

PIU Energy Review

OIL – INITIAL SCOPING NOTE

Reference: Oil 1 v1.0
Date: August 2001

PURPOSE OF THIS NOTE AND WAY FORWARD

1. The aim of this note is to set out the current position for the UK with relation to oil and to identify the main issues and questions that need to be addressed in the energy review.
2. This is one of a series of initial scoping notes that have been prepared by the PIU Energy Review Team on a series of topics. The team will not be producing scoping notes on every aspect of the Review. Some areas relevant to the Review have already been explored in depth by the PIU Resource Productivity and Renewable Energy Team which has been working since January 2001 and which has been merged into the Energy Review Team.

<p>Readers should not assume that the PIU has in any respect closed its mind. Questions are put in order to draw responses.</p>
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3. We will be taking forward discussion of the questions and propositions raised in this note over the next two months. This will be done via bilateral meetings with key stakeholders. We are also likely to arrange a workshop involving all key stakeholders where views on the key issues can be exchanged and debated, probably during October.
4. The PIU has already invited all interested parties to put submissions to it by 10th September on all aspects of the PIU Energy Review. Interested parties are invited to respond in their submissions to the questions and propositions raised in this scoping note.
5. We would also be grateful if interested parties could let us know as soon as possible if they consider this note overlooks key questions, if any of the questions posed, or propositions put, are fundamentally misconceived, or if the note contains any factual errors.

BACKGROUND

6. Oil is the second dominant fuel in the UK (after gas) accounting for some 32% of primary energy use and some 35% of all carbon dioxide emissions in 2000 (DUKES 2001).
7. As crude oil has no direct end use, the demand for crude oil is derived from the demand for the petroleum products that can be produced from it. Therefore in looking at issues connected to the oil market, both the upstream market (i.e. exploration and production of crude oil) and the downstream market (i.e. the transformation of crude oil into petroleum products and the use of those products) needs to be considered.
8. In the UK around 86 % of petroleum products are used for energy use, some 74% of which are used for transport. Other consumers of petroleum products for energy use are the domestic sector, industrial users and electricity generation¹.
9. There is a well established international market for crude oil as, compared to other fuels, oil is relatively easy to transport and to store in modest volumes. This means that oil prices are set in international markets over which UK producers have minimal influence. The UK share of world oil production is currently around 3.5% (BP Statistical Review of World Energy, 2001).
10. The market for petroleum products, however, is more regional and, owing to transportation considerations, the UK is part of the North Western European market (commonly referred ARA – Amsterdam Rotterdam Antwerp refining triangle).
11. One of the factors influencing the price of petroleum products is obviously crude oil. However, the extent of this influence is affected by the levels of tax imposed. In the UK, tax makes up some 78% of transport diesel prices, and some 82% of unleaded transport gasoline prices. This means that changes in crude oil prices do not have a proportional impact on final consumer prices. Crude oil prices also influence the price of gas on an international, regional and national level.

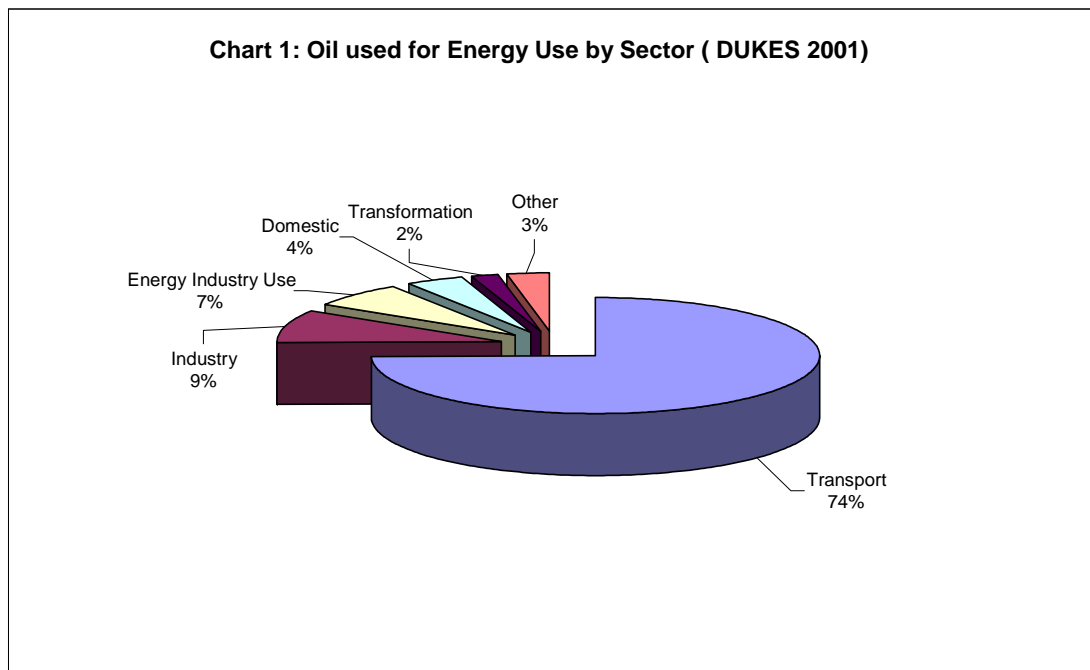
DEMAND FOR OIL

What is the current demand for oil in the UK?

12. In 2000 the total demand for Oil in the UK was 76 ½ million tonnes (DUKES 2001). The majority of oil is used for energy purposes - 86%, the rest mainly as feedstock for petroleum chemical plants, lubricating oil and grease. As illustrated by Chart 1, the oil used for energy is consumed by a number of different sectors, however, 74% of current oil consumption occurs within the transport sector. Transport energy demand and oil demand are currently strongly linked as, in addition to transport representing the majority of current oil demand, 98.5% of the energy used in transport is derived from oil products. Non-transport energy use for

¹ The use of oil in the UK for electricity generation is very small, it currently amounts to only around 1% of oil use. The proportion of electricity generated from oil is also just over 1%.

oil clearly accounts for a small percentage of final oil use – this can be considered even smaller as most of the energy industry use illustrated in Chart 1 is consumed within refineries.



How has UK Oil demand changed over time and how much will we consume in the future?

Table 1: UK Oil Demand

	1970	1980	1990	2000	2010	2020
UK demand for Oil Products for Energy Use ²	92.4	76.2	77.2	75.2	84.9	95.7
% of total energy demand	44%	37%	36%	32%	34%	37%

13. Table 1 demonstrates past trends and future projections for oil demand. It can be seen that although demand for oil fell quite sharply during the 1970s (following the decline in economic growth and industry’s substitution away from oil to other fuels following the oil price shocks of 1973 and 1979), consumption levels have remained fairly steady since. During this time there has been continued substitution away from petroleum products to other fuels - especially natural gas

² Historical data is sourced from DUKES 2001. Future projections are an average of Central Low and Central High scenario illustrated in DTI’s Energy paper 68. Since the publication of Energy Paper 68, revisions to energy use data, partly due to methodological changes, may mean that the historical data and the projections are not wholly comparable.

in electricity generation and other commercial and industrial uses. Demand for petroleum products for transport usage has continued to rise steadily throughout the period and is expected to continue to do so, with some 90% of projected increase in demand coming from the transport sector. However, it is notable that within the transport sector there is a relatively flat projection for gasoline and diesel and a relatively large increase projected for aviation fuel consumption.

Is transport, in particular aviation, likely to be the only sector where oil demand continues to grow or are there other uses for oil which will play a greater role in the future?

How does the UK currently meet its oil needs?

14. Although the UK is currently a net exporter of both crude oil and oil products, we currently import a percentage of both our crude oil and oil product requirements. Crude oil produced in the UK generally contains relatively lower levels of contaminants such as sulphur and therefore can fetch a higher price than some other crude oils on the international market. This makes it more attractive to export much of the UK production (3/4 in 2000) and import the majority of our crude oil requirements.
15. Within Europe there are well developed markets for a number of petroleum products. The UK imports around 20% of oil products consumed despite being a significant exporter of a number of these products. This is mainly due to the break down of demand for a number of different petroleum products in the UK. Exports from the UK are primarily made up of motor spirit, gas oil/ diesel oil and fuel oil. Imports include aviation fuel and motor spirit of grades different to those that the UK is able to manufacture in its existing refineries. The UK's position as a net exporter of petroleum products means that, taken across all products, UK refinery capacity is greater than UK demand.

THE UK AS AN OIL PRODUCER

16. The UK is currently a major oil producer and a net exporter. Presently, almost 95% of European oil production comes from UK, Norwegian and Danish producers operating in the North Sea (IEA). Output from the North Sea continued to rise until 1999 in spite of low / falling prices (in real terms) throughout the late 1980s and 1990s, owing to technological advances, cost-cutting and efficiency improvements that have made previously uneconomic fields attractive.

Table 2³: Remaining UK Reserves of Oil

	Oil (million tonnes)
Production in 2000	126
Demand for Oil products in 2000	71
Production to date	2,570
Remaining Discovered Reserves	630-1,490
Potential additional reserves	85-440
Estimated undiscovered	225-2,300

17. Table 2 represents estimates of the scale of the remaining UK Oil reserves. As can be seen from the size of the range illustrated in the table there is considerable uncertainty surrounding the remaining reserves, even within the discovered fields. This range demonstrates the uncertainty attached to the proportion of these reserves can be extracted at an economic price and makes it difficult to predict exactly how long the UK will continue to be a net exporter of oil.

Table 3: Total UK supply of Oil (Million tonnes of oil equivalent)

	1973	1990	1997	1998	2005	2010
Production	0.6	95.3	134.3	138.9	150.0	126.0
Exports	20.9	76.5	110.2	113.1	123.3	95.5
Imports	136.9	65.4	60.7	61.3	70.0	70.0
Net Imports	110.6	-13.6	-52.5	-54.9	-55.3	-27.5

Source: IEA, 2001

18. Development costs for the North Sea operators are higher than in many areas due to the relative maturity of production on the UKCS⁴. As a result exploration levels are highly sensitive to prices and price projections. Future exploration of the North Sea will also be dependent on technological development. However, although technological advances will continue, most commentators believe that North Sea production, especially the relatively mature UK sector will begin to decline fairly soon. This is illustrated in table 3, which shows the IEA's predictions for UK production levels to 2010, illustrating that they expect production from the UKCS expected to peak in 2005 and that the UK will continue to be a net exporter of oil until at least 2010. However, the DTI have more conservative estimates for future UKCS production levels, these suggest that production is likely to fall from 130 million tonnes in 2002 to around 88 million tonnes by 2006 and would mean that the UK would become a net importer of oil

³ Table taken from DTI's Brown Book, 2001.

⁴ The relative maturity of the UKCS means that the most accessible fields in the North Sea have been depleted and that remaining reserves are more costly to extract.

before 2010. Over the last 20 years predictions of immanent decline of oil production in the North Sea have been common. Therefore, it is worth asking whether there is something new about the information these predictions are based on that would suggest that production really will decline over the next 10 / 15 years to the extent suggested or whether, as previously has been the case, new reserves will continue to be found.

Refinery Capacity

19. The UK currently has nine major refineries operating, with a capacity of around 88 million tonnes per annum. Although it is likely that at some point the UK will become a net importer of crude oil it is possible that the UK could continue to employ this refining capacity and remain a net exporter of oil products.

How long will the UK remain a net crude oil exporter?

What, if any, barriers exist to the continued development of UK oil reserves?

Will the UK continue to be a net exporter of oil products after it becomes a net importer of crude oil?

Infrastructure issues

20. Given the maturity of oil production from the UKCS, the essential pipeline infrastructure to transport oil from the well-head is already in place. There is also significant production of oil using Flotation Production, Storage and Offtake vessels in the UKCS. Issues relating to access to this infrastructure by companies which do not own the assets are already under consideration as part of the consultation on the regulation of offshore infrastructure launched by the DTI at the beginning of the year.
21. On-shore, the oil industry has an extensive infrastructure at the refineries and in the distribution and retail network. There are also some on-shore pipelines, as well as storage facilities. A key issue is whether lack of existing refinery capacity could impose any undue risks on UK consumers. The PIU has been told that there has been little investment in new refineries over recent years

Are there any concerns about the quality and quantity of UK refining capacity?

How should the UK's needs be assessed in the light of the extensive international trade in refined oil products?

POLICY AFFECTING OIL IN THE UK

22. The Government's central energy policy objective is to ensure secure, diverse and sustainable supplies of energy at competitive prices. This objective takes into account the Government's concern for the environment, health and safety and a

fair deal for all consumers, as well as its commitment to all aspects of sustainable development.

23. The Oil and Gas Directorate of the DTI's published overall objective is to:

'Maximise the economic benefit to the UK of its oil and gas resources, taking into account the environmental impact of hydrocarbon development and the need to ensure secure, diverse and sustainable supplies of energy at competitive prices.'

To achieve this it aims to:

- promote exploration for oil and gas resources over the maximum extent of the UK Continental Shelf by means of an appropriate licensing regime which pays due regard to the environment and to the interests of other land and sea users;
- regulate and promote oil and gas developments which are technically, economically and environmentally sound;
- promote open and competitive markets and strong companies in UK and EU policy formulation and in international discussions; and
- collect, analyse and disseminate data relating to the UK's hydrocarbon reserves.

24. The government can work towards these objectives by employing of a number of policy instruments including production and exploration licensing, a special taxation regime, public spending, non-financial support for particular technologies, economic instruments (e.g. auctions, tradeable permits) and regulation.

25. On the demand side – the government also has a number of policies connected to transport use, most notably in connection to oil the Government imposes fuel duties on a range of petroleum products.

26. A key issue is whether concerns about security of supply might suggest that further government intervention to extend the lifetimes of existing oil (and gas) fields could be justified. And if so, what that intervention might be, having regard the full range of available policy instruments mentioned above and any new instruments developed.

27. DTI already co-ordinates Pilot, which is the main forum for the discussions necessary to ensure that exploration and production continue on the UKCS. This group was established in Jan 2000 to replace the Oil and Gas industry taskforce, with membership drawn from Ministers, officials and industry. It has defined a vision for the industry in 2010 with measurable targets necessary to achieve that vision and oversees the activities necessary to ensure those targets are met.

Is there more or less that the Government should be doing to influence levels of oil production and consumption in the UK?

WORLD OIL RESERVES AND FUTURE PRICES

28. One of the main debates surrounding oil is the issue of remaining world oil reserves and the ability of production levels to meet demand over the coming decades. Oil is a fossil fuel with finite resources and hence reserves will, over time, deplete to levels at which further extraction is much more expensive than currently.
29. The question, therefore is over what timescale will this begin to happen? There are a number of key factors underlying this question:
- Underlying level of known reserves and remaining undiscovered reserves;
 - Technology development;
 - Substitutes; and
 - Expected global demand.
30. All of the factors listed above have a significant impact on how long world oil supply will be sufficient to meet demand and they all have a significant amount of uncertainty attached to them. It is therefore difficult to predict how long oil reserves will be sufficient to meet demand at affordable prices.

Known Reserves

31. There are a number of different estimates of exact levels of known reserves and the proportion of these that may be extracted at an economically feasible cost. Some estimates such as those made by the US Geological Surveys suggest that existing reserves will continue to comfortably meet demand for a number of decades. Other estimates, such as those made by the Oil Depletion Analysis Centre based at Reading University are more pessimistic and suggest that world production could peak before 2020.

Undiscovered Reserves and Unconventional Oil Resources.

32. In addition to known remaining oil reserves it is virtually certain that there are currently reserves in existence that are as yet undiscovered. It is notable that the reserve to production ratio has remained constant for a number of years – as new proven reserves have been found, or as technological progress has enabled previously uneconomic reserves to be tapped. As a result, fears of imminent resource exhaustion have proved groundless to date. However, there are a number of analysts that believe that the majority of recoverable reserves have been found and that the reserve to production ratio will decrease in the future. Again, this is a view that has been expressed by some commentators for a number of years and we need to look at whether the basis for these projections are more certain than those of the past that have proved inaccurate.

33. There are also reserves of oil from more unconventional sources in existence such as sources of heavy oil, shale oil and tar sands. Currently these are in the main not cost competitive with the more conventional oil resources and the process of extraction for these reserves causes many negative local environmental impacts. However, if the price of crude oil were to rise in the future, or if technological development reduces the cost of extraction of unconventional sources, then it is possible that these unconventional sources of oil could make a sizeable contribution.

Comments are invited on remaining world oil reserves

Technological improvements

34. Although dependent on location, it is currently generally only possible to technically and economically recover around 50% of existing known reserves. In the past technological developments have increased our access to oil and gas and it is possible that they will continue to do so in the future, particularly if the price of oil increases, providing additional incentives for technological innovation.

Levels of Investment

35. To transform oil resources into production requires significant and sustained capital investment, particularly in the Middle East. Some analysts argue that it is not resources that will constraint supply over the next 20 years but levels of investment and there is concern that this investment is not currently happening at a level which will enable production to meet growing demand over the next few years.

World Oil Demand

36. During the next twenty years it is predicted that global energy demand will expand by over 50% and the IEA predict that by 2020 world oil demand is likely to be 115 mb/d, around 40,000 mb / year (an increase of around 50% from current levels).
37. In the UK, oil use is dominated by the transport sector but in many other countries oil continues to play a significant role outside the transport sector, for power generation and industrial and domestic heating. However, it is thought that much of the future growth in oil demand will come from the transport sector.

Could world oil supply and demand over the next 50 years be kept in balance by substitutions away from oil in non-transport use? On what timescale are such substitutions likely to occur?

How oil intensive are some of the key developing countries likely to become over the next two decades?

Would keeping the balance require significant changes in transport use?

Substitution possibilities

38. The main alternative to oil is currently gas. Natural gas has a lower carbon content, reduces or eliminates some local emissions and may be burned at higher efficiency. A shift from oil to gas thus has beneficial environmental implications. However, with the UK's increasingly reliance on gas and future resources facing even more pressing issues to oil, shifting from oil to gas would do little to ease security of supply concerns.
39. There are also a number of other possible fuels that could, in the longer term, form substitutes for oil, for example liquefied coal, hydrogen and electricity in transport use.

Will alternatives be found for transport fuels over the next few decades which will allow dependency on oil in this sector to decrease? And over what time frame is likely to happen?

Are there any current uses of oil for which substitutes could not be found? Are substitution possibilities for oil less costly in non-transport sector than in transport?

Given it will take a long lead time to allow widespread substitution from the use of oil products in the transport sector - should we taking action now to encourage these substitutions and if so what should we be doing?

The Price of Oil

40. There is a widespread consensus that the current high oil prices of around \$27 / barrel seen in the last few months are not sustainable over the medium term. OPEC aim to maintain the price of oil between \$22- \$28 / barrel, however, it is thought that oil prices are more likely to drop back down to around \$20 - \$23 / barrel and some analysts believe this price could drop as low as \$16-\$18/barrel, a price which reflects the full cycle costs of the marginal non-OPEC field.
41. The price for oil in the longer term will depend on a number of key factors:
- The future ability of OPEC to operate effective control on the market and the proportion of the market that OPEC countries hold;
 - After 2020, the possible impact of resource scarcity on prices;
 - The extent to which the demand for oil would respond if prices were to remain high ; and
 - The scope for substitutes for current and future oil uses.

How will the price of crude oil develop, and what will be the key factors in determining price in the future?

What can the UK do to help introduce more sustainable and stable oil prices?

SECURITY OF OIL SUPPLIES

42. From a UK perspective, some commentators have expressed concerns that the UK will become increasingly dependent on other countries for its supply. This has implications for security of supply if there are concerns about the diversity and accessibility of oil from the countries in which these reserves are located.

Table 5: Proven oil reserves at end of 2000

	North America	South & Central America	Europe	Former Soviet Union	Middle East	Africa	Asia Pacific	Total OPEC	Total Non-OPEC	Total
Thousand Million tonnes	8.5	13.6	2.5	9.0	92.5	10.0	6.0	110.7	31.4	142.1
% of total	6.1	9.0	1.9	6.4	65.3	7.1	4.2	77.8	22.2	100

Source: BP Statistical Review of World Energy, 2001

43. Although OPEC currently accounts for some 40% of production, it has some 80% of the proven reserves, as can be seen in table 5. It is therefore likely that the UK, like most of the rest of the world, will become increasingly reliant on a small number of countries for its future oil as the majority of OPEC's reserves are located in the Middle East – mainly Saudi Arabia, Kuwait, Iran and Iraq.

44. Most oil companies operate 'just in time' business practices and are therefore unlikely to hold high levels of oil stocks unless they are legally obliged to do so. The UK is currently required by an EU directive to hold the equivalent of 67.5 days of average daily oil product consumption as strategic stocks⁵. In order to comply with this directive the UK government places an obligation on companies supplying oil products into final consumption in the UK to maintain a certain level of stocks of oil products used as fuels. As part of this, oil companies are allowed to hold stocks abroad under official governmental bilateral agreements. These stocks provide a buffer in case of physical interruption. Despite recent US practice their role is not to provide a means of influencing the price of oil.

Will the UK be able access secure oil supplies in the future given the increasing concentration of remaining reserves in the Middle East or are there significant risks that the UK could be affected by periods where it cannot access supply?

If there are risks, what more can the UK do to safeguard against this?

⁵ The normal EU requirement is 90 days, however, as long as the UK continues to be a net exporter of oil it receives a 25% concession.

45. As noted in Paragraph 9, the market for crude oil is global and hence the price of crude oil is set on the world market and is determined by the interaction of demand and supply. Although prices are set in the market, it is one that where one group of suppliers (OPEC) demonstrate a high degree of market power. Hence international crude prices are heavily influenced by the decisions of the OPEC producers on supply. To date, OPEC's control over prices has tended to be a short-medium term phenomenon with non-OPEC producers responding over the medium to longer term.
46. The growth of non-OPEC supply has reduced OPEC's current market share to some 40%, from its peak of 53% in the mid-1970s. Three factors have allowed the steady increase in non-OPEC production: substantial technological innovation in exploration and production; cost reduction programmes in the oil industry; and, in some cases, government incentives to promote exploration and production. However, at least two of these non-OPEC regions (North Sea and the US) are estimated to have reached, or be reaching, maturity. Hence supply from these regions is expected to decline, while, and as can be seen from Table 5 OPEC countries currently hold almost 80% of remaining proven reserves. Nevertheless, there is debate as to whether OPEC's market power will decline or increase, and hence whether prices of crude oil will continue to be influenced to the same degree by the OPEC countries.
47. Oil prices have remained mostly stable over much of the past century but, despite their long term stability, prices can be very volatile in the short term. This short term volatility could be driven by action taken by OPEC or through fears of potential action.

Will OPEC be a successful cartel in the future in terms of keeping prices above competitive market levels or producing enough price volatility to discourage oil investment elsewhere? Will they grow more or less powerful?

How could the UK protect itself against a powerful OPEC, particularly if it was a net importer?

ENVIRONMENTAL CONSIDERATIONS

48. Oil is currently a major contributor on a slightly disproportionate scale to Carbon Dioxide emissions as oil is a relatively carbon intensive fuel. Therefore, currently oil use accounts for 32% of primary energy use in the UK but 35% of emissions.
49. Oil consumption in transport can also have serious local air quality impacts. However, vehicle technology improvements, and the removal or reduction of some pollutants from fuels (for example lead and sulphur), stimulated by tightening standards in many countries, have radically reduced these impacts.
50. There are a number of possible technological innovations that could reduce carbon dioxide emissions from oil use such as:

- *Carbon dioxide separation and sequestration at the refinery* - CO₂ is effectively ‘stripped out’ at the refinery and removed in order to produce low or zero carbon fuels. CO₂ may be then be locked away in depleted oil and gas fields and saline aquifers, or re-injected into working fields for enhanced oil recovery. As yet there is uncertainty about costs, as the technology is not well proven, and about the environmental impacts of this process.
- *Carbon dioxide separation and sequestration at the oilfield* – CO₂ is stripped out at the point of extraction to create wellhead syngas. This process, still at the research stage, would enable hydrogen to be separated and reformulated into gaseous hydrocarbon (syngas) at the wellhead, with carbon again re- injected into the working field.
- *More efficient end use technologies* – would reduce the amount of oil required for a process and therefore reduce the pollutants emitted.
- *Carbon separation and sequestration* can also occur at the point of combustion.

What needs to be done to demonstrate the cost and environmental effectiveness of capture and storage?

Can capture and sequestration at the point of use work for oil if its use is highly decentralised in the transport sector?

Will there be sufficient innovation in these technologies to allow the environmental impacts of oil use to be reduced a level that will allow the UK to meet long term challenging carbon reduction targets?

Oil Spills

51. A number of large oil spills have occurred during the transportation of oil which have attracted much public attention, the most recent in the UK was the Sea Empress oil spill in Milford Haven in 1995. These spills have serious consequences for wildlife and fisheries over relatively large areas, depending on the location, nature and extent of the spill. Localised ecological impacts can be long term, even permanent. However, standards for construction and maintenance of tankers, and for oil handling facilities have increased. The vast bulk of oil accidentally released into is through small ‘routine’ spillage that does not make the headlines. Currently the amounts of oil spilled around the coasts of the UK are relatively small in relation to total oil production and these amounts have been decreasing over recent years.

Has the technology for shipping oil and management methods for doing so led to acceptable levels of oil spills?