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The role of UK oil refining in a lower carbon future

UK **pia**
Refining Britain's fuels

Introduction

The UK oil refining sector will play a pivotal role in the future as a continued reliable, resilient and secure source of transport fuels and feedstocks for other industries; a source that potentially facilitates the introduction of alternatives capable of being blended with or distributed alongside conventional fuels but above all keeps options open on future diversified supply sources. To fulfil this role and to meet the changing patterns of demand as well as future environmental requirements, UK refineries will need further substantial investment. To attract this investment in a globally competitive market, refineries will have to put forward a sound business case, ideally underpinned by a stable and clear UK and EU policy background.

Engines powered by petroleum derived fuels, have been dominant in road, aviation and marine transport for over a century because of a number of practical and technical reasons. These include the advantages of fuels that are easily manageable, affordable, familiar to consumers, and help give engines a good power-to-weight ratio allied to a long range between refuelling. Although alternative fuels will continue to develop, fossil derived fuels are likely to remain the dominant part of the overall mix for the next twenty years and beyond.

Background

Globally, we face a huge challenge in continuing to provide secure, affordable sources of energy supply in the future while also meeting substantial carbon reduction targets proposed under international agreements such as UN FCCC, Kyoto, or the EU Climate Change Strategy and the UK's Climate Change Act, aimed at stabilising the rate of growth in greenhouse gas emissions.

By 2030, the International Energy Agency's 'Reference Scenario' (assumes no changes in energy & environment policies) estimates that global energy demand could be about 45% higher than in 2007. Most of this additional demand will be driven by population growth, higher living standards and expanding economies, particularly in China, India, the Middle East, Asia and Latin America, and is expected to be met largely by fossil fuels- oil, gas and coal.

Although a variety of alternative sources and renewables should start to be significant, particularly for power generation, the IEA observed that the projected demand increase under this scenario was not sustainable and that under an alternative scenario with action to address energy supply and climate concerns, greater emphasis on demand reduction and energy efficiency would be a vital part of solutions.

SUMMER

Energy overview

Oil supply & demand

Oil isn't running out yet but it is a finite resource. Oil is likely to be the single most important source globally for transport fuels in 2030, although a range of alternative fuels is likely to be making up a significant proportion. However, meeting the projected increase in global energy demand by then presents some major challenges, not least in finding new sources of oil and gas, but also using energy efficiently in all sectors and minimising environmental impacts.

New oil supply sources, as opposed to short term production increases, take time to bring on stream. On the demand side, developing economies have been the main drivers for growth and will continue to be so in the future. The period of 2004 to 2008, however, is instructive as an indicator of the global impact of both supply disruption events, high prices and the global recession. On the downside of the cycle, demand for transport fuel both globally and in the UK reacted fairly rapidly to the weakening conditions. During this period, consumer reaction and sensitivity to dearer energy costs also highlights the scale of the task in changing future consumer behaviour because of the perception that things will return to 'normal'.

Global estimates indicate that approximately two trillion barrels of conventional oil are yet to be produced - twice as much as all the oil consumed to date. Unconventional resources - such as heavy oil and oil sands - are likely to add significantly to the total resource base. Technology will continue to play a vital role in finding and bringing on stream new oil and gas resources, as well as accelerating energy efficiency gains that will help make these sources go further.

Transport energy demand

Road transport energy demand in the UK has reached a plateau at 47 billion litres of petrol and diesel annually (2008), although overall demand for road travel has continued to rise with a steady increase in miles driven until 2008/9. Efficiency gains in both petrol and diesel vehicles have helped offset extra fuel demand associated with increased mileage. The growing popularity of diesel cars has been boosted not only by their greater efficiency but by fiscal measures such as CO₂ based Vehicle Excise Duty and company car tax in the UK, and by lower rates of fuel duty on diesel compared with petrol in the other EU countries.

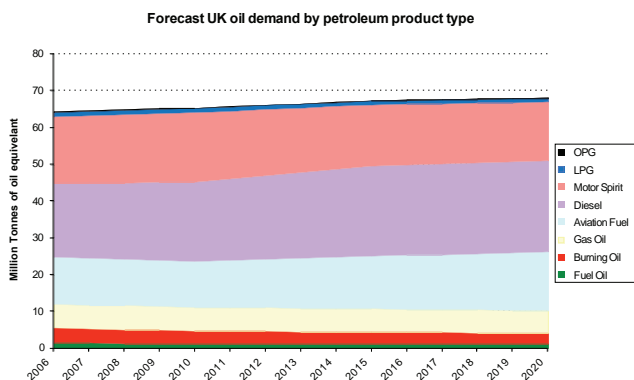


Chart 1. Source: DECC

The lower tax on diesel in the EU takes no account of its higher density and carbon content, thus making it an attractive option for consumers. Consumers may make minor changes in habits in response to policy or price signals, but it is unlikely that overall demand for mobility will reduce and any demand reductions in developed economies are likely to be offset by increases in developing ones.

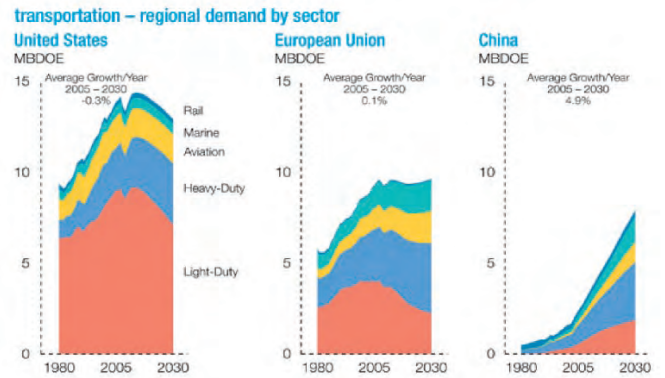


Chart 2. Source: ExxonMobil Energy Outlook

This shift in demand from petrol to diesel is increasingly significant. It has caused a structural imbalance both in the UK, which became a net importer of diesel in 2006, as well as in the EU as a whole which imported 27 million tonnes (2008), mainly from the Russian Federation. Historically, UK refinery investment has been geared to increasing petrol output but UK demand for petrol has been in steady decline since the peak in 1990. Since then, demand for fuel oil for power generation has collapsed, largely substituted by gas, with the result that both these surplus products are exported.

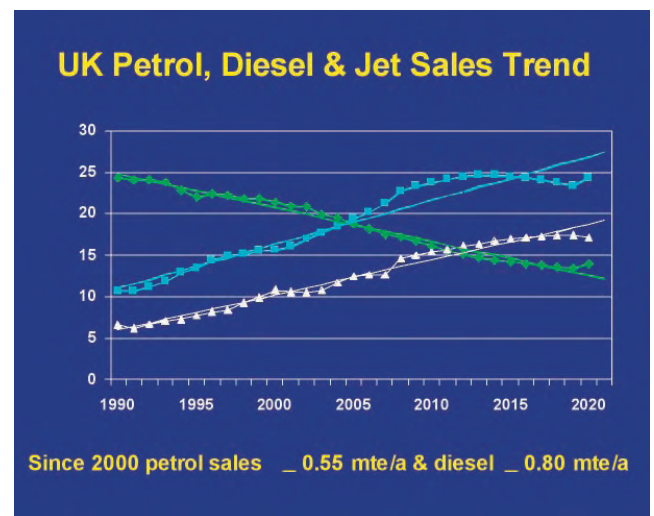


Chart 3. Source: Wood Mackenzie

Meeting the shortfall in diesel output by upgrading the 'bottom of the barrel' residues such as fuel oil will require substantial investment - typically upwards of £800 million+ per refinery for a 'hydrocracker' upgrading unit.

Is diesel more attractive overall than petrol?

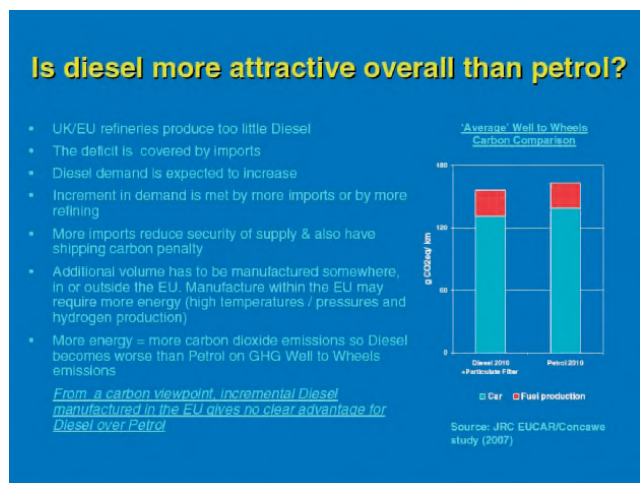


Chart 4. Source: UKPIA

More significant is the additional refinery CO₂ emissions associated with more energy intensive processes for producing this extra diesel output, in comparison with the CO₂ saved by using a diesel engine rather than a petrol one. From a carbon saving viewpoint, diesel fuel in some vehicle applications may have no clear advantage over petrol.

Aviation jet fuel demand in the UK has increased substantially from 8 million tonnes in 1997 to 12.6 million tonnes in 2008, partly because of the position of international hub airports in London. Increasingly, this demand is being met by imports, mainly from the Middle East.

The Government's 2007 report *UK Air Passenger Demand and CO₂ Forecasts to 2030*, updated in 2009, forecasts a near doubling in passenger numbers by 2030 versus 2005. The implications for fuel demand are less certain because of variables such as airport expansion, aircraft fuel efficiency improvements, aircraft size mix and modal switches particularly for short-haul flights, environmental considerations and GDP growth. Nevertheless, this indicates substantial UK demand for jet fuel in excess of 20 million tonnes per year in 2030.

Marine bunker fuel demand is very much driven by the development of international trade with the emergence of China and the Far East as significant manufacturers of consumer and capital goods. EU marine bunker fuel demand is likely to be around 50-57 million tonnes by 2020 (source ENTEC study) and a key concern in the period to 2020 will be the ability of refineries to meet legislation requiring lower sulphur content.

Move to alternatives

Within the EU, the focus is upon action to address climate change, improve energy security of supply and minimise dependence upon imported oil and gas. The EU Directives on Renewable Energy and Fuel Quality effectively mandate greater use of biofuels and alternative energy with an overall EU renewables target of 20% by 2020 and a 10% by energy biofuel target for the road transport sector.

Alternatives include conventional biofuels such as biodiesel and bioethanol largely derived from 'food' crops, second generation biofuels derived from processes that use a range of biomass or waste products, 'synthetic' fuels derived from gas to liquids processes, hydrogen and electricity.

The CO₂ savings for biofuels, measured on a 'well to wheel' life-cycle basis, vary considerably depending upon the source material, the conversion process and the extent to which low carbon or renewable energy sources are used in production or conversion. In the case of conventional biofuels there are also issues surrounding sustainability, indirect land use change and whether food crops are better used to provide food for a growing world population.

The UK's Renewable Transport Fuel Obligation, which commenced in April 2008, requires fuel suppliers to meet a 5% by volume biofuel content in road fuels in 2013/14, progressing from a base of 2.5% in 2008/9. The Climate Change Act 2008 has legislated for an 80% reduction in GHGs by 2050, underpinned by binding carbon budgets within the statutory framework of the Act, acting under advice from the Climate Change Committee.

Aside from alternative liquid fuels, electric powered vehicles have the potential to use electricity generated from renewable, low carbon or carbon sequestered sources. However, a wide-scale shift would have significant implications for power generation capacity and distribution, as well as practical challenges associated with provision of re-charge facilities.

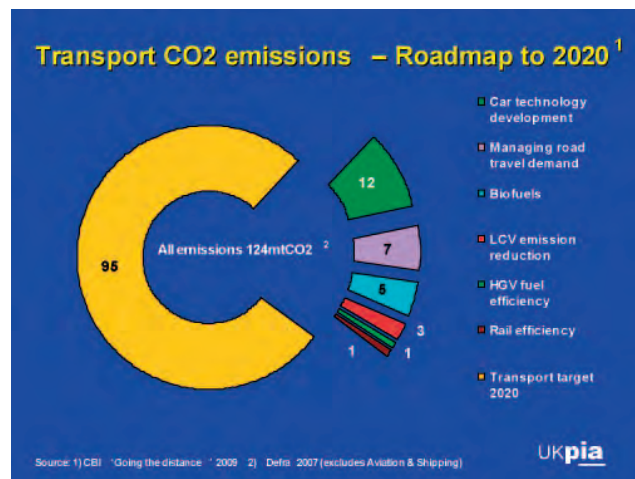


Chart 5. Sources: CBI 'Going the distance' 2009 & DEFRA 2007

For the foreseeable future, there are no indications of clear 'winners'. Some of these alternatives may be complementary to conventional petrol and diesel and perhaps capable of being blended with or distributed alongside them. To this extent, their speedy assimilation into the market may be assisted.

For aviation and marine transport, research into alternative fuels and propulsion systems is at an early stage. However, the pathway to these alternatives seems less clear and therefore the refining sector will remain crucial to meeting the needs of these sectors.

Conclusion

The shift to alternative fuels and energy sources is unlikely to be seamless. The UK oil refining sector will therefore play a pivotal role in the future as a continued reliable, secure source of transport fuels; a source that potentially facilitates the introduction of alternatives capable of being blended with or distributed alongside conventional fuels but above all keeps options open on future diversified supply sources.

Furthermore, there are other industry sectors or products that will continue in the future to rely upon refining as a source of feedstocks, such as plastics, solvents, synthetic rubber, lubricants, fibres, petrochemicals, waxes, polishes, bitumen and high grade petroleum coke for steel and aluminium smelting

UK refining also has a role in terms of continued reduction in emissions from its own operations through greater efficiency in processes, additional Combined Heat and Power (CHP) capacity as well as new

refining technology to produce fuels and lubricants with specific qualities. However, refinery CO₂ emissions are likely to increase with the move towards heavier crude oils, cleaner fuels and the need to produce more diesel, all of which require more energy intensive processes.

The realities of how we meet our future energy needs will require clear thinking and global collaboration to address some of the conflicting objectives associated with economic growth, population growth and substantial greenhouse gas emissions' reductions. Making energy go further through a combination of greater efficiency and new technologies will be vital. Equally important will be gaining societal support for change and the likely difficult policy choices that may be involved.

For UK refineries to play their part in this transition, they will need to compete for investment against other international opportunities. Their case will be assisted by clear, consistent and complementary policy direction in the UK and the EU given the comparatively short time scale in which to address these challenges.

Future of UK's Compulsory Oil Stocking

As a member of the European Union and the International Energy Agency, the UK is required to hold emergency stocks of crude oil and oil products, and to take part in any collective response to a major international disruption of oil supplies. The UK has always met its international obligations by directing commercial companies to hold stocks.



The system today is based on all product supplied into the UK market from refineries or as imports, having originally been based on company sales into final consumption.

The system for holding these emergency stocks in the UK now needs to be reviewed. As North Sea production declines and the UK's net imports increase, the nation will see its stockholding obligations rise towards 90 days of net imports.

A joint industry-Government project is underway to review the UK's future options for holding emergency stocks, primarily to ensure we continue to meet our national and international obligations by means of a cost efficient and effective system, but also with a view to improving the domestic resilience of the downstream oil sector. If improvements to the existing system do not represent a viable solution, one option that will be considered is the creation of a central stockholding entity to manage the obligation on behalf of obligated companies and the Government.

At the EU level, agreement has recently been reached on the revised EU oil stocking directive, which improves the EU's readiness in case of supply crises and aligns the EU methodologies and usage with those of the International Energy Agency.

"A project is underway to review the UK's future options for holding emergency stocks."

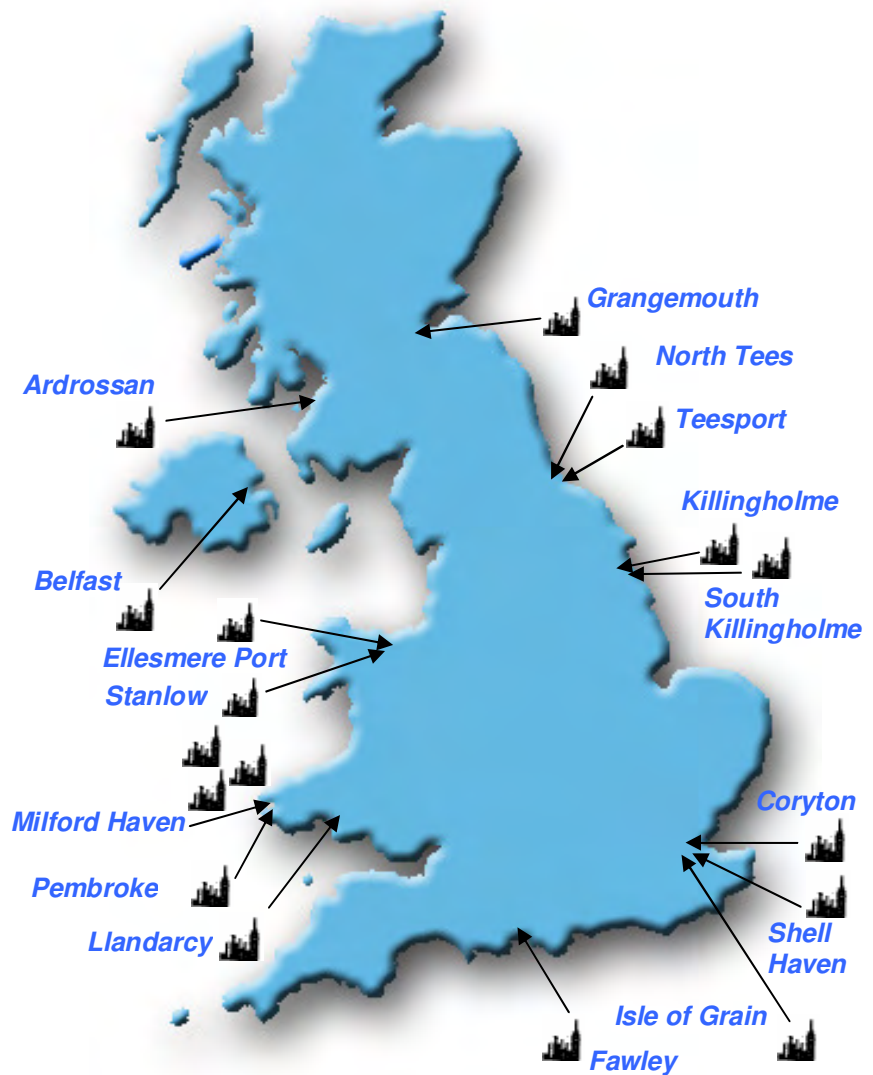
30 anniversary 1979 - 2009



“30 years representing the oil refining & marketing industry”

18 refineries
26,480 service stations
30 million tonnes of petrol, diesel and jet

1979
2009



Refining Britain's fuels

30 anniversary 1979 - 2009

UK pia
UNITED KINGDOM
Petroleum Industry Association Limited

“30 years representing the oil refining & marketing industry”

9 refineries
9,264 service stations
50 million tonnes of petrol, diesel and jet

2009



Refining Britain's fuels

Stage II Petrol Vapour Recovery at Service Stations

Petrol contains volatile organic compounds (VOCs), which evaporate inside the fuel tank of a vehicle and fill the air space above the liquid fuel. When a vehicle is refuelled, these vapours are forced out from the fuel tank by the incoming fuel and, unless controlled, escape into the atmosphere through the filler neck of the fuel tank. The technology to capture these emissions is known as Stage II vapour recovery (Stage I is the capture of VOCs from storage tanks).

On 5th May 2009, the European Parliament adopted at first reading the proposal for a Directive on **Stage II** Petrol Vapour Recovery during Refuelling of Passenger Cars at Service Stations. The proposal had been agreed by Member States prior to the vote.

The new Directive will require that any new or existing service station undergoing major refurbishment with an annual throughput of petrol above 500m³ per annum, be equipped with a **Stage II** petrol vapour recovery system. It will also require retrofitting of **Stage II** to existing service station with a throughput in excess of 3000m³ per annum by 31st December 2018. The Directive also requires that capture efficiency limits be equal to or greater than 85%. Member States are required to comply with this Directive by no later than 1st January 2012.

The Directive would increase VOCs' recovery from the 70% reduction already achieved through a number of measures, including Stage I vapour recovery.

Indeed, **Stage I** vapour recovery has been in place for a number of years at storage terminals and at filling stations, to recover vapours that would normally escape into the atmosphere during the filling of storage tanks.



Renewable Transport Fuel Obligation

The second year of the Renewable Transport Fuel Obligation, requiring suppliers of road fuels to incorporate a proportion of biofuel in petrol or diesel, commenced on 15th April 2009. The UK oil industry has exceeded the Government's 2.5% volume target for biofuel content in road fuels in the first full year of the RTFO, which has largely been met by the addition of 5% bio content into conventional 'zero sulphur' diesel.



This has been achieved seamlessly from a consumer's perspective.

In addition, the yearly obligation level for fuel suppliers has been amended. The new levels are in line with recent recommendations in the Gallagher Review of Biofuels advising a slowing down in the rate of increase of biofuel content in road fuels to reach 5% in 2013/14.

The RTFO indicative targets for carbon and sustainability performance are: at least a 45% reduction in greenhouse gas emissions, ensure that at least 50% of biofuel meets qualifying standards (sustainability), and that reports cover at least 70% of the data. The oil industry fully supports a robust system for determining sustainability and carbon saving of biofuels. In 2011 the RTFO will be updated to comply with the EU Renewable Energy Directive, and UKPIA seeks a common and consistent implementation across the EU: a level playing field a no gold plating within the UK, common sustainability criteria across the EU, a common approach to indirect land use change (ILUC) and avoidance of a wide range of biofuel blends for supply reliability.

Summary of Legislation

UK RTFO

- Commenced 15th April 2008
- 'Gallagher' review reported June 2008
- Targets revised to 3.5% volume by 2010/11 & 5.0% by 2013/14

EU Biofuels Directive 2003

- Indicative target of 5.75% by energy (ff7.5% by volume) by 2010

Energy Act 2004

- Renewable Transport Fuels Obligation (RTFO)
- Targets 2.5% volume 2008/09 increasing to 5.0% volume by 2010/11

EU Renewable Energy Directive (RED) 2009

- To be implemented January 2011
- Target 10% by energy (ff13% volume) by 2020, with review 2014.

Interview - Alan Green

Nunzia Florio interviews Alan Green, ConocoPhillips's HSE Manager for non-US downstream operations. Alan is a chemical engineer by training and has worked for ConocoPhillips for over 30 years. He has extensive experience in Process Safety and has worked for seventeen years at the Humber Refinery in various process safety engineering roles. Alan also chairs UKPIA's Process Safety Leadership Network and, as a member and Chair of the Environmental, Health & Safety Steering Committee and previously of the Refinery Emissions Working Group, is one of UKPIA's longest serving senior committee members. His hobbies include photography, hi-fi and participating in sports.

What is the Process Safety Leadership Network and who is involved?

The Process Safety Leadership Network operates at a senior level. Safety is our number one priority. The Network covers refinery and tank storage operations and manages the implementation of the 'Process Safety Commitment Statement' signed by all nine member companies. We specifically aim, as a network, to provide guidance, support and resources to UKPIA's process safety programme manager - Peter Davidson, the cross-industry Process Safety Leadership Group and other safety working groups, such as the Major Hazards Working Group.

We have been taking considerable steps to raise the profile of process safety leadership and we make sure we have the right process safety expertise from across the organisations to lead on process safety.

What can we learn from other high hazard industries and how will the newly formed Process Safety Leadership Forum help?

There is always plenty we can learn from other high hazard industries. All industries that store and handle large quantities of hazardous substances have experiences to share, both good and sometimes not so good.

The Process Safety Forum is a cross-industry forum of senior executives from UKPIA's member companies working with Oil and Gas UK, the Chemical Industries Association and the Nuclear Industry Association. The Forum has been set up to provide a platform whereby initiatives, best practice, incident learning and process safety strategy can be distilled and shared across all the industry sectors, with the aim of preventing major incidents. It is another example of the willingness of the industry to lead on process safety. The help we

get through a pan-industry dialogue is pivotal and really complements the work we do within other industry specific safety groups.

UKPIA is collaborating with the American Petroleum Institute. How is this cooperation going to feed in to what we do in the UK?

UKPIA is collaborating with the American Petroleum Institute in developing a set of process safety metrics and standards. The Process Safety Leadership Network is represented by Ian McPherson, UKPIA's Environment, Health and Safety Director.

We aim to develop a consistent and simple set of standards applicable throughout the industry. Having similar definitions, thresholds and performance indicators would allow for a consistent reporting both nationally and across organisations.

What effects have the Buncefield and Texas City incidents had on the industry?

When incidents such as Texas City or Buncefield occur they serve to remind us that our focus on process safety leadership is the right approach. Our endeavours are to build on the lessons learned by working together as an industry and leading on safety. Also, it serves to remind us that good practice is a process that goes from boardroom to the refinery floor.

What was the industry's response?

UKPIA's members reacted very promptly and continue to work very closely with the Competent Authorities - HSE, EA and SEPA.

Following the MIIB's report and recommendation, UKPIA's member companies also committed to the standards of Safety Integrity Level 1 and the installation of automatic shutdown systems at storage terminals for tanks storing gasoline received via pipeline transfer, a key recommendation of the MIIB. Further to that, the Buncefield Standards Task Group was established and published its own recommendations to improve safety at major fuel storage installations. These have been or are being implemented. Building upon this work, the Process Safety Leadership Group was formed, along with the Network and Process Safety Forum, all looking at all of the areas concerned with process safety. It is imperative that we fully understand the mechanisms that caused the incident and we continue to work very closely with the HSE. To this end, UKPIA is the main sponsor of the HSE Buncefield explosion mechanism research and sits on its steering committee. Essentially, it is vital to understand what caused such a violent explosion, so that

the knowledge informs both operational and design factors. The Phase I report is to be published soon.



How do we meet the expectations of Regulators with what the industry can deliver?

An open dialogue is key to ensuring that we can meet expectations and fully understand what is required. We are working together and learning together.

What challenges do we face going forward?

We are looking at all areas concerned with process safety and we need to prioritise our work. Also, we have a very wide range of refineries in the UK: from simple refineries to complex ones. Although the common factors such as crude distillation and upgrading units are similar, no two refineries are the same. That means that each operator will have a different set of processes and potential hazards. At present, we have developed a 'Management of Change' process which touches on different issues associated with different operations, and we hope to build on this within the next few years. We then set out to revisit all of the areas associated with process safety, and continue this process of improvement step by step, issue by issue.

We feel that through UKPIA, member companies can work together to produce a set of consistent, simple, available standards.

UKPIA has also appointed a Process Safety Programme Manager. How is this going to assist?

The appointment of Peter Davidson as UKPIA's Process Safety Programme Manager, is pivotal as the process safety programme encompasses all key areas: from inspection and maintenance, to process hazard analysis and human factors. Peter is responsible for the delivery of the guidance required to meet each of the process safety leadership commitment objectives, and represents UKPIA members on the cross-industry Process Safety Forum.

To date, the strategy for implementation has been presented and approved by the Network, together with the Management of Change (MoC) Self Assessment Module. Guidance has also been produced for analysis of assessment results and currently under development is the guideline for incident sharing.

For more details visit www.ukpia.com - Industry Issues/Health and Safety.

EVENTS

House of Commons Reception



L to R: Chris Hunt, DG UKPIA, Janet Ashdown, UKPIA President, David Kidney MP

UKPIA held its annual House of Commons Reception on Monday 15th June. The event marked UKPIA's 30th Anniversary and the lunch of the Statistical Review.

"Keeping the wheels of the UK economy turning whilst also meeting policies

that aim to move the economy to a lower carbon future, remains a key challenge for the UK oil refining industry", said Janet Ashdown President of UKPIA opening the event.

She continued: "Energy will remain a key global issue in the future, with focus in the UK and elsewhere increasingly upon security of supply and climate concerns. These are big challenges in themselves. However,



David Parker, UKPIA DG 1991-1995 and Janet Ashdown

in the UK, as in the rest of the EU, the industry is also having to address the increasingly unbalanced demand for petrol and diesel that potentially will increase refinery emissions because of more energy intense processes to produce that extra diesel within the EU. UK refining will continue to have a pivotal role in keeping future transport fuel supply options open that complement various alternative energy

sources. This could be particularly important not just for road transport but also for transport modes where developing alternatives may be more technically difficult or impractical. Refining will remain important, too, as a source of feedstocks for other products such as plastics, solvents, lubricants and so on".

The event was also addressed by David Kidney MP, Energy and Climate Change Minister. The Minister acknowledged the valuable contribution being made by UKPIA and the wider industry to the DECC led downstream oil infrastructure study and the pivotal role played by the industry in meeting the UK's energy needs. Referring to the centre spread article in the Statistical Review on the role of UK refining in a lower carbon future, he recognized the government's role to create a clear policy environment that might assist in helping the industry meet its future investment challenges.

In conclusion Janet thanked the Minister for his support.

For more details visit www.ukpia.com - Publications



Malcolm Watson, UKPIA Technical Director and Tony Fox, UKPIA Secretary 1984-1996



Mike Frend, UKPIA DG 1995-2000

Coryton Refinery Visit

On 2nd April 2009, representatives from the DECC Energy School joined UKPIA on a tour of Petroplus's Coryton refinery. The day commenced with two keynote presentations by Jasper Clark, Coryton Economics Manager and Nick Vandervell, UKPIA's Public Affairs Adviser, outlining the refining process and giving an overview of the UK's oil industry. This was followed by a guided tour of the refinery's main operations.

UKPIA thanks Petroplus for hosting the visit. We also thank Georgina Clark, Petroplus's Public Affairs Adviser and Jon Barden, Coryton Refinery Manager, for organising this very successful and engaging day.

For more details visit www.ukpia.com - Industry Information/Refining & UK Refineries.



Janet Ashdown, head of UK Fuels for BP Oil UK, has been appointed President of the UK Petroleum Industry Association. She succeeds the outgoing President **Nick Thomas** of ExxonMobil.



Janet Ashdown

Janet joined BP as a graduate trainee in refining during the 1980s. Since then, she has undertaken a number of roles including product trading - based in New York, London and Paris - and at BP's Corporate Headquarters in the Gas & Power and European Retail and Commercial Fuels Businesses.

UKPIA extends its thanks to Nick Thomas for his work as President over the last two years.

Peter Campbell of ExxonMobil has taken over as Chair of the Pension's Committee, from **David Medler** of Chevron.