National Audit Office

Renewable energy: Options for scrutiny

A Review by the National Audit Office | July 2008

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Summary

1 This review of renewable energy has been prepared in response to a request from the Environmental Audit Committee. Part 1 provides the background, setting out what is meant by renewable energy, the targets and objectives applicable to the UK, the sources of renewable energy, and the technologies and types of energy consumption they support. Part 2 explores progress to date, and the various barriers to further expansion of renewable energy in the UK. Finally, Part 3 sets out the policy landscape, describing the main public bodies responsible for policy, and the most important programmes and policy instruments.

2 Renewable energy is distinct from low carbon energy; whereas both can reduce carbon emissions, renewable energy must be derived from renewable sources – biomass, water, wind, solar or geothermal sources. The briefing therefore excludes a review of nuclear power generation and carbon capture and storage.

3 The UK faces one of the biggest challenges on renewables in Europe. The EU's proposed target is for the UK to achieve 15 per cent of its energy consumption from renewable sources by 2020; the current figure is just 1.4 per cent (ranking 25th of 27 Member States). Other targets and aspirations have also been set, by both the EU and the UK, for the proportion of energy used for transport and supplied for electricity that should be sourced from renewable sources; there are no targets for energy used for heating or cooling. Rapid progress is needed for the UK to meet these targets. The proportion of renewable fuels by volume sold will need to increase fivefold to meet a 2010 target; and the UK must more than double its renewable electricity supply by 2010. As there is less potential for increasing renewables in heat and transport, achievement of the 2020 energy consumption target is likely to need over 30 per cent of electricity, and possibly much more, to come from renewable sources.

4 Any expansion of renewable energy must overcome both resource-specific and generic constraints and barriers, including the relative cost of renewable technologies, and planning constraints (such as obtaining consent and the speed of approvals). Cost estimates of renewable technologies vary according to the nature of the assumptions applied, including expectations for the future development of technologies and their associated costs.

5 Part 3 illustrates that although there is currently no overarching strategy for renewable energy, there have been a number of individual strategies and reviews covering types of renewable energy, or energy policy as whole. There are also various funding packages, programmes and policies targeted to different stages of the innovation cycle – from research and development, to demonstration

and deployment. The biggest policy is the Renewables Obligation, which through increased electricity prices will cost consumers (including business customers) around £1 billion per year, and is currently undergoing reform to encourage a larger contribution from emerging renewable technologies. The Government is currently consulting on a renewable energy strategy, due to be published in Spring 2009, once a proposed EU Directive on renewable energy has been agreed. The consultation considers a number of measures to increase renewable energy provision in the UK to meet the 2020 energy consumption target, and BERR acknowledges that "... the level of the target will require all sectors and technologies to deliver at their maximum growth rates over the next 12 years" with associated costs estimated to be between £56 billion and £66 billion over 20 years.

6 The eventual choice and timing of inquiry topics is of course a matter for the Committee. However, despite the complexity of the topic area, and the wealth of current interest by other Committees (see Part 3 – the IUS Select Committee, the Lords EU Internal Market (Sub-Committee B) and the Lords Economic Affairs Select Committee are all either holding or have recently held inquiries on renewable energy), the review identifies some topics that could be suited to a Committee inquiry.

7 The first and perhaps the most obvious way to dissect the topic would be to look at the **nature and effectiveness of the support for specific types of renewable energy sources and technologies**. Such an inquiry could review in more detail the nature of progress made to date, the specific barriers and challenges that apply and the work being done to overcome them. This sort of review could also consider **what is known about the economics and various costs** involved in developing and deploying renewable technologies, including forecast costs and their implications for meeting the targets.

8 Another possible theme would be to review the nature, scope and accuracy of the **renewable energy projections** for the UK, and how these have been, and are being, used by Government to inform its policy decisions.

9 The Committee could also explore the **roles and responsibilities of the main public bodies involved.** While BERR sets the Government's overarching renewable energy strategy and is responsible for ensuring the UK meets its targets, BERR, Defra and DIUS each have a role in funding energy-related research and development, via a number of dedicated renewable energy funds, the Energy Technology Institute, the Technology Strategy Board and the Research Councils. HMT and DfT are responsible for fiscal incentives and renewable transport respectively; the devolved administrations, regional development agencies and local authorities also play important roles, for example in planning decisions and in delivering regional economic strategies.

10 Another way of exploring the topic would be to **review the focus of the current policy mix and approach.** This might, for example, include a review of the relative funding, efforts and progress being targeted at different stages of the innovation chain; or of the relative focus on encouraging the supply of renewable energy as well as consumer demand. An inquiry in this area might also explore how the UK compares with other EU states. This could be timely given BERR's consultation on its renewable energy strategy this year.

11 The Committee could choose to focus on **specific policy instruments** that directly encourage or promote renewable energy – such as the Renewables Obligation, the Renewable Transport Fuels Obligation, research and development funding or the Low Carbon Buildings Programme.

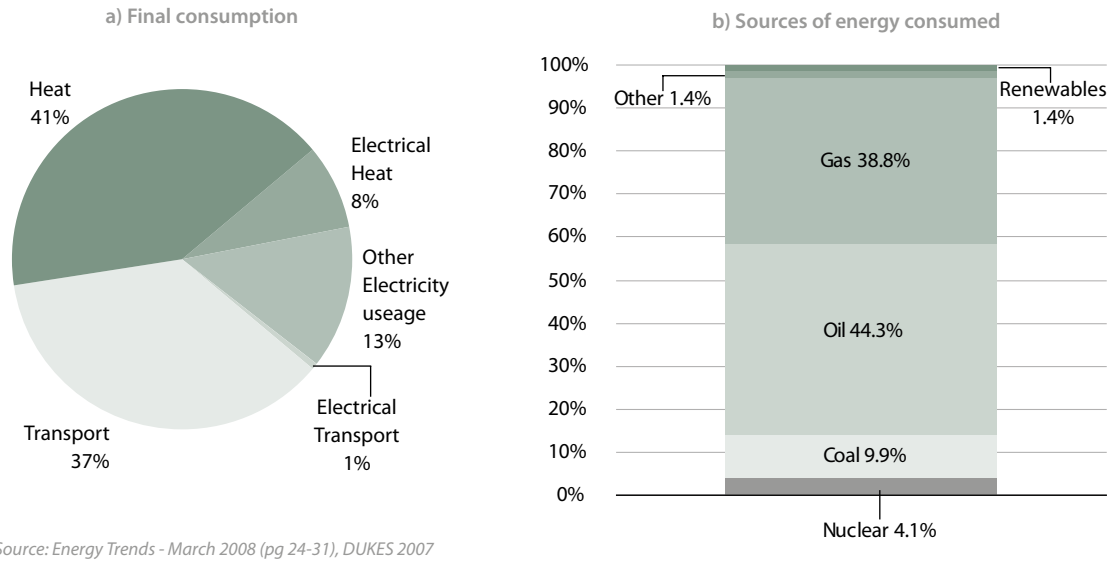
12 Finally, there are a number of **other policy areas and priorities** that might influence the growth of renewable energy in the UK, including planning, the balance or choice between low carbon and renewable energy, and the effect of specific policies that could affect the growth of renewables in the UK because of their potential to reduce carbon emissions – such as the EU ETS, the Climate Change Levy, obligations on energy suppliers, and the Carbon Reduction Commitment.

What is renewable energy?

Renewable energy contributes to four energy policy objectives

1.1 Energy is used to provide heat[1], for transport and to provide electricity – which is itself used for many purposes, such as appliances and lighting. **Figure 1a** shows that in the UK, most energy is consumed as heat, followed by transport and electricity. **Figure 1b** shows the sources of the energy consumed. Oil and gas are the primary sources of energy consumed – they are the main sources of energy for transport and heating respectively. Coal (37 per cent), gas (36 per cent) and nuclear (18 per cent) are the main sources of energy for electricity.[2] Only 1.4 per cent of energy consumed in the UK is from a renewable source.

1 Components of UK energy consumption and UK electricity generation, 2006



Source: Energy Trends - March 2008 (pg 24-31), DUKES 2007

NOTE

In Figure 1a, "electricity" is sub-divided to show the proportion of electricity that is used for heat and that used for transport. Energy policy usually focuses on electricity as a whole regardless of how that electricity is consumed.

1.2 Renewable energy is critical to achieving each of the Government's four energy policy objectives.[3] Increasing the proportion of energy supplied from renewable sources could:

- Reduce the use of fossil fuels, helping to combat **climate change**;
- Lead to more **secure energy supplies**;
- Allow the UK to be **competitive** in energy markets, as technologies develop and associated costs reduce; and
- In time, as renewable technology becomes cheaper and more readily available, contribute to ensuring that every home is adequately and **affordably heated**.

1.3 The purpose of this briefing is to set out the objectives in place for renewable energy in the UK, outline progress to date and the main policies in place to encourage renewable energy. This analysis forms the basis on which to suggest potential options for further Committee scrutiny. The rest of this Part sets out how renewable fit into the UK energy system, the nature of the targets in place, the five main sources of renewable energy and the associated renewable technologies available to supply energy for heat, electricity and transport.

Where do renewables fit in the UK energy system?

1.4 Figure 2 overleaf, overleaf, illustrates the structure of the UK energy system. Renewables tend to feed directly into the energy distribution grid to supply energy to the consumer, as do conventional sources; however renewables can also supply consumers directly at the micro-scale. For example, microgeneration (small-scale) technologies (which include small-scale renewables) allow consumers to supply their own electricity, and any excess can be sold to the grid network.

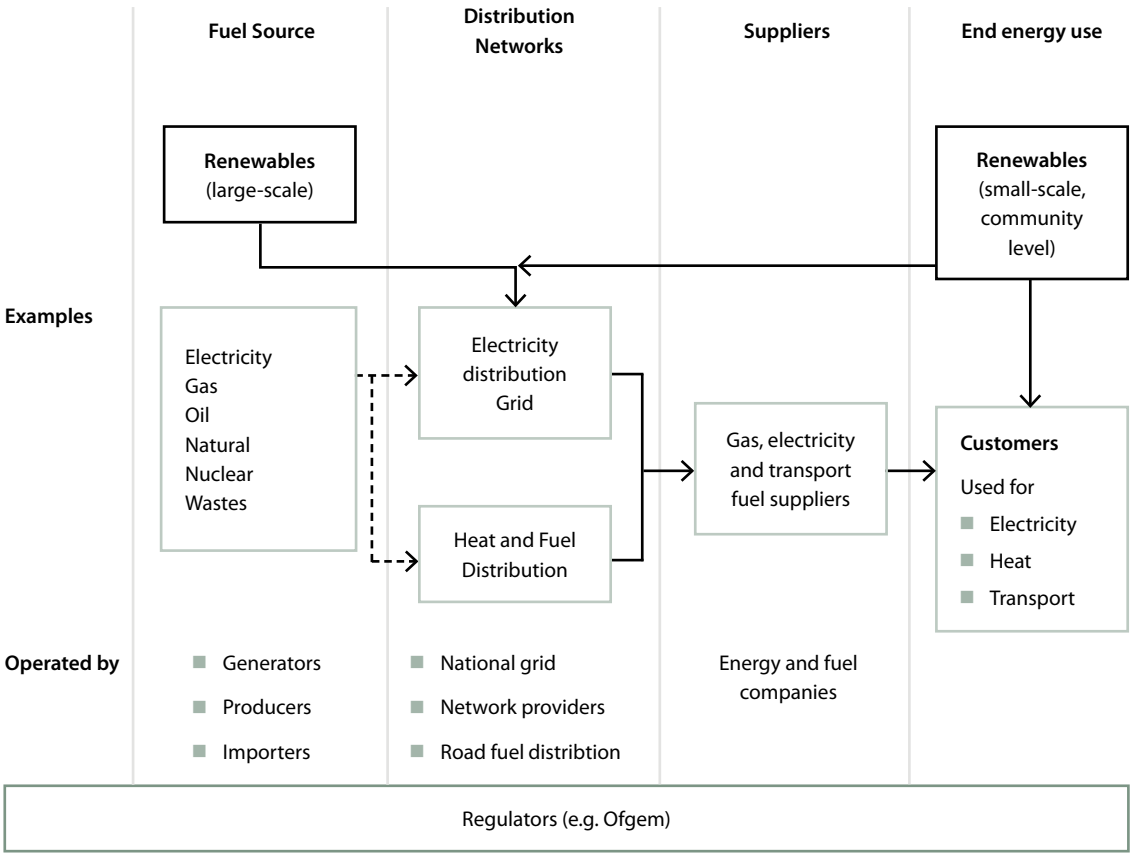
Targets have been set for renewable energy, electricity and transport, but not heat

1.5 There is a variety of objectives, ambitions and targets related to renewable energy generation and consumption in the UK, set at both the EU and UK level. The targets vary in their bases, whether they target energy as a whole or its end-user components (heat, transport and electricity), and whether the focus is on energy generation or consumption. The EU has set a series of EU-wide indicative targets[4], including the following:

- Energy consumption target – in 1997 the European Commission set a target for 12 per cent of energy consumption to be met from renewable sources by 2010;
- Electricity generation target – In 2001, the Renewables Directive[5] set indicative national targets for member states that if met would lead to renewables providing 21 per cent of EU-wide electricity generation by 2010; and
- Transport target – In 2003, the Renewable Transport Fuels Directive established indicative targets for 5.75 per cent of the energy content of petrol and diesel for transport to be accounted for by biofuels and other renewable fuels by 2010, with an interim target of 2 per cent by 2005.

The EU has set indicative[6] targets for the UK in each of these areas, to ensure the UK contributes sufficiently to the overall EU objectives. In addition, in 2007, the European Council set an EU-wide target for 20 per cent of energy consumption to be met from renewable sources by 2020 and proposed a directive which would make it mandatory for the UK to provide a fair share (currently proposed at 15 per cent) of its energy from renewable sources by 2020. This directive would also set a minimum for 10 per cent of road transport fuels to be met from a renewable source in the same time period. These EU targets for the UK are shown overleaf in **Figure 3 on page 9**, along with the UK's own domestic targets, which have been set for electricity and transport. No renewable energy targets have been set specifically related to heat, at either the EU or UK levels.[7]

2 Structure of the UK energy system



Source: National Audit Office

1.6 The bases of the domestic targets differ slightly to the EU-set targets for the UK:

- The EU's target for the UK to ensure 5.75 per cent of transport fuel comes from renewable sources by 2010, as well as the proposed 10 per cent by 2020 target, is set on the basis of energy content; the UK's domestic target is set at five per cent based on the volume of all fuel sold in the UK.[8]
- The EU-set indicative target for the UK to supply 10 per cent of renewable electricity by 2010 includes the impact of electricity imports as well as electricity generated in the UK. The UK's own 10 per cent renewables supply target for 2010 only includes electricity generated in the UK; the renewable proportion of imported electricity is counted in the country of generation.

1.7 The EU intends Member States to retain discretion as to how best to reach their overarching energy targets. Member States can choose the specific mix of renewables for energy from electricity, heat, and transport (subject to the minimums required by the transport and electricity targets), as well as the type of policy instruments used.

3 UK targets for renewable energy

Energy component and target	Source of target
Energy	
15 per cent share of renewables in UK final energy consumption by 2020 (proposed mandatory target)	EU (Proposed Renewable Energy Directive, 2008)
Transport	
5.75 per cent of energy content of petrol and diesel for transport to come from renewable sources by 31 December 2010 (indicative target)	EU (Biofuels Directive, 2003)[1]
10 per cent of UK consumption of energy in transport (petrol & diesel only) to come from renewables by 2020 (proposed mandatory target)	EU (Proposed Renewable Energy Directive, 2008)
5 per cent by volume of all road transport fuel sold in the UK to come from a renewable source by 2010-11	UK (Renewable Transport Fuels Obligation)[2]
Electricity	
10 per cent of electricity generation by 2010 to come from renewable sources (indicative target)	EU (EU Renewable Directive, 2001)
Renewables to provide 10 per cent of electricity generation by 2010	UK
Aspiration to double to 20 per cent by 2020	UK
15.4 per cent of electricity to be generated from eligible renewable sources by 2015-16	UK (Renewables Obligation)[3]

Source: BERR, Europa, DfT

NOTES

1 The EU Directive on the "Promotion of the Use of Biofuels or Other Renewable Fuels for Transport" is commonly known as the "Biofuels Directive".

2 The Renewable Transport Fuels Obligation (RTFO) is not technically a target but an obligation to supply a percentage of road transport fuels from eligible renewable sources or pay a financial penalty. It is covered in more detail at Part 3.

3 The Renewables Obligation (RO) is similar to the RTFO but applies to renewable electricity. It is also covered in more detail at Part 3. The RO target is not directly comparable to the other renewable electricity targets as not all renewable sources of electricity are eligible for the RO.

There are five energy sources which can generate renewable energy

1.8 The Department for Business Enterprise and Regulatory Reform (BERR) and the EU define renewable energy as energy produced from one of the following five renewable, non-fossil energy sources: wind, solar, geothermal, water (wave, tidal or hydropower) and biomass (landfill gas, sewage treatment plant gas and biogases).[9] The five sources of renewable energy; the key technologies available to exploit them and the type of energy consumption they can supply energy for, are summarised in **Figure 4 overleaf**. The technologies used for each of the three types of energy consumption (heat, transport and electricity) are then discussed from a UK perspective.

4 Sources of renewable energy

Source	Description of technology	Supplies renewable energy for		
		Heat	Transport	Electricity
Biomass *(Provided the sources, such as forests, are managed sustainably)*	Biomass is organic material derived either directly from plants or from secondary products or waste. Biomass can be: ● Used to generate **biogas**, usually from landfill, sewage or anaerobic digestion; or	✔		✔
	● Processed into **biofuels** which can be used in transport.		✔	
Water	**Hydro-electricity** is the generation of electricity by the movement of water (usually a dammed river). The energy is captured by means of waterwheels or hydraulic turbines placed in the way of the falling or flowing water.			✔
	Tidal power uses the tide to generate electricity by placing turbines in the tidal stream or by building barrages or lagoons.			✔
	Wave power can be generated by placing buoys in the waves' path. The movement of the buoys generates the power.			✔
Wind	**Turbines** which are rotated by the wind can be used to generate electricity. The size of turbines can vary from small single turbines mounted on the roof of a house to single large turbines and wind farms.			✔
	Turbines can also be built offshore on the seabed.			✔
Solar	Electricity can be generated using **solar photovoltaic cells** (PV) to convert sunlight directly into electricity.			✔
	Heating of air and water can also be achieved by the use of focussed solar energy. This can be used to heat air or water for buildings or as part of a concentrated solar power (CSP) plant to generate electricity.	✔		✔
Geothermal	Heat is stored beneath the Earth's surface in the form of hot water or steam. Where the source is very hot, it can be used to generate electricity or if it is at a lower temperature, it can be used directly as heat.	✔		✔
	Heat stored in the ground can also be used on a smaller scale using a **ground source heat pump** to draw out the heat.	✔		

Source: National Audit Office using BERR information

Renewable heat

1.9 In the UK, the policy aim for renewable heat technologies is to deploy those that have been proven to work. This is happening at varying rates and on different scales. The main technologies that BERR believes currently have the greatest technical potential include:

- Biomass – conventional biomass from plants can be used in boilers or stoves or at larger scales, including Combined Heat and Power (CHP) (see paragraph 1.15, opposite, for explanation). Biomass in the form of waste can also be used to generate heat through direct combustion (as above) or via advanced processes which produce combustible biogas. This biogas can be burnt locally to generate heat or potentially, after processing, injected into the gas grid as bio-methane.
- Solar and Geothermal – these are mainly used on a small scale for the microgeneration of heat. The technologies include those such as solar thermal for space heating or hot water and air or ground source heat pumps.

1.10 Even though these technologies will reduce carbon emissions, the energy produced may not be totally renewable. For example, biomass must usually be transported to combustion plants, and waste is not entirely made up of biomass (for example it includes plastics and metal), and therefore only a percentage of it can be classed as renewable heat. Also, some microgeneration technologies such as heat pumps require an input of electricity which may not be generated from renewable sources. The difference between low carbon and renewable energy is discussed at paragraph 1.14 below.

Renewable transport

1.11 The major source of renewable energy for transport in the UK is biofuels, which can be mixed with standard fuel and burnt in a combustion engine. Bioethanol can be added to petrol and is created by fermentation of sugar or starch crops such as wheat and corn. Biodiesel can be used as a diesel additive and is created from crops which naturally produce oils such as palm oil and rapeseed oil. There is also the technological potential to create new types of biofuels from waste biomass and algae.

1.12 There are a number of other sources of energy for vehicles in development such as entirely electric cars and hydrogen powered cars. However, strictly, for these sources to be classified as renewable, the electricity used, either to power the car or create the hydrogen, must itself be derived from a renewable source.

Renewable electricity

1.13 The UK supports the deployment of eleven types of renewable electricity generation technologies via the Renewables Obligation, the main policy used to drive growth of renewables to supply electricity (discussed at Part 3). These include biomass sources, such as biomass for combustion and co-firing[10], and biogas from anaerobic digestion, landfill and sewage. Hydro, tidal, wave, solar photovoltaic cells and geothermal power are all supported as are wind technologies for both onshore and offshore generation.

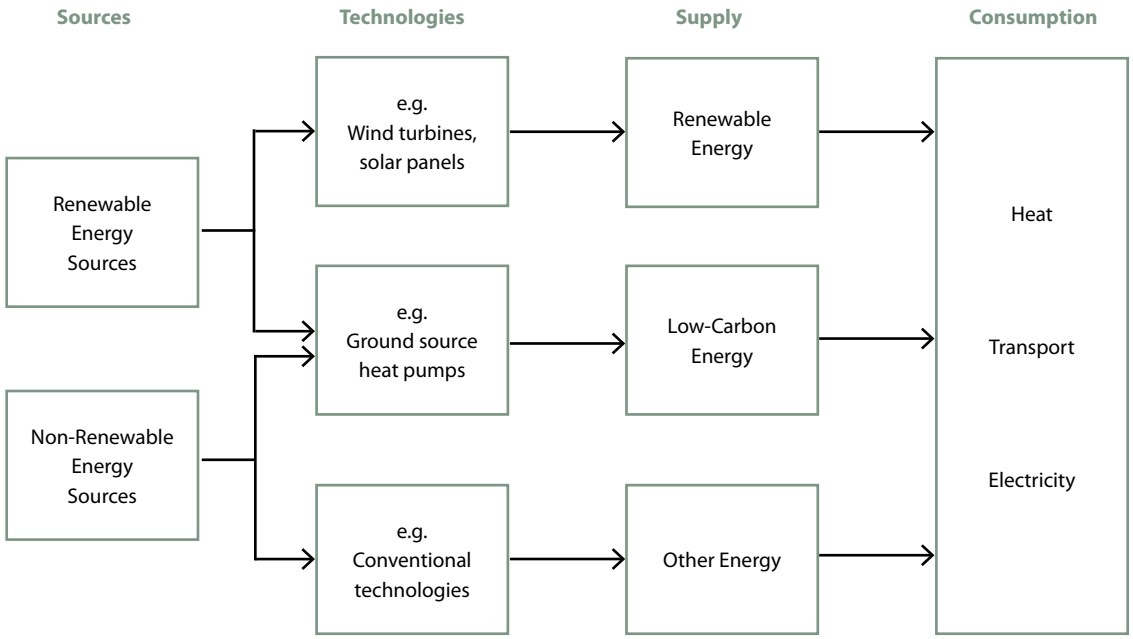
The difference between energy efficiency, low carbon energy and renewable energy

1.14 **Figure 5 overleaf** shows the links between energy sources, energy technologies, energy supply and consumption, and the difference between low carbon and renewable energy supplies. There are renewable sources of energy, for example wind and wave; and non-renewable sources such as coal, oil and gas. Non-renewable sources can generate energy with reduced carbon emissions through the use of new technologies, for example carbon capture and storage and combined heat and power. Renewable sources can be turned into renewable energy with appropriate technology, such as wind turbines, but in some cases the technology merely provides energy with lower carbon emissions. For example, ground source heat pumps extract heat from the ground, a renewable source, but require electricity which is not necessarily from a renewable source.

Most combined heat and power systems increase energy efficiency but are not renewable

1.15 Combined Heat and Power (CHP) involves the use of a power plant to generate both electricity and useful heat simultaneously. Conventional power plants generate heat as a by-product which is wasted; in a CHP plant, this heat is captured and used for heating purposes near the plant or distributed to local (as transportation of heat can be difficult over long distances) industrial and domestic properties. The majority of energy produced by CHP plants (77 per cent in 2006) is generated using fossil fuels.[11] As such, these plants are not classified as producing renewable energy despite the increased efficiency of the plant reducing overall emissions. A small number of plants are powered by biomass or industrial and municipal waste (a part of which will be biomass and therefore renewable).

5 Flowchart of energy source to consumption



Source: National Audit Office

Some technologies are low carbon but are not renewable

1.16 There are energy technologies which, whilst they will lower carbon emissions if brought into use, are not strictly renewable due to the original source of the energy and are therefore excluded from this briefing. These technologies include nuclear power generation[12] and carbon capture and storage.

1.17 However, it is worth noting that some energy policies and grants often associated with renewable energy do support these technologies. For example, the Hydrogen, Fuel Cells and Carbon Abatement Technologies Programme makes grants for the development and demonstration of technologies which could reduce emissions but would not be classed as renewable technologies unless both the energy source and electricity supply are derived from a renewable source.

Progress to date and barriers to development

2.1 This Part sets out the current status of renewable energy in the UK and progress made to date towards the various renewable targets set for energy, transport and electricity as shown at Figure 3. It then sets out the projections for future growth in renewable energy and the nature of the barriers to growth.

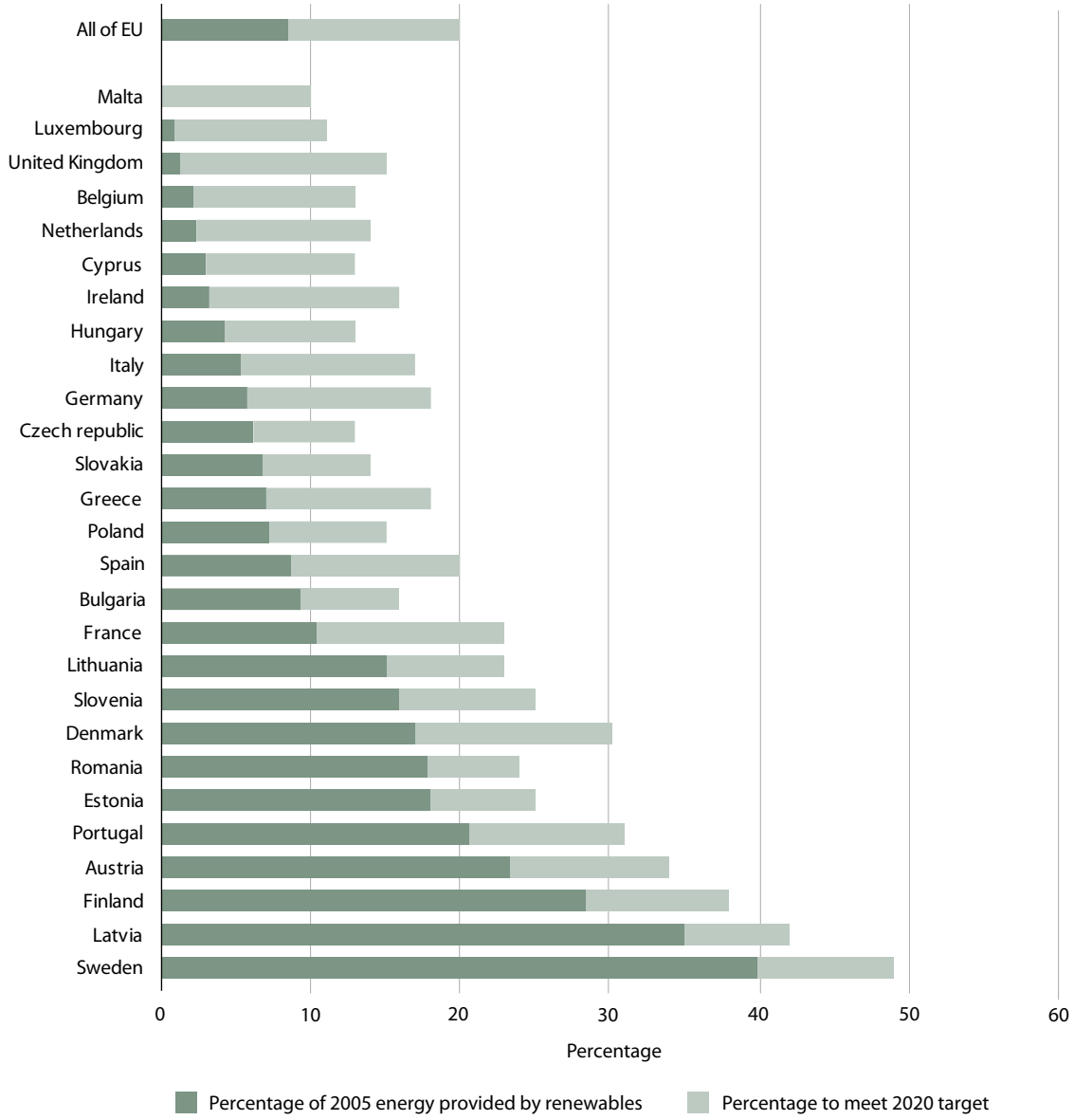
Progress to date is limited; the UK has a long way to go to meet its targets

The UK will have to work harder than most EU member states to meet its renewable energy consumption target

2.2 **Figure 6 overleaf** shows the proportion of energy consumption provided by renewable sources in 2005 in each of the EU member states, and the additional percentage required in order to meet the proposed 2020 energy consumption targets. The UK currently has one of the lowest proportions of energy consumption supplied by renewables in Europe[13], ranking 25th of all EU Member States and lagging behind the EU-wide level. It faces one of the biggest challenges if it is to meet the proposed renewables target of 15 per cent by 2020. The UK must increase its renewable energy sources by over elevenfold to meet the energy consumption targets; the only other countries with proportionately more work to do to meet their targets are Luxembourg and Malta. The Nordic states of Sweden and Finland as well as Latvia and Austria currently source the highest proportions of their energy consumption from renewable sources. Sweden, Latvia and Austria do this using large scale hydro electricity and Finland uses both large scale hydro and solid biomass.[14]

2.3 Currently the majority of renewable energy consumed is renewable electricity rather than heat or transport, as can be seen in **Figure 7 on page 15**. The proposed 15 per cent renewable energy consumption by 2020 target does not require 15 per cent of energy consumption for each of electricity, heat and transport to be supplied by renewables. A lower percentage in one area will require a higher percentage in another to compensate. Any shortfall in heat and transport would result in a proportionally larger percentage being need from electricity, because electricity makes up only 22 per cent of energy consumption (see Figure 1a, Paragraph 1.1). For example, recent analysis conducted for BERR, shown in **Figure 8 on page 15**, suggests that if only 10 per cent of heat and transport were sourced from renewable energy in 2020, around 38 per cent of electricity would need to be sourced from renewable sources in order to meet the 15 per cent target. As it is expected to be significantly harder to reach 15 per cent in heat and transport, the UK's target for renewable electricity by 2020 will need to be set considerably higher than 20 per cent to ensure the EU energy target is met.

6 Percentage of renewable energy in final energy consumption in 2005 and amount needed to meet the 2020 EU target

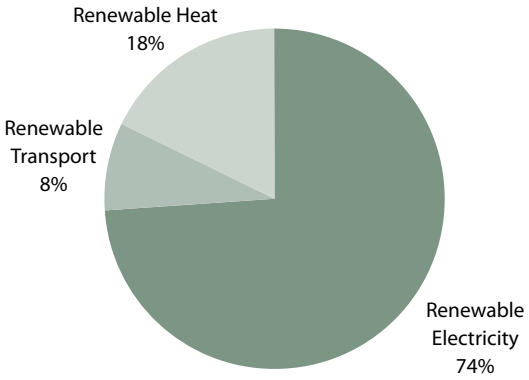


Source: DG-TREN and EuroStat

NOTE

The 'All of EU' figure is the overall percentage of energy consumption provided by renewable energy within the EU and the associated target rather than the average of the EU states. This shows that to meet the target, the proportion of energy consumption provided by renewables within the EU must more than double, from 8.5 per cent in 2005, to 20 per cent by 2020.

7 Renewable energy consumption, 2006



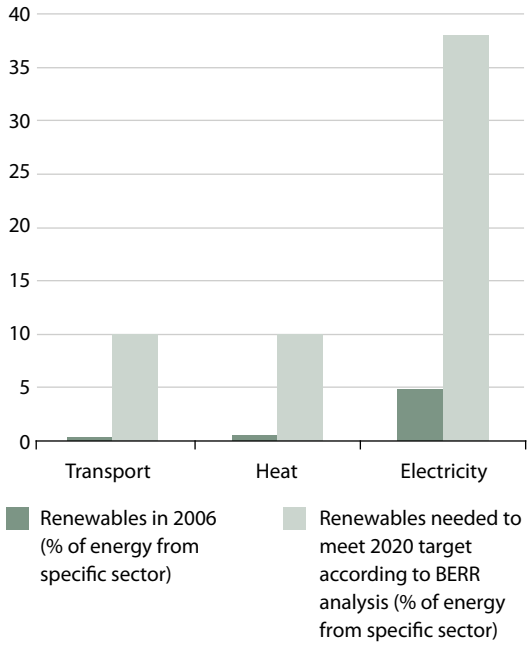
Source: BERR, Energy Trends – March 2008

NOTE

2006 was the first year for which these calculations were performed on the basis used for the EU 2020 renewables target and published in Energy Trends in March 2008. Comparatives for 2005 were also included which were four percent, 20 per cent and 77 per cent for renewable transport, heat and electricity respectively.

8 A scenario from BERR analysis for meeting the 15 per cent renewables consumption target by 2020

Percentage of consumed energy from renewables, by consumption type



Source: BERR analysis for the POYRY report, Energy Trends – March 2008

Only a very small percentage of heat consumed in the UK is generated from renewable sources

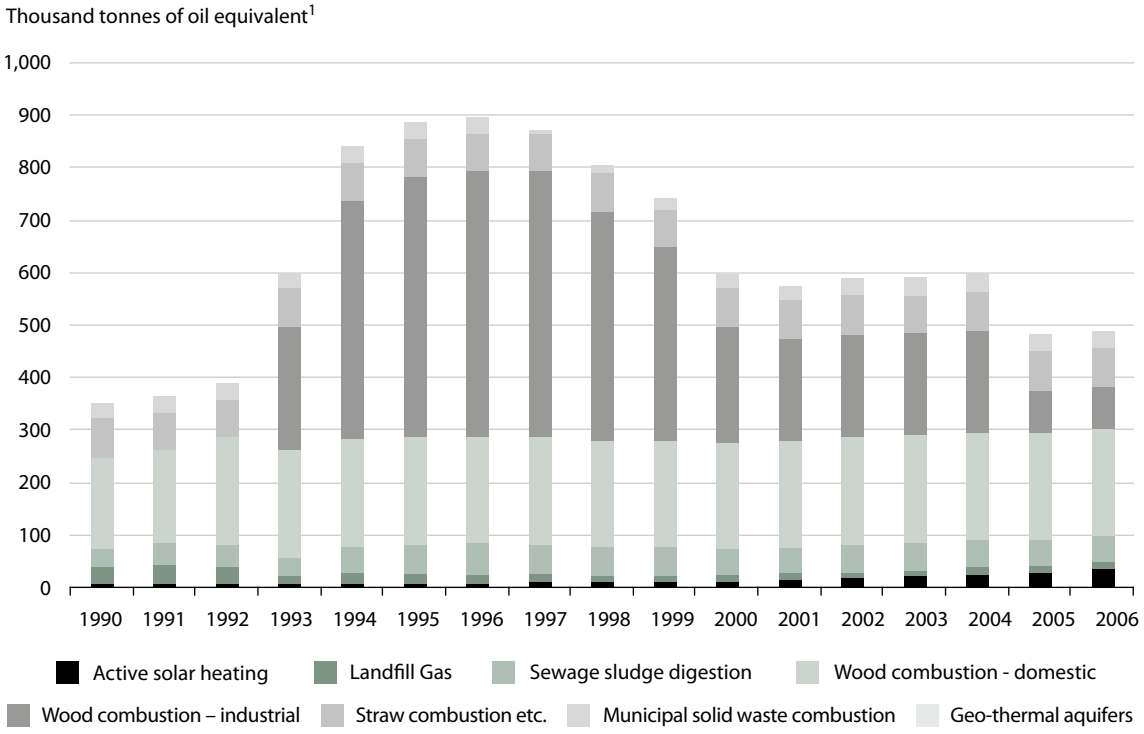
2.4 As outlined in Part 1, there are no renewable energy targets set specifically for heat. At present (2006) the amount of heat generated from renewable sources (renewable heat) in the UK is very low, at 0.6 per cent[15], as shown in Figure 8.

2.5 **Figure 9 on page 16** shows the amount of heat generated from renewable sources from 1990 to 2006. Figures for renewable heat are less accurate than those for transport and electricity[16] and so should be viewed as an indication of the level of renewable heat rather than an exact measure. The level of heat generation from most renewable sources has stayed fairly constant – the main exception being wood burning by industry. Active solar heating has increased almost six-fold over the time period but still makes up a small percentage of the total. The overall level of renewable heat generation peaked in 1996 when over 56 per cent was generated through industrial wood combustion. Since this point, the total level of renewable heat generation has declined, chiefly due to the adoption of the UK's first air quality strategy in 1997 which discouraged on-site burning of industrial waste wood. The source producing the most renewable heat in 2006 was domestic wood combustion.

Rapid progress is needed to meet targets for renewable transport

2.6 The UK has a long way to go to meet its renewable transport targets. **Figure 10 on page 16** shows the progress against both the UK RTFO target and the indicative EU targets for renewable sources of road transport fuels by 2010. The two targets are on a different basis, with the EU target based on energy content and the UK RTFO target on volume sold. In 2006 the UK used 0.54 per cent of road transport biofuels by volume and 0.45 per cent by energy content.[17] To meet the RTFO target, the proportion of renewable fuels by volume will need to increase fivefold; and to meet the EU target the proportion of renewable fuels by energy content will need to increase almost sevenfold. For progress reporting to the European Commission, conversion

9 Renewable heat sources 1990-2006



Source: Digest of UK Energy Statistics 7.1.1

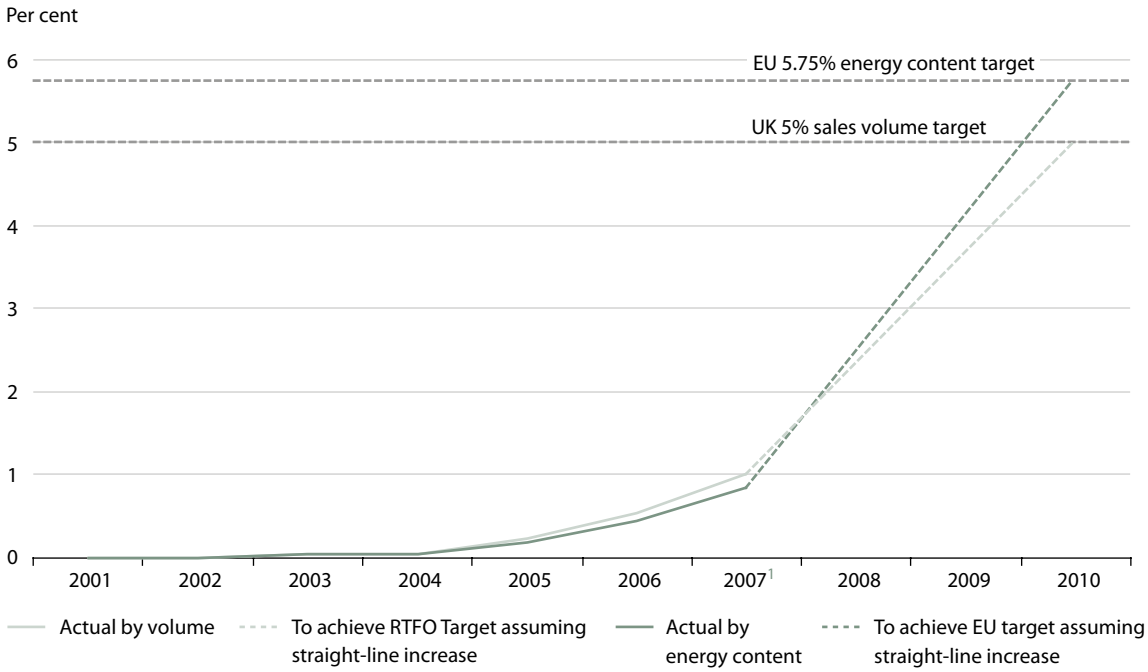
NOTE

1 For an explanation of the units used see the appendix.

factors are used to convert fuel volume to energy; these factors vary according to the energy content of the fuel. Due to the difference in energy content of bioethanol and biodiesel,[18] a change in the mix of biofuels sold will affect the difference between the energy percentage and the volume percentage. Biodiesel has a higher energy content than bioethanol, so an increase in the volume of biodiesel sold would increase total biofuel energy content more than an equivalent increase in bioethanol.

2.7 Figure 11 shows the progress to date in increasing the amount of renewable fuels sold for road transport in the UK against the UK target of five per cent by 2010. The two significant renewable fuels are bioethanol, an additive for petrol, and biodiesel which can be used as a fuel on its own or blended with regular diesel. The levels of biodiesel and bioethanol sales first became significant in 2002 and 2005 respectively. This followed the introduction of a 20p per litre duty incentive for biodiesel in 2002 followed by the same duty incentive for bioethanol in 2005 (see Part 3 for details). Biodiesel sales increased by over 400 per cent between 2005 and 2006 and subsequently doubled in 2007. DfT state that this is probably due to the effect of the duty incentive introduced in 2002 leading to increased production capacity, together with the announcement of the RTFO in 2005 which gave investors and producers more confidence in the future of a biodiesel market in the UK.

10 Percentage of UK road transport fuels supplied by biofuels by volume and energy content

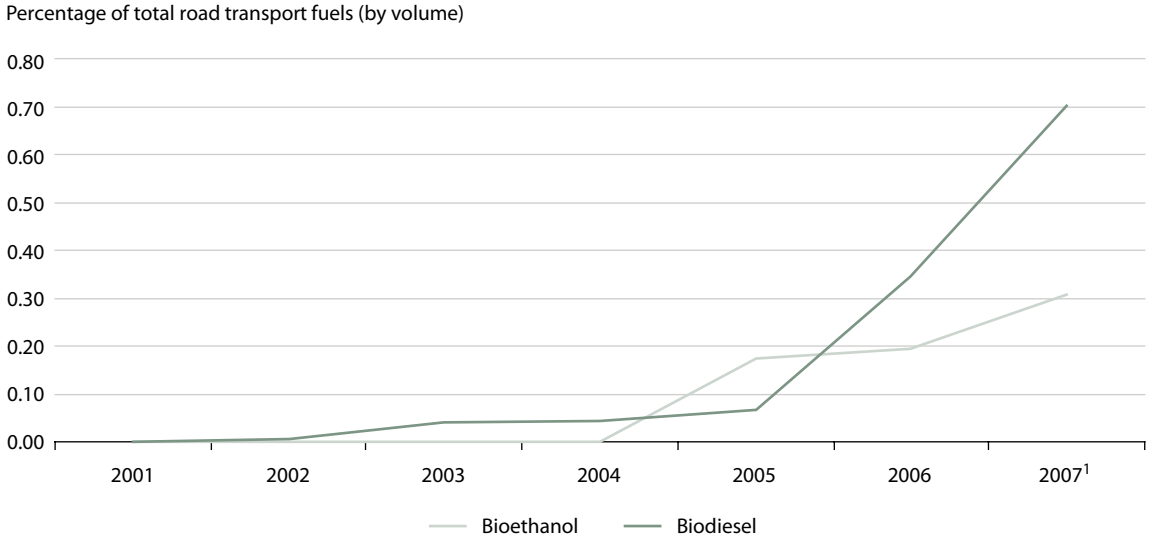


Source: UK Trade Info – Hydrocarbon Oils Duties Bulletin

NOTE

1 Provisional figures.

11 Volumes of UK biofuel sales as a percentage of total road transport fuels



Source: UK Trade Info – Hydrocarbon Oils Duties Bulletin

NOTE

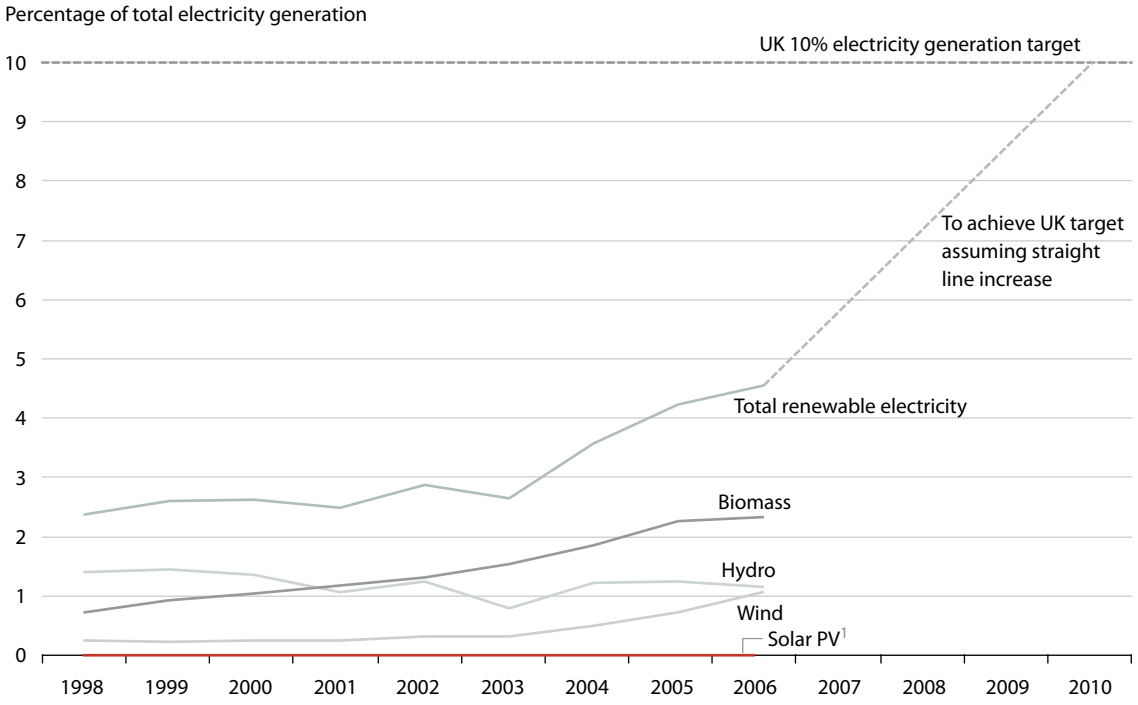
1 Provisional figures.

The UK must more than double its renewable electricity supply by 2010 to reach its target

2.8 The Government has set a target that 10 per cent of the UK's electricity supply should come from renewable energy sources by 2010, with an aspiration to double that by 2020.[19] **Figure 12** shows that in 2006, just 4.6 per cent[20] of the UK's electricity generation came from renewable sources, suggesting the UK must more than double its renewable electricity generation over the next two and a half years to reach this target. Figure 12 also shows the proportion of electricity generated by different renewable energy technologies. The percentage of electricity from renewable sources has generally increased since 2001, which aligns with the introduction of the Renewables Obligation. This policy took effect in April 2002 and required all energy providers to source a specified and increasing percentage of their energy from renewable sources. The decrease in total renewable electricity in 2003 was due to a reduction in the generation from hydro, caused by the particularly dry weather reducing water flow.[21] In 2006, a quarter of the renewable electricity supplied came from hydro sources, 23 per cent from wind, 24 per cent from landfill gas, 14 per cent from co-firing, and 13 per cent from other biomass.[22]

2.9 The biggest increases in renewable electricity generation since 1998 have been for wind and biomass. Generation from these sources has been further analysed by technology in **Figure 13**. In biomass the main increases have been in landfill gas and co-firing. These are the most mature and cost-effective biomass technologies. As the cost effectiveness and profitability of onshore wind has been improving, the use of onshore wind has increased significantly, almost tripling between 2003 and 2006. The first sizable offshore wind farm became operational in 2003 with further similar sized farms becoming operational at the rate of one a year between 2004 and 2007.[23]

12 UK Electricity generation from renewable sources



Source: Digest of UK Energy Staistics 07 Table 7.4

NOTE

1 Solar PV generation is measurable but very small. In 2006 it formed 0.002 per cent of electricity generation.

Forecasts suggest that on the basis of current policies key targets will be missed

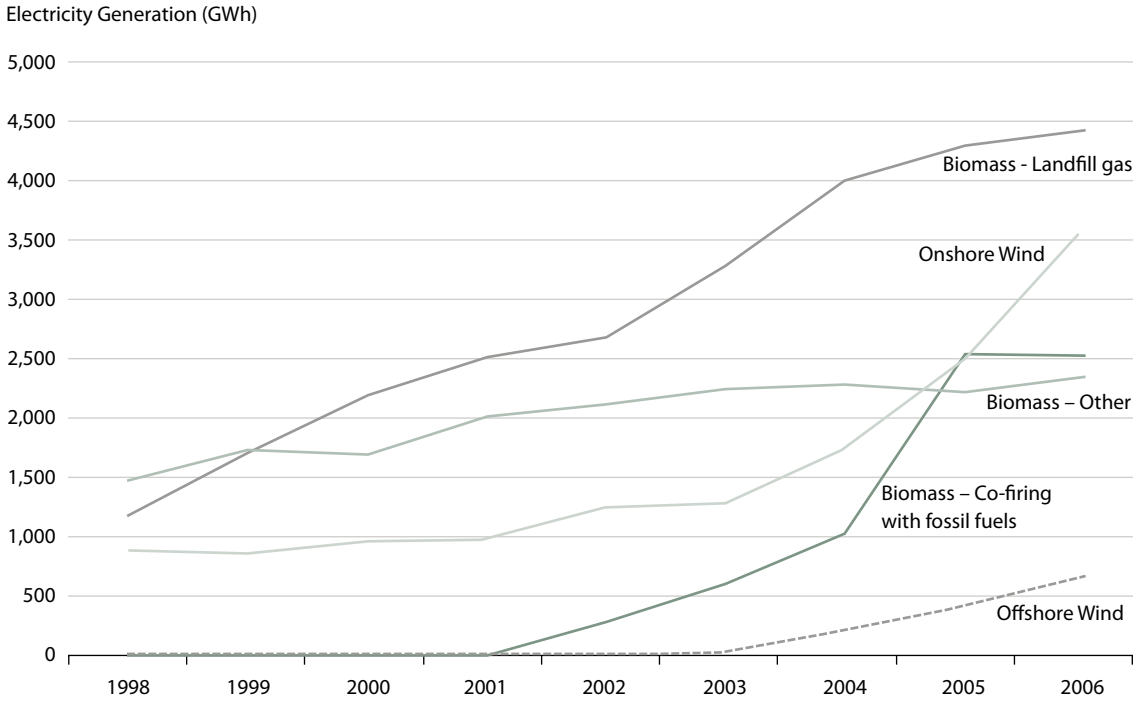
2.10 Government and wider forecasts predict that the UK will fail to meet its renewable electricity generation target of 10 per cent by 2010, although estimates suggest the 20 per cent by 2020 target could be met, provided demand continues to grow and fossil fuel prices remain high. Although the proportion of renewable heat could be increased, forecasts suggest the UK's 2020 15 per cent renewable energy consumption target will be missed by a wide margin. However, the Government's current consultation on its renewable strategy contains new proposals for increasing renewable energy use to meet the target of 15 per cent renewable energy by 2020.

Government forecasts

2.11 BERR published its Energy Markets Outlook in October 2007. This included a section on "Renewable and low carbon energy" which provided forecasts for renewable electricity and renewable heat but not for renewable transport or renewable energy as a whole.

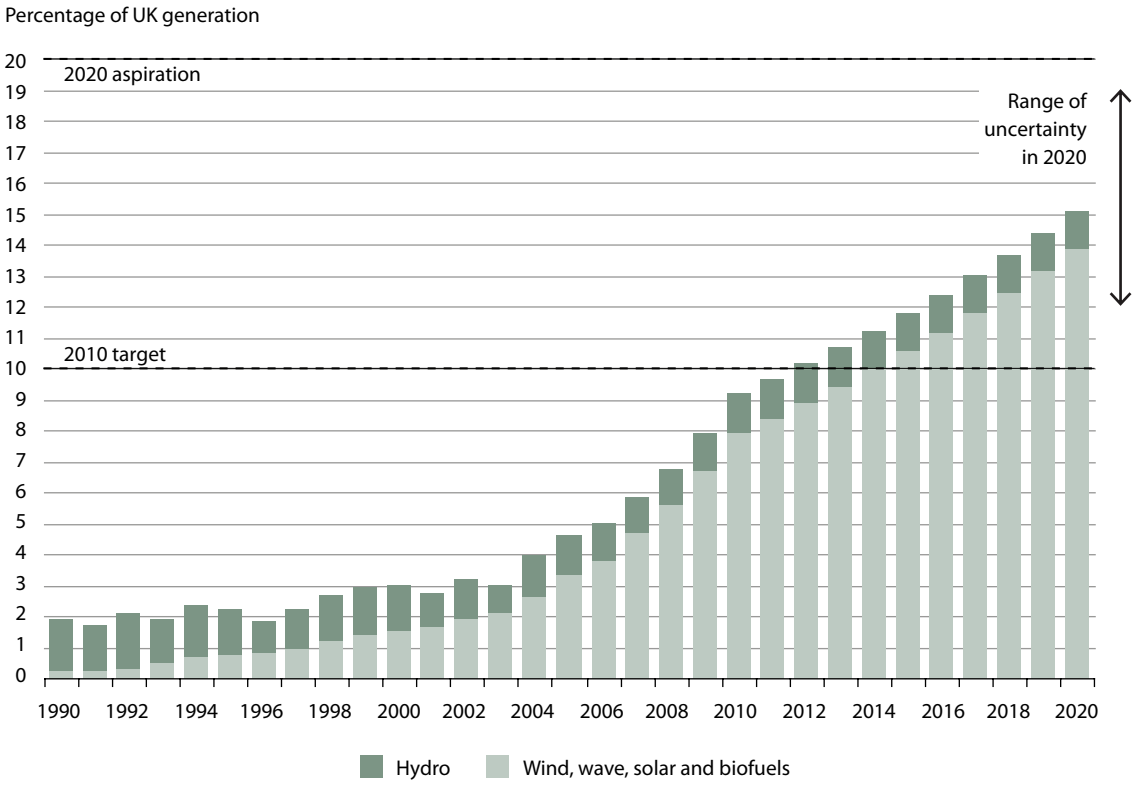
- **Renewable electricity forecasts –** the report showed expected progress towards the aspiration of 20 per cent of electricity generation from renewable sources by 2020. It used the projections from the 2007 Energy White Paper's supporting document, Updated Energy and Carbon Emissions Projections, May 2007. The path to 2020, using central carbon saving assumptions and under current policies, is shown in **Figure 14 overleaf**. The range is given in 2020 for forecasts based on low and high carbon saving estimates. The results suggest the UK will fall just short of its 2010 target, and short of its 2020 aspiration.

13 Wind and biomass generation – by technology



Source: Digest of UK Energy Statistics 2007

14 Projected growth in proportion of electricity generation from renewable sources,1990-2020



Source: Energy Markets Outlook 2007 - BERR

- **Renewable heat forecasts –** the report predicts that although less than one per cent of UK heat demand is at present supplied from renewable sources, there is potential to increase this proportion to between five per cent and 12 per cent, according to an Ernst & Young report for BERR.[24] This could be achieved through biomass heating, solar thermal and ground source heat pumps, and biogas from the energy from waste sector.

Cambridge Econometrics forecasts

2.12 Cambridge Econometrics publishes "UK Energy and the Environment" every six months which contains detailed forecasts of energy demand by fuel user and fuel type, to the year 2020. The projections take into account the latest policy measures as well as the proposed banding of the Renewables Obligation (described in Part 3). The figures are more recent than the BERR projections and use different assumptions. The report includes projections for both electricity and renewable energy as a whole, which can be used to assess progress towards targets.

- **Renewable electricity forecasts –** Like BERR's own forecasts, the latest projections, from March 2008[25] suggest that the 2010 target will be missed. Unlike BERR's forecast, Cambridge Econometrics suggests the 2020 aspiration of 20 per cent of electricity from renewables will be met. It is projected that renewables will account for around six per cent of electricity consumption by 2010, short of the ten per cent target. However on the present assumption that electricity demand grows at around 0.5 per cent per annum from 2010-2020 and that fossil fuel prices remain relatively high, the share of renewables in final electricity demand is expected

to increase to around 14.25 per cent by 2015, just short of the 15 per cent target set by the RO, but reach 21.75 per cent by 2020, meeting the Government's aspirations of a 20 per cent share.

- **Renewable energy forecasts –** the forecasts suggest that the European Commission target of a 15 per cent contribution of renewable energy to the UK's overall final energy needs by 2020 is, on the basis of current policies, likely to be missed by a wide margin. The share of renewable energy in final energy consumption is expected to rise from the current level to 2 per cent in 2010, 3.5 per cent in 2015 and reach just 4.75 per cent by 2020.

Deployment barriers, rather than natural limits, are likely to be the limiting factor in the growth of renewable energy

2.13 Attempts, by BERR and in academic literature, have been made to explore the scope for renewable energy to displace non-renewable sources, and whether there are any natural limits to renewable sources. A consistent conclusion is that the UK has a high level of resource available for renewable electricity generation, particularly from offshore wind, wave and tidal stream.

2.14 **Figure 15 overleaf** shows the estimated resource available in TWh/year from two different models used by BERR in their Energy Markets Outlook report in October 2007. These estimates do not include a number of electricity sources, including hydropower and solar power. Hydropower was excluded as it was regarded as a mature technology with few additional sites available for large scale generation. Solar is not included, as bulk electricity from solar was not regarded as likely in the UK climate.

2.15 The common conclusion is that in the medium term the more important constraining factor on the generation of electricity from renewables will be deployment barriers, outlined in **Figure 16 on page 23**, rather than resource constraints. The models also conclude that in the best case, renewables could provide for all of the UK's electricity demands.

2.16 There are number of other studies that estimate natural resources for renewable energy, although most focus on one type of technology. As with the figures above, there are significant differences between reports. This is due to the differing assumptions made for each report and whether they are attempting to estimate the total resource, the resource that could be practically extracted at any cost, or only that resource that could be economically exploited. For example, a Tyndall Centre report[26] includes estimates of practical onshore wind resource at 58 TWh/yr, but after taking into account the capacity of the electricity network, this drops to 8 TWh/yr. (See Appendix for explanation of units).

2.17 Other studies also provide figures for solar and hydropower, estimating that building-integrated photovoltaics have a maximum resource estimate of 266 TWh/yr, with a practical potential of 37 TWh/yr[27], and that hydroelectric resource is 40 TWh/yr, with practical resource of 4–4.9 TWh/yr at large-scale (mostly in Scotland) and a maximum potential of 5.79 TWh/yr.[28]

2.18 As well as natural limits, there are other generic barriers to the deployment of renewable energy; examples of these are described in Figure 16 on page 23.

15 Estimates of resource available for renewable electricity generation, as used by BERR

Resource	Enviros estimate	Green-X estimate	Constraints on available resource
Offshore wind	1,000TWh	67 TWh	Available sites that are practical – depth of water a limiting factor.
Wave, Tidal Stream and Tidal Barrages	104 TWh	59TWh	Limits to how much wave power is practically accessible.
Onshore wind	40TWh	40TWh	Number of sufficiently windy sites.
Landfill	10-12 TWh	4.7 TWh	Constraints on number of landfill sites. Only a certain proportion covered by EU directive – others – older sites and smaller sites more costly.
Biomass	3 TWh	1.6 TWh	Constraints from the amount of available biomass.
Co-firing	3.5 TWh		Maximum proportion biomass (by heat input) that can be co-fired without impacting generating capacity is 5 per cent.
Sewage gas	0.3 TWh	1 TWh	Limit on the amount of gas available.
Total	**1,160 TWh**	**173 TWh**	
Percentage of demand in 2006-07	**330 per cent**	**50 per cent**	

Source: BERR, Energy Markets Outlook 2007, BERR synthesis of work by consultants Enviros and the Green-X-model of the European electricity market

16 Deployment barriers to renewable energy

Barrier	Description
Intermittency of supply	Renewable sources often produce energy intermittently (e.g. wind power). It is argued that as such, they are not suited as a baseload power source, one whose output is constant, which are a vital part of the UK electricity network.
Supply chain	Some renewable technologies suffer from issues with their supply chain. This can include supply of the parts and equipment for the energy generation technology, manpower with specialised skills, and the technologies needed for installation – for example special ships which have legs that drop into the sea-bed to provide a stable platform to install offshore wind turbines.
Technological	In some cases, difficulties in making theoretical technologies practical can be a barrier. For example, the technology for fuel cells and solar photovoltaics is proven but making them practical to deploy on a large scale has not been accomplished. Further technological developments are needed to make them efficient enough and cost-effective enough to deploy on a large scale.
Cost and lack of financial support	Different renewables energy technologies have very varied costs and receive different levels of support. For example, whilst renewable electricity and transport are financially supported through specific policy measures[1], support for renewable heat technologies is limited. Different technologies also receive relatively different levels of support compared to their cost. Renewable energy is also at this stage generally expensive relative to other fuel sources.
Regulatory	There is a variety of potential barriers, such as planning permission requirements for the majority of renewable technologies. EU directives may also require an Environmental Impact Assessment (EIA) and/or a Strategic Environmental Assessment (SEA) before approval.
Grid connections	Renewable energy generators currently bear the cost of grid connections. Renewable sources can be comparatively small and are often remote, so the cost of connection is considerable. The increased use of distributed energy will affect the grid network, with more flexibility and monitoring needed. The timing of availability of grid connections could also be a limiting factor for provision of renewable energy to the grid.
Public opinion	Public opinion, particularly through vocal action groups and objections to planning applications, can affect the deployment of renewables. It is unclear whether the public appreciates the scale of the targets for deployment of renewables. There are also public concerns of the aesthetics and safety of renewable sources despite surveys revealing that 83 per cent of the general public support the use of renewable energy and, for example, that 59 per cent would be happy to live within 5km of a wind power development.[2]
Land/sea area required	The physical space which will be needed to deploy renewables is substantial. Damming of rivers for hydroelectricity affects large areas, as does the installation of wind farms, both onshore and offshore. The growth of biofuels could also lead to a significant increase in the use of land for growing crops. Alternatively their growth could displace food crops due to limited land area.
Conflict with other environmental objectives	The development of renewable energy can be inconsistent with other environmental objectives. For example, the proposed Severn barrier has been criticised for potentially endangering biodiversity and wildlife habitats and the London Array offshore windfarm has had to address concerns over its effects on birdlife and sea life.
Other Departmental objectives	In some cases these could conflict with renewable energy targets and distribution/deployment aspirations. For example, the MoD recently highlighted potential radar interference issues associated with windfarms.

Source: National Audit Office, based on BERR, and Ofgem information

NOTES

1 The Renewables Obligation (RO) and Renewable Transport Fuel Obligation (RTFO), are discussed in Part 3.

2 GfK NOP Social Research for BERR, Renewable Energy Awareness And Attitudes Research, 2007, http://www.berr.gov.uk/files/file41239.pdf.

Government policy on renewable energy

Responsibility and accountability

3.1 BERR sets the Government's renewable energy policy but shares responsibility with a number of other bodies:

- The Department for Environment Food and Rural Affairs (Defra) shares joint responsibility with BERR for the Domestic Environmental Transformation Fund which has brought together Defra's and BERR's existing low carbon technology funding programmes. It also produced the UK CHP strategy, the UK Biomass strategy and the Energy Efficiency plan;
- The Department for Innovation Universities and Skills (DIUS) has overall responsibility for innovation policy and the development and funding of science and research base across the UK;
- The Treasury (HMT) is responsible for tax and duty incentives;
- The Department for Transport (DfT) is responsible for renewable transport; and
- Devolved administrations and local authorities also have a role to play in renewable energy policy where energy policy has been devolved and in planning matters.

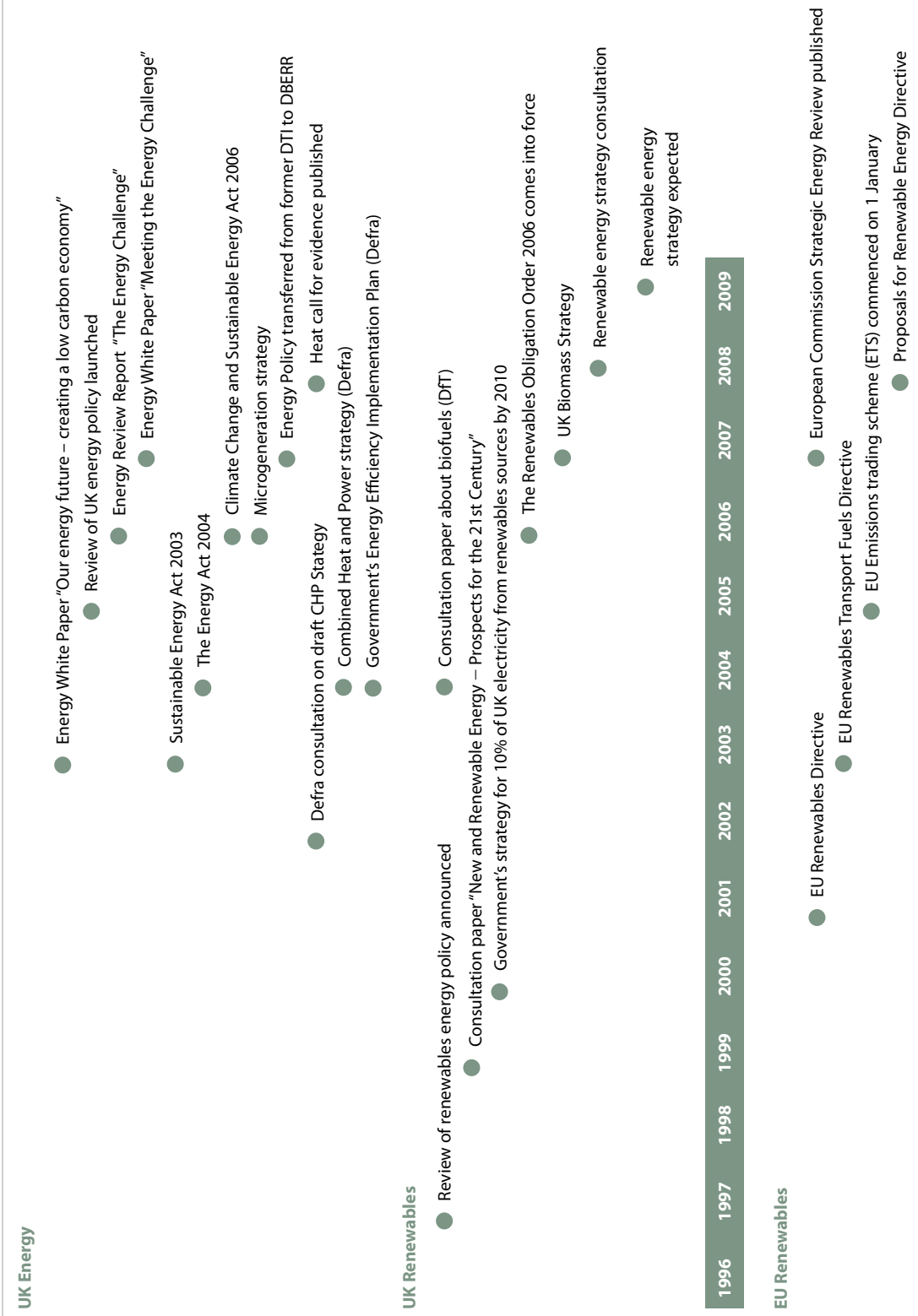
Overview of the main strategies, policies and developments

3.2 **Figure 17** is a timeline of the key energy policy strategies and reviews.[29] There have been a number of comprehensive reviews of UK energy policy leading to White Papers in 2003 and 2007, as well as strategies for specific renewable sources and technologies such as microgeneration, biomass and CHP. To date there has not been an overarching renewable energy strategy covering all sources and uses (heat, electricity and transport), but one is planned for 2009, and is currently being consulted on.

Key strategies and reviews

3.3 BERR is currently conducting a review which should lead to a **renewable energy strategy** in 2009. The aim of this strategy will be to set out how the UK intends to reach the EU target of 15 per cent renewable energy in the UK by 2020. A consultation was issued in June 2008 on policy options for the heat, transport and electricity sectors to increase the supply of renewable energy **(see Box 1)**. The full UK Renewable Energy Strategy will be published in 2009, once a proposed EU Directive on renewable energy has been finalised.[30]

17 Timeline of key energy policies, strategies and reviews



Source: National Audit Office

Box 1

The UK Renewable Energy Strategy: Consultation Document

In June 2008 BERR published a consultation on additional measures to increase the use of renewable energy in the UK in order that the UK can meet its 15 per cent renewable energy target by 2020. The consultation opened on 26 June and Closes on 26 September 2008.

Measures discussed in the consultation include:

- extending and raising the level of the Renewables Obligation to encourage up to 30-35 per cent of UK electricity to come from renewable sources by 2020;
- introducing a new financial incentive mechanism to encourage a large increase in renewable heat;
- delivering more effective financial support for small-scale heat and electricity technologies in homes and buildings;
- helping the planning system to deliver, by agreeing a clear deployment strategy at regional level similar to the approach established for housing;
- ensuring appropriate incentives for new electricity grid infrastructure and removing grid access as a barrier to renewable deployment;
- exploiting the full potential of energy from waste, by discouraging the landfilling of biomass as far as is practical;
- requiring all biofuels to meet strict sustainability criteria, to limit adverse impacts on food prices, or other social and environmental concerns;
- promoting the development of new renewable technologies, through effective support particularly where the UK has the potential to be a market leader;
- maximising the benefits for UK business and jobs, by providing a clear long-term policy framework, working with Regional Development Agencies to tackle key blockages, considering support for specific technologies and addressing skills shortages.

Source: BERR (2008) UK Renewable Energy Strategy Consultation

3.4 **A "Heat Call for Evidence"** was published on 31 January 2008 following a commitment in the 2007 Energy White Paper to "conduct further work into the policy options available to reduce the carbon impact of heat and its use in order to determine a strategy for heat". It gives the current views on the technologies that are most efficient and practical for different scenarios, and asked for replies from interested parties by 31 March 2008. The call for evidence included a renewable heat section, which discussed possible incentives for renewable heat and which are the most cost-effective. The responses will inform the formation of an overall heat strategy to be published at the end of 2008.

3.5 Microgeneration is defined as "the small scale production of heat and/or electricity from a low carbon source"[31]; this includes small scale renewables. The Government launched a **microgeneration strategy** in 2006. Research commissioned by DTI from the Energy Savings Trust has found that, by 2050, microgeneration could provide 30–40 per cent of the UK's electricity needs if there were significant financial incentives in place. Specific actions have been taken to support microgeneration, including the Low Carbon Buildings Programme (discussed below), changes to the Renewables Obligation (also discussed below) to help microgenerators gain

easier access to Renewables Obligation Certificates (ROCs), a microgeneration certification scheme (which provides independent certification of microgeneration products and installers) and incentives for household electricity exported to the grid. There have also been changes to planning policies such that household microgeneration installations that have little or no impact beyond the host property will not need specific planning consent. The Government's targets for new homes to be zero-carbon by 2016 will require the use of microgeneration. The so called "Merton rule" discussed below, also supports microgeneration. A review of progress against the actions outlined in the strategy was published by BERR in June 2008.

3.6 Three Parliamentary select committees are currently holding, or have recently held, inquiries into renewable energy:

- The Commons Innovation University and Skills Select Committee published a report into Renewable Electricity Generation Technologies in June 2008.[32] It is focused on areas common to all renewable technologies such as the level of public funding and support for research and development of renewable technologies, the establishment and role of the Energy Technologies Institute, commercialisation of renewable technologies, intermittency of supply and connection with the national grid, Government policy to enable existing technologies to meet targets, and whether the UK has the skills base to develop renewable technology.
- The Lords EU Internal Market (Sub-Committee B) is undertaking an inquiry into the EU's 20 per cent renewable energy consumption target. A call for evidence was issued with responses due by 21 April 2008. It will seek evidence as to how achievable the EU and UK targets are, the effect on EU energy security, issues with grid access in EU member states, and support schemes for renewables at an EU level.
- The Lords Economic Affairs Committee is holding an inquiry into the economics of renewable energy. A call for evidence was issued with responses due by 16 June 2008. The inquiry aims to set out the costs and benefits of renewable energy and establish how they compare with other sources of energy. It will also examine the Government's policy towards renewable energy.

Costs and cost-effectiveness of renewable technologies

3.7 Analysis completed by BERR for the 2008 renewable energy strategy consultation found that the cost to the UK of reaching the 2020 15 per cent renewables energy target could be between £56 and £66 billion over 20 years. The major costs include those arising from increased use of relatively expensive renewable generation; grid reinforcement, and transmission and distribution costs; and costs of overcoming barriers to renewable heat. The major monetised benefits come from reductions in carbon dioxide, estimated using Defra's shadow price of carbon.

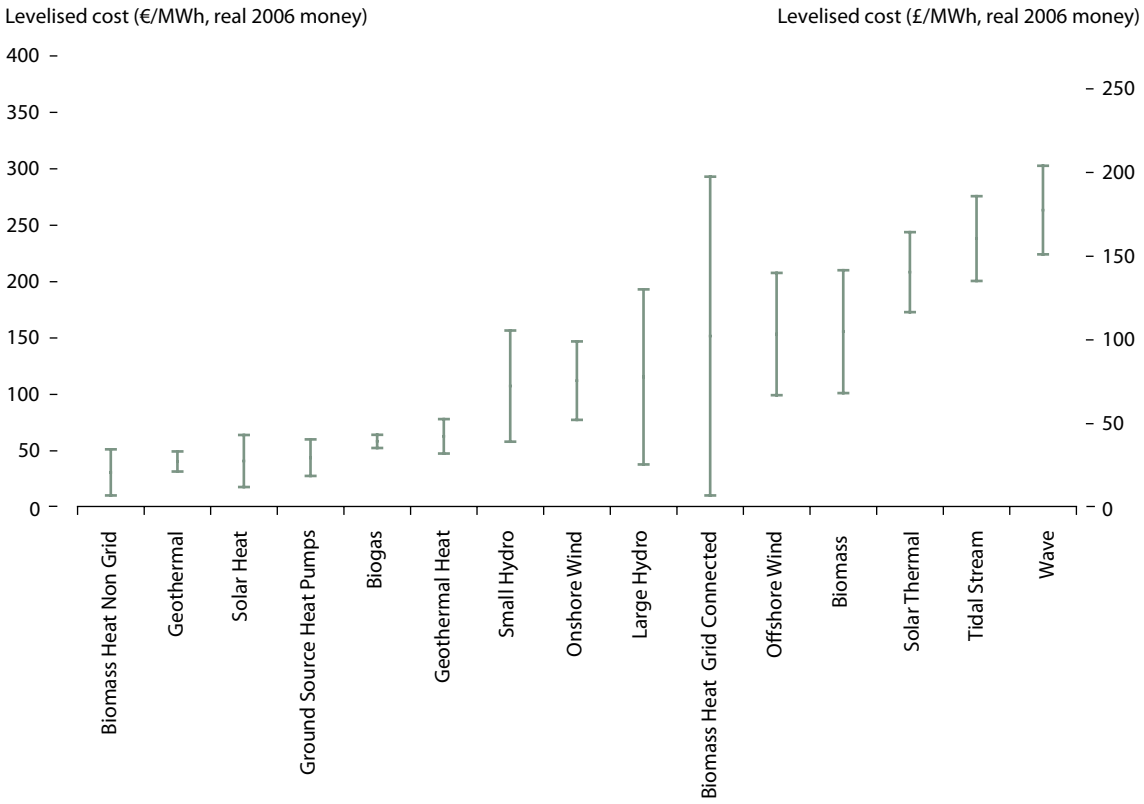
3.8 Another way of assessing the costs of policies is by using cost-effectiveness analysis, which summarises the costs and benefits associated with achieving a policy goal. For climate change policy this is measured in terms of cost per tonne of carbon emissions saved. For energy it can be estimated using cost per mega watt hour (MWh). The cost-effectiveness of various renewables programmes and policies was assessed in the 2006 Climate Change Programme Review and subsequently in the 2007 Energy White Paper. In 2007, the NAO reviewed the use of cost-effectiveness analysis in the 2006 Climate Change Programme Review and concluded that cost-effectiveness was a reliable enough method to enable comparison between policies, provided inherent limitations (e.g. policy costs change over time) are taken into account.

3.9 The cost-effectiveness of various renewables technologies across Europe was estimated in Pöyry Energy Consulting's report[33] commissioned by BERR as shown in **Figure 18 overleaf**. The report estimated costs in €/MWh by conducting a literature review of projects supplemented by workshops with renewable energy experts.

3.10 Another way that the relative costs of different renewable technologies have been considered is by setting out the marginal abatement cost curves, which show where the most cost-effective abatement opportunities lie. The 2007 Energy White Paper included a summary of the marginal abatement potential of a range of technologies and policies in 2020 – i.e. the incremental cost of reducing additional units of carbon. Although the shape of the curve would change over time, the analysis for 2020 suggests that of the renewable technologies and policies listed, onshore wind cost was estimated to deliver carbon reductions more cost-effectively than offshore wind, heat-generating microgeneration and wave generation, with electricity-generating microgeneration costing the most per tonne of carbon abated.[34] However, according to BERR, to meet the 15 per cent renewable energy consumption target by 2020, the UK will need a mix of different technologies and incentives.

3.11 Much of the cost debate centres around the economics and costs of specific renewable technologies. However, as illustrated in the **Box 2**, estimating the costs of developing renewable technologies is inherently difficult and subject to uncertainties; studies are yet to agree on the nature of the assumptions, methodologies or the resulting costs associated with future deployment of renewables.

18 Levelised project cost[1] ranges (€/MWh, 2006 prices)



Source: Pöyry Energy Consulting Analysis. The levelised cost for Solar PV is between €360/MWh to €960/MWh

NOTE

1 Levelised project costs give the ratio of total lifetime expenses to total expected outputs (measured in MWh), expressed in terms of the present value equivalent.

Box 2

Estimating the cost-effectiveness of renewable technologies

Estimating the relative cost of renewable technologies is complex, and involves inherent uncertainties and differing underlying assumptions. These might include expectations for technology development, their associated costs in the future, build and deployment rates, wholesale electricity prices and anticipated demand. It is therefore unsurprising that cost estimates tend to vary in their approach to estimating the cost and cost-effectiveness of specific renewable technologies over time, and in the nature of the anticipated future cost curves associated with them.

Many studies assume a declining cost curve over time for renewable technologies, reflecting reducing costs as a result of technological modifications, learning over time and reduced technical risks (so access to cheaper investment finance) associated with increased scales of deployment. However, there have been some recent suggestions that in certain cases, costs are at risk of rising in the future as a result of insufficient capacity to meet rising demand (for example, with offshore wind). The actual cost curves over time for different technologies will be highly dependent on project risk, availability of investment finance, policy certainty and levels of subsidy for different renewable technologies.

Wind is a significant resource in the UK and is less restricted in supply relative to other renewables. Onshore wind technologies in particular are relatively mature compared with other renewables; offshore wind technology is developing. A report conducted for the Carbon Trust in 2006 ('Policy frameworks for renewables') highlighted the near cost-competitiveness of onshore wind, with the potential for offshore wind to be cost-competitive by 2020, and additional potential export benefits to the UK of leading the development of offshore wind. However, some investors have recently voiced concern over specific offshore wind technologies which are limiting current investment opportunities.

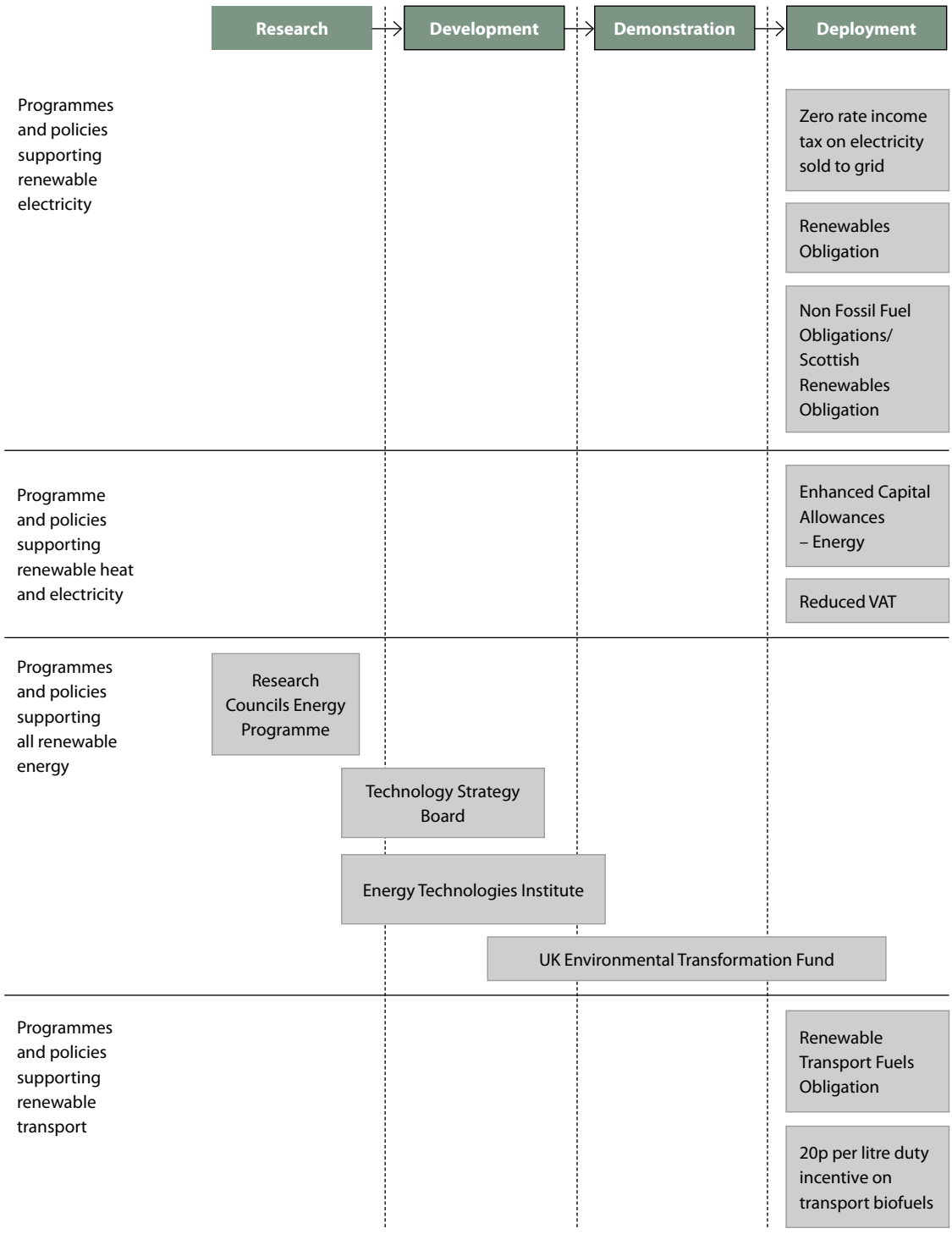
The Carbon Trust report also highlighted uncertainties over the likely cost-competitiveness of biomass and marine technologies, and supply constraints associated with hydro, landfill gas and biomass to service any generation of renewables at a significant scale by 2015.

Key policies

3.12 **Figure 19 overleaf** shows the key programmes and policies in place to support renewable energy at the different stages of development and deployment. It shows that most policies and programmes are directed towards encouraging deployment than research, development or demonstration. In general, the deployment-focused programmes and policies focus more on specific uses of renewable energy (such as electricity, heat and transport); the programmes covering the research, development and demonstration phases in general consist of bodies or funds which support technologies rather than being focused on one particular use of renewable energy.

3.13 Renewable heat currently receives little support in comparison with renewable transport and electricity. The majority of renewable heat technologies are at the deployment stage. They are supported by capital grants from the Low Carbon Buildings Programme (funded by the Environmental Transformation Fund), and some renewable CHP plants receive indirect support through the Renewables Obligation. However, these plants only receive support for the electricity they produce.

19 Programmes and policies in place to support renewable energy



Source: National Audit Office

3.14 Figure 20 sets out for the main policies that apply to renewable energy and its components (heat, transport and electricity) the periods the policies have been put in place for and indicative annual budgets or spend information to allow some comparison. It can be seen that the largest policy instrument in terms of spend is the Renewables Obligation and that therefore the majority of the money spent on renewable energy is being spent on encouraging the deployment of large-scale renewable electricity.

20 Current renewable energy policies and programmes

	Start Date	Approximate annual budget/spend
Research and development		
Research Councils Energy Programme (Not all funds used for renewable energy)	November 2005	£100 million budget for 2008/09
Technology Strategy Board (Not all funds used for renewable energy)	As an NDPB – July 2007	£237 million budget p.a[1]
Energy Technologies Institute (Not all funds used for renewable energy)	December 2007	Up to £100 million p.a. of which 50 per cent is public funds
Demonstration and deployment		
UK Environmental Transformation Fund	April 2008	£133 million budget p.a.[2]
Renewable Transport Fuels Obligation	April 2008[3]	£250 million p.a.[4]
Renewables Obligation (including Renewables Obligation (Scotland) and Northern Ireland Renewables Obligation)	April 2002 (NIRO – April 2005)	Value of RO subsidy could reach £1 billion by 2010[5]
Non Fossil Fuel Obligation/Scottish Renewables Obligation	1990	not available
Fiscal incentives		
20p per litre duty incentive on transport biofuels	July 2002 – Biodiesel January 2005 – Bioethanol	£100 million in 2007-2008
Zero rate income tax on electricity sold to grid and on receipt of ROCs. Zero CGT on sale of ROCs	April 2007	Negligible
Reduced VAT on installation and maintenance of specific domestic renewable technologies	April 2000 to January 2006 (dependent on technology)	£8 million in 2007-08
Enhanced capital allowances (ECAs) for energy efficient technologies	April 2002	N/A[6]

Source: National Audit Office based on BERR, HMT, DfT, UK Trade information

NOTES

1 Due to the recent creation of the TSB it is unclear how much of the TSBs budget of ~£1bn over the CSR period will be spent on renewable energy. Since the Technology Programme (the precursor to the TSB) was established in 2004, it has funded collaborative projects on emerging low carbon energy technologies to a total value of £90 million (with around £40 million public sector contribution). Projected annual budget provided by DIUS.

2 Based on £400 million funds available over the CSR period.

3 The Government response to the consultation indicates that there is no end date to the obligation but that it expects it to continue until at least 2020.

4 Cost figure for RTFO based on central estimate of the NPV to 2020 of minus £3 billion.

5 Provided by BERR.

6 ECAs offer a cash-flow advantage for businesses and do therefore have an impact in a given year. Over time, however, the cost impact is minimal.

3.15 The following section describes in more detail the main policies in place to support renewable energy. First the two supplier obligations for electricity and transport are considered, then other programmes and policies.

Supplier obligations

3.16 This part considers two policies that require energy suppliers to include a target percentage of renewable energy in energy supplied to customers: The Renewables Obligation and The Renewable Transport Fuel Obligation.

Renewables Obligation

3.17 The single largest government policy instrument in terms of cost to support renewables is the Renewables Obligation (RO). The Obligation requires designated electricity suppliers to ensure that a percentage of the electricity they supply to customers is generated from renewable sources and creates a trading market in renewable energy. The RO is intended to encourage new renewables; older large-scale hydro sources are not eligible. Generators that generate electricity from eligible renewable sources are issued with Renewable Obligation Certificates (ROCs) as evidence that they have done so. Suppliers demonstrate compliance by purchasing ROCs and presenting them to Ofgem at the year end as evidence that they have complied with their obligation. If the supplier fails to meet the obligation either through its own generation or by purchasing renewable energy from other sources, it is financially penalised and must pay into a "buy-out" fund at a predetermined cost per MWh. This money is then redistributed to all suppliers in proportion to the number of ROCs they presented. Some or all of the added cost of generating the renewable electricity falls upon the consumer as higher electricity prices.[35]

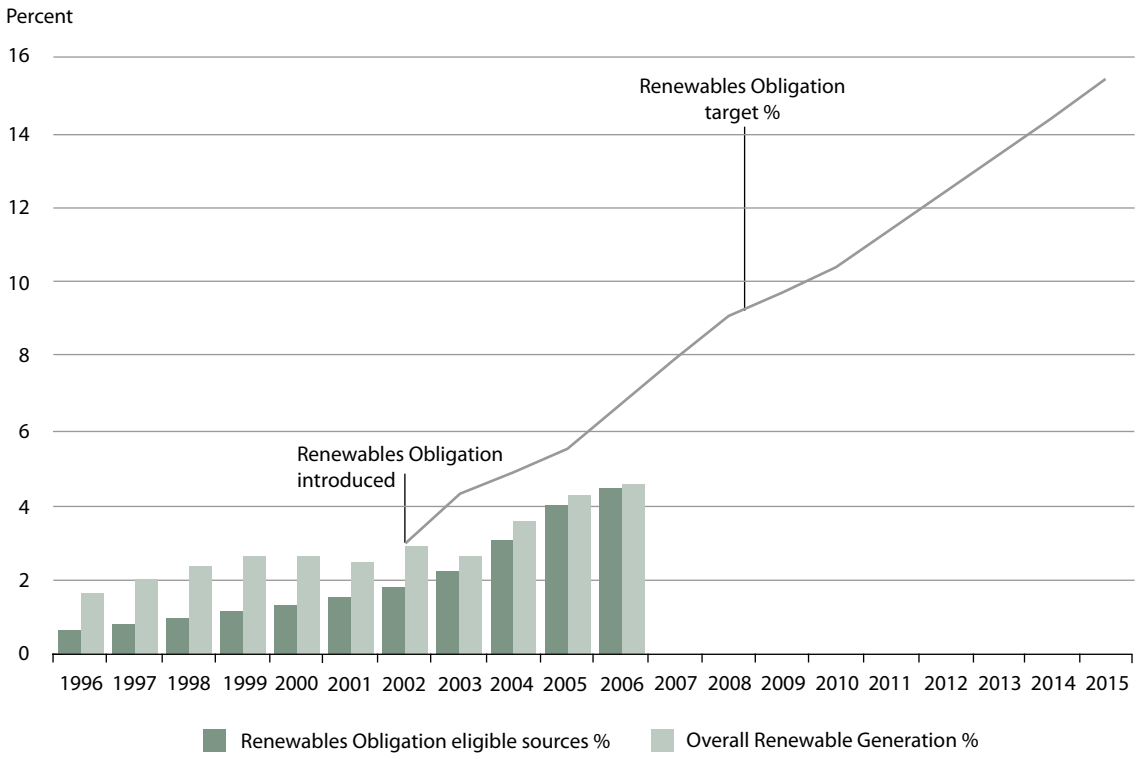
3.18 The system relies on the level of the obligation staying higher than the level of renewable electricity supplied. If the level of supply exceeded the obligation, there is a risk that the value of the ROCs in the market would crash, and generators would no longer be able to sell their ROCs to achieve the additional support they require to develop renewables. There would also be a zero buy-out fund as suppliers would have all met their targets and so would not have been financially penalised. In practice most independent generators negotiate long-term power purchase agreements with suppliers such that they are guaranteed a floor price for ROCs with a share of additional revenue from higher electricity prices and recycling of the buy-out fund.

3.19 **Figure 21** shows the overall percentage of electricity generated by renewable sources, the percentage of electricity generated under the Obligation and the level of the Obligation itself. The percentage of electricity that suppliers must source from renewable sources is currently 9.1 per cent for 2008-09 rising to 15.4 per cent in 2015-16.[36] At the end of 2006, the percentage of electricity supplied by renewable electricity sources that are eligible for the RO was 4.4 per cent.[37] It can be seen that electricity generation from RO-eligible sources has increased consistently from 1996 to 2006, and the rate of increase has grown since the RO was introduced. The overall percentage is affected by the variability of hydro sources, many of which are not eligible for the RO.

Effectiveness of the Renewables Obligation

3.20 The RO was reviewed by the NAO in a 2005 report *Department of Trade and Industry: Renewable Energy*.[38] The NAO found that the RO "...represents an expensive means by which to reduce carbon dioxide emissions – at least in the short and medium terms". It recommended the Department keeps a firm grip of the Obligation's cost relative to other instruments for reducing carbon dioxide, as well as "tracking indicators of the Obligation's contribution to longer term goals, which could include reductions in the unit generation costs of renewable technologies". The subsequent PAC report[39] stated that "Around a third of the support provided by the Renewables Obligation exceeds the extra cost of renewable generation. The Obligation provides the same level of support to all eligible technologies and sites regardless of their costs and long term potential to deliver reductions in carbon dioxide". It therefore recommended that "As part of its 2005 review of

21 Renewable electricity



Source: Digest of UK Energy Statistics, Renewables Obligation Order 2006

the Renewables Obligation the Department should reduce the excess support in the scheme. It could, for example, taper or phase out support for lower cost renewable technologies which have limited growth potential, such as landfill gas, or limit the number of years individual generating sites can benefit from the scheme". In addition, since 2002, the Environmental Audit Committee has been critical of the scheme and highlighted its potential weaknesses. These reports were one influence on the reform of the RO, particularly the decision to introduce banding, outlined overleaf.

3.21 The RO has come under criticism from some sources for not providing a guaranteed subsidy to renewable generators[40]. The amount redistributed from the buy-out fund will vary based on the total supply of renewable electricity as well as the demand for that year. Some critics have said that this results in a lack of guaranteed income in the long term, reducing the incentive to invest in renewable technologies with a longer payback period. In response to these criticisms and to give confidence to the industry, the Government announced, on 1 December 2003, proposals to raise the level of the Renewables Obligation beyond 2010-11 to 2015-16.[41] Feed-in tariffs (see box) are often suggested as a better alternative which are widely used in other European countries.

BOX 3

Feed-in Tariffs

Feed-in tariffs are a form of incentive structure used to encourage renewable energy. The policy requires utility companies to purchase electricity from renewables installations at a guaranteed rate, which can be set into the future (for example at a guaranteed rate for 20 years). The rate tends to be above-market rate, to cover the cost of adopting renewable energy sources, and varies according to the form of renewable generation.

The Stern Report (2006)[1] outlined various examples of feed-in tariffs, including information on the widely quoted German example, which some recognise as being an effective method of boosting adoption of renewable energy technologies.

Feed-in tariffs were introduced in Germany to encourage the deployment of renewable technologies to meet Germany's renewable energy goals, also to encourage the development of renewable technologies, reduce external costs and increase the security of supply. Each generation technology is eligible for a different rate. Within technologies, the rate varies depending on the size and type. Solar energy receives between €0.457 to 0.624 per kWh while wind receives €0.055 to 0.091per kWh. Once the technology is built, the rate is guaranteed for 20 years. The level of support for deployment in subsequent years declines over time by 1 per cent to 6.5 per cent each year.

In 2005, 10.2 per cent of electricity in Germany came from renewable sources and 70 per cent of this was supported with feed-in tariffs. The Federal Environment Ministry estimates that this will save 52 million tonnes of carbon dioxide by 2010. The average level of feed-in tariff was €0.0953 per kWh in 2005 (compared to an average cost of displaced energy of €0.047 kWh). The total level of subsidy was €2.4 billion, at a cost per consumer of €0.0056 per kWh (3 per cent of household electricity costs).

There are an estimated 170,000 people working in the renewable energy sector in Germany, which has an industry turnover of €8.7 billion.

NOTE

1 Based on information contained in HM Treasury's Stern Review Report (2006), Chapter 16, page 367. Available at http://www.hm-treasury.gov.uk/media/C/7/Chapter_16_Accelerating_Technological_Innovation.pdf.

Reform of the Renewables Obligation

3.22 The RO has also been critised for providing the same level of support to different technologies, even though the cost of electricity production differs between them, and therefore encourages the deployment of currently viable technologies rather than development of a broader range of technologies which might be more cost-effective in the long-term.[42] As part of the 2006 Energy Review the Government looked at how the RO could be changed to encourage a larger contribution from emerging renewable technologies. At the same time the Government also carried out a review of co-firing under the RO. Following this the Government announced changes to the RO which would provide differentiated support levels to different renewables technologies – known as banding – and give additional certainty on long-term Renewable Obligation Certificate prices. This banding involves awarding a different number of ROCs to a technology based on how much support they need to be commercially viable. Thus new generating stations using established technologies, such as landfill gas, will get a lower subsidy than those using emerging technologies like wave power. These proposals have been subject to two public consultation exercises and BERR has reported a broad agreement with the approach. The proposed level of support for each technology can be seen in **Figure 22**.

Renewable Transport Fuels Obligation

3.23 The Renewable Transport Fuels Obligation (RTFO) was announced in November 2005 and is the key government policy for deployment of renewable energy in transport. It came into force on the 15 April 2008, is modelled on the RO, and places an obligation on road transport fuel suppliers to ensure that a certain percentage of their sales are made up of biofuels. Under the RTFO, five per cent of all fuel sold on UK forecourts must come from a renewable source by 2010-11. This volume target represents the maximum biofuel content allowed by European Specifications that can be sold on the forecourts as standard petrol or diesel.

3.24 The RTFO will be administered by the Renewable Fuels Agency (RFA) which will issue Renewable Transport Fuel (RTF) Certificates according to the quantity of renewable fuel on which duty has been paid. It will be possible for companies to trade certificates. If a company cannot produce enough certificates at the end of each compliance period it will have to pay a buy-out price which will go into a buy-out fund for redistribution in proportion to the number of RTF certificates received.

3.25 There have been concerns over the sustainability of biofuels which often need to have substantial energy input to be transformed into a usable product, and risk being grown in areas that threaten biodiversity or food supplies. The RTFO requires suppliers to report on the impact of their biofuels in terms of greenhouse gas emissions and sustainability, which the RFA will use to encourage best practice. However, it is planned to reward biofuels under the RTFO on the basis of their carbon savings from 2010 and only if they meet appropriate sustainability requirements from 2011,[43] some three years after the Obligation is brought in.

3.26 In January 2008, the Environmental Audit Committee raised significant concerns over the pursuit of biofuels targets in the absence of robust sustainability standards to ensure that biofuels contribute to sustainable carbon emissions reductions, and prevent detrimental environmental impacts such as land use changes.[44] In February 2008, DfT announced a review to be led by the RFA Chairman, Ed Gallagher, of the indirect impacts of biofuel policies.[45] This reviews the "displacement" impacts of biofuel production, both within the EU and internationally, and evaluates the extent to which the production of biofuel feedstocks leads to land-conversion and greenhouse gas emissions arising from changes in land-use and cultivation practices. It also considers and describes the risk that biofuel policies may affect international food commodity prices in the period to 2020. The review was published in early July 2008.

22 Proposed banding of technologies for the Renewables Obligation

Band	Technologies	Level of support ROCs/MWh
Established 1	Landfill gas	0.25
Established 2	Sewage gas, co-firing on non-energy crop (regular) biomass	0.5
Reference	Onshore wind; hydro-electric; co-firing of energy crops; EfW with combined heat and power; geopressure; other not specified	1.0
Post-Demonstration	Offshore wind; dedicated regular biomass	1.5
Emerging	Wave; tidal stream; fuels created using advanced conversion technologies (such as anaerobic digestion); dedicated biomass burning energy crops (with or without CHP); dedicated regular biomass with CHP; solar photovoltaic; geothermal, tidal Impoundment (e.g. tidal lagoons and tidal barrages (<1GW)); Microgeneration	2.0

Source: Government Response to Renewables Obligation Consultation – January 2008

Other programmes and policies

Research and development support

3.27 There are four different bodies and organisations that provide research, development or demonstration support for renewable energy. These include:

- Research Councils – provide support to scientific research by awarding grants to particular projects and individuals. The Research Councils Energy Programme (RCEP) is a coordinated programme involving five research councils and provides funding and support to sustainable and renewable energy, low-carbon, and energy efficiency research, with the aim of helping to position the UK to be able to meet its energy targets for 2020 and beyond.
- The Technology Strategy Board (TSB), funded by DIUS, was established in 2007. It is an arms length body which has a business-led board and a business focus that will play a cross-Government role, advising on policies which relate to technology innovation and knowledge transfer, and delivering a national Technology Strategy. The TSB will promote and invest in technological innovation, by supporting research and development building networks and promoting knowledge exchange programmes. Working with the Regional Development Agencies and the Research Councils, it will jointly invest over £1 billion in the next three years. The TSB has a wide remit covering the whole of the UK economy, including renewable and low carbon energy.
- The Energy Technologies Institute (ETI) is a new public-private partnership with up to £500 million funding from DIUS (via the Engineering and Physical Sciences Research Council and the TSB) over 10 years to be matched by the private sector. Its aim is to support research and development which will accelerate the development, demonstration and eventual commercial deployment of a portfolio of low carbon energy technologies and solutions. The first three programme areas announced have been for offshore wind, marine renewables (wave and tidal stream) and distributed energy.[46] Funding will be given for business, academia and others to undertake specific projects within these programmes.
- The Environmental Transformation Fund (ETF) brings together BERR's and Defra's low carbon funding programmes to accelerate the commercialisation of low carbon energy and energy efficiency technologies in the UK. It includes the main capital grants programmes.

3.28 These bodies focus on different stages of the development cycle, but there is some overlap, particularly in the 'development' stage (see Figure 19). These bodies plan to work closely together to ensure their efforts are coordinated and complementary, for example the CEO of the Technology Strategy Board sits on the board of the ETI. In addition, funds can pass between several of the bodies, for example, the DIUS funding for ETI is provided through the Engineering and Physical Sciences Research Council and TSB. While the latter bodies provide direct support for renewable technologies as well as other low carbon technologies, their overall remit extends across a broad range of technologies.[47]

Green tariffs

3.29 There is no formal definition of a green tariff, but they can most easily be thought of as tariffs that facilitate an environmental benefit (e.g. through the additional deployment of small-scale renewable or low carbon generation) as a result of a customer choosing to sign up to the tariff – for example through contributions to green funds or carbon offset schemes[48]. Ofgem first introduced guidelines on green supply tariffs to the domestic electricity market in 2002 to make sure that where such tariffs were marketed to consumers they were transparent, verifiable and incorporated an element of additionality.

3.30 There is no specific government policy incentive for energy suppliers to offer green tariffs. Despite this, the market for green tariffs has developed significantly in recent years. An Ofgem

press release in July 2007 stated that nearly 350,000 customers had chosen a green tariff[49]. A National Consumer Council (NCC) report in January 2007 suggested that 200,000 households had done so[50]. However, according to Ofgem, consumer research and associated reports have suggested that there is a significant level of customer confusion and as a result, a level of customer mistrust regarding the contribution such tariffs make to the environment[51]. The NCC report found that to fulfil the potential for green tariffs in the UK, consumers should have clear, unambiguous information about what is on offer, and confidence that green tariffs will deliver what they promise[52].

3.31 One of the key criticisms of green tariffs is that they can simply represent a repackaging of existing supplier obligations[53]. Suppliers are already required to source a certain volume of electricity from renewable sources, through the Renewables Obligation (RO), and are subsidised for doing so. They are also required to meet specified targets relating to the installation of energy efficiency measures in domestic premises (see discussion of CERT, below) and are also subsidised for doing so. There is therefore a risk that green tariffs can represent a repackaging of the electricity sourced to meet the RO or supplier obligations associated with energy efficiency; so the tariffs have no additional benefit above what would have occurred in their absence, yet suppliers can charge a premium for them.

3.32 All of the six main electricity suppliers offer green tariffs, as do a number of smaller suppliers who specialise in them. However, there is no standard for the "greenness" of a tariff, leading to concerns that consumers can not judge tariffs against each other, especially as some companies charge more for their green tariffs whilst others do not.

3.33 To address these concerns, in June 2007 Ofgem embarked on a process to revise the existing guidelines on green supply, involving two successive consultation documents, as well as workshops and bilateral meetings with stakeholders. In light of responses to the second consultation, Ofgem decided to revisit certain aspects of the proposals. While respondents were supportive of the work to revise the guidelines, no consensus was reached on the most appropriate way to ensure the additionality of environmental benefits arising from green tariffs.

3.34 In February 2008, Ofgem issued an open letter to interested stakeholders which set out its intention to seek to incorporate additionality as a more central part of the voluntary guidelines for energy suppliers. Ofgem is currently firming up these proposals with the intention of publishing a further consultation on the proposals at the beginning of July 2008.

3.35 The key proposals are as follows:

- **Additionality:** For a tariff to achieve accreditation under the green supply guidelines it will be necessary to demonstrate a benefit over and above current legal obligations already placed upon suppliers. This will require that a minimum level of financial contribution is made towards measures that deliver an additional environmental benefit. Tariffs will also be rated based upon the financial contribution that they make towards measures of additionality.
- **Transparency:** Better Information for consumers, including the source of their fuel generation mix at point of sale to give consumers an indication of the environmental credentials of the supplier.
- **Accreditation scheme:** Ofgem is also developing an accreditation scheme to ensure the verification of supplier claims by an independent third party.

Low Carbon Buildings Programme

3.36 The Low Carbon Buildings Programme (LCBP) is part of the microgeneration strategy. The programme is intended to encourage the use of microgeneration in conjunction with the other parts of the strategy, including the Microgeneration Certification Scheme and tax duty incentives that are discussed below. The programme is funded under the ETF, which is otherwise focused on renewables and low carbon demonstration projects. Phase 1 of the programme was announced in November 2005 with funding of £30 million[54], and a further £6 million was allocated in the 2007 Budget. The programme was initially open to homeowners, communities and businesses but is now

only open to homeowners. The households stream has recently been extended for applications until June 2010 or as long as funds are available.

3.37 The households stream of phase 1 of the programme proved very popular, with monthly allocations reaching £1.4 million in November 2006. Following this, allocations were limited to £500,000 a month. The programme was suspended and relaunched in May 2007 with the maximum amount for grants reduced from £15,000 to £2,500. Since this point, allocations have averaged £200,000 per month. BERR is expecting uptake to increase as a result of its current activities to promote the household stream, and as a result of the recent changes in the planning system designed to encourage microgeneration technologies (see Paragraph 3.5).

3.38 In the March 2006 Budget, a further £50 million was announced which was used to establish phase 2 of the programme. Phase 2 is managed by BERR and provides capital grants to public sector buildings and charitable bodies for medium and large scale microgeneration projects using a framework contract approach. Phase 2 has to date committed £9 million of its £50 million budget and just under £2 million has actually been spent. BERR continues to promote the programme to ensure the amounts committed are actually spent. The amounts committed and paid at 31 March 2008 are shown at **Figure 23**.

Tax and duty incentives

3.39 Biofuel duty incentives were introduced in 2002 for biodiesel and 2005 for bioethanol. Both fuels receive a 20 pence per litre rebate until 2010-11. In the year these rebates are revoked the Treasury expects biofuel duty to equate to around £550 million per annum.

3.40 In 2007, the Government introduced a tax exemption from income tax on surplus microgenerated electricity from households sold back to the grid and any ROCs which accompany any renewable electricity generated. They also exempted these ROCs from capital gains tax on sale. The immediate cost in foregone tax is expected to be minimal, because few households generate their own electricity and have the technology in place to measure the level of renewable electricity generated or the amount put back into the grid. However it is expected that removal of the taxation and administrative burden will encourage the take-up of these technologies.

3.41 Since 1997 the Government has introduced a reduced 5 per cent VAT rate on professionally installed microgeneration technologies including heat pumps, micro-combined heat and power, solar panels and wind turbines. The 2007 Budget stated this had had a "small impact on carbon emissions".

23 Low Carbon Buildings Programme – budget, committed expenditure and amount paid

Phase/Stream	Open/Closed	Budget (£m)	Amount Committeed (£m) End March 2008	Amount Paid (£m) End March 2008
Phase 1 – Stream 1 (Households)	Open		7.8	6.8
Phase 1 – Stream 1 (Communities)	Closed	36	1.5	0.4
Phase 1 – Stream 2	Closed		10.0	0.1
Phase 2	Open	50	8.9	1.45
Total		**86**	**28.2**	**8.75**

Source: Low Carbon Buildings Programme website (at 1 April 2008), BERR

3.42 Enhanced Capital Allowances (ECAs) are a way for a business to improve its cash flow through accelerated tax relief. The ECA scheme was introduced in 2001 to encourage businesses to invest in specified energy-saving plant or machinery, including by providing businesses with 100 per cent first year tax relief on their qualifying capital expenditure. Less efficient equipment might only be eligible, for example, for a 25 per cent reducing balance[55] allowance. There is a group of capital allowances for energy efficient technologies which include solar thermal systems, CHP, and heat pumps.

Energy Saving Trust and the Carbon Trust

3.43 The Energy Saving Trust (EST) is a non-profit organisation, funded both by government and the private sector. EST was set up with offices in England, Scotland, Northern Ireland and Wales, to address the damaging effects of climate change. Its aim is to cut emissions of carbon dioxide by promoting the sustainable and efficient use of energy; EST encourages energy efficiency and renewable energy sources by providing free, impartial advice. Alongside promoting the use of cleaner transport fuels, and better insulation and energy efficiency in buildings including homes, EST also champions small-scale renewable energy such as solar and wind power.[56]

3.44 The Carbon Trust was set up by the Government in 2001 as a government-funded private company. Its aim is to accelerate the move to a low carbon economy by working with organisations to reduce their carbon emissions and develop commercial low carbon technologies.[57] Its various programmes specifically relating to renewable energy range from loans specifically available for small and medium-sized businesses to assist with investing in renewable technologies, and its commercial venture 'Partnership for Renewables', which partners with private sector organisations to plan, develop and operate renewable energy projects on public sector land.[58]

Planning

3.45 In the UK, responsibility for planning is a devolved issue. In England, CLG is responsible for national policies on planning which are outlined in Planning Policy Statements (PPS). Local government is responsible for making planning decisions based on the national policies but taking into account the local variances. There is liaison between CLG and the devolved administrations.

3.46 PPS 22 and the new PPS on climate change set out the Government's policies for renewable energy, which English planning authorities should have regard to when preparing local development documents and when taking planning decisions. PPS 22 includes the principle that planning bodies should promote and encourage, rather than restrict, the development of renewable energy resources. It also states that regional renewable energy targets should be introduced in regional plans when assessing proposals for renewable energy; that the wider environmental and economic benefits are material considerations that should be given significant weight; and planning authorities should foster community involvement in renewable energy projects.

3.47 Planning has been a consistent area of concern for renewables deployment. In the April 2008 issue of the British Wind Energy Association (BWEA) journal RealPower, the BWEA called the planning process: "the single biggest constraint of wind deployment power in the UK", stating that "nearly 8,000 MW of onshore wind farm capacity was stuck in the planning system at – equalling 6 per cent of the UK's electricity supply."[59] The report also says that average decision times for both major (over 50 MW) and local onshore wind rose from 22 months in 2006 to 24 months in 2007 and the approval rate fell from 82 per cent in 2004 to 62 per cent in 2007. For wind farms below 50 MW the statutory time period for decisions is eight weeks. For decisions which include an Environmental Impact Assessment this increases to 16 weeks. After this time an appeal for "non-determination" can be made.[60] Planning

decisions on wind farms over 50MW are made by the Secretary of State and there is no equivalent deadline. In some cases, objections to planning requests have come from government departments. The MoD has objected to a number of wind farm developments (on average about 15 per cent) due to concerns over interference with its radar system.[61] BWEA also provided higher level statistics: there are 4,486 MW of wind projects in planning with aviation related objections. Of this, the MOD has objected to 1,597 MW (35 per cent); NATS En Route have objected to 3,313 MW (74 per cent); civil airports have objected to 1,307 MW (29 per cent). The industry is currently working with other stakeholders to address these concerns.

3.48 The interaction of the planning system and renewables has been reviewed several times, with CLG and BERR working closely to develop the planning framework. There have been a number of recent developments and reforms. Planning for renewables is addressed in the Planning and Energy white papers. A new supplement to PPS 1, published in December 2007, addresses planning and climate change and is intended to help speed up the shift to renewable and low carbon energy. It expects regional and local planners to actively plan for, and support, renewable energy generation, including through allocating and safeguarding sites. The PPS on climate change includes a provision to expand a policy known as the "Merton rule", named after the borough of Merton which first introduced the policy. The "Merton plus" approach in the new PPS expects all local planning authorities to set a target percentage for a specific level of energy in new developments to come from decentralised and renewable, or low carbon, energy sources. It also provides for tailored targets for sites where there is greater potential for using local energy and is intended to be flexible to allow community schemes (for example, wind turbines serving more than one site or CHP schemes) as well as building-specific technologies.

3.49 There is also a new Planning Bill which will create an Infrastructure Planning Commission for England and Wales which will make planning decisions for significant national developments, including renewable energy power stations of above 50 MW in capacity. The Planning Bill also includes a statutory duty on local planning authorities to take action on climate change. The Renewable Energy Strategy, which went to consultation in June 2008, includes prosposed measures to improve the delivery of renewables through the planning regime.

3.50 Responsibility for granting planning consent for the deployment of renewables is currently split between the Secretary of State for BERR and local planning authorities, as shown in **Figure 24**. Following the Marine Bill and the Planning Bill, responsibility will no longer reside with the Secretary of State for BERR but with the Infrastructure Planning Commission and the Marine Management Organisation. This will remove the dual role of BERR, being both responsible for the development and promotion of renewables as well as granting planning permission for the largest projects.

3.51 Proposals for many projects must involve an Environmental Impact Assessment (EIA) in line with EU requirements. The need for an assessment is independent of the planning process. On some major programmes, such as the leasing of offshore areas for the development of wind farms, EU legislation requires a Strategic Environmental Assessment (SEA). This is a significant undertaking in each case. To address this requirement for the newest offshore wind farms, BERR is combining the SEA with its routine SEA for offshore oil and gas, which should reduce the time to development of new offshore farms.

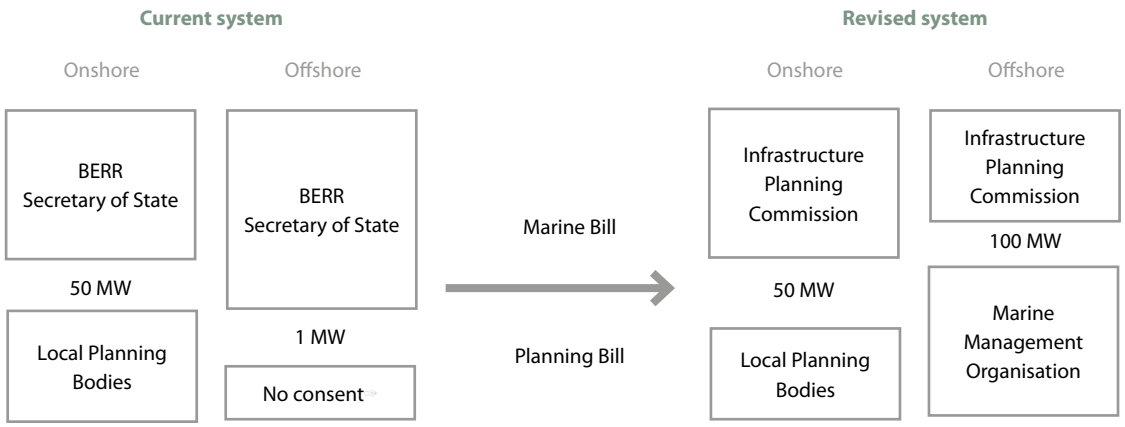
EU Emissions Trading Scheme

3.52 Under the EU ETS, large emitters of carbon dioxide within the EU must monitor and report annually on their CO_2 emissions. Scheme participants are allocated a number of allowances, each one equivalent to one tonne of CO_2. At the end of each year they are obliged to surrender allowances equivalent to their CO_2 emissions. Participants that emit less than their initial allocation can sell the surplus allowances, whilst those who emit in excess of their allocation must purchase additional allowances. As the large energy companies are included in the scheme, there is an incentive for them to develop zero-carbon renewable electricity, and thus reduce their emissions. This reduction would prevent the need to purchase additional allowances or allow them to sell any surpluses.

Climate Change Levy

3.53 The Climate Change Levy (CCL) is a tax on businesses' use of energy in the UK. Electricity generated from qualifying renewable sources is exempt from the levy; Levy Exemption Certificates (LECs) are allocated to generators in proportion to the amount of exempt power they produce. Generators pass these certificates to suppliers (or can negotiate a value for them) so suppliers can prove they are supplying electricity from renewable sources. Business consumers can enter into agreements with their electricity suppliers to purchase renewable electricity that is exempt from the CCL, so they can avoid paying the tax. In this way the exemption to the CCL provides an incentive for businesses to seek renewable energy supplies.

24 The Infrastructure Planning Commissions will become responsible for planning consents for significant national developments after the Marine Bill and Planning Bill



Source: National Audit Office, based on information supplied by BERR

NOTES

No consent is needed under S36 of the Electricity Act but consents may be needed under the Coast Protection Act and the Food and Environmental Protection Act.

In Scotland the Scottish Executive takes the equivalent roles of BERR and the Infrastructure Planning Commission.

Carbon Reduction Commitment

3.54 The Carbon Reduction Commitment Scheme (CRC), announced in the 2007 Energy White Paper, is a UK-wide scheme that will apply mandatory emissions trading to large business and public sector organisations whose annual half-hourly metered electricity use is above 6,000 Mega Watt hours (MWh). The Government estimates that the CRC will cover around 10 per cent of the UK's CO_2 emissions, and the scheme has been designed specifically to target energy-related use emissions in large, non-energy intensive organisations that are not currently covered by climate change instruments such as the EU ETS and the Climate Change Agreements. Such organisations include government departments, universities, retailers, banks, water companies, hotel chains and local authorities. The scheme is due to begin in January 2010 with a three-year introductory phase, with carbon allowances being sold at a fixed price. In the second phase, from 2013, the Government will impose an emissions cap based on advice from the Committee on Climate Change, and all allowances will be auctioned. Participants must purchase allowances corresponding to their emissions from energy use, and then surrender them at the end of the year. Revenues raised will be recycled to participants according to their 2009 emissions, adjusted according to their performance in a 'league table' of all participants. The Government has already consulted on the implementation proposals for the CRC and plans to issue a further consultation on the draft regulations in summer 2008.

3.55 The CRC could act as an incentive for some organisations to consider investing in on-site renewable energy where this could reduce energy use and carbon emissions cost-effectively. However, as the focus of the CRC is on actions taken by the end-user organisation, it does not specifically either encourage or create disincentives for organisations to buy renewable electricity via the grid (green tariffs – discussed above).[62]

Carbon Emissions Reduction Target

3.56 The Carbon Emissions Reduction Target (CERT, previously the Energy Efficiency Commitment) is an obligation on energy suppliers to install energy saving measures in households. The scheme started operating in April 2008 and will run to March 2011, after which a new design of the scheme, the supplier obligation, will take effect. The design of CERT includes a in-built incentive to encourage suppliers to install micogeneration technologies, which could include small-scale renewables. The scheme allows suppliers to choose to meet some of their obligation (up to six per cent) by promoting and trialling new energy efficient products and appliances to consumers.[63] If suppliers install microgeneration technologies that account for at least two per cent of their total obligation, they become eligible to increase the amount of their obligation that can be met by such products and appliances to eight per cent. This can be attractive to suppliers looking to trial new technologies and create new business. Defra will be working with electricity suppliers to encourage them to take advantage of these microgeneration opportunities.[64]

Appendix

Units of energy

A common unit used to measure the amount of energy in a substance is a tonne of oil equivalent (toe). It represents the calorific (heating) value of one tonne of oil. It is used by BERR in the Digest of UK Energy Statistics in common with the International Energy Agency and with the Statistical Office of the European Communities. It is a measure of energy content rather than a physical quantity; actual tonnes of oil will normally have measurements in tonnes of oil equivalent which differ from their measurements of mass in tonnes.

Units of electricity generation capacity

Electric power generation is measured in watts. This is a unit of power, or a rate of work, and measures the amount of energy transmitted per second. Thus a power station has a given maximum power output which is usually given in kilowatts (kW) – 1 thousand watts, megawatts (MW) – 1 million watts, or gigawatts (GW) – 1 billion watts.

When quantities of electricity usage or supply are talked about, the unit of measurement is the watt-hour (Wh). A watt-hour is the amount of energy equivalent to a power of 1 watt running for 1 hour. The same prefixes can be used to give kWh, MWh and GWh.

Often the total amount of energy a power station can generate in a year will be quoted as kWh/yr, MWh/yr, etc.

The power of energy generation sites publicised is the peak output. For most technologies a load factor must be used to estimate the actual energy output to take into account, for example the fact that the wind does not blow all the time.[65]

When used to compare with figures measured in toe, the conversion factor that 11,630 kWh = 1 toe can be used.[66]

Endnotes

1 Throughout the briefing, energy for 'heat' is used to describe energy used for heating and cooling (e.g. air conditioning). Energy for heat also includes energy used in industrial processes such as smelting. BERR – http://www.berr.gov.uk/energy/sources/heat/page43671.html.

2 BERR, *DUKES 2007*, p118.

3 DTI, Energy White Paper: *Our energy future – creating a low carbon economy*, 2003, http://www.berr.gov.uk/files/file10719.pdf.

4 Details of the targets are available at http://www.euractiv.com/en/energy/eu-renewable-energy-policy/article-117536.

5 The term 'Renewables Directive' is often used to describe the 2001 'Directive…on the promotion of electricity produced from renewable energy sources in the internal electricity market'.

6 The EU directives require member states to adopt targets but the level of the target suggested by the EU is only indicative; the final target is decided by the member state. If there is a chance the overall EU target will be missed The European Commission can propose mandatory targets for individual countries in order to meet the EU target.

7 The Government has a target to achieve at least 10,000 MWe of installed Good Quality Combined Heat and Power (CHP) capacity by 2010 but not all CHP is renewable (see 1.18). A 'heat' related renewables target would need to account for both this and any overlaps with targets related to electricity and transport.

8 The UK has set the target at five per cent by volume rather than 5.75 per cent by energy content because the Government is not yet confident that that higher levels of biofuels can be delivered in a sustainable way and because the five per cent by volume level is consistent with current EU fuel quality standards which impose a five per cent volume-based limit for biofuel blends. Source: *Promotion and Use of Biofuels in the United Kingdom during 2006: UK Report to European Commission under Article 4 of the Biofuels Directive (2003/30/EC).*

9 EC directive 2001/77/EC, 2001 Article 2. BERR now share this definition with Europe.

10 Co-firing involves combustion of biomass in the same plant as the fossil fuel. This can have several advantages such as improving the combustion of the biomass and reducing the pollutant emissions of the fossil fuel.

11 Percentage based on overall energy generation by different fuels, NOT number of schemes, BERR, *DUKES 2007*, Table 6.2.

12 Research into nuclear fusion is underway which hopes to create energy from deuterium (a fuel source extracted from water). This has the potential to be a renewable source of energy. We do not consider it further in this review.

13 1.4 per cent in 2006, 1.3% in 2005, BERR, *Energy Trends*, March 2008, http://www.berr.gov.uk/files/file45397.pdf.

14 European Commission, *Energy for a changing word, fact sheets by country*, Jan 2007, http://ec.europa.eu/energy/energy_policy/facts_en.htm.

15 BERR, *Energy Trends*, March 2008. This figure does not include electricity used for heating and cooling.

16 Renewable heat figures are mainly based on surveys whereas electricity figures are based on measurement of generation necessary for the RO and transport figures are measured directly due to the need to charge a reduced duty on biofuels.

17 0.45 per cent relates to road transport fuel from biofuels. This is different from the figure shown in Figure 8 of 0.3 per cent which is the percentage of total transport fuel from biofuels. Total transport fuel includes road, aviation, rail and navigation fuel.

18 For reporting to the European Commission, conversion factors from volume to energy of 68 per cent of petrol energy for bioethanol and 92 per cent of diesel energy for biodiesel, are currently assumed.

19 The target was originally set in 1999 with a five per cent target for 2003 and a ten per cent target for 2010. The Energy White Paper 2007 reaffirmed the 2010 target and included an aspiration for 20 per cent by 2020.

20 BERR, *DUKES 2007*, Table 7.4. This target is on a generation basis so the percentage of renewables differs from the 4.8 per cent in Figure 8 which is on a consumption basis. Generation counts the total amount of energy generated. Consumption counts energy finally consumed by consumers which is total generation minus distribution losses, own use of electricity by electricity generators and electricity used for pumping at pumped storage stations.

21 BERR, *DUKES 2007*, Para 5.43.

22 Other biomass includes sewage sludge digestion, the biomass part of municipal solid waste combustion, farm waste digestion, poultry litter combustion, meat and bone combustion, straw and short rotation coppice, BERR, *DUKES 2007*, http://stats.berr.gov.uk/energystats/dukes07.pdf.

23 BWEA website.

24 Ernst & Young for Defra and BERR, *Renewable Heat Support Mechanisms*, http://www.berr.gov.uk/files/file42043.pdf.

25 Cambridge Econometrics, *UK Energy and the Environment*, March 2008, http://www.camecon.com/press_releases/download/UKE3081.pdf.

26 Tyndall Centre for Climate Change Research, *Renewable Energy and Combined Heat and Power Resources in the UK*, 2002, http://www.tyndall.ac.uk/publications/working_papers/wp22.pdf.

27 Imperial College London Centre for Energy Policy and Technology & E4tech Consulting for the DTI, *The UK Innovation Systems for New and Renewable Energy Technologie*s, 2003, http://www.berr.gov.uk/files/file22069.pdf.

28 Tyndall Centre for Climate Change Research, *Renewable Energy and Combined Heat and Power Resources in the UK*, 2002, http://www.tyndall.ac.uk/publications/working_papers/wp22.pdf.

29 This excludes the main climate change strategies and reviews, which tend to be broader in scope.

30 BERR, *Heat Call for Evidence*, 2008, http://www.berr.gov.uk/files/file43609.pdf.

31 DTI, *Microgeneration Strategy*, March 2006.

32 The press notice announcing the inquiry can be found on the Committee's website here, http://www.parliament.uk/parliamentary_committees/ius/ius_281107.cfm.

33 Pöyry Energy Consulting, *Compliance Costs for meeting the 20 per cent renewable energy target in 2020*, March 2008.

34 Energy White Paper (2007) Box 10.1, *UK marginal abatement curve*; and underlying appraisal synthesis.

35 An Ofgem publication (Jan 2008) estimates the RO currently adds £10 to the cost of bills http://www.ofgem.gov.uk/media/facsheets/documents1/energy%20prices%20jan08.pdf.

36 After 2016 the obligation will remain at 15.4 per cent to 2027.

37 This is slightly lower than the total percentage of renewable electricity generation (4.6 per cent in 2006), due to the exclusion of some older large scale hydro plants from the RO.

38 NAO, *Department of Trade and Industry: Renewable Energy*, HC 210, Session 2004-05, February 2005, http://www.nao.org.uk/publications/nao_reports/04-05/0405210.pdf.

39 Committee of Public Accounts, *Department of Trade and Industry: Renewable energy*, HC 413, 6th Report 2005-06, http://www.publications.parliament.uk/pa/cm200506/cmselect/cmpubacc/413/413.pdf.

40 For example, see Ofgem (2007) *Reform of the Renewables Obligation 2006: Ofgem's response* (from Para 3.28). Available at http://www.ofgem.gov.uk/Sustainability/Environmnt/Policy/Documents1/16669-ROrespJan.pdf.

41 DTI, *New And Renewable Energy – Prospects For The 21st Century: The Renewables Obligation Order 2005 Statutory Consultation*, 2004, http://www.berr.gov.uk/files/file42920.pdf.

42 BERR has acknowledged that "As a technology neutral instrument, the RO has thus far proved less successful in bringing forward development of the more emerging renewable technologies" DTI (2006) *Renewable Energy: Reform of the Renewables obligation and Statutory Consultation on the Renewables Obligation Order* 2007 (Foreword).

43 DfT, *Summary of responses to consultation on RTFO's carbon and sustainability reporting requirements*, 2008, http://www.dft.gov.uk/pgr/roads/environment/rtfo/sumresponrtfo?page=1#a1000

44 Environmental Audit Committee, *Are biofuels sustainable?* HC 76-01, Session 2007-08, January 2008. http://www.publications.parliament.uk/pa/cm200708/cmselect/cmenvaud/76/76.pdf

45 Details of the review can be found on DfT's website here, http://www.dft.gov.uk/pgr/roads/environment/rtfo/biofuelsreviewtor

46 Distributed energy (DE), also referred to as distributed generation or decentralised energy, aims to bring energy generation closer to where it is used. DE could be anything from wind power, solar panels, CHP schemes and other renewable energy generation connected directly into the local distribution network. (Based on in formation on the Ofgem website at: www.ofgem.gov.uk/sustainability/environment/policy/smallrGens/disteng/pages/disteng.asp

47 A 2005 NAO report on renewable energy concluded that BERR should maintain an overview of renewables support and ensure that the remits and activities of public bodies are clear to those seeking support. It should be noted that the current arrangements were not in place at that time and that Technology Strategy Board and ETI have only been in existence since 2007. *NAO, Department of Trade and*

Industry: Renewable Energy, HC 210, Session 2004-05, February 2005, http://www.nao.org.uk/publications/nao_reports/04-05/0405210.pdf.

48 Based on Ofgem and Energywatch information. http://www.energywatch.org.uk/help_and_advice/green_tariffs/index.asp.

49 Ofgem Press Release, *One in five households choose an innovative energy deal*, July 2007, http://www.ofgem.gov.uk/Media/PressRel/Documents1/Ofgem29.pdf.

50 National Consumer Council, *Reality or rhetoric? green tariffs for domestic consumers*, 2007, http://www.ncc.org.uk/nccpdf/poldocs/NCC144rr_reality_or_rhetoric.pdf.

51 Ofgem press release, *Cutting the green customer confusion*, November 2007. Available at http://www.ofgem.gov.uk/Sustainability/Environmnt/Policy/Documents1/Cutting%20green%20customer%20confusion_consultation%20document.pdf.

52 National Consumer Council, *Reality or rhetoric? green tariffs for domestic consumers*, 2007, http://www.ncc.org.uk/nccpdf/poldocs/NCC144rr_reality_or_rhetoric.pdf.

53 Ibid. For example, the NCC report found that many green tariffs were not delivering the environmental benefits they claimed to, particularly as many suppliers were simply supplying electricity under the green tariff that they have to supply anyway under the Renewables Obligation.

54 DTI Press Release, *Energy Minister Announces Funding Level For The Low Carbon Building Programme*, November 2005, http://nds.coi.gov.uk/Content/Detail.asp?ReleaseID=176001&NewsAreaID=2

55 The reducing balance basis gives allowance on 25 per cent on the amount which has not previously had tax relief. In this way, the allowance reduces every year the asset it owned.

56 Based on information available on the Energy Saving Trust website: http://www.energysavingtrust.org.uk/aboutest/what/.

57 In 2007, the NAO produced a report on the operation of the Carbon Trust. This concluded that the company was providing value for money overall. However, it also suggested that the Carbon Trust is restricted in its ability to target UK businesses in order to generate carbon savings due to European Union rules on State Aid. It recommended that the Carbon Trust finds a way to target a larger proportion of businesses in the UK, and that it builds stronger links with overseas organisations developing low carbon technology.

58 Based on information available on the Carbon Trust website: http://www.carbontrust.co.uk/default.ct.

59 BWEA (April-June 2008) *RealPower,* p21, http://www.bwea.com/pdf/realpower/realpower_12.pdf .

60 The Town and Country Planning (General Development Procedure) Order 1995. Statutory Instruments 1999 No. 293 The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999

61 Information provided by BERR.

62 Based on information from the Defra website, available at: http://www.defra.gov.uk/environment/climatechange/uk/business/crc/index.htm.

63 Known as the 'Market Transformation Option'.

64 Based on Defra information available at http://www.parliament.the-stationery-office.co.uk/pa/cm200708/cmselect/cmenvfru/362/8022002.htm, paragraph 1.

65 In the UK, the annual capacity factor for wind power has varied from 24 per cent to 31 per cent with a long term average of over 27 per cent – DUKES 2005 and http://www.eci.ox.ac.uk/publications/downloads/sinden05-dtiwindreport.pdf.

66 Digest of UK Energy Statistics.

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