Chapter 1 – Why biofuels? Drivers for biofuels production

Box 1.1: Overview

Biofuels have attracted increasing interest over the last few decades. As fuels made from locally grown renewable sources, they have been proposed as an alternative to expensive fossil fuels. Moreover, they appeared to provide a single solution to three of the most important challenges of modern life, which include:

- worries over energy security;
- an interest in economic development, both in the developed world and developing countries, including the creation or sustaining of jobs in agriculture; and
- the need to mitigate climate change and achieve lower greenhouse gas (GHG) emissions.

These challenges and the attempts of policy makers and other stakeholders to address them have contributed to a rapid adoption of biofuels technology.

In Chapter 1, we take a closer look at these drivers and discuss their contribution to the current situation in biofuels development, use and policy making.

History of biofuels

1.1 Biofuels are not new. When first demonstrating the engine bearing his name, Rudolf Diesel ran it on peanut oil at the World's Fair in Paris in 1900.[40] Interest in both vegetable oils as fuels for the internal combustion engine and plant material for ethanol production for transport fuel was also reported in several countries during the 1920s and 1930s and later during World War II where there were serious fuel shortages, for example in the UK and Germany. In an interview in 1925, Henry Ford, founder of Ford Motor Company, envisaged the processing of fruit and other plant material into fuel for cars: "The fuel of the future is going to come from fruit like that sumac out by the road, or from apples, weeds, sawdust – almost anything. There is fuel in every bit of vegetable matter that can be fermented. There's enough alcohol in one year's yield of an acre of potatoes to drive the machinery necessary to cultivate the fields for a hundred years."[41]

1.2 In the 1950s and 1960s, the first patents for industrial production of biofuels began to appear but petroleum-based fuels remained dominant throughout the 20th century, mainly owing to low crude oil prices. However, during the 1940s, Belgium, France, Italy, the UK and Germany each investigated the use of vegetable oil fuels and, during World War II, Brazil, Argentina, Japan and China used vegetable oils as fuel.[42]

1.3 Interest in biofuels was reinforced in the later decades of the 20th century by various legislative and political acts.[43] The oil embargo by the Organization of the Petroleum Exporting Countries OPEC in 1973–1974, which led to a sharp increase in crude oil prices, also led to worldwide interest in alternative energy sources, including biofuels. This was also

[40] Knothe G (2001) Historical perspectives on vegetable oil-based diesel fuels *Inform* **12**: 1103–7.
[41] The New York Times (19 Sep 1925) *Ford predicts fuel from vegetation; he says electricity will heat cities in the future, tells of testing a new flour*, available at: http://query.nytimes.com/mem/archive/pdf?res=F30A15FA3E5B13718DDDA90A94D1405B858EF1D3.
[42] Knothe G (2001) Historical perspectives on vegetable oil-based diesel fuels *Inform* **12**: 1103–7.
[43] For example, the year 1970 saw the passage of the US Clean Air Act by the US Environmental Protection Agency (EPA). This Act allowed the EPA to regulate more closely emissions standards for pollutants such as sulphur dioxides, carbon monoxide, ozone, nitrogen oxides, and particulates and thus provided an incentive for US research to develop cleaner burning fuels.

the first time that worries over dependence on oil-based fuel imports were discussed publicly in many countries in the Western world.

Modern drivers of biofuels development

1.4 In recent years, several major challenges to the modern world and its way of life have become a focus of public interest. By the end of the 20th century, governments and policy makers around the world faced three key issues:

- (renewed) worries about energy security;
- an interest in economic development, both in the developed world and developing countries, including the creation or sustaining of jobs in agriculture; and
- the need to mitigate climate change and achieve lower greenhouse gas (GHG) emissions.

1.5 Fuels made from locally grown renewable sources were proposed as a contribution to addressing all three of these challenges, as well as providing a potentially cheap alternative to expensive fossil fuels. Moreover, they were also seen as a way of addressing some additional, important concerns at the time, including those over lead in fuel and losses of agricultural jobs and farming subsidies. There was also an interest in biofuels as a source of octane. From the point of view of many involved, biofuels looked like an extremely attractive option, and thus the decade 1995–2005 saw several new supportive policies for biofuels in the European Union (EU) – including the UK – and the US, as well as in many other countries around the world. These policies established markets for biofuels and acted as incentives to industry to invest in biofuels development and production. As a consequence, biofuels became available on a small but significant commercial scale, and this has remained the case.

1.6 The above three drivers, which are to some degree interlinked, have become increasingly important and the motivation to develop alternatives to fossil fuels remains strong. The following sections take a closer look at these drivers and discuss their contribution to the current situation in biofuels development, use and policy making.

Energy security

> **"Internal combustion engines will be used for a long time to come around the world. There are few alternatives to crude oil when it comes to transport, which is quite different to the broader energy picture (including heat and electricity). There is therefore a strong case for channelling a significant volume of biomass into liquid biofuels for transport."**[44]
>
> **"Biofuels offer the potential to diversify at least some of the reliance on import of fossil fuels, and to produce home-produced fuels."**[45]

What is energy security?

1.7 Much of the world's extraordinary economic progress over the last century has been facilitated by reliable and affordable sources of energy. However, at the beginning of the new millennium, one of our biggest challenges is continuing to meet rising energy demand in a sustainable way, and energy security has become a constant and universal issue.

1.8 In its 2000 Green Paper, the European Commission (EC) took energy security to be: "the uninterrupted physical availability of energy products on the market, at a price which is

[44] Swan Institute, Newcastle University, responding to the Working Party's consultation.
[45] NNFCC, responding to the Working Party's consultation.

affordable for all consumers (private and industrial)".[46] Threats to energy security come in many forms. Some can disrupt the provision of energy to consumers and businesses (e.g. through limited availability of fuel), while others affect the price of energy (e.g. price spikes as a result of geopolitical tensions and war). Threats can be immediate or longer term, and can originate from inside or outside the country affected. Furthermore, the impacts of energy insecurity can be uneven. For example, energy-intensive businesses and fuel-poor households[47] are particularly vulnerable to the effects of high energy prices. Moreover, as economies transition to low carbon patterns of energy production and use to tackle climate change, the challenge of energy security becomes one in which the threats to availability and affordability will change over time.

1.9 Energy security discussions often make a distinction between strategic security and operational security. For example, in considering 'security of supply', the UK Committee on Climate Change (CCC) distinguishes between technical security of energy supply ("the degree of certainty that energy supply will be available immediately and on demand when customers want it") and geopolitical and economic security of energy supply ("the extent to which the UK can be free of reliance on sources of energy which are geopolitically insecure or inherently and harmfully volatile in price").[48] It is often assumed that energy imports are inherently less secure than domestic 'home-grown' sources of energy, and this is commonly used to argue for increasing biofuels production from local sources. In reality, however, energy security depends on factors that are both domestic (e.g. infrastructure) and international (e.g. volume of fuel produced, prices). Access to international sources of energy can, for example, often lead to lower energy prices.

1.10 The importance of energy security is seldom disputed, but the dimensions of security that are most important – and the types of energy production and use that are required to address risks to energy security – are hotly debated. Proponents of non-fossil energy sources such as wind power, nuclear power and indeed biofuels often argue that these sources will improve security. However, the extent to which these sources can maintain or improve levels of security depends heavily on context. For example, it depends on what energy sources they are replacing, how they are deployed, and what other sources are deployed alongside them. Biofuels have a relative advantage over, for example, wind energy because they can be stored. In addition, the security benefits of energy efficiency are more universally acknowledged and lower energy demand and consumption is therefore a primary goal to secure energy security in the long term.

Threats to energy security

1.11 There are many potential risks to energy security, and these can be divided into four main categories:[49]

- risks due to fossil fuel scarcity or disruptions to fossil fuel supplies from international markets;
- risks due to a lack of investment in domestic national energy infrastructure;
- risks from technology and infrastructure failures; and
- risks due to industrial activism or terrorism.

[46] European Commission (2000) *Green Paper: towards a European strategy for the security of energy supply*, available at: http://ec.europa.eu/energy/green-paper-energy-supply/doc/green_paper_energy_supply_en.pdf, p3.

[47] I.e. when a household is unable to afford adequate warmth because it lives in an energy-inefficient home where it is necessary to spend more than 10 per cent of the family income on energy services; see: Boardman B (1991) *Fuel poverty: from cold homes to affordable warmth* (London: Belhaven Press), p205.

[48] Committee on Climate Change (2008) *Building a low-carbon economy: the UK's contribution to tackling climate change*, available at: http://www.theccc.org.uk/pdf/TSO-ClimateChange.pdf, p415.

[49] Watson J (2009) Is the move toward energy security at odds with a low-carbon society?, in *Building a low-carbon future: the politics of climate change*, Giddens A, Latham S and Liddle R (Editors) (London: Policy Network), pp35–6.

1.12 Many debates focus almost exclusively on the first of these risks, particularly on concerns that supplies of cheap oil are dwindling, while growing global demand has led to rising oil prices. A recent review of the evidence from the UK Energy Research Centre recognises that there continues to be significant debate regarding the timing of a peak in global oil production. It nevertheless suggests that "a peak of conventional oil production before 2030 appears likely and there is a significant risk of a peak before 2020".[50] The International Energy Agency (IEA) has changed its position on this issue, concluding recently that there is a real risk of a near-term global "oil-supply crunch" due to under-investment.[51] Given the expectation of continually rising future demand for transport fuel, the envisaged negative effect of such an 'oil crunch' on the transport fuel sector is lending some urgency to the search for alternative fuels – with biofuels a promising candidate from this perspective.

1.13 Access to energy by consumers depends not only on the availability of fuels, but also on timely investment in infrastructure such as power stations, refineries, transmission lines, gas grids and storage facilities. With regard to the transport sector, some biofuels might require investment in new infrastructure, while others, in particular biodiesel, could be produced, distributed and used within existing fuel infrastructure.

1.14 Technical failures due to faults or external stresses, such as extreme weather, are a feature of all large infrastructure systems, including those that supply our energy needs. If they become widespread, the consequences can be serious. Recent events such as the BP oil spill or Hurricane Katrina, and their impacts on the operation of offshore oil and gas facilities in the Gulf of Mexico, show that these risks need to be taken seriously. In comparison with offshore drilling for fossil fuels, biofuels might present fewer risks: spills are far less toxic. However, extreme weather can of course still impact on crop yields and destroy harvests. This in turn can decrease the availability of feedstocks and drive up prices of biofuels.

1.15 Threats due to industrial activism and terrorism are now an increasing feature of energy security discussions. Historically speaking, non-fossil energy sources, such as renewable fuel and energy sources, have been less vulnerable to such dangers, but, again, parts of the energy infrastructure such as pipelines, tankers and storage facilities could be vulnerable to terrorist attack. In principle, such risks also apply to biofuels, in particular to those which could be produced and distributed using established fuel infrastructure. However, there is the potential to produce some biofuels in a more decentralised way than traditional fossil fuel production, thus contributing to a lower degree of vulnerability of the production chain to terrorist activity. Some commentators also stress the value of such diversification in fuel production for national security purposes. One respondent to our consultation stated: "…if we value military strategic flexibility and understand that our reserves of fossil fuels soon will not be adequate to produce the energy needed…, then we must find ways to develop the fuel from other means...".[52]

Energy security in the UK: issues and policy responses

1.16 After about two decades as a net exporter of oil and gas, the UK has recently become a net energy importer again. In his 2009 report, Malcolm Wicks MP, then Special Representative on International Energy to the Prime Minister, proposed a UK strategy to supply energy for the transport and other sectors that would still enable the UK to achieve its climate change

[50] UK Energy Research Centre (2009) *The global oil depletion report*, available at: http://www.ukerc.ac.uk/support/tiki-index.php?page=Global+Oil+Depletion, px.

[51] International Energy Agency (2008) *World energy outlook: executive summary*, available at: http://www.worldenergyoutlook.org/docs/weo2008/WEO2008_es_english.pdf, p7.

[52] Advanced Biofuels USA, responding to the Working Party's consultation.

objectives.[53] It proposed "a framework in relation to both international and domestic policy of first, acting to reduce total energy demand; secondly, promoting the adoption of technologies that reduce reliance on oil and gas and simultaneously reduce GHG emissions; and, finally, acting to mitigate the international energy security risks inherent in the use of fossil fuels".[54] Biofuels, produced domestically, could score high on the two latter goals.

1.17 As with many reports on energy security, the report by Malcolm Wicks MP offers a partial view of the subject. However, a key strength is that there is a strong emphasis on diversity. A diverse mix of (i) energy sources and technologies in the different energy sectors, (ii) sources and supply routes of individual fuels, and (iii) distribution and stocking infrastructures can all help to minimise risks to energy security. In his report, Malcolm Wicks MP gives one view of specific energy options that he feels will strengthen diversity. However, it is important to remember that this is open to debate: diversity is a property of the energy system as a whole and views vary on the extent to which individual energy technologies or sources add to that diversity.[55]

Energy security and biofuels

1.18 In 2007, fuel for transport accounted for 27 per cent of total world delivered energy consumption.[56] In the same year, 53 per cent of liquid fuel supplied was consumed by the transport sector, and this proportion is predicted to rise to 61 per cent by 2035.[57] We have stressed before that it is vital to reduce consumption significantly over the next few decades. However, it is unrealistic to expect that the demand for liquid transport fuels will reduce significantly. Petroleum products are very convenient fuels owing mainly to their relatively high energy density.[58] Furthermore, engine and fuel development have occurred symbiotically over a long period of time resulting, technically and economically, in highly effective combinations for transport, integrally linked to a global production and distribution system. Vehicles with new types of engine which use completely different fuels or sources of energy, such as electric cars,[59] not only require research, development, demonstration and deployment, but also investment in supporting infrastructure and refuelling networks. This is a major consideration for road transport systems and is even more challenging for air transport where there are currently almost no alternatives to engines which rely on relatively high energy-density liquid fuels.[60]

1.19 The UK will therefore continue to rely heavily on imports. With the high percentage of liquid fuel used for transport in the UK, there is a strong interest in having a constant and affordable

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53 Wicks M (2009) *Energy security: a national challenge in a changing world*, available at: http://www.decc.gov.uk/assets/decc/What%20we%20do/Global%20climate%20change%20and%20energy/International%20energy/energy%20security/1_20090804164701_e_@@_EnergysecuritywicksreviewBISR3592EnergySecCWEB.pdf.

54 Wicks M (2009) *Energy security: a national challenge in a changing world*, available at: http://www.decc.gov.uk/assets/decc/What%20we%20do/Global%20climate%20change%20and%20energy/International%20energy/energy%20security/1_20090804164701_e_@@_EnergysecuritywicksreviewBISR3592EnergySecCWEB.pdf, p5.

55 Stirling A (2010) Multicriteria diversity analysis: a novel heuristic framework for appraising energy portfolios *Energy Policy* **38**: 1622–34.

56 US Energy Information Administration (2010) *International energy outlook 2010: world energy demand and economic outlook*, available at: http://www.eia.doe.gov/oiaf/ieo/world.html. This comprises the energy used in moving people and goods by road, rail, air, water and pipeline.

57 US Energy Information Administration (2010) *International energy outlook 2010: liquid fuels*, available at: http://www.eia.doe.gov/oiaf/ieo/liquid_fuels.html, Figure 31.

58 Energy density: energy available per unit volume or weight of fuel. High energy density reduces the amount of fuel storage required in the vehicles that they power. It also helps to reduce the deadweight of the vehicle (vehicle weight including engine(s) and fuel) relative to its payload (passengers and/or freight), thereby increasing its overall energy performance (number of passengers or tonnes of freight carried each kilometre per unit of fuel consumed).

59 For road transport, alternatives to current systems include electric vehicles with battery storage and fuel cell vehicles which use hydrogen.

60 For example, the 2009 report on aviation by the CCC concluded that there were significant technical and logistical barriers to the use of hydrogen-fuelled aircraft. Additionally, the climate impacts needed to be more clearly understood before the concept was pursued; see: Committee on Climate Change (2009) *Meeting the UK aviation target – options for reducing emissions to 2050*, available at: http://downloads.theccc.org.uk/Aviation%20Report%2009/21667B%20CCC%20Aviation%20AW%20COMP%20v8.pdf, pp115–8.

supply of transport fuels for strategic and operational economic reasons to avoid price volatility and restricted economic growth.[61] Hence, the possibility of deriving liquid fuels from locally grown sources and using them as alternatives to petroleum products in existing engines for all forms of transport is extremely attractive. This is the basis of initial interest in biofuels derived from biomass that can be a renewable source of energy.

1.20 Biofuels from biomass, which can be grown domestically or abroad, could improve diversity within the UK's transport fuel mix. In 2009, the UK Renewable Energy Association concluded that there is sufficient availability of sustainable feedstock for biofuel demand in both the EU and the UK to meet targets[62] (as set by the Renewable Energy Directive (RED), discussed below).[63]

1.21 Biofuels have been highlighted as a potentially important contribution to future energy supply in many recent reports concerned with energy security.[64] In its 2007 report, the IEA in particular stresses that: "Biofuels for transport represent a key source of diversification from petroleum."[65] Indeed, countries such as Brazil implemented their large-scale biofuels programmes mainly owing to worries over energy security and dependence on oil-based fuels (see Chapter 2).

1.22 The expectation that biofuels can contribute significantly to energy supply diversification is reflected in recent UK energy policy, where the Government's goal, under The Renewable Transport Fuel Obligations (Amendment) Order 2009, is for 5 per cent of total transport fuel to originate from renewable sources by 2013.[66] This may sound like a small contribution, but even a small contribution could be quite important in the energy portfolio of the future. However, as with other potential sources of energy for the future, the security benefits of biofuels will need to be analysed carefully. This analysis will need to consider not only fuel diversity, but also the sources of biofuels (e.g. geographical locations), the supply routes to and within the UK, and the resilience of infrastructure within the UK for stocking and local distribution. It will also need to consider whether other complementary or alternative ways of meeting the demand for transport could be more or less secure than a mix that includes biofuels. Finally, energy security concerns need to be integrated with other motivations, such as climate change mitigation and the need to preserve ecosystem services. In the following chapters, we offer some guidance on how to engage in this discussion.

Economic development

"The most important factor in driving the development of biofuels in the future will be the need for promoting agricultural and economic development with millions, perhaps billions of farmers around the world, living in marginal areas, facing a lack of resources, especially

[61] Beyond the transport sector, fuel price volatility has become a concern because price spikes contribute to fuel poverty.

[62] Renewable Energy Association (2009) *REA position paper on the UK's implementation of the renewable transport elements of the Renewable Energy Directive (RED) and the Fuel Quality Directive (FQD)*, available at: http://www.r-e-a.net/document-library/policy/policy-briefings/0906%20REA%20position%20paper%20on%20RED-FQD%20implementation%20FINAL.pdf, p4.

[63] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC [2009] OJ L140/16.

[64] Wicks M (2009) *Energy security: a national challenge in a changing world*, available at: http://www.decc.gov.uk/assets/decc/What%20we%20do/Global%20climate%20change%20and%20energy/International%20energy/energy%20security/1_20090804164701_e_@@_EnergysecuritywicksreviewBISR3592EnergySecCWEB.pdf, pp74–5; International Energy Agency (2007) *Contribution of renewables to energy security*, available at: http://www.iea.org/papers/2007/so_contribution.pdf, p63.

[65] International Energy Agency (2007) *Contribution of renewables to energy security*, available at: http://www.iea.org/papers/2007/so_contribution.pdf, p5.

[66] Art 4 of The Renewable Transport Fuel Obligations Order 2007 amended by The Renewable Transport Fuel Obligations (Amendment) Order 2009. This could also include other renewable sources, for example electric vehicles powered by electricity from renewable sources such as solar or wind.

energy…Addressing the needs of these people must be the driving force for promoting bioenergy development efforts."[67]

"It is my contention that the production of biofuels has contributed little to reducing poverty. There are far more efficient and effective ways of achieving this goal than through the promotion of biofuels."[68]

Introduction

1.23 Supporting economic development is an important goal of most modern societies in order to improve the wealth and well-being of their citizens. It is of particular concern in developing and emerging nations, which generally experience greater levels of poverty and lower standards of living. Patterns of industrialisation have to date been energy intensive. If emerging and less developed economies follow the established technological and economic paths of development, a global energy and environmental crisis will be inevitable. Energy and fuel consumption in emerging economies, such as Brazil and China, have risen steeply owing to advances in industrialisation and, as described in the Introduction (paragraph 5), are expected to continue to rise.

1.24 In developing countries, which are more vulnerable to changes of climate than the developed world, concerns about environmental security are especially relevant when further economic development is considered. This is mirrored in the United Nations (UN) Millennium Development Goals. The Millennium Development Goals link development and the protection of the environment explicitly together. For example, Goal 7 is titled: "Ensure environmental sustainability", while the corresponding Target 7A[69] ("Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources") and Target 7B ("Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss") are recognised as vital contributing elements of this Goal.[70] To enable development without further jeopardising the climate and environment, investment in alternative energies including biofuels can appear very attractive.

Economic development and agricultural policy

1.25 The development of biofuels policy, for example in Canada, in the US and in the EU, has important intersections with agricultural policy. For example, in the EU the Common Agricultural Policy (CAP) was reformed in 1992, effectively allowing non-food crops to be grown on set-aside land – land which was quickly earmarked as land for biofuels production.[71] In 2003, a new payment was granted which paid farmers additional amounts for biofuels crops grown.[72] The EC also authorised EU Member States to grant tax relief to biofuels to make growing biofuels crops more attractive to farmers.[73]

1.26 These interactions between policies increase the challenges in evaluating their performance and raise questions about who will benefit from expansion in biofuels production. A report by the German Marshall Fund of the United States shows that some trade policies adopted by developed countries inhibit the extent to which developing countries can benefit from this expansion, by limiting their biofuels export potential.[74] Such policies include tariffs and

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67 Bernardo Ospina, responding to the Working Party's consultation.
68 Dr Ben Richardson, responding to the Working Party's consultation.
69 In the Millennium Development Goals, each goal is subdivided into several targets.
70 United Nations (2010) *Millennium Development Goals: Goal 7 – ensure environmental sustainability*, available at: http://www.un.org/millenniumgoals/environ.shtml.
71 Library of Parliament (Canada) (2007) *Biofuels – an energy, environmental or agricultural policy?*, available at: http://www2.parl.gc.ca/content/lop/researchpublications/prb0637-e.pdf, p3.
72 Europa (22 Sept 2006) *Renewable energy: Commission proposes to extend energy crop aid scheme to all Member States*, available at: http://europa.eu/rapid/pressReleasesAction.do?reference=IP/06/1243.
73 Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC [2009] OJ L140/16, art 2.k and 3.a.
74 German Marshall Fund of the United States (2007) *EU and U.S. policies on biofuels: potential impacts on developing countries*, available at: http://www.gmfus.org/galleries/ct_publication_attachments/GMF_USEU_Final.pdf;jsessionid=abF8P5gT_Lt8l9EWS3, pp21–4.

subsidies to protect and support domestic markets. Technical norms relating to biofuels that are enshrined in policy can also have a limiting effect. Indeed, it has been suggested elsewhere that countries of the Organisation for Economic Co-operation and Development (OECD) need to reduce agricultural support regimes for biofuels to avoid limiting developing countries, which already have restricted access to OECD markets.[75]

Economic development, energy security and biofuels

1.27 Uncertainty, both about the projected impact of fossil fuels on climate change and the role which new technologies can play in providing viable alternatives, has led governments and companies to invest in energy portfolios so that investment risks are balanced across a number of new technologies, including biofuels. In addition, there is the expectation that investment in biofuels will lead to significant benefits in economic development, including the creation of new jobs and new areas of income for farmers. An early powerful incentive for biofuels in the US was significant agricultural overproduction, which led to enthusiasm to use food crops for so-called first generation biofuels. Biofuels production might also be a very attractive prospect particularly in poor countries and those in which a large proportion of the population engages in agriculture. For example, in some of the new EU Member States, such as Poland, primary agricultural productivity is relatively low on account of CAP, and it has been suggested that growing crops in these countries for some of the new biofuels could contribute significantly to economic development.[76] This in turn could afford benefits for infrastructure development and income creation. As for the UK, new biofuels which are currently under development might present a number of opportunities for economic development of rural areas, offering new avenues for both business and farmers. In 2009, the then Minister for Science and Innovation, Rt Hon Lord Drayson, said, upon launching the Biotechnology and Biological Sciences Research Council Sustainable Bioenergy Centre, the UK's biggest public investment in bioenergy research, that the centre was: "a great example of the UK investing in innovative areas which have the benefits of creating new green collar jobs".[77]

1.28 Moreover, biofuels are expected to provide cheaper energy made from locally available sources. This can be particularly important in developing countries where successful industrialisation has increased the demand for energy. In many developing countries there is a lack of indigenous energy sources, restricted access to affordable energy supplies, fragile energy infrastructure and inefficiency in energy utilisation. There is a potential, therefore, for poorer countries, which are often those countries that are expected to play a key role in growing biofuels in the future, to make developmental gains and to provide local sources of energy for the necessities of everyday life. As one respondent to our consultation put it:

> **"In many regions of the world, especially in Sub-Saharan Africa, Asia, and many parts of Latin America, many smallholder communities do not have any access to any type of energy…in many of these regions, bioenergy crops could be produced and transformed into biofuels that can be used as the first step towards processes at community level to generate bio-electricity, use clean-cook stoves, introduce mechanisation, and other technologies."**[78]

[75] Overseas Development Institute (2007) *Biofuels, agriculture and poverty reduction*, available at: http://www.odi.org.uk/resources/download/78.pdf, p1.
[76] EuropaBio, responding to the Working Party's consultation.
[77] Biotechnology and Biological Sciences Research Council (27 Jan 2009) *Biggest ever public investment in bioenergy to help provide clean, green and sustainable fuels*, available at http://www.bbsrc.ac.uk/news-test/archive/2009/090127-pr-public-investment-bioenergy.aspx.
[78] Bernardo Ospina, responding to the Working Party's consultation.

Other hopes for biofuels in countries where industrialisation strategies have not been so successful revolve around:

- the creation of employment and income;
- diversification of energy supply, especially where countries obtain a large proportion of their energy from the increasingly unstable global oil market;[79]
- diversification of agricultural output and added security of income from local agriculture; and
- increased national exports leading to greater involvement in global economic activity.

Indeed, several developing countries and emerging nations, such as Mozambique, India and China, have established biofuels strategies with some of these goals in mind.[80]

1.29 Such national energy strategies aiming to feed industrial development may of course be destabilising globally. Globalisation has led to multiple and extensive interdependencies and this means that national strategies can have broader impacts. The role of biofuels within an energy provision framework is therefore highly complex. Global economic development, particularly in non-OECD emerging economies, will increase global energy demand. Most of this growth to 2035 will be fossil fuel led, but biofuels could offer an opportunity to provide fuel for transport with the potential additional advantages of energy security, environmental sustainability and a lower carbon footprint. It is not surprising that some commentators, at least initially, regarded biofuels as a one-stop shop for developing countries on their way towards industrialised levels of development and consumption.

Climate change

"[Increased use of biofuels] is an essential part of our response to climate change. We have no other carbon neutral alternative options for transport fuels for planes and heavy vehicles."[81]

"Industrial biofuels exacerbate climate change and destroy ecosystems such as rainforests that regulate our weather patterns."[82]

Introduction

1.30 Over the last few decades, awareness of the potential consequences of climate change (see Box 1.2) has grown considerably. Although there is some dispute within the scientific community regarding the time frame, magnitude and impacts of climate change,[83] most climate scientists have concluded that it will have severe social, economic and environmental

[79] UN-Energy (2007) *Sustainable bioenergy: a framework for decision makers*, available at: http://esa.un.org/un-energy/pdf/susdev.Biofuels.FAO.pdf. For details of impacts of small-scale bioenergy initiatives on livelihoods (for example, with regard to financial capital and social capital impacts) see: Practical Action Consulting (2009) *Small-scale bioenergy initiatives: brief description and preliminary lessons on livelihood impacts from case studies in Asia, Latin America and Africa. Prepared for PISCES and FAO by Practical Action Consulting*, available at: ftp://ftp.fao.org/docrep/fao/011/aj991e/aj991e.pdf.

[80] See: International Centre for Trade and Sustainable Development (17 April 2009) *Mozambique approves policy on biofuels*, available at: http://ictsd.org/i/news/biores/45169/; Press Information Bureau, Government of India (24 Dec 2009) *National policy on bio-fuels announced*, available at: http://pib.nic.in/release/release.asp?relid=56469; National Development and Reform Commission (2007) *Medium and long-term development plan for renewable energy in China*, available at: http://www.asiapacificpartnership.org/pdf/REDGTF/4th_meeting/China-_Medium_and_Long-Term_Development_Plan.pdf, p5.

[81] Robert Henry, responding to the Working Party's consultation.

[82] Food Not Fuel, responding to the Working Party's consultation.

[83] Climate change as discussed today, involving rising average global temperatures, is often misleadingly referred to as 'global warming'. However, impacts on individual geographic locations are likely to vary widely and go further than increases in average temperature.

effects globally. Climate change has entered public debates and popular culture, and polls show that it is now a pressing concern of today's populations.[84]

Box 1.2: Defining climate change

The Intergovernmental Panel on Climate Change defines climate change as: "a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity."[85] The UN Framework Convention on Climate Change (UNFCCC) describes climate change as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."[86] Causes of climate change beyond human control are, for example, variations in solar radiation, deviations in the Earth's orbit, and changes in the Earth's plate tectonics. Important factors of human origin include the emission of GHGs, primarily through fossil fuel combustion, and the destruction of environments that absorb and store carbon from the atmosphere (carbon sinks), such as forestland and peatland.

International climate change mitigation policy

1.31 Climate change mitigation is now recognised as one of the great global challenges of the 21st century. There is still debate over who is responsible – both politically and financially – for climate change mitigation, including how it can best be achieved and how a global mitigation effort can best be orchestrated. However, there is a general consensus that lowering GHG emissions is one of the most important strategies in tackling climate change. At the same time, there is increasing pressure, particularly from vulnerable developing countries, for the international policy process to place more emphasis on adaptation to the climate change that is already likely to occur.

1.32 International policy reflects the consensus to limit GHG emissions in order to mitigate climate change, while at the same time highlighting the challenges of transnational, binding agreements. Following the UNFCCC in 1992,[87] the Kyoto Protocol[88] to the UNFCCC was adopted in 1997. There are currently 193 parties to the Kyoto Protocol, and a further 84 signatories.[89] The Kyoto Protocol is the first international treaty on climate change and includes legally binding GHG emission targets. It aims at the stabilisation of "aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in [the Protocol]", and commits 40 industrialised countries and countries with economies in transition (so-called 'Annex I' countries) to lower their GHG emissions "by at least 5 per cent below 1990 levels" by 2012.[90]

1.33 Since the ratification of the Kyoto Protocol in 2005, negotiations over long-term action on climate change have continued under the UNFCCC. The landmark Copenhagen conference in December 2009 attracted worldwide attention but failed to agree a new framework for action beyond the expiry of the current phase of Kyoto in 2012. The most recent Conference of the Parties to the UNFCCC in Cancun, Mexico, was held a year later. While it only made

[84] BBC World Service (7 Dec 2009) *Climate concerns continue to increase according to global poll*, available at: http://www.bbc.co.uk/pressoffice/pressreleases/stories/2009/12_december/07/poll.shtml.
[85] Intergovernmental Panel on Climate Change (2007) *Climate change 2007: synthesis report*, available at: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf, p30.
[86] United Nations (1992) *United Nations Framework Convention on Climate Change*, available at: http://unfccc.int/resource/docs/convkp/conveng.pdf, art 1.
[87] United Nations (1992) *United Nations Framework Convention on Climate Change*, available at: http://unfccc.int/resource/docs/convkp/conveng.pdf, art 2.
[88] Kyoto Protocol to the United Nations Framework Convention on Climate Change 1998.
[89] United Nations Framework Convention on Climate Change (2011) *Status of ratification of the Kyoto Protocol*, available at: http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php. Notably, the US is only a signatory to the Kyoto Protocol.
[90] Kyoto Protocol to the United Nations Framework Convention on Climate Change 1998, art 3.1.

incremental progress, it resulted in a number of officially recognised Cancun Agreements and a restoration of some faith in the UN negotiations.

1.34 The Cancun Agreements stress that deep cuts in global GHG emissions are urgently required and that all countries should: ”cooperate in achieving the peaking of global and national greenhouse gas emissions as soon as possible”.[91] It acknowledges that the timescale for emissions reductions will be longer for developing countries, and that the main priorities are: “social and economic development and poverty eradication”.[92] The Agreements do not contain any legally binding commitments for reducing GHG emissions beyond the first commitment period of the Kyoto Protocol (2008–2012). However, they do include important commitments on key issues such as finance, technology assistance and the reduction of emissions from deforestation and forest degradation. For example, developed countries have pledged to make available 100 billion USD a year by 2020 for developing countries, and all Parties have agreed to the establishment of a new Climate Technology Centre and Network.

UK climate change policy and targets

1.35 The UK currently has one of the most ambitious national climate change programmes in the world. In 2003, the UK Energy White Paper proposed to put the UK on a path to cut its carbon dioxide emissions by some 60 per cent by about 2050 relative to 1990 levels.[93] However, when the Climate Change Act 2008 was passed, it mandated that the net UK carbon account for the year 2050 be at least 80 per cent lower than the 1990 baseline,[94] following the suggestion of the CCC, which became a statutory committee when the Climate Change Bill became law.[95] The majority of the measures contained in the Energy Bill[96] – introduced into Parliament in late 2010, and, at the time of press, still passing through Parliament – aim to make provision for energy efficiency measures to be applied to both homes and businesses. The Energy Bill is also designed to enable and secure low carbon energy supplies.

EU climate change policy and targets

1.36 The EU speaks for its Member States in international climate negotiations and so UK climate change policies and targets, including the biofuels and renewables policies/targets, stem in part from the EU. In 2007, EU leaders endorsed an integrated approach to climate and energy policy, and made a commitment to transform Europe into a highly energy efficient and low carbon economy. To start the process, the leaders set a package of targets to be met by 2020, collectively known as the ‘20-20-20’ targets. These are:[97]

- a reduction in EU GHG emissions of at least 20 per cent below 1990 levels by 2020;
- 20 per cent of EU energy consumption to come from renewable sources by 2020; and

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91 United Nations Framework Convention on Climate Change (2010) *Outcome of the work of the Ad Hoc Working Group on long-term cooperative action under the Convention*, unedited version, available at: http://unfccc.int/files/meetings/cop_16/application/pdf/cop16_lca.pdf.

92 Ibid.

93 Department of Trade and Industry (2003) *Our energy future – creating a low carbon economy*, available at: http://www.berr.gov.uk/files/file10719.pdf, p8.

94 s1(1) Climate Change Act 2008. The ‘1990 baseline’ meant the aggregate amount of net UK emissions of carbon dioxide, methane and nitrous oxide for 1990, and the net UK emissions of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride for 1995.

95 Committee on Climate Change (2008) *Building a low-carbon economy – the UK’s contribution to tackling climate change*, available at: http://www.theccc.org.uk/pdf/TSO-ClimateChange.pdf, pv. The CCC has subsequently been critical of Government about the lack of progress towards this long-term target. Its most recent stated that emission reductions in recent years had been very modest, and going forward there needed to be a ‘step change’ if the UK’s targets between now and 2050 were to be achieved; see: Committee on Climate Change (2009) *Meeting carbon budgets: the need for a step change*, available at: http://hmccc.s3.amazonaws.com/21667%20CCC%20Report%20AW%20WEB.pdf, p29.

96 Parliament UK (2011) *Energy Bill [HL] 2010–11*, available at: http://services.parliament.uk/bills/2010-11/energyhl.html.

97 European Commission (2010) *The EU climate and energy package*, available at: http://ec.europa.eu/environment/climat/climate_action.htm.

- a 20 per cent reduction in primary energy use compared with projected levels by 2020, to be achieved by improving energy efficiency.

Binding legislation to implement the 20-20-20 targets was agreed by the European Parliament and Council in December 2008 and became law in June 2009. This 'climate and energy package' also led to the new RED (see below).[98] Tensions remain among EU Member States about the desirability of such increased targets.

Climate change and biofuels

1.37 National and international policy documents on climate change mitigation stress that there are several routes to lowering GHG emissions, all of which will have to be pursued aggressively in order to achieve successful climate change mitigation. In particular, each sector of the economy will have to make significant contributions to deep carbon cuts in a relatively short timescale (before 2050). Such a demanding requirement is particularly challenging for the transport sector, because its demand is fairly inelastic and any economy-wide policy tool that aims to reduce GHG emissions, such as a tax on GHG emissions, will result in little reduction in the transport sector.[99] In 2008, transport was responsible for 22 per cent of the global carbon dioxide emissions produced from fuel combustion.[100] In the UK in 2009, transport accounted for an estimated 22 per cent of total GHG emissions.[101] Between 1990 and 2002, emissions from transport in OECD countries and non-OECD countries increased by 25 per cent and 36 per cent respectively.[102] In a 'business as usual' scenario,[103] this rate of increase is expected to continue into the foreseeable future. Hence, the magnitude of required emissions reductions for this sector is very substantial, in absolute terms.

1.38 Widespread commercial replacement in the transport sector in a relatively short timescale with vehicles that do not rely on traditional fossil fuels and have significantly lower GHG emissions will be very demanding. As mentioned above, the large-scale introduction of vehicles with new types of engine that use completely different fuels or sources of energy is challenging, particularly in the aviation sector. Developing alternative fuels that do not require changes in vehicle technology and have the potential to reduce transport's carbon footprint is attractive, and biofuels are expected to deliver on both these counts.

1.39 It has been asserted that: "Biofuels are considered 'carbon-neutral' when burned" (see Box 1.3),[104] since on combustion they release only the carbon dioxide that was absorbed during the plant's growth.[105] For this reason, they have been heralded as an immediately available technology that might generate significant GHG emissions savings. Recently, provisional data were reported which suggested that the amount of biofuels supplied in the UK during 2009–2010 generated GHG emissions savings "equivalent of taking half a million vehicles off the

[98] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC [2009] OJ L140/16.

[99] A tax would create more savings in other sectors, such as from coal consumption.

[100] International Energy Agency (2010) *CO_2 emissions from fuel combustion: highlights*, available at: http://www.iea.org/co2highlights/co2highlights.pdf, p9.

[101] Department of Energy and Climate Change (2011) *UK climate change sustainable development indicator: 2009 greenhouse gas emissions, final figures*, available at: http://www.decc.gov.uk/assets/decc/Statistics/climate_change/1214-stat-rel-uk-ghg-emissions-2009-final.pdf, p3.

[102] HM Treasury and Cabinet Office (2006) *Stern Review: the economics of climate change*, available at http://webarchive.nationalarchives.gov.uk/+/http:/www.hm-treasury.gov.uk/sternreview_index.htm, Annex 7c.

[103] This includes any incremental improvements in fuel efficiency and the switch to biofuel that would be expected to occur even in the absence of policy intervention.

[104] Parliamentary Office of Science and Technology (2007) *Transport biofuels*, available at: http://www.parliament.uk/documents/post/postpn293.pdf.

[105] That these biogenic GHG emissions are reported as zero is based on the United Nations Framework Convention on Climate Change.

road, or making Edinburgh, Cardiff and Belfast car free".[106] Next to expectations of increased energy security and further economic development, this hope has underpinned biofuels policy as it has developed over the last decade.

Box 1.3: What is carbon neutrality?[107]

'Carbon neutral' refers to a state where the carbon dioxide produced by a process or person is balanced by the amount of carbon dioxide sequestered out of the atmosphere or offset by that process or person.[108] In the context of biofuels, this concept is usually introduced in relation to the claim that there is a balance in carbon dioxide between absorption during the growth of the biomass and emissions during combustion of the fuel. However, such calculations also need to take into account total GHG emissions from the full life cycle of biofuels production, including provision and processing as well as any land use change involving the destruction of a carbon stock.

Current biofuels policy

1.40 Policy, looking to reap the expected benefits of biofuels in all three areas of interest, has been instrumental in supporting and steering biofuels development. As part of a rapidly developing field of policy making, a multitude of different policy instruments has been introduced over the last decade in the UK, Europe and worldwide.

1.41 At the European level, mandated markets have been established. The EC passed the Biofuels Directive in 2003, which specified that biofuels and other renewable fuels must account – on the basis of energy content – for 5.75 per cent of all transport petrol and diesel by 31 December 2010.[109] A 2007 Communication from the EC later evaluated the share of renewable energy in the energy mix and the progress in this area. It proposed that the minimum target for biofuels for 2020 should be 10 per cent of transport petrol and diesel.[110] This target was subsequently mandated in the RED of 2009, which repealed the Biofuels Directive.[111] In 2009, the Fuel Quality Directive also required Member States to reduce life cycle GHG emissions of transport fuels by 6 per cent by the end of 2020, which has indirectly affected biofuels markets.[112] More European biofuels policy can be found in Box 1.4.

Box 1.4: Additional European biofuels policy

Several other European policy instruments have supported biofuels production. For example, the Energy Crops Scheme was introduced in 2003 and extended to all Member States in 2006.[113] This pays farmers 45 euros per hectare of land that is used for growing energy crops for biofuels. The scheme has been very successful: by 2007, it accounted for 60 per cent of the European domestic supply of biofuel crops.[114] The EC published its EU Strategy for Biofuels in 2006,[115] outlining seven policy axes to: stimulate demand for biofuels; capture environmental benefit; develop the production and

[106] BBC News (31 Aug 2010) *UK biofuels 'falling short' of environmental standards*, available at: http://www.bbc.co.uk/news/science-environment-11112837.
[107] Carbon Carbon (2011) *What does carbon neutral mean? Is there a war on?*, available at: http://www.carboncarbon.co.uk/cneutral.html.
[108] It may be helpful to add that PAS 2060, a new standard on carbon neutrality published by BSI, the national standards body of the UK, sets out guidance on how to quantify, reduce and offset GHG emissions from a specific subject, ranging from events to products. The standard is not specifically designed for biofuels; it is intended for demonstration of carbon neutrality status.
[109] Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport [2003] OJ L123/42, art 1(b)(ii).
[110] European Commission (2007) *Renewable energy road map: renewable energies in the 21st century: building a more sustainable future*, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0848:FIN:EN:PDF, p10.
[111] Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC [2009] OJ L140/16, art 3.4.
[112] Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC [2009] OJ L140/88, art 7(a).
[113] Europa (22 Sept 2006) *Renewable energy: Commission proposes to extend energy crop aid scheme to all Member States*, available at: http://europa.eu/rapid/pressReleasesAction.do?reference=IP/06/1243.
[114] Ninni A (2010) Policies to support biofuels in Europe: the changing landscape of instruments *AgBioForum* **13**: 131–41.
[115] European Commission (2006) *An EU strategy for biofuels*, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0034:FIN:EN:PDF.

distribution of biofuels; expand biofuels sources supplies; enhance trade opportunities; support developing countries; and support research and development. In 2007, the EC introduced the SET-Plan[116] with the aim of accelerating the development and use of cost-effective low carbon technologies, including new biofuels. In its 2009 resolution *2050: The future begins today – recommendations for the EU's future integrated policy on climate change*, the European Parliament called on the EC and the Member States to increase research and development for advanced biofuels, to ensure that they were allocated necessary funding.[117] Furthermore, it called for the promotion of the development of a global biofuels standard, drawing on previous experience of developing sustainability criteria. Also in 2009, legislation was enacted to protect European biodiesel producers. The EC published a Regulation imposing a provisional 'anti-dumping' duty on biodiesel imports from the US,[118] following concerns that the European biodiesel industry was competing with unfairly subsidised and dumped US biodiesel exports.

1.42 In the UK, following European policy, the Renewable Transport Fuel Obligations (RTFO) Order 2007 placed an obligation on fossil fuel suppliers to ensure that a certain percentage of their transport fuel supplied in the UK was made up of renewable fuels each year. The RTFO Order came into effect in April 2008 and stated that 5 per cent of road vehicle fuel supplied in the UK must come from renewable sources by 2010.[119] Following the Gallagher Review,[120] which was a review commissioned by the UK Government, the RTFO (Amendment) Order 2009[121] reset the 5 per cent target to be reached by 2013. The RTFO Order also represents policy intended to address the sustainability of biofuels, in that it requires fuel suppliers to submit reports on the GHG emissions and sustainability of biofuels. The Renewable Fuels Agency (RFA)[122] is the organisation charged by the UK Government with running the RTFO, ensuring that companies meet their annual obligations. The RFA runs the carbon and sustainability reporting system and is also the UK's independent sustainable fuel regulator.

1.43 Support for biofuels manufacturers in the UK has led to stimulation of biofuels production. A 20 pence per litre duty differential was introduced for biodiesel in July 2002[123] and bioethanol in 2005.[124] These duty differentials were abolished in April 2010 for all biofuels except biodiesel produced from used cooking oil, which would continue to benefit from a 20 pence duty differential for a further two years.[125] The UK's *Budget 2003* also outlined steps to introduce a new lower rate of vehicle excise duty (the tax commonly known as road tax) for the most environmentally friendly cars with very low levels of carbon dioxide emissions,[126] thus incentivising purchase of cars that run on biofuels. The Low Carbon Vehicle Procurement Programme – announced in the Energy White Paper of May 2007 – exists to provide funding to public sector organisations to procure innovative, low carbon vehicles.[127]

[116] European Commission (2007) *A European strategic energy technology plan (SET-Plan): 'towards a low carbon future'*, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0723:FIN:EN:PDF.
[117] European Parliament (2009) *European Parliament resolution of 4 February 2009 on "2050: the future begins today – recommendations for the EU's future integrated policy on climate change"*, available at: http://www.biofuelstp.eu/downloads/040209_resolution_ep_climate_change.pdf, p20.
[118] Commission Regulation (EC) No 193/2009 of 11 March 2009 imposing a provisional anti-dumping duty on imports of biodiesel originating in the United States of America [2009] OJ L67/22.
[119] The Renewable Transport Fuel Obligations Order 2007, art 4.
[120] Renewable Fuels Agency (2008) *The Gallagher Review of the indirect effects of biofuels production*, available at: http://www.renewablefuelsagency.gov.uk/sites/renewablefuelsagency.gov.uk/files/_documents/Report_of_the_Gallagher_review.pdf.
[121] Art 4 of The Renewable Transport Fuel Obligations Order 2007 amended by The Renewable Transport Fuel Obligations (Amendment) Order 2009.
[122] Renewable Fuels Agency (2010) *About us*, available at: http://www.renewablefuelsagency.gov.uk/abouttherfa.
[123] HM Treasury (2002) *Budget 2002*, available at: http://webarchive.nationalarchives.gov.uk/20100407010852/http://www.hm-treasury.gov.uk/bud_bud02_chapter_7.htm, paragraph 7.30.
[124] HM Treasury (2003) *Budget 2003*, available at: http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/d/Budget_2003.pdf, paragraph 7.28.
[125] HM Revenue & Customs (2010) *Excise duty: relief scheme for biodiesel produced from waste cooking oil*, available at: http://www.hmrc.gov.uk/briefs/excise-duty/brief1810.htm.
[126] HM Treasury (2003) *Budget 2003*, available at: http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/d/Budget_2003.pdf, paragraph 7.32.
[127] Low Carbon Vehicle Procurement Programme (2010) *The Low Carbon Vehicle Procurement Programme*, available at: http://www.lcvpp.org.uk/.

1.44 As regards the priority of using biomass, these could currently be described as follows in the UK: the first priority is to use biomass for electricity generation (to meet the Renewables Obligation),[128] then for biofuels (to meet the RTFO), and lastly for heat (including combined heat and power generation), where we are still waiting for the details of the Renewable Heat Incentive.[129]

Impact of current and future drivers for biofuels production

1.45 Three reasons for the development of biofuels as an alternative to fossil fuels have been described here. The attractiveness to politicians, farmers and some companies of developing current biofuels can be explained by their apparent ability to meet three important policy objectives with a single solution – the elusive silver bullet of energy security, economic development and climate change mitigation.

1.46 Alas, as the next chapter will show, biofuels are no perfect solution. Warning voices were raised from an early stage about their potential problems.[130] The efforts to address these concerns have often been criticised for not going far enough. In the next chapter, we tell the story of current biofuels, and lay out the issues which have occurred during their large-scale development using a set of case studies.

[128] The Renewables Obligation Order 2009 amended by The Renewables Obligation (Amendment) Order 2010.
[129] These priorities reflect the existing policies. Defra's UK Biomass Strategy proposed a different order (heat, combined heat and power generation, co-firing, dedicated biomass power plants and then biofuels, reflecting the hierarchy in cost of carbon saved through each measure), see Defra (2007) *UK biomass strategy*, available at: http://www.biomassenergycentre.org.uk/pls/portal/docs/PAGE/RESOURCES/REF_LIB_RES/PUBLICATIONS/UKBIOMASSSTRATEGY.PDF, p7.
[130] For example, see: International Risk Governance Council (2008) *Risk governance guidelines for bioenergy policies*, available at: http://www.irgc.org/IMG/pdf/IRGC_PB_Bioenergy_WEB-2.pdf, pp29–33.