Final report

A REPORT TO THE DTI AND THE DTLR

REGIONAL RENEWABLE ENERGY ASSESSMENTS

FEBRUARY 6TH 2002

OXERA Environmental

ARUP Economics & Planning

Executive Summary

The DTI and the DTLR invited all regions to make an assessment of the potential for renewable energy generation in 2010. This report examines whether the proposed regional targets in aggregate are sufficient to meet the target set by the UK government, and whether the assumptions made are consistent and reasonable. The report reaches the following conclusions.

- The 10% Renewables Obligation target is more or less reached under the high targets proposed in the regional assessments, but not under the low targets. The certainty of meeting the 10% target is increased if one considers the additional offshore resource proposed in the Garrad Hassan resource assessment of Scotland[1] (see section 5.10), and the further wind farm developments off the coasts of England, Wales and Northern Ireland which developers are considering (in addition to the 18 developments announced by Crown Estates in April 2001).

- The English regions' proposed targets, when aggregated, fall well short of 10% of their electricity supply. However, some regions (eg, South West and East of England) anticipate an individual contribution greater than 10%.

- Half of the total of the regions' assessments consist of on- and offshore wind. Landfill gas and biomass make up most of the remaining half. However, some of the assessments pre-date recent DTI announcements and may therefore understate contributions from onshore wind and co-firing.

- Onshore wind energy and energy from waste are the most problematic in terms of obtaining planning consent.

- The economic feasibility of substantial biomass generation is uncertain—it may rely on capital grants as well as the new market for renewable electricity created by the Renewables Obligation.

- The regional renewable energy assessments have been undertaken under consistent and reasonable assumptions of land-use and technical constraints. The economic assumptions are generally reasonable, although not always fully disclosed and there is considerable reliance on biomass, which has uncertain costs.

- The planning system may take several years to incorporate the regional targets into forward plans, and hence into development control decisions. Nevertheless, there are actions that government can take which would have an immediate effect, and which would also deliver improvements in the future.

- A more positive planning system would assist the achievement of the national target. It might place greater onus on local authorities to help deliver regional targets and more locational guidance on areas suitable for renewable energy, either in development plans or supplementary planning guidance.

- Building awareness about the wider advantages of renewable energy generation by the government, operators and environmental groups would also help. Operators need to engage with the community in advance of planning applications.

Abbreviations

AONB	Area of outstanding national beauty
DEFRA	Department for Environment, Food and Rural Affairs
DETI	Department of Enterprise, Trade and Investment
DTI	Department of Trade and Industry
DTLR	Department for Transport, Local Government and the Regions
EC	European Community
ETSU	Energy Technology Support Unit
EU	European Union
GB	Great Britain
GDP	Gross domestic product
GWh	gigawatt-hour
IEA	International Energy Agency
IRR	internal rate of return
Km	kilometre
KW	kilowatt
KWh	kilowatt-hour
KWp	Kilowatt peak output
M	Metre
m/s	metres per second
MW	megawatt
MWe	megawatts of electricity
NFFO	Non Fossil Fuel Order/Obligation
NNR	National Nature Reserves (Scotland)
NPPG	National Planning Policy Guidance
odt	oven-dry tonne
PAN	Planning Advice Note
PIU	Performance and Innovation Unit
PPG	Planning Guidance
PV	photovoltaics
RO	Renewables Obligation
ROC	Renewables Obligation Certificate
RPG	Regional Planning Guidance
SSSI	site of special scientific interest
TAN	Technical Advice Note
TWh	terawatt-hour
UDP	unitary development plan
UK	United Kingdom
yr	Year

Contents

1. Introduction

This report examines whether the targets proposed by the different regions in their regional renewable energy assessments would together be sufficient to achieve the national target for renewable electricity generation. It compares the assumptions underlying the regional targets.

Renewable energy developers have had partial success in obtaining planning permission for new generation. Acknowledging this, the DTI and the DTLR have taken the initiative for regional renewable energy assessments as a means of encouraging the adoption of regional targets and approaches within Regional Planning Guidance and within Regional Sustainable Development Frameworks. The English regions and the devolved administrations were asked to undertake detailed analyses of the renewable energy potential for their areas and to propose a reasonable target. Each region took into account factors limiting the availability of renewable energy, such as cost, volume of resources, and the impact on local amenity and the environment more generally.

The DTI and the DTLR commissioned this study as an overview of the UK's regional renewable energy assessments. The study began in October 2001 and was completed in December 2001. OXERA reviewed the economic and technical aspects of the regional assessments, and Arup Economics & Planning considered the planning issues. The study team received suggestions from a number of stakeholders, many of whom kindly travelled to London to participate in a workshop.

This report begins by restating the proposed Renewables Obligation (RO) on suppliers in Great Britain and introducing the reader to the main renewable energy technologies. The issues raised by stakeholders in the workshop are then presented.

This is followed by a discussion of the forward planning and development control aspects of the planning system, and the role of the regional renewable energy assessments within the former.

A comparison of the targets in the regional assessments and the RO target is then made, and the differences between the regions are contrasted. More detailed regional summaries follow, completed by a discussion of the resource and cost assumptions contained within them. These assumptions are compared with some other published sources where appropriate. The main conclusions are presented at the end of the report.

2. Regional Assessments and the National Target

Over the last few years, the government has developed a new renewable energy policy consisting of a target, an instrument and financial support. The target is agreed, the instrument will shortly become law, and the Cabinet Office has recently announced the distribution of financial support[1]. The DTI issued a draft Renewables Obligation Order in August 2001. It provides the detailed statutory arrangements for an obligation to be placed on all electricity suppliers in England and Wales to supply a proportion of their electricity from renewable sources. This obligation will operate under the provision of Section 62 of the Utilities Act 2000, and is likely to come into force on April 1st 2002. The obligation will rise steadily, reaching 10% in 2010[2]. Scotland is expected to adopt a similar provision when a draft order is approved by the Scottish Parliament[3]. Northern Ireland intends to match the GB target and may ultimately join the GB scheme[4]. Its contribution will count towards the EU indicative target (see Appendix 1) but not the GB RO. The target relevant for this report is the 10% target for Great Britain, which is 32.4 TWh/yr electricity supplied from renewable energy sources (see Table 2.1).

Table 2.1: The RO target for 2010 for Great Britain

Period	Estimated sales by licensed suppliers in GB (TWh/yr)	Total obligation in GB (TWh/yr)	Total obligation as % of sales (GB)
2010	324.3	32.4	10

Source: DTI (2001), 'New and Renewable Energy: The Renewables Obligation. Statutory Consultation', August 2001.

The sources of renewable energy that are considered renewable under the RO are listed in Table 2.2.

[1] Cabinet Office Performance and Innovation Unit (2001), 'Renewable Energy in the UK—Building for the Future of the Environment', November.
[2] Consistent with 10.4 % in 2010/11, which is 33.6 TWh.
[3] Scottish Executive (2001), 'The Renewables Obligation (Scotland) Order 2001' (draft), http://www.scotland.gov.uk/who/elld/_forms/ROS_Order_2001.doc.
[4] DETI (2001), 'Renewable Energy in Northern Ireland, Realising the Potential' (consultation document), http://www.detini.gov.uk./cgi-bin/thinframe?url=/energy.

Table 2.2: Eligibility of sources for Renewables Obligation Certificates

Source	Eligibility
Landfill gas	✓
Sewage gas	✓
Energy from waste	Only non-fossil-fuel-derived energy will be eligible.
	Energy from incinerating mixed waste will not be eligible.
	Energy from the non-fossil-fuel element of mixed waste using advanced technologies will be eligible.
Hydro exceeding 20 MW declared net capacity	Only stations commissioned after the date the Order is made.
Hydro 20 MW or less declared net capacity	✓
Onshore wind	✓
Offshore wind	✓
Co-firing of biomass	Eligible until March 31st 2011 for up to 25% of the supplier's obligation.
	At least 75% of biomass fuel to be energy crops from April 1st 2006.
Other biomass—eg, agricultural and forestry residues	✓
Geothermal power	✓
Tidal and tidal stream power	?
Wave power	✓
Photovoltaics	✓
Energy crops	✓

Source: DTI (2001), 'New and Renewable Energy: The Renewables Obligation. Statutory Consultation', August 2001.

3. The Planning System

3.1 Obtaining consents for renewable energy projects

This section explains how the planning system works. Onshore renewable energy developers have to obtain planning permission from the relevant district council in the conventional way. Under the plan-led system, such applications must be determined in accordance with the development plan, unless material considerations indicate otherwise. For those parts of the country covered by a two-tier local government structure, the development plan comprises the county structure plan and the district local plan. Where a unitary structure is in operation, it comprises the unitary development plan (UDP).

At present, there may or may not be guidance of relevance to renewable energy projects in the development plan, but, if there is, it is unlikely to go beyond general development control criteria.

Current national planning guidance on renewable energy is a material consideration in the determination of planning applications. In England, the Planning Policy Guidance (PPG) Note 22 promotes the environmental benefits of increasing renewable energy generation (1993) and provides detailed annexes on the implications of different technologies (1994). More general guidance in Wales is given in Planning Guidance (Wales), Planning Policy, First Review (1999), with detailed guidance in Technical Advice Note (TAN) 8 (1996). In Northern Ireland, guidance is given in the Planning Strategy for Rural Northern Ireland (1993). Only in Scotland is the national guidance up to date, where NPPG (National PPG) 6 sets wider objectives for renewable energy development within the context of the national target, and provides guidance to local authorities on balancing global benefits against local amenity disbenefits[5]. Information on the implications of the different technologies is given in Planning Advice Note (PAN) 45 (1994).

Much of this national guidance is currently under review. DTLR has given a commitment to revise PPG 22 annexes and has already consulted on a draft of a revised annex on photovoltaics published in autumn 2001[6]. A revised Planning Policy Wales is expected in spring 2002, and a review of TAN 8 is also underway. There are no current plans for a planning policy statement on renewable energy in Northern Ireland.

In addition, the DTLR is undertaking a major review of the planning system, proposals that were published in a Green Paper and associated consultation papers in December 2001. Among other things, this is expected to suggest ways of speeding up the determination of planning applications.

Offshore renewable energy projects—between the low-water mark and the edge of territorial waters, 12 miles offshore—have to gain three main consents: a licence from the

[5] DETR (2000), 'National Planning Policy Guidance 6: Renewable Energy Developments', revised November.
[6] Parliamentary Question, June 27th 2001,*Hansard*, Volume 370, C102W.

DTI under Section 36 of the Electricity Act 1989; a licence from the DTLR under Section 34 of the Coastal Protection Act 1949; and a licence from DEFRA under Section 5 of the Food and Environment Protection Act 1985. The DTI is implementing a coordinated approach to handling these licence applications[7].

There are no procedures currently in place for obtaining licences for renewable projects outside territorial waters. This will become important in the longer term, given that developers are already considering very large offshore wind installations.

Additional funding of £2.5m, to provide information and support to improve the performance of the land-use planning system in respect of renewable energy development, is part of the allocation of £100 million to renewable energy, announced by the Prime Minister in November 2001[8].

3.2 A more proactive role for regional planning

The government has begun to address these issues. A more strategic approach at regional level was heralded in February 2000, as part of the new approach to renewable energy[9]. The means of strengthening regional planning were set out by Nick Raynsford, then Planning Minister, in response to a Parliamentary Question in early March 2000.

> A positive, strategic approach to planning for renewable energy is essential to help to deliver the Government's targets and goals for renewable energy and climate change, which are central to achieving sustainable development, whilst continuing to protect the landscape.[10]

The same Parliamentary Question firmed up the intention that local plans should identify suitable sites for renewable energy. Although this guidance is included in PPG22, many local authorities, with the exception of a few in northern England, have not taken it forward.

Under the new system, regional renewable energy targets will be set based on each region's capacity to generate such energy, and they will be included in the appropriate Regional Sustainable Development Framework.

The region's land-use strategy for delivering its renewable energy target would be taken forward through the Regional Planning Guidance (RPG), which involves:

[7] DTI (2001), 'Draft Guidance Notes: Offshore Windfarm Consents Process', October.
[8] Press release from http://www.pm.gov.uk/news.asp?NewsId=2929
[9] DTI (2000), 'New and Renewable Energy: Prospects for the 21st Century: Conclusions in Response to the Public Consultation', February.
[10] DETR news release 161, March 6th 2000, Col:462w, *Hansard*, 2001.

- setting sub-regional targets—ie, feeding into subsequent structure plans and UDPs (stepping down to a lower tier), only 'where sensible to do so';[11]
- defining broad locations for renewable energy development;
- setting criteria to help select suitable sites in development plans.

3.3 Regional planning progress so far

While some progress has been made in implementing this more proactive regional planning system, it is unfortunate that most of the regional renewable energy assessments were not completed in time to be incorporated into the recent revision of RPGs or their equivalent under the devolved administrations. The coverage of renewable energy issues in the current round of RPGs is shown in Table 3.1.

[11] ibid.

Table 3.1: Renewable energy in Regional Planning Guidance

Region	National guidance	Status of RPG	Inclusion of renewable energy policies[1]	Inclusion of renewable energy target
East of England	PPG22 (1993/94)	Published November 2000	✓ 1	
East Midlands	PPG22 (1993/94)	Secretary of State's modifications March 2001	✓ 1	(✓) 400 MW by 2005
London	PPG22 (1993/94)	Pre-draft	n/a	
North East	PPG22 (1993/94)	Secretary of State's modifications, April 2001	✓ 3	(✓) 5–9%, excluding energy from waste
North West	PPG22 (1993/94)	Panel reported July 2001	✓ 1	
South East	PPG22 (1993/94)	Published March 2001	✓ 1	
South West	PPG22 (1993/94)	Published September 2001	✓ 1	✓ 11–15%
West Midlands	PPG22 (1993/94)	Draft, November 2001	✓	
Yorkshire and the Humber	PPG22 (1993/94)	November 2001	✓ 1	✓ 10% (repetition of national target)
Scotland	NPPG6 (2000) and PAN45 (1994)[2]	National planning framework under consideration[3]	n/a	
Wales	PPW (draft 2000) and TAN8 (1996)	'Spatial Plan for Wales': pre-draft[4]	n/a	
Northern Ireland	Planning Strategy for Rural Northern Ireland	'Shaping our Future', September 2001[5]	✓ 2	

Notes: [1] Refers to numbers of specific renewable energy policies in RPG or equivalent. [2] 'Planning Advice Note: Renewable Energy Technologies'. n/a not applicable, as no new-style plan has yet been produced. [3] Scottish Executive (2001), 'Review of Strategic Planning', June.[4] National Assembly for Wales (2001), 'Wales Spatial Plan: Pathways to Sustainable Development: A Consultation Document'. [5] Northern Ireland Department of Regional Development (2001), 'Shaping our Future', September.
NAW (2001), 'Wales Spatial Plan: Pathways to Sustainable Development', consultation document.
Northern Ireland Department of Regional Development (2001), 'Shaping our Future, September.
Source: ARUP Economics and Planning.

The only RPG to include a renewable energy target based on the recent regional assessments is the South West, where the target is '11–15% of electricity from renewable sources' as a contribution to 'total energy generated'. Two other regions have targets included in background text, although one of these relates to an earlier study, and a fourth region merely repeats the national target.

There will be early reviews of RPG in most regions. Indeed, some are already under way, with the aim of most being in place by 2003/04. Thus locally agreed targets will be incorporated into a more positive framework for renewable energy. However, given that it can take up to six years from conception to commissioning of renewable energy installations, this change can be expected to have its full influence only in the run-up to and after 2010. As this next round of RPG will generally set the development framework

for the period up to 2021, longer-term renewable energy targets could usefully be included, subject to the technical work having been undertaken.

When the regions are compared, the **North East** can be seen to have the most supportive RPG framework. The latest version of the North East RPG, with the Secretary of State's proposed modifications to the draft, contains the following recommendations:

- development plans should identify strategic wind resource areas, and areas of search for hydro and other technologies. There are already a few examples where such areas have been identified—for example, within the Castle Morpeth local plan;
- development plans should give careful consideration to the type and scale of renewable energy that could be located in nationally designated areas. This implies that such areas are not completely excluded;
- 14 criteria to assist local authorities when they are drafting their own criteria-based development control policies. In addition to the usual selection of environmental impact and local amenity considerations, one criterion relates to the facilitation of community participation;
- local authorities should produce a variety of supplementary planning guidance to provide a more positive framework within which operators can come forward with proposals. This should include development briefs for the location and appearance of renewable energy developments, guidance for new renewable energy technologies, and guidelines for the incorporation of various means of solar energy in buildings.

3.4 Recent planning experience

The DTI monitors the success of planning applications for renewable energy plant. Since 1999, 89% of planning applications were approved (ie, 394 projects out of 443).[12] Of these, many of the earlier NFFO schemes were for landfill gas generation and were not contentious.

According to this source, there has been a positive correlation between the rate of approval of planning applications and the existence of an up-to-date development plan. The success rate for planning applications in such areas was almost three approvals to every one refusal, compared to fewer than two to one in areas without a supportive development plan policy.

Work published by the Confederation of Renewable Energy Associations paints a more pessimistic picture.[13] When the data were converted from projects into declared net

[12] Terence O'Rourke Ltd (2000), 'Back to the Future', *New Review, Quarterly Newsletter for the UK New and Renewable Energy Industry*, **45**, August, DTI.

[13] Hartnell, G. (2001), 'Planning and Renewables: Implications for Meeting the Targets', paper presented at the conference of the Confederation of Renewable Energy Associations, March 22nd.

capacity, landfill gas schemes were excluded, and the data were extended to December 2000, the approval rate was only 70%, rather than 89%. In this new data set, larger projects fared worse, particularly large wind farms. Since many operators had delayed their planning applications after securing an NFFO contract, it was concluded that planning was the most significant barrier to deploying renewables. An alternative explanation is that some NFFO contracts were not sufficiently attractive commercially, and developers decided not to proceed with them.

Planning constraints are often perceived to be holding back the growth of renewable energy. However, this is not necessarily confirmed by recent development control experience. Appendix 3 gives further detail of the points raised by attendees of the workshop that formed part of this study, and comments submitted during the preparation of the regional assessments.

4. Overview of the Regional Renewable Energy Assessments

4.1 Regional assessments

This section presents a consolidation of the renewable generation capacity volunteered by the regions and devolved administrations in their assessments. Each regional assessment examined the potential for renewable energy generation on a bottom-up basis, with the benefit of stakeholder consultation. Most regions have volunteered targets, or a target range, for 2010. Some were still in draft form at the time of writing this report (West Midlands, Yorkshire and the Humber and Scotland).

4.2 Regional targets

The targets in the regional assessments are collated in this section, and summed for comparison with the RO target discussed in Section 2. The regional assessments quote ranges for renewable electricity generation in 2010, which are listed in Table 4.1. Since some of the regional studies are dated 2000, new information may have become available since that would cause those targets to be revised. For example, the Scottish target might be revised upwards to incorporate the availability of offshore wind identified in a study by Garrad Hassan and Partners Ltd, with or without a recently proposed West Coast offshore inter-connector and large wind farms in the Outer Hebrides.

Table 4.1: Renewable electricity generation in 2010

	Low (TWh)	% of target	High (TWh)	% of target
East of England	4.3	13.3	4.3	13.3
East Midlands	1.8	5.6	2.0	6.1
London	0.2	0.7	0.6	1.9
North East	0.9	2.7	2.0	6.3
North West	2.8	8.6	3.2	9.7
South East	1.4	4.4	3.3	10.1
South West	1.2	3.7	2.5	7.8
West Midlands	2.5	7.7	2.9	8.9
Yorkshire and the Humber	1.2	3.8	3.6	11.0
Scotland	3.6	11.1	3.6	11.1
Wales	1.3	4.2	4.4	13.4
Total RO	**21.3**	**66**	**32.3**	**100**
Scotland offshore[1]			3.5	10.8

Notes: [1] This figure is not included in the regional assessments. It equates to 1GW of offshore wind capacity built in Scotland.

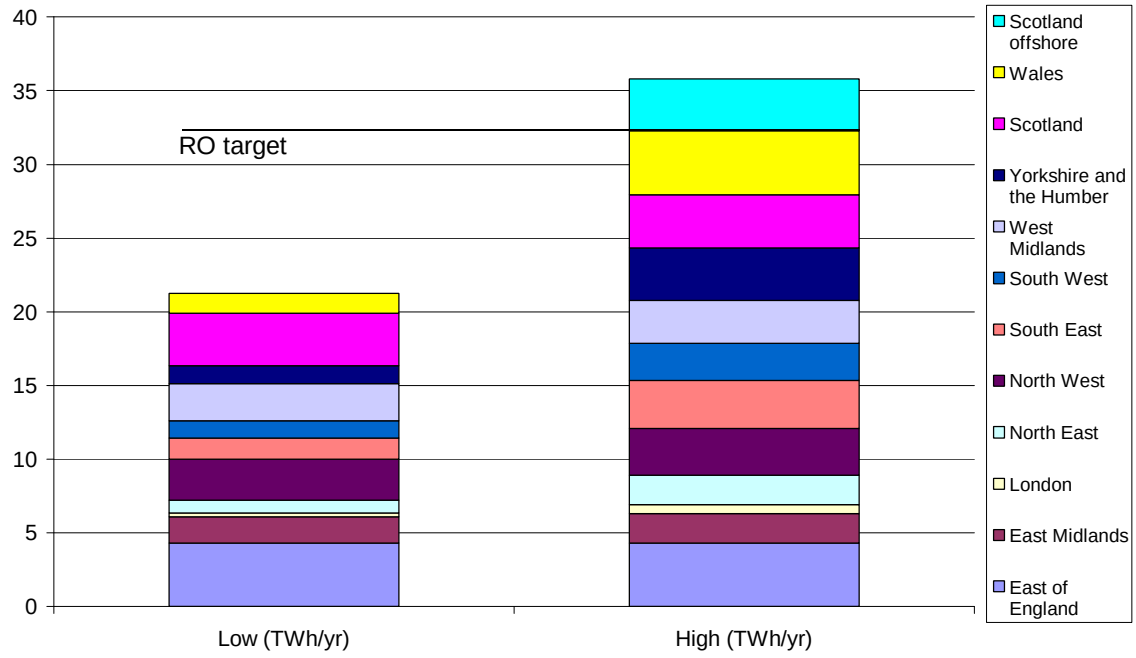
Source: The regional renewable energy assessments.

The proposed targets for renewable electricity generation sum to 21.3–32.3 TWh. The low figure is the sum of the lower end of the ranges presented as regional targets, and the high scenario is the aggregate of the top end of the ranges. A caveat applies here; the biodegradable fraction of energy from municipal solid waste and commercial and industrial waste only accounts towards the target if the plant uses advanced technologies. The low scenario includes only green waste, which is explicitly mentioned in the studies.

The high scenario assumes that all new build waste incineration uses new technology, so the biodegradable fraction (assumed to be 50% by weight) counts towards the RO target.

The data in Table 4.1 are shown graphically in Figure 4.1, where they can be compared against the RO target.

Figure 4.1: Comparison of regional targets and the RO target for 2010



Source: The regional renewable energy assessments.

The regional targets only satisfy the RO target when all the figures at the high end of the ranges are summed. The low scenario lies about 11 TWh short of the target. The largest contributions are made by Wales, East of England, Scotland and Yorkshire and the Humber.

4.3 Technology targets

The aggregation of regional targets by technology for low and high scenarios is shown in Table 4.2 and Figure 4.2. Offshore and onshore wind technologies account for more than half by output. In the high scenario, 12 TWh of onshore and 5 TWh of offshore wind would be supplied. Landfill gas and biomass would each roughly provide 15% of the total (4.8 TWh and 3.5–6.5 TWh respectively). Energy from biodegradable waste accounts for a modest 7% of the target under the high scenario. The amounts of marine technology (wave or tidal stream), anaerobic digestion and photovoltaics (PV) in the total are negligible.

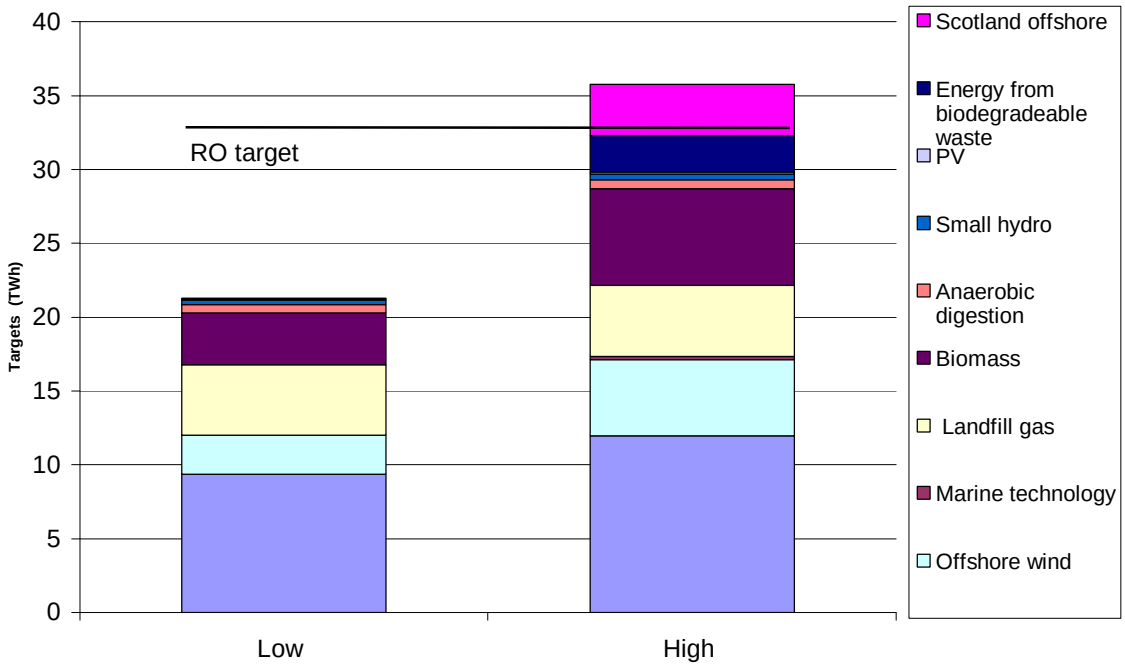
Table 4.2: Renewable electricity generation in 2010

	Low (MWe)	Low (TWh)	% of RO	High (MWe)	High (TWh)	% of RO
Onshore wind	3,563	9.4	29%	4,542	11.9	37%
Offshore wind	751	2.6	8%	1,483	5.2	16%
Marine technology	1	0.0	0%	72	0.2	1%
Landfill gas	608	4.8	15%	615	4.8	15%
Biomass	471	3.5	11%	874	6.5	20%
Anaerobic digestion	74	0.6	2%	87	0.6	2%
Small hydro	92	0.3	1%	111	0.4	1%
PV	35	0.1	0%	56	0.1	0%
Energy from biodegradable waste	4	0.0	0%	329	2.4	8%
Total	**5,598**	**21.3**	66%	**8,170**	**32.3**	100%
Scotland offshore[1]				1,000	3.5	

Notes: [1] This figure is not included in the regional assessments. It equates to 1GW of offshore wind capacity built in Scotland.

Source: The regional renewable energy assessments.

Figure 4.2: Comparison of technology targets and the UK target



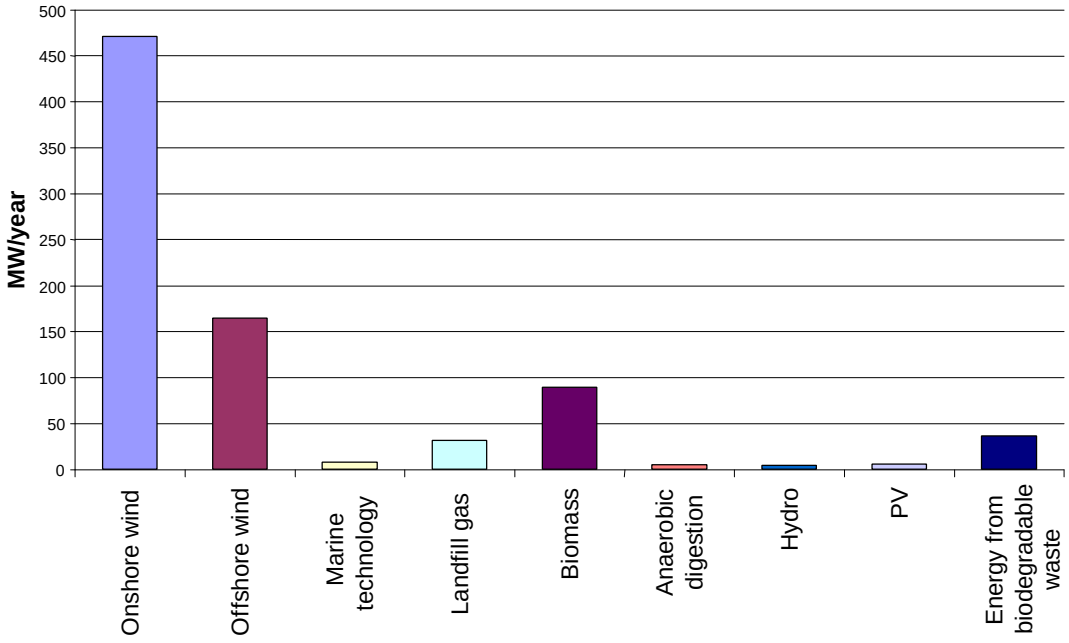
Source: The regional renewable energy assessments.

4.4 Annual rates of new build, by technology

The RO target requires a build rate of slightly less than 1,000 MW per annum over the nine-year period 2002–11. Assuming the technology mix suggested by the regional assessments under the high scenario, this number decomposes into 470MW/yr for onshore wind and 165 MW/yr for offshore wind, shown in Figure 4.3. These wind build

rates can be compared with recent rates of wind build in Continental Europe of 300–350 MW/yr in Germany and Denmark, 50 MW/yr in the Netherlands, and 400–700 MW/yr in Spain.[14] The biomass contribution translates into an average annual build rate of 90 MW/yr. Build rates for other technologies total about 100 MW/yr.

Figure 4.3: Annual build rates



Source: The regional renewable energy assessments.

4.5 Mix of technology by region

The mix of technology is determined by both economic and technical considerations. Wind energy generation is expected to be commercially viable, given the sale of Renewables Obligation Certificates (ROCs), which may have a value of about 3p/kWh, but is limited to suitable sites. Biomass energy is assumed to be of marginal economic viability, according to several regional energy assessments. In both cases, the resource that is available is greater in some regions than in others. Resource constraints limit the contribution of landfill gas and energy from biomass waste. Figure 4.4 shows the technology mix for each region.

[14] IEA (1999), 'Annual Wind Energy Report 1999'. Note that build rates have risen since these figures were compiled.

Figure 4.4. Technology mix by output for the high assessments

Note: Northern Ireland is included for ease of comparison.
Source: The regional renewable energy assessments.

There is wide variation in the technology mix across regions. With the exception of the North East and the East of England, the English regions have a target for wind energy that is below the RO average. The east coast is said to be particularly suitable for both offshore and onshore wind energy.[15] Landfill gas, energy from biodegradable waste and biomass constitute almost half the renewable energy supply in 2010, with particularly high proportions in South West and Yorkshire and the Humber. The South West is notable for its high contribution of biomass. The major share of renewable energy in Scotland and Wales is expected to come from wind energy, with relatively more being off the coast of Wales and more inland in Scotland. The target will require around 1,300 MW new onshore build in Scotland, and 574 MW onshore wind and 450 MW offshore wind in Wales. This translates into an annual build rate of around 50 MW/yr for all new wind build in Wales, and over 135 MW/yr in Scotland.

[15] See regional fact sheets in sections 5.10 and 5.11.

5. Regional Assessments

In this section, summaries of each regional assessment are presented. The assumptions behind the targets are noted, where details are known, and the regional circumstances that favour or disadvantage certain technologies are recorded.

The data have been taken directly from the regional reports and standardised to allow comparison between regions. The assessments are for total capacity—ie, existing and new build. Capacity is shown in MW, electricity generated in GWh/yr, and the target for each technology as a percentage of the total potential mentioned in each regional assessment. The capacity figures might not always correspond to the figures in the original because the load factors are harmonised and some studies only offer GWh or MW data. The total target ranges for each region are expressed as a percentage of the national target, as a percentage of forecast electricity supply in 2010, where the information is available, and as a percentage of the existing renewable energy capacity in the region. Furthermore, the target is compared to the 2000 percentage share of the region in the British landmass, population and GDP.[16]

Particular attention should be drawn to energy from biodegradable waste. Unless energy from green waste is explicitly categorised, it is assumed here that all extra incineration of mixed waste would use non-advanced technologies under the low scenario. On the contrary, under the high scenario, it is assumed that all new waste incineration capacity would use advanced technologies, so that the non-fossil-fuel component of mixed waste is eligible for the RO target. A standard assumption is made that 50% of the total mixed waste is biodegradable.

In section 6, the detailed assumptions behind the regional assessments are discussed.

[16] Office of National Statistics (2000 and 2001),*Regional Trends*, editions no. 35 and no. 36.

5.1 East of England

Table 5.1: East of England renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010	
	Capacity (MWe)	Electricity (GWh/yr)
Onshore wind	647	1,700
Offshore wind	371	1,300
Marine technologies	0	0
Landfill gas	76	600
Biomass	94	700
Anaerobic digestion	0	0
Small hydro	0	0
PV	0	0
Energy from biodegradable waste	0	0
Total RO	**1,188**	**4,300**
% of RO target	13%	
% of existing capacity	540%	
% of regional electricity supply	14%	

Source: Tony Hams, Neil Evans of ESD, and Derek Taylor of Global to Local Ltd (2001), 'Making Renewable Energy a Reality—Setting a Challenging Target for the Eastern Region'.

The East of England has set a challenging target for renewable energy generation in 2010. Not much information is given about the ease with which it could be reached. About 70% of the target is wind energy. The fact that the substantial amount of offshore wind energy is only a tiny fraction of the potential reflects the good conditions for offshore wind energy in that region. The onshore wind energy target is a large proportion of the resource available and is second only to Scotland's proposal. The energy from landfill gas is already operational and is expected to remain so. In order to reach the biomass target, 140,000 hectares would need to be set aside for energy crops. In total, the target constitutes 14% of the region's energy supply, or 11–12% of the national target, slightly above the region's share of national GDP, and more than five times the existing generation.

5.2 East Midlands

Table 5.2: East Midlands renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010			
	Low		High	
	Capacity (MWe)	Electricity (GWh/yr)	Capacity (MWe)	Electricity (GWh/yr)
Onshore wind	121	319	121	319
Offshore wind	100	350	100	350
Marine technologies	0	0	0	0
Landfill gas	56	438	56	438
Biomass	68	505	68	505
Anaerobic digestion	18	137	18	137
Small hydro	12	39	12	39
PV	5	14	5	14
Energy from biodegradable waste	0	0	25	189
Total RO	**380**	**1,802**	**406**	**1,991**
% of RO target		5%		5.9%
% of existing capacity		600%		660%
% of regional electricity supply		7.5%		8.3%

Source: Land Use Consultants and IT Power Ltd (2001), 'Viewpoints on Sustainable Energy in the East Midlands: A Study of Current Energy Projects and Future Prospects'.

The East Midlands is richly endowed with renewable energy resources, in particular offshore wind. If all the accessible resources were to be built, almost half of the regional electricity consumption could be supplied by renewable energy. The 111 km Lincolnshire coast is particularly suitable for wind energy. However, the modest target reflects the impact on coastal landscape setting, the difficulties in connecting to the grid, possible ecological impacts, and the uncertainty of planning approval. The accessible offshore wind resource has been calculated on the basis that all areas with 7 metres per second (m/s) average wind speed within 10 km offshore that do not interfere with military or commercial marine activities could be developed. The East Midlands is less suited to onshore wind development because it is one of the least windy regions in the UK. Nevertheless, a target of 122 MW is proposed, after exclusion of National Parks, green belts, AONBs, SSSIs and NNRs, and taking into account planning and network constraints. Although there is considerable biomass resource available, biomass energy generation is impeded by its commercial immaturity and impact on the landscape. The assessment identifies potential ecological and health hazards from anaerobic digestion and combustion plants, and the impact of road traffic. The discrepancy between the accessible resource and the target is greatest for PV, because of its very high cost. In terms of electricity generation, the largest contribution is expected to come from landfill gas, 438 GWh/yr, which is about 25% of the target. The East Midlands target represents a 600% increase in capacity, and compares to the average across all regions of 350%. The region's percentage contribution to the UK target, 5–6%, is slightly below its share of population, 6.8%, and its share of landmass, 6.2%.

5.3 London

Table 5.3: London renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010			
	Low		High	
	Capacity (MWe)	Electricity (GWh/yr)	Capacity (MWe)	Electricity (GWh/yr)
Onshore wind	8	22	8	22
Offshore wind	0	0	0	0
Marine technologies	0	0	0	0
Landfill gas	8	64	8	64
Biomass	4	30	11	80
Anaerobic digestion	12	87	12	87
Small hydro	2	5	2	5
PV	6	16	6	16
Energy from biodegradable waste	0	0	44	326
Total RO	**40**	**224**	**90**	**600**
% of RO target		1%		1.8%
% of existing capacity		140%		380%
% of regional electricity supply		0.7%		1.9%

Source: Government Office London and AEA Technology (2001), 'Development of a Renewable Energy Assessment and Targets for London', November.

The London contribution is uniquely low. It has few natural resources except plenty of waste. Not surprisingly, the greatest contribution could come from biodegradable waste using advanced technologies. Energy from biomass, including incineration and anaerobic digestion of sewage sludge, accounts for most of the remaining potential. This target is ambitious and depends on the deployment of about 15 new combustion plants. The existing landfill gas facility is expected to remain the sole plant. There is some scope for the recovery and combustion of arboricultural waste and civic amenity wood, although a substantial effort would be needed to establish the wood-to-energy infrastructure. Some commercial buildings may be able to install PV applications or wind turbines to provide for on-site electricity. Given the high expense, these schemes would be likely to occur only as prestige schemes, and the targets reflect the upper end of expectations. In total, 600 GWh/yr of renewable electricity could be supplied in Greater London, which is only a moderate increase on the existing capacity of waste incineration. The target reflects the small percentage share of the GB landmass and to the fact that it is a highly urbanised environment.

5.4 North East

Table 5.4: North East renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010			
	Low		High	
	Capacity (MWe)	Electricity (GWh/yr)	Capacity (MWe)	Electricity (GWh/yr)
Onshore wind	221	580	468	1,230
Offshore wind	3	10	3	10
Marine technologies	0	0	0	0
Landfill gas	20	157	20	157
Biomass	15	113	61	453
Anaerobic digestion	1	8	1	8
Small hydro	7	22	7	22
PV	1	1	2	4
Energy from biodegradable waste	0	0	20	150
Total RO	**267**	**891**	**581**	**2,034**
% of RO target		3%		6%
% of existing capacity		790%		1,800%
% of regional electricity supply		6%		13.7%

Source: Government Office for the North East and Chris Blandford Associates (2000), 'Proposed Targets for the Development of Renewable Energy in the North-East to 2010', October.

The North East renewable energy target is dominated by onshore wind energy, which contributes 65%. The usual assumptions are made: a minimum annual mean wind spread of 7 m/s at 45 m above ground, and the exclusion of developed and designated areas. The target range is produced by a variation of the minimum distance between wind farms of 7–15 km and the degree to which visual impact on the landscape character is taken as a constraint. Only one offshore scheme is foreseen, having excluded sites within 5 km distance of AONB and Heritage Coast and over 10 m seabed depth. The region appears to have relatively little existing biomass resource compared to other regions. Substantial new biomass would involve the introduction of energy crops. The wave energy and tidal stream opportunities are less than other parts of the UK coast, so no deployment is expected. In total, the target represents a modest contribution to the UK national target.

5.5 North West

Table 5.5: North West renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010			
	Low		High	
	Capacity (MWe)	Electricity (GWh/yr)	Capacity (MWe)	Electricity (GWh/yr)
Onshore wind	248	651	248	651
Offshore wind	171	600	171	600
Marine technologies	0	0	0	0
Landfill gas	75	588	75	588
Biomass	105	780	105	780
Anaerobic digestion	14	105	14	105
Small hydro	6	18	6	18
PV	10	26	10	26
Energy from biodegradable waste	1	7	51	383
Total RO	**629**	**2,775**	**679**	**3,151**
% of RO target		8%		9%
% of existing capacity		420%		480%
% of regional electricity supply		10%		11.5%

Source: Government Office for the North West and Environmental Resources Management (2001), 'Renewable Energy in North West England: Investigating the Potential and Developing the Targets', March.

The North West could provide a substantial fraction of the total RO target. Wind accounts for 40% of the proposed target. Although commercially viable under the, the relatively high onshore wind target presupposes a supportive planning environment. With annual mean wind speeds of 8–9 m/s, the North West has abundant offshore wind resources. Having limited indigenous wood and straw resource for combustion, the biomass target depends on the import of wood from other regions within a 40 km range, and on energy crops, assumed to be short-rotation coppice. The landfill contribution is based on current capacity and schemes awaiting development, but is expected to decline in the future. PV technology may contribute 1% of the target, despite its cost, but no tidal or wave energy is anticipated by 2010. The target slightly underperforms the region's share in population (12%) and GDP (10.5%), but exceeds its share in landmass (6.2%).

5.6 South East

Table 5.6: South East renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010			
	Low		High	
	Capacity (MWe)	Electricity (GWh/yr)	Capacity (MWe)	Electricity (GWh/yr)
Onshore wind	56	147	115	303
Offshore wind	46	160	183	640
Marine Technologies	0	0	0	0
Landfill Gas	108	848	108	848
Biomass	30	225	101	750
Anaerobic digestion	4	33	12	92
Small hydro	1	4	1	4
PV	1	2	5	12
Energy from biodegradable waste	2	13	82	613
Total RO	**248**	**1,432**	**607**	**3,262**
% of RO target		4%		10%
% of existing capacity		310%		710%
% of regional electricity supply		n/a		n/a

Note: Existing generation capacity is 73 MW, almost all of which is energy from waste; 59 MW of this is eligible under the RO.
Source: Government Office for the South East, ETSU/AEA Technology plc and Terence O'Rourke plc (2001), 'Development of a Renewable Energy Assessment and Targets for the South East: Final Report'. January.

The most striking feature of the proposed energy mix is the large contribution of energy from waste. More than 50% of the electricity in the low scenario is generated from landfill gas. In the high scenario, energy from landfill gas and from biodegradable waste using advance technologies could amount to about half of the total target. Renewable energy generation in the South East is highly waste-dependent because of the region's high population density and income, accounting for 14% and 16% of the British population and GDP, respectively.

Biomass, offshore and onshore wind energy provide the remaining capacity. The lower end of the biomass range represents a scenario in which little use is made of the available resources and no new energy crops are grown. Geological conditions and wind speeds are favoured for offshore wind, and the tidal range is low. However, development is constrained by the prevalence of coast designated as AONB, and, although there is little Heritage Coast, shipping is very active. Between one and four 50 MW wind farms are deemed possible offshore. There are onshore wind sites with greater than 7 m/s average wind speed, and are outside urban and designated areas. This gives a capacity of 4.5–50 MW. The higher end of the proposed range is only possible in a supportive planning environment.

Taking into account the fact that biomass is likely to be at least as expensive as offshore wind, the likelihood of the South East achieving its target depends on the development of wind farms.

5.7 South West

Table 5.7: South West renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010			
	Low		High	
	Capacity (MWe)	Electricity (GWh/yr)	Capacity (MWe)	Electricity (GWh/yr)
Onshore wind	149	390	273	716
Offshore wind	0	0	46	160
Marine technologies	0	1	34	90
Landfill gas	36	284	36	284
Biomass	55	413	141	1,050
Anaerobic digestion	8	58	8	58
Small hydro	8	25	11	34
PV	4	10	4	10
Energy from biodegradable waste	2	11	18	131
Total RO	**261**	**1,193**	**569**	**2,534**
% of RO target		4%		8%
% of existing capacity		360%		760%
% of regional electricity supply		n/a		n/a

Note: Existing capacity is 68 MW, of which 52 MW is already operational under NFFO schemes.
Source: Government Office for the South West and Terence O'Rourke plc (2001), 'Renewable Energy Assessments and Targets for the South West', February.

The South West target is notable for its reliance on biomass, which accounts for almost 50% of the target proposed. A further 30% is expected to come from onshore wind energy and 10% from landfill gas. The technology mix reflects the relatively low population density.

According to the assessment, the high biomass figure is despite the fact that the area is neither heavily wooded nor does it benefit from large resources of agricultural waste. The lower end of the target range represents solely energy from wood residues, whereas the top end involves new coppice and agricultural waste combustion schemes. The onshore wind energy minimum scenario identifies accessible areas with annual mean wind speeds greater than 7 m/s at 45 m above ground level, built outside buffer zones around nationally designated areas. A maximum density of 9 MW/km^2 and a minimum distance of 15 km between wind farm centres are also assumed. The higher end of the range comes from relaxing the planning constraints and the minimum distance between wind farms. Most of the schemes would be situated in Devon and Cornwall. A low capacity for offshore wind energy is foreseen because most of the coast is designated Heritage Coast or AONB. The most likely scheme is in the Bristol Channel and would probably connect to South Wales. The landfill gas target is mainly the sum of the proposed schemes already accepted under the NFFO. Some tidal barrage and stream energy is included in the high scenario; however, the deployment of these schemes might be on an experimental scale.

5.8 West Midlands

Table 5.8: West Midlands renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010			
	Low		High	
	Capacity (MWe)	Electricity (GWh/yr)	Capacity (MWe)	Electricity (GWh/yr)
Onshore wind	512	1,345	512	1,345
Offshore wind	0	0	0	0
Marine technologies	0	0	0	0
Landfill gas	111	877	111	877
Biomass	18	133	18	133
Anaerobic digestion	17	123	17	123
Small hydro	3	10	3	10
PV	4	11	4	11
Energy from biodegradable waste	0	0	53	392
Total RO	**665**	**2,499**	**717**	**2,891**
% of RO target		7%		9%
% of existing capacity		860%		1,000%
% of regional electricity supply		8.4%		9.7%

Note: There is 99 MW (792 GWh/yr) existing capacity, 35 (290 GWh) of which is eligible under the RO rules.
Source: Government Office for the West Midlands and Halcrow Group Ltd (2001), 'Renewable Energy Prospects for the West Midlands: Final Report', November.

The West Midlands contribution to the national target is predominantly from onshore wind and to a lesser extent from landfill gas. Together, these technologies would account for three-quarters of the West Midlands target, with onshore wind contributing around half. This is based on the usual constraints of an annual average wind speed of 7 m/s at 45 m above ground and the exclusion of all designated areas. Moreover, the calculation is based a qualitative land-use constraint. The large share of wind energy reflects the fact that it is likely to be the cheapest renewable energy technology. The contribution from landfill gas is constrained by considerations about the economic size of a site. There is moderate potential for biomass and biogas, reflecting the doubts about economic viability of biomass and biogas plants. Finally, very little solar and hydroelectricity would be provided because of the prohibitive cost in the former case and the limited number of economically viable sites in the latter case. The region's high target would be a substantial contribution to the RO, higher than its share of electricity supplied (7.4%) or landmass (5.7%). The total renewable electricity generation in 2010 would be 10 times current capacity.

5.9 Yorkshire and the Humber

Table 5.9: Yorkshire and the Humber renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010			
	Low		High	
	Capacity (MWe)	Electricity (GWh/yr)	Capacity (MWe)	Electricity (GWh/yr)
Onshore wind	82	215	305	800
Offshore wind	0	0	160	561
Marine technologies	0	0	0	0
Landfill gas	82	645	82	645
Biomass	47	348	177	1,316
Anaerobic digestion	0	0	1	7
Small hydro	0	1	1	3
PV	3	9	16	42
Energy from biodegradable waste	0	0	27	204
Total RO	**214**	**1,218**	**769**	**3,579**
% of RO target		4%		11%
% of existing capacity		260%		760%
% of regional electricity supply		n/a		n/a

Source: Summary table sent electronically by Les Saunders, Government Office Yorkshire and the Humber. Consultations based on summary table are currently ongoing. Full report to be published early 2002.

The high target for Yorkshire and the Humber builds mainly on wind energy (1,400 GWh/yr) and on energy from biomass (1,300 GWh/yr). Together these constitute 75% of the 3.5 TWh/yr target in the high scenario. In the low scenario, half of the target comes from landfill gas and the rest from onshore wind and biomass.

Under the high scenario, Yorkshire and the Humber would supply 11% of the RO in 2010, which is more than its share in landmass (6.2%), total population (9%) or GDP (8%).

5.10 Scotland

Table 5.10: Scotland renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010	
	Capacity (MWe)	**Electricity (GWh/yr)**
Onshore wind	1,272	3,343
Offshore wind	0	0
Marine technologies	0	0
Landfill gas	2	15
Biomass	10	73
Anaerobic digestion	0	0
Small hydro	49	158
PV	0	0
Energy from biodegradable waste	0	0
Total RO	**1,333**	**3,589**
% of RO target	11%	
% of existing capacity	900%	
% of regional electricity supply	6%	

Source: Estimates based on existing capacity and schemes commissioned under the Scottish Renewable Order. It is assumed that the 5% extra renewable energy generation would come from onshore wind only.

The Scottish contribution is among the highest, promising 11% of the total GB target. However, Scotland has a huge potential for renewable energy, especially for onshore and offshore wind energy, as recently reported by Garrad Hassan and Partners Ltd.[17] A relatively small fraction of the wind energy potential, amounting to only 1.3 GW capacity, would be developed in the next ten years. The report states that 1.5 GW can be developed at low cost. Apart from onshore wind energy, no other technologies are likely to be developed on a larger scale unless the Scottish Executive chooses a target greater than 18% of gross domestic consumption. The prominence of onshore wind reflects the advantageous natural circumstances and the low population density.

[17] Scottish Executive, and Garrad Hassan and Partners Ltd (2001).

5.11 Wales

Table 5.11: Wales renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010			
	Low		High	
	Capacity (MWe)	Electricity (GWh/yr)	Capacity (MWe)	Electricity (GWh/yr)
Onshore wind	248	651	573	1,507
Offshore wind	60	210	450	1,577
Marine technologies	0	0	38	100
Landfill gas	35	276	42	331
Biomass	25	186	90	670
Anaerobic digestion	0	2	4	31
Small hydro	5	16	20	65
PV	1	3	5	12
Energy from biodegradable waste	0	0	8	61
Total RO	**374**	**1,345**	**1,230**	**4,354**
% of RO target		4%		13%
% of existing capacity		260%		840%
% of regional electricity supply		n/a		n/a

Source: The National Assembly for Wales and Sustainable Energy Ltd (2001), 'The Potential for Renewable Energy in Wales'. National Assembly of Wales and AEA Technology (2000), 'Review of Strategic Study of Renewable Energy Resources in Wales', September.

Wales could deliver a substantial proportion of the RO target. Whether the higher end of the target range is reached depends almost entirely on the deployment of wind energy and biomass schemes. Wind energy accounts for up to two-thirds of the target, which reflects the region's strong natural endowment and its low population density. No offshore wind farms have been built yet in Wales, but an upper target of 450 MW has been set. The biomass target consists of small-scale combined heat and power schemes, using energy crops, agricultural waste and forestry waste. However it is uncertain how much will be built because its cost and the impact on rural areas have not yet been assessed. Landfill gas contributes a moderate amount of renewable electricity. Although a number of hydroelectricity schemes have been developed, there is still scope for small-scale hydro capacity of 5–20 MW. With special financial support, a tidal barrage scheme could be developed. The higher target is more than 13% of the RO target.

5.12 Northern Ireland

Table 5.12: Northern Ireland renewable energy assessment

Targets for renewable energy by type	Indicative target for 2010			
	Low		High	
	Capacity (MWe)	Electricity (GWh/yr)	Capacity (MWe)	Electricity (GWh/yr)
Onshore wind	97	254	97	254
Offshore wind[1]	126	441	126	441
Marine technologies	0	0	0	0
Landfill gas	15	117	15	117
Biomass	19	141	19	141
Anaerobic digestion	4	33	4	33
Small hydro	11	35	11	35
PV	0	0	0	0
Energy from biodegradable waste	0	0	10	74
Total RO	**271**	**1,021**	**281**	**1,095**
% of EU target		3%		3%
% of existing capacity		460%		690%
% of regional electricity supply		n/a		n/a

Note: [1] The figure is the lower end of the proposed range in the DETI consultation document.
Source: DETI (1999), 'Assessment of Offshore Wind Energy Resources in the Republic of Ireland and Northern Ireland'. Department of Economic Development Northern Ireland (1999), 'Renewable Energy in the Millennium, The Northern Ireland Potential', June.

Northern Ireland has a large offshore and onshore wind resource. Onshore wind is only effectively constrained by the amount of non-firm power the grid can accept, causing the target to be only a tiny fraction of the accessible resource. Offshore wind energy is even more plentiful. At a minimum distance of 5 km from the coast and a maximum seabed depth of 20 m, Northern Ireland has a practical offshore wind resource of 126–216 MW. It is not clear, however, whether much offshore development is planned or desired. Northern Ireland also has access to a considerable amount of hydroelectricity, about 5% of the total target. Biomass is more expensive than all other technologies apart from PV and marine technologies, but a large deployment of biomass is foreseen as a replacement for current low-yield grassland. Apart from economic considerations, it remains to be seen whether planning restrictions will hamper the development of biomass at the scale expected. Apart from the high current cost of wave power and tidal stream development, there are few suitable locations for either these or tidal barrage generation. Overall, Northern Ireland could make a substantial contribution towards the UK target, especially if the offshore potential is developed.

6. Assumptions

6.1 Planning

For those regions that produced a target range, the difference between the low and high ends of the range generally reflects **different assumptions about the planning regime**. For example, East of England's 'business-as-usual' scenario assumed continued constraints from the planning system, whereas its 'elevated-case' scenario assumed a more conducive regime with national and regional initiatives to promote renewables. The North West and South West distinguished between moderate planning support and a more supportive system.

In all the regional assessments, the base case assumes no**onshore wind** development within internationally or nationally designated areas. These include National Parks and AONBs and the equivalent National Scenic Areas in Scotland. They also include nature conservation areas such as Ramsar sites,[18] Special Protection Areas, Sites of Special Scientific Interest, and National Nature Reserves. The degree of protection to be afforded to such areas is a hotly debated aspect—PPG22 seeks a balance between the benefits of renewable energy and the need to take full account of the special features or qualities which justified designation. It advises that particular care should be taken in assessing proposals in such locations. PPG7, on the other hand, requires applications for major developments to be subject to the most rigorous examination, including an assessment of alternative locations.

The exceptions to this are in the high scenarios in the South East, North West and North East, where isolated examples of tightly controlled and small-scale wind generation are assumed within designated areas.

Restrictive designations generally relate to scenic and nature conservation attributes. However, the assessments in the South East and Scotland have also included green belt as an area to be avoided. green belt does not appear in the list of designated areas in PPG22 and the stakeholders consulted in this study could all envisage circumstances where a location in green belt would not be out of keeping with its purposes of maintaining separation between settlements. Indeed, the East Midlands assessment gives encouragement to the location of wind turbines on the edges of urban areas, particularly where brownfield land could be used. The main designated areas are shown in a map in Appendix 2.

The regional assessments also vary in the way they treat **offshore wind**. Most assessments assume no turbines within 5 km of the shore. A more lenient interpretation of this is contained in the North East study, which assumes this minimum distance, but only from designated areas, namely Heritage Coast and AONB; the Scottish study applies the

[18] Ramsar Convention, Ramsar, Iran, 1971.

same but includes nature conservation areas as well. In the Northern Ireland study, the distance restriction only applies to large schemes in the high scenario.

6.2 Resources

To be able to draw firm conclusions from the comparison of the regional reports, it is important to verify whether the assumptions made about resources are consistent.

6.2.1 Onshore wind

The onshore wind targets depend upon various assumptions made in the regional assessments. There is a base resource scenario, which varies between regional assessments. The region chosen to illustrate the base assumptions for onshore wind energy is the South East. In this case, the base assumptions were:

1. a minimum average wind speed of 7 m/s at 45 m above ground level;
2. maximum wind farm density of 9 MW/km;
3. a spacing of the centres of the wind farms of at least 7 km;
4. minimum wind farm size of three to eight 1.5 MW turbines, and a maximum size of 20 1.5 MW turbines;
5. no wind farms in nationally designated areas—National Parks, AONBs, NNR, SSSI, green belt areas;
6. buffer zones about 100 metres around roads, rivers, railways and canals, 400 m around towns and other settlements, and 6 km around airports.

These assumptions vary across the regional assessments.

Table 6.1: Summary of assumptions for onshore wind

Region	Assumptions mentioned
South East	1, 2, 3, 4, 5, 6
South West	1, 2, 3, 4, 5, 6
North East	1, 2, 3, 4, 5, 6
North West	1, 2, 3, 4, 5, 6
East Midlands	1, 5
West Midlands	1, 2, 5, 6
East of England	None
Yorkshire and Humber	Not available
London	Does not apply
Wales	1 (at 60 m height), 2 (7.5 MW/km^2), 5 and 6 (not explicit), areas further than 10 km from grid excluded
Northern Ireland	5
Scotland	5 (see below)

Source: The regional renewable energy assessments

It should be noted that, with the exception of Scotland, no studies take explicit account of Ministry of Defence restrictions. Only the Scottish, Welsh, West Midlands and Northern Irish studies make an explicit restriction for network availability. For Northern Ireland, the grid connection is included in the cost (see below).

The Scottish study provides a very detailed assessment of onshore wind energy development. To account for the impact on the network, connections limits on new generation were set so that no network reinforcement costs were implied. Furthermore, urban areas, inland waters, and areas where the slope of the seabed is greater than 15% were excluded, and a capacity limit of 150 kW/km^2 was set. Finally, ceilings for costs of 7p/kWh and 5p/kWh were tested. The conclusion was that everything from 1.5–3 GW capacity was feasible at a generation cost of less than 3p/kWh. In general, the addition of constraints was found to increase the cost , but did not reduce the likelihood of building 3 GW of onshore wind capacity.

6.2.2 Offshore wind

The assumptions for offshore wind are also uniform. A base-case scenario is as follows:

1. minimum annual mean wind speed of 8 m/s at 45 m above ground;
2. water depth less than 10 m;
3. no development along Heritage Coast or near to designated nature areas;
4. no development near ports, shipping lanes, military zones and pipelines;
5. minimum distance from shore of 5 km.

Table 6.2: Summary of assumptions for offshore wind

Region	Assumptions mentioned
South East	1, 2 (soft constraint), 3, 4
South West	2 (soft constraint), 3, 4
North East	2, 3, 4, 5
North West	1, 2, 4, 5
East Midlands	3, 4, 5 (10 km)
West Midlands	No resource
East of England	None
Yorkshire and Humber	Not available
London	No resource
Wales	2 (50 m), 3, 4, 5
Northern Ireland	1, 2 (20 m), 3, 4, 5
Scotland	1, 2 (30 m), 3, 4, 5

Source: The regional renewable energy assessments.

6.2.3 Biomass

There are two types of constraint applying to energy from biomass generation: the minimum capacity of the plant, and the availability of resource. Typical constraints are:

1. minimum economic scale of between 5 and 15 MW for coppice and more than 15 MW for forestry residues;
2. resource is extracted within 40 km of the plant;
3. 1 MW capacity is fuelled by 4,500 oven-dry tonnes per annum (odt/yr) of forestry residues, 4,600 odt/yr of short rotation coppice, 4,300 odt/yr of straw, 14,000 odt/yr of poultry litter, and 14,000 odt/yr of farm slurry;
4. no coppice plantation in moorland areas, statutory conservation areas, common land, Agricultural Land Capability classifications 1, 2, 3 and 5, urban, non-agricultural and

other land, land under Habitat Scheme agreements, land under Environmentally Sensitive Area agreements;
5. unlimited availability of capital grants support.

Table 6.3: Summary of assumptions for biomass

Region	Assumptions mentioned
South East	1, 2, 3, 4 (general)
South West	1, 2, 3, 4 (general)
North East	1, 2, 3, 4 (general)
North West	1, 2, 3
East Midlands	1 (10 MW size), 4 (general), 5 (implied)
West Midlands	4 (general), 5
East of England	None
Yorkshire and Humber	Not available
London	None
Wales	4, 5
Northern Ireland	4 and 5 general
Scotland	4 (tier 1 constraints)

Source: The regional renewable energy assessments.

The difference between the low and high scenarios of electricity from biomass targets depends on whether new amounts of short rotation coppice are developed by 2010. For the top end of the biomass range to materialise, about 300,000 extra hectares of coppice will be needed on the assumptions of 4,500 odt/MW and 10 odt/ha. The target for East England alone would demand about 140,000 hectares of coppice plantation. Wales would grow 40,000 ha and the other English regions between 10,000 and 20,000 ha.

6.2.4 Landfill gas

Landfill gas is the most established renewable energy resource so far. The key constraint are the EC waste directives, which rule that waste disposal to landfill should be reduced to 75% of its 1995 level by 2010.

6.2.5 Energy from biodegradeable waste

The English studies are based on an assumption that 15–40% of total municipal and solid arisings are civic amenity waste, and that 20–40% of civic amenity waste is suitable for thermal treatment. 4,500 tonnes per year is needed to fuel 1 MW capacity.

6.2.6 Other technologies

Most of the studies base their small-scale hydro assessment on the 1998 study of the University of Salford.[19] Key assumptions are that no new dams are built and that sites

[19] University of Salford (1989), 'Small-scale Hydro Generation Potential in the UK', ETSU, SSH-4063, Parts 1–3.

should have a minimum head greater than 2 m and a minimum installed capacity greater than 25 kW.

6.3 Costs

The technology mix in the regional targets seems to have been guided mainly by resource considerations. In Table 6.4, some indicative prices are listed. The cheapest renewable technology, landfill gas, is exploited to the maximum. The second-cheapest technology, wind energy, delivers half of the total target. There is no doubt that considerable amounts of wind energy can be generated at a competitive price under the RO. The more difficult question is whether energy from biomass, almost a quarter of the total, will be delivered in the quantities promised. The expected biomass price mentioned in several studies is close to or above the 5p/kWh limit of support from the RO, unless supplementary funding is available. The contribution of biomass to the 2010 target should be treated with caution.

The prices in Table 6.4 accepted in the NFFO auction are understood to be indicative of the costs used in the English assessments, although these did not state cost assumptions. These costs are broadly similar to those in the other three regions, although the Scottish figures seem to be slightly lower. Part of the reason is that the Scottish potential for renewable energy is large and, hence, the cost of the developments is cheap compared to other regions. Also, the Scottish prices are projections for 2010.

Table 6.4: Cost comparison across regions (p/kWh)

	DTI NFFO 4/5	Northern Ireland	Wales	Scotland
		(8% IRR)	(15% IRR)	(8% IRR)
Onshore wind	3.1–4.6	2.5–5.2	2.88–4.18	1.62–2.69
Offshore wind		3.2–6.8	5–6	3–4
Wave		14–23		3.1–4.4
Tidal		9–14		4–6
Energy from municipal waste	2.49–2.9	2.5–3		
Energy from industrial waste		3.5–4.5		
Landfill gas	2.9	3.3–3.7	2.71	2.15–2.4
Biomass	5.79	–	5.5–6	< 5
Forestry residues		4.1–6.3		
Coppice		4.5–7.5		
Sewage biogas		3–3.5		
Biogas from farm wastes	5.2	2.5–7.9		
Hydro	4.35	< 5	2.5–6	2–6.5
PV		> 6	£7,000/kWp	

Notes: Only three regions explicitly calculate these costs. Other regions mention NFFO5 costs or only refer to cost in a qualitative way.
Source: The regional renewable energy assessments.

7. Conclusions

7.1 Conclusions on the technology mix

The high targets proposed in the regional renewable energy assessments just satisfy the RO, and exceed it by 10% if 1 GW of offshore wind capacity in Scotland is included. In contrast, the low targets proposed are more than 34% short of the target, or 24% short if 1 GW of offshore wind capacity in Scotland is included.

However, there are important uncertainties attached to the regional targets. The likelihood of hitting the target depends on whether the economic, technological and planning assumptions turn out to be reasonable by 2010. It is uncertain by how much generation costs will fall over the next decade.

It is clear that if the rate of build of renewable energy capacity is limited by planning control, then the higher of the two regional targets will have to be delivered in order to achieve the national target. The distribution of the targets between regions seems to be fairly even relative to population, electricity supplied, and landmass, with the exception of Scotland, which makes a high contribution, and London, which makes almost no contribution. For both Scotland and London the attributes of the natural environment dictate the ability of the regions to contribute to the national target.

While is possible to reach the national target, the technology mix envisaged in the regional assessments may not be identical to the mix offered by the market. Consequently, it will be important that there is sufficient flexibility to revise targets and to compensate the 'deficit' of one technology (or possibly region) with the credit of another.

The major areas of uncertainty appear to be offshore wind and energy from biomass. The potential for offshore wind is huge and yet, apart from some specific regions such as Wales, the targets set are a small proportion of the resource. There are two possible explanations for this. First, it is not clear how commercially viable offshore wind will be by 2010. Since only one small offshore wind farm has been built in the UK, there are virtually no precedents. It remains to be seen whether offshore wind suppliers will be able to supply a large volume of output at the 5p/kWh benchmark price (ie, the market generation price plus the maximum ROC price). Second, many of the regional studies were completed before the Government announced its offshore wind grants and consenting policy.

The potential for biomass can be measured quite accurately. The main doubt about the feasibility of the biomass target stems from its uncertain economics. The current projections show that the 2010 electricity from biomass generation price straddles the 5p/kWh benchmark. If the biomass targets are not delivered or replaced by alternatives, there would be a deficit of around 15% that would need to be filled by other technologies, most probably wind energy. An urgent task is to form a better view of the likely economics of electricity from biomass generation by 2010.

In most of the studies, cost-to-customer and cost–benefit considerations have been given little consideration. Uncompetitive technologies will not be commercialised, no matter how vast the resource in the region. Apart from technology cost, generation costs are affected by local conditions. Hence, both the technological and regional mix depend to a

large extent on the actual costs of the different types of renewable electricity generation. Identifying areas of search and reporting the performance of prototypes could provide developers with crucial information.

If either offshore wind or biomass electricity generation prove uncompetitive, a massive deployment of onshore wind would be needed to meet the target. Meanwhile, onshore wind is mainly constrained by planning concerns, especially for large-scale wind farms.

7.2 Recommended improvements to the planning system

Most of the regional assessments contain suggestions for improving the workings of the planning system. There appears to be a reasonable degree of consensus that the production of regional targets is a useful starting point, but further work is needed to ensure that they are translated into effective action on the ground.

An update of **PPG22** is necessary to provide a more positive basis for development control decisions. NPPG6 in Scotland is a helpful guide here, issued in 2000 and containing an explanation of the objectives and benefits of increasing renewable energy, so that there is better understanding of the global and local benefits to be balanced against any local environmental and amenity disbenefits in determining individual applications. A consultation draft of the PPG22 Annex on PV was issued in October 2001 to begin this updating process.[20] Further elements are expected to be ready for consultation in spring 2002. In Wales, the general policy context for renewable energy will be updated in Planning Policy Wales to be finalised in early 2002, but updating the detail will await a revision of TAN November 8th 1996. There is currently no equivalent Planning Policy Statement in Northern Ireland.

Consideration also needs to be given to the status of any **sub-regional targets** that may be brought forward. Most of the English regional assessments (East Midlands, North East, North West, South East and East of England) contain such targets for counties and groupings of unitary areas. It is assumed that these will be included in the next round of structure plans and UDPs in these regions. At present, local authorities are only required by PPG22 to 'consider' the contribution their area can make in meeting objectives on a local, regional and national basis. This could be rephrased as a duty to seek to meet the specified target. Taken a stage further, renewable energy targets could be given a similar status to brownfield housing targets (ie, aspirational, backed by the equivalent of urban capacity studies at district level). Similarly, consideration could be given to introducing another sequential test in favour of renewable energy on brownfield land (support for this idea is given in the North East regional assessment).

In terms of **development plans**, there is already reasonably high coverage of renewables in general policies. Both the recent Local Government Association survey[21] and the

[20] DTLR (2001), 'Photovoltaics (PV): Annex to PPG 22', consultation revised draft, October.
[21] Local Government Association (2001), 'Onshore Wind Energy: Preliminary Analysis', unpublished, October.

regional assessments carried out by Terence O'Rourke plc found that 75% of adopted structure, local plans and UDPs within their sample areas contained general renewable energy policies.

It may now be time to add more technology-specific policies to development plans. The Local Government Association survey[22] found that only 37% of those surveyed had specific policies on wind energy. Terence O'Rourke plc found that 60% of those surveyed had technology-specific policies—generally wind and energy from waste. The inclusion of such policies might be accelerated by the publication of good-practice guidance on policies for each technology to supplement any consideration in an updated PPG22.

In terms of **identifying areas of search**, only 6% of local plans in the Local Government Association survey identified areas suitable for wind energy. Further work may be beneficial here. There is potential for partnership working between local authorities and the national environmental agencies, particularly the Countryside Agency. Several regional assessments suggest that any identification of areas of search should be done within the framework of a countryside character-area approach. Inter-agency pilot studies are planned in the East of England and East Midlands to test this. Based on this and other work in northern England, it is recommended in the PIU report[23] that part of the £2.5 million allocated to improve the planning system could be used to assemble good-practice guidance on the development of standard methodologies for identifying areas of search for different technologies. This could help to counter the scepticism reflected by some representatives at the workshops about the lack of technical experience and current lack of political support for identifying areas of search.

There is undoubtedly a role for the greater use of **supplementary planning guidance** on renewable energy. Cumbria County Council on wind energy development produced one of the few current examples as early as 1997.[24] This uses a landscape assessment method to categorise the ability of different areas to accommodate wind turbines based on how easily such vertical elements can fit within different types of topography. Clear maps are included, showing areas that might accommodate a domestic-scale turbine, a small cluster, or up to a wind farm, and those areas where any development is likely to be significantly adverse. A more recent example is from Newark and Sherwood District Council, which provides useful contextual information on average wind speed across the district and the other factors affecting viability, together with development control guidance. Encouragement is given for wind turbines proposed in association with employment development.

[22] Postal questionnaire survey carried out in September 2001 in 28 local authorities grouped largely in four county areas.
[23] Cabinet Office Performance and Innovation Unit (2001), 'Renewable Energy in the UK—Building for the Future of the Environment', November.
[24] Cumbria County Council (1997), 'Wind Energy Development in Cumbria', July.

In addition to the planning system taking a more enabling role, it is important that other initiatives identified in the regional assessments are carried forward (eg, the proposed preparation of a regional energy strategy and the formation of an energy agency in the East Midlands region). There is a demand for educational initiatives to raise the awareness of local authority members, officers and the general public of the objectives of the national drive towards renewable energy generation. This message came across clearly at the workshops. The stakeholder consultation exercises conducted in the preparation of the regional assessments have clearly contributed to this process, but there is a need for continuing effort here by government, operators and environment groups.

Appendix 1: The UK target

For the purpose of this report, the definition of renewable energy is renewable electricity generation eligible under the RO. Separate from the RO, the UK government has a non-binding commitment under the EC directive on the promotion of electricity produced from renewable energy sources.[25] This UK target is a firm political intention. The RO should enable the UK to fulfil this intention.

The UK indicative target, under the EC directive, will be 10% of gross domestic energy consumption—ie, domestic production plus imports minus exports in 2010, which amounts to 38 TWh in 2010[26].

There are three essential differences between the eligibility criteria of the RO and the EC directive:

- large hydro counts towards the EC target;
- the non-fossil-fuel part of mixed waste incineration using non-advanced technologies is eligible;
- renewable electricity of Northern Ireland is part of the UK total.

Table A1.1 shows that the UK would satisfy the EC directive, provided the RO is met.

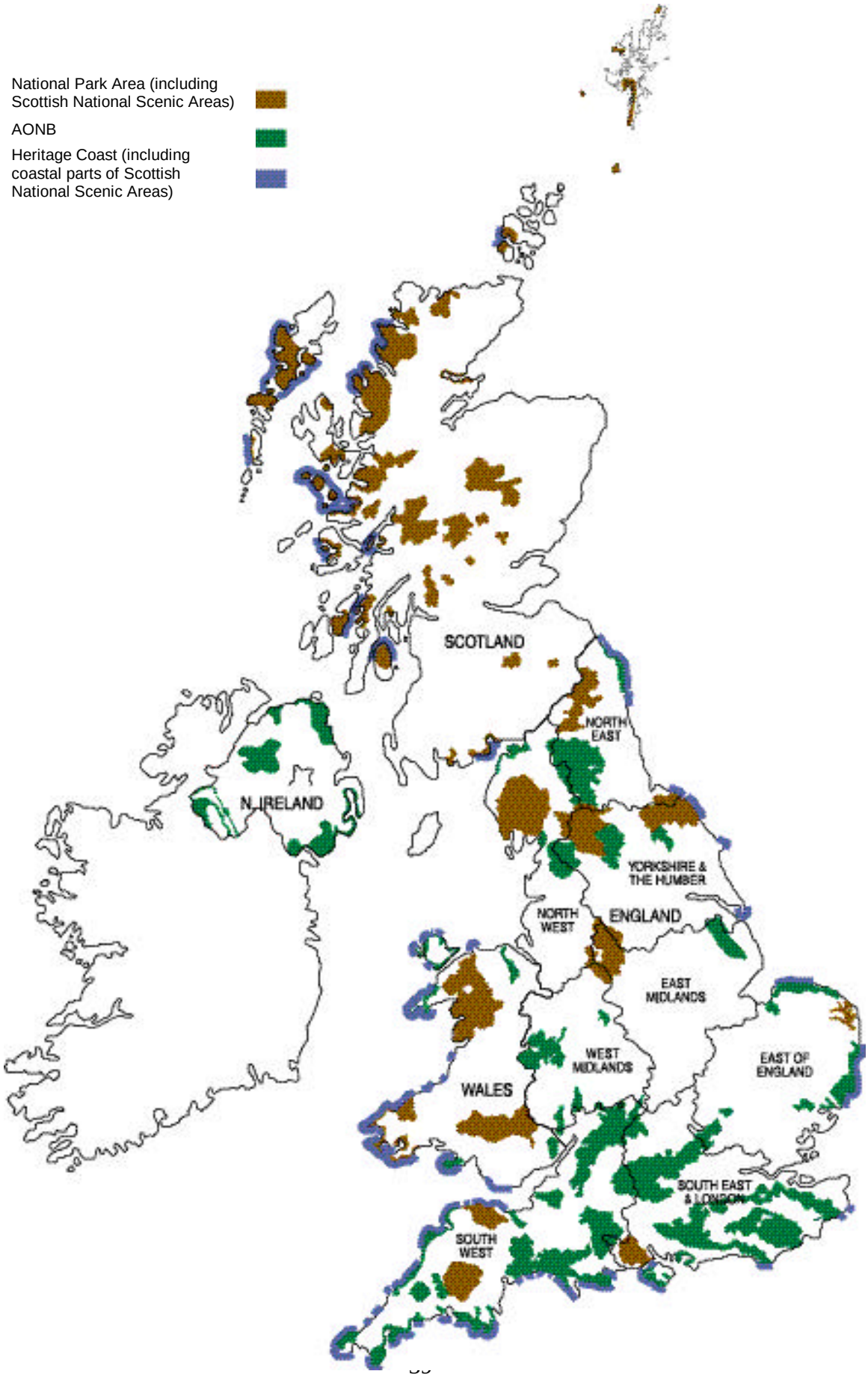
Table A1.1: Assessment of UK target under the EC directive

	Low (TWh/yr)	% of target	High (TWh/yr)	% of target
Total RO	21.3	56%	32.3	85%
Northern Ireland contribution	1.0	3%	1.1	3%
Large hydro	5.2	14%	5.2	14%
Biodegradable fraction of existing waste combustion plants	2.2	6%	0.5	1%
Total EU	**29.7**	**78%**	**39.1**	**103%**

[25] Directive 2001/77/EC of the European Parliament and of the Council of September 27th 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market.

[26] 1 terawatt-hour (TWh) is 1,000m kilowatt-hours (kWh). 1 gigawatt-hour (GWh) is 1m kilowatt-hours (kWh). DTI (2000), 'Energy Projections for the UK: Energy Use and Energy-related Emissions or Carbon Dioxide in the UK 2000–2020: Energy Paper 68', December.

Appendix 2: Designated areas in the UK



Appendix 3: Stakeholder views on the planning system

Two stakeholder workshops were held on Wednesday October 31st. The following were among the points made by delegates about the planning process, and are their own views.

- There is widespread consensus that PPG22 needs revision.
- Fine-tuning the planning system will not itself solve the inherent tension in planning concerning the balance of different public interests. Renewable energy generation proposals may bring global benefits and local nuisances that have to be weighed together. That difficult balance is tackled on a case-by-case basis in the British discretionary planning system.
- Public education via showcase projects might help to increase public acceptance of renewable energy.
- The public should be better informed. The global benefits should be stressed, and detailed in PPG22. There is a role for environmental organisations to raise consumer interest in renewable energy.
- Should developers look for schemes and seek planning permission, or should planners propose locations and seek developers for the area?
- Certainty will help to increase the rate of development of renewable energy. The current process can be lengthy, bureaucratic and centralised. A positive and focused approach is needed. The reputation of an area can play an important role in attracting or dissuading investment.
- Regional targets (for example, in RPGs) can provide a structure for developers, planners and the public. Sub-regional targets can help too, but just having them might not be enough. Strategy and guidance is needed.
- Nationally and internationally designated nature conservation areas are not suitable locations for renewable energy.
- Operators take a risk if they apply for planning permission in National Parks, AONBs and the Scottish National Scenic Areas. Most are deterred from applying. In some cases, proposals around the fringes of these areas but highly visible from them may be worse environmentally than developments in enclosed locations within them. Landscape character assessment is an important tool.
- Green belts should not be seen as an automatic restraint. In particular, biomass generation could be acceptable, with combustion plants located at the urban edge to limit visual and traffic impact. Brownfield sites should be preferred if they are in suitable locations.
- There is some resistance from environmental groups against tidal ranges and tidal barrages, as these could damage marine ecosystems.

It is felt that, in the preparation of the regional assessments, there was sufficient consultation at the local level, although the consultation did not filter down below the district level.

Some of the regional assessments summarised points made by participants in the planning process and by other stakeholders. A selection of those comments relating to the operation of the planning system is listed below.

Among the issues raised by Local Authorities were:

- conflicting emphasis of local, regional and national policies and statutory and non-statutory advice;
- lack of identified target areas for renewable energy development;
- little integration yet into main infrastructure plans;
- uncertainty over decisions being called in for adjudication at a higher level;
- usefulness of scenario modelling for renewable energy at a regional level;
- central government assistance through revision of building regulations for solar panels.

Among the issues raised by developers were:

- need for consistency in planning decisions;
- lack of strategic planning for renewable energy;

- the volume of information to be prepared for the planning application;
- the length of time taken to determine applications, which is sometimes over a year;
- under-resourcing of Local Authorities leading to low efficiency and long timescales in processing applications;
- limited awareness of national policy objectives, such as climate change policy, by Local Authority planner and council members;
- lack of strategic or regional targets for renewable energy;
- lack of use of the policy of 'presumption in favour'.

Others stakeholders made broadly similar suggestions.

Appendix 4: Acknowledgements

The contribution of the following delegates to the workshop is gratefully acknowledged.

Nick Goodall	Chief Executive	British Wind Energy Association
Tim Horwood	Principal Planner	Cornwall County Council
Paul Pinnington	Energy Crops Scheme Manager	DEFRA
Rod Robson	Office Manager of Energy Division	Department of Enterprise, Trade and Investment
Joe Finnegan	Energy and Environment Group	Electricity Association
Martin Williams	Higher Executive Officer of Steel and Energy Branch	National Assembly for Wales
Andrew Hiorns	Transmission Planning Manager	National Grid Company
Nick Starkey	Alternative Crop Uses Advisor	National Farmers' Union
Roger Higman	Senior Campaigner	Friends of the Earth
Marcus Beddoe	Policy Officer	Local Government Association
Debbie Worley	Planning Officer	Newark and Sherwood District Council
Mark Crawford	Transport and Energy Policy Officer	Royal Society for the Protection of Birds
Robert Shaw	Policy Officer	Town and Country Planning Association
Danny Chivers	Forum for the Future Scholar	Town and Country Planning Association

The helpful input of the following additional individual is gratefully acknowledged.

Helen McKay	Senior Policy Advisor	Forestry Commission

Appendix 5: Bibliography

Regional Renewable Energy Assessments

Department of Economic Development Northern Ireland (1999), 'Renewable Energy in the Millennium, The Northern Ireland Potential', June.

DETI (1999/2000), 'Assessment of Offshore Wind Energy Resources in the Republic of Ireland and Northern Ireland'.

DETI (2001), 'Renewable Energy in Northern Ireland, Realising the Potential' (consultation document), http://www.detini.gov.uk./cgi-bin/thinframe?url=/energy

Government Office for the North East, and Chris Blandford Associates (2000), 'Proposed Targets for the Development of Renewable Energy in the North-East to 2010', October.

Government Office for the South East, and ETSU/AEA Technology plc and Terence O'Rourke plc (2001), 'Development of a Renewable Energy Assessment and Targets for the South East: Final Report', January.

Government Office for the South West, and Terence O'Rourke plc (2001), 'Renewable Energy Assessments and Targets for the South West', February.

Government Office for the West Midlands, and Halcrow Group Ltd (2001), 'Renewable Energy Prospects for the West Midlands: Final Report', November.

Government Office London, and AEA Technology (2001), 'Development of a Renewable Energy Assessment and Targets for London. November 2001' (forthcoming).

Government Offices North West, and ERM (2001), 'Renewable Energy in North West England: Investigating the Potential and Developing the Targets', March.

Land Use Consultants and IT Power Ltd (2001), 'Viewpoints on Sustainable Energy in the East Midlands: A Study of Current Energy Projects and Future Prospects', March.

National Assembly of Wales, and AEA Technology (2001), 'Review of Strategic Study of Renewable Energy Resources in Wales', September.

Scottish Executive, and Garrad Hassan and Partners Ltd (2001), 'Renewable Energy Study—Volume I: The Analysis, and Volume 2: The Context', November.

The National Assembly for Wales, and Sustainable Energy Ltd (2001), 'The Potential for Renewable Energy in Wales'.

Tony Hams, Neil Evans of ESD, & Derek Taylor of Global to Local Ltd (2001), 'Making Renewable Energy a Reality—Setting a Challenging Target for the Eastern Region'.

Background documents

DTI (2000), 'Energy Projections for the UK: Energy Use and Energy-related Emissions or Carbon Dioxide in the UK 2000–2020: Energy Paper 68', December.

DTI (2001) 'New and Renewable Energy: Prospects for the 21st Century: The Renewables Obligation Statutory Consultation'.

DTI and ETSU (1999), 'New and Renewable Energy: Prospects in the UK for the 21st Century: Supporting Analysis', March.

European Commission (2001), Directive 2001/77/EC of the European Parliament and of the Council of September 27th 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market, September.

HM Government (2000), Utilities Act 2000.

HM Government (2001), 'Draft Statutory Instruments: The Renewables Obligation Order 2001', August.

HM Government (2001), 'Renewable Energy in the UK—Building for the Future of the Environment', November.

Scottish Executive (2001), 'The Renewables Obligation (Scotland) Order 2001' (draft), http://www.scotland.gov.uk/who/elld/_forms/ROS_Order_2001.doc.

Scottish Executive (2001), 'The Renewables Obligation (Scotland): Consultation Paper', http://www.scotland.gov.uk/who/elld/_forms/ROS_Final_condoc.doc.