas_Company_Strategy.pdf

Two key Strategies:

Capital Management is a crucial function. By being more disciplined, group returns should be improved and capital is freed up. Forgone capital expenditure can be used to increase shareholder cash returns – buybacks if management believes that the company is undervalued, dividends if not. One further advantage of buybacks is that they can be "turned off" should an "unlikely" oil price scenario arise. This gives companies financial flexibility and hence helps protect ordinary dividends, reduces the need for panic asset sales and major reductions in staff numbers.

Another strategic route that has been and is being tried by many companies is to diversify towards other industries in their comfort zone.

For Carbon Tracker, the issue with diversification to lower carbon sources is whether it is clearly articulated, believable, planned out, has metrics that can be measured, and generates acceptable returns to investors.



1.

Creating shareholder value by lowering risk and boosting returns

Over the past 4 years, the Carbon Tracker Initiative (CTI) has examined the risks to the fossil fuel industry that would result from action on climate change and evolving trends in energy efficiency, alternative energy trends and economic forecasts - in other words, an "energy transition".

Many fossil fuel companies acknowledge both the threat posed by climate change and the energy transition needed to mitigate that threat. But beyond this nominal acknowledgement, it is less clear how that threat has trickled through company governance, executive planning, forecasting and strategy, the overall business plan and the annual investment decisions. As analysts, Carbon Tracker recognizes the significant changes needed to transform global energy consumption patterns. However, acknowledging climate change also means recognizing the consequences society will face if it continues on its current course, primarily because those consequences suggest the magnitude of the foreseeable mitigation response. From a risk management perspective, companies should consider the financial implications of such a response.

Carbon Tracker's focus is and has always been on the financial implications of an energy transition on the fossil fuel sector. Critics in the industry have sometimes portrayed the Carbon Tracker analysis as volume focused. We beg to differ – our starting point has always been value. The overarching theme of all Carbon Tracker recommendations has been to improve shareholder value whilst lowering risk. Volume decisions may fall out of that analysis but these are always value related.

The key foundation of Carbon Tracker's research is that companies need to pursue capital discipline, focusing investment on high return projects and limiting exposure to low return projects. This is hardly an earth-shattering strategy. Indeed, it is a rare company that does not 'claim' to be disciplined with its investment in this manner. However, Carbon Tracker believes that some corporate investment decisions, which it views as high cost, call some company claims of capital discipline in to question. But putting that aside, it is obvious that greater discipline is needed in a transition scenario than under business as usual ("BAU").

Ignoring such risks and continuing with a BAU investment strategy that includes investment in high cost assets may risk shareholder value. High cost assets need high oil prices and, by implication, rising demand to achieve targeted returns. Such investments, by definition, are also more sensitive to price volatility due to operational gearing. This adds more risk to the company development portfolio and puts shareholder value at greater risk.

We believe that the fossil fuel industry has a history of failing to assess risks (e.g. price, cost, delivery date, tax) correctly. There are many examples in the past decade of investment decisions by fossil fuel companies that have not met targeted returns due to risk scenarios that were considered 'highly unlikely'. For the oil industry, examples that spring to mind are the infamous Kashagan project and recent oil sand developments. The recent wave of capex cuts for 2015 and ENI's 30% cut to its dividend implies the industry was not ready for a scenario of $60 oil. For coal, Peabody Coal's near $1bn asset write-downs for 2012 suggests another "highly unlikely" scenario that was not planned for or anticipated.

An additional, more subtle potential threat to shareholder value from a BAU investment strategy is market rating. The oil industry has been materially de-rated over the past decade: the US coal industry has been similarly de-rated over the past five. For coal, the culprit was price weakness – often the result of a weaker than anticipated demand scenario. For oil, Carbon Tracker believes the culprit was lower returns despite high prices caused by (in order of importance) a rise in capital intensity, higher operating costs and higher taxation. (See CTI's Exxon report.)[2]

Logically, one would expect companies with higher returns to deserve higher stock market ratings. For example, a company that can generate $2 of NPV for each $1 of investment should be more attractive than one that generates $1.25. Indeed, a study by Guinness Funds in June 2014 showed a strong correlation between return on capital and company price to book multiples for the oil sector.[3] Although return on capital employed (ROCE) is not the same as internal rate of return (IRR), companies that invest in high IRR projects should have higher return on capital employed (ROCE). The study showed that the average ROCE for the oil majors fell from 25% in 2008 to 15% in 2013. Over the same period, the price-to-book multiple for the sector roughly halved.

Carbon Tracker's top-down view is that industry base demand projections are likely to prove optimistic and that the risks lie to the downside. Accordingly, it is likely that the risks to their planning assumptions for fossil fuel prices will be biased to the downside. (See further discussion below – Mind the Gap.)

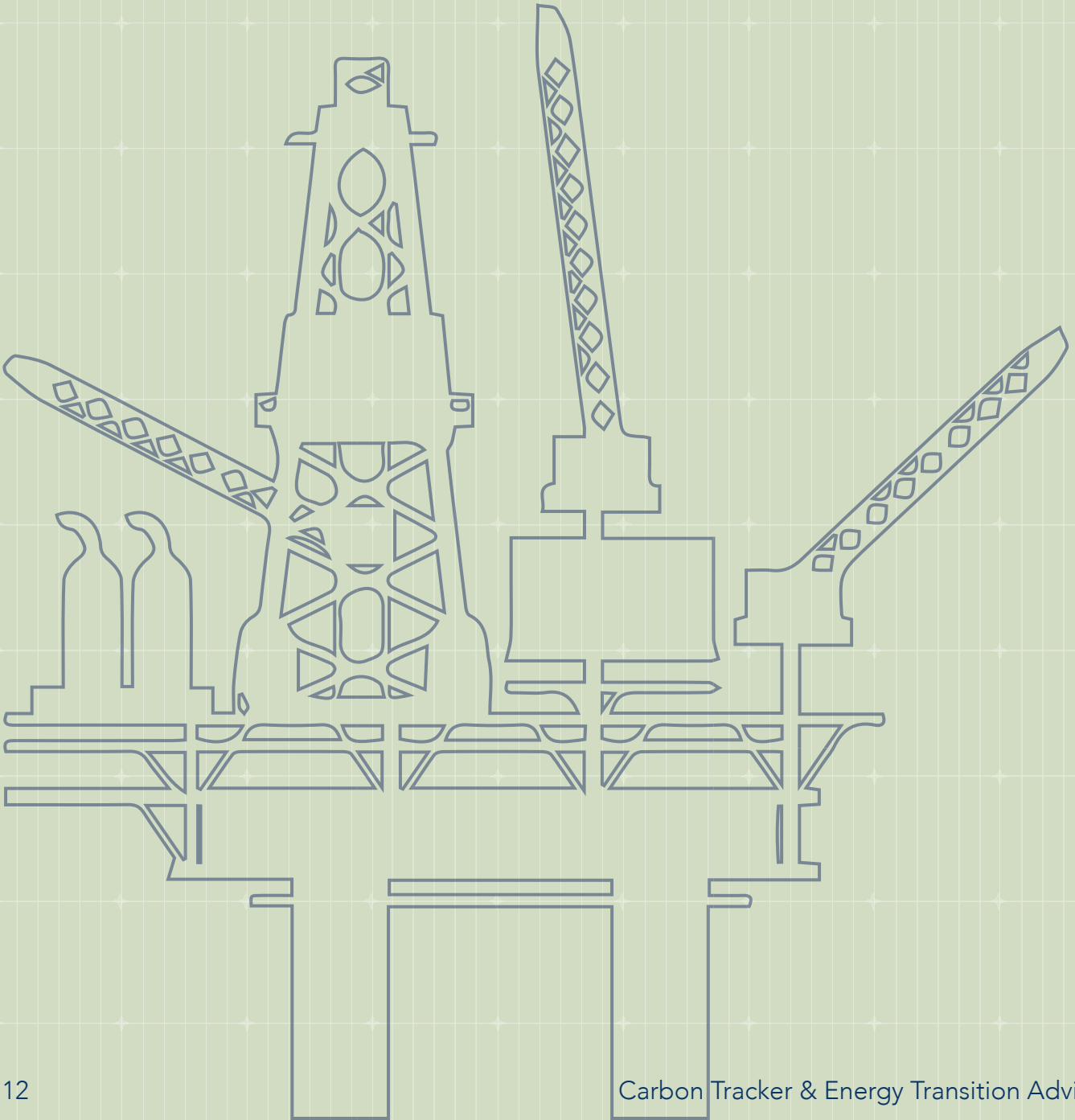
Should a price scenario emerge that is materially below company base planning assumptions (as has already happened in 2015), shareholders might have been better served if management had focused on high return, low cost assets and curtailed investment in low return projects. This would have enabled companies to retain financial flexibility.

2 http://www.carbontracker.org/wp-content/uploads/2014/09/Exxonresponse-Full-110914.pdf
3 Guinness Funds, June 2014. http://www.guinnessfunds.com/wp-content/uploads/2014/06/2014.06-Return-of-returns.pdf

After all, the normal industry reaction to weak prices of cutting dividends, slashing capital spending and selling assets in a weak market is hardly a recipe for shareholder satisfaction. Slashing dividends in particular is anathema to pension funds, especially given the weighting of the oil industry in world markets. Cutting staff, also a common reaction, is not likely to improve employee morale and performance.

A Key Conclusion:

Focusing on higher IRR - lower cost projects reduces risk for companies and shareholders. It might also create additional value by improving stock ratings should historic return/rating relationships persist.



2.

Climate/economic risk management - Good governance

Many of the ideas that Carbon Tracker has expressed in its research can be used to create a framework for assessing economic and climate related risk in order to reduce the threat to shareholder value.

We believe company management has a duty to shareholders to assess all risks, including climate change scenarios (such as IEA NPS, further technology changes, downside to economic assumptions and indeed 2DS) that may pose a risk to the business. It is very important, in Carbon Tracker's view, that management assesses the potential impact of these scenarios, especially if it regards them as "unlikely". After all, "unlikely" scenarios (such as the halving of the oil price in twelve months) can have a material impact on value. We also believe that prudent management should have blueprints to cope with "unlikely scenarios" – something the banking industry clearly did not have in place in for the last banking crisis. Most businesses, including fossil fuel companies, have business models that can cope with minor movements in external variables, such as prices and costs. However, coping with events that the industry might classify as so-called 'black swans' such as a sudden move to cap global emissions is harder and pre-planning for such events seems sensible to Carbon Tracker.

From a shareholder perspective, we believe it is important that the industry planning process should be transparent. This would help shareholders understand whether management is assessing the potential probabilities and impacts of all risks. It is important that shareholders can see if the risk assessment process has been undertaken with due diligence.

In our view, fossil fuel companies and their shareholders are exposed to the following key risks associated with climate change.

- **Commodity Price risk:** What is the risk to the value of existing company reserves in a 'low carbon' scenario for demand where commodity prices are likely to be lower but certainly more volatile?

- **Demand/Volume risk:** What is the relative exposure to future high cost, high carbon developments that may prove unnecessary and hence sub-commercial in a 'lower carbon' scenario?

- **Capital allocation risk:** Is there sufficient flexibility within existing capital budgets to avoid pressure on shareholder dividends in a 'lower carbon', low price scenario?

- **Management risk:** Are management and shareholder interests aligned correctly for a 'low carbon' scenario that would likely require a low/no growth investment strategy?

Risk Assessment – Mind the Gap

Carbon Tracker believes that fossil fuel management are overly focused on demand and price scenarios that assume business as usual and so there may be a risk assessment 'gap' between a management's view of the future and that which would result from action on climate change, technology developments and economic assumptions.

The industry reaction to Carbon Tracker's analysis suggests that it believes the probability of a 2DS scenario is very low (even non-existent) and therefore does not need to be considered. Exxon commented that it is "highly unlikely"[4]. Shell commented "[we] also do not see governments taking the steps now that are consistent with a 2DS scenario".[5] But by not even considering a 2DS scenario (or other transition scenarios that could lead to 2DS) for planning purposes, companies are failing to assess a potential risk.

4 See Exxon's "Energy and Carbon – managing the risk." http://cdn.exxonmobil.com/~/media/Files/Other/2014/Report%20-%20Energy%20and%20Carbon%20-%20Managing%20the%20Risks.pdf

5 See Shell response letter 16 May 2014. http://s02.static-shell.com/content/dam/shell-new/local/corporate/corporate/downloads/pdf/investor/presentations/2014/sri-web-response-climate-change-may14.pdf

The discussion of IEA New Policies Scenario (NPS) is more complex. Many oil and gas companies run their own versions of this. However when we look at company comments and in particular the demand forecasts for oil that they publish as their baseline, then these are above IEA assumptions. Indeed some in the oil industry appear to be placing emphasis on coal as the main problem and so assuming that coal demand will undershoot the IEA forecast. Naturally, this leaves more room for oil and gas in any emissions budget. Further, we believe that technology advances in alternative energy and efficiency can drive NPS lower. *See appendix 1*.

We further note that the IEA scenarios themselves contain commodity price assumptions. These rest on the complex interaction of supply and demand features. Demand forecasts do not mean that associated price forecasts have to be taken as given. For instance how a key supplier of the market like Saudi Arabia responds to demand and other supply factors will have a huge impact on price. Hence not only demand assumptions and their drivers need to be made transparent by companies but key supply side features that drive their price assumptions.

Looking at other aspects including disclosure, Royal Dutch Shell's 2013 report and accounts comments that "Rising climate change concerns could lead to additional regulatory measures that may result in project delays and higher costs"[6] Exxon's report on climate change says something very similar.[7] What is more worrying, in Carbon Tracker's view, is the narrow focus on costs as the only issue that results from such regulation – any impact on price is ignored by both. At least Exxon accepts that action on climate change may affect demand but does not mention any consequent effect on prices. But as Carbon Tracker's supply cost analysis concluded[8], the greatest risk from action on climate change is price, something totally missing from the climate change section of both reports. (Commodity price risks are typically identified in risk factor disclosures but not linked to climate change).

Another weakness in Shell and Exxon's reports is the lack of any assessment of the possible impact on shareholder value from the stated risks. One would hope that any coherent planning process undertaken ahead of potential investment would look at various price and cost scenarios and assess their likely economic impact. Certainly, we would argue that management is in a far better position to assess the value implications of the detailed risks than their shareholders are. Failing to provide even a qualitative indication of the scale of various risks does investors a disservice.

In the Carbon Supply Curves: Evaluating Financial Risk to Capital Expenditures, Carbon Tracker identified capital expenditures at the high end of the cost curve that could become "wasted" as the key quantitative measure.

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6 http://reports.shell.com/annual-report/2013/strategic-report/our-businesses/risk-factors.php
7 http://corporate.exxonmobil.com/en/environment/climate-change/managing-climate-change-risks/risk-factors
8 http://www.carbontracker.org/wp-content/uploads/2014/09/CTI-Oil-Report-Oil-May-2014-13-05.pdf

A key conclusion: The major fossil fuel companies need a risk assessment approach that encompasses the risks from an energy transition.

This should include:

- Scenarios that look at demand pathways that differ from Business As Usual, including the IEA New Policies Scenario and 450PPM/2Degrees Scenario.
- Planning assumptions including commodity price assumptions/scenarios and hurdle rates. These can differ from IEA price assumptions even if based upon the IEA's demand scenarios, depending on supply assumptions.
- Key indicators for the future project portfolio such as net present value (NPV), internal rates of return (IRR) and breakeven price curves.
- An indication of cash flow at risk from commodity price changes, expressed as an NPV for example.
- A discussion of the degree of flexibility within the groups committed and uncommitted capital investment program over the next five years.

This would better allow company management and boards and so investors to judge whether they are comfortable with management's risk assessment.

We now turn to this in more detail.

3.

Risk management checklist and corporate governance

From a corporate and investor perspective, it is important that management identify risks and assess their potential scale and develop strategies to deal with them, no matter how remote their probability appears. This section looks at key risks relating to the energy transition. Some build on elements we have discussed earlier. In addition, these elements align with the issues identified by shareholders who have focused on carbon asset risk through their Investor Expectations document.[9] The Investor Expectations document identifies five primary areas where oil and gas companies must address investor expectations; our checklist takes a deeper look at elements of three of them:

1. **Governance:** Clearly define board and management governance processes to ensure adequate oversight of climate change risk and the strategic implications of a transition to low carbon energy systems.

2. **Strategy:** Integrate the management of climate change risks and opportunities into business strategy and ensure business models are robust and resilient in the face of a range of energy demand scenarios through appropriate stress testing.

3. **Implementation:** Embed 'stress testing' within key business processes and investment decisions.

9 http://www.iigcc.org/publications/publication/investor-expectations-oil-and-gas-company-strategy

Finally, it is worth noting that some of the governance issues apply just as much to other risks facing many businesses.

1 Does management accept climate science?

Most fossil fuel companies accept the science behind climate change, at least on paper. So this is a particularly difficult test to fail. But acknowledging the science of climate change is an easy step. Whether it is taken in to account in planning is a more acid test.

2 Does management accept that action to tackle climate change could emerge within its planning timeframe? Has it taken into account efficiency gains and technology changes sufficiently?

A common comment from the oil majors in particular is that climate change is real but governments will not take action within its planning time frame (of 10-15 years) and so they needn't worry about it. This view should be seen as a warning sign. As we have seen in oil and other industries, change can take place far faster than the industry believes. Examples include lower sulphur limits in diesel and petrol, the phase out of lead in petrol, tougher fuel standards for cars and efficiency gains in fuel consumption. The same is true in competitor industries, especially photovoltaics. A board in denial is unlikely to be well placed to cope with change should it arrive.

We are not saying that boards should plan solely on a low carbon scenario. But Carbon Tracker believes that it would be prudent to start with a base planning assumption similar to NPS rather than BAU. And planning scenarios should include 2DS and the possibility that technological changes and government measures could cause demand to undershoot NPS. That some in the industry see such scenarios as unlikely is no reason for management not to assess associated risks, even if only on a qualitative basis. We suspect that more damage has been done to shareholder value from 5% tail-end scenarios than the central planning scenario. After all, an 'unlikely' risk such as the collapse in oil prices in 2014 that destroyed 20-50% of some companies' market capitalization needs more time spent on it than the 90% central assumption that has no impact.

Investors should be able to see if their board (i) accepts action on climate is a risk within the planning time frame (ii) has assessed the risks and potential damage of such a change and (iii) has an action plan to cope with such changes. The comments about climate change in the Exxon and Shell risk reports highlighting higher costs and ignoring potential demand and price effects are an excellent example of carbon myopia. Failure of management to address this then calls into question its readiness to protect shareholder value.

3 Has management assessed the probability and scale of risks?

We have already commented on how the Shell and Exxon risk reports offer little to help shareholders understand the scale and probability of any risks to the businesses they own. It would be helpful if companies identify the probability of various energy transition scenarios so investors that are concerned about the threat of an energy transition to their investment can determine whether they have an appetite for that level of risk.

4 Is the company strategy able to cope with an energy transition?

As we point out, it is not just "climate change" but gains in efficiency, new technologies and uncertainties on very bullish economic growth assumptions that companies have to think about in terms of an overall energy transition.

There are many examples in the world of industries that failed to cope with change – the oft-cited ones are cellulose film and the US railway industry. Lack of growth does not necessarily mean lack of shareholder returns. Is fossil fuel management willing to consider a harvesting strategy – collecting cash flow from projects and returning more of it to shareholders? Sadly, the opposite has been true for most of the oil majors over the past ten years. Capex has grown far faster than shareholder payouts – and the reward to shareholders for that strategy seems to have been a material de-rating.

For those companies unwilling to go the harvest route, a strategy that emphasized natural gas over oil would be reassuring. Investment in alternative energy, preferably with a partner who understands those businesses, might also be reassuring. (See discussion on Diversification below.)

5 Are company hurdle rates commensurate with the risks faced?

Another key issue to consider for the CFO is hurdle rates on investments (We return to this important issue in the planning discussion). Fossil fuel companies are notoriously coy about hurdle rates, often seeing them as financially sensitive. But if these are not revealed, how can investors distinguish between possible alternative investments? Clearly a company with a 15% hurdle rate is likely to be lower risk and possibly more highly rated than one with a 10% target.

Should such hurdles not be revealed, investors may need to fall back to looking at past investment decisions. A clear signal of failure is an asset write-down – a potential useful barometer for investors could be asset write-downs as a percentage of capital employed. The data for such a measure is (or should be) in the public domain. But companies are in the best position to provide and comment on it. Perhaps they should.

Other sources of return data for past projects include external data providers including Wood Mackenzie, IHS Cera, and Rystad. Such data are not easily available to most investors due to cost. But many sell side firms have access to it and we believe that institutional investors could legitimately ask such firms to provide return data for projects sanctioned historically. This would at least enable investors to rank past management decisions.

The choice of a hurdle rate is a role for management but it needs to be commensurate with the risks the industry face. However, in Carbon Tracker's view potential future changes in the energy matrix, increased volatility in commodity prices and increased pressure from governments (taxes and regulation) and service providers has already increased industry risk. Moves towards an energy transition can only increase price risk and volatility further. The risks are probably greatest for coal and least for gas but all face demand profiles below the "business as usual" central planning assumption most companies appear to use.

A simple metric that investors and companies alike can use as an acid test for management behavior is break-even prices. These are dependent on the hurdle rate assumed (as well as non-price assumptions such as costs) and are a useful surrogate for project IRRs. A project with a high breakeven price will normally have a low IRR and so should be considered as high risk. Companies can easily derive a return (IRR) or breakeven cost curve, which would show projects ranking them by breakeven prices or IRRs (see Appendix 3 for further discussion of valuation metrics). By focusing investment on projects with above average returns (or low breakeven prices), oil companies would lower investor risks. Such an approach should lead to a higher group return on capital and likely improving stock market rating. (Statoil published just such a cost curve in September 2012 on a trip to Brazil.[10])

6 Is the board's compensation policy aligned with shareholder value?

Compensation metrics should ensure that the interests of management are aligned with those of shareholders. Measures should encourage appropriate risk-weighted investment decisions that protect shareholder value. They should also encourage prudent financial management and capital allocation so that cash returns to investors are not needlessly threatened.

10 Statoil: See slide 8: http://www.statoil.com/no/InvestorCentre/Presentations/2012/Downloads/1Brazil_CFO_Sept2012.pdf

This also protects employee interests, improving morale and hence performance. From an energy transition perspective, it would seem prudent that remuneration targets should favor value not volume. (This should be true in a business as usual scenario as well.)

Some companies have a few performance-based compensation metrics that are based on volume, typically reserve replacement ratio. In our view, this should have no role in compensation as it is not a value measure. Replacing reserves at potentially high break-even costs or through expensive acquisitions in the hope of meeting targets is not value-adding. (An extreme example of the outcome of this behavior was Shell's 20% reserve write-down in 2004.) Also, because of the long lag between taking an investment decision and seeing returns from the project, managers can be compensated for replacing reserves today that may not provide economic returns tomorrow. If companies persist in using such volume-related measures, perhaps vesting should be deferred for 10-15 years when the volumes turn in to value.

Investors should also be wary of 'stealth' volume measures masquerading as financial measures. Examples of these include group cash flow and group profit targets. Although costs, an important metric, feed in to this, so does production volume. Just as reserve replacement could encourage financially imprudent behavior, so can these measures unless the remuneration committee is vigilant.

We believe that performance metrics should de-emphasize any form of volume related metrics (including 'stealth' volume measures) and emphasize those that matter most to shareholders. We would include Total Shareholder Return (TSR) relative to peers, relative ROCE, and other metrics that value lower costs. (These are all found in many current compensation policies.) Such metrics would enable companies to compensate managers even in a low-growth context.

7 Is the company planning process and governance structure fit for purpose?

All shareholders need confidence that all risks, including those related to climate change, are addressed properly. They must become embedded in the internal planning process and be supported by a suitable governance structure. Given our earlier "mind the gap" comment, our fear is that some boards merely pay lip service to risk assessments at present. Carbon Tracker believes that establishing and demonstrating the existence of such a governance structure is necessary to reassure shareholders that these strategic risks are being assessed and taken seriously.

While company governance structures may differ, most have boards divided into the following committees: (i) a compensation/ remuneration committee which deals with pay and performance incentives for executives and top level management; (ii) a governance and/or nomination committee that reviews governance, board succession, and conflicts of interest, (iii) a public policy or safety committee, which focuses on important political and social trends and concerns or non-financial risks that may affect the business, (iv) an audit committee, which oversees core financial risks and internal processes for calculating impairments, and (v) an executive committee. Companies need to ensure that every committee with related oversight responsibility properly considers energy transition risks.

Further, at a business level companies will have: i) planning and strategy groups that look at forecasting and generating scenarios ii) a head of development that is concerned with which projects go ahead and ii) an investment committee that agrees on which projects do go ahead.

It's the interaction of these governance and business processes in relation to the energy transition that is crucial to our blueprint.

8 Are energy transition risks considered by all relevant committees and business units?

Public policy and other committees are responsible for considering outside trends and non-financial risks. To properly do so, they must have the capacity to obtain and process relevant third-party information and analysis—the board should not focus exclusively on internal company analysis of non-financial risks. Such analysis would not only involve costs/pricing trends for substitute fuels, but also literature on the costs of climate change. Many companies discuss the allegedly burdensome costs of inaction as a basis for doubting it will happen—against this they should consider the costs of inaction, since it bears upon the range of reasonable policy responses.

The foregoing suggests that such committees need directors with expertise on the nexus of climate change, policy and economics. Nominating committees should consider this as a factor considered in selecting new board members to ensure that it is part of the mix of skills in the boardroom.

And, as discussed above, serious consideration of energy transition risk requires that companies assess the probabilities and consequences of more than their base case scenario. This should be integrated in planning and asset assessments. Where audit committees, for example, consider how asset impairment tests are conducted, they may need to evaluate the risk of lower future pricing from lower demand.[11]

11 See, e.g., http://www.bp.com/content/dam/bp/pdf/investors/BP_Annual_Report_and_Form_20F_2014.pdf

Finally, as discussed in greater detail below, the compensation committee needs to ensure that performance-based compensation accounts for multiple scenarios identified in the company planning process.

9 Does the company's risk management approach flow from the board through the investment planning process?

In addition to governance structure, fossil fuel companies need to have a process in place for addressing risks embedded at the business level. All fossil fuel companies claim to have a risk management system. Companies must ensure, and show investors, that there is a top-down and bottom-up flow of information regarding risks.

From a bottom-up perspective, the business units responsible for strategy and planning should assess micro issues at a project level right through to political and market/macro risks.

The key energy transition risks we see include the demand implications of new technology and government action on fossil fuel use. These demand issues could clearly affect the level of future investment needed as well as the volatility of future fossil fuel prices. Assigning probabilities to scenarios such as those of the IEA is critical.

Once appropriate scenarios have been decided, these need to be passed to the business units responsible for making investment decisions - the investment committee. It is important, in our view, that even scenarios identified as low risk are considered--especially if the potential impact on the business is material. To truly integrate the foregoing into company planning, project development should proceed by modeling not just the likely costs and returns of a given project but also the demand scenarios, developed by planning, under which those projects would or wouldn't be economic. This is a key element and we remain uncertain as to how diligently this is done.

Here we highlight the role of the CFO. When put in the context of capital management as discussed below, we believe the CFO should play an important role – if not deciding – in the final investment/capital expenditure decision.

Indeed many decisions by executive management, overseen by non-executives, need to take these risks in to account, no matter how unlikely they may seem. It is worth reiterating that it is the events that management sees as low probability that can cause most damage. Having said that, the risks we are most concerned they take seriously – the growing impact of climate policies in IEA NPS and the potential for greater efficiency and technology shifts—are already quite foreseeable.

In conclusion, the planning process could – or should in our view - involve some form of scenario planning with risks and returns being weighted by probability. Simple IRR and DCF calculations with static assumptions (single scenario) do not serve investors or companies well. To capture risks correctly, we believe a more dynamic approach is needed. Techniques cited in management literature include Quantitative Risk Analysis, which calculates the scale and probability of a range of potential losses (and gains). The key difference between these and central case analysis is that they capture – to a lesser or greater extent - probability distributions for different scenarios[12].

From a top-down perspective, the board needs to ensure that business investment planning is aligned with potential macro-trends that could impact the business. At a higher level the Board is critical to addressing long-term issues such as the implications for the business model and diversification. As discussed above, the Board and its committees should play a role in analyzing those trends.

Two Strategic Outcomes:

1. Capital management – shareholder capital returns

In the environment we are describing, the key approach to capital investment is capital discipline--another common industry mantra that often seems to be ignored more than it is respected.

By being more disciplined, group returns are increased and capital is freed up which can be used to increase shareholder returns – buybacks if management believes that the company is undervalued, dividends if not.

From a governance standpoint this becomes critical. The board needs to assess the risks to it business and ensure that it retains sufficient financial flexibility to deal with those risks. An important element of this is to focus on high return assets by ranking projects. Planning assumptions should be conservative and the scale of capital spending should be commensurate with industry risks. By focusing only on high return assets, capital can be freed up. This can be used to reduce debt or returned to shareholders.

2. The role of diversification

Another strategic route that has been and is being tried by many companies is to diversify towards other industries in their comfort zone.

12 A discussion of how Carbon Tracker has approached demand scenarios and how these could be used in a probability weighting approach is contained in Appendix 2. A further discussion of valuation is contained in the Appendix 3 as well.

Some oil and gas companies have discussed becoming "energy companies" that can then look at alternative energy options if they believe they have the expertise (which some do not). For example Lord Browne initiated the "Beyond Petroleum" phase of BP, which was subsequently dropped. More recently, Total and Statoil both have stated strategies to expand in renewable energy, for instance.

Some consider natural gas as part of the energy transition, depending on carbon content, other environmental impacts and where it compliments renewables and can replace coal in particular. Certainly, many companies are expressing this strategy.

Oil and gas companies have a history of diversifying when commodity prices are high. In the past 40 years, some have become mining companies, chicken farmers and salmon farmers (BP); others have looked at the nuclear option (Exxon and Total). Mobil moved into retailing with Montgomery Ward. Many have also looked at alternative energy. The fact that many of these alternative industries are either no longer part of the companies' portfolios or are not material might suggest that the oil majors are not that good at diversifying, or that the market is not good valuing these ventures. But, in a lower carbon scenario, this may be the only 'investment' option open to them. If so, they need to develop the appropriate skills for alternative energy. The alternative for the oil industry would be to manage the decline so that its capital spend is appropriate for a low/falling demand scenario.

Some of the largest listed coal producers are diversified mining companies. They can focus on less carbon intense commodities with better expected returns. Rio Tinto and to some extent BHP have diversified away from thermal coal due to poor returns. This has seen the disposal or restructuring of some assets, and the freezing of capex for new projects. Getting a good price for these assets going forward will be increasingly challenging if coal prices stay low.

For pure coal mining companies there are limited opportunities to diversify. Some US coal mining companies have tried to diversify geographically (e.g. Peabody buying coal assets in Australia). This assumes that the decline of coal is not structural, and that the seaborne trade and coal demand elsewhere will be stronger. The soft seaborne market reflects what many analysts see as the structural decline in coal, exacerbated by recent announcements that Chinese domestic coal demand peaked in 2014, and Indian government intentions to cease coal imports within 2-3 years.[13]

For Carbon Tracker, the issue with diversification to lower carbon sources is whether it is clearly articulated, planned out, has metrics that can be measured, and is believable to investors.

13 http://www.stats.gov.cn/english/PressRelease/201502/t20150228_687439.html
http://www.india.com/news/india/piyush-goyal-thermal-coal-imports-may-stop-in-2-3-years-192332/

Appendix 1

Mind the gap - A look of at oil company assumptions on demand compared to the IEA

Many oil companies produce a range of scenarios for fossil fuel emissions alongside their own business forecasts for demand. Within these, we focus on:

1. A forecast of an emissions pathway which includes all sources of carbon together with assumptions about economic growth, alternative energy and efficiency. The balance of the fossil fuel mix relative to the IEA scenarios is also important.
(Note: at present we are working with the IEA scenarios contained in the 2014 World Energy Outlook. New IEA scenarios are expected in June in context of the UNFCCC COP21.)

2. The company "business planning forecast" for oil demand versus the IEA NPS profile.

A number of oil companies produce and publish long-term demand forecasts which, to differing degrees, help form future investment decisions. In this Appendix, we analyze ExxonMobil's forecasts against the latest New Policies Scenario (NPS) from the IEA (their central scenario) as an example of the numerous disparities, which, while not being immediately obvious, are deeply meaningful in understanding the risk-perceptions adopted by the company. It is worth noting that Carbon Tracker sees reasons to believe the IEA NPS could be overly bullish on future oil/fossil fuel demand, not least with regards to the rate of technological progress and energy efficiency gains. Exxon presents all elements of a comparison and so the underlying assumptions are readily accessible. We find:

- Exxon has an emissions pathway that is above IEA NPS until 2035 cumulatively by 18.8BtCO2, equivalent to 49% of annual energy-related emissions in 2040.
- Exxon assumes a shift away from coal significantly larger than IEA NPS and indeed Carbon Tracker's recent work. We see risk to this assumption.
- Exxon's demand forecast for oil is cumulatively 56 million b/d (mb/d) above IEA NPS by 2040 (or 2mb/d on average). By 2040, Exxon's demand

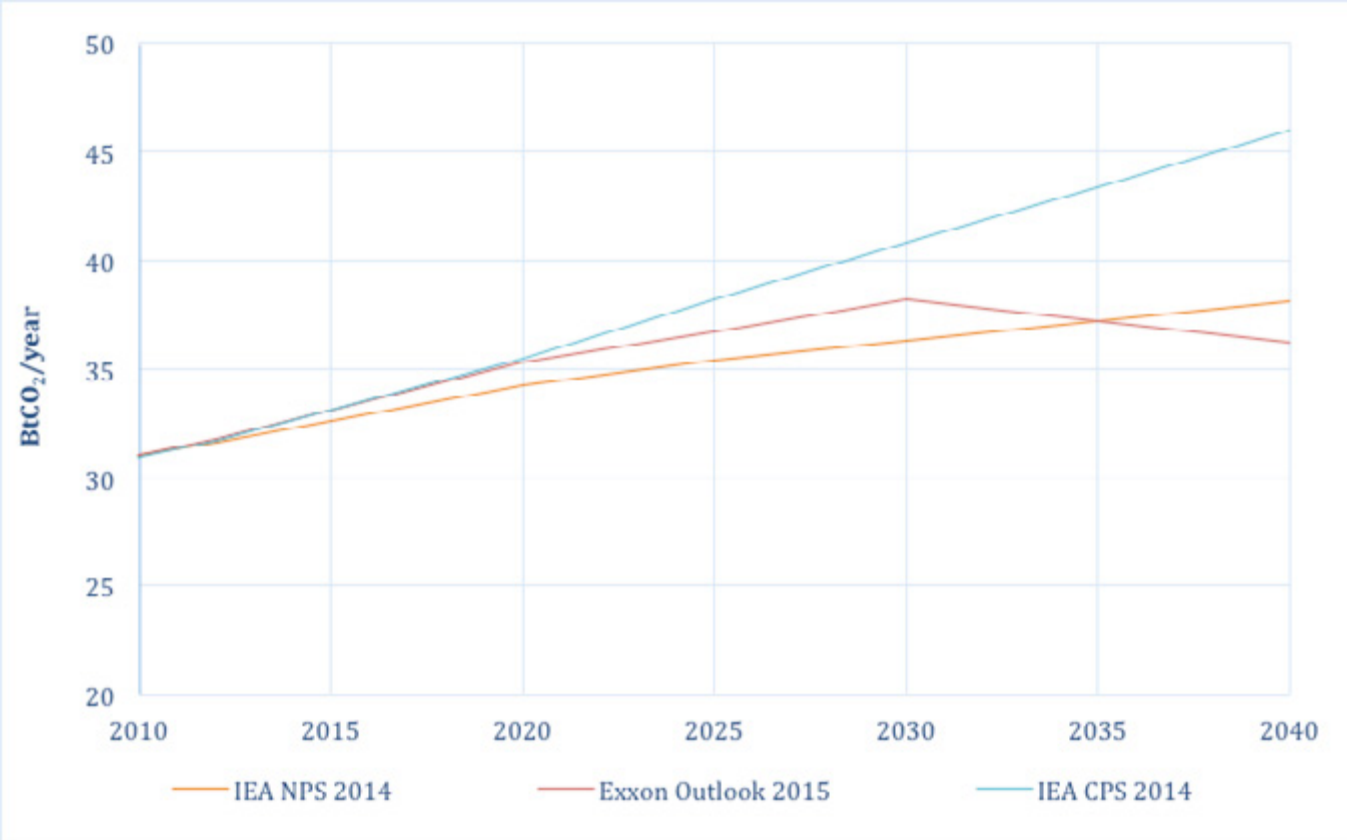
forecast for oil is 6.8% above NPS, a significant difference for planning purposes.

- Exxon's commentary implies a very low probability to anything below IEA NPS, i.e., 450PPM or 2°C.
- We note that the actual price assumptions that emerge from these scenarios can be very different depending on supply assumptions and how key players in the markets – OPEC, Saudi Arabia – approach them. We have not attempted here to address that.

Global carbon dioxide (CO^2) emissions profiles

The level of global energy-related CO^2 emissions forecast for 2040 by ExxonMobil is higher than the IEA NPS.

Figure 1: ExxonMobil's scenario exceeds the NPS CO^2 emissions trajectory



Source: IEA World Energy Outlook 2014; ExxonMobil, 2015, Outlook for Energy; Shell, 2013, New Lens Scenarios[14]

14 http://s01.static-shell.com/content/dam/shell-new/local/corporate/Scenarios/Downloads/Scenarios_newdoc.pdf

Table 1: Cumulative CO^2 emissions compared to IEA NPS

$BTCO^2$	EXXON OUTLOOK 2015	IEA CPS 2014
2010-2020	+4.8	+5.7
2020-2030	+13.9	+29.0
2030-2040	+0.1	+62.9
TOTAL	+18.8	+97.6

ExxonMobil comments that CO^2 emissions will 'rise by about 25% from 2010 to 2030 and then decline approximately 5% to 2040'[15]. This scenario exceeds the NPS by 18.8$BtCO^2$ between 2010 and 2040 cumulatively – a noteworthy disparity given the NPS implies approximately a 3.6°C rise in global temperature. See Table 1.

According to Exxon's forecast, almost all of these excess emissions occur in the next 15 years (their investment horizon runs till 2030). This assumes that short- to medium-term CO^2 emissions are not a priority for governments and so have little impact on demand for fossil fuels over the next 10-15 years. As a result, it appears to assume that investment opportunities over this timeframe will not be significantly hindered.

Digging deeper into what Exxon's forecast comprises in terms of future demand for fossil fuels reveals underlying assumptions that we believe are contestable.

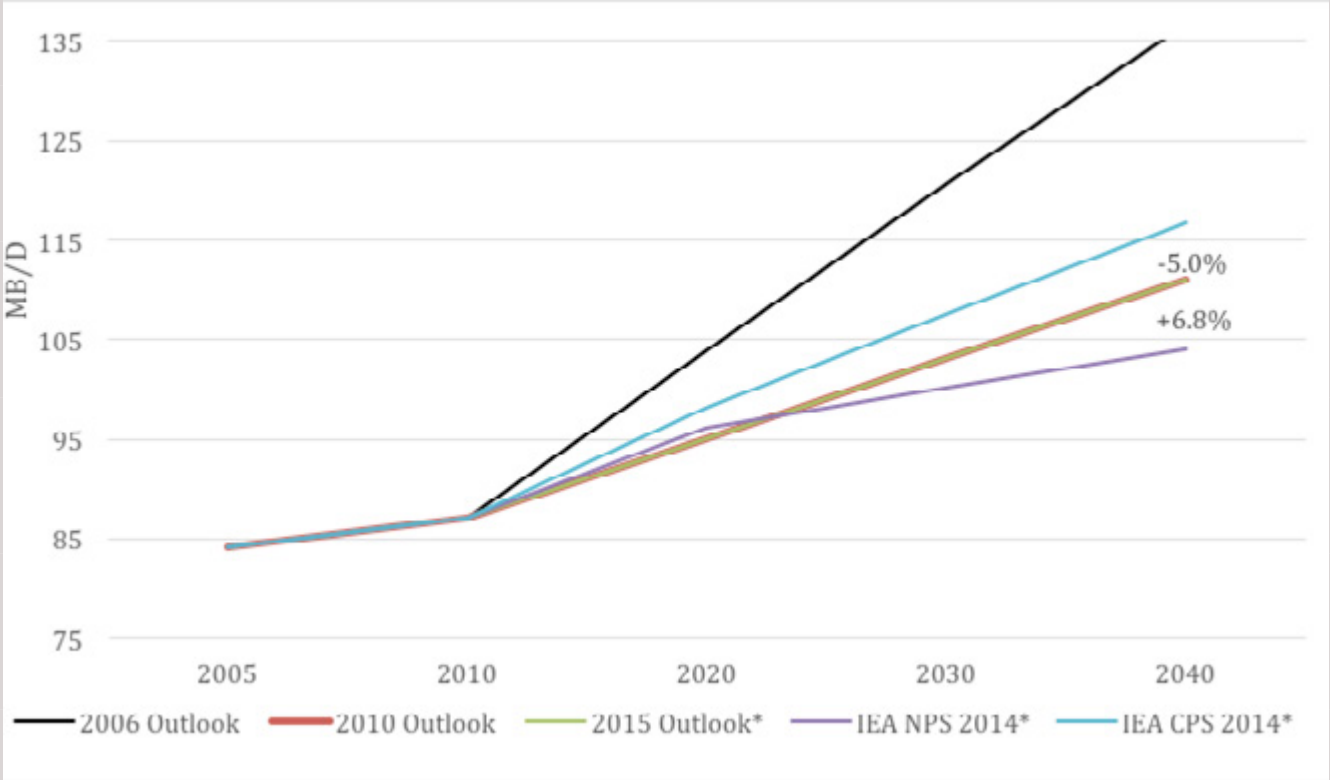
Future oil and coal demand

ExxonMobil states that their demand scenario "provides the foundation for our business and investment planning[16]. Figure 2 below shows how their forecasts for oil demand have changed over time and how that compares to the latest IEA scenarios.

ExxonMobil's 2010 and 2015 outlooks for oil are virtually identical, but it is interesting this has been significantly revised downwards from their 2006 forecast, which - at the time - far exceeded the IEA's 2014 Current Policies scenario. Global prospects for oil are very different now and Exxon acknowledge this.

15 http://cdn.exxonmobil.com/~/media/Reports/Outlook%20For%20Energy/2015/2015-Outlook-for-Energy_print-resolution.pdf
16 http://cdn.exxonmobil.com/~/media/Files/Other/2014/Report%20-%20Energy%20and%20Climate.pdf

Figure 2: ExxonMobil's oil demand forecasts against the latest IEA scenarios



**Oil only, biofuels excluded*
Source: Exxon Outlook for Energy 2006, 2010 and 2015; IEA World Energy Outlook 2014

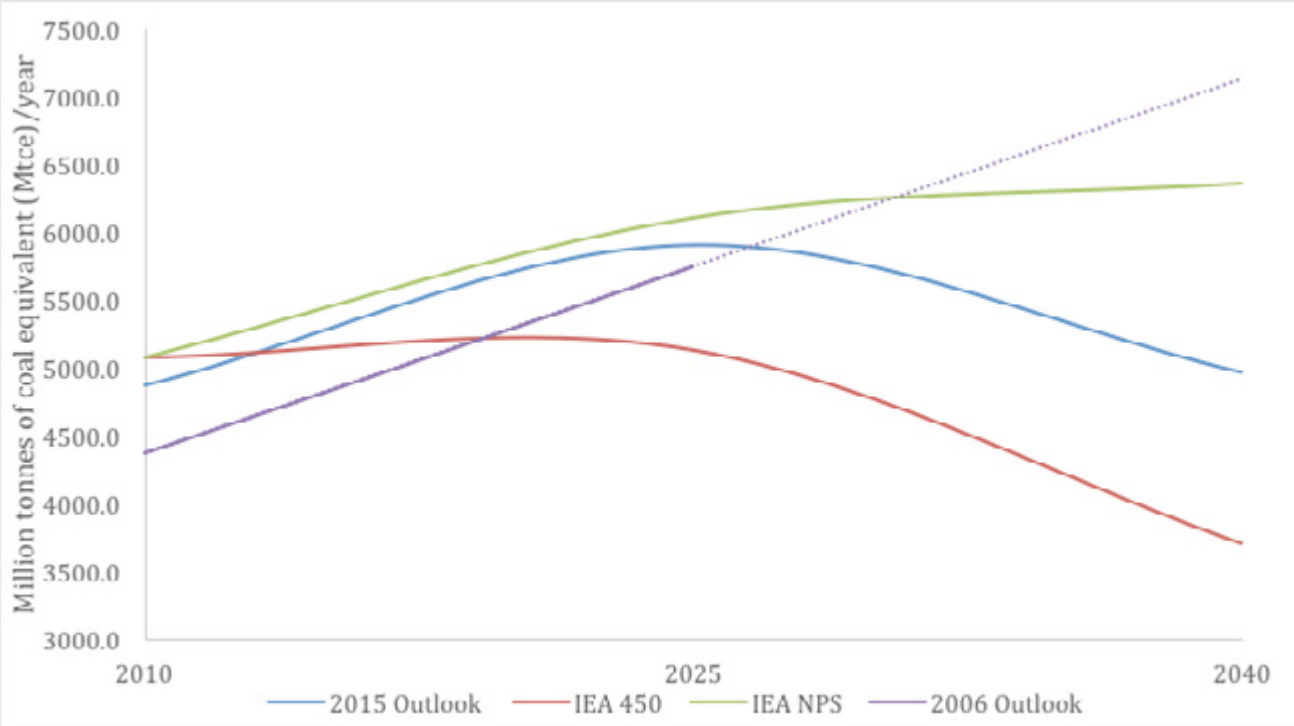
Table 2: Cumulative Million Barrels per Day compared to IEA NPS

MB/D 2006	OUTLOOK	2010 OUTLOOK	2015 OUTLOOK	IEA CPS 2014
2010-2020	+39.0	-5.0	-5.0	+10.0
2020-2030	+142.3	+10.3	+10.3	+46.8
2030-2040	+267.0	+50.8	+50.8	+100.3
TOTAL	+448.2	+56.0	+56.0	+157.0

However, Exxon's latest oil demand forecast still remains closer to the IEA's Current Policies scenario than it does to the NPS, which it exceeds by 6.8% by 2040. Cumulatively, this means Exxon's scenario delivers a cumulative 56 mb/d more oil demand (2015-2040) than the IEA NPS, equivalent to an average of 2 mb/d. So how is it that this scenario follows the NPS CO^2 emissions trajectory?

In large part, ExxonMobil's 2015 scenario offsets increased emissions from oil demand by assuming a severe drop off in coal demand – refer Figure 3.

Figure 3: ExxonMobil expects coal demand to collapse by 2040[17]



Source: Exxon Outlook for Energy 2006 and 2015; IEA World Energy Outlook 2014

Table 3: Cumulative million tonnes of coal equivalent compared to the IEA NPS

MTCE	2006 OUTLOOK	2015 OUTLOOK	450 SCENARIO
2010-2020	-7206.2	-3355.9	-2075.0
2020-2030	-3557.9	-5258.4	-9747.5
2030-2040	N/A	-9893.4	-20942.5
TOTAL	-10764.2	-18507.7	-32765.0

ExxonMobil's latest forecast has coal demand on a trajectory that peaks around 2025. It never reaches the IEA's 2014 NPS forecast for coal demand and is 21.8% lower by 2040. Between 2010 and 2040, Exxon's forecast undercuts the IEA NPS scenario by 18.5 billion tonnes of coal equivalent (Btce). As seen in Figure 3, from 2025 onwards, Exxon's 2015 forecast mimics the rate of decline of coal demand seen in the IEA's 450 scenario – this is its 2°C scenario. While Carbon Tracker certainly believes that the outlook for coal is weak, our analytical work showed an outlook closer to IEA NPS than Exxon's[18] – see chart in Appendix 2.

17 Calculated based on 1mbdoe = 2.045QBTU and 1tce = 27778243.79btus.
18 http://www.carbontracker.org/wp-content/uploads/2014/09/Coal-Demand-IEEFA-complete.pdf

This suggests that for its business planning process, Exxon is assuming business-as-usual for oil—closer to the IEA CPS—even though they believe something closer to the IEA's 450 scenario will transpire for coal. Not surprisingly, Exxon's upstream oil and gas business would be the primary beneficiary of the reduced coal demand they forecast.

Assuming business-as-usual for oil poses a potentially risky assumption for investors in Exxon. Disruptive shifts, particularly from technological progress in alternatives such as transport electrification, could expose Exxon's oil demand forecasts as overly optimistic. Carbon Tracker's oil demand study looked at the potential impact of these downside drivers in greater detail.[19]

19 http://www.carbontracker.org/wp-content/uploads/2014/05/Chapter1ETAdemandfinal1.pdf

Appendix 2

Managing demand scenarios Carbon Tracker's approach

Leading from the previous appendix we set out how we have approached demand forecasting at Carbon Tracker and how probability weighting is useful. Here we note that technology assumptions can plausibly lead to much lower demand outcomes than IEA NPS. Again we do not address commodity price assumptions.

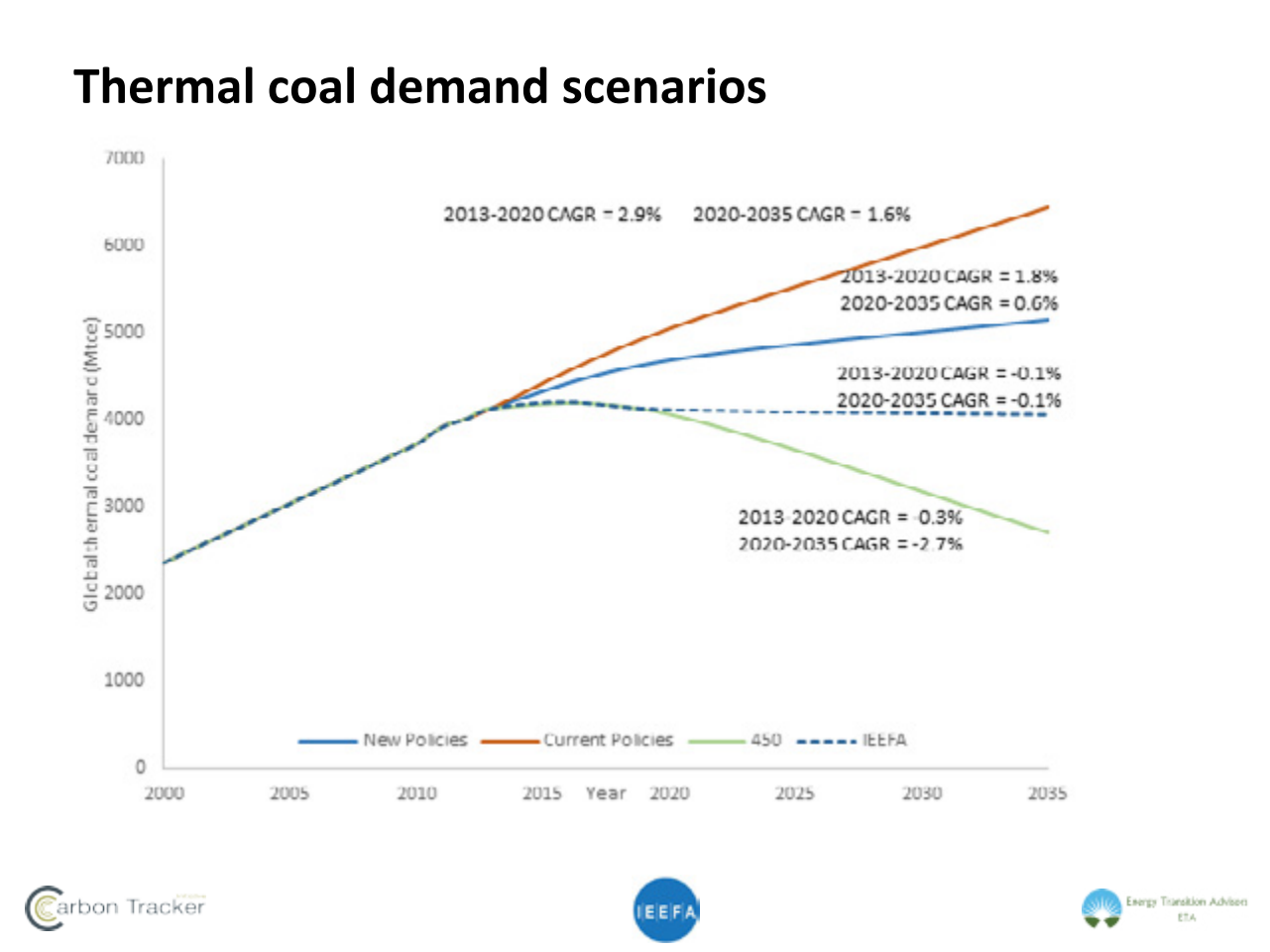
For project development, expectations of demand are obviously important. In economic terms in a longer-term time frame, demand expectations intersect with a supply curve showing costs and the most economic projects to meet that demand. Carbon Tracker's Carbon Supply Curves are based on this approach and can be derived at the company level.

In our demand central case for Carbon Cost Supply Curves, Carbon Tracker used the IEA NPS as a starting reference. (This scenario will likely reflect the country INDCs that are registered in Paris by the end of the year. Therefore, from a climate policy perspective, it is the key starting scenario before any further policy changes potentially emerge.) Carbon Tracker then compared this scenario to the demand trend under a current policies-BAU basis as well.

Carbon Tracker then looked at the full potential for efficiency gains, substitution by alternative energy and lower economic growth outlooks. This scenario is moving in the direction of the full IEA climate scenario of a 450PPM/2D climate outcome. Other more aggressive scenarios exist.

Example

In coal we show current policies BAU, IEA NPS and 450PPM and a forecast from IEEFA that in effect modeled the potential for efficiency, alternatives and economic growth. That forecast was a good deal lower than IEA NPS.



Risk weighted Probability analysis

As discussed, we believe that boards and business planning and investment units should look at all of the scenarios mentioned earlier and their implication for demand and hence capex.

One obvious way to tackle this would be to assign probabilities to the different demand scenarios to arrive at a composite. But the industry normally sees little chance of lower demand scenarios - "unlikely" being a common comment. By failing to consider such scenarios, companies are ignoring a potential risk to their businesses - we believe that needs to change.

We believe that informing investors about the probability weightings of demand scenarios would increase transparency.

Appendix 3

Quantifying valuation and risk measures.

Summary

The financial measures that would or should be useful to understand company investment decisions include:

- Company base planning assumption range and probabilities for key variables, especially the oil price;
- Company hurdle rates needed to sanction projects;
- Project NPV's or breakeven prices at the company's hurdle rate, with a sensitivity analysis for key variables;
- Project IRR's – with a sensitivity analysis for key variables.

Using NPVs at the Industry level.

At an industry level it is possible to look at the aggregate cash flows and derive an NPV for these. For sensitivity analysis, the NPVs are applied to different scenarios to generate a range of potential values. However there is no quantitative analysis applied in this case, as the probability of different scenarios is not calculated. For management and investment, it is important to understand how the value of an asset or a company can change under different oil price assumptions for example.

Risk Measures

Net present values (NPV), Internal Rates of Return (IRR) and Break Even Prices (BEP).

Much of the planning process for the fossil fuel industry involves deriving an estimate of a project's cash flows and then discounting them at the company's hurdle rate to derive an NPV. If the NPV is positive, then the project should, in theory, go ahead.

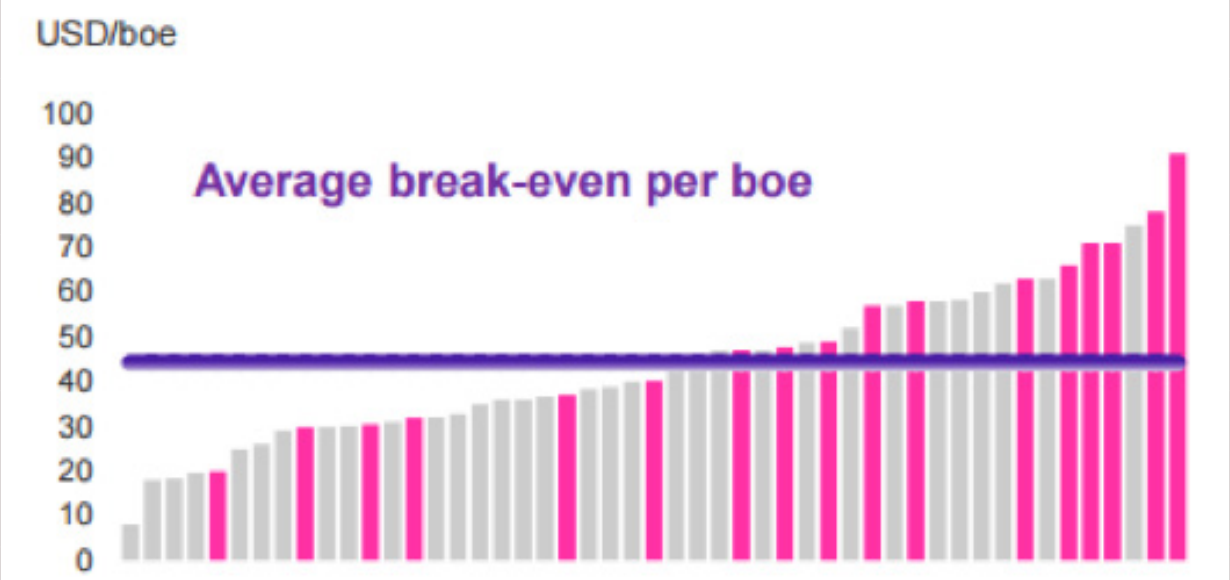
The hurdle rate should start with a company's cost of capital, which is normally calculated from a formula using the company beta, a risk-free rate (from government bond yields), the equity risk premium, the company cost of debt and its capital structure. In theory, it is assumed that this cost of capital captures all risks. But it would be sensible to allow for

project specific risk. For example, an oil project in Venezuela is likely to have more political risk than one in the United Kingdom. In contrast, the fiscal risk is likely to be higher in the UK. This shows the importance of selecting the correct hurdle rate.

Two other simple ways for a company to give an indication of project economics are internal rates of returns (IRRs) and breakeven prices, both of which are derived from an NPV analysis. The IRR (or project return) is the discount rate that gives a zero NPV. This is the return that the company and hence investors could expect from a project. Such returns can be shown on a graded graph so that the range of returns is displayed. One would hope that high return projects would be prioritized for investment.

The calculation of breakeven prices uses the oil price as an input. It calculates the oil price that produces a zero NPV at the company's hurdle rate. This is known as the breakeven price and shows the price at which the project would earn an acceptable return (defined as the hurdle rate). As with IRRs, breakeven prices can be put on a curve to see which projects are high cost and which are low. This is a chart Statoil presented during a September 2012 analysts' trip to Brazil. The pink bars refer to international projects and the grey to Norwegian projects.)

Statoil: Break-even oil price for sanctioned projects (September 2012)



Source: Statoil Slide 8[20]

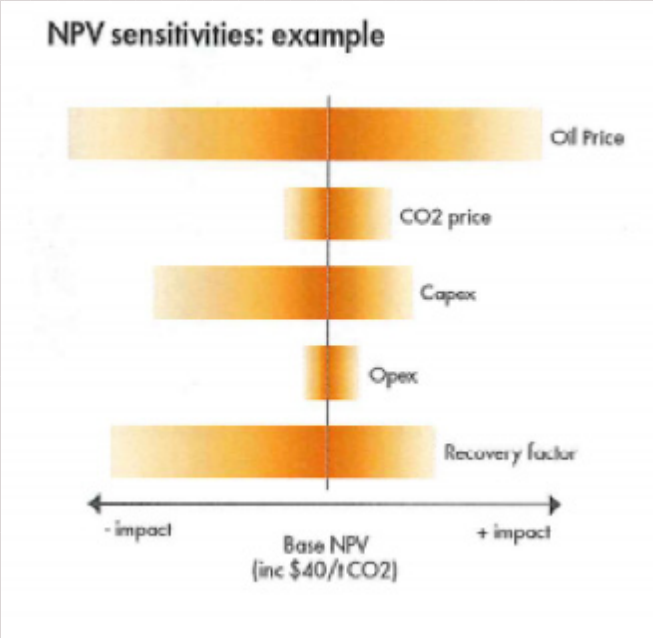
Breakeven prices (and IRRs), especially when graphed in this manner, provide a very easy way of understanding the risk profile of a company's project portfolio.

For management, NPVs are useful as they provide a single number that can be used to rank projects so that those with the greatest added value are the ones that progress. What NPV does not capture, however, is the specific risks to the cash flow forecasts - such as from movements in oil prices. The discount rate used to calculate the NPV is assumed to capture all of the risks that may face the project. But that means that two projects with a NPV of 100 would look equally attractive, even if one's NPV fell to 50 if the oil price fell by 20% and the other's fell by 40%.

20 http://www.statoil.com/no/InvestorCentre/Presentations/2012/Downloads/1Brazil_CFO_Sept2012.pdf

Sensitivity analysis

This exposes one of the weakness of a simple NPV approach – it fails to address possible changes in the assumptions used in the project analysis. Using different scenarios for project variables can be used to derive a sensitivity analysis. This provides management an indication of the scale of some risks to a project. Importantly, it can isolate the variables that cause the largest movements in NPV and hence provide the greatest threat to project economics. For example, Shell provided a simple schematic in its May 2014 letter to shareholders.[21]



As the Shell schematic suggests, the oil industry faces multiple risks. Some, such as costs and recovery factors are - in theory - either under management control or can at least be estimated with a degree of certainty. Some, such as the oil price, are not under management control. Because of their very nature, it is these non-controllable risks that management tends to focus on.

This enables management (and investors) to see where the greatest risks to a project are. But to be useful, management needs to identify the risks, the impact on project economics and the probability of the risk occurring. We suspect that this process is undertaken with insufficient due diligence in some cases.

For example, Shell gives an example in its May 2014 letter about how it assesses the oil price risk in its project analysis. "For price risks we use a project screening value of $70-$110 USD for our base Brent benchmark". That the oil price was below the screening range within twelve months is worrying. It may be that Shell did look at a $50-60 scenario as well but without knowing the probability that Shell assigned to this range, it is not of much help to investors. With the benefit of 20:20 hindsight, it is clear that Shell's risk assessment fell down this time. Without going in to detail, we would also highlight that the standard deviation of the oil price (in real terms) since 1965 is around $30/barrel. A normal probability distribution means that 70% of outcomes should lie with one standard deviation. As Shell's range is only plus or minus $20, it we believe it did not have a wide enough scenario range for the oil price to have an acceptable degree of confidence in its planning assumption.

Applying Quantitative Risk Analysis

This approach needs probability distributions for all the key variables in the model. And the range of variables needs to be realistic. Shell's 2014 $70-$110 range has already proven insufficient to cover current prices. Taking all of the key variables that affect a project's

21 see page 8: http://s02.static-shell.com/content/dam/shell-new/local/corporate/corporate/downloads/pdf/investor/presentations/2014/sri-web-response-climate-change-may14.pdf

economics and their probability distributions is complex but can be achieved. The technique is known as "Quantitative Risk Analysis." This approach gives management a range of outcomes with associated probabilities rather than the single number, static approach of the traditional NPV. By identifying the key threats to project economics, management can take mitigating steps. For example, hedging might reduce the price risk for a project. Signing a fixed price construction project or signing long term drilling contracts might reduce cost risks. But some variables, such as oil recovery factors and reserves in place, are difficult to mitigate and so greater care needs to be taken in assessing such factors. Using conservative assumptions for such variables, especially those that have not been mitigated, are key to reducing shareholder risks.

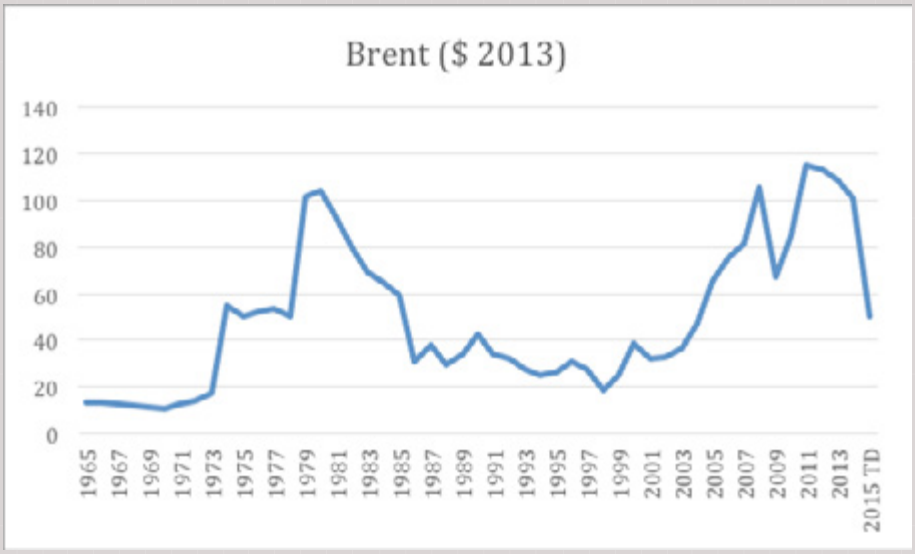
Investor risk

First, the likely distribution of the key variables used in the NPV calculation need to be derived. If the oil industry were in the business of rolling two six-sided dice, it would be easy to predict the likely outcome of its business. Probability theory says that the chance of extreme results (2 or 12) is 1-in-36. The probability of the most likely result (6) is 1-in-6. The "dice" management would be able to construct a table or chart showing the likely distribution of outcomes and have a high degree of confidence in those predictions.

But for apparently random variables like the oil price or the stock market, simple probability theory does not apply. However, it is possible to use historic performance as an indication of possible future performance. Either the actual historic performance can be used or a normal distribution can be calculated using the mean and standard deviation of the data set. Whichever approach is used, the analysis will give a probability distribution for the variable concerned.

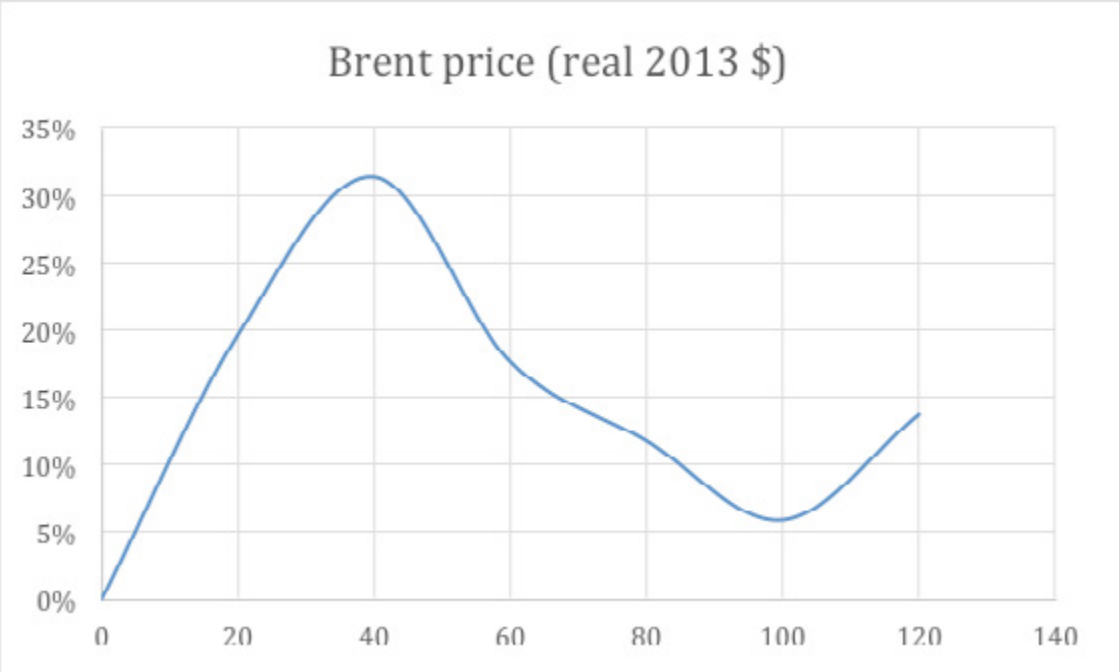
For oil companies, the oil price is a key driver for economic returns so knowing how it might move in future is important in decision making. Predicting oil prices is, in Carbon Tracker's view, extremely difficult but knowing how volatile it has been in the past can add insights. It is the range of possible future outcomes that is important in assessing project risk.

This is the price of Brent in real terms (2013 dollars) since 1965 sourced from BP's Statistical Review of World Energy.



This is clearly a very volatile data series with the oil price more than doubling and halving over relatively short periods (a few years). With oil industry lead times from development decision to production rarely under five years, such an oil price move could materially alter project economics.

This price data can be used to show a probability distribution of the oil price. We have split the data in to $20 bands and calculated the percentage of outcomes in each band.



By combining the probabilities of each band with the NPV (or IRR or breakeven price), it is possible to derive a single probability weighted measure for the project. This is more valuable than a single NPV based on a single oil price assumption as it captures outlying price scenarios. But it still is a single number. A much more important measure for risk management is the range of possible outcomes rather than a single number. For example, an investor rolling 2 dice needing 5 or better knows that his most likely outcome is 6. But he would presumably like to know the probability of rolling five or below and losing his entire stake. This is where statistical concepts that look at probability distributions of and the scale of potential risks become important. Value at risk is an example of this concept.

Drawing on simplified "value at risk"

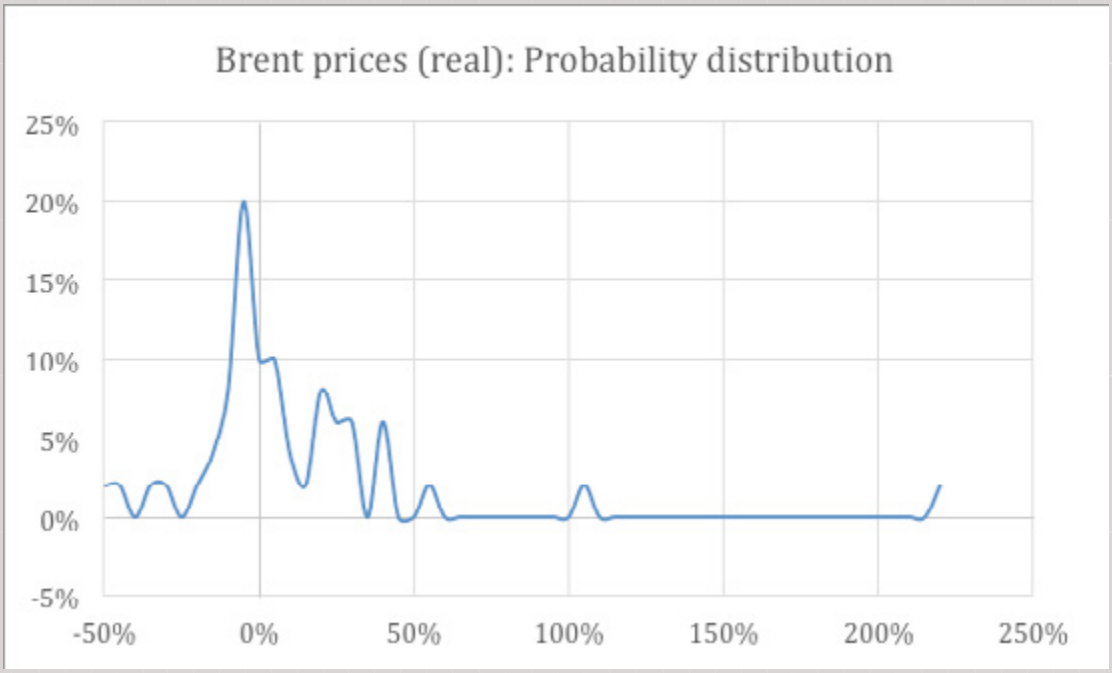
Value at risk was originally used in the financial industry to look at investor returns but its main role now is to look at overnight or daily risk for portfolios held by investment banks and other financial institutions. We believe, however, that the concepts can also be usefully applied to project economics.

At its simplest, value at risk looks at a single factor, such as investor returns. It uses three variables: the range of potential returns, the probability of those returns, and the time frame. It seeks, for example, to answer the question "What is the largest daily or weekly loss I am likely to make assuming a 95% probability?"

This approach can also be taken with the oil price. For example, assume a project's (or

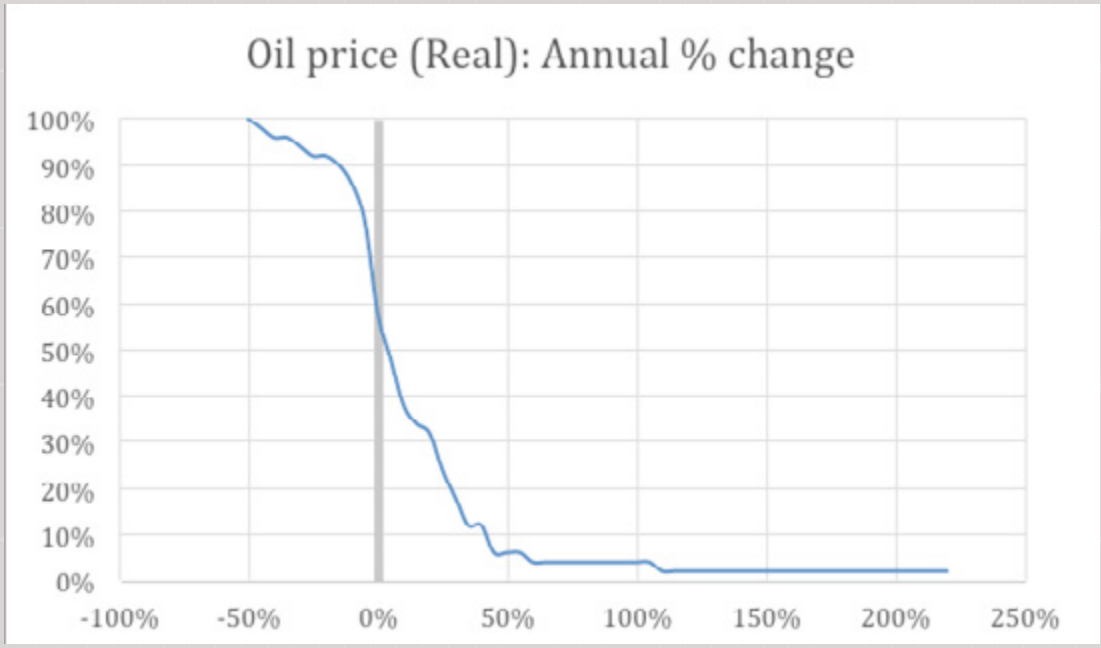
investor's) returns are the same as the annual change in the oil price. If the oil price rises by 10%, the value of the project rises by 10%.

This chart shows the same oil price data we used earlier but shows the probability distribution or the frequency of the different annual changes.



One can see the most likely historic outcome, with a probability of 20%, is an annual loss of 5%. But clearly there are several years when the returns were far higher and lower than that.

For investors and management, a key issue is the probability of a large loss. (Investors tend to care more about large losses than they do about large gains.) We can use the probability distribution of the oil price to show the cumulative probability of a given return.



It shows the probability of returns exceeding a certain level. So, looking at the heavy grey line, it can be seen that there is around a 60% chance of the annual oil price (or investor return) changing by over 0% (i.e. not falling). But from the next grid line to the right, we can see that the probability of a rise of 50% or more is only 5%.

Using historic data has one weakness, however, as it implies that there is no chance of losing all of one's capital. But just because the real oil price has never fallen by more than 50% in a year does not mean it can't happen. Using a normal probability distribution based on the historic data would capture this risk. It would also give a much smoother curve.

Either approach would enable investors and management to assess the business risks they are taking. This can be applied at the company level or for individual projects.

Within the oil industry, there are many other variables at work that can affect project economics and hence investor returns. The Shell schematic shown earlier detailed some of these. For a full value at risk calculation, the sensitivity of returns (or NPVs) to all key variables would need to be calculated and a range of probabilities assigned. Making the calculation even more complex, the degree of covariance would need to be calculated. For example, do capital costs rise when the oil price rises and what is the degree of correlation? Are gas prices and oil prices correlated? Do rising oil prices lead to higher taxation?

Once all of the relevant variables, variances and co-variances have been fed in to the calculation, a distribution of potential returns and their probability can be calculated. It would enable management to assess the largest potential loss of value with a degree of certainty. So, for example, the conclusion might be that there is 95% probability that this project will have an IRR of 15% of higher. Alternatively, it might conclude that there is a 95% probability that this project will have a net present value of $100m or higher.

Other measures apart from value or returns can also be investigated. For example, an oil company which had capital commitments and debt payment requirements might need a degree of certainty over its cash flow. "Cash Flow at Risk" is a calculation some use. The analysis might be able to conclude that there is a 95% (or some other percentage) probability that our cash flow for the year will be $100m or higher. If the company needed $200m and the probability of this outcome (or better) was only 50%, it could take appropriate measures.

A key issue though is that this analysis focuses on probabilities not certainties. And those probabilities are normally based on historic data. Nevertheless, probability curves of this nature can be valuable to investors and management in assessing the risks within their businesses. Rather than relying on relatively narrow planning assumptions, management would be able to identify the financial impact of so-called tail end risks.

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