



Briefing report for Henderson Global Investors, Insight Investment, Railpen Investments and Universities Superannuation Scheme

## Oil and gas

# Understanding the investment implications of adapting to climate change

October 2009



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**Report for**

Henderson Global Investors,  
Insight Investment,  
Railpen Investments  
Universities Superannuation Scheme

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Other reports in this series are:

- Acclimatise (2009). *'Understanding the investment implications of adapting to climate change – UK energy generation'*. Oxford.
- Acclimatise (2009). *'Understanding the investment implications of adapting to climate change – UK water sector'*. Oxford
- Acclimatise (2009). *'Understanding the investment implications of adapting to climate change – UK commercial property'*. Oxford

Companion reports have been prepared:

- Henderson Global Investors, Insight Investment, Railpen Investments and the Universities Superannuation Scheme (2008) *'Managing the unavoidable: understanding the investment implications of adapting to climate change'*.
- Henderson Global Investors, Insight Investment, Railpen Investments and the Universities Superannuation Scheme (2009) *'Managing the unavoidable: investment implications of a changing climate'*

All of these reports are available for download from

[www.acclimatise.uk.com/resources/investors](http://www.acclimatise.uk.com/resources/investors)

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This briefing report was prepared by Acclimatise, the trading name of Climate Risk Management Limited, for Henderson Global Investors, Insight Investment, Railpen Investments and the Universities Superannuation Scheme.

It is intended to support the development of an informed dialogue between institutional investors, companies and policy-makers about the direct and indirect impacts of a changing climate on key business sectors. Comments are invited from all those interested in the investment implications arising from a changing climate.

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# Understanding the investment implications of adapting to climate change

## The oil and gas sector

### Introduction

In January 2008 the Henderson Global Investors, Insight Investment, Railpen Investments, and the Universities Superannuation Scheme issued a report *'Managing the unavoidable: understanding the investment implications of adapting to climate change'*. The report highlighted a number of issues on behalf of the investment industry regarding the implications of inevitable climate change for business. These issues included:

- The lack of attention on the now unavoidable impacts of physical climate change that may have significant long-term implications for companies and their investors.
- Tools need to be developed to aid companies and investors in understanding the risks and opportunities associated with climate change.
- Investors need to engage with companies to ensure they have appropriate climate change adaptation systems in place.
- Investors also need to engage with policy makers to ensure the views of long-term investors are taken into account in policy formation in this area.

Henderson Global Investors, Insight Investment, Railpen Investments, and the Universities Superannuation Scheme commissioned Acclimatise to prepare four sector reports (oil & gas, energy generation, water and commercial property) each with a UK company focus to:

- Provide a high-level review for investors of the risks and opportunities for businesses created by inevitable climate change.
- Identify the specific investment drivers at risk.
- Provide guidance on the questions investors and their analysts should ask of companies to encourage further disclosure.

This report explores these issues for the oil and gas sector.

Governments, regulators, companies and investors have so far concentrated their climate change interests in this sector on mitigation policies and actions: emissions reductions, carbon trading, new and emerging technologies, and the development of non-fossil fuels. This report concentrates on the impact of unavoidable climate change and the adaptation issues facing those companies involved in oil and gas.

An overview of the four reports and the research findings following subsequent discussions with companies is provided in a further report by Henderson Global Investors, Insight Investment, Railpen Investments, and the Universities Superannuation Scheme published in November 2009: *'Managing the unavoidable: investment implications of a changing climate'*<sup>1</sup>

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<sup>1</sup> Available from [www.acclimatise.uk.com/resources/investors](http://www.acclimatise.uk.com/resources/investors)

## The oil and gas sector: the adaptation challenge

The oil and gas sector is particularly vulnerable to the impacts of inevitable climate change. It is an industry with large fixed assets and long asset life times, requiring significant capital investment with high operational costs. The industry often operates in extreme conditions and at the boundaries of technical knowledge and engineering capability. As the demand for oil and gas increases and the price rises, the industry is looking to exploit reserves in areas previously considered to be inaccessible, and new technology is providing opportunities to do this.

Five key areas should be taken into consideration when looking at the impacts of a changing climate on a company operating in this sector:

- Business strategies of the company
- Direct impacts of incremental climatic change and extreme events
- Indirect and compound impacts of climate change on business models
- Existing and future asset base and asset maturity
- Wider external stakeholder positions.

### Business strategies

A company's business strategies, its future objectives and plans are the starting point for any risk assessment of the impact of climate change. Although there is uncertainty in the knowledge we have about future climate change, there is sufficient information to enable robust decision making to take into account the possible impacts. Investors should challenge companies that are unable to demonstrate how they have integrated climate change into their strategic planning.

One of the key measures of companies in the oil and gas sector is the size and value of their 'legacy assets'. Our review of publicly available documents has failed to provide evidence that either buy-side or sell-side analysts have considered the potential impact of climate change on asset value when assessing company legacy. The physical impacts of climate change are now being felt across the world. Within the life of many current legacy assets and proven assets (and particularly those in the early stages of development) these impacts will become more severe, leading to increasing operational costs and additional capital investment requirements.

### Direct impacts: extreme (acute) and incremental (chronic) change

Although the oil and gas sector has a history of operating in extreme conditions it has nevertheless faced situations outside its control. The North Atlantic 2005 hurricane season illustrated how vulnerable the sector is to extreme events greater than the industry's asset design and engineering standards.

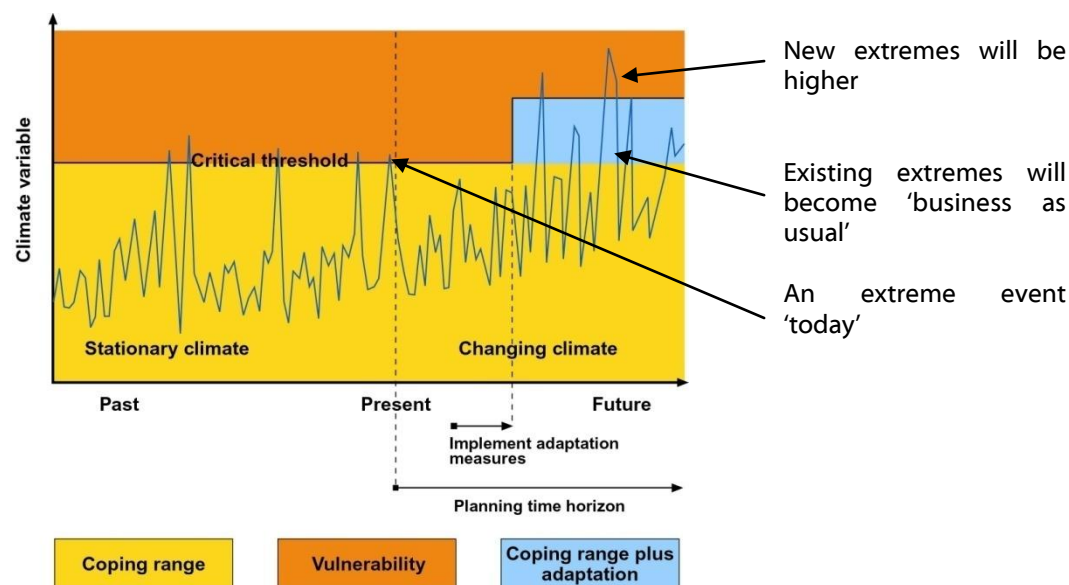
These events, combined with the availability of increasingly sophisticated climate change models, have generated greater interest in planning for more severe and frequent climatic events.

Diagram 1 illustrates the importance of identifying climatic sensitivities and critical thresholds. These provide the boundaries between tolerable and intolerable levels of risk. Information and data on current and future climate conditions can then be assessed against the thresholds, to evaluate the likelihood of their being exceeded.

Setting the critical thresholds for asset design and operation is essential, but there is always an event greater than that for which protection has been provided. The effect of climate change (as shown by Diagram 1) is to increase the risk of extreme events exceeding critical thresholds. Companies will have to assess their risks and develop strategic plans to expand the 'coping range' of their assets through adaptation measures.

Companies need to consider both reactive and proactive measures. Climate-proofing their business models to deal with incremental change and extreme events may be of interest to company investors.

**Diagram 1: Impact of extreme (acute) events and incremental (chronic) change on critical thresholds<sup>2</sup>**



The risk of increasing severity and frequency of extreme events due to climate change has grabbed the media headlines and been the focus of most interaction between companies and analysts. In contrast the 'creeping' average changes are much harder to recognise and are more likely to be overlooked.

Incremental (chronic) changes to our climate are more subtle and their impacts on business models may pass undetected until critical thresholds are breached. The responses may result in 'step-changes' for a company, increasing operational costs beyond forecasts, falling revenues, unplanned capital investment and additional balance sheet financing to manage the consequences.

<sup>2</sup> Willows, R.I. and Connell, R.K. (Eds). (2003). *Climate adaptation: Risk, uncertainty and decision-making*. UKCIP Technical Report. UKCIP. Oxford.

Business continuity and crisis-management responses are appropriate to manage the impacts of extreme events but provide limited functionality as a response to incremental change. The latter requires companies to carry out fundamental reviews of their business models and check that processes are 'fit for purpose' and climate-proof under new operating conditions.

Assets and operational processes designed without any allowance for incremental change are likely to regularly fail to meet future design criteria, operational performance targets, KPIs and regulatory standards. Understanding incremental changes to the climate and a company's current thresholds, sensitivities and vulnerabilities are significant issues to be considered in any analysis of a company's future financial performance.

### Increasing hurricane intensity and design standards



Hurricane Katrina pounded the Ocean Warwick's superstructure, ripped it from its moorings, and dragged it 66 miles before running aground in Alabama.

The American Petroleum Institute has increased its design criteria several times.

It requires offshore structures to withstand the forces generated by a hurricane with a return period of 1 in 100 years. This includes winds with a one-hour average of 80 knots (equivalent to a hurricane producing one minute of sustained 115-mph winds) and wave heights of 70 feet. Some hurricane experts say this corresponds to little more than a Category 3 hurricane.

37 hurricanes since 1900 have passed through the Gulf of Mexico oil leases with maximum sustained wind speeds of 100 knots or more.

### Indirect and compound impacts on business models

In addition to the direct physical effects of climatic change, it is important to recognise the indirect and compound impacts operating through a company's business model. These will be felt by every business irrespective of size, sector, location, markets, products and services, and will affect the following business systems:

- Natural resources and raw materials.
- Supply chains transport and logistics.
- Asset design and construction.
- Asset operation, performance and maintenance.
- Manufacturing processes.
- Asset values.



- Markets, products and services
- Workforces.
- Local communities and the environment.

For example, the increasing stress on water resources (a major raw material for oil and gas companies) due to changes in precipitation creates further problems for the operation and performance of assets, leading to potential implications for production, workforce health and safety, and conflict with local communities competing for the same water resources.

Analysis for investment purposes needs to consider not only the direct costs of climate change (such as a major flood or hurricane) but also these indirect costs. The relative thresholds and sensitivities for each part of a business model together with a company's risk attitude need to be understood.

### Permafrost thaw and increasing operational costs



The number of days in which oil exploration activities on the tundra are allowed under the Alaska Department of Natural Resources standards has halved over the past 30 years<sup>3</sup>. This is due to permafrost thaw, which is disrupting transportation, damaging buildings and assets (and in particular pipelines) and increasing the risk of pollution. Operational costs are increasing for oil and gas companies.

### Existing and future asset base

Every company has a unique asset profile based on maturity, remaining life, production capacity, cost profiles, margins, plant and equipment age and efficiency. All assets have unique operating thresholds and sensitivities. Small percentage increases in costs due to climate change may have increasingly greater financial impacts on a company's legacy assets.

The consequence of changes in climate, the impacts on business models, stakeholder positions and regulatory change will be different for each company because of its unique asset profile. Every company's risk management options (and operating and investment costs) will be partly determined by the characteristics of its existing asset base.

<sup>3</sup> Arctic Climate Impact Assessment (ACIA) (2004) *Impacts of a Warming Arctic*. Arctic Climate Impact Assessment. Cambridge University Press, Cambridge, UK

## Storm activity in the North Sea



In Autumn 2007 storms in the North Sea resulted in Norwegian oil production being cut by 10%, or 220,000 barrels per day.

The design standards for existing assets may no longer be sufficient to meet the impact of a changing climate in the future. For example, using the current design maximum probable storm standards may not provide sufficient operating and safety thresholds. These assets may also no longer be performing to their original design criteria. The combined effect of age and a changing climate is likely to lead to increased outages.

Companies with older assets are likely to find they have increased operational costs.

## Stakeholder positions

When assessing a company for investment purposes, it is important to understand the positions taken by external stakeholders in addition to considering the risks and opportunities arising from climate change and future financial performance for the individual company. Key stakeholders to consider are:

- International government agencies
- Governments
- Regulatory agencies
- NGOs
- Consumer groups
- Suppliers
- Investment banks
- Credit rating agencies
- Insurers
- Other institutional investors
- Business organisations
- Customers

The policies and responses adopted by these organisations based on their own climate change risk assessments and perceptions will have consequences for individual companies. Conflicting and converging objectives set by stakeholders may add to confusion and uncertainty. Policy initiatives (in particular changes to regulatory provisions and codes of practice) are likely to have implications for a company's plans for adaptation to climate change.

## International boundaries



Canada and Denmark have both staked their claim to Hans Island, off the coast of Greenland. Opportunities to open up new shipping routes and to exploit oil and gas reserves are leading to territorial disputes.

Oil and gas companies will need to review their strategies and assets to understand the implications of potential changes in maritime boundaries. Existing licences may be the subject of international disputes as boundaries change.

## Impacts and consequences

Investors are concerned with securing a sustainable return on investment over a given timescale. They wish to understand the consequences of climate change impacts on the value of individual businesses. Decisions to invest or withdraw investment funds in a company will be based on each investor's value drivers.

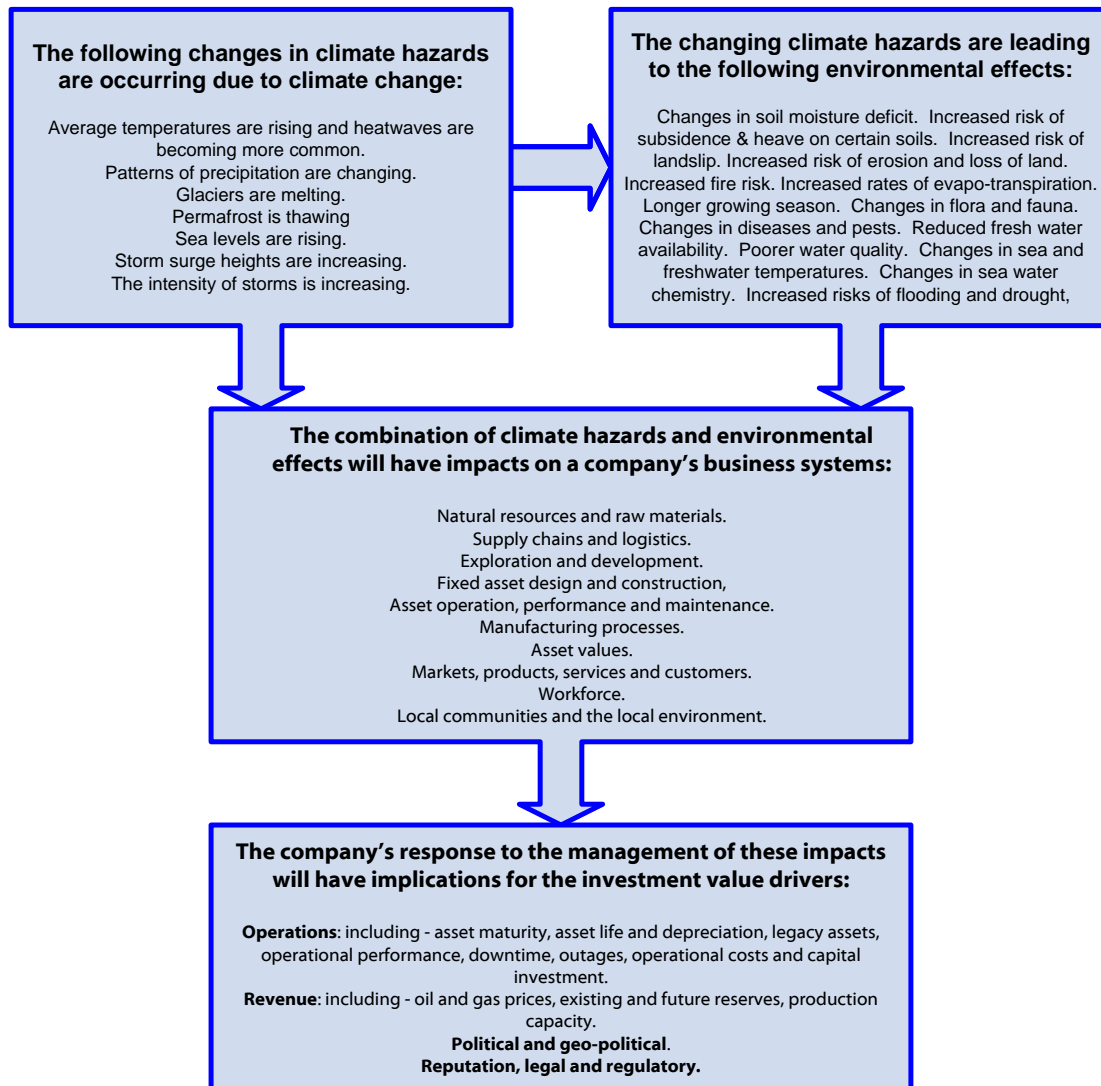
Discussions were held with Société Générale to identify the value drivers of greatest significance to investors relative to the oil and gas sector. Four were identified:

- **Operational:** Asset maturity, asset life and depreciation, legacy assets, operational performance, downtime, outages, operational costs and capital investment.
- **Revenue:** Oil and gas prices, existing and future reserves, production capacity.
- **Political and geo-political.**
- **Reputation, legal and regulatory.**

Most reports on climate change impacts focus on direct climate hazards and environmental effects due to extreme events. They concentrate on analysing a one-to-one mapping of hazard to impact, for example, flood risk for property. This oversimplifies the complex cause and effects that exist as the climate hazards and environmental effects manifest themselves within a company's business systems. It also ignores the effect of incremental climate change and under-estimates the potential costs of the impacts and the adaptation responses by the company and by its stakeholders.

Diagram 2 sets out the relationships between climate hazards, environmental effects, business systems and investment value drivers.

**Diagram 2: Relationships between climate hazards, environmental effects, business systems and investment value drivers**



Tables 1 to 4 covering each of the investment value drivers provide a high-level qualitative review of significant impacts and consequences of climate change, the key business systems affected in the oil and gas sector and appropriate risk management options.

These tables are intended to provide an illustration of the range of direct and indirect impacts. The impacts and the risk management options are given as examples. The likelihood and consequences of any impact, and the most appropriate options, can only be determined by a detailed risk assessment unique to each company.

**Table 1: Investment value driver: operational**

Business model system	Potential impacts and consequences	Risk management options
Supply chains and logistics	<ul style="list-style-type: none"> <li>• The <b>supply chains</b> for major companies may involve a number of suppliers across the world. Just-in-time manufacture, supply and distribution are already vulnerable to climate-related disruptions. <b>Manufacture, storage and distribution of equipment and supplies are likely to become more vulnerable.</b></li> <li>• Third-party transportation infrastructure is likely to be an area for increasing concern.</li> <li>• <b>Oil and gas companies will face increasing operational costs, disruptions to essential supplies and business, and increased downtime.</b></li> <li>• Land transportation routes, both rail and road, are likely to face an increased risk of disruption. The number of days that ice roads can be used will decrease.</li> <li>• <b>Transportation costs will increase.</b></li> <li>• Assets and transportation routes (together with associated essential utilities provided by third parties) located in coastal areas and on river floodplains will be at a greater risk.</li> <li>• <b>Existing flood management and drainage systems may be compromised</b> by sea level rise, storm surges, coastal erosion, changes in precipitation, and greater intensity and frequency of flooding events. This will lead to asset damage, disruptions to off-site utilities (energy, communications, water and waste treatment), disrupted transportation links, more downtime.</li> </ul>	<ul style="list-style-type: none"> <li>• Diversify supplier base.</li> <li>• Repair, maintain and upgrade company transport infrastructure.</li> <li>• Engage with government and transport providers to ensure infrastructure is resilient under a changing climate. Consider investment in private transport links for vulnerable routes or locations.</li> <li>• Provide additional storage capacity for products and raw materials in case of disruption to supply.</li> <li>• Consider projected rates of warming and impacts on permafrost during design of new assets.</li> <li>• Review asset maintenance programmes.</li> <li>• Increase storage of supplies and materials on site.</li> <li>• Developing new transport links with remote sites e.g. port facilities in northern Canada will open up other areas for exploration.</li> <li>• Flood and coastal erosion management strategies for existing facilities.</li> <li>• Flood defence measures including: upgrading hard flood defences, creating 'set-back' flood defences, purchasing removable temporary flood barriers and managed retreat (allowing areas to flood) in coastal areas.</li> <li>• Improving drainage systems to increase capacity to cope with greater rainfall intensity and installing Sustainable Drainage Systems (SuDS) which allow water to soak into ground, reducing rapid runoff. Raising floor levels and using flood-resilient materials.</li> <li>• Business continuity programmes.</li> <li>• Third party utility operators and transportation authorities to demonstrate the resilience of their facilities to increased flood risk.</li> <li>• Providing own utilities to remove dependence on third parties.</li> </ul>

Business model system	Potential impacts and consequences	Risk management options
Asset operation and performance	<ul style="list-style-type: none"> <li>• <b>Increased storm activity and flooding can disrupt and delay operational processes.</b></li> <li>• Significant increases in material, labour and reconstruction costs following an extreme event (often referred to as 'demand surge').</li> <li>• <b>Rising temperatures will affect efficiency and performance of plant and equipment</b> such as compressors, gas turbines, pumps, generators.</li> <li>• Consequences include increasing energy consumption, decreased output, more maintenance, reduction in asset performance and life, higher depreciation costs, earlier asset write off.</li> <li>• <b>Increased costs for cooling LNG</b> may be required.</li> <li>• Increasing temperatures are causing permafrost thaw in higher latitudes and in high-mountain areas. Fixed assets and oil and gas pipelines designed for permanently frozen ground will be at risk from structural failure.</li> <li>• <b>Maintaining asset performance will require changes to maintenance programmes and may lead to greater operating costs.</b></li> <li>• Delays in asset development, disruption to oil and gas pipelines, potential loss/reduced production, greater pollution risk, increased site storage or supplies and equipment, reduced asset life (leading to changes to depreciation rates and premature asset write-off). <b>Additional unplanned capital investment</b> may be required.</li> <li>• Increased capex and opex may be required to replace damaged assets. <b>'Demand surge' effect</b> following extreme events will increase repair costs.</li> <li>• Changes due to <b>sea level rise and increasing storm intensity will affect offshore facility operation and design.</b> Design return periods are being exceeded for air gaps on oil and gas rigs and production platforms.</li> <li>• Assets with historic design standards are likely to be evacuated more frequently, increasing operating costs.</li> </ul>	<ul style="list-style-type: none"> <li>• Use insurance mechanisms to cover risk.</li> <li>• Build resilient relationships with multiple suppliers to secure priority services at pre-determined prices.</li> <li>• Undertake supply chain risk assessments.</li> <li>• Increase critical operating headroom in key assets to provide greater resilience.</li> <li>• Consider provision of emergency power, water supplies and waste treatment.</li> <li>• Put in place robust and climate-proof business continuity plans.</li> <li>• Install additional cooling plant.</li> <li>• Consider merits of air-cooled and water cooled systems.</li> <li>• Review maintenance regimes to take into account increasing temperatures.</li> <li>• Technical modification to facilities to allow operation during warmer average temperatures, dry periods and extreme events.</li> <li>• Reduced heating for LNG at re-gasification stage may reduce costs.</li> <li>• Review offshore facility design standards to include climate resilience.</li> <li>• Undertake remedial works to existing assets including pipelines to ensure structural stability.</li> <li>• Undertake remedial works to existing offshore facilities.</li> <li>• Review health and safety standards and assess risk against future climatic conditions.</li> <li>• Review maintenance and monitoring programmes and implement action plans.</li> </ul>

**Table 2: Investment value driver: revenue**

Business model system	Potential impacts and consequences	Risk management options
Natural resources and raw materials	<ul style="list-style-type: none"> <li>• <b>Changes in Arctic sea ice conditions and melting of the Greenland ice cap may open up previously inaccessible oil and gas reserves.</b></li> <li>• Increasing oil and gas prices in line with growing long term energy demands under current projections (in part driven by the effects of climate change) may <b>improve rates of return for known reserves previously too expensive to develop.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Look at longer term climate impacts on prices, price drivers, and consider opportunities to develop new resources.</li> <li>• Opportunities for oil and gas companies to add to their reserves in previously difficult areas.</li> </ul>
Asset design	<ul style="list-style-type: none"> <li>• Assets and transportation routes (together with associated essential utilities provided by third parties) in coastal areas and on river floodplains are likely to be at a greater risk.</li> <li>• <b>Existing flood management and drainage systems may be compromised</b> by sea level rise, storm surges, coastal erosion, changes in precipitation, increasing intensity and frequency of flooding events.</li> <li>• <b>Production capacity may be compromised</b> during and after events.</li> </ul>	<ul style="list-style-type: none"> <li>• Careful siting of new facilities taking account of climate change.</li> <li>• Relocation of existing facilities may be necessary.</li> <li>• Flood and coastal erosion management strategies for existing facilities.</li> <li>• Flood defence measures including upgrading hard flood defences, creating 'set-back' flood defences, purchasing removable flood barriers and managed retreat (allowing areas to flood) in coastal areas.</li> <li>• Improving drainage systems including increasing drainage capacity to cope with greater rainfall intensity and installing Sustainable Drainage Systems (SuDS) which allow water to soak into the ground, reducing rapid runoff.</li> <li>• Reducing vulnerability by raising floor levels and using flood-resilient materials.</li> <li>• Business continuity programmes.</li> <li>• Supplier contracts at pre-determined prices.</li> <li>• Providing own utilities to remove dependence on third parties.</li> <li>• Insurance policies covering flood damage, business continuity and business disruption.</li> <li>• Independent third party utility operators and transportation authorities should demonstrate resilience of facilities to increased flood risk.</li> </ul>
Asset operation and performance	<ul style="list-style-type: none"> <li>• Increased storm activity and flooding can disrupt and delay distribution and production.</li> <li>• Damage to third party utilities and infrastructure can further delay returning facilities to full production.</li> <li>• <b>Production capacity may be comprised.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Use insurance mechanisms to cover risks</li> <li>• Build resilient relationships with multiple suppliers to secure priority services at pre-determined prices.</li> <li>• Increase critical operating headroom in key assets to provide greater resilience to extreme events.</li> <li>• Consider provision of emergency power and water supplies, waste treatment.</li> <li>• Develop robust climate-proof business continuity plans. .</li> </ul>

Business model system	Potential impacts and consequences	Risk management options
Markets and customers	<ul style="list-style-type: none"> <li>• Extreme weather events (e.g. hurricanes, wind storms, river and coastal flooding) can have potentially devastating effects on offshore and onshore assets.</li> <li>• <b>Disruption to production facilities and damage to assets can result in price changes</b> to the consumer and loss of markets to competitors.</li> <li>• <b>Disruption to third party utilities and transportation systems can further delay reopening</b> of production facilities, adding to costs and loss of markets.</li> </ul>	<ul style="list-style-type: none"> <li>• Review risk assessment and business continuity plans. Ensure they include actions necessary to meet existing market commitments during loss of production facilities (for example by meeting demands from other facilities).</li> <li>• Ensure legacy assets are climate-proof over the lifetime of the asset.</li> <li>• Assets in areas with increasing risk of disruption which can not be climate-proofed without considerable investment may be needed to be sold.</li> <li>• Opportunities to hedge and use alternative risk transfer mechanisms to protect against higher prices and loss of market share should be explored.</li> <li>• Actions to exploit market opportunities arising from higher prices and loss of production by competitors, by increasing production from other sources, should be considered.</li> </ul>

**Table 3: Investment value driver: political and geo-political**

Business model system	Potential impacts and consequences	Risk management options
Natural resources and raw materials	<ul style="list-style-type: none"> <li>• <b>Changes in Arctic sea ice conditions and melting of the Greenland ice cap may open up previously inaccessible oil and gas reserves.</b> Sea level rise will affect some international maritime boundaries.</li> <li>• <b>International territorial disputes</b> are likely to arise as nations lay claim to oil and gas reserves.</li> <li>• <b>Release of new licences may be delayed</b> until international disputes are settled.</li> <li>• Companies with existing licences in areas where there are potential changes in international maritime boundaries may have to <b>renegotiate licences</b> or find that licences are revoked.</li> <li>• <b>Companies with legacy assets in these areas are most at risk.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Companies operating in at risk areas should assess the potential risk of international disputes and the consequential implications for existing and future licences.</li> </ul>



Business model system	Potential impacts and consequences	Risk management options
Local communities and the environment	<ul style="list-style-type: none"> <li>Changes in rainfall patterns, reduced water resources, poorer water quality combined with increasing risk of heat wave, drought and flooding will <b>significantly increase water demands and competition for available resources.</b></li> <li>Competition for water resources with local communities and the wider environment may lead to <b>social and political conflict.</b></li> <li>Areas under severe stress will face social unrest and political instability.</li> <li><b>Restrictions on water usage for operational purposes will increase costs.</b></li> <li>Social and political conflict will create problems for local workforce, community relationships and may interfere with licensing and permitting of oil and gas reserves.</li> <li><b>Civil disturbance and military conflict may result.</b></li> <li>Companies with legacy assets in at risk areas may be faced with particular business exposures.</li> </ul>	<ul style="list-style-type: none"> <li>Careful siting of new facilities should take account of climate change and the availability of water resources over the lifetime of the asset.</li> <li>Assessments need to identify demands of future assets, local communities and the environment.</li> <li>Where there are insufficient resources companies need to explore and implement water resource management measures, including developing alternative water supplies, constructing new reservoirs and boreholes, water efficient processes, rainwater harvesting and storage, and water recycling..</li> <li>Companies will have to ensure that local communities are not competing for the same resources and are not placed at any disadvantage. They will have to work with local communities to develop and implement measures to cope with drought risks.</li> </ul>

**Table 4: Investment value driver: reputation, legal and regulatory**

Business model system	Potential impacts and consequences	Risk management options
Natural resources and raw materials	<ul style="list-style-type: none"> <li>Changes in Arctic sea ice conditions and melting of the Greenland ice cap may open up previously inaccessible oil and gas reserves.</li> <li>Increasing oil and gas prices in line with growing energy demand under current projections (in part driven by the effects of climate change) may improve rates of return for known reserves previously too expensive to develop.</li> <li>Opportunities may be available as a result of climate change for some companies to <b>increase short-term oil &amp; gas reserves.</b></li> <li><b>Working in extremely sensitive areas will create major reputational issues.</b></li> <li><b>NGOs will vigorously oppose opening up the Arctic.</b> This is likely to become the most sensitive environmental conflict of the last 100 years. Oil and gas companies should also be mindful of the pressure retail customers (particularly in Europe and the USA) can exert (for example the effect on the disposal of Brent Spar).</li> <li><b>NGOs are likely to resort to litigation and in extreme cases environmental activists will attempt to disrupt exploration activities.</b></li> <li>The reputational implications for major companies are significant.</li> </ul>	<ul style="list-style-type: none"> <li>Companies considering operating in environmentally sensitive areas (for example the Arctic) should assess the potential reputational damage and the litigation risks.</li> </ul>

Business model system	Potential impacts and consequences	Risk management options
Asset operation and performance	<ul style="list-style-type: none"> <li>• <b>Failure to identify and take appropriate action to manage and minimise impacts of extreme events on assets and production capacity</b> will become increasingly difficult to explain to customers.</li> <li>• As understanding and knowledge of climate change improves, the greater our ability to identify the impacts.</li> <li>• <b>Neglecting to take into account available information</b> and act accordingly may be seen as a failure in the company's internal risk management and its corporate governance.</li> <li>• This will have serious repercussions on company reputation and may <b>create a litigation exposure</b>.</li> </ul>	<ul style="list-style-type: none"> <li>• All companies should include inevitable climate change on corporate risk registers and assess the implications across business models.</li> <li>• Companies should disclose the assessment results to existing and potential investors and to wider stakeholder groups.</li> <li>• Oil and gas companies should consider how they can support further research into the impacts of climate change in developing countries.</li> </ul>
Workforce	<ul style="list-style-type: none"> <li>• The impact of climate change on operational processes (increasing temperatures for example) <b>may have additional health and safety implications</b>.</li> <li>• Assets and operational processes designed according to past climate data will be used under different climatic conditions.</li> <li>• Safety headrooms may be compromised.</li> <li>• Reputational and litigation implications are significant.</li> <li>• <b>Employer and public liability insurance cover may be compromised if companies fail to take climate change into account during health and safety risk assessments</b>.</li> </ul>	<ul style="list-style-type: none"> <li>• Health and safety policies and risk assessments should ensure that the implications arising from changing climatic conditions on assets and operational processes are assessed. New assets and processes should include revised safety thresholds.</li> </ul>
Local communities and the environment	<ul style="list-style-type: none"> <li>• <b>Changes in environmental conditions may be used to revoke exploration and production licences</b> by governments as the price of oil and gas increases.</li> <li>• <b>Legacy assets secured under advantageous terms may be at particular risk</b>.</li> <li>• Revocation or re-negotiation of licences (in particular those for legacy assets) will have significant implications for oil and gas companies.</li> <li>• Competition for water resources and increasing risks to natural resource systems will create conflicts with local communities.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure environmental impacts of climate change are monitored and disclose results of routine monitoring of flora, fauna and local habitats.</li> <li>• Review potential impacts on local environments in sensitive countries and ensure all measure are taken to minimise these</li> </ul>

## Risk disclosure by major companies

A review of five companies in the oil and gas sector (BG Group, BP, Cairn Energy, Shell and Tullow Oil) was undertaken to identify:

- Current good practice on the assessment, management and disclosure of risks and opportunities driven by climate change.
- Evidence of climatic change affecting the financial value drivers.
- Evidence of action by individual companies to assess emerging climatic risks.
- Evidence of action on specific adaptation measures.
- Evidence of disclosure and reporting to the investment community.

The information was obtained using the companies' public reports (e.g. annual reports, CSR reports, environmental reports, operating and financial reviews) together with responses to the Carbon Disclosure Project.

Examples of climate change signals and company responses are provided below:

- Shell
  - In 2005 Shell reported production losses of 85,000 barrels of oil equivalent per day during the hurricanes in the Gulf of Mexico, with asset utilisation rates reduced by 3%. Shell also reported that consequential damage to onshore pipelines caused a total of 3,900 tonnes of oil to be spilled.
  - In its response to the 2008 Carbon Disclosure Project Shell recognised that over time changes in the climate are likely to present new risks to the company. It noted that the "development of our understanding of the physical risks relating to climate change is in its earliest stages. Whilst we undertake to review the risks to, and integrity of, our long term, strategic assets against the physical impacts of climate change no clear trends or findings have emerged."
- BP
  - In 2005 BP reported impairment charges of \$266 million relating to fields and assets in the Gulf of Mexico damaged by hurricane activity.
  - BP stated in its 2008 Carbon Disclosure Project response that it invests heavily in engineering structures that could be vulnerable to modest changes in local climate. "The size of our exposure and the changing risk to both our future operational integrity and our current facilities is not yet well understood. In adapting to a world in which extreme weather might be more common there is also a risk of over-engineering solutions and consequently increasing our construction and abandonment costs."
  - BP is carrying out research, jointly with Imperial College London, to understand better the potential impacts on BP's operations posed by a changing climate. The initial focus of this work is in the arctic region "where melting permafrost could have a significant impact on our operations."
- Tullow
  - Tullow recognises that its onshore operations in Pakistan, Bangladesh and parts of Africa could be exposed to extreme weather conditions which "can cause further complications from disease and shortages of food and power supplies." The company notes that "offshore installations in the UK and

Africa would be exposed if the sea level rises significantly or from other extreme weather conditions, potentially causing disruption to operations and supply but also affecting crew changes and intervention work on the platforms.”

- Tullow states that it has taken a number of steps to ensure that they are prepared for the potential risks. Its design process now requires that new plant and equipment, as well as upgrades to existing equipment factor, takes into account the possibility of extreme weather patterns. The company draws attention to the design of the planned Early Production System (EPS) in Uganda which has considered a wider data set on climatic conditions including temperature and rainfall extremes.
- Cairn Energy
  - Cairn Energy provides little information about the specific steps that it is taking. The company notes that its most important risks will be from severe weather events.
- BG Group
  - BG Group reported that it is undertaking country wide climate change risk assessments. The company also states that “As part of our Environmental Expectations Standard we include mandatory requirements governing climate change adaptation which set out how we assess the risks to our operations from foreseeable environmental changes arising from climate change, together with our approach to risk mitigation.”

## Conclusions

The published reports provide limited disclosure of impacts and costs attributable to climate change. There is little evidence from the published reports that any of the companies have clearly defined strategies and risk assessment procedures in place (with the exception of BG), although references are made to changes in standards and design processes. It is noted that both BP and Shell comment that the size of their exposure and the changing risks to operational integrity is not well understood.

This may be due to a number of factors, including:

- Internal company operating and performance metrics are not designed to capture information relative to changing climatic conditions. Impacts and costs may be assigned to other risk factors.
- Impacts and costs are not being recorded or tagged with a climate change label. The early warning signals of climatic change are not being picked up by company risk ‘radar screens’.
- The reporting process tends to focus on extreme events, there is limited evidence that companies have begun to recognise that incremental climatic change will affect business performance.

In reviewing the published reports it is apparent that areas where impacts might be expected to occur are not being reported. The following case study highlights decommissioning liabilities as an area of particular concern.

## Case study: Decommissioning liabilities

A recent report from Standard and Poor's<sup>4</sup> sets out the concerns regarding disclosure by oil and gas companies of their future decommissioning liabilities. The report refers to the lack of information provided by companies. An assessment of leading companies indicates that decommissioning provisions (which are treated as additions to debt) equate to about 45% of the overall future balance sheet liabilities for oil and gas companies. Decommissioning provisions represent a significant part of their financial risk because the majority of cash flows occur at the end of a project's life.

The accounting rules for such provisions under IFRS (IAS 37) require a company to recognise a liability as soon as the decommissioning obligation is created, which is normally at the time the facility is constructed. Standard and Poor's found that the scale of decommissioning provisions tends to be based on management judgment rather than independent third-party appraisals.

There is no evidence from the review of published reports that oil and gas companies are assessing and reporting the impacts of changing climatic conditions on the decommissioning costs for their existing and planned assets. If this is correct then it is possible that companies may be underestimating their future liabilities and may not meet reporting obligations.

There are new and emerging risks to be considered: changes in temperature, increased sea levels and changes in sea conditions (temperature and acidity), coastal erosion, permafrost thaw and changes in precipitation (see Diagram 2 for more examples). All of these have the potential to create challenges for the decommissioning of assets, for example:

- Saline intrusion or rising groundwater levels may create new source-pathway-receptor relationships increasing risks associated with contaminated land.
- Increasing flood levels will result in enhanced risks to decommissioned sites requiring higher levels of flood protection.
- Environmental site protection and reinstatement plans agreed during the licensing and consenting process may not be appropriate in view of the changes in species and habitats during the life of the project.

Bonds based on risk assessments that have failed to take climate change into account may prove to be inadequate and not protect companies from further liabilities and litigation risks.

Each asset type, the area in which it is located, and the intended after-use of the site, may need to be examined and the decommissioning costs reassessed. In many cases legally binding obligations may have been given regarding the decommissioning and restoration of a site and its future use, which may not be achievable. These obligations may need to be re-negotiated.

Robust climate change information is available to help calculate the impacts on asset decommissioning costs. Failure to do so raises questions regarding the corporate governance credentials of individual companies and their fiduciary responsibilities to their shareholders. It may also raise questions regarding reporting procedures and compliance with IAS 37.

<sup>4</sup> Poor Disclosure By Europe's Chemicals, Oil & Gas, And Metals & Mining Companies Gives Limited Insight Into Decommissioning And Environmental Provisions, Standard and Poor's 27 September 2007

## Questions for investors

A series of questions has been developed to assist investors to elicit relevant information from companies for investment analysis and as a basis for further engagement. These are based on:

- Key risks and adaptation issues identified in Tables 1 to 4.
- Analysis of company public reports, together with the responses to the Carbon Disclosure Project.
- The report authors' own insight based on their understanding of the potential risks and impacts inevitable climate change will create.

Five groups of questions are provided covering each of the four investment value drivers together with a set of questions aimed at understanding issues under the broad heading of 'Governance'.

These questions should be considered as providing a framework for discussion and engagement. It is not intended that each and every question should be asked, or that there is an implied 'correct' answer. The questions can be modified to suit an investor's particular interest and concerns, and be made specific to a particular company.

## Governance

**Are you taking any steps to assess the vulnerability of existing and future assets to changing climatic risks?**

- Are there any specific knowledge gaps where further information is required?
- Have you commissioned any external research?

**Will you be taking any steps in the next 12 months to review both your strategies and your major projects to assess the risks and opportunities posed by climatic change?**

**Are there any climate adaptation strategies in place within your company? How are these integrated within existing risk management strategies?**

- How have you embedded steps to adapt to climate change across your business?
- Is there a process for ensuring climate risks are built into your investment decision making process?

**Have you taken any steps to develop internal capacity, awareness and understanding regarding the business impacts arising from inevitable climatic change?**

- Have you appointed a Director to take specific responsibility for assessing the impacts of inevitable climate change on the company?
- What are the results of engagement with external stakeholders?

**Are you engaged in any discussions with your regulators, suppliers and customers on the impacts of inevitable climate change?**

- Are you sharing information and understanding on the business impacts of climate change with your regulators, suppliers and customers?
- What steps have you taken with your suppliers to ensure they are aware of and responsive to the need to adapt to climate change?

**Investment value driver: operational**

**Will changing climatic conditions have impacts on your production capacity and downtime?**

- What steps are you taking to monitor current performance relative to changes in climate?

**Are you taking any actions to assess operational costs and investment requirements arising from the impacts of inevitable climate change?**

- What are the affects on cash flows?

**Will changes in water quality and water resources due to climate change affect your operational processes?**

- What are the consequences for operational expenditure?

**Are changes in extreme weather conditions, increasing variability and incremental climatic changes considered in project analysis?**

- How are you factoring climate change into your asset design and operational performance forecasts?

**If you are not undertaking specific adaptation measures during current project design stages, do you envisage taking steps to adapt your assets at a later date?**

**What are the impacts on asset life and depreciation after factoring in climate change?**

- What are the implications for asset write-off and future profits?

**Have you assessed how climate change may affect your future decommissioning provisions for both existing and planned assets?**

- What are the implications for future debt burden?



**Investment value driver: revenue**

**Are there any implications for future cash flows arising from changes in oil and gas prices and in energy demands driven by climatic change?**

**What steps are you taking to exploit the opportunities from changing markets and customer demands?**

**Are your company's revenue forecasts at risk as a consequence of an increase in extreme events?**

**How will seasonal changes in energy demands (e.g. increase in summer and decrease in winter) affect your revenue projections?**

**Investment value driver: political and geo-political**

**Have you assessed the consequences for your assets in locations where the availability of water resources is already recognised as creating a geo-political risk?**

**Do you have any strategic plans in place to reduce your exposure to geo-political risks driven by climate change?**

**Have you assessed the impact of climate change on national internal security and the risk of international territorial disputes in those countries where your legacy assets are located?**

- What level of risk is there that your future operations will be disrupted?

**Investment value driver: reputation, legal and regulatory**

**Will you be taking any actions to assess the implications of future changes in regulations, legislation and codes of practices on your operations?**

- Are any actions necessary to monitor such changes and to engage with regulatory agencies in policy development?
- How will these changes affect operational costs and revenue?

**Are there any emerging regulatory compliance or litigation exposures?**

- What actions are you taking to manage your exposure?

**What actions have you taken to engage with local communities in areas of future water resource stress?**

- How will you manage competition and conflict?

**What steps will your company take to ensure it complies with the Companies Act 2006 with regard to disclosure of risks due to inevitable climate change?**

**What actions are you taking to ensure the company is fully compliant with the accounting provisions of IFRS (IAS 37) with regard to future decommissioning liabilities?**

- Will you be reviewing your decommissioning provisions to assess the implications of a changing climate?
- What steps will you take to assess decommissioning provisions for new projects taking into account climate change?

## Acclimatise

Acclimatise specialises in climate change risk management operating at both strategic and project levels. We have a portfolio of tools that enable businesses and governments to adapt to inevitable climate change. We bridge the gap between the scientific community and the corporate world, reviewing the latest science, providing clear guidance on corporate and financial risks and the opportunities arising from climatic change.



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