

Chapter 7

Renewable sources of energy

Introduction

7.1 This chapter provides information on the contribution of renewable energy sources to the United Kingdom's energy requirements. It includes sources that under international definitions are not counted as renewable sources or are counted only in part. This is to ensure that this Digest covers all sources of energy available in the United Kingdom. However, within this chapter the international definition of total renewables is used and this excludes non-biodegradable wastes. The energy uses of wastes are still shown in the tables of this chapter but as "below the line" items. This chapter covers both the use of renewables to generate electricity and the burning of renewable fuels to produce heat either in boilers (or cookers) or in combined heat and power plants.

7.2 The data summarise the results of an ongoing study undertaken by the Future Energy Solutions (FES - part of AEA Technology (AEAT) Environment), on behalf of the Department of Trade and Industry, to update a database containing information on all relevant renewable energy sources in the United Kingdom. This database is called RESTATS, the Renewable Energy STATisticS database.

7.3 The study started in 1989, when all relevant renewable energy sources were identified and, where possible, information was collected on the amounts of energy derived from each source. The renewable energy sources identified were the following: active solar heating; photovoltaics; onshore and offshore wind power; wave power; large and small scale hydro; biofuels; geothermal aquifers. The technical notes at the end of this chapter define each of these renewable energy sources. The database now contains 17 years of data from 1989 to 2005.

7.4 The information contained in the database is collected by a number of methods. For larger projects, an annual survey is carried out in which questionnaires are sent to project managers. For technologies in which there are large numbers of small projects, the values given in this chapter are estimates based on information collected from a sub-sample of the projects. Further details about the data collection methodologies used in RESTATS, including the quality and completeness of the information, are given in the technical notes at the end of this chapter.

7.5 Commodity balances for renewable energy sources covering each of the last three years form the first three tables (Tables 7.1 to 7.3). These are followed by 5-year tables showing capacity of, and electricity generation from, renewable sources (Table 7.4), and generation from sources eligible for the Renewables Obligation and sources qualifying under the Renewables Directive (Table 7.5). Table 7.6 summarises all the renewable orders and Table 7.7 shows renewable sources used to generate electricity and heat in each of the last five years. A long-term trends commentary and table (Table 7.1.1) covering the use of renewables to generate electricity and heat is available on DTI's energy statistics web site and accessible from the Digest of UK Energy Statistics home page: www.dti.gov.uk/energy/statistics/publications/dukes/page29812.html.

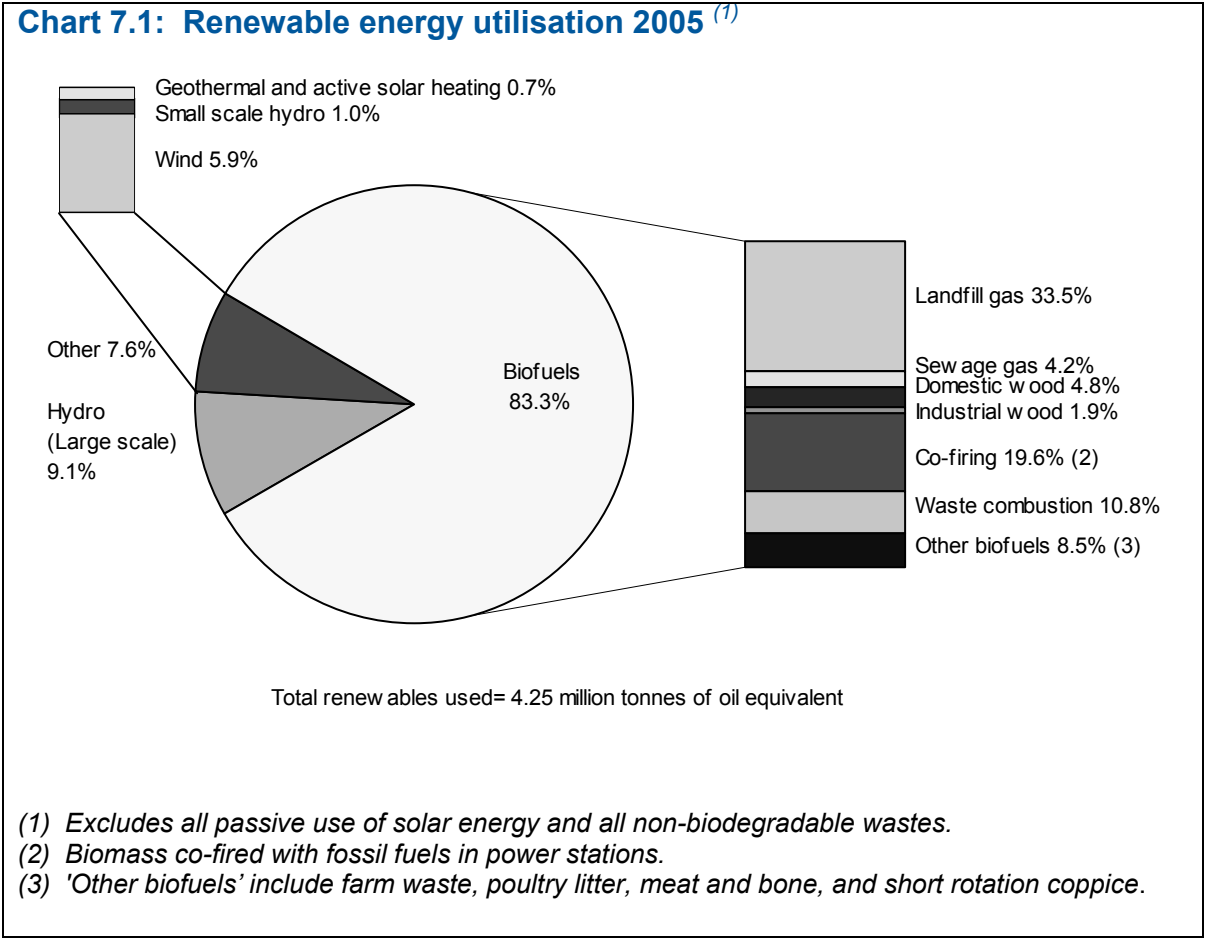
7.6 Unlike in the commodity balance tables in other chapters of the Digest, Tables 7.1 to 7.3 have zero statistical differences. This is because the data for each category of fuel are, in the main, taken from a single source where there is less likelihood of differences due to timing or measurement. These commodity balances do not include biofuels used for transport which are currently part of Chapter 3 of this Digest because they are blended with conventional road transport fuels. However, DTI has a project in hand that will investigate obtaining further statistics about these fuels.

Renewables Obligation and Renewables Directive

7.7 In April 2002 the Renewables Obligation (RO) (and the analogous Renewables Obligation (Scotland)) came into effect¹. It is an obligation on all electricity suppliers to supply a specific proportion of electricity from eligible renewable sources. Eligible sources include all those covered by this chapter but with specific exclusions. These are: existing hydro plant of over 20 MW; all plant

¹ Parliamentary approval of the Renewables Obligation Orders under The Utilities Act 2000 was given in March 2002.

using renewable sources built before 1990 (unless re-furbished and less than 20 MW); and energy from mixed waste combustion unless the waste is first converted to fuel using advanced conversion technology. Only the biodegradable fraction of any waste is eligible (in line with the EU Directive, see paragraph 7.8, below). All stations outside the United Kingdom (the UK includes its territorial waters and the continental shelf) are also excluded. The upper part of table 7.5 shows all the components of total electricity generation on an RO basis. Strictly speaking until 2005, the RO covers only Great Britain, but in these UK based statistics Northern Ireland renewable sources have been treated as if they were also part of the RO.



7.8 The European Union's Renewables Directive (RD) (which came into force in October 2001) has a different definition of eligible renewables. The Directive's definition is the same as the international definition used in this chapter (in that it excludes non-biodegradable wastes). In 2006 the European Commission clarified its definition and as a result imports of electricity generated from renewable sources cannot be included, although such imports will be part of the overall consumption of electricity in the UK which forms the denominator in the calculation of the Renewables Directive percentage (see paragraph 7.12, below). FES has estimated the percentage of municipal solid waste (MSW) that was non-biodegradable for all the years in the RESTATS database. For 2005 the estimate is that 37½ per cent of MSW was non-biodegradable and all of waste tyres (but see paragraph 7.68) and hospital waste. The lower part of Table 7.5 shows the components of total electricity generation on an RD basis.

7.9 In the past the main instruments for pursuing the development of renewables capacity were the Non Fossil Fuel Obligation (NFFO) Orders for England and Wales and for Northern Ireland, and the Scottish Renewable Orders (SRO). In this chapter the term "NFFO Orders" is used to refer to these instruments collectively. For projects contracted under NFFO Orders in England and Wales, the Non Fossil Purchasing Agency (NFPA) provided details of capacity and generation. The Scottish Executive and Northern Ireland Electricity provided information on the Scottish and Northern Ireland NFFO Orders, respectively.

Renewables Targets

7.10 Since February 2000, the United Kingdom's renewables policy has consisted of four key strands:

- a new Renewables Obligation on all electricity suppliers in Great Britain to supply a specific proportion of electricity from eligible renewables;
- exemption of electricity from renewables² from the Climate Change Levy;
- an expanded support programme for new and renewable energy including capital grants and an expanded research and development programme;
- development of a regional strategic approach to planning and targets for renewables.

The aim of the Renewables Obligation (RO) is to increase the contribution of electricity from renewables in the UK so that by 2010, 10 per cent of licensed UK electricity sales should be from renewable sources eligible for the RO, and by 2015 15 per cent should be eligible.

7.11 The EU Directive proposes that Member States adopt national targets for renewables that are consistent with reaching the overall EU target of 12 per cent of energy (22.1 per cent of electricity) from renewables by 2010. The proposed UK "share" of this target is that renewables sources eligible under the RD should account for 10 per cent of UK electricity **consumption** by 2010.

7.12 Chart 7.2 shows the growth in all sources of renewables generation since 1990 and Table 7A gives renewables shares on three different bases for the three most recent years. They show progress towards the RO and RD 10 per cent targets. Generation from all renewables in the UK (on the international definition basis) accounted for 4.22 per cent of UK electricity generation in 2005 (see paragraph 7.16, below). In 2005 the RO percentage showed its largest ever growth in a single year rising by 0.91 percentage points to 4.00 per cent of electricity sales by licensed suppliers. On the basis favoured by the Renewables Directive, the percentage of UK electricity consumption accounted for by RD eligible renewable sources rose from 3.52 per cent in 2004 to 4.14 per cent in 2005. All three percentages are affected by the rate of growth in the respective denominators as well as the numerators. For the overall percentage electricity generation in 2005 rose by just under 1½ per cent, while for the RO percentage there was also an increase of just over 1½ per cent in electricity sales by licensed suppliers. For the RD basis electricity consumption also grew by 1½ per cent in 2005.

Table 7A: Percentages of electricity derived from renewable sources

	2003	2004	2005
Overall renewables percentage (revised to the international basis)	2.67	3.58	4.22
Percentage on a Renewables Obligation basis	2.21	3.09r	4.00
Percentage on a Renewables Directive basis	2.66r	3.52r	4.14

Commodity balances for renewables in 2005 (Table 7.1), 2004 (Table 7.2) and 2003 (Table 7.3)

7.13 Nine different categories of renewable fuels are identified in the commodity balances. Some of these categories are themselves groups of renewables because a more detailed disaggregation could disclose data for individual companies. In the commodity balance tables the distinction between biodegradable and non-biodegradable wastes cannot be maintained for this reason. The largest contribution to renewables in **input** terms (over 83 per cent) is from biofuels, with large-scale hydro electricity production contributing the majority of the remainder as Chart 7.1 shows. Only 7½ per cent of renewable energy comes from renewable sources other than biofuels and large-scale hydro, but this proportion is growing. These include solar, wind, small-scale hydro and geothermal aquifers.

7.14 87 per cent of the renewable energy produced in 2005 was transformed into electricity. This is an increase from 82 per cent in 2004 and 80 per cent in 2003. While biofuels appear to dominate the picture when fuel inputs are being measured, hydro electricity is a larger contributor when the output of electricity is being measured as Table 7.4 shows. This is because on an energy supplied basis (see Chapter 5, paragraph 5.26) hydro (and also wind, wave and solar) inputs are assumed to be equal to the electricity produced. For landfill gas, sewage sludge, municipal solid waste and other

² Electricity generated by hydro stations with a declared net capacity of more than 10 MW is not exempt from the Climate Change Levy.

renewables a substantial proportion of the energy content of the input is lost in the process of conversion to electricity.

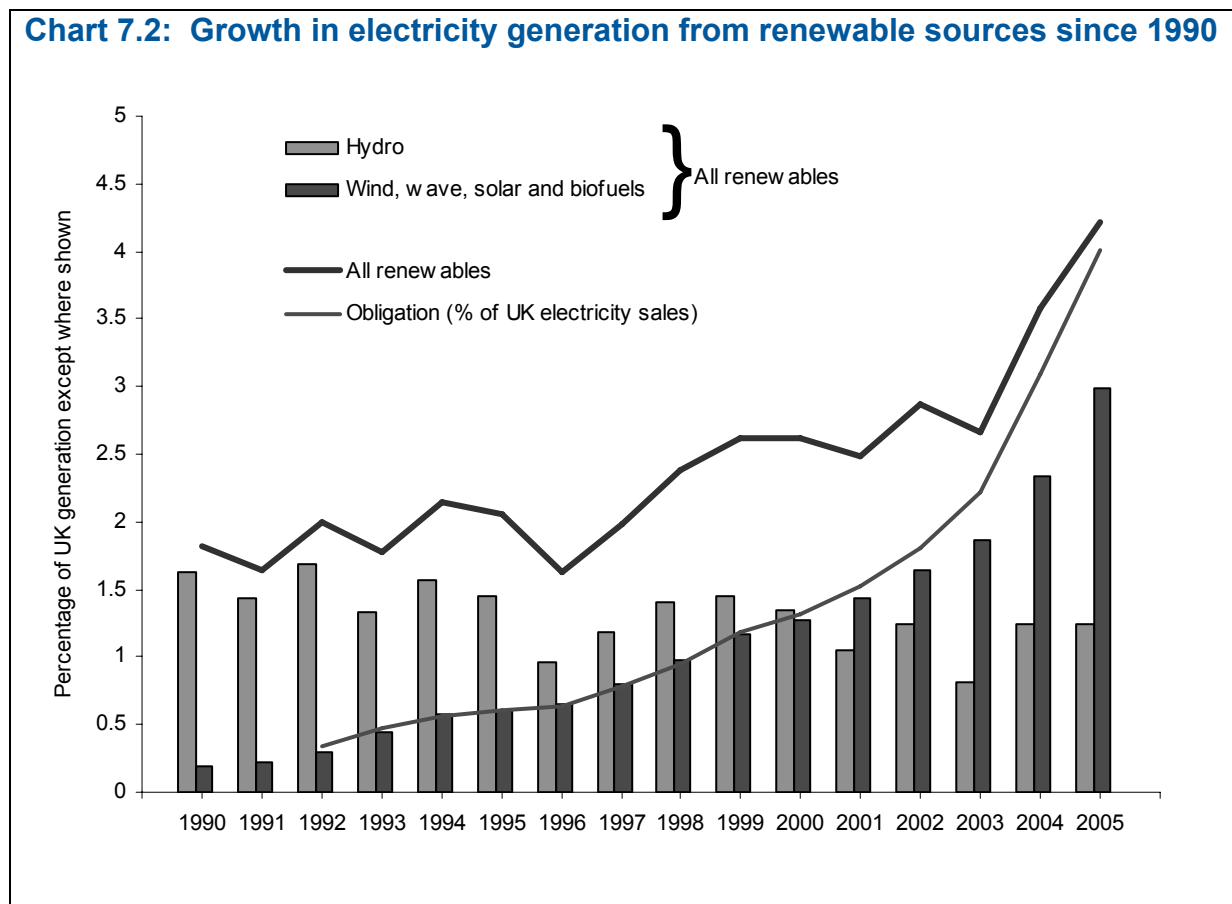
7.15 Overall, renewable sources, excluding passive uses of solar energy, provided 1.9 per cent of the United Kingdom's total primary energy requirements in 2005. This was 0.2 of a percentage point higher than in 2004, which in turn was 0.3 of a percentage point higher than in 2003.

Capacity of, and electricity generated from renewable sources (Table 7.4)

7.16 Table 7.4 shows the capacity of, and the amounts of electricity generated from, each renewable source. Total electricity generation from renewables in 2005 amounted to 16,919 GWh, an increase of 2,748 GWh (+19.4 per cent) on 2004. The main contributors to this substantial increase were 1,511 GWh from co-firing of biomass with fossil fuels (+147.9 per cent), 769 GWh from onshore wind (+44.3 per cent), 287 GWh from landfill gas (+7.2 per cent), 204 GWh from offshore wind (+102.3 per cent), and 185 GWh (+65.7 per cent) from small scale hydro schemes. There was a small decrease (-3.3 per cent) in large scale hydro generation which can be attributed to drier weather. Only 26½ per cent of generation from renewables was from large scale hydro in 2005 compared with 33 per cent in 2004. Hydro (taking both large and small scale together) remains the most important renewables technology in output terms followed by landfill gas, wind (both onshore and offshore) and the co-firing of biomass.

7.17 As a result all renewable sources provided 4.22 per cent of the electricity generated in the United Kingdom in 2005, 0.64 percentage points higher than in 2004. Chart 7.2 shows the growth in the proportion of electricity produced from renewable sources. It includes the progress towards the renewables targets set under the Renewables Obligation and Renewables Directive (see paragraphs 7.10 to 7.12 above and 7.23 below).

Chart 7.2: Growth in electricity generation from renewable sources since 1990

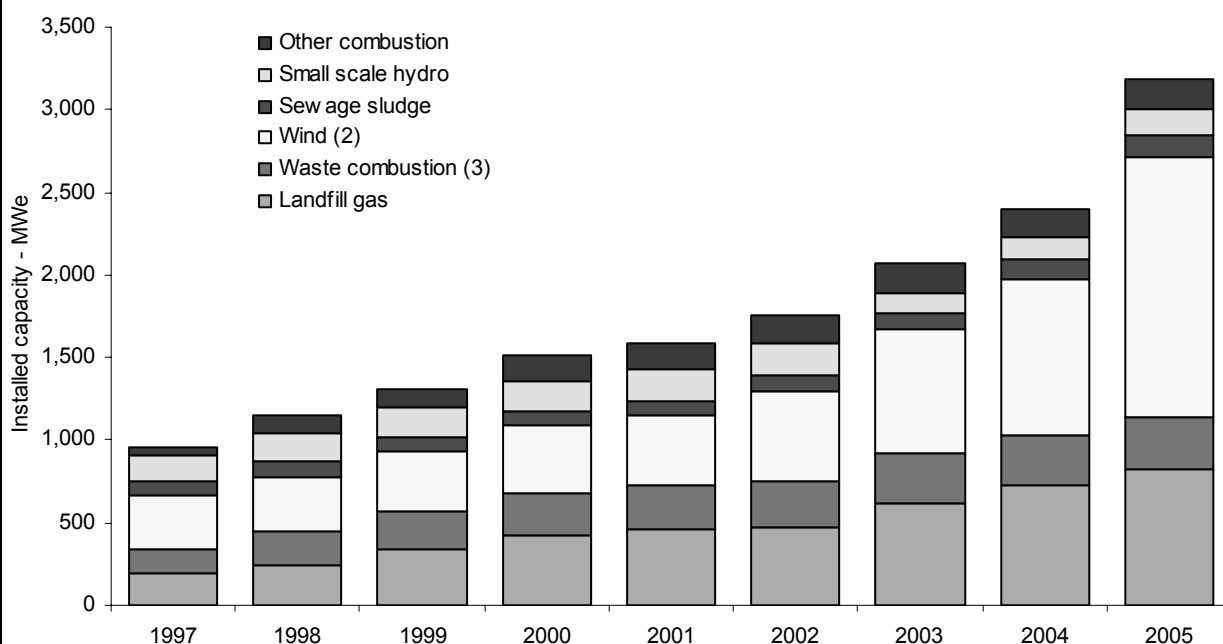


7.18 There was a 21 per cent increase (+772 MWe) in the installed generating capacity of renewable sources in 2005, mainly as a result of a 67 per cent increase (+542 MWe) in onshore wind capacity and a 75 per cent increase (+90 MWe) in offshore wind capacity. There was also a 13 per cent increase (+96 MWe) in the capacity fuelled by landfill gas and a 7½ per cent increase (+9 MWe) in

sewage gas capacity. Large-scale hydro capacity is 6 per cent lower than it was in 2001 as some stations have been adapted to fall within the capacity limits specified by the renewables obligation. The capacity to generate from solar photovoltaics showed a 33 per cent increase and has thus quadrupled in 4 years.

7.19 Chart 7.3 (which covers all renewables capacity except large scale hydro) illustrates the continuing increase in the electricity generation capacity from all significant renewable sources. This upward trend in the capacity of renewable sources will continue as recently consented onshore and offshore windfarms and other projects come on stream.

Chart 7.3: Electrical generating capacity of renewable energy plant (excluding large-scale hydro)⁽¹⁾



(1) Large scale hydro capacity was 1,355 MWe in 2005.

(2) Wind includes both onshore and offshore and also includes solar photovoltaics (10.9 MWe in 2005) and shoreline wave (0.5 MWe in 2005).

(3) All waste combustion plant is included because both biodegradable and non-biodegradable wastes are burned together in the same plant.

7.20 In 2005, (excluding large-scale hydro) 45 per cent of electricity from renewables was generated under NFFO contracts. If ex-NFFO sites (NFFO 1 and 2 in England and Wales – see paragraphs 7.24 to 7.36, below) are included the proportion increases to 58 per cent. Table 7.4, however, includes both electricity generated outside of these contracts and electricity from large-scale hydro schemes and thus reports on total electricity generation from renewables. All electricity generated from renewables is also reported within the tables of Chapter 5 of this Digest (eg Table 5.6).

7.21 Plant load factors in Table 7.4 have been calculated in terms of installed capacity and express the average hourly quantity of electricity generated as a percentage of the average capacity at the beginning and end of the year. In the past the overall figure has been heavily influenced by the availability of hydro capacity during the year, which in turn has been influenced by the amount of rainfall during the preceding period. Low rainfall in the winter of 2002/2003 led to 2003 having lower hydro load factors than in the previous very dry year of 1996. Two factors contributed to the lower load factor for wind in 2003. Firstly 110 MWe was installed late in the year and had little opportunity to contribute to generation. Secondly the long hot summer of 2003 was not as windy as previous years. While both hydro and onshore wind load factors were slightly lower in 2005 than in 2004, the load factor for biofuels fell more substantially, probably because new landfill gas capacity did not begin to operate until late in the year. As a result the overall load factor for renewables and wastes was below

the record level seen on 2004. Plant load factors for all generating plant in the UK are shown in Chapter 5, Table 5.10.

7.22 To overcome the biasing of load factors for wind caused by new turbines coming on stream either early or late in a calendar year, DTI asked FES to calculate a new statistic which appears for the first time in Table 7.4. This statistic is calculated in the same way as the load factor but includes only those wind farms that have operated throughout the calendar year with an unchanged configuration. See paragraphs 7.80 and 7.81 for the full definitions. Originally this new statistic was termed the “capacity factor” to distinguish it from the traditionally calculated load factor, but “capacity factor” is already used as an alternative term for load factor in some countries and its use could lead to confusion. The unchanged configuration load factor for offshore wind is between 1.7 and 2.6 percentage points higher than the conventionally calculated load factor in each of the 3 most recent years.

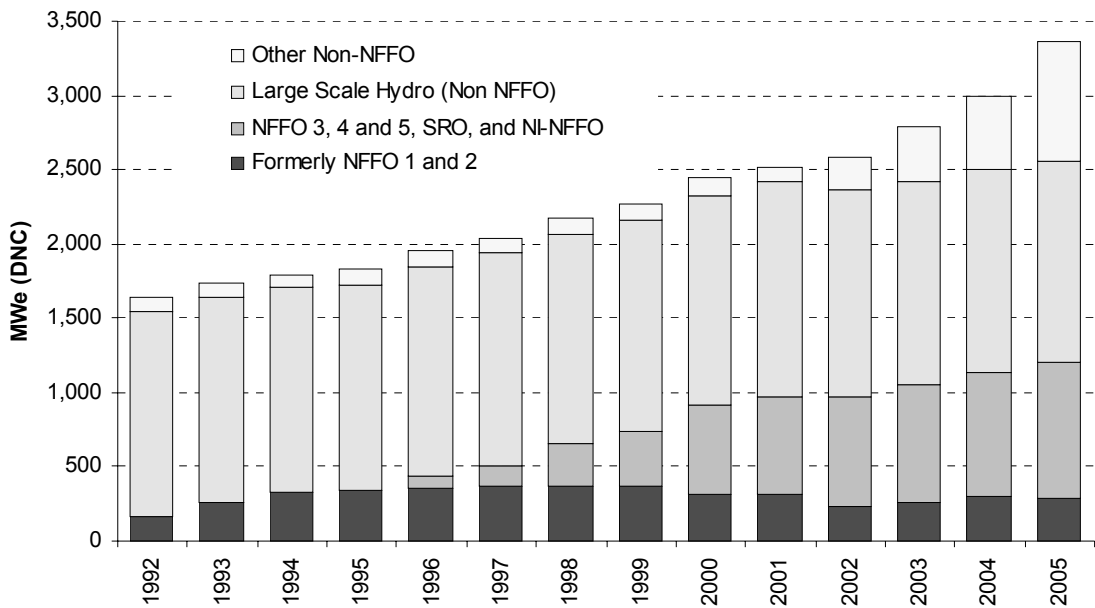
Electricity generated from renewable sources; Renewables Obligation and Renewables Directive bases (Table 7.5)

7.23 Electricity generated in the UK from renewable sources eligible under the Renewables Obligation in 2005 was 32 per cent greater than in 2004. This compares with growth of 39 per cent in 2004, 25 per cent in 2003 and 18 per cent in 2002. Electricity generated in the UK from renewable sources eligible under the Renewables Directive in 2005 was 19 per cent greater than in 2004. This compares with growth of 33 per cent in 2004, a 4 per cent fall in 2003 and growth of 17 per cent in 2002. Chart 7.2 shows the growth in the proportion of electricity produced from renewable sources under the Renewables Obligation and international definitions.

Renewable orders and operational capacity (Table 7.6)

7.24 In 1990, the first year of NFFO, projects contracted within NFFO accounted for about 32 per cent of the total capacity (excluding large-scale hydro). This percentage rose to a peak in 2001 of 91 per cent. Following the introduction of the Renewables Obligation it fell back as new capacity eligible for the RO outweighed the growth in NFFO 3, 4 and 5 and SRO and NI-NFFO projects, so that the NFFO capacity proportion (excluding large scale hydro) had decreased to 70 per cent in 2004 and fell further to 60 per cent in 2005. Fifteen new NFFO schemes totalling 70 MW (DNC) came on line during 2005. These trends are shown in Chart 7.4.

Chart 7.4: Renewable generating capacity from NFFO and former NFFO contracts (including equivalents in Scotland and Northern Ireland) and capacity outside of NFFO



(a) Non Fossil Fuel Obligation (NFFO)

7.25 The 1989 Electricity Act empowered the Secretary of State to make orders requiring the Regional Electricity Companies in England and Wales (the RECs) to secure specified amounts of electricity from renewable energy sources.

7.26 Five NFFO Orders were made, of which the first in 1990 was set for a total of 102 MW DNC. This first order resulted in contracts for 75 projects for 152 MW DNC and provided a premium price for the electricity produced which was funded from a levy on electricity sales in England and Wales. (The bulk of this levy was used to support electricity from nuclear stations).

7.27 The second Order, made in late 1991, was set for 457 MW DNC. This resulted in 122 separate contracts (for a total of 472 MW DNC) between the generators and the Non-Fossil Purchasing Agency (NFPA), which acted on behalf of the RECs. For landfill gas, sewage gas and waste-derived generation contracts were awarded at around 6p/kWh, while for wind-based generation a price of 11p/kWh was established. These prices reflected the limited period for the recovery of capital costs.

7.28 The third Order covers the period 1995 to 2014; this was for 627 MW DNC of contracted capacity at an average price of 4.35 p/kWh. The lower bid prices reflect the longer-term contracts, which are now available together with further developments that have led to improvements in the technologies. Taking into account factors such as the failure to gain planning permission it is estimated that about 300-400 MW DNC are likely to go forward for commissioning.

7.29 The fourth Order was announced in February 1997. Contracts have been let to 195 projects with a total DNC of 843 MW, at an average price of 3.46 p/kWh. In the fifth and largest Order, which was announced in September 1998, contracts have been let to 261 projects with a total DNC of 1,177.1 MW, at an average price of 2.71 p/kWh.

7.30 Since the expiry of the NFFO 1 and 2 contracts on 31 December 1998, these projects are no longer included in the monitoring of NFFO Orders and DTI no longer receives any status/output data on them from the NFPA. For some of these projects operational data have been obtained from other sources, while for the others estimates have been made based on output in 1998. From 2002 another source of information became available in the form of the Renewables Obligation data. This enabled Future Energy Solutions to identify which former NFFO 1 and 2 schemes were applying for ROCs and therefore were still running. Of the 114 NFFO 1 and 2 projects identified in this way as still live, 42 were contracted under the first order and 72 under the second order. It is appreciated that there may be some ex NFFO 1 and 2 schemes that are continuing to operate but whose output is too small to qualify for ROCs or which may need to re-furbish in order to qualify for ROCs. To that extent the estimates of NFFO capacity may be an underestimate.

7.31 As at the end of December 2005, 87 projects in the third Order were operational, with total capacities of 340 MW DNC. There were also 88 schemes with a capacity of 242 MW DNC commissioned from the fourth Order projects and 89 schemes totalling 178 MW DNC from the fifth Order. Table 7.6 sets out the technologies and capacities of schemes in all five Orders.

(b) Scottish Renewable Order (SRO)

7.32 In Scotland, the first Renewables Order was made in 1994 for approximately 76 MW DNC of new capacity and comprising 30 schemes. Four generation technology bands were covered; 12 wind, 15 hydro, two waste-to-energy and one biomass. At the end of December 2005, 20 schemes were commissioned with a capacity of 49 MW DNC.

7.33 A second SRO was launched in 1995 and was made in March 1997 for 114 MW DNC of new capacity comprising 26 schemes, 9 of which were waste to energy projects, 9 were hydro projects, 7 were wind projects and one was a biomass project. Under this Order, at the end of 2005 there were 13 commissioned schemes with a capacity of 50 MW DNC.

7.34 A third SRO was laid before Parliament in February 1999 for 145 MW DNC of new capacity comprising 53 schemes. Sixteen of these were waste to energy projects, 5 were hydro projects, 28 were wind projects, one was a biomass project and 3 were wave energy projects. Under this Order, at

the end of 2005 there were 17 commissioned schemes with a capacity of 35 MW DNC. Table 7.6 sets out the technologies and capacities of schemes in all three Scottish Orders.

(c) Northern Ireland Non Fossil Fuel Obligation (NI NFFO)

7.35 In Northern Ireland, a first Order was made in March 1994 for approximately 16 MW DNC comprising 20 schemes. The contracted schemes were spread throughout Northern Ireland and were divided into three technology bands. There were 6 wind schemes of around 2 MW DNC each, totalling 12.7 MW DNC; 5 sewage gas projects totalling 0.56 MW DNC; and 9 small-scale hydro schemes totalling 2.4 MW DNC. At the end of 2005, 15 schemes were commissioned with a capacity of 15 MW DNC.

7.36 A second NI Order was made in 1996 for 10 schemes, totalling 16 MW DNC. These comprised two wind schemes, two hydro schemes, two biomass, one biogas, two landfill gas and one municipal and industrial waste scheme, as shown in Table 7.6. At the end of 2005, 5 schemes were commissioned with a capacity of 3 MW DNC.

Renewable sources used to generate electricity and heat (Table 7.7)

7.37 Between 2004 and 2005 there was an increase of 21½ per cent in the **input** of renewable sources into electricity generation. Biofuels grew by 23 per cent, and wind by 52 per cent, but hydro grew by only ½ per cent.

7.38 Compared with 5 years earlier in 2000 total inputs to electricity generation have doubled aided by 123 per cent growth in the use of biofuels and a tripling of the use of wind.

7.39 Table 7.7 also shows the contribution from renewables to heat generation. Renewables used to generate heat are now only just over half the level they were 9 years earlier in 1996. The decline is mainly due to tighter emissions controls discouraging on-site burning of biofuels, especially wood waste, although domestic and industrial use of wood and wood waste still provide the main contribution. However the use of active solar heating has increased by 165 per cent in the last 5 years and the use of heating from biodegradable wastes has increased by 36 per cent over the same period.

Technical notes and definitions

7.40 Energy derived from renewable sources is included in the aggregate energy tables in Chapter 1 of this Digest. The main commodity balance tables (Tables 7.1 to 7.3) present figures in the common unit of energy, the tonne of oil equivalent, which is defined in Chapter 1 paragraph 1.24. The gross calorific values and conversion factors used to convert the data from original units are given on page 206 of Annex A and inside the back cover flap. The statistical methodologies and conversion factors are in line with those used by the International Energy Agency and the Statistical Office of the European Communities. Primary electricity contributions from hydro and wind are expressed in terms of an electricity supplied model (see Chapter 5, paragraph 5.26). Electrical capacities in this chapter are quoted as Installed capacities. However, in Chapter 5 Declared Net Capacity (DNC) of renewables is used when calculating the overall UK generating capacity. DNC takes into account the intermittent nature of the power output from some renewable sources (see paragraph 7.78, below).

7.41 The various renewable energy sources are described in the following paragraphs. This section also provides details of the quality of information provided within each renewables area, and the progress made to improve the quality of this information. While the data in the printed and bound copy of this Digest cover only the most recent 5 years, these notes also cover data for earlier years that are available on the DTI web site.

Use of existing solar energy

7.42 Nearly all buildings make use of some passive solar energy because they have windows or roof lights, which allow in natural light and provide a view of the surroundings. This existing use of passive solar energy is making a substantial contribution to the energy demand in the UK building stock. Passive solar design (PSD), in which buildings are designed to enhance solar energy use, results in additional savings in energy. The installed capacity of PSD in the UK and other countries can only be estimated and is dependent on how the resource is defined. The unplanned benefit of solar energy for heating and lighting in UK buildings is estimated to be 145 TWh/year. The figure is very approximate and, as in previous years, has therefore not been included in the tables in this chapter. Only a few thousand buildings have been deliberately designed to exploit solar energy – a very small proportion of the total UK building stock. It has been estimated that the benefit of deploying PSD in these buildings is equivalent to a saving of about 10 GWh/year.

Active solar heating

7.43 Active solar heating employs solar collectors to heat water mainly for domestic hot water systems but also for swimming pools and other applications. Updated figures have been obtained by FES (on behalf of the Department of Trade and Industry). For 2005 an estimated 77.1 GWh for domestic hot water generation replaces gas heating; for swimming pools, an estimated 172.4 GWh generation for 2005 replaces gas (45 per cent), oil (45 per cent) or electricity (10 per cent).

Photovoltaics

7.44 Photovoltaics (PV) is the direct conversion of solar radiation into direct current electricity by the interaction of light with the electrons in a semiconductor device or cell. There has been a significant increase in capacity and generation of PV over the last year due to increased support from the Government. There is a Major Photovoltaic Demonstration Programme offering grants for small, medium and large-scale installations, which is encouraging a significant number of new projects. This programme supported 80 per cent of the new PV capacity. The installed capacity increased from 8.2 MW in 2004 to 10.9 MW in 2005.

Onshore wind power

7.45 A wind turbine extracts energy from the wind by means of a rotor fitted with aerodynamic-section blades using the lifting forces on the blades to turn the rotor primary shaft. This mechanical power is used to drive an electrical generator. The figures included for generation from wind turbines are based on actual metered exports from the turbines and, where these data are unavailable, are based on estimates using regional load factors (see paragraphs 7.80 and 7.81 regarding load factors) and the wind farm installed capacity.

7.46 There are 277 wind farms or separately registered wind projects in the RESTATS database. Of these projects, 73 are under a current NFFO contract totalling 504.8 MW. There are an additional

27 ex-NFFO schemes accounting for a further 145.2 MW, of which 25 (144.6 MW) are now claiming ROCs. NFFO and ex-NFFO schemes account for 48.1 per cent of the UK installed capacity. A further 683.8 MW of wind power (63 schemes) claim ROCs with the remainder not receiving any form of subsidy. Wind power installations in the UK continue at pace with 577MW of onshore turbines being constructed in 2005.

Offshore wind power

7.47 The UK's offshore wind resource is vast, with the potential to provide more than the UK's current demand for electricity. Offshore wind speeds are higher than those onshore (typically up to 0.5m/s higher 10 km offshore) and also less turbulent. However, elevated inland sites can have higher wind speeds.

7.48 Due to the higher costs of installing each turbine offshore it is expected that, in general, the machines will be larger than their onshore counterparts (2 MW and above). This is driven by economics, with larger machine more cost effective per unit of electricity generated. The larger turbines also experience higher wind speeds, because taller towers put the rotors into the stronger winds. In addition, onshore constraints such as planning, noise effects and visual impact are likely to be reduced offshore. As of December 2005 there were 4 operational offshore wind farms totalling 213.8 MW. These were Blyth, North Hoyle, Scroby Sands and Kentish Flats. The last named is 90 MW and was commissioned in September 2005.

Wave and Tidal Stream Power

7.49 Waves in the oceans are created by the interaction of winds with the surface of the sea. Because of the direction of the prevailing winds and the size of the Atlantic Ocean, the United Kingdom has wave power levels, which are amongst the highest in the world. Under the DTI's shoreline programme a 75kW experimental prototype an oscillating water column device came on line in late 1991 on the Hebridean island of Islay but was decommissioned in 1999. Currently in the UK there is one grid connected wave device, the Limpet oscillating water column, also on the isle of Islay, which is a successor to the 75kW device. Limpet has a nameplate capacity of 500kW and was expected to produce an annual average output of approximately 200kW. In fact it has only produced approximately one tenth of this because the seabed profile in front of the machine was shallower than expected. A number of other wave devices are currently under development, most notably the Pelamis - an articulated tube with sections linked by hinged joints - being developed since 1998 by Edinburgh-based Ocean Power Delivery Ltd. A full-scale prototype has undergone a number of sea trials including 200 hours of grid-connected operation in 2004. The DTI has recently launched the Wave and Tidal-stream Energy Demonstration Scheme that provides a 25 per cent capital grant and £100 per MWh additional revenue support for multi-device farms. This is expected to lead to the deployment of a number of wave farms in the next few years.

7.50 Tidal currents are created by the movement of the tides, often magnified by local topographical features such as headlands, inlets to inland lakes, and straits. Tidal current energy is the extraction of energy from this flow, analogous to the way a wind turbine operates in air. A recent study estimated that the available UK resource is up to 22 TWh per year. Since 2000 the DTI's Technology Programme has supported the development of a number of concepts. A number of tidal current devices are currently emerging from their R&D phases and some of these may lead to pre-commercial farms under the DTI's new Wave and Tidal-stream Energy Demonstration Scheme. To-date, two device concepts have had full-scale prototypes deployed at sea. The first is the Seaflow machine that was installed by Bristol-based Marine Current Turbines Ltd near Lynmouth in June 2003. This has not yet been decommissioned but is not grid-connected and only operates during specific tests. The other device was the Stingray, which uses an oscillating hydrofoil instead of a rotating turbine, developed by Northumberland-based The Engineering Business Ltd (EB). The 180 tonne device was installed in Yell Sound, Shetland, in September 2002 and again in 2003. After analysing the results of these tests and the costs of building the machine, EB decided to put its development on indefinite hold.

7.51 The only commercial facilities operating by 2010 are likely to be those constructed under the DTI's Wave and Tidal-stream Energy Demonstration Scheme. These are not expected to amount to more than around 20 MW of capacity in total, the majority of which will come on stream after 2010. The costs of wave and tidal-current technologies are still much too high to enable profitable operation under current or foreseeable future market conditions. Although all new technologies generally reduce

in cost with cumulative production, it is not clear that these technologies, particularly wave, will be able to achieve sufficiently low costs without a large step change. Their long term prospects will become much clearer after the first deployments under the DTI's new Wave and Tidal-stream Energy Demonstration scheme have begun to deliver results.

Large scale hydro

7.52 In hydro schemes the turbines that drive the electricity generators are powered by the direct action of water either from a reservoir or from the run of the river. Large-scale hydro covers plants belonging to companies with capacity of 5 MWe and over. Most of the plants are located in Scotland and Wales and mainly draw their water from high-level reservoirs with their own natural catchment areas. Major Power Producers (MPPs) report their output to the Department of Trade and Industry in DTI's regular electricity surveys. Prior to 2004 these data were submitted in aggregate form and not split down by size of scheme. This meant that some small-scale schemes were hidden within the generation data for the large-scale schemes. For 2004 and 2005 MPPs have provided a more detailed breakdown of their data and some smaller sites previously included under "large scale" are for 2004 and 2005 under "small scale". There is some 1,355 MW of installed capacity for large-scale hydroelectric schemes in the UK. The coverage of these large-scale hydro figures is the same as that used in the tables in the Chapter 5 of this Digest. The data in this Chapter exclude pumped storage stations (see paragraph 5.49).

Small scale hydro

7.53 Electricity generation schemes with a hydro capacity below 5 MWe are classified as small scale. These are schemes being used for either domestic/farm purposes or for local sale to electricity supply companies. A new survey of small-scale hydro sites was carried out in 2004 giving a more detailed picture of the current situation. The survey concentrated on the non-NFFO and non-RO funded small-scale hydroelectric sites. Small-scale hydro capacity has decreased compared with previous years despite some re-allocation to small scale of schemes belonging to major power producers (see paragraph 7.52, above). This is through a combination of some scheme closures coupled with others re-powering and being elevated into the large-scale hydro band. In addition, extra work has been put in to improve confidence in the data, which has resulted in the identification and removal of incorrect and duplicated entries. Despite this reconciliation and drop in capacity, the number of small-scale sites identified in 2005 shows an 8 per cent growth compared to 2004. Data given for generation are actual figures where available, but otherwise are estimated using a typical load factor (based on NFFO schemes actual data). The variation in the time-series generation figures primarily reflects the variation in precipitation.

Geothermal aquifers

7.54 Aquifers containing water at elevated temperatures occur in some parts of the United Kingdom at between 1,500 and 3,000 metres below the surface. This water can be pumped to the surface and used, for example, in community heating schemes. There is currently only one scheme operating in the UK at Southampton.

Biofuels

(a) Landfill gas

7.55 Landfill gas is a methane-rich biogas formed from the decomposition of organic material in landfill. The gas can be used to fuel reciprocating engines or turbines to generate electricity or used directly in kilns and boilers. In other countries, the gas is cleaned to pipeline quality or used as a vehicle fuel. Landfill gas exploitation has benefited considerably from the NFFO and this can be seen from the large rise in the amount of electricity generated since 1992. Further commissioning of landfill gas projects under NFFO will continue to increase the amount of electricity generated from this technology. Ofgem's ROCs database also provides details of landfill gas sites claiming ROCs. Information on landfill gas was supplemented by a RESTATS survey carried out by FES in 2004 on behalf of the DTI, and covered the period up to the end of 2004. In 2005, 29 new schemes came on line under NFFO.

(b) Sewage sludge digestion

7.56 In all sewage sludge digestion projects, some of the gas produced is used to maintain the optimum temperature for digestion. In addition, many use combined heat and power (CHP) systems. The electricity generated is either used on site or sold under the NFFO. Information from these projects was provided from the CHAPSTATS Database, which is compiled and maintained by FES on

behalf of the Department of Trade and Industry (see Chapter 6). Within the CHAPSTATS database the majority of the data are gathered through the CHPQA Programme and the DTI's Electricity Generated Inquiry (EGI). However, many sewage treatment works are not part of the CHPQA Programme and data provided to the EGI is often in a consolidated form where data on multiple sites are amalgamated. For these reasons, a large proportion (>90%) of the sewage treatment data in CHAPSTATS was based upon historical records. To improve the quality of this data set, from 2005 onwards data on sewage treatment plant are based upon electricity generation figures provided to Ofgem via the NFFO and ROC registers.

(c) Domestic wood combustion

7.57 Domestic wood use includes the use of logs in open fires, "AGA"-type cooker boilers and other wood burning stoves. The figure given is an approximate estimate based on a survey carried out in 1989. The Forestry Commission carried out a survey of domestic wood fuel use in 1997 but the results from this were inconclusive. As an upper limit, about 600,000 oven-dried tonnes (ODTs) were estimated to be available for domestic heating. In 2001, FES undertook a study of UK domestic wood use on behalf of DTI. A methodology was devised for surveying the three major sectors involved in wood use – the stove or boiler supplier, the wood supplier and the end user. Questionnaires were devised for all these parties and then attempts were made to contact representative samples in the various regions of the UK. From the evidence obtained via the questionnaires and telephone interviews we believe that the domestic wood burning market is growing but not in the area of wood as the primary heat source. This still remains a relatively small market and a small percentage of the wood burnt. Unfortunately, the survey was unable to provide statistically sound evidence as to the amount of wood used in the domestic sector and although it was felt that there has been a small increase in the domestic use of wood as a fuel, on the basis of the results of the approach, FES could not justify modifying the current estimate for the UK. In view of the importance attached to finding out about domestic wood use, the Forestry Commission has therefore decided to undertake another study guided by the lessons learnt from the previous work. In particular they would approach the newly emerging wood cooperatives, as they are likely to be a good source of information now that they should be more well established, the National House-Building Council (NHBC) to examine new build and treating equipment suppliers, fuel suppliers and users under separate surveys. In 2005, as part of an omnibus survey, a pilot study was undertaken in Scotland by the Forestry Commission to assist in developing the correct methodology prior to a National survey but unfortunately the response rate was poor. Preliminary results suggest that current usage may be slightly less than in 1997; estimates based on population data imply 588,000 ODTs per year, whereas an estimate based on numbers of households suggests 550,000 ODTs per year.

(d) Industrial wood combustion

7.58 In 1997, the industrial wood figure (which includes sawmill residues, furniture manufacturing waste etc.) was included as a separate category for the first time. This was due to the availability of better data as a result of a survey carried out in 1996 on wood fired combustion plants above 400 kW thermal input. A follow-up survey was subsequently carried out for 2000. This survey highlighted that there were fewer sites (174) operating than in 1996 due to the imposition of more stringent emissions control. A survey of industrial wood use carried out in 2006, for schemes above 400 kW thermal input, concluded that in-house use of wood waste continued to be in decline. There is, however, increased interest in off-site use of untreated wood for space heating in schools, hospitals, nursing homes, government buildings, etc. The Port Talbot Bioenergy Plant, a 13.7 MW electric scheme involving untreated wood, is due to be commissioned in 2008. Untreated wood will increasingly form a major fuel input to schemes involving energy crops; this is further discussed in the next section.

(e) Energy crops

7.59 Short rotation willow coppice plantations have become well established but the rate of uptake of the technology has been fairly slow. Interest has also been shown in Miscanthus. Under Northern Ireland's second Non-Fossil Fuel Renewable Energy order for electricity, two projects were live at the end of 2005.

7.60 In England, Project ARBRE in South Yorkshire was contracted under NFFO 3 to generate 10 MW of electricity of which 8 MW were to be exported to the local grid. This project ran into difficulties and was sold to new owners who are still evaluating their options on taking the project forward. However, SembCorp Utilities UK has almost completed a 30 MW wood-burning power station, burning 55,000 tonnes a year of short rotation coppice (SRC) at Wilton. It should be commercially operating in

2007. Construction has also begun on a 44MW plant at Steven's Croft near Lockerbie fuelled with wood and SRC (25 per cent). A 2.6MW plant in Eccleshall, burning wood and Miscanthus, is currently being built by Eccleshall Biomass Ltd and due to be commercially operating in 2007. Work has also begun on a CHP plant (7 MW electricity plus 7 MW heat) at Charlton Energy, Somerset fuelled with Miscanthus and sawmill residues; this too is due to come on stream in 2007. In future, it is most likely that all such projects will be fuelled with a mixture of untreated wood plus energy crop as this approach represents a less risky strategy for developers.

(f) Straw combustion

7.61 Straw can be burnt in high temperature boilers, designed for the efficient and controlled combustion of solid fuels and biomass to supply heat, hot water and hot air systems. There are large numbers of these small-scale batch-fed whole bale boilers. The figures given are estimates based partly on 1990 information and partly on a survey of straw-fired boilers carried out in 1993-94. A 37 MW straw fired power station near Ely, Cambridgeshire is currently the only electricity generation scheme in operation.

(g) Waste combustion

7.62 Domestic, industrial and commercial wastes represent a significant resource for materials and energy recovery. Wastes may be combusted, as received, in purpose built incinerators or processed into a range of refuse derived fuels for both on-site and off-site utilisation. Only the non-biodegradable portion of waste is counted in renewables statistics although non-biodegradable wastes are included in this chapter as "below the line" items. The paragraphs below describe various categories of waste combustion in greater detail.

7.63 Twenty four waste-to-energy plants were in operation in 2005 burning municipal solid waste (MSW), refuse derived fuel (RDF) and general industrial waste (GIW).

7.64 **Municipal solid waste combustion:** Information was provided from the refuse incinerator operators in the United Kingdom that practice energy recovery using the RESTATS questionnaire. This included both direct combustion of unprocessed MSW and the combustion of RDF. In the latter, process waste can be partially processed to produce coarse RDF that can then be burnt in a variety of ways. By further processing the refuse, including separating off the fuel fraction, compacting, drying and densifying, it is possible to produce an RDF pellet. This pellet has around 60 per cent of the gross calorific value of British coal. The generation from MSW has been split between biodegradable sources and non-biodegradable sources using information outlined in paragraph 7.65 below. Approximately 62½ per cent of generation from MSW was estimated to be from biodegradable sources. Non-biodegradable municipal solid waste is not included in the overall renewables percentage under the international definition of renewables (see paragraph 7.1). However, such wastes are still shown in the tables accompanying this chapter as 'below the line' items.

7.65 There has been an ongoing programme of waste analysis in the UK for many years; such analyses may be carried out to an accuracy of ± 1 per cent. Such studies are guided by the use of ACORN (A Classification of Residential Neighbourhoods) socio-economic profiles which are used to select sample areas for the analysis of household collected waste and is based on the premise that households of similar socio-economic characteristics are likely to have similar behavioural, purchasing and lifestyle characteristics; this will be reflected in the quantity and composition of waste that those households produce. The large scale study in Wales showed that the only category in domestic waste to show a statistically significant seasonal variation was garden waste; as garden waste is a small percentage (certainly when compared to food and kitchen waste), the effect on the operation of biomass-to-energy plants should be almost unnoticed. As there is now virtually no regional variation to be seen within the UK; these data will probably become the UK standard. UK domestic waste has a biodegradable content of 67½ per cent ± 1 per cent and this accounts for about 62½ per cent of the energy generated from its combustion. Municipal Solid Waste (MSW) comprises of domestic waste plus other feedstocks, such as, general industrial waste, building demolition waste and tree clippings from civil amenities. This has the net effect of reducing the percentage composition of the biodegradable content to 61 per cent ± 1 per cent. Because the combustion properties of some of the other biodegradable materials added is similar to that of domestic waste, this has virtually no effect on the percentage of the energy generated from the biodegradables component, which remains at about 62½ per cent.

7.66 **General industrial waste combustion:** Certain wastes produced by industry and commerce can be used as a source of energy for industrial processes or space heating. These wastes include general waste from factories such as paper, cardboard, wood and plastics.

7.67 A survey conducted in 2001 noted that GIW is now burnt in MSW waste-to-energy facilities. As no sites are solely burning GIW for heat or electricity generation, this feedstock is being handled under the MSW category.

7.68 **Specialised waste combustion:** Specialised wastes arise as a result of a particular activity or process. Materials in this category include scrap tyres, hospital wastes, poultry litter, meal and bone and farm waste digestion. Although the large tyre incineration plant with energy recovery has not generated since 2000 the cement industry has burned some waste tyres in its cement and lime kilns. Although part of waste tyre combustion is of biodegradable waste, because there is no agreed method of calculating the small biodegradable content, all of the generation from waste tyres has been included under non-biodegradable wastes in this chapter (see paragraph 7.65, above).

7.69 In 2005 information on hospital waste incineration was supplemented by a RESTATS survey, carried out by FES in 2004 on behalf of DTI, and covered a period up to the end of 2003. The survey confirmed whether the older sites were still operating, and identified any new operating facilities. Information on both their thermal and electrical outputs between 2000 and 2003 were gathered where data were available. There were no major changes, as the sector appeared to have stabilised since the introduction of the new emission legislation. There may, however, be future changes due to the appearance of new technologies, such as microwave treatment, and increased segregation of clinical waste.

7.70 One poultry litter combustion project started generating electricity in 1992; a second began in 1993. Both of these are NFFO projects. In addition, a small-scale CHP scheme began generating towards the end of 1990 however this has now closed due to new emissions regulations. A further NFFO scheme started generating in 1998, and during 2000 an SRO scheme began to generate. Over the most recent 5 years one of the earlier poultry litter projects was fuelled mainly by meat and bone. A further poultry litter scheme became fully operational in 2001.

7.71 Information on farm waste digestion in the United Kingdom is based on a survey carried out during 1991-1992 with follow-up studies in 1996 and 2005. There was a farm digestion project generating electricity under the NFFO; its output was included in the commodity balances but ceased to operate in 1998. In 2003, however, a large centralised anaerobic digestion scheme (Holsworthy) generating electricity under NFFO 5 came on-line. With the exception of this scheme, data collected from the surveys were used to derive estimates for 1997 through to 2004. The 2005 survey has shown that number of sites using farm waste digestion fell significantly since 1996, which was mainly attributed to tightening waste regulations and lack of maintenance. However, this has not prevented new digesters being built and commissioned in 2005.

(h) Co-firing of biomass with fossil fuels

7.72 Co-firing of biomass fuel in fossil fuel power stations is not a new idea. Technically it has been proven in power stations worldwide, although, until 2002, it was not practised in the UK. The biomass fuel is usually fed by means of the existing stoking mechanism as a partial substitute for the fossil fuel. The combustion system may cope with up to a 25 per cent substitution without any major changes to the boiler design and airflows, but fuel preparation and transport systems may be the limiting feature at percentages much lower than this.

7.73 Since 2002, co-firing of biomass with fossil fuels has been eligible under the RO, the first time that any renewable energy initiative has included co-firing. As the purpose of this was to enable markets and supply chains for biomass to develop, and not to support coal fired power stations, the following limits were placed on co-firing:

- only electricity generated before 1 April 2011 would be eligible;
- from 1 April 2006 at least 75 per cent of the biomass must consist of energy crops.

7.74 However, the scheme has now been extended to allow longer for an energy crop market to develop, through establishing biomass operations at co-fired stations. The key changes are as follows:

- fossil fuel stations are allowed to convert to biomass without refurbishment;
- any biomass can be co-fired until 31 March 2009 with no minimum percentage of energy crops;
- 25 per cent of co-fired biomass must be energy crops from 1 April 2009 until 31 March 2010;
- 50 per cent of co-fired biomass must be energy crops from 1 April 2010 until 31 March 2011;
- 75 per cent of co-fired biomass must be energy crops from 1 April 2011 until 31 March 2016.
Co-firing ceases to be eligible for ROCs after this date.

To balance the above changes and reduce the risk of flooding the ROC market with co-firing ROCs, thereby affecting ROC prices and investor confidence adversely, it is proposed that the 25 per cent cap from 1 April 2006 on an individual supplier should be changed to:

- 10 per cent from 1 April 2006 until 31 March 2011;
- 5 per cent from 1 April 2011 until 31 March 2016.

(i) Biodiesel and bioblend

7.75 In the UK biodiesel is defined for taxation purposes as diesel quality liquid fuel produced from biomass or waste cooking oil, the ester content of which is not less than 96.5 per cent by weight and the sulphur content of which does not exceed 0.005 per cent by weight or is nil. Diesel fuel currently sold at a number of outlets is a blend with 5 per cent biodiesel. The use of biofuels in the UK, an estimated 445,000 tonnes in 2005, continues to grow. A plant in Motherwell, Scotland is currently producing 40-50,000 tonnes of biodiesel a year and a 250,000 tonnes per year plant on Teesside was still under construction in 2005. A 100,000 tonnes per year plant is under construction at Immingham, near Hull and is due to come on line at the end of 2006. The most usual way for biodiesel to be sold is for it to be blended with ultra-low sulphur diesel fuel and thus it would be reported as part of the road transport use of diesel in Chapter 3. The duty payable on biodiesel is just over half the duty payable on road diesel and in blended fuels the duty payable is proportionate to the duty payable on the constituent fuels. There are currently plans under consideration in the UK for the construction of a bio-ethanol plant.

Combined Heat and Power

7.76 A Combined Heat and Power (CHP) plant is an installation where there is a simultaneous generation of usable heat and power (usually electricity) in a single process. Some CHP installations are fuelled either wholly or partially by renewable sources of energy. The main renewable sources that are used for CHP are biofuels particularly sewage gas.

7.77 Chapter 6 of this Digest summarises information on the contribution made by CHP to the United Kingdom's energy requirements in 2001 to 2005 using the results of annual studies undertaken to identify all CHP schemes. Included in Tables 6.1 to 6.9 of that chapter is information on the contribution of renewable sources to CHP generation in each year from 2001 to 2005. Corresponding data for 1996 to 2000 are available on the DTI energy web site. The information contained in those tables is therefore a subset of the data contained within the tables presented in this chapter.

Generating capacity and load factor

7.78 The electrical capacities are given in Table 7.4 as installed capacities ie the maximum continuous rating of the generating sets in the stations. In Chapter 5 DNC (Declared Net Capacity) is used, ie the maximum continuous rating of the generating sets in the stations, less the power consumed by the plant itself, and reduced by a specified factor to take into account the intermittent nature of the energy source e.g. 0.43 for wind and 0.33 for shoreline wave. DNC represents the nominal maximum capability of a generating set to supply electricity to consumers. For electrical capacities of generation using renewables in DNC terms see Table 7.1.1 on the DTI energy web site.

7.79 Plant load factors in this chapter have been calculated in terms of installed capacity (ie the maximum continuous rating of the generating sets in the stations) and express the average hourly quantity of electricity generated as a percentage of the average of the capacities at the beginning and end of the year.

7.80 In this year's Digest a new term has been introduced to describe the amount of electricity generated from wind farms compared with the amount that such turbines would have generated had they been available for the whole of the calendar year and running continually and at maximum output throughout the calendar year. This term is "load factor on an unchanged configuration basis". A full account of the exercise to derive these factors can be found in *Energy Trends*, March 2006 pages 28

to 32. *Energy Trends* is available on the DTI energy web site at www.dti.gov.uk/energy/statistics/publications/trends/index.html, although here the term “capacity factor” was used. Load factors on an unchanged configuration basis for offshore windfarms cannot be given at this time because the small number of sites would lead to the disclosure of statistical information provided in confidence for the purpose of calculating overall wind generation statistics.

7.81 To compare the two calculations, the **load factor** for a calendar year (as historically reported in this Digest) is:

$$\frac{\text{Electricity generated during the year (kWh)}}{(\text{Installed capacity at the beginning of the year} + \text{Installed capacity at the end of the year (kW)}) \times 0.5 \times 8760 \text{ hours}}$$

whilst the **load factor on an unchanged configuration basis** for a calendar year is:

$$\frac{\text{Electricity generated during the year (kWh)}}{(\text{Installed capacity of wind farms operating throughout the year with an unchanged configuration (kW)}) \times 8760 \text{ hours}}$$

In addition, because load factors on an unchanged configuration basis are mainly of interest for commercial scale wind power rather than small/micro generation, turbines under 100 kW are excluded and any single turbine of 100 kW or above is considered to be a wind farm.

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7.1 Commodity balances 2005

Renewables and waste

Thousand tonnes of oil equivalent

	Wood waste	Wood	Poultry litter, meat and bone, biomass, straw, farm waste and SRC(3)	Sewage gas	Landfill gas
Supply					
Production	81	204	434	179	1,421
Other sources	-	-	-	-	-
Imports	-	-	755	-	-
Exports	-	-	-	-	-
Marine bunkers	-	-	-	-	-
Stock change (1)	-	-	-	-	-
Transfers	-	-	-	-	-
Total supply	81	204	1,188	179	1,421
Statistical difference (2)	-	-	-	-	-
Total demand	81	204	1,188	179	1,421
Transformation	-	-	1,116	131	1,407
Electricity generation	-	-	1,116	131	1,407
Major power producers	-	-	721	-	-
Autogenerators	-	-	396	131	1,407
Heat generation	-	-	-	-	-
Petroleum refineries	-	-	-	-	-
Coke manufacture	-	-	-	-	-
Blast furnaces	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-
Other	-	-	-	-	-
Energy industry use	-	-	-	-	-
Electricity generation	-	-	-	-	-
Oil and gas extraction	-	-	-	-	-
Petroleum refineries	-	-	-	-	-
Coal extraction	-	-	-	-	-
Coke manufacture	-	-	-	-	-
Blast furnaces	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-
Pumped storage	-	-	-	-	-
Other	-	-	-	-	-
Losses	-	-	-	-	-
Final consumption	81	204	72	48	14
Industry	81	-	-	-	14
Unclassified	81	-	-	-	14
Iron and steel	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-
Mineral products	-	-	-	-	-
Chemicals	-	-	-	-	-
Mechanical engineering, etc	-	-	-	-	-
Electrical engineering, etc	-	-	-	-	-
Vehicles	-	-	-	-	-
Food, beverages, etc	-	-	-	-	-
Textiles, leather, etc	-	-	-	-	-
Paper, printing, etc	-	-	-	-	-
Other industries	-	-	-	-	-
Construction	-	-	-	-	-
Transport	-	-	-	-	-
Air	-	-	-	-	-
Rail	-	-	-	-	-
Road	-	-	-	-	-
National navigation	-	-	-	-	-
Pipelines	-	-	-	-	-
Other	-	204	72	48	-
Domestic	-	204	-	-	-
Public administration	-	-	-	48	-
Commercial	-	-	-	-	-
Agriculture	-	-	72	-	-
Miscellaneous	-	-	-	-	-
Non energy use	-	-	-	-	-

(1) Stock fall (+), stock rise (-).

(2) Total supply minus total demand.

(3) SRC is short rotation coppice and other energy crops.

(4) Municipal solid waste, general industrial waste and hospital waste.

(5) The amount of shoreline waste included is less than 0.1 ktoe.

7.1 Commodity balances 2005 (continued)

Renewables and waste

Thousand tonnes of oil equivalent					
Waste ⁽⁴⁾ and tyres	Geothermal and active solar heat	Hydro	Wind and wave (5)	Total renewables	
					Supply
842	31	427	250	3,868	Production
-	-	-	-	-	Other sources
-	-	-	-	755	Imports
-	-	-	-	-	Exports
-	-	-	-	-	Marine bunkers
-	-	-	-	-	Stock change (1)
-	-	-	-	-	Transfers
842	31	427	250	4,623	Total supply
-	-	-	-	-	Statistical difference (2)
842	31	427	250	4,623	Total demand
691	1	427	250	4,022	Transformation
691	1	427	250	4,022	Electricity generation
89	-	343	-	1,153	Major power producers
602	1	83	250	2,870	Autogenerators
-	-	-	-	-	Heat generation
-	-	-	-	-	Petroleum refineries
-	-	-	-	-	Coke manufacture
-	-	-	-	-	Blast furnaces
-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	Other
-	-	-	-	-	Energy industry use
-	-	-	-	-	Electricity generation
-	-	-	-	-	Oil and gas extraction
-	-	-	-	-	Petroleum refineries
-	-	-	-	-	Coal extraction
-	-	-	-	-	Coke manufacture
-	-	-	-	-	Blast furnaces
-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	Pumped storage
-	-	-	-	-	Other
-	-	-	-	-	Losses
151	30	-	-	600	Final consumption
56	-	-	-	151	Industry
56	-	-	-	151	Unclassified
-	-	-	-	-	Iron and steel
-	-	-	-	-	Non-ferrous metals
-	-	-	-	-	Mineral products
-	-	-	-	-	Chemicals
-	-	-	-	-	Mechanical engineering, etc
-	-	-	-	-	Electrical engineering, etc
-	-	-	-	-	Vehicles
-	-	-	-	-	Food, beverages, etc
-	-	-	-	-	Textiles, leather, etc
-	-	-	-	-	Paper, printing, etc
-	-	-	-	-	Other industries
-	-	-	-	-	Construction
-	-	-	-	-	Transport
-	-	-	-	-	Air
-	-	-	-	-	Rail
-	-	-	-	-	Road
-	-	-	-	-	National navigation
-	-	-	-	-	Pipelines
95	30	-	-	450	Other
23	30	-	-	256	Domestic
51	-	-	-	100	Public administration
10	-	-	-	10	Commercial
2	-	-	-	74	Agriculture
9	-	-	-	9	Miscellaneous
-	-	-	-	-	Non energy use

7.2 Commodity balances 2004

Renewables and waste

Thousand tonnes of oil equivalent

	Wood waste	Wood	Poultry litter, meat and bone, biomass, straw, farm waste and SRC(3)	Sewage gas	Landfill gas
Supply					
Production	196r	204	304r	177	1,327
Other sources	-	-	-	-	-
Imports	-	-	402r	-	-
Exports	-	-	-	-	-
Marine bunkers	-	-	-	-	-
Stock change (1)	-	-	-	-	-
Transfers	-	-	-	-	-
Total supply	196r	204	705r	177	1,327
Statistical difference (2)	-	-	-	-	-
Total demand	196r	204	705r	177	1,327
Transformation	-	-	633r	124	1,313
Electricity generation	-	-	633r	124	1,313
Major power producers	-	-	449	-	-
Autogenerators	-	-	184r	124	1,313
Heat generation	-	-	-	-	-
Petroleum refineries	-	-	-	-	-
Coke manufacture	-	-	-	-	-
Blast furnaces	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-
Other	-	-	-	-	-
Energy industry use	-	-	-	-	-
Electricity generation	-	-	-	-	-
Oil and gas extraction	-	-	-	-	-
Petroleum refineries	-	-	-	-	-
Coal extraction	-	-	-	-	-
Coke manufacture	-	-	-	-	-
Blast furnaces	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-
Pumped storage	-	-	-	-	-
Other	-	-	-	-	-
Losses	-	-	-	-	-
Final consumption	196r	204	72r	53	14
Industry	196r	-	-	-	14
Unclassified	196r	-	-	-	14
Iron and steel	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-
Mineral products	-	-	-	-	-
Chemicals	-	-	-	-	-
Mechanical engineering, etc	-	-	-	-	-
Electrical engineering, etc	-	-	-	-	-
Vehicles	-	-	-	-	-
Food, beverages, etc	-	-	-	-	-
Textiles, leather, etc	-	-	-	-	-
Paper, printing, etc	-	-	-	-	-
Other industries	-	-	-	-	-
Construction	-	-	-	-	-
Transport	-	-	-	-	-
Air	-	-	-	-	-
Rail	-	-	-	-	-
Road	-	-	-	-	-
National navigation	-	-	-	-	-
Pipelines	-	-	-	-	-
Other	-	204	72r	53	-
Domestic	-	204	-	-	-
Public administration	-	-	-	53	-
Commercial	-	-	-	-	-
Agriculture	-	-	72r	-	-
Miscellaneous	-	-	-	-	-
Non energy use	-	-	-	-	-

(1) Stock fall (+), stock rise (-).

(2) Total supply minus total demand.

(3) SRC is short rotation coppice and other energy crops.

(4) Municipal solid waste, general industrial waste and hospital waste.

(5) The amount of shoreline waste included is less than 0.1 ktoe.

7.2 Commodity balances 2004 (continued)

Renewables and waste

					Thousand tonnes of oil equivalent
Waste ⁽⁴⁾ and tyres	Geothermal and active solar heat	Hydro	Wind and wave (5)	Total renewables	
					Supply
848r	26r	424	166r	3,670r	Production
-	-	-	-	-	Other sources
-	-	-	-	402r	Imports
-	-	-	-	-	Exports
-	-	-	-	-	Marine bunkers
-	-	-	-	-	Stock change (1)
-	-	-	-	-	Transfers
848r	26r	424	166r	4,072r	Total supply
-	-	-	-	-	Statistical difference (2)
848r	26r	424	166r	4,072r	Total demand
696r	-	424	166r	3,357r	Transformation
696r	-	424	166r	3,357r	Electricity generation
90	-	366r	-	905r	Major power producers
606r	-	58r	166r	2,453r	Autogenerators
-	-	-	-	-	Heat generation
-	-	-	-	-	Petroleum refineries
-	-	-	-	-	Coke manufacture
-	-	-	-	-	Blast furnaces
-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	Other
-	-	-	-	-	Energy industry use
-	-	-	-	-	Electricity generation
-	-	-	-	-	Oil and gas extraction
-	-	-	-	-	Petroleum refineries
-	-	-	-	-	Coal extraction
-	-	-	-	-	Coke manufacture
-	-	-	-	-	Blast furnaces
-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	Pumped storage
-	-	-	-	-	Other
-	-	-	-	-	Losses
151r	25	-	-	715r	Final consumption
56r	-	-	-	265r	Industry
56r	-	-	-	265r	Unclassified
-	-	-	-	-	Iron and steel
-	-	-	-	-	Non-ferrous metals
-	-	-	-	-	Mineral products
-	-	-	-	-	Chemicals
-	-	-	-	-	Mechanical engineering, etc
-	-	-	-	-	Electrical engineering, etc
-	-	-	-	-	Vehicles
-	-	-	-	-	Food, beverages, etc
-	-	-	-	-	Textiles, leather, etc
-	-	-	-	-	Paper, printing, etc
-	-	-	-	-	Other industries
-	-	-	-	-	Construction
-	-	-	-	-	Transport
-	-	-	-	-	Air
-	-	-	-	-	Rail
-	-	-	-	-	Road
-	-	-	-	-	National navigation
-	-	-	-	-	Pipelines
95r	25	-	-	449	Other
23	25	-	-	252	Domestic
51	-	-	-	104	Public administration
10	-	-	-	10	Commercial
2	-	-	-	74	Agriculture
9	-	-	-	9	Miscellaneous
-	-	-	-	-	Non energy use

7.3 Commodity balances 2003

Renewables and waste

	Thousand tonnes of oil equivalent				
	Wood waste	Wood	Poultry litter, meat and bone, biomass, straw, farm waste and SRC(3)	Sewage gas	Landfill gas
Supply					
Production	196r	204	460r	165	1,088
Other sources	-	-	-	-	-
Imports	-	-	110	-	-
Exports	-	-	-	-	-
Marine bunkers	-	-	-	-	-
Stock change (1)	-	-	-	-	-
Transfers	-	-	-	-	-
Total supply	196r	204	570r	165	1,088
Statistical difference (2)	-	-	-	-	-
Total demand	196r	204	570r	165	1,088
Transformation	-	-	499r	113	1,075
Electricity generation	-	-	499r	113	1,075
Major power producers	-	-	292r	-	-
Autogenerators	-	-	207r	113	1,075
Heat generation	-	-	-	-	-
Petroleum refineries	-	-	-	-	-
Coke manufacture	-	-	-	-	-
Blast furnaces	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-
Other	-	-	-	-	-
Energy industry use	-	-	-	-	-
Electricity generation	-	-	-	-	-
Oil and gas extraction	-	-	-	-	-
Petroleum refineries	-	-	-	-	-
Coal extraction	-	-	-	-	-
Coke manufacture	-	-	-	-	-
Blast furnaces	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-
Pumped storage	-	-	-	-	-
Other	-	-	-	-	-
Losses	-	-	-	-	-
Final consumption	196r	204	72	53	14
Industry	196r	-	-	-	14
Unclassified	196r	-	-	-	14
Iron and steel	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-
Mineral products	-	-	-	-	-
Chemicals	-	-	-	-	-
Mechanical engineering, etc	-	-	-	-	-
Electrical engineering, etc	-	-	-	-	-
Vehicles	-	-	-	-	-
Food, beverages, etc	-	-	-	-	-
Textiles, leather, etc	-	-	-	-	-
Paper, printing, etc	-	-	-	-	-
Other industries	-	-	-	-	-
Construction	-	-	-	-	-
Transport	-	-	-	-	-
Air	-	-	-	-	-
Rail	-	-	-	-	-
Road	-	-	-	-	-
National navigation	-	-	-	-	-
Pipelines	-	-	-	-	-
Other	-	204	72	53	-
Domestic	-	204	-	-	-
Public administration	-	-	-	53	-
Commercial	-	-	-	-	-
Agriculture	-	-	72	-	-
Miscellaneous	-	-	-	-	-
Non energy use	-	-	-	-	-

(1) Stock fall (+), stock rise (-).

(2) Total supply minus total demand.

(3) SRC is short rotation coppice and other energy crops.

(4) Municipal solid waste, general industrial waste and hospital waste.

(5) The amount of shoreline waste included is less than 0.1 ktoe.

7.3 Commodity balances 2003 (continued)

Renewables and waste

					Thousand tonnes of oil equivalent
Waste ⁽⁴⁾ and tyres	Geothermal and active solar heat	Hydro	Wind and wave (5)	Total renewables	
					Supply
874r	21	278	111	3,396	Production
-	-	-	-	-	Other sources
-	-	-	-	110	Imports
-	-	-	-	-	Exports
-	-	-	-	-	Marine bunkers
-	-	-	-	-	Stock change (1)
-	-	-	-	-	Transfers
874r	21	278	111	3,506r	Total supply
-	-	-	-	-	Statistical difference (2)
874r	21	278	111	3,506r	Total demand
723r	-	278	111	2,796	Transformation
723r	-	278	111	2,796	Electricity generation
89	-	221	-	602	Major power producers
634r	-	57	111	2,194r	Autogenerators
-	-	-	-	-	Heat generation
-	-	-	-	-	Petroleum refineries
-	-	-	-	-	Coke manufacture
-	-	-	-	-	Blast furnaces
-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	Other
-	-	-	-	-	Energy industry use
-	-	-	-	-	Electricity generation
-	-	-	-	-	Oil and gas extraction
-	-	-	-	-	Petroleum refineries
-	-	-	-	-	Coal extraction
-	-	-	-	-	Coke manufacture
-	-	-	-	-	Blast furnaces
-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	Pumped storage
-	-	-	-	-	Other
-	-	-	-	-	Losses
151r	21	-	-	710r	Final consumption
58r	-	-	-	267r	Industry
58r	-	-	-	267r	Unclassified
-	-	-	-	-	Iron and steel
-	-	-	-	-	Non-ferrous metals
-	-	-	-	-	Mineral products
-	-	-	-	-	Chemicals
-	-	-	-	-	Mechanical engineering, etc
-	-	-	-	-	Electrical engineering, etc
-	-	-	-	-	Vehicles
-	-	-	-	-	Food, beverages, etc
-	-	-	-	-	Textiles, leather, etc
-	-	-	-	-	Paper, printing, etc
-	-	-	-	-	Other industries
-	-	-	-	-	Construction
-	-	-	-	-	Transport
-	-	-	-	-	Air
-	-	-	-	-	Rail
-	-	-	-	-	Road
-	-	-	-	-	National navigation
-	-	-	-	-	Pipelines
93	21	-	-	443	Other
23	21	-	-	247r	Domestic
51	-	-	-	104	Public administration
10	-	-	-	10	Commercial
-	-	-	-	72	Agriculture
9	-	-	-	9	Miscellaneous
-	-	-	-	-	Non energy use

7.4 Capacity of, and electricity generated from, renewable sources

	2001	2002	2003	2004	2005
Installed Capacity (MWe) (1)					
Wind:					
Onshore	423.4	530.6	678.4	809.4	1,351.2
Offshore	3.8	3.8	63.8	123.8	213.8
Shoreline wave	0.5	0.5	0.5	0.5	0.5
Solar photovoltaics	2.7	4.1	6.0	8.2	10.9
Hydro:					
Small scale	188.7	194.2	118.6r	135.9r	157.9
Large scale (2)	1,440.0	1,396.0	1,366.6r	1,367.9r	1,355.2
Biofuels and wastes:					
Landfill gas	464.7	472.9	619.1	722.2	817.8
Sewage sludge digestion	85.0	96.0	100.6	119.0	127.9
Municipal solid waste combustion	260.0	278.9	298.8	307.4	321.4
Other (3)	157.0	176.5	183.9	176.3r	186.1
Total biofuels and wastes	966.8	1,024.3	1,202.4	1,324.8r	1,453.2
Total	3,025.9	3,153.6	3,436.2r	3,770.5r	4,542.8
Co-firing (4)	-	..	92.4	146.2	308.8
Generation (GWh)					
Wind:					
Onshore (5)	960	1,251	1,276	1,736	2,505
Offshore (6)	5	5	10	199	403
Solar photovoltaics	2	3	3	4	8
Hydro:					
Small scale (5)	210	204	143r	283r	467
Large scale (2)	3,845	4,584	3,085r	4,647r	4,494
Biofuels:					
Landfill gas	2,507	2,679	3,276	4,004	4,290
Sewage sludge digestion	363	368	343	379	400
Municipal solid waste combustion (7)	880	907	965	971	964
Co-firing with fossil fuels	-	286	602	1,022	2,533
Other (8)	776	840	937	927	855
Total biofuels	4,526	5,080	6,122	7,302	9,042
Total generation	9,549	11,127	10,638	14,171	16,919
Non-biodegradable wastes (9)	528	545	579	583	578
Load factors (per cent) (10)					
Onshore wind	26.4	29.9	24.1	26.6	26.5
Offshore wind (from 2004 only)	24.2	27.2
Hydro	28.7	34.0	24.0r	37.7r	37.5
Biofuels and wastes (excluding co-firing)	61.1r	61.2r	62.5r	62.0r	58.2
Total (including wastes)	38.6	42.1r	36.8r	43.5r	41.1
Load factors on an unchanged configuration basis (per cent) (11)					
Onshore wind	25.6	28.3	26.1	29.2	28.2

(1) Capacity on a DNC basis is shown in Long Term Trends Table 7.1.1 available on the DTI web site - see paragraph 7.78.

(2) Excluding pumped storage stations. Capacities are as at the end of December.

(3) Includes the use of farm waste digestion, waste tyres, poultry litter, meat and bone, straw combustion, and short rotation coppice.

(4) This is the proportion of fossil fuelled capacity used for co-firing of renewables based on the proportion of generation accounted for by the renewable source.

(5) Actual generation figures are given where available, but otherwise are estimated using a typical load factor or the design load factor, where known.

(6) Latest years include electricity from shoreline wave but this amounts to less than 0.05 GWh.

(7) Biodegradable part only.

(8) Includes the use of farm waste digestion, poultry litter combustion, meat and bone combustion, straw and energy crops.

(9) Non-biodegradable part of municipal solid waste plus waste tyres, hospital waste and general industrial waste.

(10) Load factors are calculated based on installed capacity at the beginning and the end of the year - see paragraph 7.79.

(11) For a definition see paragraphs 7.80 and 7.81.

7.5 Electricity generated from renewable sources - Renewables Obligation basis and Renewables Directive basis

	GWh				
	2001	2002	2003	2004	2005
Generation : Renewables Obligation basis					
Wind:					
Onshore (1)	960	1,251	1,276	1,736	2,505
Offshore (2)	5	5	10	199	403
Solar photovoltaics	2	3	3	4	8
Hydro:					
Small scale (1)	210	204	115	282	467
Refurbished large scale hydro	61	120	616	1,434	1,710
Biofuels:					
Landfill gas	2,507	2,679	3,276	4,004	4,290
Sewage sludge digestion	363	368	343	379	400
Co-firing with fossil fuels	-	286	602	1,022	2,533
Other (3)	776	840	937	927	855
Total biofuels	3,646	4,173	5,158	6,331	8,078
Total renewables generation on an obligation basis (4)	4,884	5,755	7,177	9,986	13,171
Generation : Renewables Directive basis					
Wind:					
Onshore (1)	960	1,251	1,276	1,736	2,505
Offshore (2)	5	5	10	199	403
Solar photovoltaics	2	3	3	4	8
Hydro:					
Small scale (1)	210	204	115	282	467
Large scale (5)	3,845	4,584	3,113	4,648	4,494
Biofuels:					
Landfill gas	2,507	2,679	3,276	4,004	4,290
Sewage sludge digestion	363	368	343	379	400
Municipal solid waste combustion (7)	880	907	965	971	964
Co-firing with fossil fuels	-	286	602	1,022	2,533
Other (3)	776	840	937	927	855
Total biofuels	4,526	5,080	6,122	7,302	9,042
Total renewables generation on a directive basis (4)	9,549r	11,127r	10,638r	14,171r	16,919
Imports of electricity certified as CCL exempt (6)	1,740	1,668	2,865r	3,522	2,243

- (1) Actual generation figures are given where available, but otherwise are estimated using a typical load factor or the design load factor, where known.
- (2) Latest years include electricity from shoreline wave but this amounts to less than 0.05 GWh.
- (3) Includes the use of farm waste digestion, poultry litter combustion, meat and bone combustion, straw and short rotation coppice.
- (4) See paragraphs 7.7 and 7.8 for definitions. Note that the Renewables Directive definition has been amended - see footnote (6).
- (5) Excluding pumped storage stations.
- (6) Mainly hydro electricity exported to England from France. In the 2005 Digest these figures were included within the Renewables Directive basis but have now been removed following clarification by the European Commission.
- (7) Biodegradable part only.

7.6 Renewable orders and operational capacity

Technology band	Contracted projects		Live projects operational at 31 December 2005 (1)		
	Number	Capacity MW	Number	Capacity MW	
England and Wales					
NFFO - 1 (1990)	Hydro	26	11.85	13	4.83
	Landfill gas	25	35.50	13	25.09
	Municipal and industrial waste	4	40.63	4	40.63
	Other	4	45.48	3	45.38
	Sewage gas	7	6.45	4	4.08
	Wind	9	12.21	5	8.14
	Total (2)	75	152.11	42	128.16
NFFO - 2 (late 1991)	Hydro	12	10.86	9	10.43
	Landfill gas	28	48.45	21	34.64
	Municipal and industrial waste	10	271.48	2	31.50
	Other	4	30.15	1	12.50
	Sewage gas	19	26.86	17	18.56
	Wind	49	84.43	22	51.97
	Total (2)	122	472.23	72	159.60
NFFO - 3 (1995)	Energy crops and agricultural and forestry waste - gasification	3	19.06	-	-
	Energy crops and agricultural and forestry waste - other	6	103.81	2	69.50
	Hydro	15	14.48	8	11.74
	Landfill gas	42	82.07	41	80.55
	Municipal and industrial waste	20	241.87	9	114.62
	Wind - large	31	145.92	12	50.50
	Wind - small	24	19.71	15	13.52
	Total	141	626.90	87	340.43
NFFO - 4 (1997)	Hydro	31	13.22	9	2.49
	Landfill gas	70	173.68	62	161.46
	Municipal and industrial waste - CHP	10	115.29	4	33.48
	Municipal and industrial waste - fluidised bed combustion	6	125.93	-	-
	Wind - large	48	330.36	6	38.67
	Wind - small	17	10.33	6	4.03
	Anaerobic digestion of agricultural waste	6	6.58	1	1.43
	Energy crops and forestry waste gasification	7	67.34	-	-
	Total	195	842.72	88	241.57
NFFO - 5 (1998)	Hydro	22	8.87	-	-
	Landfill gas	141	313.73	80	170.41
	Municipal and industrial waste	22	415.75	-	-
	Municipal and industrial waste - CHP	7	69.97	-	-
	Wind - large	33	340.16	-	-
	Wind - small	36	28.67	9	7.45
	Total	261	1,177.15	89	177.86
NFFO Total		794	3,271.11	378	1,047.61

(1) Sites that have closed and sites that are not currently using renewables as fuel have been excluded.

(2) See footnote 2, on next page.

7.6 Renewable orders and operational capacity (continued)

Technology band	Contracted projects		Live projects operational at 31 December 2005 (1)		
	Number	Capacity MW	Number	Capacity MW	
Scotland					
SRO - 1 (1994)	Biomass	1	9.80	1	9.80
	Hydro	15	17.25	10	10.75
	Waste to Energy	2	3.78	2	3.78
	Wind	12	45.60	7	25.13
	Total	30	76.43	20	49.46
SRO - 2 (1997)	Biomass	1	2.00	-	-
	Hydro	9	12.36	2	1.46
	Waste to Energy	9	56.05	6	17.65
	Wind	7	43.63	5	31.29
	Total	26	114.04	13	50.40
SRO - 3 (1999)	Biomass	1	12.90	-	-
	Hydro	5	3.90	-	-
	Waste to Energy	16	49.11	10	22.36
	Wave	3	2.00	1	0.20
	Wind - large	11	63.43	1	8.29
	Wind - small	17	14.06	5	4.28
	Total	53	145.40	17	35.13
SRO Total		109	335.87	50	134.99
Northern Ireland					
NI NFFO - 1 (1994)	Hydro	9	2.37	9	2.37
	Sewage gas	5	0.56	-	-
	Wind	6	12.66	6	12.66
	Total	20	15.60	15	15.03
NI NFFO - 2 (1996)	Biogas	1	0.25	-	-
	Biomass	2	0.30	2	0.30
	Hydro	2	0.25	1	0.08
	Landfill gas	2	6.25	-	-
	Municipal and industrial waste	1	6.65	-	-
	Wind	2	2.57	2	2.57
	Total	10	16.27	5	2.95
NI NFFO Total		30	31.87	20	17.98
All NFFO and equivalents (2)		933	3,638.85	448	1,200.59

(1) Sites that have closed and sites that are not currently using renewables as fuel have been excluded.

(2) The NFFO database has reported that at the end of December 2005 473 sites totalling 1,226.19 MW had gone live under NFFO, but this includes all NFFO-1 and NFFO-2 sites for England and Wales, some of which have closed or are not currently using renewables as fuels. The following table compares the totals for live projects, above, with the overall NFFO total:

	Number	MW
All live NFFO and equivalents	448	1,200.59
NFFO-1 no longer classed as live and operational	17	12.85
NFFO-2 no longer classed as live and operational	8	12.76
All NFFO and equivalents	473	1,226.19

7.7 Renewable sources used to generate electricity and heat⁽¹⁾⁽²⁾

Thousand tonnes of oil equivalent

	2001	2002	2003	2004	2005
Used to generate electricity (3)					
Wind:					
Onshore	82.5	107.6	109.7	149.3	215.4
Offshore	0.4	0.4	0.8	17.1	34.6
Solar photovoltaics	0.2	0.2	0.3	0.3	0.7
Hydro:					
Small scale	18.1	17.5	12.3r	24.3r	40.2
Large scale (4)	330.7	394.2	265.3r	399.5r	386.4
Biofuels:					
Landfill gas	822.2	878.5	1,074.5	1,313.1	1,407.2
Sewage sludge digestion	119.0	120.6	112.5	124.1	131.1
Municipal solid waste combustion (5)	387.1	420.2	445.8	429.5	426.3
Co-firing with fossil fuels	-	94.0	197.3	335.1	830.7
Other (6)	282.2	273.6	304.3r	301.1r	288.5
Total biofuels	1,610.5	1,786.8	2,134.5r	2,502.9r	3,083.7
Total	2,042.4	2,306.7	2,522.8r	3,093.5r	3,761.0
Non-biodegradable wastes (7)	266.2	286.1	273.8r	263.9	262.0
Used to generate heat					
Active solar heating	13.2	16.1	19.8	24.6	29.4
Biofuels :					
Landfill gas	13.6	13.6	13.6	13.6	13.6
Sewage sludge digestion	49.4	53.4	52.5	52.5	48.0
Wood combustion - domestic	204.2	204.2	204.2	204.2	204.2
Wood combustion - industrial	195.6r	195.6r	195.6r	195.6r	80.9
Straw combustion, farm waste digestion and short rotation coppice	72.2	72.2	72.2	73.9	73.9
Municipal solid waste combustion (5)	26.2r	33.7r	33.7r	33.7r	33.7
Total biofuels	561.1r	572.8r	571.9r	573.6r	454.3
Geothermal aquifers	0.8	0.8	0.8	0.8	0.8
Total	575.2r	589.7r	592.5r	598.9r	484.5
Non-biodegradable wastes (7)	80.7r	92.2r	117.1r	115.7r	115.7
Total use of renewable sources and wastes					
Solar heating and photovoltaics	13.4	16.3	20.0	24.9	30.1
Onshore and offshore wind (9)	83.0	108.0	110.5	166.4	250.1
Hydro	348.7	411.7	277.5	423.9	426.6
Biofuels	2,171.6r	2,359.6r	2,706.3r	3,076.4r	3,538.0
Geothermal aquifers	0.8	0.8	0.8	0.8	0.8
Total	2,617.6r	2,896.4r	3,115.2r	3,692.4r	4,245.5
Non-biodegradable wastes (7)	347.0r	378.3r	390.9r	379.6r	377.7
All renewables and wastes (8)	2,964.6r	3,274.7r	3,506.1r	4,072.0r	4,623.2

(1) Includes some waste of fossil fuel origin.

(2) See paragraphs 7.40 to 7.81 for technical notes and definitions of the categories used in this table.

(3) For wind, solar PV and hydro, the figures represent the energy content of the electricity supplied but for biofuels the figures represent the energy content of the fuel used.

(4) Excluding pumped storage stations.

(5) Biodegradable part only.

(6) Includes electricity from farm waste digestion, poultry litter combustion, meat and bone combustion, straw and energy crops.

(7) Non-biodegradable part of municipal solid waste plus waste tyres, hospital waste, and general industrial waste.

(8) The figures in this row correspond to the total demand and total supply figures in Tables 7.1, 7.2 and 7.3.

(9) Latest years include energy from shoreline wave but this is less than 0.05 ktoe.