

## 19 ENERGY

### 19.1 Introduction

#### *Sector classification*

- 19.1.1 The BERR business sector classification system does not provide a clear definition for the energy sector. Elements of what might be considered parts of the Energy Sector are instead classified under a range of BERR business sector classifications<sup>151</sup>.
- 19.1.2 For the purpose of this assessment, the energy sector has been defined as set out by the BERR Energy Group which relates to the production and supply of energy, specifically: coal, nuclear power, oil and gas, renewable energy and sustainable technologies<sup>152</sup>. This definition includes biofuels as part of the renewable energy sector.
- 19.1.3 It is difficult to assess the energy sector as a whole without breaking it down into smaller sub-sectors. This is because different types of energy production are classified under different sectors within trade classification systems, and because different fuels are classified under different commodity classifications. For example Palm Oil, which is used to generate biodiesel, would usually be captured under the agricultural sector and not the energy sector. This means that different fuels need to be assessed separately. For the purpose of this study the sector has been subdivided as follows:
- Oil, gas, and coal
  - Nuclear
  - Renewables
  - Biofuels
  - Other power

### 19.2 Scope of the Assessment

- 19.2.1 The scope of this assessment has been refined and focused so as to identify the most significant impacts in the limited time available. The assessment has therefore focused on the key resources that are used within the sector. It has centred on direct exploitation of fuels and the transportation of these fuels.

<sup>151</sup> Business Sector: Environmental Industries – *Sub-sector*: Renewable Energy / Business Sector: Materials and Engineering - *Sub-sector*: Power Generation / Business Sector: Wholesale – *Sub-sector*: Petroleum and fuel products / Business Sector: Mining, energy and utilities– *Sub-sector*: Mining and oil and gas extraction / Business Sector: Mining, energy and utilities– *Sub-sector*: Energy utilities – Source: <http://www.businesslink.gov.uk/bdotg/action/sectorSiteMap>

<sup>152</sup> See: <http://www.dti.gov.uk/energy/index.html>

- 19.2.2 The study does not include an analysis of the embodied energy needed to produce or refine energy fuels, or needed to construct the power stations, reactors, turbines, photovoltaic cells and other types of machinery used to generate energy.
- 19.2.3 The study focuses on impacts beyond the UK, Europe and OECD countries. The assessment of renewable energy sources such as wind and tidal energy have not been assessed as the biodiversity impacts are likely to occur within UK land and sea boundaries<sup>153</sup>. However, it is acknowledged that a significant shift towards the use of more renewable energy sources in the UK would make a contribution to stabilising and hopefully in the long-term reducing global CO<sub>2</sub> emissions; thus minimising the adverse effects of climate change on biodiversity.
- 19.2.4 The scope of this assessment does include the identification of impacts on biodiversity through the use of biofuels. Biofuels can be classified as any fuel that is derived from biomass, but for the purpose of this study, the assessment has focused on bioethanol and biodiesel which are currently the most widely used biofuels.
- 19.2.5 This assessment has looked in brief at the extraction of uranium for nuclear energy generation. However, limited data availability and the irregular importing activities and stockpiling of nuclear fuels have made it difficult to identify trade flows with any accuracy. Evidence suggests that the majority of uranium used to generate power in the UK is imported from Australia and Canada. Furthermore, globally a large proportion of nuclear fuels in recent years have been supplied from secondary sources such as decommissioned arms. The decommissioning of nuclear power stations and the treatment and disposal of nuclear waste has not been considered as part of this assessment as it has been assumed that these activities occur in the majority of cases within the UK.
- 19.2.6 The carbon trading market has not been considered as part of this assessment as it is seen as a separate emerging sector relating not only to energy but also to transport, business and industry in general.
- 19.2.7 It is acknowledged that the energy sector has the potential to make a positive contribution to reducing impacts to biodiversity, through helping to facilitate a cut in global CO<sub>2</sub> emissions. The UK energy sector has a history of supplying technology for the energy sector, and in more recent years have been developing carbon sequestration and clean coal technologies. This does not, however, form part of this assessment.

### 19.3 The Energy Sector

*How significant is the Energy Sector in the UK?*

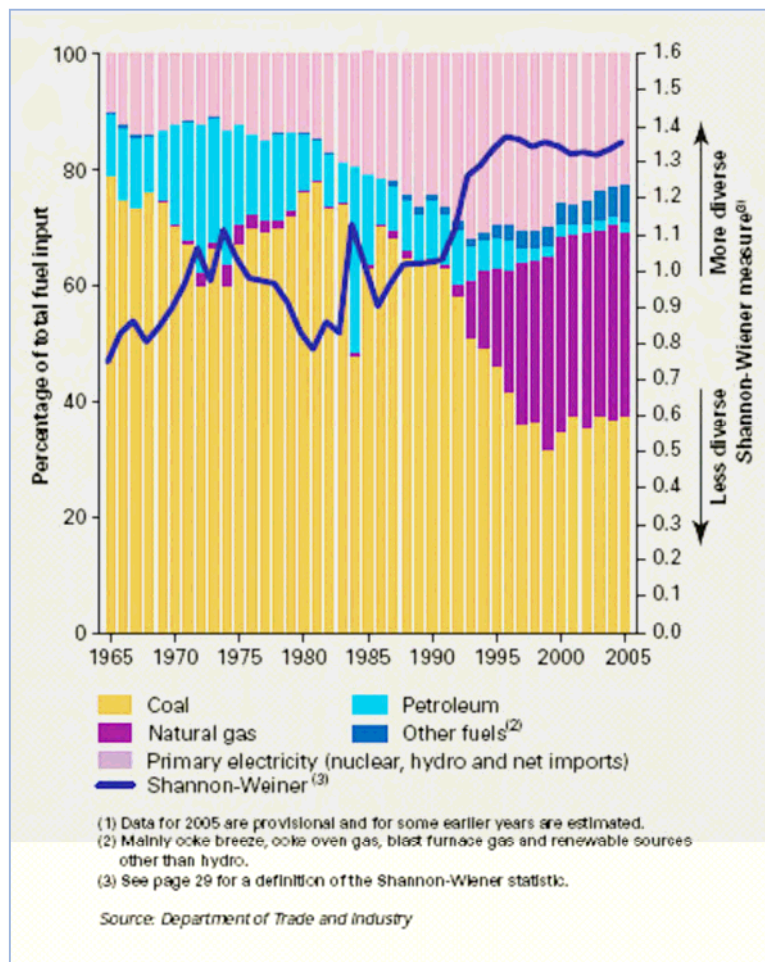
- 19.3.1 The Energy Sector accounts for approximately 3% of GDP (2005), and in 2004 approximately one third of all UK industrial investment was in the energy sector<sup>154</sup>. The majority of overseas trade in the energy sector is in oil and oil products. Oil and gas contributed 1.5% of GDP in 2005, although this has been decreasing in

<sup>153</sup> It is acknowledged that impacts may occur to species of migratory birds which may be of international importance. This study is focusing largely on ecosystems and so this has not been covered in any detail.

<sup>154</sup> DTI (2006) UK Energy Sector Indicators 2006

recent years. Coal plays less of a significant role in the economy, accounting for a much lower percentage of total GDP than either oil or gas.

Figure 18: Shares and diversity of fuels used for electricity generation<sup>155</sup>



19.3.2 Figure 18 illustrates that coal, oil and gas make the largest contributions to electricity generation in the UK. Others – including renewables – make a relatively small contribution.

19.3.3 In order to identify the most significant impacts and areas for necessary action, it is important to understand the current status of the sector areas of future growth on which to focus. Certain factors are currently influencing the future development of the energy sector:

- energy security;
- reducing carbon emissions;

<sup>155</sup> DTI (2006). *UK Energy Sector Indicators 2006*.

- diversity of energy sources; and
- technological innovations

## 19.4 Oil, Gas and Coal

19.4.1 The UK oil and gas sector comprises:

- UK Offshore Operators licensed to undertake exploration and production of oil and gas in UK waters;
- suppliers of expertise, services and technology for both upstream and downstream oil and gas processing;
- specialist supply and service companies for exploration;
- UK refineries and distributors; and
- UK companies with global exploration and production interests.

19.4.2 The UK coal sector is more limited, and includes UK mining infrastructure and operations, and to some extent carbon abatement and cleaner coal technologies.

*How significant is the oil, gas and coal sector in the UK?*

19.4.3 The contribution of the oil and gas industry to total UK GDP has decreased in recent years from 1.94% in 1995 to 1.51% in 2005<sup>156</sup>.

19.4.4 The supply and impacts of oil, gas and coal is unquestionably linked to demand. It is therefore important to consider not only UK imports and exports; but also the demand and end-use of oil gas, and coal products within the UK.

19.4.5 Gas and coal are the main fuels used in the production of electricity, supplying approximately 39% of all electricity generated, compared to 1% from oil<sup>157</sup>. The largest end user of petroleum products for energy in the UK is the transport industry (including aviation), accounting for 76% of petroleum products used for energy in 2005<sup>158</sup>. Other significant sectors that use petroleum products for energy are general industry (9%), and the energy industry itself (8%)<sup>159</sup>.

*How significant is the UK in terms of the global oil, gas and coal market?*

19.4.6 The supply of oil and gas from the North Sea reserves continues to decrease<sup>160</sup>, and “the UK was a net importer of oil and gas in the third quarter of 2006 by 2.5 million tonnes”<sup>161</sup>. Coal production within the UK has fallen continuously over the past 20 years. As a result of decreasing coal production and rising demand for

<sup>156</sup> See: <http://www.dti.gov.uk/files/file29731.xls>

<sup>157</sup> See: <http://www.dti.gov.uk/files/file36183.pdf>

<sup>158</sup> See: <http://www.dti.gov.uk/energy/stats/dukes06.pdf>

<sup>159</sup> See: <http://www.dti.gov.uk/energy/stats/dukes06.pdf>

<sup>160</sup> See: [http://www.og.dti.gov.uk/information/bb\\_updates/appendices/Appendix9.htm](http://www.og.dti.gov.uk/information/bb_updates/appendices/Appendix9.htm)

<sup>161</sup> See: <http://www.gnn.gov.uk/content/detail.asp?ReleaseID=254155&NewsAreaID=2&NavigatedFromSearch=True>

power generation, coal imports have increased significantly to a record level of 44 million tonnes in 2005.

19.4.7 The value<sup>162</sup> of oil, gas and coal<sup>163</sup> imported into the UK almost tripled from \$14,340,055,040 to \$42,780,991,461 in three years between 2002 and 2005<sup>164</sup>. In 2005, the UK accounted for approximately 3% of the total trade value of oil, gas and coal imported worldwide<sup>165</sup>. In the same year, the UK exported \$36,581,985,930 of oil, gas and coal globally, accounting for approximately 3.7% of the total trade value of exports for this commodity group worldwide<sup>166</sup>. The International Energy Agency report: Key World Energy Statistics 2006, placed the UK 4th in the list of coal importers, 9<sup>th</sup> in the list of crude oil importers<sup>167</sup>, and 9th in the list of exporters of petroleum products.

19.4.8 BP, one example of a British oil and gas company, is one of the world's largest producers and suppliers of oil, gas and petroleum related products. BP operates globally in more than 100 countries, and has its exploration and production activities are centred on the Russian Federation, Colombia, Venezuela, China, Indonesia, Vietnam and Pakistan, Algeria, Angola and Egypt.

#### *Where are oil, gas and coal imported from?*

19.4.9 The BP publication: Statistical Review of World Energy 2006 indicates that the most significant imports of gas to the UK come from Algeria<sup>168</sup>, and from Norway by pipeline<sup>169</sup>. Details of trade movements of oil to the UK (specifically) are not available in the review; however the report indicates that the most significant imports of oil to Europe arrive from Russia, the Middle East and North Africa. In terms of non-OECD / EEA import partners for coal, the Russian Federation, South Africa, Colombia, Indonesia, China and Malaysia are the largest suppliers of coal to the UK<sup>170</sup>.

#### *Market trends*

19.4.10 General trends in the UK oil, gas and coal sector include the diversification of gas, oil and energy companies into the renewables market; the depletion of north sea oil and gas reserves and a reliance on oil and gas imported from Europe and further afield<sup>171</sup>; developments in technology enabling access to previously unreachable

<sup>162</sup> No data was available for oil and gas commodities imports / exports in units of weight or volume. The value of the commodity imported / exported as a percentage of world trade value, provides an indication of the UK's role in the global oil and gas market.

<sup>163</sup> Under the Comtrade HS 2002 system, this is the broad category of 'Mineral fuels, mineral oils and products of their distillation' which includes: Coal, briquettes, ovoids etc, made from coal; Lignite, except jet; Peat (including peat litter); Retort carbon, coke or semi-coke of coal, lignite, peat; Coal gas, water gas, etc. (not gaseous hydrocarbons); Tar from coal, lignite or peat, other mineral tars; Coal-tar distillation products including oils; Pitch and pitch coke, from coal, mineral tars; Petroleum oils, oils from bituminous minerals, crude; Oils petroleum, bituminous, distillates, except crude; Petroleum gases and other gaseous hydrocarbons; Petroleum jelly, petroleum wax, other mineral waxes; Petroleum coke, bitumen & other oil industry residues; Bitumen, asphalt, oil shales, tar sands, asphaltites; Bituminous mix, mastic from asphalt, bitumen/tar/pitch; Electrical energy

<sup>164</sup> <http://comtrade.un.org/>

<sup>165</sup> The total value of all imports worldwide in 2005 = \$1390652572754

<sup>166</sup> The total value of all exported worldwide in 2005 = \$ 986222356752

<sup>167</sup> Based on 2004 data

<sup>168</sup> Liquefied natural gas

<sup>169</sup> BP (2006) BP statistical Review of World Energy

<sup>170</sup> 2005 Comtrade import data -

<http://comtrade.un.org/db/dqBasicQueryResultsd.aspx?action=print&cc=2701&px=H2&r=826&y=2005&rg=1&so=1001>

<sup>171</sup> Parliamentary Office of Science and Technology (2004) Postnote: The future of UK gas supplies

reserves; and the depletion of current reserves leading to the exploration and exploitation of more isolated and undeveloped areas for oil and gas resources.

- 19.4.11 The recent political climate, and messages from government, suggest that the direction in which the UK goes in respect of energy supply is likely to change in the coming years in response to changes in global climate, global energy security, and a shift in policy. An example of future home policy that may have an effect on the way in which energy is sourced and the development of more sustainable technologies is the Climate Change Bill, which is currently in the form of a consultation draft. The Draft bill proposes the introduction of a legal framework for tackling climate change, and would demand more ambitious cuts and the creation of binding limits for carbon dioxide emissions<sup>172</sup>.

#### *Carbon Emissions from the oil, gas, and coal sector*

- 19.4.12 A study of global carbon emissions generated by FTSE 100 companies in 2003/4 indicates that the oil and gas sector was responsible for emitting the most carbon, with the electricity sector identified as the second largest carbon emitter<sup>173</sup>. The top five largest emitting companies were identified as Shell, BP, Scottish Power, Corus Group and BHP Billiton<sup>174</sup>. The carbon emissions for these companies were further increased when indirect emissions were taken into account.

## 19.5 Biofuels

- 19.5.1 Biofuels can be used as fuel in transport and for heating systems and may also be used for larger scale energy generation. They are generated as liquids from biomass, usually in the form of bioethanol and biodiesel from crops that include: sugarcane, corn, wheat, sorghum, rapeseed, sunflower, palm, soya, coconut or jatropha. Biofuels have the potential to make a significant contribution towards reducing global greenhouse emissions, however there are growing concerns that this could occur at the expense of natural resources and biodiversity in particular.
- 19.5.2 Currently more bioethanol is produced globally than biodiesel. The biggest players in the bioethanol market are America and Brazil, whilst Europe accounted for approximately 9% of global production in 2004. Approximately 60% of bioethanol produced globally comes from sugarcane. However, the majority of biofuel consumed within the EC is biodiesel.
- 19.5.3 There is limited information currently available with regard to the wider environmental impacts of biofuel production and trade<sup>175</sup>. It is known that in some areas substantial land conversion has taken place as a response to the growing biofuel market with consequences for biodiversity, and it is anticipated that this will continue as the demand grows and self-sufficiency becomes less and less feasible.

<sup>172</sup> See: <http://www.defra.gov.uk/environment/climatechange/uk/legislation/index.htm>

<sup>173</sup> See: [http://www.trucost.com/Trucost\\_The\\_Carbon\\_100.pdf](http://www.trucost.com/Trucost_The_Carbon_100.pdf)

<sup>174</sup> The headquarters of BHP Billiton Limited, and the global headquarters of the combined BHP Billiton Group, are located in Melbourne, Australia. BHP Billiton Plc is located in London.

<sup>175</sup> "existing research focuses on the economic and technological aspects of biofuels production" with a tendency to concentrate on energy balance and GHG emissions (IIED, 2006)

*How significant is the biofuels sector in the UK?*

19.5.4 In summary, the European and UK biofuels market is still in its infancy. Biofuels are seen as an alternative fuel with large benefits in terms of reducing carbon emissions, improving energy security and bolstering the agricultural sector. It is likely that new measures will be put in place to encourage the increased use of biofuels and investment in the biofuels industry. Subsequently it is expected that demand will grow and internal EU supply may not be sufficient to meet future demands.

*How significant is the UK in terms of the global biofuels market?*

19.5.5 The most up to date data available seems to suggest that at this stage the majority of bioethanol is consumed domestically and the trade market is limited. In fact the UK is identified as one of the main ethanol exporting countries, exporting 8% of global ethanol exports<sup>176</sup>. Europe is identified as a major importer of bioethanol, mostly sourcing the fuels from Brazil, Pakistan as well as Guatemala, Ukraine, and Peru. Countries such as Germany, France and the Netherlands are identified as significant importers, unlike the UK which does not feature on the list of significant importers of global bioethanol<sup>177</sup>.

19.5.6 There is even less data available on the trade flows of biodiesel, which has a trade market that is younger and smaller than that of bioethanol. However it is predicted that EU countries will begin to import more and more biodiesel, and that palm oil is expected to supply 20 percent of Europe's biodiesel by 2010<sup>178</sup>. Suppliers such as Brazil, Malaysia and Indonesia are expected to increase their exports of fuels for biodiesel in order to meet Europe's growing demand<sup>179</sup>.

*Where are biofuels imported from?*

19.5.7 In Europe and the UK, a large proportion of biofuels are currently imported, and European biofuels are not currently cost competitive. This along with other factors including land scarcity may yet mean that Europe is heavily reliant on the imports of bioethanol and biodiesel into the future.

19.5.8 On the data available<sup>180</sup> it is currently difficult to be certain of bioethanol and biodiesel trade flows. This sector is currently in its infancy and the products used in biofuel production are also used in to make many other products. In fact in the cases of palm and soy, only a very small percentage is used in the production of biofuels. Therefore the data released by organisations such as UN Comtrade and UK Trade Info, tells us very little at this stage.

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<sup>176</sup> Despite being identified as a key exporter of ethanol, the UK is not identified as a significant producer (Commission of the European Communities (2007) Biofuels Progress Report / Dufey (2006) Biofuels production, trade and sustainable development. IIED)

<sup>177</sup> Dufey (November 2006) Biofuels production, trade and sustainable development: emerging issues. IIED, London

<sup>178</sup> *Ibid*

<sup>179</sup> See: <http://www.reuters.com/article/GlobalBiofuel07/idUSL1863894920070118?pageNumber=2>

<sup>180</sup> Comtrade and UK Trade Info

*Market trends*

- 19.5.9 The biofuel industry has experienced rapid growth, and the demand for biofuels has grown significantly over the past five years. This is due to changes in global climate, global security, and a shift in policy. This has subsequently led to the promotion of biofuels in order to reduce carbon emissions, improve energy fuel security and to encourage agricultural diversification in Europe. It is likely that the market will continue to grow, and with increasing targets for a share of transport fuels to be provided from biofuels, demand is likely to continue to rise. In the five years leading up to 2004, the growth in the production of biofuels was estimated at 12% annually<sup>181</sup>.
- 19.5.10 There are two key European initiatives that are likely to reinforce the drive for biofuels use: firstly the Biofuels Directive (2003/30/EC) introduced in May 2003, and secondly the Biofuels Strategy. The Biofuels Directive sets indicative targets for the production of biofuels to constitute 5.75 per cent of motor fuels by 2010. The first set of targets were not however met in 2005 and the supporting measures put in place do not seem to have stimulated investment and growth in the biofuels sector.
- 19.5.11 On the 10<sup>th</sup> January 2007, the EU issued proposals for a new Energy Policy for Europe. Included in the policy proposals are a binding target of 20% of Europe's overall energy mix to be sourced from renewable energy by 2020; and a supplementary minimum target for biofuels of 10%<sup>182</sup>.
- 19.5.12 In the UK the government introduced the Renewables Obligation in 2002, which requires electricity companies to derive a rising percentage of electricity from renewable energy sources, including biomass<sup>183</sup>.
- 19.5.13 If the EU is to meet its target of 5.75% of transport fuels being produced from biofuels by 2010, then internal production will have to increase fivefold<sup>184</sup>. The EU believes that the majority of the demand can be met through internal production without jeopardising food supply. However it is likely that the EU will miss its 5.75% biofuel target for 2010 with substitution for fossil fuels being likely to reach only 3% - 3.5%. Production capacity trends and rapeseed and cereal production forecasts suggest that for 2010 EU production capacity for biodiesel and bioethanol will more or less match demand. In both cases there will be imports of cheaper feedstocks (ethanol, palm oil, soya) from tropical producers<sup>185</sup>.
- 19.5.14 It is expected that the international trade of biofuels will increase substantially in the coming years, as European countries are unable to match the growing demand for biofuels with domestic feedstocks. One prediction is that biofuel production will quadruple over the next 20 years when it will account for approximately 10% of all motor fuel (IEA, 2004 in IIED, 2007). With increasing targets, as demand inevitably exceeds supply, the EU will need to draw-in increasing amounts of plant oils from outside the EU, particularly palm oil and soya. On present trends for agricultural

<sup>181</sup> Dufey, A. (2006). Biofuels production, trade and sustainable development: emerging issues. IIED, London.

<sup>182</sup> See: <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/07/29&format=HTML&aged=0&language=EN>

<sup>183</sup> The energy review 2006, DTI

<sup>184</sup> Dufey (November 2006) Biofuels production, trade and sustainable development: emerging issues. IIED, London.

<sup>185</sup> JNCC unpublished review

production of EU oilseeds, and growing domestic demand, this situation is likely to occur soon after 2010.

- 19.5.15 Critical to limiting excessive imports of biofuels / feedstock, in particular for biodiesel, is the development of 2<sup>nd</sup> generation technology that uses wood and straw rather than plant oils. Some of the current estimations for import requirements incorporate assumptions on the advance of second-generation biofuel technologies. However, if the development of second-generation biofuel technology does not progress at the anticipated rate, then EU demand is likely to outstrip internal capacity to supply. If this occurs, substantial amounts of biofuel imports will be required.
- 19.5.16 Based on the recently published Commission scenarios<sup>3</sup>, with 10% substitution in 2020, approximately 11 million tonnes of biodiesel imports could be needed if 2<sup>nd</sup> generation technology fails to develop at the assumed rate; this would significantly add to global demand for plant oils with implications for food supply and land use pressure in supplying countries which would include Indonesia, Malaysia, Brazil and Argentina. In the worst-case scenario, the scale of import demand would be sufficient to make a significant contribution to the global market in these materials and create significant pressures for land use change. Significant support for 2<sup>nd</sup> generation industry, by discrimination in favour of certain fuel types may be needed to avoid the risk of significant environmental impacts in sourcing countries.
- 19.5.17 Other factors within the UK are also likely to contribute to growth in the biofuels market. At present biofuels are expensive, and firms are struggling to sell their output. However, it is anticipated that the UK government will replace a tax break on biofuels with a legal obligation for refineries to blend a proportion of biofuels into the fuel products<sup>186</sup>.
- 19.5.18 There is also evidence to suggest that British companies are starting to switch to the use of biofuels in order to enhance their green credentials. Most recently Marks and Spencer voiced its intention to switch their entire delivery fleet to B50: a mix of biodiesel and petroleum diesel. This trend suggests that UK demand is likely to grow in the coming years.
- 19.5.19 Currently different technical and environmental standards are emerging, but with no standard aims objectives or requirements. If internationally agreed standards were in place this would have benefits for both the consumer and the supplier. Impacts are likely to vary depending on the crop in question, the country and the technologies used.

## 19.6 Other Power

- 19.6.1 The UK trade and investment website identifies UK strengths in the power industry in the supply of technologies, management consultancy and in the management and operation of power stations. Additionally, the UK has a growing capability in the field of renewables, clean coal technologies, and CO<sub>2</sub> sequestration and storage; and in the future carbon trading may also be an area of development for

<sup>3</sup> EU Commission Review of economic and environmental data for the biofuels progress report. COM 2006 845

<sup>186</sup> The Economist, February 24<sup>th</sup> 2007

UK trade and industry, whilst London is already the leading financial centre for emissions trading.<sup>187</sup>

## 19.7 Impacts on key biodiversity drivers

### *Habitat change (moderate- major)*

#### **Oil, Gas and Coal**

- 19.7.1 The loss or transformation of habitat can potentially arise through primary (relating directly to project activities) and secondary impacts (normally triggered by the presence of the project and commonly caused by population changes) of oil and gas exploration and production. In the first instance direct habitat loss or conversion may arise through exploration and the installation of infrastructure.
- 19.7.2 In recent years with the depletion of existing reserves, oil and gas exploration occurs ever more in isolated and previously uninhabited areas. These areas often have the potential to be high in biodiversity value due to the previous lack of human disturbance, and new projects in these areas “often lead to further economic and social activities, including migration, spontaneous settlement, infrastructure development and agricultural conversion” potentially resulting in significant adverse impacts. Fragmentation may also occur (sometimes over extensive areas) as a result of primary and supporting infrastructure. Species populations may suffer as a result of disturbance.
- 19.7.3 Other impacts include deforestation, soil erosion and compaction, the sedimentation of rivers, and loss of productivity and ecosystem functions. Many of these impacts are associated with both onshore and offshore exploration and production. Other changes that may affect the composition and functionality of ecosystems include changes to food and nutrient supplies, interruption and disturbance of breeding grounds or migration routes, increased vulnerability to predators or changes in herbivore grazing patterns, and alterations to microbial activity in the soil<sup>188</sup>. Offshore oil projects have also been proven to harm fisheries, and may affect the feeding grounds of particular marine species such as the Gray Whale<sup>189</sup>.

#### **Biofuels**

- 19.7.4 The impacts of the biofuels sector are by and large the same as those associated with large-scale agriculture, monocrops, and more specifically those impacts associated with soy and palm oil production which has had an impact of large areas of valuable habitat in South America and Southeast Asia.
- 19.7.5 A major concern is that the biofuel industry is likely to contribute to the expansion of the agricultural frontier, resulting in direct impacts to biodiversity through conversion of virgin habitats (primarily grassland, forest, and wetland). Expansion of the agricultural frontier may also occur in marginal areas of degraded land that would be suitable for crops such as *Jatropha* which require fewer inputs and have

<sup>187</sup> See: [https://www.uktradeinvest.gov.uk/ukti/appmanager/ukti/sectors?\\_nfls=false&\\_nfpb=true&\\_pageLabel=SectorType1&navigationPageId=/power](https://www.uktradeinvest.gov.uk/ukti/appmanager/ukti/sectors?_nfls=false&_nfpb=true&_pageLabel=SectorType1&navigationPageId=/power)

<sup>188</sup> UNEP & the E&P Forum (1997) *Environmental Management in oil and gas exploration and production*

<sup>189</sup> See: [http://www.foe.co.uk/resource/press\\_releases/rare\\_gray\\_whales\\_threatene\\_14122005.html](http://www.foe.co.uk/resource/press_releases/rare_gray_whales_threatene_14122005.html)

drought resistant qualities. This expansion may therefore lead to either positive or negative impacts on biodiversity depending on the existing value of land.

- 19.7.6 There are currently mixed messages as to whether biofuels have already contributed to the expansion of the agricultural frontier at the expense of biodiversity. The main fuel sources currently in demand for biofuel production originate from sugarcane, palm oil and soy. The impacts of increased soy production in Brazil to cater for growing demand for biodiesel has been raised as a major concern<sup>190</sup>. Some information sources would suggest that conversion of land to harvest soy and palm oil has led to significant land conversion in Asia and South America, threatening the habitats of the Orang-utan in Borneo and virgin forest in the Brazilian Amazon. Palm oil production has been identified as the cause of the deforestation of large areas of rainforest in Southeast Asia<sup>191</sup>. There is evidence that adverse impacts have been inflicted on biodiversity as a result of the spread of oil-palm plantations in Indonesia and Malaysia (IIED 2007), and the expansion of production of soy in Brazil which has been at the expense of valuable forest habitat. In Brazil, the Atlantic Forests and the Cerrado are also being affected by the encroachment of sugarcane, which has already been linked to the destruction of many unique and valuable ecosystems in Brazil and elsewhere. Some estimates suggest that as much as two-thirds of the Cerrado have already been destroyed by the encroachment of sugarcane, and the impacts of an increased demand for bioethanol are not yet known<sup>192</sup>.
- 19.7.7 There are conflicting views over whether biofuels can be directly linked to the destruction of forests in Malaysia, Indonesia and Brazil. At present it is difficult to ascertain to what extent biofuels are impacting on virgin habitat, as spatial data for the distribution and growth of feedstock crops is not readily available. Furthermore, it is difficult to ascertain the extent to which biofuels are contributing to the demand for crops such as soy and palm, which have multiple end uses. A recent report published by the EU claims that the increase in global palm oil production is not driven by the biofuel industry but by the food market<sup>193</sup>.
- 19.7.8 Expansion of the agricultural frontier will almost certainly become more of a concern as demand for biofuels grow. Countries are identifying opportunities arising from the increasing demand for biofuels in Europe and the rest of the world, and this is likely to result in the need to either convert land currently used for food production or the conversion of currently unused land, often in areas of biodiversity value. By way of an example, Brazil will need to cultivate an extra 3 million hectares of land to meet domestic and foreign demands by 2013<sup>194</sup>.

<sup>190</sup> See: <http://www.i-sis.org.uk/BiofuelRepublicBrazil.php> & See: <http://www.bioenergytrade.org/downloads/kruglianskasnovdec05.pdf>

<sup>191</sup> <http://environment.newscientist.com/article/mg18825265.400>

<sup>192</sup> <http://www.i-sis.org.uk/BiofuelRepublicBrazil.php>

<sup>193</sup> European Commission (2007) Biofuels Progress Report.

<sup>194</sup> Dufey, A. (2006) Biofuels production, trade and sustainable development: emerging issues. IIED, London.

- 19.7.9 Other associated impacts may arise through the provision of infrastructure to facilitate the expansion of a particular agricultural crop to provide biofuels. Illegal deforestation may also occur to make way for more plantations<sup>195</sup>. Both of these impacts not only mean the potential destruction of areas of biodiversity value, but also the fragmentation of ecosystems.
- 19.7.10 Given the fact that the biofuel industry is still in its infancy and the anticipated growth of the market, this could cause major impacts to biodiversity in the future unless the countries producing the crops put safeguards in place and those countries importing the crops put measures in place to ensure that they are not having negative impacts on biodiversity.
- 19.7.11 Further research will be needed to predict the direction in which the biofuels market is likely to grow, and to determine any policy recommendations that may be needed to reduce the impacts that the UK and Europe are likely to have on biodiversity as a result.
- 19.7.12 Different biofuel feedstocks are likely to be cultivated in different areas and climates, and are also likely to have different environmental impacts, further research in this area is also necessary in order to properly weigh-up the pros and cons of different feedstocks in order to maximise environmental benefits and minimise adverse effects. A greater understanding of present and future demand and import requirements is essential in determining the impacts of the UK's portion of the biofuels sector.

*Over-exploitation (minor)*

**Oil, Gas and Coal**

- 19.7.13 As previously discussed, new oil and gas projects in previously remote and undeveloped areas may trigger significant in-migration of human populations. Where this occurs, local people may not have access to sufficient food resources and have been known to convert land for agriculture and hunt for food. Such projects may also provide new access to previously unreachable resources, drawing people to the area specifically to make use of these resources, often in the form of logging and hunting.

**Biofuels**

- 19.7.14 Past experience has shown that the conversion of land for large-scale agriculture has led to the degradation of land and increased levels of water consumption, with the potential to affect the water table and water flows. This may in turn have an effect on local biodiversity.

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<sup>195</sup> See: [http://www.rio6.com/proceedings/RIO6\\_181106\\_IT\\_1630\\_Oritz.pdf](http://www.rio6.com/proceedings/RIO6_181106_IT_1630_Oritz.pdf)

*Invasive species (minor -moderate)*

**Oil, Gas and Coal**

19.7.15 The introduction non-native soil, seed and other faunal species has previously occurred as a result of oil and gas projects, through the movement of machinery, materials, employees, and through revegetation programs. Past evidence exists to show that the movement of invasive species may be facilitated through oil and gas associated infrastructure such as pipelines and roads.

**Biofuels**

19.7.16 The issue with biofuels relates less to invasive species and more to the introduction of genetically modified crops. GM crops are likely to play a role in the development of biofuel production as this provides one way of improving the efficiency of biofuels. There is concern that biofuels will lead to the spread of GMOs with potential knock on effects for biodiversity.

*Pollution (moderate - major)*

**Oil, Gas and Coal**

19.7.17 Water and soil pollution may occur as a result of both exploration and production – both onshore and offshore. Contamination of soils and water may result from improper waste disposal procedures and accidental spillage. Further negative impacts may arise through the pumping of water used to cool machinery or extract oil and gas from the ground, producing large volumes of water with undesirable quality known as produced water. Drilling muds, cuttings and well treatment chemicals may also impact upon benthic flora and fauna. A risk previously identified is that of corrosion resulting in the leakage of hydrocarbons from transmission pipes and storage vessels posing a threat of serious pollution.

**Biofuels**

19.7.18 Impacts to biodiversity are likely to occur with large-scale agriculture and the use of agrochemicals. This may have local impacts and where agrochemicals leach into rivers and streams impacts may occur to ecosystems downstream.

19.7.19 In some developing countries it is common practice to burn sugarcane crops prior to harvest, resulting in localised air pollution. This may similarly result where large areas of palm oil plantations are cleared.

*Climate change (moderate - major)*

**Oil, Gas and Coal**

19.7.20 The linkage between anthropogenic climate change and the oil and gas sector is clearly apparent. As stated above, the top five largest carbon emitting FTSE 100 companies were identified as Shell, BP, Scottish Power, Corus Group and BHP Billiton, mainly relating to the oil, gas and energy sector. Although it may be argued that the sector's output is generated by demand, the potential

consequences need to be acknowledged within the sector. UK registered companies not only provide oil and gas to the UK, but are also global suppliers, whose responsibilities extend beyond the UK boundaries. The main sources of emissions resulting from the oil and gas sector, and contributing to climate change, arise at the production and end user stages. Exploration activities are not generally considered to generate sufficient emissions to cause atmospheric changes. Evidence suggests however, that other activities such as gas flaring, contribute a substantial amount of carbon emissions; and the global oil and gas industry accounts for a significant proportion of global methane emissions. Oil and gas sector related activities that contribute to the total carbon emissions for the sector include gas venting, combustion processes, fugitive gases from loading operations, transportation of oil and gas (and related commodities) and most obviously, end use for power and transport.

### **Biofuels**

- 19.7.21 Biofuels offer the potential to significantly reduce global greenhouse gas emissions, and this is the reason that many countries are now adopting mandatory targets for the replacement of a proportion of fossil fuels with biofuels.
- 19.7.22 There are however some risks relating to emissions from biofuels. Depending on the method of production and the extent and nature of land use change to grow feedstocks, biofuels can potentially generate significant greenhouse gas emissions. An example was provided last year in a study of impacts relating to the conversion of swamps to palm oil plantations, which found that 33 tonnes of CO<sub>2</sub> were emitted per tonne of palm oil produced by speeding up the decomposition of peat in the swamps<sup>196</sup>.
- 19.7.23 Some methods of biofuel production use electricity generated from fossil fuels to convert feedstocks into bioethanol, and some fertilisers used to grow feedstocks are made from natural gas<sup>197</sup>. There is the potential that deforestation in areas such as the Amazon could also be a major generator of greenhouse gas emissions<sup>198</sup>, counteracting the benefits of biofuels as the emissions savings from bioethanol can be eclipsed by the ability of natural forest to absorb CO<sub>2</sub>.

## **19.8 Geographical factors**

### *Ecoregions*

- 19.8.1 Of the non-OECD / EEA countries identified as key import partners of oil, gas and coal and related products to the UK or priority areas for the UK oil and gas sector, the following countries partly or wholly contain G200 ecoregions<sup>199</sup> (the number of G200 ecoregions in each of these countries is also indicated):

<sup>196</sup> The Economist, February 24<sup>th</sup> 2007

<sup>197</sup> The Economist, February 24<sup>th</sup> 2007

<sup>198</sup> See: <http://www.i-sis.org.uk/BiofuelRepublicBrazil.php>

<sup>199</sup> See: <http://www.worldwildlife.org/science/ecoregions/g200.cfm> - WWF's Global 200 is a first attempt to identify a set of ecoregions whose conservation would achieve the goal of saving a broad diversity of the Earth's ecosystems. These ecoregions include those with exceptional levels of biodiversity, such as high species richness or endemism, or those with unusual ecological or evolutionary phenomena.

**Table 21: The number of G200 ecoregions in or partly within the non-OECD/ EEA countries, identified as key markets or import partners for the UK, where oil, gas and coal have been identified as a specific threat**

Country	Number of G200 ecoregions in or partly within the country <sup>200</sup> where the oil and gas sector has been identified as a specific threat
Russia	19
Brazil <sup>201</sup>	18
China	17
India	15
Mexico	12
Venezuela	12
Angola	8
Nigeria	7
Malaysia <sup>202</sup>	7
South Africa	6
Saudi Arabia	3
Algeria	3
Libya	2
Kazakhstan	2
Iraq	2
United Arab Emirates	2
Kuwait	1
Latvia	1

19.8.2 Of those G200 ecoregions identified as being located either partly or wholly within the boundaries of these countries, oil, gas or coal has been specifically identified as a threat<sup>203</sup> in 22 of these ecoregions:

- Barents-Kara Sea
- Guianan-Amazon Mangroves
- Upper Amazon Rivers and Streams
- Upper Parana Rivers and Streams

<sup>200</sup> Non-OECD / -EEA countries only

<sup>201</sup> Also a likely growth market in the production of feedstocks for biofuels

<sup>202</sup> Also a likely growth market in the production of feedstocks for biofuels

<sup>203</sup> The WWF profiles of each ecoregion also identify specific threats

- Patagonian Southwest Atlantic
- Daurian Steppe
- Naga-Manupuri-Chin Hills Moist Forests
- Sundarbans Mangroves
- Maldives, Chagos, Lakshadweep Atolls
- South Caribbean Sea
- Mesopotamian Delta and Marshes
- Gulf of Guinea Mangroves
- Niger river delta
- Red Sea
- Arabian Sea
- Mediterranean Sea
- Californian Current
- Mesoamerican Reef
- Kayah-Karen / Tenasserim Moist Forests

19.8.3 Large-scale agriculture for palm oil was specifically identified as a threat in the Borneo Lowland and Montane Forests G200 ecoregion, located in Indonesia and Malaysia.

## 19.9 Financial Levers

*British influence / investment / Major trade partner*

19.9.1 The UK Trade and Investment website highlights the following priority areas for the UK oil and gas sector:

**High-priority markets**

Brazil

China

Russia

Kazakhstan

India

Venezuela

**Secondary markets**

Mexico

Angola

Algeria

Malaysia

Iraq  
Nigeria  
Saudi Arabia  
Libya

19.9.2 The UK Trade and Investment website highlights the following priority areas for the UK power sector:

- USA
- India
- China
- Russia
- Canada
- South Africa
- Middle East particularly Saudi Arabia
- South East Asia particularly Vietnam, Philippines and Thailand

19.9.3 Although trade data does not exist to be able to identify UK trade partners in biodiesel and bioethanol, it is possible to identify the key trading partners in soy and palm oil which are the key feedstocks used in the production of biofuels.

*Table 22: Major UK import partners of palm oil (calculated from aggregated palm oil and derivative classifications: SITC3 - 4222, 8138 and 4224) (source: UN Comtrade)*

Partner	Trade Value
Malaysia	\$175,565,245
Papua New Guinea	\$154,954,026
Indonesia	\$148,230,415
Netherlands	\$100,560,873
Colombia	\$98,309,567

*Table 23: Major UK import partners of palm oil (calculated from aggregated HS2002 soy classifications) (source: UN Comtrade)*

Partner	Trade Value
Brazil	\$193,151,995
USA	\$20,872,831
Canada	\$9,261,719
Belgium	\$7,148,398
Italy	\$2,975,320

19.9.4 Furthermore, Brazil, Indonesia and Malaysia may appear to have increased production in response to increasing demand for biofuels in the EU, and are likely to be key suppliers to the UK in the future. Africa has also been earmarked as an area for the production of biofuels.

#### *Development Assistance*

19.9.5 The following countries have been identified as either priority markets for the UK oil and gas sector, or major exporters of oil, gas and related products to the UK, and have featured amongst the top twenty recipients of DFID bilateral aid in the years 2003/4 -2005/6:

- South Africa
- China
- Nigeria
- Iraq
- India

## 19.10 Policy Levers

### *Bilateral agreements*

19.10.1 The UK has developed specific bilateral trade agreements and trade relations with countries that are key players in the biofuel industry. For example Brazil and the UK recently issued a joint statement on trade and investment flows. This was produced by the Joint Economic and Trade Committee (JETCO), which is a Ministerial led committee tasked with furthering the UK's strategic economic relationship with Brazil. The key recommendations of the joint statement included establishing partnerships in trade and investment in renewable energies, particularly ethanol. Agreement was also made to jointly promote bioethanol globally, with the intention to explore with Southern African countries their potential involvement in a Taskforce to develop biofuels within Africa.

### *Commonwealth*

19.10.2 The following commonwealth countries have been identified as either priority markets for the UK oil and gas sector, or major exporters of oil, gas and related products to the UK:

- South Africa
- Malaysia<sup>204</sup>
- Nigeria
- India

### *Sustainable Development Dialogue*

19.10.3 The UK has a sustainable development dialogue with Brazil, Mexico and India, which are identified as priorities for the UK oil and gas sector; and with South Africa, which is a major exporter of oil and gas to the UK. Brazil is also a likely growth market in the production of feedstocks for biofuels.

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<sup>204</sup> Also a likely growth market in the production of feedstocks for biofuels.