NATIONAL AUDIT OFFICE

DEPARTMENT OF TRADE AND INDUSTRY

Renewable Energy

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EXECUTIVE SUMMARY

1 The generation of electricity from renewable sources of energy, such as wind, wave and solar power, produces significantly less environmental pollution than generation from fossil fuel sources. Increased use of renewable sources, as one part of the Government's wider Climate Change Programme, will assist in achieving its target of moving towards a 20 per cent cut in carbon dioxide emissions, from 1990 levels, by 2010, and its goal of putting the United Kingdom on a path towards a reduction of some 60 per cent from current levels by about 2050.

2 The Government has set a target that by 2010, 10 per cent of Great Britain's supply of electricity should be from renewable sources, subject to the costs being acceptable to the consumer. It aspires to double this level by 2020. The use of renewable energy on this scale would reduce carbon dioxide emissions by between 20 million and 27 million tonnes, and increase the diversity and hence the security of the United Kingdom's energy supplies.

3 Within Government, the Department of Trade and Industry (the Department) is responsible for promoting electricity from renewable sources. Most renewable technologies are not currently commercially viable, and therefore need Government support to secure their more widespread use and development. The Department has put in place a variety of mechanisms to assist technologies at different stages of their development, so that they can mature and be deployed on a scale that will reduce their unit costs.

4 The main mechanism for technologies closest to commercial viability, such as onshore wind, is the Renewables Obligation (the Obligation). This requires all electricity suppliers to source a growing percentage each year of their total sales from renewable sources. Under the Obligation, generators who produce electricity from eligible sources receive Renewables Obligation Certificates (Certificates) which they may sell to suppliers along with the electricity they produce, or trade separately. Suppliers must either surrender sufficient Certificates in any year to meet their Obligation, or pay a buy-out related to the size of their shortfall. Funds raised from buy-out payments are then re-distributed to suppliers according to the volume of Certificates they surrendered. The value of the buy-out underpins the market value of Certificates. Provided the demand for Certificates exceeds supply, the Certificates add considerably to the income of companies generating electricity from renewable sources. A more detailed description of the Renewables Obligation is given in **Figure 7 on page 14**.

5 In addition to the support provided by the Renewables Obligation the Department makes grants to technologies further from the market to support initial operational and demonstration projects, and relevant research and development. There are also other Government policies to tackle climate change, which indirectly encourage the development of renewable energy. Total public support for the renewables industry is expected to average £700 million per annum between 2003 and 2006. Around two thirds of this support will come through the Renewables Obligation, the cost of which is met by consumers and will reach up to £1 billion per annum by 2010 (the equivalent of a 5.7 per cent increase in the price of electricity).

6 Against this backdrop of large-scale public investment in renewable technologies this report examines:

- the Department's achievements to date in supporting renewable energy and its progress against targets (Part 1);
- key factors which will determine the future growth of renewable energy (Part 2); and
- the cost to the consumer and taxpayer of supporting renewable energy (Part 3).

Our methodology is explained in Appendix 1. We employed economic consultants, Oxera, to conduct a critical review of the Department's policies for providing financial support, and to estimate future levels of renewable generation.

Increasing renewable generation

7 Support for renewable generation has a considerable history. During the 1990s, a Non-Fossil Fuel Obligation set targets for the level of electricity generated from renewable sources. Under this scheme renewable generating companies bid for competitively let, long-term contracts, to provide electricity at premium rates. The scheme had mixed success. It was partly responsible for reducing the cost of renewable generation, but a number of contractors experienced planning, technical and commercial problems in developing sites, and generating capacity remains 25 per cent short of the policy's target of 1,500 megawatts.

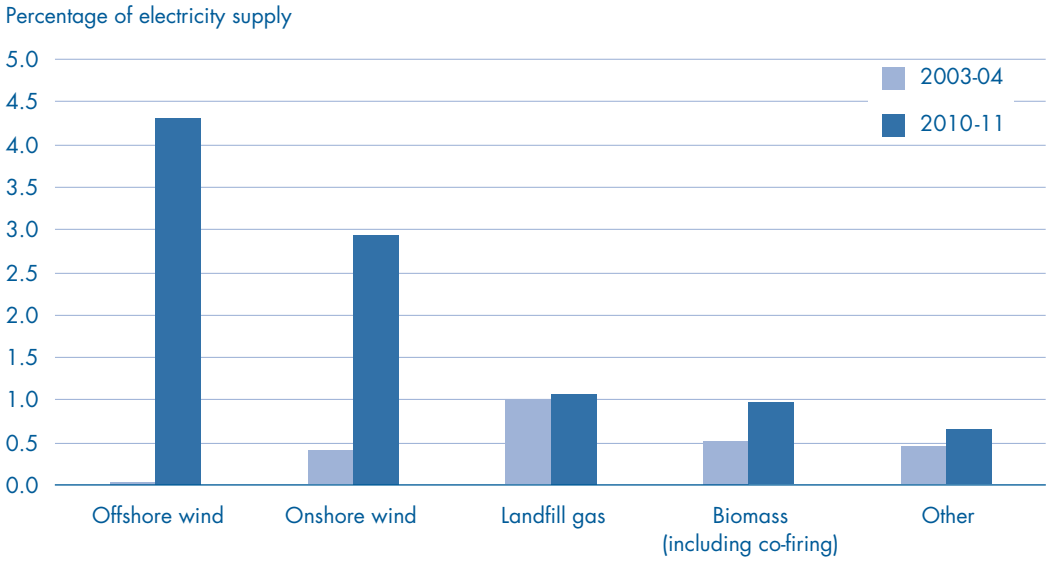
8 In 2003-04, the second year of the Renewables Obligation, eligible renewables accounted for 2.4 per cent of Great Britain's electricity generation, significantly lower than the Obligation level of 4.3 per cent. A recent House of Lords Science and Technology Select Committee[1] report concluded that the Department was likely to achieve not more than 7.5 per cent by 2010, in comparison with its target of 10 per cent. In January 2005, our consultants, using a similar model to that underlying some of the evidence submitted by the Department to that Committee, but with updated assumptions on the potential barriers to progress, have estimated 9.9 per cent for 2010, very close to the target. **Figure 1** gives the expected breakdown of generation levels by renewable technology. The difference between estimates is mainly due to recent increases in wholesale electricity prices. Our consultants' sensitivity analysis of this estimate shows that, by 2010, more favourable conditions for renewables produces barely any more generation than their central estimate, but their less favourable scenario, based on lower than expected wholesale electricity prices and higher technology unit costs, yields just 7.5 per cent for renewables generation - below target.

Key factors for future success

9 Achieving the 10 per cent target will require a step-change in the level of renewable generation and depends upon five key factors. The Department has been active in addressing these factors, but the situation is complicated, and an ineffective or delayed response to any given factor could jeopardise target achievement.

10 The planning system can pose difficulties for renewables developers: Variation in the planning system across the United Kingdom has meant significant differences in the duration and success rate of planning applications within England, and between England, Scotland and Wales. In 2001, the Scottish Executive issued revised guidance which has contributed to a large increase in onshore wind developments. The Office of the Deputy Prime Minister has now issued similar guidance for England, requiring local planning authorities to give due consideration to regional and national renewable energy targets when assessing planning applications. It is too early to assess the likely impact of the revised guidance in England, where the physical and social context is different from that of Scotland. The Welsh Assembly Government is also in the process of issuing revised planning guidance on renewables, which it hopes to finalise in summer 2005.[2]

1 Eligible generation under the Renewables Obligation in 2003-04 and estimated levels in 2010-11 for Great Britain



Source: Oxera; Ofgem

NOTE

Co-firing is where coal and biomass are mixed for combustion in existing coal-fired power stations. 'Other' category includes smallscale hydroelectricity, sewage gas and marine renewables.

1 'Renewable Energy: Practicalities' 4th Report of Session 2003-04.
2 'Technical Advice Note 8: Renewable Energy' was issued for consultation in July 2004 (Welsh Assembly Government).

11 Timely reinforcement of the grid network is required: Electricity is transmitted long distances in Great Britain via the transmission network, and is supplied to users through local distribution networks. Future renewable energy projects will connect to these networks, often in new places, affecting the flow of electricity across the system. This will require parts of the networks to be upgraded. For the transmission network this could cost between £1.1 billion and £1.3 billion by 2010, although there is continuing uncertainty as to exactly how much network reinforcement will be necessary to meet the 10 per cent target. The costs of network enhancement are initially met by the owners of the transmission networks, who pass these on to generators and suppliers through use-of-system charges. The network owners have identified a number of specific enhancements to the transmission network likely to be required to accommodate significant additional wind capacity. These have been put forward to Ofgem, which has so far approved proposals for £560 million of funding for the first stage of this work. Similarly, for the distribution networks, the Department and Ofgem are seeking to put in place the incentives to ensure the necessary upgrades are made.

12 The wholesale electricity market is a determinant of investor confidence: The market value of electricity is an important determinant of the economic viability of many renewable technologies. Changes to the arrangements for trading electricity in 2001 contributed to a fall in wholesale electricity prices which reduced the confidence of investors in the renewable sector at the time. However, wholesale electricity prices have risen recently and are likely to remain high by historical standards for the next few years, driven by factors including higher fuel costs for coal and gas, and the effective introduction of carbon dioxide pricing through the new European Union Emissions Trading Scheme. Although the Renewables Obligation does not provide the guaranteed long-term prices enjoyed under the Non-Fossil Fuel Obligation, higher wholesale electricity prices give some measure of comfort to developers.

13 The stability of Government renewable energy policy is important to encourage investment: Rapid growth in renewable energy generation depends upon having a policy framework which provides a stable environment for investment, secures returns on investments, and has clear long-term goals. The Department has sought to achieve stability through the Renewables Obligation. Initially the Department set increasing annual Obligation levels up to 10.4 per cent by March 2011. In response to concerns from the renewables industry the Department proposed, in December 2003, extending Obligation levels up to 15.4 per cent by 2015-16. This proposal, which is due to come into force in April 2005, has provided investors with more long-term confidence of future revenues and increased the likelihood that the 2010 target will be met.

14 The renewables industry, however, has continuing concerns about the operation of some aspects of the Renewables Obligation. One issue on which there are mixed views is the eligibility of co-firing for Certificates. This is where coal and biomass are mixed for combustion in existing coal-fired power stations. So as to encourage the development of energy crops, the eligibility of co-firing within the Renewables Obligation has been extended from 2011 to 2016. Analysis conducted by our consultants suggests that co-firing will not discourage the development of other non-bioenergy sources of renewable generation. However, there is a concern that some of the environmental benefits of co-firing may be lost because it increases the commercial life of coal-fired power stations, thus leading to greater burning of coal. Work conducted for the Department in 2003 suggested that this was not a material risk. However, our consultants estimate that an average of 21 per cent of the carbon dioxide savings from co-firing may be offset by higher coal burn.

15 The value of Renewables Obligation Certificates, and hence the income available from renewable generation, was reduced by the financial failure between 2002 and 2004 of three electricity supply companies who defaulted on their payments to the buy-out fund. Defaults totalled £23.6 million in 2002-03 and £9.2 million in 2003-04. Independent renewable generating companies are also concerned that larger electricity supply companies have limited interest in buying and selling Certificates because they are usually able to purchase them from the electricity generating arm of their business. The Department is addressing the first of these issues as part of its amendments to the Renewables Obligation, which will shortly be laid in Parliament with the aim of bringing them into force by 1 April 2005. It will consider the second as part of its current review of the Renewables Obligation.

16 Some technologies require additional support: Some renewable technologies are not commercially viable under the Renewables Obligation alone. In response, the Department has provided capital grants to enable the bioenergy and offshore wind sectors to reduce their unit costs of generation. For bioenergy, the Department and the Lottery-supported New Opportunities Fund have allocated £55 million to 22 projects. To date, two projects are under construction and the programme is running a year behind schedule. Developers face various difficulties. For example, some have found it hard to sign long-term power purchase agreements with an electricity supplier for the electricity they propose to generate, at prices which would make the projects commercially viable.

17 The Department has seen greater success with its offshore wind scheme. It has allocated capital grants of £117 million to 12 projects, two of which are now fully operational. It expects the remaining projects to come online in the next three years, providing total capacity of over 1,000 megawatts, enough to supply more than 600,000 households. Much larger offshore wind farms in the future could provide up to seven times as much capacity. It is too early to say with confidence the extent to which experience from the first round of offshore wind farms will help reduce the costs of construction and operation. These, and other factors, will determine the case for support being provided to future offshore wind projects.

18 Success or otherwise in dealing with these five factors will help determine whether the Department meets the 10 per cent target for 2010. Meeting the Government's longer term aspirations for 2050 is likely to require further renewable technologies to become more commercially viable. The Department's New and Renewable Energy Programme (the Programme) has sought to encourage new technologies by funding research and development. £230 million has been spent since 1988. Throughout the 1990s, the Department's expenditure was lower than forecast, but a change in its long-term strategy in recent years has produced an increase in expenditure. Focus is now increasingly on supporting technologies, such as wave and tidal energy, which the Department considers have greater potential to succeed over a 10 to 20 year timescale.

19 The Department has clear procedures for monitoring the performance of individual projects supported by the Programme and recognises that a proper assessment of its long-term achievements needs to be conducted regularly and systematically. The most recent evaluation, which the Department commissioned in 2001, found that there were relatively few examples of the Programme's high risk projects - which focus on developing core technology or equipment - providing outputs which were subsequently used commercially by renewable generators. The Programme's non-technology work to address barriers to the uptake of renewable energy, such as planning and finance, had been more successful in assisting developers.

20 In 2004, the Department subsumed the Programme into its wider corporate Technology Programme, for which it has secured additional funding over the next three years. The Technology Programme aims to maximise value for money by focusing Departmental support on those areas where the case for it is strongest. Increasingly, the renewables sector will now have to compete with other technologies for this increased funding, and demonstrate success from the support it receives. For the period 2005-06 to 2007-08 the Department has recently agreed an indicative allocation of at least £20 million per annum of Technology Programme funding to support research and development into renewables and low carbon technologies, subject to high quality proposals coming forward and the ability of the sectors to demonstrate success from the support received.

21 Historically, the Department provided the large majority of Government funding for research into renewable energy. In recent years, however, a wider range of public bodies have started to support the renewables industry. This has increased the opportunities for companies to obtain funding, provided they develop an understanding of the range of support schemes operating at a regional, national and European level.

The cost of supporting renewable energy

22 One of the goals of the Government's energy policy is to put the United Kingdom on a path towards a reduction in carbon dioxide emissions of some 60 per cent from current levels by about 2050. Given the scale of the desired reduction, it has implemented a variety of policy tools of which the promotion of renewable energy through the Renewables Obligation is only one. By 2010, public support for the renewables sector will cost consumers and taxpayers over £1 billion a year – the bulk of this accounted for by the Renewables Obligation. As a means of reducing carbon dioxide emissions, the Obligation is several times more expensive than other measures currently being implemented by Government. However, the Government sees renewables as a necessary part of its Climate Change Programme. This is because there are limits to which some other approaches, such as energy efficiency, can contribute to the required long-term reduction in carbon dioxide emissions. The Department chose the Obligation to meet its target to supply 10 per cent of electricity from renewable sources by 2010. It is unlikely that a policy tool focused directly on reducing emissions across all sectors of the economy, such as a carbon dioxide tax, would have yielded the same level of renewable generation in this time. In addition, the Obligation has other aims, including assisting with the security of the United Kingdom's electricity supply and creating economic opportunities for domestic companies, although the Department views them as subsidiary to the Obligation's main objective of reducing carbon dioxide emissions. The Department also expects that the Obligation will result in innovation which will reduce the unit costs of renewable technologies in the future.

23 In designing the Renewables Obligation and the capital grants schemes the Department sought to strike a balance between the environmental benefits of increased renewable generation and controlling the costs to the taxpayer and consumer by, for example, excluding largescale hydroelectric power stations from the Obligation. Costs to the consumer are driven by the level of the buy-out price and the size of the annual Obligations placed on suppliers. In July 2000, the Department was planning to set a buy-out price of £20 per megawatt hour for the first year of the Obligation and provide capital grants totalling £200 million to the pre-commercial technologies offshore wind and bioenergy. The Department subsequently found that the amount of capital grants it could provide each new project had to be reduced due to European Union regulations and a lower than anticipated budget of around £80 million. Owing to the reductions in capital grant funding, offshore wind and bioenergy projects required increased revenue support to be viable.

24 During August 2000, the Department examined the impact on each of the major renewable technologies of changing the buy-out price and consequently it made a number of changes to the Renewables Obligation. It decided that, in addition to largescale hydroelectric power, another low-cost technology, energy from incinerating mixed waste, should be excluded from the Obligation. Some waste projects were considered to have the potential to be commercially viable without support from the Renewables Obligation, and the Government was concerned that supporting the incineration of mixed waste might inhibit efforts to encourage greater recycling.

25 Both the reduction in capital funding and the exclusion of energy from waste had, however, made the 2010 target more difficult to achieve as they discouraged the development of some higher cost projects. The Department therefore raised the buy-out price to £30 per megawatt hour to increase incentives for those technologies remaining in the Renewables Obligation. The higher buy-out price increases the amount electricity suppliers are willing to pay renewable generators, thus increasing the incentives to build new capacity and ultimately increasing the level of renewable generation. The higher buy-out price was seen as particularly important for encouraging the development of pre-commercial technologies, such as offshore wind and bioenergy, given the lower levels of capital grants available. In 2000, the Department estimated that the net effect of these changes to the Renewables Obligation would be to increase the cost to consumers by around £150 million per annum by 2010.

26 In 2001, the Department decided to include live Non-Fossil Fuel Obligation sites in the Renewables Obligation. This more than doubled the supply of Renewables Obligation Certificates in 2002-03 and thus significantly aided the introduction of the Renewables Obligation by helping to create a market for Certificates. Alternative approaches available to the Department would not have provided the same momentum to the introduction of the Obligation and could have jeopardised progress against the 2010 target. However, the inclusion of these sites has increased the cost to electricity consumers, but has benefited the Exchequer by equal measure. The size of this transfer is likely to be in the range of £550 million to £1 billion over the period to 2010. The additional payments made by consumers are held in a fund administered by Ofgem. Through the Sustainable Energy Act 2003 the Government has earmarked £60 million of this fund to promote the use of renewable energy. The remainder is likely to be paid into the Consolidated Fund.

27 The Department's planned review of the Renewables Obligation in 2005 is a good starting point for managing the on-going cost effectiveness of the scheme. The Department has announced the review will consider amongst other issues 'the transition to market of renewable technologies over time, either from the impact of carbon dioxide pricing, falls in technology costs or other factors'. Our consultants' analysis shows that most renewable technologies continue to need public support to be commercially viable, but the level of support provided by the Renewables Obligation is greater than necessary to ensure that most new onshore wind farms and large landfill gas projects are developed. Our consultants estimate that, if the Renewables Obligation and other policies remain unchanged until 2026-27, around a third of the total public support provided could be in excess of that needed by generators to meet the higher costs of renewable generation. Competition in the electricity supply industry, however, may lead to some of this excess being competed away and passed back to consumers.

28 The Department has assured industry that if the 2005 review were to result in less support being provided for some technologies, the entitlement to Renewables Obligation Certificates of currently operating projects, and those actively under development, would be protected. To maintain business confidence in the Renewables Obligation the Department has also excluded certain issues from the review which affect the cost of the scheme to consumers. In particular, it will not consider reducing the buy-out price or the level of annual Obligations placed on suppliers.[3]

3 The Department explained that changes might be made to the level of annual Obligations but only where necessary to compensate for any changes to the Renewables Obligation eligibility rules for energy from waste and combined heat and power.

CONCLUSIONS AND RECOMMENDATIONS

The Department of Trade and Industry (The Department) has put in place a number of measures clearly aimed at achieving the Government's target that 10 per cent of electricity supplied by 2010 should come from renewable sources. The Renewables Obligation is an innovative mechanism which provides support to companies generating renewable energy. The Department has worked hard to provide a package of measures designed to provide a level of financial support to renewable energy technologies at different stages of development and commercial viability. The United Kingdom is recognised as a country which provides strong support for renewables – a recent assessment by Ernst & Young rated the United Kingdom's renewable energy market as one of the two most attractive in the world.[4] The following conclusions and recommendations are designed to help the Department to meet the 10 per cent target while minimising costs to the taxpayer and consumer.

1 The Department has responded quickly to emerging problems threatening the achievement of its 2010 target. It has recently developed a formal project plan, bringing together the various elements of its on-going programme of work. The ability to establish a 'critical path' for the project, and monitor key milestones, is crucial in an area where the lead times for action on matters involving the electricity grid network or planning changes are measured in years, rather than months.

2 The Department has commissioned major reviews on the progress of, and prospects for, its renewable energy programme. It has set out work plans to deal with barriers to progress which it monitors monthly; and it collects a range of data on, for example, the level of renewable generation and the scale and success rate of planning applications for new generating plant. These elements provide a good basis for monitoring progress. They could be refined by defining a balanced scorecard of key indicators and critical milestones, clear expectations of the trajectories for these indicators, and a suitable strategic monitoring schedule, so that the significance of the information can more readily be assessed.

3 Indicators of value for money should form part of the scorecard. The Renewables Obligation represents an expensive means by which to reduce carbon dioxide emissions – at least over the short and medium terms. The Department therefore needs to keep a firm grip of the Obligation's cost relative to other instruments for reducing carbon dioxide by regularly monitoring indicators such as cost per tonne of carbon dioxide saved, 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.

4 Under the Department's new corporate approach to funding research and development, renewables now have to compete with other new and emerging technologies for the increased funding the Department has secured. To ensure that the renewables sector is well placed to compete under these new arrangements, the Department needs better evidence of achievements from previous research and development grants, and improved processes for learning and disseminating the lessons from that experience.

4 Renewable Energy Country Attractiveness Indices (December 2004) Ernst & Young




5 Many public bodies now support renewables research, development and demonstration projects. This situation is potentially confusing for those seeking funding. The Department should ensure that it maintains an overview of renewables support, and that the remits and activities of public bodies are clear to those seeking support.

6 One of the aims of support is to develop technologies, and the industry as a whole, so that they make a growing, sustainable and competitive contribution to energy supply. To achieve this, the Department has put in place a range of support mechanisms, such as the Renewables Obligation and capital grants programmes, to help technologies at different stages of development. The Department should set out, for the renewables industry, the criteria that it uses to judge when to move technologies from research, through development and demonstration to assisted large-scale operation and, hopefully, commercial operation. This would provide companies with a clear view of the nature and, where possible, an indication of the level of public support they might expect over time.

7 The Department needs to pay special attention to the potential move from support under the Renewables Obligation to fully commercial operation. This is the area where estimates of excess support are highest. Any significant changes in support can affect market confidence, and hence financial backing for the development of renewables in the round. To balance the interests of taxpayers and consumers with those of the renewables industry, the Department should establish the criteria for reducing or withdrawing support. The 2005 Renewables Obligation review is an opportunity to do this. Factors it will need to consider include:

- the need for a lead time for changes which reflect the long life-cycles and payback periods in a capital intensive industry;
- the need to define 'fully commercial'– by technology, by reference to a standard, average or 'good practice' efficiency, and by age of project;
- the case for a period of tapered support, to ease the transition; and
- the impact of other initiatives, such as the European Union Emissions Trading Scheme and the Climate Change Levy, which affect the relative competitiveness of renewable generation against other electricity sources.

8 The Department decided not to consider the buy-out price and the level of annual Obligations placed on suppliers in the 2005 review. If it is to ensure that the Renewables Obligation will achieve its objectives in the long-run then the Department will need, in future reviews, to take account of all the factors that influence the cost of the scheme to consumers. In so doing, it will need to consider both the interests of consumers and the importance of maintaining investor confidence.

9 By 2010, the Government is likely to have had access to an accumulated surplus in the range of £550 million to £1 billion, resulting from the inclusion of Non-Fossil Fuel Obligation contracts in the Renewables Obligation. As this surplus will arise from charges levied on the electricity customer, the Department and HM Treasury should explain to Parliament the origin of these funds and how they will be treated.

PART ONE
Increasing renewable generation

Helping to reduce carbon dioxide emissions

1.1 The 2003 'Energy White Paper – Our Energy Future: Creating a Low Carbon Economy' sets out the four pillars of the Government's energy policy:

- protecting the environment;
- energy security through diverse and reliable supplies;
- affordable energy for the poorest; and
- competitive markets for United Kingdom business, industries and households.

The White Paper states that urgent action is required to reduce greenhouse gases[5] – notably carbon dioxide released by the burning of fossil fuels such as coal, oil and gas – which cause climate change and impose substantial environmental and economic costs. In 2002, the Government Economic Service suggested that the effects of climate change on agriculture, wildlife and health, and in causing rising sea levels and extreme weather effects, could impose costs to society in the order of £20 per tonne of carbon dioxide emitted.[6]

1.2 The Government is seeking to move towards a 20 per cent cut in carbon dioxide emissions, from 1990 levels, by 2010 and putting the United Kingdom on a path towards a reduction of some 60 per cent from current levels by about 2050. To achieve this substantial reduction, in 2000 it launched the cross-departmental Climate Change Programme. This outlines the need to use a variety of approaches to reducing carbon dioxide emissions through, for example, the promotion of energy efficiency; low carbon dioxide transport; the adoption of a European-wide carbon dioxide emissions trading scheme; and by encouraging the generation of electricity from renewable sources which do not add carbon dioxide to the atmosphere **(Figure 2)**.

2 What is renewable energy?

Renewable sources of energy include the sun, the wind, water and biomass. Generation of electricity from these sources produces no carbon dioxide or, in the case of biomass, produces only the carbon dioxide already absorbed from the atmosphere when it was growing. Appendix 3 describes the main renewable technologies.

1.3 Cross-departmental responsibility for tackling emissions is reflected in a joint Department of Trade and Industry, Department for Environment, Food and Rural Affairs and, from April 2005, Department for Transport Public Service Agreement target to:

- reduce greenhouse gas emissions to 12.5 per cent below 1990 levels by 2008-12, in line with the United Kingdom's Kyoto[7] commitment. By 2002, greenhouse gas emissions were 15.3 per cent below 1990 levels;
- move towards a 20 per cent reduction in carbon dioxide emissions below 1990 levels, by 2010. By 2003, emissions had fallen by 7 per cent to 560 million tonnes per year. Recent Government projections show carbon dioxide emissions falling by 15 per cent by 2010.

1.4 As one part of the Climate Change Programme, the Department is responsible for promoting electricity from renewable energy technologies and achieving the Government's target to supply 10 per cent of Britain's electricity from renewable sources by 2010, subject to the costs being acceptable to the consumer.[8] If achieved this would reduce carbon dioxide emissions by some 9 million tonnes a year, contributing about a tenth of the targeted move towards a 20 per cent reduction in carbon dioxide emissions by 2010. It would also have other positive environmental impacts as most renewable technologies produce negligible emissions of other pollutants such as sulphur dioxide, solid wastes and other harmful by-products. The Government's aim is for renewables to account for 20 per cent of electricity by 2020, saving an additional 11 to 18 million tonnes of carbon dioxide a year. The Government will evaluate progress made by the Climate Change Programme in reducing emissions as part of a forthcoming review of the Programme, reporting in 2005.

5 The six main greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluoro-carbons (PFCs) and sulphur hexafluoride (SF_6).
6 'Estimating the Social Cost of Carbon: Government Economic Service Working Paper 140'. The central estimate of £20 per tonne of carbon dioxide is within a range of £10 to £40 per tonne.
7 Legal targets were set for developed countries to reduce greenhouse gas emissions by an average of around 5 per cent of 1990 levels in the period 2008-2012.
8 The target excludes generation from largescale hydroelectricity and from non-biodegradable waste.

1.5 The Department considers that the expansion of renewables will have two subsidiary benefits. First, it will help the Government combat the decline in indigenous supplies of oil, gas, and coal, and the gradual retirement of existing nuclear power thereby increasing the diversity and self-sufficiency of the United Kingdom's energy supplies. Secondly, it offers considerable economic opportunities for companies to create jobs in manufacturing, services and supplies, and to increase exports. The Department estimates that the current annual turnover of renewables projects being developed, constructed or operated is £290 million with 8,000 jobs sustained by the sector.[9]

Government support for renewable technologies

1.6 Most renewable technologies are not currently commercially viable. The Department and other public bodies, therefore, provide support[10] to help technologies at different stages of development to grow and achieve the economies of scale that could reduce the unit cost of generation and thus improve their long-term commercial viability **(see Figure 3)**.

Support for near market technologies: the Non-Fossil Fuel Obligation

1.7 In 1990, the Department introduced the Non-Fossil Fuel Obligation in England and Wales. Similar arrangements were introduced in Scotland and Northern Ireland in 1994. The Non-Fossil Fuel Obligation was the first major policy instrument to encourage renewable technologies which required further development to compete with established fossil fuel generation. It required electricity supply companies to purchase non-fossil fuel generated electricity from generating companies who had won long-term contracts, let by competition at price levels above the wholesale price of electricity. The additional cost of the renewable electricity was met by levies paid by consumers. The levies peaked at an annual cost of around £125 million in 1997-98 and 1998-99.

3 The main sources of Government support for renewable technologies at different stages of maturity

Innovation stage	Definition	Technologies include	Support schemes
Research, development and demonstration	Blue skies thinking of energy solutions through to the development of smallscale prototype generating systems. Unit costs are still high, so technologies are unlikely to be commercially viable for many years.	Wave, tidal, solar	■ Department's research and development programmes ■ Carbon Trust ■ Devolved administrations ■ Regional Development Agencies ■ Research Councils ■ European Union
Pre-commercial	Larger scale technology deployment with the potential to supply customers, but requiring support to further reduce unit costs. Projects are still high risk.	Offshore wind, biomass	■ Renewables Obligation ■ Capital grants provided by the Department and Lottery-supported New Opportunities Fund
Supported-commercial	Technologies closest to market competitiveness, with innovation characterised by learning-by-doing.	Onshore wind, landfill gas, co-firing	■ Renewables Obligation ■ Non-Fossil Fuel Obligation

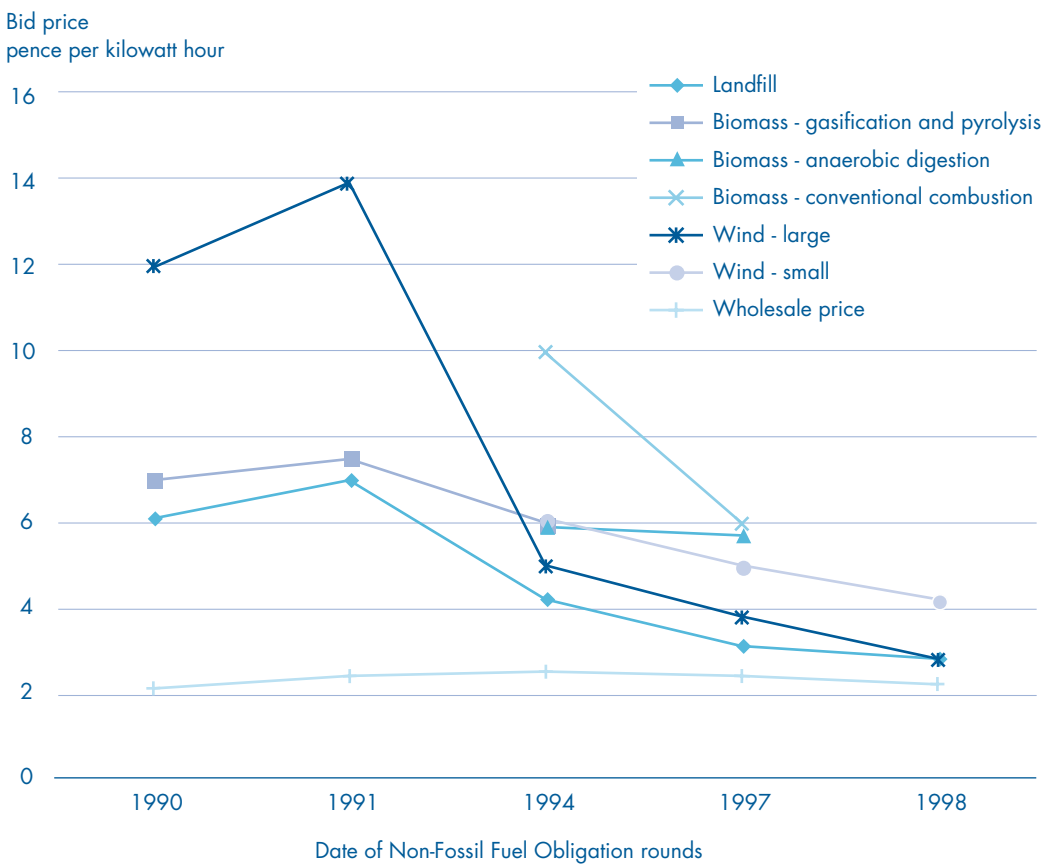
Sources: Department of Trade and Industry (2004) Renewables Innovation Review

9 'Renewable Energy Industry Gap Analysis: Summary Report', Department of Trade and Industry (2004).
10 While the prime focus of this study is on the Department's support mechanisms, the cost figures quoted in this report are generally provided for Great Britain matching the geographical scope of the 2010 target. The figures therefore also include costs of the support mechanisms managed by the devolved administration in Scotland and Wales.

1.8 The average unit price of electricity for contracts let under the Non-Fossil Fuel Obligation fell by more than 50 per cent in real terms between 1990 and 1998. **Figure 4** shows how the prices of technologies, which together account for around 70 per cent of commissioned capacity, converged with the average wholesale price of electricity. A Department-sponsored evaluation of the Non-Fossil Fuel Obligation in 2001 concluded that the scheme had partly contributed to the reduction in the price of renewable generation by helping companies gain experience of developing and running renewable energy projects, and by increasing the availability of finance. Prices also fell because of improvements in core technology, most of which had been developed abroad, and through the Department increasing the length of contracts. Contracts let between 1994 and 1998, the last of which run until 2018, gave generators more time to recover their capital costs.

1.9 **Figure 5 on page 12** shows that since the introduction of the Non-Fossil Fuel Obligation the level of generation from renewable sources such as wind and landfill gas has increased. But generation from renewable sources in the United Kingdom is about half the European Union average, although it is not far from the levels achieved by other G8 countries **(Figure 6 on page 13)**. Generation remains significantly below the Department's target from 1999 to produce 5 per cent of electricity from all forms of renewable energy, including largescale hydroelectricity plants, by 2003.

4 Average contracted price for renewable technologies under the five Non-Fossil Fuel Obligation rounds (2000 prices)



Source: Department of Trade and Industry sponsored evaluation of the Non-Fossil Fuel Obligation (2001)

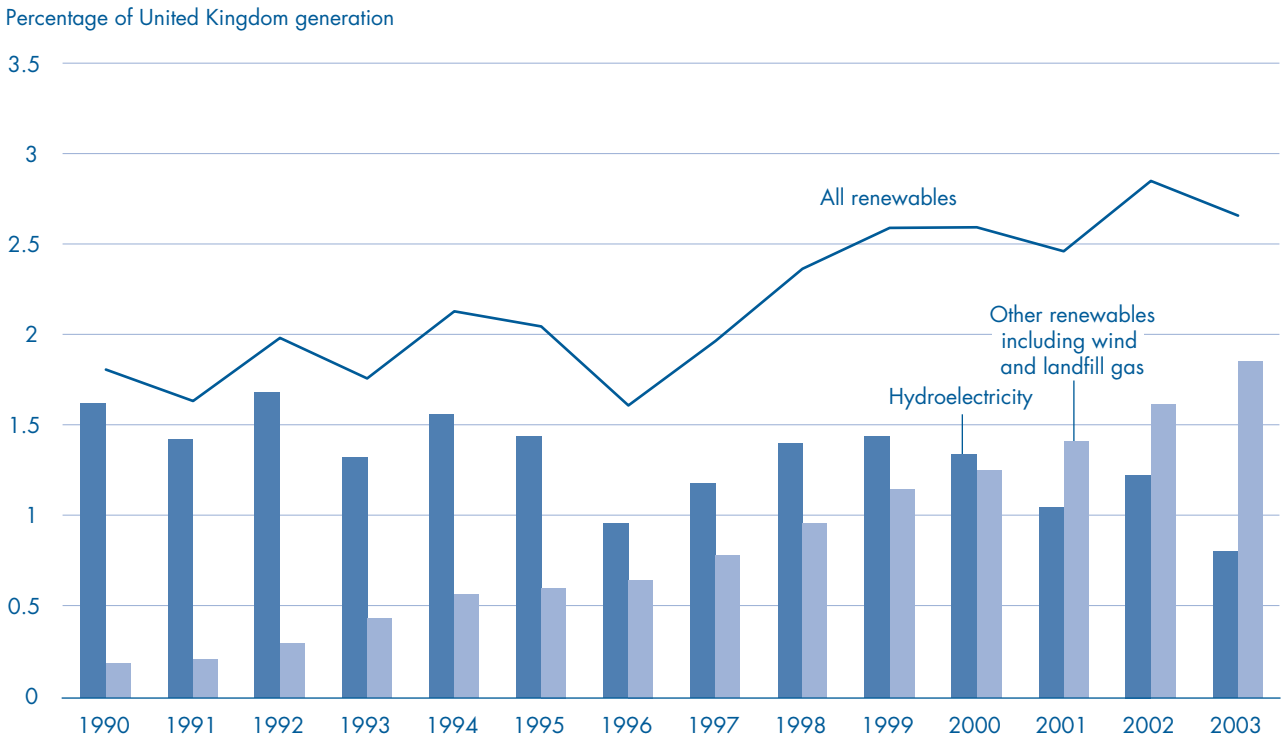
NOTES

1 The Department sponsored evaluation found no significant difference between the contracted price of a sample of commissioned and uncommissioned sites. It therefore concluded that the average contracted price is likely to be a fair reflection of the actual price paid for electricity.

2 The wholesale price is measured by the Pool Purchase Price. This was the price awarded by the Pool for electricity generated and purchased at Grid Supply Points prior to the introduction of the New Electricity Trading Arrangements in 2001.

3 Contracted prices are not adjusted to take account of the effect of greater contract lengths, from eight years for NFFO rounds 1 and 2, to 15 years for NFFO rounds 3, 4 and 5.

5 Growth in electricity generation from renewables since 1990



Source: Energy Trends (2003), Department of Trade and Industry

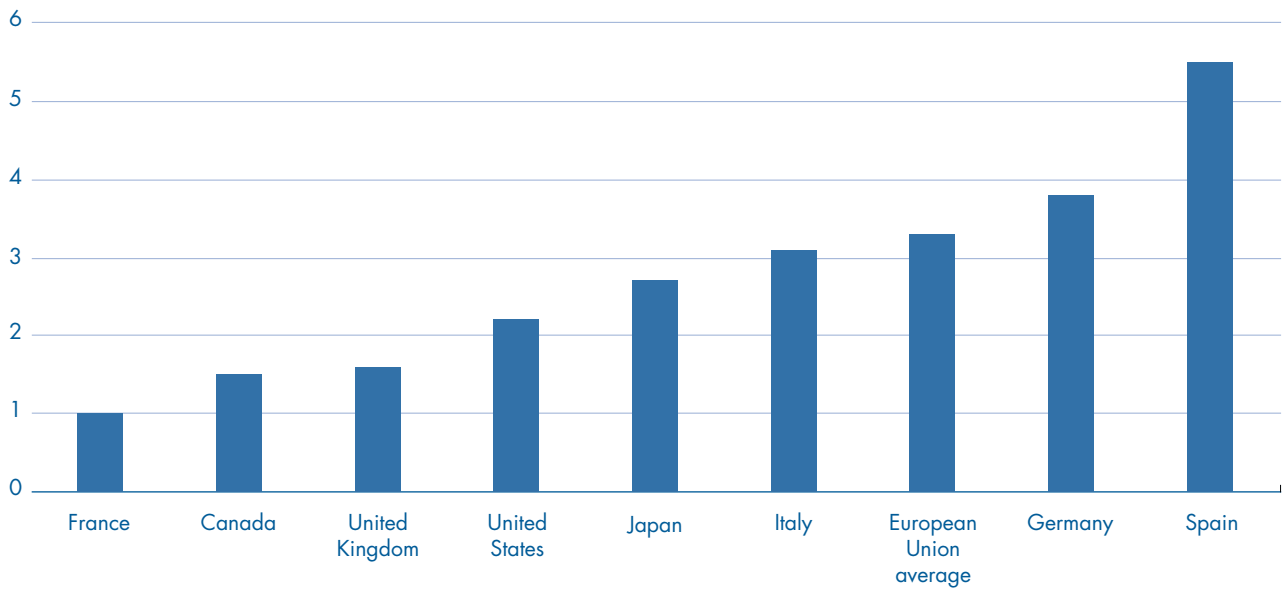
1.10 The relatively low level of renewable generation in the United Kingdom is partly because the proportion of Non-Fossil Fuel Obligation contracts fulfilled has been less than expected due to some developers experiencing planning, technical and commercial problems. By 2003, 1,100 megawatts of generating capacity had been commissioned compared to a target of 1,500 megawatts by 2000. The Department has responded to problems faced by developers by allowing contracts to be moved to new locations where, for example, planning permission could be easier to obtain. In addition, from April 2004 it has allowed sites with contracts that are not being fulfilled to be developed under the Renewables Obligation so long as this is not undertaken by the original contractor or a person who is linked to them.

Support for near market technologies: the Renewables Obligation

1.11 In the late 1990s, following the new Government's manifesto[11] commitment for 'a new and strong drive to develop renewable energy sources' the Department reviewed the status and prospects for renewable energy. It wanted to provide stronger incentives for generating companies to identify and develop low cost sites. It was also concerned that revisions to the definition of public expenditure meant that the levy paid by consumers to fund Non-Fossil Fuel Obligation contracts would count as Departmental expenditure.

11 'Because Britain Deserves Better', Labour Party (1997).

6 International comparison of the share of electricity production from renewable sources (2002)



Source: International Energy Agency – Renewables Information (2004)

NOTE
All figures exclude generation from hydroelectricity power stations.

1.12 From 1 April 2002, following four years of development and consultation, the Department introduced a more flexible market-based mechanism – the Renewables Obligation. This places an Obligation on electricity suppliers to supply a specified and growing percentage of their annual sales from electricity generated from eligible renewable sources **(see Figure 7 on page 14)**. The Department expected that suppliers would pass the costs of complying with the Renewables Obligation on to consumers. These costs, which do not count as part of the Department's expenditure, rise in real terms each year in line with increases in the percentage level of the Obligation and the overall demand for electricity, rather than the actual level of renewable generation. In 2001, the Department estimated that, by 2010, the introduction of the Renewables Obligation, and similar arrangements in Scotland[12], were likely to increase the cost to consumers of supporting renewable energy to £1 billion per annum at 2002 prices - equivalent to a price increase in electricity of 5.7 per cent. A similar scheme will also be introduced in Northern Ireland in 2005.

Support for renewable technologies further from commercial viability

1.13 Since 2002, the Department has also employed capital grants to help provide a stimulus for renewable energy projects which are unlikely to be economically viable under the Renewables Obligation alone. To date, the Department and the Lottery-supported New Opportunities Fund have pledged £170 million in capital grants to a number of offshore and bioenergy wind projects.

1.14 Since the mid-1970s the Department has also funded a research and development programme for renewables. The programme has evolved in recent years so that its £15 million annual budget has been focused on technologies with the potential to increase the level of renewable generation over a 10-20 year timeframe. In addition, around £60 million per annum is available from other public bodies for renewable energy research, development, demonstration and capital support. We discuss further the impact of capital grants and grants for research and development in Part 2.

12 Renewables Obligation Scotland established in 2002.

7 The Renewables Obligation

The basic principle:

The Renewables Obligation is a traded certificate scheme designed to encourage greater electricity production from renewable sources by increasing the income renewable generators receive.

The Department places an annual Obligation on each electricity supplier, which they meet by:

- purchase of certificates from renewable generators, in addition to the purchase of renewable electricity. Generators receive these certificates free from Ofgem for each unit of electricity they produce from renewable sources; or
- where a supplier has insufficient certificates to meet its Obligation, payment of a buy-out to Ofgem, to make up the shortfall. Proceeds from the buy-out payments are distributed to those electricity suppliers who have purchased certificates.

The presence of the buy-out, combined with the reward of redistributed buy-out payments, provides a strong incentive for suppliers to purchase certificates from generating companies. This increases the income of generators, helping them to cover the higher cost of producing electricity from renewable sources, and provides the renewables industry with an incentive to build new capacity.

The nuts and bolts:

What is the Obligation?

Since April 2002, the Department has placed an Obligation on all licenced electricity suppliers in England and Wales to purchase a specified and growing number of Renewables Obligation Certificates from renewable generators, or pay a buy-out to Ofgem (See **A** in the diagram). The Department has put in place the Obligation under the Utilities Act 2000, and it is administered by Ofgem. The Renewables Obligation Scotland is the equivalent instrument in Scotland, and similar arrangements are due in Northern Ireland from 1 April 2005.

How do electricity suppliers meet their Obligation?

In two ways - a supplier can either redeem Renewables Obligation Certificates with Ofgem **(B)**, or they can pay Ofgem a buy-out **(C)**. One Certificate represents one megawatt hour of renewable electricity. The buy-out price was set at £30 per megawatt hour for 2002-03. It changes each year in line with the Retail Price Index and rose to £30.51 per megawatt hour in 2003-04. Suppliers are free to meet their Obligation through any combination of Certificates or buy-out payments. The example below shows how a hypothetical large electricity supplier might have met their Obligation in 2003-04.

1	Total electricity supplied by the company to its customers	= 34.9 million megawatt hours
2	Renewables Obligation (% of electricity supplied)	= 4.3 per cent
3	Renewables Obligation for the company (in megawatt hours)	= 1.5 million megawatt hours (4.3 per cent of 34.9 million)
4	Obligation met through Certificates	= 0.8 million megawatt hours (i.e. 0.8 million Certificates)
5	Obligation met through buy-out payment	= 0.7 million megawatt hours
6	Total buy-out payment to Ofgem	= £21.4 million (0.7 million x £30.51)

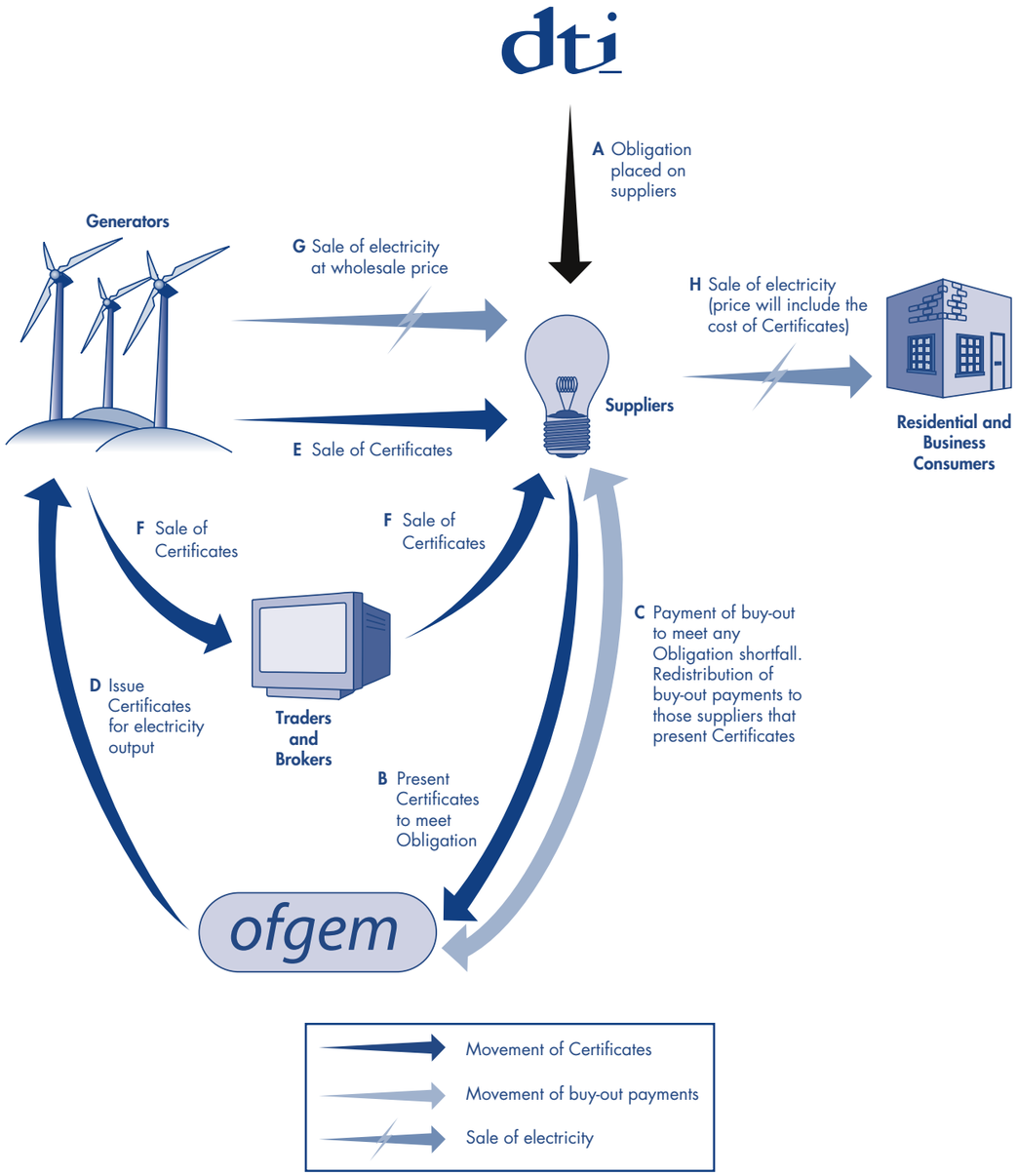
Where do suppliers get their Renewables Obligation Certificates from?

Renewable electricity generators. Generating companies, which have been accredited, submit to Ofgem monthly renewable electricity output figures. They receive one Certificate for every megawatt hour of renewable electricity they generate **(D)**. They can then sell these to electricity suppliers either directly **(E)** or through market traders **(F)**. The sale of Certificates may be combined with or separate to the sale of the electricity itself **(G)**. Suppliers usually pay for electricity from renewable sources at the wholesale market price. As such, the sale of Certificates provides the additional income necessary to cover the higher cost of generating electricity from renewables.

The Renewables Obligation

continued

Figure overleaf



What happens to the buy-out payment?

This is kept in a fund by Ofgem, and returned to electricity suppliers on an annual basis **(C)**. The amount that each supplier receives is determined by the number of Certificates they choose to redeem, relative to the total number of Certificates redeemed by all suppliers. For example, in 2003-04 the buy-out fund totalled £158,462,331 for England and Wales. The total number of Certificates produced to Ofgem by suppliers was 6,914,524. As such, each supplier received back approximately £22.92 (£158,462,331 ÷ 6,914,524) for every Certificate they had redeemed. For our hypothetical supplier, this would have been as follows:

7	Number of Certificates redeemed with Ofgem	= 0.8 million
8	Funds returned to the supplier	= £18.3 million (0.8 million x £22.92)

What determines the value of Certificates to suppliers?

Two factors – the buy-out price and the level of renewable generation in a particular year. If suppliers chose not to buy Certificates to fulfil their Obligation, they would have to pay a buy-out instead. So for a buy-out price of £30 per megawatt hour, they would pay up to £30 for Certificates. However, as noted above, suppliers that purchase Certificates also receive money back from the redistribution of the buy-out fund. The amount they get back depends on the size of the fund. This is determined by the number of Certificates available each year, which in turn depends on the level of renewable generation. As such, Certificate prices will be high in a year when renewable generation is low. In 2004, the price of Certificates was up to £50 each. This suggests that suppliers purchasing Certificates at this price were expecting to receive around £20 back per Certificate from the buy-out fund. It follows that the value of Certificates decreases, the closer the level of renewable generation is to the Obligation level in any year because the suppliers pay less into the buy-out fund.

What is the purpose of the buy-out?

The buy-out provides electricity suppliers with an alternative to buying Certificates. It means that, in any year, if the total number of Certificates available is less than required to meet the Obligation, rather than excessively bidding up the price of Certificates, suppliers can pay the buy-out instead. In doing so, the total cost of the scheme to consumers in any year is capped at a certain level.

What happens to the level of the Obligation over time?

The Department has set the Obligation level to increase each year from 3 per cent in 2002-03, until 2015-16 when it will reach 15.4 per cent of total electricity supply. In this way, year-on-year, suppliers have an incentive to purchase more Certificates, and renewable generators have an incentive to increase their renewable capacity. After 2015-16, the Obligation level is set at 15.4 per cent until 2026-27.

When do electricity suppliers have to show they have met their Obligation?

Each financial year. The Obligation level is for total electricity supply in each financial year. After the year-end, electricity suppliers have 6 months in which to submit Certificates to Ofgem or pay the buy-out, in order to meet their Obligation for the previous year. Suppliers are also able, within pre-defined limits, to 'bank' Certificates to use in the following year.

Are all sources of renewable energy eligible for Certificates?

No. Eligible technologies include onshore and offshore wind, wave and tidal energy, landfill and sewage gas generation, smallscale hydroelectric power (under certain conditions), energy crops, and solar power. There are some renewable technologies, such as largescale hydroelectricity, which are considered commercially viable without the support of the Renewables Obligation, and so are ineligible for Certificates. There are also controls and limits on the eligibility of co-firing biomass with fossil fuels. More information on particular technologies is provided in Appendix 3. Maps showing the location of renewable energy sites in the United Kingdom (accredited and not accredited for the Renewables Obligation) are given in Appendix 4.

What income do renewable electricity generating companies get?

There are two components to generators' income – that from the sale of their electricity to suppliers, and income from the sale of their Certificates to suppliers or traders. Currently, Certificate income accounts for around two thirds of generators' total income. The electricity is sold in the wholesale electricity market, so most renewable generators, because of their higher costs, would make a loss without the additional income from Certificates. Because the value of Certificates is dependent on the total level of renewable generation in a particular year, this means that the income of renewable generators from Certificates is subject to a degree of uncertainty. Generators usually overcome this risk by agreeing contracts with suppliers for the sale of their Certificates over a number of years.

Who pays for the increase in renewable generation?

The Department expects that, to a large extent, the cost suppliers incur from the purchase of Certificates are passed onto the consumer through higher electricity prices **(H)**.

Other programmes that benefit generation from renewable sources

1.15 In 2001, the Government introduced the Climate Change Levy to encourage energy efficiency and reduce carbon dioxide emissions by taxing energy used by non-household consumers. This levy of £4.30 per megawatt hour increased electricity prices for industry by around 7 per cent in 2002. Renewable generators are exempt from the Levy as they generally do not produce carbon dioxide. They also benefit from the higher price for electricity. The Department has estimated that by 2010 exemption from the Climate Change Levy will be worth up to £160 million per annum to renewable generators.

1.16 From January 2005, the European Union has put in place an Emissions Trading Scheme (the EU Scheme). This applies to carbon dioxide emissions from a number of industrial sectors, including power stations that generate electricity from fossil fuels. Firms that emit carbon dioxide can choose either to reduce their own emissions or buy allowances from other firms in Europe who have spare allowances to sell. As total allowances are reduced over time, the EU Scheme will increasingly push up the cost of producing electricity from fossil fuels and, thus, is expected to increase the wholesale electricity price. This will benefit renewable generators who are generally exempt from the EU Scheme.

Government support should lead to a significant increase in renewable generation by 2010

1.17 During 2003-04, the second year of the Renewables Obligation, the level of electricity from eligible technologies accounted for 2.4 per cent of total supply in Great Britain, significantly below the 4.3 per cent Obligation level. Achievement of the 10 per cent target will require a more than four-fold increase in renewable generation by 2010.

1.18 Recent forecasts indicate that with the existing support mechanisms the level of generation is likely to grow significantly by 2010 **(Figure 8)**. In autumn 2003, our consultants (then working with the Department and the Carbon Trust, but using a similar model to that underlying their later work for us) predicted that renewables would account for 8.2 per cent of electricity supplied in 2010. Since then electricity prices have risen and are expected to remain high for the next few years. As a result our consultants' central estimate is now 9.9 per cent, which would mean that the Department would be very close to meeting the target to supply 10 per cent of electricity from renewable sources by 2010. Most of the increase will be through further growth of onshore wind and the development, for the first time in Great Britain, of offshore wind sites. Our consultants' predictions are in line with the findings of a December 2004 report by Ernst & Young[13], which rated the United Kingdom's renewable energy market as one of the two most attractive in the world, and rated the United Kingdom as the most attractive country for wind power.

1.19 As with all models, however, predictions are uncertain and depend heavily on a few key assumptions. These include those relating to institutional barriers to increasing renewable generation, such as obtaining planning approval. They also relate to general uncertainty over important parameters such as wholesale electricity prices. On institutional barriers, our consultants have assumed that changes made to planning policy in 2004 and intended upgrades to the electricity grid network will reduce the difficulties developers face in getting sites commissioned, thus increasing the rate at which new sites can be developed. In contrast, the House of Lords took a more sceptical view of these solutions in arriving at their judgement earlier in 2004. On uncertainty, our consultants have employed three scenarios based on different assumptions about the capital and operating costs of new sites and the future wholesale price of electricity. The latter, in particular, influences the commercial viability of newer technologies such as offshore wind. The estimated growth in renewable generation under these three scenarios is shown in **Figure 9 on page 18**. While the favourable scenario estimates the proportion of renewable generation at levels barely above that from the central estimate, the unfavourable scenario depresses that proportion to 7.5 per cent of all electricity supplied.

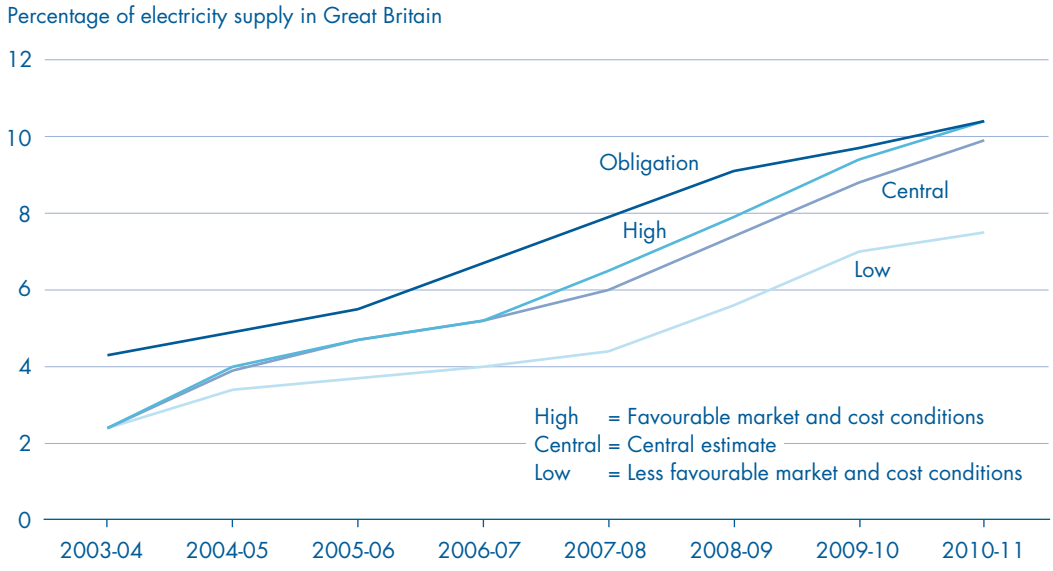
13 Renewable Energy Country Attractiveness Indices (December 2004) Ernst & Young

8 Predicted levels of renewable generation as a percentage of electricity supplied by 2010-11

Source	Prediction	Method	Comments
Oxera for the National Audit Office, January 2005	Central estimate of 9.9 per cent, with a low estimate of 7.5 per cent and high estimate of 10.4 per cent.	Used latest available data, for example, on current levels of renewable generation, the future wholesale price of electricity and progress on new developments, to rerun a model developed for the Department and Carbon Trust in 2003.	Oxera assumed that changes in planning policy in 2004 and intended upgrades to the grid will reduce the problems developers have faced in getting sites commissioned thus increasing the rate at which new sites can be developed. Oxera took into account the Government's expansion of the Obligation to 15.4 per cent in 2015. The three different scenarios are driven by varying assumptions about the capital and operating costs of plant and the wholesale price of electricity.
Oxera for the Department and Carbon Trust, autumn 2003	8.2 per cent.	Model developed for the Department, which included a series of assumptions, for example, on the build rates and costs of new renewables plant, operating and maintenance costs and the prices of wholesale electricity.	Oxera used broadly the same assumptions as in its work for the National Audit Office in January 2005. The main differences were assumptions about the future price of wholesale electricity and the fixed cost of new generating capacity. Oxera ran three scenarios using different assumptions about the contributions of individual technologies. Each scenario gave an estimate of around 8.2 per cent.
House of Lords Select Committee on Science and Technology, July 2004	The Committee did not provide a specific estimate, but judged that renewable electricity supply would be unlikely to exceed 75 per cent of the Obligation level in 2010-11.	Committee took evidence from a large number of stakeholders including the Department, generators, electricity suppliers and financiers.	The Committee concluded that renewables would not achieve the 10 per cent target partly for practical reasons - planning consents, availability of labour and equipment and so on - but also as a direct consequence of the Renewables Obligation method of support, which may act as a 'cap' on renewable output.

Source: Oxera; 'Renewable Energy: Practicalities', House of Lords Science and Technology Select Committee, July 2004

9 Estimated outturn under the Renewables Obligation in each year to 2010-11



Source: Oxera

1.20 Two main messages can be taken from our consultants' findings. First, events external to Departmental support, such as market movements in electricity prices, can have a significant influence on the level of generation and therefore progress towards the 2010 target. Secondly, the impact of such external events will vary:

- where electricity suppliers get to close to fulfilling the Obligation, as our consultants predict they may do by 2010, favorable conditions, in terms of higher electricity prices and lower technology unit costs, may yield little extra renewable generation, while the converse of lower electricity prices and higher technology unit costs, can have a significant adverse impact. This is because as the supply of Renewables Obligation Certificates increases relative to the Obligation level, their price reduces, thus decreasing the incentive for generators to build new capacity;
- where the amount of generation is significantly below the Obligation level in any year, as it is currently, the same favorable conditions can provide strong incentives to increase output. The actual growth of generation, however, may be limited by the capacity of the renewables industry to develop new sites. We discuss the potential barriers to development, and the Department's response to them, in the next Part.

PART TWO

Key factors for future success

Achievement of the 10 per cent target is dependent on several critical factors

2.1 Meeting the target for 2010 will require a step-change in the rate of growth of renewable generation. The Government has put in place policy mechanisms to achieve the target, but success is contingent on a number of key factors over which the Department has varying degrees of influence. The five main issues are: the planning system; upgrading the electricity grid network; ensuring confidence in the electricity market; developing confidence in the Government's policy framework; and the provision of public funds to leverage private finance. The outcome of these issues will also significantly determine the Government's ability to reach its aspiration of 20 per cent of electricity from renewables by 2020.

2.2 The Department outlined the required actions for several of these issues in its Renewables Innovation Review published in February 2004. As a result of the review the Department has now created a policy team responsible for delivering the 2010 target and established plans for tackling the main barriers to success. The plans specify the critical actions required, expected outcomes and contingency arrangements. The Department monitors progress against these plans on a monthly basis, and also tracks performance indicators, for example the level of renewable generation. The following five sections consider the main barriers to progress, the actions the Department and others in Government have taken to date, and the work still remaining.

Renewables developers can face significant difficulties in acquiring planning permission

2.3 The construction of renewable energy power stations and any resulting network upgrades, as with any form of building, require approval for planning, either at a local or a national level. As far back as the mid-1990s the Department identified the acquisition of planning permission as a key constraint in the take-up of Non-Fossil Fuel Obligation contracts, particularly for onshore wind sites. In designing the Renewables Obligation, the Department sought to create a policy mechanism that gave developers greater flexibility to choose sites where planning would be less of a constraint. **Figure 10** gives an example of how the Department has dealt with planning for future offshore wind farms.

10 Planning for the next generation of offshore wind farms

The Department has developed a strategy for the development of future offshore wind farms. It has identified three strategic areas off the English and Welsh coasts where development in the next few years will be centred. Each area was subject to a Strategic Environmental Assessment, which considered the impact of future offshore development, including the impact on other users of the sea. This helped those bidding for licences to build offshore wind farms in these areas, and those assessing the bids. The Department has given licences for up to 7,200 megawatts of generating capacity, enough to provide electricity for one in six homes in the United Kingdom. It has also established a one-stop-shop for offshore developers to assist them in acquiring the consents they need before construction can begin.

Source: Department of Trade and Industry

2.4 Despite the introduction of the Renewables Obligation, there remain a number of factors which can make it difficult to acquire planning approval for renewable energy projects, particularly for onshore wind farms. The Ministry of Defence currently has a policy that it will register its concerns regarding proposed wind farms at the pre-planning stage. Such concerns stem from proposed wind turbines that are within 74 kilometres and line of sight of its air defence radar sites; 66 kilometres and line of sight of its air traffic radars; compromise seismic monitoring; or interfere with aerodrome safety. This policy has meant that in the period from 1996 to 2003 the Ministry registered concerns with almost half of all pre-planning proposals for proposed onshore wind farms, although it formally objected to very few planning applications.

2.5 The Ministry has long been aware of the need to maintain a more constructive approach to assist the Government in meeting its target for renewable energy, and continues to take steps accordingly. It is aiming to speed up the time it takes to decide whether to lodge concerns against a proposed wind farm with the introduction of an electronic version of its pre-planning consultation form. It is not automatically raising concerns where wind turbines, although within guideline distances, would not for reasons of topography affect any radar system. The Ministry is also working to improve communication with regional renewable bodies and with the devolved administrations in Scotland and Wales to improve relations. Most importantly it has initiated research through the auspices of the cross-Government Working Group on Wind Energy, Defence and Civil Aviation Interests to review the line of sight criteria between a radar site and wind farm and to support a move to a risk-based assessment strategy. The Ministry is also assisting research into the possibility of developing radar software that will mitigate some of the effects of wind farms.

2.6 More generally, there are currently wide variations in the success of planning applications and the duration of the planning process, both within England, and between England, Scotland and Wales. Between 1999 and 2003, 94 per cent of planning applications in Scotland received approval against 50 per cent in England and 40 per cent in Wales, although this latter figure masks a significant legacy of wind farms in Wales that were approved before 1999. Within England, between 1999 and 2003, local planning authority approval rates for wind farms ranged from zero to nearly 100 per cent, with most authorities reporting approval rates of between 50 and 80 per cent. As regards the average time for applications to go through the planning process, for England this is 8.5 months, for Scotland 10.0 months, and for Wales 23.4 months. There is also significant variation at a regional level.

2.7 These differences between England, Scotland and Wales are partly a consequence of the variation in guidance provided to local planning authorities on how to assess renewable energy projects. In 2001, the Scottish Executive revised its planning guidelines, requiring local authorities to give due consideration to local and national renewable energy policy objectives, when assessing wind farm planning applications. The revised planning process, combined with excellent wind resources, means that the majority of onshore wind development is currently taking place in Scotland.

2.8 In August 2004, after a number of delays, the Office of the Deputy Prime Minister issued a new planning statement in England on renewable energy similar to that already in use in Scotland. Under this new approach each English region should set targets for renewable generation. Local planning authorities have to take account of these targets when assessing planning applications for renewable energy projects, since these will be set out in the regional plans[14] that form part of the development plan for each local authority area. The Office of the Deputy Prime Minister expects that the revised planning statement will provide a stimulus to renewable energy development in England and help correct the disparity between English and Scottish approval rates. Whether the guidance is likely to have the same impact as its forerunner in Scotland is unclear. England is, for example, much more densely populated than Scotland and applications for renewable projects are more likely to provoke opposition. The House of Lords Science and Technology Select Committee 2004 report 'Renewable Energy: Practicalities' also questioned how regional targets will be set, and how this will influence individual planning decisions.

2.9 In July 2004, the Welsh Assembly Government issued for consultation its own draft renewables planning guidance for Wales.[15] This guidance adopts a different approach by identifying strategic areas as the favoured location for the large wind farms which it is expected will provide the majority of the renewable energy output in Wales by 2010. The Assembly hopes to issue the final guidance in Summer 2005.

2.10 The success of the planning changes adopted in England will to a large extent be determined by the weight of public opinion, for or against the deployment of renewable generation on a wide scale. The Department has a vital role to play in making the case for renewable energy to the general public. It has begun to do this, for example, in 2004 through the launch of the 'It's Only Natural' campaign which aims to broaden public knowledge of renewable energy. Surveys show that the general public are in favour of renewable energy, with, for example, two thirds of those surveyed in England being happy to have an onshore wind farm in their area. There remains, however, a small but vocal level of opposition posed by a number of national and local interest groups.

14 These plans are known as Regional Spatial Strategies which are replacing Regional Planning Guidance following the enactment of the Planning and Compulsory Purchase Act 2004.
15 Technical Advice Note 8: Renewable Energy.

Timely upgrading of the electricity grid network is required

2.11 In Great Britain the majority of electricity generation takes place far from the point of consumption. Electricity is carried long distances at high voltage along the transmission network, which is owned and operated in England and Wales by National Grid Transco, and in Scotland by Scottish Power and Scottish and Southern Electricity. From the transmission network, electricity is delivered to end-users through local distribution networks. A change in the locations at which electricity enters either the transmission or distribution networks affects the flow of electricity across the system. While the impact of a single renewable project connecting to the system is small, the Government's objective is to effect a profound change in the sources of electricity supply over the next 20 years. Renewable power projects are often in remote locations and increasingly, for wind farms, offshore. These changes in the sources of generation mean that both the transmission and the distribution networks require upgrading to accommodate these shifts in electricity flows.

2.12 To ensure that transmission and distribution network companies meet the requirements of their licences, these companies require that new generation only comes online when sufficient network capacity exists. If new capacity must be established, as is likely to be the case in certain parts of Scotland, then delays in reinforcing the networks – for example due to planning consents inquiries or regulatory issues – could delay renewable generation in coming online. If this occurred, it would be considerably more difficult for the 2010 target to be met. The Department's Renewables Innovation Review acknowledged the importance of upgrading the grid, and that the transmission and distribution network operators need to be given the necessary incentives to make the required investment.

2.13 The Department and Ofgem are aware that upgrades to the transmission network need to begin as soon as practicable while trying to ensure that such investments are made efficiently. A Departmental working group has identified the extent, cost and timescales of the required improvements for a number of scenarios for increased renewable generation in Scotland, and England and Wales. The Renewables Innovation Review estimated that the total cost of this work could be between £1.1 billion and £1.3 billion, although there is continuing uncertainty as to exactly how much network reinforcement will be necessary to meet the 10 per cent target. It also stated that investment needed to begin in 2004, assuming the necessary planning consents are in place, if the required upgrades were to be made in time for 2010. The costs of any network investment are initially met by the three transmission network owners, who pass these on to generators and suppliers through use of system charges. The three British grid companies have identified a number of specific enhancements to their networks likely to be required to accommodate significant additional wind capacity. During 2004, Ofgem announced its proposals for £560 million of funding for the first stage of this work, as well as the treatment of this investment in the regulatory regime. The grid companies have now begun the required preparatory work. The House of Lords Science and Technology Select Committee concluded, in 2004, that National Grid Transco is 'doing what it can to provide an accurate assessment of the grid reinforcement and extension necessary to provide largescale development of renewable energy'. Nevertheless, a remaining key question for the development of future renewable projects, especially offshore wind, is how the cost of new grid connections and upgrades will be met by electricity generating companies.

2.14 Echoing a House of Commons Environmental Audit Committee report from 2001,[16] the House of Lords Science and Technology Select Committee also raised two issues regarding upgrading of the distribution networks. The first of these is the apparent lack of a requirement on distribution network operators to respond quickly to generators requesting a connection to their networks. The second is that generators who are the first to set up in a particular area, and wish to connect to the distribution networks, currently have to pay the full cost of their connection rather than sharing that cost with any later entrants as they come online. The Department and Ofgem have taken the opportunity to consider the requirements of distribution network operators as part of the recent Distribution Price Control Review. In its final proposals in November 2004, Ofgem confirmed the introduction of incentives for distribution network operators to facilitate connection of distributed generation together with revised charging arrangements. These changes should address the issues raised by the House of Lords Select Committee. As a significant proportion of future renewable generators will connect directly to distribution systems the outcome of this Review will be crucial in determining investment decisions.

16 'A Sustainable Energy Strategy? Renewables and the PIU Review' (Fifth Report, 2001-02) House of Commons Environmental Audit Committee

The wider electricity market is a determinant of investor confidence

2.15 Currently, around a third of the income for renewable generators comes from the sale of electricity, with the Renewables Obligation providing the bulk of the rest. The expected market price of electricity is therefore a crucial factor in determining the economic viability of any generation plant, particularly for marginal technologies, and hence, the success of the Government's additional support for renewables. In general, the higher the price of fossil fuel power, which the wholesale price of electricity reflects, the greater the commercial viability of renewables.

2.16 The electricity market in England and Wales operates under the New Electricity Trading Arrangements (NETA), introduced in March 2001. NETA is a fully competitive market in which supply and demand determine prices, and electricity is traded between generation and supply companies through bilateral contracts set into the future. Ofgem now oversees the wholesale electricity market in two important respects. It monitors the market to make sure it remains free from abuse. It also approves or rejects changes to market rules proposed by the industry or customers.

2.17 The introduction of NETA contributed to a large fall in wholesale electricity prices. Those renewable generators who held Non-Fossil Fuel Obligation contracts continued to receive the price for their electricity set in their contract. For other renewable generators the fall in electricity prices reduced their income and hence the confidence of developers to invest in new plant at that time. The design of NETA seeks to allocate more accurately the costs associated with generation breakdowns and intermittency, rewarding electricity generators able to predict their output with some accuracy, and those able to respond rapidly to fluctuations in demand - such as those producing electricity from natural gas. However, this had a negative effect on renewable generators such as wind farms where potential output is not so predictable. These effects were more significant in the period before April 2002, after which the introduction of the Renewables Obligation supplemented the income of renewable generators.

2.18 Since its introduction, Ofgem has approved a number of adjustments to NETA to improve the way it operates, some of which have mitigated the difficulties faced by those renewable energy generators whose output is intermittent. In 2005, NETA will be replaced by the British Electricity Transmission and Trading Arrangements (BETTA) which will bring together the wholesale electricity markets for England, Scotland and Wales under a single set of regulations, which effectively extend the NETA system to cover Scotland as well. In line with the Government's objectives for energy policy, Ofgem expects BETTA to make the wholesale electricity market more competitive, thus putting some downward pressure on wholesale prices. In principle, these arrangements could expose renewable generators to considerable uncertainty over wholesale prices, which could be particularly damaging for smaller companies, especially if prices fell. In practice, the current pressure on wholesale electricity prices is upwards, for a variety of reasons such as rising fossil fuel prices and the introduction of the European Union Emissions Trading Scheme. There is a widespread view that prices will remain above recent historical levels for some time, although there remains a degree of market uncertainty.

Confidence in the Government's policy framework is essential for encouraging investment

2.19 International evidence suggests that the creation of a thriving renewables industry requires implementation of a policy framework which provides: a stable environment for investment; high certainty on investment returns; and which commits to long-term goals. Countries, such as Germany, which have adopted such an approach, have had greatest success in developing their renewable energy sectors. It is these principles which must underpin the Department's own policy framework if it is to manage a similar level of achievement.

The Department's long-term approach

2.20 Unlike the Non-Fossil Fuel Obligation and schemes adopted in many other countries, the Renewables Obligation does not provide a guaranteed price for renewable energy. This is because generator income is determined by the wholesale electricity price and the value of Renewables Obligation Certificates. Uncertainty over future revenues can make financiers less willing to invest. So in December 2003, to bolster industry confidence in the Government's long-term commitment to renewable energy, the Department proposed an extension of the Obligation levels from 10.4 per cent in 2010-11 to 15.4 per cent by 2015-16.[17] Industry representatives believe this has given developers greater confidence of their income streams after 2010 and increased the likelihood of the Department getting close to meeting its 2010 target. Our consultants estimate that electricity suppliers will now meet approximately 95 per cent of the Obligation level of 10.4 per cent in 2010.

2.21 Despite this change, the renewables sector is aware that the level of the Obligation could act as a potential cap on the expansion of renewable generation. This is because were generators to meet the Obligation level in full, and produce more Renewables Obligation Certificates than required in any one year, the market price of Certificates would drop significantly as suppliers would not have to compete for them. At that point developers might hesitate to bring on stream new projects to protect their revenues from a collapse in Certificate prices. In practice the annual Renewables Obligation levels for the next few years are sufficiently stretching for the risk of a price collapse to be remote. Our consultants' analysis suggests, however, that by 2010 the picture may have changed when the level of generation may be approaching the target and therefore the Obligation level.

Changes to the Renewables Obligation rules on co-firing

2.22 In April 2004, the Department introduced various technical changes to the Obligation, reflecting the experience of the first year of its operation and to increase the likelihood that future Obligation levels would be met. One important change involved the mixing of coal and biomass for burning in existing coal-fired power stations, a process known as co-firing. The bioenergy proportion of the generated electricity which is eligible for Renewables Obligation Certificates will now receive support under the Renewables Obligation until 2016 where previously such projects had only been eligible for support until 2011. The reason for this change is to encourage the development of an energy crop sector by providing a market for the crops. As the rules on co-firing had stood, farmers and generators faced little incentive to start growing energy crops.

2.23 This change has created disquiet amongst some independent bioenergy generating companies, who fear that their fuel supplies may be under threat from large co-firing generators who are able to pay more to suppliers of biomass fuels. It is relatively easy for coal-fired power stations to introduce co-firing, as doing so requires limited capital investment. The renewables industry also fears that the extended time for which co-firing is now eligible under the Renewables Obligation may reduce the price of Renewables Obligation Certificates and discourage the growth of other renewable generation. In order to mitigate the potential impact of the changes on Certificate prices, the Department placed a cap on the extent to which any electricity suppliers' Obligation can be met by using Renewables Obligation Certificates generated from co-firing. Analysis undertaken by the Department prior to the implementation of the technical changes, suggests that they will not have a significant impact on the non-bioenergy renewables sector. Indeed, analysis conducted by our consultants, looking at the impact of co-firing in general, reached a similar conclusion, suggesting that construction of only a small amount of offshore wind capacity may be delayed. Nevertheless, the success of the extended eligibility of co-firing will be dependent on the extent to which it succeeds in promoting the growth of energy crops. Tracking performance in this area is important if the Department is to maintain the case for co-firing in the long-run.

17 Although subject to formal consultation, the Department and industry are operating under the assumption that the extension will come into effect from 1 April 2005.

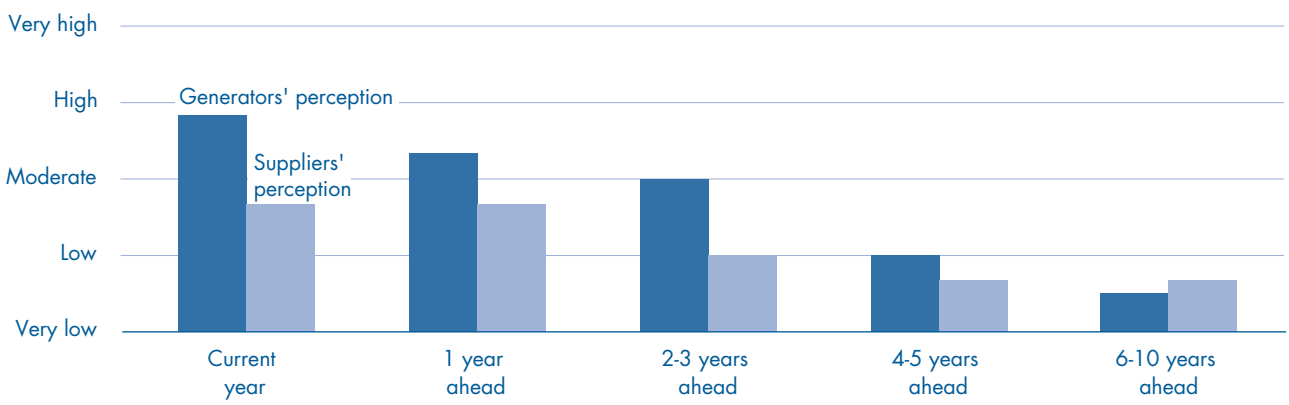
2.24 A further concern regarding co-firing is the extent to which the environmental benefit of using biomass is offset by an increase in the burning of coal. This is because the revenue from the Renewables Obligation increases the economic viability of coal-fired power stations. Concern that this could perversely extend the use and economic life of coal-fired plant was one of the reasons why the Department limited the extent to which electricity suppliers could meet their Obligation through co-firing. Work conducted for the Department in 2003, relating specifically to the effects of extending co-firing's eligibility under the Renewables Obligation, reached the view that it would not improve the commercial viability of coal-fired power stations, and would therefore not increase coal use. However, our consultants' analysis, looking at co-firing in general, estimates that an average of 21 per cent of the environmental benefits of co-firing may be lost because of the increased burning of coal. This problem would be worse were it not for the mitigating effect of the European Union Emissions Trading Scheme, which will encourage lower carbon dioxide emissions from fossil fuel users.

Problems with the Renewables Obligation

2.25 The Department is currently considering other industry concerns about the way the Renewables Obligation works. First, the market for Renewables Obligation Certificates has been upset by the financial failure of three electricity supply companies; TXU UK Ltd in November 2002, Maverick Energy Ltd in June 2003, and Atlantic Electric and Gas Ltd in April 2004. All these companies, particularly TXU, had substantial liabilities to the Obligation buy-out fund at the time of going into administration. By defaulting on their payments to the buy-out fund, they reduced the amount of money available to be redistributed to other electricity suppliers who had submitted Renewables Obligation Certificates to fulfil their Obligation. In 2002-03, the total of these shortfalls was £23.6 million[18] leaving a final buy-out fund of £90 million, and in 2003-04 it was £9.2 million with the final buy-out fund totalling £175 million. This problem reduced the market price of Certificates for a short time, which in turn reduced the return on investment to renewable generating companies. The Department is addressing this issue, given industry concern about other possible company failures in the future, as part of its amendments to the Renewables Obligation, which will shortly be laid before Parliament with the aim of bringing them into force by 1 April 2005.

2.26 There are also more general concerns within the renewables sector regarding the Renewables Obligation mechanism. One in particular is the level of liquidity in the market for Renewables Obligation Certificates. This is the ease with which generators and suppliers are able to buy and sell Certificates, now and in the future. Low liquidity indicates a market where those wishing to sell Certificates have difficulty finding buyers, and vice versa. This can affect the price at which Certificates are traded, with prices often being discounted where liquidity is low. Our consultants conducted a survey of both large and small electricity supply and generating companies' perceptions of liquidity in the market for Certificates which is summarised in **Figure 11**. This shows that market perceptions of liquidity are low for those sales of Certificates which are for more than four years ahead.

11 Perceptions of liquidity in the market for Renewables Obligation Certificates



Source: Oxera

18 TXU administrators have since paid out around £7 million to suppliers who had been affected by the shortfall in the buy-out fund for the first year of the Renewables Obligation.

The small number of players operating in the Certificate market, and uncertainty caused by political and credit risk, are likely causes. Factors such as these can reduce contracted Certificate prices for generators. This issue is a particular concern for small independent renewable generating companies that do not own an electricity supplier and must find one in the market with whom to contract for their electricity output and accompanying Certificates. In 2005, the Department is undertaking a review of the Renewables Obligation which will reflect on the first three years of operation. The Department will consider issues on the liquidity of the market for Renewables Obligation Certificates as part of this process.

Additional financial support is necessary for some renewable technologies to be commercially viable

2.27 There are several renewable technologies that are not commercially viable under the Renewables Obligation alone. A report by the Performance and Innovation Unit[19] highlighted bioenergy and offshore wind as two technologies that could make a significant contribution to the 10 per cent target, but which required additional support to get early projects started. The Government has made available £170 million for two capital grants schemes, supporting bioenergy and offshore wind projects. In so doing, it expects that developers will gain experience and confidence, and be able to reduce their unit costs of generation so that future projects will require less additional support. The Department has contracted out the administration and management of both schemes to Future Energy Solutions - a subsidiary of AEA Technology, which has long-term experience of the renewable energy sector.

Bioenergy projects

2.28 In 2003, the Department and the Lottery-supported New Opportunities Fund allocated £55 million of capital grants to 22 bioenergy projects. Grants were awarded to smallscale ventures involving clusters of biomass heating installations, as well as to larger bioenergy power, and combined heat and power stations that, once in operation, will earn Renewables Obligation Certificates. For the larger schemes, the Department encouraged applicants for both conventional bioenergy technologies as well as newer technologies. One priority area of the competition was set aside for advanced technologies.

2.29 Of the 22 projects offered funding, one declined to take up the offer and the company behind another entered administration. Of the remaining 20 projects, 11 are for larger power and combined heat and power generation and account for the bulk of grant support. Two such plants are currently under construction. The remaining nine are running at least a year behind schedule in starting construction. Developers face several difficulties including:

- contracting with local farmers for a biomass fuel supply;
- contracting with a supply company for the sale of electricity at a commercially viable price;
- acquiring planning permission to build the power station (six projects have so far been given planning consent); and
- overcoming technical difficulties where technologies are relatively new.

Problems with any of these factors can hinder a developer's ability to secure adequate project finance, without which ventures cannot go ahead - in which case the Department will not pay the grant to them. Developers have generally viewed the capital grants as vital for helping to overcome these difficulties and get a number of projects started, but the risk remains that many of the projects will not go ahead. If so, the scheme will fail in its objectives to provide confidence and reduce unit costs both of which are vital if the bioenergy sector is to be self-sustaining under the Renewables Obligation in the future.

Offshore wind projects

2.30 Modelling conducted for the Department's Renewables Innovation Review suggested that offshore wind could contribute up to 4 per cent of total generation towards the 2010 target – a figure compatible with our consultants' estimates. But this is dependent on the sector overcoming a number of difficulties. There is currently little worldwide experience of building and operating offshore wind farms and, until recently, virtually none in the United Kingdom. The risks and costs for early developers are high as generating plant will be partly experimental in nature, with improved designs and cost reductions evolving as experience develops.

19 'The Energy Review' (February 2002)

2.31 The Department, supported by the New Opportunities Fund, has allocated £117 million of capital grants, via three rounds, to 12 projects, which will provide just over 1,000 megawatts of offshore wind capacity. To date, two projects are fully operational - North Hoyle, situated off the north coast of Wales near Rhyl, and Scroby Sands, 2.5 kilometres off the Norfolk coast near Great Yarmouth. The remaining projects are at varying stages of development. Once built, these wind farms should generate enough electricity to supply more than 600,000 households. The projects were relatively smallscale, capped at a maximum of 30 turbines each, to which the Department allocated capital grants of up to £10 million. It hoped that this programme would give industry greater confidence to prepare for the much larger wind farms due to be built towards the end of this decade.

2.32 Future Energy Solutions expects that six of the current round of offshore wind farms, in receipt of grants, will be built and commissioned by late 2006 as there should be no significant barriers to any of the projects going ahead. The remainder are expected to come online in the subsequent two years. All the proposals required planning consent before a grant could be given. The Department's offshore wind unit worked effectively with the Department's capital grants team to ensure that the consents procedure for proposals was completed in time for applicants to bid into the scheme. The capital grants for offshore wind are seen by the renewables industry as having made projects economically viable under the Renewables Obligation. Without them, the projects would not have gone forward. Under the conditions of the grants, companies must provide the Department with information on the final costs of the project, lessons learned during construction, and performance during the initial period of operation. The first of these reports will feed into the 2005 Renewables Obligation review which will consider, amongst other issues, the extent to which offshore wind costs have fallen, with the help of capital grants.

Further support for new offshore projects

2.33 In 2003, the Department allocated licences for the next round of proposed offshore wind farms. Licences have been given for over 7,000 megawatts of capacity, enough to provide electricity for one in six homes in the United Kingdom, and seven times the capacity licenced under the first round. Average construction costs should reduce through economies of scale - the size of each project will be much larger than current projects - and because the offshore wind industry will have gained experience from the earlier projects. To facilitate its planning for this next round of development the Department should already be identifying from the current round of offshore wind farms under construction, the extent to which average build costs have reduced. This will help it establish whether further Government support will be needed. The Department will also need to consider the outcome of the 2005 Renewables Obligation review on the economics of proposed schemes, the state of the wider electricity market, and together with Ofgem, finalise arrangements for the regulatory regime for offshore network, including the grid connection costs required for these new wind farms - a significant element in the economics of any offshore venture.

Achievement of the Government's aspirations beyond 2010 will require the development of new technologies

2.34 The Government expects that to achieve its goal of putting the United Kingdom on a path towards a reduction in carbon dioxide emissions of some 60 per cent from current levels by about 2050, renewables will need to contribute at least 30 to 40 per cent of electricity generation, and possibly more. This is likely to require both the expansion of existing renewable technologies, such as onshore wind, offshore wind and bioenergy, as well as generation from new renewable technologies. The Department is therefore assisting industry to research, develop and demonstrate a number of new technologies. The Renewables Innovation Review examined the long-term technology options and identified wave and tidal energy technologies as one of the options which could provide the best balance between achieving cost effective reductions in carbon dioxide emissions and generating economic benefits for the United Kingdom.

Research and development

2.35 Until 2004, the Department supported research and development for the renewables sector through the New and Renewable Energy Programme (the Programme). The Programme looked to develop near-market and medium-term technologies through research and development; identified and addressed the barriers to the uptake of renewables; and disseminated information to industry and the public. The bulk of the Programme's expenditure, totalling around £230 million since 1988 (at 2002 prices) went in grants to renewable energy companies, research organisations and consultants.

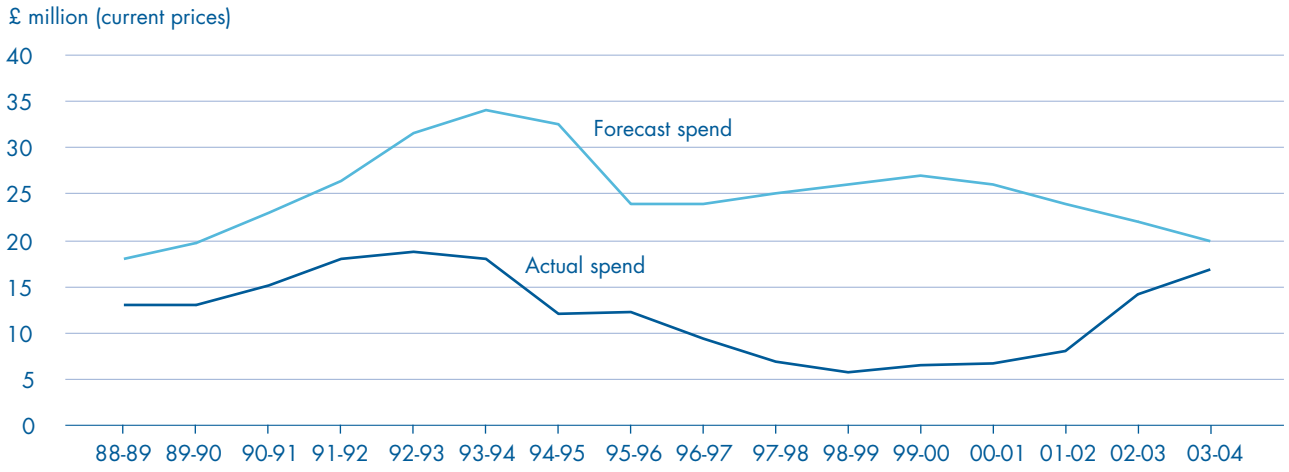
2.36 **Figure 12** shows that during most of the 1990s the expected level of research and development expenditure set out in the Department's energy papers of 1988 and 1994 was not achieved. The value of grants fell during the mid-1990s as a result of budget cuts and budget underspends. Expenditure has increased in the last five years and the annual budget is now fully utilised. The Department attributes this change to more energetic and public promotion of the Programme; more active management of individual projects; and increased business confidence in research stimulated by the Government's wider package of support measures for renewables.

2.37 The technology focus of the Programme changed over time **(see Figure 13 on page 30)**. During the mid-1990s the Department stopped funding geothermal, wave and tidal projects as it considered these technologies were unlikely to contribute economically to the United Kingdom's electricity supply by 2025. In the last four years, it returned funding to wave and tidal projects, and spent increased sums on solar power, as the Department now sees these technologies as having the potential to expand the use of renewable energy within the next 20 years. The Department's Renewables Innovation Review accepted that the degree of change in the Programme's strategy and technology focus over the last 15 years may have undermined the potential confidence of investors and developers.

2.38 In 2002, the Department made public its strategies for each individual renewable technology. The strategies set down the Department's rationale for supporting each technology; the technology's level of development; the readiness of the relevant domestic industry; and targets for the commercial competitiveness of the technology. These strategies have been used to inform the Department's funding priorities and provide the basis for monitoring the success of the Programme, although some strategies have now to be updated.

2.39 The Department has clear procedures for monitoring the performance of individual projects supported by the Programme and recognises that a proper assessment of its long-term achievements needs to be conducted regularly and systematically. The Department has sponsored two evaluations of the research and development programme. The most recent evaluation, in 2001, concluded that the output from the Programme's non-technology work to address the barriers to the uptake of renewable energy, such as planning and finance, had been successful in assisting contractors to develop generating capacity. However, the evaluation also stated that many contractors, especially wind generators, said they had not received significant benefits from technological developments funded by the Programme. The evaluation concluded that there were few examples of funded technology or equipment, especially in the onshore wind sector, being commercially implemented by contractors.

12 Expenditure on research and development grants compared to energy paper forecasts

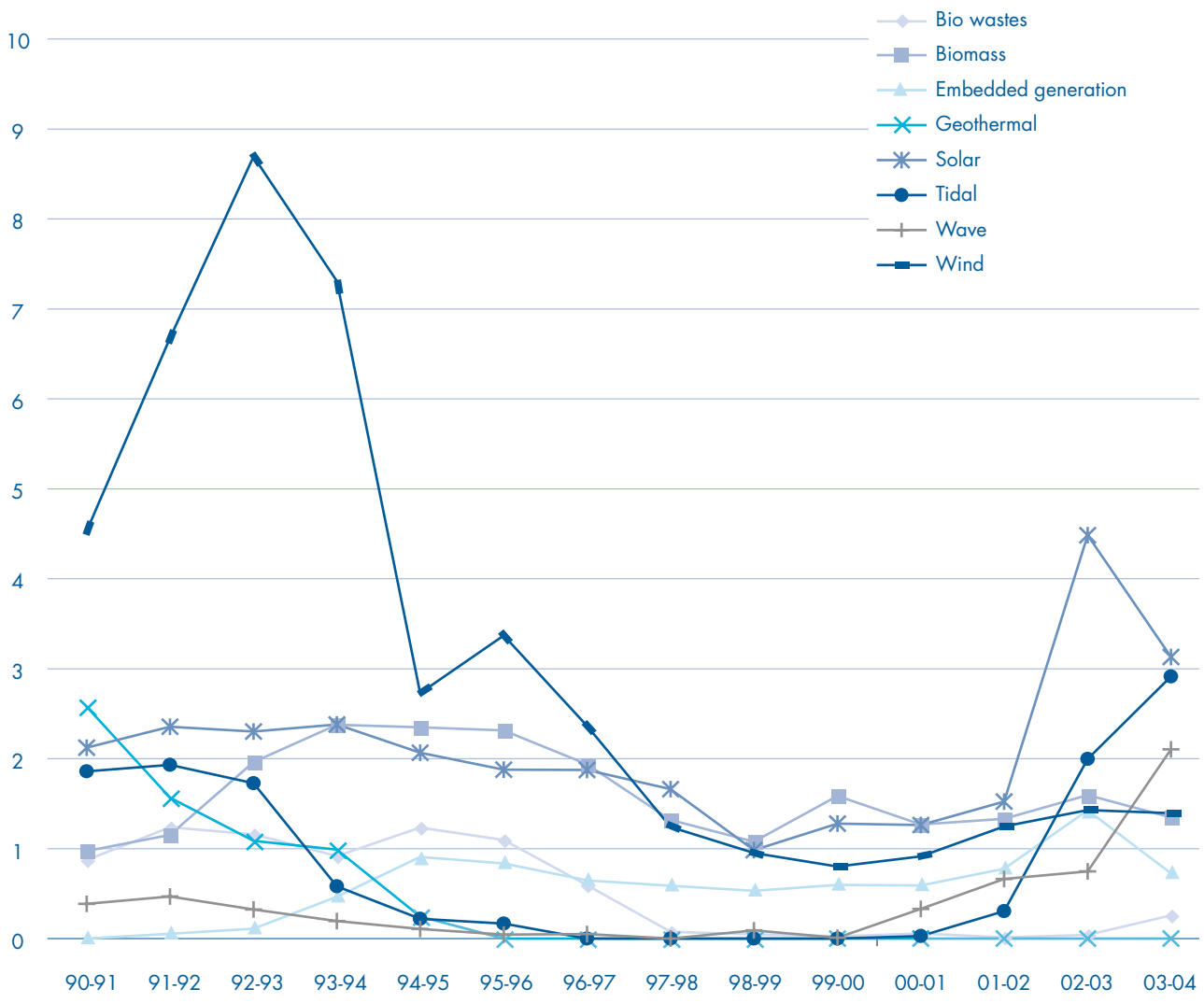


Source: Department of Trade and Industry

NOTE

Expected spend for the years 1988-89 to 1994-95 figures are based on expectations set out in the Department's 1988 Energy Paper. Thereafter figures are based on the 1994 Energy Paper.

13 Expenditure on research and development grants by technology



Source: National Audit Office analysis of Departmental data

2.40 The Department considers that technology and equipment projects funded by the Programme are by their nature high risk and that a relatively high failure rate is likely and should not necessarily be interpreted as a weakness of the Programme. The Department points to the success of the Programme in areas such as:

- providing Government and others with a better understanding of a range of renewable technologies and the barriers to their deployment;
- supporting the development of equipment which enables the quick installation of offshore wind turbines; and
- assisting a number of wave and tidal concepts which are now sufficiently mature that their technical viability can be tested at sea.

2.41 From 2004-05, research and development for renewable energy has been subsumed into a Department-wide Technology Programme through which the large majority of all the Department's business research and development will be provided. During the period 2005-06 to 2007-08 the Department has secured additional funding for this new approach to supporting research. A Technology Board will develop an overall technology strategy and advise on the broad allocation of resources to all technologies. Increasingly, the renewables sector will have to compete with other technologies for funding. For the period 2005-06 to 2007-08 the Department has recently agreed an indicative allocation of at least £20 million per annum of Technology Programme funding to support research and development into renewables and low carbon technologies, subject to high quality proposals coming forward and the ability of the sectors to demonstrate success from the support received. The Technology Programme will assist the Department to take a more strategic approach towards providing support for all new and emerging technologies, but could bring instability to the funding of renewables research. Better evidence on the achievements of previous grants could help reduce this risk.

Funding gap for some pre-commercial and demonstration technologies

2.42 Emerging technologies pass through various phases of development prior to becoming commercially viable, namely: research and development; demonstration; pre-commercial; and supported commercial. The aim of the Department's financial support should be to assist new technologies in progressing through each stage. However, many sector representatives have expressed concern that there is not sufficient backing for those technologies at the demonstration and pre-commercial phase of development. This lack of support can reduce a companies' ability to hold together skilled teams and cause the loss of some technologies abroad. The Renewables Innovation Review also identified this gap in support.

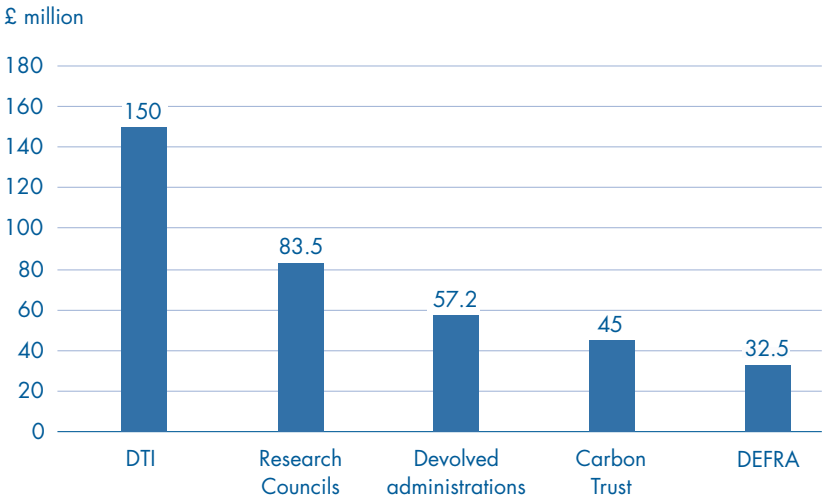
2.43 The United Kingdom has the physical, scientific, and offshore resources, to be a world leader in the wave and tidal energy industry where technologies are currently at the demonstration stage of development. There are several businesses operating in this sector which are developing small generating units. To address the funding gap identified in the Renewables Innovation Review, in August 2004 the Department announced the allocation of £50 million to help support the sector. £8 million of this will go towards projects which should aid the deployment of these technologies in the future. For the remainder, the Department has worked in close consultation with the renewables industry trade associations, and developers, to determine an appropriate mechanism for allocating funds to specific demonstration projects. Support is likely to be available to each project for a five year period, although the first of these will not be in operation for at least another two years. The Department's initial estimate is that the £42 million will enable support for up to seven projects, potentially providing 40 to 50 megawatts of capacity. Projects in the wave and tidal energy sector face various technical risks, particularly in the scaling-up of generating units and their deployment at sea. The Department hopes that its support will assist firms in overcoming these risks, leveraging private finance, and in the long-run helping to reduce the high unit cost of electricity generation. Current estimates of the cost of wave and tidal generation are up to £100 per megawatt hour. This will need to halve if this source of energy is to be commercially viable under the Renewables Obligation.

The complexity of funding arrangements

2.44 Historically, the New and Renewable Energy Programme has provided the large majority of Government funding for research in the sector. In recent years, however, Government funds for research and development and demonstration projects have been allocated from a wide variety of sources as new bodies have started to support the renewables industry. This greater interest in the sector reflects the increased importance placed on renewable energy as part of the Government's wider energy strategy and Climate Change Programme. **Figure 14 overleaf** shows the estimated level of public expenditure on research, development and demonstration projects funded by central government and the devolved administrations in Scotland and Wales, apart from the Renewables Obligation and the capital grants for offshore wind and bioenergy, discussed above.

2.45 Figure 14 does not include funding provided by the Regional Development Agencies or available from the European Union for which aggregate figures were not available. Available evidence indicates that there is variation in the level of support for renewable energy from the Regional Development Agencies. For example, One North East has allocated £18 million for renewable energy projects between 2003-04 and 2005-06, whereas the East of England Development Agency will spend £5.7 million across this period. At a European level, funds are available under a number of schemes including Framework Programme 6 and Intelligent Energy – Europe. The Department estimates that the United Kingdom share of this funding will be in the region of £20 million per annum over the period 2003 to 2006.

14 Main sources of support for renewables research, development and demonstration (2003-04 to 2005-06)



Source: Department of Trade and Industry

2.46 The large number of Government and related bodies working in the renewable energy field and operating an even larger number of support schemes for renewable energy innovation across the different stages of development indicates a complex situation. This has increased the opportunities for companies to obtain funding, but a lack of knowledge of what is available can create difficulties for small firms seeking funding for their projects. The Department's Renewables Innovation Review raised this concern, concluding that those public sector bodies operating in the sector need to have their roles more clearly defined.

PART THREE

The cost of supporting renewable energy

The level of public financial support for renewable energy

3.1 To meet its target of 10 per cent of electricity to be supplied from renewable sources by 2010 the Government is providing significant financial support to the renewable energy sector to encourage growth in generation capacity. For example, the Department estimates that, during the period 2003 to 2006, the industry will receive around £700 million per annum of support. This assistance takes different forms and the cost falls on consumers, through higher electricity prices, and on taxpayers. **Figure 15** gives the Department's estimate of average annual costs, and on which group they fall.

3.2 The impact of each new Government policy or regulation on businesses in the United Kingdom is assessed through a Regulatory Impact Assessment. In the Assessment for the Renewables Obligation the Department estimated that by 2010, the Obligation was likely to increase the total cost to consumers of supporting renewable energy to £1 billion per annum at 2002 prices - the equivalent of a 5.7 per cent increase in the price of electricity. The Assessment did not consider the implications of the need to upgrade the transmission and distribution networks - associated one-off costs for the former of these are now estimated to be between £1.1 billion and £1.3 billion by 2010. Although the operators of the networks will meet the initial costs of carrying out this work, the costs will eventually fall to consumers in the form of higher electricity prices.

15 The annual cost of supporting renewables between 2003 and 2006

Income source	Average annual cost (£ million)	Who pays
Renewables Obligation Certificate income	470	Consumer
Climate Change Levy Exemption Certificate income	30	Taxpayer
Government grants and other public support	180	Taxpayer
European Union research funding	20	Taxpayer (European)
Total	**700**	

Source: 'Renewables Innovation Review' (2004) Department of Trade and Industry

The different costs of reducing carbon dioxide emissions

3.3 Given its intention to put the United Kingdom on a path towards a reduction in carbon dioxide emissions of some 60 per cent from current levels by about 2050, the Government has implemented a variety of policy tools of which the promotion of renewable energy through the Renewables Obligation is only one. **Figure 16** provides a comparison of the estimated cost of some of the key policy mechanisms currently in place to tackle climate change in the United Kingdom. There is considerable uncertainty regarding the reliability of carbon dioxide abatement costs. Nevertheless, this suggests that the cost of reducing carbon dioxide emissions varies widely between instruments, with the Renewables Obligation being the most expensive at an estimated cost of between £70 and £140 per tonne of carbon dioxide saved - a range compatible with the figure in the Obligation's Regulatory Impact Assessment which estimated £85 for each tonne of carbon dioxide saved in 2010, if the 10 per cent target is achieved. This is high compared to the Government's illustrative estimated value of the benefit that reducing carbon dioxide emissions has to society, which was calculated in 2002 as being in the range of £10 to £40 per tonne of carbon dioxide.[20] These figures are, however, currently being reviewed by an inter-departmental group on the social cost of carbon dioxide, to take account of a broader range of environmental costs, and to factor in recent research by bodies, such as the Hadley Centre for Climate Prediction and Research, indicating that the pace of climate change is accelerating.

16 Cost of different policies to reduce carbon dioxide emissions

Policy instrument	Policy objectives	Cost (£/tonne CO_2)
Renewables Obligation[1]	■ Climate change	70 – 140
	Subsidiary:	
	■ Energy security	
	■ New technologies	
	■ United Kingdom industry	
	■ Rural economy	
Energy Efficiency Commitment	■ Climate change	Negative – 16
	■ Improve energy efficiency	
	■ Alleviate fuel poverty	
Climate Change Levy	■ Climate change	5 – 11
	■ Improve energy efficiency	
United Kingdom Emissions Trading Scheme	■ Climate change	18
	■ First mover advantage for United Kingdom firms	
	■ Establish London as a trading centre	
European Union Emissions Trading Scheme[2]	■ Climate change	3–21
	■ Improve energy efficiency	

Source: Ofgem (2004)

NOTES

1 Lower limit based on the Obligation level being met in 2010, with the upper limit based on 50 per cent of the Obligation being met.

2 This range depends on the price of carbon dioxide allowances under the Scheme. The high end of the range assumes that the Scheme leads to largescale replacement of coal-fired power stations with gas-fired stations.

20 'Estimating the Social Cost of Carbon Emissions: Government Economic Service Working Paper 140', (January 2002).

3.4 The high cost of the Renewables Obligation largely reflects the high current costs of generating renewable electricity. However, the Government sees renewables as a necessary part of its Climate Change Programme. This is because there are limits to which some other approaches, such as energy efficiency, can contribute to the required long term reduction in carbon dioxide emissions. The Department chose the Renewables Obligation as the best means to meet the Government's target to supply 10 per cent of electricity from renewable sources by 2010. It is unlikely that a policy tool focused directly on reducing emissions across all sectors of the economy, such as a carbon dioxide tax, would have yielded the same level of renewable generation in this time.

3.5 Figure 16 also shows that current policy instruments have non-climate related aims. The Department's policy on renewables also has the aims of encouraging diversity and security of electricity supply, and promoting manufacturing through the development of a new industry. The Regulatory Impact Assessment did not quantify the benefits resulting from greater security of supply, although it estimated that working towards the 10 per cent target could result in between 10,000 and 45,000 jobs being created in the renewables sector. To date the Department has collected information on aspects of these objectives, but it has not set formal measures or targets against which it can track progress consistently over time. This is because it views them as, to varying degrees, subsidiary to the Renewables Obligation's main objective of reducing carbon dioxide emissions.

3.6 A further rationale for supporting renewables is that the Department expects that investment in the sector will lead to unit cost reductions for most technologies in the future, which should make renewable energy more cost effective as a means of reducing carbon dioxide emissions. In the recent Renewables Innovation Review the Department established estimates of average unit costs for each main technology, and will revisit some of these estimates as part of the 2005 Renewables Obligation review. Such cost information is key to shaping the scale of future support for the sector.

The cost of the Renewables Obligation

3.7 In designing the Renewables Obligation the Department was mindful of achieving a balance between the environmental benefits of lower carbon dioxide emissions and controlling the financial burden on consumers. For example, the Department excluded commercially viable, large hydroelectricity plants from the Obligation, introduced capital grants to reduce the support that some pre-commercial technologies would need from the Renewables Obligation, and also consulted widely on the operation, size and cost of the Obligation.

Changes to the buy-out price

3.8 The level of the buy-out price and the size of the annual Obligation levels are the two main factors which determine the amount of support provided to the renewables industry and the cost of the Renewables Obligation to consumers. A higher buy-out price further encourages suppliers to meet the Obligation by redeeming Renewables Obligation Certificates, thus increasing the price suppliers are prepared to pay to generators. This increases the revenue earned by generators and the incentive to build new capacity.

3.9 In July 2000, the Department was planning to set a buy-out price of £20 per megawatt hour for the first year of the Obligation, and provide capital grants to the pre-commercial technologies offshore wind and bioenergy. It expected that £200 million of capital grants would bring forward sufficient initial capacity to provide impetus to these new technologies. The Department subsequently found that the amount of capital grants it could provide each new project had to be reduced as only around £80 million was initially made available to fund grants and the European Union required that grants should not exceed 40 per cent of a project's cost. Due to the reductions in capital funding, offshore wind and bioenergy projects were likely to require increased revenue support to be viable.

3.10 During August 2000, the Department examined the impact on each of the major renewable technologies of changing the buy-out price and consequently it made a number of changes to the Renewables Obligation. It decided that, in addition to largescale hydroelectric power, another low-cost technology, energy from incinerating mixed waste should be excluded from the Obligation, but its output should continue to count towards the 2010 target.[21] Some energy from waste projects were felt to have the potential to be commercially viable with the support of the Climate Change Levy alone, and the Government was concerned that supporting the incineration of mixed waste through the Renewables Obligation might inhibit efforts to encourage greater recycling.

3.11 Both the reduction in capital funding and the exclusion of energy from waste had, however, made the 2010 target more difficult to achieve as they discouraged the development of some higher cost projects. The Department therefore raised the buy-out price to £30 per megawatt hour to increase incentives for those technologies remaining in the Renewables Obligation. The higher buy-out price was seen as particularly important for encouraging the development of pre-commercial technologies such as offshore wind and bioenergy, given the lower levels of capital grants available. In 2000, the Department estimated that the net effect of these changes to the Renewables Obligation would be to increase the costs to consumers by around £150 million per annum by 2010. Subsequent increases, in 2001, in the size of the annual Obligations placed by the Department on electricity suppliers have increased the impact of the higher buy-out price on consumers and raised the costs of the Renewables Obligation to the levels discussed in paragraph 3.2 and Figure 15 on page 35.

The inclusion of live Non-Fossil Fuel Obligation sites in the Renewables Obligation

3.12 In 2001, the Department decided that sites operating under live Non-Fossil Fuel Obligation contracts and producing electricity from eligible sources, such as wind power and landfill gas, would receive Renewables Obligation Certificates. It worked with the Non-Fossil Purchasing Agency - the body which manages the Non-Fossil Fuel Obligation contracts - to put in place arrangements to ensure that the income received by generators was unaffected by the introduction of the Renewables Obligation during the life of their contracts which run until at least 2014. As a consequence of these arrangements:

- Non-Fossil Fuel Obligation generators continue to operate under the conditions of their original Non-Fossil Fuel Obligation contracts;
- electricity suppliers, and thus ultimately consumers, pay higher prices for the output from these sites as they now also purchase the associated Renewables Obligation Certificates;
- the revenue collected by the Non-Fossil Purchasing Agency from these higher prices exceeds the amounts it pays to Non-Fossil Fuel Obligation contractors and results in annual surpluses which are held in a fund administered by Ofgem. The value of future surpluses depends on the price of Renewables Obligation Certificates, the level of generation from live Non-Fossil Fuel Obligation sites, and wholesale electricity prices. The Department estimates that the surpluses, including those which arise from similar arrangements in Scotland, are likely to accumulate to between £550 million and £1 billion in the period up to 2010; and
- through the Sustainable Energy Act 2003 the Government has earmarked £60 million of the surpluses to promote the use of renewable energy. The remainder are likely to be paid into the Consolidated Fund and will benefit the Exchequer. Ofgem has informed us that it is likely there would be practical difficulties in returning surplus monies to consumers.

21 In 2001, the Department changed the definition of the 2010 target and the coverage of the Renewables Obligation. It made the target more stretching by excluding output from those technologies, such as largescale hydroelectricity and energy from the incineration of mixed waste, which were not eligible for the Renewables Obligation. It also decided to encourage the development of more efficient and/or environmentally beneficial technologies for generating energy from waste, such as pyrolysis, gasification and anaerobic digestion, by reintroducing them back into the Obligation.

3.13 The inclusion of live Non-Fossil Fuel Obligation sites in the Renewables Obligation helped smooth the introduction of the scheme by creating a market for Renewables Obligation Certificates. In 2003-04, output from live Non-Fossil Fuel Obligation sites accounted for around 50 per cent of all Certificates issued. Without these Certificates some electricity suppliers would have had no means, or very limited means, of meeting their Obligation. In addition, alternative approaches available to the Department would not have provided the same level of momentum to the introduction of the Obligation and could have jeopardised progress against the 2010 target. However, the inclusion of live Non-Fossil Fuel Obligation sites in the Renewables Obligation has come at a cost to the consumer. If the Department had excluded these sites, and made corresponding reductions in the size of the annual Obligations placed on electricity suppliers, it could have prevented the transfer from the consumer to the Exchequer without reducing the incentives for Non-Fossil Fuel Obligation contractors to generate electricity.

Non-Fossil Fuel Obligation sites using municipal industrial waste

3.14 A problem has arisen on a small number of live Non-Fossil Fuel Obligation contracts for sites generating both electricity and heat from a source - municipal industrial waste - which is not eligible for Renewables Obligation Certificates. These sites are covered by contracts which run until 2016 or 2018. With the introduction of the New Electricity Trading Arrangements in 2001, changes had to be made to the definition of contract electricity prices. The new definition chosen by the Non-Fossil Purchasing Agency, with the approval of the Department and Ofgem, has unintentionally resulted in developers being entitled to a higher reference price if they generate only electricity, rather than if they comply with the terms of their contracts and generate heat and electricity. The higher price is linked to the value of Renewables Obligation Certificates. At present there are four contractors with live Non-Fossil Fuel Obligation projects, two of whom are fully compliant with the terms of their contracts, with the other two currently generating only electricity but planning to produce heat in the future. The latter two contractors are at present being paid as if they were fully compliant with their contract. This position reflects an agreement reached between the Non-Fossil Purchasing Agency and the contractors. It means that the contractors are currently being paid more for their output than intended when the contracts were signed – around £2 million per annum - but are receiving around £4 million per annum less than they would if the higher reference price was used. Similar contracts were let for another 12 sites but these have remained undeveloped and the Department considers that they are unlikely to be utilised. The Department aims to produce a consultation paper later in 2005 looking at ways to address this issue.

The treatment of former Non-Fossil Fuel Obligation sites

3.15 When the Department was designing the Renewables Obligation, all contracts covering the early Non-Fossil Fuel Obligation sites had expired. The Department considered whether these sites should continue operating on a purely commercial basis or should be entitled to Renewables Obligation Certificates. The Department chose the latter option. It took the view that although former Non-Fossil Fuel Obligation sites would benefit from the introduction, in 2001, of the Climate Change Levy, many of them were not viable without additional support and would face bankruptcy given the low underlying electricity prices at that time. The inclusion of these sites in the Renewables Obligation reduced the risk that they would close and smoothed the creation of a market for Renewables Obligation Certificates. The Department's decision has, however, imposed a cost of around £35 million per annum on consumers and it was not supported by a thorough assessment of:

- the on-going commercial viability of former Non-Fossil Fuel Obligation sites and the level of support they needed to continue to operate; or
- alternative mechanisms that could have been used to provide support to the sites at a lower cost. Potential options included awarding output from former Non-Fossil Fuel Obligation sites with a lower entitlement to Certificates or linking their entitlement to Certificates to the wholesale electricity price.

The 2005 review of the Renewables Obligation

3.16 The Department's planned review of the Renewables Obligation will reflect on the first three years of its operation and is a good starting point for assessing the scheme's on-going cost effectiveness. The Department has announced that the review will consider amongst other issues 'the transition to market of renewable technologies over time, either from the impact of carbon dioxide pricing, falls in technology costs or other factors.' Our consultants examined the rates of returns likely to be earned by individual technologies under the current Renewables Obligation and the other policy mechanisms

which support renewable generators. They based their calculations on predictions about the costs of developing and operating sites and the future wholesale price of electricity. They compared estimated returns to 'hurdle rates' derived in 2003 by the Department and the Carbon Trust from discussions with developers and bankers. These hurdle rates reflect the minimum returns required to ensure new projects are developed. The actual rates considered necessary by a developer for a specific site may be higher depending on its view of risks to project costs and future revenue flows.

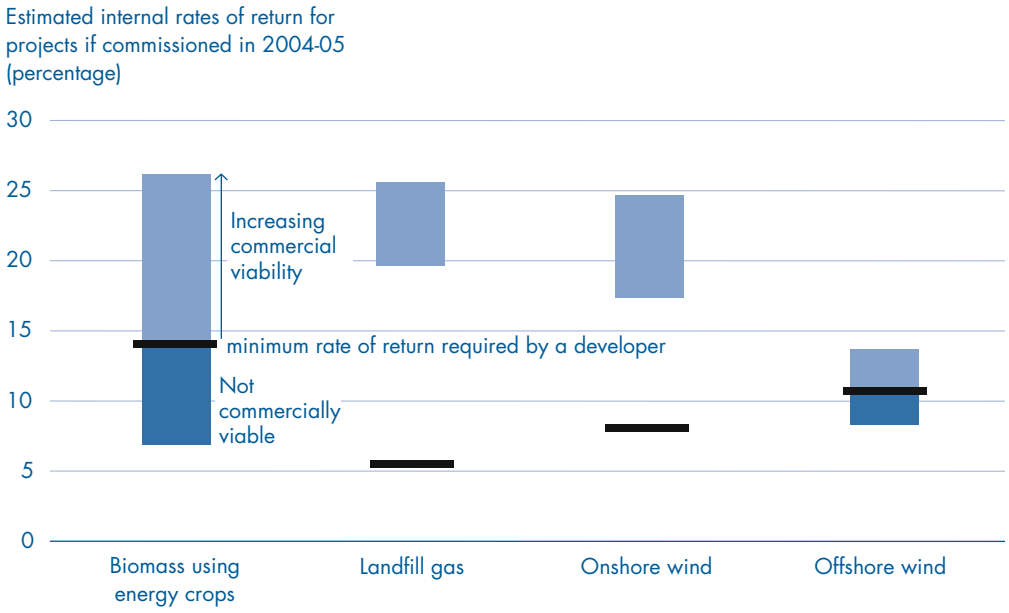
3.17 Our consultants' findings show that most renewable technologies continue to need public support to be commercially viable, but the level of support provided by the Obligation is greater than necessary to ensure that most new onshore wind and large landfill gas projects are developed. **Figure 17** shows that at the current buy-out price of £30 per megawatt hour (2002 prices) the internal rates of return likely to be earned by new offshore wind projects and some bioenergy projects using energy crops are inadequate or barely adequate to cover the hurdle rates of return.

3.18 For the best landfill gas sites the rates of return under the Renewables Obligation are very attractive as some of these sites approach commercial viability without any support (Figure 17). Our consultants' work, however, indicates that the scope for the Renewables Obligation to encourage the development of new large landfill gas sites is now limited as:

- much of the existing landfill gas resource is already utilised, often under live Non-Fossil Fuel Obligation contracts; and
- the number of new sites opening is likely to fall as a consequence of environmental legislation, which discourages the disposal of domestic biodegradable waste in landfill sites. This legislation has followed on from the 1999 European Landfill Directive.

The main impact of the Renewables Obligation is, therefore, on the existing, mainly smaller, landfill sites where it had previously been uneconomic to generate electricity, and also in extending the economic life of sites currently generating electricity. Our consultants estimate that the growth in landfill generation is likely to be small, rising from 1.0 per cent of total electricity supply in 2003-04 to 1.1 per cent by 2010-11.

17 Estimated range of internal rates of return earned by potential projects compared to minimum rates of return required by a developer, by technology



Source: Oxera

NOTES

1 The internal rate of return is defined as the rate of interest which when used to discount the money flows from an investment, reduces their net present value to zero.

2 The large range for energy crops is due to the wide variation of operating costs. Other technologies are not subject to this uncertainty.

3 The cost of landfill generation is assumed to be the same as the price of successful landfill bids in the last round of Non-Fossil Fuel Obligation contracts. These tended to be the best sites. Costs at other potential sites are likely to be somewhat higher and thus internal rates of return lower.

3.19 The returns earned by most onshore wind projects commissioned in 2004-05 are likely to be well in excess of the hurdle rates (Figure 17). They are also likely to exceed any higher rate that a particular developer might require. In addition, our consultants' work shows that onshore wind projects should remain viable for the foreseeable future under the current design of the Obligation. Our consultants have estimated that a buy-out price of £15 per megawatt hour would broadly be sufficient to bring forward the majority of onshore wind projects, although it might not be adequate to support the more expensive schemes which are not, for example, located on good sites due to planning problems. A higher buy-out price, possibly £20 per megawatt hour, would be required if in the future developers are required to meet all the costs of connecting new plant to the grid. It is, however, clear from our consultants' work that, at the current buy-out price of £30, the level of support provided by consumers is in excess of that needed by many onshore wind schemes.

3.20 Our consultants' work indicates that if the Renewables Obligation and other policies remain unchanged until 2026-27[22] around two thirds of total public support provided to renewable generators would go towards the additional costs they face in generating renewable electricity. The remaining third would represent support in excess of that needed to secure the increased level of renewable generation. These estimates are necessarily subject to uncertainty and the value of excess support would vary if, for example, unit costs turn out to be higher or lower than those assumed, and would fall if competition in the electricity market led to some of the excess support being competed away and passed back to the consumer.

3.21 Most forms of government assistance result in a degree of excess support. The relatively large estimates for the Renewables Obligation result from the maintenance of common levels of support across technologies of widely varying costs. The amount of excess support and the cost of the Renewables Obligation to consumers could be reduced if the Department revises the scheme, for example, as a result of the 2005 review. Options include time-limiting the period during which support would be available for projects or technologies, or moving to a banded support structure, where the less profitable technologies receive a greater share of support. The latter option would, however, alter the relative economic ranking of potential projects – some intrinsically higher cost projects could be brought forward with extra public support, ahead of lower cost projects attracting less support. And any changes to the structure of support could undermine market confidence in renewable generation.

3.22 The Department has assured industry that if the 2005 review were to result in less support being provided for some technologies, the entitlement to Renewables Obligation Certificates of currently operating projects, and those actively under development, would be protected. To maintain business confidence in the Renewables Obligation the Department has also excluded certain issues from the review which will impact on the cost of the scheme to consumers. In particular, it will not consider reducing the buy-out price or the level of annual Obligations placed on suppliers.[23] If the Department is to ensure that the Renewables Obligation will achieve its objectives in the long-run then it will need, in future reviews, to take account of all the factors that influence the cost of the scheme to consumers. In so doing, it will need to consider both the interests of consumers and the importance of maintaining investor confidence.

22 The Renewables Obligation is currently due to end in 2026-27. The calculations assume generators do not meet the cost of any extension or increase in the capacity of the transmission network necessary to accommodate their generating capacity.

23 The Department explained that changes might be made to the level of annual Obligations but only where necessary to compensate for any changes to the Renewables Obligation eligibility rules for energy from waste and combined heat and power.

APPENDIX 1

Study methodology

The overarching question which drove this study was whether the Department had designed and implemented its renewables programme so as to ensure the cost effective achievement of the Government's renewable energy target for 2010. To answer this, and triangulate our findings, we adopted a range of research techniques.

Analysis of policy development

In evaluating the effectiveness of the Department's renewable energy programme we wanted to understand the process it had gone through in developing its set of policy tools. We used criteria on best practice in policy-making set out by the Cabinet Office. In conjunction with our consultants, Oxera, we carried out a review of the Department's policy development files and interviewed civil servants who had been part of the process. This work informed our understanding of how the Department had arrived at the current policy framework and the scope for revising the framework.

Economic critique of the Renewables Obligation

The Department designed the Renewables Obligation so as to provide market-based incentives to the generating industry to increase its renewable capacity. To explore whether this market mechanism is operating cost-effectively and efficiently, our consultants conducted an economic critique of the Obligation. Since an understanding of both current and future progress is key to the successful pursuit of the 2010 target, they employed a model of the renewables sector, based on one used in work for the Department and the Carbon Trust as part of the 2004 Renewables Innovation Review. Factors which they considered included:

- the level of incentives provided by the Obligation to renewable generators;
- the extent of any perverse incentives;
- the level of trading of Renewables Obligation Certificates;
- whether the Obligation provides sufficient long-term incentives; and
- the estimated costs to the consumer.

Stakeholder interviews

Although the Department is in the lead for the implementation of renewable energy policy, there are a number of other Government departments, agencies and regional bodies that are involved in the sector. We met many of these in order to understand their roles and to determine how effectively the Department works with them. The market players in the renewable energy industry include both large multinational companies and small independent operators. Firms also vary in the portfolio of renewable technologies they use. As such, we spoke to a cross-section of renewable generators and trade associations, spanning all the main renewable technologies, to fully understand the wide range of different interests in the sector. In addition to generating companies, we met electricity suppliers to appreciate their views on the operation of the Renewables Obligation, and with National Grid Transco, to get a full understanding of the issues posed for the grid network. Finally, we met several non-governmental organisations with environmental interests to understand their opinions on the Government's policy, and with various financiers on the issue of whether the Renewables Obligation provided sufficient confidence to finance the achievement of the 10 per cent target. As such, so as to cover the large number of stakeholders in the sector we spoke to the following organisations:

Government bodies:

Department of Trade and Industry
Carbon Trust
Department for Environment, Food and Rural Affairs
Environment Agency
HM Treasury
Ministry of Defence
Office of the Deputy Prime Minister
Ofgem
South West of England Regional Development Agency
The Scottish Executive
Welsh Assembly Government

Trade associations:

Association of Electricity Producers
British Biogen
British Wind Energy Association
Renewable Power Association

Renewable energy companies:

EDF Energy
Energy Developments (UK) Ltd
Energy Power Resources
National Grid Transco
Non-Fossil Purchasing Agency
Northumbrian Water
Peninsula Power Ltd
Powergen
Rolls-Royce Fuel Cell Systems Ltd
RWE npower
Thames Water
The Engineering Business Ltd

Financiers:

Halifax Bank of Scotland
Englefield Capital
Royal Bank of Canada Europe Ltd

Non-government organisations:

Friends of the Earth
National Trust
Royal Society

Other:

Future Energy Solutions
Imperial College

Analysis of data

We analysed Non-Fossil Fuel Obligation data on the size and growth of renewable generation during the 1990s, and data on expenditure trends in the New and Renewable Energy Programme. This assisted us in determining the success of the Department's earlier initiatives and in identifying issues for the future. We also looked at data on the Renewables Obligation and the capital grants programme. This gave us an early view on how these schemes were performing against their initial objectives.

Literature review

We reviewed a range of recent Departmental publications, as well as documents produced by other Government departments, select committees, non-governmental organisations, and private sector consultancy firms. These helped inform us of the latest developments in the renewables sector, and guided our fieldwork towards areas of the subject where the National Audit Office could add the most value in its contribution.

International comparison

Our consultants carried out some high level comparisons of the United Kingdom's renewable energy programme, against those of other countries with established policies for promoting renewables. This was to see whether there were any lessons that could be learnt from experience abroad. In addition, we met representatives from the Netherlands' Court of Auditors, who conducted a review of their own national arrangements in 2004, to see if there was anything we could learn from their experience.

Expert panel

We invited experts from the renewables sector to provide advice and guidance on our methodology and emerging findings. The following were members of the panel:

Prof Dennis Anderson	Imperial College
Sir Eric Ash	Royal Society
Lewis Dale	National Grid Transco
Tom Delay	Carbon Trust
Marcus Rand	British Wind Energy Association
Philip Wolfe	Renewable Power Association
Bryony Worthington	Friends of the Earth

APPENDIX 2

Glossary

Anaerobic digestion	A biochemical process by which organic matter is decomposed by bacteria in the absence of oxygen, producing methane and other by-products. The methane can then be used for energy generation.
Bioenergy	Energy derived from plant material and animal waste, which can be used to generate electricity, heat or transport fuel.
Biomass	Plant material or animal waste, which can be used to generate electricity, heat or transport fuel.
British Electricity Transmission and Trading Arrangements	The new wholesale electricity and transmission arrangements, which will create a single electricity market for the whole of Great Britain. It will be effective from April 2005.
Buy-out price	The price per megawatt hour charged to electricity supply companies unable to meet their Obligation by presenting Renewables Obligation Certificates to Ofgem.
Buy-out fund	The funds accumulated by Ofgem during a particular compliance period from payment of the buy-out price by electricity supply companies. This is redistributed to suppliers according to their compliance with the Renewables Obligation.
Carbon dioxide	A gas that occurs naturally in the Earth's atmosphere, significant quantities of which are also emitted by fossil fuel combustion and deforestation. It is a greenhouse gas and therefore a major cause of global warming.
Carbon dioxide tax / pricing	A charge on carbon dioxide emissions which is directly proportional to the level of carbon dioxide produced by the emitter.
Carbon Trust	An independent company funded by Government, which helps business and the public sector cut carbon dioxide emissions and capture the commercial potential of low carbon dioxide technologies.
Climate change	A long-term change in atmospheric and/or ocean conditions due to natural or human activity.
Climate Change Levy	A levy charged on non-household consumers of energy in the United Kingdom, administered by HM Customs and Excise.
Climate Change Programme	The Government's package of policies and measures designed to help the United Kingdom meet its Kyoto target of reducing greenhouse emissions by 12.5 per cent of 1990 levels by 2008-12.

Co-firing	The combustion of biomass products with fossil fuels in conventional fossil fuel power stations. The biomass element of the electricity generated can be eligible for Renewables Obligation Certificates.
Consolidated Fund	The general fund into which almost all Government receipts (in the form of taxes, duties, etc.) are paid and out of which almost all Government expenditure is met.
Demonstration	The stage in the innovation chain, following research and development. For renewable technologies, this is typically the construction of a smallscale electricity generator. Funding at this stage is predominantly through the public sector.
Departmental Technology Programme	The Department of Trade and Industry's new technology support programme under which renewable energy research and development is funded, from 2004. It focuses on key technologies identified as critical to United Kingdom economic strengths.
Distribution networks	The local electricity grid networks, which distribute electricity from the transmission network to domestic and other local users. They are owned by a range of electricity companies.
Distribution Price Control Review	Ofgem's five-yearly process of reviewing the prices that distribution network operators charge to users of their systems, such as renewable generators.
Eligible technologies	Those renewable technologies for which electricity generation is eligible to receive Renewables Obligation Certificates.
Embedded generation	Electricity generation which is connected to the distribution network rather than transmission network.
Energy crops	Specifically grown crops for electricity generation, either in a dedicated biomass plant or for co-firing. They include miscanthus and short-rotation coppice.
Energy efficiency	The process of using less energy or electricity to perform the same function.
Energy Efficiency Commitment	A three year Government initiative that requires electricity suppliers to achieve improvements in domestic energy efficiency by the end of March 2005.
European Union Emissions Trading Scheme	A policy being introduced across the European Union to tackle emissions of carbon dioxide and other greenhouse gases. It commenced in January 2005, and caps countries' annual carbon dioxide emission levels.
Fossil fuels	Non-renewable, naturally-occurring fuels, such as coal, natural gas, and crude oil, that come from the compressed remains of ancient plants and animals.
Fossil Fuel Levy	A charge levied on domestic and industrial electricity users in England and Wales to support non-fossil fuel electricity sources, including renewables through the Non-Fossil Fuel Obligation.
Framework Programme	The European Community's programme for research, technological development and demonstration.

Generators	Firms that produce electricity, which is usually sold to electricity supply companies. Some generators also own supply companies.
Gigawatt	A unit of power equivalent to one thousand megawatts; sufficient to light 10 million 100-watt light bulbs and roughly the capacity of a modern United Kingdom nuclear power station.
Greenhouse gases	Gases that trap the heat of the sun in the Earth's atmosphere, contributing to climate change. They include carbon dioxide, water vapour, methane, ozone, chlorofluorocarbons, and nitrous oxide.
Hurdle rate of return	The minimum return on investment required by financiers, given a particular level of risk, for them to commit funds.
Internal rate of return	A measure of the profitability of an investment. It is defined as the rate of interest which, when used to discount the cash flows of an investment, reduces its net present value to zero.
Liquidity	The ease with which an investor can convert an asset into cash. The easier the conversion the more liquid the asset. Illiquidity is a risk in that an investor might not be able to convert the asset to cash when most needed.
Megawatt	A unit of power equivalent to one million watts; sufficient to light 10,000 100-watt light bulbs, or enough electricity for around 3,000 households.
Megawatt hour	One hour of electricity production at a constant rate of one megawatt.
Mixed waste	Waste which is a mixture of biodegradable and non-biodegradable material.
New and Renewable Energy Programme	The Department of Trade and Industry's former programme for funding renewable energy research and development.
New Electricity Trading Arrangements	The current regulatory trading arrangements for electricity in England and Wales, in place since 2001.
New Opportunities Fund	One of the former bodies, which distributed funds raised for good causes from the National Lottery. Now part of the Big Lottery Fund.
Non-biodegradable waste	Waste such as tin cans, glass and ceramics, which do not decompose, and cannot be used to generate energy.
Non-Fossil Fuel Obligation	The Government's main policy mechanism for supporting renewable energy during the 1990s. It required the then regional electricity companies to contract for certain amounts of electricity from renewable sources.
Non-Fossil Purchasing Agency	A body set up by the 12 former regional electricity supply companies, in England and Wales, as their agent for the purpose of enabling them to enter into collective arrangements to fulfil their Non-Fossil Fuel Obligations. It also manages on-going Non-Fossil Fuel Obligation contracts.
Ofgem	The regulator for Great Britain's gas and electricity industries. Its role is to protect and advance the interests of consumers by promoting competition where possible, and through regulation where necessary.

Performance and Innovation Unit	A body whose aim is to improve the capacity of Government to address strategic, cross-cutting issues and promote innovation in the development of policy and the delivery of Government objectives. Now called the Strategy Unit.
Pool purchase price	The price awarded for electricity produced by generators and purchased by suppliers, prior to the introduction of NETA.
Pre-commercial	Refers to renewable technologies such as offshore wind with the potential to supply customers, but requiring further support to reduce unit costs. Projects are still relatively high risk.
Regulatory Impact Assessment	A requirement before the introduction of any regulations that affect businesses, charities or voluntary bodies. It should include details of both the costs and benefits of the proposed regulations, and the wider economic, social and environmental impacts.
Renewables Innovation Review	A joint Department of Trade and Industry and Carbon Trust study, published in February 2004, which, amongst other things, aimed to identify the barriers to the development and deployment of the key renewable technologies.
Renewables Obligation	The Government's main policy mechanism for supporting renewables. It requires all licenced electricity suppliers in England and Wales to supply a specified and growing proportion of their electricity sales from a choice of eligible renewable sources.
Renewables Obligation Scotland	The equivalent instrument in Scotland to the Renewables Obligation in England and Wales.
Renewables Obligation Certificates	Certificates issued to generators by Ofgem for the production of eligible renewable electricity. One Certificate is issued for each megawatt hour of generation.
Suppliers	Firms which buy electricity from generators and sell it to domestic, commercial and industrial customers. Some are also responsible for the local distribution networks. Supply companies may also own electricity generating capacity.
Supported commercial	Refers to technologies that are very close to market competitiveness, with innovation characterised by learning-by-doing. In the United Kingdom they include onshore wind and landfill gas.
Transmission network	The system of high voltage power lines, which transport electricity from power stations to local distribution networks.
Wholesale electricity price	The price of electricity determined by supply and demand between generators and suppliers.

APPENDIX 3

Renewable technologies

A 6 megawatt hydroelectric power station at Kielder Water, Northumberland.

Hydroelectricity

Description

One of the oldest forms of renewable generation. It exploits the energy of flowing water (e.g. from a reservoir or river) to drive a turbine connected to an electricity generator. The amount of power generated depends on the rate of flow and the volume of water available to drive the turbine.

Status

Regarded as a proven technology that is fully commercialised. Developments continue on all design aspects, with the most modern plants having energy conversion efficiencies of up to 90 per cent. Further opportunities to use the technology are limited in the United Kingdom other than through the upgrading of existing plant.

	Smallscale	**Largescale**
Eligibility for the Renewables Obligation	Yes – for stations with capacity < 20 megawatts and built or refurbished since 1990	Only stations commissioned after 1 April 2002
Eligible generating capacity (2003-04, megawatts)	427.1	Zero[24]
Eligible output (2003-04, gigawatt hours)	1,291.0	Zero

24 Non-eligible capacity was 1,394 megawatts in 2003, which generated 3,113 gigawatt hours of electricity.

Hagshaw Hill onshore wind farm, Lanarkshire, Scotland.

Blyth offshore wind farm, Northumberland.

Wind power

Description

Involves the harnessing of power contained in moving air. Wind turbines are mounted on a tower of 25-80 metres height so they can take advantage of faster and less turbulent wind. Turbines catch the wind's energy with propeller-like blades. Usually, two or three blades are mounted on a shaft to form a rotor. The United Kingdom has the largest potential wind energy resource in Europe.

Status

Onshore

Now a viable option for power generation with no outstanding research and development issues preventing exploitation. Both the technology and the market are mature enough that improved research and development can take place as part of the normal commercial development process. The biggest issue between now and 2010 is likely to be planning consent.

Offshore

There is relatively little direct industry experience of operating offshore. As such, the sector requires further development, demonstration and assessment before becoming a proven and commercial technology. The success of onshore wind provides some confidence, although uncertainty remains over the potential for a substantial reduction in costs.

	Onshore	Offshore
Eligibility for the Renewables Obligation	Yes	Yes
Eligible generating capacity (2003-04, megawatts)	625.4	63.8
Eligible output (2003-04, gigawatt hours)	1,234.9	43.8

A landfill gas generating station.

Landfill gas

Description

Biodegradable waste is broken down by micro-organisms under oxygen-free conditions in landfill sites, to form landfill gas - a mixture of carbon dioxide and methane. This is extracted and burnt in a gas turbine.

Status

Currently one of the cheapest and largest sources of renewable generation. However, growth in capacity is constrained by European Union legislation restricting new landfill sites.

Sewage gas

Description

Originates from the biomass element of raw sewage, which is extracted by water companies during the water purification process. Under the same process as for landfill, methane gas is burnt in a gas turbine.

Status

Generation is primarily used to provide for the electricity needs of sewage farms. Gas use has largely taken place where it is cost effective to do so, with mainly smaller sites remaining unutilised.

	Landfill gas	Sewage gas
Eligibility for the Renewables Obligation	Yes	Yes
Eligible generating capacity (2003-04, megawatts)	592.9	55.4
Eligible output (2003-04, gigawatt hours)	3,143.9	192.8

Drax Power Station, one of the largest power stations in the United Kingdom, co-fires biomass fuel with coal.

A chicken litter power station at Thetford, Cambridgeshire supported under NFFO 3.

Co-firing of biomass

Description

The combustion of biomass, for example wood pellets, pine shavings and olive residue, in conjunction with coal in conventional coal-fired power stations.

Status

Fossil fuel power stations can burn up to 25 per cent biomass without incurring significant capital costs. However, co-firing is only eligible under the Renewables Obligation so as to encourage growth of energy crops.

Other biomass

Description

The use of plant material or animal waste as a fuel for electricity and/or heat generation. Sources include straw, chicken litter and energy crops.

Status

Despite a large potential fuel supply resource, there is relatively little installed capacity in the United Kingdom. The Department's Bioenergy Capital Grants Scheme is seeking to address this, although developers face various difficulties.

	Co-firing of biomass	Other biomass
Eligibility for the Renewables Obligation	Any biomass until 2009; thereafter a growing proportion of energy crops is required before co-firing becomes ineligible in 2016.	Yes
Eligible generating capacity (2003-04, megawatts)	509.5[25]	160.0
Eligible output (2003-04, gigawatt hours)	796.2	816.9

25 Co-firing capacity based on Ofgem's estimate of renewable capacity.

'Pelamis' wave energy converter undergoing sea trials near the Forth Bridge before its installation at the European Marine Energy Centre.

'Seaflow' tidal power generator off Lynmouth, with generator, rotor and collar raised above water.

Wave power

Description

Ocean waves are created by the interaction of wind with the surface of the sea. Wave energy converters extract and convert this energy into electricity. They can be deployed either on the shoreline or in deeper waters offshore.

Status

The United Kingdom has wave power levels that are amongst the highest in the world. One small project is in operation in Scotland. However, the technology is currently not commercially viable.

Tidal power

Description

Tidal streams are high velocity sea currents created by periodic horizontal movement of the tides. Tidal stream energy is derived from the kinetic energy of the moving flow; analogous to the way a wind turbine operates in air.

Status

The United Kingdom is at the forefront of the development of these technologies, with several prototypes currently receiving Government support. It expects tidal power to make a small contribution to the 2010 target, although it is still expensive.

	Wave power	Tidal power
Eligibility for the Renewables Obligation	Yes	Yes
Eligible generating capacity (2003-04, megawatts)	Zero	Zero
Eligible output (2003-04, gigawatt hours)	Zero	Zero

Solar/Photovoltaics

Description

Sunlight can be converted directly into electricity using photovoltaic cells. First utilised for powering satellites, it is now increasingly used to provide electricity around the world, particularly in locations without access to an electricity grid network.

Status

The main applications are for household power. This is an area of growing importance, but because systems are numerous and small, they are not well suited to Government support schemes.

Geothermal energy

Description

The natural heat that exists within the earth and that can be absorbed, through several developed means, by fluids occurring within, or introduced into, the crustal rocks. Where water temperatures exceed 150ºC, it is feasible to generate electricity.

Status

The United Kingdom has some potential resource in the Bournemouth area, but the commercial risks of speculative drilling remain high. The technology is currently not commercially viable.

	Solar/Photovoltaics	Geothermal energy
Eligibility for the Renewables Obligation	Yes	Yes
Eligible generating capacity (2003-04, megawatts)	Zero[26]	Zero
Eligible output (2003-04, gigawatt hours)	Zero	Zero

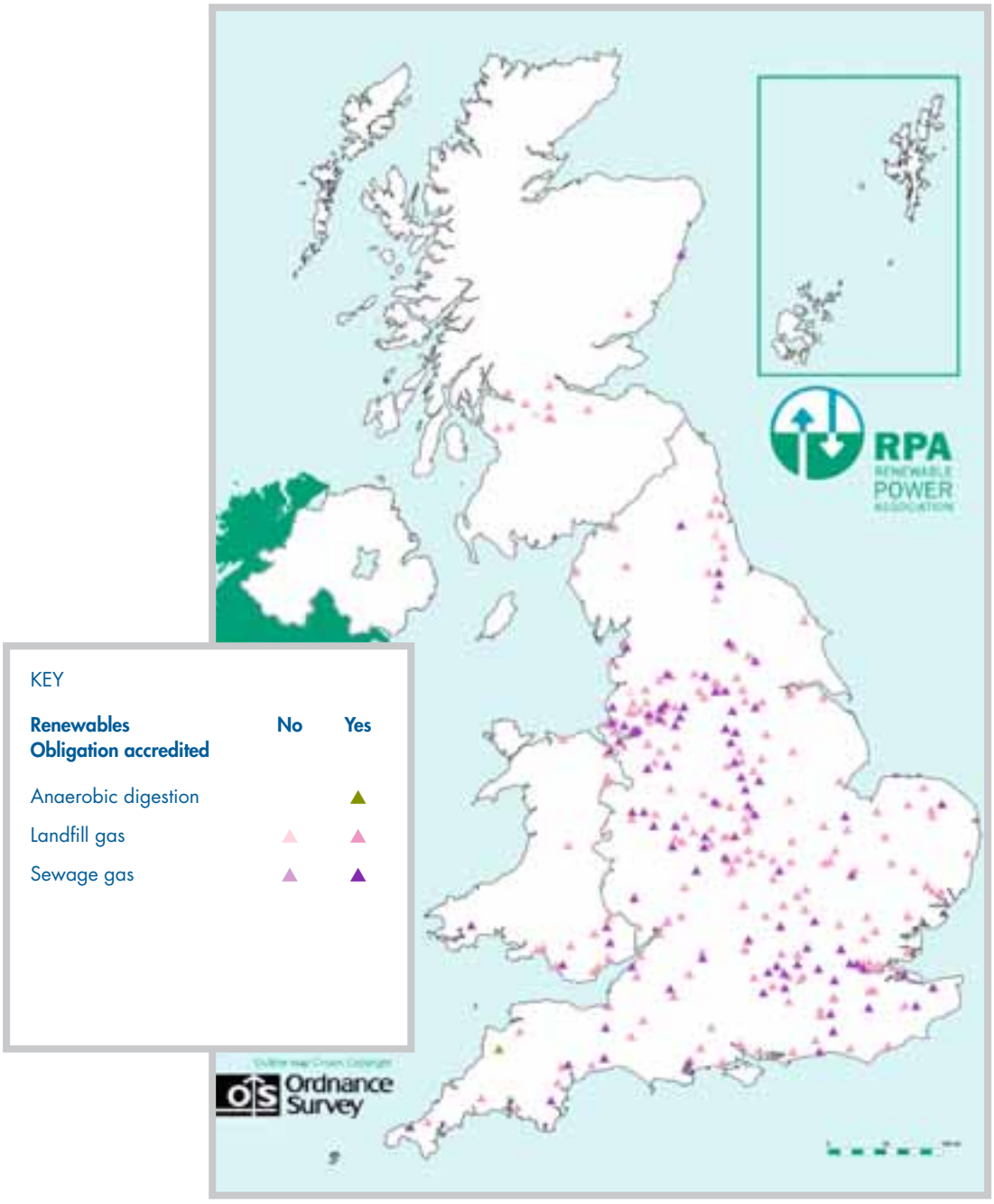
Source: For all the tables in Appendix 3 - Department of Trade and Industry; Ofgem figures for Renewables Obligation 2003-04

26 Capacity not eligible for the Renewables Obligation in 2003 was 6 megawatts, generating 3 gigawatt hours of electricity.

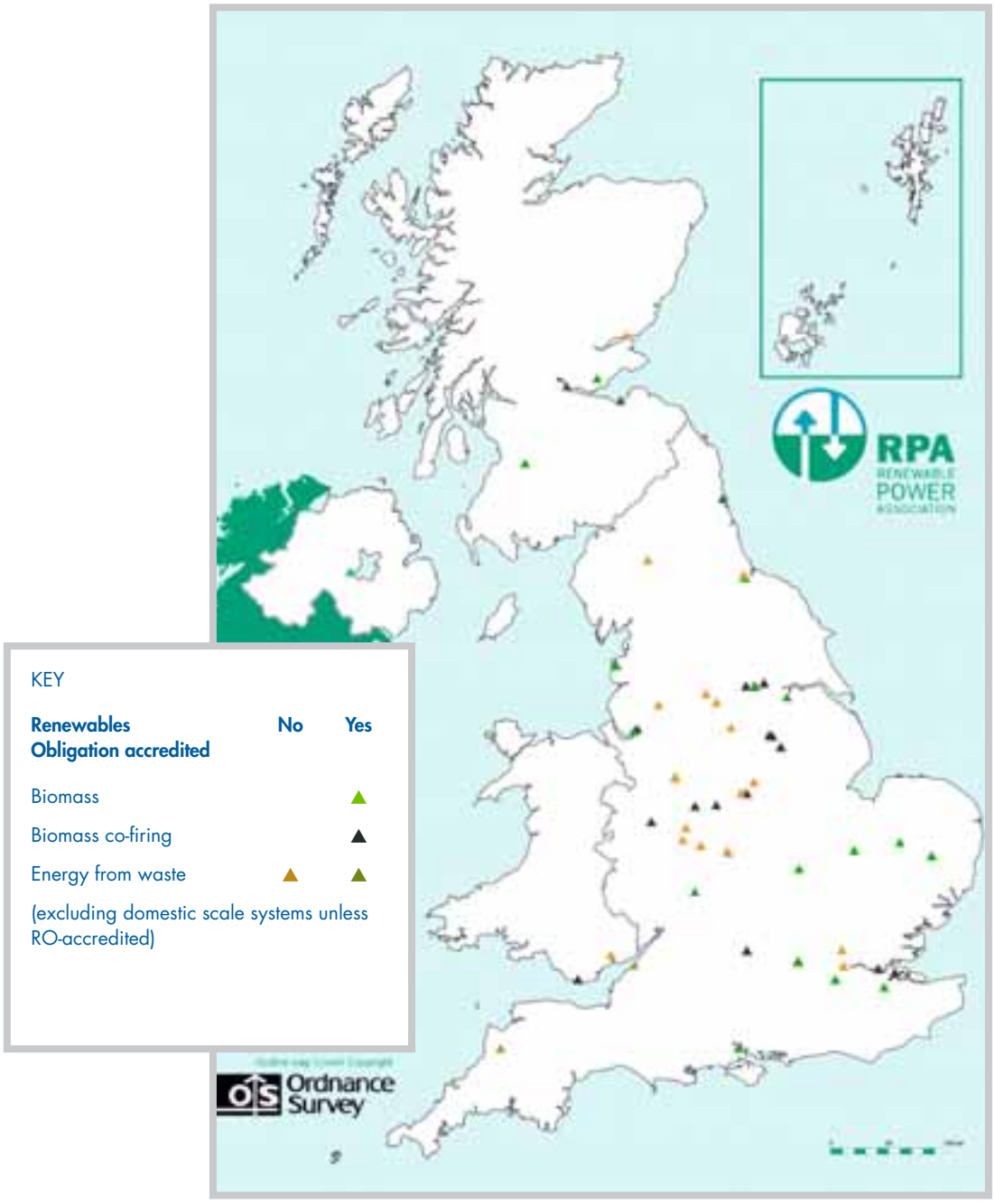
APPENDIX 4

Location of renewable energy sites in the United Kingdom

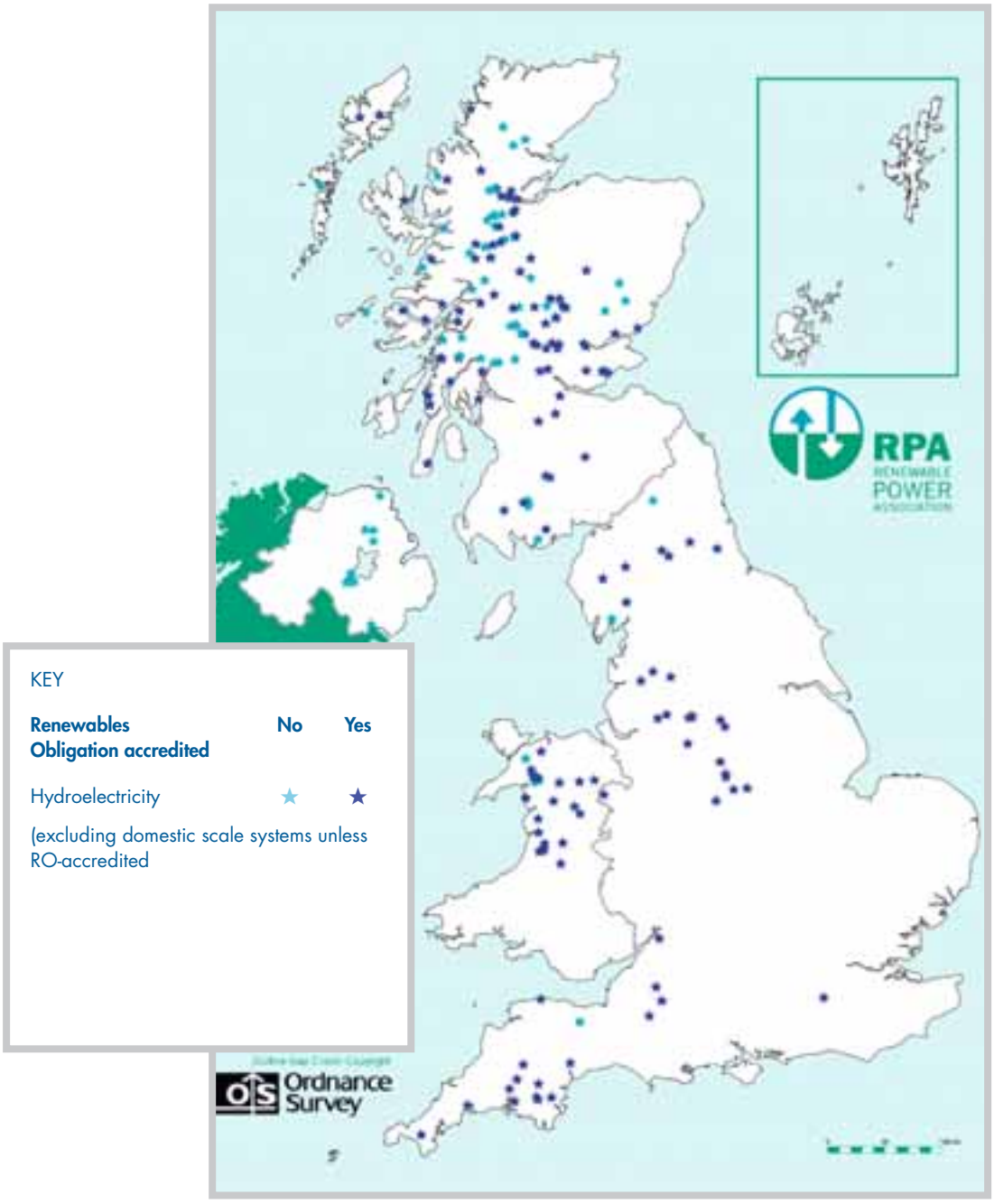
Landfill gas, sewage gas and anaerobic digestion sites



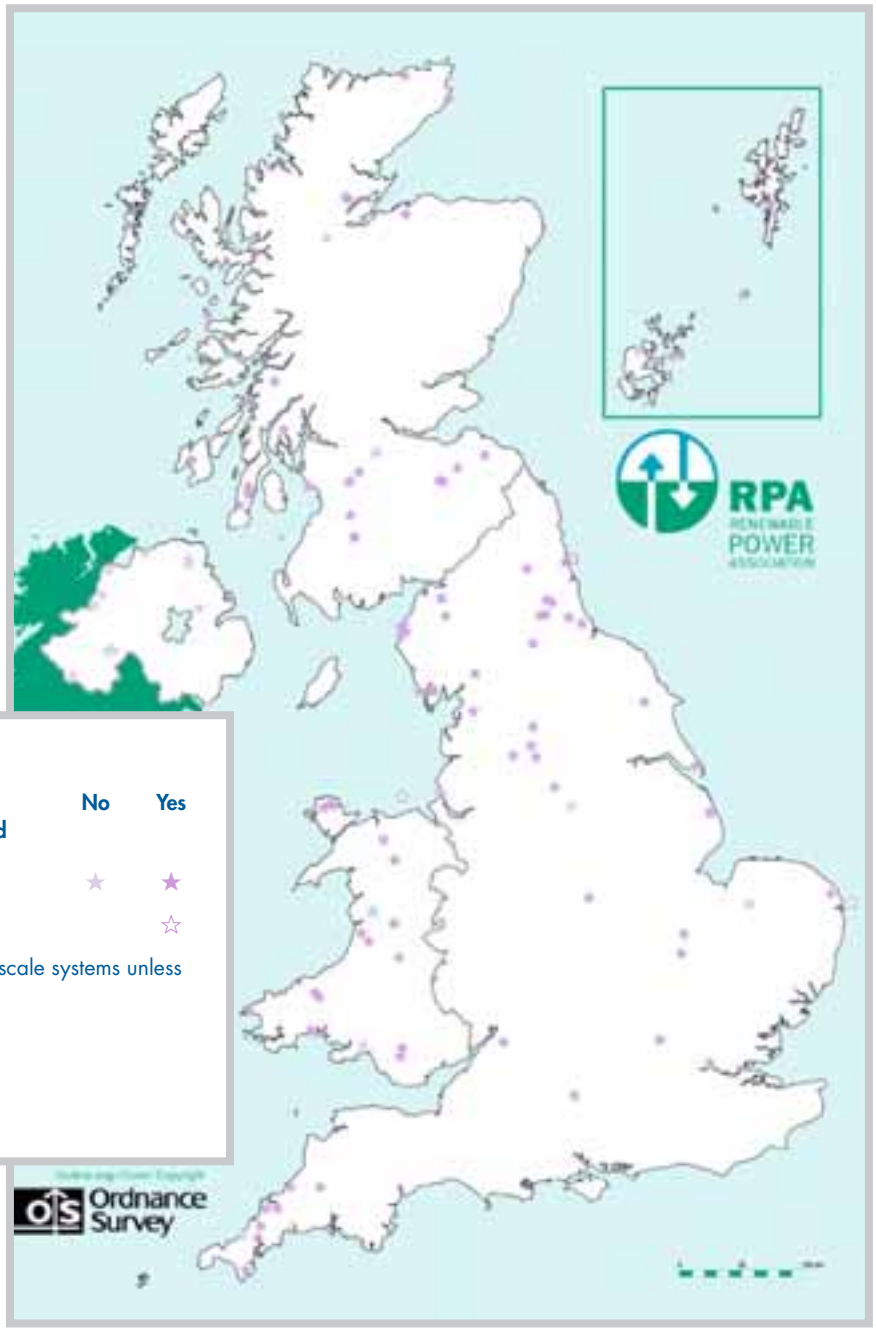
Dedicated biomass, co-firing, and energy from waste sites



Hydroelectricity sites



Onshore and offshore wind sites



KEY

Renewables Obligation accredited	**No**	**Yes**
Onshore wind	☆	★
Offshore wind		☆

(excluding domestic scale systems unless RO-accredited)