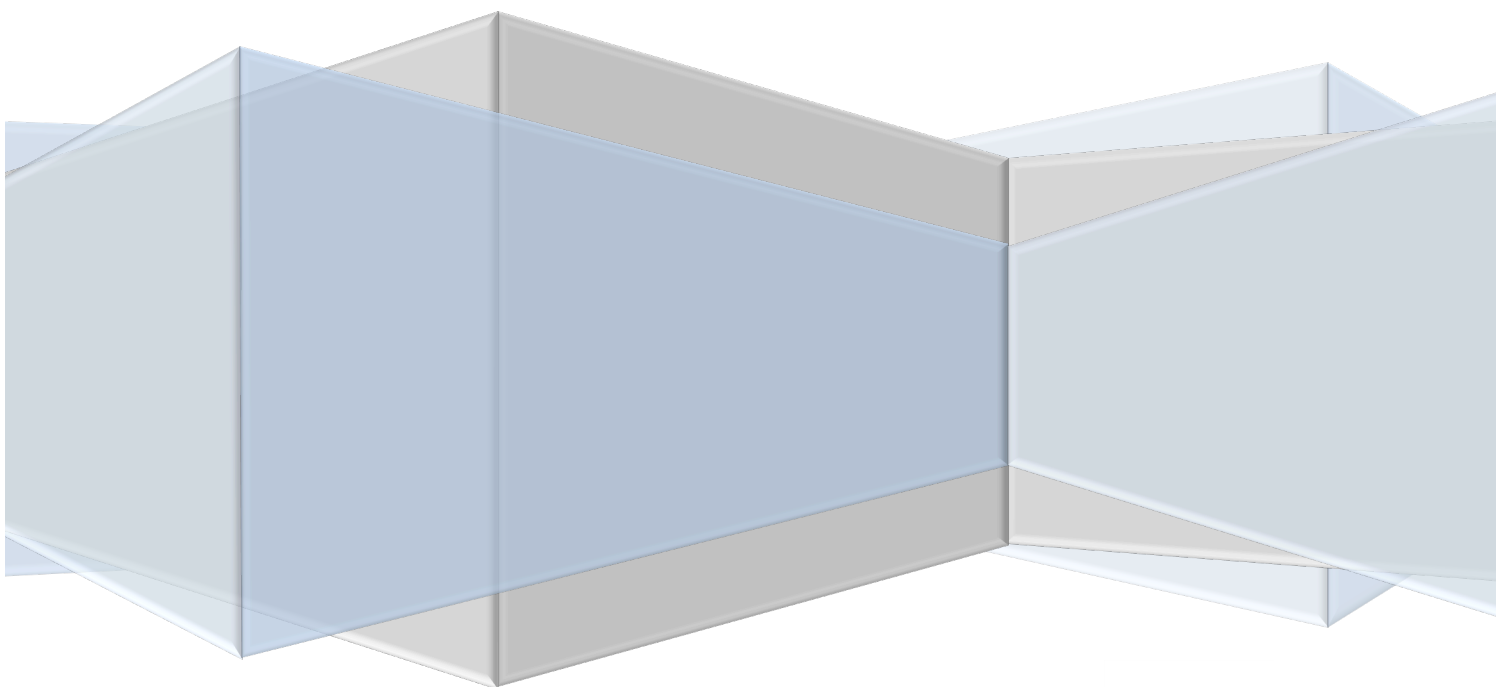


Rustat Conferences



# The Geopolitics of Oil and Energy

*Proceedings of the sixth Rustat Conference, Jesus College, Cambridge,  
Wednesday 4 April 2012*



With thanks to our sponsors



## **Contents**

**3. Participants list**

**6. Conference agenda**

**7. Summary**

**8. Introduction**

**9. Conference report:**

**9. Session one: The Global Macroeconomic Outlook for Hydrocarbons.**

**20. Session two: Geopolitics, Security and Access to Scarce Resources: Russia, China and Beyond**

**24. Session three: The Role of Technology and Research?**

**28. Session four: Risk and Volatility for Producers, Transporters, Consumers and Investors**

**30. Session five: Gas and Changing Hydrocarbon Markets**

**10. Sponsor Information**

# Rustat Conferences

## The Geopolitics of Oil and Energy

Jesus College, Cambridge    Wednesday, 4 April, 2012



Jesus College  
Cambridge

---

### Conference Participants

<b>Richard Bridge</b>	<i>Head, Government and Political Affairs</i>	<i>BP</i>
<b>Ben Caldecott</b>	<i>Analyst</i>	<i>Climate Change Capital</i>
<b>John Cornwell</b>	<i>Director</i>	<i>Rustat Conferences</i>
<b>James Crawford</b>	<i>Whewell Professor International Law</i>	<i>University of Cambridge</i>
<b>Dr Hakim Darbouche</b>	<i>Research Fellow</i>	<i>Oxford Institute of Energy Studies</i>
<b>Charles Emmerson</b>	<i>Senior Research Fellow</i>	<i>Chatham House</i>
<b>Ben Ferrari</b>	<i>Senior Advisor</i>	<i>The Climate Group</i>
<b>Dougal Goodman</b>	<i>Chief Executive</i>	<i>The Foundation for Science and Technology</i>
<b>Geoff Holmes</b>	<i>Senior Vice President</i>	<i>Talisman Energy</i>
<b>Edmund Hosker</b>	<i>Director, EU, International and Energy Security</i>	<i>DECC</i>
<b>Charlie Houston</b>	<i>Director Oil and Gas</i>	<i>Lloyds Banking Group</i>
<b>Rosalind Kainyah</b>	<i>Vice President, External Affairs &amp; CSR</i>	<i>Tullow Oil Plc</i>
<b>Ben Koppelman</b>	<i>Senior Policy Advisor</i>	<i>Royal Society</i>
<b>Amanda Kruvand</b>	<i>Energy Analyst</i>	<i>United States European Command - Nato Intelligence Fusion Centre</i>
<b>Dr Seung Lee</b>	<i>BPI</i>	<i>University of Cambridge</i>
<b>Terry Macalister</b>	<i>Energy Editor</i>	<i>The Guardian</i>
<b>Fergus Macleod</b>	<i>Group Head, Strategic Planning</i>	<i>BP</i>
<b>Dr Nazrin Mehdiyeva</b>	<i>Gas market analyst</i>	<i>PA Consulting Group</i>
<b>Alexander Naumov</b>	<i>Macroeconomist</i>	<i>BP</i>

<b>Pierre Noel</b>	<i>Research Associate and Director, Energy Policy Forum</i>	<i>Judge Business School</i>
<b>Rodolphe Olard</b>	<i>Managing Director, Global Head</i>	<i>ING Bank</i>
<b>Professor Peter Oppenheimer</b>	<i>Economist</i>	<i>former Fellow, Christ Church College, Oxford University</i>
<b>Lord Oxburgh KBE, FRS</b>	<i>former Chairman, Shell; former Head, Department of Earth Sciences, University of Cambridge; and Rector</i>	<i>Imperial College, London</i>
<b>Marc Ozawa</b>	<i>Docotral Student, Cambridge University and Director</i>	<i>TPG Energy</i>
<b>Frederick Pollack</b>	<i>Senior Analyst Energy Security</i>	<i>NATO Intelligence Fusion Centre</i>
<b>Stephanie Prior</b>	<i>Commercial Manager</i>	<i>Ophir Energy</i>
<b>Tim Reilly</b>	<i>Arctic Advisory Group - Director and researcher Scott Polar Research Institute</i>	<i>Scott Polar Research Institute, University of Cambridge</i>
<b>Stefan Ricketts</b>	<i>General Counsel</i>	<i>EnQuest</i>
<b>David Robson</b>	<i>Head, Energy and Environmental Foresight</i>	<i>Scottish Government</i>
<b>Dr Siddharth Saxena</b>	<i>Chairman, Cambridge Central Asia Forum; and Fellow</i>	<i>Jesus College, University of Cambridge</i>
<b>Paul Sheng</b>	<i>Global Leader in Energy and Gas</i>	<i>McKinsey &amp; Company</i>
<b>Chris Skrebowski</b>	<i>Editor, Petroleum Review; and Director</i>	<i>Peak Oil Consulting</i>
<b>Norman Smith</b>	<i>Oil Industry Specialist</i>	<i>Independent</i>
<b>Professor Paul Stevens</b>	<i>Senior Research Fellow</i>	<i>Chatham House</i>
<b>Robert Trice</b>	<i>Director</i>	<i>Hurricane Exploration Plc</i>
<b>Charles Whiddington</b>	<i>Partner</i>	<i>Field Fisher Waterhouse</i>
<b>Professor Ian White FREng</b>	<i>Van Eck Professor of Engineering; and Master</i>	<i>Jesus College, University pf Cambridge</i>
<b>Charles Woodburn</b>	<i>CEO</i>	<i>Expro</i>

**Professor Andy Woods**

*Head, BP Institute*

*BP Institute, University of  
Cambridge*

**Dr Shamil Midkhatovich Yenikeyeff** *Research Fellow*

*Oxford Institute of Energy  
Studies*



### 08.15–09.15: Registration and Refreshments – Prioress's Room, Cloister Court

Following registration participants make their way to the conference venue in Upper Hall by 09.30

### 09.30: Welcome - Professor Ian White, Master, Jesus College and Chair, Rustat Conferences

### 09.40–10.40: 1. Global Macroeconomic Outlook for Hydrocarbons

What are the major challenges and potential solutions to long-running problems? Will the gap between public and scientific opinion on climate change widen or narrow and what will this mean for regulation?

- **Chair: Professor Andy Woods** *Head, BP Institute, University of Cambridge*
- **Dr Alexander Naumov** *Macroeconomist, BP*
- **Chris Skrebowski** *founding Director, Peak Oil Consulting; and Consulting Editor, Petroleum Review*

### 10.40–11.40: 2. Geopolitics, Security and Access to Scarce Resources

Russia, the Arctic, and beyond: what are the implications for policy in UK, EU, United States, China, Russia and OPEC members?

- **Chair: Richard Bridge** *Head, Government and Political Affairs, BP*
- **Dr Shamil Midkhatovich Yenikeeff** *Research Fellow, Oxford Institute of Energy Studies*
- **Tim Reilly** *Co-Founder, Arctic Advisory Group; Researcher, Scott Polar Research Institute, University of Cambridge*

### 11.40–12.00: Break

### 12.00–13.00: 3. The Role of Technology and Research

How will research and technological innovation affect the geopolitics of energy in the short, medium and long terms? What are the policy implications for governments and industry?

- **Chair: Lord Oxburgh** *former Chairman, Shell; former Head, Department of Earth Sciences, University of Cambridge; and former Rector, Imperial College, London*
- **Professor Andy Woods** *Head, BP Institute, University of Cambridge*
- **Dr David Reiner** *University Senior Lecturer in Technology Policy, Cambridge Judge Business School*

### 13.00–13.50: Lunch - Master's Lodge, Jesus College

### 13.50–14.50: 4. Risk and Volatility for Producers, Transporters, Consumers and Investors

Current and future geopolitical scenarios in the Middle East, Mediterranean and beyond. What are the energy implications of the rise of Asia? What does this mean for business and government policy?

- **Chair: Dr Pierre Noël** *Director, Energy Policy Forum, Cambridge Judge Business School*
- **Professor Paul Stevens** *Senior Research Fellow, Energy, Chatham House*

### 15.00–15.10: Break

### 15.10–16.10: 5. Gas and Changing Hydrocarbon Markets

Changes to gas and oil markets: what are the implications for energy planning, business, markets, consumers, the environment and geopolitics? Europe and its changing demand profile; Russia and the Caspian basin. The influence of geopolitical situations on supply.

- **Chair: Professor Siddharth Saxena** *Chair, Cambridge Central Asia Forum*
- **Dr Pierre Noël** *Director, Energy Policy Forum, Cambridge Judge Business School*
- **Dr Nazrin Mehdiyeva** *Principal Consultant, Energy and Foreign Policy, PA Consulting Group*

### 16.10 - Closing Words



The Rustat Conferences thank BP for their support of this conference

## The Geopolitics of Oil and Energy – Summary

The Rustat Conference on the Geopolitics of Oil and Energy discussed, over five sessions, some of the key challenges that face the industry today.

In the first session Alexander Naumov from BP produced a series of slides that detailed the projected outlook for both the supply and demand of hydrocarbons over a 5, 10 and 20 year period. His report focused largely on the implications of new efficiency technologies and of the USA's decreasing reliance on OPEC since the discovery of extractable energy reserves in North America. His conclusion was that, despite increased efficiency and green agendas, carbon emissions would increase and far exceed the so-called 'safe' threshold of 450 parts per million.

Chris Skrebowski's projections were even more dire, and focused on his contention of the 'peak oil scenario'. The nub of his argument centred on the accuracy of the official OPEC reserve quotas. This sparked much debate among the plenary, and some participants wanted to know how Mr Skrebowski's projections incorporated the (perhaps unforeseen) role development of oil alternatives, such as LNG.

The second session focused on the access to resources and the geopolitical sensitivities dealing with Russia and China. It was Dr Shamil Midkhatovich Yenikeeff's contention that political instability in Russia made long term projections incredibly difficult, while Russia's power ensured it would remain a major player. Tim Reilly discussed access to the oil reserves in the Arctic and the processes of the Arctic Council and UNCLOS.

The third session, headed by Professor Andy Woods and Dr David Reiner, discussed technological advancements and what effect this would have on the geopolitics of oil. One of the main points of the session, brought up by Dr Reiner, was the incongruity between the timeframes of the energy sector and the technology sector: where 10-15 years would constitute the short term in the energy sector, but the longer term in the technology sector. Much of the discussion focused around the risk-averse culture of oil and energy companies and their reluctance to embrace new technology, culminating in a 'race to second' attitude.

Much of the discussion in the fourth session centred the turbulent time the oil and energy sector is going through at present, thanks in part to the instability caused by the Arab Spring. Professor Paul Stevens discussed the fallibility of projections made 20 years ago as to the demand for oil – he put this down to ever-rising oil prices. The discussion then focused on the price of oil and what technological advancements could be brought in (e.g. more efficient transportation) to lower supply-side costs.

The final session was on the role that gas would make on the changing hydrocarbon market. Dr Pierre Noel produced a series of slides that showed the 'golden age' of gas use in Europe lasted from 1965 to 2005, but now was falling sharply. During the discussion, a number of delegates asked the panel about the role of LNG, and how this would alter the oil and energy sector. Dr Nazrin Mehdiyeva outlined the role Russia and Gazprom would have on the hydrocarbon landscape.

## The Geopolitics of Oil and Energy - Introduction

Conference Chair: Professor Ian White FREng, Van Eck Professor of Engineering and Deputy Vice-Chancellor, University of Cambridge, and Master, Jesus College, Cambridge.

*What follows is an extract taken from the introduction made by Professor Ian White:*

Ladies and Gentlemen,

Today, we are to discuss a topic that in its widest sense has been of much interest to members of this College for many years. Malthus<sup>1</sup> conceived what has come to be known as the Malthusian Catastrophe: a forced return to subsistence-level conditions because of a proposition that population growth would outpace agricultural production, something that has been applied to oil also. Such a catastrophe, of course, has not happened, but the debate has continued, with predictions of potential oil shortage having been prominent for much of my life and only in recent years having been eclipsed by concerns relating to climate change. Against this, the famous *New York Times* science review of 2007, raised the claim that the Industrial Revolution had enabled the modern world to break out of the Malthusian growth mode, and many have argued that technology, coupled with valid national and international policies will allow continued growth in living standards.

In this meeting today therefore we are seeking to discuss this crucial area, dividing the discussion into five main themes, namely:

- (i) What is the macroeconomic outlook for hydrocarbons?
- (ii) How important will politics – and, one supposes, the national political agendas of those countries which are growing rapidly in economic terms such as China and India – be in the use of such resources?
- (iii) What can technology be expected to offer, and again what impact will that have on climate change (for example intensity of water usage in shale gas).
- (iv) What might the impact of all of this be on governments?
- (v) What might the impact of all this be on markets?

It should be stressed at the outset that this meeting owes its existence to support not just from the College, but also from BP whose Institute within the University also plays a most important role. We are particularly grateful for the support of key individuals including Professor George Joffé, Lord Oxburgh, Professor Andy Woods, Dr Pierre Noël, Dr Andy Leonard, Charlie Houston, and Dr Norman Smith. The involvement of sponsors, particularly from the corporate sector, has been a growing feature of the Rustat meetings in recent years and is something that the College is keen to engage with more in the future. Thank you so much – we are most grateful for your support for this meeting.

---

<sup>1</sup> The economist Rev. Thomas Robert Malthus (1766 -1834) was first a student, then, 1793, elected a fellow of Jesus College.



## Session One: The Global Macroeconomic Outlook for Hydrocarbons.

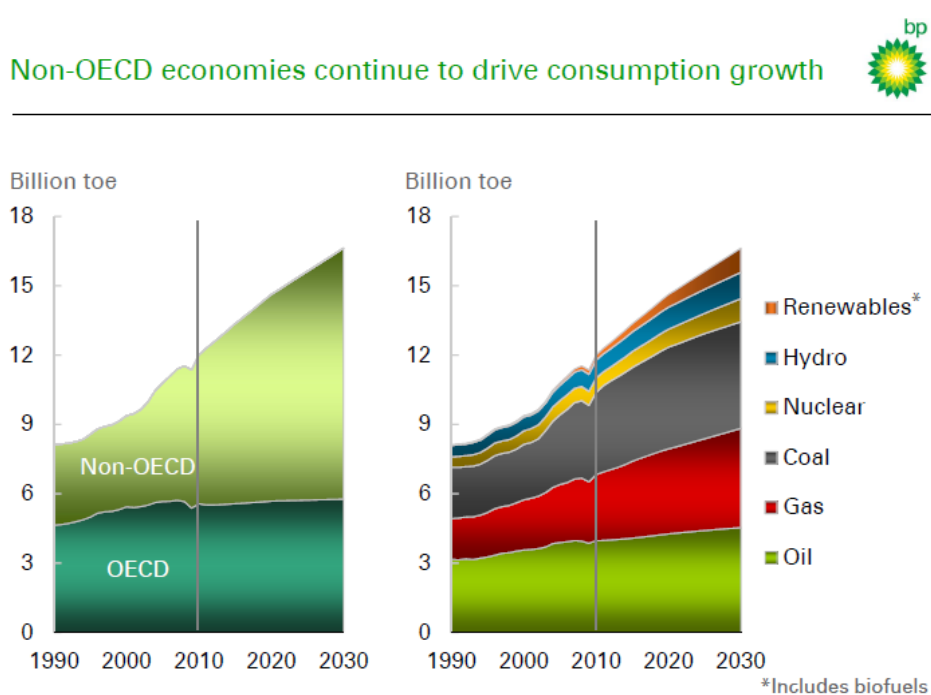
Chair: Professor Andy Woods Head, BP Institute, University of Cambridge, University of Cambridge.

Speaker: Alexander Naumov, Macroeconomist, BP

Speaker: Chris Skrebowski, founding Director, Peak Oil Consulting; and Consulting Editor, Petroleum Review

**Alexander Naumov** said the following slides represented what BP feels is the 'most likely course of action' – neither the worst case scenario, nor 'business as usual'.

Slide one:

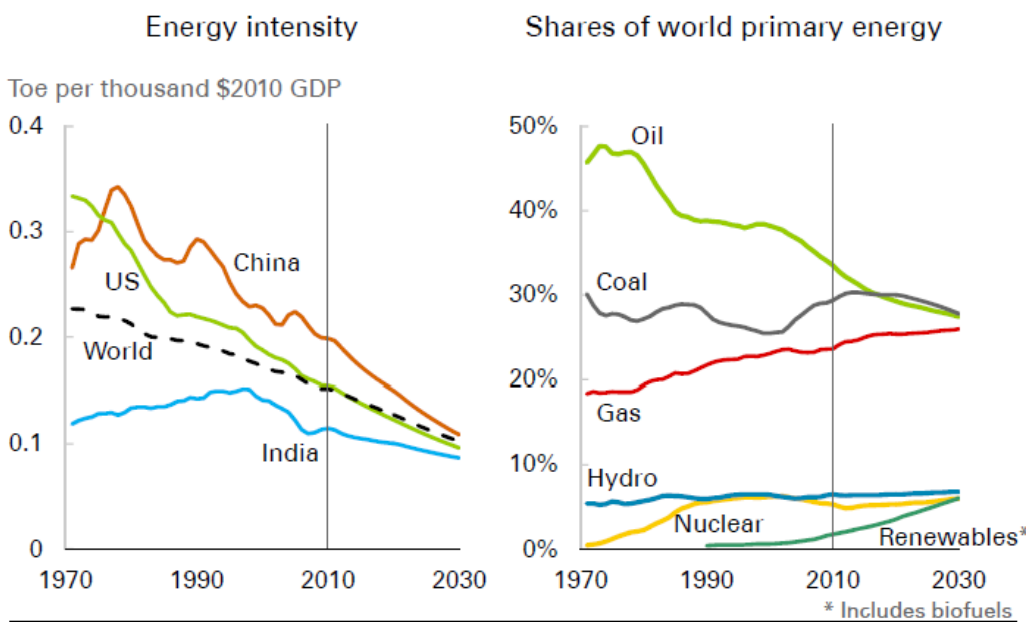


BP expects global energy demands to increase by 1.6% per year, down from 2% per year in the last 20 years. More than 95% of this growth in demand is predicted to come from the so-called developing nations. The developed nations are set to further diversify their energy sources. Of these sources (or fuels) the fastest growing is renewables, which BP predicts will grow at 8% per year. In addition, all non-fossil fuels combined account for 34% of the overall primary energy growth over the next 20 years. This is the first time since the industrial revolution that the sector's proportion has been larger than any of the others. In effect, it is an alert to the fact that the world has slowly started to decarbonise. Nevertheless, in 20 years' time still 80% of the world's energy will come from fossil fuels.

Two trends used to help determine the above forecasts are energy intensity and the division of energy shares.

Slide two:

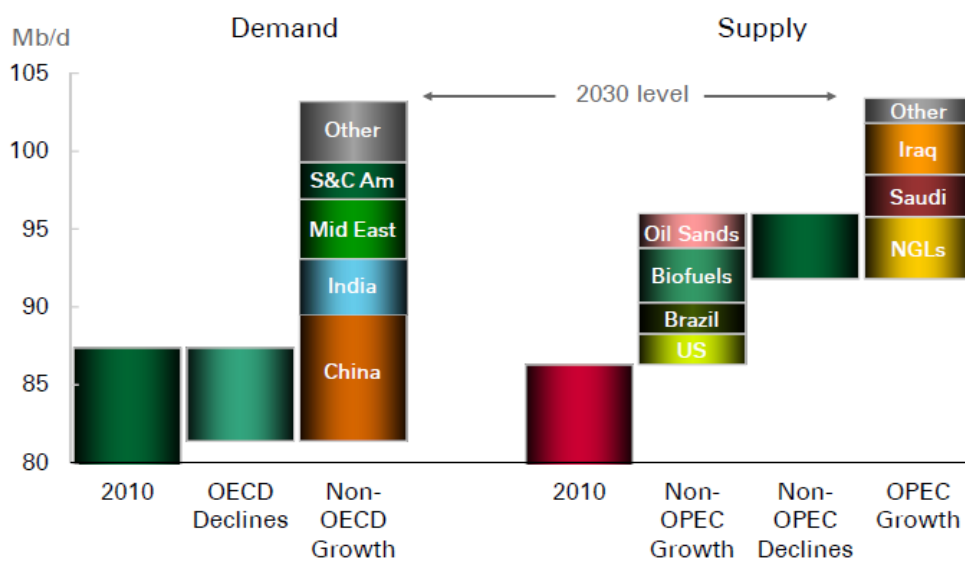
## Convergence of energy intensity and fuel shares



Energy intensity is a very broad measure of efficiency. The convergence of energy intensity around the world at lower and lower levels – facilitated by improved technology – means that the high rate of economic growth seen in developing countries need not be constrained by the cost of energy. In the second graph, the convergence of energy shares indicate that, by 2030, there will not be a single dominant world fuel, but rather two types: renewables, that will converge at around 7%; and fossil fuels, that will converge at approximately 27%.

Slide three

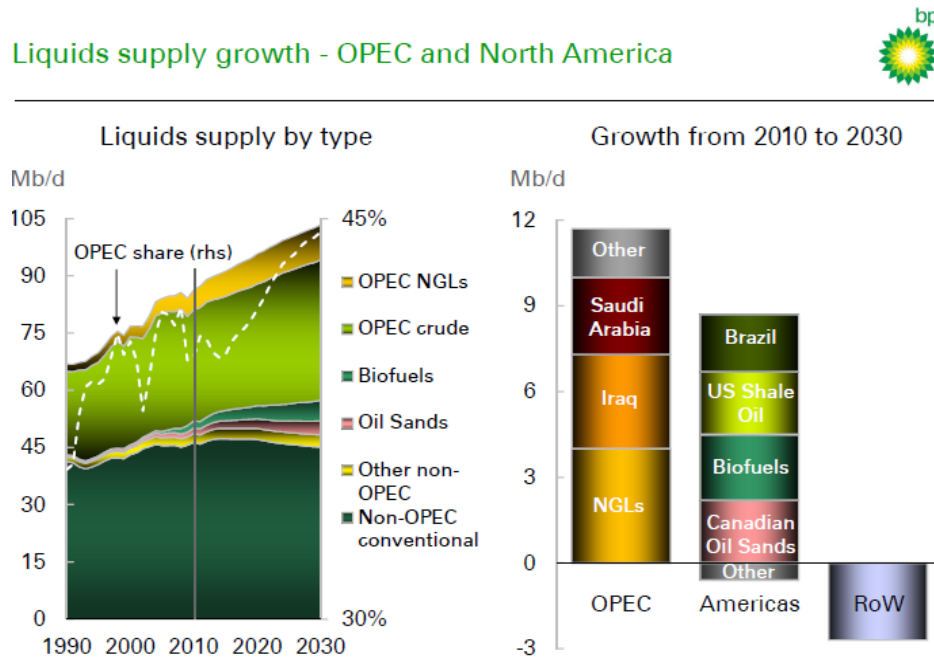
## Global liquids – demand and supply



BP predicts that by 2030, the world will demand 103 million barrels of oil per day. The increase of 16 million barrels per day from 2010 stems from the increasing demand in developing nations. In the developed world, the demand for liquid fuel is set to fall by 6 million barrels per day over the same period – according to the structured decline begun in 2005, when demand for oil reached its peak.

The implications on the supply side for these projections are as follows:

Slide four:

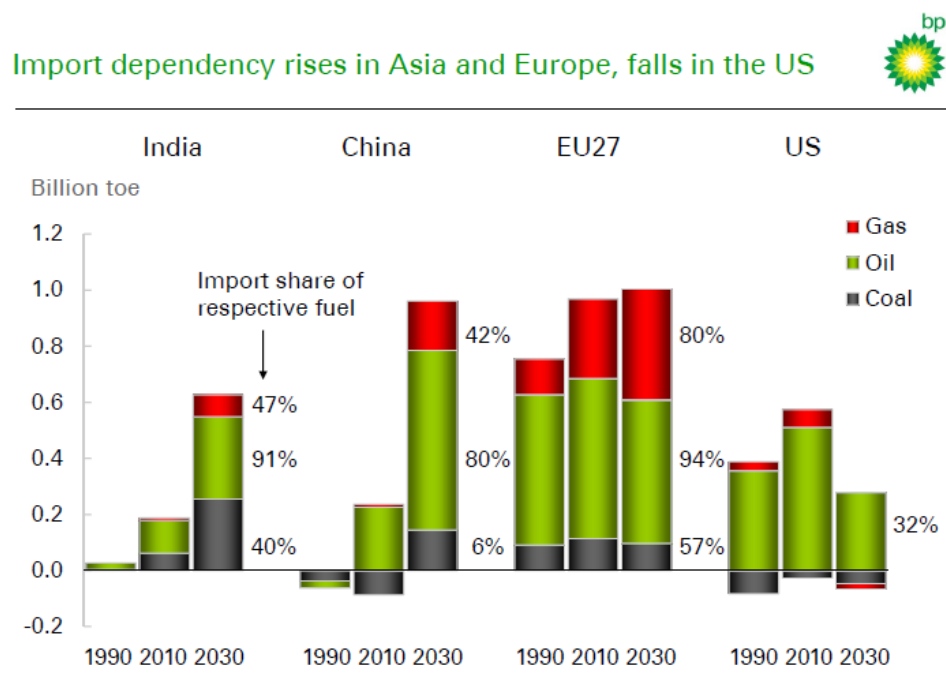


These projects are based on two main assumptions. Firstly, that overall energy efficiency in the Middle East and in OPEC will increase. And secondly, that domestic energy consumption, which is predominantly oil and gas based, will have to shift largely from oil to gas.

The rise in energy production in the Americas (as shown in the graph on the right) is facilitated, not simply by the physical location of reserves (as a geologist might tell you) but also by recent advances in drilling technologies and the competitive nature of the local markets.

The impact of the above forecasts on international import dependencies – and, therefore, the scope for the concomitant geopolitics – is outlined in the following slide.

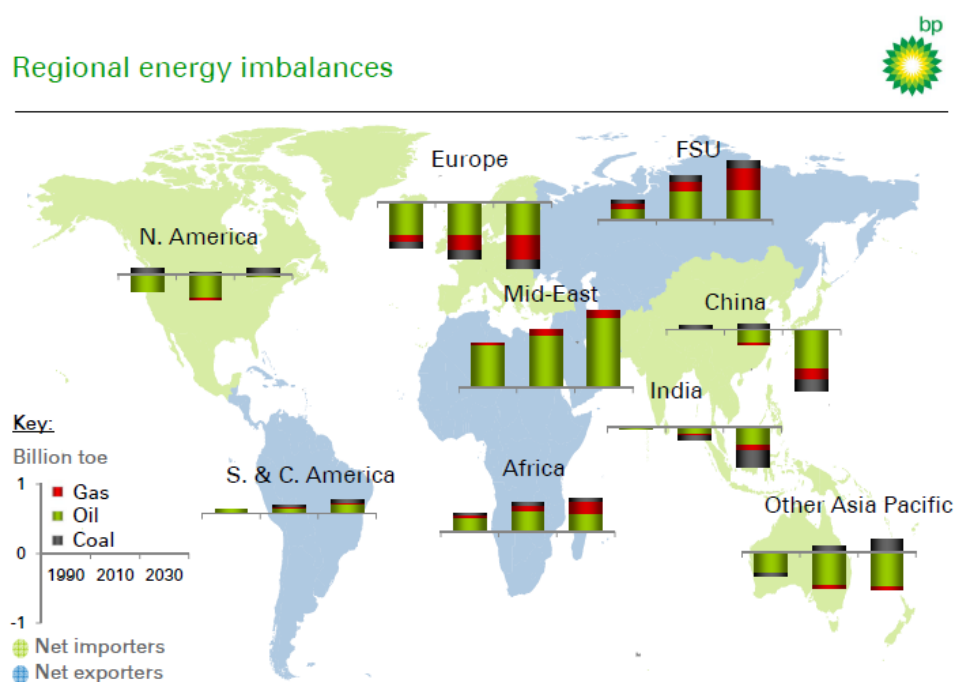
Slide five:



The rise in extractable energy reserves in the Americas will lead to a decrease in import dependency. However, on practically every other continent, import dependency is set to rise in the next 20 years. Though Indian and Chinese oil imports are set to skyrocket, it is Europe that, in terms of energy security issues, will be the most vulnerable

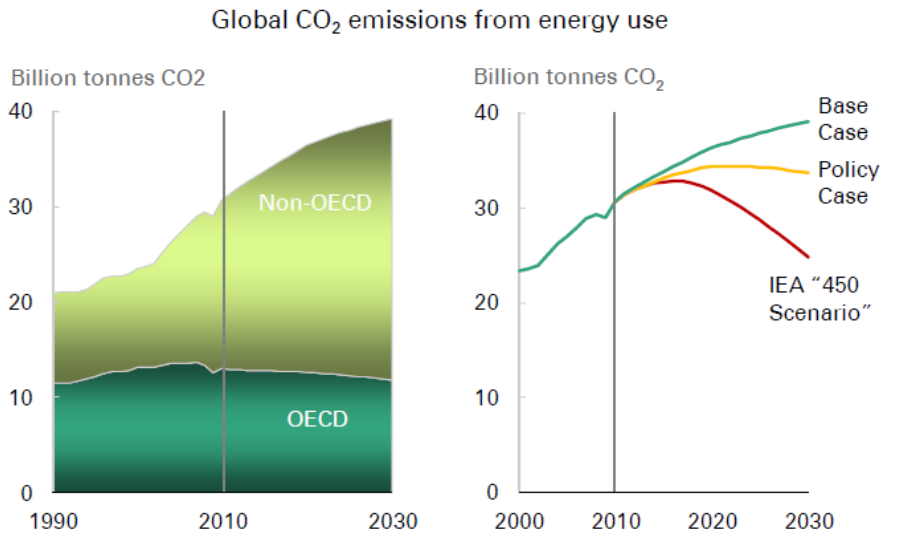
The imbalance of energy around the world is most clearly shown in the following graph.

Slide six:



Slide seven:

### Carbon emission growth slows, but more action is needed



The final slide shows the preceding projections' impact on carbon emission targets.

Not only are carbon emissions going to rise, but they will be a long way from the so-called 'safe' pass of 450 parts per million and the forecasted two degree rise in temperature. If the world is to meet that target, then much more is needed to be done.

**Chris Skrebowski** said he would focus on shorter-term projections than BP, feeling that after around five years forecasts become progressively unreliable.

Though unconventional, Mr Skrebowski thought it wise to begin by stating his conclusions, asking the plenary to decide over the duration of his talk whether or not he had legitimised their choice. His main contentions were:

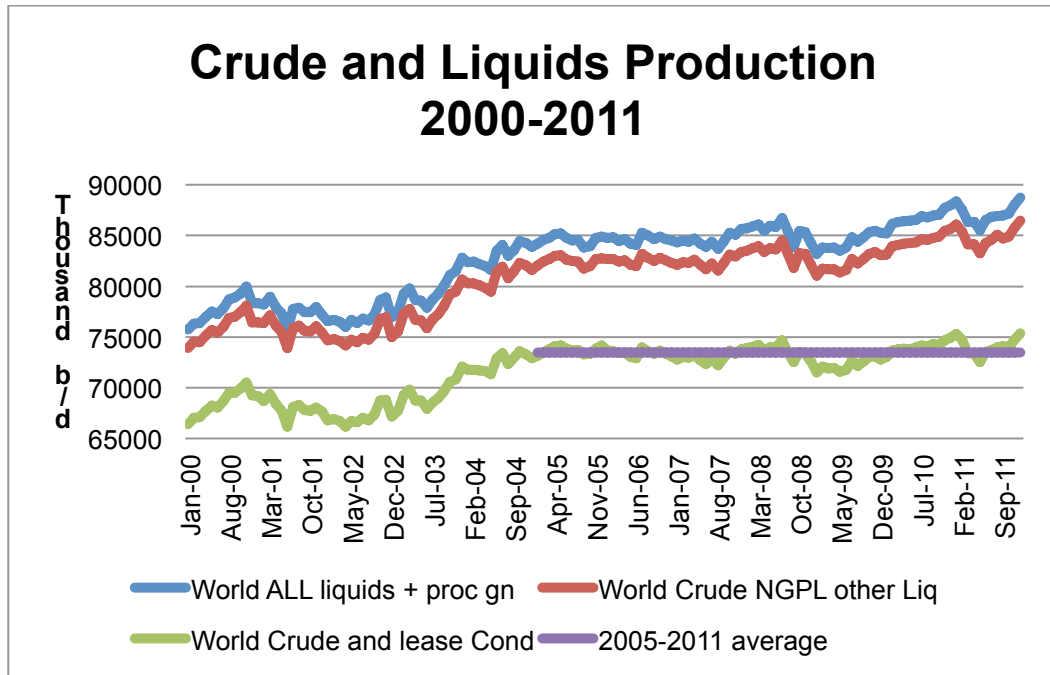
- The oil industry should focus far more on the availability of net exports (production minus local consumption), rather than on production.<sup>2</sup>
- Research into the sustainability of oil prices is required. At current prices consumers are sending \$4.3 billion per day or \$1.6 trillion per year to OPEC.
- The one possibly positive observation is that over recent months the US economy appears to have grown while reducing oil consumption. All previous experience has been that economic growth was associated with increased oil use.

Mr Skrebowski provided the plenary with the following slides:

---

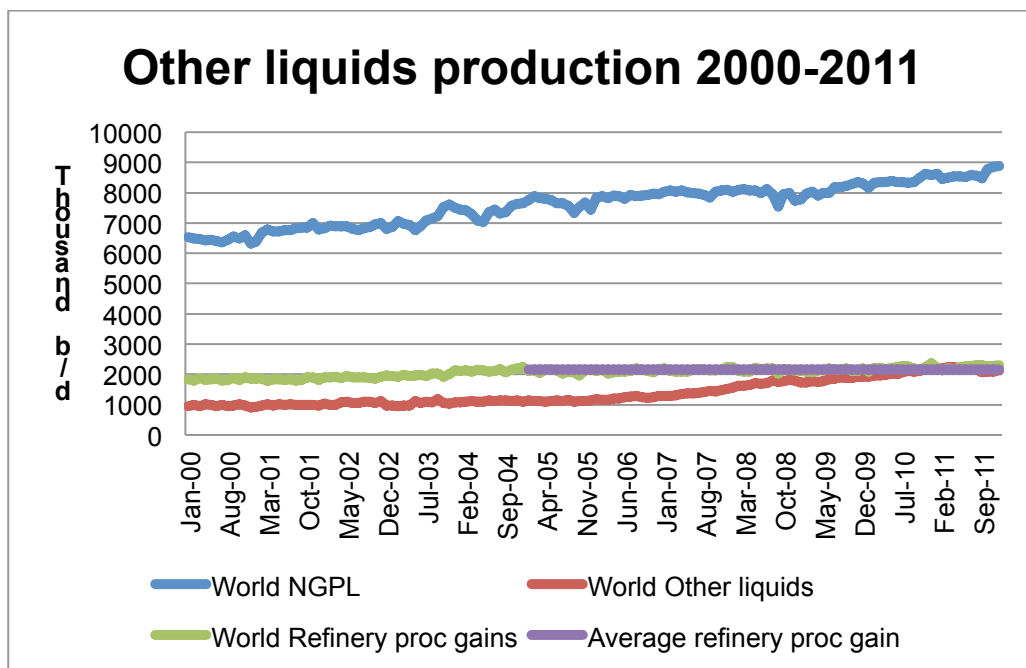
<sup>2</sup> Case in point: Saudi Arabia increased production by 1 million barrels per day in 2011 but exports were actually lower than in 2005 because of the rapid growth in local consumption.

Slide One:



From 2005 to date crude oil production averaged 73.45 million barrels per day and that over the last six years it held within a +/- 2.5% range – to all intents and purposes, crude oil production is flat lining.

Slide two:

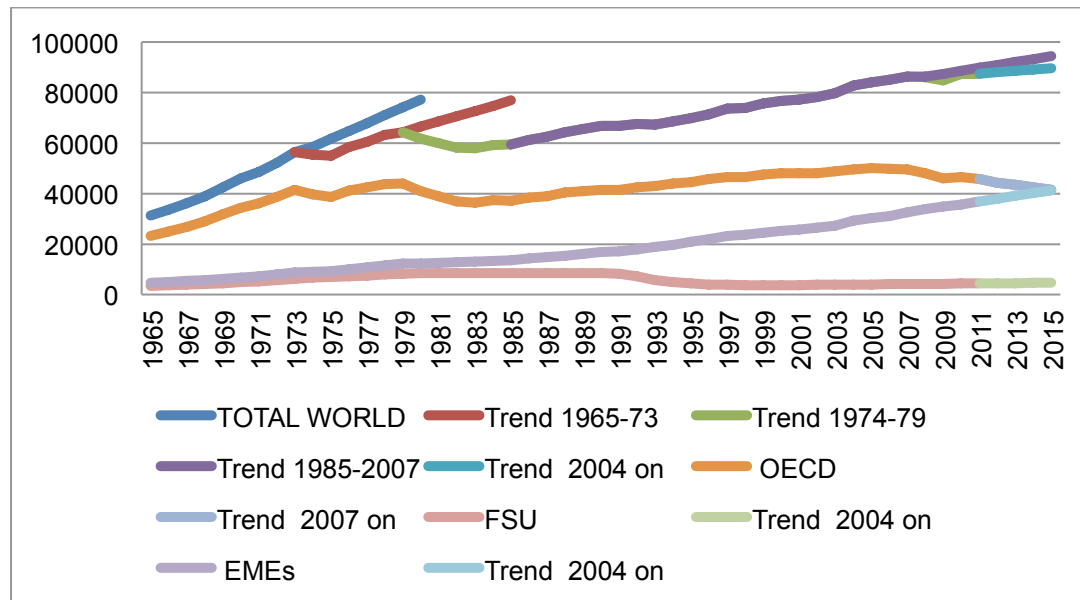


The second slide shows the way Natural Gas Plant Liquids, the liquids extracted from gas production streams has grown steadily, as have biofuels since 2005. The challenge is that with up to 80% of oil use being for transport fuels Natural Gas Liquids (predominantly Ethane, Propane and Butane) makes only a minor contribution to transport use being used for heat and petrochemicals feedstock. Biofuels are fuel

extenders but volumetric measurements flatter their importance as they have a significantly lower calorific value than oil-derived gasoline and diesel.

Slide three:

Global Oil Consumption 1965-2010 trended to 2015

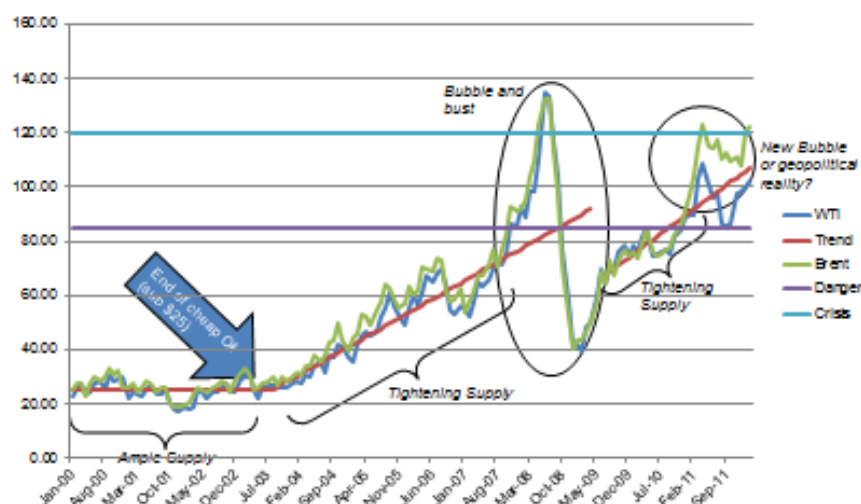


There is a slowing in demand growth after the first (1973/4) and second (1979/80) oil crises. There are some indications that demand may have slowed after 2008. It is too early to be certain particularly as demand from the 6 billion people living in the non-OECD world is set to overtake the demand from the 1 billion people living in the OECD world.

The year 2005 was the key turning point as crude output and refinery output moved onto a plateau they have remained on to date. Global export availability peaked in 2005 and has declined steadily since and production of crude and liquids by the Oil majors peaked either side of this date.

Slide three:

## High oil prices now needed to balance supply and demand - Again





Rustat Cambridge

4 April 2012



4 April 2012

Rustat Cambridge

Rustat Cambridge

Rustat Cambridge

## Rustat Cambridge



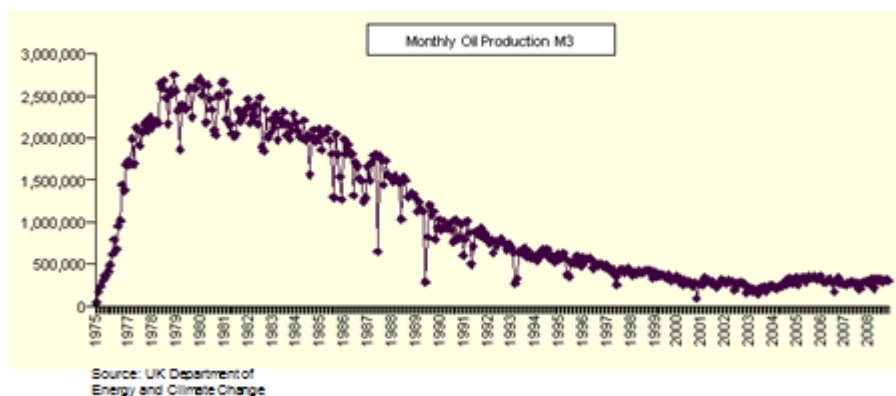


The future supply challenge graph shows what happens if demand continues to grow or even flattens out.

Slide six:



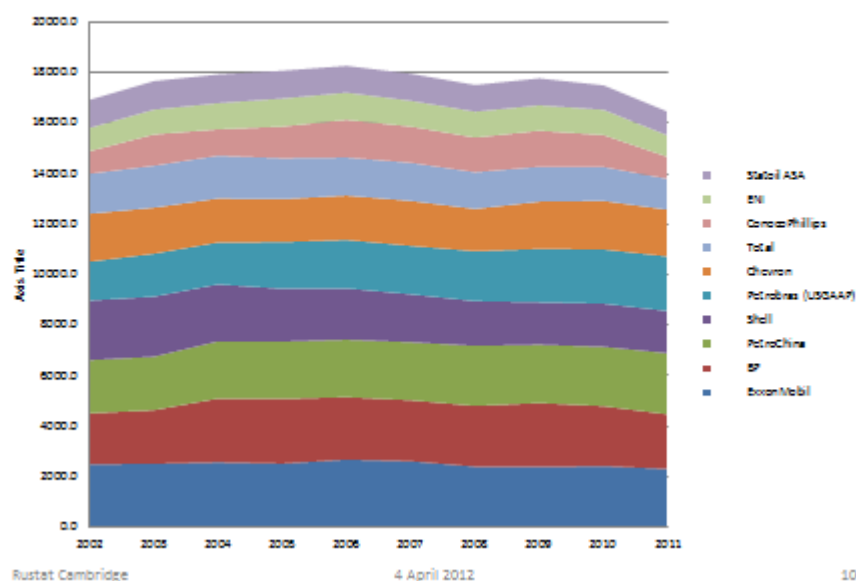
### North Sea –Forties field monthly production



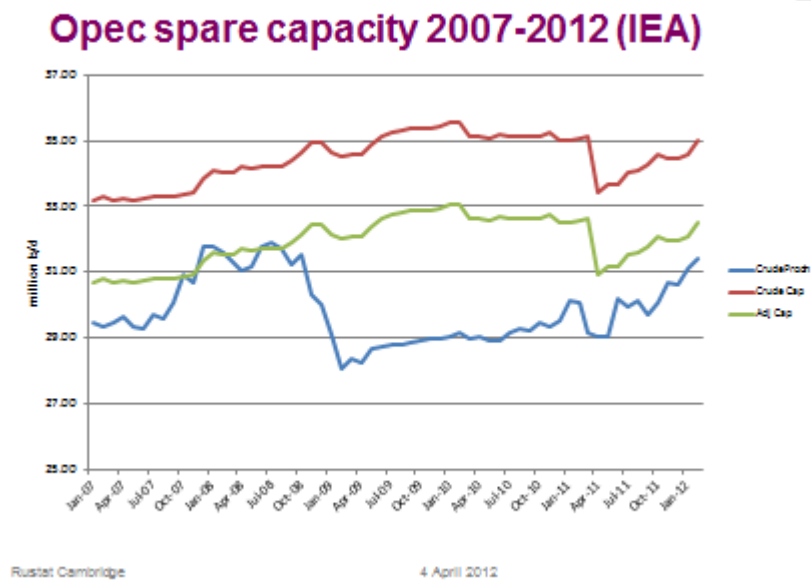
This slide shows a well-developed mature field continuing to flow at around 10% of peak flows. The Global challenge is too many mature and depleted fields and too few new fields at peak flows.

Slide seven:

### Big Oil failing to expand oil production after 2006



Slide eight:



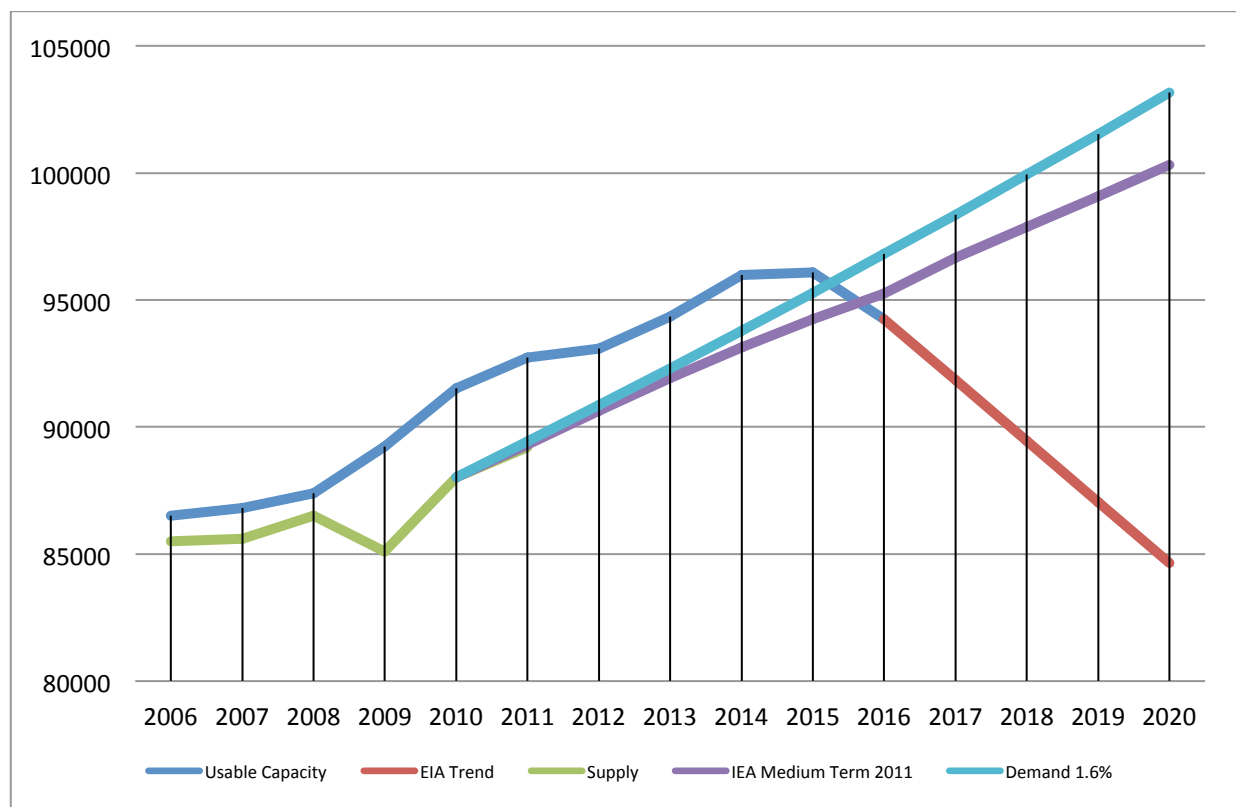
These two graphs show the declining oil flows from the 10 largest quoted oil companies with only two, PetroChina and Petrobras expanding production in 2011. The second shows that realistic OPEC spare capacity is now very small. When prices were high during and immediately following the 2008 crisis, it is Mr Skrebowski's contention that the incentive was in place for OPEC to produce at capacity. He believed they were, or at least were close to, so has revised downwards OPEC's potential accordingly.

Before discussing his final slide, Mr Skrebowski issued the following summary:

- Little or no incremental oil supply response
- Short term consequence: economic recession
- Longer term: attempt to expand supply and diversify fuels
- The key question is affordability

Slide nine:

## Usable Capacity, Supply and Demand to 2020



The final slide gives the best indication as to where Oil Phase Two might occur. Oil Phase two is described as the point when there is no supply increase and overall demand has to fall. This is likely to be in the 2015-2016 period although the economically weaker countries will experience it sooner as their demand falls to meet demand from economically stronger regions.

### Discussion

The two main areas of questioning regarded OPEC reserve quotas and the developing role of LNG. Though several members of the plenary queried the validity of the OPEC statistics, Mr Naumov was prompted to say that, though BP does not forecast reserves, he had seen nothing that would undermine the official numbers offered by OPEC.

With regards to LNG, some participants asked Mr Skrebowski how his projections coped with the shifting uses of fossil fuels, for example, possible developments in the use of LNG in transport.

Mr Skrebowski returned to the relative brevity of his projections. He said that the best one could do is watch the markets very closely, if a shift were to take place than this would be factored in, however, there was little or no evidence for it at the time.

The final questions were concerned with the use of the dollar as the standard unit of energy pricing (petrodollar).

## Session Two: Geopolitics, Security and Access to Scarce Resources: Russia, China and Beyond.

Chair: Richard Bridge, Head, Government and Political Affairs, BP

Speaker: Dr Shamil Midkhatovich Yenikeyeff, Research Fellow, Oxford Institute of Energy Studies

Speaker: Tim Reilly Co-Founder, Arctic Advisory Group; Researcher, Scott Polar Research Institute, University of Cambridge

**Dr Shamil Midkhatovich Yenikeyeff** said there were three topics that would be of paramount importance to investors in Russian energy:

- Political risks
- Privatisation
- Policy challenges from the Russian government

The political risks stem from the following dilemma: though Russia is ostensibly a democracy, its power structure is still the archetypal 'inverted pyramid', with the president controlling the country as a CEO. The stability of power relies on the mass-popularity of the president, Vladimir Putin. As this slips away, so the frailties of the Russian system are exposed.

Furthermore, it is the perception that corruption is rife and Putin has sent mixed messages to the elite – allegedly treating oligarchs and other HNWIs with both nepotism and suspicion. Both attitudes have been reported in the press.

As a result, often Russian oligarchs rely on the international legal system to protect their assets, or enter into partnerships with international companies as a safeguard.

The history and future of the privatisation of assets is also a contentious issue. In February 2012, Putin asked all Russian oligarchs to pay a one-off windfall tax. 'The reason why Putin brought this issue back on the agenda is to keep the people that benefited from Yeltsin's privatisation drives in line.'

With regard to a further privatised future, he said: 'There are two types of people currently pushing for privatisation in Russia today:'

'There are those people that say: "We need to have less government involvement in the oil and gas sectors because it is inefficient, it is corrupt and rife with nepotism." Then there are those conservatives, who say: "We should not privatise companies such as Rosneft, Rosneft should stay as it is because it is the government's eye in the oil sector as Gazprom is in the gas sector. Such companies promote Russia's interests abroad.'"

Further privatisation of the oil and gas sectors, if it does go ahead, will result in a new group of people playing a very major role in international oil and gas. It will have numerous knock-on implications for the Rosneft-Exxon Mobile group and for other future partnerships.

With regard to policy challenges: again this is an issue involving the conservatives and the liberals in the government, who see the energy sector as either the chief vehicle for modernisation in Russia, or its main obstacle. The conservatives say the oil and gas sector can help bring in the latest technological

advancements from overseas; the liberals say, ever since Putin came in, the government has capped the scope and profitability of the sector through taxation

Russia needs the influx of foreign technology to successfully exploit its oil reserves, especially those in the Siberian Arctic. However, to attract foreign interest and investment Russia needs a long-term taxation strategy. Unfortunately, this is not in place, and the future balance of tax regimes is uncertain.

With regard to the environmental concerns over Russia's role in the Arctic, it was Dr Yenikeeff's assumption that, though it may be an important consideration elsewhere, it was not so important in Russia.

**Tim Reilly:** 'In the Arctic, a lot of the issues that have been brought up today – security of supply, tax regimes, power shifts, the relationships between NOCs and IOCs – are coalescing in the region.'

In the 21<sup>st</sup> century so-called big oil is a political problem. This is because the majority of reserves are controlled by NOCs or politically sensitive states like Kirchner's Argentina, Putin's Russia and Ahmadinejad's Iran.

In the Arctic, councils such as the Arctic Council<sup>3</sup> and UNCLOS<sup>4</sup> will have to deal with renewed disputes over sovereignty and ownership in the course of the next ten years. Though there seems to be a relative calm at the moment, with the development of fossil fuel extraction in the area and as gas is transported over and through sovereign boundaries, the arguments over who owns what in the Arctic will become monetised and will come back to the fore.

The necessity for the oil industry to focus on the Arctic is clear. Though the technical challenges involved in extraction are great, the reserves are such that it still makes obvious economic sense.

'Ninety per cent of the region's gas reserves are in Russian sovereign territory, there is no debate about that – we must take their concerns over security very seriously'. Though the Arctic was once frozen and impossible to cross, now Russia has, in effect, a new border, and one open to attack and exploitation like any other.

For these reasons the geopolitical value of the Arctic is increasing – at the last Arctic council meeting Hilary Clinton was present; and the President has been in attendance as well. Britain, so far, has not been diplomatically involved. This should change.

The difference between the geopolitics of the Arctic and any other region is in the way meetings are structured. The UNCLOS meetings' modus operandi is one of consensual approach: 'There is no decision

---

<sup>3</sup> The Arctic Council is an advisory group consisting of:

- Canada
- Denmark; representing also the dependencies of
  - Greenland
  - Faroe Islands
- Finland
- Iceland
- Norway
- Russia
- Sweden
- United States

The primary mandate of the council is to protect the environment and promote development sustainability.

<sup>4</sup> UNCLOS (United Nations Convention on the Law of the Sea). The treaty is ratified by 60 nations. The United States is one notable exception.

making and no “shall we do this?” It’s all passive, it’s: “would anyone have an objection if we did this?” No one says anything and then you come back in six months and it’s done – it is a very efficient way of getting things done quickly. It also keeps everybody else out.’

In this way, the role of governance is essentially played by UNCLOS. Other countries believe a new treaty should be drawn up and a new way of governance should be settled upon. One important attitude comes from some countries in the EU and China which are not represented by the Arctic Council. They say that the arctic is a zone of peace and is one of paramount importance to mankind’s heritage and as such should belong to everyone – the more the Arctic Council exclude countries from the EU and China, the more this argument will be heard.

‘The Arctic is the most important area in the world [for another reason]. If Greenland becomes independent, which they wish too – presumably off the back of their reserves of natural gas – they will be the first aboriginal people to be given statehood. This has enormous implications around the world.’

Typically, the meeting of NOCs and IOCs has been characterised thus: the west brings the technology, China brings the money, and Russia brings the resources. The strategic advantage of partnerships between an NOC and an IOC can be seen in the recent collaboration between Rosneft and Exxon Mobile which has put the US in the heart of the Russian-controlled Arctic.

Further geopolitical factors are: the fact that the area is still a nuclear zone from the days of the cold war; and the potential of the Northwest Passage as a new trade route, incurring all the political spats concomitant with trade routes (cf. the Panama Canal, the Suez Crisis etc.).

The desire of UNCLOS, essentially, is to de-link the connection between territory and sovereignty.

## **Discussion**

The first delegate said the environmental concerns connected with exploiting the Arctic should be important to Britain. Despite Dr Yenikieff’s remarks about environmental concerns not being imperative to Russia, she felt this was not the case. ‘Environmental concerns are important to Russia and China as [disruption to the environment] will directly affect them<sup>5</sup> – in terms of their people and their economies’. Environmental protection might be a way to take sovereign control more seriously because, it was the delegate’s contention, studies have proven matters of preservation are better dealt with on a national level.

Tim Reilly said that, as yet, Britain’s foreign policy in the region had the primary mandate of ecological protection. With regards to Russia’s commitment to ecological issues, he added: I think Russia’s history is to blame.’

He said: ‘Under Stalin there was such a thing as “Soviet Man”, and the Russian north was where Soviet man conquered nature.’ Those under a certain age in Russia see that as unacceptable, especially since the oil spill in the Gulf of Mexico, but this is not universal.

Dr Yenikieff said that it was his intention not to suggest that Russia did not care about climate change or improving energy efficiency, but simply that it was not at the top of the agenda. He added, with the privatisation of the sector in Russia, there may come an added emphasis on green issues because they can be dealt with more efficiently than under state control.

---

<sup>5</sup> Projections suggest that rising sea levels will greatly affect low-land areas across Siberia and China.

Other delegates questioned the differences between western and eastern perceptions of competition in the market place. In western markets, competition is seen as a potentially positive thing, in the east, it was suggested, it is viewed as potentially negative.

Further questions regarded the role of scientific research in UNCLOS and the Arctic Council.

Tim Reilly said that science –and, incidentally, the law – plays a vitally important role in the formation of the Arctic Council’s policy making. ‘With scientific research into breeding patterns or migration or species mortality rate, the council can make policy. What they are determined to do is keep geopolitics out of it.’

## Session Three: The Role of Technology and Research.

Chair: Lord Oxburgh former Chairman, Shell; former Head, Department of Earth Sciences, University of Cambridge; and former Rector, Imperial College, London

Speaker: Professor Andy Woods Head, BP Institute, University of Cambridge

Speaker: Dr David Reiner University Senior Lecturer in Technology Policy, Cambridge Judge Business School

Professor Andy Woods: technology is not only able to increase yield and efficiency in the energy sector but, because of the range of types of resource, technology can also bring together resources to create a varied and more economically sound source of supply.

The two key technological advancements that have benefitted the extraction of conventional resources are improvements in drilling technology, where techniques have been developed to drill horizontal wells; and seismic imaging, which gives a much clearer idea of the extent and habitat of oil reserves.

With regard to amalgamating sources of supply, one technology becoming increasingly important is the advancement of deep-water wells, which can access oil reserves through 2-3km of water. Though these are expensive, costing a few hundreds of millions of dollars rather than the few tens of millions of dollars for conventional wells, in the future, when costs come down, these could seriously affect extraction strategies.

Two other important developments that will affect the oil industry are: the extraction and refinement of tar sands; and the advancement of steam flooding – though both of these practices are carbon expensive, they do have the potential to supply large yields.

Longer term developments in technology include the tapping of various forms of hydrocarbons in the earth:

In north Colorado there are enormous deposits of oil shales, which are essentially buried organic material that haven't been converted to oil but are in the geological process of converting to oil. People are looking at speeding up the rate of conversion by actually heating up the ground with electrodes. If you can heat up that ground by several hundred degrees you can convert that material into oil over a timescale of months. And that may sound ridiculous, but the energy cost associated with producing that oil represents perhaps 20% of the recovered energy.

Some of these outcomes are still decades away, but the process is moving forward all the time.

A concurrent technological challenge is to reduce CO<sub>2</sub> emissions. Therefore, carbon capture and storage developments are attracting a lot of attention and are potentially very important – especially with regard to its inherent costs and keeping them to a more viable level.

A lot of the technology is owned by service companies, but there is a shifting balance back toward NOCs and this is where matters of geopolitics come in to the fray.



**Dr David Reiner** framed the question thus: how will technology affect the geopolitics of oil and energy in the short, medium and long terms?

‘The problem then becomes “what do we mean by short, medium and long terms?”’.

In technological terms, short term means ‘now’; medium term means ‘within the next five years’; and longer term means ‘between 15-20 years.’ By contrast, in the oil and energy sector: short term means ‘within 10 years’; medium term means ‘10-25 years’; and long term means ‘25-50 years’. There is almost no overlap between the technological timeframe and the oil and gas timeframe.

From the perspective of climate change, the timeframes are even longer: centuries long.

If discussions of climate change are essentially discussions about coal, then discussions about oil are essentially discussions about transport. The need to electrify the transport system is critical. And over the medium term of 10-25 years, there is easily enough scope for this to happen.

With regard to demand, the emergence of smart grids and smart meters will be an important development. The UK government alone is prepared to pay out billions of pounds to have smart meters installed in people’s homes, without any clear indication of how people will respond to the technology. Though over the next ten years it is probable many mistakes will be made, over the longer terms, there are clear gains to be achieved.

With regard to research, the most reliable strain is economics. The social sciences are liable to exhibit ‘armchair observations’, rather than actually going out there and measuring what opinion is.

‘The final set of questions is to determine what we mean by energy.’ The first session stated that we used to talk about China as a coal exporter. That is no longer the case, since 2009 China is now a net importer of coal. In fact, as of 2012, it is the world’s largest importer of coal, and this is not to forget that China is still mining 3bn tonnes of its own coal a year and has enormous coal reserves.

With this in mind, Dr Reiner discussed the realistic benefits of ecological targets and efficiency drives:

‘If what we’re doing is having some sort of efficiency penalty associated with the burning of coal in those countries [such as China and India] which are already consuming coal as a non-secure resource, their inclination to make the generation of energy from coal more efficient is perhaps unlikely.’

As a cautionary note, Dr Reiner said finally: ‘There is a hubris involved with making projections.’ One must be sympathetic to the pressures placed upon energy analysts being forced to come up with these forecasts, but there is reason enough in the not-too-distant past to give us caution. In 2004 studies predicted – with the sector-typical 95% certainty rate – that in 2005 oil prices would be between \$18-\$14 per barrel; the price range was actually between \$45-\$60 per barrel.

Though these oil price projections were inaccurate, the same studies projected gas prices fairly accurately – but this is only because the study failed to miss both the hike and fall in prices during the interim.

We should, therefore, think carefully about how we use numbers.

## **Discussion**

Before opening the floor for debate, Lord Oxburgh shared a thought he once heard from a US senator:

There are three ways to lose money: horses, the fastest; loose living, the most enjoyable; and technology, the surest.

One delegate questioned the optimism that surrounds international technology transfer protocols.

Dr Reiner said these ideas were nothing new. It had been the idea that developed nations [of which Japan was the exponent he exemplified] would make innovative steps forward and then surrender advancements to the developing nations. 'That wasn't terribly resonant [in the 1980s] and I think it is less resonant now,' said Dr Reiner.

'At a certain point you wonder, given that the Chinese are building four or five power plants that are far more efficient than anything we have in this country, why we aren't talking about technology transfer *that way*.'

Professor Andy Woods said as a side note, because a lot of these large oil and gas projects are run by consortia rather than single companies, technology gets dispersed very quickly due to diverse ownership. It is not just about technological advancement, he added, nowadays it is about approaches.

Other delegates brought up the oil industry's historical aversion to embracing new technologies. Because of the risks, one delegate suggested there was 'always a race to be second.'

With regard to this, a question arose about the role of service-side companies like Schlumberger, and whether they might make better partnerships with NOCs than the major IOCs.

Professor Andy Woods agreed and said that he felt this was 'already apparent.'

Further questions revolved around intercontinental basins and how the intellectual understanding of these deposits was still in its infancy. Though technological advancements such as horizontal multi-stage fracking has opened these reserves up for exploitation, there is a lack of understanding from geologists and geophysicists as to what hydrocarbon potential they actually contain – the intellectual understanding, it seems, has not caught up with the technological innovation. The conclusion was that 'more minds' were needed in that area to better understand, map and potentially exploit these formations.

Trust issues were also discussed, with Dr Reiner suggesting that, within the oil sector, though there was a lot of trust from scientists and university reports, but the closer one gets to governments the less trust there seems to be. This imbalance, whatever the reasons for it, should be addressed.

Another delegate questioned the ease with which major IOCs can share technological information: 'It would be like the man from Coca-Cola sharing his secrets with the man from Pepsi – it's just not likely.' The consensus was that it is starting to happen, and several examples were cited, but that such freedom in the transfer of information will take time.

Returning to the Arctic, some delegates stressed the need for companies to collaborate in this area. 'Exploration of the Arctic is more difficult than exploration of outer space,' one delegate remarked, "and for it to be a success there needs to be an international space station in the Arctic, as it were, so technology can be transferred easily.'

Lord Oxburgh said that the role of technology in the energy sectors is both 'nebulous and complicated,' and he reminded the plenary how the term 'reserves' is used in oil and gas:

The definition of a quotable reserve is that it is a quantity of oil or gas that can be extracted and transported to market commercially under the current economic conditions. In other words if the economic conditions change then what was a reserve before is no longer a reserve – you just can't economically get it out. So, although finding more stuff in the ground is important, new technology can come along and make something that was previously uneconomic economic.

## Session Four: Risk and Volatility for Producers, Transporters, Consumers and Investors

Chair: Dr Pierre Noel, Director, Energy Policy Reform, Cambridge Judge Business School

Speaker: Professor Paul Stevens, Senior research Fellow, energy, Chatham House

**Professor Paul Stevens** said the energy market has not been this uncertain since the 1970s. He said the content of his talk would deal with three issues:

- Supply
- Demand
- Trade

With regards to supply there are short-term issues and long-term issues. Short term supply is incredibly tight: 'Last year we lost Syria and South Sudan (at the cost of 5 million barrels a day), and effectively Yemen and Libya.'

'Against this context the EU, in its wisdom, decided to enforce an embargo on oil from Iran – the people who made this decision knew nothing about the oil industry, nor did they bother to talk to anyone from the oil industry.' The result is a \$15 price increase on the barrel.

If Saudi Arabia step in to fill this gap, then oil production will be approaching maximum capacity, a dangerous situation because 'Iran is not the only geopolitical game in town.'

The Arab Spring has already caused a massive increase in the price of oil. But if it leads to greater democracy, and by extension greater levels of transparency, what will be the implication on respective governments' depletion policies?

Professor Stevens posed the question: 'Is a greater level of democracy in the region likely to speed up the rate of depletion or slow it down?' History suggests it will speed it up, with democracies tending to favour privatisation and IOCs over state control and NOCs.

With regard to demand: 'Conventional wisdom says that the most growth in oil demand will come from Asia.'

In fact, most demand will come specifically from the MICs (Middle East, India and China). Each has a history of high subsidisation, but this is changing, and consumers will need to pay more in the future (price rises have already started in India and China, but in those countries affected by the Arab Spring price increase has been artificially slow due to their current political sensitivity).

In the 1970s forecasters predicted that oil demand in the so-called developed nations would rise practically indefinitely. They were wrong because they underestimated the effect of rising prices. So, as this slowed oil demand in the US, Europe and Japan, rising prices will similarly cool demand in the MICs.

'If we were to come back in 20 years' time – presuming I could get my zimmer frame up the stairs – I suspect we will look at the numbers and the demand is nothing like what was forecast.'

With regards to trade: many consider the US's import dependency to reduce dramatically. The implication of this on US foreign policy – which, arguably, has been shaped around protection of supply – is uncertain.

It should not affect oil price in theory. The oil market is an interconnected system: 'Even if the United States didn't import a single barrel of oil from the Middle East, if the oil price is \$120 a barrel in the Persian Gulf, it is \$120 a barrel in the US.'

The US government could impose subsidy on oil barrel price, but would the electorate accept the added taxation?

## **Discussion**

The first delegate described the correlation between energy use and population. On that basis, he said it was reasonable to suggest that global demand will follow population increase and therefore the growth trend in forecasted figures was perhaps more accurate than Professor Stevens contested.

Professor Stevens did not disagree with the delegate's reasoning, but said that this was energy consumption, not demand for oil. His assumption was that price rises would diversify energy sources.

Several delegates said that infrastructure costs (oil transportation etc.) could be cut and this could lower the overall barrel price.

Another mentioned different 'oil swap' schemes that could be incorporated. Professor Stevens thought this was a good idea, but felt he was unable to comment on logistics of them in any great detail.

With regard to Professor Stevens' comments on the Arab Spring, one delegate questioned the progression from democracy that Stevens implied was inevitable (i.e. whether added transparency, further privatisation, and quicker depletion policies, were concomitant with democracy). Professor Stevens said he wanted to propose two extreme scenarios: 'business as usual', and 'total regime change'. He said that his projection was not what he felt was certain to occur, but what would happen in the 'total regime change' scenario.

When pressed on this, Professor Stevens said: 'It doesn't really matter which model of democracy you choose – the Islamic model, or the political model or whatever - it is in the nature of democracies that someone stands up and says: "vote for me and I'll give you...".'

One delegate suggested a real world model of the development of Professor Stevens' theories is Libya, and that IOCs should go on a PR offensive to demonstrate their transparency to the Libyan people.

Professor Stevens said 'of course, there is one other outcome, and that is the new democracies may ignite a new sense of resource nationalism.'

Dr Pierre Noel said 'studies have shown that all regime change – whatever the regime and whatever it changes to - is always very very bad for oil production and capacity for many years.'

Another area of discussion was on the future US foreign policy. One delegate said that the interconnectedness of world import and export markets would mean that, though the US would not import so much oil, they would still require enormous amounts of imports from sensitive areas like China and the Middle East.

## Session Five: Gas and Changing Hydrocarbon Markets

Chair: Professor Siddharth Saxena, Chair, Cambridge Central Asia Forum

Speaker: Dr Pierre Noel, Director, Energy Policy Forum, Cambridge Judge Business School

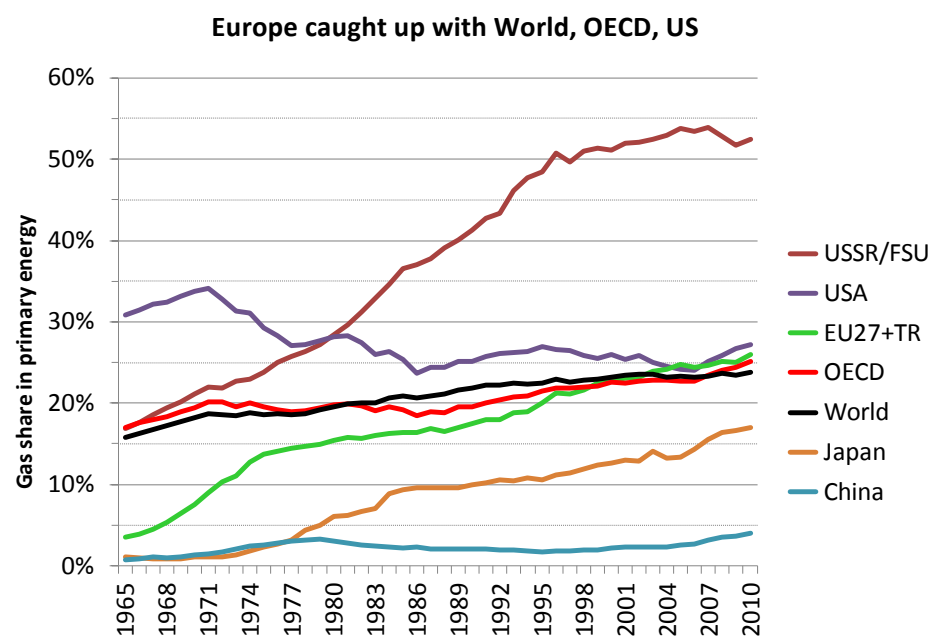
Speaker: Dr Nazrin Mehdiyeva, Principal Consultant, Energy and Foreign Policy, PA Consulting Group

**Professor Siddharth Saxena** spoke about the political sensitivity of gas, and described its position in the energy sector as a 'game changer'.

**Dr Pierre Noel** presented the plenary with a series slides. He said that the main messages in his presentation would be:

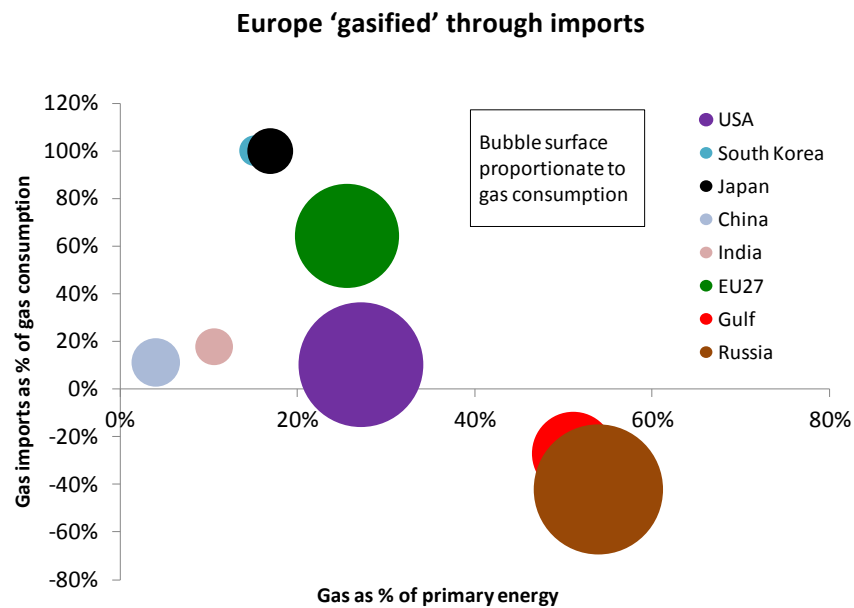
- The gasification of Europe (1965-2005) has been remarkable – but demand is now declining.
- Europe is becoming part of a global gas “system”, which is growing and changing fast.
- Market forces should first create a Eurasian gas market, promoting a price convergence between NWE and Asian spot price...
- The market should then re-integrate North America into the global market. Thus putting long-term pressure on the Euro-Asia price.
- High prices, renewables' deployment and weak carbon price create a very difficult situation for gas.

The golden age of gas in Europe ran between 1965 and 2005:



Source: BP Statistical Review (2011)

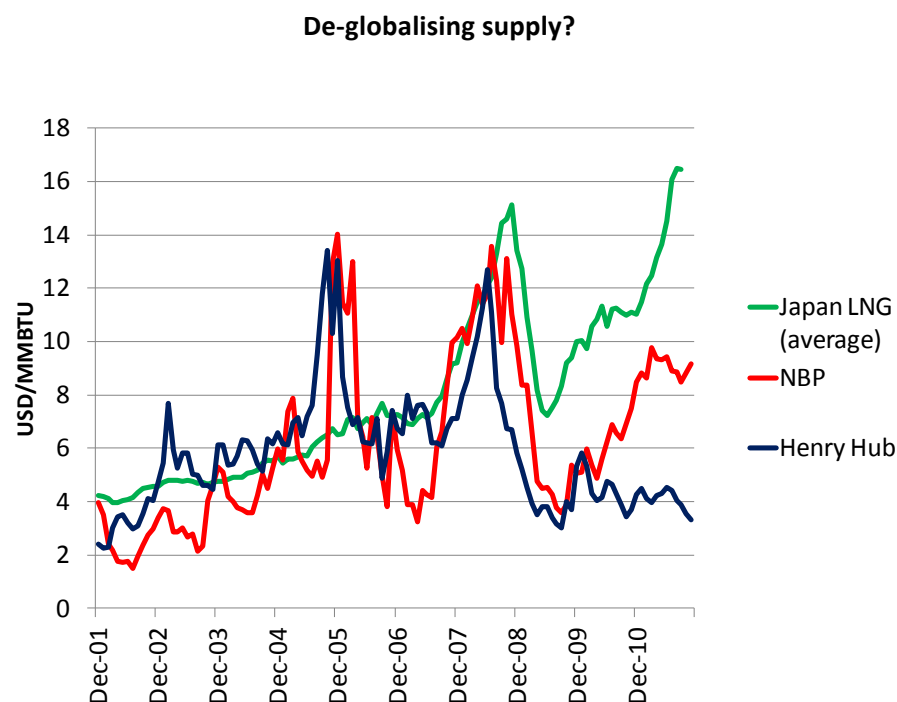
The remarkable thing about Europe is that it is gasified through large import relationships. Normally, those countries where gas is the prime energy are themselves producers of gas. Mainland Europe is the exception to this, importing 50% of all the gas imports in the world:



Figures for 2010

Source: BP Statistical Review (2011)

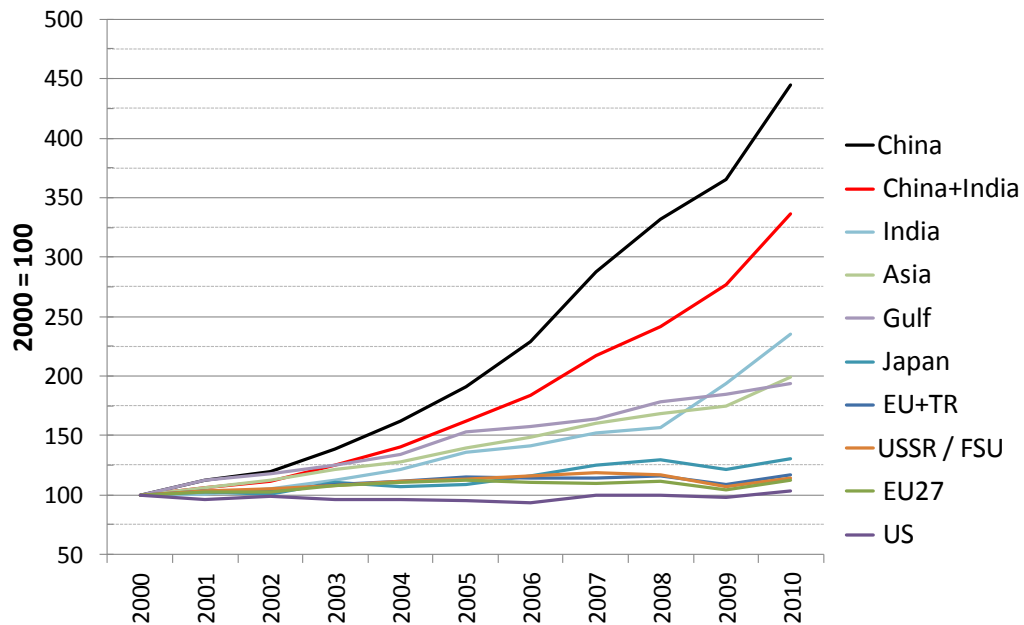
The European gas supply system is globalising – even if it may not appear so at first glance. The following graph plots the price points of LNG from Japan, NBP from Britain and Henry Hub from the US:



Source: Bloomberg

However market forces will bring these price points together again. A wave of LNG has come into Europe market largely from Qatar since 2005. Furthermore, demand is booming in Asia – a process sped up by Fukushima, which has led to gas once destined for the UK to be rerouted back to Japan.

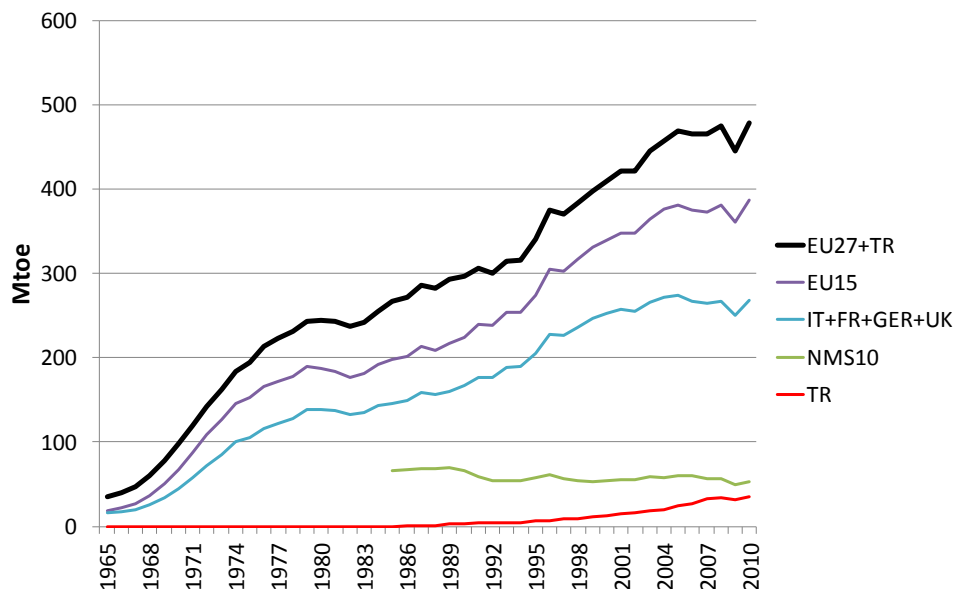
### Strong demand growth from Asia and the Gulf



Source: BP Statistical Review (2011)

This is in contrast to demand levels in Europe, which peaked in 2005, at the end of the so-called 'Golden Age' of gas.

### EU: gas demand peaked in 2005



Source: BP Statistical Review (2011)

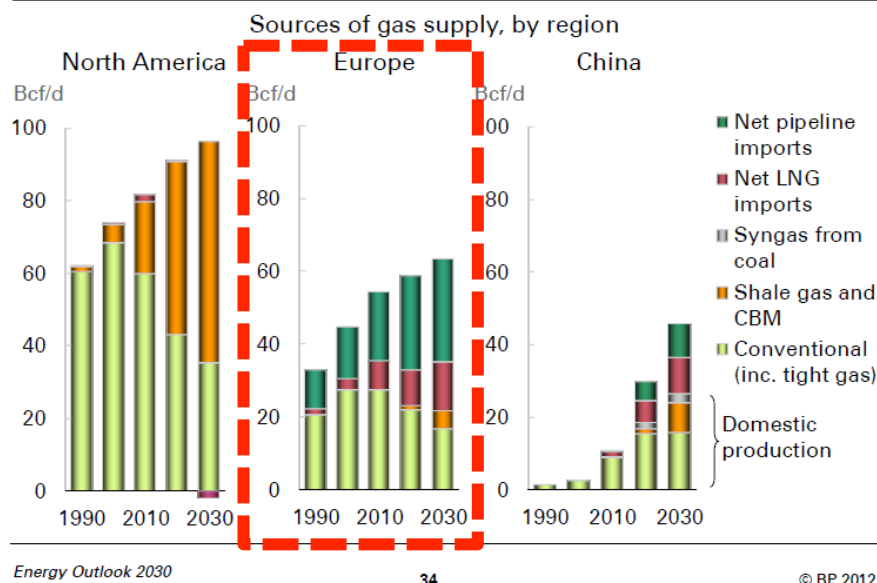
Since that p  
ever increas  
demand uni

ing an  
e in



## 2010-2030

- Consumption up by 100bcm
  - Idem IEA 'Golden Age'
- Conv. prod. down by 100bcm
  - IEA 'Golden Age': - 70bcm
- About 40bcm shale+CBM
- Imports up by 160bcm
  - IEA 'Golden Age': 140bcm
- Pipeline imports grow nearly as quickly as LNG imports
- Power is key to demand growth – mainly through fuel substitution



Dr Pierre Noel said:

Europe has quietly given up on its carbon policy, and replaced it with a renewable deployment policy which, for gas, has far more adverse consequences because it will depress the carbon price. This has always maintained the competitiveness of coal against gas. In effect, gas will be squeezed by directly and indirectly subsidised coal on the one hand, and very heavily subsidised renewables on the other.

An example of this is already happening in Spain, where the rise of coal and wind exactly compensate the decline in gas production.

**Dr Nazrin Mehdiyeva** said she would look at the basics of Russian energy strategy. 'The two agendas that Russia has been consistently pursuing are: organisational stability and political manoeuvrability.'

Russian relations fall into three bands: relations with the CIS (former Soviet) states; relations with Europe; and relations with Asian-Pacific countries.

With regard to CIS states: Russia has shown little propensity to compromise with these countries with regard to energy supply. Putin described this as: 'Russia's refusal to succumb to the dictate of transit states.' A policy exemplified in the aggressive nature of Gazprom's involvement in the history of Russian-Ukrainian gas disputes.

Further animosity can be seen in the undervaluing of the Ukrainian infrastructure by Gazprom. Ukraine values its own grid at \$20bn, Moscow claims it is \$10bn – but this is just the latest example of Russia pursuing a policy that routinely undervalues Ukrainian infrastructure.

If the north stream pipeline is fully expanded (not to the added 55% proposed by the second pipeline, but to the 400% projected when third and fourth lines are laid down), the Kremlin says that the value of the Ukrainian transit will reduce to zero.

Though the visibility in the media of the Russian-Ukrainian disputes has diminished recently, the conflict is still very much ongoing, and in February 2012, tensions flared over gas supply to Ukraine from Gazprom.

The disagreement highlighted two things:

- The increased ability of the Kremlin and Gazprom to use the security of supply argument- whereby due to Ukraine's instability as a gas transit country, Russia needs to augment its own supply to protect itself from shortages.
- The inability of Gazprom to ramp up its own supply quickly.

The focus for Russia in Europe therefore is very much on building new pipelines, and not just diversifying, but by diverting away from CIS transit states.

'What the Energy Strategy for 2030 says is probably true: by 2030 Europe will be the primary market for Russian gas.' This is not to say that there will be no diversification, simply that the exports to the European market will stay largely stable at 165 bcm, and then grow incrementally until it reaches 189-190bcm by 2030, when it is expected to plateau.

This is in sharp contrast to what we can expect in the Asia-Pacific region, which is set to rise sharply. Since Fukushima the scope of the market in the region is far larger than it has been in the past. In the future, we can expect Russian gas to comprise roughly 20% of the Asia-Pacific gas import market, either in conventional gas or LNG – this is as a result of the consistency with which Russia has prepared the way for the region's expanding market. Gazprom itself has released statements predicting that 2017-2018 would be a good time for them to enter the Asia-Pacific market so expect gas lines and LNG projects to materialise soon.

## **Discussion**

One delegate questioned Dr Pierre Noel's comparison of oil and gas, saying that he felt the analysis failed to represent the different capabilities of the two fuels for producing electricity. Furthermore, in a country like the UK, with its commitment to wind energy – the output of which has the propensity to dip dramatically – he suspected that gas-powered energy plants would be incorporated to redress the balance and maintain an adequate level of power.

Dr Pierre Noel's said, in Germany, where there is already an established wind energy programme, most of the swing is counteracted by coal and lignite plants.

The delegate disagreed. 'I'm sorry, most of the swing in Germany is made up for by the European grid imports.'

Dr Pierre Noel repudiated this. The balance of the renewables (which in Germany is solar as well as wind) is made up mostly by coal and lignite –they have very little gas.

Another delegate suggested that in Dr Pierre Noel's projections, when he spoke about falling demand for gas, he had not factored in the price drop connected to falling demand and, therefore, the rejuvenated interest this will bring about in gas.

Dr Pierre Noel said: 'As gas prices collapse, people switch to gas in electricity dispatch decisions and that brings the price of coal down, so coal catches up.'

What will have an enormous impact on the balance of coal and gas use is the 'heavy-handed' intervention by the Obama administration that intends to remove a number of coal-generated gigawatts from the system for political reasons.

A delegate asked Dr Nazrin Mehdiyeva whether she felt the arrival of Novotek will affect Gazprom.

Dr Nazrin Mehdiyeva: Novotek will not make a lot of difference to Gazprom's position as Russia's gas exporter. No matter who is in the Kremlin, it is a widely held belief that gas exports are best dealt with when controlled by a single company.

Another delegate asked how they felt, post Fukushima, that Germany's nuclear exit strategy would affect the gas market. Dr Pierre Noel said that the impact would be zero: 'there are currently 10 gigawatts' of coal power plants being built in Germany, there are no gas power plants being built.'

With regards to the British reticence to nuclear, Dr Pierre Noel said that 'if the renewables fail to deliver and the nuclear plants are not replaced with nuclear, then the UK will have more gas for longer'.

Dr Nazrin Mehdiyeva was questioned on Gazprom's plans in those areas of the globe that she had not directly dealt with in her presentation (Australia, the middle east, etc.). She said that Russia very much considers itself a European power. As such it does not want to ruin its market share in Europe, so growth in other areas will be incremental. Asia will be more profitable, and so there will be expansion there but this will not be at the cost of surrendering their position in Europe.

# Rustat Conferences

## The Geopolitics of Oil and Energy

Jesus College, Cambridge    Wednesday, 4 April 2012



Jesus College  
Cambridge

### Sponsors

BP is one of the world's leading international oil and gas companies, providing its customers with fuel for transportation, energy for heat and light, retail services and petrochemicals products for everyday items

For more information visit the [BP website](#)



The BP Institute at the University of Cambridge was established in 2000 by a generous endowment from BP, which has funded faculty positions, support staff and the Institute Building, in perpetuity. The Institute research focuses on fundamental problems in multiphase flow and is highly interdisciplinary, spanning five University Departments.

For more information visit the [BP Institute website](#)

