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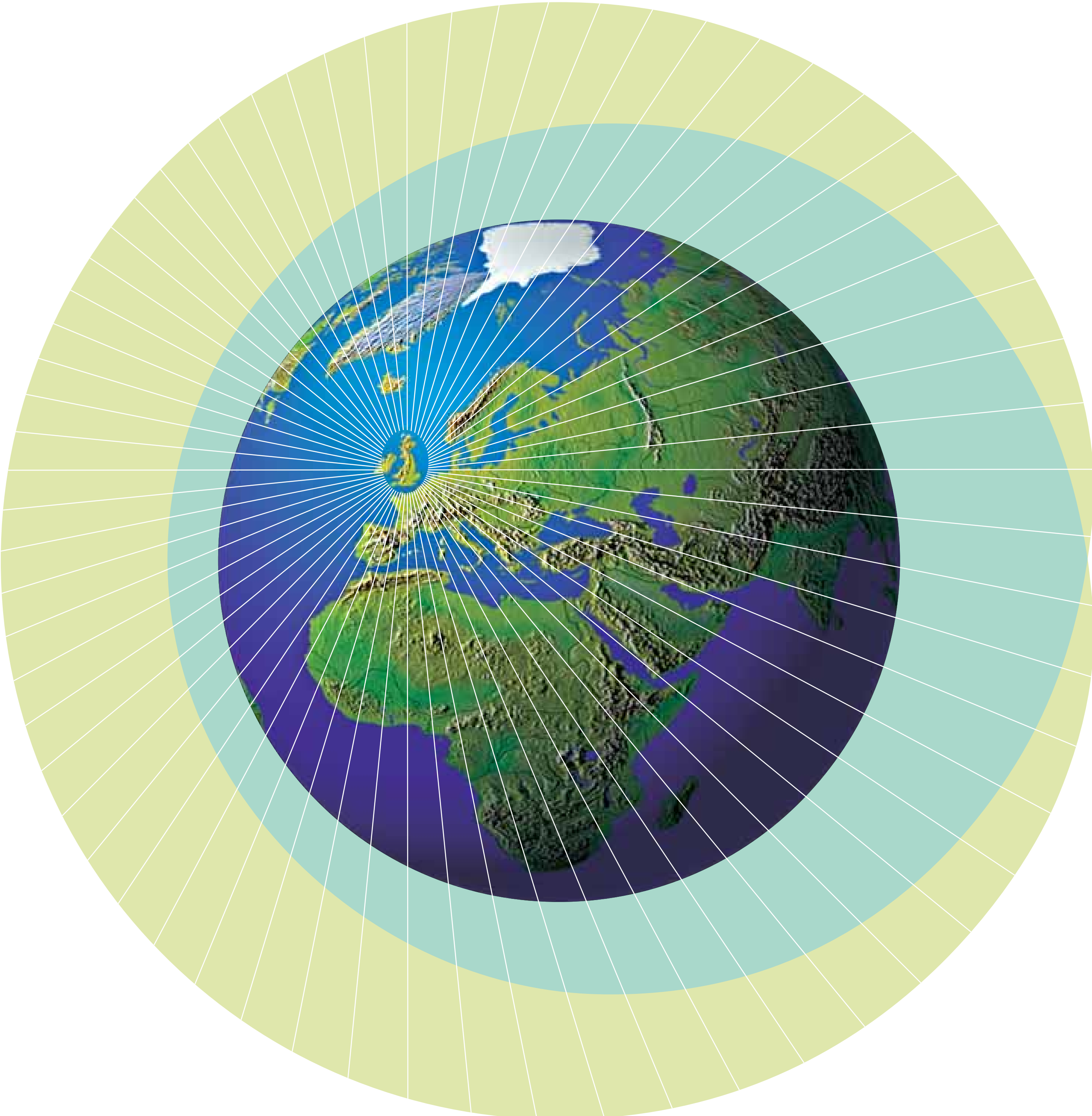

BERR | Department for Business Enterprise & Regulatory Reform

UK RENEWABLE ENERGY STRATEGY

Consultation

JUNE 2008

Why is the Government conducting this consultation?

This consultation seeks views on how to drive up the use of renewable energy in the UK, as part of our overall strategy for tackling climate change, and to meet our share of the EU target to source 20% of the EU's energy from renewable sources by 2020.

Responses to this consultation will help shape the UK Renewable Energy Strategy, which will be published in spring 2009, once the UK's share of the target has been agreed.

Issued: 26 June 2008

Respond by: 26 September 2008

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Foreword

Renewable energy is key to our low-carbon energy future. We need to radically reduce greenhouse gas emissions, as well as diversify our energy sources. As part of this move to a low-carbon economy, we need a step change in renewable energy use in heat, electricity and transport over the next 12 years.

Last spring we agreed with other Member States to an EU-wide target of 20% renewable energy by 2020. The UK's proposed share would be to achieve 15% of the UK's energy from renewables. That is almost a ten-fold increase in renewable energy consumption from where we are now. It will involve all of us in a revolution in how we use and generate energy.

The opportunities are significant in the UK and beyond. The market for renewable energy technologies and investments will grow substantially. Up to 160,000 jobs could be created to deliver the necessary investment in the UK alone.

We are already putting in place mechanisms to deliver more renewable energy in the current Energy and Planning Bills. To meet our new target we will need to do much more. So we are consulting on a number of new measures including:

- additional financial incentives for renewable electricity;
- new financial incentives for heat;
- new incentives for microgeneration and distributed energy;
- removing grid barriers to renewables;
- making the planning system more responsive, while increasing the benefits going to local communities;
- using more energy from waste and biomass;
- stimulating innovation and the supply chain.

We will decide on the final package of measures in the light of people's views, and publish the UK Renewable Energy Strategy next spring. Our aim is to reap the maximum benefits for the UK, whilst minimising the costs.

Saving energy is crucial – the less energy we use, the lower the cost. And greater energy efficiency reduces bills for households and business, which is more important than ever in the light of recent increases in energy prices. So the Government will bring forward new measures to save energy and address fuel poverty. We will consult on new measures this autumn to tackle the need for even more efficient use of energy in all areas of our lives.

We estimate that the investment necessary to meet our target will be of the order of £100 billion over the next 12 years. It is the private sector which will undertake this. Investors need a clear understanding now of our ambitions for renewables alongside other low-carbon energy generation for 2020. So in parallel with this document, we are publishing the conclusions of the BERR-Ofgem Transmission Access Review. We are also publishing later this month a consultation on the proposed EU Directive on the capture and storage of carbon dioxide from power plants.

In coming to our final decisions next spring, we will carefully consider the evidence on the sustainability of biofuels.

This is an immense challenge. It will affect us all. But it is vital to our future and an important contribution to the global efforts to tackle climate change.

I look forward to hearing your views.

The Rt. Hon John Hutton MP
Secretary of State for Business, Enterprise & Regulatory Reform

Executive Summary

We face two key energy policy challenges: to tackle climate change and ensure security of energy supply. To meet these challenges, we are already acting to develop a diverse low-carbon energy mix including renewables, nuclear power and carbon capture and storage, and to promote energy efficiency and demand reduction.

Renewable sources of energy are a vital part of this strategy. They provide low-carbon energy, increase the diversity of our energy mix, and bring key business and employment opportunities. We therefore agreed with our EU partners last year to a binding target that 20% of the EU's energy consumption must come from renewable sources by 2020. The European Commission has proposed that the UK's contribution to this should be to increase the share of renewables in our energy mix from around 1.5% in 2006 to 15% by 2020. This would be a very challenging target. It will be important to meet it in the most cost-effective way possible.

In this document we are consulting on a range of possible measures to deliver our share of the EU target. Together they could lead to almost a ten-fold increase in our use of renewable energy – across electricity, heat and transport – by 2020. This will affect consumers, businesses and the wider environment. Indeed, everyone in the UK will have a role to play in this endeavour.

We already have a wide range of policies in place to deliver increased renewable deployment in the UK. We want to hear your views about the additional measures that we will need to employ. These could include:

- extending and raising the level of the Renewables Obligation to encourage up to 30-35% of our electricity to come from renewable sources by 2020;
- introducing a new financial incentive mechanism to encourage a very large increase in renewable heat;
- delivering more effective financial support for small-scale heat and electricity technologies in homes and buildings;
- helping the planning system to deliver, by agreeing a clear deployment strategy at regional level similar to the approach established for housing;
- ensuring appropriate incentives for new electricity grid infrastructure and removing grid access as a barrier to renewable deployment;
- exploiting the full potential of energy from waste, by discouraging the landfilling of biomass as far as is practical;

- requiring all biofuels to meet strict sustainability criteria, to limit adverse impacts on food prices, or other social and environmental concerns;
- promoting the development of new renewable technologies, through effective support particularly where the UK has the potential to be a market leader;
- maximising the benefits for UK business and jobs, by providing a clear long-term policy framework, working with Regional Development Agencies to tackle key blockages, considering support for specific technologies and addressing skills shortages.

Introduction

Renewable energy in the UK

1. Energy policy in the UK faces two very serious challenges: tackling climate change by reducing emissions both here and abroad, and ensuring that our energy supply remains secure. The Energy White Paper 2007 set out the Government's response to these challenges.

2. As well as strongly supporting international action to address climate change at EU, G8 and UN level, we have set ourselves the ambitious target of reducing the UK's carbon emissions by at least 60% by 2050. Under the Climate Change Bill our emission reduction goals for 2020 and 2050 will become statutory, with the introduction of five-year 'carbon budgets' (total emission limits). The Government will be required to produce plans to meet its carbon budgets, and to report to Parliament on how it is doing so.

3. Our main policy for achieving carbon reductions involves putting a price on carbon, notably via the EU Emissions Trading Scheme, which caps emissions in the power and other heavy industry sectors in the EU. However, in line with the principles of the Stern Review into the economics of climate change, we also encourage behavioural change to reduce energy use, and we provide support for specific low-carbon technologies.

4. Ensuring security of energy supply is essential to climate and energy policy. Fundamental to securing our energy supplies is to ensure that we are not dependent on any one supplier, country or technology. By increasing the level of energy we generate domestically, we will be less dependent on imports of fuel from abroad. Investment in more renewable energy in the UK, alongside other low carbon sources such as nuclear power and carbon capture and storage, can contribute to a more diverse mix of technologies and lower levels of fossil fuel imports. Our Renewable Energy Strategy (RES) can make an important contribution to this – we estimate that increased investment in renewables in the UK to meet a 15% renewable energy target in 2020 will reduce UK gas imports by 11-14% in 2020.

5. It will be very important that this diverse, low-carbon energy mix is achieved at competitive prices. We believe that the best way to ensure this is through

independently regulated markets, with the right interventions to correct specific market failures.

6. This document focuses on renewable energy. Since 2002, the chief policy mechanism to encourage the deployment of renewables has been the Renewables Obligation (RO), which requires electricity suppliers to obtain a specified and increasing proportion of their electricity from renewable sources or pay a buy-out price. Since its introduction, the RO has increased the level of RO-eligible renewable generation in the UK from less than 2% in 2001 to around 4.4% in 2006. This year we will overtake Denmark as the country with the highest operating offshore wind capacity in the world at over 400 MW. We have also recently introduced the Renewable Transport Fuel Obligation (RTFO) to bring forward biofuels in the transport sector.

7. The 2007 Energy White Paper set out proposals to reform the Renewables Obligation to make it more effective and efficient. It also suggested policies to address key stumbling blocks for renewable deployment, arising from planning controls and difficulties with grid connection. Many of these reforms are now being enacted through the Energy and Planning Bills currently before Parliament.

8. At the end of 2007, we launched a Strategic Environmental Assessment on a draft plan for up to 25 GW – nearly a third of our current total electricity generating capacity – of new offshore wind development rights in UK waters. In June 2008 The Crown Estate launched Round 3 of the offshore wind leasing programme, with bids expected in early 2009. In January this year we also announced the terms of reference for a cross-Government feasibility study into a barrage or other tidal power scheme in the Severn Estuary.

9. However, we will need to go much further. As part of our long-term support for renewables, in spring 2007 we helped secure agreement in the EU to an ambitious target to source 20% of the EU's total energy use – a combination of electricity, heat and transport – from renewable sources by 2020. This compares to around 8.5% across the EU in 2005. Member State contributions to this overall target have yet to be agreed, but the European Commission has proposed that the UK should provide renewable sources for 15% of its total energy use by 2020.

10. This is a very challenging target. In 2006 only around 1.5% of our final energy consumption[1] came from renewable sources, and under current policies[2] we expect this to rise to 5% by 2020. To meet the proposed EU target by 2020 we will have to increase the proportion of our energy coming from renewables ten-fold from 2006 levels, three times more than current policies are designed to achieve.

11. Delivering this level of change in renewable energy in such a short time will need action at all levels. Government – central, devolved, and local – will need to set the overall policy framework, as well as increasing its own use of renewable energy. This document is drafted from the perspective of UK policy, but the Welsh Assembly and the Scottish and Northern Ireland Ministers all recognise the importance of renewable energy, and they will

1 This is equivalent to 25 Terawatt hours (TWh), out of a total 1,800 TWh consumed in the UK.

2 Policies set out in the Energy White Paper 2007.

be essential in meeting the target. The market will also need to provide the necessary investment, and businesses and individuals will have to play an important role, for example by using less energy and supporting increased renewable deployment. This document sets out initial ideas of how each group could contribute. We want to hear your views on the proposals it contains, as well as any other ideas for achieving our ambitious goal in the most cost-effective way.

A new strategy

12. To meet the EU Renewable Energy target, we will need a far-reaching new strategy to increase the contribution of renewable sources in the three main energy-consuming sectors – electricity, heat and transport.

13. This document contains a range of possible additional measures to encourage deployment of renewable energy in the UK. These measures are designed to achieve a 15% renewable energy target for the UK by 2020. However, in a market economy policy alone cannot guarantee outcomes. How much these measures will deliver will depend on how energy companies, developers and investors in the market, and the supply chains which serve them, respond to the signals we provide. It will also depend on how successful we are in overcoming the constraints on development. Indeed, because renewable deployment depends on decisions by governments, businesses, communities and individuals in all parts of the UK, it will depend to some extent on how committed we are as a country to achieving our goals.

14. If all the options set out in this document were successfully implemented (and if no cost constraints were applied in deciding the measures we should take), our scenarios suggest that it will be possible to reach 15% renewable energy in the UK by 2020. This is at the top end of the range of possible outcomes and would require a very rapid response from suppliers, with a step change in the rate of building renewable technologies. We would need to develop a completely new approach to renewable heat: providing a substantial incentive to jump-start this new market, developing supply chains and encouraging large numbers of households to find renewable ways of heating their homes. We would also need to develop a new sustainable biomass market. The country's current wind generation capacity, on and offshore, would have to increase by a factor of ten.

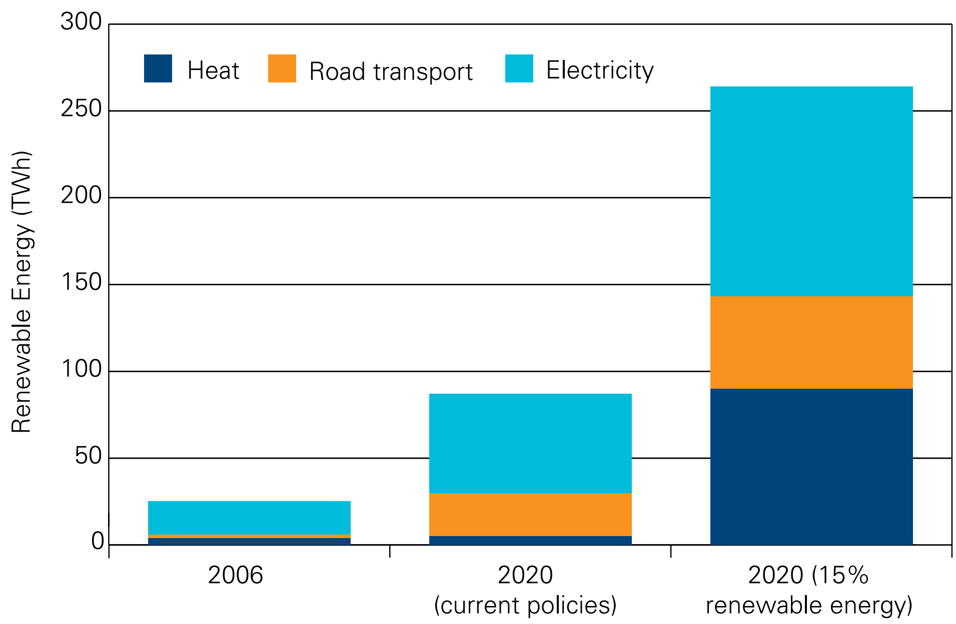
15. Achievement of the target will also depend on the extent to which we can reduce overall energy demand. The renewable target is a percentage of total energy consumed: the lower that figure, the easier it will be to achieve the required share. Reducing energy demand is of course also important for other reasons: it is cost-saving to households and businesses, it reduces greenhouse gas emissions, and it contributes to security of supply. That is why the starting point for our Renewable Energy Strategy is energy saving. All of us have a role in this. We seek views on how this can be achieved.

16. This document does not set out a definitive division of the renewables target between electricity, heat and transport. That will depend on how markets react to the incentives and opportunities provided. There are particular uncertainties over the contribution which can be made by renewable transport. In line with the draft EU Renewable Energy Directive, this document assumes a 10% renewable share of transport fuel. In the light

of the increasing concerns raised in recent months about the indirect effects of biofuels, we commissioned Professor Ed Gallagher of the Renewable Fuels Agency to carry out a review of evidence on this issue. Gallagher's findings will be important to the development of the Government's biofuel policies and targets. We are committed to meeting both our and the EU's renewable energy goals in a sustainable way. We also need to explore how far other renewable transport strategies, such as the development and use of electric-powered cars, can contribute to the renewable transport fuel target by 2020.

17. To understand how the 15% target might be shared between electricity, heat and transport, we have modelled different scenarios, using estimates of cost, practical feasibility (such as 'build rates' for onshore and offshore wind) and technology development. This analysis suggests that – if 10% renewable transport is feasible and sustainable – then one possible scenario to deliver 15% renewable energy in the UK in 2020 might be: 10% renewable energy in transport (compared with less than 1% today), 14% in heat (less than 1% today) and 32% in electricity (less than 5% today). If sustainability concerns meant that the transport sector could not contribute 10%, and the same overall renewables target were retained, then the contribution from the other sectors would have to be higher. In this circumstance it is unclear how we could meet the target domestically without making use of other options such as trading with other countries.

Figure 1: The size of the challenge – a potential scenario to reach 15% renewable energy by 2020

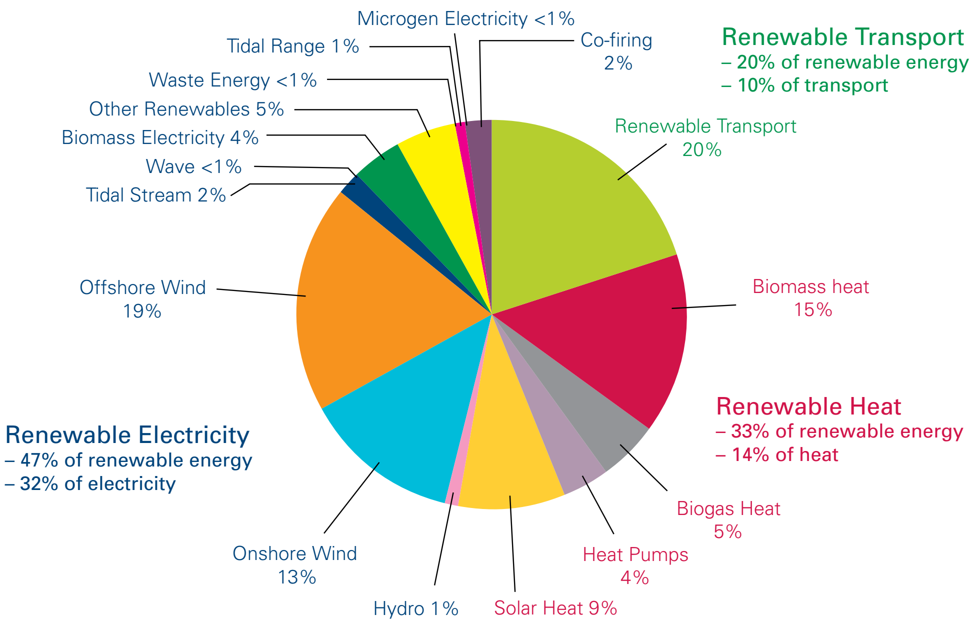


Source: BERR analysis

18. Within the overall framework the Government puts in place, the market will need to determine which technologies should be used, and then to deploy them. Initial analysis based on our current understanding of relative costs and constraints suggests that the key growth areas will be the currently commercial technologies of wind (on and offshore) and biomass. Figure 2 provides one possible scenario of what the final shares of different types of renewables

in 2020 might look like. Other, less-established technologies such as marine power generation may have more of a part to play over the longer term.

Figure 2: Illustrative renewable technology breakdown to reach 2020 target



Source: Redpoint et al (2008), NERA (2008), Department for Transport estimates.[3]

19. We do not underestimate the challenge of delivering this scale of renewable deployment in a little over a decade, although we note that the rate of building needed for offshore wind could be similar to the rapid rates of building that took place for coal in the 1970s and gas and onshore wind in the 1990s. However, to meet our target, we have no choice but to face this challenge head-on. This document seeks views on the measures we need to take to achieve it.

How much will it cost?

20. Meeting the UK's share of the renewable energy target will involve difficult trade-offs and costs. Providing companies with incentives to make the necessary investments will require an increase in the amount of consumer subsidy. So there will be an effect on fuel prices for all energy users over the longer term, although further energy efficiency measures, and changes in our use of energy could reduce the impact on bills, as discussed below.

21. How far it will involve additional cost for the economy and consumers will depend on the relative costs of renewables and alternative sources of energy. Our initial research, which is set out in the impact assessment attached to this document,[4] suggests that a central estimate of the cost to the UK of meeting a 15% target could be around £5 to £6 billion a year in 2020 (at

3 The chart shows the split of total renewable energy in 2020 between the three sectors: 20% coming from renewable transport sources; 33% from heat; and the remaining 47% from electricity.

4 www.berr.gov.uk/renewableconsultation

today's prices).[5] This is based on a range of projected prices for oil and other commodities by 2020 which are inherently uncertain: it assumes oil, for example, at $70 a barrel in 2020. If oil and other energy prices were higher than this, at $150 a barrel, the cost of the renewable strategy could fall by 35 to 40%. Similarly, these figures assume that demand for energy is at the level projected in the 2007 Energy White Paper; if demand could be reduced below this, the costs would fall.

22. The costs will also depend on the final design of the EU Renewable Energy Directive. A particular issue under discussion is whether trading with other EU member states or investment in renewable projects outside the EU should be allowed to count towards the target. The measures set out in this document relate to increasing renewable deployment in the UK. But because the cost of renewables projects in some other countries (both within and outside of the EU) are lower than the cost in the UK, allowing a specified and limited proportion of our target to be delivered abroad would make the task significantly less expensive – we estimate that trading one percentage point of the target could save 15 to 20% of the costs of meeting the target domestically, with a correspondingly lower impact on energy prices. Supporting the deployment of renewables outside the EU could also provide investment in clean energy technology in poorer countries. We want to hear your views about the extent to which we should seek to use such opportunities.

23. If we are to drive up renewables deployment in the UK to this degree and within this timescale, these costs will have to be incurred. But it is important to recognise what these costs are paying for: a reduction in the risk of catastrophic climate change and dangerous energy insecurity. These risks carry real and much higher costs. The Stern Review showed that the damage caused by global climate change could cost five times more than the cost of actions to stabilise global emissions by 2050. So the Government believes strongly that the cost of meeting our renewables target should be seen as an investment to avoid much higher costs to the economy in the longer term.

24. We want to hear your views about how we can make the step change transition to using renewable energy in the most cost-effective way.

Saving energy

25. The starting point for our energy policy is to save energy. If we can reduce the amount of energy we use, this will reduce carbon emissions, reduce the need for additional energy supplies and reduce costs. Saving energy can also reduce the amount of renewable energy needed to meet our target by reducing our overall energy consumption; and it is cheaper than investing in new generation plant.

5 These estimates are based on economic modelling by Redpoint et al (2008), Nera (2008) and Department for Transport estimates. Resource costs are net of the value of ETS allowances saved from carbon abated by additional renewable generation in the ETS sectors. Valued at forecast carbon price. Estimates are based on central fuel price estimates.

26. We have already introduced a range of measures to reduce energy use. In the business sector the EU Emissions Trading Scheme, the Climate Change Levy and Climate Change Agreements all provide incentives for greater energy efficiency. In 2010 we will introduce the Carbon Reduction Commitment, a mandatory trading scheme for large non-energy intensive businesses and public sector organisations. In the domestic sector the new Carbon Emission Reduction Target sets obligations on energy suppliers to deliver energy efficiency improvement measures to households. After 2011, as set out in the 2007 Energy White Paper, the Government's aim is to introduce a Suppliers Obligation which aligns the incentives of energy companies with a reduction in demand through the development of 'energy services' markets. Building on already tougher building regulations, we intend that all new homes in England will be zero-carbon from 2016, and all new buildings by 2019. In the transport sector we are negotiating new compulsory emissions targets for new cars.

27. These policies will deliver considerable reductions in projected energy demand over the coming years. However, the EU 2020 renewable energy target changes the context, making more radical measures to reduce energy use more economically attractive than previously considered. Because energy efficiency measures are generally lower cost than building additional renewable supply, our analysis suggests that it will be economically worthwhile to introduce such measures by comparison with marginal electricity options, up to a cost of around £45/tCO_2.

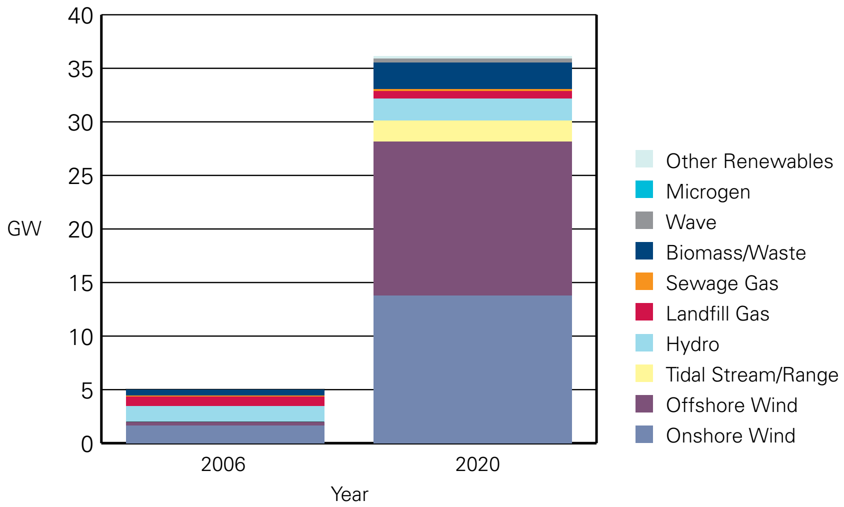
28. This suggests that in this context there is still scope for significant further increases in energy efficiency across the household, business and public sectors. We are not consulting specifically on these issues in this document. However, later this year, we will consult separately on a range of new and enhanced energy efficiency policies that will help promote cost-effective savings across the economy.

29. Using every unit of energy as efficiently as possible has to be our ultimate ambition. This may lead to an absolute reduction in energy demand in the longer term. To achieve this, our intention is to introduce policies so that every sector of the economy benefits from energy efficiency, that where possible all economic opportunities to save energy are realised, and that our energy efficiency policies are integrated so that links can be exploited. Improving the energy performace of people's homes will play a particularly important role in this, reducing emissions and helping us all to manage our energy bills. We will consult on a new strategy to achieve a step change in household energy efficiency, including a Suppliers Obligation, later this year. All this will be closely linked with our work to develop a low-carbon heat strategy.

Centralised electricity

30. As outlined above, if we are to meet our 2020 goal, up to 30-35% of our electricity may need to come from renewable sources. Today that figure is less than 5%, made up mostly of biomass, hydro and wind.

Figure 3: Renewable electricity generation capacity – comparison between 2006 and projected 2020



Source: DUKES 2007

31. As shown in Figure 3, we expect the key growth area to be wind power, both on and offshore. Analysis on electricity constraints suggests that up to 33 GW of offshore wind might be achievable by 2030.[6] However, our initial modelling suggests that by 2020 deployment may be closer to 14 GW, compared to less than 1 GW today. This would equate to around 3,000 extra offshore turbines of 5 MW. Others have suggested that higher levels might be achievable – for example, RAB estimated that around 18 GW of offshore wind could be deployed by 2020.[7] BERR is undertaking a Strategic Environment Assessment (SEA) to assess the feasibility (economic, technical and environmental) of proposals for up to a further 25 GW of offshore wind on top of the 8 GW already planned. We want to make full use of the potential for offshore development.

32. Our initial modelling suggests that we might need approximately 14 GW of onshore wind too, compared to 2GW today – equating to around 4,000 new 3 MW onshore turbines in addition to the approximately 2,000 turbines already installed. Others have estimated a slightly lower level of onshore deployment, for example, RAB estimated that around 13 GW of onshore wind could be deployed by 2020. Subject to planning permission, we would expect that a large proportion of onshore wind development will take place in Scotland. Tidal barrages and lagoons, such as the options being discussed in Severn Estuary, could also make a key contribution if they are able to meet environmental assessment, economic and other criteria.

33. The level of renewables deployment in the UK has historically been low, largely due to the availability of cheap alternative energy sources, particularly North Sea oil and gas. While the Renewables Obligation has provided a strong financial incentive mechanism since 2002, several non-financial constraints have inhibited and slowed renewables deployment. These include, in

6 SKM (2008a)
7 RAB (2008)

particular, planning issues (including conflict with other Government policies); access to the electricity grid; and supply chain constraints. In this consultation we would like to hear your views on our proposals to address each of these issues, as set out below.

Financial incentives

34. The current financial incentive to produce renewable electricity comes from the Renewables Obligation,[8] by which electricity suppliers must obtain a specified and increasing proportion of their electricity from renewable sources. Since it was introduced in 2002, the RO has increased the level of RO-eligible renewable generation in the UK from less than 2% in 2001 to around 4.4% in 2006. Under measures set out in the Energy Bill, it is estimated that the RO will lead to around 14% of our electricity being generated from renewable sources by 2015-20.

35. To meet the EU 2020 renewable energy target, however, we will need to at least double this figure. This consultation examines various alternative ways to provide the financial incentive for this, including strengthening the RO or introducing a new scheme such as feed-in tariffs (which guarantee renewable generators a fixed sum per unit of electricity generated). Our analysis indicates that, while feed-in tariffs could in some circumstances have theoretical financial advantages, these benefits could be within the margin of modelling error and would be small for the scale of deployment required. More significantly, it is less likely that a new system of feed-in tariffs could achieve the target by 2020, due to the delay and uncertainty that a change of support scheme (which could take several years to introduce) would necessarily entail. There could also potentially be difficulties in the operation of feed-in tariffs in the UK's market-based system. This document therefore concludes strongly in favour of maintaining the RO for large-scale electricity while recognising that we need to continue to improve its efficiency. The RO will nevertheless need modifying, including significantly increasing the level of the Obligation (e.g. 30–35%), and extending its end date. On the assumption that the RO is maintained, we would like your views on any further changes required.

36. This document also considers the most appropriate financial incentive for microgeneration of electricity (see below).

Planning issues

37. A robust planning regime is vital to ensure that the national, regional and local economic benefits; environmental and social objectives; and the interests of individuals, communities and society as a whole are all taken properly into account in reaching decisions about new developments. We are firmly committed to maintaining the democratic, participatory values of our planning system.

38. We know there are potential tensions between local concerns and wider national policy and needs. Renewable developers often complain that the balance between them is not always struck correctly; that the planning system takes too long, costs too much and, in some cases, does not consistently reflect national policy. This can block new generation and the

8 The Renewables Obligation covers England and Wales. Scotland and Northern Ireland have their own renewables obligations.

extensions to the electricity grid which are necessary for it to become operational, adding delay and cost to investment.

39. We are already seeking powers to address some of these concerns through the Planning Bill and the Marine Bill, notably by ensuring that all onshore wind developments above 50 MW and offshore wind developments above 100 MW in England and Wales are considered by a new Infrastructure Planning Commission (IPC) on tight timeframes and on the basis of a new National Policy Statement for renewables.

40. To achieve the 15% target all parts of the UK, in particular the Devolved Administrations, English Regions, Local Authorities and local communities, will have to play their part in contributing to the achievement of the target. We would like to hear your views on a range of potential additional measures to support onshore renewable developments within the context of the reformed planning regime. These could include:

- development of a suite of stronger National Policy Statements for renewables and electricity networks that would set a clear, comprehensive, national policy framework for local planning authorities;
- helping the planning system to deliver, by agreeing a clear deployment strategy at regional level similar to the approach established for housing;
- the creation of an expert body to provide specialist advice on renewable energy to local planners and developers;
- further extension of Permitted Development Rights for domestic microgeneration to include wind turbines and air source heat pumps, extension to smaller-scale non domestic renewables and using Local Development Orders to speed up the re-powering of existing wind turbines.

41. We also need to create the conditions in which communities are able to see local benefits in renewables developments. Sometimes it is only the disadvantages they see. We would also like to hear your views on how this could be achieved. Measures could include:

- establishing a single benchmark for the local community benefits that renewable developers are expected to provide and producing best practice guidance;
- considering the particular needs and circumstances of the renewables sector in developing the detailed design of the Community Infrastructure Levy (CIL), which secures contributions from developers towards funding for local infrastructure;
- providing mechanisms that will enable communities to benefit financially from the development of community energy assets.

42. A significant number of planning applications for new renewable developments, notably wind farms, are blocked as a result of conflict with other Government policies. This reflects legitimate policy concerns – notably to avoid degradation of radar that could have adverse effects on national security; to protect the local environment; and to secure adequate space for sea transport. We would like to hear your views on how to resolve such policy conflicts, potentially through:

- implementation of the new Memorandum of Understanding between the Government and the wind industry, and the development of an aviation action plan to identify workable solutions to mitigate the impact of wind turbines on radar systems;
- extending the Vessel Traffic Service (VTS) – a system for assisting shipping movements at sea – to allow offshore wind farms to be built closer to shipping lanes;
- providing clarity on the scope and application of UK and EU environmental regulation – relating in particular to the Birds and Habitats Directives – to help renewable development proposals to comply with environmental legislation.

43. The Marine Policy Statement, proposed under the draft Marine Bill, will also help to address planning issues in relation to offshore renewable developments by integrating the Government's existing and new policies on marine issues, and identifying and resolving conflicts of this type.

44. The Devolved Administrations are also working on these issues in the light of their responsibilities for planning outside England and Wales. The Government seeks to work collaboratively with the Scottish, Welsh and Northern Ireland administrations in achieving our UK renewables target.

Grid issues

45. New renewable electricity needs secure connection to the national grid to gain access to the electricity market in order to sell its output. Some new grid infrastructure will be needed to meet our target. For example, new offshore wind projects will need sub-sea cables to take the electricity generated onshore, and further upgrades to the onshore network may be needed to transport that power to the end users (businesses and homes).

46. We have already taken the major decisions on the shape of a new Offshore Transmission Regime which will ensure swift and cost-effective grid connections for offshore generation. Measures will include the licensing of offshore transmission through competitive tenders run by the Gas and Electricity Markets Authority (Ofgem).

47. In the Transmission Access Review (TAR), published at the same time as this document, we have announced a number of measures that should, over time, remove the constraints on grid access for onshore generation. We aim to ensure that all generators, not just of renewables, who want to connect to the electricity grid can do so when they need to. We are announcing short-term measures in the TAR to speed up the grid connection of projects that already have planning permission through a form of 'connect and manage', for an interim period. We have also concluded that fundamental changes are needed to the rules that govern access to the grid. Ofgem and the industry have been tasked with delivering that change. However, the Government will review progress at the end of the year and if it is insufficient we will consider further options, including legislation, to bring about the changes we believe are

needed. Ofgem also intends to review the incentives on network operators to build the necessary infrastructure in a timely fashion, and to review with National Grid the system planning standards to allow the connection of more generation to a given network.

48. We are also consulting separately on revised statutory social and environmental guidance for Ofgem, the energy regulator. Ofgem must have regard to such guidance, which sets out the Government's expectations of how it can make a contribution to the achievement of social or environmental policy goals appropriate to its remit and functions. We are seeking views on whether the proposed revised guidance is sufficient and appropriate.

Supply chain issues

49. Delivering the proposed increase in renewable electricity generation will put considerable strain on supply chains in the energy sector. The drive to increase renewable deployment elsewhere in the EU and around the world will increase these pressures. Our core approach to reducing supply chain constraints is to provide a clear, long-term policy framework which will give investors and suppliers confidence in future demand. We will also be working with Devolved Administrations, Regional Development Agencies and business to tackle specific blockages, identify key gaps in the supply chain, and encourage those best able to fill them to the benefit of UK jobs and the economy.

Impacts on the electricity generation market

50. We would like to hear your views on the potential impacts that a large increase in renewable deployment might have on the electricity generating market. One important area is the relationship between renewable and fossil fuel plants. The intermittency and variability of wind and some other renewable generation will have implications for the rest of the electricity generating fleet, as well as presenting challenges to the system operator in the vital task of ensuring instantaneous balance on the national grid. Our initial analysis suggests that these challenges can be met through back-up generation from fossil fuel plants. Even though meeting the European target would mean a large share for renewable generation in the UK electricity mix, the need for back-up plants, along with the large numbers of conventional plants due to close in the next two decades, means that the next decade will also require considerable new build of fossil fuel generation. On these assumptions, including the impact of new measures to meet the renewables target, we would expect to need over 45 GW new generating capacity by 2020 – of which around 30 GW will be renewable.

51. New techniques of 'dynamic demand management', utilising new technologies such as commercial-scale electricity storage and smart meters, may also be able to play a role in addressing the intermittent nature of some renewable technologies. The future widespread use of electric vehicles could provide distributed energy storage capacity via batteries and could potentially improve the efficiency of the electricity grid by smoothing power demand between day and night. Smart metering is likely to have a particularly important role in dynamic demand management. It could also help with optimising network operation, for instance through the provision of far more data on energy usage than is available at present. The Government recently announced that it will proceed with a rollout of advanced metering for larger business sites from early 2009, and a call for evidence on smart or advanced

metering for other business customers will follow this summer. Decisions will be made after the second report from the Energy Demand Research Project, which is due in November 2008.

Heat

52. Heating accounts for the largest single proportion of the UK's final energy demand at approximately 49%, and also the largest proportion of our carbon emissions at 47%. Increasing renewable heat is therefore crucial for delivering the UK target. However, deployment is presently at a very early stage, and only about 0.6% of heat is generated from renewable sources. Unlike electricity, heat cannot travel for long distances without significant losses and expense so most deployment is decentralised and local. Because heat is typically generated on site, the existing market consists of fuel, equipment and services. There is thus no heat unit price or traded sector as there is for electricity. The fragmented nature of the heat market, compared to electricity, means it is more difficult to develop renewable heat policies that encourage efficient and cost-effective deployment of these technologies and fuels.

53. The main technologies to increase renewable heat in the UK are likely to be biomass-based technologies (such as heat from biomass waste) and microgeneration technologies (such as solar water heating and ground and air source heat pumps). Other possibilities include biogas and biomass-fuelled Combined Heat and Power (CHP) plants, which would generate both heat and renewable electricity.

54. Building on responses to the Heat Call for Evidence which the Government published in January 2008, we would like to hear your views on how to increase renewable heat generation in the UK. Measures proposed in this document include:

- introducing a new heat incentive mechanism, such as a Renewable Heat Obligation or a Renewable Heat Incentive, akin to a feed-in tariff, to provide the financial stimulus for new renewable heat deployment;
- improving the regulation of biomass heating systems to ensure that their rollout minimises the impact on air quality standards;
- providing regulatory incentives to install renewable heat technologies in new buildings through the implementation of the zero-carbon homes and non-domestic buildings initiatives;
- providing better information to consumers, businesses and Local Authorities on the potential of renewable heat, including for the planning process.

Distributed energy

55. Households, businesses and communities can play an important role in reducing carbon emissions by generating their own electricity or heat from renewable or fossil fuel energy sources. Such distributed energy can be

an important tool in tackling the carbon impact of the built environment, particularly when combined with energy efficiency measures. The Government is putting in place ambitious policies to harness this potential, including our zero-carbon new building policies. Furthermore, most of the renewable heat to be brought forward by a new heat incentive mechanism is likely to be produced at local level.

56. Many of the non-financial barriers to increased take-up of distributed energy are being addressed by policies in place or under development. However, the complexity and novelty of some of the technologies, together with their need to be integrated into the built environment, often by players new to the energy business, means there is a significant gap between potential and delivery. Moreover, many of the technologies are not yet cost-competitive at their current state of development and with current fuel and carbon prices. This document proposes a range of possible measures to overcome these cost and information barriers, on which we would like to hear your views. These include:

- delivering more effective financial support for small-scale heat and electricity technologies in homes and buildings (including considering whether a move to a feed-in tariff system may have advantages);
- establishing a decentralised energy 'information hub' under the Government's Act on CO_2 advice service, to bring together and signpost information for households, businesses, communities, developers and others wanting to generate their own energy;
- supporting outreach activity to identify the potential for retrofit of distributed energy in the community.

Transport

57. The EU's draft Renewable Energy Directive includes a binding target for all Member States to source 10% of their transport energy consumption (excluding aviation and shipping) from renewable sources by 2020.[9] At present the main source of renewable energy available for transport is biofuels. However, vehicles powered through the electricity grid using renewable energy may have a growing part to play.

58. In 2006, biofuels accounted for less than 1% of the UK's road transport fuel. However, the Renewable Transport Fuel Obligation, which was introduced in April this year, now requires fuel suppliers to ensure that their road transport fuel contains 2.5% by volume of biofuels, rising to 5% in 2010.

59. It is essential that our biofuel use is sustainable – environmentally, socially and economically. We therefore commissioned Professor Ed Gallagher to carry out a review of evidence on this issue. Gallagher's findings will be important to the development of the Government's biofuel policies and targets.

9 The proposed target requires renewable energy to make up 10% of the energy consumption in transport excluding petroleum products other than petrol and diesel. This effectively excludes aviation and shipping, except that any renewable energy in these sectors would count towards the target.

60. Over the next few years, motor manufacturers have committed to developing electric and, potentially, hydrogen-powered vehicles. In widespread use, such vehicles would have the potential to contribute to the EU renewable transport target. Since electric vehicles may be charged at night (when not in use), and would entail a system of battery replacement, they could have other benefits too. They could improve the returns to renewable energy generation, and through vehicle-to-grid technologies could help smooth electricity demand. They would have the ancillary benefits of reducing air and noise pollution. The Government is keen to promote all options for future technological development (including electric and hydrogen) and is interested in examining now how the development of electric vehicles and an appropriate charging infrastructure could be accelerated in the UK.

61. We would therefore like to hear your views on potential measures for increasing renewable transport in the UK, including:

- agreeing robust sustainability criteria for all biofuel use;
- adapting the Renewable Transport Fuel Obligation (RTFO) to provide incentives for greater levels of renewable energy in transport with safeguards to ensure these levels are sustainable, and ensuring our support provides the greatest greenhouse gas savings;
- facilitating the development of second and third-generation biofuels, which are made from non-food sources and therefore avoid many of the sustainability concerns around current biofuels;
- extending the use of biofuels in rail transport and shipping so far as is sustainable;
- exploring the potential contribution of alternative vehicle technologies such as electric or hydrogen cars to meeting our renewable energy targets, taking into account the possible impact on electricity demand, and the potential for vehicle-to-grid technologies to help smooth electricity demand.

Bioenergy

62. Bioenergy is produced either directly, by burning biomass material such as forestry products, or indirectly, such as through the conversion of food wastes to biogas, generating heat and electricity. Currently, biomass accounts for about 2.3% of our electricity generation and for less than 1% of our heat needs. To meet our share of the EU 2020 renewable energy target our analysis suggests that biomass-fuelled technologies, including biogas, may need to provide around 30% of the UK's renewable electricity and heat generation. An increase on this scale means we will have to make the best possible use of UK-produced biomass resource, including waste, as well as meeting some of the increased demand through sustainable imports.

63. This document seeks views on a range of measures for maximising our biomass resources, including:

- ensuring the sustainability and fuel quality standards for biomass, both domestic and imported;
- supporting research into new energy crops and the development of local supply chains via the existing Bio-Energy Infrastructure Schemes and the Bio-Energy Capital Grants Scheme;
- discouraging the landfilling of biomass as far as is practical, thereby maximising its availability as a renewable fuel;
- considering the scope for Local Authorities to collect and separate organic food waste, so that it can be broken down to biogas through anaerobic digestion;
- encouraging Waste Incineration Directive compliant infrastructure and support for anaerobic digestions as a means of generating energy from waste;
- a biomass communications programme to raise awareness about the benefits of bioenergy including energy from biomass waste.

Innovation

64. The development of new and emerging renewable energy technologies will be important for meeting our 2020 target and vital for our longer term climate change goals. Innovation can make improvements to existing renewable technologies and reduce costs, as well as create new technologies. The Government has many ways of supporting innovation – including regulatory and market-based measures, as well as direct funding for research, development and demonstration of new technologies.

65. We would like to hear your views about how we can most effectively encourage innovation in renewable technologies, including technologies such as electricity storage and smart metering which can help support increased renewable deployment. In particular:

- Should we adapt the Renewables Obligation to ensure that it better supports emerging as well as existing technologies? Are there more effective mechanisms to achieve this?
- Is there evidence that specific emerging renewable and associated enabling technologies are not receiving appropriate support?
- Are there other barriers to the development of renewable and associated enabling technologies that are not addressed by current or proposed support mechanisms, particularly in areas where the UK has the potential to be a market leader?

Business benefits

66. Dealing with climate change by reducing carbon dioxide emissions will require a major change in the way the world's economies are powered, as all countries move from high-carbon fossil fuels to renewable or low-carbon fuels and resource-efficient products and services. This rapid expansion in clean technology offers considerable business opportunities. For example, the Carbon Trust estimates that UK annual revenues from offshore wind alone could reach £2 billion per year by 2020, around half of which would come from exports, while revenues from marine renewables could range from £300-900 million by 2020.[10] Our own analysis suggests that the expansion in renewable energy in the UK has the potential to generate 160,000 new jobs in the sector by 2020. There is no guarantee that all these jobs will be sited in the UK, but we want to ensure that we secure as many of them as possible for the UK by putting in place an appropriate policy framework.

67. To maximise the benefits for UK business, the core need is to provide a clear, long-term policy framework within which British companies can invest in renewables. This is what the policy proposals in this document are designed to do. But we also want to take further steps specifically to maximise the UK business and employment benefits of these policies. So we will work closely with our key delivery partners, UK Trade and Investment and the Regional Development Agencies, to encourage investment in the UK from overseas renewables companies, and to encourage UK businesses to turn to renewable technologies. Subject to State Aids clearance, BERR expects to launch a new offshore wind capital grant scheme in 2009. We also intend to ensure that the right economic conditions exist for entrepreneurial growth and spin-out companies for supporting technologies, and to encourage markets that can help to introduce dynamic products to meet renewable targets at competitive prices. We would like your views on how best we can support UK businesses in these ways.

Wider impacts

68. Delivering such an ambitious shift to renewable energy in just over a decade will involve trade-offs and create some additional challenges and costs in the short to medium term to our economic, social and environmental goals. Our renewables strategy will be underpinned by the principles of sustainable development, integrating social, environmental and economic objectives. We will seek to ensure that we strike the right balance between the contribution of renewable energy to tackling climate change and its potential impacts on other sustainable development priorities. This document sets out our initial analysis of the key impacts.

Carbon savings

69. Emissions from large-scale electricity and a small part of the heat sector are covered by the EU Emissions Trading Scheme (ETS), which sets a Europe-wide cap on emissions in those sectors and provides incentives for firms

10 EEF (2008)

to seek least-cost emissions reductions by creating a carbon price. Our Renewable Energy Strategy will therefore not reduce overall emissions in Europe in the large-scale electricity sector.

70. This strategy will, however, also considerably increase renewable energy use in the heat and transport sectors, most of which are not covered by the ETS. We estimate that the measures in this document will provide additional savings of around 20 $MtCO_2$ from heat and transport outside the ETS in 2020 (around 4-5% of our projected 2020 emissions).

71. By requiring an increased use of renewable technologies within the EU ETS cap, one effect of the EU renewables target will be to reduce the EU-wide carbon price. The Commission has estimated that the carbon price will be around €39/tCO_2 across 2013-20, compared with €49 if there were no renewables target.

72. However, as the Stern Review demonstrated, carbon pricing alone is not enough. We will also need policies to support the development of more costly technologies to deliver effective carbon reduction in the longer term. By 2050, we expect renewables, along with other technologies such as nuclear and carbon capture and storage, to be playing a very significant part in delivering a largely decarbonised electricity mix.

Security of supply

73. A diversity of energy sources – ensuring that we are not dependent on any one supplier, country or technology – is fundamental to managing the risks to the UK's security of supply. Energy from diverse renewable sources across the electricity, transport and heat sectors will play an important role in this regard. Meeting our targets could reduce gas imports by between 12-16% in 2020, with increasing benefits as these become more scarce and expensive. The challenges presented in the electricity sector by an increase in largely intermittent renewable generation are discussed above.

Energy prices

74. In recent years, as in other countries, we have seen increases in prices for electricity, gas and oil as the cost of fossil fuels on the world markets has increased. Our existing policies to reduce carbon emissions have contributed a small amount to such price increases: about 7% of current domestic energy bills arises from climate change policies. Our measures to incentivise renewable energy deployment will also have an effect on energy prices. Because of the time it will take to accelerate investment, in the short term, up to 2010, the impact on bills will be close to zero. Small increases will then occur in the period 2010-15. By 2020, we estimate that the measures set out in this consultation document, taken together, could result in increases in electricity bills of 10% to 13% for domestic and 11% to 15% for industrial customers; increases in gas bills of 18% to 37% for domestic and 24% to 49% for industrial customers; and increases in petrol and diesel prices of 2% to 4% and 1% to 3% respectively. The distribution of these costs will partly depend on the policy instruments used and how the market responds to them. We are interested in your views on how these costs will and should be distributed across the economy.

75. All things being equal, greater use of renewables should reduce upward pressure on fossil fuel prices. These estimates are based on our central projections of fossil fuel prices in the future (consistent with a projected oil price of $70/barrel in 2020). If fossil fuel prices were higher (in line with an oil price of $150/barrel in 2020) the percentage increase in electricity bills could fall by three-quarters. The percentage increase in gas bills could fall by around a half.

76. Further energy efficiency measures could also reduce the impact of these price increases on bills, and will be a focus of further consultation later this year. As far as domestic consumers are concerned, we remain committed to supporting, through our Fuel Poverty Strategy, those households disproportionately affected by energy prices. We will consider these issues further within the context of the Fuel Poverty Strategy in England and Wales. The Welsh Assembly Government will also be reviewing its Fuel Poverty Commitment as part of its work on developing a National Energy Efficiency and Saving Plan. The impact of high energy prices on business and competitiveness will depend partly on actions taken by other EU Member States to meet their targets.

Next steps

77. We are inviting views on this consultation by **26 September 2008**. We will provide a summary of responses towards the end of the year. In the autumn we will also be consulting on the potential for further energy efficiency measures and considering other low-carbon heat solutions. We will publish our full Renewable Energy Strategy in spring 2009, once the EU Directive has been agreed, along with the UK's share of the target, and the framework in which we can deliver it. The Strategy will set out a clear framework to provide certainty and detail on the policies we will introduce and actions we will undertake to reach our 2020 target and to promote renewable energy in the UK for the long term.

78. We will develop any measures and further work set out in this consultation document in accordance with the principles of better regulation to ensure that the regulatory burden on business is kept to a minimum.

79. Some of the potential measures discussed in this document, for instance the introduction of new financial incentives, would require primary legislation. Following publication of the Strategy, we will introduce any such legislation in England and Wales as soon as Parliamentary time allows.

How to respond

This consultation seeks views on how to drive up the use of renewable energy in the UK, as part of our overall strategy for tackling climate change, and to meet our share of the EU target to source 20% of the EU's energy from renewable sources by 2020.

Responses to this consultation will help shape the UK Renewable Energy Strategy, which will be published in spring 2009, once the UK's share of the target has been agreed.

We want to hear from members of the public, industry, non-Governmental organisations (NGOs) or any other organisation or public body.

The consultation began on 26 June 2008 and will close 26 September 2008.

There are a number of ways to let us know your views.

Online

Visit our website at www.berr.gov.uk/renewableconsultation. The online consultation has been designed to make it easy to submit responses to the questions. If you decide to submit your response through the website you will be provided with a user name and a password to enable you to edit or update your submission as many times as you wish whilst the consultation is open.

By letter, fax or e-mail

A response can also be submitted by letter, fax or e-mail to:

Renewable Energy Strategy Consultation
Ropemaker Court
11 Lower Park Row
Bristol
BS1 5BN
E-mail: renewableconsultation@opinionsuite.com
Fax: 0117 3169 512

Additional points about this consultation

When responding please state whether you are responding as an individual or representing the views of an organisation. If responding on behalf of an organisation, please make it clear who the organisation represents and, where applicable, how the views of members were assembled. The website registration form provides space to do so.

After the consultation has closed, all responses (including respondents' names) will be published unless respondents specifically request that their responses be kept confidential. This will apply to all responses whether submitted online, posted, faxed or emailed. Please indicate on your response if you want us to treat it as confidential. You should also read the section on confidentiality and data protection below.

Confidentiality & Data Protection

Information provided in response to this consultation, including personal information, may be subject to publication or disclosure in accordance with the access to information regimes (these are primarily the Freedom of Information Act 2000 (FOIA), the Data Protection Act 1998 (DPA) and the Environmental Information Regulations 2004).

If you want other information that you provide to be treated as confidential, please be aware that, under the FOIA, there is a statutory Code of Practice with which public authorities must comply and which deals, amongst other things, with obligations of confidence.

In view of this it would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information we will take full account of your explanation, but we cannot give an assurance that confidentiality can be maintained in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded as binding on the Department.

The Department will process your personal data in accordance with the DPA and in the majority of circumstances this will mean that your personal data will not be disclosed to third parties.

Additional Copies

You may make copies of this consultation document without seeking permission. Further printed copies of the consultation document or copies of the response form can be obtained from:

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Copies of the document in Welsh, Braille, large print and audio are also available on request from the orderline. An electronic version can be found at www.berr.gov.uk/renewableconsultation

Help with queries

Questions about the policy issues raised in the document can be addressed to:

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Information about the relevant Devolved Administration policies is available from:

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E-mail: energy@wales.gsi.gov.uk
Tel: 029 2082 6852

If you have comments or complaints about the way this consultation has been conducted, these should be sent to:

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A copy of the Code of Practice on Consultation is attached at Annex 5.

Related documents, including the Impact Assessment, can be found at: www.berr.gov.uk/renewableconsultation.

Chapter 1
Renewables and the Energy and Climate Challenge

1.1 The role for renewable energy

1.1.1 Renewable energy has a central role in meeting the growing policy challenges of climate change and energy security. Our 2007 Energy White Paper made clear that these are the two key energy policy challenges that we face, requiring urgent action at home and abroad. We need a variety of policy instruments (with a central role for independently regulated, competitive markets, carbon pricing and energy efficiency) and a variety of low carbon technologies (notably nuclear, carbon capture and storage and renewables) to meet them. This document focuses on the role of renewables in this mix.

1.1.2 Our understanding of the science and the costs of climate change is rapidly progressing: we know there are severe risks and economic costs to our world from the impacts of global warming. The Stern Review showed that there is therefore a clear business case, as well as a moral one, to take action to reduce the risks of serious climate change. The damage caused by climate change could cost at least five times more than the cost of action to stabilise global greenhouse gas emissions by 2050.[11] Renewable energy is an integral part of the solution.

1.1.3 At the same time, over the next few decades, the growth in global demand for energy and the depletion of our North Sea oil and gas resources mean that we need to re-think our approach to sourcing and using energy. The International Energy Agency (IEA) expects global demand for energy to increase by 53% by 2030 unless major policy reforms are undertaken to deliver more efficient energy use.[12] Ensuring secure, clean and affordable energy over the coming decades will be a major challenge. Renewable energy can help us meet this challenge.

11 Stern (2007)
12 IEA (2007)

Box 1.1: The UK tackling climate change domestically and internationally

International framework

The UK plays a leading role on climate change at the international level, working through the EU, G8 and UN Framework Convention on Climate Change (UNFCCC). Crucial to achieving our climate change goals is securing a global agreement to a realistic, robust, durable and fair framework for the post-2012 period, when the first set of targets under the Kyoto Protocol expire. At the UN Bali Climate Change Conference in December 2007, agreement was reached to launch negotiations for a global and comprehensive agreement, to be concluded in 2009 at the UN Climate Change Conference in Copenhagen.

EU Climate and Energy package

The EU Climate and Energy package, published in January 2008, sets out proposals to achieve a reduction in EU greenhouse gas emissions of 20% by 2020, increasing to up to 30% in the event of an international agreement on climate change, compared to 1990 levels. The package shares the effort to achieve these emissions reductions between Member States. The proposed UK target to deliver 15% renewable energy by 2020 sits within the package as part of an overall goal for 20% of the EU's energy to be sourced from renewables. Other key elements are proposals for strengthening the EU Emissions Trading Scheme (EU ETS), proposed targets for each Member State to reduce emissions in sectors not covered by the EU ETS (16% for the UK, compared to 2005 levels) and plans both for promoting and regulating the deployment of carbon capture and storage technologies.

UK carbon budgets

The Climate Change Bill, which is currently passing through Parliament, creates a new legal framework for the UK to reduce, through domestic and international action, its carbon dioxide emissions to at least 60% below 1990 levels by 2050. The Government will be required to set five-year carbon budgets, which place binding limits on carbon dioxide emissions and set out the trajectory towards the targets. Decisions on the carbon budgets for the first three five-year periods (2008-2012, 2013-2017, 2018-2022) and the level of the 2050 target will be informed by advice received from the independent Climate Change Committee (CCC) by 1 December 2008, and will need to be agreed by Parliament before June 2009. The Bill requires the carbon budget for 2018-22 to be set at a level that is at least 26% below 1990 levels. The Government must set out how it will achieve its carbon budgets, and report annually to Parliament on progress. The CCC has been asked to report on whether the 60% target for 2050 should be raised, up to 80%.

1.2 UK climate and energy goals

1.2.1 Our 2007 Energy White Paper set out our strategy for delivering energy security while also accelerating the transition to a low carbon economy. Underpinning this strategy is our belief that independently regulated, competitive markets are the most cost-effective way of delivering our objectives. We also understand that we need to look both at the UK and internationally if we are to make a difference: no one country can on its own achieve the reduction in emissions required to prevent serious climate change, nor secure and develop all its energy needs without international engagement.

1.2.2 We want to reduce carbon emissions by at least 60% by 2050, and to make real progress towards this goal by 2020. As described in Box 1.1, we are putting in place legally binding 'carbon budgets' that will set out the UK's trajectory towards this goal. But tackling climate change is a global challenge: the UK's carbon emissions account for only 2% of global emissions, so if we are to make a real impact we need to work with other countries. We therefore strongly support international action such as the EU's climate and energy package and actions by the G8 and UN. We are also actively engaged with EU and international partners to develop transparency in our global energy markets. Diversity of energy sources, ensuring that we are not dependent on any one supplier, country or technology, is fundamental to managing security of supply risks.

1.2.3 At the heart of our long-term strategy to cut emissions at least cost is the EU Emissions Trading Scheme (EU ETS), which was introduced in 2005 and has two fundamental components: a cap on emissions; and a system for trading the 'right to emit'. The EU ETS cap sets a regulatory limit on the total emissions from the power sector and other large emitting industries across Europe. Some 11,000 installations across the EU are required, together, to operate within this cap. We are currently in the process of negotiating the level of the cap for the third phase of the EU ETS, which will run from 2013-2020. The proposal, which we welcome, is for the cap to get progressively tighter year on year from 2013, continuing beyond 2020, setting a clear pathway towards our long-term emissions targets. By 2020, the cap would be 21% below 2005 reported emissions levels. The Government launched a public consultation in April 2008 on the Commission's proposals for the EU ETS from 2013.[13]

1.2.4 However, as the Stern Review emphasised, carbon pricing alone will not be sufficient to reduce emissions at the scale and pace required. Working with industry, Government action is needed to stimulate the development of a broad portfolio of low-carbon technologies and reduce costs. By promoting the development of renewable technologies, alongside measures to facilitate the deployment of nuclear and demonstrate carbon capture and storage technologies, we are ensuring that there is a range of options available to power companies when they are looking at managing their emissions while also meeting the energy needs of their customers.

13 DEFRA 2008(c)

1.2.5 To meet our emissions goals, while providing secure energy supplies, we will need to use a range of cost-effective low-carbon energy technologies in the UK. This means we will need renewable energy technologies such as biomass in heating, biofuels for transport and wind-powered electricity to be used alongside nuclear and carbon capture and storage in electricity generation, and more distributed energy. It is also clear that, as we raise the levels of renewable generation in the electricity sector, the intermittent nature of many renewable energy sources means there will continue to be a need for investment in new flexible generation from coal and gas to provide back-up capacity. This is particularly true given that at least six of our older coal power stations will be closing over the next decade.

1.2.6 We aim to use a range of policy instruments that offer opportunities for all technologies to compete to facilitate the move to a clean and secure energy future in the most cost-effective way possible. For the electricity sector, we announced earlier this year that private companies who saw profitable opportunities to develop new nuclear stations would be able to do so in the future. We are also conducting a feasibility study to consider potential tidal projects in the Severn estuary, and last November we launched a competitive tender to build the first full-scale demonstration of carbon capture and storage that will start operating by 2014.

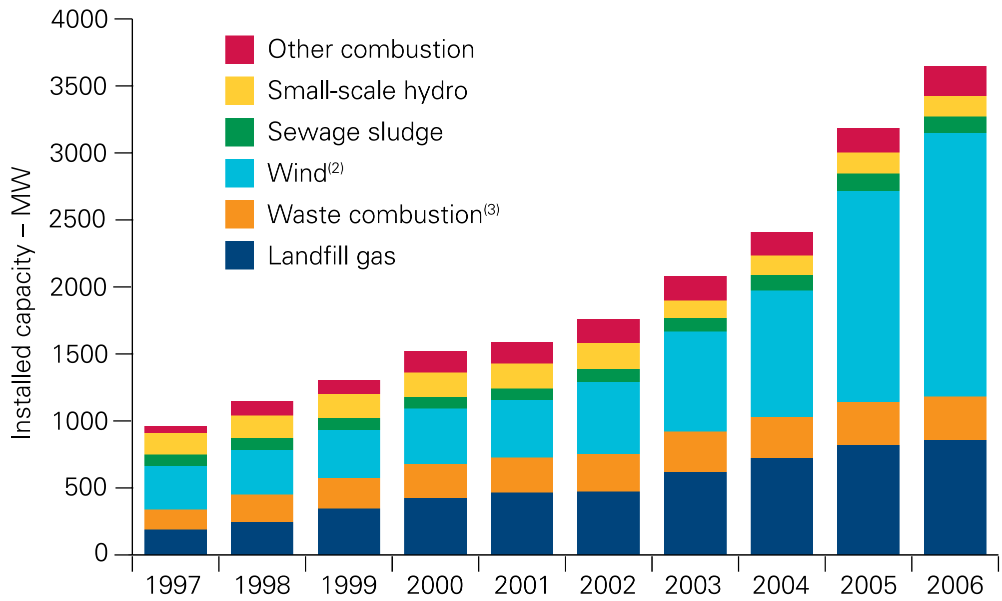
1.2.7 The third of Stern's policy principles is that governments need to help overcome barriers to more energy efficient consumer and business behaviour. Improving the extent to which we save energy across the UK economy will help to meet both our energy security and climate change goals. Saving energy and thereby reducing the level of energy demand in the UK will continue to be the most cost-effective way to reduce greenhouse gas emissions for some time. Reducing the absolute level of energy consumed will also reduce the overall volume of investment in energy generating capacity that we need to make in the UK.

1.3 UK renewable energy policy

1.3.1 Government policy has long recognised the role for renewables in meeting our energy and climate change goals. Our intervention is necessary to ensure that a range of renewable energy investments can be delivered at scale. This is due to the ongoing barriers to investment. Renewables are generally more expensive than other energy sources, and a number of renewable technologies (such as wave and tidal power) are still emerging and not yet ready for commercial-scale deployment. This means the risks and costs involved in developing them are too high for companies to invest in them alone. Further, barriers such as delays and uncertainty in the system for connecting projects to the electricity grid and gaining planning approval have slowed investment and deployment of renewables in the UK.

1.3.2 To date the main focus for our renewable policy has been in the electricity sector. In 2000 we set ourselves a target for 10% of our electricity to come from renewable sources by 2010, and in 2006 we announced our aspiration to double that level by 2020. Our key mechanism for delivering this growth has been the Renewables Obligation (RO), which requires electricity suppliers to source a prescribed and increasing proportion of their electricity from renewable sources. As Figure 1.1 shows below, the proportion of electricity generated using renewable sources has been growing since 1997. The introduction of the RO in 2002 incentivised more rapid growth, almost trebling eligible renewable electricity generation within four years to 4.4% in 2006. The RO is currently expected to deliver near to 14% renewable electricity by 2015.

Figure 1.1: Electricity generating capacity of renewable energy plant (excluding large-scale hydro)[1]



(1) Large–scale hydro capacity was 1,369 MW in 2006.
(2) Wind includes both onshore and offshore and also includes solar photovoltaics (9.9 MW in 2006) and shoreline wave (0.5 MW in 2006).
(3) All waste combustion plant is included because both biodegradable and non-biodegradable wastes are burned together in the same plant.

Source: DUKES (2007)[14]

1.3.3 The 2007 Energy White Paper proposed a number of key policy measures to increase investment in renewables in the UK. It set out proposals to reform the RO to make it more effective and efficient, and to address key barriers to renewable deployment arising from grid and planning issues. It also explained proposals to introduce a new Renewable Transport Fuel Obligation (RTFO) to incentivise up to 5% of road transport fuel to come from renewable sources by 2010. The RTFO started operation in April this year. We have also committed funding for research and development (R&D) in renewable technologies within the remit of our low-carbon energy programmes such as the Environmental Transformation Fund and the Energy Technologies Institute.

1.3.4 As a result of these existing policies, renewables are expected to account for approximately 5% of the energy mix across electricity, heat and transport in 2020, more than treble the proportion in 2006.

14 See BERR (2007a) Chart 7.3; www.stats.berr.gov.uk/energystats/dukes07c7.pdf

1.4 The EU Renewable Energy Directive

1.4.1 Although current policies will deliver a significant increase in renewable energy over the coming years, we want to go much further. This is why at the 2007 Spring European Council we agreed with our EU counterparts to a binding target of 20% of the EU's energy to come from renewable sources by 2020.

1.4.2 This target will make an important contribution to the rapid development and deployment of renewable technologies. This will help us to reduce the EU's greenhouse gas emissions and enhance security of supply. Given the growing international market for renewable energy technologies, meeting the target also offers an opportunity for EU business to capture and develop new markets in these technologies. It is expected that the future market for renewable energy technologies could be substantial, making up a growing part of the estimated £3 trillion global market for low-carbon goods in 2050.[15] UK business should be at the forefront of shaping and benefiting from these markets. The EU target should also help to reduce the cost of renewable technologies in the longer-term, due both to economies of scale arising from increased deployment levels and the development of new technologies.

1.4.3 The UK is committed to playing its full role, by meeting its fair share of the EU renewable energy target. The current proposal is for the UK to have 15% of all energy consumption in the heat, transport and electricity sectors coming from renewable sources in 2020.[16] Under the terms of the current draft Renewable Energy Directive, in common with other EU Member States and as part of its overall target, the UK will also be required to deliver 10% of its transport from renewable sources by 2020.

1.4.4 Our proposed target of 15% renewable energy by 2020 is very ambitious, requiring a ten-fold increase on the 2006 share of 1.5% renewables in our energy mix (equating to 4.5% of UK electricity use, less than 1% in heat and less than 1% in transport).[17] It will require a step change in the very short time frame to 2020. It has been estimated that it could require investment of at least £100 billion over the next decade.[18]

1.4.5 Analysis of the potential for renewable deployment in the UK, and results of independent studies[19] of how much of this can be realised by 2020 in the UK, suggests that reaching this level (as well as the 10% transport target) is achievable, although extremely challenging. There is a range of possible outcomes for the way in which we might deliver our target: our analysis suggests that one scenario might be around 14% renewable energy in heat (from less than 1% today), 10% in transport (from less than 1% today) and 32% in electricity (from less than 5% today). Figure 1.2 illustrates the extent

15 Stern (2007)

16 EC (2008a). The term 'energy consumption' as proposed in the draft Renewable Energy Directive, and used throughout this report, is defined as energy delivered to final consumers for energy purposes, and is an output-based measure. It includes transmission and distribution losses in the electricity and heat sectors and energy industry own use. It excludes non-energy use and energy consumed for air transport. It measures energy consumption on a net calorific basis.

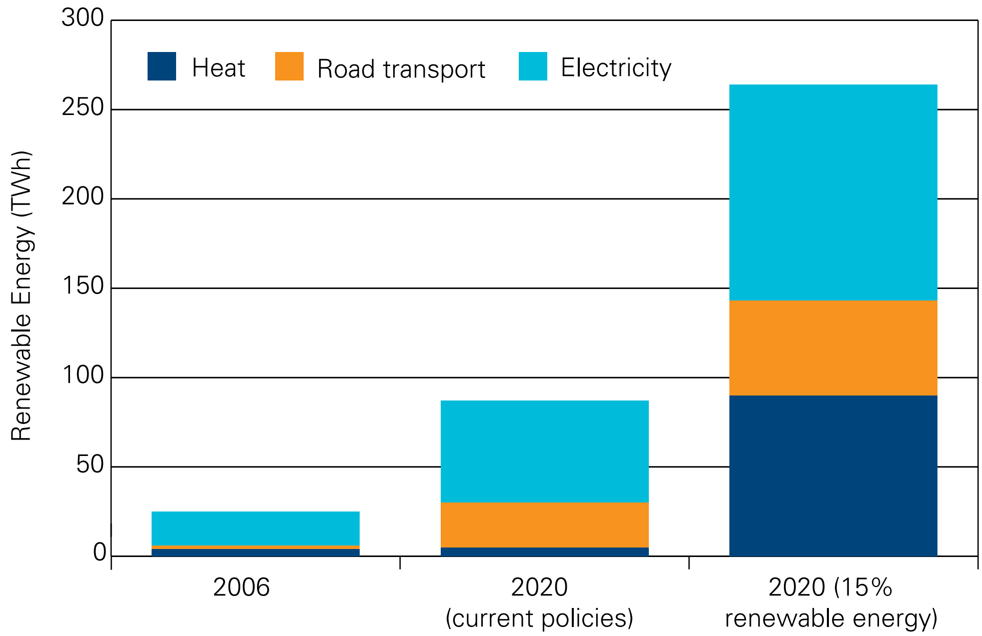
17 2006 is the latest set of figures for UK energy use, see BERR (2007a).

18 RAB (2008); see: www.renewables-advisory-board.org.uk/vBulletin/showthread.php?t=136

19 BERR-commissioned studies on barriers in the electricity and heat sectors. See SKM (2008a) and ENVIROS (2008) respectively.

of this growth for each sector – electricity, heat and transport – well beyond what the 2007 Energy White Paper aimed to deliver. This may be close to the limits of what is achievable in each sector.

Figure 1.2: The size of the challenge – a potential scenario to reach 15% renewable energy by 2020



Source: BERR analysis

1.4.6 In absolute terms a 15% target would mean a jump from 25 TWh of renewable generation across all sectors in 2006 to just over 260 TWh by 2020. Table 1.1 presents projected final energy consumption in 2020 and the amount of renewable energy that would be needed by sector to meet the proposed 15% share, again based on the illustrative scenario of 32% renewable electricity, 14% renewable heat and 10% renewable transport. In terms of the level of energy consumed by renewable sources in each sector, this scenario would require an increase from 2 TWh in transport in 2006 to 55 TWh by 2020; an increase from 4 to 90 TWh in heat; and an increase from 19 to 120 TWh in electricity.

Table 1.1: Final energy consumption in 2006[20] and projections for 2020 based on an illustrative mix of renewable energy needed to meet the 2020 renewable energy target[21]

In TWh	Renewable energy in final energy consumption, 2006	Renewable energy in final energy consumption, 2020	All energy final energy consumption, 2006	All energy final energy consumption, 2020
Heat (excluding electricity for heat)	4	90	735	635
Electricity	19	120	393	375
Transport	2	55	653	730
All sectors	25	265	1781	1740

Estimates for 2020 rounded to nearest 5 TWh.

Source: Energy Trends, March 2008

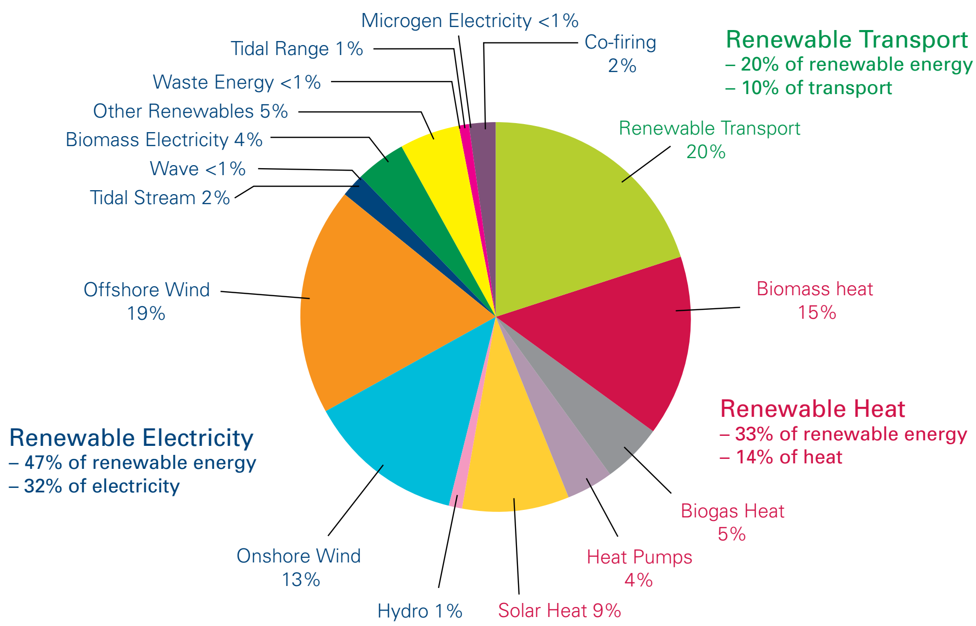
1.4.7 This document contains a range of possible additional measures to encourage deployment of renewable energy in the UK. These measures are designed to achieve a 15% renewable energy target for the UK by 2020. However, in a market economy, policy alone cannot guarantee outcomes. How much these measures will deliver will depend on how energy companies, developers and investors in the market, and the supply chains which serve them, respond to the signals we provide. It will also depend on how successful we are in overcoming the constraints on development. Indeed, because renewable deployment depends on decisions by governments, businesses, communities and individuals in all parts of the UK, it will depend to some extent on how committed we are as a country to achieving our goals.

1.4.8 Within the overall framework the Government puts in place, the market will therefore need to determine what technologies should be used, and then to deploy them. Initial analysis based on our current understanding of relative costs and constraints suggests that the key growth areas will be the currently commercial technologies of wind (on and offshore) and biomass. Figure 1.3 provides one possible scenario of what the final shares of different types of renewables in 2020 might look like. Again, this is based on a scenario with 32% electricity, 14% heat, 10% transport. The chart shows that a range of already commercial or near commercial technologies are likely to be deployed. Other, less-established technologies such as marine power generation may have a part to play over the longer term.

20 Final energy consumption is based on the EUROSTAT definition. This comprises final consumption less non energy use, plus distribution losses for electricity, plus own use of electricity by electricity generators, plus electricity used for pumping at pumped storage stations.

21 The 10% biofuels target in the transport sector excludes aviation which is included in overall energy demand.

Figure 1.3: Illustrative contribution of renewable technologies to 15% renewable energy by 2020[22]



Source: Based on BERR analysis using modelling estimates by Redpoint et al (2008), NERA (2008) and internal DfT analysis.

1.4.9 We want to minimise the overall costs of reaching the renewable energy target in 2020. To do so, we need to understand the cost per unit of renewable energy generated (MWh) of different technologies and sectors. Figure 1.4 below illustrates the additional costs per MWh of using different levels of renewable heat, electricity and transport to meet the 2020 renewable energy target. These are based on results from modelling the costs of different technologies and maximum build rates over time. As costs are uncertain and future relativities between costs in different sectors may change, this chart is only illustrative of our current understanding of least-cost options.

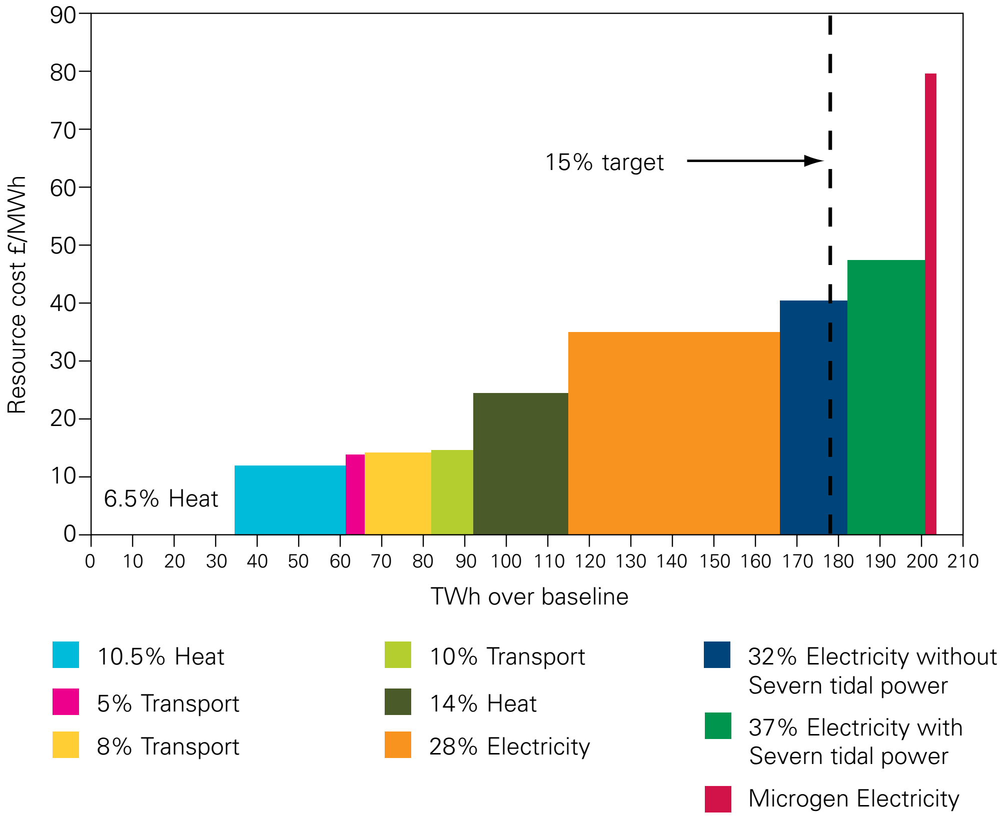
1.4.10 To give certainty to business, we need to make decisions on the level of ambition in each sector and our preferred financial support instruments. This is particularly important given the short time frame to 2020. On the other hand, cost effectiveness and ability to overcome build rate constraints may imply a need for some flexibility in our approach as new information emerges.

1.4.11 Figure 1.4 shows that using up to 6.5% of renewable heat could produce a cost saving – as renewables replace higher-cost conventional heating sources, although this is an initial estimate.[23] Transport biofuels provide the next most cost-effective option, followed by renewable heat up to 14%. Higher levels of renewable electricity are the more expensive options, but will be necessary to achieve the proposed UK 15% target. The use of microgeneration electricity technologies are currently the most costly, in terms of the technologies considered here for deployment by 2020.

22 Source: BERR forecasts. The chart shows the split of total renewable energy in 2020 between the three sectors: 20% coming from renewable transport sources; 33% from heat; and the remaining 47% from electricity.

23 These indicative estimated costs are expected to increase somewhat once costs of overcoming demand side barriers to heat deployment have been taken into account.

Figure 1.4: Resource cost of renewable energy generation options to meet the renewable energy target[24]



Source: BERR analysis

Q1: How might we design policies to meet the 2020 renewable energy target that give enough certainty to business but allow flexibility to change the level of ambition for a sector or the level of financial incentive as new information emerges?

1.5 Policies to deliver – domestically and internationally

1.5.1 While it will ultimately be for the market to deliver this scale of increase, the Government must set the policy framework to allow it to do so. This framework must be comprehensive, cost effective and credible. Consumers, communities and individuals will need to understand, support and drive the changes necessary to facilitate the ten-fold increase in renewable energy consumption by 2020. We are therefore consulting widely to ensure we develop the most appropriate policies for meeting our goals.

24 The costs in the electricity sector do not take account of the value of ETS allowances saved in the ETS.

1.5.2 We believe that the key considerations for choosing between particular approaches can be summarised as follows (and it needs to be recognised that there are potential trade-offs between them):

- **Delivery:** how much renewable deployment can the relevant sector or policy lever or technology be expected to deliver by 2020 and beyond – and with what confidence? In assessing this criterion it will be important to consider the time taken to implement new policy measures and the impact of policy change on investor confidence.
- **Cost effectiveness:** for each incremental unit of renewable energy, what are the net costs to society (taking into account the value of any CO_2 or innovation or other ancillary benefits or costs, and any second-order or unintended consequences)? In assessing this criterion it will be important to consider the business benefits arising from a measure as well as the costs.
- **Compatibility:** how compatible is the approach with other policies – both in energy (low carbon, security of supply, competitiveness and reduction in fuel poverty) and more widely (for example, local planning and environmental controls, sustainability)? How does the policy fit into our path to 2050 carbon reductions? Does it risk locking in to technologies that are not likely to be effective in the longer-term? In assessing this criterion it will be important to remember that our policies to deliver increased renewable deployment need to fit with, and contribute to, wider policy goals.

1.5.3 The measures in this document relate almost entirely to UK deployment. However, the draft EU Renewable Energy Directive allows Member States to achieve their target by supporting renewables in other countries as well as their own. As the Directive is still being negotiated it is unclear how open this flexibility will be. Currently it is restricted to investment in EU Member States and countries that have the ability to export electricity into the EU.

1.5.4 If the UK made use of these flexibilities, we could meet the 15% renewables through a combination of increased renewable energy within the UK, and credit received for any renewable energy deployment we support in the EU (and perhaps further afield). This could allow us to meet our target in more cost-effective ways. Because the costs of renewable projects in some countries (within the EU and outside it) are lower than in the UK, trading has the potential to significantly reduce the costs of meeting the target. Trading the marginal, or last, one percentage point of the proposed 15% target could save 15-20% of the cost of meeting the target domestically.[25]

1.5.5 Using investments outside the UK to meet the renewables target would still bring in business opportunities for UK companies in developing these renewables projects. If the investments took place outside the EU, it could also help contribute to our global approach to fighting climate change by helping other countries invest in clean energy technologies. Nonetheless, without careful consideration of the design and scale of investments abroad that are used to contribute to meet the UK target, there may be risks, for example in potentially undermining our domestic support mechanisms.

25 This assumes no further energy efficiency savings are made. Cost estimates of renewable energy projects are based on projects in the current CDM pipeline at listed on UNFCCC website and June 2008 internal estimates by BERR on the potential supply of renewable CDM projects to 2020.

1.5.6 We therefore consider that we would use the flexibility allowed in the Directive to trade to help meet our share of the EU renewable target, with the following principles in mind:

- Only a limited and pre-specified proportion of the UK target would be tradeable. The vast bulk of the target would have to be delivered in the UK.
- An early decision should be reached on whether and what flexibilities will be allowed so as to give certainty to business on what options are available and what scale of investment is required in the UK.
- Trading would be based on voluntary bilateral agreements between the UK and another country.
- We would need to be clear that the flexibilities allowed in the final Directive offer genuine cost savings to the UK.
- We should ensure that openness to these flexibilities would not undermine the existing support schemes in the UK such as the Renewables Obligation or a renewable heat support mechanism.
- The flexibility options in the Directive should not result in the responsibility for renewable energy policy being moved from national Governments to the EU institutions. The renewable energy targets set in the Directive are national targets, and national Governments should maintain control over the means to pursue them.
- We would need to ensure that investments outside the UK support sustainable use of renewable energy.

Q2: To what extent should we be open to the idea of meeting some of our renewable energy target through deployment in other countries?

1.5.7 The draft EU Renewable Energy Directive provides for other flexibility by allowing very large (>5,000 MW) renewables projects that are not operational by 2020 (but are under construction by 2016, and expected to be operational by 2022) to count towards the national 2020 renewables targets.[26] We would expect the Commission to take into account how soon after 2020 the actual generation is expected to take place when considering the amount of credit that partially-built projects receive.

1.5.8 This means that where investment in large projects to meet the 2020 target has begun well in advance of 2020, but these projects are yet to begin generating energy, they could still contribute to meeting our overall target. Without such a provision, Member States would have no direct incentive to invest in ambitious projects from 2015-16 onwards if there is a likelihood that the project in question will not be operational by 2020 and therefore not count towards their national targets.

26 Article 5.2 of EC (2008a)

1.6 Impacts

1.6.1 Delivering this level of renewable energy by 2020 will impact on all of our lives. These impacts are explored in more detail in Chapter 8 (Business Benefits) and Chapter 10 (Wider Impacts). However, some headline messages from the analysis we have done to date are as follows:

- **Carbon saving:** we estimate that delivering the target could save an additional 20 $MtCO_2$ in 2020 outside of the EU ETS sectors. Using renewables to meet the target will result in 45-50 $MtCO_2$ of reductions in 2020 from those sectors already in the EU ETS.

- **Energy security:** increasing generation from renewables will contribute to security of energy supply, reducing gas imports by between 12-16% in 2020 – with increasing benefits as these fossil fuels become more scarce and expensive.

- **Business benefits:** may be in the order of 160,000 jobs created in 'green' sectors (although not all of these will be in the UK). This may be offset by job losses in other sectors – for example in the energy-intensive industry, which is particularly sensitive to higher energy costs.

- **Overall cost:** we estimate that the additional costs to the UK economy of delivering this level of renewable deployment could be around £5 billion to £6 billion a year in 2020 (at today's prices), above the costs involved in meeting our existing energy and climate change goals.[27] This assumes fossil fuel prices consistent with an oil price of $70/bbl in 2020. At fossil fuel prices consistent with an oil price of $150/bbl, the costs could fall by 35-40%.[28] Similarly, these figures assume that demand for energy is at the level projected in the 2007 Energy White Paper; if demand could be reduced below this, the costs would fall. In addition, if international renewables trading was used to meet the UK target, the costs would be further reduced.

- **Energy bills:** these costs will translate into higher energy prices, but the impacts will not be felt until after 2010. The main increases will be felt from 2015 onwards: by 2020 domestic consumer bills are expected to increase by 10-13% in electricity and by 18-37% for gas bills as a result of the EU 2020 renewable energy target. The impact on bills will continue beyond 2020. These price impacts are based on fossil fuel price assumptions in line with an oil price of $70 a barrel. Under higher fossil fuel prices (in line with $150 a barrel), the percentage increase in gas bills could fall by around half.

27 These estimates are based on economic modelling by Redpoint et al (2008), NERA (2008) and internal Department for Transport estimates. Resource costs to the UK are net of the value of EU ETS allowances saved from the carbon abated by additional renewable generation in the ETS sectors. Carbon savings are valued at the forecast carbon price for the post 2012 period. See www.pointcarbon.com. All estimates are based on central fuel price estimates of $70 per barrel of oil.

28 The Impact Assessment to this consultation details the impact of different fuel price assumptions on the additional costs of the Renewable Energy Strategy.

- **Visible changes:** across the UK, there will be visible changes as a result of this shift: for example, an estimated 4,000 new wind turbines onshore and 3,000 offshore. There will need to be public understanding of the value of these new features of our energy system in terms of the benefits they have for tackling climate change and energy and other goals.

1.6.2 Some of these impacts may be challenging to manage, and require compensatory measures. These are discussed further in later chapters. However we believe it is necessary to take difficult decisions and manage these impacts as part of our drive to reduce climate change and ensure security of energy supplies. At the same time we are seeking views on how best to make these necessary changes while keeping costs to a minimum and maximising the benefits to the UK both for 2020 and our longer-term carbon and energy goals for 2050.

1.6.3 In the light of responses to this consultation, we shall produce our UK Renewable Energy Strategy in spring 2009, once the EU Directive has been agreed. This will form a key part of our overall strategy for ensuring safe, secure and affordable energy and tackling climate change.

Chapter 2
Saving Energy

Summary

The starting point for our energy policy is to save energy. If we can reduce the amount of energy we use, this will reduce carbon emissions, reduce the need for additional energy supplies and reduce costs. Saving energy can also reduce the amount of renewable energy needed to meet our target by reducing our overall energy consumption; and it is cheaper than investing in new generation plant.

We have already introduced a range of measures to reduce energy use. In the business sector the EU Emissions Trading Scheme, the Climate Change Levy and Climate Change Agreements all provide incentives for greater energy efficiency. In 2010 we will introduce the Carbon Reduction Commitment, a mandatory trading scheme for large non-energy intensive businesses and public sector organisations. In the domestic sector the new Carbon Emission Reduction Target sets obligations on energy suppliers to deliver energy efficiency improvement measures to households. After 2011, as set out in the 2007 Energy White Paper, the Government's aim is to introduce a Suppliers Obligation which aligns the incentives of energy companies with a reduction in demand through the development of 'energy services' markets. Building on already tougher building regulations, we intend that all new homes in England will be zero-carbon from 2016, and all new buildings from 2019. In the transport sector we are negotiating new compulsory emissions targets for new cars.

These policies will deliver considerable reductions in projected energy demand over the coming years. However, the EU 2020 renewable energy target changes the context, making more radical measures to reduce energy use more economically attractive than previously considered. Because energy efficiency measures are generally lower cost than building additional renewable supply, our analysis suggests that it will be economically worthwhile to introduce such measures by comparison with marginal electricity options, up to a cost of around £45/tCO_2.

This suggests that in this context there is still scope for significant further increases in energy efficiency across the household, business and public sectors. We are not consulting specifically on these issues in this document. However, later this year, we will consult separately on a range of new and enhanced energy efficiency policies that will help promote cost-effective savings across the economy.

Using every unit of energy as efficiently as possible has to be our ultimate ambition. This may lead to an absolute reduction in energy demand in the longer term. To achieve this, our intention is to introduce policies so that every sector of the economy benefits from energy efficiency, that where possible all economic opportunities to save energy are realised, and that our energy efficiency policies are integrated so that links can be exploited. Improving the energy performace of people's homes will play a particularly important role in this, reducing emissions and helping us all to manage our energy bills. We will consult on a new strategy to achieve a step change in household energy efficiency, including a Suppliers Obligation, later this year. All this will be closely linked with our work to develop a low-carbon heat strategy.

2.1 Introduction

2.1.1 Saving energy is key to our long-term energy challenges. One of the most important steps we can take to meet our energy and climate policy objectives is to reduce the amount of energy we use. Energy demand can be reduced both through improving the efficiency of products and processes where the basic economic activity or behaviour remains the same, and through changes in our patterns of consumption or behaviour. These are referred to as energy efficiency measures, and can be effective across the electricity, heat and transport sectors. Individuals, communities, businesses and public sector bodies can all play their part by reducing the energy they use and can often benefit from lower energy bills by doing so.

2.1.2 Energy efficiency is at the forefront of our efforts to reduce emissions, as it is one of the most cost-effective means of carbon abatement. Energy efficiency also contributes to achieving our other energy policy goals by:

- contributing to security of supply – increasing energy productivity (using fewer energy inputs to obtain the same amount of output) can contribute to reducing the economy's and customers' exposure to global energy prices;
- maintaining competitiveness – by reducing energy bills, energy efficiency can boost profits and improve the competitiveness of UK business; and
- tackling fuel poverty – improving the energy performance of homes through the installation of energy saving measures can reduce fuel bills and help take households out of fuel poverty.

2.1.3 The EU renewable energy target makes using less energy even more crucial. The target is a percentage of overall energy use, so by reducing the overall amount of energy we use, we reduce the absolute level of renewable energy we need to meet the renewable energy target. Therefore, energy efficiency can make an important contribution to achieving our target.

2.1.4 Of course, this potential contribution should not be exaggerated. In order to reduce the amount of renewable energy needed to meet the target by 1 kWh, we would need to find energy efficiency reductions of almost 7 kWh. There are also obstacles and market failures which currently prevent us realising the full technical and economic potential for energy efficiency, including lack of information; lack of access to capital; and lack of motivation and awareness among consumers. Nevertheless new energy efficiency measures could prove a more cost-effective way of meeting our target than some of the more expensive renewable technologies. And due to the other benefits energy efficiency provides, particularly the central role it will play in meeting our climate change targets, we will urgently renew our efforts to address these barriers and introduce new policies where appropriate.

2.2 Energy efficiency policies

2.2.1 Energy efficiency can benefit everyone – individuals, businesses and the public sector – but it requires all of us to take action. We can all play our part, for example by improving the insulation of our homes, turning our thermostats down, buying energy saving products, choosing more energy efficient cars, and thinking about the amount of energy our cars use. Businesses can also take the initiative to cut the energy they use in making and selling their products and help consumers make more informed decisions on how they use energy.

2.2.2 The Government has a role to play in ensuring that the right regulatory framework is in place to incentivise action and to deliver continuing improvements to the energy efficiency of buildings and products. In addition we can ensure that the right policy framework is in place to support technological innovation.[29] Improvements in energy efficiency have already made a substantial contribution to our energy and climate change goals, accounting for over 40% of projected carbon savings by 2010. The 2007 Energy White Paper set out a further series of new policies and measures – including the Carbon Emissions Reduction Target, the Carbon Reduction Commitment, improvements to metering and billing, zero carbon homes and work with retailers and manufacturers to improve the efficiency of consumer products – which together will result in annual savings of 25.7-42.9 $MtCO_2$ by 2020. It also set out measures to reduce emissions from transport, through new agreements on fuel efficiency standards for cars. Table 2.1 summarises the current key policy measures we use to reduce energy consumption.

29 DEFRA (2007d)

Table 2.1: Current key policies to reduce energy consumption in the UK

Sectors		
	Measures to increase technical energy efficiency	Measures to reduce demand and avoid waste
Household	Building Regulations	Energy Saving Trust advice and information programmes including the Act on CO_2 advice line
	Code for Sustainable Homes	Improving consumer information through more informative bills and metering to allow more informed choices about energy use
	Market Transformation Programme and Product Standards	Energy Performance Certificates
	Warm Front	Act on CO_2 communication campaign and carbon calculator
	Carbon Emissions Reduction Target	
	Voluntary agreements with suppliers of fuels other than gas and electricity, to promote energy efficiency	
Business and Public	EU Emissions Trading Scheme	
	Carbon Reduction Commitment	
	Climate Change Agreements	
		Billing and metering
	Environmental Transformation Fund	Energy Performance Certificates and Display Energy Certificates
	Market Transformation Programme and Product Standards	Climate Change Levy
	Voluntary agreements with energy suppliers to promote energy efficiency to SMEs	Carbon Trust programmes and carbon calculator for businesses
Transport	EU voluntary agreements with motor manufacturers on new car fuel efficiency, to be followed by mandatory targets for CO_2 emissions from new cars	Fiscal incentives (such as Vehicle Excise Duty, Road Fuel Duty, Company Car Tax, Air Passenger Duty)
		Smarter driving and car purchasing campaigns
	Voluntary agreements with transport fuel distributors to promote energy efficiency	Vehicle labelling
		Inclusion of aviation in the EU Emissions Trading Scheme
	Measures set out in the Low Carbon Transport Innovation Strategy	Act on CO_2 campaign

Saving energy in homes

2.2.3 Emissions from the use of electricity and heating by households were 148.5 $MtCO_2$ in 2005, roughly 6 tonnes of CO_2 per household, adding up to around 27% of the UK's total CO_2 emissions. We need to see emissions from households decline significantly to remain on track towards at least a 60% reduction in carbon emissions by 2050 over 1990 levels. Investing in the energy standards of our homes has other benefits too, beyond addressing climate change. It helps to reduce energy bills, tackle fuel poverty, improve the security of our energy supplies and create jobs.

2.2.4 We are already making significant progress. Policies in the Climate Change Programme and the 2007 Energy White Paper are expected to take emissions from the household sector to less than 110 $MtCO_2$ by 2020.

2.2.5 Yet the scale of the challenge is growing. Increases in demand for electricity in homes are working in the opposite direction (rising at 1.5% per annum currently). Additional action is needed to compensate for this. Household energy consumption has increased by 28% since 1970 – largely due to increasing household numbers; rising income; and lifestyle changes such as increasing numbers of appliances.

2.2.6 We are delivering a broad package of energy efficiency measures through economic instruments, regulation and information to drive behavioural change. Our economic instruments include the Carbon Emissions Reduction Target (CERT), introduced in April 2008. This is an obligation that the Government has placed on energy suppliers to deliver low-carbon and energy efficiency improvement measures to householders. CERT will lead to some £2.8 billion investment by energy suppliers in households and will run to 2011. We are committed to maintaining an obligation on suppliers until at least 2020. We intend to consult later this year on the broad options for a post-2011 Supplier Obligation. For new homes, we are committed to further strengthening of energy efficiency standards in the Building Regulations in 2010 and 2013, with the aim that all new homes will be zero-carbon by 2016. In addition, Energy Performance Certificates, providing information on the energy efficiency of houses and opportunities for making cost-effective improvements, will be required for all homes to be sold or rented from October 2008.

2.2.7 Other regulatory instruments to drive energy efficiency in the home include the Market Transformation Programme, through which we are working with industry to deliver sustainable household products, such as ovens, kettles and televisions. We have already begun the phase-out of inefficient incandescent light bulbs through a voluntary agreement, with the aim of removing them from the market by 2011. Our Act on CO_2 campaign focuses on the steps we can all take to reduce the energy we use and save costs and carbon. It is supported by our carbon calculator which enables individuals and households to calculate their carbon footprint and provides advice on steps that can be taken to reduce it. Behavioural change measures include £100 million of support over the next three years for the Energy Saving Trust, including its Act on CO_2 advice line. This will provide advice on household energy efficiency, how to save water, reduce waste, make green travel choices and connect to grants and offers from energy companies.

Box 2.1: Act on CO_2

In spring 2007 we launched a new campaign, 'Act on CO_2', aimed at encouraging individuals to take action to reduce their own carbon emissions. The campaign was initially rolled out by DEFRA and the Department for Transport, focusing on encouraging more energy efficient behaviour in the home, and more fuel efficient driving behaviour, as well as highlighting fuel efficiency as a factor when purchasing vehicles. The brand is now being adopted by other Departments, a number of agencies, and other bodies. One of the centrepieces of the campaign is an online carbon calculator (www.direct.gov.uk/actonCO_2), which enables people to calculate their carbon footprint and receive personalised recommendations about how to reduce it. Since its launch in June 2007, the website has received over one million unique visitors. The campaign also directs people to the Energy Saving Trust's Act on CO_2 advice line which provides sustainable energy, water, waste and travel advice (0800 512012).

Saving energy in the business sector

2.2.8 Similarly, in the business sector we have introduced economic instruments to encourage energy efficiency. The EU Emissions Trading Scheme, which caps emissions from the power and other large emitting sectors, is at the heart of our efforts to put a price on carbon. In doing so it will help to drive energy efficiency across the whole economy. Energy-intensive industrial sectors facing large energy bills are likely to respond most effectively to these price signals. Climate Change Agreements engage over 50 sectors of energy-intensive industry in a wider range of energy efficiency measures designed to reduce demand for energy. The new Carbon Reduction Commitment cap and trade scheme, which will come into effect in 2010, will provide additional incentives to increase energy efficiency in other large businesses. These large schemes will operate alongside the Climate Change Levy, a tax on energy use, which will continue to rise with inflation.

Box 2.2: Carbon Reduction Commitment

The Carbon Reduction Commitment (CRC) is a groundbreaking mandatory emissions trading scheme being introduced by the Government to cover large non energy-intensive business and public sector organisations, such as Government Departments, universities, retailers, banks, water companies, hotel chains and Local Authorities. The CRC will have a significant impact on reducing UK carbon emissions and analysis indicates it should lead to £755 million of net benefit to participants due to increased energy efficiency. The CRC will cover large organisations whose annual half-hourly metered electricity use in Great Britain (and 70 kilo Volt-Ampere (kVA) metered use in Northern Ireland) is above 6,000 MWh. We anticipate between 4,000 and 5,000 organisations will be involved in the scheme. The CRC will cover electricity use, direct energy use emissions outside the EU Emissions Trading Scheme (EU ETS) and Climate Change Agreements.

DEFRA aims to publish a consultation on the detailed regulations for CRC in the autumn 2008. CRC regulations are expected to come into force by October 2009.

2.2.9 We also use regulatory instruments, such as Energy Performance Certificates, which will be required at the point of sale for all non-domestic buildings by the end of 2008. In addition, we have announced an ambition for all new non-domestic buildings to be zero-carbon from 2019. And we are also providing business with information, advice and financial support to help them improve their energy efficiency and move towards a low-carbon economy through provision of £108 million of Government support in 2008-09 for the important work of the Carbon Trust. The Regional Development Agencies are also working with key regional partners to support small and medium-sized businesses on energy efficiency.

Saving energy in the public sector

2.2.10 In the public sector, we have set new targets for the Government Estate (for example, to reduce emissions by 30% by 2020[30]) with an ambition to achieve zero-carbon new buildings by 2018, and we have also adopted a new procurement strategy. The public sector will participate fully in the Carbon Reduction Commitment, and all central Government Departments will be covered by the scheme regardless of their size. We have set a target for carbon efficiency of new passenger cars used by central Government. DEFRA has also announced additional funding of £30 million for Salix Finance, an independent company to facilitate energy efficiency work in the public sector. We are investing £110 million to trial measures to reduce carbon emissions from schools, and £100 million to help the NHS make further energy savings. In 2007 we announced a goal for all new schools to be zero-carbon from 2016, and we have appointed a taskforce to advise how this challenging goal can be achieved.

Saving energy in the transport sector

2.2.11 In the transport sector, we are encouraging energy efficiency through economic measures, such as banded Vehicle Excise Duty for lower-carbon cars. Regulatory measures include a mandatory European approach to new car CO_2 emission standards, which is currently being discussed in the EU, where the UK is calling for a longer-term target of 100g/km by 2020. To encourage behavioural change in the transport sector, we are investing heavily in public transport, including over £4 billion last year on the railways and around £2.5 billion on local transport. This complements a substantial programme to promote changes towards more sustainable patterns of travel behaviour, such as the Act on CO_2 communications campaign to provide advice on smarter driving and new car purchasing. The Safe and Fuel Efficient Driving campaign encourages efficient operating practices in the haulage and logistics industry, which helps reduce fuel consumption and accidents. We have also published 'A Sustainable Future for Cycling' which sets out our approach and aspirations for cycling including background to our £140 million investment to 2011. Our Sustainable Travel Towns Initiative also aims to create showcase towns to show what can be achieved through measures such as workplace, school and individual travel planning, travel awareness campaigns and marketing.

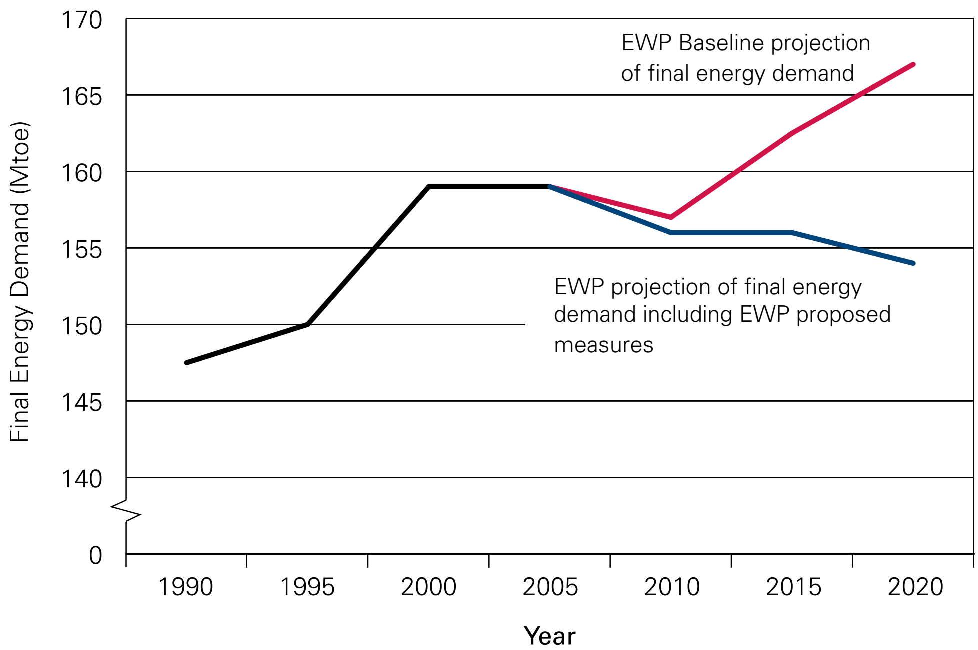
30 Relative to 1999-2000 levels.

Summary of savings

2.2.12 Figure 2.1 shows the projected impact on energy demand of the measures already agreed and set out in the 2007 Energy White Paper. In summary, we expect our existing policies to reduce energy demand by 152 TWh, equivalent to 8% of the business as usual figure in 2020 (1,942 TWh per year or 167 Mtoe). The corresponding consumption in 2006 was 1,835 TWh (258 Mtoe).[31] In terms of CO_2 emissions, we expect to deliver around 70 $MtCO_2$/year of savings by 2020, which constitutes a saving of 12% relative to business as usual.

2.2.13 In addition to providing benefits in themselves, the energy efficiency measures already in place will reduce the level of renewable deployment needed to meet our EU 2020 renewable energy target. As energy demand is projected to be 152 TWh lower than it would otherwise have been, we will have to find about 20 TWh less renewable energy than would otherwise be the case. This reduces the total amount of renewables needed by around 7%.

Figure 2.1: Energy demand projections: baseline (excluding Energy White Paper measures) v central projection including central estimates of White Paper measures



Source: Updated energy projections, produced for the 2007 Energy White Paper

2.3 Future action to save energy

2.3.1 Despite the significant work already in hand to deliver energy efficiency, we need to do more. The challenges of climate change, energy security, and higher energy prices require a step change in energy efficiency policy. We will do this in three ways. First, in terms of scope, our intention is that practically every sector in the UK will be able to benefit from cost-effective energy

31 These figures exclude emissions gained through the purchase of EU Emissions Trading Scheme allowances from abroad.

efficiency. Second, we will deepen and strengthen our policies, consistent with our carbon budgets, so that in time, all cost-effective energy savings can be realised. Finally, we will better integrate our policies, maximising the links between, for example, the support we provide for homes and for small and medium enterprises, and for policies to support large businesses and the public sector.

2.3.2 UK energy efficiency policies have historically focused on measures that result in cost savings, as well as a reduction in carbon emissions. There are other measures which still achieve carbon savings but which cost more than current policies. The EU 2020 renewable energy target means such measures may be more attractive than previously considered. Indeed we expect energy efficiency measures to be economical relative to marginal electricity options up to around £45/tCO_2. We are therefore considering options to strengthen the current energy efficiency policy framework across all sectors of the economy.

Transport

2.3.3 In the transport sector, the Department for Transport (DfT) is considering additional options to improve energy efficiency and to reduce the level of carbon dioxide emissions for which transport is responsible:

- for road transport, the UK is pressing the European Commission to include a longer-term target of 100g/km by 2020 in its proposals to reduce CO_2 emissions from new cars;
- for rail transport, DfT is working with the rail industry to develop and deliver options for improving energy efficiency and reducing rail's carbon emissions against a background of strong continuing growth in rail passenger and freight demand;
- work is also underway to assess the potential of energy efficiency measures and options to reduce carbon dioxide emissions from the aviation and shipping sectors. This analysis is still at an early stage.

Business

2.3.4 Budget 2008 announced that the Government will develop voluntary agreements with all energy suppliers to promote the market for energy services. Energy suppliers will be expected to develop, trial and promote innovative service packages, commit to better data sharing and monitor their impact; and to work with businesses to promote knowledge of energy services. The Chancellor will host an Energy Services summit, bringing together energy service providers and energy suppliers with business groups. We intend to focus particularly on small and medium enterprises so that they can receive fuller benefits from energy efficiency. We will focus on a voluntary agreement in the first instance, but will also consider our experience of CERT and the Supplier Obligation, and of cap and trade schemes, and their possible applicability to this sector.

2.3.5 Many large businesses are covered by Climate Change Agreements (CCAs) or, for those that are less energy intensive, by the Carbon Reduction Commitment (CRC). Our vision is for a UK Emissions Trading Scheme to sit underneath the EU Emissions Trading Scheme, promoting energy efficiency throughout all those participating. We intend therefore to exploit linkages between the CRC and CCAs so that trading can occur between the two. It is also our intention to set an ambitious CRC emissions cap, on the advice of the Climate Change Committee, and to review the scope of the CRC during the introductory phase, with a view to more businesses participating. We will also shortly be consulting on the next stage of the CCAs, including on whether we should move towards targets representing absolute savings in these sectors. For those businesses covered by the EU Emissions Trading Scheme, we expect that the tighter cap in Phase III (post-2012) will mean that all sectors within the Scheme will need to take action to reduce emissions, and not only the power sector.

Homes

2.3.6 An average existing home requires four times as much energy to heat it as the average new home. Substantial further energy savings exist in the residential sector that could also help customers better manage their energy bills. The barriers to achieving these are well known, including the high upfront cost of some of the measures, the lack of a 'whole house' approach, and the need to create stronger incentives on the demand side, yet these barriers are difficult to overcome. This suggests that the Government needs to strengthen its approach. But it is also clear that the Government cannot act alone. We must better understand the potential role of other actors, such as energy companies, house builders, banks, Local Authorities and the third sector. Over the coming months we will explore with stakeholders how to address some of these barriers in order to help householders improve the energy efficiency of their homes. We will consult on the outcome of this work later in the year, and this consultation will inform a low-carbon homes strategy, which we intend to publish in 2009. As part of the process leading to this new strategy, the Government will convene a summit bringing together the relevant actors to identify various roles and the steps that need to be taken.

2.3.7 Through this low-carbon homes strategy, we will explore what stimulus is needed to create a robust, self-sustaining commercial market for low-carbon energy services for homes. The development of the Supplier Obligation is central to this. The current market is focused on the delivery of units of energy. We are exploring the scope to deliver the energy services that consumers need – heat, light, power – while minimising the units of energy used.

2.3.8 In some cases we need to look beyond people's homes, and consider whole communities, and so as part of this work we will consider the role of community heating and community energy. Similarly, when assessing the market for low-carbon energy services, we will need to look at both energy saving measures such as insulation, and at microgeneration technologies. Distributed, or community, energy is considered in more detail in Chapter 5 and will play a key role in our strategy. Finally, the actions and decisions we take as individuals are crucial in achieving our overall goal of saving energy. Understanding how to influence these is central. This is partly about providing clear information at the right time, and also offering easy options for individuals to act upon. Identifying and exploiting these opportunities, such as better utilising Energy Performance Certificates, could play an important role, as will developing our Act on CO_2 campaign.

Technology

2.3.9 Looking to 2020, we need to continue to monitor and assess more innovative approaches to delivering our energy and climate policy goals. We are currently funding research into technologies such as dynamic demand, which could have the potential to play a considerable role in carbon saving and facilitating the deployment of renewable intermittent energy. We will be publishing further analysis on this particular technology later on this year. The Government's Foresight programme is conducting a project on Sustainable Energy Management and the Built Environment and is also due to report later this year. This project, commissioned alongside the 2007 Energy White Paper, has been assessing the role the built environment can play in the transition to secure, sustainable, low-carbon energy systems. And through the Carbon Trust and the Energy Saving Trust, the domestic Environmental Transformation Fund will fund investments in new and emerging energy efficiency technologies for households and business. Key areas such as insulating solid wall properties will require additional focus.

Conclusion

2.3.10 Saving energy cannot be seen as a separate element of energy or climate change policy; it is integral to all of it. In the light of the EU 2020 renewable energy target and other climate change goals, reducing the energy we need has become even more important. The Government will take forward urgent wide-ranging analysis of options for further action to promote energy efficiency, which we will consult on in the autumn. We will place particular emphasis on energy efficiency in the household sector and our work to develop a market for low-carbon energy services. We will look at the scope of our policy to ensure that every sector of the economy is covered, at the depth of our policy so that where possible all economic opportunities to save energy are realised, and at integrating our policies so that links can be exploited. Our ultimate ambition is that we use every unit of energy as efficiently as possible, which may in the longer term lead to an absolute reduction in energy demand.

Q3: **In the light of the EU renewable energy target, where should we focus further action on energy efficiency and what, if any, additional policies or measures would deliver the most cost-effective savings?**

Chapter 3
Centralised electricity

Summary

Approximately half of our share of the EU 2020 renewable energy target might need to be met in the electricity sector. On that basis, perhaps a third or more of our electricity would come from renewable sources by 2020 – compared to less than 5% today. This would give 35 to 40 GW of renewable generating capacity, compared to 5 GW today. We expect the majority of this would come from onshore and offshore wind, with important contributions from biomass, hydro and potentially major tidal range projects in the Severn Estuary and elsewhere. Sections 3.1 and 3.2 of this chapter explore these issues in more depth.

Delivering this level of increase is extremely ambitious and will require us to consider further action to address all of the key issues, notably:

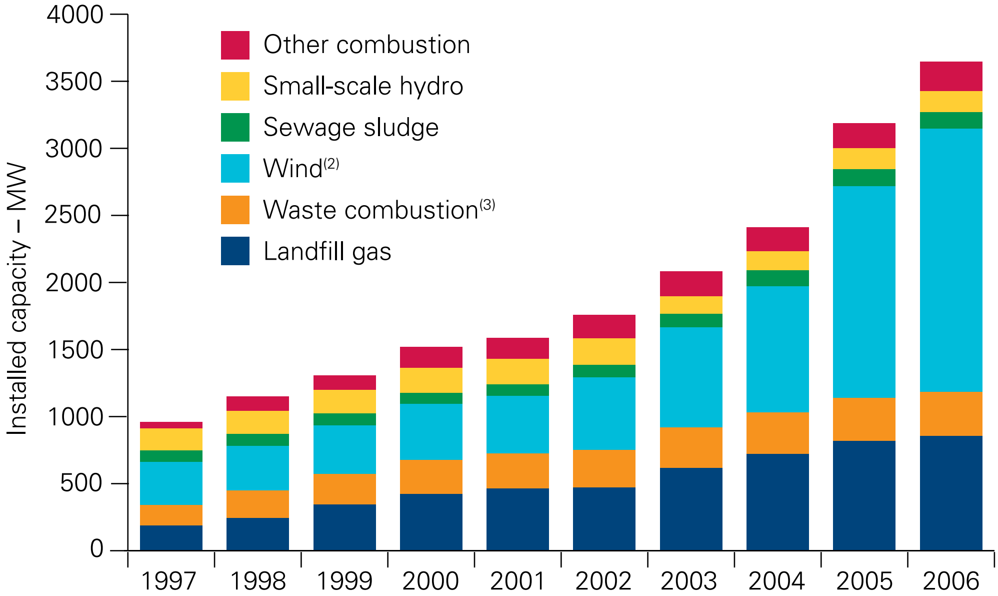
- improving delivery through planning (section 3.3 considers the planning process; section 3.4 considers impacts on local communities; and section 3.5 considers the integration between regulatory frameworks);
- ensuring connection to the electricity grid (section 3.6 examines the key grid constraints and how they might be addressed);
- supply chain (section 3.7 considers the extent to which the supply chain might be a constraint on renewable electricity deployment);
- financial incentives (section 3.8 considers how this increased renewable deployment might best be incentivised).

This level of renewable deployment will also have implications for the security of electricity supply. This is explored in section 3.9.

3.1 Introduction

3.1.1 Achieving our share of the EU 2020 renewable energy target could require a third or more of our electricity to be generated from renewable sources by 2020. This would be a huge increase: due to historically cheap and secure supplies of domestically produced gas, only 4.5% of the UK's electricity was generated from renewable sources in 2006. We have already more than tripled the share of renewables (excluding large-scale hydro) in the generation mix over the last 10 years (see Figure 3.1); over the period to 2020 we need to increase the total renewable generating capacity by seven to eight times the 2006 level.

Figure 3.1: Electricity generating capacity of renewable energy plant (excluding large-scale hydro)(1)



(1) Large–scale hydro capacity was 1,369 MW in 2006.
(2) Wind includes both onshore and offshore and also includes solar photovoltaics (9.9 MW in 2006) and shoreline wave (0.5 MW in 2006).
(3) All waste combustion plant is included because both biodegradable and non-biodegradable wastes are burned together in the same plant.

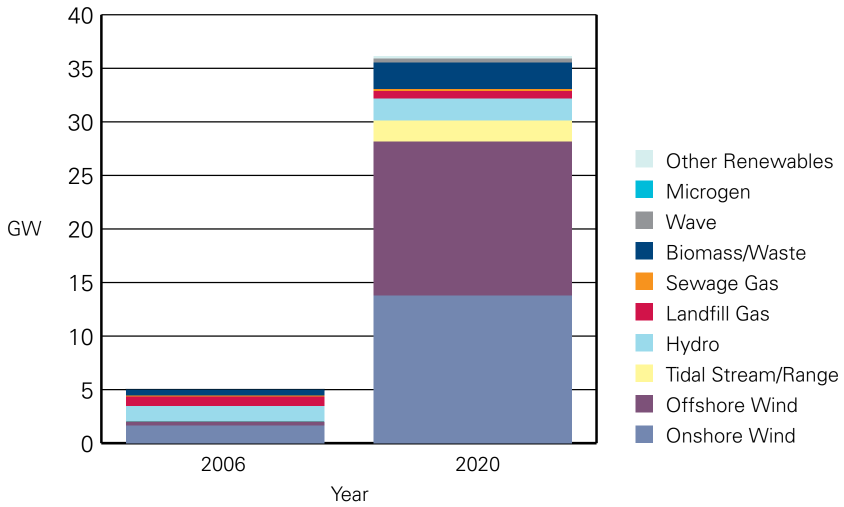
Source: Digest of United Kingdom Energy Statistics 2007, Chart 7.3

3.1.2. Currently, there are five main types of renewable electricity generation – biomass, wind (onshore and offshore), hydro, wave and tidal, and solar. Of these, the key contributors in the UK are currently biomass (30% of renewable electricity generating capacity at the end of 2006), wind (39% – 33% onshore and 6% offshore) and hydro (30%).[32] In 2006, we had some 5 GW of renewable generating capacity in the UK, supplying about 4.5% of our electricity. In 2020, if around one third of our electricity consumption were to come from renewables, this would mean around 35 to 40 GW of renewable capacity – seven to eight times 2006 levels. Our modelling of costs and constraints suggests that to meet our 2020 targets the key growth areas are likely to be offshore and onshore wind (see Figure 3.2). A barrage or other tidal scheme could also potentially contribute.[33]

32 BERR (2007a), Table 7.4; http://stats.berr.gov.uk/energystats/dukes07_c7.pdf

33 A clause was inserted in the draft EU Renewable Energy Directive which allows exceptionally large projects that are not operational by 2020 (but are under construction) to count towards national targets, provided they meet specific qualifying criteria (installation at least 5 GW, under construction by 2016, and must be possible to be fully operational by 2022), EC (2008a).

Figure 3.2: Renewable electricity generation capacity – comparison between 2006 and projected 2020



Source: DUKES 2007

3.1.3 The UK has the natural resources to fuel an increase on this scale. Delivering it will require action to address a range of financial and non-financial constraints. This action falls:

- to Government, to set a regulatory and wider framework to enable a step change in the supply of electricity from renewable sources;
- to the electricity industry, its suppliers and the investment community to plan, finance, build and connect new capacity;
- to local communities to seek to balance local and national needs in reaching planning decisions, and to consider with the supplier industry how local communities can benefit from new renewables development; and
- to consumers, to use electricity efficiently.

3.1.4 In our analysis, the key constraints that have held back development have been:

- difficulties in securing **planning permission** – arising from the planning process, and objections from individuals or Government itself (in particular due to conflicts with other policy objectives in aviation radar, shipping lanes and environmental protection regulation);
- difficulties in connecting new renewables capacity to the **electricity grid**;
- limitations in the ability of the **supply chain** to meet demand for renewables deployment.

3.1.5 In addition, this consultation considers how additional financial incentives to address the costs of renewables projects could contribute to a step change in renewables investment.

3.2 Renewable technologies for centralised electricity supply

3.2.1 With 2 GW of onshore wind developments already in place and a further 10 GW in the planning process, one of the best offshore wind profiles in Europe, and the opportunity to harness both wave and tidal energy, the UK has access to an extensive and diverse renewable energy resource. A summary of current deployment and the key potential types of centralised energy generation in the UK is set out below.

Onshore wind

3.2.2 As of May 2008, there are 165 onshore wind farms operating in the UK, providing a combined generating capacity of 2 GW (2.5% of current UK capacity).[34] An interactive map of the operational wind farms in the UK, together with details of each, is available at http://www.bwea.com/ukwed/map-operational.html.

3.2.3 If those that are under construction, those that have received planning and related consents, and those held in the planning stage are fully realised there would be an additional 366 farms, delivering a further 10 GW capacity. Our initial modelling suggests that meeting the 2020 target might involve a total of approximately 14 GW of onshore wind, equating to around 4,000 new 3 MW turbines (compared to around 2,000 turbines currently installed onshore in the UK). This would be particularly challenging, and others have estimated a slightly lower level of onshore deployment – e.g. the Renewables Advisory Board estimated that around 13 GW of onshore wind could be deployed by 2020.[35] Subject to planning permission, we would expect that a large proportion of onshore wind development will take place in Scotland. Planning, grid, supply chain and financial issues will be key constraints on this growth.

Offshore wind

3.2.4 There is a finite number of sites suitable for onshore wind. We therefore also need to deploy the considerable offshore wind resource available to the UK. While offshore developments are relatively more expensive and complex to build than their onshore equivalents, larger turbines can be deployed. With relatively shallow waters and strong wind resources extending far into the North Sea, the UK will in 2008 overtake Denmark as the country with the largest offshore wind deployment in the world.

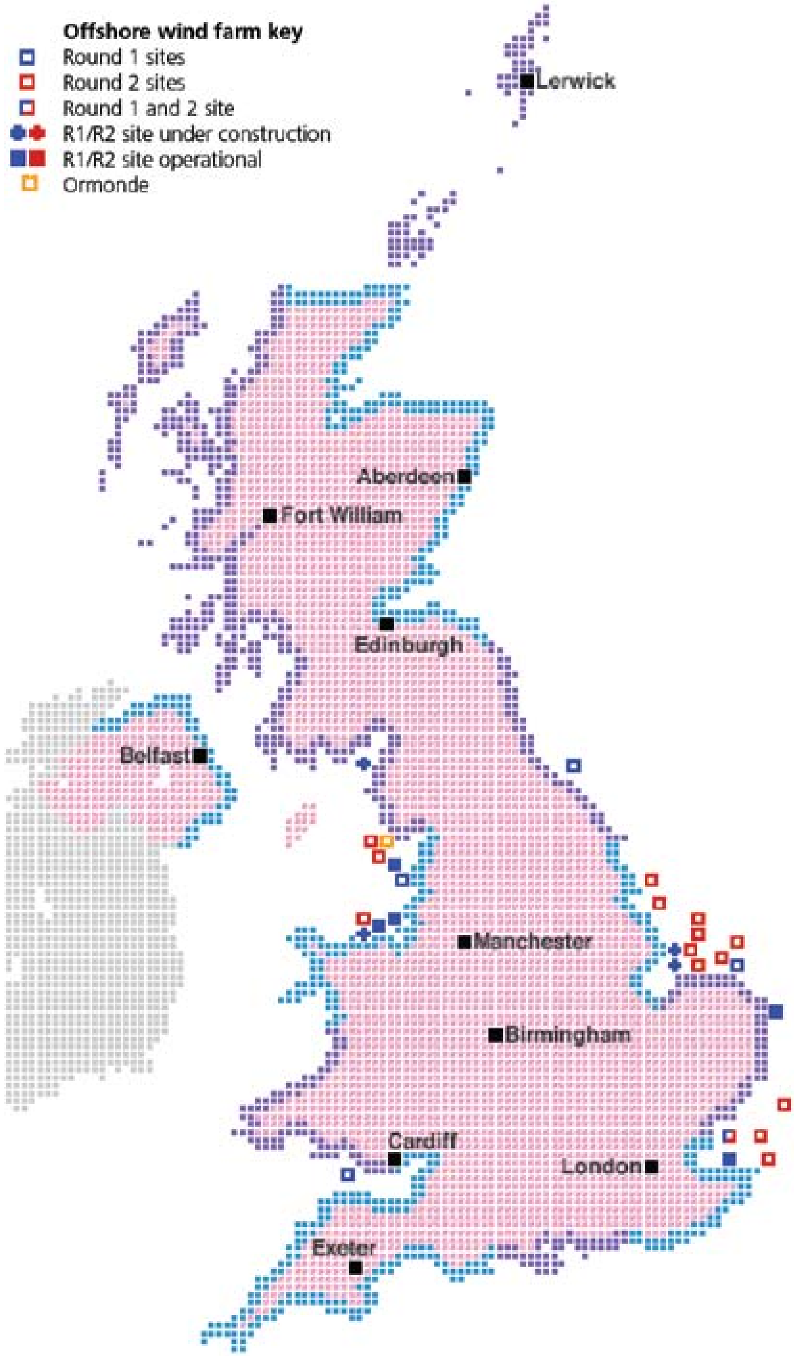
3.2.5 The Crown Estate, which owns the UK sea bed and rights for renewables development, administers the process for allocating sites and awarding leases to developers through bidding ‘rounds’. In the first round of the UK offshore programme for which leases were awarded in 2001, 12 sites received consent, representing around 1 GW of capacity. These projects all have planned commercial operating dates by 2010.

3.2.6 In 2003, Round 2 areas for development were announced. These projects are much larger in scale than in the first round, providing a generating capacity of up to 7.2 GW (9% of current UK generation). Over 2.3 GW of Round 2 wind

34 British Wind Energy Association, http://www.bwea.com/statistics/
35 RAB (2008)

has been given consent, and over 1.8 GW of applications are currently under consideration.

Figure 3.3: Round 1 and 2 wind farm areas



Source: http://www.thecrownestate.co.uk/our_portfolio/interactive_maps/70_interactive_maps_marine.htm

3.2.7 In addition, the Government announced in December 2007, proposals for a major expansion of offshore wind in UK waters. BERR is currently undertaking a Strategic Environmental Assessment (SEA) to assess the feasibility of the proposals for a further 25 GW (31% of current UK generation) of offshore wind. The SEA is expected to conclude in spring 2009. In parallel with the SEA, The Crown Estate has opened the Round 3 leasing programme, with the caveat that indicative areas of potential commercial interest being considered by The Crown Estate may be reduced in size dependent upon the outcome of the SEA. Following consents being approved, the earliest these new sites could be built would be from 2012–2014, coming on-stream to the network at the earliest in 2014–2015.

3.2.8 Analysis on electricity constraints suggests that up to 33 GW of offshore wind might be achievable by 2030.[36] However, our initial modelling suggests that by 2020 deployment may be closer to 14 GW, compared to less than 1 GW today. This would equate to around 3,000 extra offshore turbines of 5 MW. Others have suggested that higher levels might be achievable – for example, RAB estimated that around 18 GW of offshore wind could be deployed by 2020.[37]

3.2.9 We want to make full use of the potential for offshore development. Key non-financial constraints to deployment of offshore wind are shortages in the supply chain; the length of time for developers to attain development consents; compliance with the EU Birds and Habitats Directives, which protect wildlife habitat and bird migration paths; the possible implications for radar systems; and accommodating an increase in the numbers of turbines with a growth in shipping and the development of new ports. These issues and the Government's approach to resolving them are discussed further below.

Biomass

3.2.10 The term 'biomass' covers a range of renewable fuel sources derived from organic matter. In 2006, about 2.3% of electricity generated in the UK was from biomass, including electricity generation from landfill gas (gas formed from the decomposition of organic material in landfill), sewage gas (the biodegradable portion of municipal solid waste), wood (either from virgin timber, forestry management wastes or recovered waste wood) and specially grown energy crops such as short rotation coppice or miscanthus grass.[38] Sometimes this biomass is co-fired with fossil fuels.

3.2.11 Landfill gas is currently the most significant source of biomass-based renewable generation in the UK (although there is none in Northern Ireland), but the potential for growth is small in the short term as most large landfill sites are already being exploited, and may decline in future as existing sites are depleted. Further growth in biomass electricity generation is likely to be sourced from waste or energy crops.

36 SKM (2008a)

37 RAB (2008)

38 BERR (2007a), Tables 5.6 and 7.4
http://stats.berr.gov.uk/energystats/dukes07_c5.pdf and
http://stats.berr.gov.uk/energystats/dukes07_c7.pdf

Hydro

3.2.12 In 2006, 1.2% of the electricity generated in the UK came from hydropower,[39] with some 1,369 MW (1.7% of UK generation) of installed capacity from large-scale hydro schemes in the UK.[40] There have been few large hydro schemes constructed since the 1980s, and there are few sites left that would permit the construction of large hydropower schemes. Glendoe, Loch Ness (100 MW), currently under construction, may be the last major scheme in Scotland.

3.2.13 The untapped resource for further hydropower generation in the UK is that from micro and small-scale schemes. At present plants with capacity of less than 5 MW are primarily used for domestic or farm purposes, or for local sale to electricity supply companies. There are currently 153 MW (0.2% of current UK generation) of installed small-scale schemes in the UK.

3.2.14 Non-financial constraints to the further deployment of hydro are the planning process, access to the grid and environmental legislation such as the Water Framework Directive and the Habitats Directive.

Wave and tidal

3.2.15 There are three broad types of wave and tidal generation: tidal range (which uses the difference in water height between low and high tide by impounding – in barrages or lagoons – volumes of water at high tide, which is then released through turbines at lower tide levels); tidal stream (which harnesses the energy contained in fast-flowing tidal currents); and wave (which converts the energy contained in the movement of the waves into electricity).

3.2.16 Currently the level of generation from these sources is negligible. Tidal stream and wave generation technology is in its infancy, and unlikely to generate large quantities by 2020. Development of these technologies is discussed in Chapter 8 (Innovation). However, the potential energy resources in the UK are significant. There is a range of estimates which shows that between 15% and 20% of current UK electricity demand could eventually be met by wave and tidal stream energy,[41] and that a maximum of 2% (around 2 GW) of the UK's current electricity needs could come from wave and tidal stream generation by 2020, rising to around 30 GW by 2050.[42]

3.2.17 Tidal range is a proven technology, though no tidal lagoons currently exist. A 240 MW tidal barrage has operated at La Rance in France since 1966. Tidal range technologies could provide at least a further 5% of UK electricity supply, the resource for which is primarily focused in a limited number of locations, including the Severn Estuary, Liverpool and Morecambe Bays, the Solway Firth, the Wash, the Duddon, the Wyre and the Conway.

39 BERR (2007a), Tables 5.6 and 7.4
http://stats.berr.gov.uk/energystats/dukes07_c5.pdf and
http://stats.berr.gov.uk/energystats/dukes07_c7.pdf

40 Large-scale hydro plants are defined as those with a capacity of 5 MWe or over.

41 Carbon Trust (2006a)

42 BWEA (2005) and UKERC (2008)

3.2.18 A Sustainable Development Commission (SDC) study looked in detail at two particular sites for a tidal barrage in the Severn Estuary (see Figure 3.4).[43] The Cardiff-Weston scheme could cost around £15 billion, have a generation capacity of some 8,640 MW and an annual electricity output of 17 TWh per year or around 5% of UK annual electricity demand. It would take some five to seven years to construct. The Shoots Barrage is estimated to have an installed capacity of 1,050 MW, a capital cost of £1.5 billion, to produce 2.75 TWh and take in the order of four years to construct. Proposals also exist for tidal lagoons in Swansea and Liverpool Bays.

Figure 3.4: Potential for renewable energy in the Severn Estuary

Source: Sustainable Development Commission, 'Turning the Tide', 2007

3.2.19 The Severn Tidal Power Feasibility Study, for which the Secretary of State published the terms of reference on 22 January 2008, builds on the SDC study and previous work.[44] The two-year Feasibility Study, which will enable the Government to decide whether and on what terms a tidal range power scheme in the Severn Estuary could be supported, will focus on tidal range technologies, including barrages and lagoons. It will assess in broad terms the costs, benefits and impacts of such a scheme, including environmental, social, regional, economic and energy market impacts. It will consider what measures the Government could put in place to bring forward a scheme, or combinations of schemes, which fulfil regulatory requirements. It will include a Strategic Environmental Assessment to ensure a detailed understanding of the Estuary's environmental resource, recognising the nature conservation

43 SDC (2007)
44 The terms of reference for the study are available at: http://www.berr.gov.uk/files/file43810.pdf

significance of the Estuary. The Feasibility Study will also consider what legislative framework might be required for planning and other consents.

3.2.20 Should the outcome of the Feasibility Study be a decision to proceed, extensive and detailed further work would be needed to plan and implement a tidal power project, and secure the regulatory consents that would be required. It is unlikely that a Cardiff-Weston Barrage for example could be operational before 2022. The draft Renewable Energy Directive includes a clause which would allow exceptionally large projects that are not operational by 2020 (but are under construction) to count towards national targets, provided they meet specific qualifying criteria (installation at least 5 GW, under construction by 2016, and the possibility of being fully operational by 2022).

Q4: Are our assessments of the potential of different renewable electricity technologies correct?

3.3 Improving delivery through planning

3.3.1 Planning will be key to getting the renewable energy infrastructure needed to be built in time for 2020. Planning is where we ask economic, environmental and social objectives to be integrated; and where potential conflicts between the interests of individuals, or local communities, and the needs of the nation as a whole are reconciled. With the scale of the challenge we face, each and every decision on a project for renewable energy counts. We will not make the switch to renewables in the timescale required without the right response from the planning system.

3.3.2 This means being aware of the interests of local communities, listening to legitimate concerns about specific proposals and their location and giving industry as much certainty as possible on whether a project is likely to gain consent and if so when. If the risk to development is too big, investment stops flowing and could move into other countries. We therefore need to tackle delays in planning and ensure that projects for renewable energy are only refused planning permission where there are compelling reasons to do so.

3.3.3 A common complaint from the renewables industry is the length of time taken to get projects through the planning system. It can take too long to get some projects to a decision and the time to reach a decision is too unpredictable. For example, according to figures from the British Wind Energy Association (BWEA), while the time taken by Local Authorities in England to reach decisions on wind farms in 2007 has gone down from the 17 months taken in 2006, it is still around 14 months on average. Local Authorities gave permission to just under 60% of the applications they considered. This, and the time taken to reach a decision, compares poorly with the track record for commercial developments. However, the average masks huge variation and, in the time taken to reach decisions, is broadly comparable with other proposals accompanied by an Environmental Impact Assessment, and which generate intense scrutiny, such as for waste management.

3.3.4 Nationally, the impact is significant, especially on onshore wind developments. According to industry statistics there are currently 217 projects, representing a generating capacity of nearly 7 GW, within the UK planning system. 4 GW of these are individually of over 50 MW capacity (for decision by the Scottish Executive in Scotland or by the Secretary of State for Business, Enterprise and Regulatory Reform in England and Wales). The remaining 3 GW are below this capacity and in the local planning system for decision. There has been a significant drop in new applications from wind farms in the past 18 months.[45]

3.3.5 The reasons for delay are complex. Some proposals for renewable energy, windfarms in particular, can be highly controversial within the local communities concerned. This puts tremendous pressure on elected members and their officials, and can lead to unwarranted delay and decisions that are inconsistent with national policy. Some proposals have been inadequately prepared before being submitted to Local Authorities. Delay can also be rooted in matters outside planning authorities' control. Examples include the assessments required by European Directives and conflicts with other national concerns such as with the requirements of defence radar. In England, the Department for Communities and Local Government (CLG) has commissioned an end-to-end review of the planning application process to identify in detail what can disrupt the successful progress of an application before a decision is made.[46] This will include renewables in its scope. The review will make recommendations for improving the process, but importantly it will not seek to shift the balance of decision-making, weaken important safeguards, or reduce public consultation.

Improvement and reforms of the planning process for renewables

3.3.6 We are gearing up the planning system to help make the move to a low-carbon economy with much higher use of renewable energy. We know business relies on a quick, predictable and efficient planning service to deliver the renewable energy needed by the nation, and in the timeframe set by our international obligations. This has been, and remains, a central concern of our planning reforms. We committed in the 2007 Planning and Energy White Papers to wide-ranging reforms of the planning system to enable more efficient and timely decision-making.

3.3.7 Subject to the current Planning Bill receiving Royal Assent as drafted, these include:

- setting up an independent Infrastructure Planning Commission (IPC), which will take planning decisions on nationally significant infrastructure projects (in this context, onshore projects over 50 MW and offshore projects over 100 MW) using streamlined inquiry procedures and subject to statutory timetables;

45 In 2007, 819 MW were submitted, compared to 1614 MW in 2005 and 1783 MW in 2006.

46 The Killian Pretty Review was announced in March 2008 and has been jointly commissioned by the Department for Communities and Local Government and the Department for Business, Enterprise and Regulatory Reform. The final report is expected in autumn 2008.

- a new suite of National Policy Statements (NPS) covering renewables and electricity networks will apply directly to the IPC's decisions on renewables projects in England and be applicable more widely to regional and local plan-making and to decisions taken by local planning authorities;
- issuing new guidance to help developers know what constitutes best practice in preparing and consulting on applications to be made to the IPC. The IPC itself will also be able to advise developers about the application process, for instance on the information which needs to be included in the application.

3.3.8 Our reforms are designed to retain the confidence of all those who use and experience the planning system or are affected by its decisions. This is why we expect there to be full and fair opportunities for engagement with communities and for decisions to be transparent, accountable and taken at the right level.

3.3.9 It has been suggested by some stakeholders that all renewable schemes should be passed to the IPC; that the threshold we have proposed should be lower; or that the NPSs should be an overriding rather than a material consideration in local decision making. We have said that onshore renewables projects below 50 MW capacity will continue to be dealt with locally and we do not think it appropriate to change this threshold. The Government has arrived at this threshold and its view on the status of NPSs because it is important to ensure that local planning decisions are made at the appropriate level and also because smaller projects decided under the Town and Country Planning Act (TCPA) will benefit from the clarity on national need and impacts that will be set out in the new National Policy Statements.

3.3.10 We have said it could be appropriate, through Ministerial direction, for the IPC to consider applications that are below the normal threshold but are nevertheless of national significance, or which have potential cumulative impacts with other applications above the thresholds. The Ministerial power of direction would be exercised on the basis of clear criteria set out in a Ministerial statement, or possibly in the NPS itself. We will consult with local government, industry and other interests on the circumstances that would warrant making use of the proposed power. On the basis of current levels of applications we would expect this power only to be used exceptionally.

3.3.11 Our new Planning Policy Statement (PPS) on climate change is helping to create an attractive environment for innovation and for the private sector to bring forward investment in renewable energy.[47] At the same time, the PPS gives local communities real opportunities to influence and take action on climate change. Regional and local planners are expected to actively plan for, and support, renewable energy generation, including by allocating and safeguarding sites. Regions are expected to set targets for renewable energy capacity in line with national targets, or better where possible. Applicants for renewable energy should no longer be questioned about the energy need for their project, either in general or in particular locations. These new rules are being supported in the Planning Bill by a statutory duty on local planning authorities to take action on climate change.

47 CLG (2007)

3.3.12 Other improvements being implemented by the Department for Communities and Local Government (CLG) which will help projects for renewable energy include:

- the standard application form introduced in April 2008 and accompanying clarity on the information required to support planning applications;
- Planning Performance Agreements, which are designed to give applicants more certainty about the timescale and requirements for processing complex applications;
- a new fees regime that has responded to industry concerns about the way fees for planning applications for wind energy developments were calculated;[48]
- removing the need for planning permission for many small-scale developments, to boost the take-up of microgeneration and free up resources for where they are needed most.

3.3.13 For offshore projects, subject to Parliamentary approval the Marine Bill will introduce a new Marine Policy Statement (MPS), which will be prepared by the UK Government and Devolved Administrations in Wales and Northern Ireland. Along with the National Policy Statement on renewables under the Planning Reform Bill, the Marine Policy Statement will set out our policies for sustainable development of the UK marine area, including offshore renewables. The MPS and NPS along with marine plans will then guide and direct decisions in the marine environment, ensuring a strong link between national policy and individual developments.

Options for further action

3.3.14 We are putting in place many changes to help deliver the positive and supportive planning needed for timely consenting of renewable energy projects. We want to ensure we are doing all we can to guarantee that renewable energy applications are dealt with positively and expeditiously. Our aim is to reduce uncertainty and risk for the public and for developers and see projects decided within as short a timeframe as practicable. The Planning Bill will bring enormous improvements in the handling and consenting of nationally significant projects. We want to see commensurate improvements in the local planning system by building on the new expectations set out in the climate change PPS and making the fullest possible use of the freedoms and flexibilities provided by our planning reforms.

3.3.15 We have set out below a range of ideas. They are possible measures, and not fully-defined proposals. They have been put forward as a basis for the engagement we will have with stakeholders during this consultation. They differ in their scope, have different costs attached to them and some are more readily deployable than others. Their adoption would be subject to funding being made available. We are interested in your views on their likely effectiveness and whether you would see them as value for money.

48 Town and Country Planning (Fees for Applications and Deemed Applications) (Amendment) (England) Regulations 2008.

Locally-owned Renewables Delivery

3.3.16 Where and when we get new renewable energy developments is dependent on business wanting, and having the confidence, to invest. The planning system must therefore create an attractive environment for innovation and for the private sector to bring forward investment in renewable technologies. In other policy areas, the Government has identified the critical role that a clear delivery strategy through the planning system plays. This has most clearly been demonstrated in housing through the model set out in Planning Policy Statement on housing (PPS3),[49] and the support provided to housing delivery.

3.3.17 We are interested in considering to what extent and which elements of such a model could be applicable to supporting the delivery of the level of renewables build that is needed to meet the 2020 renewable energy target.

Box 3.1: Planning Policy Statement 3 Housing: an example of a locally-owned delivery strategy

PPS3 sets out the national planning policy framework for delivering the Government's housing objectives. It expects rigorous housing targets to be set in regional spatial strategies (RSS) and reflected in Local Development Documents (LDDs). These targets are set taking into account various factors, including national projections on the number of households and advice from the new National Housing and Planning Advice Unit on the level of house building needed in the region.

The PPS3 approach has several other strands. For example:

- the availability of land for development was identified as a key barrier to delivery and in part addressed by identifying public sector land that could be used for housing;
- a package of financial incentives is in place to support delivery of local development frameworks through the Housing and Planning Delivery Grant. This rewards completion of LDDs containing agreed housing numbers and delivery against agreed trajectories;
- growth points: those localities which feel particularly able to and are suitable for accommodating housing growth get special attention and support.

The 'softer' parts of the planning for housing package, including the incentives which shape the delivery context for the formal planning process, also play a very important role in delivering the Government's housing objectives.

3.3.18 Our planning policies already require Regional Spatial Strategies (RSS) to include targets for the minimum amount of installed capacity for renewable energy in the region to be achieved by 2010 and 2020. These targets should be derived from assessments of the region's renewable energy capacity and be ambitious. Monitoring against these targets should be reported in the

49 CLG (2006)

annual monitoring reports produced regionally and locally. However, these targets and their monitoring do not form a consistent delivery mechanism akin to the delivery management which is a central part of planning for housing. This seems to be a wasted opportunity.

3.3.19 Drawing on the planning for housing model would require the new Regional Strategy to include targets on renewable energy capacity. These targets would be informed by the potential for renewables across the regions and could be informed by, and in turn inform, the national targets detailed in the National Renewables Action Plan. We are interested in views on whether there would be merit in disaggregating regional targets to local authority areas. Doing so could help in providing benchmarks for the preparation and monitoring of LDDs, and in implementation, but implies a degree of prescription that would be new.

3.3.20 If there is to be confidence in a regional and local framework based on targets, it would need to be based on a rigorous assessment of potential in the region. This would need to be adequately resourced. We are also mindful of the need to avoid importing further delay into the handling of planning applications for renewables in implementing such an approach. Similarly, we would design an approach that provides greater clarity on the land resource available for renewables in a way that ensured innovation was not stifled. In particular, we would guard against proposals being rejected solely because they were outside an area identified for energy generation.

3.3.21 If we were to adopt this approach to renewables, we would do so in a way that avoided adding unnecessarily to demands on regional and local planning processes. We would want to be sure that the delivery management systems for both housing numbers and renewable energy can be supported at the same time. Subject to funding being made available for new burdens on Local Authorities, we could therefore build on the groundwork already underway in support of the energy policies in our climate change PPS.

3.3.22 A possible example of how incentives might be used to encourage renewable energy developments is to consider something like renewables growth points. This could involve inviting proposals from localities which felt particularly able and willing to be pace-setters in providing renewable energy generation. Subject to the availability of funding these localities could be supported in their efforts through a package of community benefits. As well as helping release capacity this would accord with Government policy for local communities themselves to benefit from the economic opportunities of windfarms and other energy installations. The Renewables Advisory Board has identified community benefits as a priority issue for their work this year and we are keen to develop new ideas that do not rely solely on the 'largesse' of the developer.

3.3.23 The Planning Bill makes provision for the introduction of a new Community Infrastructure Levy (CIL), by which developers can be asked to contribute to the cost of infrastructure needed to support development. We will consider further the particular needs and circumstances of the renewables sector in developing the detailed design of the CIL.

A clear planning framework

3.3.24 We have a rapidly evolving set of national policy and guidance affecting renewable energy projects, including the Renewable Energy Strategy. We know it may not always be clear to local planning authorities, applicants and other users how elements of this framework come together in any given case. We will therefore ensure our planning policies for renewable energy are updated quickly to reflect the new Renewable Energy Strategy when in place next year. In considering planning applications before RSSs and LDDs can be updated to be consistent with national planning policy, including the NPS on renewables, we will expect planning authorities to have regard to national policy as a material consideration which may supersede the policies in their development plan.

3.3.25 As well as ensuring this framework is as simple and clear to follow as possible, we need to enhance the capability of the planning process. The Department for Communities and Local Government is working on practice guidance in support of our climate change PPS. A working draft has been published and we are engaging widely with practitioners on its development. BERR runs a programme of practitioner workshops on renewable energy for planning officials, councillors and planning inspectors in England. The aim is better to equip participants to assess planning applications for renewable energy.

3.3.26 This support could be bolstered and targeted at those areas where it can make the biggest difference. We could also consider adding to the type of support that is currently available. This could, subject to funding being made available, be provided in a number of ways, such as:

- **a national Renewables Advisory Service:** available to both the local planning community and developers, where a small telephone-based central team could provide advice on technology and the planning process, and provide details of local consultants and specialists, who could be engaged for more in-depth support;

- **creation of a body to work with Local Authorities on renewables development:** an advisory body could be set up to provide a dedicated source of hands-on advice for those involved in the planning process. Such a body would need to be set up quickly to provide support in various ways to improve delivery, such as by providing advice on existing applications in the process, recognising that the majority of applications for onshore wind contributing to the 2020 target will need to be consented by 2015. It could also contribute to target-setting, including providing information on how regional and local targets should relate to overall national targets.

3.3.27 Box 3.2 below outlines the types of support and advice services that have been set up to help deliver other types of development.

Box 3.2: Examples of bodies set up to help deploy national policy

The Planning Advisory Service is funded by the Department for Communities and Local Government (CLG) to facilitate self-sustaining change and improvement in the Local Authority planning sector and help councils provide faster, fairer, more efficient and better quality services. Their website provides a peer review facility and a resource for pointing to areas for further help. CLG funds PAS through an annual grant of £3.5 million.

- The Advisory Team for Large Applications (ATLAS), provided through English Partnerships, provides targeted help for taking forward housing applications over 500 units in size in housing growth areas. It helps unblock the issues holding up large applications, and increase the knowledge and expertise of Local Authorities in handling such projects. CLG's annual grant to ATLAS is £2.5 million with an additional £0.25 million supplement specifically to facilitate Planning Performance Agreements.

- The National Housing and Planning Advice Unit (NHPAU) was established as a non-departmental public body, in response to Kate Barker's Review of Housing Supply (2004). It provides independent advice to both Government and regions about the impact of planned housing provision on affordability, as well as researching specific practical and policy issues, and has a budget of around £1.4 million per year.

- A similar challenge to that set by the EU 2020 renewable energy target is faced by the waste management industry where targets have been set by the EU for the diversion of municipal waste away from landfill. As part of DEFRA's response to this challenge the Waste Infrastructure Delivery Programme (WIDP) was specifically set up within DEFRA to work with Local Authorities and the regions to accelerate the build of new waste infrastructure. (Further details at: http://www.defra.gov.uk/news/2006/061107b.htm)

Delivering timely and robust decisions

3.3.28 **Statutory consultees:** We are working closely with statutory consultees to make improvements to the way they respond to planning applications, while recognising the challenges they face. Statutory consultees now have a duty under the Planning and Compulsory Purchase Act 2004 to respond to requests for advice within 21 days and they have to provide the Secretary of State for Communities and Local Government with an annual report on their performance. These reports do not suggest there are significant delays caused through missing the 21-day deadline, but there are nevertheless issues around timing of responses. For example, the 21-day deadline itself does not begin until the statutory consultee is in receipt of all the information they require to provide informed advice. We are therefore reviewing how statutory consultees could have access at an earlier stage to the information they need to provide consistent and quality responses and to ensure that conditions requiring further studies are not placed in consents unless unavoidable.[50] Further work is needed to ensure advice is consistent with our overall objectives on renewable energy.

3.3.29 **Appeals:** Developers of renewable energy projects can take their application to appeal if a decision is not taken by the Local Authority concerned, or if it is turned down. In England, when a project is accompanied by an Environmental Statement the appeal can be made after 16 weeks. On appeal the developer can ask for costs to be awarded against the Local Authority concerned if they have acted unreasonably. Some developers have used this route but fewer than might be expected. The reasons for this are not entirely clear. There may be a combination of factors: reluctance to prejudice working relationships with Local Authorities, the cost of going to appeal, and the fact that not all proposals – even after the 16-week threshold – are sufficiently well-developed to be tested by an inspector.

3.3.30 Another reason could be that developers are concerned about the support given on appeal. However, on closer examination this concern should not hold true. In England, 22 of the 54 planning appeals for windfarms and turbines decided in 2007-08 were successful. At about 40%, the success rate is broadly the same if not slightly better than that for other development proposals. Some sites are clearly unacceptable on landscape and other grounds. Most appeals are determined by planning inspectors on behalf of the Secretary of State for Communities and Local Government. A small but significant number are decided directly by the Secretary of State herself. 'Recovering' appeals adds time to the decision-making process and may result in additional costs to the developer and local planning authority. Even so, the Secretary of State will not hesitate to use her powers to take decisions herself in order to reinforce the Government's policies on renewable energy. CLG is therefore amending the recovery criteria for planning appeals to make it clear that the Secretary of State will recover significant appeal cases which contribute to delivering the Government's Climate Change Programme and energy policies.

3.3.31 **Community benefits:** The provision of tangible benefits to local communities from renewables developments is considered in Section 3.4.

Extending Permitted Development Rights

3.3.32 In April 2008, amendments were made to the General Permitted Development Order which enable small-scale domestic microgeneration development including solar, ground and water-source heat pumps, biomass heating and Combined Heat and Power systems to proceed without the need for a specific planning application. Further amendments are planned once further work has been carried out by DEFRA and industry on potential nuisance to neighbours from structure-borne noise and vibration. CLG is considering the scope for extending Permitted Development Rights to non-domestic small-scale renewables and has commissioned a report to look into this. The aim is to consult later in 2008 on proposals derived from this report.

50 For example, habitat studies required under European legislation could be carried out in advance of an application where a particular area or location has been identified as being suitable for renewables development.

3.3.33 Some applications entering the planning system will be for repowering wind turbines; that is replacing turbines which have come to the end of their useful life or replacing existing turbines with more efficient ones. In these cases the principle for the development has already been considered and in practice permission should be given more quickly. BWEA estimate that 49 developments in England have the potential to be submitted for repowering applications by 2020. These types of development might be capable of fast tracking through the use of a Local Development Order (LDO). An LDO is made by a planning authority in order to extend permitted rights for certain forms of development, in support of policy in a local development document.

Q5: What more could the Government or other parties do to enable the planning system to facilitate renewable deployment?

Devolved Administrations

3.3.34 Land planning in Scotland is a responsibility devolved to the Scottish Executive. Some 2.8 GW of installed renewable electricity capacity is currently in place in Scotland,[51] a further 1 GW is under construction, with applications for a further 3.4 GW currently being considered. Both power generation and grid reinforcements are given priority in the new National Planning Framework, which is currently being prepared following a public consultation in early 2008.

3.3.35 In 2004, the Welsh Assembly Government published a Ministerial Interim Planning Policy Statement (MIPPS) and accompanying Technical Advice Note (TAN) outlining its policy and approach to planning for renewable energy. Central to its policy was the identification of seven Strategic Search Areas (SSAs) within which major onshore wind farm developments (over 25 MW) should be located. An extensive independent all-Wales assessment informed the location of the SSAs. In addition, the TAN contains indicative targets of installed capacity expected by 2010 for each SSA. Local planning authorities are expected to reflect the SSAs in emerging Development Plans and in their determination of wind farm applications submitted under Town and Country Planning legislation. The designation of SSAs has provided a clear framework for LPAs and the energy sector. SSAs are not simplified planning zones and developers are still required to obtain consent for individual projects either from the LPA or from BERR. SSAs are a material consideration and this has been reflected in appeal decisions by the Planning Inspectorate.

3.3.36 In Northern Ireland, a recent consultation on Planning Policy Statement 18 has closed. It is expected to provide a boost to renewables generation in Northern Ireland. There is currently some 400 MW of renewables capacity (largely wind) with planning approval, of which 170 MW is installed and in operation. A further 1.2 GW is currently in the planning process. The recent Electrical Grid Study showed that significant grid strengthening would be required to support renewables generation of up to 42%. The Department of Enterprise, Trade and Investment is working with the Department of Environment (which has responsibility for planning) to ensure that the planning system facilitates any such reinforcement.

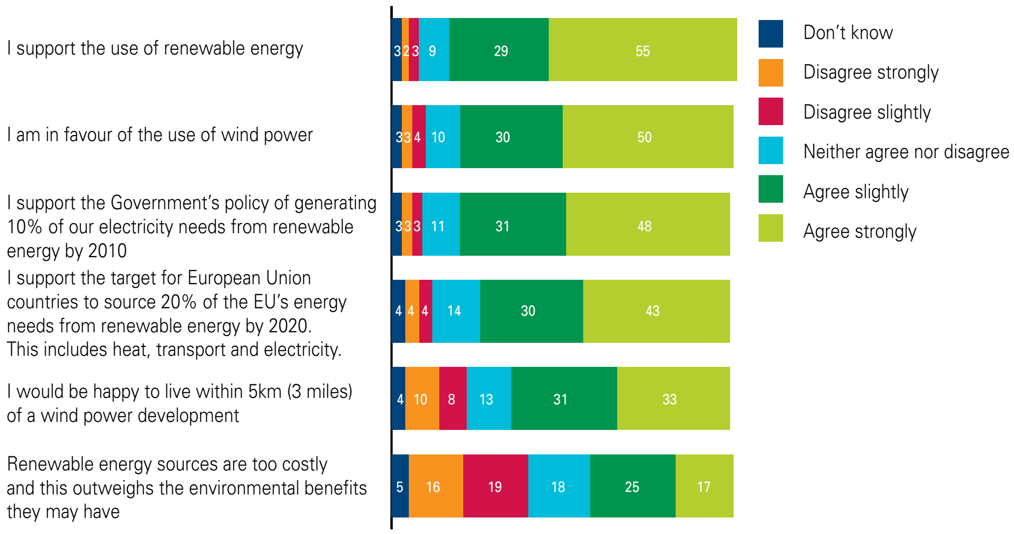
51 BWEA http://www.bwea.com

3.4 Delivering community benefits

3.4.1 The attitude of local communities to a renewables development can be pivotal to the success of a project. If people see little direct benefit for themselves or their local community they are less likely to support renewables projects. This may then lead to objection to planning applications and cause delay, and possibly complete blockage to deployment.

3.4.2 As Figure 3.5 below shows, public attitude to renewables is generally favourable, with 80% of those interviewed agreeing to the use of wind power, and 64% happy to live within 5 km of a wind power development.

Figure 3.5: Level of agreement to attitude statements about renewables



Source: BERR Renewable Energy Attitudes Research, May 2008

3.4.3 However, wind farms in particular are often seen as having a negative impact on the local communities living near them, while delivering benefits to society at large. The routine provision of meaningful benefits to communities hosting renewable energy projects could well be a significant factor in securing public support.

3.4.4 A study commissioned by the Renewables Advisory Board (RAB) and DTI examined practice in providing benefits to communities hosting wind farms in the UK, and compared this with practice in Spain, Germany, Denmark and Ireland. The work was focused on commercial-scale developments because they dominate development activity. As shown below in Figure 3.6, while in the UK community benefits rely upon voluntary cash contributions by the developer to a community fund, the evidence from Spain, Denmark and Germany (where renewables deployment is much higher) indicates that significant local benefits are effectively built into the fabric of all wind power projects. Indeed, the concept of a voluntary developer contribution was unfamiliar in Spain, Germany and Denmark. The study concluded that there was a need to make meaningful community benefit more routine and systematic in UK wind power projects if future rates of deployment are to grow.

Figure 3.6: Comparison of 'typical' community benefits from wind power in different countries[52]

Benefit/Feature	UK	Denmark	Germany	Ireland	Spain
Community fund contribution	Yes	No	No	No	No
Community compensation	No	No	Yes	No	No
Pre-approval contribution	No	No	No	No	Yes
Local taxes	No	Yes	Yes	Yes	Yes
Jobs	No	Yes	Yes	No	Yes
Individual investments	No	Yes	Yes	No	No
Co-operative investments	No	Yes	No	No	No

3.4.5 We have already implemented three of the six recommendations made by the Renewables Advisory Board (RAB). In particular we have:

- developed a national good practice 'toolkit' on community benefits for developers, planners and community groups;
- established new good practice guidance on how to liaise effectively with local communities during the project development process, and in particular how to explore and negotiate community benefits with key stakeholders;
- researched, in collaboration with the finance sector, ways in which to establish reliable and 'bank-approved' models for the commercial and financial structure for projects, which enable local community ownership.

3.4.6 RAB is also currently revisiting its work on community benefits in order to provide clear advice to BERR and the Government on how perceptions of community benefits from renewables deployment can be improved and marketed. This will include examining long-term benefits of renewables to local economy, links with financial support mechanisms and the consideration of any new community benefit ideas in light of the EU 2020 renewable energy target.

3.4.7 Potential further measures could include:

- establishing a single benchmark for the local community benefits that renewable developers are expected to provide and producing best practice guidance;
- considering the particular needs and circumstances of the renewables sector in developing the detailed design of the Community Infrastructure Levy (CIL), which secures contributions from developers towards funding for local infrastructure;
- providing mechanisms that will enable communities to benefit financially from the development of community energy assets.

Q6: What more could the Government or other parties do to ensure community support for new renewable generation?

52 RAB (2005)

3.5 Integration between regulatory frameworks

3.5.1 New renewable deployment can also be affected by other legitimate policy objectives – particularly in relation to marine navigation, environmental legislation, and aviation and radar. In these cases the Government itself may block the building of new renewable generation.

(I) Marine navigation

3.5.2 Consenting of offshore wind farms requires the careful balancing of economic, security, social and environmental interests in the marine sphere, including shipping, ports, and fishing.[53] While BERR and DEFRA have given consent to 100% of offshore wind farm applications to date, finding compromises and compensation packages to manage these competing interests is becoming increasingly difficult as wind farms increase in size and number, shipping levels expand, and new ports are developed.

3.5.3 To date, various measures have been employed by the Government and industry to minimise the impact of wind farms on marine navigation and reconcile the need to expand offshore wind farms whilst maintaining the economic contribution of shipping and ensuring its navigational safety.[54] These have included:

- establishing a safety zone scheme;[55]
- carrying out generic research projects (including demonstration projects);[56]
- producing guidance on assessment of key concerns and impacts;[57]
- holding regular forum meetings surrounding navigation, shipping and fishing;
- funding the creation and maintenance of a maritime database, including data for some shipping routes, fishing areas, port details and locations and recreational vessels, providing information to both developers and decision makers within the UK.

3.5.4 BERR, DfT, MoD and the Maritime and Coastguard Agency (MCA) have worked hard to resolve conflicts for individual consent applications. Together with additional navigation consultants they have provided both informal and formal advice to developers throughout the consenting process – from scoping and drafting of Environmental Impact Assessments, through to the final submission of consent application and subsequent assessment and negotiation. In respect of scoping Environmental Impact Assessments for an application, they have identified where additional environmental information

53 Details of recent decisions on consents can be found on the BERR website athttp://www.berr.gov.uk/energy/markets/consents/applications-decisions/page27942.html

54 Shipping and ports account for 95% of the UK's international trade by volume and play a crucial part in the successful working of the UK economy. Export earnings for shipping were £7.35 billion for 2006.

55 A safety zone is an area of water around or adjacent to a renewable energy installation (such as a wind turbine or wave and tidal device) from which certain or all classes of vessels are excluded and within which activities can be regulated.

56 Trials have been undertaken to assess the effects of wind farms on navigation radar and recommendations established for fisheries liaison.

57 Includes a preferred methodology for assessing marine navigational safety risks of offshore wind farms.

would help, and generally aimed to ensure that there is adequate information available such that a decision can be made on an application.

3.5.5 Additional solutions may be required to tackle the issues surrounding the conflicting interests of the various users of the sea. In particular:

- in December 2007, BERR began a Strategic Environmental Assessment (SEA) paving the way for The Crown Estate to launch the 'third round' of offshore wind energy development in June 2008, to assess the feasibility of the proposals for a further 25 GW (31% of current UK generation) of offshore wind. The key purpose of the SEA is to assess the potential of offshore energy in the seas surrounding the UK. The SEA will take up to a year and will take into account the level of deployment expected to result from the first and second rounds of offshore development (up to 8 GW). The SEA will enable informed decisions to be made as to the acceptable scale of impacts on navigation against the need for a clean and secure supply of energy from renewables. Northern Ireland will also be undertaking a Strategic Environmental Assessment to assess the potential of offshore wind and marine renewables in its territorial waters.

- in line with the Planning Bill, the Government will issue a National Policy Statement on renewables which will form the framework within which the new Infrastructure Planning Commission will consider applications for development consent for nationally significant infrastructure, including offshore developments above 100 MW. The intention is that the National Policy Statement (NPS) will be clearly written in a way that takes full account of all those involved in the maritime sector but allows trade-offs to be made between economic, social and environmental interests. The shipping industry accepts the need for flexibility, perhaps by managing shipping into narrower routes, and accepting additional operating costs for ports, the shipping industry and other users of the sea (including developers). At the same time navigational safety must also be safeguarded. This approach should enable the IPC to take swift and appropriate consenting decisions.

- in the Marine Bill, the Government is seeking implementation of measures including a system of marine spatial planning, based on a UK-wide Marine Policy Statement.[58] This system will enable us to articulate clearly our policy for the sustainable development of the marine area, including our commitment to renewable energy generation at sea. This Marine Policy Statement, and the marine plans produced under it, will have a binding impact on development consenting decisions. The Marine Bill will also establish a new Marine Management Organisation for England with a clearly defined responsibility for decision-making for marine renewable energy installations of 100 MW and under. This will significantly increase our capability to integrate marine activities effectively, including shipping, defence, renewable energy generation and environmental protection.

58 Published in draft in April 2008.

3.5.6 Further action may also be appropriate. For example:

- **Availability of comprehensive data and information to inform site selection:** DfT will ensure that a dataset of current shipping patterns and predications for growth is made available (legally defined formal routeing measures and also commonly-used shipping routes). In addition, areas of safe anchorage, areas of embarkation or disembarkation for pilots, engineers, technicians and crew, and areas for inwater repairs and surveys in lieu of drydocking will be made available. This will enable the offshore renewables industry to pick sites for development that have a reasonable chance of being acceptable to the shipping and ports industry.

- **Enhanced marine traffic management:** The Vessel Traffic Service (VTS) is a marine traffic monitoring system used to keep track of vessel movements. It provides basic information and limited assistance on shipping movements at sea and in approaches to ports around the UK. A programme of work could be undertaken to identify all potential vessel management solutions or mitigation measures. VTS could be one resolution for consideration; others could include establishing ship routeing traffic separation schemes or developing potential new technology such as marine electronic highways. It is envisaged that work could include assessing the feasibility and capabilities of any potential marine traffic management schemes, the probable costs and how best these solutions could be funded.

- **Effective advice from the Maritime and Coastguard Agency's (MCA) Navigational Safety Branch throughout the site selection and consenting process:** Consideration needs to be given to facilitating appropriate resourcing levels within the MCA to carry out the future workload that more offshore renewables will bring with it. In addition to work advising on site selection and for consenting purposes, further evaluation work and advice will also be required by the MCA on search and rescue issues.

(II) Environmental legislation

3.5.7 It is right that environmental standards are properly maintained and legislation effectively enforced. Environmental legislation plays an important role in protecting our valuable natural environment and we will need to accommodate the growth of renewable energy while minimising environmental impact. There will need to be a compromise on all sides and a willingness to work together in order to balance the requirements of the Renewable Energy Directive (once agreed), climate change policy, and the requirements of other EU environmental Directives.

3.5.8 The Government has set up a range of environmental work streams to stimulate further discussion around best practice and progress towards better regulation. Such forums include:

- Offshore Renewables Research Advisory Group (RAG);
- Offshore Renewable Energy and Environmental Forum (OREEF); and
- Strategic Environmental Assessment (SEA) Steering Groups.

To date the Government has also funded the advisory bodies to ensure there is sufficient resource to assist in research projects, and develop better guidance, together with consents and monitoring advice.

3.5.9 The Government's statutory nature conservation advisors (SAs) have a key role in advising on the environmental effects of consenting nationally significant renewable energy infrastructure. When considering the environmental effects of a proposal, lead Departments rely heavily on SAs to provide prompt and accurate interpretation on a wide range of environmental issues.

3.5.10 An appropriate balance needs to be struck between the UK's obligations for nature conservation and renewable energy. There are a number of ways in which the system could be improved, such as:

- **Improving EU guidance:** There may be scope to work with the European Commission and EU partners to improve the process and guidance relating to environmental legislation.
- **Improving UK application of EU regulation:** We need to ensure that our guidance is clear and unambiguous and applied consistently and in a timely way by statutory agencies and others. Regulatory requirements need to be appropriate and clear, so that renewable energy developers have early clarity on how to comply with necessary protections to our environment. This may involve looking at how well we integrate our nature conservation and renewable energy goals.[59] Renewables will continue to face significant barriers if we designate suitable areas for further environmental protection without setting clear objectives for the management of these areas and clear guidance for potential development projects.
- **Improving quality of applications:** Developers have a responsibility to ensure that their proposals are environmentally responsible and comply with environmental protection legislation. The demands of renewable electricity production must be balanced with our obligations to protect and conserve the environment.
- **Streamlining planning processes:** The timescales for assessments might be reduced if developers, planners and statutory advisers had access to pre-published environmental data. An increasing amount of information on environmental issues (such as ornithology) now exists because it has been required for previous renewable development applications. This information could be helpful in assessing other projects and reduce the need for new surveys. However, much of the information remains in the hands of developers or is otherwise not readily available. Further investment in capacity and the necessary range of environmental skills in those involved in the planning process, including in Statutory Advisors, may also be required to keep pace with the expected increase in renewables planning applications.

59 For example Dogger Bank and the North Norfolk Sandbanks have significant potential for the development of offshore wind yet both areas are currently being considered for designation as protected European sites.

(III) Aviation and radar

3.5.11 Wind turbines can have potentially significant effects on different kinds of aviation radar, which can in turn impact on deployment. BERR and MoD have been working closely together to explore technical and other potential solutions to try to resolve radar issues where they arise. However, a significant number of proposed wind farm developments have been blocked by MoD and civil aviators because of these radar concerns.

3.5.12 BERR has committed considerable funding in the past and continues to explore opportunities for supporting solutions to help wind farm developers reduce both civil and military aviation constraints. Working with the wind sector, MoD, DfT and civil aviation bodies (including the CAA and NATS), the Department has developed an Aviation Plan. This identifies work streams to help mitigate the effects of wind power on radar and the work required to develop and implement workable solutions (for example proposed research into stealth blade technology). The Plan incorporates short-term improvements to the planning application process, including shortening of the pre-application timescales, and the introduction of a web-based screening tool for pre-applications, which it is hoped will be in place by the end of 2008. A Memorandum of Understanding has been signed between BERR, MoD, DfT, CAA, NATS and BWEA that commits all parties to the implementation of the Plan.[60]

3.5.13 A number of other priority areas within the Plan have already been identified. These include assessing the feasibility of defining performance criteria for radar development; the development of technical solutions to mitigate impact on Air Defence, Air Traffic Control and En-Route Radar; the development of radar absorbent wind turbine technology; and the introduction of mandatory transponder carriage zones. Wind industry financial support will be required to support the Plan.

3.5.14 The work programmes within the Aviation Plan now have to be developed in order to identify the potential impacts on radar, the ways in which they can be addressed, and the work required to implement a solution.

3.5.15 In addition, the MoD has procured and will be installing a T102 Air Defence radar along the east coast. This will allow this new technology to be tested to establish its capability in dealing with the presence of wind farms. At present any further upgrades to radar, once solutions have been developed, would be funded by the developers.

60 The Memorandum of Association is available at: www.berr.gov.uk

Q7: What more could the Government or other parties do to reduce the constraints on renewable wind power development arising from:

a. marine navigation;

b. environmental legislation;

c. aviation and radar;

d. any other aspects of regulation?

3.6 Removal of electricity network constraints

3.6.1 Electricity networks transport electricity from the point of generation to the point of use. Obtaining a timely grid connection – and thus access to the electricity market to sell the power generated – is a key enabler for increasing the UK's proportion of renewable generation. Meeting the UK's share of the EU 2020 renewable energy target will require a significant increase in renewable generation, with most of this new capacity expected to come from onshore and offshore wind farms. As the areas with the best wind (and other renewable) resource are generally further from areas of demand this is likely to require new grid infrastructure to be built (see Box 3.4 below). To meet our EU 2020 target we therefore need to speed up the build of new infrastructure and ensure that other barriers to renewable generators gaining access to the grid are addressed.

3.6.2 In Great Britain, electricity is transported over high and low voltage power lines. Generation from large power stations is transmitted through the high voltage transmission network which then enters, via transformers, the low voltage distribution system, from which consumers receive their electricity.

3.6.3 National Grid owns the England and Wales transmission system, with Scottish Power Transmission Ltd (SPT) and Scottish Hydro-Electric Transmission Ltd (SHETL) each owning a part of the transmission system in Scotland. As transmission owners, these companies are responsible for building and maintaining safe and efficient networks and are regulated by Ofgem. The grid in Northern Ireland is owned by Northern Ireland Electricity. As the transmission system operator, National Grid also has responsibility for overseeing and managing the flow of electricity across the whole GB transmission network, including the elements owned and operated by SPT and SHETL; and for co-ordinating the process of making connection offers to new generators. The system operator for Northern Ireland (SONI) manages the electricity system and flows within Northern Ireland. There are 14 electricity distribution networks owned and operated by seven different companies.[61]

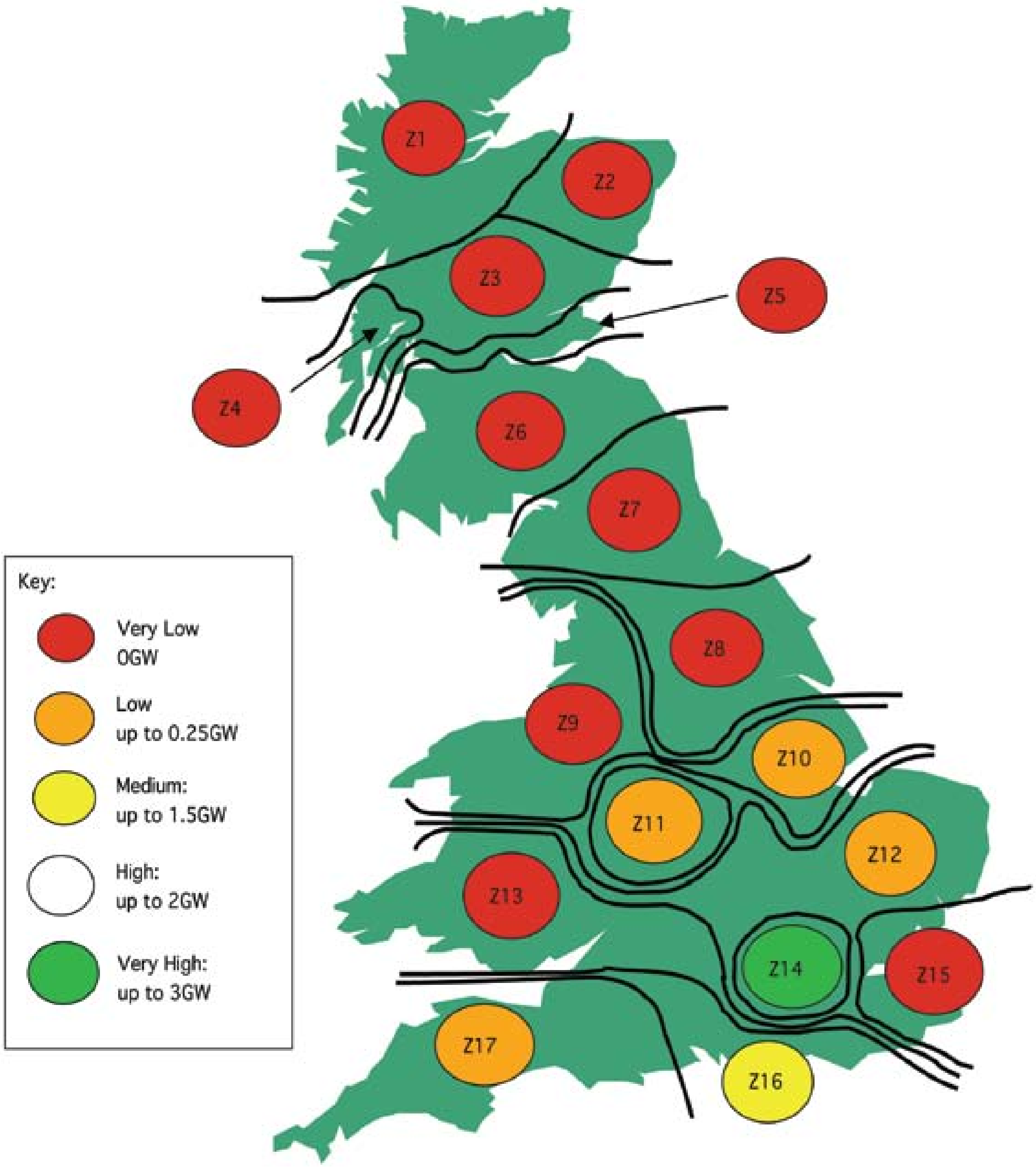
61 These are Scottish Hydro Electric Power Distribution, SP Distribution, United Utilities, Central Networks, CE Electric, Western Power Distribution and EDF Energy Networks.

3.6.4 Securing a grid connection on suitable terms remains a major barrier to the deployment of new renewable generation. Delays to connection lengthen project timescales and can call into question the commercial justification for a development, adversely affecting the developer's ability to secure investment. Developers of renewables projects need to have a high degree of confidence that, if they achieve planning consent, they will have a grid connection offer with appropriately defined and enforceable transmission rights that is consistent with their project development timeline.

(I) Clearing the backlog: managing the GB grid queue

3.6.5 In many areas of the country (as shown in Figure 3.7) the GB transmission system has very limited potential to accommodate new generation without further system reinforcement. Consequently there is a significant number of renewables projects held in what has become known as the GB Queue (sometimes referred to as the BETTA Queue). This refers to projects that applied for connection ahead of the introduction of the single Great Britain electricity and transmission trading arrangements (BETTA) in 2005. These projects benefited from transitional arrangements allowing them to be dealt with in an order determined by the date of application. This resulted in a large number of projects seeking to connect to the system (currently up to 10 GW in Scotland alone). Developers in some parts of the country have been offered dates approaching 2020, as the earliest connection date to the network. In Northern Ireland, significant grid strengthening will be necessary to accommodate increased levels of renewable generation.

Figure 3.7: Generation connection opportunities in Great Britain



Source: National Grid

[The key indicates the level of spare capacity on the system]

3.6.6 National Grid has consulted on its proposed approach to managing the queue of projects in Scotland, and has published its GB Queue Management Methodology.[62] The approach set out in the methodology seeks to maximise the amount of generating capacity able to connect to the system, by offering available connection capacity to those projects that are best placed to connect (that is, those projects that have consent). It is too early to say how effective these latest measures by National Grid to address the queue will be, but we will be monitoring the situation closely.

62 www.nationalgrid.com/NR/rdonlyres/820D630D-6294-4913-A47C-E9FC06F85ECD/23805/GBQueueManagementMethodology250208.pdf

(II) Ensuring access

3.6.7 The 2007 Energy White Paper announced a joint review (the Transmission Access Review) by Ofgem and BERR of the electricity transmission access regime in Great Britain. The purpose of the review was to support more cost effective and faster connection of renewable generation. The review explored a range of issues associated with the technical, commercial and regulatory arrangements for electricity transmission networks, with the chief aim being to support the delivery of the Government's aspiration of 20% of electricity to be supplied by renewable generation by 2020, and any further growth required to meet the EU 2020 renewable energy target.

3.6.8 The Transmission Access Review (TAR), published alongside this document, sets out a number of measures that BERR and Ofgem believe will remove, or significantly reduce, the barriers to timely connection that all forms of new generation currently face.[63] The TAR concludes that:

- bringing forward the effective and efficient connection of the significant volume of new renewable electricity generation capacity needed to meet the UK's EU 2020 renewable energy target will require fundamental changes to the codes that govern access to the grid;
- BERR and Ofgem believe that the changes needed to deliver these new and enduring arrangements can be made through the existing industry governance process that has been set down by Ofgem. However, the Government will review progress at the end of 2008 and if progress is insufficient we will consider all options (including legislation) in the context of the Renewable Energy Strategy;
- given the current delays in grid connection and that it will take some time for the necessary changes to the codes to be made, BERR and Ofgem also believe that there should be urgent steps taken to connect new generation more quickly and ahead of the implementation of the new and enduring arrangements. This means that for an interim period there should be a form of 'connect and manage' to accelerate new connections.[64] This entails the network operator, National Grid, connecting a generator to the grid as soon as the connection can physically be made and without the need for wider transmission reinforcements. National Grid then manage the system to minimise any costs that could arise as a result of the connection. This will be achieved through limited sharing of the grid network and by derogations from the system planning standard;
- the system planning standard – the GB Security and Quality of Supply Standards (SQSS) – should be reviewed to ensure consistency with access reforms and allow the connection of more generation to a given network;[65]

63 The Transmission Access Review is available at: www.berr.gov.uk/renewableconsultation

64 'Connect and manage' enables a developer to use the transmission network when local connection works have been completed, irrespective of whether wider network reinforcements, if required, have been made. The transmission companies would be required to manage the consequences of accommodating the additional capacity.

65 The GB Security and Quality of Supply Standards (GB SQSS) sets out a coordinated set of criteria and methodologies that the GB Transmission Licensees shall use in the planning and operation of the GB Transmission System.

- in addition to the new and enduring grid access arrangements, the way in which new grid infrastructure is planned and developed also needs to be accelerated. Ofgem will take forward with the transmission companies and the system operator development of appropriate incentives to deliver the new network to meet the EU 2020 renewable energy target;
- a significant system study setting out the necessary grid network to meet the 2020 target will begin shortly and will conclude by the end of 2008.

3.6.9 These measures are expected to give developers increased confidence that if they bring projects forward, a grid connection on suitable terms will be available in a timeframe reasonably consistent with the likely project development timetable. We estimate that these measures are capable of bringing forward 1 GW of new renewable connections, including just under 600 MW of projects that already have planning consent.

3.6.10 The Government is also currently consulting on revised statutory social and environmental guidance for Ofgem, the gas and electricity markets regulator. Ofgem must 'have regard' to such guidance, which sets out the Government's expectations of how the regulator can make a contribution to the achievement of Government social or environmental policy goals appropriate to its remit and functions. As part of this, the draft guidance calls on Ofgem to carry out its functions in relation to the regulatory arrangements for network access in the manner best calculated to support timely deployment of renewables, both on and offshore. Specifically in relation to grid access, the draft guidance calls on the regulator to do all it can to enable new generators to connect to the networks in a timeframe consistent with their development programme.

Box 3.3: Ofgem duties

As the independent economic regulator, Ofgem has an important role to play in the gas and electricity market through:

- providing the regulatory stability necessary for investor confidence through independence from Government and a clear statutory framework;
- enabling competition in the market wherever possible; and
- regulating the prices of natural monopolies (such as networks) where this is not.

Ofgem's principal objective is to protect the interests of consumers, present and future, wherever appropriate by promoting effective competition. Amongst its other duties, it is required to carry out its functions in the manner which it considers is best calculated to contribute to the achievement of sustainable development and to have regard among other things to the effect on the environment of the sector's activities and of statutory guidance on social and environmental matters issued by the Secretary of State for Business, Enterprise and Regulatory Reform.

The Government considers these duties to be an essential element of Ofgem's remit and to be the basis for the regulator to make an appropriate contribution to the achievement of the Government's environmental objectives.

Some commentators have called for Ofgem's primary duty to be changed to focus specifically on sustainability or reducing greenhouse gas emissions. This would be a very significant change for an independent economic regulator, requiring it to focus on wider public interest issues which overlap substantially with Government policy making on sustainability.

We believe there are distinct roles to be played by Ofgem and the Government: the Government's role is to set the framework for environmental policy, and the economic regulator's role is to police markets and competition. We do not think that the proposed dramatic changes to the model of independent economic regulation are necessary as we have seen little evidence to demonstrate that Ofgem's remit is acting as a barrier to the achievement of the Government's climate change targets. Investors in renewable technology have themselves called not for a change to Ofgem's remit but for clearer statutory guidance, and we will be implementing updated statutory guidance for Ofgem on social and environmental matters this year, after the consultation and Parliamentary scrutiny.

This consultation document therefore does not contain a specific question on this subject. We would nonetheless be keen to hear from anyone with evidence to the contrary that demonstrates that Ofgem's statutory remit was causing real difficulties in the achievement of our renewable and emission targets. If you do have such evidence, please include it when responding to this consultation.

3.6.11 The draft Renewable Energy Directive includes an obligation on Member States to ensure network owners provide priority access to the grid for renewables projects. Under the previous Directive, this is a discretionary matter for Member States. We are working closely with our European counterparts to clarify this obligation, and ensure that generators from non-renewable sources are not penalised or disadvantaged. The Government's initial view is that the approaches set out in the TAR are capable of delivering significant improvements in grid access for renewable generators without specifically giving preference to renewable generation. In particular, arrangements that give a firm connection date reasonably consistent with the development time of individual projects are likely to speed up connection and improve investor certainty and will be consistent with the objectives of priority access.

(III) Delivering new infrastructure

3.6.12 The best renewable energy sources, in particular wind, are often in more remote locations with limited grid connections, which means that significant upgrades to the network are also required. However, at present transmission companies can find it difficult to plan for additional investment in the network, due to the relative uncertainty of the scale and timing of many new renewable and conventional developments. This can lead to delays in identifying the need, and obtaining planning consents, for the construction of new or reinforced grid infrastructure. For example, the original estimated completion date for the Beauly-Denny reinforcement was 2008, but it is yet to be started, with the planning application now subject to a public inquiry.

3.6.13 Following the Renewable Energy Transmission Studies carried out by the then DTI Transmission Working Group in 2003 and 2005, Ofgem approved £560 million of investment through the Transmission Investment in Renewable Generation (TIRG) mechanism and a further £4 billion (to support connected and newly connecting generation of all types) in the transmission price control review 2007-12.[66] However, there have been delays in delivering this investment. In part this is attributable to the time needed to achieve planning consent, but also to the longer time needed to deliver transmission assets compared to renewable generation projects. In Northern Ireland, the Grid Study completed in conjunction with the Republic of Ireland highlighted the need for significant grid strengthening, particularly in the west, to accommodate higher levels of wind energy in particular.

3.6.14 Work commissioned in support of this consultation (see Box 3.4) suggests that the scale of reinforcement needed onshore, over and above current investment plans, may be relatively modest, although there is a degree of uncertainty about the type, volume and location of renewable generation developments.[67] The majority of new investment will be needed to bring offshore generation to the most suitable (not necessarily the nearest) connection point to the main onshore network.

66 DTI (2003)
67 SKM (2008b)

Box 3.4: Implications for electricity networks

In April 2008 independent energy consultants Sinclair, Knight and Merz (SKM) were commissioned by BERR to carry out a high level study of the implications for the UK's networks of accommodating increasing levels of renewables generation.[68] A number of scenarios were developed against which an assessment was made of network design and operation and associated costs.

Network expansion and reinforcement

By far the greatest proportion of new network will be that needed to connect offshore windfarms, with over 6,000 km of DC and around 1,900 km of AC submarine cable required. Onshore, assuming that certain presently approved and planned reinforcements have been commissioned by 2020, the study suggests that significant additional reinforcements will not be needed beyond those already consented or planned.

Investment Costs

Based on a 40% renewable electricity scenario (assuming up to 14 GW of onshore wind), the study estimates the scale of investment needed to expand and reinforce the network (onshore and offshore) at about £13 billion over the period to 2020.

Approximately 85% of this cost is for offshore connection with the remainder onshore grid reinforcements, including some already approved by Ofgem and planned but yet to be completed (about £1 billion) and distribution costs (about £1 billion).

Box 3.5: Approved and planned renewable onshore reinforcements

The SKM report referred to in Box 3.4 concluded that grid reinforcement costs associated with accommodating renewables are relatively small compared with the grid expansion costs.[69]

The SKM report identifies a number of consequential issues, including the future appropriateness of the current access regime and approach to system planning and operation including the balancing mechanism (see section 3.9 below).

The Grid Study completed by authorities in Northern Ireland and the Republic of Ireland and published in January 2008, noted that it was technically feasible for up to 42% of electricity to be generated from renewable resources by 2020. The study advised that in Northern Ireland, around 200 km of transmission reinforcement at a cost of £280 million, and 1,450 km of network reinforcements at a cost of £167 million would be required to accommodate this level of renewable energy, which will largely be from onshore wind.

68 SKM (2008b)

69 SKM (2008b). This estimate assumes that the network planning criteria of the GB SQSS are modified to take account of the impact of intermittent generation; and that generating plant runs on the basis of the lowest short run marginal cost, with conventional plant 'flexing' down to allow access for wind generation.

3.6.15 Nevertheless, if we are to create greater certainty for renewable developers the system operator and transmission owners need to have effective incentives to connect new generation and develop infrastructure at an early stage ahead of firm commitments from generators. Those development plans need to be transparent and to have been developed in dialogue with renewable (and other) generators so that projects are brought forward with full knowledge of network capabilities.

3.6.16 Setting out the likely programme of investment now and beginning the (relatively low cost) initial design and preparatory work up to and including submitting planning applications will allow an early start to be made on delivering new investments.[70] This will require upfront investment from the transmission companies, for which they will need permission from the regulator. The revised statutory guidance for Ofgem referred to above therefore specifically calls on the regulator to encourage network companies to undertake more preparatory work on network extensions in advance of a firm commitment from any single developer; and to ensure greater involvement of project developers in the development of network companies' investment plans.

3.6.17 Given the long life of transmission assets, the strategic planning undertaken by the transmission companies needs to take a view out to 2030. There is likely to be a need for further transfer capacity between Scotland and England and we will need to consider options such as offshore transmission routes in deciding the most cost-effective solution. The case for increased interconnection with other European countries also needs to be explored further. Such options will require consideration of the appropriate regulatory framework, for example where both onshore and offshore generation link to the same sub-sea transmission line.

3.6.18 Developing a clear vision of the electricity network architecture that will be needed to support the necessary expansion of renewable generation and further developing our understanding of the challenges for its delivery and operation will be a crucial first step. The three transmission companies, led by the GB system operator, National Grid, will undertake studies to look at investment scenarios and requirements to meet the EU 2020 renewable energy target. The companies are committed to carrying out these studies and delivering a report within six months.

3.6.19 The Electricity Networks Strategy Group (ENSG), which is jointly chaired by Ofgem and BERR, will have oversight of this process, in particular supporting the development of credible network scenarios. The ENSG will have revised terms of reference and will be tasked with developing and promoting a vision of the UK electricity networks that will effectively and efficiently facilitate the increase in renewable and other low-carbon generation necessary to meet the EU 2020 renewable energy target and our longer-term energy goals.

3.6.20 In the final report of the Transmission Access Review we set out the commitments from the National Grid and the Scottish transmission companies to develop an investment plan in support of our 2020 target and

70 Ofgem has begun discussions with the network companies to ensure that the right framework is in place to ensure that the risks of this activity, leading up to the next round of price controls, are shared appropriately between the network companies and consumers.

to work with Ofgem to develop a revised incentive regime that will support timely delivery. The work that will be undertaken includes a review of system planning standards in the light of reforms in the access regime.

(IV) Offshore grid

3.6.21 To encourage the development of offshore renewables as a major contributor to our renewable energy aspirations, BERR and Ofgem are leading a project to establish a new enduring regulatory regime for offshore transmission. The regime will enable large amounts of electricity from renewable sources generated offshore to connect to the onshore electricity network in a safe, economic and efficient manner, while maintaining the integrity of the electricity system as a whole.

3.6.22 Following extensive consultation with stakeholders, BERR and Ofgem have set out the high-level design of the new regulatory regime. The new regime extends the principles behind regulation of the onshore grid to offshore, but includes the licensing of offshore electricity transmission through competitive tenders to be run by the Gas and Electricity Markets Authority (supported by Ofgem). This additional element of competition will enable new companies to compete for the right to build the new offshore grid that we will need. Providing a regulated income stream, as happens onshore, for new transmission companies to build and operate the offshore grid should attract lower cost investment to deliver cheaper and timelier connections, bringing benefits to generators, transmission owners and consumers.

3.6.23 Discussions and consultations with stakeholders continue on a number of detailed implementation aspects of the new regime. BERR and Ofgem issued on 13 June 2008 the latest consultation document setting out the first draft of the detailed changes to the existing grid licences and codes needed to implement the new regime. We are also seeking additional powers in the Energy Bill for the Gas and Electricity Markets Authority to enable it to run the proposed tender process efficiently and effectively. We currently expect the new regime to go active in April 2009 to enable the first tenders to be run and for the full regime to come into effect in April 2010.

3.6.24 The Crown Estate launched on 4 June 2008 its Round 3 leasing process for the delivery of up to 25 GW of new offshore wind farms by 2020. BERR and Ofgem will be working closely with Crown Estate to ensure that the two processes complement each other and deliver the most economic and efficient grid connections for Round 3 projects, in addition to those already planned for Round 1 and 2 projects.

3.6.25 Offshore wind developments in other countries' territorial waters may also wish to supply the electricity they generate to the GB grid. And there may be opportunities to build grid connections between offshore wind farms in UK waters to those in the seas of other countries within Europe, to increase the amount of interconnection between the GB grid and the European grid. Further work, including at the European level, may be required to consider the regulatory, commercial and technical regime that would apply to such arrangements.

Q8: Taking into account decisions already taken on the offshore transmission regime and the measures set out in the Transmission Access Review, what more could the Government or other parties do to reduce the constraints on renewable development arising from grid issues?

3.7 Supply chain constraints

3.7.1 To deliver our share of the EU 2020 renewable energy target we need a supply chain able to deliver the necessary technology, skills, installation capacity, operations and maintenance, and related infrastructure. Supply chain pressures in the UK are exacerbated by global demand increases for wind generation technology in particular, driven by key onshore wind markets such as the US and China. On the other hand, while the renewable energy target requires a significant response from the supply chain, the build rate is broadly similar to that achieved for coal-powered generation in the 1970s and gas-powered generation in the 1990s.

3.7.2 Analysis commissioned by BERR (see Box 3.6) suggests that supply chain constraints could have a significant impact on development across all available technologies, and in particular on the deployment of offshore and onshore wind (with lead times for turbines of 14 to 18 months, for blades up to 24 to 36 months, and few manufacturers active in the supply of gearboxes). This is also an important issue for investigation in the Severn Tidal Power Feasibility Study. Chapter 7 (Bioenergy) focuses on the constraints for biomass, in particular identifying and securing the sources of supply and the challenges of their transportation.

Box 3.6: Conclusions from the SKM and Douglas Westwood studies on renewable supply chain constraints – offshore wind

- Offshore turbine supply – with only three players in the market, strong demand may further increase the existing three-year lead times.
- Key component supply – gearboxes, bearings, forged components, and generators have significant lead times.
- Project cost increases – over 100% in five years. £2.4 million per MW is now seen as common, with project costs increasing to £2.8 million per MW.
- Turbine installation vessels – lack of capacity – the market leader is booked to 2013. Vessel build costs have doubled in the past five years and new build time is up to four years.
- Cable supply – two suppliers dominate the sector and new specialist players are finding difficulty in accessing the market.
- Cable installation – more capacity will be required as the lead-times are expected to rise significantly in the next decade.
- Ports – UK ports are considered by developers to be under-developed and expensive in comparison to continental ones.
- Skills – experience and desire to work offshore are becoming increasingly scarce.
- Weather risks – top level players are not accepting installation weather risk, with increasing risks borne by the supply chain.

3.7.3 Within the UK's market-based framework it is ultimately up to individual businesses to decide where and how to invest in expanding the supply chain capacity, based on their view of the long-term financial returns. Indeed the supply constraints represent significant business opportunities. Nevertheless the Government does have a role in helping to ensure the supply constraints, and associated business opportunities, are appropriately addressed.

3.7.4 The Government should provide stable policy and a strong commitment to the EU 2020 renewable energy target: this document reiterates such firm commitment and seeks views on the associated policy required. In addition we take a lead in identifying key gaps in the supply chain and encouraging suppliers to meet them. As shown above in Box 3.6, there are significant opportunities for UK businesses to fill gaps in the supply chain, in particular for offshore wind, in areas such as the manufacture of bearings, gearboxes, cables, blades and castings; the development of ports infrastructure; and the installation and maintenance of turbines. We will be working with the Regional Development Agencies, UK Trade and Investment and other relevant bodies to develop a coordinated strategy to address these supply chain barriers (as detailed in the analysis commissioned by BERR on supply chain constraints).

Q9: What more could the Government or other parties do to reduce supply chain constraints on new renewables deployment?

3.8 Financial support for renewable electricity

3.8.1 Most renewable electricity technologies currently need financial support to make them cost competitive. The EU Emissions Trading Scheme creates an incentive for generators to invest in low-carbon generation by putting an additional cost on carbon-based generation, but the current or expected carbon price is not high enough to bring forward the required level of renewable deployment. Additional support is needed. In the UK our prime means of providing such support is the Renewables Obligation (RO). This requires electricity suppliers to source a specified and increasing proportion of their electricity from renewable sources, or pay a buy-out price. Since its introduction in 2002 the RO has nearly tripled the level of eligible renewable generation sources in the UK to around 4.4% in 2006. Provisional figures suggest this rose to just under 5% in 2007. As a result of changes to the RO proposed in the Energy Bill, we estimate that nearly 14% of our electricity generation will be from renewable sources by 2015.

3.8.2 The 2020 renewable energy target is likely to require more than double this figure. Our analysis suggests that an expanded and extended RO – combined with measures to address non-financial constraints as discussed above – could provide the incentive for such growth. However, it has been suggested that alternative support mechanisms, such as feed-in tariffs (see Box 3.7), might be more appropriate. The RO was designed to bring on the first 10% of renewable electricity within a decade of its introduction. Both the scale of the EU 2020 renewable energy target and its urgency are very different from the RO's original purpose, so it is appropriate that we should consider whether the RO is still the right support scheme for the UK; and if it is, what changes might need to be made to it. At the same time, we fully recognise that renewables operators have made and are making significant financial commitments on the basis of the RO. We want to ensure that any change to the financial support system resulting from this consultation protects the position of such investments.

3.8.3 A number of different approaches to providing financial support can be seen worldwide and across Europe (see Box 3.7). Across the EU, the two broad categories used are obligation systems (seven Member States, including the UK) and feed-in tariff systems (18 Member States).[71] This explains why feed-in tariffs (whereby renewable generators receive fixed payments per unit of electricity) are the most commonly discussed alternative to the RO. The discussion below therefore focuses on a comparison between the RO and feed-in tariffs.[72] It is useful to note, however, that in practice no two support schemes are the same – within the feed-in tariff 'family', a wide range

71 EC (2008b)

72 A full comparison between the RO, feed-in tariffs and a feed-in tariff/ tender hybrid scheme is given in Redpoint et al (2008).

of variants could be considered, including for instance 'premium' tariffs, or 'contracts for difference'.

Box 3.7: Types of support schemes

Support schemes used across various countries differ greatly, both in terms of basic design principles and details. Broadly speaking, the following types can be identified.

- Schemes that introduce an **obligation** to deliver a certain quantity of renewable electricity deployment. These schemes are referred to as 'obligation', 'quota', 'quantity', 'trading' or 'certificate' schemes. The Renewables Obligation falls in this category. This type of scheme requires those bound by the obligation (usually electricity supply companies) to buy renewables certificates from renewable electricity generators. Other countries using such schemes include Sweden and Italy.
- **Feed-in tariffs** provide a guaranteed rate of compensation per kWh to the generator, and are used for instance in Germany and Spain. Either generators receive all their revenue in the form of the guaranteed payment, or the guaranteed payment is an additional compensation on top of what generators receive by selling their renewable electricity on the wholesale market.
- **Tender schemes:** the Government holds auctions with regard to new renewables capacity, specifying parameters such as the amount of capacity that will be awarded support in the auction, the maximum level of support available, and other details. Companies bid in, offering a certain amount (and type) of renewable generation or capacity in exchange for a certain level of support. Those who are awarded the tender (typically, those offering to deliver the required renewables at least cost) may build the projects in question and will receive the level of support which they proposed in their bid. In the UK, the Non-Fossil Fuel Obligation (which preceded the Renewables Obligation) was a tender scheme.
- **Grants:** refer to lump-sum, upfront financial support to cover capital investment or other start-up costs of renewables projects. Grant-based schemes are typically funded from tax receipts, which means that their costs are borne by tax payers as a whole.
- Schemes that place **additional costs on non-renewable generation** technologies, on the basis that, as a result, renewable technologies become comparatively more attractive. These include for instance taxes placed on all non-renewable generation technologies; or a 'cap and trade' scheme such as the EU Emissions Trading Scheme (note however that the ETS supports all low-carbon technologies, not only renewables).

In theory all schemes could be funded through tax monies. In practice, however, support schemes (other than grants) tend to place the burden of the costs on transmission system operators, electricity suppliers and/or similar parties, who will pass through the costs onto electricity consumers (rather than the general tax payer).

3.8.4 Our analysis focuses on three key elements:

- Effectiveness: to what extent can any given support scheme be relied upon to deliver the high level of renewable electricity deployment needed to reach our 2020 target and longer-term goals?
- Efficiency: what cost does the support scheme impose on the economy as a whole, and on consumers, in achieving such deployment?
- Compatibility with the UK's competitive electricity market (to safeguard the benefits of competition for the UK economy and consumers).

(I) Effectiveness – deployment numbers achieved

3.8.5 We are confident that the RO can provide the financial incentive for the necessary level of deployment of large-scale centralised electricity generation. In addition to changes currently before Parliament (see Box 3.8), the RO would at least need to be increased in level (above the current maximum of 20%) and end date (currently 2027). Modelling undertaken to inform this consultation[73] suggests that with such changes – and subject to non-financial constraints being addressed as discussed earlier in this chapter – the RO could bring on up to 32% renewable generation by 2020.[74]

3.8.6 On the other hand, feed-in tariffs are used in a number of countries (for example, Germany and Spain), several of which have achieved impressive rates of renewable deployment significantly beyond those achieved in the UK. However, it would be wrong to attribute such results to the type of support mechanism alone. Levels of renewable deployment result from a combination of factors in addition to the type of financial support scheme, including the level of such support, non-financial barriers (such as planning, grid and supply chain), long-term policy stability, and natural resources.

3.8.7 Furthermore, one of the key historical differences between the RO and feed-in tariffs – namely the lack of differentiation in support levels for different technologies in the former – is being addressed. We acknowledge that in the past the overall effectiveness of the RO has been hampered by the fact that it did not incentivise a sufficiently wide range of technologies. Feed-in tariffs typically have an advantage here: they usually provide 'differentiation' of support. Different tariffs are provided for different technologies, tailored to their cost levels. This allows a range of technologies to come forward in parallel, leading to higher total deployment levels. But it is important to emphasise that we are already changing the RO to do the same through the introduction of 'banding' of support (see Box 3.8), thereby removing one of the key differences between the RO and feed-in tariffs.

73 Redpoint et al (2008)

74 This is excluding any large tidal barrage or lagoon schemes that might come forward, such as the project envisaged in the Severn Estuary.

Box 3.8: Differentiation of support: reform of the Renewables Obligation in the Energy Bill

A 'differentiated' support scheme provides different levels of support to different technologies, to ensure that a range of technologies (with a range of cost levels) can come forward. Differentiation of support is usually a feature of feed-in tariffs such as in the Spanish and German system.[75]

Where renewables targets can be met by deploying only the cheapest technologies which are at a similar cost level, it may not be necessary to bring forward a range of technologies that includes more expensive ones. In this case, a support scheme can be limited to a single level of support. Under the current UK regime one Renewables Obligation Certificate (ROC) is issued to generators for each MWh of renewable electricity, regardless of the source. This provides an effective incentive to a group of comparatively cheap renewable technologies such as landfill gas and onshore wind power.

However, we concluded in 2006 that we needed to differentiate the level of support for different technologies in recognition of their different costs: some less developed technologies such as offshore wind need more support to be economic, while others such as landfill gas are being over-rewarded and need less support. In order to meet this challenge the Government has proposed in the Energy Bill to 'band' the RO to provide greater reward to some technologies, in particular offshore wind and wave and tidal power.[76] At the same time, this change will reduce the subsidy to established technologies (such as landfill gas, co-firing of biomass with fossil fuel). Subject to Parliamentary and State Aid approval, this change is expected to become effective in April 2009.

3.8.8 There are some potential remaining differences between feed-in tariffs and the (banded) RO in terms of effectiveness:

- In both systems, the Government has to take key decisions on how high the support levels should be (either by setting the tariffs or the bands). If tariffs or bands are set too low, this may result in under-delivery and targets not being reached. This risk may be lower under the RO because trading of Renewables Obligation Certificates (ROCs) and the resulting change in the ROC price could compensate for that. However, this advantage of the RO has decreased with the introduction of headroom (see below). Also, where the ROC price responds to a band that is set at the wrong level for one technology, this could result in potentially undesirable changes in funding level for technologies in other bands.

75 However, for instance Hungary provides a single (undifferentiated) feed-in tariff.
76 For details of the proposals for a banded Renewables Obligation, BERR (2008b).

- The RO places an obligation only on the electricity supply companies. This has the advantage that it encourages a high level of involvement in renewables from some of the largest energy companies. On the other hand it means that independent (small) renewable generators depend on being able to find a buyer for their electricity and ROCs in order to benefit from the support scheme. In many cases this is done through long-term power purchase agreements with electricity supply companies. It has been suggested that this might represent a significant barrier to independent generators, although we do not have any evidence that this is in fact the case.

3.8.9 **Disruption due to policy change may jeopardise meeting the target.** Perhaps the most important argument against changing from the RO on effectiveness grounds is the disruption that such change could be expected to bring. A change of scheme could be expected to lead to considerable uncertainty for several years – probably at least until 2012 – as the details of the new scheme were developed, the necessary legislation passed, inevitable teething problems overcome and investors became familiar with the new system. The inevitable delay would be particularly risky given the urgency of action to meet the 2020 target, and could also increase costs associated with a new mechanism.

3.8.10 We, therefore, do not believe that effectiveness (in terms of the level of renewable deployment achieved) raises significant arguments against keeping the RO – indeed the very process of changing support scheme would be likely to reduce the level of deployment achieved within the timeframe relevant for our 2020 target.

(II) Efficiency – the cost of renewables support

3.8.11 Our analysis has pointed us towards two factors which could lead to cost differences between the (banded) RO and feed-in tariffs:

- **Level of risk exposure for renewable generators:** Feed-in tariffs provide a guaranteed level of compensation, and hence shield generators from the 'subsidy risk' associated with a renewables obligation: support under the RO takes the form of tradable certificates (ROCs), the value of which fluctuates as a result of trade. This risk presents a cost to renewable generators, either in the form of a higher cost of capital when financing their projects (to account for revenue uncertainty), or the electricity supply company with which they enter into long-term power purchase agreement will keep a percentage of the ROC revenue.

  On the other hand, the ROC price fluctuation can also have both cost-reducing and revenue-increasing effects for the generator: it incentivises generators to minimise costs; competition between electricity supply companies will encourage them to give the renewable generator the best possible deal; also ROC price fluctuation can cushion some of the risks of intermittency for the generator (in a year when there is little wind, the ROC price will tend to go up, ensuring that the generator's revenue does not drop as much as under a feed-in tariff, and vice versa).

Our modelling suggests that any resulting cost differences between the two schemes are relatively minor – for instance, in the scenario where we achieve 32% renewable electricity by 2020, the modelling projects additional cost to domestic annual electricity bills over the period 2010-2030 (compared to status quo policies) of 7-9% (£23–£33) under an enhanced RO, and 6-9% (£20-£30) under feed-in tariffs, under central fossil fuel price assumptions (with, for example, oil prices at $70 per barrel).[77]

Our preliminary conclusion is that such small differences are likely to be within the margin of error of the modelling – there is no guarantee that they would materialise in reality, particularly considering the uncertainties and delays resulting from a switch of support scheme (as discussed above). Such delays might well turn out to be greater than modelled, in which case we might have to set feed-in tariffs at a higher level than modelled to incentivise the market to 'catch up'. This effect could outweigh the result shown by the model, in which case switching to feed-in tariffs could turn out to be more expensive than staying with the RO. We therefore do not think that these modelling results in themselves justify the uncertainty and delay resulting from a switch in support scheme.

Also, these modelling results are based on deliberately aggressive pre-set annual targets for the RO. In the model this led to high levels of volatility for the ROC price in the early years – and this is likely to contribute to the higher costs. We believe that the 'headroom' approach we are currently introducing to the RO through the Energy Bill will match the obligation level to actual conditions in the renewables market more closely. We designed this mechanism to reduce excessive fluctuation of the ROC price, and it should therefore reduce any cost advantages feed-in tariffs may have in this respect even further.

- **Volatility of electricity wholesale prices.** In a typical feed-in tariff system, the generator only receives the fixed tariff. A change in electricity wholesale prices does not affect the cost of supporting renewables. By contrast, the RO is a 'premium' subsidy, meaning that it is paid in addition to revenue the generator gets in the wholesale market. Due to the design of the RO, the ROC price is, in the short to medium term, unlikely to change much in response to wholesale price changes. This means that the total compensation received by renewable generators will tend to fluctuate in line with changes in wholesale prices. The current RO was designed on the basis of wholesale prices fluctuating around a relatively stable level of £40/MWh. At the time of writing the wholesale electricity prices for a year ahead are closer to £70/MWh. If this development continues, the result may be that we are providing more support through the RO than feed-in tariffs might do.[78] On the other hand, if wholesale prices fall, this effect reduces. If we conclude that the downside risks of such wholesale price volatility are becoming more significant, it may be possible to amend the RO to address this.

77 See the Impact Assessment accompanying this consultation document as well as Redpoint et al (2008), both available on www.berr.gov.uk/renewableconsultation.

78 See the Impact Assessment accompanying this consultation document as well as Redpoint et al (2008), both available on www.berr.gov.uk/renewableconsultation.

3.8.12 The modelling indicates that the potential benefits of change are uncertain and relatively small, so we do not believe that they justify the risks – including on cost – associated with a change of support scheme. Nevertheless, we believe it is important that we ensure the RO operates as efficiently as possible. We are currently increasing the efficiency of the RO through introduction of headroom, and we will consider whether further improvements can be made (see below).

(III) Compatibility with the UK electricity market

3.8.13 A switch to a different support mechanism such as feed-in tariffs would raise a number of practical questions on how this would fit with our existing market arrangements.

- We would have to consider who would pay the feed-in tariffs. We do not believe that it would be practically feasible to place such an obligation on electricity suppliers – since any renewable generator could ask any supplier to pay the tariff, a supplier might end up with a disproportionate burden of tariff payments. This would result in a competitive disadvantage which could probably not be addressed adequately through redistribution of burdens later on. If the tariffs were paid by a single agency (for instance the grid operator, or a newly formed agency), the cash flow needed by this agency would have to be financed.

- Further questions arise on the impact on competition in the wholesale electricity market of 30% or more of our generation coming from renewables compensated through fixed feed-in tariffs rather than through a competitive market system. Under the RO, renewable generators participate in the wholesale market; if they receive fixed feed-in tariffs, they no longer do. We would want to ensure that the renewable electricity itself (if not the support paid through feed-in tariffs) could still remain part of the competitive wholesale market. Ideas that would have to be explored include implementing the feed-in tariff as a variable top-up to the revenue from the wholesale price, to take it to the guaranteed total tariff.[79] Alternatively the institution which would buy renewable electricity from generators and pay the feed-in tariff to them could sell or auction the corresponding renewable electricity back into the electricity market.

(IV) Conclusion

3.8.14 We are not convinced that the above factors should lead us to switch our support scheme for bulk electricity. This is for the following key reasons:

- We do not believe feed-in tariffs would be more *effective* in delivering our 2020 target. Indeed the disruption resulting from a change of support scheme would jeopardise meeting the 2020 target.

- In terms of *efficiency*, our analysis suggests that cost differences between the (banded) RO and feed-in tariffs are marginal, and depend crucially on a number of assumptions. Also, further improvements to the RO might reduce any disparity.

79 Sometimes referred to as 'contract for difference' – used for instance in the Netherlands.

3.8.15 In the light of the above, we are strongly minded to retain the RO as the main support mechanism for bulk electricity. (Financial support for microgeneration and distributed generation is considered further in Chapter 5; for emerging technologies such as marine power in Chapter 8).

Q10: Do you agree with our analysis on the importance of retaining the Renewables Obligation as our prime support mechanism for centralised renewable electricity?

Changes to the Renewables Obligation

3.8.16 Assuming that we retain the RO as our principal support mechanism, changes would have to be made in two key areas:

- **extending the end-date of the RO from 2027 as now to 2035 or beyond:** The long-term nature of most renewable electricity investments means they need long-term support to make them attractive. With a 2027 end date, the RO is not expected to bring on much new generation beyond 2015. It will therefore need to be extended. However, in extending the end date we would expect to limit the maximum time for which any project could earn support under the RO (for instance to 20 years);
- **increasing or removing the current cap on the level of the obligation:** The maximum obligation level is currently capped at 20%. This cap needs to be increased significantly, or even removed totally, to allow the RO to incentivise the required level of renewable generation.

  Also, our current reforms to the RO remove the predetermined annual target levels, and instead set the obligation at a certain level above the forecast level of renewables deployment from year to year ('guaranteed headroom'). Given the higher target levels to 2020, we will also have to reconsider the pros and cons of the headroom approach compared to having predetermined annual target levels in the RO. Headroom reduces excess ROC price increases where renewables build rates may be constrained by non-financial barriers; on the other hand fixed annual target levels increase delivery certainty against the overall EU 2020 renewable energy target.

3.8.17 Given the much higher growth rate and volumes of renewable electricity needed as we work towards our 2020 target, we want to ensure that the RO is as effective and efficient as possible. We are therefore considering whether changes in other areas, which could for example be implemented through the next planned RO review in 2013, could deliver further improvements:

- **Banding:** We have consulted on the number of bands before, but the need to consider how to achieve the 2020 target through the RO justifies revisiting the issue. We could change the number of bands either to one band per technology (as opposed to grouping several technologies in one band), or, potentially, to several bands within a single technology. Putting each technology in its own band would allow us to adjust the level of compensation for that technology (for instance to account for reductions in the cost of a technology) without undesired effects on the support for other technologies. Introducing several bands within one technology (for instance onshore wind) might contribute to a higher annual build rate by incentivising both the most economic and less economic sites at the same time. Encouraging more project proposals to come forward in parallel might also reduce the impact of any constraint at the planning consent stage. On the other hand, the more bands the system contains, the more complex the system gets and the higher the risk of setting bands at the wrong level. Also, we would need to balance any benefits from further modifications to the banding system against potential risks to investor certainty from further change.

- **Stability of the ROC price:** The current reforms of the RO introduce headroom (discussed above) to reduce the ROC-price risk to investors. We are open to views on whether there are further options for increasing the stability of the ROC price.

- **The impact of wholesale price volatility:** As discussed above, a sustained rise in electricity prices may lead to increased rewards to renewable generators with no corresponding reduction in the costs of renewables support through the RO. If so, we need to consider whether there are ways of improving value for money to consumers. It may be possible, for example, to set out a predictable mechanism by which the value of rewards under the RO was linked to the wholesale electricity price so that investors receive a predictable and sufficient incentive to build new stations and consumers receive better value for money during times of increased electricity prices.

3.8.18 Assuming we maintain the RO, we will consult in more detail on changes to the RO further to publication of our Renewable Energy Strategy in spring 2009.

Q11: What changes (if any) should we make to the Renewables Obligation in the light of the EU 2020 renewable energy target?

3.8.19 **Grandfathering:** We remain committed to the principle of grandfathering – that any reduction of support will only apply to future projects (with the exception of co-firing). We also want to ensure that those intending to build renewables projects over the next few years feel confident to go ahead. We are therefore minded to adopt similar principles for grandfathering to those applied with regard to the current changes to the RO in the Energy Bill – see our consultation document of 23 May 2007 for details.[80] In essence this would aim at applying changes in the RO only to projects which become operational

80 BERR (2007d) pp26-30

from the moment we introduce the changes, but allowing projects that become operational between the date of this consultation document (26 June 2008) and the effective date of such changes to benefit from any increase in support. We will provide further details on grandfathering once the nature of the changes to the RO has become clear.

3.9 Impact of renewables on the security of electricity supply

3.9.1 Within any electricity system, supply and demand have to be kept in balance on a second-by-second basis. A large amount of electricity supply whose volume is difficult to predict (except over short time periods) and control (except by curtailment) therefore presents some challenges to the system operator.

3.9.2 The power available to a wind turbine increases with the cube of the wind speed. Therefore, small changes in wind speed can have a significant impact on output. With a good dispersion of wind turbines, the variability of wind output over the UK as a whole can be expected to be smoother than output from any individual site or region.[81] Nevertheless, the intermittent nature of wind power in particular will require new more dynamic ways of operating the network, and back-up generating capacity to maintain current levels of system reliability.

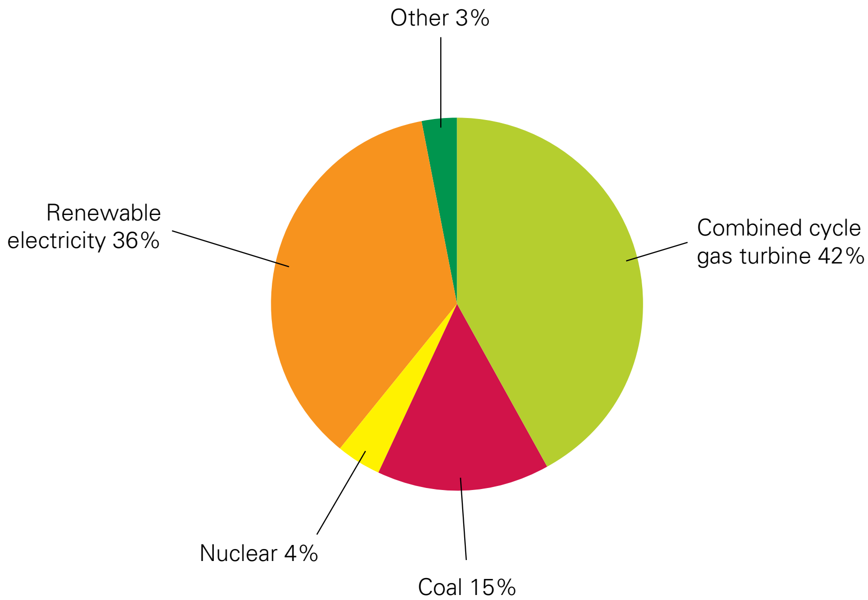
3.9.3 More generally, a higher level of penetration by generating capacity whose output is variable (output levels can change rapidly), with varying degrees of predictability means that the whole electricity system needs to become more flexible. This is not only a challenge for the system operator but also has implications for the efficiency, reliability and economic viability of other electricity generating plant.

3.9.4 Analysis of wind patterns suggests that, at high penetration levels in the UK, wind generation offers a capacity credit of about 10-20%. This is an indicator as to how much of the capacity can be statistically relied on to be available to meet peak demand and compares to about 86% for conventional generation. This means that controllable capacity (for example fossil fuel and other thermal or hydro power) still has to be available for back-up at times of high demand and low wind output, if security of supply is to be maintained. New conventional capacity will, therefore, still be needed to replace the conventional and nuclear plant which is expected to close over the next decade or so, even if large amounts of renewable capacity are deployed.

81 ECI (2005)

3.9.5 Analysis commissioned by BERR suggests the possible mix of electricity generating capacity by 2020 as shown in Figure 3.8.

Figure 3.8: Potential breakdown of generating capacity to reach the renewables target in 2020



Source: Redpoint et al (2008)

3.9.6 In the British market electricity generating capacity does not earn money simply for being available; it earns money only when it actually generates. This is consistent with striking the optimal balance between costs and benefits of spare capacity on the system. It also means that wholesale electricity prices are likely to rise to very high levels at times when high demand and low wind speeds coincide. This is necessary in order to cover the costs of plant which does not get to generate very often, and so ensure that generators are incentivised to provide back-up capacity.

3.9.7 It is nevertheless possible that uncertainty over returns on investment, because of the difficulty of knowing how often plant will get the opportunity to run, will discourage or delay investment in new conventional capacity – or speed up the closure of existing capacity – and hence increase the risk of occasional capacity shortfalls. However, preliminary results from modelling by consultants suggests that, as long as price signals are allowed to operate freely, the market is likely to provide sufficient capacity to maintain a very low probability of interruptions.[82]

3.9.8 There will of course be the reverse issue when wind speeds are high and demand is low, for example during the summer or overnight. This may lead to negative prices to generators. The system may not be able to absorb all of the output of both wind and nuclear generating plants (the only technologies likely to operate at times of very low electricity prices). So some controllable plant needs to be kept on the system to enable reliable and rapid response to wind output variability and unplanned outages.

82 Redpoint et al (2008)

3.9.9 This excess of supply can be addressed to a certain extent through the use of pumped storage and exports through interconnectors, both of which can be used as sources of electricity demand as well as supply. It is nevertheless likely that some plant will have to be prevented from running on such occasions. One possibility is that the existing regime of constraint payments could continue to be effective in curtailing generation in excess of demand. In theory, this could apply to wind generation as much as any other although any generating technology earning Renewables Obligation Certificates would take the opportunity cost of the certificates into account in setting the price at which it would be prepared to be constrained off. Further work is, however, required to assess the scale of constraint payments likely to be necessary and whether measures to limit those payments might be desirable.

3.9.10 An increase in the requirement to vary electricity output in response to greater variability in residual demand (demand over and above that which is met by wind generation) is also likely to have a negative impact on the efficiency and reliability of existing plant. This is particularly the case for the UK's present nuclear fleet, which was designed to run continuously and is not well suited to short-term response to shifts in the supply-demand balance, for safety as well as economic reasons. However, nuclear plants can be designed to run flexibly and this has been shown to operate effectively in practice by the experience of the Flamanville 3 plant in France. We therefore believe that the expectation of a greater penetration of intermittent generation is not in itself a barrier to the deployment of new nuclear capacity.

3.9.11 We also need to consider how the development and deployment of other forms of flexibility, such as improved electricity storage technology and dynamic demand response technologies, can be encouraged. It is also possible that smart metering will play a role in helping to optimise network operation, for instance, through the provision of more data on energy use than is currently available and assisting with network planning and design.

Q12: What (if any) changes are needed to the current electricity market regime to ensure that the proposed increase in renewables generation does not undermine security of electricity supplies, and how can greater flexibility and responsiveness be encouraged in the demand side?

Chapter 4
Heat

Summary

Building on responses from the Heat Call for Evidence which the Government published in January, this chapter seeks views on a number of potential measures to increase the extent of renewable heat generation in the UK and facilitate the development of the market for renewable heating technologies and fuel. In particular:

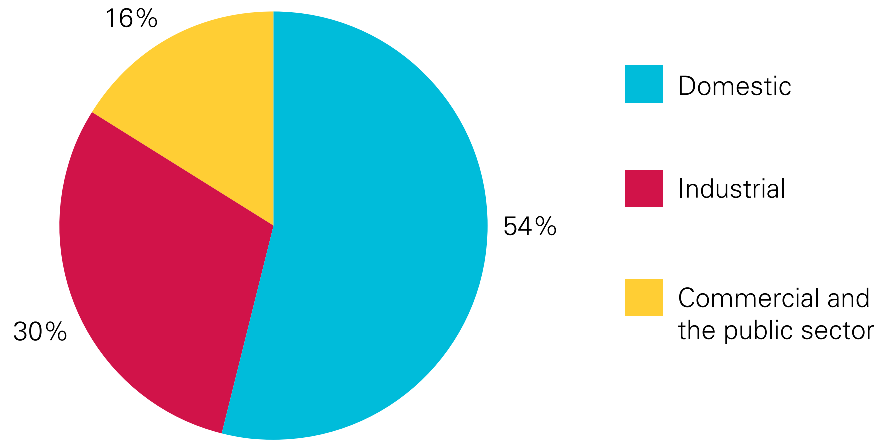
- introducing a new heat incentive mechanism, such as a Renewable Heat Incentive (akin to a feed-in tariff) or a Renewable Heat Obligation, to provide the financial stimulus for new renewable heat deployment; and
- addressing the barriers and constraints which limit the potential to increase renewable heat deployment. For example:
  - improving the regulation of biomass heating systems to ensure that wider deployment minimises the impact on air quality;
  - providing regulatory incentives to install renewable heat technologies in new build through the implementation of Zero Carbon Homes and Zero Carbon Buildings initiatives; and
  - providing better information to consumers, businesses and local authorities on the potential of renewable heat, including for the planning process.

4.1 Introduction

4.1.1 Heat, in all its forms, currently accounts for 49% of the UK's final energy demand[83] and 47% of our carbon emissions.[84] It follows that our commitments to reduce carbon emissions by 2020 and 2050 will require us to 'decarbonise' heat significantly. We will need to move forward on two fronts: reducing the absolute demand for heat through energy efficiency measures; and decarbonising the delivery of the heat itself.

83 BERR (2007c)
84 NAEI (2005)

Figure 4.1: Heat use by sectors (2005)



Total Heat Use: 906.6 TWh *(note: includes electrical heating)*
Source: BERR, 2007, 'Energy Trends'

4.1.2 This chapter covers renewable heat and the contribution it could make to meeting the UK's 2020 renewable energy target. The present level of renewable heat in the UK is very low; only 0.6% of UK heat demand, the majority of it wood combustion in the domestic and industrial sectors. This is partly due to the easy availability of cheaper fossil fuel alternatives, and a range of other factors including the high upfront capital costs of many renewable heat technologies. Equally, only very large heat users are subject to the carbon price imposed by the EU Emissions Trading Scheme. Without a carbon price or a financial incentive, investment in renewable heat is less attractive. In other EU countries renewable heat is more widespread – for example, in Austria widespread native woodland and lack of an indigenous gas supply has meant biomass heating is common and in 2005 more than 20% of Austria's final energy demand was met from renewables.

4.1.3 The UK heat market is more complex and decentralised than the market for electricity. It is very unusual for UK households or businesses to buy or sell heat in the same way that electricity is bought or sold on the national grid. And unlike electricity, heat cannot be transported for long distances easily without significant losses. As a result UK heat consumers generally buy heating fuel (gas, oil, coal, wood) or electricity and convert these to heat on site in boilers or electric heaters. At present most of the UK heat demand is met by gas piped directly to the customer and converted to heat on site. The majority (81%) of household heat demand is met by gas, with electricity providing 8%, and heating oil 8%. We need to take this complex market structure into account when developing policies that will enable the heat sector to contribute fully to our economic and environmental objectives.

4.1.4 In order to meet the EU 2020 renewable energy target we will require significant levels of renewable heat, and ambitious policies to deliver them. We need to change the way we generate and use heat, with energy efficiency becoming increasingly important. Recent consultancy work commissioned by BERR suggested that if renewable heat met 11% of overall heat demand, this could mean approximately 100,000 householders using heat pump technology, as well as substantive amounts of biomass heat capacity – sufficient to meet the heat demands of around 3.2 million households[85] – being deployed in total across the domestic, commercial and industrial sectors. An even higher level (14% of overall heat demand) would require, in addition to deployment of heat pumps and biomass heat, a very high market penetration of solar thermal microgeneration technology in the order of 7 million installed units.[86]

4.1.5 Initial cost estimates suggest that assuming a 15% renewable energy target for the UK, a target of around 14% of heat from renewable sources might be appropriate, particularly given the constraints affecting increasing renewable electricity beyond the levels outlined in Chapter 3. Achieving this level of take-up would depend on removing constraints and putting in place sufficient financial support.

4.1.6 The Office of Climate Change's (OCC) Heat Project was tasked in early 2007 with examining how heat could be 'decarbonised'. They concluded, amongst other things, that renewable heat had the potential to deliver significant amounts of low-carbon heat cost-effectively. The OCC work estimated that 6% of UK heat demand could be met from renewable sources in 2020 with a moderate level of financial support, mainly through encouraging switching by industrial, commercial and residential customers located off the gas grid from oil, coal or electrical heating, to biomass or other renewable technologies. Off the gas grid customers are believed both to be more able to switch and to face lower additional costs.

4.1.7 Building on the conclusions of the Heat Project, the Government issued the Heat Call for Evidence in January 2008[87] setting out the OCC's analysis. This attracted more than 120 responses which can be viewed, along with a summary, on the BERR energy website. These responses have helped us better understand the opportunities and prospects for heat, including the potential of renewable heat and the constraints to its expansion, and they are reflected in the discussion below. In addition to the OCC's work and its own analysis, BERR has commissioned analysis from the consultants Enviros on the barriers and constraints to heat deployment, and from the consultants NERA on the use of a financial instrument to promote renewable heat.[88] The Enviros work is a key input in the NERA study.

4.1.8 Given the challenging nature of the EU 2020 renewable energy target, and the significant role renewable heat will have to play to meet it, all plausible forms of renewable heat deserve full examination in developing the UK Renewable Energy Strategy. Several responses to the Heat Call for Evidence made the point that it is too early to pass judgement on which technologies offer most potential in the medium and longer-term, given that the renewable heat sector is not yet well developed.[89]

85 This has been calculated using an approximate level of heat demand of 12 MWh per household and the possible contribution biomass could make to a scenario where we deploy 11% of heat demand from renewables in 2020 (38.3 TWh).

86 Enviros (2008)

87 BERR (2008c)

88 Enviros (2008) and NERA (2008)

89 BERR (2008c)

4.1.9 Many respondents to the Heat Call for Evidence commented that the Government should seek to increase low-carbon heat in general, rather than simply renewable heat. Renewable energy does have some further advantages, such as diversifying supply. However, efforts to increase renewable heat should be complementary to those encouraging other low-carbon heating types and improving energy efficiency. Other Government policies, such as the EU ETS, already impart an advantage to low-carbon heat technologies in the large industrial sector.[90] This area will be examined in more detail as part of our work on a comprehensive heat strategy and we will consult further in the autumn. Given the current range of available technologies, the Government's judgement is that renewable heat will be required to make a significant contribution if we are to meet our CO_2 and greenhouse gas reduction targets out to 2050.

4.2 Current heat policies

4.2.1 The Government has introduced a number of policies to increase energy efficiency and reduce carbon emissions, and these already affect the heat sector. Improved energy efficiency is often a low cost option, bringing benefits in energy affordability and security of supply as well as reducing the absolute amount of heat required and carbon emitted. A reduction in total heat demand will also reduce, in absolute terms, the amount of renewable energy required to meet the 2020 target as set out in Chapter 2 (Saving Energy).

4.2.2 Scotland is intending to produce a Renewable Heat Action Plan during 2008. The Action Plan will be informed by a recently published report from the Forum for Renewable Development in Scotland (FREDS).[91]

Households

4.2.3 Gas and electricity suppliers to the household sector have statutory targets for the installation of carbon-saving measures under the Carbon Emissions Reductions Target (CERT, formerly the Energy Efficiency Commitment (EEC)) – with 40% to be delivered from households at risk of fuel poverty. From 1 April 2008, CERT has allowed suppliers to meet their targets by installing all forms of microgeneration, as well as community-level combined heat and power (CHP) and biomass-fuelled district heating. The Government has already announced the continuation of some form of supplier obligation from 2011 to at least 2020, with annual savings at least equal to those under CERT. This autumn, DEFRA will be consulting on the broad shape of a post-2011 obligation, including whether it will be measures-based (like the EEC/CERT) or whether it will take the form of a cap and trade scheme or a hybrid version combining both elements.

90 The EU ETS applies to energy installations with an installed capacity greater than 20 MW capacity, which will include some large heat producers.

91 Scottish Government (2008)

Large businesses and public sector

4.2.4 The Carbon Reduction Commitment (CRC), which will commence in 2010, is a proposed mandatory cap and trade scheme that will apply primarily to emissions from large organisations which are not part of Climate Change Agreements or captured by the EU Emissions Trading Scheme – including large energy intensive business and public sector organisations, such as Government Departments, universities, retailers, banks, water companies, hotel chains and Local Authorities. By putting a cost on their carbon emissions, organisations will be incentivised to save carbon through improving their energy efficiency or deploying low-carbon heat, including renewable heat.

Heat use in new buildings

4.2.5 The Government has put in place a number of policies to support energy efficiency and renewable heat through building regulations and planning policies. This includes a target for all new homes to be zero carbon from 2016 and an ambition for all new non-domestic buildings to be zero carbon from 2019. The public sector will lead the way, building on the 2016 zero carbon schools policy, with an ambition for all new public sector buildings to be zero carbon from 2018. In December 2007 the Government published a new Planning Policy Statement on climate change which confirms the central role of planning to speed up the shift to renewable and low-carbon energy.

4.3 Renewable heat technologies

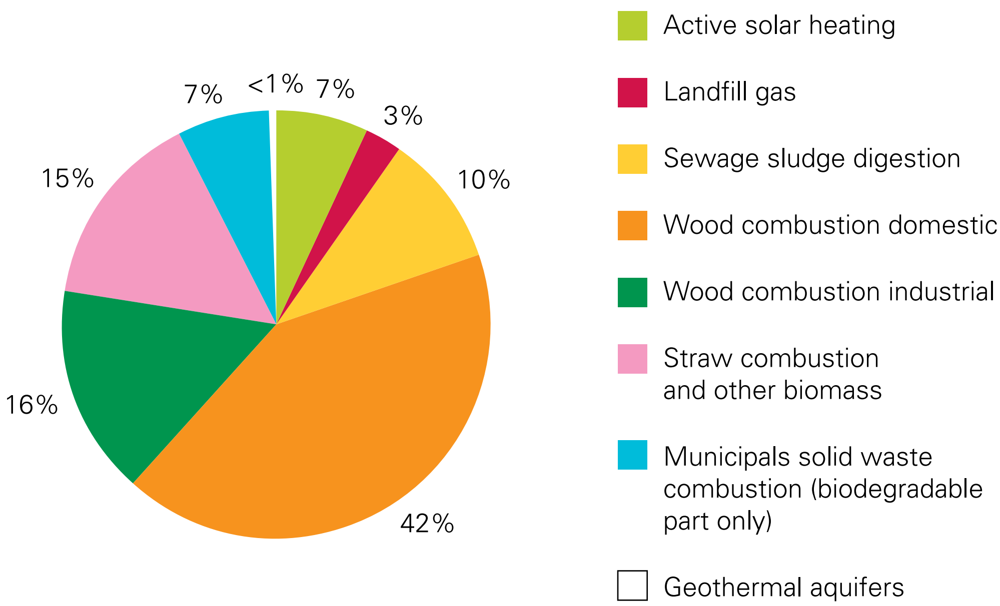
4.3.1 Currently in the UK, the most important renewable heat technologies are: heat generated from biomass, particularly woody biomass; heat generated from burning waste with a high biomass content (for example, municipal 'black bag' waste, 68% of which is biogenic material on average); and microgeneration technologies, such as solar thermal water heating units and ground and air-source heat pumps.[92]

4.3.2 The Government can help drive demand through planning policy and building regulations: Merton Rule-type planning policies[93] have the practical effect of creating demand for low-carbon and renewable heat solutions, such as biomass and heat pumps, as will the target for new homes to be zero carbon from 2016.

92 Although there is a legal definition for the size of 'microgeneration', both heat pump and solar thermal technology can also be deployed at larger scales.

93 'Merton Rules' (first introduced by the London Borough of Merton) require the use of renewable energy onsite in new build developments to reduce annual CO_2 emissions by a specified level, e.g. 10%.

Figure 4.2: Renewable heat generation in 2006 by technology (total: 5.72 TWh)



Source: BERR, 2007, 'Digest of UK Energy Statistics'

Microgeneration heat

4.3.3 Several renewable microgeneration heat technologies are available in the UK, and the number of installations is growing. These include an estimated 90,000 solar water heaters and up to 2,000 ground-source heat pumps.[94] Air and water-source heat pumps are also available (see Box 4.1). Domestic-scale biomass heat systems are considered in the 'Biomass' section below. At high levels of market penetration, microgeneration heat technologies have the potential to meet a significant share of heat demand in the medium and longer-term, even though the amount of heat produced by individual installations is low in absolute terms. Some obvious constraints affect microgeneration technologies; for example, solar water heating units are most effective on properties with south (or SW or SE) facing roofs. Ground-source heat pumps, meanwhile, require access to a suitable area of land (though this can be minimised by using a vertical borehole), while air-source heat pumps require sufficient installation space.

94 Element Energy et al (2008)

Box 4.1: How heat pumps work

Heat pumps exploit the heat present in the natural environment. Ground and air-source heat pumps are the most common types. Both use electric power to compress liquid or gas which naturally heats it up. The liquid or gas is then allowed to expand, releasing heat as it cools down. The resulting cooler liquid or gas is circulated via a pipe next to a natural source of warmth, such as the ground or the air. Because the liquid or gas is much colder at this stage than the surrounding air or ground, it will absorb heat energy until it warms up to the same temperature. At this stage the process is repeated by compressing the liquid or gas again.

Because of the natural characteristics of liquids and gases, although heat pumps consume electrical power, they generate heat energy at a factor greater than the electrical energy they consume (this ratio is called the coefficient of performance, or CoP). This is because they exploit the warmth in our natural environment, which is a renewable energy source.

Ground-source heat pumps (GSHP) extract heat from the subsoil by passing a viscous liquid through a loop system placed in either a trench or borehole depending on the space available. Air-source heat pumps exploit the heat energy in the air through a similar system. They work best when combined with under-floor heating as this requires water heated to lower temperatures than conventional household radiators. They are very reliable (comparable to modern condensing boilers) and are less expensive to install in new build housing than to retrofit. Once the initial capital investment has been made, the annual running costs of a heat pump can be significantly lower than for an equivalent fossil fuel installation – which could offer advantages to groups vulnerable to fuel poverty.

4.3.4 Solar water heating installations are most cost-effective when sized to produce 50-70% of a household's average hot water requirements,[95] while a ground-source heat pump can meet the majority of a household's water and space heating needs. Scaled up in size, both can provide space and water heating for relatively large buildings. All heat pumps require electricity to operate and the coefficient of performance (CoP) is crucial to determine how much carbon abatement can be achieved by a heat pump. Grid electricity will typically have been produced from fossil fuels at an efficiency of (say) around 50% or less, so to represent a genuine energy and carbon saving (compared to gas-fired boilers which have an efficiency close to 100%) they need to have a CoP of around 2.0 or greater. Typically figures of around 3.0-4.0 are quoted for heat pumps, implying significant savings. However, as some respondents to the Heat Call for Evidence suggested, in some circumstances lower CoPs will be observed, for example where a heat pump has been installed in a badly insulated house. This highlights the need for microgeneration installations – and other interventions such as improvements in energy efficiency – to be tailored to individual locations. In the longer-term, heat pumps will achieve a higher rate of carbon abatement if the carbon intensity of grid electricity decreases (due to the deployment of renewables, nuclear or fossil fuels with carbon capture and storage).

95 Element Energy et al (2008). Solar heating systems can also be used to provide space heating in some circumstances.

Biomass heat, heat from waste and biogas

4.3.5 The OCC's analysis suggested that available renewable heat technologies capable of delivering at scale are few in number. Their front runner was biomass heat, which could be deployed at all scales from intermediate industrial use down to households. Biomass heat comes from the burning of organic matter of recent origin. Wood is the most common biomass fuel – small-scale domestic biomass appliances usually run on wood pellets, wood chips or wood logs, and larger plant that is compliant with the Waste Incineration Directive can burn 'waste wood' or mixed waste containing biomass.

4.3.6 Biomass heat is a proven technology and is one of the most cost-effective potential sources of renewable heat. At present it has only a small market share in the UK, although the sector is growing strongly from this base. The responses to the Heat Call for Evidence broadly agreed that biomass heat might be the leading renewable heat technology, although many raised potential constraints such as the sustainability of the biomass fuel supply. Given the likelihood that imports of woody biomass fuel may be necessary to support high market levels of biomass heat, this issue is important. Ensuring that woody biomass fuels used in the UK are produced sustainably is discussed in Chapter 7 (bioenergy).

4.3.7 Some types of biomass can also be used to produce 'biogas' through the process of anaerobic digestion, which can then be used directly to generate electricity or heat on site. Biogas can also be upgraded (or 'reformed') to make 'biomethane' and injected into the existing gas grid. This is a relatively new process, though in some EU Member States projects have already begun injecting biomethane into the grid. The potential for biogas in the UK is discussed in Chapter 7.

Heat from biomass waste

4.3.8 Where biomass waste cannot be reused or recycled, it makes economic and environmental sense to use biodegradable waste as a renewable fuel. The OCC's analysis suggested that with moderate financial support in place, the potential for heat from waste could be approximately 4 TWh a year, and with more ambitious policies in place the long-term potential to generate energy from waste might be in the order of 45 TWh. However, there are significant barriers, especially public acceptability of the deployment of new waste incineration plant (see Chapter 7 on Bioenergy) which manifest as objections to planning applications. Other technologies such as gasification may offer a low emission alternative to direct burn incineration although there may be some way to go before such technologies become commercially viable and planning objections could remain. There could be significant potential to generate energy, including heat, from the substantive waste wood stream.[96]

Renewable combined heat and power

4.3.9 Combined heat and power (CHP) technology is a carbon-efficient process that captures and uses the waste heat produced during electricity generation. It can be used whenever electricity is generated through combustion of a fuel,

96 See for example DEFRA (2008a)

including all types of biomass and biogas electricity generation. Currently most CHP in the UK is powered by fossil fuels, but there is potential to increase the use of renewable fuels such as biomass or biogas. CHP can greatly increase the overall fuel efficiency of the power plant, resulting in fewer carbon emissions from fossil fuels and more efficient use of renewable feedstocks. Gas-fuelled CHP, which can deliver low-carbon heat, will be addressed by our work on a heat strategy later this year.

4.3.10 Generally, using biomass and biogas for energy generation in CHP plants is more efficient than for power generation alone. The electrical efficiency of power-only biomass plants is quite low, due to the lower energy content of the fuel and the technologies involved. As the heat to power ratio of renewable CHP scheme is typically of the order of 3:1[97] they could be significantly more effective to deliver the EU renewable energy target than power only plant, per input unit of fuel.

Potential for renewable CHP

4.3.11 CHP is most economic when there is a continuous heat demand, such as on industrial sites in continual operation or in mixed-use community developments consisting of offices, retail space and homes. Currently most CHP is gas-fuelled. There could be potential to convert to renewable CHP in industrial applications where the bespoke nature of the original investment may make adaptation easier, and in district heating schemes – either in new build developments or existing schemes that are currently run on oil.

4.3.12 Our initial analysis indicates that there is potential to achieve up to 23 TWh from Combined Heat and Power fuelled by renewable sources.[98]

Increasing renewable CHP

4.3.13 The Government has introduced a range of measures to support the growth of Good Quality CHP (GQ CHP) in the UK.[99] These include Enhanced Capital Allowances for all GQ CHP eligible expenditure and Business Rates exemption for certain GQ CHP power generation plant and machinery. These apply to both CHP fuelled by fossil fuels and biomass, so not all the plant supported by these policies will be renewable.

4.3.14 However, planning policies and future revisions of the Building Regulations in the drive towards zero carbon homes and non-domestic buildings could make renewable CHP, coupled with district heating schemes, an attractive heat technology for new developments in the near future. This could also be met by small-scale biomass CHP, although this is not commercially available to the market in the UK yet[100] and may require research and development (discussed in Chapter 8).

97 Annex A, DEFRA-DTI-DfT (2007)

98 Enviros (2008). Figures estimate the potential contribution of any individual technology in 2020, where the higher end of the range can only be achieved if steps are taken to overcome constraints to the maximum deployment of the technology – taking into consideration only non-financial constraints.

99 The UK has a domestic target of 10 GW of installed Good Quality (GQCHP) capacity by 2010, where GQ CHP refers to the outputs of schemes that meet the energy efficiency criteria laid down in the UK's CHP Quality Assurance Programme (CHPQA).

100 RAB (2007)

4.3.15 Under the proposed reforms to the Renewables Obligation (RO) currently being taken forward through the Energy Bill, the proposal is that dedicated biomass CHP plants will receive two Renewables Obligation Certificates (ROCs) per MWh of generated electricity, as opposed to 1.5 ROCs for power-only plants. This is in recognition of the costs associated with installing heat recovery and supply equipment, along with the additional maintenance and management costs, and to offset the higher risks associated with heat supply contracts.

4.3.16 As this chapter sets out, we are currently considering which market mechanism would best incentivise renewable heat. Should such a mechanism be introduced, the Government would expect to review the level of support that electricity generated by biomass CHP stations receives under the RO, as the installations involved may then also be able to benefit directly from support for their renewable heat output. Changes to the support offered for biomass CHP stations under the RO would apply to existing projects if those projects benefited from any new heat incentive. We recognise the importance of protecting existing investments in biomass CHP stations. In reviewing their overall financial support under the RO, in the light of a new heat subsidy, we would therefore aim to ensure that any reduction in their level of support under the RO did not reduce the overall support available for the installation.

Q13: Assuming financial support measures are in place, what more could the Government do to realise the full potential of renewable combined heat and power?

Electric heating

4.3.17 New buildings are highly thermally efficient and require minimal space heating in comparison with the typical existing housing stock, although water heating will still be required. For these buildings it may be cost-effective (because of upfront capital costs and the space requirements of gas boilers) to install only electric heating. To the extent that electricity is renewable (which may be over 30% by 2020), electric heat would also be partly renewable. However, on the basis of the draft Renewable Energy Directive, this would not contribute directly towards the 2020 target as the renewable electricity involved would already have been counted. Government analysis indicates that to meet the current total UK heat demand for both new and existing buildings through electrical heating would require a 130% increase on the present UK electricity generation capacity to allow for peak winter heat demand.[101] In the longer-term, using decarbonised electrical heating for existing buildings may become more attractive, but many of the responses to the Heat Call for Evidence argued against expanding electrical heating now, apart from via heat pumps (which are in effect a sophisticated form of electric heating).

101 BERR (2008c), pp20. The figure is based on total heat demand in 2020 being equivalent to 80 GW of continuous demand.

District heating networks and renewable heat

4.3.18 The national gas grid is the largest element of the UK's heat delivery infrastructure. The only renewable heat solution that can use it is biomethane (see Chapter 7 on Bioenergy), which can be blended with natural gas. For heat users with access to the gas grid, the most cost-effective renewable heat solutions that could be deployed at a large scale (heat from larger-scale boilers or combined heat and power units using renewable fuels) may require district heating networks to be built.

4.3.19 It is estimated that about 40-60% of hospitals, universities and industrial sites, but only 1-2% of housing, are currently connected to district heating networks. This is equivalent to approximately 4% of the UK building floor area.[102] Most were established in the 1970s or earlier and use a wide range of fuels and heat sources including gas, coal and waste combustion plants. At present very few of these district heating systems use renewable fuels. The existing heat networks (for example, Southampton, Birmingham, and others) have the potential to grow organically within urban centres to supply an increasing number of heat customers.

4.3.20 Heat networks of this type are not only useful for renewable heat; they could also play an important role in creating developed markets for heat produced from fossil fuels, for example, gas combined heat and power. The widespread emergence of such heat networks will raise questions about consumer protection and the need for market regulation of heat markets in general. Heat networks will be considered in detail in our development of a heat strategy during the autumn.

4.4 The potential for renewable heat

4.4.1 Meeting the EU 2020 renewable energy target will require the deployment of far more renewable heat than was anticipated by the OCC analysis. The Enviros study[103] looked at scenarios where 11% and 14% of UK heat demand is met by renewables in 2020 and suggested that biomass could make the largest contribution to cost-effective renewable heat delivery, largely due to the comparatively modest extent of constraints affecting take-up. In the 'medium' scenario[104] equating to around 11% of heat demand being met from renewable sources, the study suggested that biomass could deliver more than half of the total, falling slightly as a share of the total in the 14% 'high' scenario. This share of biomass in total renewable heat takes into account the potential competition for biomass feedstock with the electricity sector.[105]

102 Based on analysis DEFRA (2007b)

103 Enviros (2008)

104 In this case 'low' 'medium' and 'high' refer to levels of effort towards meeting the target.

105 In recognition of the potential constraints on availability of biomass feedstocks as world demand for renewables increases, BERR has assumed a limit on the total amount of biomass available within the UK, which takes into account estimated UK potential as well as the potential for imports. This feedstock has been apportioned between the heat and electricity sectors according to cost-effective potentials established in the Poyry report. In the absence of this constraint biomass would be expected to represent an even greater share of the total potential for renewable heating.

4.4.2 In the medium and high renewable heat scenarios, it was also suggested that biogas could contribute significant amounts – perhaps around a quarter of the total in the latter case. However, the costs per MWh of overcoming constraints to capacity expansion are significantly higher for biogas than for biomass. As a result, the NERA study, which looks to minimise the costs of attaining a given share of renewable heat, identified a smaller role for biogas.

4.4.3 Microgeneration heat would also need to play a significant role in renewable heat delivery. In the medium scenario heat pumps and solar thermal units could account for a quarter or more of total renewable heat in 2020. However, this level of market penetration would require a rapid expansion in the installation rate; for example, a 40% increase per year in the case of solar thermal.[106] This is consistent with expansion rates observed recently in other EU countries, though they would need to be sustained for a longer period of time.[107] In the high scenario the Enviros analysis suggested that in the order of 25% of households would need to be fitted with solar thermal units – equivalent to about 2.5% of total UK heat demand in 2020.

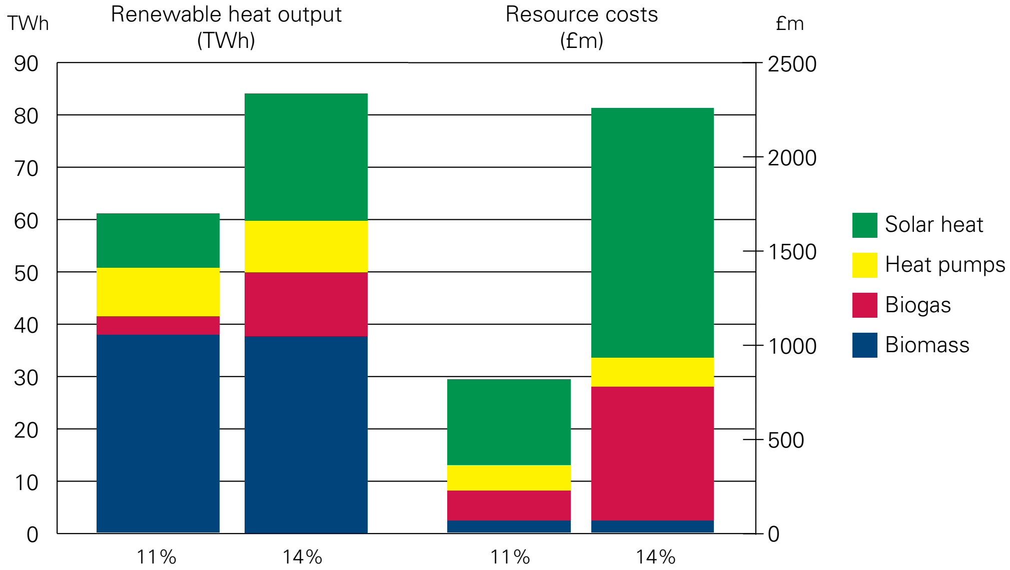
4.4.4 The analysis indicates that the cost of overcoming constraints rises dramatically as the share of total heat demand rises. This is because the costs associated with barrier removal and market expansion are higher for the solar thermal and biogas technologies which play a bigger role in the technology mix at higher total uptake levels. The 'true' potential for renewable heat in 2020 will depend on how competitive it proves to be on the ground (factoring in any financial incentives) and the extent to which the sector can take advantage of the removal of constraints to deployment and respond to the market incentives to expand. New renewable heat technologies, or refinements to existing ones, may also come to market.

4.4.5 NERA's modelling of renewable heat uptake has taken into account technology costs, as well as the cost of removing constraints established by Enviros, to estimate the mix of technologies which may achieve 11% and 14% renewable heat at least cost. Figure 4.3 depicts illustrative scenarios showing the role that each technology may play in 2020, as well as the total resource costs for each technology. It is evident that in moving to the high scenario, resource costs rise more rapidly than total generation, largely due to the bigger role for more costly technologies such as solar thermal and biogas.

106 Enviros (2008)

107 Total market growth rates observed in 2006: France 83.1%; Germany 56.1%; Denmark 55.3%; Italy: 46.4%. from EurObservER (2007).

Figure 4.3: Illustrative heat scenarios and associated resource costs in 2020[108]



4.4.6 The OCC work strongly suggested that renewable heat technologies will be closest to commercial off the gas grid, where they will be competing with heating technologies such as heating oil and electric heating which have historically been more expensive than gas heating. It follows that this is where renewable heat can be brought on for least cost in the nearer term. Indeed, BERR has announced that, in partnership with the Welsh Assembly Government and three RDAs, it will fund a pilot fuel poverty workstream within the Low Carbon Buildings Programme to provide economically viable, renewable space-heating technologies to households in fuel poor communities.

4.4.7 82% of domestic properties in Great Britain have access to the gas grid (the figure is significantly lower in Northern Ireland where most places outside Belfast are not connected to the gas grid).[109] This places a practical limit on how much renewable heat demand can be delivered off the gas grid by 2020 (the rate at which heating units are replaced is another factor here, as is the distribution of large heat loads suitable for renewable heat solutions). An issue for Government policy is the desirability of encouraging renewable heat technologies in locations where cheaper gas heating alternatives are available. To do so could imply larger amounts of financial support, though in some cases consumers may be prepared to pay more for technologies they perceive as 'greener' or more sustainable technologies.

Q14: Are our assessments of the potential of renewable heat deployment correct?

108 NERA (2008) and BERR analysis
109 BERR (2007c)

4.5 Financial incentives

The case for a financial incentive

4.5.1 Some of the renewable heat technologies that could be used within the UK have higher upfront capital costs than fossil fuel alternatives – even if a carbon price is included – and heat customers will need a financial incentive to encourage them to switch to renewable energy.

4.5.2 Financial incentives will be a crucial factor but a number of other 'demand-side' factors will also affect customer willingness to switch. Some of these issues, and the steps being taken to address them, are discussed in section 4.6 below. A financial support scheme will need to make renewable heat options more attractive than conventional alternatives, and it will need to be introduced in parallel with measures to address the various 'supply-side' constraints to renewable heat discussed in this chapter. The Government may wish to consider using regulation to ensure that households and businesses claiming any financial incentive for renewable heat have already taken all appropriate energy efficiency measures.

4.5.3 The Government could also use regulation to bring about an increase in the take-up of renewable heat; for example by encouraging the use of renewable heat technologies in certain situations, such as new build. The benefit of a financial instrument over regulation is that it targets customers who have the lowest cost of switching to renewable heat and allows individual choice. Many of those with the lowest costs of switching to renewable heat – in part due to the high costs of their current heating systems – are off the gas grid, and may be more likely to be fuel poor. Equally, the use of regulatory options should not be seen as a direct alternative to financial support. There may be a case, at a later date, for introducing some regulatory measures in addition to financial support to increase the uptake of renewable heat.

Options for a financial incentive

4.5.4 The use of a scheme to promote the uptake of renewable heat is a new step for the UK and involves certain challenges given the nature of the UK heat market.

4.5.5 Respondents to the Heat Call for Evidence strongly supported the view that a financial incentive for renewable heat is essential to increasing market penetration, both to increase the attractiveness of heat opportunities and to equalise incentives between the use of biomass in the heat and electricity sectors. To date, UK schemes to promote renewable heating have been customer or technology specific, such as the Low Carbon Buildings Programme, which provides grants to support the cost of installing microgeneration including biomass boilers, solar thermal units and heat pumps. A financial incentive able to deliver a substantial share of renewable heat by 2020 will need to be of an entirely different scale, applying to a wide range of technologies and customer segments, and at a sufficiently high level of financial reward to promote substantial take-up of these technologies.

4.5.6 The evidence base for a possible financial incentive has come from stakeholders' responses to the Heat Call for Evidence and research commissioned by the Government into the various options.[110]

4.5.7 The broad categories of policy measures which could be used to promote the take-up of renewable heat are:

- financial support for the installation of renewable heat technologies: grants, soft loans;
- a 'bonus' or 'incentive' paid to all generators of renewable heat at a given £/MWh: akin to a feed-in tariff in electricity;
- an 'obligation' requiring that a pre-determined share of heat used in the UK is generated from renewable sources; and
- the use of cap and trade emissions, or energy taxes, increasing the cost of conventional heating options and indirectly making renewable heat options more financially attractive.

4.5.8 Each of these options has pros and cons. Respondents to the Heat Call for Evidence presented arguments both for and against each of the three main options of a grant scheme, an obligation and an incentive. In particular, respondents identified that different schemes may be more appropriate for different customer groups. The views from the Heat Call for Evidence and the qualitative evaluation of the alternative policy options have given us an improved understanding of the relative merits of alternative policies. The various options are set out below.

Grants

4.5.9 Capital grant schemes can offer simplicity of design and are relatively easy and cheap to administer. They can also be adjusted over time. They are particularly suited to encouraging domestic and community uptake where high upfront installation costs are often the greatest obstacle. However, in practice the time-limited nature of many schemes, and their dependence upon tax funding and therefore the Government's budget position, can create uncertainty for equipment suppliers over future demand, leaving them unwilling or unable to invest in further capacity. Their public sector-led nature also reduces the role of the market within the energy sector. These problems could be acute for a grant scheme on the scale required to deliver significant renewable heat by 2020. Grants also carry a risk of permitting large economic 'rents' to develop, especially for larger schemes (though this can be countered by auctioning). Overall, using grants alone to incentivise renewable heat looks unattractive, though they may have a role to play for some customer segments.

A renewable heat incentive

4.5.10 A Renewable Heat Incentive (RHI) would pay revenue on the basis of the quantity of heat generated – and so is similar in nature to the use of feed-in tariffs in electricity markets. As discussed in Chapter 3 (Centralised

110 NERA (2008) and BERR (2008c)

Electricity), there have been international examples of the use of feed-in tariff schemes to stimulate renewable electricity take-up. However we are not aware of an example of the use of a RHI-type instrument for renewable heat.

4.5.11 For the heat sector, a RHI could be administered by assigning certificates to the heat producers based on the renewable heat generated, with energy suppliers (or another organisation) required to purchase these certificates at a pre-arranged price. RHIs could provide a predictable income stream to the heat generator. Box 4.2 sets out in more detail how a RHI scheme could work.

4.5.12 In the case of smaller generators such as individual households, the cost of meters to measure heat output is likely to be too high to justify their use, and hence 'deeming' the output may be a more practical option. Where output of an installation is 'deemed', the installation's heat output over time is estimated based on its characteristics, and certificates could be awarded based on this estimated level of output rather than actual output measurement.

4.5.13 Regardless of the method of measurement, the level of the RHI is crucial in determining the amount of renewable heat which comes forward. If set too low the RHI would have limited effect on take-up, but if set too high the costs of the policy would be very high. Flexibility to change the level of the RHI over time is therefore required.

4.5.14 A key characteristic of a RHI is that it relies upon heat generators, or businesses elsewhere in the supply chain such as installers, identifying the market opportunities which are offered by the newly available financial support. For this potential to be realised the barriers to switching to renewable heat, including inertia, 'hassle factors', and consumer awareness must be overcome.

A renewable heat obligation

4.5.15 In contrast to a RHI, an obligation-type instrument is placed on a party to, in effect, require the production of a certain amount of renewable heat. In this case it is likely that suppliers of fossil fuels for heating (or heat from fossil fuels directly in the case of the small number of heat-selling schemes) could be required to present certificates equal to a given share of their total fossil fuel sales. These certificates could either be bought on the open market from generators of renewable heat or could be obtained by the suppliers directly contracting for the generation of renewable heat. The latter arrangement could be akin to the model used by the large energy suppliers to meet their obligations to ensure the installation of energy efficiency measures under the EEC and CERT. More detail about how an obligation may work is provided in Box 4.3.

4.5.16 An obligation could fit well with the UK's existing market-based policy landscape. Being a market mechanism, it would allow the market to search out the lowest cost opportunities for the installation of renewable heat.

4.5.17 However, there are difficulties with using an obligation within the heat sector. Unlike the electricity sector, where the RO operates by placing an obligation on the relatively small number of businesses supplying electricity, the heat sector features a very large number of heat generators including more than 20 million domestic householders. It could be necessary to lay the obligation on fuel suppliers as a proxy for heat generation using fossil fuels, and to cover a wide range of smaller fuel suppliers who deliver fuel to properties off the gas grid. These smaller suppliers would be unlikely to have the capacity to enter direct contracts for renewable heat generation at reasonable costs, and so in the absence of a liquid secondary market in certificates, there may need to be a buy-out option. In the absence of such an option small suppliers could face higher relative costs of compliance than larger operators.

4.5.18 As with the RHI, good information about the costs and potentials of renewable heat technologies is essential in setting the level of the obligation. Under a RHI the level of financial support is known, whereas under an obligation the level of uptake is determined first. If set at too high a level, the obligation could result in high energy prices for the consumer. The danger of this could be alleviated by including a buy-out price, as with the RO, but in order that the purpose of using an obligation is not undermined, the scope for larger suppliers to buy out could need to be limited. As emphasised by respondents to the Heat Call for Evidence, it may be desirable to link an obligation across the electricity and heat sectors, as a means of removing the distortion in incentives available for biomass used in the different sectors and increasing the chance of attaining the least-cost mix of renewable installations.

4.5.19 As with a RHI, deeming of output could be required for smaller heat generators. Equally, under both schemes it could be necessary to consider how combined heat and power (CHP) schemes, which generate both heat and electricity, should be treated. It is important to reward CHP schemes for both of their energy outputs, and to remove any distortions to the efficient choice (from both a carbon and financial perspective) between heat-only, electricity-only and CHP generation resulting from the design of existing financial instruments.

Measures to increase relative costs of non-renewable heat

4.5.20 There is a range of measures which could be used to increase the relative costs of non-renewable heating, and so indirectly stimulate take-up of renewable heating technologies. These include the expansion of the Emissions Trading Scheme to cover all users of heat, rather than just the largest installations. This could be administratively difficult and could require suppliers of heating fuels to bear the burden on behalf of their customers. Given the evidence on energy efficiency measures, which indicates a limited responsiveness of households and small businesses to increased energy costs, the increase in fossil fuel prices would need to be very substantial to drive even a limited uptake of renewable heat. This suggests that while such measures to alter relative prices may be a useful step within a package of measures, alone they are unlikely to deliver the step change in renewable heat uptake required.

Criteria for selecting an instrument

4.5.21 The key criteria to consider in the design of an incentive mechanism to promote renewable heat are:

- feasibility of implementation and workability of the policy;
- effectiveness of the policy in generating take-up of renewable heat opportunities;
- cost-effectiveness of the policy in delivering renewable heat;[111]
- carbon savings associated with the policy;
- distributional consequences of the policy – relative impacts across different groups; and
- consistency with existing energy market policies.

4.5.22 Captured within these criteria are a number of issues highlighted by respondents to the Heat Call for Evidence, including the benefits of a simple scheme, and the desirability of providing long-term investor certainty. Given the large numbers of actors that will be affected by the policy, workability will be a crucial determinant of the choice of scheme. Other factors will present trade-offs, in particular the conflicting desires to ensure that the incentive encourages the least-cost technology mix through technology-neutral support, versus a wish to use banded support to tailor payments to the cost of the technology installed.

4.5.23 It is also important to consider whether the different measures will provide the necessary incentives to different customer groups. In particular we will aim to minimise the complexity of any scheme for the household sector. There may also be merits both of treating all heat generation across all the sectors within the same scheme, or of treating all heat generation within the domestic and small commercial sector within the same scheme.

4.5.24 Two key policy options to support renewable heat have emerged from the NERA work examining the various proposals against these criteria: we have called these the **Renewable Heat Incentive (RHI)** and the **Renewable Heat Obligation (RHO)**.

Scheme design

4.5.25 Many aspects of design are relatively simple in theory but their application to the fragmented UK heat market would be very complicated. The best instrument for delivering renewable heat may be determined by practical issues – alternatives which appear attractive in theory may not have the capacity to deliver what is needed. In particular, the large number of small heat suppliers appears to affect the workability of the RHO substantially, rendering it potentially much harder to implement. An obligation works well in the electricity market because of the small number of large players who are

111 Ensuring that the policy does not give any incentive for 'heat dumping' – where it is profitable for installations to operate and claim the financial pay-out, even though they have no use for the heat – is an important component of cost-effectiveness.

able to seek the least cost method of renewable electricity delivery. However, the large number of small heat suppliers might find it difficult to meet an obligation for renewable heat at reasonable cost. Whilst a de minimis clause could be used to exempt the large number of small fossil fuel suppliers from the policy, this appears inappropriate given the important role that these suppliers play collectively within the fossil fuel heating market, particularly off the gas grid, and the impact such an exemption would have on people's decisions to switch. An obligation could therefore exempt some of the heat users most likely to switch to renewable heat, who currently use some of the more expensive and carbon intensive fuels such as coal.

4.5.26 The key features of a possible Renewable Heat Incentive and Obligation scheme are set out in the boxes below.

Box 4.2: Key characteristics of a model Renewable Heat Incentive scheme

Scheme design:

- Any heat user who can prove that they have generated heat from a renewable source is entitled to claim a set payment per MWh from a central fund or from one of the obligated fossil fuel energy suppliers (depending upon scheme design).
- This could apply to all suppliers of non-renewable heating fuels, including suppliers of non net-bound fuels such as heating oil, or alternatively only to suppliers over a certain size.
- Output is likely to be deemed for small installations.
- If suppliers make payments to claimants directly, a methodology for balancing of payments across fossil fuel suppliers ensures that all suppliers of fossil fuels for heating bear a proportionate share of the total costs of RHI support, though some suppliers may face cash-flow implications if they are required to meet a high share of claims upfront, and balancing only takes place at the end of a period.
- Alternatively the policy could be operated by a central body which makes all payments to renewable heat users and collects its revenues from suppliers according to their share of costs. This would insulate suppliers from cash flow issues, though the agency itself would require some form of 'float' to ensure that it always had sufficient monies to cover claims.
- The cost of the scheme would be expected to be passed on by suppliers to all buyers of non-renewable heating fuels.
- The financial support paid to any installer of renewable heat would be known in advance, but the total amount of renewable heat coming forward – and therefore total costs of the scheme to suppliers, and ultimately their customers – would depend upon uptake of the offer.

Box 4.2: Key characteristics of a model Renewable Heat Incentive scheme (cont)

Market development issues:

- Value of the payment per MWh must be sufficiently generous to make it financially worthwhile for large numbers of heat users to switch to using renewable heating in place of their current fuel, and so is crucial in determining uptake of renewable heat.
- It is assumed that smaller heat users will not switch to higher cost renewables in the expectation of a future revenue stream from the RHI. Instead they will need to access the financial support upfront in order to assist with capital investment costs.
- Upfront support could either be offered directly through the scheme, for example with 10 years' worth of payments being made together, or through commercial arrangements. For example, suppliers of renewable fuels or equipment may enter into agreements with customers whereby the renewable firm subsidises the upfront cost of installation in the customer's premises, in return for ownership of the rights to the revenue stream arising from the RHI over time.
- Rapid development of the market relies upon firms – energy suppliers, equipment manufacturers or new businesses – identifying the opportunities offered by the availability of financial support for renewable heat and effectively marketing these to heat users.

Box 4.3: Key characteristics of a model Renewable Heat Obligation scheme

Scheme design:

- Suppliers of non-renewable heating fuels are obliged to present a quantity of Renewable Heat Certificates (RHCs) demonstrating the production of heat from renewable sources, determined in proportion to the total quantity of fossil fuels for heating that they supply. These RHCs will be obtained from producers of renewable heat.
- For small installations, eligibility for RHCs is likely to be deemed; for larger installations it could be calculated accurately using a heat meter.
- Compliance with the obligation would be monitored by a regulator, with penalties for energy suppliers not meeting the obligation.
- The scheme could apply to all suppliers of non-renewable heating fuels, including suppliers of non net-bound fuels such as heating oil, or limited to suppliers over a certain size.
- RHCs could be purchased by energy suppliers within a market for certificates, or secured through direct involvement in renewable heat projects.
- A buy-out price could be used as a ‘safety valve’, limiting the costs of compliance. This would be particularly important for smaller suppliers, and the use of the buy-out by larger suppliers would need to be limited if the benefit of the obligation in driving an increase in renewable heat uptake were not to be undermined.
- The cost of the scheme would be expected to be passed through by suppliers to all buyers of non-renewable heating fuels via fuel bills.
- The amount of renewable heat delivered by the scheme will be determined by the level of the obligation set by the Government and the availability of a buy-out option. Costs of compliance with the obligation will depend on the cost-effectiveness of the opportunities identified by energy suppliers for meeting their target, and if appropriate the level of the buy-out price.
- It would be necessary to channel any buy-out monies into renewable heat investments to ensure projected renewable heat deployment can be achieved.

Box 4.3: Key characteristics of a model Renewable Heat Obligation scheme (cont.)

Market development issues:

- The suppliers of conventional heating fuels face an obligation to present a given quantity of RHCs. Given the potential penalties for non-compliance, suppliers need to ensure that large numbers of installations take place.
- If penalties for non-compliance are sufficiently high, suppliers are likely to be unwilling to trust that sufficient certificates will be available for them to be able to purchase in the open market. Instead larger suppliers intervene directly in the renewable heat supply chain through vertical contracting for projects, as under CERT. Suppliers fund installers to invest in schemes, in return for ownership of the certificates that these schemes generate.
- Costs of direct action to install renewables are likely to be very high for smaller suppliers who do not have the necessary capacity or access to economies of scale. To limit costs of compliance these smaller suppliers would be expected to make a heavy use of any buy-out opportunity.
- Channelling the buy-out monies to suppliers who have presented RHCs, as under the RO, would result in a transfer of funds from small to large suppliers. Equally it would limit delivery of renewable heat. Hence the funds would need to be used to deliver additional renewable heat projects. The fund administrator would need to be tasked with identifying renewable heat opportunities without interfering with the market-based actions incentivised directly by the Obligation.

4.5.27 The analysis suggests that many key aspects of scheme design would be similar for any form of generation-related financial incentive. This is because of the characteristics of the heat market, including the need to deem output for smaller generators due to high costs of metering either fuel input or heat output; the extremely large number of heat generators in the domestic sector; and the fact that virtually none of these generators produce heat as their core business. This makes them unlikely to be willing to make heat investments in the expectation of future revenues from either certificate sales or RHI revenue. Feedback from stakeholders on the feasibility and practicality of policies as proposed will be crucial in aiding the Government to design an effective scheme.

Q15: Have we captured the key features of a Renewable Heat Incentive and a Renewable Heat Obligation as they would apply to the heat sector correctly? Would both of these schemes be workable and are there alternative ways of structuring the schemes to ensure they can operate effectively?

4.5.28 High upfront capital costs are a key feature of many renewable heat technologies, and a key feature of any scheme will be its capacity to stimulate uptake of small-scale installations by giving sufficient financial support to potential customers upfront, rather than over a long pay-back period. This implies that for the domestic and small commercial sectors, it may be necessary not only to deem output but to bundle these payments into one upfront subsidy. This will require us to set an upper size threshold for installations that will qualify for upfront payments – which could coincide with the size of unit where installing an individual heat meter may be uneconomic.

4.5.29 This upfront transfer could be achieved through the market, for example with the financial services sector giving upfront loans in exchange for ownership of future certificates as collateral (however, the need to transfer the loan on sale of a house or business premises would complicate this market). Alternatively, energy suppliers or equipment manufacturers could offer upfront help with installation costs in exchange for ownership of the future certificate revenue. Suppliers, manufacturers or potentially new entrants such as energy service companies would need to identify this as a profitable opportunity under the RHI if there was to be large-scale deployment of renewable heat. In the case of an obligation the larger energy suppliers would be more likely to play this role to ensure they are able to meet their legal obligation to present certificates.

4.5.30 Hence an obligation-type policy can theoretically offer some advantages relative to an RHI. An obligation, by definition, offers a 'stick' which can be expected to deliver robustly substantial amounts of renewable heat. However, if the costs of renewables delivery proved to be higher than anticipated, the obligation would result in excessive costs to the consumer or extensive buy-out, which would undermine the benefits of the policy. In contrast, there is a risk that if the 'carrot' offered by the RHI was not set at the right level (or levels, as it could potentially be banded by technology), it would prove insufficient to bring on renewable heat deployment quickly enough to ensure that the 2020 target could be met.

4.5.31 Both policy options would give investors an assured financial return for the renewable heat they planned to generate. However, an RHI would offer the renewable heat market more certainty over this income. Under an obligation, the return on generating a unit of renewable energy would depend upon the market value of a Renewable Heat Certificate (RHC), which in turn would depend upon the number that were being generated and offered for sale within the market (if deemed upfront, the value of RHCs to the investor would be much more certain). For larger schemes where revenue payments are made over time, the certainty of RHI payments should reduce the cost of capital which firms apply to the investments made in renewables, increasing the number of potential projects which become financially viable.

4.5.32 While the economic basis of the two policy options being proposed appears sound in theory, it is unclear whether the disparate nature of the UK heat market would allow a RHO to function as intended. It is difficult to construct a model which does not disadvantage the smaller suppliers within the market place. The RHO would also potentially require the creation of a central body to channel funding to projects using the buy-out fund, which would increase the complexity of the policy significantly. Heavy use of any buy-out option by the smaller suppliers would render the scheme very similar in practice to a RHI from their point of view (though the total cost to the supplier would be proportional to the amount of renewable heat coming forward under the two policies). The additional complexity of introducing a RHO under the practical constraints of a UK heat market could thus be significant, and may present an insurmountable barrier. The key argument in favour of the RHI is therefore its apparent workability in this complex market.

4.5.33 Hence the theoretical benefit of the RHO needs to be considered alongside concerns regarding workability. Respondents to the Heat Call for Evidence generally expressed a preference for one of the RHO and RHI, while not categorically ruling out the other. Initial modelling work has attempted to quantify the costs to the UK of using these financial incentives to promote substantial uptake of renewable heat.[112] The work is at an early stage and can give a guide as to the costs of using renewable heat to meet our 2020 target, but it cannot recommend which instrument should be used as it implicitly assumes that either instrument could deliver the desired uptake. Actual costs of the financial instrument selected will depend upon the details of scheme design and on the renewable heat projects which actually come forward, and of course how well the scheme works in practice.

4.5.34 The modelling work suggests resource costs and carbon benefits of a financial heat incentive, as set out in Table 4.1. These figures incorporate the costs of overcoming barriers and constraints to potential uptake alongside the costs of the technologies and fuels, and so include the barrier costs discussed above. They do not, however, incorporate the impact of demand-side factors, where work to quantify costs is ongoing. Costs can therefore be expected to rise somewhat as the analysis becomes more developed. At a renewable heat penetration of around 14%, resource costs in the year 2020 are projected to be in the range of £2 billion to 2.5 billion, with carbon benefits additional to the EU ETS valued at around £380 million.

112 NERA (2008)

Table 4.1: Indicative resource costs and carbon benefits associated with achieving 11% and 14% renewable heat[113]

Scenario	Resource costs in 2020 in £ billion	Carbon benefits in 2020 in £ billion	Net welfare effect in 2020 in £ billion	Resource costs cumulative to 2030 in £ billion	Carbon benefits cumulative to 2030 in £ billion	Net welfare effect to 2030 in £ billion
11%	£0.8 – 1	£0.25	-£0.5 to -£0.7	£8 – 11	£3.3	-£5 to -£7.5
14%	£2 – 2.5	£0.38	-£1.6 to -£2.1	£23 – 28	£4.8	- £18 to -£23

4.5.35 These resource costs – the cost of using renewables to generate heat compared to the costs of using the conventional heat generation technology that would have been used in the policy's absence – are potentially small relative to the total subsidy cost associated with the policy. This is because some generators of renewable heat may be able to extract significant 'rents', which are payments over and above the costs which they will actually incur in switching to using renewable heat. Rents may be particularly large in the heat sector due to very large variations in performance and cost-effectiveness across installations, which would make it difficult to tailor financial support to directly reflect installation costs even where banding is used. Estimated subsidy costs for the policy are at a very early stage, but may be in the region of £1.9 billion in 2020 for 11% renewable heat and £4 billion for 14% take-up.[114] Assuming that costs of compliance with the policy are passed through by fuel suppliers to their customers, this could imply gas price increases in the region of 18-37% for domestic customers in 2020 under a 14% scenario, and increases of 6-16% in the case where renewables achieve an 11% share of heating.[115] There will also be price impacts on other fossil fuels used for heating including heating oil and coal.

4.5.36 Either of these policies – the RHO or the RHI – could in theory help incentivise renewable heat and ensure that it plays its full role in delivering the 2020 target. Both financial instruments may require primary legislation to implement and State Aid clearance before they could be introduced. However, whilst the RHO could theoretically prove more reliable in bringing on the levels of renewable heat we need, serious questions about its workability imply that the RHI is more likely to be able to deliver the increase in renewable heat required to meet our 2020 target. The Government's emerging thinking is to favour a RHI.

Q16: Do you agree with our assessment that a Renewable Heat Incentive would work better in the heat market?

113 Based on NERA (2008). Values are discounted to 2008 and presented in 2008 prices. The resource costs take into account the value of EU Allowances saved in the EU ETS sectors.

114 NERA (2008) and BERR analysis

115 These price impacts are based on central fossil fuel assumptions and will be lower in the case of higher fossil fuel prices (and higher in the event that fossil fuel prices are below the central projections).

4.6 Non-financial constraints

4.6.1 Providing additional financial support for renewable heating technologies will be crucial in encouraging individuals and businesses to use renewable heat. However, the impact of the financial incentives will be limited by other, non-financial factors impeding the take-up. This is likely to be particularly true in the domestic sector, where individuals will consider factors other than simple cost-effectiveness when making a decision on new heating technologies, such as habit and the experiences of their neighbours.

4.6.2 Some constraints are common to all new renewable heat technologies, for example wariness of new technologies and lack of information about alternatives. Others are specific to the individual technology, such as the requirement for a suitable area of ground to install a ground-source heat pump. Some of the key non-financial constraints to renewable heat take-up are set out below:

- limited awareness of renewable heat among Local Authorities, suppliers and potential producers of renewable heat;
- air quality impacts from the combustion of biomass;
- a range of supply chain issues, such as lack of qualified installers and designers; and
- planning and building regulations.

4.6.3 Issues relating to increased deployment of biomass, such as the development of robust supply chains, and fuel quality standards, are dealt with in Chapter 7 (Bioenergy). We also expect that some constraints will be overcome by the market 'pull' of the financial incentive for renewable heat (for example, as jobs emerge for trained installers, more workers will seek to acquire the necessary qualifications).

Raising awareness of renewable heat

4.6.4 Despite its recent higher profile, relatively speaking, in environmental and energy circles, renewable heat remains a little known technology option. It has a very limited tradition in the UK, and must make headway in the marketplace among a range of other 'green' technology innovations. To encourage the use of renewable heat we will need to bring all types of consumers, administrators and commentators up to speed on what renewable heat is, and what it can offer, and instil confidence that the technologies are serious alternatives to traditional heating systems.

4.6.5 Heat generation is generally localised and de-centralised, therefore some of the decision-making that will affect the take-up of renewable heat will happen at a local and regional level, and Local Authorities and Regional Development Agencies (RDAs) will be critical players. While some Local Authorities and RDAs are proactive in encouraging renewable heat use and biomass supply chains in their areas, the potential for renewable heat could be better understood at regional and local level as others develop their response to the Planning Policy Statement: planning and climate change.

4.6.6 We believe that, at a local level, Local Authorities will play a crucial role in developing heat solutions appropriate to the local area and natural resource. The Government has been encouraged by the number of Local Authorities which have included the climate change mitigation indicator in their proposed local area agreements. Heat strategies could form part of the response to delivering this indicator. The proposals set out elsewhere in this chapter will provide a strong framework within which Local Authorities can play their part.

4.6.7 At a regional level, RDAs can act to encourage supply chains and identify the knowledge base among Local Authorities (a number of the English regions already have renewable energy bodies). They could also identify areas with potential for larger scale renewable heat, for example in regional industrial clusters.

4.6.8 One potential area for Government action would be to work with appropriate best practice partners to devise and deliver a training programme for Local Authority and RDA planners, decision-makers, architects, developers and investors, which presents clear information on renewable heat potential, options and solutions.

4.6.9 Another potential measure would be to develop options to work with RDAs to fill the regional information gap and promote sustainable biomass sourcing and use. This could involve giving Local Authorities and/or RDAs responsibility for:

- identifying the most suitable heat loads in their areas, and proactively contacting the relevant heat customers to determine whether they are familiar with a renewable heat option. Local Authorities and RDAs would receive assistance and support from Central Government; and
- identifying or cataloguing the biomass fuel resources in their locality in order to enable the faster development of local biomass supply chains. This would include woody biomass resources, as well as other potential heat fuel stocks such as wet wastes.

4.6.10 There is already a range of channels to communicate messages on new and changing policy objectives to public sector officials. It is more challenging to reach those who are key to driving an increase in renewable heat; architects, developers and, crucially, heat customers for whom renewable heat solutions may represent a realistic option. The discussion in Chapter 3 (Centralised Electricity) on improving advice for planners, developers and others is clearly applicable here. One example of where work of this type is already underway for one renewable energy technology (biomass heating) is the Carbon Trust's Biomass Heat Accelerator. Working with technology providers and a large number of suitable biomass heat customers, the project covers the full implementation process and enables highly cost-effective installations to come forward. It should significantly expand the potential market for this particular technology.

Air quality and biomass

4.6.11 Air pollution, in the form of fine particles and nitrogen dioxide, is still a major concern in urban areas in the UK.[116] The EU Air Quality Directives set mandatory limits on the concentration of both, which many urban areas are struggling to meet primarily due to pollution from transport and transboundary sources.[117] All combustion processes produce these pollutants to some extent, dependent on the type of combustion and the fuel used, including biomass boilers and biomass Combined Heat and Power. However, these emissions can be significantly reduced through high quality burner design and modern scrubbing technologies. Some responses to the Heat Call for Evidence highlighted the potential dangers of airborne pollutants from biomass combustion. Given the potentially crucial role that biomass heat could play in delivering renewable heat, it is worth considering this issue in some depth.

4.6.12 Under the Environment Act 1995, Local Authorities are required to designate Air Quality Management Areas where national air quality objectives are not met, or are unlikely to be met, and to prepare an air quality action plan. However, Local Authorities have no practical powers of intervention so far as emissions from biomass are concerned.

4.6.13 Air quality in urban areas is also covered by the Clean Air Act 1993, which requires that in 'Smoke Control Areas', non-smokeless fuels (including biomass) must be burnt in an approved or 'exempted' appliance. However, it is generally accepted that modern biomass boilers can easily meet these, and far higher, emission standards. Table 4.2 summarises the current regulatory framework for limiting emissions from static combustion plant of various sizes.

116 The requirements on air quality set by the EU apply across the UK. Environmental policy is a devolved matter (though compliance with EU legislation is not), and the Scottish Executive has set its own air quality objectives for some pollutants, as could the other Devolved Administrations if they so wished. The approach to local air quality management is consistent across the UK.

117 Air pollution which originates in other countries and is transported to the UK through atmospheric processes. The distances travelled can vary from the relatively short (Northern Europe) to inter-continental (North America and Eastern Asia). The UK also 'exports' pollution to other countries.

Table 4.2: Permits required for combustion plants

Combustion plant size in kW	Control mechanism
>45	Testing for use in Smoke Control Areas using set standards (PD6434)
Up to 240	No controls for installations outside of Smoke Control Areas
240 – 20,000	Clean Air Act (Emission of Grit and Dust from Furnaces) Regulations 1971
20,000-50,000	Local Air Pollution Prevention and Control permit (LAPPC); including commitment to use the Best Available Techniques (BAT)
>50,000	Integrated Pollution Prevention and Control (IPPC) permit; including commitment to use the Best Available Techniques (BAT)
Waste combustion[122]	Compliance with the Waste Incineration Directive

4.6.14 The potential cumulative effect on air quality of fine particles and nitrogen dioxide emissions from a future large-scale deployment of biomass appliances or plant is not yet well understood. DEFRA and the Scottish Executive have undertaken programmes of research looking into the 'real world' emissions of currently installed modern plant, and the potential impact on air quality and public health of different uptake scenarios for biomass heat. In rural areas the impact on air quality, and public health, is likely to be lower, due to both lower population densities and 'background' levels of pollution.

4.6.15 The results from preliminary analysis undertaken by AEA Energy and Environment on behalf of DEFRA indicates that if high levels of solid combustible biomass were used in dense urban areas, where heat demand is highest, the impact on air quality would be likely to be very significant. Stringent emission controls on individual plant would mitigate this effect. However, it should be noted that high biomass heat uptake in urban areas could be very unlikely for commercial and spatial reasons, and indeed undesirable at levels that would cause air quality issues. Uptake of domestic biomass heat is likely to occur mainly off the gas grid, where the dominant heating technologies (such as heating oil, electrical heating, or coal heating) are currently more expensive than gas. Coal heating emits higher levels of nitrogen dioxide and particulate matter than wood, and there is evidence that, for particulate pollution at least, modern wood fired heat gives comparative emissions to oil.

4.6.16 DEFRA is undertaking further analysis to assess the impacts of realistic uptake scenarios. In order to facilitate the level of biomass uptake necessary

118 Note that the control of waste combustion is complex, and depends on the nature of the waste, and the throughput of the plant, in addition to its size.

to meet the UK's renewable energy obligations, while at the same time protecting air quality and public health, controls will be needed both on the emissions of individual plant and on the cumulative emissions of plant depending on the existing air quality in a given area. The controls on cumulative emissions must be seen in the context of controls on other pollution sources, and opportunities to reduce emissions from road transport and other combustion sources must also be sought.

4.6.17 There is currently no clear advice about the locations, types and sizes of boilers that would not cause air quality issues, and there is currently no agreed European test procedure.

4.6.18 In response to these issues we are considering possible measures that will allow the deployment of biomass-fired plant, in both rural and urban areas, at the maximal sustainable rate that does not compromise our objectives on air quality or public health. The possible measures listed below aim to avoid suppressing biomass heat uptake in areas where it is unlikely to impact significantly on air quality, and to simplify the regulatory regime for plant up to 20 MW, updating it to reflect a modern environmental and regulatory context.

4.6.19 A possible measure would be to determine what product and emission standards should be established for biomass boilers and combustion plant to restrict the future impact on air quality to a minimal level. There are a number of options to take this forward, such as applying a single set of emission standards, broken down by unit thermal rating, to be applied everywhere. These would be dictated by the need to protect urban air quality.

4.6.20 Another option would be to apply a two-tier standard, with the top tier reflecting the 'best possible' in terms of emissions. This top tier could then be used as a specification standard for areas where air quality is or may be compromised. There is also the option to apply standards in two stages, with a standard which allows only high quality design applying from, for example, 2010, and a second stage 'stretch target', which allows only the very best performance applying from, for example, 2014.

4.6.21 In addition to controls on emissions from new biomass plant, this would involve some form of type approval scheme and appropriate enforcement. Legislation may be required to introduce such a system, and to amend the provisions of the Clean Air Act 1993. These controls may increase the cost of individual units, although evidence from emission controls elsewhere shows that innovation may reduce such costs over time. However, the benefits of such controls in terms of monetised health impacts are highly likely to outweigh the costs by a substantial margin. An additional benefit will be increased public and regulator confidence in biomass as a system of heating.

4.6.22 We are also considering giving Local Authorities more control over the installation of biomass in areas where air quality may be compromised (for example, in Air Quality Management Areas) to give reassurance that biomass installations will not create significant additional air quality issues in that area. This could involve enabling Local Authorities to require the installation of only the highest quality units in these areas.

4.6.23 This measure could be linked to the measures set out in paragraphs 4.6.19 and 4.6.20 for product and emission standards and would not apply to domestic units, e.g. below 45 kW, which would still be covered under the Clean Air Act 1993. It would involve extending Local Authorities' current powers and duties under the local air quality management regime (LAQM), either through new legislation or regulations made under the Environment Act 1995; it would also require the updating of current guidance to Local Authorities on LAQM.

4.6.24 For both proposals there is likely to be an additional cost to potential operators in urban areas, and a small associated administrative burden. However, the benefits of such controls in terms of monetised health impacts are highly likely to outweigh the costs by a substantial margin. An additional benefit will be increased public and regulator confidence in biomass as a system of heating.

4.6.25 Given that equipment deteriorates over time and needs to be operated properly, we may need to update regulations to ensure that installed equipment continues to be run in a way that meets emissions standards. Any type of approval scheme may therefore need to be complemented by arrangements to ensure that emission standards are maintained. In other countries, including Austria, Germany, Denmark and the United States, concerns over air quality deterioration caused by older style biomass boilers has led to the introduction of an MOT-type scheme, whereby the owners are required to have their boilers serviced on a regular (for example, annual) basis. If arrangements to maintain emission standards are considered necessary for the UK, proposals as to the mechanism for doing so will be the subject of a later consultation.

4.6.26 We are aware that it may be necessary to do further work to help Local Authorities understand the opportunities available to them under the new Planning Policy Statement: planning and climate change to make strategic decisions about the location, size and type of biomass boilers and district heating systems; and to link up developers wanting to install renewable heating and encourage installation of heat networks. This should encourage developers in urban areas considering biomass options to install larger plant. These can be easier to control in terms of emissions and tend to be more fuel efficient – potentially offering running cost savings to the users.

4.6.27 To help decision-making on the impact on air quality of a biomass installation, both in the planning process and in environmental permitting, we are considering how we can develop and disseminate advice about where different types and sizes of boiler are most appropriately applied (see Planning and Building Regulations section below).

4.6.28 This would involve the Government undertaking research to identify acceptable limits on aggregate biomass heat deployment and to identify areas where clean, modern biomass heat installations will not represent a significant threat to national air quality standards, and areas (particularly urban areas) where further regulatory controls will be required, and the acceptable upper limits of deployment in both areas. From this research the Government could then issue clear interim guidance to Local Authorities on the present risks to air quality posed by current biomass applications and an acceptable level of deployment over next two to three years.

The need for trained installers

4.6.29 Most renewable heat technologies are present in the UK only at low levels. To make a significant contribution towards the 2020 renewable energy target, their installation rates will need to rise at a high rate – 20% per year and above. Similar rates have been achieved on the Continent, though not over such a prolonged timeframe. Such a step change will require a matching increase in the number of skilled installers for biomass, solar thermal and heat pump technologies. Research commissioned by BERR suggests that the cost of training a biomass heat installer is around £20,000, training a borehole engineer (to install ground-source heat pumps) costs around £5,000, and training a solar thermal water heating installer costs around £3,000.[119] The work by Enviros suggests that in the order of 38 TWh per year of biomass heat could feasibly be deployed by 2020, but this would require an additional training spend of approximately £25 million by 2020. We expect the 'market pull' of the financial incentive for renewable heat to create substantial job opportunities to which the sector should respond, assisted by the policies set out under the framework of the Sector Skills Councils (see Chapter 9 on Business Benefits).

Planning and building regulations

4.6.30 We need to ensure we achieve maximum cost-effective penetration of the appropriate renewable heating solutions in all new build developments by 2020 and, where appropriate and cost-effective, in existing buildings as well.

4.6.31 The new Planning Policy Statement: planning and climate change (PPS) confirms the central role of planning in helping to achieve the Government's climate change and energy objectives. In particular, it challenges Local Government to do more to support delivery of local renewable and low-carbon energy, including through setting targets for the percentage of energy in new development to be secured from local renewable or low-carbon sources such as microgeneration or community schemes. It also expects councils to think about the potential for local low-carbon energy generation and carbon emissions when identifying the best sites for development.

4.6.32 The new PPS will help speed up the shift to renewable and low-carbon heat and electricity. This is discussed in Chapter 3 (Centralised Electricity), which sets out the other positive steps already being taken to improve the planning process for renewables. It also considers further options to streamline and improve the effectiveness of the planning system to deliver timely, transparent and robust decisions. Most, if not all of these, are potentially relevant to planning applications for renewable heat. Chapter 3 also highlights how the proposals in the Planning Bill for a more streamlined system for nationally significant infrastructure will benefit renewables project by ensuring national policy is articulated in new National Policy Statements.

4.6.33 As set out in Chapter 3, it is possible to fast track some categories of smaller local projects, for example up to a permitted installed capacity of say, 1-10 MW, through the use of a local development order (LDO).

119 Enviros (2008)

4.6.34 To ensure that all unnecessary constraints to renewable heat uptake are removed or minimised, the Government will also work to ensure that future changes to building regulations will appropriately support our policy objectives for incentivising renewable heat technologies. The Government has already announced that building regulations will be progressively tightened as part of the programme for achieving the target for all new homes to be zero carbon from 2016. A 25% reduction in carbon emissions from current (2006) levels will be set in new building regulations in 2010, followed by a 44% reduction from current levels in 2013. The regulations are supported by standardised methods for the calculation of energy performance that take into account the benefits of renewable systems. House builders and developers can choose how to meet the standards, and progressive strengthening is expected to encourage the greater take up of renewable heat. The Government will be consulting separately on the definition of zero carbon to be applied for new homes from 2016, which will have implications for renewable heat technologies; and on a programme and timetable to achieve the ambition of zero carbon new non-domestic buildings from 2019.

4.6.35 The Government will be consulting on the detailed changes to the relevant parts of the building regulations (Part L) in 2010 and the 'Approved Document' early in 2009. We will also be working on changes to the accompanying Heating Compliance Guides and we are planning to make revised drafts of these available following the consultation, which will cover biomass boilers.

4.6.36 Part J of the building regulations covers standards for the installation of boilers, which would include biomass boilers. The Government will be undertaking a 'backward look' review of Part J this autumn to help identify changes which will need to be made in the next update.

Q17: What more could the Government or other parties do to encourage renewable heat deployment with regard to:

a. awareness raising;

b. air quality;

c. building regulations;

d. planning;

e. anything else?

Renewable heat off the gas grid

4.6.37 In general, policy actions introduced by the Government to encourage renewable heat will be applicable both on and off the gas grid, including any financial renewable heat instruments. If renewable heat technologies prove to be more cost-effective off the gas grid, then that is where a financial support instrument can be expected to drive increased installation rates first. The relative price of gas and the off gas grid alternatives will be a major factor here, and there is no reason why renewable heat technologies will not also become established on the gas grid.

4.6.38 It has been suggested that the Government could regulate to achieve the gradual phasing out of relatively high-carbon, non-renewable heating technologies in off gas grid locations where low-carbon and/or renewable heating technologies could be installed. However, a pre-condition of taking this approach would be that those heat consumers affected, for example, householders looking to replace oil-fired boilers, would need access to a competitive range of replacement products, which were supported by robust supply chains. This appears unlikely to be deliverable in the UK in the near term. Another factor would be managing the impact of such a regulatory change on the existing heat supplier industries. For these reasons the Government is not at present considering this option.

Q18: How far should the Government go in focusing on areas off the gas grid as offering the most potential for renewable heat technologies?

4.7 Heat beyond 2020

4.7.1 In the longer-term we need to de-carbonise heat to a significant extent if we are to deliver on our climate change targets. This will present challenges. For example, we estimate that in 2050 houses built to the new zero carbon standards will make up only 30% of the total housing, and the need for heat in the remaining pre-1990 housing stock will be substantial. Furthermore there will still be about 9 million homes built before 1938 with poor thermal properties and, based on currently available technologies, limited opportunities for cost-effective insulation. Installing renewable (or low-carbon) heat in these homes, aside from solar thermal water heating, may require a large investment in infrastructure, such as the retro-fitting of district heating networks.

4.7.2 Looking ahead to 2050, when highly energy efficient buildings have become more widespread, and the electricity grid is increasingly decarbonised, electric heating may become the default low-carbon option for new heating, at least in buildings with low heat loads. This longer-term potential must be factored into policy development in the nearer term.

4.7.3 These issues, and others relating to the efficient and cost-effective delivery of heat across the economy as a whole, will be addressed in the Heat Strategy, which we are developing over the coming year. The heat strategy will focus primarily on issues affecting the whole heat sector and will build on the responses to this consultation, as well as those to the Heat Call for Evidence. It will set out how the Government can enable the heat sector to help deliver on its energy, environmental and other objectives.

Chapter 5
Distributed Energy

Summary

Households, businesses and communities can play an important role in reducing carbon emissions by generating their own electricity or heat from renewable or fossil fuel energy sources. Distributed energy can be an important tool in tackling the carbon impact of the built environment, particularly when combined with energy efficiency measures. The Government is putting in place ambitious policies to harness this potential, including our Zero Carbon new building policies.

Many of the non-financial barriers to increase take-up of distributed energy are being addressed by policies in place or under development. However, the complexity and novelty of the technologies, together with their need to be integrated into the built environment, often by players new to the energy business, means there is an information gap. Moreover, many of the technologies are not yet cost competitive, at their current state of development and with current fuel and carbon prices. So lack of information and cost are remaining barriers. We seek views here on a number of possible measures to overcome these constraints, including:

- ensuring that financial incentives for heat and electricity allow distributed energy technologies to contribute fully to the EU 2020 renewable energy target and considering the case for the introduction of a feed-in tariff for small-scale electricity;
- establishing a distributed energy information hub under the Act on CO_2 brand to bring together and signpost information for households, businesses, communities, developers and others wanting to generate their own energy;
- supporting outreach activity to identify the potential for retrofit of distributed energy in the community.

5.1 Introduction

What is distributed energy?

5.1.1 Distributed energy is the local supply of electricity and heat which is generated on or near the site where it is used. In practice it is often delivered as a package of energy efficiency and energy supply measures and covers a range of technologies, at varying scales from the household to the community, which can generate electricity and heat from renewable or fossil fuel energy sources.

5.1.2 As opposed to buildings using energy from large generation plants far from the point of use, in this chapter we focus on those aspects of renewable distributed energy that relate chiefly to the built environment. This includes building-integrated renewable microgeneration technologies providing heat and electricity, and larger on-site or near-site renewable electricity technologies. Distributed heat networks and issues related to biomass are considered in detail in Chapter 4.

Table 5.1: Examples of renewable distributed energy technologies[120] [121]

Technology	Description	UK Installations	Average cost of retrofit installation in 2008[126]
Heat			
Solar water heating (solar thermal)	Uses the heat of the sun to produce hot water or to supplement space heating	90,000	£3,900 (2 kW)
Air-source heat pumps	Uses warmth in the air to heat water for space heating	>150	£8,500 (11 kW)
Ground-source heat pumps	Uses warmth in the ground to heat water for space heating	745-2,000	£10,500 (11 kW)
Electricity			
Solar photovoltaics (PV)	Panels that generate electricity from daylight	2,300	£10,500 (2 kW)
Micro-wind (<50 kW)	Converts wind energy to electricity	1,100	£5,000 (1 kW)

120 Unless otherwise noted, source is Element Energy et al (2008).
121 Technology installations are often likely to be larger than the average installation figures quoted here.

Technology	Description	UK Installations	Average cost of retrofit installation in 2008[126]
On-site wind (>50 kW) installed to meet own electricity needs	Converts wind energy to electricity	Unknown	Approximate installed costs (excluding transportation to site)[127]: 25 kW – £48,000 50 kW – £150,000 100 kW – £250,000 1.25 MW – £1.7 million
Micro-hydro (Considered in Chapter 3)	Captures energy in flowing water and converts to electricity	65-75	

5.1.3 Distributed energy in its widest sense currently brings over 10 GW of electricity to the energy mix, accounting for just under 10% of electricity supply. This figure includes all generation that is linked to the electricity distribution networks, regardless of fuel or size.[123] The contribution of renewable community distributed energy (electricity and heat) is thought to be very low at present;[124] indeed the lack of precise figures illustrates the immaturity of the sector. However, the number and variety of sites that could be utilised for generation make clear that community distributed energy has the potential to make a significant contribution to renewable energy and carbon reduction targets. Important policy drivers are already in place to harness this, most notably the recent Planning Policy Statement on climate change,[125] and the drive towards zero carbon homes and non-domestic buildings.[126]

Benefits and costs of distributed energy

5.1.4 Distributed energy has a number of important benefits:

- By opting to use a distributed, local solution for their own energy needs householders, communities, businesses and schools can move from being passive consumers of energy to become producers, making an active contribution to energy and climate goals. For many this is an attractive proposition.

122 Data provided to BERR by Perpetual Energy Ltd.
123 Estimated from data in DUKES, see BERR (2007a).
124 Element Energy et al (2008) estimates only 16 MW of electricity from microgeneration technologies. There is no accurate data about the amount of microgeneration heat generated.
125 CLG (2007)
126 http://www.communities.gov.uk/planningandbuilding/theenvironment

- Alongside, and in some cases as an alternative to, energy efficiency measures, distributed energy has a crucial part to play in reducing the carbon impact of the built environment. Energy generation technologies can be integrated into the fabric of buildings as they are built; retrofitted to existing buildings, including those where energy efficiency measures such as double glazing or cavity wall insulation are not suitable; or installed near the point of use on waste land, nearby roofs or outdoor spaces such as car parks.

- Technologies at household scale can be installed and connected relatively quickly, particularly where recent changes to rules on household permitted development apply.[127] In the light of the EU 2020 renewable energy target, this takes on added importance as larger renewables face greater challenges in terms of deployment, planning and infrastructure investment.

- Distributed energy can help tackle fuel poverty, particularly as the fuel poor tend to be 'heat poor'. Household heat technologies cut the amount of energy the consumer needs to buy, so also cutting their bills. Once installation costs are covered, there are good examples of positive benefits for the fuel poor.[128] [129] In view of this, the Government announced on 30 May 2008 that £3 million of Low Carbon Buildings Programme funds would be directed towards a pilot fuel poverty stream to demonstrate the potential of microgeneration technologies to fuel poor communities.

- Distributed energy can increase overall system efficiency, as the losses that occur in transportation are reduced,[130] leading to lower generation requirements and consequently lower carbon emissions.

- Distributed energy brings valuable diversity to the energy mix, offering opportunities for households, small businesses and communities to become engaged more directly in the generation of the energy they use. Schools, supermarkets and hospitals, for example, can 'host' renewable energy technologies, thereby raising awareness and understanding of alternative energy sources.

127 Permitted Development Rights remove the need for lengthy and potentially costly planning applications for some household generating technologies. Further information on CLG website. The Government is also considering the possibility of Permitted Development for non-domestic buildings and we hope to consult on any proposals later this year.

128 See BERR-DEFRA (2007)

129 An example of this is BERR and RDA funded Community Energy Solutions, which delivers community-based renewable energy technologies and a package of heating and insulation measures to deprived off-gas communities through its demonstration project in the North East, Yorkshire and Humber.

130 Heat by its nature cannot be transported over long distances, and generating electricity closer to the point of use can reduce losses; about 1% of electricity is lost in transporting it across the transmission system and 6.5% in distribution. See Ofgem (2007a).

Box 5.1: Renewable energy in schools

The installation of renewable energy technologies in a community setting such as a school can be an excellent way to educate the next generation and the wider community about climate change and renewable energy. The Government has recognised this opportunity and has pledged that all new schools will be zero carbon from 2016. 225 schools have already been offered grants totalling £2.8 million for the installation of local renewables under Phase 2 of the Low Carbon Buildings Programme.

Case study: Sandhills Community Primary School, Oxford

Sandhills School has gained several awards for its work towards becoming more sustainable. Its implementation of energy efficiency measures and installation of a wind turbine have dramatically reduced the school's energy demand.

After a period of consultation with the Local Authority and the local community, the school was granted planning permission for the 12 metre, 5 kW wind turbine that was installed over 100 metres away from its nearest neighbour. Due to its proximity to the busy A40, the turbine is clearly visible to the thousands that drive past every day, but also, any local concerns about noise are drowned out by local traffic.

The £28,500 turbine was funded by a combination of Low Carbon Buildings Programme grants, local sponsorship, the local council and the school. It will generate 25% of the school's electricity needs and is expected to generate additional income when the school claims Renewable Obligation Certificates and exports surplus electricity to the National Grid, particularly in the school holidays.

Since its installation, the wind turbine has become a local landmark and is leading the way for other schools in the area, showing how energy bills and carbon emissions can be reduced, and children can be educated about climate change. Pupils monitor the turbine's power output and teachers are linking this directly to the curriculum.

5.1.5 Distributed energy also faces some key challenges, notably:

- Technology-specific factors: all renewable distributed energy technologies have certain requirements to be able to operate, and the ability to fulfil these requirements tends to vary by location and specific installation situation. For example, small wind turbines need locations with high wind speeds, which are only found in certain areas. Even in an area that is generally windy, it may be inappropriate to site a turbine close to a building because that building causes sheltering. The effectiveness of wind turbines will be heavily influenced by the wind profile of their location: as the wind speed doubles, power output will increase by a factor of eight. These factors can increase installation costs or decrease energy outputs, affecting the cost effectiveness of individual projects.

- The scale of generation: reducing the size of a wind turbine by half will decrease the power output by a factor of four. For this reason a housing development could be better served by a single free-standing turbine than a number of micro-wind turbines attached to each dwelling. Feasibility studies will tend to be less rigorous for small-scale generation than for major investment projects such as wind farms, so installation and use may often be different to that expected by product designers leading to sub-optimal efficiency and lower generation outputs.

- Cost: microgeneration electricity technologies are expensive compared to larger-scale renewable generation. They were seven to ten times more expensive than large-scale wind in 2006; this is projected to fall to five to seven times more expensive in 2020.[131] The relative costs of small-scale electricity generation, and its comparison to the costs of heat generation are discussed further below.

5.2 Current policy and potential

Policy to date

5.2.1 The 2007 Energy White Paper discussed the potential advantages to be gained from more use of distributed energy, alongside the traditional centralised system. The Energy White Paper committed to level the playing field for distributed energy ,[132] overcoming the key barriers to more widespread take-up and allowing distributed solutions to compete effectively.

5.2.2 Through the Microgeneration Strategy[133] and the Review of Distributed Generation[134] there is now a range of policies in place or under development to address identified constraints; these are set out in Table 5.2. For example, through the Low Carbon Buildings Programme we have provided grant funding to reduce the capital costs for early adopters of microgeneration technologies, and through the Renewables Obligation we provide ongoing revenue support. Householders who opt to install most microgeneration technologies can now do so more easily without the need to apply for planning permission thanks to changes in Permitted Development Rights for microgeneration. At the larger scale we are working with Ofgem to ensure that electricity market and regulatory structures do not discourage community schemes.

131 Projected levelised costs for solar PV in 2020 are £444 /MWh compared to £61-83 /MWh (depending on wind speed and turbine size) for onshore wind. See Ernst & Young (2007b)

132 DTI (2007a)

133 DTI (2006)

134 DTI-Ofgem (2007a)

Table 5.2: Key policy measures to tackle constraints to uptake of distributed energy

Constraint	Policy	Outcome
Cost	Low Carbon Buildings Programme Phase 1	To date 5,500 householders have been offered grants totalling £8.1 million under Phase 1. The community and business streams have committed £11.4 million to 316 non-domestic projects.[135]
	Low Carbon Buildings Programme Phase 2	Charities and public sector bodies can get up to £1 million in grants to help in the purchase and installation of microgeneration technologies. To date £9.7 million has been committed to 617 projects amounting to 6.79 MW of installed renewable energy capacity.
	Renewables Obligation Certificates	Proposals under the current Energy Bill will lead to two ROCs for microgenerators once reforms are introduced. Changes have also been made to improve accessibility, with accredited microgenerators increasing from 300 before the changes to over 1100 after the changes.
	Export tariffs	All six major energy suppliers now publish tariffs, providing information for exporting distributed electricity. Ofgem reports that the export price is fair.[136]
	Fiscal incentives	Reduced 5% VAT rate for microgeneration technologies. Payments made for microgenerated electricity are exempted from income tax; Business Rates; and Relief from Stamp Duty Land Tax for new zero carbon homes up to 2012.

135 Full statistics for Low Carbon Buildings Programme Phase 1 and Phase 2 are on the BERR website.
136 Ofgem (2008)

Constraint	Policy	Outcome
Information & Skills	Energy Saving Trust Act on CO_2 Advice service	Provides basic information to domestic consumers and small businesses on choosing and installing microgeneration, plans for more proactive advice in future. Non-Government organisations are also responding to the highlighted need for information on community DE.[137]
	Carbon Trust	Carbon Trust Solutions provides guidance to businesses and public sector organisations on renewable energy technologies which they might consider installing.[138] In addition, Partnerships for Renewables, a business created by Carbon Trust Enterprises, is helping public sector organisations to develop renewable energy projects on their land.
	BERR Microgeneration Certification Scheme	Improves consumer confidence in microgeneration technologies through independent certification of microgeneration products and services.
	National Occupational Standards for Environmental Technologies	Provides standard competences for microgeneration technologies, which can be integrated into existing qualifications and, where necessary, new Scottish and Southern NVQs.[139]
Electricity Industry issues	Simplified market and licensing framework for distributed energy operators	Allows larger-scale distributed energy schemes to be accommodated within the competitive market on a cost-proportionate basis, so they can realise the value of their schemes whilst maintaining full consumer protection.
	Easier connections for distributed energy	Householders producing microgeneration electricity no longer need to seek permission to connect to a local network from a distribution network operator; they can now 'connect and inform'. Ofgem are proceeding with a range of activities, including a review of Distribution Use of System charging.[140]
Regulatory issues	Permitted development rights extended to microgeneration	Saves time and money for the householder as they no longer need to apply for planning permissions for installation. Also reduces the burden on Local Authorities.[141]

137 For examples see CHPA-TCPA (2008)
138 See Carbon Trust (2006c)
139 See Skills4business website for more details.
140 Ofgem (2007b)
141 Permitted Development will save £875 per installation (£150 planning application and £725 transaction cost), further information can be found in CLG (2008b). Further information on permitted development for households is available on the planning portal website.

5.2.3 Progress in tackling constraints has been recognised by stakeholders and energy suppliers, and large installation and manufacturing companies are moving into the market in response to the more supportive policy environment.[142] More detailed discussion of progress and successes can be found in the BERR/Ofgem Distributed Energy Consultation Response published earlier this month[143] and the Microgeneration Strategy progress report.[144]

5.2.4 The focus to date has been on piloting approaches, creating favourable conditions and learning from the experiences of those at the forefront of the uptake and development of distributed energy. However, it is clear that there is more to be done to tackle costs and information gaps if distributed energy is to become a realistic choice for community energy supply, contributing significantly to renewable energy and carbon reduction targets in the next decade.

Potential for distributed energy

5.2.5 A number of independent studies have made predictions about future potential uptake of distributed energy. They have mainly focused on the role of microgeneration, especially at the household level.[145] BERR has recently worked with industry and other interested parties to assess the current situation and future potential for microgeneration.[146] This latest analysis has looked in detail at consumer (investor) behaviour, giving greater depth to the analysis of constraints to uptake. BERR has also commissioned new research to look at the potential for larger on-site renewable electricity; renewable heat is discussed in Chapter 4.

Microgeneration

5.2.6 Figure 5.1 shows the impact of three different specific support scenarios specifically for microgeneration, based on recent analysis. The graph shows the additional renewable energy that would result in 2020 from various financial reward schemes specific to domestic microgeneration:[147]

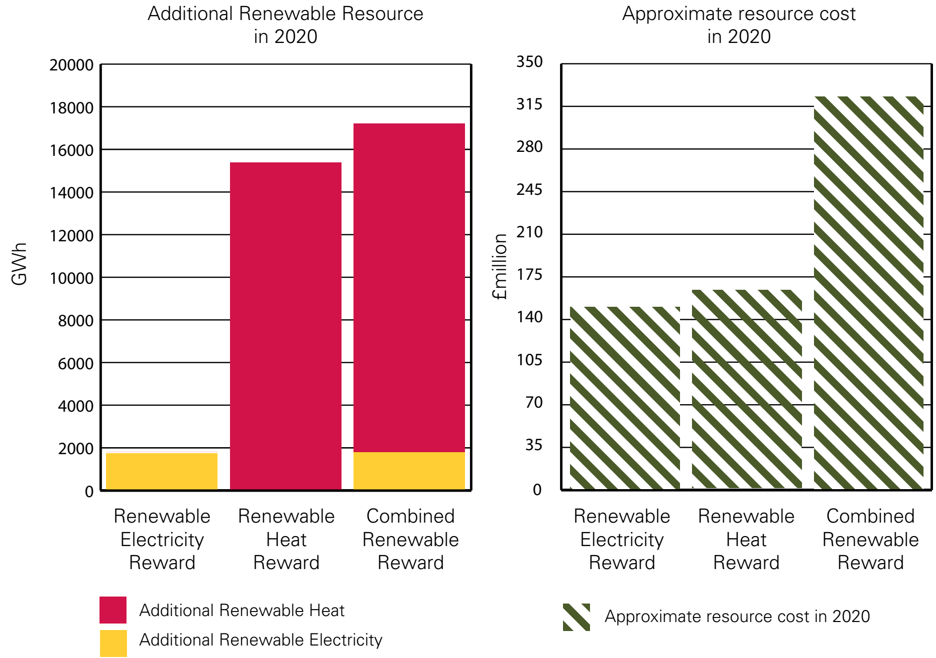
- one targeted at rewarding domestic microgeneration of renewable electricity, paying 40p/kWh of renewable electricity generated;
- one targeted at rewarding domestic microgeneration of renewable heat, paying 2p/kWh of renewable heat generated; and
- a combined scenario that rewards the domestic microgeneration of both renewable electricity and renewable heat at the levels of 40p/kWh and 2p/kWh respectively.

5.2.7 The reward schemes modelled involve a payment of a fixed rate for each kilowatt hour of renewable energy generated from either electricity or heat sources. In each case, the model provides financial reward on installation of the technology of a lump sum anticipating 10 years of generation ('deemed

142 Micropower Council (2007)
143 BERR-Ofgem (2008a)
144 BERR (2008d)
145 Energy Saving Trust (2007); Element Energy (2005); RAB (2007)
146 Element Energy et al (2008). The Element study looked at the full range of microgeneration technologies including fossil fuel fired micro-CHP. In this chapter we draw only on the findings for renewable microgeneration.
147 We recognise that the contribution from non-domestic settings could be significant. The figures provided here are to give an indication of the relative costs and benefits involved when considering heat and electricity installations.

and paid upfront')[148] but discounted at 3.5%. Over the life of the model, the reward rate per kilowatt hour is reduced annually by 1% for new electricity installations and by 2% for new heat installations. This reflects the expectation of falling capital costs over time.

Figure 5.1: Estimated impact of financial reward schemes on domestic microgeneration uptake and associated resource costs in 2020



Source: Element Energy "Growth Potential for Microgeneration in England, Wales and Scotland" and BERR analysis

Additional domestic renewable resource in 2020 (TWh)	Scenario 1: Renewable electricity reward (deemed)[149]		Scenario 2: Renewable heat reward (deemed)[150]		Scenario 3: Renewable electricity and heat reward (deemed)[151]	
Electricity	1.8 TWh		0 TWh		1.8 TWh	
Heat	0 TWh		15.4 TWh		15.4 TWh	
Approximate resource costs in 2020		£135 – £155 million		£155 – £175 million		£290 – £330 million

148 Where 10 years of payments are bundled and paid in a single sum upfront the value of this payment is calculated using the social discount rate of 3.5% to reflect the fact that £1 today is valued at a higher rate than £1 tomorrow.
149 Renewable electricity reward 40p per kW/h, reduced by 1% per annum, deemed and paid upfront at 3.5% discount rate.
150 Renewable heat reward 2p per kW/h reduced by 2% per annum, deemed and paid upfront at 3.5% discount rate.
151 Renewable electricity and heat reward is a combination of the electricity and heat rewards.

5.2.8 This analysis suggests that a reward system that is focused on domestic renewable electricity could deliver approximately an additional 1.8 TWh of renewable energy in 2020 (0.1% of energy demand in 2020), at an estimated cost in 2020 of £135 million – £155 million. This compares to 15.4 TWh of renewable energy (0.9% of energy demand in 2020) that would be delivered from a reward system focused on domestic renewable heat, at an estimated cost in 2020 of £155 million – £175 million. The financial reward would be expected to be paid to microgenerators by energy suppliers, who would then recoup their costs through bills. The costs of the domestic renewable electricity reward could add at least £8-12 to the annual average domestic electricity bill in 2020, with the potential for bills to rise by up to £40 per year in 2020 depending upon how suppliers recoup the costs of a scheme with high upfront costs due to the availability of deemed rewards.

5.2.9 The combined domestic reward system is estimated to produce a total of 17.2 TWh of renewable energy in 2020 at an approximate resource cost in 2020 of £290-330 million. When compared to the heat-focused system, this shows that an increase in spend of 85% over the period increases delivery of renewable energy in 2020 by only 12%.

5.2.10 On cost effectiveness grounds alone, this illustrates that there are reasons at the micro-scale for focusing support now on heat technologies, which can bring generation of renewable energy, at lower cost, and with greater CO_2 reductions. However, as discussed later in this chapter, there are arguments for providing support to householders wishing to generate their electricity. Also, cost effectiveness can improve at larger scales than the microgeneration technologies modelled in this analysis.

5.2.11 Technology costs are likely to fall over time and our modelling seeks to take this into account, on the basis of peer review with industry. However, technological breakthroughs could mean that costs fall faster. For example there are currently several types of third-generation photovoltaic cells under development, but it is too early to predict which will come to market or if they will be competitive. Nonetheless, in recognition of future potential, the Government is supporting research into new types of photovoltaic cells, including dye sensitised and organic polymer devices, through the Carbon Trust, Engineering and Physical Sciences Research Council and Technology Strategy Board Technology Programme.

Larger community distributed electricity

5.2.12 To date, much less attention has been focused on the potential for retrofitting larger on-site renewable electricity generation in the existing built environment. There is a clear opportunity to increase generation in the community by making use of car parks, brown-field sites or large flat roofs on commercial buildings, for example, to install these technologies. As discussed above, economies of scale are likely to mean such opportunities will be less cost-effective than centralised generation. However, for the same reason, they are also likely to be more cost-effective than microgeneration, and may share many of the benefits. We have therefore commissioned a study to scope this potential, and results will be published on the Renewable Energy Strategy Consultation website during the consultation period.[152]

152 http://www.berr.gov.uk/renewableconsultation

Box 5.2 Case Study – Renewable Energy at McCain, Cambridgeshire

At its production site in Whittlesey, Cambridgeshire, McCain Foods has implemented a number of initiatives to improve its operational efficiency and sustainability. As part of its strategy to save on manufacturing costs, McCain has invested in energy efficiency measures, in three wind turbines and an anaerobic lagoon, digesting waste water to produce biogas. Around £10 million was invested in three of the UK's most powerful 80 metre high 3 MW wind turbines, in expectation of future energy cost increases.

During an 18 month period of consultation, planning and installation, the suitability of the ground conditions and the wind profile, and data from an existing large wind farm within 15 miles of the Whittlesey plant were assessed. From initial discussion stages, McCain worked closely with the distribution network operator, and associated costs were lower than expected, as a robust 11 kW connection already existed on the site. The turbines were situated on the industrial site, approximately half a kilometre from the nearest property, minimising any objections to the turbines' visual and noise impact. Through close work with the local council and the Environment Agency, the support of the local community was secured.

Six months since their activation, the wind turbines have already reduced the plant's carbon dioxide emissions by 7,500 tonnes. At certain times of the year, the turbines will power the entire site, potentially generating 60% of the plant's electricity needs – 32,200 MWh annually, enough to power around 7,500 domestic houses.[153] When the plant is not in use or the turbines are producing surplus power, unused electricity is sold back to the National Grid.

McCain saw the investment in renewable electricity generating technologies not only as a sustainable way to power the plant, but also as a good financial case. Conservative estimates predict the wind turbines to payback in around 3½ years, with increases in energy prices and better wind speeds likely to improve this payback period.

153 Based on an average three-bedroom house using approximately 4,200 kWh per annum.

5.3 Financial incentives

The impact of existing policies

5.3.1 The higher costs of distributed energy technologies when compared to alternatives (usually grid electricity and burning fossil fuels for heating) mean that financial incentives are necessary to encourage investment. Policy to date has applied a range of approaches to tackle cost constraints as illustrated in Table 5.2 above.

5.3.2 The limited scale and the stop-start nature of grant funding, as seen in the Low Carbon Buildings Programme running since 2006, and its predecessors,[154] have not provided sufficient volume or certainty for industry to scale up to mass-market production. Budget 2007 therefore committed the Government to moving away from grants as the main system to support microgeneration.

5.3.3 The detailed discussion of renewable heat in Chapter 4 (Heat) has shown that microgeneration is likely to play a significant role in renewable heat delivery. Much will depend on how cost competitive it proves to be on the ground and this will be influenced by the design of the support mechanism for renewable heat. As such the support will be designed with microgeneration specifically in mind. It may also be desirable to design the heat instrument in such a way that it can benefit microgeneration electricity as well, so as to simplify the offer to householders. However, it would make sense to design the scheme around what is most appropriate for heat, given its potential to contribute to the EU 2020 Renewable Energy Target as discussed in Chapter 4. In this chapter we will limit our discussion to considering the best financial incentives for microgeneration electricity alone.

5.3.4 The Renewables Obligation (RO) is designed to increase large-scale deployment of the most cost-effective renewable electricity, and integrate it into the liberalised UK electricity market. It also provides support for local renewable electricity, but in practice has not been a major factor in encouraging microgeneration investment, particularly for households. The Government recognised this and has proposed changes to double the level of support from the RO for microgeneration. We have already simplified the system to make it more accessible. While this will bring benefits, we need to consider if it will do enough to encourage uptake in the light of the EU 2020 renewable energy target.

5.3.5 Although microgeneration electricity technologies have limited potential to make a significant contribution to the target, it is important to consider how existing support for renewable electricity can work better for microgeneration, or whether we need a new support mechanism. There is growing individual interest in generating energy, motivated by a desire to contribute to the fight against climate change and increase self-sufficiency. Moreover, whilst most households consume far more heat than electricity,[155] an increase in the use of electrical appliances in domestic settings could cause future electricity consumption to rise, increasing interest in household electricity generation.

154 Such as the Major Solar PV demonstration programme and the Clear Skies programme which ran from 2002-2006.
155 82% of all domestic energy consumption is for space and water heating. See DTI-ONS (2007)

High street retailers have responded, and microgeneration electricity technologies can now be bought 'off the shelf'. Nonetheless, electricity generation technologies remain a discretionary purchase because in the vast majority of cases households will have access to grid electricity. As such, the Government believes that, in order to harness and encourage this interest, it is important to consult now on how best to support microgeneration of electricity.

Comparing the Renewables Obligation and feed-in tariffs for small-scale electricity generation

5.3.6 In considering future design of financial incentives for small-scale electricity generation we want to ensure that the support provides stability and long-term certainty to the microgeneration industry and to those considering installation of electricity generating equipment to meet their own energy requirements. To date, much of the focus has been on incentivising household microgeneration, and we will discuss these issues in detail here. However, many of the arguments will also apply to community-scale technologies and final decisions should take this into account.

5.3.7 The Renewables Obligation (RO) provides long-term certainty to industry and investors. We have made it more effective for smaller generators with the introduction of agents last year, and are looking to double the level of support it provides to microgenerators.

5.3.8 However, as discussed, we now wish to explore what more could be done to give financial support to renewable electricity generation at this scale. In doing so, it is appropriate to consider whether an alternative support scheme for microgeneration would be advantageous. As with the discussion on financial support for bulk electricity in Chapter 3, the main alternative would be a move to feed-in tariffs, which pay a guaranteed rate of compensation per unit of electricity generated.

Effectiveness – deployment of distributed electricity achieved

5.3.9 Our analysis in Chapter 3 suggests that the inherent differences in design between the RO and feed-in tariff schemes do not lead to significant differences in terms of effectiveness for large-scale generation. However, this may not be the case at the household level, where administrative barriers under the RO and the uncertainty resulting from fluctuation in the value of ROCs may have a greater effect.

5.3.10 Under the RO, generators have to register to obtain ROCs, and will subsequently need to find a buyer for them, usually by entering into an agreement with their electricity supply company. Commercial generators are better placed to deal with these procedures, which are a part of their business as energy producers. Sometimes household and community players, for whom electricity generation is not their primary purpose, tend to be deterred by the 'hassle factor' of accessing their ROCs, then seeking a buyer for them and negotiating a price.

5.3.11 In addition, the nature of the RO means that the level of support it provides varies under market conditions, resulting in uncertainty about compensation levels. At the commercial level, the risks from such uncertainty may be offset by the benefits of competition and trade. However, it is more difficult for householders to realise such benefits, so uncertainty over revenue reduces the attractiveness of market based support.

5.3.12 Changes to the RO so that agents can participate in the system sought to reduce the impact of the 'hassle factor' by allowing agents to act on behalf of household generators in dealing with administration; and to remove uncertainty about revenue as agents or electricity supply companies can offer householders a fixed rate of compensation for their generation. There is evidence that this is working.

5.3.13 In Chapter 3 we identified the delays in deployment and uncertainty in the market that would result from a change in support mechanism as the overriding argument against using feed-in tariffs for large-scale generation. While we would also be concerned that a switch to feed-in tariffs for microgeneration would take time, it is likely that the impact of such a delay in the microgeneration market would be less severe. As we have seen, the level of microgeneration installation is still comparatively low and driven by factors other than economics alone. The contribution of microgeneration electricity towards the 2020 renewable energy target will be lower than that of large-scale generation, so we may be able to afford to take the time required to switch to a new scheme for microgeneration if this would be beneficial to the development of this area in the longer term.

5.3.14 It is crucial that the design of financial incentives for renewable electricity and renewable heat take account of investor behaviour at this scale: both that of householders and of businesses and other organisations whose primary purpose is not energy generation. Similarly we need to consider how our policies for incentivising renewable heat, renewable electricity, and energy efficiency will work together at the householder or business level.

5.3.15 The consumer survey carried out in our most recent consultancy study on this subject shows that in practice household consumers investing in distributed technologies are chiefly influenced by the capital costs of installation, even more so than by the ongoing future savings to their fuel bills (which would determine the payback period of their investment).[156] Non-domestic consumers appear to make similar choices.[157]

5.3.16 The survey showed that consumers placed most value on a financial incentive that delivered frontloaded support, where they receive upfront payment to offset initial capital costs.

5.3.17 The RO in its current form does not provide support that acts as a significant contribution to the upfront capital costs of installation, and neither does a typical feed-in tariff system. Instead, they provide smaller ongoing payments, usually over a period of at least 15 years. We can therefore see that the benefit of the RO in this regard is limited for microgeneration, but also that a switch to a typical feed-in tariff would not address this important issue. Both systems could, however, be adapted to include a front-loading element.

156 Consumers are only willing to pay an average of £2.91 upfront to make an annual saving of £1. See Element Energy et al (2008)

157 Figure 13.2, Element Energy et al (2008)

5.3.18 Benefits from the RO could be frontloaded by providing a very high number of ROCs in the first year or in early years of the lifetime of the installation. Similarly, a very high feed-in tariff could be paid in the early years following installation, dropping down to a lower level later (or ceasing altogether).

5.3.19 Alternatively, we could consider other policies that would run alongside and be linked to the main scheme, so offering the support desired by consumers. Such policies could, for example, encourage the financial markets:

- to develop financial products turning the regular yearly support payments into an upfront capital payment (similar to car lease arrangements); or
- to introduce a scheme of favourable loans whereby householders could use the initial loan to pay for the microgeneration, after which the ongoing support from the RO or feed-in tariffs would be used to help pay back the loan.

5.3.20 On balance, we believe that the differences between the RO and feed-in tariffs in terms of effectiveness for microgeneration deployment are not significant. Instead, the effectiveness of any scheme is more likely to depend on the stability of the system (providing greater long-term certainty than grants); on the level at which the support is set (be it microgeneration RO band(s) or feed-in tariffs); and on the extent to which frontloading would be incorporated.

Efficiency – the cost of supporting distributed electricity

5.3.21 In section 3.8 of Chapter 3 we identified some features of feed-in tariffs which could, in certain circumstances, make them more efficient compared with the RO. We concluded that, in practice, the resulting cost differences appear to be small at the large-scale generation level. However, there are indications that this may not be the case at the small-scale generation level.

5.3.22 The RO and feed-in tariffs could each provide effective support, but we have noted that feed-in tariffs give more certainty to renewable microgeneration electricity generators, offering full transparency and clarity about the level of support they can obtain and possibly less significant administrative barriers. By contrast, under the RO, householders can deal with the 'hassle factor' of accessing ROCs for themselves and accept the uncertainty of revenue level; or they can allow an agent to act on their behalf and accept fixed revenue levels offered by agents or electricity supply companies. On the face of it, accessing financial support through an agent or an energy supplier seems attractive, but in practice it may lead to the household generator not receiving the true value of their electricity, as the relationship between the market value of the ROCs for electricity generated and the level of compensation offered by agents or suppliers would be opaque. Competition between suppliers should in theory ensure that customers receive a fair return, but generators may not have access to information or the bargaining position to ensure that this value is fully passed on to them.

5.3.23 There is a relationship between the level at which support is set and the efficiency of these systems. Feed-in tariffs could be set at any level (including at very high levels during initial years to provide a frontloading element, as noted above) without loss of efficiency. However, if we use the RO to provide higher levels of support for microgeneration as described above then ROC price fluctuations in any one year would be magnified, further increasing the inefficiency of the system.

5.3.24 If we conclude that these efficiency issues have a significant impact, we might have to set ROC bands at a higher level (incurring higher costs) than corresponding feed-in tariffs to achieve the same effectiveness of support. We would need to do further work to assess the extent of any cost advantages of feed-in tariffs at the small and microgeneration level.

Conclusion

5.3.25 On balance this analysis suggests that there may be a good theoretical case for the introduction of feed-in tariffs for microgeneration, but we have to give careful consideration to how such a system could operate in practice.

5.3.26 Furthermore, given that microgeneration heat is likely to be a much more significant contribution to our EU 2020 renewable energy target than microgeneration electricity, we will also need to consider whether it is possible to have a single instrument covering both microgeneration heat and electricity.

5.3.27 The decision on whether to introduce an instrument for microgeneration heat and electricity, to amend the Renewables Obligation or to introduce feed-in tariffs would depend significantly on our conclusions as to what could work within the UK electricity market. Given the widespread interest in a feed-in tariff for micro and small-scale electricity, we have set out initial ideas and questions as to how such a mechanism might be designed in Annex 2. We welcome your views.

5.3.28 Whatever our decision on whether to use the RO or feed-in tariffs, the more critical questions in terms of microgeneration electricity deployment are likely to be the level of support, and the extent to which this is frontloaded. Neither of these questions is affected by whether the RO or feed-in tariffs are used as the support mechanism.

Q19: Do you agree with our analysis of the mechanisms for support of small-scale renewable electricity?

Q20: Given the analysis on the benefits, costs and potential, in what way and to what extent should we direct support to microgeneration electricity?

5.4 Further action to tackle non-financial constraints

5.4.1 Even with strong drivers for distributed energy and effective financial incentives to support take-up, there remain constraints to the development of this sector, arising from a lack of information.

Information for distributed energy practitioners

5.4.2 Householders, businesses, developers, Local Authorities and the construction industry require wide-ranging information and advice when considering if, and how, to use distributed energy solutions. Larger distributed energy schemes will require partnership between parties who have varying levels of energy expertise, who will often operate at different scales, and ultimately have different interests. When seeking to establish a distributed energy scheme a number of parties need to be involved, from the Local Authority to the Distribution Network Operator to the energy supply company. The distributed energy operator will need to know details of contacts in relevant organisations in their area, they should be able to understand what services are available to help them and at what price, and of course what technologies are suitable for their needs. To address this need, established and emerging energy players such as large energy companies, energy service companies, installers, technology suppliers and distribution network operators will need to adapt their service to the needs of small and/or inexpert players. In addition a range of other parties, including government at all levels, have a role in providing technical, financial and regulatory information and advice in this space.

5.4.3 The provision of clear and impartial information will aid the development of the emerging market for distributed energy, thus encouraging competition and driving down prices. We believe that better information, alongside other policies outlined or proposed in this and other chapters of this document, will tackle the costs, complexities and 'hassle-factor' associated with distributed energy. There is encouraging evidence that the provision of information for the distributed energy sector is improving. In response to the Call for Evidence that supported the Review of Distributed Generation, stakeholders highlighted a lack of clear information as a key barrier to the development of distributed energy.[158] Respondents to the BERR/Ofgem Consultation on flexible market and licensing arrangements for Distributed Energy, published in December 2007,[159] offered a more mixed view of the availability and relevance of information for distributed energy developers. However, it was acknowledged that it would be useful if this developing information was drawn together in one place. The Government could assist with this, for example, by establishing an online distributed energy information hub under the Act on CO_2 brand. This would bring together and signpost information relevant to the use of energy from distributed sources and to the establishment of distributed energy schemes.

5.4.4 An online hub could be designed to signpost existing sources of information and provide advice on distributed energy; providing a road map for those wishing to use distributed energy solutions, offering contact details for more detailed advice and best practice examples. Such a hub would cover all aspects of distributed energy – renewable and low carbon, and electricity and heat. Alongside development of this service we would work with and influence other relevant parties to improve and develop their own specific information and advice.

158 DTI-Ofgem (2007b)
159 BERR-Ofgem (2007)

Householder-specific advice and information

5.4.5 The Energy Saving Trust Act on CO_2 advice service was launched on 2 April 2008.[160] The service includes carbon-saving information and advice for householders including energy efficiency, microgeneration, transport, water and waste. In the future, this will provide clear and impartial information to consumers on microgeneration including costs, benefits, comparison of technologies, and information on installation.

5.4.6 The Energy Saving Trust plans to roll out a Green Concierge Service, as piloted in London in 2007. This subsidised 'paid for' service will provide individualised energy audits and develop 'personal carbon reduction plans'. The Concierge will offer support from first contact through to action, including project managing the installation of an agreed package of measures that will include microgeneration where appropriate.

Information for businesses, schools and other organisations

5.4.7 There is more that could be done to build on existing and proposed policies to boost the market for distributed energy. There is potential for distributed energy across all our communities: a small business may have roof space suitable for the installation of solar PV or solar water heating; and a school or supermarket may own land suitable for a small wind turbine. However, it is likely that not all businesses, schools and supermarkets are aware of this opportunity to generate their own energy and thereby play their part in the fight against climate change, right on their doorstep. There may therefore be a case for the Government to support proactive community outreach activity to identify potential for distributed energy in the built environment, and to advise relevant parties.

Q21: If you agree that better information will aid the development of distributed energy, where should attention be focused?

5.5 Further regulatory incentives for distributed energy

5.5.1 In the light of the need to rapidly deploy renewable energy technologies in order to meet the EU renewable energy targets, we can consider whether the Government needs to take further regulatory action to stimulate the market for distributed energy technologies. We have considered two types of intervention: setting targets for the deployment of microgeneration; or expanding the approach to tackle climate change through the building and planning system into the existing building stock.

Targets

5.5.2 In the Microgeneration Strategy,[161] the Government committed to assessing the suitability of setting a target for microgeneration; this commitment was later put into statute in the Climate Change and Sustainability Act 2006.

160 Act on CO_2 advice on Energy Saving Trust website www.energysavingtrust.org.uk
161 DTI (2006)

Research shows that it is in fact a positive policy environment and not targets per se that drive decisions made by industry and investors.[162] Targets will only stimulate investment in distributed energy technologies if backed up by effective policy measures. The research was not able to uncover any discernible benefit of having a target on its own.

5.5.3 Existing targets already have potential to provide significant stimulus to the market for microgeneration, most notably the Government's targets on reducing carbon dioxide emissions and increasing the use of renewable energy, and the ambition for zero carbon new developments and those allowed by the Planning Policy Statement on climate change.[163] The Government is not currently minded to introduce a specific target for microgeneration technologies at this stage in its development.

Q22: Do you agree with the Government's current position that it should not introduce statutory targets for microgeneration at this stage in its development?

Planning and building regulations

New Build

5.5.4 New build developments provide the opportunity to install and connect to distributed energy solutions at the start of the building's lifetime, when it is easiest, least disruptive and cheapest to do so. They also provide the opportunity to link developments, providing joined-up energy solutions across new housing, commercial and community buildings, as well as the existing infrastructure. The Government has recognised this and put in place ambitious policies that place distributed solutions at the forefront of thinking for the energy supply of new developments. These policies provide the main driver for increased demand and uptake of distributed energy, and should also provide stimulus to the market that will lead to wider benefit to the retrofit sector.

5.5.5 The Planning Policy Statement on climate change makes it clear that tackling climate change is central to good planning. The PPS expects local planning authorities to set evidence-based target percentages for the use of decentralised renewable or low-carbon energy in new developments.

5.5.6 In the future the Government's drive towards achieving zero carbon in the built environment has significant potential to bring on energy generation in the community. We have set a target for all new homes to be zero carbon from 2016 and an ambition for all new non-domestic buildings to be zero carbon from 2019. The public sector will lead the way, with the ambition that all new schools will be zero carbon from 2016 and all new public sector buildings zero carbon from 2018. In line with commitments in Budget 2008, the Department for Communities and Local Government is publishing dual consultations on how the zero carbon policy for new homes and commercial buildings

162 Element Energy et al (2008)

163 The Planning Policy Statement on climate change sets out the expectation that all local planning authorities should adopt local targets for a proportion of the energy supplying new development to come from decentralised and renewable or low-carbon sources.

should be achieved. These consultations will, by the end of the year, provide a definition for "zero carbon", and certainty to investors on the extent to which off-site or remote renewable and low-carbon generation can be utilised alongside on-site and near-site solutions.

5.5.7 We cannot therefore be certain about the uptake of distributed energy, described as on-site or near-site solutions, from these policies until the consultations are concluded. In addition, it should be noted that we may see a limited contribution before 2020, because of the delay between building consent and construction. Nevertheless, we could expect to see significant potential demand for distributed energy solutions.[164] Subject to the outcome of the forthcoming consultation, meeting the zero carbon standards is likely to require developers to consider a hierarchy of measures. These are likely to start with energy efficiency measures, for example in the design and fabric of the building, some on-site or near-site energy supply, and then additional off-site solutions. There will be flexibility as to the precise combination of these elements and this will enable investors to seek out cost-effective solutions in, and indeed across, new developments taking into account the technology and location-specific factors.

5.5.8 This necessary flexibility makes it difficult to make accurate predictions of the amount of generation that will arise from the zero carbon policy, but analysis has set out a number of scenarios, as summarised below. Whatever the final definition of zero carbon, developers will be incentivised to choose on or near-site solutions first. This is important given the demands for renewables at all levels and the need to harness the potential of the built environment for energy generation if we are to meet the EU 2020 renewable energy target and other carbon reduction goals.

Existing building stock ('retrofit')

5.5.9 New build policies such as the Planning Policy Statement on climate change, and zero carbon new developments will lead to substantial energy efficiency improvements in new build stock, and increased generation of energy in the community. However, new build development accounts for only a very small amount of building stock, only 1% a year in the housing sector. Two-thirds of the homes likely to exist in 2050 already do so today.[165]

5.5.10 The majority of the policies we have in place or under development to support distributed energy technologies (summarised in Table 5.2 above) have sought to encourage their installation in existing buildings, and we are seeking to do more through financial incentives and greater provision of information. Alongside this, there are existing instruments such as Energy Performance Certificates and Home Information Packs which, by giving building occupants more information on the energy performance of their building and highlighting the benefits of lower running costs, are expected to create increasing consumer demand for improvements in existing building stock.[166] These provide a valuable tool for future improvement when used in conjunction with the Carbon Emission Reduction Target and in future the Supplier Obligation (instruments which place obligations on suppliers to offer

164 UK GBC (2008)
165 CLGSC (2008)
166 See CLG website for details on EPCs and HIPs

a range of solutions to reduce energy demand). The key driver for these policies is energy efficiency, and we have seen suppliers focus on measures such as loft and cavity wall insulation and boiler replacement, which are the most cost-effective measures at this time. However, suppliers can consider distributed energy technologies when seeking to fulfil their obligations and in the future we expect them to pursue them to a greater extent, as lower cost opportunities, such as insulation, become rarer. There are also opportunities for larger-scale initiatives focusing on building types such as those linked together by a communal boiler, district heating network or electricity system; or perhaps a row of terraced housing with shared roof-space, where the scale of installation could make a distributed energy solution cost competitive with more expensive energy efficiency measures.[167]

5.5.11 It would be possible to go further to mirror the approach taken for new build, and use building regulations to mandate the use of distributed energy technologies at appropriate points in the development or sale of existing building stock. However, for reasons of cost and disruption this is not an attractive option at this time.

Q23: What more could the Government do to incentivise retrofit of distributed energy technologies?

167 Details of the role that microgeneration and community on-site technologies will play in supplier offerings will be discussed in the DEFRA consultation on the Supplier Obligation to be published in the autumn.

Chapter 6
Transport

Summary

At present the main source of renewable energy available for transport is biofuels. However in the future vehicles powered through the electricity grid using renewable energy may have a growing part to play.

It is essential that our biofuel use is sustainable – environmentally, socially and economically. In the light of the increasing concerns raised in recent months about the indirect effects of biofuels, we commissioned Professor Gallagher of the Renewable Fuels Agency to carry out a review of evidence on this issue. Gallagher's findings will be important to the development of the Government's biofuel policies and targets.

Subject to emerging evidence on the sustainability of biofuels, this chapter seeks views on potential measures for increasing renewable transport in the UK, including:

- agreeing robust sustainability criteria for all biofuel use;
- taking steps to adapt the Renewable Transport Fuel Obligation (RTFO) to provide incentives for greater levels of renewable energy in transport with safeguards to ensure these levels are sustainable, and ensuring our support provides the greatest greenhouse gas savings;
- facilitating the development of second and third-generation biofuels, which are made from non-food sources and therefore avoid many of the sustainability concerns around current biofuels;
- extending the use of biofuels in rail transport and shipping so far as is sustainable; and
- exploring the potential contribution of alternative technologies such as electric or hydrogen cars to meeting our renewable energy targets taking into account the possible impact on electricity demand, and the potential for vehicle-to-grid technologies to help smooth electricity demand.

6.1 Introduction

6.1.1 Reducing emissions in the transport sector will be vital in addressing overall emissions. The European Commission has acknowledged this by including a binding 10% renewable transport target in its draft Renewable Energy Directive. The analysis below is developed on this basis.

6.1.2 The potential measures for increasing the use of renewable transport fuel outlined in this Chapter form part of wider Government policies on sustainable transport. For the UK to reduce the climate change impacts from transport, we need to enable smarter, more energy efficient use of transport and to bring about changes in the types of vehicles and fuels we use. As discussed in Chapter 2, improving energy efficiency in transport is an important step we can take to meet our climate goals. In addition to this, policies that reduce transport's reliance on oil, diversify transport technology and improve fuel efficiency, will also deliver improved security of energy supply.

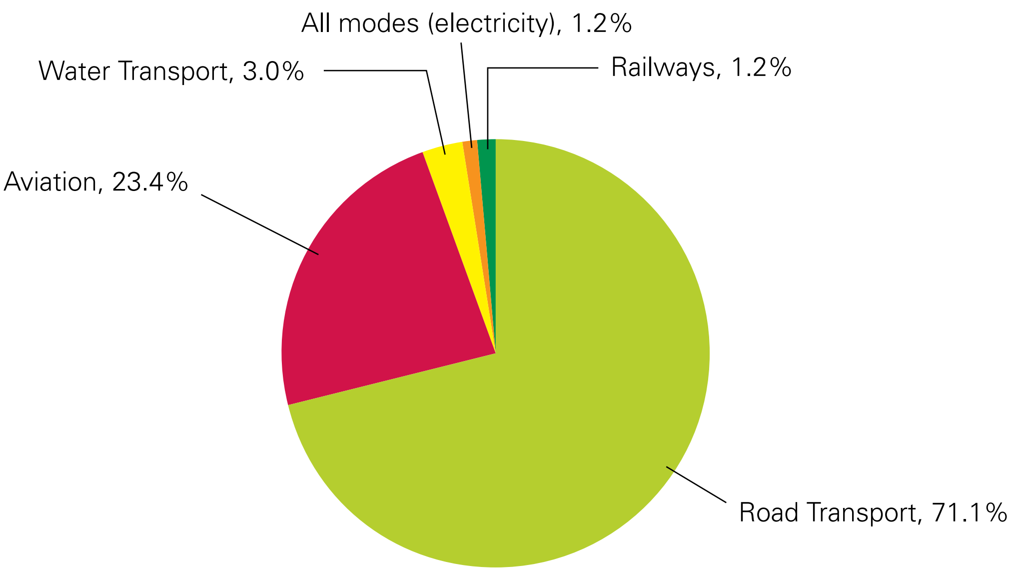
6.1.3 Currently transport is heavily dependent on petroleum fuels. Figure 6.1 below illustrates how UK transport energy consumption is divided between the different modes. Road transport constitutes the majority of energy use in the transport sector, followed by aviation and water transport (both domestic and international). Almost 99% of transport energy consumption comes from petroleum based fuels, with potential consequences for the security of our energy supply.

6.1.4 The proposed EU 2020 renewable energy target requires renewable energy to make up 10% of the energy consumption in transport excluding petroleum products other than petrol and diesel. This effectively excludes aviation and shipping, except that any renewable energy used in these sectors would count towards the target. Domestic transport (not including international aviation and shipping) accounts for around a quarter of the UK's energy use and carbon emissions. As road transport is responsible for about 93% of domestic transport carbon dioxide emissions in the UK (and passenger cars for almost two thirds of this) the biggest opportunity for savings will be through developments in road transport. Although aviation is not included in the transport target, aviation fuel for flights fuelling and refuelling in the UK is included within the scope of the proposed 15% renewable energy target for the UK.

6.1.5 As biofuels are the only renewable transport fuel option commercially available on a significant scale today, it is likely that this target would have to be met almost entirely through biofuels. This Chapter therefore focuses on their potential, while also considering future alternatives such as electric and hydrogen vehicles, which are likely to be of greater significance in the longer term. The sustainability of biofuels has become an increasingly important issue, and the draft Renewable Energy Directive lays down sustainability criteria which biofuels would need to satisfy to count towards the 10% target; nevertheless, we need to look further at what would be needed to meet the target so as to achieve net greenhouse gas savings without compromising wider goals on food production. Reaching the target would be a significant challenge for the UK even if sustainability were not an issue. Some of these concerns about sustainability might be addressed by the development of 'second-generation' biofuels, which can be made from waste, residues and non-food crops (grown on marginal land).

6.1.6 Our aim in this consultation is to set out policies that would reach the target of 10% renewable energy in transport, subject to evidence that this target could be reached in a sustainable way.

Figure 6.1: Energy Consumption by Transport Mode – 2006 (including international aviation and shipping)



Source: BERR (2007a) 'Energy Trends'

Box 6.1: Costs and Benefits of Meeting the 10% Renewable Transport Target

The main cost of increasing the consumption of biofuels in the UK will be the extra resource cost of the fuels compared to what consumers would expect to pay for the fossil fuel equivalent. The benefits include significant greenhouse gas (GHG) savings and increased security of supply in an area where the UK is a net importer.

The table below illustrates the estimated costs and GHG benefits from meeting the 10% energy target through biofuels:

Costs, benefits and GHG savings of meeting the target (central oil price scenario of $70/bbl in 2020 and $75bbl in 2030)

	In 2020	Cumulative to 2030
Present Value Costs	-£0.2 billion to -£0.7 billion	-£8.7 billion to -£3.3 billion
Present Value Benefits	£48 million to £116 million	£0.7 billion to £1.6 billion
GHG Savings	2.3 $MtCO_2$ to 5.5 $MtCO_2$	34 $MtCO_2$ to 80 $MtCO_2$
Net Present Value (NPV)	-£632 million to -£106 million	-£7.9 billion to -£1.8 billion

These figures show the ranges for the central oil price scenario for changing the RTFO to meet a 10% energy target. The high cost figures assume that in 2020 biofuel prices (all 2007 prices) are 50ppl for bioethanol (compared to 31ppl for petrol) and 60ppl for biodiesel (compared to 33ppl for diesel). The low cost figures assume biofuel prices are 30ppl for bioethanol and 40ppl for biodiesel.

The ranges around the benefits primarily reflect scenarios where the average level of GHG savings from biofuels is either 50% or 20%, compared to the fossil fuel alternatives (note that the GHG savings benefits assume there is no impact on emissions from indirect land use changes). The NPV shown excludes ancillary impacts, which occur if using biofuel increases fuel costs and so has a knock-on impact on driving behaviour – reducing the amount that people drive. The value of these ancillary impacts (improved air quality, reduced noise and accidents, reduced transport infrastructure costs) is estimated to be £77 million to £94 million present value cumulative to 2030.

Allowing for different oil price scenarios broadens the NPV ranges to -£807 million to +£122 million in 2020, and -£10.4 billion to +£1.6 billion for the period to 2030. The high NPV figures assume a sustained oil price of $150, causing biofuel prices to fall to the same level of fossil fuels on an energy equivalent basis and thus resulting in no additional resource costs. More detail on these and other scenarios are presented in the Impact Assessment.

6.2 Road transport: biofuels

What are biofuels?

6.2.1 Biofuels are fossil fuel substitutes that can be made from a range of organic materials including oilseeds, wheat and sugar, and are typically blended with conventional petrol and diesel. Biofuels offer the potential to reduce greenhouse gas from road transport. Such a technology is vital for global efforts to tackle climate change as car and vehicle use grows rapidly across the globe in the next few decades. At present the two main types of biofuel are biodiesel and bioethanol. Biodiesel, a diesel substitute, is generally produced from oily crops (or 'feedstocks') such as rapeseed, sunflower or palm oil, or from recovered cooking oil. Bioethanol, a petrol substitute, is generally produced from starchy feedstocks, such as wheat, sugar beet or sugar cane – although it can be produced from any organic substance (such as wood, grass or municipal solid waste). Other forms of biofuels include biomethane, which is a gas produced by the biological breakdown of organic matter and can be used as a renewable alternative to natural gas, either as a transport fuel or for electricity generation and heating (see Chapter 7).

Box 6.2: Efficiency of biofuels and impact on the 10% target

Biofuels are less energy efficient than fossil fuels. For a given volume, bioethanol has about two-thirds the energy content of petrol and current forms of biodiesel have about nine-tenths the energy content of fossil diesel. To achieve a 10% biofuels share by energy would therefore require a target of 11-15% by volume.

Sustainability

6.2.2 The UK is committed to ensuring we use only sustainable biofuels to meet our targets. Sustainability means that the biofuels are produced in ways which do not damage the environment or create social conflict. It would be unacceptable therefore to clear rainforest to grow feedstock for biofuels, as – apart from the loss of diversity – there would be a net increase in carbon emissions. Conversion of other biodiverse ecosystems would be equally unacceptable. There are concerns too about the indirect effects of biofuels, for instance where biofuel feedstocks displace other crops which are then grown on previously forested land that is cleared for this purpose. Such effects can mean that some biofuels would produce an overall increase in greenhouse gas emissions. We are sensitive to the impact that biofuels may have on food security in the current context of rising food prices.

6.2.3 Biofuel sustainability is a complex issue with many aspects that are by no means fully understood. With the biofuels market growing rapidly, more evidence is becoming available about their impact, and sustainability tests modified as a result. The latest evidence on indirect effects suggests that these can be more significant than had generally been assumed (see below), and although they cannot always be quantified it is clear that they can make the difference between whether a biofuel is better or worse, in terms of its greenhouse gas emissions, than the fossil fuel it replaces.

6.2.4 Biofuels have different potential impacts on CO_2 savings. Although biofuels release carbon dioxide when burnt in a vehicle engine, the plants from which they are grown absorb an equivalent amount of CO_2 from the atmosphere. Potentially therefore they are carbon-neutral over their lifecycle, though this is not normally the case in practice because, for example, energy from fossil fuels may be needed to process and transport them and the cultivation of crops results in nitrous oxide (which is a greenhouse gas) emissions from the soil. Nevertheless, if produced appropriately, the greenhouse gas savings can be significant compared with fossil fuels. Assuming the 10% target for renewable energy in transport could be met through sustainable biofuels of the sort we expect will be dominant in the market by 2020, and that there were no additional emissions due to indirect land use changes, UK greenhouse gas emissions could be reduced by between 57.2 $MtCO_2$ and 69.1 $MtCO_2$.

6.2.5 Table 6.1 lists typical greenhouse gas savings for a range of biofuel feedstocks and production techniques, as shown in the draft Renewable Energy Directive.[168] These figures assume no emissions from land use change. In some cases higher savings might be possible in time from more advanced production techniques or from some so-called 'second-generation' biofuels.

Table 6.1: Types of biofuels and greenhouse gas savings[169]

Biofuel type	Greenhouse gas saving
Bioethanol	
Wheat ethanol	0-69%
Sugar beet ethanol	35-48%
Corn ethanol	49-56%
Sugar cane ethanol	74%
Biodiesel	
Palm oil biodiesel	16-57%
Hydrogenated vegetable oil	24-83%
Rape seed biodiesel	36-44%
Sunflower biodiesel	51-58%
Pure vegetable oil from rape seed	55-57%
Waste animal or vegetable oil biodiesel	77-83%
Biomethane	75-88%

168 EC (2008a)
169 EC (2008a), pp50

6.2.6 In the UK we have been working on developing evidence on the sustainability of biofuels. The UK Renewable Transport Fuel Obligation requires fuel suppliers to report on the sustainability of their biofuels, and lays down the principles set out in Table 6.2 below. A similar range of issues underlies the criteria under discussion in the draft EU Renewable Energy Directive.[170]

Table 6.2: Sustainability principles laid down by the Renewable Transport Fuel Obligation

Environmental principles
1. Biomass production will not destroy or damage large above or below ground carbon stocks
2. Biomass production will not lead to the destruction or damage to high biodiversity areas
3. Biomass production does not lead to soil degradation
4. Biomass production does not lead to the contamination or depletion of water sources
5. Biomass production does not lead to air pollution
Social principles
6. Biomass production does not adversely affect workers rights and working relationships
7. Biomass production does not adversely affect existing land rights and community relations

Review of the indirect effects of biofuels production

6.2.7 Biofuel production and use is a relatively new technology. Given this, the Government is keen that biofuel targets and support policies should be underpinned by robust scientific evidence. To complement and build on previous work, in February 2008, the Government invited Professor Ed Gallagher to lead a review of the fast-emerging new evidence on the indirect effects of biofuels, including their impact upon greenhouse gas emissions and food security. Professor Gallagher is the Chair of the Renewable Fuels Agency (RFA), the non-departmental public body set up in October 2007 to administer the UK's Renewable Transport Fuel Obligation (see below).

6.2.8 The review's terms of reference required it to "focus on recent evidence on the indirect or 'displacement' impacts of biofuels production, both within the EU and internationally, and evaluate, for current and future demand and production scenarios:

- the extent to which the production of biofuel feedstocks leads to land conversion; and
- GHG emissions arising from changes in land use and cultivation practices."

170 See Article 15, EC (2008a)

6.2.9 To ensure the review was based on the widest possible range of evidence, the RFA issued a call for evidence in March 2008 and undertook a series of international seminars to ensure that key global evidence was collected. This evidence has been analysed by several expert study teams as part of their consultancy reports to the RFA. The conclusions have been peer-reviewed by a team of Chief Scientists, Economists and Officials, led by the Government's Chief Scientific Adviser, John Beddington.

6.2.10 The report of the Gallagher Review covers the following areas:

- the broad effect of indirect land use change on the GHG benefits of biofuels;
- the global availability of land suitable for the anticipated expansion in demand for food, feed and biofuel feedstock;
- the role of second-generation technologies in sustainable biofuels support policies;
- necessary revisions to current GHG-calculation methodologies;
- the suitability of GHG-based targets in contrast to volume or energy based targets;
- the suitability of current UK and EU biofuels targets and whether they need to be re-examined in the light of emerging evidence on indirect land use change;
- the role of biofuels in contributing to rising food and commodity prices and how these prices affect the developing world;
- which policies can mitigate the potential negative effects of indirect land use change on the GHG benefits of biofuels and food security; and
- the areas of further work now necessary to progress our understanding of the wider environmental, social and economic impacts of biofuels and how they can best be managed.

6.2.11 The conclusions of the Gallagher review will – alongside the recently published DEFRA-commissioned review of the environmental sustainability of international biofuels production and use[171] – help to shape the development of future biofuel policies in the UK. They will be reflected in our negotiating position on the draft Renewable Energy and Fuel Quality Directives, and in particular on the sustainability criteria and the biofuels and greenhouse gas reduction targets. The review has drawn on experts and evidence from across the EU, and its findings should be of relevance to other EU Member States in their own consideration of these proposals.

6.2.12 It is for the Council of Ministers and the European Parliament to decide whether or not to modify the renewable energy proposals in the light of the developing evidence on biofuels. Negotiations on the draft Directive are still ongoing, and our current expectation is that the Directive could be agreed

171 DEFRA (2008b)

in spring 2009. However, if the targets were adopted in their present form, and the 10% target turned out not to be achievable, this would make it very difficult to meet a 15% share of renewable energy, as envisaged under the draft Directive. Our final Renewable Energy Strategy will be published in spring 2009, including details of what we expect from the transport sector.

Current UK biofuel policies – renewable transport fuel obligation

6.2.13 The use of biofuels in the UK has until now been low – about 1% of the total road fuel market in 2007-08. In the year from 15 April 2008 the Renewable Transport Fuel Obligation (RTFO) will require transport fuel suppliers to ensure that 2.5% (by volume) of total petrol and diesel sales are from renewable sources. The Government has said that increases in the level of the RTFO beyond current targets would be subject to important conditions, including confidence that the biofuels would be produced in a sustainable way. The Government remains committed to the promotion of sustainable biofuels, and we shall review the targets in this light.

6.2.14 The Government announced last year the aim that, from April 2010, the RTFO should reward biofuels in accordance with the greenhouse gas savings they offer, rather than by volume; and that from April 2011 biofuels should be rewarded only if the feedstocks from which they are produced meet 'appropriate sustainability standards'.[172] These changes would be subject to EU and international obligations.

Box 6.3: Current financial incentives for biofuels

Under the RTFO, fuel suppliers are awarded certificates for each litre of biofuel, and these can be traded. Suppliers can also buy themselves out of the obligation, at a price set by the Government at a level intended to be higher than the additional cost of supplying biofuel (over and above the fossil fuel based alternative). If the buy-out price could be retained under EU legislation, it would have to be set high enough to come into effect only in exceptional circumstances.

The Government originally encouraged the use of biofuels through a duty differential for biodiesel and bioethanol of 20 pence per litre below regular fuel. The combination of duty incentive and the buy-out price paid by fuel suppliers who fail to meet their RTFO obligation is guaranteed at 35 pence per litre until 2010-11, when the duty differential will cease and the RTFO buy-out price will change to 30 pence per litre.

6.2.15 Currently, only a limited amount of biofuels can be used in most engines, but a lot more is possible. Most biofuels on the market at present can be used in unmodified vehicles and are sold with blends of up to 5% biofuel with the remainder consisting of fossil fuels. Some petrol vehicles, known as 'flex-fuel' vehicles, can operate on a range of mixtures of fossil fuel petrol and bioethanol (usually up to 85% ethanol by volume, commonly referred to as E85 fuel), with the engine being adjusted automatically according to the fuel mix.

172 DfT (2007a)

6.2.16 To use more biofuels in the UK, we will need more investment in infrastructure. There is only a limited infrastructure in the UK for the production, refining and supply of biodiesel, and an even more limited infrastructure for bioethanol. This is now improving, with a number of new biofuel plants getting off the ground. In the next 10-12 years, a greater number and volume of biofuels are likely to be available in the UK, with some of the more common biofuels coming from Brazilian sugarcane, UK sugar beet and rapeseed, European sunflower oil and wheat and palm oil.

Box 6.4: Case Study: Brazilian Biofuel Market

In no other country are biofuels as important as in Brazil, where a requirement for petrol to include 5% of ethanol, derived from sugar cane, was first introduced in 1931. In 1975, the Brazilian Government began the world's first major programme to promote biofuels, know as Proalcool, using a mixture of policies including subsidies, lower taxes and fuel content requirements. In most of Brazil, ethanol is now cheaper than petrol, and the volume of ethanol sold is almost equal to that of petrol, with flex-fuel vehicles accounting for more than half of new car sales.

Constraints to biofuel deployment

6.2.17 Although biofuels are more expensive than fossil fuels, sustainability, rather than finance, is currently the major constraint to using biofuels to meet our EU 2020 renewable energy target. As described above, it is not yet clear that biofuels could be produced sustainably in sufficient quantities to achieve a 10% by energy share by 2020.

6.2.18 If stringent sustainability and greenhouse gas-saving criteria were to restrict the supply of cost-effective bioethanol or biodiesel, this could hinder policies to meet the 10% transport target. In a global market in which many countries across the world are rapidly increasing the use of biofuels, measures that would restrict the supply of biofuels to the UK could also significantly increase their cost. This would increase the cost of meeting the proposed target, and increase the risk of failure. However, biofuels could have a significant negative impact on the environment, including possible increases in greenhouse gas emissions and on people, through increased pressure on land and food prices, if produced in the wrong way, and the Government's priority is therefore to ensure their sustainability. We are fully involved in the EU and at the wider international level to draw up robust sustainability criteria for biofuels. There are a range of other constraints to renewable road transport deployment:

Regulatory constraints

6.2.19 Currently EU fuel quality standards only allow up to a 5% bioethanol blend (by volume) with petrol; and industry standards only allow up to a 5% biodiesel blend. Member States are discussing a proposed amendment to the Fuel Quality Directive which would change the fuel standard blend to 10% by volume (equivalent to 8% by energy). The Fuel Quality Directive could be further amended to allow blends in excess of 10% by 2020. This would require a proposal from the European Commission.

Vehicle technical constraints

6.2.20 It is generally accepted that a large majority of current petrol vehicles could run on a 10% (by volume) bioethanol blend[173] and by 2020 it is likely that all petrol vehicles will be able to operate on at least a 10% bioethanol blend. There is also evidence that by 2020 the majority of diesel vehicles will be able to run on a 10% biodiesel blend or more. But even if all road vehicles used a 10% blend, this would achieve only 8% renewable energy, because of the lower energy content of biofuels. A solution to this issue would be to mandate new compatibility standards for new vehicles, which would have to be agreed at least at a European level.

Fuel distribution technical constraints

6.2.21 There should be no significant infrastructure costs to refineries or at the point of sale in moving to biofuel blends of up to 10% (by volume). However, at blend levels above 10% it may be necessary to produce new base petrol and diesel fuels to suit the higher blends. It would also be preferable to include a single biofuel blend for each of the three existing fuel products (petrol, diesel and super unleaded petrol) rather than adding a distribution chain for a new product, which industry experts estimate would cost over £150 million.

Options to amend the RTFO

6.2.22 To meet the 10% renewable energy target for transport would require a very big increase in the use of biofuels, compared with existing levels. We need to consider if further financial incentives would be necessary to achieve this level. Assuming the 10% transport target were to remain in place, and assuming we had the evidence that it could be met sustainably, the Renewable Transport Fuel Obligation would need to be amended to increase the level of the obligation to an appropriate level by 2020.

6.2.23 The amendments to the RTFO would also need to take account of the draft proposal to amend the Fuel Quality Directive, which is currently being negotiated in the EU. If adopted as currently proposed, this would require suppliers of fuels for road transport and non-road mobile machinery to reduce the lifecycle greenhouse gas emissions of the fuel by 10% between 2010 and 2020. Although some of the savings would come from measures such as carbon capture and storage, refinery improvements and reductions in flaring at oilwells, it is clear that the largest element would need to be from increased use of biofuels.[174]

173 Although Germany has recently had to delay plans to increase its minimum blend requirements to 10% after if became apparent that more vehicles than previously anticipated may be incompatible with an E10 fuel.

174 See EC (2007)

Table 6.3: Options to amend the RTFO

How the RTFO could be amended	Key considerations
Increase the level of the RTFO volume target (by amending the Renewable Transport Fuel Obligations Order 2007)	• Would need evidence that the increase in biofuel consumption could be met sustainably. • Straightforward to implement. • Energy target of 10% does not convert exactly to a volume target (equivalent to between about 11 and 15% by volume, depending on market shares for petrol and diesel). • No specific mechanism to encourage greenhouse gas savings to meet requirements of the Fuel Quality Directive.
Amend the RTFO to move to an energy target	• Would meet the requirements of the directive exactly. • The market could decide the most cost-effective volume proportions to meet the energy obligation. • No specific mechanism to encourage greenhouse gas savings to meet requirements of the Fuel Quality Directive.
Amend the RTFO to a greenhouse gas saving target	• Would help the Government achieve the greenhouse gas savings needed in the Fuel Quality Directive. • Not guaranteed to hit the 10% by energy target.
Amend the RTFO to create separate energy and greenhouse gas saving targets	• Would help the Government achieve the greenhouse gas savings needed in the Fuel Quality Directive.
Broaden the RTFO to include transport fuels or non-biofuel renewable transport and potentially to band it to provide differential levels of support	• Potential to provide greater support to incentivise second and third-generation biofuels. • Potential to encourage the development of other transport options such as electric or hydrogen-powered vehicles. • Potential to encourage improvements in the production of petrol and diesel to achieve less well-to-tank CO_2 emissions.

6.2.24 If both the greenhouse gas target in the Fuel Quality Directive and the renewable energy target were adopted as proposed, it might be necessary to amend the RTFO to create separate energy and greenhouse gas saving targets. The RTFO Order would in any case need to be amended to include other types of renewable energy sources as they come on the market.

6.2.25 There are concerns that, under current proposed vehicle standards, the general vehicle stock would only be able to contribute 10% biofuels by volume (equivalent to around 8% by energy). The European Commission's impact assessment suggests that the 2% shortfall could be made up through increased use of flex-fuel vehicles,[175] which could run on any mixture of petrol and bioethanol. This option could be combined with any of the measures to amend the RTFO described above, but it would be expensive, owing to the cost of vehicles and fuel, and might require further incentives. Flex-fuel vehicles have a cost premium of between €100 and €500 compared to a standard petrol vehicle,[176] and industry experts suggest that vehicles running on E85 use 25% more fuel in volume terms than an equivalent vehicle running on petrol. It would also be possible to promote the use of vehicles designed for a specific high-biofuel blend, but again there would be a cost premium. This option would also mean increased biofuel demand, which could add to sustainability concerns.

6.2.26 It would be possible to replace the RTFO altogether with an alternative mechanism such as a feed-in tariff, which would require fuel suppliers to pay a fixed or minimum price (or tariff) to biofuel producers to compensate them for the additional production cost of biofuels. However at this stage we do not feel that the complexity and uncertainty of setting up a new mechanism would be justified in this market.

Impact of biofuels on security of supply

6.2.27 Biofuels can contribute to energy security by diversifying energy supply sources for transport, reducing our heavy dependency on a single energy source and increasing the number of supply sources and routes. Achieving the renewable energy target in the transport sector could reduce UK consumption of fossil fuels by 6%-7% in 2020. Displacement of petroleum fuels by biofuels reduces exposure to the risks associated with the international oil market.

6.2.28 However, the production and supply of biofuels is not risk free as there are a number of factors that could limit or disrupt supplies. These are:

- the competition for feedstocks used in biofuels for other uses such as food;
- the availability of agricultural land;
- variations in supply due to climatic conditions and seasonal cycles;
- risks of crop failures from disease and pests; and

175 EC (2008c)
176 According to the Commission's Impact Assessment, the cost premium of an E85 vehicle would be around €100.

- as with other products, using biofuels sourced internationally that have to be transported over great distances increases the risks of disruption through longer supply-chains (for example through problems with the transportation and transiting of goods).

6.2.29 It is difficult to quantify the likelihood of disruptions to the supply of biofuels, and therefore compare their comparative impact on security of supply. However, because the risks to conventional petrol and diesel are independent of those to biofuels, increasing the market share for biofuels would provide more resilience to any disruptions in supply.

The future for biofuels

6.2.30 Biofuels currently in commercial production are made from the parts of plants that could otherwise have a food use, such as wheat grain, beet or cane sugar, or vegetable oil. 'Second-generation' biofuels contrast with these 'first-generation' fuels in that they are manufactured from waste, from residues such as straw, or from other ligno-cellulosic material including whole plants not suitable for food. In that sense they are better (so long as the feedstock is not grown on land that would otherwise have been used for growing food). However, the technologies are still emerging and are not yet available on a commercial scale. The manufacture of second generation biofuels is likely to require major capital projects unsuitable for less developed areas. And although they can have significant potential for greenhouse gas savings, so can some first-generation biofuels when the impact of coproducts are taken into account. Longer-term, 'third-generation' biofuels, derived from algae, may become a viable option.

6.2.31 The draft Renewable Energy Directive seeks to incentivise the development of second-generation biofuels through a requirement that certain biofuels (those produced from wastes, residues, non-food cellulosic material and ligno-cellulosic material) should be doubly rewarded under national renewable energy obligations. Chapter 8 (Innovation) looks at the development of second-generation biofuels in more detail. It will be important to ensure that second and third-generation biofuels meet sustainability criteria. It is also important to note that second and third-generation biofuels will be competing for the same biomass resources as the heat and electricity sectors (see Chapter 7 – Bioenergy).

6.2.32 In the longer-term biofuels may prove less suitable for road transport than other technologies, especially in urban areas where options such as electric cars could become more attractive (see below). But there may be a continuing market for biofuels in less developed countries and markets, as they are likely to remain cheaper than other options for many years to come.

6.2.33 Sustainability of biofuels will continue to be a major concern. It will be important to develop sustainability criteria further, as more data is gathered on the impact of biofuels and experience is gained of enforcement of existing criteria, in developing countries as well as the EU. New and improved sustainability indicators could form the basis of new agreements, ideally at the global level, and new technologies could aid enforcement.

Box 6.5: Case Study – German Biofuel Market

In the last few years there has been a huge increase in biodiesel in Germany, so that it is now the largest producer and user in Europe. This increase was driven by the availability of more land for non-food crops; vehicle warranties offered by German manufacturers; and a tax incentive from the Government.

By 2004 Germany was producing over 1 million tonnes of biodiesel, more than half the total EU production. Germany became the only EU Member State to achieve its 2005 biofuels target under the 2003 Biofuels Directive (a 2% market share).

Partly because of the loss of revenue due to these tax reliefs, from the beginning of 2007 Germany imposed new taxes on biofuels. At the same time, the Biofuels Quota Act came into force, introducing a quota system intended to increase the market share of biofuels to 8% by 2015. In the short term the change led to a fall in demand and to financial difficulties for some producers.

In 2007 the German Government announced a new 'Biofuels Roadmap', under which the biofuels target for 2010 would be doubled from 5% to 10% and the 2020 target would be 20%. It was subsequently reported that the revised 2010 target might not be achievable because it would need to be met partly through the widespread sale of petrol containing 10% bioethanol, for which many vehicle engines were unsuitable.

6.3 Alternative road transport technologies

6.3.1 Increased use of non-fossil fuel based technologies can help efforts to meet the EU 2020 renewable energy target. Aside from biofuels, there are a range of potential technological options for road transport which offer alternatives to the combustion of fossil fuels. These include 'plug-in' hybrids (which use batteries charged from the electricity grid, as well as a standard combustion engine); and fully electric vehicles. Future technologies could also include hydrogen-fuelled vehicles, powered either by an internal combustion engine or a fuel cell. Electric and hydrogen vehicles have potential for the energy they consume to be sourced from renewable energy, particularly as the proportion of renewable energy in the electricity grid increases. Recent research for the Government concluded that as the transport sector is the most CO_2 intensive sector per KWh of energy delivered, using renewable energy in battery electric vehicles could save more CO_2 than using it in the electricity generation or heat sectors.[177]

6.3.2 To address concerns about CO_2 emissions from transport, the Chancellor commissioned Professor Julia King to carry out an independent review of the vehicles and technologies which could help decarbonise road transport over the next 25 years. The King Review of Low-Carbon Cars concluded that

177 E4tech (2007)

almost complete de-carbonisation of road transport could be possible by 2050, most likely through electric or hydrogen-powered vehicles.[178] This would however require major technological improvements, as well as substantial de-carbonisation of the power system (for example, through higher levels of renewable electricity). The potential implications on renewable electricity requirements are considered below.

6.3.3 The King Review makes a series of recommendations aimed at bringing existing low-carbon transport technologies forward as soon as possible: ensuring a market for these vehicles; moving the focus from biofuels to automotive technology; ensuring effective sustainability criteria for biofuels; and sending the right signals to the automotive industry. It recommends increased R&D funding to low-carbon technologies, including vehicles.[179] The Review concludes that substantial progress on battery and/or fuel cell issues, and cleaner electricity, will be needed in order to deliver decarbonised transport by 2050. Advanced (second-generation) biofuels will also have a part to play. [180]

6.3.4 Supporting the development of innovative lower-carbon technologies is an important part of the Government's approach to tackling carbon reduction in transport, and DfT published the Low Carbon Transport Innovation Strategy (LCTIS) in May 2007.[181] DfT have also announced further measures to stimulate low carbon vehicle technologies:

- Initial funding of £20 million to support a new programme of public procurement of lower-carbon vehicles, which could be extended to £50 million if the initial stages were successful.[182]

- Funding from the Technology Strategy Board (TSB) in conjunction with DfT and the Engineering and Physical Sciences Research Council (EPSRC) for a new Low Carbon Vehicles Innovation Platform supporting UK research and development into technologies to deliver future lower-carbon vehicles. The first call for proposals was launched in September 2007 and in May 2008 sixteen projects across a broad range of key technologies were awarded funding totalling £23 million.

- The next stage of the Innovation Platform will see the Technology Strategy Board, DfT, EPSRC and Advantage West Midlands coordinate funding for a £70 million Low Carbon Vehicles Integrated Delivery Programme. This will manage low-carbon vehicle activity from initial research to procurement, speeding up the time it takes to get low-carbon vehicle technologies into the market place.

178 King (2008)
179 King (2008)
180 King (2007)
181 DfT (2007b)
182 DfT (2007d)

Potential impact of vehicles powered through the electricity grid

6.3.5 Widespread emergence of electric vehicle options such as all-electric vehicles and plug-in hybrids could potentially contribute to long-term carbon reduction and renewable energy targets in a number of ways:

- even with today's electricity mix, a switch to vehicles powered through the electricity grid would be likely to offer a carbon reduction benefit relative to typical conventional petrol or diesel cars. For example, all-electric vehicle CO_2 emissions have been estimated at around 77g/CO_2/km based on re-charging from today's grid mix (compared to a 2007 new car CO_2 average of 167g/CO_2/km).[183] Local air quality would also benefit as there are no tailpipe emissions when vehicles operate in electric mode;

- electric vehicles are generally considered to be more energy efficient over the full life cycle compared to conventional petrol or diesel vehicles, so they could potentially reduce the overall amount of energy used by transport, despite the increase in electricity demand – making renewable energy and carbon reduction targets easier to achieve;

- greater use of vehicles powered through the electricity grid could potentially improve the efficiency of the operation of the electricity grid by smoothing power demand between day and night (assuming vehicles were principally charged at night, i.e. during times of low electricity demand);

- grid powered vehicles could provide distributed energy storage capacity via on board batteries, potentially helping mitigate some of the issues of intermittency of renewable electricity and allowing a greater proportion of intermittent renewables to be accommodated within the overall grid mix. Using vehicle to grid 'V2G' technology, electric vehicles could be charged and discharged at times of low or peak demand;

- vehicles powered through the electricity grid could potentially contribute to the 10% renewable transport target, if the proportion of renewable electricity used to provide energy to the vehicles could be counted towards the transport target (rather than towards the renewable electricity target). This would be subject to negotiations in the EU. Making any meaningful contribution would require a very steep growth in such vehicles in a short space of time and from a very low base.

6.3.6 Realising the potential benefits of electric vehicles for long-term carbon reduction, renewable energy and efficient grid operation is dependent on significant market penetration of vehicles powered through the electricity grid. Currently these kind of vehicles are not widely available mass market options for the majority of consumers, although extensive development work by major automotive companies is ongoing. Many major global vehicle manufacturers have announced plans to introduce or develop all-electric or plug-in hybrid, or hydrogen vehicles for potential mass market commercialisation in the next decade and beyond. Sustained higher oil prices, improvements in battery technology cost and performance, and the emergence of new technologies and/or business models which allow hydrogen refuelling or rapid battery re-charging or replacement are some of the key factors which could address

183 E4tech (2007)

existing barriers to market penetration of vehicles powered through the electricity grid.

6.3.7 A further key consideration to take into account will be the response of the market and consumer demand. Existing vehicles deliver very high standards of quality, performance and utility. In order to facilitate a mass market switch to vehicles powered through the electricity grid, consumers are likely to demand and expect better, or at least equivalent, performance at an affordable cost.

6.3.8 However, even if technologically robust and economically and commercially viable vehicle options do emerge in the next decade, there is considerable uncertainty about the potential for significant large-scale impacts on renewable energy or carbon targets, power demand or grid operation from electric vehicles prior to 2020. A major constraint would be the time taken for new vehicle technologies and supporting infrastructure to penetrate the total UK vehicle fleet.

6.3.9 In the longer term widespread adoption of electric vehicles could significantly increase demand for electricity (recently estimated at around a 16% (approx 64 TWh) increase if all 26 million of the UK's passenger cars were electrically powered), around 8% (32 TWh) if plug-in hybrids were adopted and around 34% (138 TWh) if the car fleet was converted to vehicles using hydrogen produced from grid electricity.[184]

6.3.10 A number of significant caveats should be placed on these figures. First, they are based on only one type of technology being used, whereas a mix of technologies might be deployed and new solutions could emerge. Second, they assume that distance travelled remains static at 2004 levels. The analysis also relies on a range of detailed assumptions around vehicle efficiency, technical performance, etc, including improvement in energy efficient electric vehicle applications. There are thus very considerable uncertainties around the potential impact of transport on electricity demand.

6.3.11 It is however clear that electricity demand for transport could have a large impact on total UK power demand – though this might not require a proportional increase in power generating capacity. This is because recharging of electric vehicles or plug-in hybrids, or production of hydrogen by electrolysis, might take place principally at night when demand is lowest. The benefits in terms of renewable energy and carbon targets will therefore principally depend on the extent to which the extra electricity demanded is produced from renewable and other low-carbon sources, and the amount of energy (including renewable energy) used by electric vehicles compared to the vehicles they would displace.

6.3.12 The Government is exploring the scale and viability of potential future market penetration of vehicles powered through the electricity grid. This work will examine the factors affecting the current and likely future economics of these options; the wider environmental impact; the potential impacts on and benefits to UK grid operation; and the case for further Government measures to help accelerate the development and introduction of vehicles powered

184 E4tech (2007). (Based on a base level of electricity demand in 2005 of 1,096 TWh). Demand from hydrogen could be higher because the hydrogen supply chain may be less efficient than electricity transmission and distribution.

through the electricity grid, and the associated supporting re-charging infrastructure. We will also examine how the UK automotive and other industries could benefit from expansion into these new markets.

6.4 Non-road transport

6.4.1 The overall 2020 renewable energy target applies to all final energy consumption in the transport sector, including energy demand in UK road, rail, national navigation (inland shipping) and aviation (including international aviation). However, the 10% renewable transport target excludes petroleum products other than petrol and diesel.

Aviation

6.4.2 It is estimated that UK energy consumption in aviation (including international) will account for around 11% of our final energy demand in 2020.[185] This document does not however suggest any proposals for the sector, as there are not expected to be safe, commercially viable options for renewable energy in aviation by 2020.

6.4.3 Biofuels such as FT kerosene (kerosene manufactured from biomass using the Fischer Tropsch process) and hydrogen produced from renewable sources could potentially be used in commercial aircraft, and the aviation industry has announced plans for biofuel trials. Biofuels are not however currently approved for commercial aviation as there are concerns about supply issues, compatibility challenges and safety risks.

6.4.4 A recent Government-commissioned study examined both the potential for biofuels and hydrogen-based fuel chains for aviation.[186] It concluded that methanol, ethanol and biogas were unsuitable for commercial jet aircraft but that hydrogen, biodiesel and FT kerosene all had the technical potential to bring savings in the aviation sector's use of fossil fuel energy and emissions of greenhouse gases. All of these options would be significantly more expensive to produce compared to the current costs of kerosene though, in the long term, the costs of producing hydrogen and FT kerosene may drop sufficiently for them to become more viable options.

6.4.5 Hydrogen-fuelled aircraft would require new engines and airframes and are unlikely to be seen for many decades. Nor would aeroplanes fuelled by alternative fuels necessarily have a lower climate impact in relation to those using conventional fuels because of the effects of water vapour and nitrogen oxide at high altitude. Moreover, due to a range of technical, safety and economic challenges, it is arguable that both hydrogen from renewables and biofuels would be used either in road transport or electricity generation in preference to aviation.

185 BERR Energy Projections Model
186 IC (2003)

Rail

6.4.6 Rail is responsible for a small amount of transport energy consumed, but it will mostly likely use the same proportion of biofuels as road transport, so will make a small contribution to the EU 2020 renewable energy target. About 2% of UK transport energy and 1% of UK carbon emissions come from rail. Trains are currently powered either by gas oil (red diesel)[187] or electricity. Currently 39% of the rail network is electrified with electric trains accounting for about 65% of total passenger kilometres, while the vast majority of freight in the UK is diesel hauled.

6.4.7 Rail industry research has considered the possible impacts of using biodiesel blends in trains,[188] and this research is now being supplemented by a series of in-service trials. Because proposed changes to the Fuel Quality Directive are likely to require rail to switch to zero sulphur diesel (road use diesel) from the end of 2009, it is likely that rail will be offered automotive quality diesel fuel with whatever level of biofuel is required for road use. So the industry's working assumption is that its fuel will include 5% biofuel by volume by 2010–11 and thus increase to up to 10% by energy by 2020.

6.4.8 It might be possible to require new or replacement train diesel engines to be compatible with higher blends of biofuels. This might involve changes to both the engine and exhaust after-treatment systems to ensure that they operate efficiently and reliably when using biofuels. There may also be associated maintenance impacts. Given the international market for rail engines, this would require agreement at EU level.

6.4.9 Another option for increasing renewable energy in rail is through increased use of electricity. Electric trains are more energy efficient than diesels. Like electric cars, the carbon performance of electric trains (and their potential contribution to the renewable transport target) is inextricably linked with that of the national electricity grid.

6.4.10 The 2007 rail White Paper, 'Delivering a Sustainable Railway', highlighted the environmental and operational benefits of electrification but concluded that investment for the period 2009–14 should be focused on providing much needed additional rail capacity. However, in the White Paper the Government committed to keeping the case for further electrification under review.

6.4.11 Since then, Network Rail has been invited to lead the rail industry's work on the development of complex options such as electrification to support the Department for Transport's wider strategic transport planning process. This work will re-examine the business case for electrification considering a range of economic, operational and environmental factors, explore how costs can be reduced and agree priority schemes. The first stage of this work should be completed by the end of 2008.

6.4.12 The rail industry has also shown interest in the possibility of generating its own electricity from renewable sources such as photovoltaics and wind turbines, based on the rail companies' own land. However, thinking on this is

187 Gas oil is used for industrial heating, by off-road machinery and vehicles, as a marine fuel and as a train fuel. As it currently benefits from a lower rate of duty it is marked with a red dye to distinguish it from road fuels.

188 RSSB (2006)

still at an early stage and the most likely early applications will be for stations and depots.

6.4.13 The rail sector is characterised by its relatively long-life assets. Trains, for example, generally have an operational life of 30-35 years. As a result, introducing radical technological change throughout the rail network can be a relatively long process. However, hybrid diesel-battery trains are currently being demonstrated and the expectation is that these will be commercially available within a few years. Hydrogen fuel cells are also a long-term possibility for rail transport, and trials are already taking place in Japan.

Shipping

6.4.14 As with rail, the national navigation industry expects that, going forward, its fuel will include the same proportion of biodiesel as fuel for road use. National navigation[189] is projected to account for 1% of UK total energy demand by 2020. Shipping is a very fuel-efficient method of moving bulk freight and remains the most low carbon method currently available for long distance movement of freight on a per tonne basis. However, it is estimated to account for around 2-4.5% of worldwide carbon emissions and the movement of goods by ship continues to grow.

6.4.15 A recent Government-commissioned study highlighted a range of options for reducing the carbon impacts of shipping – of which the most promising are incremental improvements to existing marine engines, improved fleet management techniques, biofuels and using kites or skysails as a means to supplement the existing propulsions systems of commercial shipping.[190] The Government considers that, over time, carbon pricing should be applied to the shipping sector. As with aviation, shipping is primarily international and thus any approach to reduce greenhouse gas emissions needs to be developed at an international level to be effective. The Government has already put a discussion paper to the International Maritime Organisation on the possibilities of extending emissions trading to the shipping sector.

6.5 Conclusion

6.5.1 Whether or not the UK would be able to meet the target for 10% renewable energy in transport by 2020, and whether this could be achieved cost-effectively, depends crucially on the availability of sustainably-produced biofuels. The Government has emphasised that we will not agree to any increase above current biofuels targets unless it is clear that this could be done in a sustainable way. The emerging evidence confirms that we have been right to be cautious in the targets we have set so far.

6.5.2 Assuming that biofuels were available in sufficient quantities, the simplest and most cost-effective way to increase the amount of renewable energy in

189 Defined under the draft Renewable Energy Directive as "fuel oil and gas/diesel oil delivered, other than under international bunker contracts, for fishing vessels, UK oil and gas exploration and production, coastal and inland shipping and for use in ports and harbours".

190 The Government commissioned AEA Energy & Environment and Newcastle University to advise on the technology options available in this area and their likely viability. Their report is being published alongside the Low Carbon Transport Innovation Strategy.

transport would be to increase the biofuel content of normal petrol and diesel. Administratively this would be straightforward, through a simple amendment of the target figures in the RTFO. Achieving the entire 10% target through biofuels would require a biofuel content of between 11% and 15% by volume. These levels might be too high for some vehicle engines. If biofuel content of normal petrol and diesel were limited to 10% by volume then 2% of the target would need to be met through vehicles designed to operate on much higher blends.

6.5.3 The UK sees renewable energy primarily as a means of reducing greenhouse gas emissions and thus countering the effects of climate change as well as a means to improve security of supply by reducing our dependency on oil. It is important that there should be compatibility between the targets for renewable energy in transport and for greenhouse gas savings from petrol and diesel. The UK has been pressing for this to be the case in EU negotiations on the Fuel Quality and Renewable Energy Directives.

6.5.4 If it were concluded that the production of biofuels could not safely be promoted at the levels needed to meet the 10% target, then it may be necessary to review the target. Electric vehicles and greater fuel efficiency measures could also have the potential to contribute to the target. The EU could still set a target for reduction of greenhouse gas emissions which the industry would be free to achieve partly in other ways.

6.5.5 It will be important to understand and take full account of the emerging evidence on biofuel sustainability in setting policy on renewable transport going forward. As well as having targets to increase renewable energy, the impacts of carbon emissions and dependency on oil in the transport sector are big issues that we need to address in the longer term. We will set out our policy decision on renewable transport for 2020 in the Renewable Energy Strategy, which we will publish in spring 2009.

Q24: **How can we best incentivise renewable and low-carbon transport in a sustainable and cost-effective way?**

Q25: **What potential is there for the introduction of vehicles powered through the electricity grid in the UK? What impact would the widespread introduction of these kinds of vehicles have on:**

a. energy demand and carbon emissions;

b. providing distributed storage capacity;

c. smoothing levels of electricity demand on the grid?

What factors would affect the scale and timing of these impacts?

Q26: **Over what timescales do you think electric vehicles could plausibly contribute to our renewable energy and carbon reduction targets and what could the Government most effectively do to accelerate the introduction of such vehicles in the UK?**

Chapter 7
Bioenergy

Summary

According to our analysis, the least cost delivery of our 2020 renewable energy goals might require approximately 30% of the UK's renewable energy to come from bioenergy (energy produced from the direct or indirect combustion of biomass material such as energy crops, wood and waste, and biogas) across the heat and electricity sectors. This is in addition to the bioenergy needed for transport, discussed in the previous chapter. This chapter seeks views on a number of potential measures for maximising our biomass resources for heat and electricity, including:

- ensuring the sustainability and the fuel-quality of biomass supply, both domestic and imported;
- continuing support for energy crops with research into new energy crop options; and support for local supply chain development via the Bio-Energy Infrastructure Scheme and the Bio-Energy Capital Grants Scheme;
- as far as is practical, discouraging the landfilling of biomass, thereby maximising its availability as a renewable fuel;
- considering the scope for Local Authorities to collect and separate organic food waste as far as is practical to provide an additional biomass fuel;
- encouraging Waste Incineration Directive-compliant combustion infrastructure and support for anaerobic digestion as a means of generating energy from waste;
- a biomass communications programme to raise awareness about the benefits of bioenergy including energy from waste.

7.1 Introduction

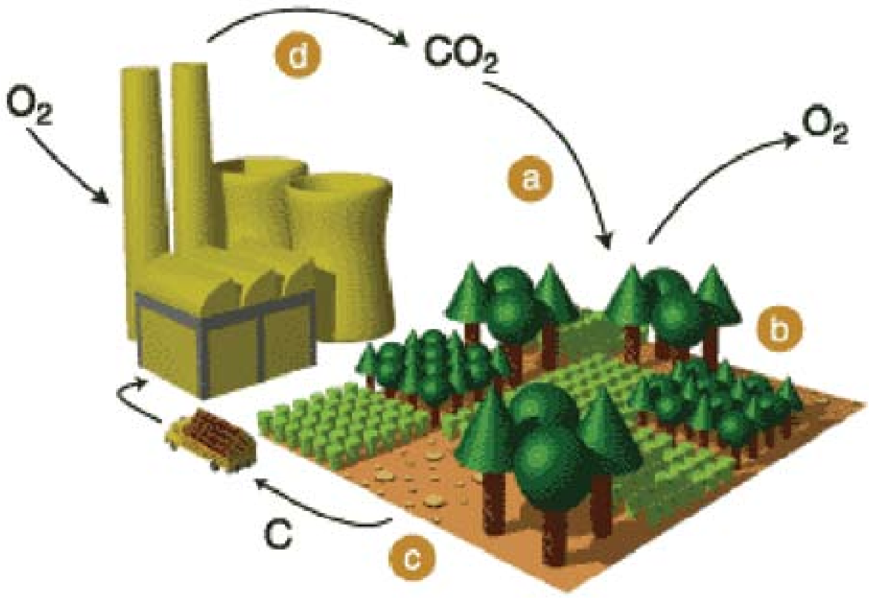
7.1.1 Bioenergy is energy produced from the direct or indirect combustion of biomass material, such as energy crops, wood, manures and slurries or organic (e.g. food) waste converted to biogas, and waste wood. It can be used to generate heat or electricity and to produce transport fuel. The infrastructure needed to convert biomass material to bioenergy is similar whether it is specifically grown or is a by-product of another process, though additional rules may apply to regulate possible contamination of waste fuels. It is important to ensure that all biomass is obtained from sustainable sources, and that biomass, including that derived from waste materials, is not used as a fuel when it could more beneficially be re-used or recycled.

7.1.2 Bioenergy, when produced and processed with due regard to sustainability and carbon concerns, has the potential to make a valuable contribution to heat and electricity generation and in the development of greener fuels for transport.[191] Our analysis indicates that, for heat and electricity, it may be one of the most cost-effective ways to meet the EU 2020 renewable energy target, as well as delivering significant carbon savings. Our estimates suggest that to achieve up to 14% renewable heat and up to 37% renewable electricity would require around 80 TWh of bioenergy. This would be equivalent to approximately 4.5% of the UK's forecast energy consumption in 2020, or nearly one third of the proposed UK share of the EU target.

7.1.3 We also estimate that there is between 64-78 TWh of domestic biomass resource currently available for bioenergy production for heat and electricity (the long-term potential is dealt with below).[192] If all this resource was substituted for grid electricity and heating oil, this would deliver carbon savings of between 4.8–5.8 MtC by 2020, and avoid 1.8 MtC from landfill gas emissions.

191 DEFRA-DTI-DfT (2007)
192 Annex C, DEFRA-DTI-DfT

Figure 7.1: Simplified carbon cycle



(a) As trees in the energy plantation grow, they absorb carbon dioxide from the atmosphere.

(b) Through photosynthesis the trees store carbon in their woody tissue and oxygen is released back into the atmosphere.

(c) At harvest, woodfuel is transported from the plantation to the heat or power generating plant.

(d) As the wood is burned at the heat and/or power generating plant, the carbon stored in the woody tissue combines with oxygen to produce carbon dioxide, this is emitted back into the atmosphere in the exhaust gases.

The cycle (a–d) continues through continued planting and growth of the biomass.

Diagram courtesy of the IEA Bioenergy Task 39[193]

7.1.4 This chapter focuses primarily on biomass used for electricity and heat and considers current policies to develop more reliable sources of biomass and increase the sustainable supply from domestic production and imports. It also considers how we can use our waste more effectively and how to facilitate the production and use of biogas. Biofuels for transport and the issues surrounding their sustainability are discussed in Chapter 6 (Transport).

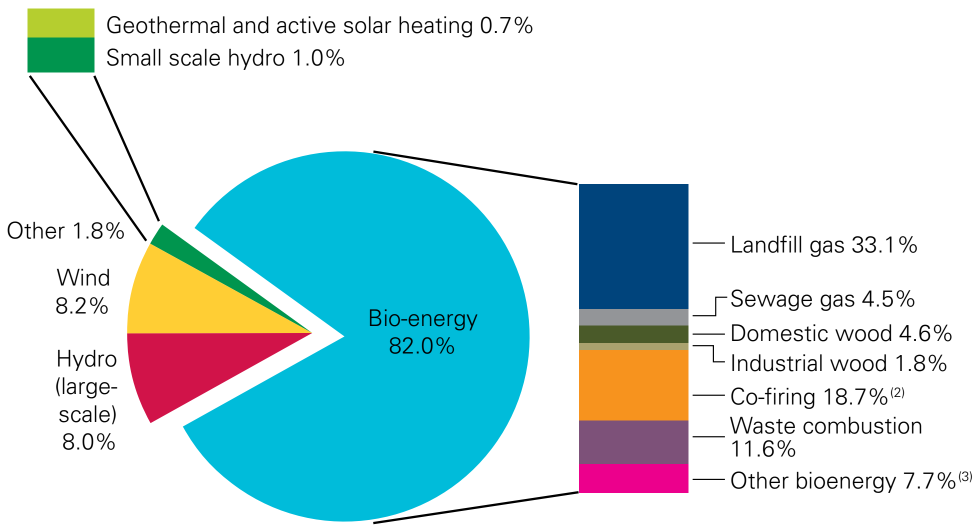
193 Matthews et al (2001)

7.1.5 As with all renewable energy, it will be crucial to ensure that biomass production is optimised but it also needs to be sustainable. This will be achieved by making appropriate use of sustainable indigenous supplies and ensuring that imports of bioenergy materials also come from sustainable sources.

Current use

7.1.6 Currently bioenergy, including waste, accounts for the majority of renewable energy deployment in the UK. Current biomass usage for electricity and heat generation and in the production of biofuels is approximately 42 TWh, of which approximately 5.9 TWh is imported.[194] In 2006, biomass electricity generation accounted for 9.3 TWh, equivalent to 2.3% of the UK's electricity generation, while heat from biomass generated less than 1% of our heat needs.[195]

Figure 7.2: Bioenergy utilisation as a % of total renewable energy utilisation 2006[(1)]



Total renewables used = 4.43 million tonnes of oil equivalent

Source: BERR, 2007, '*Digest of UK Energy Statistics*'

(1) Excludes all passive use of solar energy and all non-biodegradable wastes. In this chart renewables are measured in primary input terms.

(2) Biomass co-fired with fossil fuels in power stations; imported 11.2% of total renewables, home produced 7.5%

(3) 'Other bioenergy' include farm waste, poultry litter, meat and bone, and short rotation coppice.

194 BERR (2007a)
195 BERR (2008c)

Future supplies of bioenergy

7.1.7 If fully exploited, current UK biomass resource could meet between 80-98% of our estimated bioenergy requirement in the heat and electricity sectors for the UK share of the EU renewable energy target. Longer-term, we estimated that, technically, the resource could be expanded to as much as 100 TWh per year (see Table 7.1),[196] equivalent to approximately 6% of the UK's overall energy demand, by:

- Sourcing an additional 1 million dry tonnes of wood per year from currently unmanaged woodland in England, and from increasing the recovery of wood for energy from managed woodland and other sources of wood waste products across the UK.
- Increasing the amount of perennial energy crops produced in the UK to meet market demands. We have previously estimated that there is potential to use an additional 350,000 hectares across the UK by 2020.[197] Combined, this would bring the total land availability for biofuel and energy crops to around 1 million hectares, equivalent to around 17% of total UK arable land.[198]
- Increasing supply from organic waste materials such as manures and slurries, certain organic wastes, source separated waste biomass and waste derived Solid Recovered Fuels (SRF).

Table 7.1: Estimated long-term technical potential of bioenergy sources for heat and electricity available in the UK (TWh of primary energy) per year[199]

Forest woodfuel	Straw	Wood waste	Waste	Agricultural waste	Energy crops[200]	Total
13	14.5	30.4[201]	15.5	10	17.2	100.6

7.1.8 In the future, it is likely that the UK will, as today, make use of a mix of domestically produced and imported products. For example, the 350 MW proposed biomass electricity power station at Port Talbot will use biomass imported from the US and Canada. As we move beyond the EU 2020 renewable energy target and towards 2050, we expect the amount of biomass used for renewable energy generation to increase further. It will be therefore be important to ensure that biomass production, whether in the UK or overseas, is sustainable.

Constraints to increasing the supply of biomass for bioenergy

7.1.9 There have been several studies into the barriers to increased supply of biomass for bioenergy production, the most comprehensive of which was

196 These figures do not consider financial and market constraints such as the impact of current world food prices or the recent increased focus on sustainability on land availability for biomass. Nor do the figures consider the implications of potential for export of biomass from the UK.
197 DTI-Carbon Trust (2004)
198 These estimates may be amended in light of the conclusions of the Gallagher Review.
199 DTI (2007d)
200 These are perennial energy crops such as miscanthus, short rotation coppice and canary grass.
201 Taken from ERM/Golder (2007)

that of the Biomass Task Force (2005).[202] In summary, this found that the development of a 'biomass industry' was constrained by a lack of market confidence brought about by three main factors:

- the lack of a mature, robust fuel supply chain;
- lack of knowledge, interest or awareness of the potential of bioenergy; and
- lack of strong market signals and the appreciation of the true costs and long-term benefits of bioenergy, due either to regulatory or structural issues, particularly in the heat market.

7.1.10 In addition, the issue of sustainability of bioenergy supplies has come to the fore in recent months. Developing markets by incentivising renewable heat is discussed in Chapter 4 (Heat), while issues of sustainability, the supply chain and information and awareness are discussed below.

7.2 Current bioenergy policies

The UK Biomass Strategy

7.2.1 The Government's response to the Biomass Task Force,[203] together with its Biomass Strategy, aims to remove or reduce the barriers identified and includes a number of measures:

- establishing the Biomass Energy Centre to provide expert information and best-practice advice to industry and the public;
- working with the Regional Development Agencies and other organisations to ensure effective, co-ordinated mechanisms for delivery of policy and advice;
- supporting energy crops under the Rural Development Programme for England,[204] with £47 million available over the 2007-2013 period;
- supporting the development of biomass supply chains through the Bioenergy Capital Grants Scheme[205] and the Bioenergy Infrastructure Scheme with £10 million available under the Environmental Transformation Fund in 2008-09;[206]
- a review of the Government's approach to anaerobic digestion within England;[207] and
- the Woodfuel Strategy for England 2007 which aims to bring an additional 2 million green tonnes (1 million oven dried tonnes) of wood onto the market annually by 2020.[208]

202 Biomass Task Force (2005)
203 See DTI (2006b) and DEFRA, DTI, DfT (2007)
204 For further information see: http://www.naturalengland.org.uk/planning/grants-funding/energy-crops/default.htm
205 For further information see: http://www.defra.gov.uk/farm/crops/industrial/energy/capital-grants.htm
206 For further information see: http://www.defra.gov.uk/environment/climatechange/uk/energy/fund/
207 DEFRA (2007c)
208 The Forestry Commission England (2007)

7.2.2 In Northern Ireland, the results of a current study into the potential for the sustainable development of the bioenergy sector will inform the development of a cross-cutting strategy to be brought forward during 2008/09. In 2007/08, the Scottish Executive committed £7.5 million to biomass support via its Scottish Biomass Support Scheme. Currently, Scotland offers support for biomass via a number of grant schemes, including the Scottish Rural Development Programme. In Wales, following the consultation on a Renewable Energy Route Map,[209] the Welsh Assembly Government intends to publish a consultation on a bioenergy strategy/action plan that will also cover the complex issues of sustainability and potential land conflict.

The Waste Strategy

7.2.3 The Government's Waste Strategy for England[210] set out its vision for sustainable waste management. This included two key objectives to help reduce greenhouse gas emissions: by diverting greater amounts of biodegradable waste away from landfill; and by increasing the recovery of energy from waste. It identified combustion as the preferred option for waste wood (over recycling), and anaerobic digestion as the preferred option for food waste. In addition:

- there is a £2 billion programme of PFI (Private Finance Initiative) credits for waste infrastructure, together with Renewables Obligation Certificates for electricity generated from biomass. The resulting infrastructure will help to overcome the current shortage of geographically-located, Waste Incineration Directive (WID) compliant combustion capacity, and to support other forms of energy from waste technology, such as anaerobic digestion. Currently there are about 23 PFI projects in train;
- the Waste and Resources Action Programme (WRAP) is conducting research into food waste collection costs, which will be disseminated to Local Authorities and others;
- DEFRA recently published a market report into waste wood, to enable industry to understand the issues and begin to build supply chains;[211]
- the Environment Agency and WRAP are developing an end of waste protocol for digestate (the treated material from anaerobic digestion which can be used as a fertiliser), to facilitate access to end-markets (see below). They are currently considering the responses to the recent consultation on the draft protocol which closes on 27 June 2008.[212]

The Renewables Obligation

7.2.4 The Renewables Obligation (RO) also encourages the use of biomass for generating electricity. Biomass for electricity generation generally receives, like other renewable technologies, one Renewables Obligation Certificate (ROC) per MWh. In order to bring on projects using less mature or emerging technologies, we are proposing to band the RO, rewarding different

209 WAG (2008)
210 DEFRA (2007e)
211 DEFRA (2008a)
212 Environment Agency and WRAP (2008)

processes with an appropriate number of ROCs. We intend to continue to support co-firing (the blending and burning of renewable biomass materials with coal) with 0.5 ROCs, or 1 ROC if coal is co-fired with energy crops, as this has a role in mitigating emissions from coal-fired power stations and stimulating the biomass supply chain. Proposed support levels are set out in Table 7.2.

Table 7.2: Proposed level of support for biomass under the banded Renewables Obligation

Technologies	Level of Support (ROCs/MWh)
Landfill gas	0.25
Sewage gas; co-firing of biomass	0.5
Energy from Waste with CHP	1.0
Co-firing of energy crops; energy from waste with CHP	1.0
Dedicated biomass	1.5
Fuels created using advanced conversion technologies; dedicated biomass with CHP, dedicated energy crops with or without CHP	2.0

7.3 Best use of biomass across sectors

7.3.1 The versatility of biomass means that it can be used across the energy spectrum for heat, electricity and transport. The development of second-generation biofuels for transport (see Chapter 6) could increase the competition for resource across the sectors as more types of biomass material would be able to be used to produce biofuel. In addition, they can be used for alternative, non-energy purposes, such as for renewable construction materials, lubricating oils and pharmaceuticals, so giving rise to competition for biomass resource across a wide range of industrial sectors.

7.3.2 The UK Biomass Strategy (2007) was clear that the most cost-effective (in terms of £ per tonne of carbon abated) energy use of biomass is through heat generation, either in heat only or Combined Heat and Power plant. Clearly, this is influenced by the relative cost of processed fuels, the relative cost and scale of the generating technologies themselves and by energy efficiency, and will differ across the different types and sources of biomass. Overall sustainability and the availability of other options for reducing carbon emissions within a sector are equally important considerations.

7.3.3 Market intervention through the Renewables Obligation provides an incentive to use biomass to generate electricity over heat – we are considering addressing this issue via a financial incentive for renewable heat (see Chapter 4). In developing the financial incentives for both sectors we aim to adopt a consistent approach to help ensure that the market uses bioenergy in the most efficient way, and in particular once second and third-generation biofuels become commercially available to ensure that our EU 2020 renewable target for renewable energy can be met in the most cost and carbon-efficient manner. The EU 2020 renewable target will require each sector to deliver to its maximum, sustainable potential.

7.4 Sustainability and imported biomass

7.4.1 It is important that all renewable energy production is sustainable – environmentally, economically and socially.[213] If biomass sourcing were to take place without sufficient regard to environmental, social and economic impacts, its continued production and expansion would not be possible in the longer term.

7.4.2 We recognise that increasing the production of biomass energy crops has the potential to lead to competition with food crops for land and so to increased food prices. To a limited extent, recent commodity price rises are due to an expansion in the production of biofuels, but other factors have together made a greater contribution: the world-wide shortage of cereals resulting from the severe drought in Australia and elsewhere; high energy prices; the burgeoning demand for meat and animal feed in wealthier developing countries; export restrictions by some commodity exporting nations; and speculation in the commodity markets. Biomass heat and power generation, in comparison, is often expected to use by-products of other processes, such as forestry thinnings, and should therefore have a smaller direct impact on arable land use. But there will be some impact, particularly when growing dedicated energy crops, and the increased demand for biomass across Europe as a result of the EU 2020 renewable energy target. This needs to be addressed through the ongoing work described in this Chapter. While the issue of sustainability of biofuels is covered in more detail in Chapter 6 (Transport), it will be important, in taking forward the development of second and third-generation biofuels, that these too meet sustainability criteria.

7.4.3 In the case of biomass for heat and power generation, the draft Renewable Energy Directive proposes that a report on sustainability requirements should be produced by the Commission by 31 December 2010,[214] at the latest. There is significant interest in the UK and internationally in developing such requirements. The European Committee for Standardisation (CEN) is producing a sustainability standard for biomass.[215] We anticipate that it will draw on the draft Directive's criteria for biofuels and related work undertaken in Member States. The UK is actively contributing to this project via the British Standards Institution's Mirror Committee.[216] We will also look to work closely with industry and non-governmental organisations to develop a UK view on what the sustainability requirements should include.

213 DEFRA, DTI, DfT (2007)
214 Article 15(7) of EC (2008)
215 CEN, Technical Committee TC383
216 See http://www.bsi-global.com/

7.4.4 Implementation of new standards has the potential to be both costly and time consuming. One approach that could be used to reduce this burden would be to identify existing certification schemes for the product in question which could deliver similar sustainability controls. For biomass, examples of such schemes might include the Forest Stewardship Council (FSC) for wood or the Roundtable on Sustainable Palm Oil (RSPO). While such an approach could help to reduce the burden on suppliers and users of biomass there are also important questions that would need to be addressed, in particular whether the existing schemes fully meet our sustainability ambitions.

7.4.5 Prior to these standards being developed the Government has already proposed to introduce sustainability reporting for all stations that use biomass for electricity generation under the Renewables Obligation from April 2009. The reporting criteria are based on those developed under the Renewable Transport Fuel Obligation (RTFO), including whether biomass has been sourced under the types of existing certification schemes referred to above. Sustainability reports for each station using biomass will be published on an annual basis by the energy regulator, Ofgem.

7.4.6 Greenhouse gas emissions over the full life-cycle of biomass should be taken into account. For example, sustainably-produced wood pellets and wood chip that have been transported by bulk shipping can provide valid low-carbon options within the supply chain. We will need to consider what processes, guidance and regulations may need to be put in place to take account of all carbon costs.

The development of a global market for sustainable biomass

7.4.7 Currently the bioenergy market is disparate, often relying on small, locally sourced supplies. Unlike gas or oil, there is no global market or price. Our analysis suggests that, given increasing global demand for biomass, it will develop towards a fully competitive market up to 2020. This may have implications for the UK's ability to import biomass, for the biomass industry to compete on the open market and on long-term prices and costs of biomass.

7.4.8 Many studies have been undertaken of the global availability of biomass, covering current and future years, with estimates of bioenergy potential reported as ranging from less than 100 EJ/yr (exajoules per year or 27,800 TWh/yr) to over 500 EJ/yr (138,900 TWh/yr).[217][218] Some studies have sought to refine their estimates further to identify the potential global availability of sustainably-sourced biomass. The Government is reviewing the main studies to assess their applicability to the UK situation and, depending on the outcome of this work, may look to fund a more UK-specific analysis.

217 McCormick (2005)
218 EJ = exajoule, 10^{18}J

Q27: How can we best ensure that our use of biomass is sustainable?

Q28: How do you see the market for biomass developing to 2020? What are the implications for:

a. imports;

b. longer-term prices and costs?

7.5 Bioenergy supply chain

7.5.1 Measures set out in the UK Biomass Strategy (2007) will help to support the UK's biomass supply chain; ensure the development of competitive markets; and promote innovation for higher energy yields. Moreover, the financial incentives for renewable heat and electricity will be a big driver to develop the supply chain further. However, we would like to explore what more we can do to encourage biomass, particularly given its importance in meeting the EU 2020 renewable energy target. One such way is through grant support. In England, the Bioenergy Infrastructure Scheme helps to develop biomass supply chains from harvest through to delivery to heat and power end-users, providing grants for essential, dedicated equipment such as chippers. The scheme has allocated £3 million of support to date to provide some market 'push'. The second round of this scheme was launched in early June 2008.

7.5.2 Market 'pull' has been provided by grant schemes such as the Bio-energy Capital Grants Scheme, which supports the installation of biomass fuelled heat, and Combined Heat and Power projects. Around £11 million of grant support has been allocated under Round 3 of the scheme in 2007-08. Round 4 was launched in April 2008, with total funding of around £4 million available for new projects for the 2008-09 financial year. Other schemes which support the biomass supply chain include the Biomass Heat Accelerator project run by the Carbon Trust, the Low Carbon Buildings Programme, and various initiatives by Regional Development Agencies and the Forestry Commission. Looking forward to the EU 2020 target for renewable energy, we will review the outcomes delivered by the present and past DEFRA-sponsored schemes.

7.5.3 The Devolved Administrations are also considering ways to increase the production of woody biomass. For example, the Scottish Executive has recently published its response to the Woodfuel Task Force, which sets out actions to ensure availability of resource for bioenergy use.[219] In Wales, projects such as the Wood Energy Business Scheme have encouraged the development of the wood supply chain, including the active management of Welsh forests.

219 Forestry Commission Scotland (2008)

Woody biomass

7.5.4 Woody biomass is obtained from woodland or arboricultural management, such as coppicing or as part of a continuous programme of forest replanting and management. Material can also be obtained as a by-product of wood processing, for example, off-cuts, bark and sawdust from timber production. It is suitable for the production of heat and/or power at a range of scales and requires little in the way of processing except air drying to reduce water content and sizing by chipping or pelletising to improve the efficiency of the combustion process.

Fuel Quality Standards

7.5.5 The UK biomass industry is at an early stage of development compared with the same sectors on the Continent, with the supply of biomass stoves, biomass boilers and fuel dominated by small and medium sized enterprises. Fuel suppliers are often local or informal. To reach its full potential, the supply chain for woody biomass fuels in particular needs to be more robust and guarantee a reliable multi-year supply of the right type of biomass fuel. Comprehensive quality standards for woody biomass fuels (size, moisture content etc) are emerging only now, even though most boilers and incinerators must have fuel of a specified standard to work at maximum efficiency. There are currently only limited sustainability standards or guidelines covering indigenous or imported biomass.

7.5.6 Europe-wide biomass fuel standards are being developed by the European Committee for Standardisation (CEN), which provide details of appropriate sampling and testing methodologies for assessing biomass fuel quality. This process is expected to conclude in 2010. However, as the demand for biomass expands, particularly if we see the introduction of a financial mechanism for renewable heat, additional suppliers will enter the market and we may see more examples of fuel not meeting the specifications required for boilers.

7.5.7 A system to certify or guarantee the fuel specification of biomass is needed to increase user confidence. Industry bodies[220] have held initial discussions to try to progress the implementation of a voluntary fuel-quality certification scheme for solid biomass fuels, such as woodchips, pellets and logs. These discussions are at an early stage, but could have the potential to deliver important benefits for the development of robust quality standards.

Energy crops

7.5.8 Energy crops are grown specifically for use as fuel. The types of energy crop currently grown in the UK for the generation of heat and electricity include: fast growing tree species which can be continually harvested every three to four years (so called short rotation coppice) or, depending on the tree species, coppiced over longer periods; grasses such as Miscanthus which can be harvested annually; and agricultural residues such as straw.

220 Led by HETAS with the Renewable Energy Association (REA).

Planting Grants

7.5.9 The Government encourages the production of specific energy crops through support schemes. In England this is under the Energy Crops Scheme and through infrastructure support for specialist equipment. However, recent steep rises in agricultural commodity prices have helped to make the growing of energy crops less attractive compared with some other arable crops. Indications are that plantings of energy crops will have decreased by approximately 60% this year compared with the 2007 planting levels. We are currently exploring options for improving the level of plantings in England, including carrying out an assessment of whether an increase in the planting grant to up to 50% of actual costs would have any impact on take-up and be justified in carbon cost terms.

7.5.10 The Northern Ireland Department of Agriculture and Rural Development's Forestry Service introduced a three-year Challenge Fund in 2004 to encourage the establishment of short rotation coppice for renewable energy. Following its review, DARD is currently considering a successor programme of support for the continued development of short rotation coppice under the Northern Ireland Rural Development Programme 2007-2013. The Scottish Executive also offers grant aid for growers of short rotation coppice and, under the Rural Development Plan for Wales, the Welsh Assembly Government is exploring whether to introduce a grant scheme to help farmers grow energy crops.

7.5.11 The Commission has recently published draft legislative proposals for the Common Agricultural Policy (CAP) Health Check[221] which might provide further opportunities to enhance the Energy Crops Scheme.

7.5.12 Any potential increase in energy crops will need to be sustainable. At present, detailed environmental appraisals are carried out before planting grants are awarded under the Energy Crops Scheme. However, longer-term changes in, for example, rainfall in the South East of England due to climate change, could mean that future energy crop plantings may need to demonstrate specific environmental characteristics, such as greater water use efficiency, in order to be sustainable.

New Energy Crops

7.5.13 The current selection of biomass energy crops – short rotation coppice willow and poplar, miscanthus and a range of coppiced tree species – was determined following research programmes in the UK and overseas. However, there may be other potential energy crops that would be suitable for use in specific locations or applications. For example, the fuel characteristics and yields of non-coppiced short rotation forestry are reported to offer particular benefits for power and heat generators. This type of Short Rotation Forestry is currently underdeveloped with further knowledge needed of its environmental interactions. If Short Rotation Forestry species – both native and/or non-native – show improved yields and can be produced sustainably, they may offer a more cost-effective option for some producers and users. The same may also be true of alternative, novel energy crops species which have yet to be fully assessed within the UK.

221 The CAP Health Check will review the effectiveness of the 2003 CAP reforms and will contribute to the discussion on the future of the CAP.

7.5.14 We are therefore considering:

- initiating research on new energy crops, including re-examining existing trial data to explore the potential of alternative biomass crops for energy, and the crops' impacts on local hydrology, biodiversity and landscape change; and
- working with industry to conduct the field-scale site trials required to assess the environmental impacts of Short Rotation Forestry species.

7.5.15 The field-scale trials would consider factors affecting the performance (and survival) of the different species, including winter hardiness. It is likely that they would be jointly funded by industry and Government with the overall cost dependent on the final range and scope of the trials. If the trials demonstrate significant yield, cost and fuel quality advantages of the Short Rotation Forestry species, it could lead to a major expansion of UK biomass production for electricity generation based around these species, and may offer benefits for other energy applications.

'Waste' biomass

7.5.16 An estimated 9 million tonnes of waste food and 6 million tonnes of wood are currently landfilled in the UK, with a combined energy value of 42 TWh.[222] There is a double cost to climate change policy, since not only is potential renewable energy lost by not burning the biomass energy in this material, but in landfill the waste produces climate-damaging methane (only a proportion of which can be captured to generate electricity). And in the case of food, very significant energy is embodied in the food itself, making it imperative to reduce food waste. For this reason, the Government's Waste Strategy has identified food and wood as two of seven priority material streams for which better waste management options must be sought. Minimising food waste; separating and collecting that food which is wasted for anaerobic digestion to create biogas; and the combustion of wood waste for either electricity or heat, are the leading waste management options. All would contribute to increasing renewable energy in the UK.

7.5.17 The biomass in waste can be collected and converted to energy or fuel in a variety of ways. There are several different energy recovery routes available for food and residual wastes: anaerobic digestion can be used to generate biogas from food and other biomass in mixed residual waste; the same waste can be burned with energy recovery from the biomass and non-biomass fractions; mixed waste can be turned into a fuel with a biomass content (such fuels, known as Solid Recovered Fuel (SRF), are often burned in processes involving Combined Heat and Power to maximise the useful energy recovered); and finally, if biomass is still present in waste once it reaches landfill, energy can be recovered over a long period by capturing the landfill gas. There are other technologies, such as gasification and pyrolysis that may in the longer term provide additional ways to recover energy from waste.

7.5.18 In order to maximise the recovered energy from the biomass waste, waste management needs to ensure that the biomass content of waste is routed to

222 Tables A1.26 and B1.1 of ERM/Golder (2007). The figure of 42 TWh assumes 100% energy recovery. Using an 85% recovery efficiency will give 35.6 TWh.

the process offering the best conversion efficiency and that the energy itself is used as efficiently as possible.

7.5.19 Recycling is more sustainable than energy recovery, in energy terms, for most materials because of the energy embodied in, for example, plastics. However, waste wood is a special case given its high calorific value, low embodied energy and the difficulty of finding recycling routes for some types of wood. Some waste wood may currently be diverted from more beneficial energy recovery by recycling targets. Work being taken forward under the Waste Strategy aims to ensure that waste wood is managed in the most sustainable way, which will usually be energy recovery.

7.5.20 The 2007 Waste Strategy for England states that the best use of waste wood is to burn it in the form of a solid recovered fuel, or in other Waste Incineration Directive (WID)-compliant Combined Heat and Power facilities.

7.5.21 Government strategy strongly encourages Local Authorities to consider the use of anaerobic digestion for food waste for a number of reasons. Any incineration of food waste would require an initial input of energy to remove the moisture content. Conversely anaerobic digestion requires no drying of the waste and produces a particularly versatile fuel – biogas – plus a digestate, which has additional environmental benefits. There are also synergies with food and other wastes from agriculture, which can be co-digested. Hence anaerobic digestion is seen as one of the leading waste management technologies for dealing with food waste. Even though landfilled biomass produces methane that can be captured and combusted, it still emerges as an inefficient way of converting and using the energy in waste biomass. Uncontrolled methane emissions from landfill are also a significant source of greenhouse gas emissions.

7.5.22 The Government favours **source segregation** of food waste for anaerobic digestion for a variety of reasons, including the ease of obtaining markets for digestate (compared with those for digestate from mixed wastes), and synergies with farming policy.

7.5.23 Wood waste cannot be treated via anaerobic digestion, is energy intensive to recycle or reuse, and will not decay in landfill to any significant extent. It is most energy efficient to burn it (with or without any previous treatment via gasification or pyrolysis) in order to utilise the bioenergy. The key issues for wood are therefore:

- making sure it does not end up in landfill where its energy potential will be lost;
- ensuring sufficient plant capable of burning the different types of waste wood efficiently; and
- building supply chains, including ensuring that collection arrangements are adequate.

7.5.24 A workstream being taken forward under the Waste Strategy is looking at these questions.

Discouraging the landfilling of biomass waste

7.5.25 There has already been a shift away from landfill due to current Government policy, which relies on the landfill tax escalator to raise the cost of landfill above alternative treatment methods. This, together with the Private Finance Initiative (PFI) and the financial incentives for heat and electricity produced from bioenergy, should result in a rapid shift to using waste as a fuel.

7.5.26 In the 2007 Waste Strategy, the Government committed to consult, subject to further analysis, on whether the introduction of further restrictions on the landfilling of biodegradable (or other) wastes would make an effective contribution to policy. Regulatory measures to discourage the landfilling of food and/or wood might help to accelerate the desired shift to seeing biomass waste as a fuel. Any such measures would need to be carefully designed in order to achieve this shift at minimum cost.

7.5.27 The cost of landfill is currently about £22 per tonne, and once the landfill tax has been added, the cost rises to close to £50 per tonne. The escalator is increasing by £8 per year, which means that the price at which alternatives to landfill become cost-effective is currently £50 per tonne, rising at £8 each year. This means that, depending on the cost-effectiveness and timing of collection, separation and processing, further measures to discourage the landfilling of biomass waste could have very little or even no cost implications, since the landfill tax escalator could have already rendered landfill more expensive than the alternatives. Such measures could be a useful additional signal to Local Authorities and business that the Government did not wish to see valuable biomass energy sources going to landfill.

Collecting food waste

7.5.28 However, if alternative facilities to handle biomass wastes were not available, further restrictions on landfilling them would simply raise costs and might be impracticable. Moreover, food waste is commonly composted, with no energy being recovered, and additional measures would be required to ensure that all available energy was recovered. It is not clear what form such measures could take.[223]

7.5.29 We already encourage Local Authorities to carry out a separate food waste collection, and we expect the landfill tax escalator to act as a strong driver for industry and Local Authorities to separate and use waste. For example, the food industry already has a commitment not to landfill any food waste after 2015 and anaerobic digestion will provide an important alternative use.

7.5.30 We are therefore considering the scope for the separate collection of food waste, as far as is practical, either from households or businesses, or both.

7.5.31 This could potentially result in the separation and collection of up to half of all the food waste currently generated by households. Unfortunately, it is not yet possible to carry out an assessment of the costs and benefits of doing so as current information is sparse. Clearly, though, there could be considerable

223 It should also be noted that the Government is working on reducing the amount of food that is being wasted in the UK (currently, food and food products valued at £10 billion are being wasted each year). The quantity of food waste produced should reduce by about 0.5% each year as a combination of increasing food prices and better public awareness takes effect.

extra costs to Local Authorities from the additional collection required – the question is whether the additional energy and other benefits (reduced landfill, production of soil conditioner) would justify these costs. Further information on the costs of Local Authority food waste collection is expected to become available later this year, as a result of a series of trials coordinated by the Waste and Resources Action Programme (WRAP).

7.5.32 As with a landfill ban, the separate collection of food waste would not, in itself, result in the use of that food waste for bioenergy. The Government has told Local Authorities that it expects them all to consider anaerobic digestion of separate food waste. We are considering what further measures might increase the likelihood that Local Authorities would make such waste available for anaerobic digestion treatment, or demonstrate the (local) benefits of another appropriate treatment where source separation may or may not be required.

7.5.33 The existing mechanisms to encourage Local Authorities to use food waste to produce biogas via anaerobic digestion provide strong encouragement – for example, the Renewables Obligation proposes to reward electricity generated from anaerobic digestion with two Renewables Obligation Certificates (ROCs). The Waste and Resources Action Progarmme is also providing information to Local Authorities including on the costs of anaerobic digestion. Existing research carried out by WRAP[224] shows that anaerobic digestion is the cheapest suitable treatment for food waste compared to alternative treatment methods such as in-vessel composting (IVC). Since IVC does not produce any renewable energy, and anaerobic digestion is cheaper anyway, there is a case in principle for more Local Authorities to use anaerobic digestion.

Q29: Should the Government take further regulatory measures to discourage biomass waste, including food waste, from going to landfill? If so, which types? What, if any, other measures should be taken to encourage its use to generate bioenergy?

Encouraging Waste Incineration Directive-compliant infrastructure

7.5.34 Around 7–10 million tonnes of waste wood are generated each year by the construction, demolition, commercial and industrial sectors. With a biomass content of 90%, this material is currently going to landfill as it has not traditionally been viewed as a biomass resource. To use wood waste efficiently to generate energy would require combustion plant capable of meeting the strict pollution control requirements of the EU Waste Incineration Directive, so that all types of suitable biomass can be burned, including contaminated waste wood. The UK is short of Waste Incineration Directive-compliant combustion capacity that can burn renewable waste and non-waste fuels, allowing this potential resource to be used to generate energy.

7.5.35 The principal constraints to the provision of such infrastructure are:

- the high investment costs of complying with the Waste Incineration Directive (WID);

224 Eunomia (2007)

- public hostility to combustion plant, particularly those burning waste;
- lack of information available to some of those responsible for facilitating the infrastructure;
- supply chain issues, such as obtaining sufficient biomass fuel and ensuring waste wood is efficiently collected;
- potentially, poorly designed measures aimed at encouraging recycling which impact on wood from which it would be better to recover energy.

7.5.36 We are already undertaking a number of initiatives to support and facilitate the use of solid recovered fuel (SRF), which is made by removing the recyclable elements of waste in a waste treatment plant. These include:

- increasing SRF supply through Private Finance Initiative (PFI) credit support for waste projects;
- improving access to commercial and industrial waste supply through market-led fuel mixing and aggregation activity for waste and non-waste biomass, including waste wood;
- identifying, region by region, industrial energy intensive users with existing heat loads in order to expand SRF fuel demand;
- disseminating information on the cost and security of supply benefits of SRF relative to fossil fuel use to these users; and incentivising SRF-fired Combined Heat and Power by rewarding heat;
- ensuring that provisions in the Renewables Obligation and any successor scheme, and regulatory regimes, support use of SRF appropriately;
- developing and publicising a minimum standard for SRF.

7.5.37 In addition, to support suitable WID-compliant combustion capacity for waste wood and other biomass, possible measures include adapting the waste Private Finance Initiative scheme to encourage Local Authorities to offer long-term contracts for the supply of waste wood.

7.5.38 The final round of the waste Private Finance Initiative programme is due to complete later this year, and work is in hand to establish whether it can be adapted to provide further encouragement for the provision of capacity that is capable of burning waste wood.

Q30: What more could the Government or other parties do to help to ensure the provision of sufficient Waste Incineration Directive-compliant combustion capacity to burn available waste wood alongside other biomass, and what else might constrain the development of this capacity?

Encouraging combined heat and power from waste

7.5.39 Although Combined Heat and Power is possible in any plant generating electricity from waste, it is most common in industrial boilers fuelled by solid recovered fuel.

7.5.40 Solid recovered fuel is an important part of our effort to ensure that the biomass component of waste is converted to energy as efficiently as possible. It has a variable biomass content, depending principally on how much biomass has been recovered during intermediate treatment, but this can often exceed 50%.

7.5.41 Proposed reforms to the Renewables Obligation are designed to make it easier for eligible stations to generate energy from waste and access the support available from the RO.[225] Eligibility for enhanced capital allowances for the plant and equipment needed to convert industrial boilers to fire on solid recovered fuel has also been introduced and will become effective later this year.[226]

Q31: What further actions will improve supply chain efficiency, consumer confidence and sustainable growth of the biomass supply chain?

7.6 Biogas and biomethane

7.6.1 Biogas is produced by the natural process whereby organic material (such as food waste, livestock slurries, sewage sludge and energy crops) is broken down by bacteria in the absence of oxygen. This can be done through a controlled process called anaerobic digestion. The materials ferment in a closed vessel and produce a biogas which is a mixture of about 60% methane and 40% carbon dioxide, with other trace gases, such as hydrogen sulphide. The process also produces a material called digestate that can be used as a fertiliser or a biomass fuel. Biogas is also produced when organic waste decomposes in landfill sites (this is known as landfill gas).

7.6.2 Biogas can be used as a renewable energy source, both for heat and power, and as a transport fuel. Alternatively, the carbon dioxide and other impurities can be removed to produce a product to the same standards as natural gas, known as biomethane. Other processes that can produce gas from organic material include gasification, which converts solid biomass fuels to syngas (a mixture of carbon monoxide, hydrogen and smaller quantities of methane).

225 BERR (2008b)

226 These will become effective when a revised Energy Technology Criteria List and accompanying Guidance Note 42 are published later in 2008.

The potential for biogas

7.6.3 The UK produces over 100 million tonnes of organic material per year that could be used to produce biogas. This breaks down as follows:

- 12-20 million tonnes of food waste (approximately half of which is municipal waste collected by Local Authorities, with the rest being hotel or food manufacturing waste);
- 90 million tonnes of agricultural material such as manure and slurry;
- 1.73 million tonnes of sewage sludge.[227]

Biogas can also be produced from energy crops such as maize or grass leys.

7.6.4 Each has a different calorific value when fed through an anaerobic digestion plant – with, for example, food waste usually producing more useful biogas than sewage sludge. The water industry already has a system of anaerobic digestion plants to maximise output of sewage sludge and there are incentives to exploit anaerobic digestion for agricultural material and food waste for on-site generation.[228]

7.6.5 Our initial analysis suggests that the anaerobic digestion of food waste, livestock slurries, sewage sludge and energy crops to produce biogas could contribute approximately 10-20 TWh by 2020.[229] Achieving this potential by 2020 would depend upon the collection and separation of organic waste as well as the development of a network of anaerobic digestion plants.

Government support for anaerobic digestion and biogas

7.6.6 Anaerobic digestion technology is much more widely deployed in many countries, both developed and developing, than it currently is in the UK. The Government believes that a significant growth in the use of anaerobic digestion in the UK would be in the national interest. The Government is therefore working with stakeholders to drive faster growth in the use of anaerobic digestion by Local Authorities, farmers and land managers, and other businesses. DEFRA is leading the Government's efforts in England to stimulate and develop the markets for anaerobic digestion and its products, to address administrative and technical challenges, and to raise awareness of the significant potential of anaerobic digestion technology. More details about how we are doing this – and future plans – are set out below.

7.6.7 Fuel suppliers can use biogas to meet their obligation under the Renewable Transport Fuel Obligation; and electricity generated on-site from biogas will qualify for two Renewables Obligation Certificates under the new banding of the Renewables Obligation. This, along with the potential revenue from

227 Water UK (2007)

228 Currently the water industry feeds 66% of sewage sludges to either AD or advanced AD, with plans to generate 0.8 TWh/yr of electricity by 2010. DEFRA estimates that there is technical potential to increase this by a further 0.6 – 0.8 TWh/yr by 2020.

229 DEFRA-DTI-DfT (2007) and Enviros (2008). These numbers are based on estimates calculated for the Biomass Strategy and work done by consultants, Enviros on renewable heat to estimate the potential contribution of any individual technology in 2020, where the higher end of the range can only be achieved if steps are taken to overcome constraints to the maximum deployment of the technology – taking into consideration only non-financial constraints.

electricity sales will provide an incentive for biogas to be used for on-site Combined Heat and Power units.

7.6.8 To help improve the market for digestate – the material produced from the anaerobic digestion process – the Environment Agency is developing a standard and protocol for the use of digestate in England and Wales. These will provide clarity about when the material has been 'fully recovered' and is therefore a product which can be used without being subject to waste management controls. The Environment Agency launched a consultation on the draft standard and protocol in April 2008 which closes on 27 June 2008.

7.6.9 Biogas in the UK is a developing market and there is limited experience within the UK waste or farming sector of operating anaerobic digestion plant. There are only a handful of sites producing biogas from anaerobic digestion in these sectors in the UK. To demonstrate how anaerobic digestion can work in practice in a range of different applications, DEFRA is making £10 million available from the Environmental Transformation Fund to contribute towards the construction of new anaerobic digestion demonstration plants in England. The money will be used to support the construction of a number of plants operating in different sectors and generating renewable energy from a range of feedstocks. It will enable potential investors and other key decision makers to gain confidence in the use of this technology. The programme will also gather and share experience of the most effective practical operation of anaerobic digestion plants.

7.6.10 £98 million of voluntary modulation money under Axis 1 of the Rural Development Programme for England 2007-2013 (RDPE) is being dedicated to the livestock sector, and anaerobic digestion is eligible for support from this money (along with a range of other measures and activities). In addition, anaerobic digestion is eligible for support from DEFRA's Bioenergy Capital Grants Scheme (see above). Anaerobic digestion projects are also eligible to apply for support under the Waste and Resources Action Programme (WRAP) Organics Capital Grant Programme VI. This can provide financial assistance of up to 30% towards the capital costs of plant, equipment and infrastructure for food waste processing capacity. The Programme was launched on 4 April 2008 and is open for applications until 30 June 2008.

7.6.11 DEFRA has commissioned a review of current access to and availability of advice on anaerobic digestion. DEFRA will work with advice providers and other stakeholders to identify the range of advice needs and the most effective way of ensuring these can be met in a co-ordinated way.

7.6.12 As part of this consultation, DEFRA Ministers will convene, this summer, a high level meeting of stakeholders from all the relevant sectors to discuss how we can work together to make best use of anaerobic digestion. The meeting will build on earlier discussions to examine the blockages to progress, and the realistic scale of ambition for anaerobic digestion across the economy. The aim will be to identify specific issues for early attention and a process of ongoing collaboration to address them.

Biomethane

7.6.13 Upgrading biogas to biomethane, by removing carbon dioxide and injecting it into the gas grid, could enable it to be used to produce heat or electricity. The key issues with injecting biomethane into the gas network are the removal of impurities such as carbon dioxide, hydrogen sulphide water vapour and siloxanes and ensuring that the biomethane is at the correct pressure for the grid. The technology is emerging. Biomethane is not currently injected into the gas grid in the UK, but plants are operating or planned in several European countries.

Box 7.1: Biogas use in the EU and the UK

The German Government recently introduced legislation which aims to substitute at least 10% of Germany's natural gas consumption with biomethane by 2030. This will be produced from a range of feedstocks, including food waste, livestock slurries, sewage sludge and energy crops. A considerable part of the cost has to be paid by the grid operators and not the biogas producers. In Sweden, a range of measures promotes the use of biogas for both heating and transport and in 2005, Sweden became the first country to run a biogas-powered train. Differences in pipelines and gas standards between countries mean that these examples are not necessarily immediately transferable to the UK.

In the UK, several Local Authorities are already starting to collect food waste separately to feed into an anaerobic digester to make biogas. For example, the London Borough of Ealing sends its food waste to an anaerobic digestion plant in Bedfordshire. The compacted food waste is mixed with pig slurry from a farm, then fed into the plant. Over a 30-day period, microbes digest the waste, creating heat which is used to warm the plant, and gas, which is used to create the electricity. The process creates enough power for 1,000 homes, as well as a large quantity of fertiliser, which is used by the farm.

Similarly, the Biocycle Anaerobic Digestor Plant in Ludlow, South Shropshire, runs on a mixture of food and green waste. The plant has been set up by DEFRA's New Technologies Demonstrator Programme to show how anaerobic digestion can successfully process municipal waste.

7.6.14 Given the potential for biomethane identified by other EU Member States, we are proposing to work with Gas Transporters (including National Grid and the Gas Distribution Networks) and Ofgem to make a more detailed assessment of the legal, technical and regulatory requirements for flowing biomethane directly into the gas pipe-line system. We will make this document publicly available as a guide for interested parties.

7.6.15 We are also considering supporting biomethane injection into the gas grid via the new heat financial incentive.

Q32: What barriers exist to the cost-effective deployment of anaerobic digestion, biogas and the use of biomethane injected directly into the gas grid, and what are the options to address them?

7.7 Information and awareness raising

7.7.1 Lack of knowledge, interest or awareness was identified by the Biomass Task Force as a key barrier to biomass production and uptake.[230] In response, the Biomass Energy Centre was established to provide expert information and best practice advice to industry, Local Authorities and the public on biomass and bioenergy, and link with regional information hubs to answer specific enquiries. It has proved to be a highly effective information centre, providing targeted advice and progressively covering all the relevant areas of biomass in detail, and it is increasingly the first port of call for information and advice on biomass in the UK.[231]

7.7.2 In response to feedback from regional and industry contacts and in order to support the stimulation of a rapid, sustainable and appropriate expansion of biomass production and use, the Government is considering the development of an overarching biomass communications programme. This would involve working with the Regional Development Agencies, the Local Government Association, key regional and national bodies, and with relevant planning organisations to identify current and future information needs, and apply best practice in communication as identified from within the regions and overseas. (This work could be linked to training Local Authorities, RDAs, planners and architects on renewable heat and biomass solutions, discussed in Chapter 4).

7.7.3 The communications programme could include advice packs for specific audiences, detailed guidance leaflets on issues relating to planning, website materials, summaries of 'Frequently Asked Questions' and/or standard presentations, for use by and in liaison with, planners, Local Authorities and the general public. It could also involve expanding the role of the Biomass Energy Centre, including the helpline and email enquiry service. The benefits of a well-targeted and informed communications programme could be significant, with a major increase in awareness of the opportunities, practicalities and constraints of biomass use in different situations, leading to increased uptake.

Public opinion and acceptability

7.7.4 Historically there have been considerable public concerns about energy from waste plants and biomass combustion plants located close to residential areas, and about the overall validity of going down this route rather than

230 Biomass Task Force (2005)

231 Over the period from April 2007 to April 2008 there were 360,810 page views of the Biomass Energy Centre website. The Centre itself answers around 100 enquiries each month by phone and email and is ranked around second and third in Google worldwide search rankings for 'biomass', and first and second in Google UK-only rankings.

recycling. Exploiting heat from waste and biomass via Combined Heat and Power units requires plant to be situated near to the heat customer, and also depends (in common with other large-scale heat technologies) on finding a suitable heat customer.

7.7.5 In order to facilitate a better informed and more balanced debate about energy from waste and biomass, and the use of Combined Heat and Power plants, the Government is considering a public information and awareness raising programme which presents evidence-based facts on bioenergy to explain current Government policy and to help inform individuals' decisions on their use of bioenergy and Combined Heat and Power. This could involve, for example, the development of materials and tools linked to the Act on CO_2 campaign.

Q33: What action could we take to make biomass communications more effective to both improve public awareness and help to address acceptability issues, and how should this be delivered?

Q34: Are there issues constraining biomass supply and use other than sustainability, supply chain and information issues? How should these be tackled?

Chapter 8
Innovation

Summary

The development of new and emerging renewable energy technologies will be important for meeting our 2020 target and vital for our longer term climate change goals. Innovation can improve and reduce costs of existing renewable technologies, as well as developing new technologies. The Government has many ways of supporting innovation – including regulatory and market-based measures, and direct funding for research, development and demonstration of new technologies.

This chapter seeks views on how we can most effectively encourage innovation in renewable technologies. In particular:

- how we can ensure the Renewables Obligation effectively supports emerging technologies and whether there are more effective ways to achieve this;
- whether there is evidence that specific emerging renewable and associated enabling technologies are not receiving an appropriate form of support; and
- whether there are other barriers to the development of renewable and associated enabling technologies that are not addressed by current or proposed support mechanisms, particularly in areas where the UK has the potential to be a market leader.

8.1 Why we need to support innovative technologies

8.1.1 Innovation is essential to the UK's future economic prosperity and quality of life. The Science and Innovation White Paper 'Innovation Nation'[232] published in March 2008 by the Department for Innovation, Universities and Skills, argued that Government can support innovation through the right regulatory design, through appropriate use of public procurement, and through specific policies for research, development and demonstration of new technologies. In this chapter we examine how we can create the right conditions for renewable technologies to flourish.

232 DIUS (2008)

8.1.2 Renewable energy technologies are key to combating climate change. They need to be able to compete with other low-carbon technologies to contribute to a low-cost, low-carbon energy future. However, many renewable technologies remain very costly or are at an early stage of development.

8.1.3 Innovation is therefore needed to improve and reduce costs of existing renewable technologies, as well as developing new ones. Technologies that are at the deployment stage, such as offshore wind, will help the UK meet its EU 2020 renewable energy target. More innovative technologies, such as wave and tidal energy, are likely to have only a small impact on the 2020 renewable energy mix, but remain an important element of our plans to meet our longer-term climate change goals. Supporting these technologies, for example by direct support or by regulatory intervention in the market, means investing in energy sources which may not be cost-effective in the short-term in order to accelerate learning and cost reduction to secure economic return and wider social benefit in the future.

8.1.4 Despite the potential for renewables to meet carbon energy goals, market forces alone are unlikely to deliver sufficient investment in innovation. This is because there are many barriers to investing in innovative energy technologies, which account for the relatively low rate of private sector investment in the sector. Some of these barriers are general to all innovation, and some are specific to energy technologies and the markets they operate in. These include:

- **The regulatory risk faced by energy technologies** – energy technologies have a long payback time and most renewable technologies rely on specific aspects of the market design to generate a commercial return as they are more expensive than conventional generation. Any perceived uncertainty over future policy direction could make firms reluctant to invest in innovative or higher-risk technologies.

- **A particularly lengthy and expensive development process** – energy generation usually involves large, capital-intensive investments. Energy innovation therefore needs costly full-scale trials. The type of engineering and learning-by-doing associated with the energy innovation process is particularly vulnerable to free riding, as all firms benefit from lessons learned from major investments in innovation. Some innovative technologies face a high cost to establish new enabling infrastructure (for example, transmission network costs) while in competition with established technologies whose development is publicly supported.

- **The homogenous nature of electricity** – electricity is a commodity, which means there are few niche markets where developers of generation technologies can secure early returns. Energy companies have little appetite for using unproven and more costly technologies to deliver their basic commodity.[233]

8.1.5 The UK has an opportunity to support innovative technologies, or could choose to wait for others to develop them and import them. Waiting may

233 The differences between renewable energy sectors mean that they operate in very different manners with respect to innovation. Unlike the electricity market, the transport sector has allowed the development of some market niches where new renewable energy products can differentiate on performance.

mean that the UK can learn from experience elsewhere. However, this approach also has significant risks: little innovation would occur if all countries were to take this approach. In particular, others are unlikely to invest in technologies where the UK has significant untapped energy sources, such as wave and tidal energy. This might mean that the UK foregoes opportunities to build business benefits from competitive advantage and expertise in new markets for technologies.

8.2 How we support innovative renewable technologies

8.2.1 There are several ways to support energy innovation, including renewables, as set out in the 2007 Energy White Paper.[234] The framework for these policies was based on the need to use appropriate pricing and 'market pull' measures alongside direct funding for basic research, development and demonstration, as well as tackling other barriers.

Pricing and 'market pull' measures

8.2.2 The UK uses pricing and 'market pull' measures to provide enhanced financial support for technologies with particular characteristics. The prospect of receiving this support in the future can be a significant stimulus for technology development.

- The **EU Emissions Trading Scheme** supports all low-carbon electricity and some heat technologies through imposing a cost of carbon. The carbon price is necessary, but not sufficient to pull through far from market technologies, as confirmed by the Stern Review.[235]

- The **Renewables Obligation** and the **Renewable Transport Fuels Obligation** support renewables specifically. Current plans to reform the Renewables Obligation through 'banding' will provide more support for technologies such as offshore wind and biomass,[236] but we will have to consider whether these changes are enough for technologies which are still further from market.

- **The use of regulation and standards** can change behaviours and give strong signals to existing or potential markets;[237] and may also drive innovation by ensuring that technologies with particular characteristics are adopted.

- **Fiscal measures** can be effective in influencing the behaviours of large customer groups or businesses, such as the Climate Change Levy (which is effectively a tax to encourage energy efficiency) and the waiving of stamp duty on zero-carbon homes. Research & Development Tax Credits also help investment in energy technology innovation as they help overcome the low incentives for private sector investment.

234 DTI (2007a)
235 Stern (2007)
236 BERR (2008b)
237 DIUS (2008)

Direct funding

8.2.3 Markets often do not function perfectly, particularly when considering the generation of new ideas and the high degree of uncertainty and coordination that typifies the innovation process. The knowledge produced by research in universities and institutes is a key public good in which businesses will under-invest and must therefore be supported by the Government. In addition, the Government can also help overcome barriers to business innovation by, for example, providing funding for research, development and demonstration of new technologies, in partnership with industry. Grants are offered for applied research, development and demonstration, typically covering 25-50% of the total cost. There are four main sources of UK support for energy technology development, set out in Table 8.1.

Table 8.1: Main UK sources of support for energy technology development[238]

Academic research	Applied research and development		Demonstration
Research Council's Energy Programme	Technology Strategy Board	Energy Technologies Institute	UK Environmental Transformation Fund
Funds basic strategic and applied research in energy related subject areas, and related postgraduate training. Will spend nearly £300 million between 2008-11 on their energy portfolio, which will include renewables.	Business focused Non-Departmental Public Body playing a cross-Government role. Budget over £1 billion in 2008-11 (with Regional Development Agencies and Research Councils). Supports research into emerging low-carbon energy technologies; energy efficiency (through Innovation Platforms developed with Government departments); and key underpinning technologies.	Public-private partnership funding R&D in low-carbon and renewable energy technologies. Recently announced calls for proposals in offshore wind, marine and distributed energy. ETI currently has a budget of up to £600 million over the next 10 years. With potential to increase to over £1 billion.	Offers flexible support for a portfolio of innovative low-carbon technologies, such as through capital grants for large-scale demonstration. Has a £400 million budget (BERR and DEFRA) for 2008-11 to invest in low-carbon and energy efficiency technologies.

238 These indicate the main areas of spending. There are several other organisations that fund research, development and demonstration and some of these organisations also fund other aspects of the innovation chain, for example the Environmental Transformation Fund also funds some applied research through the Carbon Trust.

8.2.4 These support measures are vital as public and private sector energy R&D has fallen over the last 30 years in the UK and across the global energy sector. OECD figures for 2002 found R&D intensity (R&D as a share of total turnover) of 0.33% for the power sector compared with 2.65% for the overall manufacturing sector.[239] The Stern Review[240] suggested that global public investment in low-carbon R&D needs to more than double in order to successfully tackle climate change. Stern also suggested that such increases combined with deployment support and carbon pricing would encourage an upswing in private sector R&D levels.

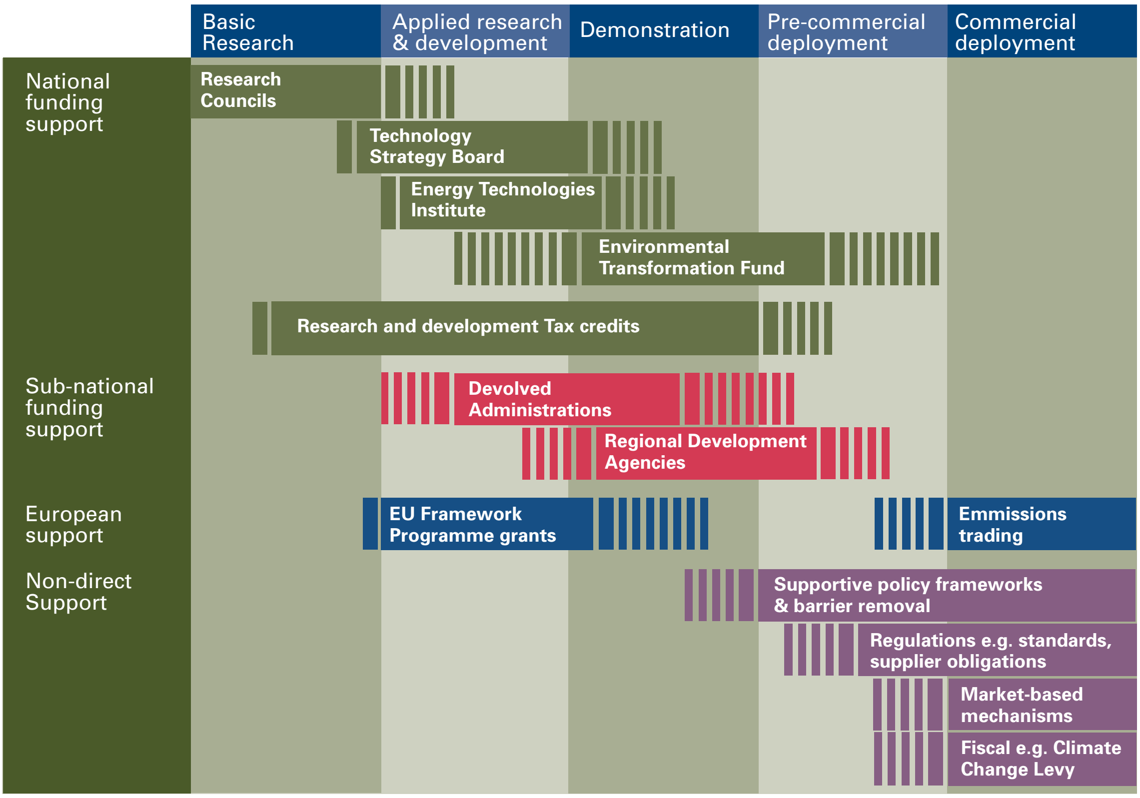
8.2.5 In the UK, changes in funding at the later stages of development and demonstration were announced in the 2007 Energy White Paper. The recent establishment of the Energy Technologies Institute and the unification of UK demonstration funding schemes under the Environmental Transformation Fund,[241] provide a more coherent approach to Government support. Figure 8.1 shows the main sources of support for renewable energy technologies in the UK across the technology development chain.

239 OECD (2006)

240 Stern (2007)

241 The Environmental Transformation Fund (ETF) began operation in 2008 and combines schemes previously run by DEFRA and BERR supporting technologies for the sustainable production and use of energy (such as the Low Carbon Buildings Programme and the Marine Renewables Deployment Fund), as well as technology development work delivered by the Carbon Trust and the Energy Saving Trust. A strategy for the ETF will be published this summer.

Figure 8.1: An overview of the main sources of funding support for energy technology development in the UK (both direct and indirect), categorised by the broad stage of technology development.[242]



8.2.6 European and international support such as the EU's Framework Programme for Research and Technological Development, which currently focuses on accelerating the development of sustainable energy technologies and ensuring the competitiveness of European industry,[243] is crucial. The International Energy Agency provides a framework for international R&D collaboration, and has had particular success in developing common standards for new technologies.

242 This chart represents major spending areas in terms of energy technology: some of the organisations shown also have activities in other policy areas, and some (such as the Carbon Trust activities under the ETF) also run schemes supporting other stages of energy development. Devolved Administration programmes include ITI Energy in Scotland, and SMART Cymru in Wales.

243 The Framework Programme offers grant funding for applied research and potentially, going forward, for limited demonstration activity in some technology areas. It aims to improve collaboration between EU Member States and companies: all projects have to be consortia of several countries. Interested parties should contact the Energie Helpline at www.energiehelpline.co.uk for assistance on FP7 and Intelligent Energy Europe funding programmes.

Box 8.1: Case Study – The Beatrice Wind Farm Demonstrator Project

Support from the EU, BERR and the Scottish Executive was recently pooled to support an innovative experiment in offshore wind technology. The Talisman Beatrice experiment installed two large offshore wind turbines to power the nearby Talisman Beatrice oil platform, some 12 miles off the Scottish coast.

At a cost of over €50 million, this demonstration project was a crucial step forward in deploying offshore wind power in deeper waters – and the first time turbines had been installed at a depth of 40 metres.

This was a highly collaborative project, with 15 European companies and research agencies and universities from six countries involved in the project.

UK Government funding provided early stage feasibility support and contributed to the development of radical deepwater offshore wind deployment technology. Further Government support was provided for the installation of two 5 MW turbines.

Installation of one of the two 5 MW turbines on the Caithness coast, Scotland.

Tackling barriers to innovation

8.2.7 Government support for emerging technologies goes beyond the provision of direct or indirect financial assistance, and includes a consideration of a wide range of issues associated with deploying a new technology. Work to remove barriers, such as streamlining regulatory frameworks, can also be important for new technologies. Ensuring reliable information may ensure the benefits of investment in new technologies are recognised, such as the introduction of accreditation schemes for technology installers. Regulation can also create a market for innovative technologies in some cases. For example, highly efficient condensing boilers became near-ubiquitous in new installations within a few years after they were mandated by a change to building regulations.

8.3 Providing 'market pull' for emerging electricity technologies

8.3.1 Financial incentives such as the Renewables Obligation (RO) are a major form of support for the deployment of renewable technologies. They can also act as a crucial form of 'market pull' for the innovation stages that precede mass deployment, and we believe that technology developers will be influenced by the prospect of market pull at a sufficient level. This section seeks views on what mechanisms would provide the most effective market pull for new emerging technologies.

8.3.2 As set out in Chapter 3 (Centralised Electricity), we are strongly minded to maintain the RO for large-scale electricity. In considering the support available for innovative technologies, there are advantages in building on the existing Renewables Obligation mechanism, for example in allowing newer technologies to move relatively seamlessly into the electricity market. Under such an approach, enhanced support could be offered to classes of emerging technology that may not be getting sufficient incentive under our current banding proposals, by the creation of one or more, higher ROC[244] multipliers specifically aimed at emerging technologies.

8.3.3 Support could potentially also be offered for technologies that are still 'under development', in the form of indicative banding defined at an early stage in the development process, before a technology becomes fully viable. The prospect of this support is likely to provide a stronger market pull for developers and investors. Independent analysis for BERR,[245] which looks at different instruments to meet the EU 2020 renewable energy target, models higher levels of financial support than are currently available for emerging technologies. This is because the modelling suggests that in order to meet the level of renewables needed to meet the 2020 target, contributions will need to be made across a broad spectrum of technologies, including wave and tidal, and these will need further support to become commercially viable. Nevertheless, further analysis on non-financial barriers to deployment[246] shows that investment levels for emerging technologies will be constrained by the risks that such technologies will not be developed by 2020 as well by other factors such as supply side and planning constraints.

8.3.4 To support a range of technologies at a reasonable cost, the support provided needs to be flexible and respond to information on the real costs of technologies. However, setting prices correctly is never straightforward, and determining the appropriate level of support for technologies that are still being developed may be particularly difficult. If we proceed with this approach there are also a number of detailed issues that would need to be addressed, on which we would be interested in views, such as:

244 ROC – Renewables Obligation Certificate
245 Redpoint et al (2008)
246 SKM (2008a)

- how broadly support bands should be defined – for example by technology area, or by one band for all 'new' technologies. Defining too narrowly could make a system over complex and unworkable, but defining bands too broadly risks favouring only the more established technologies;
- how support for particular technologies under this approach could wind down as they become more established, and costs reduce, without creating undesirable levels of uncertainty for developers;
- providing higher ROC multipliers would multiply the effect of ROC price fluctuation, on top of exposure to the volatility of energy wholesale prices. This could expose innovative technologies to a degree of revenue risk, and may also increase volatility in the support received by mainstream technologies.

8.3.5 There are possible alternative approaches. Competitive processes could be used – for example, some form of prize could be offered for a technical advance. This is likely to be most effective where a development need can be clearly defined and where new and inventive ideas are needed, rather than sustained incremental development. Another option is some form of feed-in tariff system for emerging technologies. These could provide enhanced market certainty for technology developers, by providing a firm income stream if the technology works. Chapter 3 has a general discussion of feed-in tariffs. A feed-in tariff that could operate alongside a more general deployment support mechanism is being considered in support of small-scale electricity generation technologies (including emerging microgeneration electricity technologies) as set out in Chapter 5.

8.3.6 In addition to making our market mechanisms effective in supporting innovative technologies, we want to ensure continuity and coherence of support as technologies make the transition from the demonstration stage, where they may receive capital grants towards development costs, to a deployment situation, where they receive support based on output. Any new form of support mechanism for innovative technologies offers an opportunity to integrate support for demonstration capital costs more closely with output-based support mechanisms. The recent Marine Renewables Deployment Fund[247] was designed in this way, with a mixture of capital grants and revenue support for early-stage commercial generation facilities. This was done to provide upfront capital funding to assist the installation of demonstration projects, coupled with ongoing supplementary support for actual generation that reflects the additional costs of generation in such early-stage facilities.

Q35: How can we adapt the Renewables Obligation to ensure that it effectively supports emerging as well as existing renewable technologies? Are there more effective ways of achieving this?

247 This is a scheme operated as part of the Environmental Transformation Fund.

8.4 Supporting specific technologies

8.4.1 Supporting a portfolio of renewable technologies alongside a portfolio of low-carbon technologies generates a number of advantages. Risk is spread, both in terms of a technology family not progressing due to broad technical limitation or in terms of specific devices failing due to specific technical limitation, or the capacities or funding of the developer. The various technologies supported tend to offer solutions for different sources of carbon emissions and the diversity contributes to security of supply. Innovation policy also has to support technologies which 'fit together' and account for different requirements in terms of infrastructures, skills sets, degree of commercialisation, future market opportunities, user context and application domains, and so forth.

8.4.2 There are many renewable technologies which the UK supports, for example, wave and tidal energy, offshore wind and biomass energy. As discussed above, far-from-market technology is principally supported by grant funding, often in collaboration with industry. The following section gives a short overview of only some emerging renewable energy technologies which have been supported by the Government to date, and the technologies covered here are not exhaustive. Innovative technologies for microgeneration of electricity including solar technologies are discussed in Chapter 5 (Distributed Energy).

Offshore wind

8.4.3 It is also worth noting that some technologies that are already being deployed, such as offshore wind, still have scope for innovation. Offshore wind has scope for innovations to reduce cost and risk, and increase yield. It is supported by both the Renewables Obligation and grant funding for R&D and Demonstration. The Government has funded early-stage deployment (Round 1) projects to develop experience and learning, such as reducing maintenance requirements to reduce risk and costs of offshore wind. Further innovation is required to bring forward next generation, offshore-specific technology, aimed at increasing reliability and increasing yield from 3 MW to 7-8 MW and beyond, including foundation design, blades, installation and generators.

8.4.4 The Energy Technologies Institute and the Carbon Trust have launched a call for proposals for offshore wind energy and expect to fund a number of projects, totalling around £40 million. Subject to State Aids clearance, BERR expects to launch a new offshore wind capital grants scheme in 2009.

Wave and tidal stream technologies

8.4.5 Wave and tidal is still in early-stage development. Successful deployment could be key for UK electricity generation in the long term. The waters around the UK offer an abundant resource for the generation of renewable energy in a sustainable manner. The Carbon Trust Future Marine Energy report has estimated that, in the UK, the practical offshore wave energy resource is in the region of 50 TWh/year, that the UK tidal stream resource is 18 TWh/year, while the practical near-shore and shoreline wave energy resources have been estimated at 7.8 TWh/year and 0.2 TWh/year respectively.

8.4.6 Many of the leading marine energy technologies are based in the UK and the support framework put in place by the Government has made a vital contribution to establishing the UK's current lead in this sector. Since 2000 there have been numerous publicly-funded programmes to support marine energy in the UK, ranging from university-based fundamental research to large-scale facilities designed to facilitate the deployment of commercial-scale devices. The funding has committed a total of £173 million to date, with programmes either ongoing or just commencing. For example, the Marine Renewables Deployment Fund is expecting its first projects to gain access to the scheme this year. This Fund also provides for enabling infrastructure projects such as the South West Wave Hub, which is planned for 2010. In addition, the new Energy Technologies Institute has recently launched a call for proposals for marine energy, and expects to fund a small number of projects, each in the range of £5 million to £10 million.

8.4.7 The UK is well placed to exploit the economic potential of an emerging wave and tidal energy sector, with many of the main device developers based here as well as a strong academic and expert base. This year, commercial-scale devices are beginning to be deployed for testing in UK waters. In the longer term, if technology proves successful and can be deployed at competitive cost, there is potential for UK marine energy technology developers to exploit both domestic and other markets with a rich marine resource, such as the Atlantic coast of Europe and Africa and both the Atlantic and Pacific coasts of the American continent.

Second generation biofuels

8.4.8 The King Review of Low-Carbon Cars[248] said that in the future, biofuel technology will improve and highly land-efficient biofuels may become cost effective. In the right circumstances, biofuels can deliver good carbon savings over comparable fossil fuels, but reservations are increasingly being raised over issues such as their effects on land use and food production. Biofuels will mainly be used in road transport, but testing has already started on aviation biofuels. Innovation in this area, through development of second-generation biofuels utilising non-food materials such as wood waste, municipal waste and crop residues, is critically important in helping to address concerns and potentially provide a low-carbon solution for rapidly growing sources of global emissions. In the longer term, biofuels derived from novel sources such as algae are predicted to have commercial possibilities, and may further reduce the potential negative impacts.

8.4.9 As explained in Chapter 6 (Transport), the draft Renewable Energy Directive proposes that biofuels produced from certain non-food materials should count double under national renewable energy obligations. If linked to a financial reward system, this should incentivise second-generation biofuels, although the high capital costs may remain a significant barrier to commercial deployment. The UK currently devotes some of its public funding to basic research relevant to sustainable biofuels, with the Research Councils funding a number of research programmes into bioenergy.[249] Other funding

248 King (2008)

249 The Research Councils currently spend some £4.5 million per annum on bioenergy research. The Biotechnology and Biological Sciences Research Council has launched a £20 million initiative to focus on second generation biofuels, with a further £18 million available for exploring longer-term alternatives to petrochemicals.

organisations are currently considering R&D priorities in respect of transport, including sustainable biofuels. The Government-funded National Non-Food Crops Centre has published an assessment of the prospects for second-generation biofuels[250] and is working with partners on a specific concept for establishing the biomass-to-liquid technology in the UK.

Bioenergy & renewable heat technologies

8.4.10 As noted in Chapter 4 (Heat), there is already a number of relatively mature and well developed renewable heat technologies that could be deployed in the UK. These include microgeneration heat technologies (such as ground and air-source heat pumps, and solar water heating), heat from biomass at various scales, Combined Heat and Power and heat from waste – some of which have been deployed on a large scale in other countries for several decades.

8.4.11 Other technologies that could play a significant role in delivering renewable heat in the UK, such as the various applications of biogas, and its upgrading to biomethane, require more innovation. DEFRA is making £10 million available from the Environmental Transformation Fund to contribute towards the construction of new anaerobic digestion demonstration plants. Chapter 7 (Bioenergy) provides more detail on these demonstrator projects. In Europe, various sites have just started to use biogas to create biomethane for injection into the existing gas grid. Gasification and pyrolysis, which have lower emissions than direct incineration, may prove to be an additional way to generate energy from biomass, particularly waste biomass. The technology, explained in more detail in Box 8.2 below, has yet to be proven at large scale.

Box 8.2: Bioenergy from Gasification and Pyrolysis

During gasification, biomass is heated to over 1000°C in the near absence of oxygen. This yields ‘syngas’ which can be used to produce heat and power or as a feedstock for petrochemicals and other products.

Diagram of gasification process

In pyrolysis the fuel source is burnt in the absence of oxygen producing char, oil and syngas which can also be used as fuel for Combine Heat and Power plant or as feedstock.

Over 80% of the energy in the material can be retained in the products, providing a highly efficient process. There are many small scale pilot plants in operation across the world, including the UK.

8.4.12 Innovation could help with reducing the cost of all the technologies described above, increasing their efficiency and ease of installation. Grant funding for demonstration of small-scale commercial and industrial bioenergy technologies is already available through the Environmental Transformation

250 Evans et al (2008)

Fund. As discussed in Chapter 4 (Heat), the design of the renewable heat financial incentive could consider the extent to which price support is offered for further-from market technologies.

Enabling technologies

8.4.13 The challenge of meeting the EU 2020 renewable energy target also means the development of other technologies besides specific renewable technologies. Technologies which enable renewable energy to be used will be crucial to successfully deploying more renewables, for example ways of accommodating intermittent and distributed sources of energy within the UK's electricity network. Energy efficiency technologies such as smart metering, as mentioned in Chapter 2 (Saving Energy), will also be key to reducing our overall energy consumption and therefore the absolute level of renewable energy we need to meet the target. Dynamic demand technologies, also mentioned in Chapter 2, will be important for saving carbon and facilitating the deployment of renewable intermittent energy.

Electricity supply networks

8.4.14 In Chapter 3 (Centralised Electricity), we set out the key electricity network-related barriers to the deployment of renewable generation, both in the immediate and medium to longer term and the various initiatives that are already underway to address those barriers. The innovation challenge for networks will be finding efficient ways to operate a network with potentially higher levels of intermittent generation while ensuring security of supply and grid stability.

8.4.15 We need to understand and manage the implications of integrating such high levels of intermittent renewables into the power system. There is a strong role for innovation in helping us move towards a more sustainable energy system. Potential areas for research include the adequacy of generation capacity, real-time system balancing and the effect of high levels of renewable generation capacity on system stability.

8.4.16 The energy regulator, Ofgem, has introduced the Innovation Funding Incentive (IFI), which supports innovation in energy network technology. Operators of electricity networks are able to draw on IFI funding for research and development into the technical development of their networks. Ofgem has also introduced Registered Power Zones to encourage distribution network operators to find new ways of connecting and operating distributed generation on their networks. In addition, the Energy Technologies Institute is considering a programme in network technology.

Energy storage

8.4.17 As we make increasing use of renewable sources of electricity, where significant quantities of electricity could be generated at times of low demand, energy storage may become increasingly important. Currently we mainly use pumped hydro to store energy, but there are limited sites for new development. There is therefore significant potential for emerging technologies such as flow batteries, super-capacitors and micro-compressed air energy storage.

8.4.18 Fuel cells enable the use of hydrogen as a store of energy. They have potential applications for stationary power or Combined Heat and Power, for remote and portable power (as a battery replacement), and for transport (as a replacement for the internal combustion engine). The Government has been supporting R&D in fuel cells for over a decade and we currently spend £4 to £5 million a year through support for basic research at universities, research in programmes under the Research Councils, and the Technology Strategy Board. Work on demonstration for both fuel cells and hydrogen storage is also supported through the Environmental Transformation Fund, which has allocated £5 million to hydrogen and fuel cell demonstration projects.

8.4.19 There are a number of innovative ideas under consideration for commercial schemes involving electric vehicles, several of which could have additional benefits in providing electricity storage. For example, electric vehicles could be charged at off-peak times such as overnight when demand is generally low and discharged at peak times. This is commonly known as "vehicle-to-grid" technology. This load-balancing of the electricity grid could be instigated through preferential charging regimes and smart-charging cards.

8.4.20 While moving to electric cars for transport would increase overall electricity demand, power that was merely stored and used for non-transport purposes that would otherwise have drawn on the grid will not add to overall demand. This could lead to a flattening of demand between peak and off-peak and may address some of the renewable electricity intermittency issues. Details of how the Government supports innovation in low carbon transport technologies including electric vehicles is set out in Chapter 6 (Transport)

Q36: Is there evidence that specific emerging renewable and associated technologies are not receiving an appropriate form of support?

Q37: Are there barriers to the development of renewable and associated technologies that are not addressed by current or proposed support mechanisms?

Chapter 9
Business Benefits

Summary

The world is starting a huge change in the way its economies are powered, moving from high-carbon fossil fuels to renewable or low-carbon fuels and resource-efficient products and services. The rapid expansion in clean technology that will be deployed to deliver this offers considerable business opportunities.

We want to maximise the benefits of renewables for UK business through:

- ensuring the right overall conditions exist for business growth;
- providing support for new technologies for which the UK could have a comparative advantage;
- providing a clear, long-term policy framework for renewables against which companies can invest;
- working closely with delivery partners, UK Trade and Investment and the Regional Development Agencies in making the most of the opportunities available through specific interventions to tackle supply chain blockages; and
- having the skills in place to develop original technology, and to build and manage projects.

We estimate that the expansion in renewable energy in the UK could provide 160,000 new jobs by 2020, and we want to ensure that as many jobs as possible are located in the UK. We also want to maximise the number of UK jobs associated with the expansion in the global renewable energy sector.

9.1 Growth in renewable energy – potential business benefits

9.1.1 There are potentially large business opportunities arising from the EU's proposed increase in renewable energy both here and abroad. We want to maximise the benefits to UK business and employment arising from these opportunities. Meeting the UK share of the EU renewable energy target successfully requires a step change in the very short time frame to 2020, and brings with it huge investment opportunities. For example, the Carbon Trust has estimated that since 2000 the capacity of the UK offshore wind industry has been growing by 86% a year and annual revenues could exceed £2 billion by 2020, with around half coming from export revenues.[251]

Box 9.1: Expanding Markets and Opportunities

- The global onshore wind generation market has been expanding by 30% year on year – driven by the US and China. The EU commitment to the renewable energy target across 27 Member States will see this grow further.
- By the end of 2010 it is projected that the UK offshore wind market alone will be worth annual capital expenditure of more than £1 billion.
- It is estimated that globally overall added value in the low-carbon energy industry could be as high as $3 trillion per year worldwide by 2050.

Source: EEF (2008) and CEMEP

9.1.2 Many companies stand to benefit from the widening renewables market. In 2004 the UK Environmental Goods and Services Market was worth £25 billion[252] and accounted for around 400,000 jobs: this gives some indication of the potential size of markets as they develop. While it is a challenge to predict where these successful markets will be, we anticipate that opportunities exist for companies that have the ability and motivation to innovate with new products, or to fill the many gaps in various supply chains.

9.1.3 To help identify the way forward the Government established the Commission on Environmental Markets and Economic Performance (CEMEP) in 2006. They considered what we had to do as a country to ensure we were in the best place to seize the market opportunities presented by the growth of the environmental industry and how the Government could support this. In November 2007 CEMEP published their report describing how the threat of climate change will stimulate investment in new technologies and innovations, helping to transform existing sectors of the economy and creating entirely new industries.

The Government welcomed this report and in response has identified four main prerequisites for building a low-carbon economy:

- a clear, consistent long-term policy framework to provide business with the confidence to invest and to enable the timely development of innovative products and services;
- policies that positively support innovation, to create the conditions that allow innovation to flourish;
- developing the right skills by drawing on the talent and creativity of the British people; and

251 Carbon Trust (2006a)
252 UKCEED (2006)

- fostering true partnerships between Government, business, trade unions, higher education bodies and others.

9.1.4 The market opportunities extend beyond renewable energy generation assembly companies. A wide range of other industries that are able to supply the components and services required by larger assembly manufacturers and energy companies stand to gain. Examples of such markets include the supply of components for onshore and offshore wind turbines, electric cabling, lightweight materials, efficient motors and drives, air separation units, marine propulsion systems, flue gas scrubbers, gasification and oxyfuel combustion and the development of specialist ships and ports for renewable generation installation and maintenance. The opportunities are considerable; the fundamental question for companies operating in the UK is which market segments offer the best opportunities and whether there are any barriers stopping these opportunities from being exploited.

9.1.5 Business opportunities from expanding renewables markets in the UK, EU and across the globe are already delivering returns for companies that take an active role. But it should not be taken for granted that UK businesses will necessarily realise the benefits from this global shift to a low-carbon economy. The Government, trade associations and companies themselves all have a responsibility to seek out and make the most of the emerging opportunities. The Government understands that business needs the appropriate market conditions, regulatory framework and support structures to facilitate growth. There may be further roles the Government could play that would benefit business.

9.1.6 Major investments in renewable energy will also offer significant employment opportunities. We estimate that the expansion in the UK renewable energy sector will potentially create around 160,000 new jobs by 2020. A recent Douglas-Westwood report suggested the expansion in centralised renewable electricity generation alone could create up to an additional 133,000 jobs.[253] In the area of renewable microgeneration (for electricity and heat) there are likely to be around 1,100 maintenance and installation jobs by 2020 and up to 2,000 associated manufacturing jobs.[254] Also, if the UK were to meet the EU renewable transport target through domestic biofuel feedstock and refinery, this could sustain 13,000 agricultural jobs and 4,000 processing plant jobs in transport biofuels.[255]

9.1.7 There is of course no guarantee that these jobs will accrue in the UK – many may occur overseas, for example in the manufacture and supply of components and inputs. However, the UK should be well placed to take a sizeable proportion if we get the frameworks right. There will also be the opportunity to create additional jobs in the UK to service the overseas expansion in renewables. We must make the most of these prospects.

253 Douglas-Westwood (2008)
254 Element Energy et al (2008)
255 Based on pro-rating figures from DfT (2007c)

9.2 The Government's role

9.2.1 It is ultimately for individual businesses to seize the opportunities presented by the renewable energy sector. However, the Government can play a key role in facilitating UK business growth through promoting a positive overall business climate; ensuring a clear, stable and long-term market for renewables; providing support for new technologies; identifying market opportunities; and enabling an appropriately skilled workforce.

Overall business climate

9.2.2 The UK is a good place to do business. It has economic and political stability, flexible labour markets and an internationally competitive regulatory environment. These have come together to create the conditions business needs to make long-term investment and see stable and predictable returns on capital employed. As a result, the UK has a well developed investment community and is the leading recipient (19% market share in 2006) of Foreign Direct Investment in Europe.[256] This is mirrored in the green business sectors, with the UK attracting about 30% of all European Cleantech Investment in 2007.[257]

Clear long-term market for renewables

9.2.3 It is vital that the Government ensures there is a clear, stable, long-term market for renewables so that business has the confidence to invest. The Commission for Environmental Markets and Economic Performance emphasised that, in order to make the most from the development in low-carbon markets, the Government should set credible, long-term environmental goals that are consistent with business investment cycles. That is why the Government has already set demanding targets for renewable deployment in the UK and adopted a range of financial and non-financial measures to enable the market to respond. The Government has also set out its commitment to a long-term policy framework for reducing carbon with the introduction of the Climate Change Bill and carbon budgets. This consultation document seeks views on a range of other potential measures that the Government could take to provide the incentives, address the barriers and give the certainty that is necessary for us to meet the much more stretching goals implied by the EU 2020 renewable energy target.

Support for new technologies

9.2.4 To complement the regulatory system, the Government has also worked to put in place a number of direct and indirect support mechanisms designed to help stimulate either market demand or market supply. Support for market supply is primarily built around the Environmental Transformation Fund, the Energy Technologies Institute and support delivered to energy projects from the Research Councils, the Technology Strategy Board and through the Regional Development Agencies. This support has helped to see the further research, development and deployment of a range of low-carbon technologies, including renewables. These issues are discussed in more depth in Chapter 8 (Innovation).

256 Ernst & Young (2007a)
257 Ernst & Young (2007a)

9.2.5 To maximise the benefits from such investment, it is important to identify the sectors where the UK has, or could have, a comparative advantage and to focus policies on ensuring that the market failures in these sectors are tackled.[258] For example, we can see the development of new large-scale opportunities opening up for building and maintaining offshore wind farms. We also see key opportunities in the development of marine and tidal renewable energy technologies, which the UK should be in a good position to exploit given its geography. (The Carbon Trust estimates that UK annual revenues from marine renewables could range from £300-900 million by 2020).[259] The UK also has a significant strength in particular specialist high-tech manufacturing processes and in the offshore engineering industries. These skills are considered by analysts to combine to create a considerable comparative advantage for a number of UK-based industries, which are ideally placed to take a central role in the supply and installation of renewable generation technologies.

Creating market opportunity

9.2.6 The UK economy and Government is firmly committed to the development of a strong, high value added manufacturing sector with the ability to compete successfully in global markets. We are currently reviewing our manufacturing strategy to help British industry build on its existing strength and reputation as a competitive global player. An important element will be to establish and support areas where the UK is able to compete in the production of low-carbon and resource efficient products, with an aim of helping to enable businesses to make the most of existing and new opportunities in these emerging low-carbon markets.

9.2.7 In many instances businesses may not be aware of the opportunities arising from the expansion in renewables. For example, businesses currently involved in markets such as jet-engine manufacture may not be aware of the comparative advantage they may have in wind-turbine design. The Government has a role in providing information to help overcome this. For example, Regional Development Agencies deliver business support and sector development initiatives, including inward investment, site finding and overseas trade promotion.

9.2.8 The thriving UK energy sector will also make the most of international market opportunities. To support this UK Trade and Investment (UKTI) has developed the UK Energy Excellence Marketing Strategy. This looks at the global energy challenges, including renewables, to 2030 and highlights some of the key opportunities for UK firms to make a leading contribution to the provision of technology, innovation and expertise needed to supply more reliable cleaner, higher value energy. During 2008 UKTI will also produce an Advanced Engineering and UK Climate Change Strategy to assist companies in finding export markets for renewable energy products and to provide help and advice to inward investors to the UK.

9.2.9 The Government will work with the Regional Development Agencies, UK Trade and Investment and other relevant bodies to develop a coordinated

258 A country possesses a comparative advantage when it is able to produce a good at lower cost, relative to the costs of other goods, than is the case in other countries.

259 EEF (2008), quoting the Carbon Trust.

strategy to address supply chain barriers as detailed in BERR Supply Chain Constraints Report.[260]

Box 9.2 Inward investment from Clipper Windpower

In October 2007, US wind turbine manufacturer Clipper Windpower Plc announced that it had established a Centre of Excellence for Offshore Wind in the North East of England to develop a 7.5 MW offshore-specific wind turbine (the "Britannia" Project). In developing this project over the past three years, there has been close collaboration between Clipper, One NorthEast, BERR and UK Trade and Investment.

One NorthEast's New and Renewable Energy Centre will provide the Britannia Project with a support package for engineering and test facilities including its world-class wind turbine blade testing facilities. Funding from One NorthEast will also support the development of Clipper's turbine supply chain and related manufacturing facilities. Clipper views the North East as its global location of choice for this project, which will lead to future manufacturing and job creation in the region.

Skills

9.2.10 To maximise the potential development of the renewable energy industry, it is important that we get the right skills, in the right places, at the right time and in the right quantities to enable business to take advantage of the growing markets in this area. For emerging technologies this is challenging because there are uncertainties about the timing and extent of deployment, and, hence, when the skills will be needed; and there will not be a critical mass of employers to lead on training and development.

9.2.11 A strategic approach is needed to meet these challenges. The Government is working with employers and wider stakeholders to develop a framework for meeting the emerging skills needs of the environmental industries. There are also emerging plans to develop skills strategies for the environmental industries, which would cover microgeneration in buildings, and the wind and marine renewables sector, but these are at an early stage of development. Many in the current wind energy workforce were trained in the mainstream sectors – nuclear, oil and gas power – so there is potential to make use of existing training structures in the interim and to build on these for the future. We will ensure that investment in the Further Education system over the coming years supports the development of capacity to meet the strategic challenges our economy faces, such as the need to move to a sustainable economy.

9.2.12 The new employer-led Commission for Employment and Skills, which started work in April 2008, has a key role to ensure that the UK has an employment and skills system fully geared to delivering the demand-led approach to skills recommended by Lord Leitch in his 2006 report on the UK's future skills needs. One part of the Commission's role is to ensure that we have a uniformly powerful network of Sector Skills Councils (SSCs). The SSCs have a vital role to play in setting out the future skills needs of employers in their

260 Douglas-Westwood (2008)

sectors. In particular, those SSCs with key interest in environmental markets and issues should be increasingly able, through their Sector Skills Agreements and Sector Qualification Strategies, to influence the future shape of public education and training provision so that it is fully aligned with the needs of the future economy, including environmental sustainability.

9.2.13 The Government and industry will be working with the Commission for Employment and Skills and the Sector Skills Councils, such as Energy and Utility Skills, to develop solutions to the skills needs of the emerging renewable energy businesses.

9.2.14 The Government is also currently reviewing its manufacturing strategy, and as part of this process will look at how it can help British industry take advantage of the opportunities presented by globalisation and climate change. Exploring the future skills needs of manufacturing is a key element of the review.

Q38: What more could the Government or other parties do to ensure that the UK secures the maximum business and employment benefits from the EU renewable energy target?

Chapter 10
Wider impacts

Summary

We believe that the options in this document have the potential to deliver a 15% share for renewables in the energy mix by 2020. This will have a number of impacts, including:

- climate change: Renewable electricity will provide a means to deliver the emissions cap set through the EU Emissions Trading Scheme, while renewable transport and heat could contribute additional carbon savings of around 20 $MtCO_2$ in 2020 (around 4-5% of our projected 2020 emissions);
- security of supply: Renewables contribute to our security of supply by increasing the diversity of our energy mix. We could also see a 6-7% reduction in UK consumption of fossil fuels in 2020, which implies an 11-14% reduction in gas imports. But there will also be some challenges to manage, including the development of secure supplies of sustainable biomass and biofuels and the impact of higher levels of intermittent generation on the electricity market;
- energy prices: Our measures to encourage renewable energy deployment will not impact energy bills before 2010, and have a comparatively modest impact to 2015, with the main increases being felt thereafter as the deployment of renewables increases. However, the higher oil prices are, the lower the cost of these measures. Further steps on energy efficiency can also reduce the impact on bills.

10.1 Introduction

10.1.1 Our proposals for delivering an ambitious shift to renewable energy by 2020 sit within our broader strategy for delivering our energy and climate change goals, which was set out in our 2007 Energy White Paper and continues to be based on the principle that independently regulated, competitive energy markets are the most cost-effective way of delivering our objectives. Renewable energy is an important part of our strategy, but we recognise that it cannot, on its own, deliver our goals and that delivering such an ambitious shift to renewable energy in a short space of time will create some additional challenges and costs.

10.1.2 This chapter considers how delivering a step change in the deployment of renewable energy by 2020 impacts on our goals for greenhouse gas emissions, local environment, security of supply, energy prices, fuel poverty, competitive energy markets and UK economic growth.

10.2 Impact on climate change

10.2.1 Renewable energy is key to our strategy for meeting the climate change challenge. Renewable electricity will contribute to the emissions reductions needed for the power sector to operate within the EU Emissions Trading Scheme cap, while renewable heat and transport will provide additional emissions reductions.

Emissions from heat and transport

10.2.2 23% of our carbon emissions result from transport and 47% from heat for space and water heating, for cooking, and for industrial processes. The transport sector sits outside the EU Emissions Trading Scheme (EU ETS), which caps emissions from large industrial sectors including the electricity generators, while much of the emissions from the heat sector arise from domestic, commercial and smaller industrial scale use, and so are also not covered by the EU ETS. Any contribution that renewable energy can make to reducing emissions in these sectors will therefore provide additional savings, which go beyond the EU ETS cap. We have considered carbon abatement potential as a key criterion for the policy options for renewable heat and transport, discussed in Chapters 4 and 6. Our analysis suggests that, if we could achieve 14% renewable heat and 10% renewable transport, they could provide additional carbon savings of around 20 $MtCO_2$ (million tonnes of CO_2) in 2020; around 4-5% of our projected 2020 emissions.

10.2.3 Looking beyond 2020, as electricity is increasingly generated from clean technologies – renewable, nuclear and carbon capture and storage (CCS) – a shift towards electric transport and heating may prove an effective way to decarbonise these sectors. Such a shift could significantly increase demand for electricity, creating an ongoing need for investment in low-carbon generation.

Emissions from electricity generation

10.2.4 Today a third of UK carbon emissions result from electricity generation. By 2050, we expect a range of low-carbon generating technologies (renewables, nuclear and CCS) to be playing a part in delivering a largely decarbonised electricity generation mix.

10.2.5 The EU Emissions Trading Scheme (EU ETS) is core to our long-term strategy for reducing carbon emissions from electricity generation at least cost, minimising the impacts on domestic and industrial electricity bills. It operates by setting an overall limit, or cap, on emissions from electricity generators and other sectors with high emissions, with the cap set to tighten year on year. By requiring companies to operate within the cap, and allowing them to trade the 'right to emit', we create a carbon price and an incentive for investment and operational decisions to reflect the costs of carbon emissions to society.

We are currently in the process of negotiating the level of the cap for the third phase of the EU ETS, which will run from 2013-2020. The proposal, which we welcome, is for the cap to get progressively tighter year on year from 2013, continuing beyond 2020, setting a clear pathway towards our long-term emissions targets. By 2020, the cap would be 21% below 2005 reported emissions levels.

10.2.6 However, as the Stern Review emphasised, carbon pricing alone will not be sufficient to reduce emissions at the scale and pace required. Government action is also needed to stimulate the development of a broad portfolio of low-carbon technologies and reduce costs. By pushing the deployment of renewables, while also taking active steps to open up the way to the construction of new nuclear power stations (set out in our January 2008 Nuclear White Paper) and taking a leading role in developing and demonstrating CCS technologies, we are ensuring that there are a range of options available to power companies when they are looking at managing their emissions. The choice of which generating technology to invest in is then for the market to make.

10.2.7 As emissions from sectors within the EU ETS are determined by the level of the cap, while renewable electricity generation will help to deliver the cap, it will not provide additional reductions in emissions. Of the 4 $GtCO_2$ cumulative carbon savings that the EU ETS will deliver between 2013-2020 under the cap proposed in the EU Climate and Energy Package, we estimate that around a quarter will be met through the deployment of renewables, with around 190-204 $MtCO_2$ of these savings from renewable generation in the UK.

10.2.8 This is a significant saving in emissions, but it is important that we understand the impact of a push for renewable energy in the period to 2020 on our long-term strategy. The EU ETS would not, on its own, bring forward the level of renewable electricity generation that might be required to meet our 2020 target because there are a number of lower-cost alternatives for reducing emissions that companies would be expected to exploit first. One consequence of incentivising investment in renewables is therefore to reduce the demand for ETS allowances and so result in a lower EU ETS carbon price relative to what it would be without a renewable energy target. To limit this effect, the proposed EU ETS cap for 2020 takes some account of the renewable energy target and is to that extent tighter than it would otherwise have been. The European Commission has estimated that the carbon price will be around €39/tCO_2 across the 2013-2020 trading period, compared to €49/t CO_2 if there were no renewable energy target.[261] This compares to a carbon price today of around €27/tCO_2.

10.2.9 We do not expect the effect of the EU 2020 renewable energy target on the carbon price in 2013-2020 to significantly affect investment in other low-carbon generation technologies, as industry will be making investment decisions on assets with lifespans that extend considerably beyond 2020.

Delivering our carbon budgets

10.2.10 By June 2009, we will have set the first three five-year carbon budgets that will set out the UK's trajectory for reducing carbon emissions over the period

261 EC (2008c)

2008-22. Contributions to achieving these budgets will come from those sectors that are covered by the EU ETS (including electricity generation), which will be determined by the level of the EU ETS cap, and from sectors outside the EU ETS, where domestic and EU policy measures will determine what progress we make. Our priorities are therefore to ensure that the EU ETS cap is set at an appropriate level, which is currently subject to EU negotiation, and to develop a package of measures for sectors outside the EU ETS that will deliver the emissions reductions necessary for us to stay within the carbon budgets. The contributions from renewable energy for heat and transport will be key parts of this package.

10.2.11 At EU level, the strategy for delivering a reduction in EU greenhouse gas emissions by 20% by 2020 depends both on the level of the EU ETS cap and on targets for each Member State to reduce emissions in sectors outside the EU ETS; the proposed target for the UK is to reduce emissions by 16% compared to 2005 levels. Again, the contribution from renewable heat and transport will be key to delivering this target.

10.3 Impact on the environment

10.3.1 Our Renewable Energy Strategy will be underpinned by the principles of sustainable development, integrating social, environmental and economic objectives. We will seek to ensure that we strike the right balance between the positive contribution of renewable energy to tackling climate change and its potential negative impacts on other sustainable development priorities.

10.3.2 In increasing the use of renewable energy, we will also need to consider the potential environmental impacts such as those on biodiversity, landscapes, air quality, soils and land, as well as the marine environment. Chapter 3 (Centralised Electricity) considers potential options for ensuring that renewable electricity development proposals comply with environmental legislation, which will help speed up the deployment process and facilitate the delivery of the renewable energy target. Chapter 4 (Heat) consider issues around air quality and biomass. We need to ensure that delivery of the UK Renewable Energy Strategy will be carried out in such a way as to secure the climate change benefits of renewables alongside minimising negative impacts on the natural environment.

10.3.3 Chapter 3 also describes our plans for amending the planning system, including publishing National Policy Statements which integrate economic, social and environmental policy objectives, including the Government's climate change commitments, to deliver sustainable development. These National Policy Statements will underpin planning decisions made by the Infrastructure Planning Commission and will form a basis for consistent, well-informed decision making.

10.3.4 There are particular issues around the sustainability of biofuel and biomass supply, which are discussed in Chapters 6 (Transport) and 7 (Bioenergy). We are strongly of the view that all biofuels and biomass used in the UK should come from sustainable sources and we are active in the EU and internationally in seeking agreed definitions.

10.3.5 We also need to ensure our renewable energy sources are sustainable in the light of the unavoidable impacts of climate change that we expect to experience over the coming decades. For example, substantially drier summers are projected to become more frequent over the whole of the UK, and winters are projected to be wetter with an increase in the number of intense rainfall events. While all aspects of the economy are likely to feel the effects of a changing climate, there will be particular challenges for the energy sector. For instance, changing wind speeds may affect the operation of wind turbines, our ability to grow biomass may be affected by reduced water availability, and power stations may be at risk from flooding and over heating. We will seek to make appropriate use of the new climate projections due out later in the year to adequately assess and address the risks of climate change to the delivery of our Renewable Energy Strategy.

10.4 Impact on security of supply

10.4.1 In considering the impact on security of supply we need to look at several factors including: the impact on our exposure to prices and availability in international energy markets, where a challenge for the UK is our increasing imports of oil, gas and coal; the impact on the reliability of energy supplies in the UK of, for example, a diverse energy mix, and our requirement for substantial investment over the next two decades in power stations and electricity networks; and the impact on the cost of securing reliable supplies. The particular challenges for our electricity system of a high penetration of intermittent and variable wind generation are discussed in Chapter 3.

Diversity of our energy mix

10.4.2 Diversity of energy sources – ensuring that we are not dependent on any one fuel type, country or technology – is fundamental to managing the risks to the UK's security of supply. Energy from diverse renewable sources across the electricity, transport and heat sectors will help in this regard.

10.4.3 At the same time, maintaining diversity from non-renewable energy sources will remain important. For our electricity sector, we need to provide the market conditions that see a mix of gas, coal, biomass and pumped storage plant able to respond to the unpredictable output from wind generation, discussed further in Chapter 3. This means that we expect to see construction of new fossil fuel plant in parallel with the growth in renewables. Provided there is sufficient back-up capacity available on the system, the technical challenges of maintaining reliable supplies of electricity with high levels of wind generation should be manageable, albeit at a higher cost than today.

10.4.4 For the heat and transport sectors, it is difficult to assess how resilient the emerging supply chains for sustainable sources of biofuels and biomass will be to risks around, for example, crop failure or competition from other land uses (discussed further in Chapter 6 and Chapter 7) and how these compare to the risks associated with fossil fuels. However, as the risks to the supply of fossil fuel sources are largely independent of the risks to biofuels and biomass, the risks can again be mitigated by diversity of fuels.

10.4.5 Our Renewable Energy Strategy should reduce our exposure to risks associated with higher imports of fossil fuels. Under our 'central' scenario, in 2020 our consumption of fossil fuels could be around 10% lower than otherwise, implying 12-16% lower gas imports even if gas provides the majority of the flexible back-up generation, alongside coal.

10.4.6 This diversity will bring long-term security of supply benefits as fossil fuels become progressively more scarce and difficult to extract. However, in the short-term, uncertainty over the extent of future fossil fuel demand may affect the investment decisions of fossil fuel suppliers. Any uncertainty over the extent to which renewables might replace fossil fuels could delay or hinder investments in both upstream and downstream infrastructure in the oil and gas sector.

Electricity investment

10.4.7 Over the next decade or so, some 22.5 GW, around a third of our total current capacity, of power stations may close as coal and oil generation become subject to increasingly stringent environmental standards, and nuclear stations reach the end of their licensed lifetimes. A high penetration of variable and intermittent wind generation makes it more challenging to establish how much capacity will be needed to replace the closures. However, it is clear that by 2020 the total capacity of our electricity generating system will need to be significantly larger than today in order to provide back-up for wind generation. Therefore, in parallel with the investment in renewables, and with new nuclear unlikely to come forward for a decade or so, companies are likely to want to invest in new fossil fuel-fired power stations.

10.4.8 In the 2007 Energy White Paper, we estimated that we needed to see 20-25 GW of new generating capacity constructed in the UK by 2020 if roughly the same margins of capacity were to be available as today. In our central scenario, where renewables account for 32% of our total electricity output in 2020, we would now need to see investment in around 30 GW of new renewable capacity and a further 17 GW of new conventional capacity. Beyond 2020, further investment is likely to be seen as further power station closures take place and the financial incentive for renewables continues to encourage investment: our modelling projects build of a further 4 to 7 GW of new renewable capacity and 10-12 GW of conventional capacity in the period from 2020 to 2030. The new conventional capacity includes gas, coal and nuclear plant, with new nuclear plant becoming operational after 2020. However, this is only one of a number of scenarios; for example, some energy companies have indicated that they expect new nuclear to be operational before 2020.

10.4.9 This will require significant levels of capital investment, with an overlap in demand between the renewables and conventional sectors, whether for financing, supply of turbines and engineering skills, or access to the grid. We also need to recognise that such a large tranche of investment carries inherent risk, particularly investments in relatively new technologies, such as offshore wind.

10.4.10 Alongside investment in new generating capacity, we also need investment in our electricity networks. If we are to maintain security of supply, both new renewable generation and new conventional plant will need to be able to secure connection to the electricity grid (discussed in Chapter 3). In addition, some parts of the network may need to be strengthened to accommodate the increase in renewables generation.

10.4.11 The timeliness of this new investment will be key to ensuring security of electricity supplies. One challenge for industry will be to understand how the market signals, and hence their business models, will change with a high proportion of wind generation on the system. Investors have indicated that uncertainties over the market and regulatory framework are particularly difficult for them to assess, so companies may decide to wait until such uncertainties are reduced before investing. The Renewable Energy Strategy will provide the market with greater certainty over future renewable energy policy.

10.5 Impact on energy prices

10.5.1 In a competitive market, retail energy prices are influenced by factors including the costs of fuel and carbon; of generating, processing and transporting the energy; and of Government policy interventions aimed at tackling climate change. In recent years we have seen energy prices rising as a result of increasing costs in many of these areas, with the most pronounced increases coming from trends in global fossil fuel markets.

10.5.2 Reflecting some of the costs of tackling climate change through energy prices means that prices more closely reflect the true social, economic and environmental costs of climate change. This should encourage investments in low carbon technologies and encourage both domestic and industrial customers to save energy in order to reduce their bills. Our initial analysis suggests that there is still significant scope for increases in energy efficiency and we will be consulting later in the year on further measures.

10.5.3 Our current climate change policies (e.g. the Renewables Obligation, EU Emissions Trading Scheme, and the Carbon Emission Reduction Target) make up around 14% of average domestic electricity bills and 3% of average domestic gas bills. On the industrial side, for an average medium-sized consumer, the Renewables Obligation, EU ETS, and Climate Change Levy together contribute around 21% to industrial electricity bills and about 4% to gas bills. We expect that incoming climate change policies such as Better Billing will add further to retail prices, as suppliers pass on policy costs downstream; however, as some of these policies will reduce consumption of energy, the net effect on actual energy bills will be lower.

10.5.4 Today, most renewable technologies need financial support if they are to compete with conventional energy sources. As a result, our policies to encourage renewable energy deployment in line with our 2020 goals will add further to energy bills. There will be no immediate impact on bills. The impact will increase as 2020 approaches and our renewable deployment rises, particularly post 2015, and will continue beyond 2020. Industrial bills are expected to increase by a greater proportion than domestic because the price they pay is typically lower per unit, so an equivalent actual increase results in a greater percentage increase. The sections below discuss the specific price impact for each energy sector.

10.5.5 The contribution to energy bills that can be attributed to renewables measures will depend both on the measures we introduce to incentivise renewables, and on how the costs of the other components of energy prices change over the coming years, particularly fossil fuel prices. With higher fossil fuel prices, the impact on bills would be lower, and vice versa.

10.5.6 In the longer term, in the decades beyond 2020, as the EU ETS cap tightens, as renewable energy technologies develop and become cheaper, and as fossil fuels become more scarce, we might expect society's investment today in renewable energy to lead to consumer prices that are lower than they would otherwise have been.

Electricity bills

10.5.7 Our existing climate change policies are projected to add around 18% to annual domestic electricity bills and around 55% to industrial electricity bills by 2020.

10.5.8 The additional measures to increase deployment of renewable electricity will add further to bills. These arise from the costs of expanding and reinforcing the electricity transmission and distribution networks, and from the financial support scheme used to incentivise the deployment of renewables, as described in Chapter 3. We expect additional costs arising from our policy measures to be passed on to consumers through their energy bills. In deciding which options to pursue, cost-effectiveness and impact on bills will be key considerations.

10.5.9 The projected impact of our policy measures on electricity bills would be dampened by the expectation that the wholesale price for electricity, a key component of consumer bills, will, on average, be lower than otherwise as renewables will replace the most expensive conventional generation.

10.5.10 Based on a scenario where renewables make up 32% of our electricity capacity and assuming our central fossil fuel price projections, our projections for the impact on electricity bills are shown in Table 10.1 and are over and above other climate change policies. Under fossil fuel price assumptions consistent with $95/bbl, the percentage increase in electricity bills could fall by 50 to 60%. Under fossil fuel prices consistent with $150/bbl, the percentage increase in bills could fall by three quarters. Further details are set out in the Impact Assessment to this Consultation.

Table 10.1: Impact on annual electricity bills, resulting from measures to achieve 32% renewable electricity*

	Domestic Bills	Industrial Bills
2010-2014	-1 to 4 % (-£3 to £13)	-1 to 4% (-£4 K to £19 K)
2015-2019	1 to 5% (£3 to £19)	1 to 6% (£4 K to £28 K)
2020-2024	9 to 15% (£32 to £53)	10 to 16% (£46 K to £78 K)
2025-2029	10 to 14% (£33 to £48)	11 to 16% (£48 K to £70 K)

* The range reflects the standard error of differences of changes from the status quo. In some years the impact of high penetration of renewables leads to lower short-run marginal costs which reduce wholesale prices. This impact is greater under high fossil fuel price assumptions.

10.5.11 These figures are based on a scenario where a 15% renewable energy target is achieved in 2020, with shares of renewable energy in heat at 14%, electricity at 32% and transport at 10%. As stated in Chapter 1, in a market economy, policy alone cannot guarantee outcomes. How much these measures will deliver will depend on how energy companies, developers and investors in the market, and the supply chains which serve them, respond to the signals we provide. A key part of the Renewable Energy Strategy is to minimise the overall costs of reaching the target in 2020. To do so, we will need to understand the cost per unit of renewable energy generated (MWh) of different technologies and sectors. These costs will differ and may change over time.

10.5.12 Cost effectiveness may imply a need for some flexibility in our approach as new information emerges. On the other hand, to give certainty to business, we need to make decisions on the level of ambition to aim for in each sector and our preferred financial support instruments. This is particularly important given the short time frame to 2020. We have therefore asked for views in Chapter 1 on how we might design instruments that give enough certainty to business, whilst being able to change the level of ambition of financial incentives in sectors in the light of emerging information on costs.

Gas bills

10.5.13 The initial options for a financial incentive for the renewable heat sector are set out in Chapter 4 and would place an obligation on suppliers of non-renewable heating fuels. The cost of the incentive would be expected to be passed on by these suppliers to their customers, so there would be an impact on bills for those using gas and other fossil fuels for heating. Our initial analysis of the impact on gas bills suggests that the impact will be greater than on electricity prices, partly because we do not expect our heat policies to have any impact on the gas wholesale price while, as explained above, our electricity measures are projected to lead to a lower wholesale electricity price. The projected impact on gas bills in a scenario where we deliver 14% renewable heat and assuming our central fossil fuel price projections, are shown in Table 10.2. Under fossil fuel prices consistent with oil prices of around $150/bbl, the percentage increase in bills would be reduced by around a half. Those households who install renewable heat technologies, particularly those households currently off the gas grid, could see reduced ongoing heating bills.

Table 10.2: Impact on annual gas prices and gas bills resulting from measures to achieve 14% renewable heat.

	Domestic Prices (Domestic Bills)	Industrial Prices (Industrial Bills)
2010	0% (£0)	0% (£0)
2015	2 to 6% (£11 to £30)	3 to 7% (£3 K to £9 K)
2020	18 to 37% (£104 to £209)	24 to 49% (£29 K to £58 K)
2030	No higher than 2020	No higher than 2020

Petrol and diesel prices

10.5.14 In a scenario where we achieve 10% renewable transport, our modelling suggests that the Renewable Transport Fuel Obligation (RTFO) will cause increases in petrol prices of 2-4% and in diesel prices of 1-3% by 2020.

10.6 Impact on fuel poverty

10.6.1 Every household in the UK should be able to heat and light their homes affordably. However, for some people, meeting this basic energy need accounts for a disproportionate amount of their income. The generally accepted definition of fuel poverty is when a household has to spend 10% or more of its income on energy to maintain an adequate standard of warmth. The main factors that influence whether a household is fuel poor are the cost of fuel, the income of the household and the energy efficiency of the home.

10.6.2 Tackling fuel poverty is a priority for the Government and since 2000 the Government has targeted around £20 billion on fuel poverty programmes and benefits across the UK. The range of measures to alleviate fuel poverty include:

- programmes to improve energy efficiency;
- ensuring fair treatment for the less well off by energy suppliers, and encouraging industry initiatives to combat fuel poverty; and
- continuing action to tackle poverty and increase incomes through the take-up of all benefits.

10.6.3 From 1996 to 2004 the Government made good progress towards meeting its fuel poverty targets as we saw 4 million households in the UK lifted from fuel poverty. But new challenges and rising energy prices mean that the numbers in fuel poverty are now increasing. That is why in Budget 2008, the Government said it would like to see the energy suppliers increase their spend on social programmes, and subsequently secured individual agreements with the six largest suppliers to treble their collective spend on social programmes from £50 to £150 million by 2010-11.

10.6.4 In late May 2008, the Government also announced a new raft of measures to help vulnerable consumers, particularly the elderly, make their homes warmer and more energy efficient. Measures designed to help with bills and make sure consumers are on the best value tariff include:

- seeking changes in the law to allow data sharing with energy suppliers;
- a pilot scheme involving 3,000 households to make sure those applying for Warm Front grants are referred to their energy supplier for tariff advice so they can make maximum savings; and
- £150,000 of funding to roll out Ofgem's national Citizen's Advice Bureau awareness campaign on social assistance for the vulnerable.

Measures designed to improve home energy efficiency include:

- £3 million of funding as part of a pilot within the Low Carbon Buildings Programme (LCBP) to introduce microgeneration to poor communities; and
- publication of the results of the Heat Call For Evidence, which will help the Government develop a strategy to reduce demand for heat.

10.6.5 It is likely that the measures we need to use to increase renewable energy will add to the challenges we face in combating fuel poverty. There is, however, potential for synergies between the uptake of renewable heat and off-gas grid fuel poverty. We will consider these issues further within the context of the UK Fuel Poverty Strategy.

10.7 Impact on energy markets

10.7.1 It is the Government's view that wherever possible, independently regulated, competitive energy markets are the most cost-effective and efficient way of delivering our policies. We aim to provide the markets with certainty over our policies, so that they can plan for the long term.

10.7.2 However, we recognise that markets alone will not deliver our wider social and environmental objectives. There are specific market failures associated with climate change and the development and deployment of new energy technologies that therefore require Government interventions to correct them.

10.7.3 The aim of our Renewable Energy Strategy will be to correct these market failures. In doing so, we must remain vigilant that our interventions do not unduly limit the number and range of firms in relevant markets, nor excessively limit firms' abilities and incentives to compete.

10.7.4 In the wholesale electricity market, where electricity generators and suppliers interact, we expect to see more volatile electricity prices as a result of the large amounts of intermittent renewable generation (around 30% or more) on the system. However, on average, we expect the wholesale price to be lower than otherwise, as renewables will replace the most expensive conventional generation. This would be a more complex operating environment than today, creating new opportunities and risks for suppliers and generators.

10.7.5 The financial incentive for renewables energy might see entrepreneurial activity, bringing new entrants to the renewable generation market, thereby increasing diversity and competition, and driving innovation. For conventional generation, we may see new investment in flexible fossil fuel back-up plant that is able to respond quickly to changing price signals. Decisions on investment in back-up capacity will depend on the frequency with which an investor expects their plant to run, and the price they expect to receive for that operating time. A key issue from a security of supply perspective is whether the very high wholesale prices expected to occur infrequently, when low output from wind generation coincides with high levels of demand, will be sufficient incentive for independent investors to construct or maintain peaking plant that may be operational for only a few hours each year. We could also see a greater response from the demand side, where there will be opportunities to make savings on energy costs by shifting the pattern of demand from high-price periods to low-price periods.

10.7.6 In the wholesale gas market, the main impacts of our renewables policies are likely to be a small reduction in overall gas demand, a reduction in seasonality (as some customers switch to renewable heating), but an increase in within-day and day-to-day volatility, due to more variable demands from the power sector. While these may have impacts on investment decisions and prices in the sector, they are less likely to have a material impact on levels of competition in the gas market.

10.7.7 In the retail markets, there are some large industrial customers who purchase electricity at 'spot' prices which means that, unlike other customers, they will be exposed to the volatile wholesale price effects. This may create a market response that causes changes in industrial customers' contracts with their suppliers. For most domestic and business consumers, such price volatility is likely to be absorbed by their suppliers. As such, the need for suppliers to manage the changed risks associated with wholesale price volatility could create a barrier to new entrants in the supply market. Ofgem, as the regulator for the gas and electricity industries, will be alert to any competition issues that might impact on consumers.

10.7.8 The heat market is in its infancy, but would be expected to grow if we introduce a renewable heat incentive. We will need to assess potential market impacts as we develop our policy in this area.

10.7.9 We do not expect there to be significant impacts on the nature of the oil market from the measures we implement to meet our renewable energy target.

10.8 Impact on the economy

10.8.1 The increased costs caused by higher levels of renewable deployment will have a negative impact on GDP, at least in the short term. However, these impacts need to be seen in the context of global efforts to tackle climate change. The Stern Review concluded that the benefits of strong, early co-ordinated action against climate change far outweigh the economic costs of inaction. It is estimated that the cost of not taking action could be equivalent to losing between 5% and 20% of annual global GDP whereas the costs of taking action can be limited to around 1% of annual global GDP, if the world pursues optimum policies.

10.8.2 We estimate that the additional costs to the UK economy of delivering this level of renewable deployment could be around £5 to £6 billion a year in 2020 (at today's prices), above and beyond the costs involved in meeting our existing energy and climate change goals.[262] These estimates are based on fossil fuel prices in line with $70 bbl oil. If prices were higher (in line with $150 bbl oil) the costs could fall by 35 to 40%.[263] Similarly, these figures assume that demand for energy is at the level projected in the 2007 Energy White Paper; if demand could be reduced below this, the costs would fall. In addition, if trading was used to meet the UK target, the costs would be further reduced.

10.8.3 Oxford Economics have undertaken macroeconomic modelling work for BERR on various climate change and energy measures, including the renewables target. The results of these studies suggest that the impact of delivering 15% renewable energy in the UK by 2020 could lead to a reduction in GDP of 0.5 to 1%, and a reduction in competitiveness of 1 to 1.5% compared to what they might otherwise have been. This underlines the importance of meeting our renewable energy targets in the most cost-effective way. Precise impacts depend on the cost of renewables in the UK relative to the EU; how different sectors and economies adjust; and the extent to which the rest of the world undertake climate change mitigation measures.

10.8.4 These impacts should also be seen in the context of the longer-term security of supply benefits offered by a more diverse energy mix, the acceleration of technology developments bringing down costs in the longer term and the opportunities created for UK business. This places us in a good position to meet our long-term climate change and security of supply challenges.

262 These estimates are based on economic modelling by Redpoint et al (2008), NERA (2008) and internal Department for Transport estimates. Resource costs to the UK are net of the value of EU ETS allowances saved from the carbon abated by additional renewable generation in the ETS sectors. Carbon savings are valued at the forecast carbon price for the post 2012 period. See www.pointcarbon.com. All estimates are based on central fuel price estimates of $70 per barrel of oil.

263 The attached Impact Assessment details the impact of different fuel price assumptions on the additional costs of the Renewable Energy Strategy.

Q39: Do you agree with our analysis of the likely impacts of the proposed increase in renewable deployment on:

a. carbon dioxide emissions;

b. the local environment;

c. security of supply;

d. energy prices;

e. fuel poverty;

f. the energy market;

g. the economy;

h. any other wider issues that we should be considering?

Chapter 11
Delivering the Target

Summary

Delivering a step change in renewable energy in such a short time will need action at all levels. Everyone will have a role to play. Government – Central, Devolved, and Local – clearly has a key role in terms of setting the overall policy framework (and in increasing its own use of renewable energy). However, ultimately it will be for the market to provide the necessary investment. Individuals and businesses can all play an important role too, for example in reducing energy use and encouraging renewable deployment. This chapter sets out our initial ideas of how each group could contribute.

11.1 Introduction

11.1.1 Tackling climate change and moving the UK to a low-carbon economy with a step change in our use of renewable energy cannot be achieved by any institution or individual alone. Energy affects everyone and all economic sectors, so there is a role for all to play in changing the way we generate and consume energy. Collaborative, comprehensive action is needed at all levels, starting with re-doubling our efforts to make energy efficiency savings a priority. Beyond that, significant rather than incremental change is needed in how Central Government, Local Government, the regions and Devolved Administrations play their part in leading delivery of renewable energy. Business, consumers and the third sector also have a role in taking full advantage of the opportunities offered by our policies to deliver rapid deployment of renewable energy; and all have the option to go beyond any minimum standards we set.

11.1.2 As many of the preceding chapters have demonstrated, much of the work building the mechanisms and taking through changes that will be key for the EU 2020 renewable energy target is already underway. Efforts to increase our renewable energy use do not begin in 2009 when we publish our Renewable Energy Strategy – they have already begun. This chapter set out the key issues for various sections of government, society and business in delivering the next phase of our efforts to meet the 2020 targets.

11.2 Role of individuals, business & third sector

11.2.1 Each of us contributes to climate change due to the carbon emissions from our everyday activities. But this also means that, by changing our behaviour, each of us can make a real difference and play our own part in becoming more energy efficient. Chapter 2 (Saving Energy) explains that reducing our overall energy consumption can be a cost-effective way to reduce the amount of energy we consume and that there is still scope for further increases in energy efficiency to play an important role in helping us achieve our renewable ambitions.

11.2.2 Research suggests that, while 97% of people now acknowledge that humans are contributing to climate change (and 80% think humans are the main cause), people are still confused about the specific causes of climate change and what they can do about it.[264] When asked what actions they could take to limit climate change, 44% of people said recycle more, 28% said drive less often, only 14% said reduce electricity use and only 7% said use less heating. A recent annual survey of the public's attitudes to and awareness of renewable energy, undertaken in March 2008, provides a useful benchmark of public opinion on renewables.[265] The survey reported substantial public support with 84% saying they supported the use of renewable energy. 80% were in favour of the use of wind power and 64% of respondents said they would be happy to live within 5 km of a wind power development.

11.2.3 The individual, as consumer, investor and member of a local community, can play a direct and crucial part in efforts to meet the renewable energy target. This could be through:

- being more energy efficient and using less energy – for example by reducing electricity use, turning down the thermostat, improving insulation, driving less and more efficiently, or buying energy efficient products. DEFRA's Act on CO_2 campaign provides more information on how individuals can make the link between their own everyday behaviour and climate change, and sets out some of the simple, easy things we can all do to reduce their impact on the climate that will often save them money too;

- using and generating renewable energy – for example through microgeneration electricity or heat technologies, or a hybrid car;

- supporting deployment of renewable generation in the local area.

11.2.4 Business has a central role to play. Some businesses will clearly have a key role in building and supplying the renewable energy generation implied by our EU 2020 renewable energy target, and in supplying energy efficient products. However, all businesses and organisations can also play a role in a similar way to individuals, reducing energy use, using and generating renewable energy, and supporting deployment of renewable generation locally.

264 ICM (2007)
265 GfK NOP (2008)

Box 11.1: Using renewable energy – green tariffs

A number of electricity suppliers now offer so-called 'green tariffs', whereby customers can choose to pay higher prices on the understanding that the electricity they consume will be generated from renewable or low-carbon electricity.

Ofgem first introduced guidelines on green supply tariffs in the domestic electricity market in 2002 to ensure that where such tariffs were marketed to consumers they were transparent, verifiable and incorporated an element of additionality (contributing to renewable energy deployment that would not have happened otherwise). The market for green tariffs has developed significantly in recent years but consumer research and associated reports have suggested that a significant level of customer confusion remains in this area and that, in addition to this, there is growing mistrust amongst consumers regarding the contribution such tariffs make to the environment.

To address these concerns, Ofgem has been consulting stakeholders and undertaking customer research to develop new guidelines. This has demonstrated that domestic customers often do not understand the current green tariffs on offer or realise that they are already making a significant contribution to renewable and energy efficiency through their bills. There is a clear expectation from domestic customers that signing up to a green tariff will lead to a clear environmental benefit.

In response to customer views, Ofgem are currently working to establish a clearer link between green tariffs and additional environmental benefits. This is likely to require that suppliers can demonstrate environmental benefits over and above their existing obligations, most notably the Renewables Obligation (RO). The aim is to develop guidelines which can provide confidence to customers that signing up to accredited green tariffs will have environmental benefits.

On 18 June 2008, DEFRA issued advice to consumers and businesses on how they could establish what benefits their green electricity tariff delivered above and beyond the supplier's existing legal obligation to provide electricity from renewable sources. In order to make the picture clearer they have:

- asked Ofgem to provide detailed guidelines for suppliers of green tariffs with a view to developing a rating system that will distinguish between the different environmental potential of green tariffs;
- written to the Chief Executives of energy supply companies to ask them to provide the clearest possible information about the benefit their green tariff brings for the environment;
- announced that they (DEFRA) will change their guidance on corporate reporting so that it reflects the latest evidence on the benefits of green tariffs.

11.2.5 Individuals, business and the third sector can also have powerful influence in delivering change in attitudes and behaviour of others. This can be used to encourage others to take positive steps toward increased use of renewable energy and more environmentally sustainable behaviour more generally.

11.3 Role of Local Authorities

11.3.1 Local Authorities have a key role to play in ensuring that the UK meets its targets for renewable energy, as already outlined in many of the chapters above. As the UK moves towards a less centralised energy supply system, the challenge will be to find solutions that have a local fit – suitable to local conditions and variation, whether it is population density, building mix or local geography. Renewable energy is more visible to local people, and local councils have a key role to play in securing local support for renewable projects.

11.3.2 Local Government plays various roles – as consumers of energy, planners, economic regenerators, housing providers, community leaders and convenors of local partnerships. Each role provides a platform for promoting renewable energy supply:

- in exercising their spatial planning powers, local planning authorities are required to identify suitable locations for low-carbon and renewable energy sources and decentralised energy networks. Through the Local Development Framework and associated planning documents, local councils can require renewable energy supply as a condition of new development;
- through the ownership and management of public land and property (including street lighting, housing, transport and public buildings), local councils can exercise a powerful demonstration effect through their use of renewable energy;
- in the new Regional Economic Strategies, bringing together regional plans, local councils can work with regional partners to both assess and develop the opportunities for renewable supply;
- as major energy consumers, local councils and their local public sector partners can enter into long–term supply contracts;
- as the providers of grants and through their investment in local economic regeneration, local councils can facilitate access to finance for renewable energy companies;
- as community leaders, local councils can build acceptance for renewable projects, by engaging local residents, ensuring that projects are transparent and accountable and by ensuring that there is a clear benefit to the local economy. They can also act as trusted information providers to citizens, to builders, to equipment installers and repairers and to small and medium sized enterprises (SMEs) on support schemes.

11.3.3 There is a new context for local council action on renewable energy. Many local councils will be looking afresh at renewable energy in their communities, as a way of ensuring low-carbon development and meeting their commitments, set out in the local area agreements, to combat both fuel poverty and climate change. Increasingly, councils are looking to new low-carbon industries to boost employment and develop the local economy. The Government has been encouraged by the number of Local Authorities that have included the climate change mitigation indicator in their proposed local area agreements. The proposals set out in this document will provide a strong framework within which Local Authorities can play their part.

11.3.4 Recent Government policy announcements have rightly recognised that local government is well placed to drive forward decentralised energy supply in their areas. Indeed some councils, such as Barnsley, Harrogate, Southampton and Woking, have played a pioneering role. The new Planning Policy Statement (PPS): planning and climate change should enable these and other councils to build on the 'Merton Rule', commonly seen as a key driver for renewable energy supply in England, by setting targets for the percentage of energy in new development to be secured from local renewables or low-carbon sources such as microgeneration or community schemes as part of their spatial planning policies. Chapter 4 (Heat) gives further detail of the crucial role that Local Authorities play in developing heat solutions appropriate to the local area and natural resource.

11.4 Role of Regional Development Agencies

11.4.1 England's Regional Development Agencies (RDAs) play a significant role in contributing to the development and delivery of national energy policy at regional level. Their Regional Economic Strategies and action plans reflect the importance of secure and sustainable energy in providing the critical underpinning to economic success. They recognise the imperative to achieve a low-carbon economy and the 'double-dividend' which can result, both in terms of environmental improvement and sustainable wealth creation, particularly through accessing rapidly expanding global markets for low-carbon technologies and services.

11.4.2 The RDAs bring together several key agendas which are critical to the successful delivery of a sustainable energy policy, and, within it, achieving the development and deployment of renewable energy technologies with the scale needed given the EU targets for 2020 – and beyond. While these targets are ambitious, they also present very significant business opportunities for the UK, which the RDAs will aim to maximise.

11.4.3 Currently the RDAs:

- directly support research and development and demonstration and deployment of renewable energy technologies;
- deliver business support (for example, through Business Link), including supporting energy efficiency and deployment of renewables, and sector development initiatives, including inward investment, site-finding and overseas trade promotion;

- are active in assisting the development of energy-related supply chains and energy skills (including research and training);
- deliver high standards of sustainable construction and exemplar developments which meet high standards of energy performance;
- work with regional partners to agree and deliver regional targets for carbon reduction and renewable energy deployment;
- are responsible for administering European Structural Funds in their regions, and can use them to promote, develop and invest in renewable energy technologies; and
- have an important role in public sector specification and procurement where, especially through working with other public sector bodies, they can assist market development for renewable energy technologies and services.

11.4.4 Voluntary commitments by the RDAs to contribute to the delivery of energy policy at regional level in all of these areas were included in the 2007 Energy White Paper. All RDAs are making good progress in delivering these commitments. They also have an important strategic influencing role, including improving the alignment of policy and delivery at regional, sub-regional and local level. This includes, for example, liaison with Central Government and working with energy companies to develop sustainable energy solutions in each region.

11.4.5 Changes in regional governance in the near future following HM Treasury's Sub-National Review will give additional responsibilities to RDAs, including the task of preparing a Single Integrated Regional Strategy, which will cover both economic and spatial planning. This will provide a clear, robust strategic framework, with a stronger emphasis on delivery at local and sub-regional level. RDAs will have the opportunity to develop regional planning policy which supports improved delivery and deployment of renewable energy in the regions through removing barriers and better co-ordination.

11.4.6 While good progress is being made, it is clear that renewable energy deployment and take-up in the regions will need to increase significantly in order to achieve the EU 2020 renewable energy target and to make the most of the business opportunities presented. The idea of a delivery strategy model that would be applicable to supporting installed capacity for renewable energy in the region is discussed in Chapter 3 (Centralised Electricity). RDAs can act to encourage supply chains too. Potential measures to hasten this process are identified in Chapter 4 (Heat).

Box 11.2: Case Study – The economic contribution of renewable energy to the South West's economy

Regen SW is the sustainable energy agency for South West England, and is core funded by the South West RDA. Their mission is to speed up the transition to a low-carbon economy in South West England, by:

- unlocking sustainable-energy business opportunities;
- accelerating the uptake of the region's renewable energy resources; and
- championing effective energy demand-reduction initiatives in the region.

A new study 'Economic Contribution of the Renewable Energy and Energy Efficiency Sectors in the South West of England', commissioned by Regen SW and carried out by DTZ, reveals that, since 2005, the value of the renewable energy sector to the region's economy has grown hugely from £34 million to £215 million. Employment in this sector has jumped from 1,140 in 2005 to 2,900 in 2008 – equivalent to a massive 37% year on year employment growth.

The study also showed that the value of the energy efficiency sector is £294 million. Combined, the two sectors now include over 300 companies, which directly employ 7,200 workers and have an economic value to the region in excess of £500 million per year.

The results of this survey provide evidence that the ambitious EU 2020 renewable energy target present a significant economic opportunity for the regions.[266]

11.5 Role of Devolved Administrations

11.5.1 Much of the renewable deployment necessary for achieving our overall UK targets and longer-term goals will be in Scotland, Wales and Northern Ireland. The Devolved Administrations have responsibility for a number of key policy levers for facilitating this. The UK Government and Devolved Administrations will therefore need to work closely together in order to meet our shared goals of increasing renewable energy use and meeting our share of the EU 2020 renewable energy target.

Scotland

11.5.2 Scottish Ministers have a range of responsibilities in respect of the delivery of energy policy in Scotland. To support these responsibilities, Scottish Ministers will be consulting shortly on a framework for the development and deployment of renewable energy in Scotland, which complements the proposals in this document. Groups with an interest in developments

266 For more information on the survey see Regen SW sustainable energy agency website.

in Scotland are also encouraged to read and respond to that proposed framework.

11.5.3 The key responsibilities which fall to Scottish Ministers in respect of renewable energy development and deployment lie in the fields of:

- planning and energy consents;
- implementation of the Renewables Obligation in Scotland;
- energy efficiency initiatives;
- environment and climate change policy and legislation;
- research and development;
- economic development; and
- education and training.

11.5.4 Working with the Forum for Renewable Developments in Scotland, Scottish Ministers are developing a comprehensive approach to promoting the development and deployment of renewables as part of their overall aim in the Strategy for Economic Development to promote sustainable economic growth in Scotland. Key indicators designed to support renewable development include commitments to reduce emissions, such as working towards a reduction of emissions by 80% by 2050 and to meet 50% of Scottish electricity demand from renewable sources by 2020, with 31% by 2011.[267] These indicators are also reflected in the overall performance framework for Scottish local government.

11.5.5 Scottish Ministers are also working to develop and deploy renewable energy in heat systems, in transport and to promote distributed energy systems. A new initiative to promote pooling in energy research and development through the new Energy Technology Partnership, which brings together the Scottish Universities, will have a strong focus on renewable energy, as will the Scottish European Green Energy Centre, which will start work this year.

Wales

11.5.6 The Welsh Assembly Government strongly believes that Wales should be at the global forefront of the transition to minimising carbon emissions and maximising low-carbon energy production. In that regard, Wales should exploit its considerable renewable energy resources to the full, as well as showing leadership in achieving major energy efficiency improvements in buildings, processes and transport. This includes the aspiration that all new buildings in Wales should be constructed to zero carbon standards from 2011 onwards.

11.5.7 The Assembly Government's analysis is, against the background of Wales's current annual electricity consumption of around 24 TWh, that by 2025 Wales could be producing some:

267 The 31% target will require installed capacity of some 5 MW; the 50% target over 8.2 MW. Much of this will be from the existing portfolio and new onshore wind, but other renewable sources will also make a contribution, especially after 2011.

- 33 TWh per year of renewable electricity; and
- 3 TWh of renewable heat.

With electricity, they estimate that around half of this might come from marine sources, utilising waves and tides, a third from wind and the rest mainly from biomass resources, including waste, with smaller contributions from hydropower and microgeneration.

11.5.8 In respect of the massive electricity generating potential of harnessing the tidal power of the Severn estuary, the Assembly Government is working closely with BERR and the South West Regional Development Agency on the in-depth Feasibility Study (see Chapter 3).

11.5.9 All these ambitions were described in detail in the 'Renewable Energy Route Map for Wales',[268] which was published for consultation in February 2008. The route map explains how Wales could maximise the use of its natural resources to generate renewable energy and explores the associated potential environmental, planning, grid and community benefits issues alongside how best to overcome barriers to each type of renewables developments. It will be followed by more detailed action plans covering potential marine and biomass developments in Wales.

11.5.10 The route map also summarises the Assembly Government's challenging ambitions for building energy efficiency and small-scale generation. These will be expanded further in a Wales National Energy Efficiency and Savings Plan, to be published for consultation later this year, prior to the planned publication of an overarching Wales energy strategy in 2009.

Northern Ireland

11.5.11 Energy policy is largely a transferred or devolved matter in Northern Ireland. The main areas of transferred responsibility which are relevant in the context of the draft EU Renewable Energy Directive include:

- renewable energy policy and legislation;
- planning and energy consents;
- the Northern Ireland Renewables Obligation;
- energy efficiency;
- microgeneration;
- climate change policy and legislation;
- economic development; and
- building regulations.

11.5.12 Northern Ireland and the Republic of Ireland have led the way in the creation of a single wholesale electricity market (SEM) across the island: the SEM

268 WAG (2008)

is the first cross-border market of its kind in Europe. The SEM will facilitate a significant growth in electricity generated from renewable sources over the next decade. Northern Ireland is almost totally dependent on imported fossil fuels, although it has significant potential for large-scale renewables generation. From a security of supply perspective, maximising the contribution of renewables sources to the generation mix will therefore be a particular policy imperative for Northern Ireland.

11.5.13 The current renewable energy target in Northern Ireland relates to electricity and aims to have 12% of electricity generated from indigenous renewable resource by 2012. In addition, the Northern Ireland Sustainable Development Strategy contains challenging targets for energy, ensuring that beyond 2025, where technologically and economically feasible, 40% of all electricity consumed in Northern Ireland will be obtained from indigenous renewable energy sources, with at least 25% of this being generated by non-wind technologies.

11.5.14 The results of the recently published Electrical Grid Study showed that, across the island of Ireland, it is technically feasible to have a significant increase in renewable electricity generation (up to 42% by 2020), but that this will require significant investment in the electrical grid infrastructure.

11.5.15 During 2008-09, the Department of Enterprise, Trade and Investment, the Northern Ireland Department responsible for energy policy, will review its Strategic Energy Framework (first published in 2004) with a view to ensuring that its policy goals remain relevant to current energy challenges. Any revised document will take account of the implications for Northern Ireland of the draft Renewable Energy Directive and the Department aims to issue a Northern Ireland Renewable Energy Strategy after publication of a revised Strategic Energy Framework.

11.5.16 Several other Departments in Northern Ireland also have a role in delivering elements of renewable energy policy and practice. A concerted and joined-up effort will be required to ensure that renewable energy targets are delivered in Northern Ireland.

11.6 Role of Central Government

11.6.1 Central Government clearly has a key role in setting the overall framework which will allow the market to deliver our renewable energy goals. Much of this document explores how it should best undertake that role, including through:

- giving clear and stable policy direction, to give business the confidence to invest;
- ensuring appropriate financial and regulatory incentives to encourage the deployment of renewables;
- addressing key constraints to such deployment, in the planning system, grid and elsewhere;

- providing clear information and training to ensure that all those who take decisions impacting on renewable energy use can do so in an appropriate way.

11.6.2 The Government also has an important role to play as an energy user. The public sector spent £3.25 billion on gas and electricity in 2006. This is equivalent to 19% of the total commercial and industrial market volume in gas and 8% in electricity. Effective procurement of public sector energy could therefore make a substantial contribution to meeting the UK's share of the EU 2020 renewable energy target.

11.6.3 For this reason the Government undertakes a range of actions to encourage sustainable energy use and procurement. For example, we have published a new policy framework for Government procurement which emphasises the need to consider the environmental impact of goods and services in procurement decisions in the future, and we are setting up a new Centre for Expertise in Sustainable Procurement. The Office of Government Commerce (OGC) works with Government Departments and other public bodies to influence £72 billion of common spend. One of the key aims of the programme is to deliver solutions to meet the sustainability agenda through better contracts and innovative solutions.

11.6.4 In energy procurement, a Collaborative Category Board (CCB) and a cross-Government Energy Strategy Team (EST) have been formed. These two groups between them represent approximately 70% of total public sector spend on electricity and gas. The groups will develop a plan to deliver a collaborative approach to energy procurement, including work to develop a sustainability strategy that will address microgeneration and renewable energy. On average, current OGC BuyingSolutions' customers access 30% of their electricity requirements from renewable energy sources.

Box 11.3: Partnerships for Renewables

Partnerships for Renewables was set up by Carbon Trust Enterprises in 2006 to work in partnership with the public sector to develop, construct and operate wind and other renewable energy projects with Local Authorities, health trusts and other public sector bodies on public sector land. By providing a tailored one stop shop for the development of projects, Partnerships for Renewables provides a way for public sector bodies to access the economic and environmental benefits associated with renewable energy and contribute towards the fight against climate change.

In March 2008 the Carbon Trust and HSBC announced a landmark deal which will see HSBC Environmental Infrastructure Fund making a substantial investment in Partnerships for Renewables Limited (PfR). HSBC Environmental Infrastructure Fund will commit up to £18 million to acquire 49% of PfR and provide development funding, as well as make a £30 million revolving construction capital facility available to fund an estimated £100 million of equity required to build renewable energy projects. This will be HSBC Environmental Infrastructure Fund's first investment.

The target is to develop a 500 MW portfolio of renewables projects on public sector land across the UK during the next five years. This portfolio of projects would generate enough electricity to power the equivalent of some 230,000 homes. It is already talking to more than 100 public sector organisations, including Oxford City Council and Reading University, with the primary aim of delivering onshore wind projects of size 2-15 MW.

11.6.5 Work is also underway, led by DEFRA, to explore the potential for installing biomass boilers to heat Government buildings. The Government committed, in the UK Biomass Strategy 2007, to expanding the use of biomass on the Government estate in England. A number of Departments have already completed an assessment exercise and are considering installing biomass heating systems on sites on their estates. DEFRA's assessment identified 21 sites across its Estate as being potentially suitable. Of these, one site is currently installing a biomass system while planning and landlord approval has so far been progressed for a further four sites. These first sites offer the largest carbon reduction impact. Additionally, a biomass boiler has been installed as part of the redevelopment of Lion House, Alnwick, DEFRA's first carbon neutral building.

11.7 Next steps

11.7.1 We are inviting views on this consultation by 26 September 2008. We will provide a summary of responses towards the end of the year. In the autumn we will also be consulting on low-carbon heat solutions more generally, and the potential for further energy efficiency measures. We will publish our full Renewable Energy Strategy in spring 2009, once the Renewable Energy Directive has been agreed and the UK's share of the target is agreed.

The Strategy will set out the details of the actions we will undertake to reach our 2020 target and to promote renewable energy in the UK for the long term.

Q40: What more could the Government or other parties do to ensure the UK meets the EU renewable energy target?

Q41: Do you agree with our overall approach to developing a UK Renewable Energy Strategy?

Annex 1
Consultation Questions

Chapter 1

Q1: **How might we design policies to meet the 2020 renewable energy target that give enough certainty to business but allow flexibility to change the level of ambition for a sector or the level of financial incentive as new information emerges?**

Q2: **To what extent should we be open to the idea of meeting some of our renewable energy target through deployment in other countries?**

Chapter 2

Q3: **In the light of the EU renewable energy target, where should we focus further action on energy efficiency and what, if any, additional policies or measures would deliver the most cost-effective savings?**

Chapter 3

Q4: **Are our assessments of the potential of different renewable electricity technologies correct?**

Q5: **What more could the Government or other parties do to enable the planning system to facilitate renewable deployment?**

Q6: **What more could the Government or other parties do to ensure community support for new renewable generation?**

Q7: **What more could the Government or other parties do to reduce the constraints on renewable wind power development arising from:**

a. marine navigation;

b. environmental legislation;

c. aviation and radar;

d. any other aspects of regulation?

Q8: **Taking into account decisions already taken on the offshore transmission regime and the measures set out in the Transmission Access Review, what more could the Government or other parties do to reduce the constraints on renewable development arising from grid issues?**

Q9: **What more could the Government or other parties do to reduce supply chain constraints on new renewables deployment?**

Q10: **Do you agree with our analysis on the importance of retaining the Renewables Obligation as our prime support mechanism for centralised renewable electricity?**

Q11: **What changes (if any) should we make to the Renewables Obligation in the light of the EU 2020 renewable energy target?**

Q12: **What (if any) changes are needed to the current electricity market regime to ensure that the proposed increase in renewables generation does not undermine security of electricity supplies, and how can greater flexibility and responsiveness be encouraged in the demand side?**

Chapter 4

Q13: Assuming financial support measures are in place, what more could the Government do to realise the full potential of renewable Combined Heat and Power?

Q14: Are our assessments of the potential of renewable heat deployment correct?

Q15: Have we captured the key features of a Renewable Heat Incentive and a Renewable Heat Obligation as they would apply to the heat sector correctly? Would both of these schemes be workable and are there alternative ways of structuring the schemes to ensure they can operate effectively?

Q16: Do you agree with our assessment that a Renewable Heat Incentive would work better in the heat market?

Q17: What more could the Government or other parties do to encourage renewable heat deployment with regard to:

a. awareness raising;

b. air quality;

c. building regulations;

d. planning;

e. anything else?

Q18: How far should the Government go in focusing on areas off the gas grid as offering the most potential for renewable heat technologies?

Chapter 5

Q19: Do you agree with our analysis of the mechanisms for support of small-scale renewable electricity?

Q20: Given the analysis on the benefits, costs and potential, in what way and to what extent should we direct support to microgeneration electricity?

Q21: If you agree that better information will aid the development of distributed energy, where should attention be focused?

Q22: Do you agree with the Government's current position that it should not introduce statutory targets for microgeneration at this stage in its development?

Q23: What more could the Government do to incentivise retrofit of distributed energy technologies?

Chapter 6

Q24: How can we best incentivise renewable and low-carbon transport in a sustainable and cost-effective way?

Q25: What potential is there for the introduction of vehicles powered through the electricity grid in the UK? What impact would the widespread introduction of these kinds of vehicles have on:

a. energy demand and carbon emissions;

b. providing distributed storage capacity;

c. smoothing levels of electricity demand on the grid?

What factors would affect the scale and timing of these impacts?

Q26: Over what timescales do you think electric vehicles could plausibly contribute to our renewable energy and carbon reduction targets and what could the Government most effectively do to accelerate the introduction of such vehicles in the UK?

Chapter 7

Q27: How can we best ensure that our use of biomass is sustainable?

Q28: How do you see the market for biomass developing to 2020? What are the implications for:

a. imports;

b. longer-term prices and costs?

Q29: Should the Government take further regulatory measures to discourage biomass waste, including food waste, from going to landfill? If so, which types? What, if any, other measures should be taken to encourage its use to generate bioenergy?

Q30: What more could the Government or other parties do to help to ensure the provision of sufficient Waste Incineration Directive-compliant combustion capacity to burn available waste wood alongside other biomass, and what else might constrain the development of this capacity?

Q31: What further actions will improve supply chain efficiency, consumer confidence and sustainable growth of the biomass supply chain?

Q32: What barriers exist to the cost-effective deployment of anaerobic digestion, biogas and the use of biomethane injected directly into the gas grid, and what are the options to address them?

Q33: What action could we take to make biomass communications more effective to both improve public awareness and help to address acceptability issues, and how should this be delivered?

Q34: Are there issues constraining biomass supply and use other than sustainability, supply chain and information issues? How should these be tackled?

Chapter 8

Q35: **How can we adapt the Renewables Obligation to ensure that it effectively supports emerging as well as existing renewable technologies? Are there more effective ways of achieving this?**

Q36: **Is there evidence that specific emerging renewable and associated technologies are not receiving an appropriate form of support?**

Q37: **Are there barriers to the development of renewable and associated technologies that are not addressed by current or proposed support mechanisms?**

Chapter 9

Q38: **What more could the Government or other parties do to ensure that the UK secures the maximum business and employment benefits from the EU renewable energy target?**

Chapter 10

Q39: **Do you agree with our analysis of the likely impacts of the proposed increase in renewable deployment on:**

a. carbon dioxide emissions;

b. the local environment;

c. security of supply;

d. energy prices;

e. fuel poverty;

f. the energy market;

g. the economy;

h. any other wider issues that we should be considering?

Chapter 11

Q40: What more could the Government or other parties do to ensure the UK meets the EU renewable energy target?

Q41: Do you agree with our overall approach to developing a UK Renewable Energy Strategy?

Annex 2: Feed-in tariffs for small-scale electricity generation

QA1: Do you agree with our assessment of the basic starting principles that feed-in tariffs for small-scale electricity generation should adhere to? Are there other principles you think we should consider?

QA2: What are your views on the option we have described? Factors we would like you to consider in your response include:

- **if there are problems with the option described or improvements you could suggest;**
- **if you can envisage a more effective way of implementing feed-in tariffs for small-scale electricity generation.**

QA3: Are there any other bodies or organisations that would be impacted by feed-in tariffs for small-scale electricity generation that we have not considered?

QA4: Who do you think should have access to feed-in tariffs for small-scale electricity generation? Factors that we would like you to consider in your response include:

- **different generation technologies;**
- **size of generation station (i.e. to distinguish from eligibility of large-scale generation for support under the Renewables Obligation);**
- **whether generation is primarily for own use, supply locally or for export;**
- **whether generation is on or off-grid;**
- **whether or not energy efficiency measures should be required.**

QA5: **Do you think it is reasonable to put in safeguards to limit the potential cost of feed-in tariffs for small-scale electricity generation, and if so how could those safeguards be set, and what would the access criteria be? Possible factors and criteria we would like you to consider include:**

- **a limit on overall number of new installations in a given period;**
- **a limit on new installed capacity in a given period;**
- **whether priority should be given to particular groups; for example, people in fuel poverty.**

QA6: **How would we set the feed-in tariffs for small-scale electricity generation? Factors that we would like you to consider in your response include:**

- **the basis for setting the number of tariffs and their level;**
- **initial costs, electricity production rates and differing carbon saving potential of generation equipment;**
- **how long installations should receive the relevant tariff;**
- **how, when and on what basis we would vary the tariffs for new installations;**
- **how different tariffs would impact on multiple installations at one location, e.g. a building with wind turbines and solar panels.**

QA7: **What arrangements should apply to:**

- **currently existing small-scale renewable electricity installations;**
- **installations which enter into operation before feed-in tariffs come into effect?**

QA8: **Do you think that financial markets will move to assist potential small-scale electricity generators with financing of the initial capital cost of renewable installations, or should we seek to introduce policies that will guarantee frontloaded support?**

QA9: How should the costs of feed-in tariffs for small-scale electricity generation be met? Factors we would like you to consider in your response include:

- **who the payment should be administered by;**
- **how payments should be monitored and regulated;**
- **how the overall costs of feed-in tariffs should be disbursed and among which organisations;**
- **how administrative costs should be funded;**
- **how frequently payments should be made to generators and how frequently costs should be disbursed;**
- **who should meet charges by the DNO for use of their system for exported electricity.**

Annex 2
Feed-in tariffs for small-scale electricity generation

1. In Chapter 5 we discuss ways in which we could direct financial support to microgeneration electricity, and whether it would be an advantage to move to a feed-in tariff system as an alternative to current support through grants and the Renewables Obligation. The relative merits of these financial incentive mechanisms are also discussed in Chapter 3 (Centralised Electricity).

2. In order to reach a balanced decision on whether we should introduce feed-in tariffs for small scale renewable generation, it is important to consider how such a system would work in practice. We welcome your views.

Principles of feed-in tariffs

3. The design of a feed-in tariff system should take place within a framework of overarching principles to which it should conform. This is necessary to ensure that it can interact with the UK's liberalised electricity market, and to avoid perverse incentives. At the current time, we have established some basic starting principles; these may expand and develop over time as our thinking develops and is informed through this consultation process. They are that:

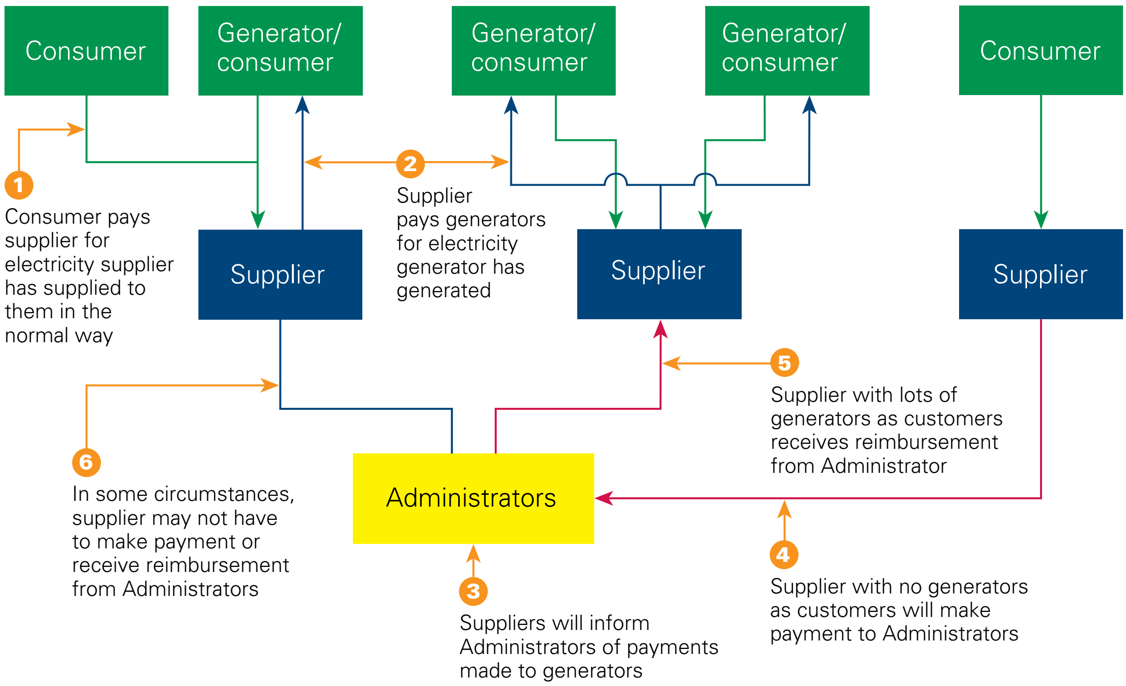
- investment certainty in the Renewables Obligation as the incentive mechanism for large scale generation should be maintained;
- installations should not receive double incentives: for example, owners would not be able to claim Renewable Obligation Certificates (ROCs) and feed-in tariffs;
- owners of generating equipment should not be discriminated against in any way compared with other electricity consumers.

QA1: Do you agree with our assessment of the basic starting principles that feed-in tariffs for small-scale electricity generation should adhere to? Are there other principles you think we should consider?

How a feed-in tariff could be implemented

4. Figure 1 and the accompanying text provide a hypothetical structure for a feed-in tariff system and a methodology that it could follow. This is just one possible approach to implementation, intended to stimulate discussion and comment.

Figure 1: Possible implementation of feed-in tariffs in the UK



In this illustrative example:

- Each consumer is supplied electricity by an electricity company ('supplier') and pays for it in the normal way **(1)**.
- Owners of eligible generation equipment (a 'generator') generate electricity and use it in their building. Any surplus electricity generated is exported to the local distribution network.
- Consumers of electricity who are also generators inform their supplier how much electricity they've generated and/or exported to the local distribution network, on a quarterly basis.
- Supplier provides reward to generator accordingly through credit to their electricity bill **(2)**. The level of the reward would be fixed by regulation.
- Supplier totals their costs i.e. the reward paid to all of the generators that they supply, less the value of the electricity that those generators have exported to the local distribution network. This information is sent to an administration body ('Administrator') **(3)**.

- Administrator ensures redistribution of the cost of payments to generators across supplier companies. Those suppliers who have no, or few, generators in their customer base will probably have to make a payment to the Administrator **(4)**, some of which would be reimbursed to those suppliers with many generators in the customer base **(5)**. Other suppliers may have a balanced customer profile and will not have to make a payment or receive a reimbursement **(6)**.

- Costs to suppliers should therefore be proportionate to their size (determined on market share or total (non-renewable) MWh sales basis) and not to the number of generator/customers they have. The share will be determined by the Administrator.

- It would be left to suppliers to decide how they fund the costs of payment to generator/customers or compensation to other suppliers. It is likely that Suppliers will vary in their approach, dependent on their desire to protect market share or profits. This would influence the extent to which the costs are passed back to their customer base through increases in electricity prices.

QA2: What are your views on the option we have described? Factors we would like you to consider in your response include:

- **if there are problems with the option described or improvements you could suggest;**

- **if you can envisage a more effective way of implementing feed-in tariffs for small-scale electricity generation.**

Who would be impacted by feed-in tariffs?

5. A number of bodies/organisations might be impacted by, or involved in, the delivery of a feed-in tariff. They include:

- Small-scale electricity generators
  - generators who produce electricity on a small-scale either for own use or for export to the local distribution network.

- Administrator
  - organisation that may be needed to administer and regulate the feed-in tariff system. This may, or may not, be the current electricity market regulator Ofgem.

- Distribution Network Owners, or DNOs
  - owners and managers of the local, lower voltage electricity networks into which the output of small-scale electricity generators is fed;
  - DNOs do not buy or sell electricity; instead they levy a Distribution Use of System (DUoS) charge to generators and suppliers transporting electricity across the local distribution network to end consumers. DNOs traditionally have no relationship with end consumers of electricity.
- Electricity suppliers
  - providers of electricity to end consumers, i.e. the companies who send electricity bills;
  - competition for customers puts pressure on electricity suppliers to keep their costs down, i.e. by sourcing electricity from the cheapest source; most often in bulk from large-scale fossil fuel generation.
- Electricity customers
  - consumers of electricity purchased from the electricity suppliers. Are likely to be affected by feed-in tariffs through increased bills to cover costs of the tariffs.

QA3: Are there any other bodies or organisations that would be impacted by feed-in tariffs for small-scale electricity generation that we have not considered?

Further issues for consideration

6. In Figure 1 we have provided for consideration an illustrative example of how a feed-in tariff system might work. But we realise that there are other issues that need to be considered to enable us to reach a balanced decision on whether we should move to a feed-in tariff system for small-scale electricity generation, and if so, how it would work in practice.

Eligibility for and access to feed-in tariffs

7. To date, financial support for microgeneration electricity technologies has been through the Low Carbon Buildings Programme and its predecessor grant schemes. Renewable microgeneration electricity technologies can also benefit from the Renewables Obligation (see chapter 5 for more information). If we were to proceed with establishing a new financial incentive mechanism then we have the opportunity to look again at eligibility criteria, and how the financial incentive is to be accessed.

QA4: Who do you think should have access to feed-in tariffs for small-scale electricity generation? Factors that we would like you to consider in your response include:

- **different generation technologies;**
- **size of generation station (i.e. to distinguish from eligibility of large-scale generation for support under the Renewables Obligation);**
- **whether generation is primarily for own use, supply locally or for export;**
- **whether generation is on or off-grid;**
- **whether or not energy efficiency measures should be required.**

8. If a feed-in tariff system were to prove highly effective, we could see very high and rapid levels of take-up for small-scale renewable electricity generation. This could lead to higher annual costs of making payments to generators than would be anticipated. Level or pace of take up, and therefore cost, could be reduced through introduction of a limit on the number of installations that could benefit from feed-in tariffs in a particular period, or a reduction of the tariff in proportion to the number of installations in a particular time period.

QA5: Do you think it is reasonable to put in safeguards to limit the potential cost of feed-in tariffs for small-scale electricity generation, and if so how could those safeguards be set, and what would the access criteria be? Possible factors and criteria we would like you to consider include:

- **a limit on overall number of new installations in a given period;**
- **a limit on new installed capacity in a given period;**
- **whether priority should be given to particular groups; for example, people in fuel poverty.**

Setting the feed-in tariff

9. Different installations and technologies would involve different costs and carbon savings, would generate energy at different rates and have different product lifetimes. The rate at which different technologies and installations should be rewarded could be set to reflect these factors accordingly. It should be noted that having multiple tariffs would increase system complexity.

QA6: How would we set the feed-in tariffs for small-scale electricity generation? Factors that we would like you to consider in your response include:

- **the basis for setting the number of tariffs and their level;**
- **initial costs, electricity production rates and differing carbon saving potential of generation equipment;**
- **how long installations should receive the relevant tariff;**
- **how, when and on what basis we would vary the tariffs for new installations;**
- **how different tariffs would impact on multiple installations at one location, e.g. a building with wind turbines and solar panels.**

Interaction with the Renewables Obligation and other support schemes

10. There are a number of different schemes and policies in place to encourage and support small-scale generation of electricity; these are set out in Table 5.2 in Chapter 5. We propose that installers of new small-scale electricity generation equipment who are eligible to receive feed-in tariff payments should not also be able to benefit from other schemes. This would reduce complexity and also remove the risk of double incentives, which we do not think appropriate.

QA7: What arrangements should apply to:

- **currently existing small-scale renewable electricity installations;**
- **installations which enter into operation before feed-in tariffs come into effect?**

Financing the purchase of small-scale generation installations

11. As Chapter 5 of the consultation document shows, the initial costs of small-scale generation technologies can be significant, and consumers place most value on a financial incentive that delivers frontloaded support.

QA8: Do you think that financial markets will move to assist potential small-scale electricity generators with financing of the initial capital cost of renewable installations, or should we seek to introduce policies that will guarantee frontloaded support?

The costs of feed-in tariffs

12. Under a feed-in tariff system generators of electricity would receive payment for each kilowatt hour of electricity that they generate, the costs of which are ultimately likely to be met through increased consumer electricity bills. In some cases the generator may produce more electricity than required to meet their own demand, and as such, some output will be exported to suppliers via the local distribution network. This exported electricity would then be re-sold to other consumers and substituted for electricity that would otherwise have been bought from large-scale central generators and transmitted through the National Grid. This electricity has some market value, though the lack of certainty about the time of day at which the electricity will be available, and in what quantity, limits its value to electricity suppliers.

QA9: How should the costs of feed-in tariffs for small-scale electricity generation be met? Factors we would like you to consider in your response include:

- **who the payment should be administered by;**
- **how payments should be monitored and regulated;**
- **how the overall costs of feed-in tariffs should be disbursed and among which organisations;**
- **how administrative costs should be funded;**
- **how frequently payments should be made to generators and how frequently costs should be disbursed;**
- **who should meet charges by the DNO for use of their system for exported electricity.**

Conclusion

13. We have outlined here one example of how a feed-tariff might operate for small-scale electricity generation; and set out a number of issues on which we seek views. The information provided through responses to this consultation and ongoing discussions with industry and other stakeholders will inform our decisions on how best to support electricity generation at this scale, including whether a move to a feed-in tariff system would be advantageous.

14. A key factor in these decisions will be whether a feed-in tariff system could be designed to encourage the development of small-scale electricity generation in line with wider renewable energy and wider climate change objectives. We must also ensure that it is compatible with the incentive mechanism for large-scale electricity generation; with any mechanism for encouraging renewable heat; and with the electricity market as a whole.

Annex 3
Glossary of terms

AC – Alternate current

AD – Anaerobic Digestion

AEA Energy – Company name

ATLAS – Advisory Team for Large Applications

bbl – barrels of oil (measurement of oil)

BERR – Department for Business, Enterprise & Regulatory Reform

BETTA Queue – British Electricity Trading and Transmission Arrangements Queue, also known as the GB Queue

BWEA – British Wind Energy Association

CAA – Civil Aviation Authority

CAP – Common Agricultural Policy

CCAs – Climate Change Agreements

CCB – Collaborative Category Board

CCC – Committee for Climate Change

CCS – Carbon Capture and Storage

CDM – Clean Development Mechanism

CEMEP – Commission on Environmental Markets and Economic Performance

CEN – European Committee for Standardisation

CERT – Carbon Emissions Reductions Target

CHP – Combined Heat and Power

CLG – Department for Communities and Local Government

CO_2 – Carbon dioxide

CoP – Coefficient of Performance

CRC – Carbon Reduction Commitment

DARD – Northern Ireland Department of Agriculture and Rural Development

DC – Direct current

DE – Distributed Energy

DEFRA – Department for Environment, Food and Rural Affairs

DfT – Department for Transport

DIUS – Department for Innovation, Universities and Skills

DPA – Data Protection Act

DTI – formerly Department of Trade and Industry (now BERR)

DTZ – Company name

EDF – Electricite de France

EEC – Energy Efficiency Commitment

EEF – Engineering Employers' Federation

EJ/yr – exajoules per year

ENVIROS – Company name

EPSRC – Engineering and Physical Sciences Research Council

EST – Energy Saving Trust

ETF – Environmental Transformation Fund

ETI – Energy Technologies Institute

EU ETS – EU Emissions Trading Scheme

EWP – Energy White Paper

FIT – Feed-in tariff

FOIA – Freedom of Information Act

FP7 – Framework Programme 7 (EU programme to support R&D)

FREDS – Forum for Renewable Energy Development in Scotland

FSC – Forest Stewardship Council

FT – Fischer Tropsch

g/km – grammes per kilometre

G8 – Group 'of eight' nations

GB – Great Britain

GB Queue – the Great Britain Queue

GB SQSS – Great Britain Security and Quality of Supply Standards

GDP – Gross Domestic Product

GHG – Greenhouse gas

GQ CHP – Good Quality Combined Heat and Power

GSHP – Ground Source Heat Pump

$GtCO_2$ – giga tonnes of CO_2

GW – Gigawatts

HETAS – A body recognised by Government to approve solid fuel heating appliances, fuels and services

HMT – Her Majesty's Treasury

HSBC – Hong Kong and Shanghai Banking Corporation

ICM – Company name

IEA – International Energy Agency

IFI – Innovation Funding Incentive

IPC – Infrastructure Planning Commission

IPPC – Integrated Pollution Prevention and Control

IT – Information Technology

IVC – in-vessel composting

K – thousand

kVA – Kilo Volt-Ampere

KW – Kilowatts

kWh – Kilowatt-hour

LAPPC – Local Air Pollution Prevention and Control permit

LAQM – Local Air Quality Management regime

LCBP – Low Carbon Buildings Programme

LCTIS – Low Carbon Transport Innovation Strategy

LDDs – Local Development Documents

LDO – Local Development Order

MCA – Maritime and Coastguard Agency

MoD – Ministry of Defence

MOT – Annual test of car safety and road-worthiness

MPS – Marine Policy Statement

Mt – Million tonnes

MtC – Million tonnes of carbon

$MtCO_2$ – Million tonnes of carbon dioxide

Mtoe – Million tonnes of Oil Equivalent

MW – Megawatts

MWe – Megawatts of electricity

MWh – Mega Watt hours

MWth – Megawatts of heat (therms)

NATS – National Air Traffic Services

NERA – Company name

NHPAU – National Housing and Planning Advice Unit

NHS – National Health Service

NPS – National Policy Statement

NVQ – National Vocational Qualification

OCC – Office for Climate Change

OECD – Organisation for Economic Cooperation and Development

Ofgem – Office of Gas and Electricity Markets (UK energy regulator)

OGC – Office of Government Commerce

OPEC – Organisation of the Petroleum Exporting Countries

OREEF – Offshore Renewable Energy and Environmental Forum

PAS – Planning Advisory Service

PFI – Private finance initiative

PfR – Partnerships for Renewables Limited

PPL – pence per litre

PPS – Planning Policy Statement

PV – Photovoltaics

R&D – Research and Development

RAB – Renewables Advisory Board

RAG – Research Advisory Group

RDAs – Regional Development Agencies

RDPE – Rural Development Programme for England

REA – Renewable Energy Association

Regen SW – The renewable energy agency for South West England

RFA – Renewable Fuels Agency

RHCs – Renewable Heat Certificates

RHI – Renewable Heat Incentive

RHO – Renewable Heat Obligation

RO – Renewables Obligation

ROC – Renewables Obligation Certificate

RSPO – Round Table on Sustainable Palm Oil

RSS – Regional Spatial Strategies

RSSB – Rail Safety and Standards Board

RTFO – Renewable Transport Fuel Obligation

SAs – Statutory nature conservation advisors

SDC – Sustainable Development Commission

SEA – Strategic Environmental Assessment

SEM – Single wholesale electricity market

SHETL – Scottish Hydro-Electric Transmission Ltd

SKM – Sinclair Knight Merz

SMEs – Small and Medium Enterprises

SONI – System Operator for Northern Ireland

SPT – Scottish Power Transmission Ltd

SRF – Solid Recovered Fuels

SSAs – Strategic Search Areas

SSCs – Sector Skills Councils

TAR – Transmission Access Review

tCO_2 – tonnes of CO_2

TIRG – Transmission Investment in Renewable Generation

toe – tonnes of oil equivalent

TCPA – Town and Country Planning Act

TSB – Technology Strategy Board

TW – Terawatts

TWh – Terawatt hours

TWh/yr – Terawatt hours per year

UKTI – UK Trade & Investment

V2G – vehicle to grid

VAT – Value Added Tax

VTS – Vessel Traffic Services

WID – Waste Incineration Directive

WIDP – Waste Infrastructure Delivery Programme

WRAP – Waste and Resources Action Programme

Annex 4
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Annex 5
Code of practice for consultation

The six consultation criteria:

1. Consult widely throughout the process, allowing a minimum of 12 weeks for written consultation at least once during the development of the policy.

2. Be clear about what your proposals are, who may be affected, what questions are being asked and the timescale for responses.

3. Ensure that your consultation is clear, concise and widely accessible.

4. Give feedback regarding the responses received and how the consultation process influenced the policy.

5. Monitor your department's effectiveness at consultation, including through the use of a designated consultation co-ordinator.

6. Ensure your consultation follows better regulation best practice, including carrying out a Regulatory Impact Assessment if appropriate.

These criteria must be reproduced within all consultation documents.