



# Addressing adaptation in the oil and gas industry

Climate  
change  
2013

[www.ipieca.org](http://www.ipieca.org)





The global oil and gas industry association for environmental and social issues

5th Floor, 209–215 Blackfriars Road, London SE1 8NL, United Kingdom

Telephone: +44 (0)20 7633 2388 Facsimile: +44 (0)20 7633 2389

E-mail: [info@ipieca.org](mailto:info@ipieca.org) Internet: [www.ipieca.org](http://www.ipieca.org)

© IPIECA 2013 All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior consent of IPIECA.

# Addressing adaptation in the oil and gas industry

Photographs reproduced courtesy of the following: cover, top left: Bikeworldtravel/Shutterstock.com; cover, top centre: jan kranendonk/Shutterstock.com; page 2: WIANGYA/Shutterstock.com; Figure 3, bottom right: Tracing Tea/Shutterstock.com. All other photographs courtesy of Shutterstock.com.

## Contents

<b>Executive summary</b>	<b>1</b>
<b>Introduction</b>	<b>2</b>
<b>Risk identification</b>	<b>4</b>
<b>Risk evaluation/assessment</b>	<b>6</b>
<b>Risk management</b>	<b>8</b>
<b>Reflection</b>	<b>11</b>
<b>Workshop programme</b>	<b>12</b>
<b>References</b>	<b>14</b>

## Executive summary

As responses to climate change impacts extend beyond greenhouse gas (GHG) emissions mitigation, governments and companies increasingly recognize the need to integrate adaptation planning and implementation into balanced risk

management strategies. This report examines oil and gas industry awareness of climate change-related risks, and identifies appropriate responses and ways in which these responses are being integrated into broad risk management frameworks.

### Summary of key observations

1. Risk management is integral to business decision-making frameworks in the oil and gas industry.
2. Adaptation in climate risk management involves:
  - identification and evaluation of risks;
  - development of risk mitigation and management strategies; and
  - implementation of strategies.
3. Oil and gas companies continue to adapt to climate risks.
4. The oil and gas industry assesses a range of current and future climate change-related risks to its operations, infrastructure and value chains. These include risks such as climate variability, floods, sea level rise, extreme events, species migration shifts, permafrost thawing and water availability.
5. As many impacts are local and projects unique, local adaptation assessments enable the identification of appropriate design and operational action.
6. Projections indicate that changes to climate and climate variability over the next 30–40 years will be similar regardless of mitigation scenarios. Over this timeframe, adaptation to climate change will likely take place in addition to, or regardless of, any mitigation efforts.
7. There is uncertainty over climate variability and significant divergence in projections beyond 2040–50. Flexible and robust design coupled with adaptive management practices will be critical for managing climate risks and adapting to a range of impacts.
8. Adaptation measures are being implemented by private actors; the private sector is best placed to adapt its own infrastructure and operations to manage climate risks.
9. Lessons learned, and long shared within companies, are now being reported externally via stakeholder disclosure processes. Sharing with other industries, governments and society can broaden recognition and understanding of climate change risks, and can highlight adaptation options which may be easier to implement.
10. Governments have an important role to play in developing and protecting critical infrastructure and land use, promoting research to enhance climate science understanding and engineering solutions, and strengthening observation networks for weather and climate variations.

Structured to provide an overview of the adaptation planning process, the report includes: examples of climate risks identified by the oil and gas industry; an outline of risk-evaluation processes related to specific potential impacts; and in-use examples of risk adaptation and management.

To help inform risk management processes across the industry, IPIECA organized a workshop that brought together experts from academia, the insurance industry, a GHG emissions disclosure organization, engineering consultants, government research organizations, and the oil

and gas sector. Participants discussed the role of adaptation in climate risk management for society, ecosystems, and the oil and gas industry. This report builds on the workshop's findings.

The workshop and this publication are part of IPIECA's long-term initiative to promote both climate change understanding and engagement in developing solutions for mitigating risks to society and to the oil and gas industry. The workshop presentations—and all other IPIECA publications on climate change—can be downloaded from the IPIECA website at [www.ipieca.org](http://www.ipieca.org).

## Introduction

While a significant amount of attention surrounding climate change has been focused on mitigation strategies, a growing perspective has re-emerged on the necessary role of adaptation for climate risk management, in the context of society, infrastructure and

ecosystems. Understanding climate change risks and opportunities, and ways to incorporate them into broader risk management systems, is an integral part of the oil and gas industry's framework for business decisions.

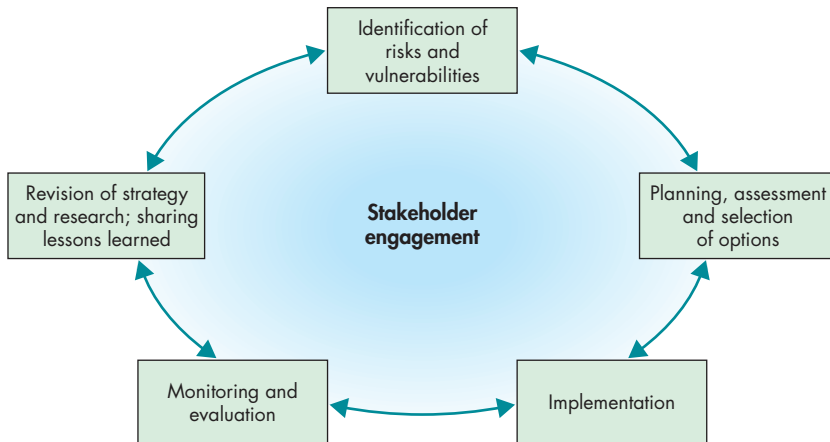


Developing an adaptation plan as part of a climate risk management strategy requires first identifying and evaluating the projections of potential impacts, the uncertainty involved, and how these projections modify current operating environments (see Figure 1). At the company level, a multidisciplinary team of stakeholders must be engaged in understanding vulnerabilities, evaluating risk, and providing feedback on the applicability of the proposed implementation plans. Whilst uncertainty surrounding projections from climate science will likely remain for the foreseeable future, investment decisions will need to be made by industry in the interim. With appropriate information, the oil and gas industry can conduct an assessment to evaluate where climate risks expose vulnerabilities in business operations and assets. Understanding these vulnerabilities leads to the development and implementation of adaptation strategies aimed at managing the risks. Subsequent efforts to monitor and



evaluate risks, as well as apply adaptive management responses, allow for the continual management and mitigation of risk. In practice, there may be iteration between these steps as learning increases about the risks and the effectiveness of the plans and actions.

**Figure 1** Generalized adaptation process



## Risk identification

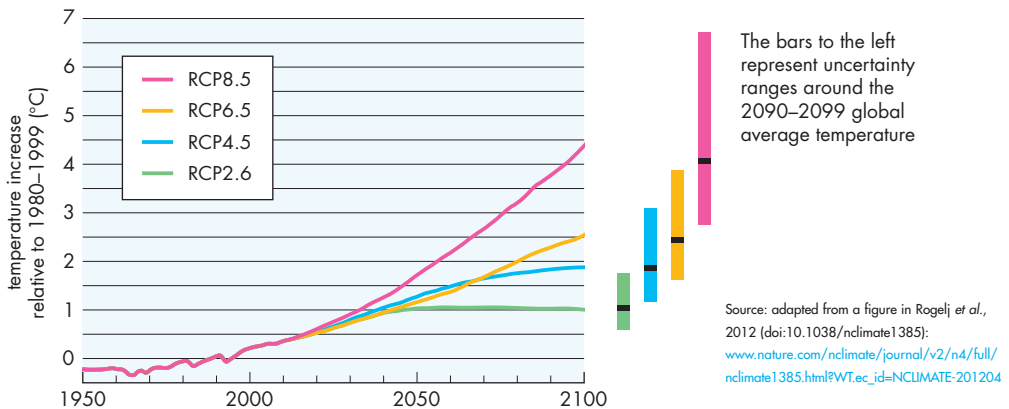
Climate change poses risks to society, infrastructure and ecosystems that vary across regions and arise from a diverse set of climate factors. Despite uncertainty in climate variability and diversity of future projections, indications are that additional changes to climate and its variability over the next three to four decades are inevitable regardless of mitigation scenarios (see Figure 2). Over this timeframe, adaptation to changing climates is likely to take place anyway irrespective of, or in addition to, any mitigation efforts. Identifying the risks of climate change to industry operations and assets provides an opportunity to develop business plans aimed at minimizing disruptions.

While temperature variations are the primary concern associated with climate change, the impacts associated with these changes, which include water scarcity, flooding, extreme weather and temperature events, sea level rise and food security, will likely be some of the most important effects for the oil and gas industry and society at large. The uncertainty in



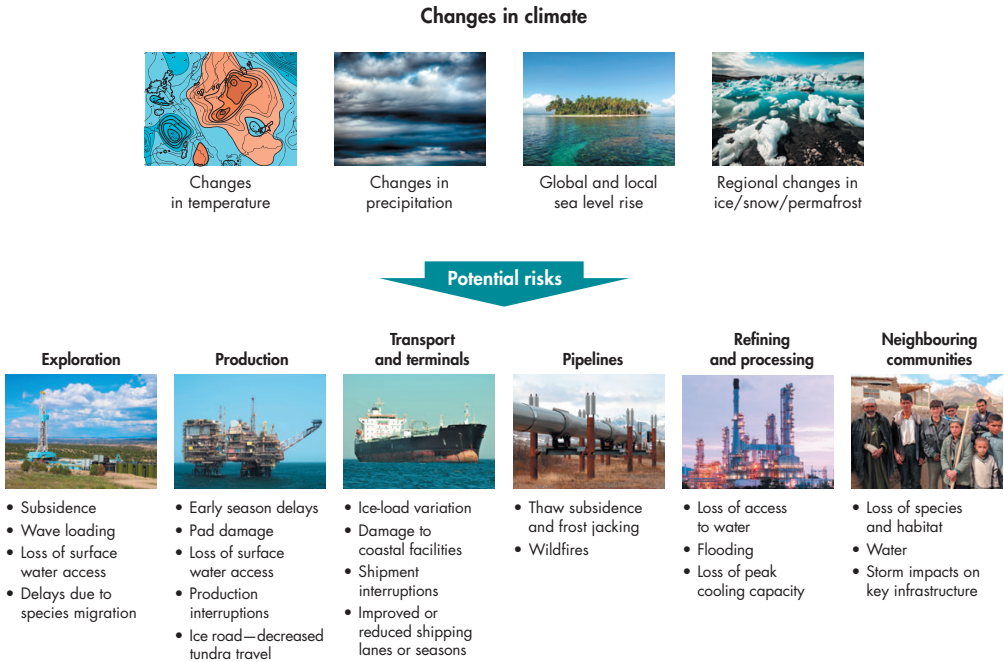
projecting future climate change, including changes in temperature and weather extremes, remains substantial, particularly for work that seeks to inform adaptation options on a local scale. Identification of climate risks therefore requires utilizing the range of projected outcomes, which may or may not have a common directionality to it (and which will vary by region of interest), to formulate a management plan.

**Figure 2** Historical and projected global surface temperatures for a range of future emissions scenarios





**Figure 3** Potential risks to oil and gas operations from changing climate



Source: adapted from Jan Dell's presentation

The oil and gas industry is identifying a range of risks from current and future climate variability (e.g. floods, sea level rise, extreme events, migratory shifts of species, permafrost thawing, water availability, etc.) to their operations, supporting infrastructure and the value chain (Figure 3). Examples include:

- reduced window of time for tundra travel due to increased permafrost melting;
- increased lightning strikes in northern latitudes, potentially causing damage to infrastructure and impacts on communities, particularly where electrical grounding is lacking or there is a greater susceptibility to wildfires;
- increased coastal erosion leading to a degradation of coastal barriers;

- changes in storm strength leading to increased wind speed and wave loading on offshore facilities;
- regional changes in precipitation pattern and frequency, altering the availability of water resources for operations and susceptibility to flooding of infrastructure; and
- reduced certainty regarding assumptions made about the efficiency of equipment, such as gas turbines.

An important consideration is to understand the climate risks to neighbours and communities who are outside the fence of a given company's operations and facilities. Oil and gas operations can be reliant on community infrastructure,

including electricity systems and infrastructure for water, transportation and communication at regional and urban scales. Investments to adapt inside the fence line may have limited value if surrounding communities and infrastructure are

not resilient. Working with local government in identifying vulnerabilities in the surrounding communities is also important from a staffing perspective, as this is where employees and their families usually reside.

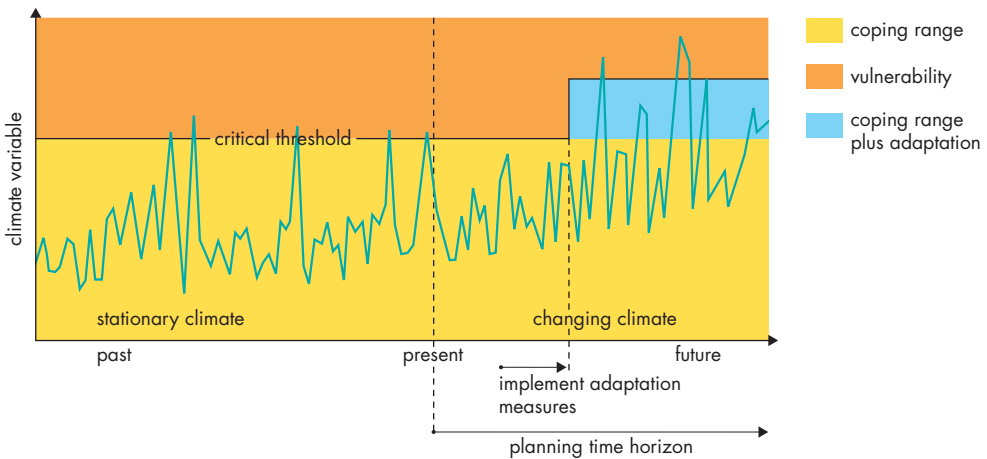
## Risk evaluation/assessment

Climate projections suggest that the future climate will be one in which various thresholds (e.g. temperature) will be exceeded on a more regular basis (Martin Parry's presentation— IPIECA, 2012; NOAA, 2012), thereby putting society at a greater risk of experiencing various outlier<sup>1</sup> events. (See Figure 4.) The oil and gas industry currently operates in a range of environments that are subjected to extremes (e.g. the arctic, deep water, hot arid regions,

etc.). Therefore, it is valuable for the industry to assess how climate change may alter the risks presented by these already challenging environments.

While climate change may have local benefits in some regions, adaptation planning is generally focused on understanding the risks from potentially hazardous situations. The process of risk assessment will involve understanding how

**Figure 4** Coping ranges, critical thresholds and vulnerability



Source: Richenda Connell presentation

<sup>1</sup> Outlier events are those considered to be beyond the extreme, i.e. events that are greater than two or three standard deviations from the average. An example would be the 2003 European summer heatwave, with temperatures a full six standard deviations from the norm.



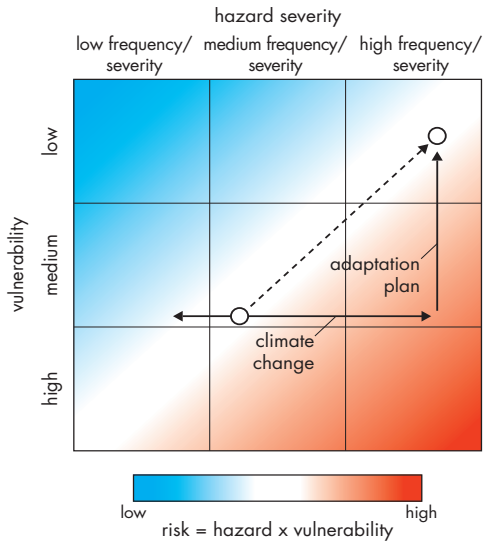
climate change will alter the severity of a given hazard by changing its severity frequency and/or intensity (see Figure 5). The remaining component of such an assessment is the determination of a project’s vulnerability to the hazard. The climate risk is then characterized by combining the hazard severity due to climate change with the asset’s vulnerability to this hazard. The associated adaptation response would therefore attempt to reduce the risk due to a change in climate by reducing the vulnerability of an operation or facility.

Impacts are local and projects are unique, hence risk assessments and adaptation planning should be performed at the local level to identify design and operational actions.

Important parameters that can go into an assessment of climate risks include:

- the location of the operation and/or facility;
- the type of facility (e.g. offshore platform, pipeline, refinery);
- facility design (e.g. appropriateness of codes and standards);
- the project lifetime;

**Figure 5** Climate risk assessment matrix



Source: adapted from Alison Brown’s presentation (slide 11)

- current environmental baseline conditions (e.g. ecosystem status; water availability);
- historical and current observations of climate variability; and
- the projected change in climate and environmental conditions, and the rate at which this will occur.

For example, a local change in precipitation frequency in the future may alter local water availability and the potential for flooding, but if the project lifetime is short, the associated risk may be lower than a specified threshold. Alternatively, the current change in lightning strikes at high latitudes, coupled with a lack of electrical grounding or susceptibility to wildfires, may be identified as a high risk to regional operations for a relevant location and timescale.

Assessment of climate risks allows companies to place the potential for business interruptions due to changes in climate alongside the other risks inherent in the oil and gas industry. The potential for overlap in these business and climate-related risks may make an integrated approach preferable. However, whether these assessments are run concurrently with other standard risk assessments, or as a stand-alone climate assessment, should be decided by the individual company.



With the arrival of new science, the assessment of climate risks will continue to be updated in the context of the criteria listed above. An important connection could be made between the atmospheric and oceanographic scientific communities and the classification societies (e.g. Det Norske Veritas—DNV) to facilitate how the science may influence rules and standards for infrastructure that could apply across the industry.

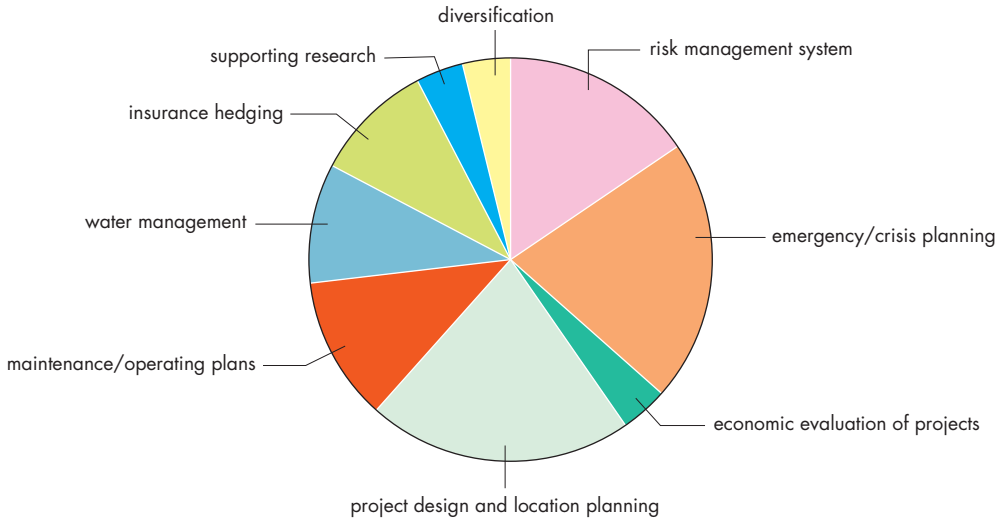
## Risk management

The oil and gas industry develops and deploys risk management practices for many of the risks, both above and below ground, that are ubiquitous in business operations. Changes in climate could add another dimension of complexity to these risks. Climate risk management therefore looks to develop adaptation plans that will mitigate and manage the risks identified and evaluated as being hazardous to business operations and facilities.

The process of identifying and assessing climate risks associated with a project can lead to a determination of ‘no-regrets’<sup>2</sup> adaptation plans. These no-regrets plans can define low cost actions to design resiliency into new projects and existing operations. As already noted, the uncertainty ranges of future climate projections increase significantly beyond the next three to four decades. Therefore, flexible but robust designs, together with adaptive management

<sup>2</sup> ‘No-regrets’ activities are those which offer mitigation of the risk, but would still be a chosen option even if the risk does not materialize.

**Figure 6** Incorporating climate change risk into key business decisions and practices



Source: Michelle O'keeffe (CDP) presentation, based on CDP Questionnaire response. Qualitative responses were analysed for a set of commonly identifiable 'practices', then the number of occurrences of each practice counted across all responses. NB: any single company response may have mentioned a number of different practices.

practices will be critical for managing climate risks and adapting to a range of impacts.

The oil and gas industry continues to adapt to climate risks by employing a myriad of risk management strategies (Figure 6), for example identifying alternative personnel and supply transportation methods to avoid disruptions. A broader form of energy supply diversification is occurring across the oil and gas industry with the development of new shale gas and tight oil resources, in a wider number of geographical areas, that can mitigate supply disruptions associated with severe weather events offshore.

Project design planning for offshore infrastructures could incorporate 'metocean' projections of future climate conditions (e.g.







wave and wind speed conditions) at the outset of development. These could inform not only the design of the assets, but also their most appropriate location and the emergency protocols required to keep personnel safe and avoid incidents. Insurance against weather-related risks may be a viable option for smaller oil and gas companies. Risk management systems can incorporate protocols and procedures to deal with unforeseen incidents and to periodically re-evaluate climate risks.

Companies responding to the Carbon Disclosure Project (CDP) disclose the strategies, both undertaken and in development, to deal with current and future climate variability. According to the 2011 results, 75% of responding oil and gas companies identified (one or more) significant physical climate change risks, with 96% of those physical risks being seen to have an impact on the companies' own operations (and the rest on the supply chain). Physical risks from cyclones,

sea level rise, and snow and ice were most commonly identified as high significance risks. Oil and gas companies stated that they integrate climate risks into their business strategy, although most of the companies did not specifically mention 'adaptation'.



## Reflection

The oil and gas industry is continuing to adapt its operations, facilities and risk management practices to deal with climate risks. Climate risk management and implementation of adaptation actions will require increasing internal capability, as well as enhancing the knowledge base of management personnel, design engineers and contractors. In addition, it may also require significant capital investments (for example plant modifications), particularly in the longer term. Adaptation planning for climate risk management involves identifying and evaluating risks, developing strategies to mitigate and manage risks, and subsequently implementing these strategies. Given the uncertainty and evolution of knowledge regarding climate impacts, the industry will continue to re-evaluate its preparedness to manage climate risks alongside the other inherent risks the oil and gas industry faces on a day-to-day basis.

Adaptation actions are being taken up by private actors, and the oil and gas industry is best placed to adapt their own infrastructure and operations to manage climate risks. Lessons learned and best practices are being shared within companies, and are now being reported externally via stakeholder disclosure processes (for example the Carbon Disclosure Project). Sharing with other industries, governments and society can broaden each organization's recognition and understanding of climate risks, and avoid missing easy adaptation options.

Beyond private actors, governments will also have important roles in adaptation planning. Certain critical infrastructure (for example



roads, bridges, water infrastructure) and land use development are in the domain of government regulation, and will therefore require planning, coordination and implementation by the relevant government authorities. Scientific research (receiving both governmental and non-governmental support) should prove valuable for enhancing understanding in climate science as well as developing engineering solutions. Continued support of observational networks of weather and climate variables should be important for both short- and long-term predictability of climate-related risks.

# Addressing adaptation in the oil and gas industry

An IPIECA Workshop, London, UK, 9 October 2012

## Workshop programme

- **Welcome**

*Chair: Rebecca Heaton, Shell*

- **Introduction**

*Workshop Chair: Billy Landuyt, ExxonMobil*

- **Session 1: Adaptation and climate change risk management**

*Chair: Billy Landuyt, ExxonMobil*

- Impacts of climate change and the challenge for adaptation (Martin Parry, Grantham Institute, Imperial College)
- Economics of adaptation (Richard Tol, University of Sussex)
- Discussion

- **Session 2: Assessing risks and opportunities for the oil and gas sector**

*Chair: Laura Verduzco, Chevron*

- Impacts to industry and oil and gas (Jan Dell, CH2M Hill)
- Impacts and strategies for energy infrastructure (Tom Wilbanks, Oak Ridge National Laboratory)
- Discussion

- **Session 3: Managing risks to the oil and gas sector**

*Chair: Mark Johnston, BP*

- Risks of physical climate change (Andreas Spiegel, SwissRe)
- Approaches to adaptation (Michelle O’Keeffe, Carbon Disclosure Project)
- Building climate resilience in the oil and gas industry: practical experiences (Richenda Connell, Acclimatise UK)
- Adapting to climate change: a regional climate model study of the Caucasus (Ralf Toumi, Imperial College)
- Discussion



● **Session 4: Industry case studies**

*Chair: Rebecca Heaton, Shell*

- Gulf coast and arctic asset studies (Karl Fennessey, ConocoPhillips)
- Research and development initiatives on impact vulnerability adaptation (Chris Campos, Petrobras)
- Assessment of risk of impacts to assets (Alison Brown, Shell)

● **Discussion panel**

*Chair: Arthur Lee, Chevron*

- Participants: Alison Brown, Shell; Chris Campos, Petrobras; Richenda Connell, Acclimatise UK; Jan Dell, CH2M Hill; Karl Fennessey, ConocoPhillips; Richard Tol, University of Sussex; Tom Wilbanks, Oak Ridge National Laboratory.

---

All presentations are available from the workshop webpage:

[www.ipieca.org/event/20120621/addressing-adaptation-oil-and-gas-industry](http://www.ipieca.org/event/20120621/addressing-adaptation-oil-and-gas-industry)

## References

IPIECA (2012). 'Addressing adaptation in the oil and gas industry'. An IPIECA workshop. [www.ipieca.org/event/20120621/addressing-adaptation-oil-and-gas-industry](http://www.ipieca.org/event/20120621/addressing-adaptation-oil-and-gas-industry)

NOAA (2012). National Oceanic and Atmospheric Administration (NOAA), U.S. Climate Extremes Index 2012, National Climatic Data Center. [www.ncdc.noaa.gov/extremes/cei/graph/1/01-12](http://www.ncdc.noaa.gov/extremes/cei/graph/1/01-12)

Bierbaum, Rosina *et al.* 2012. A comprehensive review of climate adaptation in the United States: more than before, but less than needed. *Mitigation and Adaptation Strategies for Global Change*, March 2013, Volume 18, Issue 3, pp 361-406. <http://rd.springer.com/article/10.1007%2Fs11027-012-9423-1#>





IPIECA is the global oil and gas industry association for environmental and social issues. It develops, shares and promotes good practices and knowledge to help the industry improve its environmental and social performance, and is the industry's principal channel of communication with the United Nations.

Through its member led working groups and executive leadership, IPIECA brings together the collective expertise of oil and gas companies and associations. Its unique position within the industry enables its members to respond effectively to key environmental and social issues.

## Members

Addax Petroleum	INPEX	PTT EP
BG Group	KPC	Qatargas
BP	Mærsk Oil	RasGas
Chevron	Marathon Oil	Repsol
CNOOC	Nexen	Saudi Aramco
ConocoPhillips	Noble Energy	Shell
EDF	NOC Libya	SNH
eni	Occidental	Statoil
ExxonMobil	OMV	Talisman
Hess	Petrobras	Total
Hunt Oil	Petronas	Tullow Oil
Husky Energy	Petrotrin	Woodside Energy

IPIECA also has an active global network of oil and gas industry association members. Please refer to our website for a full list.

## IPIECA

5th Floor, 209–215 Blackfriars Road, London SE1 8NL, United Kingdom  
Telephone: +44 (0)20 7633 2388 Facsimile: +44 (0)20 7633 2389  
E-mail: [info@ipieca.org](mailto:info@ipieca.org) Internet: [www.ipieca.org](http://www.ipieca.org)