Summary and recommendations

Introduction and overview

1. Biofuels are not a new technology. Rudolf Diesel ran an engine on peanut oil at the World's Fair in Paris in 1900, and liquid fuels made from sources such as food crops have been researched for more than a century. For most of that time, interest in biofuels was confined to rather specialist research projects, largely unnoticed by members of the public (with the exception of Brazil). However, towards the end of the 20th century, a number of challenges to the modern way of life combined to bring biofuels to national and international attention (discussed in Chapter 1). Increasing worries over energy security in the face of growing demand, dwindling supplies of oil, and international conflicts and wars drove countries dependent on energy imports to look for alternative, home-grown sources. Interest in biofuels further intensified with the search for new opportunities for economic development, especially in agriculture. This was particularly relevant in emerging economies such as India and China; however, creating new jobs and a new industry are also attractive prospects in the developed world, where many established sectors such as agriculture and manufacturing are increasingly precarious. And, most recently, the growing awareness of the dangers of global climate change reinforced the challenge to find alternatives to fossil fuels as the dominant form of energy.

2. Biofuels appeared, therefore, to promise a great deal; indeed, the expectation of some was that they would solve these great challenges all at once: i.e. provide a new source of income for farmers and revenue from 'clean' technology, as well as renewable – and therefore endless – sources of fuel, leading to far less greenhouse gas (GHG) emissions than fossil fuels. Though not a silver bullet, they were certainly regarded by some as a 'green' answer to many problems. Even the former US President, George W Bush, not known to be a strong champion of green issues, was convinced of the potential of biofuels and promised his fellow Americans that: "the best way and the fastest way to replace oil…is to expand the use of ethanol…. It's good for economic development for rural America….Ethanol is good for the environment. I keep emphasizing that we can be good stewards of our environment and at the same time continue with our economic expansion."[3]

3. Successive governments recognised the potential of biofuels and in the last decade a number of policy and regulatory mechanisms were implemented that made the introduction and blending of biofuels mandatory (Chapter 1). The two main biofuels, bioethanol (to blend with petrol) made from, for example, corn, wheat or sugar cane, and biodiesel (to blend with diesel) made from palm oil or rapeseed oil, were produced at progressively industrial levels. While still making up only a small fraction of fuel and energy use worldwide, biofuels production increased significantly and very rapidly. For example, between 1998 and 2009, the production of biodiesel in the European Union (EU) increased more than ten-fold.[4] Currently, biofuels make up more than three per cent of UK road transport fuel. Worldwide, it is expected that by 2030 biofuels will account for seven per cent of road transport fuel.[5]

4. While excitement over biofuels was still in full swing, important problems with their large-scale production began to emerge (discussed in Chapter 2). The claims that biofuels produce significantly lower GHG emissions compared with fossil fuels were contested. Concerns were also raised over the competition that biofuels pose to food production, and their consequent effects on food security and food prices. Moreover, many worried about infringements of the

[3] The Washington Post (25 Apr 2006) *Bush delivers speech on renewable fuel sources*, available at: http://www.washingtonpost.com/wp-dyn/content/article/2006/04/25/AR2006042500762.html.
[4] European Biodiesel Board (2009) *The EU biodiesel industry*, available at: http://www.ebb-eu.org/stats.php.
[5] International Energy Agency (2007) *Renewables in global energy supply: an IEA factsheet*, available at: http://www.iea.org/papers/2006/renewable_factsheet.pdf, p15.

rights of farmers, farm workers and land holders, particularly in vulnerable populations in the developing world. There were also reports of severe environmental consequences, including pollution and the loss of biodiversity, for example through the destruction of rainforest, following large-scale biofuels production. In addition to possible direct land use change (dLUC), biofuels were implicated in the 'knock-on effect' of indirect land use change (iLUC), where the displacement of other activities also led to deforestation and depletion of scarce water resources.

5. These negative effects are still contested (Chapter 2) but there have already been major political and social repercussions, with protests against biofuels which, in some instances, have been as extreme as violence in the streets. In the case of some commentators and activists, the backlash against the use of biofuels has been severe. The technology heralded as a potential all-round solution to many problems has been accused of harmful impacts ranging from near extinction of the orang-utan to pushing the poorest even further into poverty, thus "driving a global human tragedy".[6]

6. The demand for biofuels created by legislation and regulation has prompted research into more efficient sources of biomass and more efficient production and conversion techniques. These developments are often known as 'second generation' biofuels (the established biofuels are, in contrast, now often called 'first generation' biofuels). The goals of this research are to provide biomass sources – feedstocks – that: i) do not compete with food; ii) have a high energy yield with low inputs of water, land and fertiliser etc.; iii) do not negatively affect the environment or local populations; and iv) can be produced in sufficient quantities to allow economically viable biofuels production. A diverse and active field of research trying to meet these goals is rapidly emerging. Among the most promising candidates so far are those biofuels made from wastes and energy crops using full lignocellulosic conversion and, more speculatively, biofuels made from algae (discussed in Chapter 3).

7. At present, it is almost impossible to predict exactly whether a technology will emerge as a successful biofuels pathway that avoids causing harmful consequences. What can be said with confidence is that the lessons learned from the problems of established biofuels must be integral in the development of new ones in order not to repeat the mistakes of the past. Meanwhile, it is clear that established biofuels will continue to play a role while new products emerge, but mechanisms to mitigate their negative effects are imperative.

8. What this report seeks to do, therefore, is to provide a framework of evaluation on the basis of which more ethical production of current biofuels and the emerging biofuels production systems can be established. In Chapters 4, 5 and 6, we offer such an ethical framework and use it to point out where current policy can be improved. We also make recommendations regarding the direction of future policy development. While taking a necessarily global perspective, we apply specific focus in many instances to the EU, and particularly to the UK.

Chapter 1: Why biofuels? Drivers for biofuels production

9. In this chapter, we describe the main drivers of recent biofuels production. By the end of the 20th century, governments and policy makers around the world faced three key issues: i) (renewed) worries about energy security; ii) commitment to economic development, including the creation and sustaining of jobs, particularly in agriculture; and iii) the need to mitigate global climate change and achieve lower GHG emissions.

[6] The Guardian (15 Feb 2010) *EU biofuels significantly harming food production in developing countries*, available at: http://www.guardian.co.uk/environment/2010/feb/15/biofuels-food-production-developing-countries.

Energy security (paragraphs 1.7–1.22)

10. Energy security is: "the uninterrupted physical availability of energy products on the market, at a price which is affordable for all consumers (private and industrial)".[7] 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). Biofuels contribute to energy security by increasing the diversity of supply choices and introducing a component of supply that is not necessarily import dependent (some biofuels can be produced domestically in the UK). In addition, biofuels that are locally produced are less susceptible to some threats to energy security, although extreme weather events and terrorist attacks on infrastructure can still affect them.

Economic development (paragraphs 1.23–1.29)

11. Patterns of industrialisation have to date been energy intensive, and this trend continues. Total world energy consumption has been predicted to increase by 49 per cent between 2007 and 2035. This is mainly attributed to increased demand in developing countries that are not members of the Organisation for Economic Co-operation and Development (OECD). In these countries, energy consumption is forecast to increase by 84 per cent, compared with an increase of a comparatively modest 14 per cent in OECD countries.[8] Fuel for transport, i.e. cars, aviation and shipping, makes up almost one-third of total world delivered energy consumption.[9] In addition to the pursuit to meet this rising demand, there is the expectation that investment in biofuels will lead to other 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 biofuels. Biofuels production might also be a very attractive prospect in developing countries, where a large proportion of the population is engaged in agriculture, and where biofuels might provide a local energy source in energy-deprived areas. As for the UK, new biofuels might present a number of opportunities for economic development of rural areas, offering new avenues for business and farmers, while creating 'green collar' jobs along the way.

Climate change (paragraphs 1.30–1.39)

12. Most climate scientists have concluded that global climate change will have severe social, economic and environmental effects, and the issue has entered public debates and popular culture. International policy reflects the consensus to lower GHG emissions, while at the same time highlighting the challenges of achieving binding transnational agreements. The Kyoto Protocol of 1992 commits industrialised countries to reduce their GHG emissions by at least 5 per cent below 1990 levels by 2012,[10] but further policy, following the Copenhagen Summit in 2009, is still being negotiated. Despite some progress at the most recent Climate Conference in Cancun, Mexico, in 2010, agreement on a legally binding document that goes beyond the Kyoto Protocol has not yet been reached. The UK currently has one of the most ambitious national climate change programmes in the world. The Climate Change Act 2008 demands an 80 per cent cut overall in six GHGs by 2050, relative to 1990 levels.[11] The EU has committed to the "20-20-20" goals, i.e. a reduction in EU GHG emissions of at least 20 per cent below 1990 levels; that 20

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7 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, p4.

8 US Energy Information Administration (2010) *International energy outlook 2010 – highlights*, available at: http://www.eia.doe.gov/oiaf/ieo/highlights.html.

9 US Energy Information Administration (2010) *International energy outlook 2010*, available at: http://www.eia.doe.gov/oiaf/ieo/world.html.

10 Kyoto Protocol to the United Nations Framework Convention on Climate Change 1998, art 3.1.

11 s1(1) Climate Change Act 2008.

per cent of EU energy consumption is to come from renewable resources; and a 20 per cent reduction in primary energy use compared with projected levels, all by 2020.[12]

Current European and UK biofuels policy (paragraphs 1.40–1.44)

13. As well as more general policies on reducing GHG emissions and improving energy security, there are a number of European and UK policies which specifically promote the use of biofuels. The European Commission (EC) passed the Renewable Energy Directive (RED) in 2009,[13] which effectively established that biofuels should account for a minimum of 10 per cent of transport petrol and diesel by 2020. The Fuel Quality Directive 2009 also requires Member States to reduce life cycle GHG emissions of transport fuels by 6 per cent by 2020 – a move which has indirectly affected biofuels markets.[14] The UK's Renewable Transport Fuel Obligations (RTFO) (Amendment) Order mandates that 5 per cent of total transport fuel should originate from renewable sources by 2013,[15] and is in accord with RED.

Chapter 2: How did we get here? The story of biofuels

14. Three case studies illustrate the development of current commercially established biofuels in three different countries: bioethanol from corn in the US; bioethanol from sugar cane in Brazil; and biodiesel from palm oil in Malaysia. They do not represent all biofuels production nor all the issues associated with current biofuels. However, these case studies, which include the two biggest producers of biofuels in the world (the US and Brazil), vividly demonstrate some of the main issues that have emerged from large-scale production of biofuels, providing important material for the ethical analysis of biofuels undertaken later in the report.

Case study I: Bioethanol from corn in the US (paragraphs 2.9–2.19)

15. The US is the world's largest bioethanol producer: in 2009, it produced an estimated 40 billion litres of ethanol,[16] mainly derived from corn. The main motivations for biofuels production were economic as well as finding a source of octane and using surplus agricultural production; however, worries over energy security following the oil crisis in the early 1970s played an important role as well. Domestic legislation and policy have in recent years created a favourable environment for the US corn-based bioethanol industry and production has been increasing rapidly.

16. As the industry grew, the production of bioethanol in the US was blamed for increasing the price of corn and other grains by diverting cereal from food uses. The widely publicised 'tortilla riots' in Mexico during late 2006 and early 2007 are one example. Whether these attributions are correct and US biofuels production (and production from other countries) can be blamed for harming food security is currently the subject of fierce debate. Put briefly, biofuels and in particular US corn bioethanol appear to be one contributing factor to changing food commodity prices, which can affect vulnerable countries and populations in particular. However, there are several other factors that also play important roles in destabilising food prices. Blaming food price spikes on biofuels production alone – as is often expressed in the 'food versus fuel' debate – is too

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

[13] 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, commonly referred to as the Renewable Energy Directive.

[14] 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).

[15] 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.

[16] Renewable Fuels Association (2010) *Climate of opportunity: 2010 ethanol industry outlook*, available at: http://ethanolrfa.org/page/-/objects/pdf/outlook/RFAoutlook2010_fin.pdf?nocdn=1, p6.

simplistic. That said, there is clearly the potential for more serious effects on food security as biofuels production increases.

17. One of the most contentious issues that arose from evaluations of US corn bioethanol is the debate around iLUC. The concept of iLUC is based on the assumption that growing biofuels crops on existing agricultural land results in new cultivation of food and other crops elsewhere to make up the shortfall in their production. This requires the conversion of land elsewhere in the world to agricultural use. Such iLUC, if it involves the destruction of carbon stocks in grassland, forest/woodland, peatland or wetlands, results in the release of substantial GHG emissions. However, the calculation of both these emissions and the attribution of land use change are extremely difficult and fraught with uncertainty. While some report that production of corn-based bioethanol overall produces more GHG emissions than fossil fuels, other studies cite far more favourable results. Indirect LUC has by now been largely recognised as relevant in principle, but how it should be calculated and dealt with is still a matter of much debate which has yet to be resolved.

Case study II: Bioethanol from sugar cane in Brazil (paragraphs 2.20–2.33)

18. Bioethanol production from sugar cane in Brazil, one of the longest standing biofuels programmes, has been described as the most successful example of producing and using biofuels on a large scale. In 1975, the Brazilian government launched the national alcohol programme 'PróÁlcool' (Programa Nacional do Álcool). The intention was to phase out fossil fuels and to replace them with bioethanol made from sugar cane. The uptake rate of bioethanol in Brazil is unparalleled compared with anywhere else in the world.

19. However, Brazilian sugar cane ethanol production has been criticised for its negative environmental effects, for example caused by field burning and water use, and in particular deforestation. Some say that rainforests and other environmentally valuable land has been and will increasingly be cleared for sugar cane production, and deforestation in the Cerrado and the Amazon has been linked to an increased area of sugar cane plantation elsewhere in Brazil. The degree of causation is unclear. Expansion of agriculture into areas of high biodiversity is neither an inevitable consequence of nor necessarily due to increased biofuels production. However, rapid scaling up of production in response to increasing worldwide interest in biofuels may act as an incentive to expand production into valuable wildlife habitats. To avoid the destruction of valuable forestland and in response to international criticism, in September 2009 the Brazilian Government set up countrywide agro-ecological land use zoning (ZAE Cana) to restrict sugar cane growth in or near environmentally sensitive areas.

20. Brazil has also been accused in the past of not tracking breaches of workers' rights. There have been reports of unhealthy working conditions and even deaths from overwork during sugar cane cutting. Wages are low, and cutters are often paid by the amount they produce, encouraging overworking. There is also informal child labour and, even though Brazil has strict labour laws, enforcement is weak. On the other hand, many sugar cane mills in the ethanol production sector now maintain schools, nursery centres and day care units, as well as some medical, dental, pharmaceutical, sanitation, and educational services for sugar cane workers.

Case study III: Biodiesel from palm oil in Malaysia (paragraphs 2.34–2.42)

21. Malaysia is the second largest producer of palm oil in the world (after Indonesia). In 2009, it produced approximately 17.6 million tonnes of crude palm oil.[17] The main motivations for biofuels production were economic and agricultural development and energy security. The Malaysian

[17] Malaysian Palm Oil Board (2009) *Production of crude palm oil for the month of December 2009: Jan – Dec total*, available at: http://econ.mpob.gov.my/stat/web_report1.php?val=200904.

Government has introduced policies and legislation to encourage the production and use of palm oil-based biodiesel. In 2008, Malaysia produced approximately 1.3 million litres of biofuel, and production is expected to increase steeply.

22. The rapid expansion of Malaysian palm oil biodiesel has led to worries over the conversion of forests to oil palm plantations that might have detrimental impacts on South-East Asia's biodiversity. The potential impacts of lost forestland and biodiversity in this region are particularly significant given that, by some estimates, South-East Asia contains 11 per cent of the world's remaining tropical forests which are home to many rare species, and reports have warned of the extinction of, for example, the orang-utan of Borneo. Moreover, the conversion of lowland tropical rainforest would result in significant GHG emissions. Malaysia also faces issues of illegal logging, which at current scales poses significant threats to the environment and local communities.

23. There have also been accusations of so-called 'land grabs' by palm oil producers. Companies have been accused of clearing large areas of land and displacing indigenous tribes who, despite often not having official title to the land, may exercise Native Customary Rights because they have lived there for generations and depend on the land for their livelihood.

Consequences for policy (paragraphs 2.43–2.47)

24. Some policy changes have occurred following reports about the US, Brazil, Malaysia and other countries detailing the negative consequences of large-scale biofuels production. For example, the UK *Gallagher Review* called for further investigation of the issue of iLUC and suggested postponing a higher mandated percentage of biofuels in the UK by a few years.[18] The RED now includes several social and environmental standards. In view of this recent history of biofuels production, there is an urgent need to look at the issues openly, in the light of new technical developments, and with a clear statement of principles governing any future implementation and expansion.

Chapter 3: New biofuels – scientific developments

25. The development of new biofuels technology is a rapidly growing field, focussing on the use of abundant biomass feedstocks that: can be produced without harm to the environment or local populations; are in minimal competition with food production; need minimal input of resources such as land and water; can be processed efficiently to yield high-quality liquid biofuels; and are deliverable in sufficient quantities. Various biomass feedstocks have been proposed, including lignocellulosic biofuels and algae.

Lignocellulosic biofuels (paragraphs 3.5–3.30)

26. In the production of lignocellulosic biofuels, all of the plant biomass is used, including the lignin and the cellulose, instead of just the sugary, starchy or oily parts (such as in biofuels from food crops). Because of this, lignocellulosic biofuels yield more energy per unit mass of feedstock; however, they also require far more sophisticated processing. Agricultural waste can be processed into biofuels, making some crops effectively 'dual-use', i.e. producing food as well as fuel. The supply of this source of fuel is, however, limited. For this reason, a lot of activity surrounds dedicated biofuels crops, such as willow, miscanthus and switchgrass, which are nutrient-efficient and, once established, require no tillage, thus preserving soils. They also have significant genetic diversity and therefore there is potential to improve their characteristics such as yield, water use and pest and frost resistance using advanced plant breeding strategies (APBS). An important goal for dedicated biomass crops is to identify or develop variants that can grow on land unsuitable for food cultivation and which require little in terms of water and other

[18] 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.

inputs, such as fertiliser. Nevertheless, the danger still exists that agricultural resources – mainly land – are diverted away from food production, and that the overall demand for these resources intensifies, resulting in significant GHG emissions due to iLUC.

Algae (paragraphs 3.31–3.40)

27. Algae are a very diverse group of aqueous photosynthetic organisms that are being investigated for their potential to be processed into biofuels. Some algae produce an array of oil-related compounds that can be used directly to produce biodiesel, thus avoiding the technical challenges of converting lignocellulosic biomass to biofuels. They can use wastewater as a source of nutrients and waste combustion gas as a source of carbon dioxide. They are also expected (with added carbon dioxide) to produce a higher biomass yield per unit area than crop plants. Depending on where and how they are cultivated, algae could minimise or avoid competition with food production for land and nutrients, and using algae that can be grown in the sea might reduce the need for freshwater. Finally, algae are compatible with processing in biorefineries, producing a variety of fuels and valuable co-products such as vitamins. However, currently, the production of algal biofuels is mostly experimental and, mainly owing to costly harvesting and processing, very expensive.

28. Lignocellulosic feedstocks and algae both show significant potential for improvement in the production of biofuels. Advances in using modern biotechnology illustrate the options available to avoid the problematic consequences of current biofuels, in particular regarding land use, environmental impacts and competition with food. However, just like established biofuels, new approaches have to avoid harmful effects, and the next chapter offers an ethical framework that can be used in decision making about which path to pursue.

Chapter 4: Ethical framework

29. As shown, current biofuels give rise to a number of concerns, and the new approaches to biofuels development and production are also likely to be controversial. Chapter 4 proposes a number of moral values for considering both current and new biofuels. These key moral values are both commonly shared and of relevance to current and future biofuels. Together, and through their confluence, they constitute a moral framework enabling us to construct strong Ethical Principles (set out in paragraph 35 below) that should enjoy widespread support.

Human rights (paragraphs 4.8–4.13)

30. International human rights establish a moral minimum below which the treatment of people should not fall. Human rights are universally enjoyed by *all* human beings, no matter the state or nation to which they belong; they capture a universal element of the concept of global justice. Biofuels clearly have international implications, and states have a duty to design regulatory frameworks to ensure that the development of biofuels does not violate those human rights which are essential conditions for at least a decent opportunity for human flourishing, giving equal weight to the human rights of their citizens and non-citizens. Biofuels production breaches basic human rights when it endangers local food security or displaces local populations from the land they depend on for their daily subsistence. Similarly, biofuels production becomes a human rights issue when it threatens or destroys ecosystems and natural resources that are critical to the health and subsistence of people. Invoking human rights to support our Ethical Principles does not mean that we adopt an exclusively human rights-based approach to the evaluation of biofuels technology. However, mainly through their legal dimension, human rights serve very well to justify some minimum moral conditions which must be met and which are set out mainly under Principle 1.

Solidarity and the common good (paragraphs 4.14–4.17)

31. Solidarity focuses on the importance of protecting individuals as members of groups or populations. It is the idea that we are all 'fellow travellers' and that we have duties to support and help each other and, in particular, those who cannot readily support themselves. In the context of biofuels, the value of solidarity directs ethical attention to the most vulnerable people within societies, reminding us that we have a 'shared humanity', a 'shared life' and that those who are most vulnerable should be given special attention. For biofuels development, the value of solidarity thus requires countries or companies to ensure just reward, that benefits are shared equitably and that burdens are not laid upon the most vulnerable in society (see Principles 4 and 5).

32. Common good arguments capture the idea that there are some goods that we believe all – including future generations – should share equitably, in whichever society they live. A common good is more than the sum of individual benefits. Common goods are often goods of global relevance, such as the protection of the climate or important ecosystem services. This provides justification for several Principles (in particular Principles 2 and 3). A common good perspective also underlines the urgency of the debate about biofuels. Although there are justifiable criticisms of some of the consequences of biofuels and fears about the possible implications of new ones, the status quo involving increasing use of fossil fuels does not itself accord with a common good perspective. Doing nothing can sometimes amount to doing something extremely damaging, and finding other ways of securing essential energy needs might be required to realise the common good. This is reflected in Principle 6.

Sustainability, stewardship and intergenerational justice (paragraphs 4.18–4.21)

33. Stewardship and sustainability generate obligations to those elements of the natural world which are not of immediate material benefit to people, particularly where the interests of future generations are involved. Sustainability implies the requirement to sustain some entity or value over time. Considering what it is that should be sustained, our focus here is primarily on environmental sustainability, calling for "the sustaining into the future of some aspect of the natural environment".[19] Protection of the natural world and environmental security are vital for human life, which depends on the preservation of many benefits provided by the environment. A second key issue inherent in the value of sustainability is a commitment to intergenerational justice and the obligations of each generation to those that follow them. A sustainable approach to biofuels development thus requires that we do not deplete the world's natural resources without regard for the legitimate interests of future generations.

34. The concept of environmental sustainability thus leads to the idea of stewardship. Sustainability requires us to act as stewards of the natural world with legitimate rights to use it, but also with obligations to leave it in a state fit for future generations. We take stewardship to mean that governments and other stakeholders have an obligation to ensure that the natural world and its resources are sufficiently protected, both for current and future generations. Current generations should also ensure that they treat their successors in the same way that they would want to have been treated by preceding generations.

Six Ethical Principles (paragraphs 4.24–4.53)

35. These moral values contain elements that can overlap, and they can in certain circumstances have different implications. We have therefore derived practical Ethical Principles, drawn from one or several of the values, which can be applied more clearly. We thus offer an ethical framework consisting of six Principles which, rather than endorsing a particular course of action

[19] Dobson A (1998) *Justice and the environment: conceptions of environmental sustainability and theories of distributive justice* (Oxford: Oxford University Press), p41.

or technology pathway, can be used to help others to come to decisions about which path to pursue. The first five Principles specify the conditions that should be met for biofuels development to be permissible. These are as follows:

i. Biofuels development should not be at the expense of people's essential rights (including access to sufficient food and water, health rights, work rights and land entitlements).

ii. Biofuels should be environmentally sustainable.

iii. Biofuels should contribute to a net reduction of total greenhouse gas emissions and not exacerbate global climate change.

iv. Biofuels should develop in accordance with trade principles that are fair and recognise the rights of people to just reward (including labour rights and intellectual property rights).

v. Costs and benefits of biofuels should be distributed in an equitable way.

We then consider whether in some cases there may be a duty to develop biofuels. To address this we propose a sixth Principle:

vi. If the first five Principles are respected and if biofuels can play a crucial role in mitigating dangerous climate change then, depending on additional key considerations, there is a duty to develop such biofuels.

The additional key considerations are: absolute cost; the availability of alternative energy technologies; alternative uses for biofuels feedstocks; the existing degree of uncertainty in their development; their irreversibility; the degree of participation in decision making; and the overarching notion of proportionate governance.

36. Our Ethical Principles should guide all policy making in the field of biofuels. We see them as important benchmarks or criteria that policy makers should use whenever technology developments and new policy are envisaged. This alone would represent an important step forward towards more ethical production of biofuels. Our first most, and most general, recommendation is therefore:

37. **We recommend that policy makers and other stakeholders use the Ethical Principles as a benchmark when evaluating biofuels technology and policy development and always make sure that serious consideration has been given to relevant aspects before proceeding.**

38. Finally, as well as considering biofuels against alternative uses for land, such as food agriculture, the Ethical Principles should be considered with regard to the full range of alternative energy technologies, not just fossil fuels. While it is not the aim of this report to undertake such an extensive assessment of all energy technologies, we believe that the ethical framework laid out in this chapter can be applied to all other technologies, and we urge policy makers to do so.

Chapter 5: Ethical Principles and biofuels policy

39. A major cause of the ethical issues associated with biofuels production is not the technologies, but rather the policies that led to their extremely rapid adoption. In Chapter 5, we consider how the interaction of policy, technology and their practical implementation can be filtered through the Ethical Principles, supporting the development of a more ethical 'biofuels system'.

Ethical Principles and their application through policy (paragraphs 5.8–5.10)

40. While we believe that the Ethical Principles developed in Chapter 4 should be adhered to in all biofuels policy, whether existing or newly developed, we are aware of the enormous challenges when developing policy in an area of rapid development and great uncertainty. There can be many difficulties in enforcing a firm ethical framework in the real world, because the policy-making reality is complex, messy and often far from perfect. Moreover, there is also the danger of too much 'red tape' and bureaucratic burden, and the challenge is to develop policy that is proportionate to the specific risks and benefits involved. However, it is precisely because of the extent to which biofuels developments are driven by policy and regulation that it is important to identify where existing policy is failing to meet the required ethical standards, and how this could be avoided or ameliorated.

41. In Chapter 5, we test existing biofuels policies against our Ethical Principles and develop recommendations as to how these policies could be improved. In doing so we are not claiming that this is the only way to proceed; in a complex policy area, there may be other options. However, we believe that our recommendations offer a way forward, and we hope that these will provide helpful guidance for those developing future biofuels policy.

Principle 1: Biofuels development should not be at the expense of people's essential rights (including access to sufficient food and water, health rights, work rights and land entitlements) (paragraphs 5.11–5.23)

42. Target-based policies, such as those contained in the RED, have been criticised for contributing to human rights violations. Firstly, they effectively establish artificial markets for large-scale biofuels production. Biofuels providers, incentivised to fulfil targets, scale up production quickly and in the easiest way possible, often resulting in producers moving into countries with a less rigorous regulatory environment. Secondly, biofuels markets which are supported and incentivised by target-based policies make it attractive for developing countries to scale up their own biofuels production rapidly; however, in some cases this has been associated with human rights violations.

43. The RED has recently incorporated some social requirements, giving a broad commitment to monitoring every two years the impacts of biofuels production on issues related to human rights. In the UK, the Renewable Fuels Agency developed some standards for social sustainability. Within the EU, such standards will not be too difficult to implement and enforce as they are set within a strong legal and policy framework, which supports similar standards in many other areas. However, the RED also proposes equivalent compliance for biofuels sourced *outside* the EU, and enforcement in this context is more difficult to secure.

44. However, a promising international approach is emerging through sustainability initiatives that cover human rights as well as other elements. The Roundtable on Sustainable Biofuels (RSB) standard[20] currently appears to have the most comprehensive set of sustainability criteria relating to human rights. The RSB ultimately aims to operate as a certification scheme.

45. **We recommend to European Commission (EC) and national policy makers that any mandatory national biofuels targets required by the Renewable Energy Directive should be set in such a way as to avoid incentivising human rights abuses. Where monitoring through biannual reports detects such effects, sanctions need to be enacted effectively and swiftly. We recommend that the EC develops and implements effective structures of oversight to this effect.**

[20] Roundtable on Sustainable Biofuels (2010) *RSB principles & criteria for sustainable biofuel production*, available at: http://rsb.epfl.ch/files/content/sites/rsb2/files/Biofuels/Versionper cent202/PCsper cent20V2/10-11-12per cent20RSBper cent20PCsper cent20Versionper cent202.pdf.

46. **We recommend making certification based on comprehensive standards related to human rights mandatory for all biofuels developed in the EU or imported into the EU, for example as part of a certification scheme such as the one developed by the Roundtable on Sustainable Biofuels. This should be included in the Renewable Energy Directive and national policy instruments such as the UK Renewable Transport Fuel Obligation Order.**

Principle 2: Biofuels should be environmentally sustainable (paragraphs 5.24–5.35)

47. Biofuels targets could also harm environmental sustainability because they encourage rapid expansion of current biofuels production and use. At present, such expansion is unlikely to be environmentally sustainable owing to dLUC and iLUC, the relatively poor environmental performance of some current biofuels feedstocks, and the import of biofuels, sometimes from countries with less stringent sustainability regulations. For example, only 31 per cent of biofuels used in the UK met an environmental standard in 2009–2010.[21]

48. The RED includes standards for the protection of areas of high biodiversity which apply to biofuels used towards the EU renewable energy target. Again, the situation is different *outside* the EU. The RED suggests multilateral and bilateral agreements, and voluntary international or national schemes to cover environmental sustainability of biofuels systems outside the EU. Such provisions might lack sufficient 'bite'. Overall, existing policies to ensure sustainability and sound stewardship of biofuels production are weak. This has prompted a number of governments, international organisations and the private sector to develop sustainability standards for biofuels that could be used to support environmental policies and, again, a positive example of this is the RSB. Environmental sustainability of biofuels systems is a global problem. Policies are disparate across countries and the large number of standards and certification systems under development is likely to cause confusion for end users.

49. **We conclude that the best possible standard of environmental sustainability should be developed for biofuels production, for example by an international organisation already working towards such a standard, such as the United Nations Environment Programme. This standard should be implemented as part of a proportionate biofuels certification scheme. This should be achieved in such a way as to prevent displacement and/or the leakage of unsustainable practices into other forms of agriculture.**

50. Technologies for genetic improvement, such as genomics and marker-assisted breeding strategies and genetic modification, could be important tools in achieving a sustainable increase in biofuels production, without endangering the environment, for example by increasing the efficiency of biofuels production at all points in the production pathway. These benefits should be captured, while minimising the risks through appropriate case-by-case risk assessment and post-release monitoring. This applies equally to the introduction of new non-native plants, such as foreign crops, through to the application of nascent technologies such as synthetic biology.

51. **Policies are needed to investigate the application of biotechnologies for genetic improvement of crops where this has the potential to support the environmental performance of biofuels production, with appropriate regulatory oversight.**

[21] Renewable Fuels Agency (2010) *Year two of the RTFO*, available at: http://www.renewablefuelsagency.gov.uk/sites/rfa/files/Year_Two_RTFO_v2.pdf, p16.

Principle 3: Biofuels should contribute to a net reduction of total greenhouse gas emissions and not exacerbate global climate change (paragraphs 5.36–5.53)

52. Targets may also incentivise the scaling up of biofuels production in countries that do not have climate change mitigation policies, leading to production of biofuels with low GHG emissions savings. In the EU, both climate change mitigation and GHG emissions reductions have become a primary driver for biofuels developments and, accordingly, the RED specifies requirements for net GHG emissions savings from biofuels counted towards the European target. However, without a policy instrument such as a certification scheme ensuring *all* biofuels imported into Europe deliver GHG emissions savings throughout their whole production process ("from field to tank"), the RED could be seen to be 'outsourcing' the pressing problem of climate change mitigation.

53. The recommendation that GHG emissions be measured as part of a life cycle assessment (LCA) raises manifold difficulties itself, including choosing the appropriate type of LCA. Chief among these many difficulties is the debate over iLUC and the extent to which the release of stored carbon can be attributed to biofuels production: these issues have proved to be the most contentious. It is now generally appreciated that biofuels production is one of many activities that can generate dLUC and iLUC, and that dLUC for biofuels production should usually be avoided, and most biofuels policy now requires this. However, such regulations, which only apply to one form of land use, are an ineffective way of dealing with the destruction of carbon stocks. Instead, a much better approach is for internationally agreed policies, with strong monitoring and policing measures, to prevent the loss of major carbon stocks. This would address land use change directly at the point where it takes place and by those who are immediately responsible. If such a targeted approach were successful, the need to consider iLUC would become irrelevant for biofuels or any other activity involving significant land use. We therefore suggest more holistic changes to policy than have recently been put forward by the EC.[22]

54. **We recommend to the European Commission (EC) Directorate-General for Energy and Transport and the UK Department for Transport, Department of Energy and Climate Change, Department for Environment, Food and Rural Affairs and Department for International Development that different biofuel types be certified on the basis of their life cycle greenhouse gas emissions according to attributional life cycle assessment (LCA), and based on a single international standard. This requires elucidation of the important distinction between attributional and consequential LCA. Such certification should be complemented by a robust regulatory mechanism to ensure compliance. The standard should be drawn up by the original authors of the Renewable Energy Directive, including the Joint Research Centre and the subsequent regulators who must translate EC policy into individual Member State practice. The standard should be extended globally, for example in cooperation with the United Nations Framework Convention on Climate Change.**

55. **We recommend to the European Commission Directorate-General for Energy and Transport and the UK Department of Energy and Climate Change, as well as to the United Nations Framework Convention on Climate Change Secretariat, that policies on land use change should be set within a wider framework of global agreement on a coordinated response to climate change, which directly tackles land use change, with strong international and local measures to prevent destruction of high carbon stocks, thereby eliminating or minimising harmful direct or indirect land use change.**

56. Some new biofuels technologies are likely to fare well in terms of their GHG emissions savings, and some may be able to avoid any significant land use change. However, suppliers are obliged

[22] European Commission (2010) *Report from the Commission on indirect land-use change related to biofuels and bioliquids*, available at: http://ec.europa.eu/energy/renewables/biofuels/doc/land-use-change/com_2010_811_report_en.pdf.

to reach target contributions and are penalised financially if they do not. There is thus pressure to avoid penalties, and this may lead developers to choose established technologies over better ones that need further development and investment.

57. **Specific biofuels policies should include technology-relevant instruments to stimulate the development of those biofuels and biofuels crops that can be demonstrated to produce significant net greenhouse gas emissions savings, for example through high biomass yield with minimal inputs and land use. Such instruments could, for example, be developed by national research councils.**

Principle 4: Biofuels should develop in accordance with trade principles that are fair and recognise the rights of people to just reward (including labour rights and intellectual property rights)

Fair trade (paragraphs 5.54–5.66)

58. Much investment in biofuels feedstock production in developing countries has been accused of benefiting neither smallholders nor farm labourers, for example through the use of unfair wages and prices. Moreover, some countries are investing in large-scale biofuels plantations. Given the four to five year maturation of some of these crops (e.g. jatropha), such countries might become vulnerable to changing demand, for example following EU policy changes. On the other hand, the potentially very large expansion of the global biofuels industry stimulated by target-based policies might provide additional revenue and economic development as well as new jobs in developing countries.

59. The protection of labour rights to ensure adequate payment to labourers in all countries producing biomass feedstocks for EU biofuels supplies is addressed in the RED. Again, a key issue is whether countries outside the EU adhere to these protective policies when faced with strong incentives for scaling up biofuels production. One approach to ensure fair wages and fairer trade relationships has been the introduction of Fairtrade schemes;[23] however, these have been criticised for a number of reasons, and some have been connected with fraudulent activity in the past. Instead of simply applying a Fairtrade scheme, trade principles that are fair should be incorporated into the efforts described above, for example as part of certification. These principles should respond to the particularities of biofuels value chains, and also be harmonious with both the complexities of competing drivers and systems of governance that currently drive investment in biofuels.

60. **Current and future biofuels blending targets for the EU and UK need to take a long-term view and promote trade principles that are fair. The effects on developing countries of future changes in targets need to be monitored carefully.**

61. **Given the limitations of current Fairtrade schemes, we propose that trade principles that are fair be developed as part of sustainable biofuels certification requirements by EU and national stakeholders, such as the authors of the Renewable Energy Directive and the UK Department for International Development. This needs to happen in a proportionate and flexible way to acknowledge the differences between countries and production systems, while at the same time strictly maintaining the protection of vulnerable populations.**

Intellectual property (paragraphs 5.67–5.84)

62. Just reward also means finding a balance between rewarding parties for their innovation and investment while trying to encourage access to knowledge and materials. For biofuels in many

[23] Fairtrade International (2011) *What is Fairtrade?*, available at: http://www.fairtrade.net/what_is_fairtrade.0.html.

cases, financial return will only be possible after the investment of very large sums of money, and intellectual property (IP) will play a key role in attempts to secure such a return. Intellectual property regimes are fraught with tensions and political agendas, and there has been a tendency towards more and stronger intellectual property rights (IPRs) over the years. In the negotiations around trade agreements that address IPRs, developing countries often have very little influence.

63. It is unrealistic and probably economically imprudent to suggest that the number or scope of IPRs should be reduced. An alternative approach might be to recognise the distinction between their existence and their exercise. Another approach is to influence the way in which IP is exploited – which is done principally through the granting of licences. The widespread use of non-exclusive licences which utilise the principles and best practices outlined in a recent OECD report[24] should be encouraged in the area of biofuels.

64. **We recommend the drafting and adoption by the UK Intellectual Property Office of a licensing scheme and a framework of biofuels principles and best practices along the lines of the Organisation for Economic Co-operation and Development guidelines.**

65. **We recommend increasing the availability of licensing arrangements with respect to biofuels technologies and more research on the economic and social impacts of intellectual property in these fields.**

66. Plant breeding strategies may lead to the development of new plant varieties that can be protected by plant variety rights. These provide a reward for innovation but permit access to the results of innovation, for example through the breeders' exemption. This allows breeders to use protected material for the purpose of breeding other varieties without the authorisation of the plant variety right holder. Where this research leads to a new variety, the breeder of the new variety can claim rights over it without having to obtain permission from the first breeder. This reflects public interest in allowing breeders free access to plant material to breed new varieties.

67. **We recommend to the UK Department for Business, Innovation and Skills and the Intellectual Property Office the introduction of the breeders' exemption into UK patent law.**

Principle 5: Equitable distribution of costs and benefits (paragraphs 5.85–5.102)

68. Equitable cost–benefit distribution is the only one of our Principles that is not in some way addressed in specific current biofuels policies or in the continuing initiatives to establish biofuels sustainability standards. The costs and benefits of biofuels production relevant to equity extend well beyond purely financial losses or revenue. They may be complex, ranging from environmental to political, social or economic aspects, and accumulate in different ways in different contexts. There is also a distinction between benefits that might be described as public goods and benefits which may accrue only to certain segments of society in certain parts of the world. The specific benefit of a public good also needs to be offset against the burdens on others in society. For example, investment in biofuels to reduce GHG emissions may pose livelihood implications for only certain, poorer or more vulnerable, segments of society. Trade-offs in creating policy that aims to distribute costs and benefits equitably are inevitable, and it is more realistic to aim to ensure that policy (broadly) maximises benefits and reduces costs, while ensuring that additional inequities are not created in an already inequitable world.

69. A key concern regarding the equitable international distribution of biofuels benefits is to ensure appropriate management of global versus local production. There are many examples of successful, small-scale, local biofuels initiatives that provide energy, income and livelihoods in fuel-poor areas, such as in rural Mali. Policies that encourage biofuels production therefore need

[24] Organisation for Economic Co-operation and Development (2006) *Guidelines for the licensing of genetic inventions*, available at: http://www.oecd.org/dataoecd/39/38/36198812.pdf.

to balance production for local needs and production for international markets. It is also important to recognise that policies aimed at ensuring sustainable industrial production, such as, for example, certification, have to be wielded with care. Where local small-scale production serves important needs, such as providing essential fuel and energy, certification should allow for exceptions in order not to stifle such production and disadvantage small-scale producers in developing countries.

70. **We recommend that biofuels policy and future sustainability and certification initiatives should not discourage decentralised biofuels production, particularly in developing countries that suffer from fuel poverty.**

71. **Protection against the imposition of unfair costs on vulnerable populations should be developed and implemented.**

72. Public–private partnerships (PPPs) constitute one mechanism for risk and benefit sharing and the development of technologies and products. Where they exist, these partnerships sometimes involve public–private interaction between multiple stakeholders, opening up new innovation pathways in areas where there are barriers to development such as market failures or lack of incentives for commercial development. With appropriate adaptation to local contexts and the policy areas involved in biofuels, such PPPs could be envisaged for biofuels.

73. **Policy instruments, such as innovation incentives, bilateral agreements between the UK and other countries, and project funding, should be developed and implemented to ensure that benefits of biofuels production are shared equitably. This could, for example, be done through public–private or product-development partnerships. National instruments should be implemented with the help of governmental departments such as the UK Department for International Development and Department of Energy and Climate Change. International organisations such as the United Nations Framework Convention on Climate Change could oversee international schemes.**

General policy instruments (paragraphs 5.103–5.123)

74. In addition to these biofuels-specific instruments, a wider policy background is relevant to meeting our Ethical Principles in biofuels systems, such as research guidelines. Research outcomes can be important elements in either causing or mitigating some of the ethical problems discussed. Existing academic ethical guidelines are probably sufficient for early-stage academic research where it is unclear what the basic research outcomes are going to be. However, once basic research outcomes have been clarified, i.e. at the stage of proof of concept, our ethical framework could be used as a checklist or benchmark for considering whether a technology has the potential to violate one of our Ethical Principles.

75. **We recommend to research councils, funders and managers that work should be undertaken to evaluate the likely ethical effects of implementing particular biofuels technologies on a larger scale. This should happen at the stage of proof of concept. In the future, ethical impact assessment should become a requirement of larger research grants aimed at bringing technologies towards wider commercial use.**

76. The IP regime can play a role in ensuring that the costs and benefits associated with biofuels are distributed in an equitable way. This could be achieved by taking one of the key objectives of the Convention on Biological Diversity (CBD)[25] – i.e. the fair and equitable sharing of the benefits arising from the utilisation of genetic resources – and integrating it into the IP regime. In 2010, agreement was reached on a legally binding protocol to the CBD on access to, and sharing of,

[25] Convention on Biological Diversity of 1992.

the benefits from the use of genetic resources, called the Nagoya Protocol. If successful, the Nagoya Protocol would allow developing countries, in particular, to exploit their genetic resources and reduce possible occurrences of misappropriation of those resources. This in turn may alleviate some of the harmful consequences that the Trade Related Aspects of Intellectual Property Rights[26] (TRIPs) Agreement has had on developing countries. The UK should take the lead in ensuring the operation of such an effective global multilateral benefit-sharing mechanism.

77. **We recommend to the UK Department for Business, Innovation and Skills and the Intellectual Property Office that the UK continues to promote compliance to access and benefit-sharing schemes by all users of genetic resources including those employing them for the purposes of biofuels production.**

78. **We also recommend that a 'disclosure of origin' requirement be introduced into UK patent law to improve transparency about genetic resource use in order to facilitate access and benefit sharing.**

79. **We recommend that consideration be given to the introduction of a mandatory 'disclosure of origin of genetic resources' requirement in intellectual property law with appropriate sanctions, either outside or within patent law, for non- or incorrect disclosure.**

80. **We recommend that the UK updates current access and benefit-sharing arrangements to take account of the legislative, administrative and policy measures introduced in the Nagoya Protocol on Access and Benefit Sharing. This process could be overseen by the UK Department for International Development and should be integrated into more specific biofuels polices, such as a sustainability standard and certification scheme.**

81. **We recommend to the UK Department for International Development that the UK should take the lead in giving support to developing countries to set up competent national authorities on access and benefit sharing and in providing advice on the practical implementation of the requirements of the Nagoya Protocol and Bonn Guidelines.**

82. **We recommend that international organisations such as the World Trade Organization and the World Intellectual Property Organization look into the feasibility of integrating the key concepts of the Convention on Biological Diversity into intellectual property law. This may lessen the adverse impact that the Trade Related Aspects of Intellectual Property Rights Agreement has had on developing countries.**

Chapter 6: Biofuels and the bigger picture

83. Biofuels occupy a space where almost all of the great future challenges facing the world converge – the so-called 'perfect storm'. As Sir John Beddington asked, how can we feed 9 billion people? How can we respond to future demand for water? Can we provide enough energy to supply the growing population coming out of poverty? Can we do all this while mitigating and adapting to climate change?[27] And, we would like to add, can we do all of this while protecting basic human rights and maintaining ecosystem services?

84. No single technology can address all these challenges. A mix will be necessary, and we believe that biofuels should be part of that mix if they overcome the hurdles of our Ethical Principles. There is a significant role for biofuels to contribute to some dimensions of energy security, in particular in the transport sector, as well as to climate change mitigation by reducing fossil fuel consumption, especially given the new scientific advances described in Chapter 3. There is significant energy available in biomass that can be accessed within a relatively short timescale. Moreover, there is a medium-term requirement for transitional technologies that can work with

[26] Agreement of Trade Related Aspects of Intellectual Property Rights of 1994, Part II.
[27] John Beddington (2010) *Food, energy, water and the climate: a perfect storm of global events?*, available at: http://www.bis.gov.uk/assets/bispartners/goscience/docs/p/perfect-storm-paper.pdf.

current infrastructure to deliver renewable transport fuels during the transition to future more effective solutions. While uncertainty remains about the extent of the potential contribution of biofuels to climate change mitigation, they have an impressive potential range of production scales. There are strong reasons to support biofuels developments that will, given an appropriate and proportionate policy environment, comply with our Ethical Principles, alongside other renewable energy sources and attempts to reduce overall demand for energy.

Some general considerations (paragraphs 6.13–6.26)

85. To support ethical biofuels production, the best use of current biomass resources needs to be found. In addition to our Ethical Principles, practical tools of comparative assessment, such as cost curves using a multitude of criteria and indicators, should be employed as an essential part of informed policy and decision making. In addition, because of their apparent advantages over established biofuels, the potential of the new approaches should be explored further. There is a large discrepancy between the powerful targets and related penalties that are in place for currently used biofuels and the very few incentives for new methods for developing biofuels that would stand a better chance of complying with our Ethical Principles.

86. **We recommend to research councils that specific policies be developed and implemented that directly incentivise research and development of new and emerging biofuels technologies that need less land and other resources, avoid social and environmental harms in production, and deliver significant greenhouse gas emissions savings.**

87. Modern biotechnology, including advanced plant breeding strategies and genetic modification, might play a central role in bringing about further improvements. Therefore, the regulation of these technologies should be considered in the light of new evidence on risks and benefits. Although developed with the best of intentions at a time when there was much more uncertainty around the potential risks and benefits of genetic modification, current regulatory systems might no longer be in accord with recent evidence-based assessment. In order not to be overly restrictive and prevent the development of technologies that have the potential to contribute to meeting the requirements of our Ethical Principles, these policies should be reviewed.

88. **We propose that, in order to address our Ethical Principles effectively, some modifications might be needed to existing policies and regulations related to new crop developments for agriculture and forestry. This might require some modifications to international agreements. Evidence-based and proportionate review of these policies should take place as soon as possible.**

Implementing Principle 6 (paragraphs 6.27–6.38)

89. Having looked at Principles 1–5, how do we determine whether there is a responsibility to develop biofuels? Meeting the standards required by Principles 1–5 is but the first step to establishing that a biofuels technology should become an ethical imperative and can be adopted widely. Such a duty also depends on whether a number of additional key considerations are met. These relate to the efficient, effective and equitable use of resources and technology, and we need to ask the following questions of any technology before it is considered for wide implementation:

    - Will the costs of the development be out of all proportion to the benefits, compared to other major (public) spending priorities?
    - Are there competing energy sources that might be even better, for example at reducing GHG emissions, while still meeting all the required Ethical Principles?
    - Is there is an alternative and better use of the biomass feedstock?

- Is sufficient attention given to the areas of uncertainty in the development and implementation of a technology, and are there efforts to reduce them?
- Will the implementation of the technologies lead to irreversible consequences and damage, once they are scaled up?
- Has fair attention been paid to the voices of those directly affected by the implementation of a technology?
- Can policy instruments such as certification be applied in a proportionate way?

90. Answering these questions in the context of Principle 6 should be part of a comprehensive comparative analysis of all different future energy and climate change abatement options, including comparison of energy *portfolios* with a different mix of technologies. In fact, our ethical framework as well as the questions we draw could serve as a template or a benchmark against which the ethical robustness of a range of possible pathways can be assessed. It could be a yardstick to hold up against a range of options to decide which is most appropriate in the future – a checklist of ethical appropriateness.

91. Put simply, if a technology, or a particular mix, after careful consideration of this checklist meets our Ethical Principles 1–5 and has a positive evaluation under the additional considerations of Principle 6, then there is a duty to develop it.

92. **We suggest that UK and EU policy makers as well as those in the research community conduct comparative analysis of different energy portfolios rather than simply different technology options.**

93. **We encourage UK and EU policy makers undertaking comparative analyses of the impacts of different energy and climate change abatement technology options to apply our Ethical Principles 1–6 as a template or benchmark against which the ethical robustness of a range of possible pathways can be assessed when engaging in policy and technology appraisal.**

94. **If a biofuels technology, or a particular mix, meets all elements of our Ethical Principles 1–6 then there is a duty to develop it.**

An approach to support Ethical Principles 1–6 (paragraphs 6.39–6.50)

95. In trying to bind together the more specific recommendations we have proposed in Chapter 5, we believe a proportionate governance approach, consisting of standards, targets, certification schemes and regulatory systems, will be helpful to guide future governance and policy developments. While *targets* provide long-term stability to developers and other stakeholders, targets of the type used in the RED are very blunt instruments, and we believe that the incentivisation of a particular technology development should be more sophisticated and responsive.

96. **We recommend that policy makers at the European Commission level and in Member States replace current Renewable Energy Directive and national biofuels targets with an alternative, proportionate, target-based strategy that is in accord with our Ethical Principles and that drives change in a more nuanced, flexible and responsive way.**

97. Biofuels-specific *standards* and *certification schemes*, continually improved, will be important instruments of change in biofuels developments. They will be most effective if they are accompanied by elements from *regulatory systems*, for example financial sanctions, and incentives such as subsidies or assured markets where specific standards are met. However, so far, despite the best intentions, the outcomes of such initiatives have not been entirely positive. Our policy recommendations refer to the need to use these instruments intelligently to effect improvements in the biofuels systems, and this requires continuing monitoring of impacts.

98. **We suggest the development and implementation of a comprehensive ethical standard for biofuels, to include the protection of human rights and the environment, full life cycle assessment of greenhouse gas emissions, trade principles that are fair, and access and benefit-sharing schemes. It should be set within wider frameworks for mitigating climate change and addressing land use change (direct and indirect), and should be open to future revision as needed.**

99. Standards need to be enforced, and the instrument of choice to ensure this is *certification*. The latter instrument needs to be wielded with care and include some clear guidance to enable their proportionate application. Certification, as it is envisaged here, implements our Ethical Principles which should ideally apply across all EU Members States, if not globally, with accompanying efforts in monitoring its impacts.

100. **The ethical standard for biofuels should be enforced through corresponding certification for all biofuels developed in and imported into the EU. We recommend that, instead of voluntary schemes developed by each Member State, a unified certification scheme be developed and implemented. Such certification should allow for proportionate application, for example in the case of local small-scale biofuels production. The EU should provide financial support and advice to countries who might find it difficult to implement such certification.**

Why just biofuels? (paragraphs 6.51–6.59)

101. We have suggested above that a comprehensive standard should be applied to biofuels production through certification. However, several elements of the standard and the associated certification scheme should ideally be applied equitably to *all* similar products and not just biofuels. There is no reason why our ethical framework and its Principles should apply to just one sector of agricultural and technological activity. In particular, the considerations flowing from Principle 6 apply to many technologies and activities, not just to biofuels. Indeed, there is a risk that in putting barriers (i.e. ethical conditions) in the way of biofuels development, this could inhibit their development, while the Principles we have developed continue to be violated in other agricultural, energy generation or trade practices. We therefore propose that our Ethical Principles be used as a model or benchmark in *all* comparable technologies and products, taking one important step towards the development and improvement of the wider policy context that is needed to tackle the enormous challenges of the future.

102. **We recommend that our Ethical Principles be applied, ultimately, as a benchmark to all comparable technologies and products.**