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Government Office for the West Midlands

Renewable Energy Prospects for the West Midlands

Final Report

Halcrow Group Ltd

November 2001

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Renewable Energy Prospects for the West Midlands
Final Report

Contents Amendment Record

This report has been issued and amended as follows

Issue	Revision	Description	Date	Signed
1.0	Final	Renewable Energy Prospects for the West Midlands Final Report	02/03/01	
2.0	Revised Final	Revised final report incorporating additional assessment of wind resource and sub-regional assessments	05/11/01	

Contents

Executive Summary

Aims

The Government published its policy for renewable energy in February 2000 following an extensive consultation exercise. The main objective of this policy is to increase the contribution of electricity supplied by renewables from the current 3%, to 5% by the end of 2003 and to 10% by 2010. This is to be achieved only if the costs to consumers are considered to be acceptable.

In order to understand how this increase in renewable generating capacity may be achieved, the Government Offices for the Regions have been asked to undertake regional resource assessments. These assessments have the key aim of illustrating how the region may contribute toward the national targets. This report covers the West Midlands Region, and includes the counties of Staffordshire, Shropshire, Herefordshire, Worcestershire, Warwickshire and the West Midlands Conurbation.

Whilst the term 'renewable energy' can be defined as all those sources of energy that are continuously and sustainably available in the environment, it must be emphasised that this study is only concerned with those resources that have the potential to generate electricity.

Resources

The physical nature of the region dictates which renewable energy technologies will be suitable for electricity generation. Thus, in the West Midlands, technologies that tap the significant energy resource at sea (tidal, wave and offshore winds) are not appropriate. In addition, the geological structure of the region is such that temperatures are not sufficiently elevated near to the surface to allow the use of geothermal heat. Whilst parts of the Region do have significant rainfall totals, the landscape is generally low lying, and thus not particularly suited to large-scale hydro electric development.

Development will therefore be limited to those technologies that utilise wind, biomass (including energy crops and wastes), solar energy and running water.

The theoretically available resource from these technologies is extremely large, at about nine times the current electricity consumption. However the development of this resource can be expected to be limited to projects that are economically viable, which gain the necessary development consents, and have the support of the host community.

Planning

At present in the development plan process there is a distinct lack of specific guidance at all levels Whilst some plan policies generally encourage the use of renewables, these tend to be too vague, non technology specific, and lacking in locational guidance Regional Planning Guidance could have a vital role in communicating the relevant technical and planning issues down to all levels and to ensure that these are accurately and comprehensively incorporated into plans under development.

Conclusions

Currently 3% of the region's electricity consumption is generated from renewable energy, primarily from energy from waste resources Whilst there is the potential for the region to treble this figure from sites that are probably commercially viable and generally environmentally acceptable, this would be extremely challenging to achieve in the next decade – particularly as a large proportion of this total resource would have to come from wind developments The commercial and regulatory environment for investment in renewable energy generation is being set by Government initiatives including the Climate Change Levy, the Renewable Energy Obligation and New Electricity Trading Arrangements It is not certain that these will provide sufficient stimulation. They will in any case need to be complemented by a sea change in the support offered to renewable energy from the public and government at all levels

On present indications and without additional support, only projects of existing types mainly in the energy from waste sector may actually be delivered by 2010 and these could generate around 5% of the Region's electricity consumption.

This report provides the data which enables local authorities to identify resources in their areas and review their policies and guidance accordingly

The analysis assumes a continuing, modest growth in demand for electricity It must be noted that the impact of this electricity demand growth is that significant new generation capacity will be required over the next decade just to maintain the existing percentage of supply from renewables in the region

The potential for renewable energy and energy efficiency improvements for heat and transport applications to ameliorate the environmental impact of energy usage should not be overlooked

Recommendations

- Specific policies and guidance on the exploitation of renewable energy resources should be included in all strategic and local plans This study has shown that renewable energy is an issue for all authorities, whether urban or rural, as development throughout the Region of all technologies will be required if the environmental benefits are to be realised

- Regional activities should assist central government in continuing to support renewable energy development through mechanisms such as the proposed Renewables Obligation and by forms of subsidy where appropriate. The importance of pre-commercial developments cannot be stressed enough as they have a vital role in building market and public confidence in change. Additionally, long term stability in support mechanisms is required to enable commercial projects to raise finance from any source.

- Small scale projects face particular financial barriers to development under the anticipated market conditions. However, this type of project can be valuable in raising awareness of many types of technologies at a local scale, and can stimulate community involvement in sustainable development. Specific support measures should be developed that recognise these important roles.

- The electricity distribution network needs to be developed to recognise that in future it will have to be operated in a way that allows for the benefits of embedded generation to be delivered. Reinforcement of lines and other transmission equipment will be required to enable many renewable generators to be connected.

- The time frame of the development of many renewable energy technology projects can be up to 5 - 6 years. Thus, action and support is required immediately if the 2010 targets are to be met, let alone the 2003 targets.

- Many renewable energy resources are well suited to the direct delivery of heat to domestic, commercial and industrial applications. To the extent that they substitute for electrically generated heat, they could be argued to contribute directly to the 2010 target. They could also substitute for other fossil fuel combustion and help combat global warming in that way. Therefore, it is recommended that regional assessments are also carried out to research the potential of these resources and of vigorous energy efficiency measures to meet the UK's climate change and sustainability objectives.

1 Introduction

1.1 Content

The Government Offices for the Regions have been asked by Central Government to prepare regional assessments to determine the extent to which the Regions could contribute to national targets for renewable energy development. This report, for the Government Office for the West Midlands, identifies the potential for renewable energy in the Region and shows how the West Midlands can contribute towards these national targets

1.2 Context

The Government published it's new policy for renewable energy in February 2000 [DTI, 2000a] The main objective of this policy is to increase the contribution of electricity supplied from renewables to 5% by the end of 2003 and 10% in 2010, subject to the costs to the consumer being acceptable In order to achieve this target, the Government has introduced four key initiatives

(i) The Renewables Obligation
The Utilities Act 2000 provides powers for an obligation on all electricity suppliers to provide an increasing proportion of their electricity from renewable sources. The Renewables Obligation will succeed the Non Fossil Fuel Obligation (NFFO)

(ii) The Climate Change Levy
A Levy on electricity sales came into effect in April 2001 as part of the UK's Climate Change Programme With the exception of large-scale hydro, electricity produced from renewables will be exempt from this Levy

(iii) R&D Support
The budget for research and development of renewable technologies has been increased.

(iv) Regional Planning and Targets
Regional strategies for renewable energy are being developed and these will be incorporated into Regional Planning Guidance

This study forms part of the 4th element – a regional planning strategy for harnessing the renewable energy resource In its' policy document the Government notes that:

"The planning system has an important role in helping to deliver the Government's targets and goals for renewable energy and climate change, which are central to achieving sustainable development, while continuing to protect the countryside A positive, strategic approach to planning for renewable energy is essential There needs to be an open and constructive dialogue between prospective operators, planning authorities and local people about identifying suitable sites with sensitivity and care."

Current planning guidance [DETR, 1993] notes that " The Government's policies for developing renewable energy sources must be weighed carefully with its continuing commitment to policies for protecting the environment." There will inevitably be conflicts of interest here and this has been evident, to date, with a relatively poor rate of success for developers in obtaining planning permission for renewable energy projects This was not addressed under the previous Non-Fossil Fuel Obligation and is critical if the Government is to meet its targets for renewable energy provision

Subsequent to the publication of the new renewable energy policy, the Minister for Housing and Planning, Mr Raynsford addressed the issue of regional strategies in Parliament In his speech [DETR, 2000a] Mr Raynsford linked the Government's policy for renewable energy to the development of Regional Sustainable Development Frameworks Guidance on preparing Regional Sustainable Development Frameworks was published in February [DETR, 2000b] and the Government anticipates that the Frameworks will draw on these renewable energy assessments The initial Framework for the West Midlands has already been published, stating that "renewable energy generation must be increased in the Region" Any update to this Framework is likely to be more specific Mr Raynsford also highlighted how the studies will be used to inform a review of Regional Planning Guidance

" we envisage RPG [Regional Planning Guidance] taking forward in land use terms a region's strategy for delivering renewable energy targets by defining broad locations for renewable energy development and setting criteria to help local authorities select suitable sites to set targets in RPG, where sensible to do so

This sets the context for this study Mr Raynsford then continued to outline his vision for renewable energy development with a cautionary note concerning public participation

"More positive planning at regional and local levels will contribute to greater familiarity with, and acceptance of, prospective renewable energy developments It remains important, however, for operators to prepare the ground with local authorities, environmental organisations and local people before formal planning applications are submitted and to develop proposals in consultation with them "

1.3 Purpose and Scope

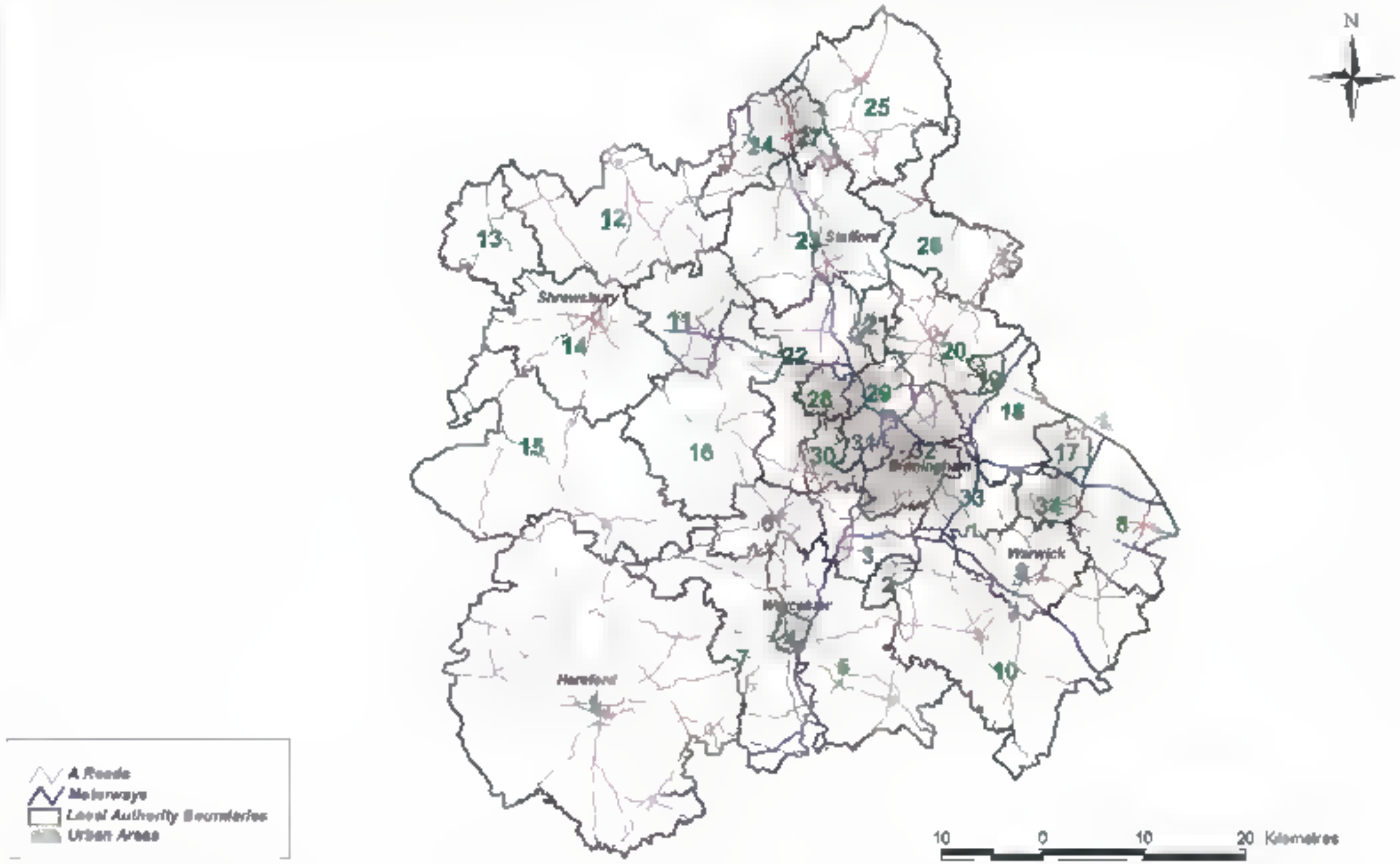
In light of the national policy, outlined above, the purpose of this study is to

- establish the extent to which the West Midlands Region can contribute towards the national target of achieving 10% of the electricity supply from renewables,
- inform a review of the Regional Planning Guidance

The West Midlands Region is shown in Figure 1 1

The scope of the study was further clarified and agreed with the Government Office for the West Midlands as follows

Firstly, the study will consider all renewable energy technologies considered as appropriate or viable in the West Midlands Region. There are a wide range of technologies available for generating electricity from renewable sources and these are described in some detail in the Supporting Analysis [DTI, 2000c], accompanying the Government's policy document While marine technologies (offshore wind, tidal barrage, tidal stream and wave) are obviously not an option for the West Midlands, the scope for electricity generation is still considerable (a brief synopsis of the different technologies is provided in Chapter 3) In some instances dual fuelling may be applied, whereby a renewable source is used in conjunction with a fossil fuel for a particular generator This relates mainly to biomass, for example the use of natural gas in conjunction with landfill gas or two separate furnaces for say coal and straw to feed the same steam turbine While such cases may improve the economics of a project in specific instances, they are not common in the UK and do not affect our calculation of the renewable energy resource on a regional level



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The West Midlands Region

Figure 1.1

Secondly, in line with the Government's target to generate 10% of electricity from renewable sources, this study will not examine the potential for providing thermal energy. It is perhaps pertinent to note here that electricity use only accounts for 15% of final energy demand and that the scope for producing thermal energy from renewable sources is considerable. Within the European Union, targets for both electricity generation (12%) and primary energy supply (22%) have been set. In the UK renewable energy use accounted for 2.8% of electricity supply but only 1.7% of primary energy demand in 1999.

Thirdly, while the importance of energy efficiency and energy conservation is equally important to the Government's aim to reduce CO_2 emissions, they are a large subject in themselves and are not the subject of our investigations here. A brief comment is made in Chapter 2 concerning the projected increase in electricity consumption over the next 10 years and the implications of this for target setting. Since energy efficiency and energy conservation will influence the total electricity demand there is a link between these and the targets for renewable electricity generation.

Finally, it is important to bear in mind that this resource assessment is being conducted across a large and diverse area and so a level of analysis appropriate to a regional study has been assumed. This entails using a number of broad assumptions when identifying suitable areas for development. This does not preclude development outside these areas and individual sites will have to be considered on their merits. Whilst a level of sub-regional assessment is provided (in Appendix D), the assumptions and level of detail remains the same as for the regional level assessment. Additionally, even within broad areas identified as suitable for development, local factors will need to be taken into account. The methodology applied is set out in 1.4 below.

1.4 Methodology

This study builds on previous resource assessments such as those carried out for Shropshire [1998a] and the Manweb distribution area [ETSU, 1994a], but represents the first analysis of the renewable energy resource on a regional level. Where appropriate data from previous studies has been used. However, due to recent developments in technology and the rapidly changing commercial regulatory and planning policy framework many of the original assumptions have had to be revisited.

For the purposes of this study the resource has been calculated on 3 different levels – theoretical, economic and deliverable

Theoretical Resource

The resource that is technically accessible and limited only by reasonable physical constraints The technically accessible resource can be expected to increase with time and is calculated here on the basis of existing technology or that which is likely to be developed before 2010

Economic Resource

The resource that is economically viable within the proposed commercial and regulatory framework. The 'proposed' framework includes the introduction of the Renewables Obligation, the New Electricity Trading Arrangements and the Climate Change Levy

Deliverable Resource

The resource that can be harnessed after taking into account both economic constraints and the public policy framework. The policy framework includes environmental protection, development control, land use and waste management practices

The resource assessment is set out in two different ways In the main body of the report the theoretical resource is presented followed by a discussion of the various policies that are likely to limit the resource in some way It sets out the background to the assumptions upon which the calculation of the deliverable resource is based It is important that the deliverable resource, targets and conclusions are seen not in isolation but in the light of the preceding discussion The calculations themselves are presented in Appendix A, together with a record of all the assumptions that have been made From this the progression from theoretical to economic to deliverable can be clearly traced

Chapter 3 describes the different technologies that are considered within the scope of this study and the theoretical resource that exists for each This is then refined by applying two 'filters' – an economic and a planning/environmental filter

The economic viability of the different technologies is described in Chapter 4 Although the electricity market is not a truly 'free' market it is assumed that only those technologies which are competitive, within the context of the proposed commercial and regulatory framework, will be developed It is possible that certain developments will occur, for non economic reasons but these are expected to be a small minority

The environmental and planning frameworks are described in Chapter 5 While these are not as easily quantified as costs and prices, some clear conclusions can be derived from a study of national, regional and local planning guidance The essence of these policies is to reconcile the Government's targets for renewable energy with those for protecting the environment and reflecting public perceptions of acceptability

By applying an economic and environmental/policy filter, the 'deliverable' proportion of the theoretical resource can be calculated However, first some comment is made on the ability of the electricity distribution network to accept embedded (such as renewable) generation There is considerable concern as to how large quantities of new embedded generation will be incorporated within the existing electricity network However, it is not considered as the base case in this study since it is believed that many of the issues identified can be resolved by changes in the regulatory framework at the national level It is important to emphasise that these changes must be forthcoming if the deliverable renewable energy resource is to be realised

Finally, the deliverable resource is presented in Chapter 7, together with a sensitivity analysis of the key constraints The deliverable resource is then discussed in relation to potential targets for the Region (Chapter 8)

2 Electricity Generation and Supply in the West Midlands

2.1 Introduction

As described in Chapter 1, the primary purpose of this study is to show how the West Midlands region can contribute towards the national target, which is to supply 10% of the UK's electricity from renewable sources by 2010

The aim of this chapter is to estimate the current level of conventional and renewable generation in the Region, and compare this to the Region's expected electricity demand in 2010 While this might seem like a simple calculation, it depends on a number of assumptions

Firstly, it is not known by how much electricity consumption will increase (or decrease) over the next 10 years While assumptions can be made based on recent trends, there are a number of uncertainties depending on, for example, the uptake of energy efficiency measures and possible changes in energy prices These issues are examined in 2 2

Secondly, electricity consumption is measured in units of energy as GWh[1] , which reflects both the power used and the number of hours for which it is used However, electricity generation is typically recorded in terms of installed capacity (MW)[2], the maximum power that can be produced at any one instant. To relate these figures, an assumption must be made about the number of hours for which the generating plant is operational and at what proportion of its maximum capacity In Appendix A, a number of 'conversion factors' (load factors) have been estimated for each different type of generating plant This enables a direct comparison between electricity generation and consumption However, it should be noted that a regional figure for consumption (GWh) can not be easily converted into a figure for installed capacity because the conversion factor is different for each technology and so the mix of technologies applied is important

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[1] At the meter electricity consumption is recorded, normally, in units of kWh Since this study is considering electricity consumption on a regional level a larger unit must be used. 1 GWh equals 1,000,000 kWh

[2] Electrical power is measured in Watts 1 MW equals 1,000,000 W For comparison the 'average' light bulb is rated at 60 W

For example, a 1 MW wind turbine can be expected, on average, to produce 2 63 GWh over the course of one year, compared with 0 75 GWh per MW installed for solar photovoltaics and 7 88 GWh per MW installed for landfill gas

Finally, it should be noted that electricity generated within the Region will not necessarily be consumed within the Region This has always been the case since electricity distribution and supply are not influenced by regional boundaries however, this fact has been accentuated now that the supply industry has been opened up to competition Between September 1998 and May 1999, competition (previously reserved to large electricity consumers) was extended to the under 100 kW market and by October 1999, 3 3 million electricity customers had changed supplier [DTI, 1999b] It is therefore perfectly feasible that a customer in the West Midlands could choose to obtain their electricity from a supplier as far away as Scotland It is therefore more appropriate to refer to electricity distributed rather than supplied There are three companies distributing electricity within the West Midlands Region GPU Power, East Midlands Electricity and Manweb, each with a monopoly over distribution in their area

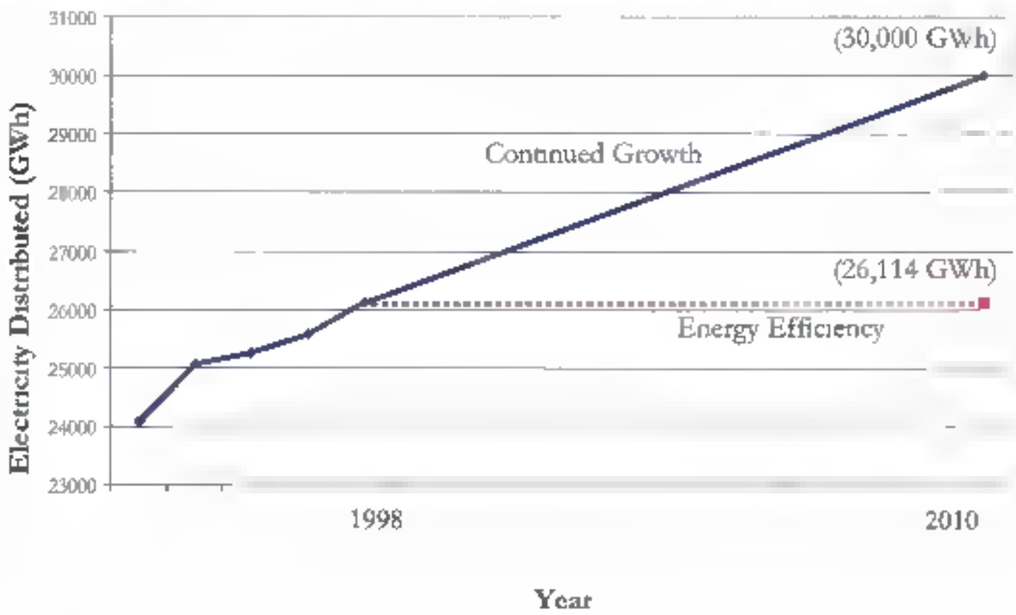
2.2 *Electricity Consumption*

In 1998/9, 26,114 GWh of electricity was distributed within the West Midlands region [WMLGA, 1999] In order to estimate the electricity consumption by 2010 it is interesting to examine both national and regional trends

Nationally, electricity consumption continues to increase Between 1995 and 1999, the net electricity supplied in the UK increased from 317,000 GWh to 345,000 GWh – an increase of almost 9% In its recent Energy Paper [DTI, 2000c], the Government has prepared two possible energy scenarios for the future In the 'Low energy price' scenario generation increases from 345,000 GWh in 2000 to 390,000 GWh in 2010 In the 'High energy price' scenario generation increases form 343,000 GWh in 2000 to 371,000 GWh in 2010 (Both scenarios start from 1995 figures) These correspond to a total increase, over the 10 year period, of 13% and 8% respectively – a significant increase although less than that seen between 1995 and 1999

In the West Midlands region, electricity distributed increased from 24,079 GWh in 1994/5 to 26,114 GWh in 1998/9 [WMLGA, 1999] in line with the national trend In this study, two different scenarios will be considered for electricity consumption by 2010 and these are indicated graphically in Figure 2 1

Figure 2.1. Existing and predicted electricity demand in the West Midlands



(i) 'Energy Efficiency'

In this scenario it is assumed that electricity consumption is maintained at 1998/9 levels i e 26,114 GWh Based on trends over the last 5 years this does not seem likely, but is almost certainly achievable with a determined programme of energy efficiency measures in industry, business and the home The Climate Change Levy is one such initiative, with exemptions from the tax granted to industry and business only on the basis of some stringent energy saving measures

(ii) 'Continued Growth'

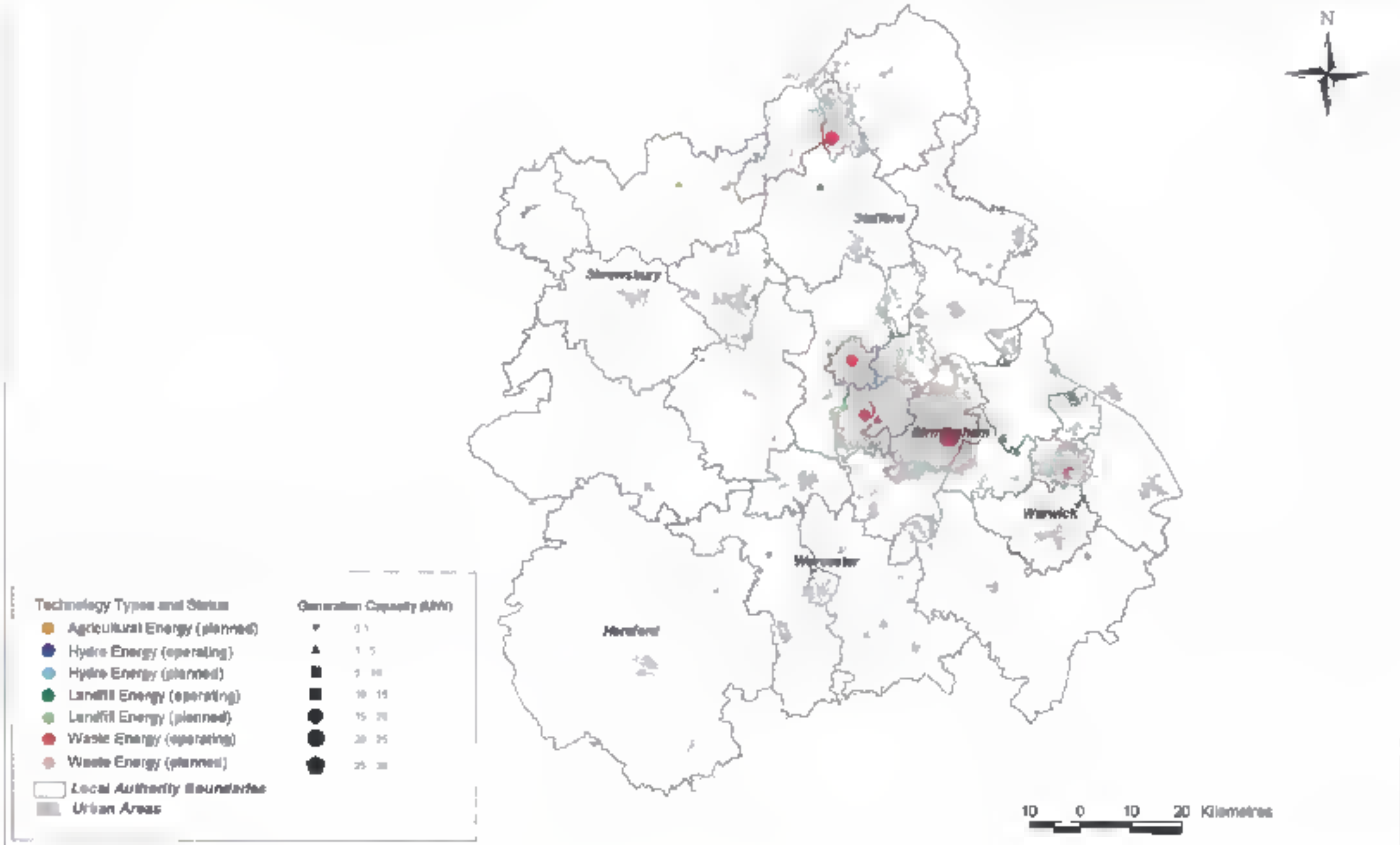
In this scenario it is assumed that the growth in electricity demand continues at a similar rate to that seen, both locally and nationally over the past 5 years, and reaches 30,000 GWh by 2010

These demand predictions are compared with the existing renewable electricity generation in the Region in 2 3 Meanwhile, it is interesting to note that the anticipated growth in electricity demand (scenario ii) exceeds 10%, and this highlights the fact that renewable electricity generation must be seen in context of the 'bigger picture' This 'bigger picture' includes the fact that energy efficiency has an equally important role to play in reducing CO_2 (and other) emissions Any target for renewable energy is a moving target and thus a significant quantity of new renewable capacity (delivering about 120 GWh) will be needed in the next 10 years simply to maintain the present contribution of renewables to overall electricity supply The 'bigger picture' also includes the fact that electricity only accounted for 15% of final energy consumption in 1999 (with petroleum and natural gas 46% and 34% respectively) [DTI, 2000c]

2.3 *Electricity Generating Plant*

2 3 1 *Renewable*

Figure 2.2 and table 2 1 show all the known renewable electricity generators in the Region.



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Renewable Electricity Generators in the West Midlands

Figure 2.2

[illegible]1. Renewable Electricity Generation Capacity in the West Midlands

Technology	Location	NFFO	Operating Capacity (MW)	Planned Capacity (MW)
Landfill Gas	Packington, Coventry	1	2 70	
	Tuttle Hill Warwickshire	1	0 54	
	Martley, Warwickshire	1	0 27	
	Martley, Warwickshire	1	0 28	
	Rowley Regis, Staffordshire	1	2 00	
	Packington, Coventry	2	5 00	
	Ryton, Coventry	2	0 85	
	Cannock, Staffordshire	2	1 32	
	Telford, Shropshire	3	1 39	
	Buddenhall, Coventry	3	0 80	
	Tuttle Hill, Warwickshire	3	1 16	
	Himley, Staffordshire	3	1 82	
	Tuttle Hill, Warwickshire	4	2 73	
	Pershore, Worcestershire	4	3 38	
	Rugby, Warwickshire	5		0 95
	Coventry, West Midlands	5		2.42
	Tamworth Staffordshire	5		0 91
	Leamington Spa, Warwickshire	5	0 93	
	Tamworth, Staffordshire	5	1 86	
	Prees, Shropshire	5		0 57
	Bridgnorth, Shropshire	5		0.86
	Shrewsbury, Shropshire	5		1.26
	Telford, Shropshire	5		2 86
	Meriden, Coventry	5		8 48
	Meriden, Coventry	5		12 11
	Bromsgrove, Worcestershire	5		0 91
	Pelsall, Walsall	5		0 78
	Stone, Staffordshire	5	1 75	
	TOTAL		**28 78**	**32 11**
Waste	Coventry	1	8.43	
	Wolverhampton, West Midlands	3	8.35	
	Dudley West Midlands	3	6 20	
	Tyseley Birmingham	3	28 20	
	Stoke on Trent, Staffordshire	3	12 50	
	Coventry	4		4 50
	Telford	4		1 78
	Coseley	5		9 30
	Kidderminster	5		13 70
	TOTAL		**63 68**	**35 78**

Technology	Location	NFFO	Operating Capacity (MW)	Planned Capacity (MW)
Sewage Gas	Minworth, Birmingham	3	6.00	
Agricultural Residues	Redditch Worcestershire	3		0.30
	Telford, Shropshire	4		2 00
	TOTAL			**2 30**
Hydro	Oswestry	1	0 12	
	Oswestry	3	0 36	
	Winshill	4	0 07	
	Pershore	4		0.22
	Tamworth	4		0 09
	TOTAL		**0 55**	**0 31**
Solar Photovoltaics	Falling Park West Midlands		0 015	
	Bilston, West Midlands		0 015	
	Birmingham		0 015	
	Birmingham		0 015	
	Redditch		0 001	
	Hereford		0 003	
	Birmingham		0 001	
	Sandwell, West Bromwich		0 007	
	Dudley			0 01
	TOTAL		**0 072**	**0 01**
TOTAL			**99 08**	**70 51**

Most of the data was obtained from records of contracts issued under the Non-Fossil Fuel Obligation (NFFO) The 'round' under which a contract was awarded, has been indicated where appropriate This gives an idea of the date, with NFFO 1 beginning in 1992 and the last order (NFFO-5) being issued in 1998 A number of plants with a NFFO contract have yet to be built or commissioned This may be due to a number of reasons such as difficulty in obtaining planning permission or finance It is likely that some will never become operational but for the purposes of this study such generators are listed as 'planned capacity'

Regarding solar photovoltaic systems, because of their size and dispersed nature it is very difficult to keep a record of what has been installed They do not contribute, at present, noticeably to the region's generation capacity and the list here is indicative only The larger schemes (15 kW) have been installed on petrol stations as part of BP's 'Sunflower' project The 10 kW planned accounts for projects that have received a contract under the DTI's Domestic Field Trial and should be installed during 2001

A summary has been compiled in Table 2 2

[illegible] of Renewable Electricity Generation in the West Midlands

Technology	Existing capacity (MW)	Annual yield (GWh)	Existing and planned capacity (MW)
Landfill Gas	28 8	240	60 9
Waste	63 7	502	99 4
Other	6 6	50	9 2
Total	99 1	792	169 6

From this a number of important points can be drawn

(i) There is already 99 MW of renewable generation in the Region It is estimated that this produces around 792 GWh per year or 3% of the Region's current electricity demand This is slightly higher than the national average (2 8% [DTI, 2000c])

(ii) If all the 'planned' capacity becomes operational then this will provide a total of 170 MW of capacity and approximately 1310 GWh per year This accounts for 5.0% of the Region's <u>current</u> electricity generation Consequently, the Government's target to generate 5% of electricity from renewables by 2003 can be met on the basis of existing and planned capacity <u>if</u> it all becomes operational and consumption does not increase in the next 3 years

(iii) Almost all the renewable generation in the Region is accounted for by just two technologies landfill gas (29%) and energy-from-waste (64%) Most of the remainder is generated from a single sewage gas plant. This is in contrast to the national mix shown in Table 2.3 However, it is obvious that large hydro schemes (>10 MW) which account for over half of the renewables electricity generation on a national basis, will be inappropriate for the West Midlands region

Table 2.3 Renewable Electricity Generation Capacity in the UK [DTI, 2000c]

Technology	Capacity (MW)
Wind	151
Hydro small scale large scale	 64 1413
Landfill Gas	309
Sewage Sludge	91
Wastes	159
Other Biofuels	84
TOTAL	**2271**

2 3 2 *Conventional*

A list of non-renewable generation in the Region is indicated in Table 2 4 for comparison.

[illegible] Conventional Electricity Generation Capacity in the West Midlands

High Wind	Predicted Generation Mix			Deliverable Resource		
	Consumption Scenario			Total	As UK Mix	
		Growth Continued GWh	Energy Efficient GWh		Growth Continued	Energy Efficient
Onshore Wind	26%	780	679	1,345	780	679
Energy Crops	3%	90	78	67	67	67
Waste	13%	390	339	282	282	282
Landfill gas	13%	390	339	398	390	339
Other biomass	3%	90	78	95	90	78
Other	3%	90	78	11	11	11
Small hydro	1%	30	26	4	4	4
subtotal	62%	1,860	1,619	2,201	1,624	1,461
Offshore Wind	18%	540	470	0	0	0
Existing	20%	600	522	792	792	792
Total	100%	3,000	2,611	2,993	2,416	2,252
					8 1%	8 6%

The data in Table 2 4 was compiled from three different sources the DTI Energy Report [DTI, 1999b], the Electricity association [EA, 2000a], and National Grid Company's 7 Year Statement [NGC, 2000]. Where there was a conflict between these references the figure has been indicated in bold italics and an average calculated Note also that the Table indicates installed capacity and not operating capacity It is understood that some of these power stations may not be operating at full capacity but this information is difficult to obtain since it of a commercial rather than purely statistical nature

Of the 3112 MW of 'conventional' capacity, 102MW is 'embedded' i.e connected within the distribution network rather than directly to the national grid. This is roughly equivalent to the total renewable capacity which, without exception, will also be embedded However, it is thought that some small generators have not been included in the references used for Table 2 4 The significance of embedded generation is discussed in Chapter 6.

The total capacity in the West Midlands (conventional and renewable) is 3211 MW This is approximately 4% of the UK's total capacity (75,305 MW [DTI, 2000c])

3 Renewable Generation Technologies

3.1 *Introduction*

The definition of renewable energy in its broadest sense is often given as those " sources of energy which are continuously and sustainable available in our environment " [DTI, 1999c] This definition mainly encompasses sources of energy that are ultimately derived from sunlight This contrasts with fossil fuels, which although their energy content is also derived from the sun, our use of is unsustainable – i e they are being used up at a rate in excess to the rate at which they are being formed There are also other reasons for minimising the use of fossil fuels their combustion adds to the total carbon dioxide concentration of the atmosphere and subsequent potential climate change. Additionally, local air pollution effects can have direct short and long health and ecosystem impacts

Renewable energy technologies may provide energy in the form of physical effort, heat, or electricity However, in the UK, the emphasis has been on the growth of technologies that can generate electricity as this is considered the key market that has the potential to use renewable resources on a major scale

An important aspect of renewable energy technologies is that as they depend on the natural environment and the dispersed energy flows within it This is in marked contrast to fossil fuel energy which generally is highly concentrated Thus the development of renewable energy can be expected to be at a relatively small scale and will need to be close to the resource itself This concept requires changes in the commercial framework and infrastructure that delivers electricity to consumers, as these are currently designed and operated with the aim of transmitting electricity from large scale, remotely located, installations

Most renewable technologies can be used across a wide range of generating capacities This report will concentrate on the larger scale installations that have the ability to contribute significantly to achievement of the 2010 target However, it is important not to lose sight of the potential of medium and small scale installations where appropriate Factors affecting take-up are considered in detail in later Sections, but some characteristics of smaller units are

- They may be economically viable as generators for on site consumption, substituting retail price electricity, but not for external sale at wholesale prices

- They may be publicly acceptable at sites where large-scale installations are not. This is particularly true in environmentally sensitive areas and areas of high population density

- They may be operationally viable in more marginal natural conditions, and on sites where a CHP (combined heat and power) configuration may be attractive.

- Smaller technologies do generally require a higher level of capital investment per unit of installed capacity

Therefore, it is important that regional strategies do not focus solely on large-scale development, but make appropriate provision for medium and small systems

3.2 *Selection of Technologies Suitable Technologies for the West Midlands*

The physical nature of a country or region dictates the renewable energy technologies that will be suitable for electricity generation in that location. Thus, in the West Midlands technologies that tap the significant energy resource at sea (tidal, wave and offshore winds) are not appropriate. In addition, the geological structure of the region is such that temperatures are not sufficiently elevated near to the surface to allow the use of geothermal heat. Whilst parts of the Region do have significant rainfall totals, the landscape is generally low lying, and thus not particularly suited to large-scale hydro electric development

The basis for selecting the technologies to be considered is thus based on an assessment of the realistic likelihood of their development using existing or developing technology that will be commercially exploited by 2010

Technologies are thus limited to those that use the following resources

- Onshore wind,
- Biomass – consisting of energy crops, wastes and residues,
- Solar energy, and
- Hydro electric

Each of these technologies is discussed in outline detail in the sections that follow, where the particular types of resource they utilise are discussed and key issues relating to their exploitation are explained More details can be found on the relevant assumptions that have been made in estimating the resource in Appendix A. For more technology specific information a good recent source is the 'Supporting Analysis' published for the Renewables Consultation undertaken by DTI in 1999 2000 [DTI, 1999a]

Section 3 7 summarises this discussion and presents the theoretical electricity generation resource in the region

3.3 Onshore Wind

Mankind has harnessed wind power for over 2,000 years through the construction of wind devices or many types and sizes In modern wind turbines, electricity is generated from the wind by a moving air mass turning a shaft (and hence generator) utilising the aerodynamic lift generated by the wing sections of turbine blades

Estimating the energy available in the wind is a complex task and requires a knowledge of the long term wind speeds at height, taking into account climatic variations, the effect of topological features and ground friction impacts Although there is a cubic relationship between the energy contained in the wind and the wind speed, in reality the situation is more complex. For example, the blades of the turbine will be optimised to be most efficient at the wind speed that is most likely to be encountered However, in general terms the same turbine operating at a site with an average wind speed of 8 m/s will generate 80% more electricity over the year than a site with average wind speeds of 6 m/s As the capital and operating costs for these turbines would be broadly similar, the costs of the electricity generated will be correspondingly cheaper for the high wind speed site

Wind turbines for electricity generation are available in a wide range of sizes, from a few hundred watts up to 2 MW for onshore installations Typical turbine sizes for developments have been increasing rapidly over the last few years, with most developments in Europe favouring a few large (greater that 1 5 MW) turbines over many smaller turbines of a lesser capacity The very largest of these machines can have towers of up to 80 m and rotor diameters of up to 80 m, giving a total swept height of up to 160 m above the ground More typically machines can be expected to reach a total height of 80 120 m The net energy output of a typical 1 5 MW machine would be around 3 9 GWh/year on a site with an average wind speed of 7 0 m/s

Although the majority of the resource in the West Midlands is expected to come from large-scale developments using turbines of the type described above, small scale schemes may be locally important. This is where small individual wind turbines generate electricity primarily for consumption at an individual dwelling or small business (such as a farm) or for indirect applications such as water pumping Turbines for this purpose may have a rotor diameter of approximately one metre

These small wind turbines are available from a number of manufacturers which can be used in connection with an electricity transmission and distribution system (grid-connected systems), or in stand alone applications that are not connected to the utility grid Uses would primarily be in rural areas where the generation output could be used either to supply the general electrical demands of the dwelling or business, or can be used to run specific electrical applications This can often be of most use in remote parts of a farm where the cost of cables from a utility power supply point could be prohibitive Typical applications are electric livestock fencing, water pumping, lighting or any kind of small electronic system needed to control or monitor remote equipment, including security systems

The most common sizes of these small wind generators are around 0 2 kW, although machines typically of 2 kW or larger are also available Stand alone installations are commonly constructed in conjunction with storage battery capacity and it is this factor that can make higher capacity installations uneconomic This is due to the high capital costs of batteries, which can be in the order of the cost of the wind turbine itself

3.4 *Biomass*

Biomass resources are defined as those that generally derive energy from the photosynthetic growth of plants For the purposes of this study biomass resources have been divided into two main groups

- Energy Crops

  These are plant crops that are specifically grown for their ability to utilise photosynthesis to convert atmospheric carbon into their vegetative matter When this matter is harvested it may be converted into usable energy and atmospheric carbon as part of a carbon cycle The main carbon emission savings thus occur from the displacement of conventionally generated electricity, which utilises the stored carbon in fossil reserves, such as coal

- Organic Residues

  Where plant material has been used as part of another process or for another purpose (e g animal feed or timber production) often considerable quantities of organic carbon can remain in subsequent residues These may be conveniently divided into two main forms, reflecting the range of treatment options available wet (such as animal slurries or sewage sludge) and dry (such as forestry residues or municipal and commercial wastes)

  Whilst a proportion of the carbon in municipal and commercial wastes is contained in materials such as plastics, and hence derived from fossil oils, evidence shows that the majority of the energy content of these materials is derived from biomass as paper, card and kitchen scraps [DTI, 1999d]

  There is a certain controversy over this issue, with the European Commission specifically excluding energy derived from municipal and commercial wastes from renewable energy targets for Europe [EC, 2000] This is primarily due to the commercial structures and support that are available, as large scale hydro electric generation is also excluded from these targets Thus, the UK Government has taken the view that these resources should be included, but they are unlikely to gain additional financial support, or be included under the Renewables Obligation [DTI, 2000d]

3 4 1 *Energy Crops*

Whilst there are a wide range of crops that can be grown as energy crops, only a few have been studied in detail in the UK Of these the following have been selected as the most probable for development in the West Midlands over the next decade

- Short Rotation Coppice (SRC)
  Willow or poplar is grown as an energy crop in a short rotation coppice system that has been adapted from traditional coppice systems and is based around a rotation of 2 to 4 years The crop is established by planting 15,000 - 20,000 cuttings per hectare and these are cut to ground level at one year of growth [Forestry Commission, 2000] The resulting plant sends up multiple shoots and these form the base of the coppice The fuel is harvested mechanically to ground level as wood chip or whole stems after a further 2 – 4 year's growth, which maintains the plant in its most productive phase

  Current yields for SRC, after the first three years of establishment, are in the region of 10 – 15 dry tonnes per hectare per year However, crop improvements are indicating that this yield may rise to 20 tonnes per hectare per year [Forestry Commission, 2000, DTI, 1999a]

- Miscanthus
  This plant is a grass that belongs to a type of plant, deriving from tropical regions, that utilises a more efficient photosynthetic process (termed C4) than temperate region plants for converting light to organic carbon Thus the plants offer a very high yield potential However, the growing conditions required include mild temperatures and high rainfall, and thus the crop is likely to be more successful in the western parts of the West Midland Region Maize is another C4 plant, and requires similar growing conditions

  The plant is established by the planting of rhizomes, which then shoot to give an annual crop that can be harvested mechanically using similar equipment to SRC One potential advantage of miscanthus as an energy crop is that it is harvested relatively dry during the winter, when plant moisture is relocated to the rhizomes This feature has the potential of matching energy generation to times of peak demand and thus avoiding storage costs

  The yield potential is considerably greater than for SRC, and is likely to be in the region of 15 to 30 tonnes per hectare per year [MAFF, 2000a]

- Oil Seed Plants

  Some crops, such as rape and linseed, produce a oil rich seed These oils may be processed to generate a 'bio-diesel' that can be used directly in boilers and internal combustion engines However the liquid nature of this fuel is such that it is highly prized as a transport fuel, and development of this crop for this use is likely to predominate

3 4 2 *Organic Residues*

For the purpose of this study wet organic residues are defined as animal manure, food processing residues and sewage sludge with a dry matter content of not above 20%

(i) Wet Organic Residues

The primary method by which energy may be recovered is through anaerobic digestion (AD) of the residues

AD is the fermentation of the organic fraction in the residues, which generates a methane rich biogas This biogas typically consists of 65% methane and 35% carbon dioxide, and has a calorific value of approximately 25 MJ/m^3 In normal processes about 50% of the carbon content of the residue is converted to biogas, with the remainder forming a potential fertiliser product for land spreading In most modern AD processes the action of prolonged temperature, which can be combined with a pasteurisation stage, destroys many pathogens and weed seeds

The biogas can be used in a variety of applications, with spark ignition reciprocating gas engines the most common method of generating electricity

- Animal Manure

  Animal manure accumulates whenever animals are held in open yards or housed indoors The three main sources of such slurries that will be examined in this study are from cattle, pigs and poultry Dairy cattle are normally only housed during the winter and at milking time, whilst a significant proportion of beef cattle, pigs and poultry are housed all year round Changes in agricultural practice to reflect higher welfare standards are likely to increase the total amount of manure for housed animals in addition to increasing the dry matter content due to the inclusion of bedding materials The increase in outdoor production of pigs and some poultry products will have the opposite effect, decreasing the quantity of manure collected

- Food Processing Residues
  Many types of food processing residues are available for energy recovery, including vegetable and fruit rejects and off-cuts, abattoir wastes and process industry residues, such as brewery grains Whilst some of these residues have alternative uses, most could be also used for energy recovery Unfortunately, statistics on the details of these residues are not generally available as the level of these arising is often viewed as commercially confidential by the industry

- Sewage Sludge
  It is estimated that the West Midlands Region generates approximately 2 5 million tonnes (at 4% dry matter) of sewage sludge per annum at wastewater treatment plants This is available for digestion, and many large wastewater treatment plants already generate sewage gas in this way

(ii) Dry Residues

Dry residues in this study are those that are likely to have energy recovered from them by a thermal process, either by combustion, gasification, or pyrolysis

- Agricultural Residues
  Straw is the most common dry agricultural residue that is utilised for energy recovery, and a substantial quantity of straw in generated in the West Midlands Region However, straw is also highly prized as an animal bedding material and the proximity of a high density of animal raising farms implies a ready market for any excess straw in the region

- Municipal, Commercial and Industrial Wastes
  Energy may be recovered from municipal, commercial and industrial wastes by two primary routes thermal treatment and anaerobic digestion The most common method is by the incineration of mixed wastes in a furnace with a moving inclined grate Energy is subsequently recovered by steam cycle generating plant This 'mass burn' technology is well established and in widespread use world wide Research and development continues to ensure that emissions from such processes meet increasing demands for better air quality A number of alternative approaches are under development, such as gasification and pyrolysis, which offer the expectations of economic plant at smaller scales

  Anaerobic digestion of the organic matter in municipal, commercial and industrial wastes can convert approximately 50% of the organic matter in the waste to methane for energy recovery This can take place as a controlled reaction in a digester vessel or in the uncontrolled environment of a landfill site

- Forestry Wastes
  Thinning and harvesting of commercial forestry crops leaves a considerable quantity of material as brash on the forest floor. Whilst this represents a significant energy resource, the difficulties of extraction of such a low value product have been a barrier to the utilisation of this material

3.5 *Hydro Electric*

In the West Midlands region, energy from water could be derived from the following applications

3 5 1 *Run of the River*

In this case existing sluices and weirs or open flowing water are used to turn small turbine devices of many different types These are typically in the range of 25 kW to 1 MW capacity In general the environmental effects are small and unlikely to be a barrier to development.

3 5 2 *Storage Dams*

The traditionally thought of Hydro electric scheme would include a large storage dam and a generating capacity of many 10's, or even 100's of MW The relatively low lying terrain of most of the West Midlands allows little or no scope for such developments, even if the considerable environmental implications of such a development were acceptable

A smaller storage dam or reservoir could be used to generate electricity at peak demand (and hence peak price) periods Typical generating capacity may be in the order of a few hundred kW Environmental implications of such a scheme would still be locally important, as would the acceptance of a fluctuating water level

3 5 3 *Water Supply Company Resources*

The transfer of water to urban areas often relies on gravity, and may require the installation of pressure reducing valves and pressure break tanks These represent a point at which the potential energy in the water can be harnessed by small hydroelectric installations However the topography of the region, with the main conurbation on a saddle in the landscape, does not lend itself to the wide use of such a technique There may be situations adjacent to high ground where this technique could be used

3.6 *Solar*

There are two main ways in which solar energy may be directly utilised for the generation of renewable electricity

- Solar Photovoltaic

  The action of light falling on special materials directly generates an electric voltage There are a number of different types of materials as crystals and films that have this effect, with possible future technology able to deliver up to 30% of the energy in the light as electricity [Progress in Photovoltaics, 2000] However, values for current commercial products are in the region of 6 to 15% range Thus a typical panel of photovoltaic material of around 1 m^2 would yield in the region of 150 W as a peak output in the West Midlands

- Solar Thermal

  In countries with frequently clear skies it is possible to concentrate the incident sunlight by the use of mirrors and concentrators to generate steam for the direct generation of electricity in steam cycle plant.

However, this is not an option in the UK, and solar thermal would only contribute to renewable electricity supply by displacing electricity utilised for water heating

3.7 *Theoretical Resource for the West Midlands*

By undertaking a number of calculations based on assumptions (detailed in Appendix A) that reflect the technical potential of technologies to deliver renewable electricity it is possible to calculate an estimate of the 'theoretical' resource for the West Midlands This resource is set out in Table 3 1 below and illustrates that there are sufficient renewable resources to deliver eight times the predicted 2010 electricity consumption

[illegible] ewable Electricity Resource for the West Midlands

Resource	*Technology*	*Annual generation GWh*
Wind	Large wind turbines	225,482
	Small wind turbines	2
Biomass	Energy crops	1,727
	Agricultural residues	421
	Forestry residues	92
	Wastes	4,504
	Sewage gas	107
	Landfill gas	1,018
Solar	Photovoltaics	2,249
Hydro electric	Run of the river	11
TOTAL		**235,613**
Renewable Electricity Resource as % of estimated 2010 consumption		**785%**
ESTIMATED 2010 CONSUMPTION		**30,000**

4 Economic and Commercial Structure

4.1 *Introduction*

The Government's target to generate 10% of the UK's electricity requirements from renewable sources by 2010 is subject to the cost to consumers being acceptable. Thus, although Government policy does not preclude support for renewables as they seek to penetrate the electricity market, customers will be protected against excessive price rises. While the question of what price is acceptable to the customer is open to debate it is clear that renewable technologies must attain a near fossil fuel price if they are to be commercial.

As in all markets, whether or not a product (in this case electricity) is economic is determined by the cost of production and the commercial framework within which that product is being sold. With regard to the latter there are currently three major changes underway in the UK.

The first is, the introduction of the Renewables Obligation on suppliers (as a replacement for the Non-Fossil Fuel Obligation) and the second the commencement of the New Electricity Trading Arrangements (NETA). While NETA, unlike the Renewables Obligation, is not explicitly part of the Government's renewable energy policy, both will have a profound influence on the development of renewable energy in the UK. The legal framework for both was set by the Utilities Act 2000, although only NETA has been implemented to date with the Renewables Obligation now planned to start in the spring of 2002.

The third initiative in the introduction of the Climate Change Levy, introduced in April 2001. This levy is an additional charge that must be placed on electricity sales to business energy users. However, suppliers of electricity that derive solely from renewable sources (except for large hydro-electric schemes) are able to exempt these sales from the levy. This measure is designed to enhance the value of renewable electricity against that provided from fossil fuel sources.

The purpose of this chapter is to assess firstly, which renewable energy technologies are likely to be cost competitive in the next 10 years under the proposed legislative framework and, secondly, where these technologies will be viable in the West Midlands This research is then used as the basis for the calculation of the economic resource in Appendix A. By nature, the economic analysis must be speculative since the details of the Renewables Obligation have not yet been agreed and the response of the market to NETA has been uncertain in its early stages and is now under review However, there is sufficient evidence to predict with a reasonable degree of certainty, the type of development that is likely to be seen and hence the economically accessible resource

The commercial framework and then the cost of generation are reviewed separately (4 2 and 4 3) before being brought together to produce a summary of the prospects for each technology in the new market place (4 4)

4.2 Commercial Framework

The last round of the Non Fossil Fuel Obligation (NFFO) was issued in 1998 and it is now due to be superseded by the Renewables Obligation However, there are still a large number of projects contracted but not yet commissioned These are likely to account for the majority of the renewable generation installed in the next two years and it is for this reason that a brief resume of the NFFO process is provided below This is followed by a review of the key features of the Renewables Obligation and NETA in order to permit an estimate to be made of the price that renewable technologies are likely to command in the new market place

4 2 1 *The Non Fossil Fuel Obligation*

The Government introduced the Non Fossil Fuel Obligation (NFFO) in England and Wales under the 1989 Electricity Act, together with similar Obligations in Scotland and Northern Ireland

The NFFO required electricity supply companies to secure a specified amount of new generating capacity from non-fossil sources, including renewables, and guaranteed a premium price for this electricity for a set period of time It operated through a series of 'orders' or 'rounds' of which the 5th and final Order was issued in 1998 The Secretary of State was responsible for issuing an Order and the Non-Fossil Purchasing Agency then invited bids for prospective schemes from renewable generators In each order different technologies were identified in bands, in such a way that projects in each technology area were competing together for a supply contract. Subsequently, the technical, economic and legal aspects of the tenders were then assessed and finally the cheapest schemes selected to secure the required capacity within each band.

Additional costs incurred by the electricity suppliers under these contracts, compared with the cost of 'conventionally' generated electricity, were financed through a tax on electricity (the Fossil Fuel Levy) This Levy was ultimately funded from all electricity consumers and decreased in value over time Between January and September 1999 it was set at 0 7% of the electricity price

The NFFO 'kick-started' the renewable energy industry in the UK by providing secure, fixed term (up to 15 year) contracts for a variety of technologies in different technology bands The contracts enabled developers to obtain finance and there was an explosion of new entrants into the newly privatised electricity sector However, the NFFO process did not take into account the planning systems Contracts were awarded for specific projects in specific, non transferable locations Furthermore, because contracts were awarded on a fiercely competitive basis, developers went to locations where there was the greatest concentration of resource in order to drive down costs and stand the greatest chance of winning contracts In the case of wind and hydro this meant that many projects were proposed in remote locations which were prized for their unspoilt character Consequently, of the in excess of 3000 MW of contracts awarded, less than a quarter have so far been physically delivered[3]

4 2 2 *The Renewables Obligation*

Following a change of Government, an alternative support mechanism for renewables was sought to replace the NFFO The Government wished to continue to develop renewables within the framework of a competitive market but to remove the existing levy on fossil fuel that underpinned the NFFO system This was because the Levy was classified as a tax Following public consultation, the Government published its conclusions in February 2000 [DTI, 2000a].

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[3] As of the 30 June 2000, 757 MW (DNC) of capacity had been commissioned in England and Wales as a result of the Non Fossil Fuel Obligation. This compares with a contracted capacity of 3271 MW (Note that the Government had set a target to achieve 1500 MW of renewable electricity generating capacity, through the NFFO mechanism, by 2000)

In this policy document the Government confirmed its intention to replace the NFFO by a legal obligation on suppliers to obtain a certain percentage of their electricity from renewable sources, which would be backed up by a 'buy out' price for non-compliance to protect consumers against excessive price rises To prevent the Obligation being classified as a tax, and to give suppliers an added incentive to purchase electricity from renewable sources, all receipts from suppliers 'buying out' of their obligation would be recycled to suppliers

Two further consultation documents, devoted specifically to the proposed Renewables Obligation, were published by the DTI in October 2000 [DTI, 2000d] and August 2001 [DTI, 2001] The key features, pertinent to the financing of renewable energy development, are highlighted below

(i) Ineligible Technologies

Existing large scale hydro and energy from the fossil portion of wastes are included in the 10% target for renewable electricity supply, but are currently excluded from the Obligation The basis of this is that, according to the Government, 'they are already commercially viable, well established in the market and can compete with electricity from fossil fuels' (see Table 4 1)

(ii) No Technology Bands

Unlike the NFFO, there will be no technology bands The Government has chosen to adopt a market led approach whereby suppliers will meet their Obligation by the most economic means on the presumption that they (the Government) 'do not wish to 'pick winners' amongst the different technologies but rather let competitive forces shape the industry'[4] While the 'winners' depends largely on the level of the buy-out price (see iv) it clearly implies that technologies such as photovoltaics and wave power will not play a significant role under the Obligation They will continue to be supported under the R&D programme until such time as they are commercially viable

[4] However, Government has indicated that it will intervene where it feels that the market alone may fail to deliver Hence, capital grants from DTI are being permitted for offshore wind and energy crops and some energy crops will qualify for additional subsidy from DEFRA.

(iii) Capital Grants

Capital grants will be available for two specific technologies offshore wind and energy crops This is justified on the basis that a) a significant contribution from these technologies will be necessary if the Government is to achieve its target and b) these technologies are almost commercial but require assistance in bridging the gap between R&D and commercial deployment. Grants of up to 40% of eligible costs will be awarded on the basis of the lowest cost per MW capacity installed Eligible costs are defined as the cost over and above that of building a combined cycle gas turbine power station

(iv) Buy Out Price

In order to protect consumers from excessive price rises the Obligation sets a buy out price This has been provisionally set at 3 0 p/kWh (to be linked to the Retail Price Index) The level of the buy-out price is pivotal to the success of the Obligation If electricity from renewable sources can be developed below this (see section 4 2 4) then it will be cheaper for the supplier to buy renewable electricity rather than buying non-renewable electricity in the market and paying the buy out price The Government believes that a price of 3 0 p/kWh will strike the best balance between the probability of meeting the 10% target with associated environmental benefit and an acceptable level of additional cost to the consumer The Government estimates it will result in a maximum increase in electricity prices of 3 7% by 2010 (relative to 1998 prices) However, it must be stressed that these figures represent an estimate of the effects of the obligation, and are currently subject to much debate

(v) Profile of the Obligation

The percentage of sales that must be derived from renewable generated electricity will be staggered, increasing from 3 0% in 2002/2003 to 10 4% by 2010/2011 (currently, on a national basis, 2 8% of electricity is generated from renewable sources)

The scope of the Government's proposed support for renewable technologies is set out in Table 4 1 Exclusion from the proposed Climate Change Levy, as mentioned previously, is also included as another 'strand' of the Government's renewable energy policy, although in fact it is being introduced to minimise CO_2 emissions rather than explicitly to promote renewables

Table [illegible] 1: Summary of Incentives for Renewables [DTI, 2000d, DTI, 2001]

Source	10% Target	Renewables Obligation	CCL Exemption	Capital Grants
Landfill Gas	✓	✓	✓	
Sewage gas	✓	✓	✓	
Energy from waste	✓	✓ (non fossil)	✓	
Hydro (>20 MW)	✓	✓ (new only)		
Hydro (< 20 MW)	✓	✓	✓	
Onshore wind	✓	✓	✓	
Offshore wind	✓	✓	✓	✓
Agricultural & forestry residues	✓	✓	✓	
Energy crops	✓	✓	✓	✓
Wave power	✓	✓	✓	
Photovoltaics	✓	✓	✓	

4 2 3 *The New Electricity Trading Arrangements*

Under NFFO, the prices bid per unit of electricity by renewable generators were (assuming they were successful) the prices they were paid Under the new arrangements, renewable generators will be exposed to market forces and prices The New Electricity Trading Arrangements which replaced the Electricity 'Pool' have affected renewable generators as much as (if not more than) generation from conventional sources

Under NETA, electricity is traded in a way that is more like commodity trading with electricity sold in advance through bilateral contracts between generators and suppliers Generators and suppliers take out sufficient contracts to cover their projected outputs and off-takes in each ½ hour trading period At the end of each trading period, every party's actual metered output/off take is measured against its notified contracts and any party that has over or under shot its contracted amounts is 'out of balance' and has to settle its imbalance in the Balancing Mechanism

It is not appropriate or necessary here to describe the full details of NETA, but instead to highlight the implications for renewable generators Although coincidental, rather than deliberate policies for or against renewable energy, there are likely to be a number of consequences

(i) Trading Direct to Suppliers

It is highly unlikely that renewable generators, simply because of their size, will have access to the spot market and the opportunities that may afford. They will therefore be forced to sell directly to suppliers. One result of this is that independent generators are unlikely to see the full value of the buy out price as they will need to offer some discount or incentive to suppliers to purchase certificates instead.

(ii) Penalties for Variable Generation

Pricing in the Balancing Mechanism is uncertain and penal. It is designed to force parties to actually generate/take what they say they will generate/take. This should have little effect on energy from waste, landfill gas and biomass technologies, as these are all reasonably predictable forms of generation. However, wind generation will be largely unpredictable within the time frames required for the Balancing Mechanism and may suffer severe imbalances.

(iii) Shorter Contract Periods

Under NFFO, generators were given contracts for up to 15 years, receiving the final bid price (index linked) for each kWh generated. NETA is likely to produce much shorter contract periods. It is estimated/ anticipated that contracts between suppliers and generators will be no longer than 10 years. This will affect the renewable energy technologies in different ways depending on the extent to which they are capital intensive [D Millborrow, 2000]. Energy from waste projects are the most capital intensive and therefore will be most affected, with estimates indicating that electricity prices may need to be raised by up to 50% if contract lengths are reduced to 10 years. Similarly, wind generators and land fill gas may need to increase prices by around 20% and 15% respectively.

(iv) Increased Market Risk

The cost of finance for projects is likely to be higher to reflect the increased uncertainty and risk. The increase in risk perceived by financiers is a result of both the everyday pricing under NETA and political decisions concerning, in the near term, exemptions from the Climate Change Levy and, in the longer term, possible changes to the Obligation if there was to be a change in Government. Higher discount rates will again have a greater impact on capital intensive projects such as energy from waste and wind.

4 2 4 *Renewable Energy Prices*

Together, NETA and the Renewables Obligation will determine both the price of electricity generated from renewable sources and the financial viability of such projects The final electricity price that is likely to be achieved for renewable generation is calculated below (Table 4 2) followed by some explanatory notes on each price component. For the purposes of this calculation, generation has been grouped into 3 classes

(a) Biomass (energy crops, agricultural residues, forestry residues, landfill gas, sewage gas)
(b) Wind, hydro
(c) Energy from waste

Furthermore, a distinction has been drawn between independent and supplier tied generators Independent generators are defined here as not tied in any way to a company that holds an electricity supply licence or which owns generating assets previously held by the CEGB

[illegible] Estimates of Renewable Energy Prices in the New Market Place, in pence/kWh

	Independent generator			Supplier tied –generator		
Price element	**a**	**b**	**c**	**a**	**b**	**c**
Baseload electricity price	1 8–2 0	1 8–2 0	1 8–2 0	1 8–2 0	1 8–2 0	1 8–2 0
LEC value	0 2–0 4	0 2–0 4	0 2–0 4	0.4	0 4	0 4
ROC value	1.5-2 1	1 5 2 1		3	3	-
Embedded generation benefit	0	0	0	0	0	0
Penalties for variable generation	0	0 3 0 5	0	0	-0 3-0 5	0
Total	**3.5-4 5**	**3.0-4 2**	**2 0-2.4**	**5.2-5.4**	**4.7-5.1**	**2.2-2.4**

Explanatory notes

(i) Base Electricity Price
Projections [DTI, 2000d] indicate that the value of electricity is likely to be between 1 8 and 2 0 p/kWh in 2002/2003 (the first year of the Obligation)

(ii) Levy Exemption Certificate (LEC) Value
The Climate Change Levy on electricity sales will be set at 0 43 p/kWh for non domestic customers Renewable electricity generators will compete against electricity on which the Levy has been placed, so in theory renewable energy generators should be able to realise higher prices However industry, fearing that the Levy will make them uncompetitive in comparison with other countries, is campaigning hard for exemptions and the Government has already made a number of concessions The average value of the levy placed on base load electricity could therefore drop to 50% or lower of the levy rate

(iii) Renewable Obligation Certificate (ROC) Value[5]
The value of the certificates will be determined by the 'buy out price', which the Government propose to set at 3 0 p/kWh Generators tied to suppliers will value their certificates at the same level as the buy out price, as their certificates will be directly replacing this cap However, independent generators may see a lower value than the buy out price as they will need to offer some discount or incentive to suppliers (to purchase certificates rather than simply pay the cap) The size of the discount will be dependent on the availability of certificates in relation to the size of the Obligation. It has been estimated here that independent generators will only receive 50 – 70% of the ROC value, although this is of widespread debate

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[5] These were previously referred to as 'green certificates' The term ROC was introduced to avoid any possible confusion with certificates used for CCL exemption, carbon trading and international green certificate trading

(iv) Embedded Generation Benefits

Embedded generation is generation that is directly connected to the distribution network, and is likely to represent the majority of renewable generation projects The principle that small embedded generators can be beneficial to the distribution (and even transmission) network has been established However, there are a number of problems to realising these benefits, which will vary both regionally and locally Since at present there is no framework for network operators to reward embedded generators this is not being included in the current calculations although the situation may change in the future This issue is discussed further in Chapter 6

(v) Penalties for Variable Generation

Most renewable generators are unlicensed and therefore will not be compulsorily exposed to the Balancing Mechanism. However, as most are too small to trade directly themselves, they will need to deal with a licensed supplier, or 'consolidator', who will then pass back some, or all, of the imbalance charges to them Renewable generation, such as wind, will be largely unpredictable within the time frames required for the Balancing Mechanism and this could reduce income by between 0 3 – 0 5 p/kWh.

Table 4 2 gives an indication of the target that generators must seek to achieve These are, for independent generators, of a similar order to the prices achieved under NFFO (Table 4 3) However, as it was noted in 4 2.3, there is one crucial difference – prices in the new market place must be achieved on the back of short term contracts with higher rates of return expected Thus the price only indicates half of the story and there is a real risk that many developers will not be able to secure finance in a post NFFO environment

It must be stressed that the prices indicated in 4 3 are those achieved in the bidding round, not those of operating projects

Table 4.3: Convergence of Prices Under NFFO

	Weighted average price [1]			Highest price contracted – NFFO5 (p/kWh)
	NFFO3 (p/kWh)	NFFO4 (p/kWh)	NFFO5 (p/kWh)	
Hydro (small-scale)	4 46	4 25	4 08	4 35
Landfill Gas	3 76	3 01	2.73	2 9
Municipal and industrial waste	3 84	2 75	2 43	2 49
Wind energy – small[2]	5 29	4 57	4 18	4 6
Wind energy – large[3]	4 32	3 53	2.88	3 1
Energy crops, agricultural and forestry wastes- gasification	8 65	5 51	Note 4	Note 4

1 Average price to be paid, weighted according to the expected output from each project, as of 30/06/00 Note that many of these projects will not have been financially viable at this price, and thus will not be developed

2 NFFO3 < 1 6 MW, NFFO4 < 0 768 MW, NFFO5 < 0 995 MW

3 NFFO3 > 1 6 MW, NFFO4 > 0 768 MW, NFFO5 > 0 995 MW

4 Not included as a technology for NFFO 5

4 2 5 *Financing Renewables*

The ability to obtain finance depends upon a number of factors, including the size of the project, the type of developer and the market risk.

Broadly speaking, project finance is only likely to be an option for projects over £10 million (equating to roughly a 10 MW generator) Below this projects are likely to be financed by commercial debt secured via smaller banks or co-operatives or, depending on the nature of the developer, on the strength of the developer's own balance sheet

It is appropriate at this point to consider who the developer is Commercial developers are unlikely to be interested in projects with a capital value less than £1 million and will be looking for high rates of return corresponding with their perception of market risk. A second class of developers can broadly be defined as those seeking to exploit a renewable energy resource as part of a wider strategy Examples could range from building a biogas plant as part of a waste management strategy on a farm, to harnessing energy crops as part of a rural diversification strategy Finally, a third group of developers exists for micro-generation such as PV or small wind or small hydro – projects that are likely to be developed for environmental reasons or (possibly) because they simply represent the cheapest option for an application that is not connected to the grid

Large projects such as wind farms, energy from waste plants and landfill gas generators are likely to be financed by banks or, in the case of the latter two, by the waste management company themselves (who may then lease the plant once it is up and running) However, this leaves a significant fraction of the renewable energy industry – looking to develop projects below say 5 MW who will find it difficult to attract finance Micro-hydro, biogas, energy crops, agricultural and forestry residues may be economically viable but simply not large enough to attract the attention of a commercial developer and too expensive for a home-owner or farmer to secure a loan for

Financing renewables will be considerably harder in the absence of long term secure NFFO contracts Developers are unlikely to be able to secure more than 10 year contracts, resulting in considerably higher repayments[6] Additionally, in the light of NETA, financiers may perceive their income subject to increased market risk

4.3 *Prospects for Individual Technologies*

A detailed economic analysis of the various renewable energy technologies was published by the DTI alongside its new renewable energy policy [DTI, 1999a] While it is not wished to repeat the significant amount of work that has already been done in this area, a brief commentary on each technology is provided here to provide the foundations for an assessment of the economic resource In each case the cost of electricity generated is determined by the efficiency of the energy conversion technology, offset by the capital, operational and maintenance costs of the plant

[6] This is already some evidence for this NFFO 1 and 2 contracts were set on the basis that the developer had to pay off all capital costs before 1998, rather than spread over the lifetime of the project. This partly explains why NFFO 1 and 2 prices were much higher than NFFO 3 when this requirement was removed

It is worth noting two points Firstly, that 'micro' technologies in particular (PV, small wind and small hydro) are unlikely to be assessed purely on the basis of their payback period Secondly, it is important to draw a distinction between technologies such as wind and hydro where the economics are strongly determined by the physical attributes of the site and technologies such as PV, energy crops and organic residues where an economic assessment is not (generally) site specific. This has important implications from a planning point of view since the latter allow a much greater degree of flexibility when incorporating renewables in a strategic planning policy

4 3 1 *Wind (Large-Scale)*

The economic viability of a turbine is strongly dependent on the wind speed since the power is proportional to the wind speed cubed[7] The BWEA in their analysis [BWEA, 2000] state 'It has been assumed that 7 0 m/s at 45 m height represents the lower limit of commercial viability for wind power in the UK in the expected economic conditions between 2000 and 2010 Although local circumstances and improvements in the technology may allow some projects to be constructed in areas with wind speeds below 7 m/s, these are not expected to significantly affect the total capacity '

The BWEA calculate that the cost of electricity, in the minimum wind speed band, will be 4 5 p/kWh using a discount rate of 10% and 'typical industry data for capital costs'

According to our analysis (Table 4 2), it will be difficult for independent generators to achieve this at the present time, although it seems realistic to assume that the cost of generation will drop further The DTI analysis predicts that capital costs (which typically account for 75% to 90% of the total cost of a wind farm) will decrease to 75% of 1996 costs by 2010 based on recent trends

[7] Note that energy yield does not in fact increase with the cube of wind speed since power conversion efficiencies vary with wind speed and, as the mean wind speed increase, a greater proportion of the energy is 'spilled' as the control system limits the output to its rated level Typically a site with an average wind speed of 8 m/s could be expected to produce 80% more electricity than the same turbine at a site of 6 m/s

4.3 2 *Wind (Small Scale)*

In most instances diesel generators are used for small power generation on farms where a connection to the grid is not available The economic resource can therefore be calculated from a comparison with the cost of diesel generation For diesel generators the fuel and operating costs are estimated to be approximately 7 p/kWh The difference in capital cost for a 200 W wind generator, as opposed to diesel is around £500 If the wind generator has an average load factor of 0 25 then it can be expected to produce 438 kWh of electricity per year, thus saving £30 on fuel and operating costs This results in a payback period greater than 15 years Although only a 'ballpark' calculation it is assumed that none of the theoretical resource will be economic, especially considering that wind generators are typically sold with just a 2 year warranty There is probably scope for a large reduction in costs if small wind turbines were to be mass-produced but this is difficult to foresee

4 3 3 *Energy Crops*

British Biogen estimate that the cost of electricity generated from energy crops is between 5 5 – 6 p/kWh [British Biogen, 2000]

Table 4 4 Estimate of Generating Cost for Energy Crops

Elements of cost	**Cost (p/kWh)**
Capital	2 0 – 2 5
Operations	1 0
Fuel	2.5
Total	**5.5 – 6.0**

Although this is higher than prices indicated in Table 4 2, capital grants are available for a limited number of schemes and the fuel cost should be reduced by the Government's Energy Crops Scheme. This will offer planting grants of between £920 and £1,600 per acre with the aim of delivering 20 – 25,000 ha of energy crops by 2007 [MAFF, 2000b]

Even so, the difference between cost and price is marginal and it seems safe to assume that the economic resource will be defined by those areas covered by both the MAFF planting grants <u>and</u> the capital grants for the energy conversion plant itself

4 3 4 *Agricultural Residues*

A recent detailed investigation of the economics of biogas plant in England [Cannington College, 1998] indicated that the anaerobic digestion of animal manure is likely only to be commercially economic if a substantial quantity of food processing residues are also available This is because the disposal costs for these residues can be received as a gate fee at the biogas installation In this case a generation cost of under 4 5 p/kWh may well be achievable However, the scale of facilities that are installed has a significant effect on the cost of generation, with one study in 1996 putting the generation cost for small farm scale plant as high as 5 9 p/kWh [ETSU, 1996a]

Thus it can be assumed that, in absence of any direct government support, that the only projects that will be economic by 2010 are those that will be able to attract food processing or other organic residues for a substantial part of their through put This will therefore favour centralised AD plant Typically this will include a net generation capacity of over 1 MW_e and will source manure from 40 – 60 farms within a 5 km radius of the facility A facility such as this would require 15,000 to 20,000 tonnes of food processing residues annually to make it viable

4 3 5 *Forestry Residues*

Due to the diverse nature of tree surgery operations, it is assumed that these will not be sufficiently reliable for the development of forestry residue projects This reduces the quantity of waste wood available to that from commercial tree felling operations and this is estimated to amount to 0 20 dry tonnes per annum per hectare of woodland Subsequently it is unlikely that forestry projects will be viable unless they contribute to a nearby energy crop project. In this circumstance all residues collected can expect to be used, as they can make a significant contribution to the economic viability of these projects by providing additional low cost resource

4 3 6 *Energy from Waste*

Energy from waste plant is capital intensive plant, and requires a guaranteed waste delivery for full operation. Thus it is assumed that the only plant that will be developed will serve only the domestic sector, as it is in this area that long term waste management contracts are available (up to 20 years) The Government is also proposing that electricity generated from energy from mixed waste projects will not be eligible under the Renewables Obligation on the basis that this technology (like existing large hydro electric schemes) is mature and commercial at base load electricity prices This is justified by the fact that the revenue from electricity sales for an energy from waste project is likely to only contribute in the order of a third of the total revenue for the project, with the remainder being raised from gate fees for waste disposal

4 3 7 *Landfill Gas*

Whilst landfill gas offers some of the lowest priced renewable energy available, installations are generally only effective if there size of the site is above a certain level. This is partly due to the economics of the grid connection, and partly due to the difficulties of providing effective anaerobic (without oxygen) environments at smaller sites The size of site held to be as economic has decreased from approximately 1,000,000 tonnes of waste capacity to 500,000 tonnes in recent years [DETR, 2000c]

4 3 8 *Sewage Gas*

Sewage gas was removed from the NFFO process after round 2, on the basis that it had reached, in the eyes of the Government, a fully commercial status

Currently it has only proved economic to installed anaerobic digestion facilities at sewage works that serve major urban areas with populations of over 80,000 – 100,000 This is a situation that is considered unlikely to change.

4 3 9 *Solar (Photovoltaic)*

Whilst there is evidence that PV is a cost effective option for some small off grid applications and there is a large world market for such systems, the opportunities are limited in the UK Thus only building mounted, grid connected systems are considered in this study For such PV systems the cost of electricity generation is currently > 50 p/kWh This is unlikely to be reduced to below 5 p/kWh in the foreseeable future and thus will not feature under the framework of the Renewables Obligation

However, PV is fundamentally different to all other forms of electricity generation in that it can be installed within the built environment (i e at the point of demand) and, furthermore, can be used instead of conventional building materials Under the present pricing structure this embedded generation benefit is not realised in economic terms, although there are moves to introduce 'net metering'[8] for PV

[8] At present, electricity exported to the network from a PV system is sold at, or close, to the 'pool' price (~ 2 p/kWh) despite the fact that the electricity is likely to be used locally and thus should not incur, it can be argued,

systems In regard to the latter it is more appropriate to calculate the cost of a PV systems in £/m² and to then offset the cost of alternative construction materials When PV is calculated in this way, as opposed to p/kWh generated, it may be economic in certain situations

A recent study [ETSU, 1998b] to determine the value of electricity generated from PV systems in buildings examined 5 case studies a new build office, office refurbishment, a superstore, a new-build domestic dwelling and a prestige public building. The study compared the cost of a PV system with conventional cladding in each case For curtain walling (say for a new office building) the PV system cost of £784/m² compares to £300/m² (stone), £420/m² (glazing), £640/ m² (granite faced precast concrete) The study concluded "Where PV replaces high cost, prestige cladding the PV electricity generation will become cost-effective in the short to medium term (after 2005) under all market development scenarios If a more supportive policy framework is in place, PV-integrated buildings are expected to become a commercial reality by 2010" The market for 'prestigious' wall claddings for new or refurbished offices is taken as the economic resource for PV between 2000 and 2010

4 3.10 *Hydro (Micro/Small)*

The economic viability of hydro power generally increases with installed capacity This in turn is determined by the product of design head and flow rate, which are both site specific factors.

A recent study for the Environment Agency [Environment Agency, 1999] investigated the potential for hydro power in the Anglian Region 15 sites with a head greater than 1 7 m were surveyed and the 5 most attractive sites selected for a more detailed economic analysis The results are presented below

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the full use of system charge Where PV generated electricity can be used in the building it is displacing electricity purchased from a supplier at ~ 7 p/kWh Hence under the existing commercial framework there is a large incentive to minimise the export to the grid 'Net metering' is a situation whereby the price paid for an exported kWh is equal to the cost of an imported kWh i e the owner only pays for the net electricity imported TXU Europe are the first (and currently only) utility to introduce net metering in the UK but it has been widely implemented in a number of countries such as the US Although net metering will not dramatically affect the economics of a PV system, introduction on a wider scale would provide a strong political statement and may add impetus to the growth of the small scale PV market in the UK

Table 4.5. Illustration of Costs for Micro-hydro

Site	Gross head (m)	Installed power (kW)	Total cost (as part of refurbishment) (£)	Tariff required[1] (p/kWh)	Tariff required[2] (p/kWh)	Capital cost/kW (£)
Castle Mills	2 8	72	140,000	4 15	3 29	1940
St Neots	2 37	61	132,000	4 28	3 38	2160
Elton	2 28	40	118,000	5 91	4 67	2950
Irthlingborough	2 34	34	112,000	7 45	5 90	3290
St Ives	1 78	44	129,000	6 13	4 87	2930

1 The Environment Agency set a criteria of an IRR 6% above inflation (which was 2 9% at the time of the study) and a 20 year design life

2 20 years was thought to be a rather pessimistic design life for a hydro scheme and so the analysis was carried out for a different set of parameters 30 year design life and 2% O&M costs (as opposed to 3%)

It can be seen that the tariff required is strongly dependent on the design life that is assumed for the plant but in any case the feasibility of each project is described as 'borderline' (Note that this study was carried out before the New Electricity Trading Arrangements and Renewables Obligation were announced and so the economic assessment is indicative only)

In this study, it is assumed that all sites with a head over 2 m will be economic This is probably a fairly optimistic view since micro-hydro is not a new technology and thus viable sites are likely in the vast majority of cases to have already been assessed and developed However, it can be justified on the grounds that.

(a) micro-hydro could feature as a strategic policy in part of the Environment Agency's weir refurbishment programme (in such an instance it is estimated that approximately only 10 – 20% additional costs would be associated with the hydro-scheme civil component)

(b) many micro hydro projects will be developed by large private landowners to met on site electricity demand This is more likely to be economic since the generated power is replacing that imported from an electricity supplier at ~ 7 p/kWh For example, at Houghton Mill (East Anglia), the National Trust are proceeding with a hydro-electric scheme as part of a major refurbishment of the Mill despite the fact that the design head is only 1 37 m The system is expected to produce 116 MWh/year and the Trust intend to consume the power in its properties in the region.

4.4 *Summary and Conclusions*

The economic resource is influenced, and determined by, the cost of electricity and the commercial environment. Both have been analysed separately and the aim here is to pull the two elements together to present a concise view of what renewable energy development can be expected in the next 10 years

From the review of the new commercial framework for electricity generation, two things are clearly apparent Firstly, that the economic assessment is highly sensitive to the details of the Renewables Obligation, NETA and, to a lesser extent, the Climate Change Levy The Government has chosen to introduce all three initiatives in parallel and this has resulted in a high degree of uncertainty in the market place This assessment is carried out based on the best information available to date but this information is changing on a monthly basis Secondly, it has become apparent that the economic viability of a project is significantly different when viewed from the perspective of an independent, as opposed to a supplier-tied, developer Consequently, each are presented in turn

Supplier tied Generator

For a generator tied to the supplier it is assumed that the full value of the Renewables Obligation Certificate and the Levy Exemption Certificate are met. This is in line with the Government's expectations of the Obligation.

In the 'best case' scenario (Table 4 2), biomass is likely to command a price of 5 4 p/kWh, wind and hydro (because of their intermittent nature) 5 1 p/kWh and energy from-waste (because it is excluded from the Obligation) 2 4 p/kWh In the 'worst case' scenario envisaged this could drop to 5 2 p/kWh, 4 7 p/kWh and 2 2 p/kWh respectively With the exception of energy from waste these prices are markedly higher than those achieved under NFFO and should therefore support the development of significant new capacity However, there are a number of caveats

1 Energy crops will only attain a price of 5 4 p/kWh if supported by both capital grants and the MAFF subsidies for farmers The extent of the economic resource is therefore determined by the size of these support measures Given the budgets proposed for these measures, only a relatively small proportion of the theoretical resource will be developed in the near term (see Appendix A) This also affects the exploitation of forestry residues since they are only likely to be developed in conjunction with energy crops

2 There are serious concerns as to whether energy-from-waste will be financeable with no support other than the Climate Change Levy exemption As noted earlier, if contract lengths fall from 15 years to 10 years, electricity prices for capital intensive projects, such as energy from waste, will need to increase by 50% Energy from waste plants will in many cases be financed by waste management companies on the strength of their balance sheet and will thus not necessarily need a 'bankable' contract. For the purposes of this study, we have assumed that this will be the case and that the economic resource will only be constrained by local targets for recycling waste However, we note the concerns of the relevant trade association in response to the Government's consultation document and surmise that that the Government is putting a sizeable renewable energy resource at risk in this way by assuming, without due evidence, that 'energy from waste is commercially viable, well established in the market and can compete with electricity from fossil fuels'

3 Supplier-tied generators are unlikely to be interested in 'small projects', say less than 1 MW This covers micro-hydro, biogas, PV and small wind Such projects have been, and are likely to continue to be, developed by independents (see below)

<u>Independent Generator</u>

For reasons mentioned earlier, independent generators may not receive the full value of the Renewables Obligation Certificate (ROC) and Levy Exemption Certificate (LEC) While the exact value is highly debatable at the present time, it has been assumed that they will receive between 50 – 70% of the ROC value and 50 – 100% of the LEC value Consequently, biomass will receive between 3 5 – 4 5 p/kWh, wind and hydro 3 0 – 4 2 p/kWh and energy-from waste 2 0 – 2 4 p/kWh At these prices only wind, landfill gas and sewage gas projects are likely to be viable and, in the case of wind, this will entail the development of 'prime' locations Since the windiest places are normally the most visible and often located in protected environments this reduces the chances of planning success

From the perspective of a regional resource study, it may not seem relevant as to whether projects are developed by an independent or supplier-tied company However, in the light of the third point (above), it is logical to conclude that there will be little or no development of small generators – micro-hydro, PV, small wind and biogas (agricultural residues) It is worth noting at this point that many of these may be developed as an alternative to grid connection for remote dwellings or on the basis of environmental concern, but from a purely economic perspective they are unlikely to be able to attract finance

It should also be noted that, historically, independent generators have achieved a far higher rate of success in achieving planning consent and so , apart from concerns that the Renewables Obligation may be viewed as anti-competitive (in favour of generators tied to suppliers), this has real implications for the likelihood of renewable energy development

A summary of the prospects for each technology is presented in Table 4 6 and this forms the basis for the calculation of the economic resource (Appendix A)

Table 4.6. Prospects for RE Technology

	Wind (large)	Wind (small)	Energy crops (forestry residues)	Agricultural residues	Waste	Landfill gas	Sewage gas	PV	Hydro (micro/small)
Technology status	Commercial	Commercial in niche markets	Under development	Combustion proven, gasification and pyrolysis under development	Combustion proven, gasification and pyrolysis under development	Commercial	Commercial	Under development	Commercial
Unit plant size (MW)	0 – 2	0 0002 – 0 006	5 – 30	0 5 – 20	> 5	0 1 1	0 5 – 6 0	0 – 0 1	0 025 5
Capital cost (£/kW)	650 – 800	2000 5000	1800 – 3000	2000 4500	3000 4500	750 – 1000	1000 – 1200	> 5000	2000 3000
Average NFFO5 price (p/kWh)	2 88 – 4 18	N/A	N/A	N/A	2 43	2 73	N/A	N/A	4 08
Price (p/kWh) under Obligation, CCL, NETA **i) supplier-tied** **ii) independent**	4 7 – 5 1 3 0 – 4.2	N/A	5 2 – 5.4 1 5 – 4 5 + capital grants & planting subsidy	5 2 – 5 4 3 5 – 4 5	2 2 – 2 4 2 0 – 2 4	5.2 – 5 4 3.5 – 4 5	5.2 – 5 4 3 5 – 4 5	N/A	4 7 – 5 1 3.5 – 4 5
Key variables	Size, Wind speed	Application, Wind speed	Transport + fuel costs	Transport costs, proportion of food processing residues	Size	Size	Size	Value as a building material	Head, flow rate, existing civil structure
Economic resource (key assumptions)	Wind speed > 7 m/s	More expensive than a diesel generator	Only for sites with capital grants and MAFF planting subsidy	Only if includes food processing or other organic residues	Domestic sector only	Sites over 500 000 tonnes capacity	Sewage works serving populations above 90,000	Replacement for 'prestigious' office claddings	> 25 kW Head > 2 m
Scope for reduced prices	Moderate	Moderate (could decrease if large number of units sold)	Good in medium term	Depends on agricultural policies	Limited	Limited	Limited	Good in medium / long term (depends on market size)	Limited
Comments	Depends on network & planning constraints		Resource limited by extent of capital grants & planting scheme	Difficulty financing small biogas projects	Development may be constrained by waste recycling policies	Potentially large profits under Obligation but many sites have already been developed	Potentially large profits under Obligation but many sites have already been developed	Potentially large growth in domestic sector even though not economic	Viable sites likely to already be developed

5 Planning and Environmental Policy

5.1 *Introduction*

The development of renewable energy resources in the West Midlands Region is governed by National, Regional planning guidance and policies presented within Development Plans (Structure Plans, Local Plans and Unitary Development Plans) These three levels of advice set a context for the identification of appropriate sites suitable for the development of renewable energy initiatives

For the purposes of this study the 'West Midlands' is taken to refer to the Government Office for the West Midlands Regional Area covering

- The Shire Counties of Shropshire, Staffordshire, Warwickshire, and Worcestershire,
- The Unitary Areas of Herefordshire, Telford and Wrekin, and Stoke on Trent, and
- The Metropolitan Districts of Birmingham, Coventry, Dudley, Sandwell, Solihull, Walsall, and Wolverhampton

This chapter of the report begins by describing the three levels of planning advice governing the development of renewable energy in the West Midlands region, and the planning application process It then describes the renewable policies that cover the study area (both adopted and draft/deposit policies) and discusses the main planning policies that guide the use/siting of renewable technologies

The Planning regime at any time reflects historic public attitudes and concerns Attitudes to the balance between protection of local and global environments and, thus, to renewable energy are changing rapidly This is evident in recently adopted Plans, and even more so in current draft revisions, which are specifically considered in Section 5 7 It is also likely to affect the level of support or otherwise for individual Planning applications in the future Given the lead time on renewable energy developments, change may not have any significant impact for the Government's 2010 target, but should be a relevant consideration for the longer timescale of RPG

5.2 Hierarchy of Planning Guidance Relating to the Development of Renewable Energy in the West Midlands

At the national level, Planning Policy Guidance Note 22. Renewable Energy (PPG22) [DETR, 1993] describes the general aims of government policy as they relate to renewable energy and land use planning At the regional level, Regional Planning Guidance for the West Midlands (RPG11) [DETR, 1994a] sets out a framework for development in the region Together, Planning Policy Guidance and Regional Planning Guidance provide the basis for the preparation of Development Plans These plans guide development control decisions at the local level Both strategic Structure Plans and Local Plans or the combined Unitary Plans have been reviewed for this study The following sections provide an explanation of the role of planning policy at each of these levels

National Guidance

Planning Policy Guidance (PPG) notes set out the Government's policies on different aspects of planning They provide guidance that should be taken into account by local authorities as they prepare their development plans In addition, PPGs may be material to decisions on individual planning applications and appeals

PPG22 issued in 1993, and its annex issued in 1994 [DETR, 1994b] deal specifically with renewable energy It states clearly that

In planning for the use of land by energy generating installations, the Governments general aims are

(a) *To ensure that society's needs for energy are satisfied, consistent with protecting the local and global environment,*

(b) *To ensure that environmental damage or loss of amenity caused by energy supply and ancillary activities is minimised, and*

(c) *To prevent unnecessary sterilisation of energy resources*

PPG22 identifies the development plans as being the framework documents for identifying sites and suggests that each authority should consider the contribution it can make to meeting the local, regional and national targets However, in suggesting that all authorities should contribute towards the delivery of renewable energy, it is recognised that renewable energy resources can only be developed where they occur

The PPG recognises that sites likely to be promoted for the development of renewable energy sources will often be in rural areas, and as such will almost always have some local environmental effects Thus, it is also recognised that the Government's aims to encourage the development of renewable energy sources will have to be balanced with the need to protect the environment.

The PPG recognises the special designations that cover rural areas, and their impact on the ability to develop renewable energy schemes That is, particular care should be taken in developing renewable energy projects in National Parks, Areas of Outstanding Natural Beauty and Sites of Special Scientific Interest Similar conditions arise in areas of archaeological or historic importance Following are quotes from PPG22 that note the potential conflict between renewable energy and environmental issues

PPG22 "Particular care should be taken, in assessing proposals for developing renewable energy projects in National Parks, Areas of Outstanding Natural Beauty and Sites of Special Scientific Interest"

PPG22 "In line with PPG2 very special circumstances are needed to justify development in the Green Belt, unless the particular proposal constitutes a use appropriate to a rural area. Any development should not injure the visual amenities of the Green Belt"

PPG22 "Local authorities should take account of the Government's policy for renewable energy sources along with those on such topics as Green Belts, conservation areas in town and country, and industrial and commercial development"

PPG22 contains a number of detailed Annexes considering different forms of renewable energy Each form of development has its own potential impacts that need to be taken into consideration before a scheme is implemented The forms of renewable energy covered are:

- Wind energy,
- Waste combustion,
- Hydro power;
- Wood fuel,
- Anaerobic digestion,

- Using landfill gas, and
- Active solar systems

Other Planning Policy Guidance Notes are also relevant to this study in determining constraints to the development of renewable resources When considering the constraints to the introduction of renewable energy schemes, the PPG7 (Countryside) [DETR, 1997], PPG2 (Greenbelts) [DETR, 1995], PPG 9 (Nature Conservation) [DETR, 1994c], PPG15 (Planning and the Historic Environment) [DETR, 1994d] and PPG16 (Archaeology) [DETR, 1994e] should be considered These PPG notes seek to protect the more sensitive parts of the environment and thus their requirements need to be balanced with the requirements of the national renewable energy strategy

<u>Regional Guidance</u>

The primary purpose of Regional Planning Guidance is to set the framework for development plans in the region As such, RPG11 presents a general strategy for development in the West Midlands during the period to 2011 This is currently under review RPG11 sets out a series of broad themes for development Of particular relevance to the development of renewable energy are the following objectives

- "encouraging the conservation of natural resources through reducing demand, using renewable resources and recycling",

- "ensuring that development is carried out in an environmentally sensitive manner", and

- "ensuring a strong and permanent Green Belt"

The guidance builds on PPG22 to state that "The development of renewable energy resources should be encouraged where there are prospects of them being economically viable and environmentally acceptable The advantages of having a clear renewable energy resource, which can contribute to local, regional and national requirements, and the benefits to the local economy, should be weighed against other environmental impacts" It identifies the following resources to be potentially available in the region

- biofuels,

- solar radiation,
- wind energy, and
- small scale hydro

The RPG review process is currently considering the contributions that Regional Planning Guidance can bring to emerging energy policy The results of this study, indicating the potential for renewable energy in the region, will inform the direction of future regional guidance.

Development Plans

Development plans contain policies and proposals for the development and use of land, the conservation of the natural beauty and amenity of the land, the improvement of the physical environment; and the management of traffic In preparing plans, local authorities must have regard to national policies set out in PPGs and RPG Indeed, the role of the development plan is to implement national and regional policy at the local level.

The development plans covering the country comprise Structure Plans and Local Plans or Unitary Development Plans The Structure Plan is where the strategic planning authority, the county council, sets out its strategic policies for development in the County over the next 15 years These are not generally site specific

Using these policies as a framework, local planning authorities produce local plans These plans containing the district councils' detailed site specific development control policies and proposals In metropolitan areas, and some larger free standing towns and cities, the strategic and local planning responsibilities are combined within an Unitary Authority Accordingly, the functions of structure and local plans are combined in a Unitary Development Plan (UDP)

Policies in Structure Plans seek to summarise the authorities overall stance in planning for different types of development. The Structure Plan policies are not site specific Accordingly, PPG22 states that authorities preparing Structure Plans "should include their general polices and proposals on providing renewable energy in their areas, including the general location of any individual project likely to have a significant effect on their area" (emphasis added)

Structure plan policies provide the basis for more detailed policies to be developed in Local Plans PPG22 advises that authorities preparing Local Plans should "include their specific policies for developing renewable energy sources and should identify broad locations, or specific sites suitable for the various types of renewable installations" (emphasis added)

In the case of Unitary Development Plans, Part I fulfils a role comparable to that of the Structure Plan as described above, and Part II serves a purpose analogous to that of the local plan

Development plans follow a staged preparation, such that a review of the current/adopted plan begins before the end of the plan period Most planning authorities begin the review process by issuing topic papers to stimulate debate on the general themes to be addressed in the plan. A consultative draft plan is then produced, with a public consultation period of six weeks duration The plans are then modified to take account of comments received and placed on deposit for formal public consultation Objections to plan policies that remain unresolved are considered at an examination in public, in the case of Structure Plans, and a public local inquiry in the case of Local Plans A report to the local planning authority is prepared by the inquiry inspector, recommending amendments to the plan Subsequently, a series of proposed modifications are issued by the planning authority for further public comment Assuming no further issues are raised, the modified plan progresses to adoption

5.3 *Planning Applications*

Planning permission is required for building, engineering operations and changes in land use Most activities involved in renewable energy projects will therefore require planning permission The erection of wind turbines, for example, is classed as a building operation, and may also require engineering operations, and therefore needs to have planning permission Growing crops will not generally require planning permission, although the construction of a generating plant for the processing of crops would. Similarly the creation of landfill sites, sewerage plants, and related generating plants also require planning permission

Connection to the local electricity distribution network may also need permission from the local planning authority or consent from the Secretary of State In the case of solar power, the erection of solar panels on a commercial basis will usually require planning permission However, solar panels on domestic properties do not normally require planning permission, unless the properties lies within a conservation area

It is also possible, for some kinds of renewable energy schemes, to secure a temporary planning permission This may be appropriate where the local planning authority is uncertain about the impact on the local environment and it wishes to trial a potential 'bad neighbour' development This may not be appropriate where a large capital set up cost is required, but may be appropriate for small schemes or where the infrastructure costs can be easily transferred

In order to take account of the environmental impact of renewable energy schemes, PPG22 states that local planing authorities and others should consider, at an early stage, whether an environmental assessment (EA) should be undertaken The environmental assessment procedure allows issues such as landscape, air quality, water quality, local ecology and noise to be considered prior to the determination of planning application, therefore ensuring that planning decisions are made with due regard to likely environmental effects Only two categories of renewables technologies carry a mandatory requirement for environmental assessment These are thermal power stations or other combustion installations with a heat output of 300 MWs or more and waste disposal installations for the incineration or treatment of special waste

Most renewable energy schemes fall within Schedule 2 of the Town and Country Planning Act (Assessment of Environmental Effects) Regulations 1988 They therefore require environmental assessment if they are likely to have significant effects on the environment The responsibility for deciding whether a Schedule 2 project requires environmental assessment lies with the local planning authority, though the decision is open to challenge by appeal to the Secretary of State

In 1989, as part of the privatisation of the electricity supply industry, the Non-Fossil Fuel Obligation (NFFO) was introduced. This obliges the regional electricity companies to secure a specified part of their electricity supply from non fossil fuel sources Since 1990, 933 projects have been contracted under the NFFO, Scottish Renewables Obligation (SRO) and the Northern Ireland (NI NFFO)

Table 5 1 summarises the status of these applications Nationally 89% of the planning applications determined to date, have been approved However, this data hides marked differences between technology bands, with wind farm proposals accounting for a majority of projects refused planning permission to date

Over a third of all contracted renewable energy schemes have yet to enter the planning arena Therefore whilst the statistics on approved applications appear encouraging, it is important to note that many schemes have not yet reached this stage Thus, whilst less than a quarter (760 MW DNC) of the of renewable energy capacity contracted in England & Wales under the NFFO process (3270 MW DNC) had been commissioned by 30 June 2000 this is only partly due to planning policy

Table 5.1. Planning Status of all NE[illegible] Contracted Renewable Ener[illegible] Pro[illegible]ects – February 2000

PLANNING STATUS	NFFO -1	NFFO -2	NFFO -3	NFFO -4	NFFO-5	NI NFFO	NI NFFO	SRO 1	SRO -2	SRO 3	ALL
No application required	23	28	4	4	1	6	1	1	0	0	68
No application submitted	8	13	23	75	160	0	4	4	15	42	344
Application awaiting decision	0	0	5	16	30	0	1	3	1	3	59
Application withdrawn	0	8	8	2	1	0	0	0	0	0	19
Planning permission granted	44	63	85	85	65	14	4	18	9	7	394
Planning permission refused	0	10	16	13	4	0	0	4	1	1	49
TOTAL	75	122	141	195	261	20	10	30	26	53	933

Source [K Cadick, 2000]

5.4 *Methodology*

In reviewing the planning policy context for the development of renewable energy in the West Midlands a two tier approach was adopted In the first instance a questionnaire based consultation exercise was undertaken The second, more intensive stage, comprised a detailed review of development plan policies

Consultation

In August 2000, an invitation to comment was sent to each of the local planning authorities as well as other interested organisations The purpose of this consultation exercise was to gather information on four issues as follows

(a) Existing renewable energy generation,

(b) Previous estimates of the resource,

(c) Potential impacts and constraints, and

(d) Planning policies

Responses were received from 22 organisations Appendix B contains a table summarising these responses Reponses to (a) and (b) are largely reported elsewhere in this report. However, responses to issues (c) and (d) have informed the review of planning policy context and constraints, the findings of which are reported in the following sections

Review of Development Plans

The development plans (Structure, Local and Unitary Development) relevant to this study are set out in Table 5 2

For each planning authority a two stage review was conducted In the first instance, adopted plans were reviewed in order to determine the stance of the local planning authority in terms of the development of renewable energy resources, and also the nature of any policies (primarily environmental) that might act as a constraint to such activity In the second, where available, deposit draft plans were considered in order to understand the way in which renewable energy issues are being dealt with through the plan review process

For each authority a proforma was completed as a means of summarising plan policies as well as responses from the consultation exercise. These are presented in Appendix C.

The findings of this review are reported in the following sections

Table 5.2 Plans Reviewed for this Study

County (Structure Plan)	District (Local Plan)	Unitary Area (UDP)
Warwickshire	North Warwickshire	
	Nuneaton and Bedworth	
	Rugby	
	Warwick	
	Stratford on Avon	
Worcestershire	Wyre Forest	
	Bromsgrove	
	Redditch	
	Wychavon	
	Worcester	
	Malvern Hills	
Staffordshire	Newcastle – under – Lyme	
	Staffordshire Moorlands	
	Stafford	
	East Staffordshire	
	South Staffordshire	
	Cannock Chase	
	Lichfield	
	Tamworth	
Shropshire	Oswestry	
	North Shropshire	
	Shrewsbury and Atcham	
	South Shropshire	
	Bridgnorth	
	Wrekin#	
		Herefordshire
	Hereford #	
	Leominster #	
	South Herefordshire #	
		Telford and Wrekin
		Stoke-on Trent
		Birmingham
		Coventry
		Dudley
		Sandwell
		Solihull
		Walsall
		Wolverhampton

Note # Adopted Plan before local authority reorganisation

5.5 *Current Planning Policy and Renewable Energy*

This section outlines the planning policy context in the West Midlands region. It discusses the nature of adopted policies and the differences in stance between each of the areas Section 5 6 will draw further on the policies described here, considering their implications in terms of the actual development of renewable resources

Overview

Table 5 3 summarises way in which the adopted development plans deal with renewable energy It highlights those that include a planning policy on renewable energy as well as those that address the issue in more detail through the inclusion of a technology specific policy

None of the adopted County Structure Plans contain policies relating to renewable energy This is perhaps a function of the age of the documents, dating from the early 1990s, prior to the publication of PPG22 However, two of the Unitary Development Plans include a general policy relating to renewable energy

14 of the 27 adopted Local Plans include a general planning policy on renewable energy Those Local Plans making reference to renewable energy are those that have been most recently published, with 12 of the 14 dating from post 1997 This is encouraging, suggesting that local authorities are increasingly recognising the potential contribution of renewable resources

Local Authority Approaches

The style and detail of the local plan policies, as well as explanatory text, varies between districts In several of the local plans renewable energy is dealt with in a single fairly broad statement. In such cases the local authority has very little to base their development control decisions on In other cases, development plan policies are more detailed, providing more specific guidance on the factors that would be considered in the granting of planning permission.

The Lichfield Local Plan (adopted in June 1998) makes a brief and concise statement in support of renewable energy It states that

"The District Council will support proposals for the production of power from renewable sources provided there is no unacceptable impact on the environment and the criteria of policy DC 1"

South Shropshire is an example of an authority that is more detailed and prescriptive in their approach For example, Policy GP6 (Renewable Energy) of the Local Plan (adopted in October 1994) states that:

"Proposals will normally be permitted for developments designed to generate or capture energy from naturally sustainable sources if

(a) The adverse effects upon agriculture, forestry and other existing lands uses or activities are minimised,

(b) The proposals would not adversely affect the Area of Outstanding Natural Beauty or the Area of Special Landscape Character;

(c) The proposals take full account of policy LN11 (protection of sites of special scientific interest and nature conservation),

(d) The proposals are consistent with the criteria set out in policy GP2 (new development general requirements), and

(e) The proposals area accompanied by an environmental statement where this is required by the Town and Country Planning (assessment of environmental effects) Regulations, 1988 "

Similarly the Wychavon Local Plan states that:

"In determining applications for renewable energy developments, the Council will need to be satisfied that there will be no adverse environmental effects which would present a risk to health and safety, loss of residential amenity due to noise or other disturbances, damage to ecological and nature conservation interests or damage to important landscape designations Applicants are asked to demonstrate the extent that the proposal would contribute to national and local energy needs, limiting greenhouse gases, the likely effect of the proposal on the local environment and the likely impact on the qualities and character of the area In addition, proposals will not normally be allowed within the Cotswold AONB "

The Peak District National Park Structure includes a general, fairly restrictive, policy on energy:

"Major development to generate or store energy will not be permitted other than in exceptional circumstances. Small scale development to generate or store energy to meet a local need will normally be permitted provided that it does not detract from the appearance of the landscape and the buildings it serves."

The National Park local plan however, is more encouraging, stating that

"The development of a renewable energy source will be permitted provided that the development and all ancillary works including transmission lines can be accommodated without harm to the valued characteristics or other established users of the area"

In general, the tone of the planning policies is one of overall encouragement, subject to certain criteria. The nature of the criteria mentioned in the plan policies varies between districts. The following issues are illustrative of the types of factors considered by local planning authorities across the region

- Effects on agriculture, forestry and existing land uses,
- Effect on designated landscapes,
- Effect on ecological or nature conservation interests,
- Visual impact,
- Impact on conservation areas, listed buildings, scheduled ancient monuments, and archaeological remains,
- Health and safety implications,
- Noise levels,
- Effect on the amenity of local residents,
- Provision of adequate vehicular access,
- Impact on the highway network and additional traffic,
- Impact on land after operation ceases;
- Impact of connection to the grid,
- Electromagnetic disturbance, and
- Effect on airport flight paths

Environmental/Development Led Policies

In general terms, the planning policies of the Staffordshire districts stand out as being particularly detailed Policies for the South Staffordshire, Stafford and Cannock Chase areas describe a number of criteria, to which applications for the development of renewable energy resources are expected to comply The policies for these three districts are very similar, considering ecological, environmental and conservation issues as well as more technical concerns such as connection to the national grid and levels of electromagnetic disturbance. The Wrekin local plan adopts a similar standpoint stating that proposals should accord with other policies relating to countryside, open land, and historic environment and should also not damage public rights of way or cause electromagnetic interference

In Shropshire (Oswestry and South Shropshire) those polices relating to renewable energy appear to be more concerned with environmental effects and in particular landscape impacts Similarly, in the Dudley Unitary Development Plan, the approach is very much environmental led, stating simply that "The council will encourage and support the development of renewable energy products provided that the visual and environmental impact on the surrounding area is acceptable "

However, in the Worcestershire districts (Wychavon and Malvern Hills) a less qualitative, more quantitative stance is conveyed. For example policies state that proposals will be permitted provided that they have the potential to make a contribution to national, regional or local targets This is a factor that is not stated in policies elsewhere in the region. Whilst the Wychavon plan acknowledges the need to protect the Area of Outstanding Natural Beauty, policies in this do not seem to emphasise environmental and conservation issues as is the case elsewhere. Rugby is also of a similar standpoint, setting out a range of criteria addressing the need to avoid adverse effects on dwellings and businesses nearby and airport flight paths, but giving very little emphasis to environmental effects

Technology Specific Policies

Of the 14 adopted development plans that address renewable energy, 4 (Malvern Hills, Oswestry, South Shropshire and Wrekin) adopt a dual approach including, firstly, a policy generally seeking to encourage the development of renewable resources, and secondly more detailed policy relating specifically to wind farm development

As with the general policies the tone of the technology specific policies differs between districts Indeed, the South Shropshire plan makes clear that visual impact and effect on landscape quality are primary concerns

"Proposals for windfarm development will only be permitted within the Area of Outstanding Natural Beauty and Area of Special Landscape Character where its prominence and visibility would not adversely affect the quality, setting and enjoyment, of the landscape Elsewhere windfarm development will normally be permitted where its scale, siting or cumulative effect would not have an adverse impact on landscape quality and recreational enjoyment"

However, the approach of the Wrekin Local Plans is more positive, addressing design issues and ways in which adverse impact may be mitigated For example, it states that:

"The Council will permit the development of schemes to generate from wind subject to the Countryside and Open Land policies of this plan and provided that:

(a) The size, grouping and colour of turbines are designed to the scale and grade of the landform, to ensure that, while a stable air flow is maintained to the turbine, its visual impact on the landscape is minimised,

(b) The buildings and infrastructure are designed to minimise their impact on the landscape,

(c) The turbines are located so as they avoid sensitive skylines where they would dominate long distance views,

(d) Descriptive material, for example photomontage, is provided, to enable an assessment to be made of the visual impact of the development,

(e) The links to the electricity grid have no detrimental impact on wildfowl migratory pathways, wildlife habitats, or sites of natural scientific or archaeological interest,

(f) The turbines are located so as to minimise their impact on residential development, highways, or public rights of way with particular regard for noise, shadow flicker and possible machine failure,

(g) The direction of turbine rotation is designed to minimise visual impact, and

(b) *An assessment is made of the likely impact upon operational airfields, radar and telecommunications "*

Similarly, the Malvern Hills Local Plan states that

"Proposals for wind energy installations will be permitted provided it can be shown that

(a) *There would be no significant harm on the amenity of adjoining residential properties,*

(b) *Details of material and colour are provided which are sympathetic to the character of the area as a whole,*

(c) *Details of the practical availability of the means of connection to the existing electricity supple network are acceptable,*

(d) *Details of photo-montages are provided to assess the visual impact of the development for larger scale developments,*

(e) *Adequate vehicular access, parking, servicing and manoeuvring can be provided within the site,*

(f) *The development is set back from major roads and railways at least by the height of the proposed turbines so as to achieve maximum safety,*

(g) *They do not conflict with other relevant policies of this local plan.'*

Table 5.3. Summary of Review of Adopted Plans

Structure Plan/UDP area	Local Plan Area	Date of Adoption	Policy on renewable energy	Technology specific policy
Warwickshire		Sept '91	X	X
	North Warwickshire	May '95	X	X
	Nuneaton and Bedworth	Feb '93	X	X
	Rugby	Jun '97	✓	X
	Warwick	Apr '95	X	X
	Stratford upon Avon	May '00	X	X
Worcestershire		Jun '93	X	X
	Wyre Forest	May '96	X	X
	Bromsgrove	Feb '96	X	X
	Redditch	Jan '98	X	X
	Wychavon	Mar '98	✓	X
	Worcester	Jan '98	X	X
	Malvern Hills		✓	✓
Staffordshire		Apr '91	X	X
	Newcastle – under – Lyme	May '95	X	X
	Staffordshire Moorlands	Sept '98	✓	X
	Stafford	Oct '98	✓	X
	East Staffordshire	Mar '99	X	X
	South Staffordshire	Dec '96	✓	X
	Cannock Chase	Mar '97	✓	X
	Lichfield	Jun '98	✓	X
	Tamworth	Jan '95	X	X
Shropshire		Jan '93	X	X
	Oswestry	Jun '99	✓	✓
	North Shropshire	Aug '96	X	X
	Shrewsbury and Atcham	'92	X	X
	South Shropshire	Oct '94	✓	✓
	Bridgnorth	-	X	X
	Wrekin*	Feb '00	✓	✓
Herefordshire				
	Hereford *		✓	X
	Leominster *		✓	X
	South Herefordshire *		✓	X

Structure Plan/UDP area	Local Plan Area	Date of Adoption	Policy on renewable energy	Technology specific policy
Stoke on Trent		Sep '93	X	X
Birmingham		Jul 93	X	X
Coventry		Mar '93	X	X
Dudley		Nov '93	✓	X
Sandwell			X	X
Solihull		Apr '97	X	X
Walsall		Mar '93	X	X
Wolverhampton			X	X
Peak District National Park		April 1994	✓	X
	Peak District National Park	Dec 2000	✓	X

Note * Adopted Plan before local authority reorganisation

5.6 *The Constraints of Planning Policy*

Overview

Whilst generally encouraging the use of renewable energy resources planning policy does, nonetheless, constrain the development of renewable technologies in certain respects and in certain locations Indeed, as described above, development plan policies outline a number of criteria to which proposals must accord Furthermore, renewable energy operations are required, in the same manner as all other development, to correspond with other development plan policies

In the case of renewable energy sources environmental concerns are paramount and thus the priority accorded by the planning system to protect the natural and built environment is a potentially significant constraint to their development. At the macro scale the planning system seeks to control development of protected landscapes, often covering large areas Indeed, PPG22 recognises that the development of renewable energy will be subject to stricter planning controls in areas designated to protect the landscape and wildlife As such, proposals to generate power from certain renewable technologies in areas designated as National Parks, Areas of Outstanding Natural Beauty, and locally important landscapes (classed as Special Landscape Areas or Areas of Great Landscape Value) will be subject to special scrutiny Indeed, whilst these designations do not preclude development, they introduce additional development control issues which seek to ensure that development is compatible with the environmental quality of the area Sites of Special Scientific Interest, Special Protection Areas, and Special Areas of Conservation, Ramsar Sites, National Nature Reserves, Ancient Woodland are also significant.

In terms of the development of certain technologies such environmental planning policies are likely to be a significant constraint Whilst it is recognised that these policies do not entirely preclude development, for the purpose of this study, and the calculation of the deliverable resource, these have been considered as 'blanket' constraints That is, it is considered that significant development of renewable resources in these areas, of the scale that could make a contribution to regional output, is unlikely to go ahead. These areas have therefore been excluded Table 5 4 illustrates the likely constraint that each of these designations may have upon the development of each of the renewable technologies considered in this study

The following paragraphs describe the significance of these environmental planning constraints and their relevance to each of the technologies

Table 5 4 Planning Policy Constraints

	Large Scale Wind	Small Scale Wind	Energy Crops	Agricultural Residues	Forestry Residues	Municipal Commercial and Industrial Wastes	Sewage Sludge	Landfill Gas	Hydro	Solar
National Park	✓	✓[3]	✓[3]	-	-	✓[2]	✓[2]	✓[2]	-	-
AONB	✓	✓[3]	✓[3]	-	-	✓[2]	✓[2]	✓[2]	-	
Green Belt	✓	✓[3]	✓[3]	-	-	✓[2]	✓[2]	✓[2]	-	-
National Nature Reserve	✓	✓	✓	✓[1]	✓[1]	✓	✓	✓	✓	N/A
Special Protection Areas	✓	✓	✓	✓[1]	✓[1]	✓	✓	✓	✓	N/A
Special Areas of Conservation	✓	✓	✓	✓[1]	✓[1]	✓	✓	✓	✓	N/A
Ancient Woodlands	✓	✓	✓	N/A	✓[1]	✓	✓	✓	✓	N/A
SSSI	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
Ramsar Sites	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A

KEY

✓ Indicates a constraint to the resource

✓[1] Designation would be a constraint to the development of processing/generation facilities but would not necessarily be a constraint to the use of land to collect the resource (For example, Forestry residue could be collected from an ancient woodland as long as the processing plant was situated elsewhere)

✓[2] Indicates a constraint to the resource if an entirely new facility is required These designations may not necessarily constrain the resource if power were to be generated from an existing site (for example, generation from an existing landfill site)

✓[3] Indicates a constraint to the resource dependant upon scale of the technology

\- Indicates no significant constraint to the resource

National Park

The Peak District National Park covers the northern section of Staffordshire The National Park Authority is a local planning authority in its own right and therefore has its own Structure and Local Plans, as indicated above. Whilst the National Park Authority supports the principles of sustainable development it gives priority to conserving and enhancing the National Park. The Structure Plan therefore allows only for small scale power schemes that are consistent with local needs and where they can be accommodated without damage to the appearance of the area. This states that:

"Major development to generate or store energy will not be permitted other than in exceptional circumstances and that "Small scale development to generate or store energy to meet a local need will normally be permitted provided that it does not detract from the appearance of the landscape or the buildings it serves"

The local plan policy suggests that the development of renewable energy resources will be permitted provided that they do not harm the National Park's valued characteristic Renewable energy schemes need therefore to be acceptable in the landscape Size, design, siting, impact on wildlife and associated landscape are all important considerations

The plan states clearly that "wind farms or large scale individual wind turbines are not acceptable" Indeed, it considers free standing structures of more than a few meters in height to have a significant visual impact and thus unacceptable within the National Park. For this reason, the area of the Peak District National Park has been excluded from the area in which large scale wind turbines might be developed

However, the local plan states that small scale wind turbines located on farm buildings or properties may be permitted Indeed, the explanatory text states that

"Some small scale, normally supplementary, power generation, may constitute 'permitted development' (for example, a small individual turbine, sited on a domestic property or farm building)"

Permission is likely to depend on the siting and scale of equipment Table 5 4 therefore notes that within the National Park, small scale wind technology may be constrained, subject to precise location and visual impact

The local plan does not make specific reference to other technologies However, it is important to consider the way in which the National Park may influence other technologies. In the case of energy crops, the development of processing plants may be constrained by the general development policies In addition, whilst the conversion of agricultural land to energy crops would not require planning permission, any large scale change in the National Park (particularly where this might impact visually) is likely to be resisted.

Similarly, generation of power from waste, sewage or landfill gas is unlikely to be acceptable, unless the basic facilities already exist National Park status is not considered to be a constraint to generation from agricultural or forestry residues

AONB

Areas of Outstanding Natural Beauty (AONB) are recognised as nationally important landscapes in much the same way as National Parks The West Midlands region contains three AONB, The Malvern Hills, The Shropshire Hills, and Cannock Chase Unlike National Parks, these areas are the responsibility of local planning authorities Structure Plans and, where relevant, Local Plans, therefore include policies that seek to preserve the natural beauty and landscape quality of these areas

For example, the Cannock Chase AONB is described in both the Structure Plan and the Local Plan The Structure Plan Policy is as follows

"The local authorities will continue to conserve and enhance the landscape and the nature conservation and recreation interests of Cannock Chase Area of Outstanding Natural Beauty and its setting Within the AONB, development will normally be restricted to uses compatible with the conservation of the natural beauty of the area Any proposals for development will be subject to special scrutiny, having regard particularly to the environmental effects of the proposals "

The Cannock Chase Local Plan states that

"The integrity of the Cannock Chase AONB will be protected in the following way

(a) The District Council will continue to conserve and enhance the landscape, nature conservation and recreation interest of the AONB and its setting,

(b) *Only development which is compatible with the conservation of the natural beauty of the AONB and is in accordance with other relevant policies of the Local Plan will be permitted,*

(c) *Proposals for development on the fringes of the AONB will be considered in the context of the primary objectives of protecting the Area's quality,*

(d) *The District Council will support measures to reduce the impact of traffic on the roads throughout the designated area "*

Proposals for development of renewable energy in the AONB are therefore judged by such criteria In several cases, it was found that renewable energy policies refer specifically to the protection of the AONB For example, the South Shropshire plan states that generation from renewable resources will only be permitted if they do not adversely affect the AONB

AONB status is a particular constraint on the construction of wind turbines, as it is perceived that their visual impact would be detrimental to landscape quality For example, the South Staffordshire plan states that proposals for wind turbines will not be permitted where they have a significant impact on the landscape quality of the AONB

In terms of constraining the development of renewable energy resources, AONBs have a similar influence as the National Park Indeed, whilst their status does not necessarily preclude development, the overriding concern to protect landscape and environmental quality is likely to be a constraint to development, particularly of large scale wind turbines AONBs have therefore been excluded from the area used to calculate the wind resource The impact of AONBs on the other technologies is much the same as described above in the context of the national park

Green Belt

Green Belts are designated around major urban areas Within the study area they apply around the West Midlands and North Staffordshire conurbation's and also Burton on Trent. Green Belts serve five main purposes These are to

- Check the unrestricted sprawl of large built up areas,
- Prevent neighbouring towns from merging into one another;

- Assist in safeguarding the countryside from encroachment;
- Preserve the setting and special character of historic towns, and
- Assist in urban regeneration, by encouraging the recycling of derelict and other urban land

These areas are therefore not designated for any particular landscape value However, in seeking to achieve the objectives outlines above Green Belts seek to prevent development which is likely to prejudice the openness of the countryside Inside, the Green Belt, approval should not be given, except in very special circumstances, for the construction of new buildings or for the change of use of existing buildings for purposes other than agriculture and forestry, outdoor sport, cemeteries, institutions, or for other uses appropriate to a rural area.

Therefore, the development of infrastructure associated with renewable energy resources in the Green Belt is likely to be strongly resisted. Indeed, PPG22 on renewable energy states that "in line with PPG2 very special circumstances are needed to justify development in the Green Belt, unless the particular proposal constitutes a use appropriate to a rural area. Any development should not injure the visual amenities of the Green Belt" Green Belts are therefore likely to be a constraint to the development of large scale wind farms and to the construction of facilities required for the generation of power from energy crops, waste, sewage, or landfill However, small scale wind turbines fixed to existing buildings would be more appropriate in the Green Belt

SLA/AGLV

Special Landscape Areas and Areas of Great Landscape Value are locally designated landscapes, usually following a review of landscapes instigated by the County or District Authority As such, these areas do not carry the same status as nationally designated landscapes (National Parks and AONBs) Notwithstanding, the local designation of these areas, in considering proposals for development, the local planning authority will have particular regard for the effect on the landscape

Research has found that the local planning authorities are beginning to take a different approach to the designation of these locally important landscapes Current adopted Structure Plans define broad areas, which are subsequently detailed in current adopted Local Plans However, more recent Structure Plans tend not to define such areas on the key diagram, instead taking a broader view seeking to protect landscape and environmental quality across the county in a more holistic sense

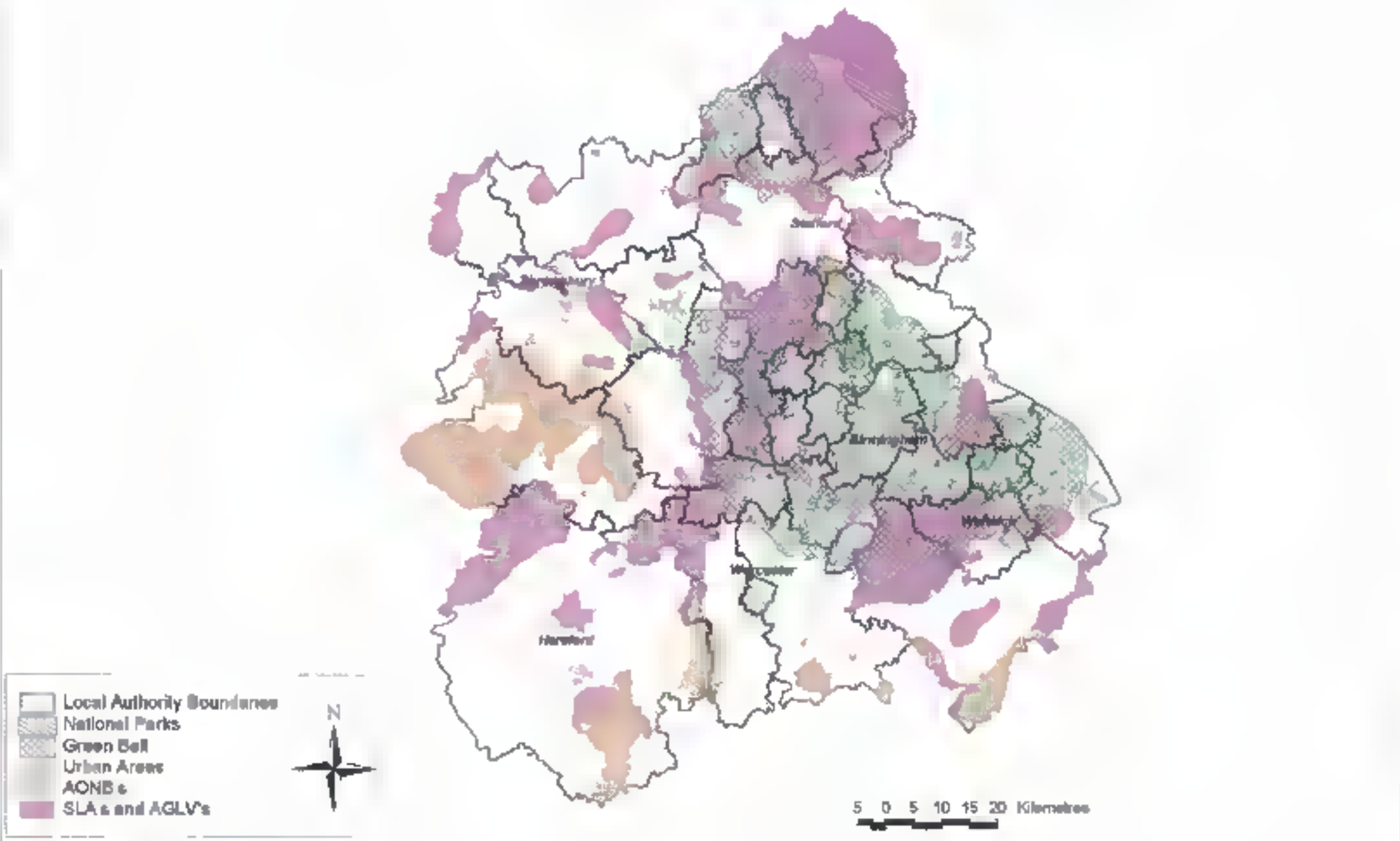
Given the current policy context in which these areas are defined within adopted Local Plans, these designations are considered to constrain the development of renewable energy resources in the same manner as the other landscape designations However, it is important to recognise that these are not nationally recognised and thus, carry a lower importance as a basis for development control decisions

Figure 5 1 illustrates the extent of National Park, AONB, Green Belt and SLA/AGLV within the West Midlands region.

<u>Sites of Special Scientific Interest/Ramsar Sites/National Nature Reserves/ Scheduled Ancient Woodland/Special Protection Areas and Special Areas of Conservation</u>

SSSIs, Ramsar Sites, NNRs, Scheduled Ancient Woodland, SPAs and SACs are nationally recognised sites which afford a high level of protection to flora and fauna The location of these sites is illustrated in Figures 5.2-5 7 It is important when considering the impact of development on these sites that attention is paid to the potential damage which could occur from development adjacent to, or some distance from, the site Local Plan Policies therefore seek to control development that may have an adverse effect on such areas

Most of these areas cover a relatively small area However, they a significant constraint upon the siting of infrastructure They are therefore a constraint to the development of renewable energy schemes One exception to this may be the managed collection of agricultural and forest residues, provided that physical infrastructure was located elsewhere



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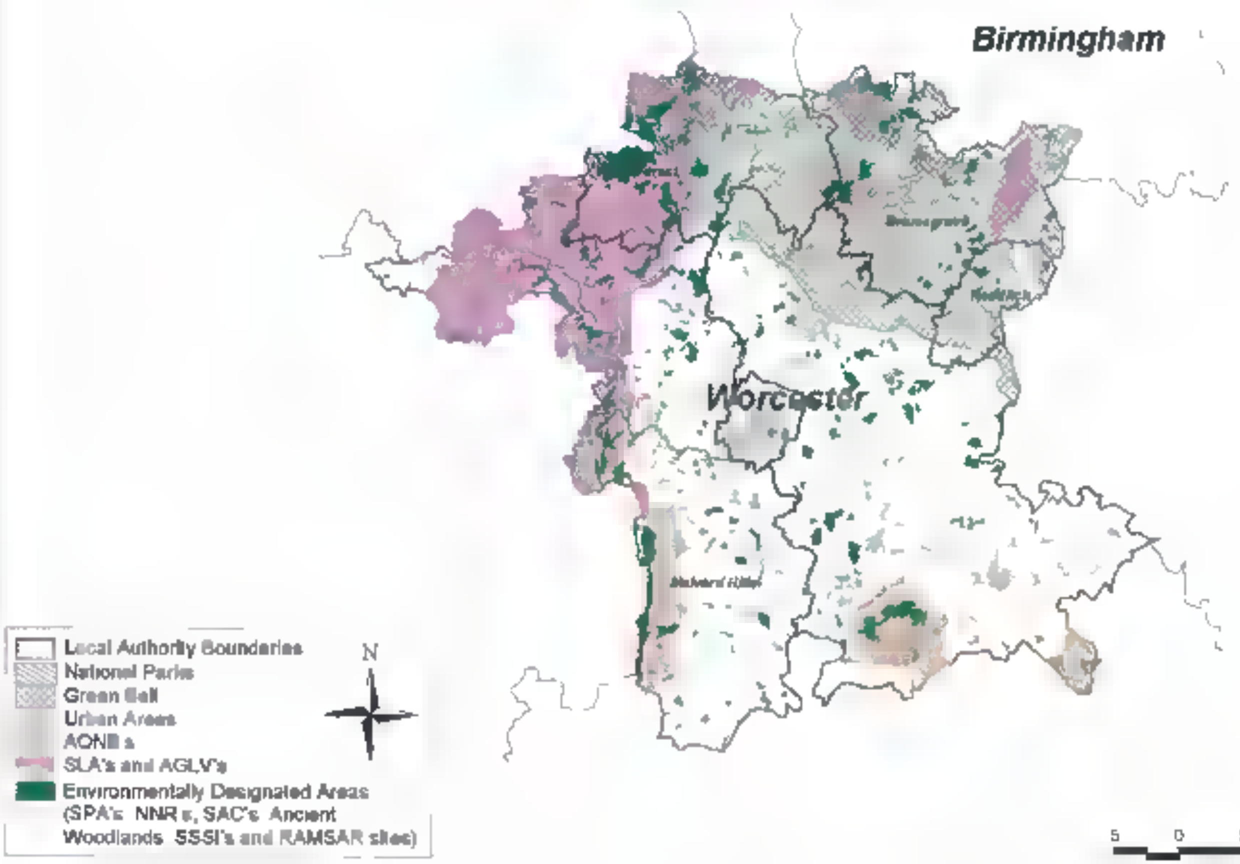
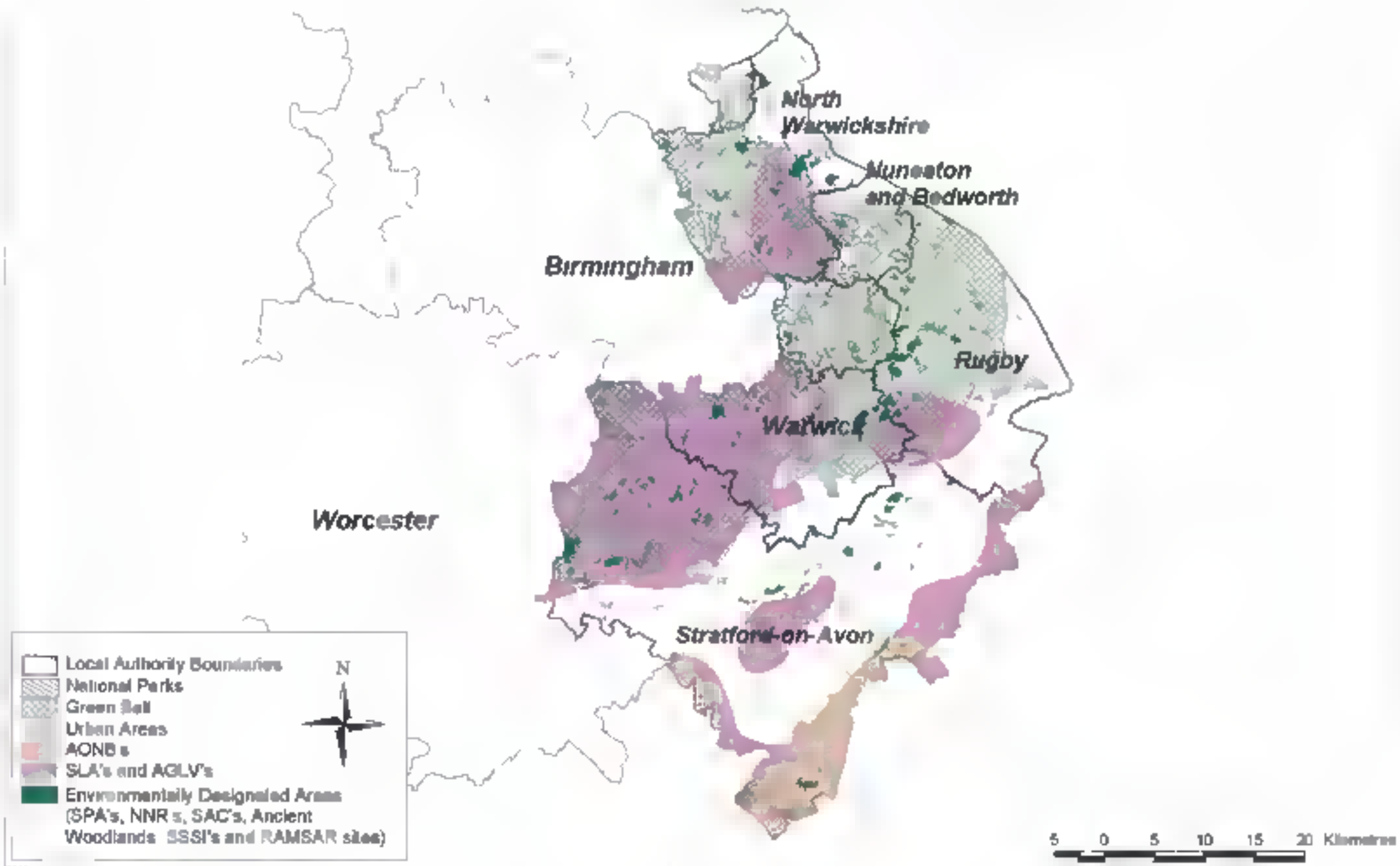
Regional Planning and Environmental Constraints

Figure 5.1



Regional Planning and Environmental Constraints - Worcestershire

Figure 5.2



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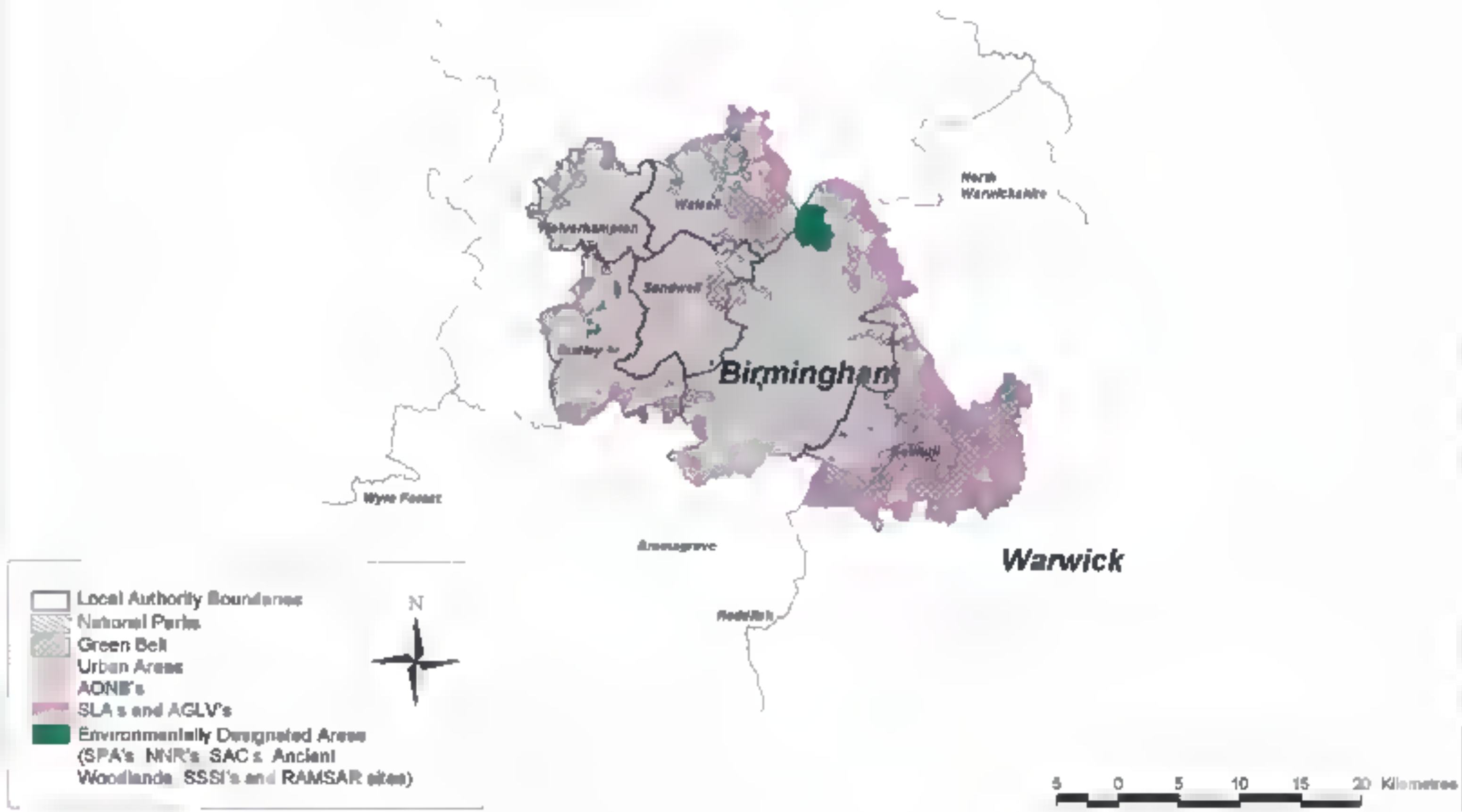
Regional Planning and Environmental Constraints - Warwickshire

Figure 5.3



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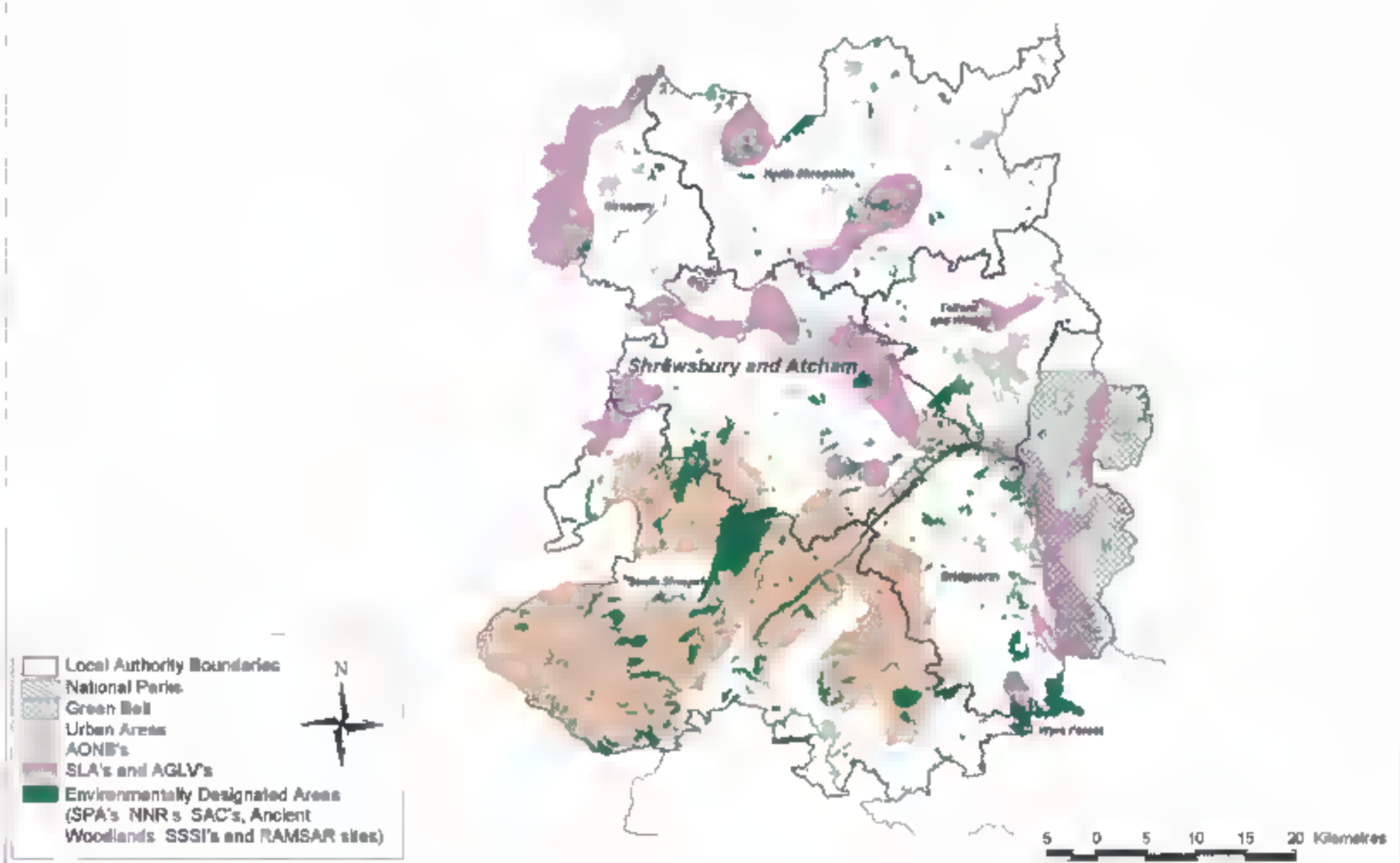
Regional Planning and Environmental Constraints - Metropolitan Areas

Figure 5.4



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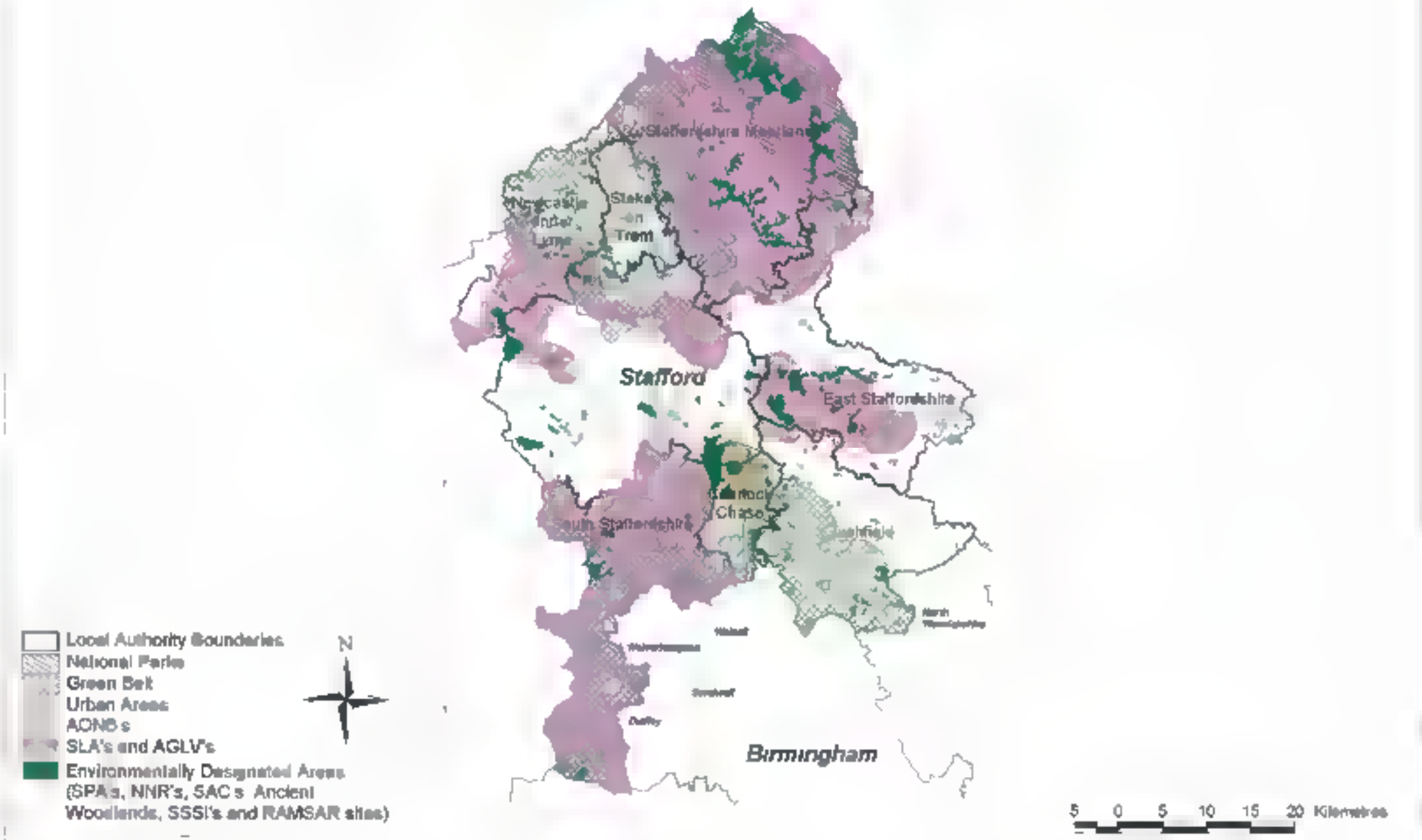
Regional Planning and Environmental Constraints - Shropshire

Figure 5.5



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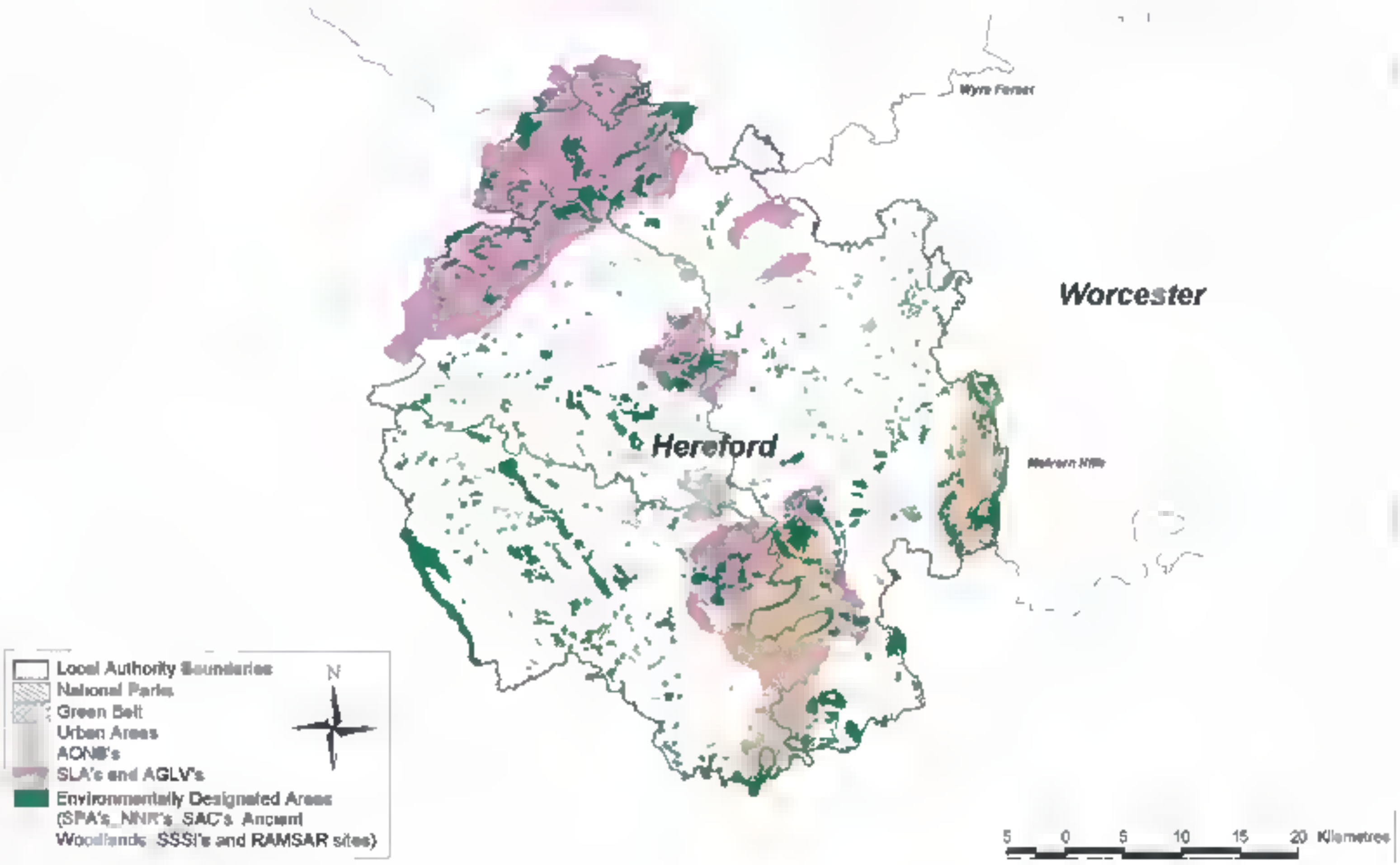
Regional Planning and Environmental Constraints - Staffordshire

Figure 5.6



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Regional Planning and Environmental Constraints - Herefordshire

Figure 5.7

Results of Consultation

Responses received in reply to the invitation to comment sent out in August reinforce the significance of these constraints Indeed, many local authorities, in their written responses, highlighted their concern over the environmental impact of renewable energy technologies Their impact on protected landscapes was a particular concern of many respondents Indeed, authorities frequently noted that the protection of open countryside and landscape quality would continue to be given high priority and that for renewable energy resources to be exploited they would need to be satisfied that the impact on the landscape was acceptable Visual impact was also frequently mentioned as a potentially significant constraint to the development of renewable resources, particularly in the case of wind

5.7 *Future Planning Policy*

This section builds on section 5 5 to consider the future nature of planning policy as found in emerging plans

In reviewing the planning policy context for the development of renewable energy in the West Midlands region it is also important to consider the direction of policies currently being developed as part of the local plan review process Indeed, in assessing future development potential these policies, and the thinking behind them, reflecting the current position of the local authority, are valuable In considering draft policies of this nature, it is important to acknowledge that these have yet to be subjected to Examination in Public or Inquiry That is, they have yet to be tested in the public arena and subject to central government scrutiny As such, they should not be viewed as policy per se, rather they should be considered as an indication of the possible direction of future policy

Deposit draft plans and documents detailing proposed modifications have been reviewed, where appropriate, for the study area as a whole In areas where the review process is at an early stage (prior to the drafting of specific policies) discussions with planning officers were held to establish the likely direction of policies and the aspirations regarding renewable energy

Structure Plan Policies

Whilst none of the adopted structure plans make reference to renewable energy, all of the counties have included specific policies within their deposit draft plans. The way in which each of the counties addresses renewable energy differ in terms of style and level of detail as well as the way in which they guide Local Planning Authorities to deal with the issues. In general the policies endorse renewable energy, subject to compliance with other plan policies, in particular those relating to environmental protection.

Renewable energy is given the most detailed consideration in the Worcestershire Deposit Draft Structure Plan. Here, three policies are presented, supported by detailed explanatory text. Policy EN1 (Renewable Energy Facilities) provides the general statement, indicating the broad position of the County. It states that:

"Proposals for the development of facilities to provide renewable energy will be supported subject to other policies of the plan, particularly those relating to local environmental effects of the development."

The plan also includes two technology specific policies. Policy EN2 (Wind Turbines) states that:

"Proposals for the development of individual wind turbines or small clusters will be allowed, provided that they:

(a) Do not cause unacceptable harm to the surrounding environment in particular sensitive landscapes;

(b) Do not cause unacceptable harm to nature conservation interests;

(c) Do not result in excessive noise pollution; and

(d) Are acceptable in relation to other plan policies."

The explanatory text clarifies these points stating that proposals for wind turbines "should be assessed against other policies contained in this Plan to ensure that the same considerations are given to the location and development of wind turbines as to other development".

The Structure Plan also recognises that there is potential within Worcestershire to generate energy from methane gas from landfill waste and the incineration of waste. To this end, Policy EN3 (Waste to Energy) states that:

"Proposals for facilities for the generation of energy from landfill waste or from the incineration of waste will be endorsed subject to other policies in the plan and if they provide the best practicable environmental option.

Warwickshire however, takes a very different approach. Indeed, in the deposit draft version of the Warwickshire Structure Plan renewable energy is not considered as a specific stand alone policy. Instead, it is addressed as part of Policy GD1 (general development) and thus presented as one of the overriding principles of the Structure Plan. The policy states that:

"The overriding purpose of the Structure Plan is to provide for a pattern of development which ... conserves resources of land and energy, including minerals and water, and makes maximum use of renewable energy resources.

Shropshire and Staffordshire take an approach that is essentially somewhere between these two extremes, both presenting renewable energy as a single specific plan policy. Policy p57 of the Shropshire and Telford & Wrekin Joint Structure Plan Deposit Draft (2000) states that:

"Developments which generate and use energy from renewable resources are encouraged in principle. Local Plans will contain detailed policies which will, ensure that the national and local environmental, social, and economic benefits of individual schemes are not offset by adverse effects in people and the environment and that there is safe and adequate access"

Similarly, the Staffordshire Structure Plan and Stoke-on Trent Structure Plan (Deposit Draft) considers the issue as part of a broader policy considering the conservation of energy and water. Policy D7 states that:

"In assessing development proposals, measures which help to conserve natural resources will generally be supported. These include ... use of renewable energy resources for the development of renewable energy generating installations such as wind turbines, will be considered on their merits, having regard to any potential adverse impacts on local people and the local environment. Developments should also be encouraged to incorporate photovoltaics or other renewable energy generators where appropriate.

Local Plan Policies

Table 5 5 provides an indication of the local plan review process in the region and the way in which renewable energy is being considered The results of this table should be interpreted with caution as it summarises the findings of telephone conversations with planning officers and therefore (in the cases where plans are at the pre-deposit stage) represents the opinion of individual officers, rather than the local planning authority as a whole

Many of the local plans are currently at an early stage of review The majority of local plans are currently at the pre draft consultation stage At this stage most authorities are primarily concerned with key issues such as housing and employment However, discussions with planning officers suggest that some authorities have a very clear intention to include policies on renewable energy as part of the local plan review process In other areas, however, it seems that renewable energy is considered to be a peripheral concern.

For example, Stratford on Avon District Council, whilst currently at the pre draft stage of review, are conscious that the local plan should address issues concerning renewable energy The Stratford adopted plan (March 2000) does not include reference to renewable sources and the Council are aware that this is an omission that needs to be addressed The Stratford plan is unusual in that although very recently adopted, has been subject to a prolonged process of agreement and therefore reflects policies initially drafted some years ago

Discussions with officers suggest that in future policy renewable energy is likely to be addressed as a stand alone policy, or in conjunction with wider issues of energy efficiency Authorities seem reluctant to identify sites for the development of specific resources but are keen to encourage technologies that will be compatible with environmental, economic and social concerns

Results of the Consultation

Correspondence received in response to the invitation to comment sent out in August 2000 highlighted a general recognition amongst local authorities that issues concerning renewable energy were likely to be important considerations during the process of plan review Indeed, those authorities commenting in this manner acknowledge the importance of addressing renewable resources through the planning process However, it is important not to generalise on the basis of these comments, as they do not constitute a full sample Indeed, the responses received are likely to be bias towards those authorities with a greater interest in renewable energy

Table 5 5 Status of Plans Under Review

Structure Plan/UDP area	Local Plan Area	Existing re policy	Stage of Review	New/ Redrafted policy	Intention to include policy
Warwickshire			Deposit	✓	
	North Warwickshire	X			✓
	Nuneaton and Bedworth	X	Pre Deposit [2]		
	Rugby	✓	Pre Deposit [2]		
	Warwick	X	Pre Deposit [2]		
	Stratford on Avon	X	Pre Deposit		✓
Worcestershire		X	Deposit	✓	
	Wyre Forest	X	Pre Deposit [2]		
	Bromsgrove	X	Deposit	✓	
	Redditch	X	Pre Deposit [2]		✓
	Wychavon	X	Pre Deposit [2]		
	Worcester	✓	Deposit Draft	✓	
	Malvern Hills	✓	Pre Deposit [2]		
Staffordshire and Stoke on Trent			Deposit Draft	✓	
	Newcastle – under – Lyme	X	Pre Deposit	✓	
	Staffordshire Moorlands	X			
	Stafford	✓			
	East Staffordshire	X			
	South Staffordshire	✓			
	Cannock Chase	✓	Pre Deposit		
	Lichfield	✓	Pre Deposit		
	Tamworth	✓	Pre Deposit		✓
Stoke on Trent		X	Pre Deposit		
Shropshire and Telford and Wrekin		X	Deposit Draft	✓	
	Oswestry	✓	Pre Deposit		
	North Shropshire	X	Pre Deposit		
	Shrewsbury and Atcham	X	Deposit Draft	✓	
	South Shropshire	✓	Pre Deposit	✓	
	Bridgnorth	X			

Structure Plan/UDP area	Local Plan Area	Existing re policy	Stage of Review	New/ Redrafted policy	Intention to include policy
Telford & Wrekin UDP					
Herefordshire		-	Pre Deposit		✔
Birmingham		X	Deposit Draft	✔	
Coventry		X	Deposit Draft	✔	
Dudley		X	Deposit Draft	✔	
Sandwell		✔	Deposit Draft	✔	-
Solihull		X	Pre Deposit		
Walsall		X	Pre Deposit		✔
Wolverhampton		X	Pre Deposit		✔
Peak District National Park					
	National Park				

Key: ✔ indicates positive response

- indicates uncertainty – too early in the review process, policies not yet considered

5.8 ***Conclusions***

Impact of Planning Policy on the Development of Renewable Energy

At present, there is a lack of specific guidance, at all levels, relating to the development of renewable energy resources. Whilst development plan policies generally encourage the use of renewables, there are few specific policies or locational guidance within existing adopted plans. The review of development plans has shown that whilst those plans and policies that do address the subject seem to encourage the use of renewable technologies, their development is generally subject to a series of strict policy controls.

Environmental policies and land use designations are currently a significant constraint to the development of renewable energy. The development of renewable technologies is likely to be most strictly controlled in cases where it will impact upon areas designated to protect landscape quality, Green Belt, the open countryside and ecologically important areas. These represent a significant proportion of the area available in the region, thus considerably limit the search for viable sites. Furthermore, outside of these broad areas, it is important to recognise that planning permission will also be dependent upon a number of other local factors, with each case judged on its merits

Planning policies are a particular constraint to the development of wind technologies. Indeed, in addition to policies controlling development per se, the development of wind turbines is constrained, through the planning system, by policies seeking to protect residential amenity and prevent adverse visual intrusion on the landscape

Given that wind power has the greatest potential to contribute to national renewable energy targets, the constraints on its development are particularly significant. However, the calculation of the deliverable resource suggests that despite these likely constraints, wind power in the region can nonetheless make a potentially significant contribution to national targets

The development of other technologies is likely to be constrained where building is required within these protected areas Generating and processing plants will therefore need to be sensitively located Whilst the planting of energy crops does not require planning permission, such development, on a large scale, is likely to be strongly resisted where it is perceived to have an adverse effect on landscape quality or visual impact

Implications for Future Planning Guidance

The current wording of planning policies in Structure Plans, Local Plans and UDPs, is such that very few parameters are clearly defined, and there is therefore rarely a structured basis on which planning decisions should/could be based Policies that state that renewable energy should make a significant contribution to national or regional targets or should not have an adverse impact on residential amenity are thus open to wide interpretation Thus there is a need for more specific guidance on the development of renewable energy resources at all levels

If the region is to make a significant contribution to the achievement of national targets there is a need, in the first instance, for Regional Planning Guidance to address the issue in more detail, indicating targets for each part of the region or highlighting broad areas where the development of specific resources might be viable, or should be considered In this way RPG can provide a more robust framework for the development of Structure and Local Plan policies, paving the way for more effective policy at the local level

Structure Plans are beginning to give renewable energy a higher profile However, there is a need for them to give the issue more detailed consideration and give clearer guidance in the future Structure Plans should consider the viability of a range of renewable energy technologies in more detail within the County and should draft policies and identify broad areas accordingly Policies being developed by Worcestershire County Council are the best example in the region, to date Indeed, evidence suggests that there is a clear link, on a national level, between supportive planning policies and positive planning outcomes.

At the local plan level, it is clear that renewable energy is being addressed through the local plan process However, there is a need for future policies to more clearly identify specific ways in which generation from renewable resources should be encouraged Again, policies should be technology specific Local Plans should define the criteria for controlling the detailed design of renewable energy schemes, as well as detailing those circumstances in which development will not be permitted The latter need not be presented in a negative tone. Indeed, by setting out more detailed policies in this respect, the local authority will have be able to exert stricter controls on development and thus ensure that adverse impacts are minimised Thus, local plan policies that provide advice on design, siting and layout (such as in the current Wrekin Local Plan) should be followed as examples of best practice

6 Network Constraints

6.1 *Introduction*

Network connection enables a generator to sell the electricity that is surplus to on site demand to suppliers, for consumption elsewhere It also provides a back up source, ensuring a secure supply It is therefore probable that all, or nearly all, new generators (whether using a renewable energy source or not) will be connected to the electricity network Consequently, the ability to connect to the network, at a reasonable cost, is a major factor in assessing the potential for new renewable energy schemes

The Utilities Act 2000 formally separated the supply and distribution functions of the Regional Electricity Companies (RECs) in order to introduce competition in electricity supply whilst recognising that the distribution network is a natural monopoly within each region. The bodies responsible for management and operation of the network are now known as the Distribution Network Operators (DNOs) and it is the DNO that is responsible for the connection of embedded generators

There are 12 DNOs covering England, Scotland and Wales The distribution network in the West Midlands is operated by three DNOs GPU Power UK (formerly Midlands Electricity), Manweb and East Midlands Electricity[9] Approximately 75% of the West Midlands network (in terms of land area) is owned and operated by GPU Power North West Shropshire and Oswestry are operated by Manweb and Nuneaton, Burton upon Trent, Coventry, Rugby, Warwick and part of Stratford upon Avon are operated by East Midlands Electricity

The purpose of this chapter is to determine the extent to which the existing electricity network in the West Midlands region can accommodate the development of renewable energy sources and to identify, where possible, areas most appropriate for development

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[9] Rapid changes in the electricity supply industry in the past few years have produced a number of mergers and acquisitions The parent companies for GPU Power, Manweb and East Midlands electricity are, respectively GPU Inc , Scottish Power and PowerGen UK

6 2 Why the Electricity Network may be a Limiting Factor

6 2 1 A Question of Design

In order to understand why the present electricity network may prove a limiting factor on the exploitation of the renewable energy resource it is necessary to describe something of the history of the UK electricity supply industry and the infrastructure that currently exists

Increasingly large power stations were built as the 20th century progressed, determined by the economies of scale in fossil-fuelled and then later nuclear power generation. This trend towards very large power stations required the evolution of a national transmission system (the 'National Grid') Operating at very high voltage (275 or 400 kV) the National Grid enabled power to be transferred over long distances around the country so generators no longer needed to be built close to areas of demand and relatively few, centralised plants could supply customers throughout the UK.

These large power stations were connected to the national grid and their output regulated or 'centrally dispatched' so that the system operator could respond to the requirements of the connected load by scheduling stations in order of merit. In this respect the high voltage (transmission) grid was, and is, an essentially active system with the National Grid Company (NGC) both managing network assets and maintaining a national balance between demand and supply

Below the National Grid system a medium and low voltage network exists, operated by the DNOs, to distribute the power to individual customers This is indicated in Figure 6 1 The network is tiered with electricity distributed through a series of 'layers' from high voltages (132 kV) to progressively lower voltage systems (typically 66 kV, 33 kV, 11 kV) and finally to the domestic customer at 230 V The key characteristic of this system is uni-directional power flow – from the grid supply points (GSPs) down through the medium and low voltage networks to the customer The distribution system was thus designed as a largely passive network

Figure 6 1 Traditional Electricity Distribution Network

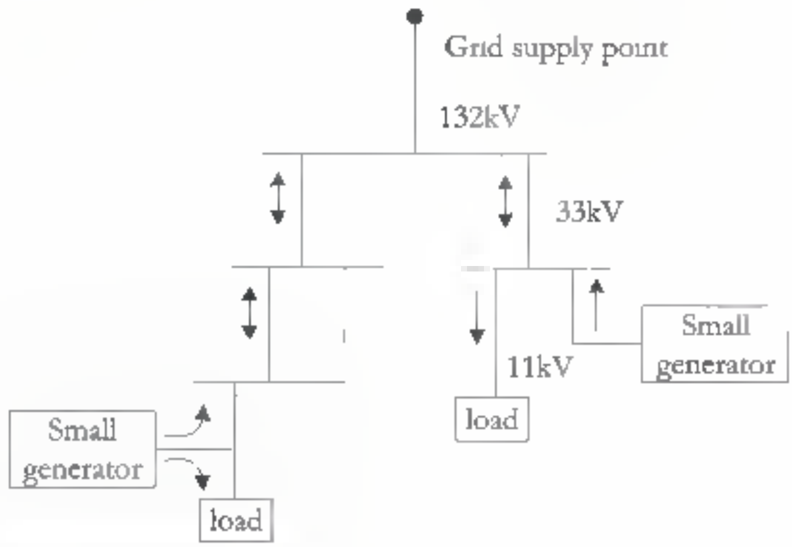
Wind Constrained	Predicted Generation Mix Consumption Scenario			Total	Deliverable Resource As UK Mix	
	Growth Continued GWh		Energy Efficient GWh		Growth Continued	Energy Efficient
Onshore Wind	13%	390	339	1,345	390	339
Energy Crops	16%	480	418	67	67	67
Waste	17%	510	444	282	282	282
Landfill gas	17%	510	444	398	510	444
Other biomass	5%	150	131	95	95	131
Other	3%	90	78	11	11	11
Small hydro	1%	30	26	4	4	4
subtotal	72%	2,160	1,880	2,201	1,459	1,278
Offshore Wind	8%	240	209	0	0	0
Existing	20%	600	522	792	792	792
Total	100%	3,000	2,611	2,993	2,150	2,069
					7.2%	7 9%

Embedded generation is defined as electricity generation that is connected to the distribution system[10] as opposed to the transmission system (as shown in Figure 6 2) With the development of high efficiency gas turbines and renewable energy sources the number of embedded generation connected in the UK has accelerated in the last decade and this trend is likely to continue Embedded generation can be connected as low as 230 V (for example photovoltaic systems below 5 kW), up to 11 kV and even at 132 kV (for a very large wind farm for example) Crucially, the power flow is no longer necessarily in one direction and is no longer controlled by the system operator The UK electricity supply infrastructure was not designed with this in mind and this represents a fundamental difficulty to the development of embedded generation It is by no means impossible to connect further embedded generation but using the existing network imposes a number of design limitations – these are described in further detail in 6 3 The bottom line is that

[10] The distribution system comprises overhead lines, cables, transformers, switchgear and other equipment to enable the transfer of electricity from the transmission system and generators connected to the distribution network to customers' premises

embedded generation must not cause a decrease in the quality of supply, introduce commercial risk or impact on levels of safety – all of which are of paramount concern to the Distribution Network Operator (DNO) and a mandatory requirement of their licence or the subject of regulation

Figure 6 2 Embedded Generation Within the Distribution Network



6 2 2 *The Cost of Connection*

Under the current framework, the DNO's main source of revenue is from the DUoS (Distribution Use of System) charge on each unit distributed for suppliers Generators do not pay DUoS on their exports and hence the connection of loads (consumers) and generators must be treated differently

The cost of connecting a generator is currently assessed on an individual basis In response to specific applications, most DNOs currently offer a free initial meeting with generators to discuss details of the proposed connection and provide outline data on the DNO's requirements If the generator decides to proceed with the connection this will normally be followed by a charge for further network studies and cost estimates A technical guide for prospective embedded generators has been produced by the DTI [ETSU, 1998c] – this sets out in more detail the statutory framework , costs and charges for connection The generator is currently entitled to be charged the full cost of connection and any associated reinforcement, irrespective of depth into the network ('deep charging') As an example, a small (100 kW) generator wishing to connect to a distribution substation (11kV) may anticipate a charge of perhaps a few £1000s, but this may result in increased fault levels 'upstream' and the necessity to replace some higher voltage switchgear In this case the cost of connection could easily escalate from a few £1000s to £1/4 million or more

The DNO's licence contains a requirement to 'facilitate competition in generation' This means that the DNO must not introduce unnecessary barriers to connection or favour one generator in preference to another (without due technical reason) However, if connecting a generator to the network is likely to require additional hardware or upgrading existing equipment then the DNO is entitled to pass on the cost of this to the generator as above Under the present regulatory framework this is the only method by which DNOs can recover their costs (there is currently no cost passed onto other consumers to spread the effect) The result can be very high connection charges in some locations and 'arbitrary' costs dependent on the 'first come first served' nature that requests are taken on Thus if a single application puts the network above a threshold then they will bear the full incremental cost of the upgrade Subsequent requests will then benefit for this new capacity in the system

This is a particular problem for renewable generators because they are relatively small in size and so the connection costs represent a significantly larger part of the total investment cost than for a conventional plant Consequently, connection costs may prohibit the exploitation of renewable energy sources in these sites

6.3 *Technical Limitations*

As discussed in 6 2, the network was not designed with embedded generation in mind. The existing infrastructure therefore imposes a number of limitations on the connection of new capacity – most are relevant to all potential embedded generators, not just those from renewable sources Discussions with GPU Power and East Midlands Electricity highlighted two technical factors in particular that are likely to restrict the capacity for further embedded generation fault levels imposed on 132 kV and lower voltage switchgear and voltage regulation on 11 kV lines

6 3 1 *Fault Levels*

A fault in the network is a low-impedance electrical connection between live conductors or from a live conductor to earth, which short circuits the normal loads on the network. This will result in a collapse in voltage close to the location of the fault and abnormally high currents in those parts of the network which form pathways from sources of electrical energy to the fault location These faults can occur at any time due to inclement weather, third party damage or equipment failure

Different types of faults are possible The fault level at a point in the distribution network is a measure of the short circuit current that would occur in the event of a fault at that point (worse case scenario)

The fault level depends on the characteristics of the electrical source and the total impedance of the network components between the source and fault The main grid supply into a distribution network, induction motor run on and embedded generators all contribute towards the fault level. When distribution systems were planned the designs assumed that fault levels would increase with load growth but that the significant fault contribution would be from the higher voltage transmission system The extensive development of embedded generation has caused an increase in fault levels far in excess of that originally anticipated

Five of the GSPs within the GPU area are currently close to, or equalling, their fault level capability. Of these one lies outside the West Midlands region and it is understood that the switchgear at Gloucester is due to be replaced shortly The areas affected by the remaining three GSPs at Bustleholm, Bishops Wood and Cellarhead are indicated on Figure 6 3 It is clear that Bishops Wood and Cellarhead in particular preclude extensive development across a large part of the Region and, if the deliverable resource is to be fully exploited, should be seen as priorities for upgrading Regarding the East Midlands Electricity network, the company note 'there is very little scope in the Coventry/Rugby/Daventry/ Hinckley/Nuneaton area for significant generation without major reinforcement Fault levels are very close to limits However, in the Warwick/Harbury area generation connected at 132 kV could be more easily be accepted '

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Fault Level Constraints on the Electricity Network

Figure 6 3

Computer-based short circuit studies must be carried out for prospective new generators (in line with the procedures described in Engineering Recommendation G74 [EA, 1992]) However, where the fault level at the GSP has already been reached, this effectively prevents the connection of any embedded generator 'downstream' i e to that section of the network below 132 kV The connection of further generation would increase the fault levels beyond the equipment's design rating and thus contravene the Health and Safety regulations It is therefore clear that fault levels constrain the development of renewable energy across large areas of the West Midlands region

It is of course possible to upgrade the 132 kV switchgear However, the cost is likely to be prohibitive and beyond the capabilities of a generator[11] even if the cost of upgrading was to be shared between a number of potential generators Switchgear in the West Midlands was largely installed in the 1960s and is expected to have a minimum of 50 years life A prospective generator can therefore be expected to be charged for the cost of bringing forward this investment by about 10 years the charge equates to approximately half of the capital cost for this part of the work

The contribution from a generator to fault levels can be reduced by increasing the impedance of the network itself or between the network and the generator (such as by using reactors, transformers or fault current limiters) An alternative, for smaller generators, is to connect via an inverter which does not store energy and which is designed to prevent the transfer of short circuit current from the generator[12] DC sources such as photovoltaic cells would automatically be inverter connected Wind turbines may also be inverter-connected, although inverters may contribute towards other problems such as harmonic emissions.

6 3 2 *Voltage Regulation*

The DNO is required to supply electricity within a certain tolerance band For domestic customers this is presently 230 V + 10/ 6% The voltage on the 11 and 33 kV network is also regulated (to ± 6%)

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[11] According to reference [ETSU, 1999a] the cost of installing a 45 MVA 132/33 kV substation is expected to be in the order of £1 million

[12] Inverter connected generation does still contribute towards fault levels but with no short circuit contribution the fault level is reduced to ~ 15%

Voltage levels vary with location and time Voltages tend to fall when people are using a lot of electricity and they are often lower at the end of long distribution line due to the resistance of the cables Conversely, power in feeds from embedded generators tend to increase local voltage levels

For the GPU network many of the distribution substations are operating very close to the upper statutory limit (11 6 kV) This is in order to sustain the voltage along the long rural lines Therefore the ability to connect embedded generation is limited in many of the more rural areas because it may increase the voltage above 11 6 kV

One solution is to connect embedded generators directly to the 33 kV network, where the voltage is more easily regulated This is likely to be an option only for generators above 5 MW where the cost is more readily absorbed in the total project cost

6 3 3 *Other*

In addition to voltage regulation, the power transport capacity (for both the cables and equipment) may be limited by the thermal ratings Power quality issues such as harmonics and voltage flicker are already covered by the appropriate Engineering Recommendations i e a generator not meeting the required quality of supply would not be approved for connection anyway, regardless of the network capacity

6.4 Network Benefits

Developers draw attention to the fact that embedded generation can actually enhance the network and save the DNO money and that therefore they should be rewarded for this in some way The potential benefits are discussed below.

(i) Improve Security of Supply

It is argued that the presence of additional generation capacity on the system located close to the demand must improve the security of supply to the local network, such that if there is a fault the embedded generator will continue to support the demand. However, this is only true if the availability of the embedded generator can be relied upon, that the generation itself does not require a connection to the network to operate and if the system can be operated 'islanded' from the rest of the system In relation to the former, Engineering Recommendation P2/5 [EA, 1978] does not recognise any benefit to a DNO if embedded generation supplies an island of demand, such benefits are considered incidental For safety reasons, operation in this mode will certainly be prevented by control and protection equipment, which is required by Engineering Recommendation G59/1 [EA, 1991]

(ii) Reduce Distribution Losses

If all the generation is absorbed close to its connection point, at all times of the day and for all times of the year, it is likely that the generation will reduce the energy losses on the distribution system Conversely, if the generation exceeds the level of local load at all times and causes large power flows back through the system into the transmission systems it is likely that the generation will increase the energy losses In practice, depending on how the system is balanced, the truth will lie somewhere in between – a generator will tend to decrease the power flows during periods of peak demand but increase the power flows during periods of minimum demand Note that for a very small generator, such as a roof mounted photovoltaic system, the distribution losses will generally be reduced

(iii) Avoid or Defer Network Reinforcement

Embedded generation may reduce the thermal loading on lines and transformers thereby extending the life of the asset However, the generation can only be used to avoid/delay reinforcement if its output can be relied upon by the DNO, as mentioned previously, and is bound by contract The most common reason for network reinforcement is to satisfy security rather than capacity requirements In such cases the DNO is very unlikely to consider the use of embedded generation in preference to spending capital on lines, cables etc The former is a much higher risk option [J Sinclair, 2000]

Undoubtedly, embedded generation does have 'added value' in certain locations and for certain generator types However, besides the technical barriers there are a number of significant regulatory barriers to realising these benefits

A DNO is not allowed any return on assets that provide a connection if they were funded by the generator, and the generator does not pay any use of system charge Consequently, the DNO has no direct financial benefit from a generator However, a DNO is allowed a return on assets that it funds to extend its distribution network Since there is no financial incentive (currently) for the DNO to make use of embedded generation to reduce network investment it is likely to regard generation as more of a hindrance to meeting the conditions in its licence than an opportunity from which it could benefit in the near future[13]

6.5 *Estimated Network Capacity*

The ability of the distribution network to accommodate more embedded generation was reviewed on a national basis in 1999 [ETSU, 1999b] Two calculations were undertaken

(i) A 'crude estimate' simply assuming that 100 MW of new generation can be connected at each GSP in a DNO's area (taking account of the views of DNO companies where they have specifically indicated that a GSP has limited scope for connection of new capacity)

(ii) A revised estimate based on the following assumptions

- It may be possible to connect between 10 MW (rural) and 20 MW (urban) at most 33 kV substations,
- It may be possible to connect between 2 MW (rural) and 5 MW (urban) at most 11 kV substations

A correction factor was then applied to account for the interaction between generators The interaction could be caused by transient stability considerations, the cumulative effect of the reactive power flows under start up conditions, system protection, earthing or system operation

The totals are indicated below for each DNO

[13] A series of three workshops entitled 'Embedded Generation – Realising the potential for network benefits' were held between February and March 2000 and addressed these issues in depth

Table 6 1 Indicative network capacity

DNO	i) Estimated capacity (MW)	ii) Revised estimate (MW)
GPU Power	885	330
East Midlands Electricity	2766	920
Manweb	1244	460

The 'revised estimates', above, are used to calculate the total capacity for new renewable generation in the West Midlands region, by applying the following assumptions

(i) The West Midlands network is comprised of sections of all three networks (GPU, EME and Manweb) As a first approximation, the regional capacity is therefore taken according to the proportion of the region covered (75%, 20% and 5% respectively)

(ii) Since the study was undertaken, approximately 40 MW of new generation (renewable and conventional) has been connected The remaining capacity is thus adjusted accordingly

(iii) Currently, over half of the embedded generation connected to the network is non-renewable (as in Chapter 2) This trend has been assumed to continue

On this basis, the capacity for new embedded generation in the West Midlands region, without major network reinforcement, is estimated to be in the range of 300 – 500 MW, of which half (between 150 – 250 MW) can be expected to be available for renewable generation This will also be location-dependent, it does not imply that this capacity necessarily exists where the resource is most viable

6.6 Summary

The capacity for connecting further renewable generation in the West Midlands is estimated to be of the order of 150 – 250 MW While there is a considerable degree of uncertainty in this result it is clear that it is almost an order of magnitude short of the calculated deliverable resource (1367 MW) and significantly short of the new capacity required if the Region is to supply 10% of its electricity from renewable sources (approximately 600 MW)

The current distribution network imposes two key limitations on the connection of further embedded generation, namely fault levels and voltage regulation. These limit the areas suitable for development even before planning restrictions and the physical resource itself are accounted for In the case of fault levels, the problem can be overcome, to some extent, by using DC (inverter) connections but this is not an option for all technologies

However, the problem is essentially commercial rather than technical The network can be upgraded to accommodate more embedded generation – sufficient to accept 10% or more renewable (embedded generation) But, under the current regulatory framework the DNO receives no incentive for connecting embedded generators and so, in order to prevent an increase in the cost to consumers, must pass on the full ('deep') connection charge to the generator This is the limiting factor – the ability of the generator to meet the connection costs

Following responses to the DTI consultation document 'Network management issues' (published in November 1999) a joint industry/government working group on embedded generation was set up in March 2000 The Group are currently preparing a number of papers, which are likely to be made available to the public and to form the basis of a consultation document to be issued by the Government early next year

One of the key issues is the provision of information by each of the DNOs highlighting areas within their network where the connection of embedded generation is not expected to be a problem In such areas connection costs will be lower and will serve to channel the development of renewables into the most suitable areas (from a network perspective) However, it is important to note that even if this is introduced as a requirement for DNOs (similar to say the NGC's 7 year statement) it will only consider constraints at 33 kV and above simply because of the extent and susceptibility to change of the 11 kV network[14] Consequently, it will not help small embedded generators wishing to connect at 11 kV and trying to identify areas where voltage regulation may be a problem.

[14] For the GPU Power network there are 48,600 distribution substations and 26,101 km of medium voltage (11 kV, 7 kV and 6 6 kV) lines

In the longer term alternative mechanisms must be found for financing the cost of upgrading the network to permit more widespread connection An opportunity for addressing this issue was missed in April 2000 when the regulator, OFGEM, completed its' price review Another price review is not due for 5 years One option would be to subsidise the connection cost by the generator from a central source (e g the Climate Change Levy) Another alternative is the notion of introducing a Distribution use of System (DUoS) type charge for all generators that could be used by the DNO to raise the required finance [J Sinclair, 2000]

This issue is addressed, but not resolved, in the EC proposal for a Renewable Energy Electricity Directive [EC, 2000] The following comment is made on Article 7 (grid connection and reinforcement issues

'It has been suggested, as a general rule, that connection costs of renewable generators should be borne by the grid operator, to facilitate deployment of RES installations It is doubtful whether this approach can be considered appropriate In fact, it would lead to a situation where the distance to the grid would be irrelevant to potential investors Such an approach would thus encourage non economic installations '

It concludes with some general principles

- The full costs and benefits associated with the connection of a new RES-installation should be made transparent;

- Future costs and benefits to the grid-system, such as avoided or postponed reinforcement, should be taken into account, and

- There should be rules foreseeing compensation payments if subsequent persons connecting to the grid benefit from a grid asset (connection or strengthening) associated with and paid for by a first person connecting to the grid

It is interesting to note how other countries have addressed the problem of network connection Denmark, for example, has a very high penetration of wind energy (over 25% of installed generation capacity in the western half) The fee for connecting embedded generation is the same, whether or not network reinforcement is required The cost is then averaged and passed onto the consumer In Germany, reinforcement for a particular project is reflected in a general increase in the Use of System charges

7 Deliverable Resource for the West Midlands

7.1 *Introduction*

Section 3 of this report has demonstrated that, whilst a limited number of technologies are technically feasibly in the West Midlands, the electricity that they can theoretically generate is many times the current consumption in the region Section 4 followed this with a discussion of the factors that make renewable electricity generating projects economically viable This included the key financial issues that may influence the investment decisions of prospective project developers of various types

This section will draw together the results of these analyses and, together with an understanding of the environmental and planning constraints, attempt to define a deliverable resource for the region

7.2 *Definition of Deliverable Resource*

For this study, the deliverable resource for the region has been defined as

'The electricity that could be realistically expected to be generated from renewable sources in 2010, after taking into account:

- The technical ability of equipment to generate electricity in the natural environment of the region

- An economic framework, built on the proposed Renewables Obligation, Climate Change Levy, and currently proposed capital grants schemes, that is complete and implemented in such a way that it stimulates commercially viable developments

- The likelihood that these projects will gain sufficient public support and all necessary development consents as required'

This deliverable resource could therefore be viewed as the maximum generation that could be achievable with all possible support and encouragement from government at the local and national level However, it must be recognised that whilst the resource may have no particular barriers to its full development as defined by this study, almost certainly a number of potential projects will not be realised due to unforeseen circumstances The Region wide nature of this study will have contributed to this inaccuracy and it can be anticipated that more detailed local investigations will be required to fully take into account site location issues and detailed project specific design economics

7.3 *Deliverable Renewable Resource*

In order to evaluate the deliverable resource for the region it is necessary to apply the constraints detailed in Sections 4, 5 and 6 The specific assumptions that have been applied in each technology area will vary significantly, and these are summarised in Table 7 1 below More detailed explanations can be found in Appendix A.

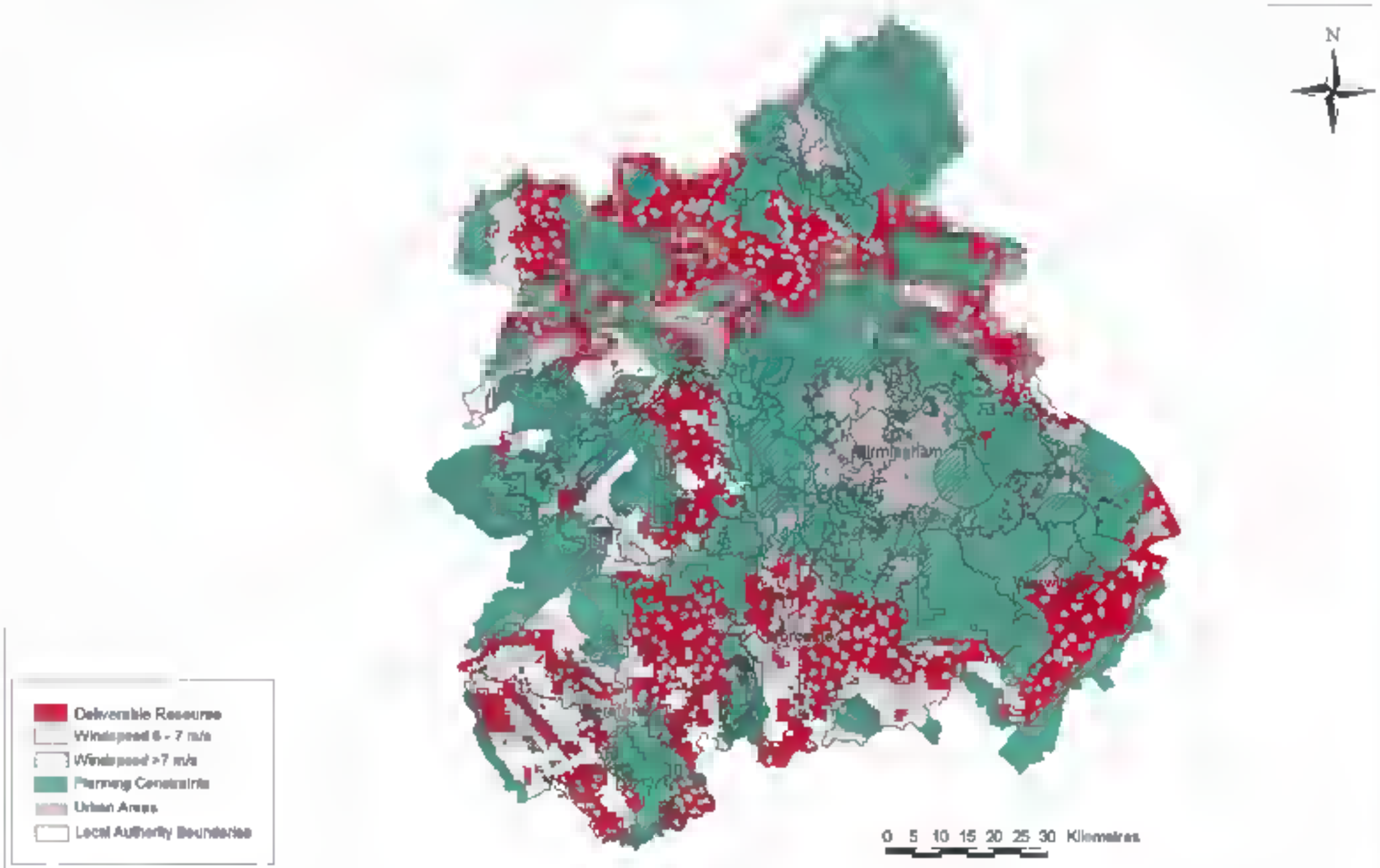
Table 7.1 Deliverable Resource Assumptions

Resource	Technology	Deliverable resource assumptions	Type of Key constraint
Wind	Large scale - potential	Only those sites with higher average wind speeds (above 6 ms^{-1}) will be developed Although development of lower wind speed sites is technically possible, these are less likely to be developed in the foreseeable future Planning and development constraints will exclude most development from all designated areas	Planning, Environmental & Economic
	Large scale - probable	Only those sites with higher average wind speeds (above 7ms^{-1}) will be developed Although development of lower wind speed sites is technically possible, these are less likely to be developed in the foreseeable future Planning and development constraints will exclude most development from all designated areas	Planning, Environmental & Economic
	Small scale	Small scale development of wind turbines is likely to occur at only a very limited scale, as these systems are only economic in very specific circumstances	Economic

Resource	Technology	Deliverable resource assumptions	Type of Key constraint
Biomass	Energy crops	The resource will only be developed in conjunction with Government planting and capital grants, which are limited by budget.	Economic – grant funding required
	Agricultural residues	Resource will only be developed in conjunction with other food residues These are of limited availability in the region	Economic – gate fees required
	Forestry residues	It will only be economic to collect material from on going forestry operations in conjunction with local energy crop project.	Resource – only some forestry residues
	Wastes	Capital intensive projects require long term disposal contracts that will only be available in municipal waste sector Energy is recovered from a significant proportion of region's wastes in existing or planned facilities and thus further development may hamper resource recovery or recycling potential	Resource - Recycling and recovery targets
	Sewage	Assumed only to be economic at sewage works serving major population centres	Economic
	Landfill gas	Gas generation is only significant at larger sites to justify generation plant	Economic
Solar	PV (domestic)	Although no domestic PV systems will be economic, a national PV grant scheme will deliver development	Economic – grant funding required
	PV Commercial	Majority of development will be as an alternative to high quality cladding on prestigious office buildings	Economic
Water	Small Hydro	There are very few sites that have sufficient flow and head for development.	Economic

Table 7 2 illustrates the extent of the deliverable resource and how there is variation from the derived figures for the theoretical and economic resource Plant that is already operating and projects that are planned are differentiated in the right hand section The table also illustrates the relationship between the deliverable resource and the current and predicted electricity supply in the region.

The 'potential large wind resource' is based on the development of all areas with wind speeds of over 6 ms^{-1}, and the 'probable large scale wind resource' is for areas over 7 ms^{-1} These areas are illustrated in Figure 7 1 and Figure 7.2 respectively



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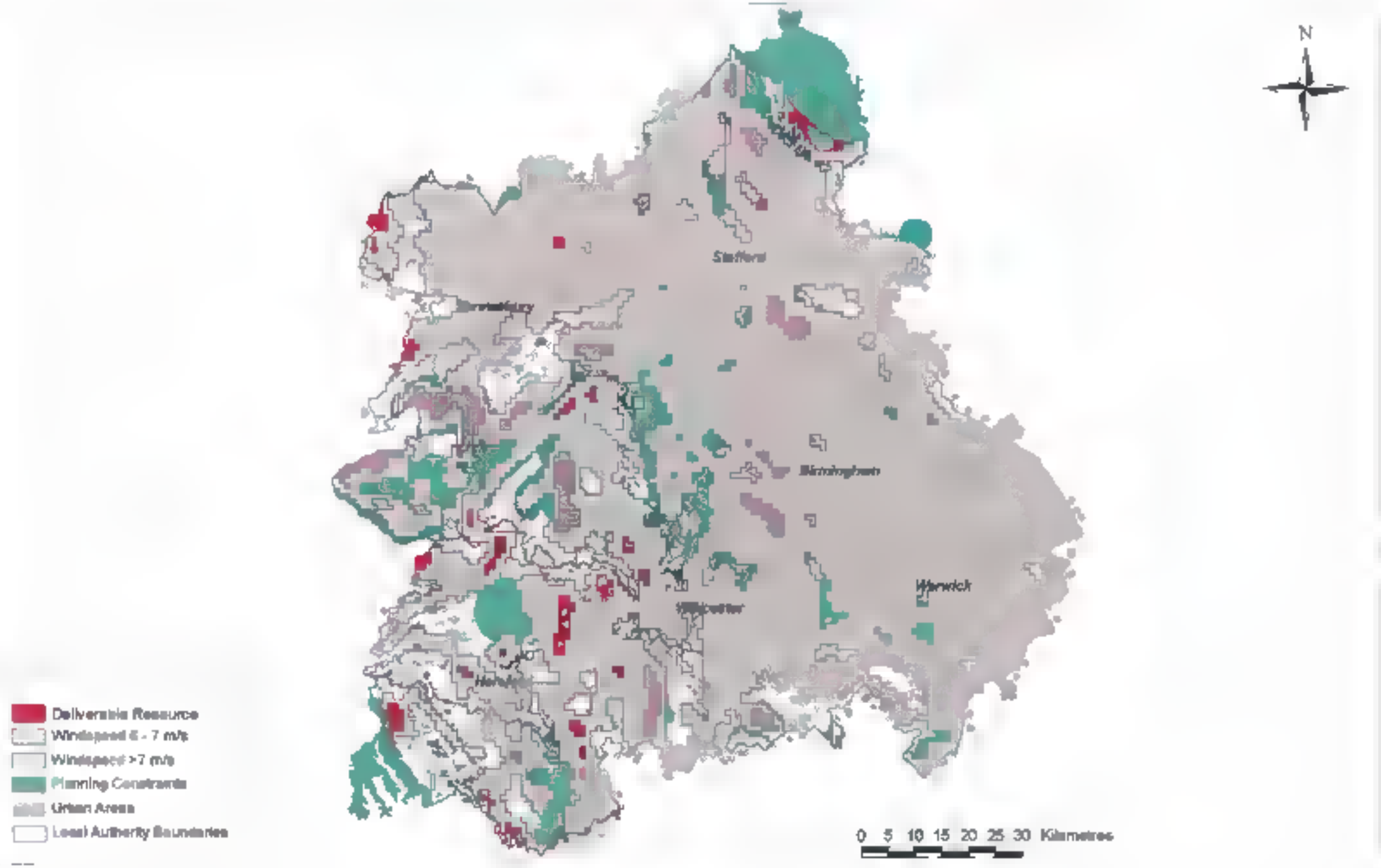
Potential Wind Resource in the West Midlands

Figure 7.1



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Probable Wind Resource in the West Midlands

Figure 7.2

Table 7.2 also illustrates the impact that the assumptions made in the assessment of the wind resource makes on the potential deliverable resources in the region This table shows a significant increase in the 'potential' deliverable resource available in the region compared to the 'probable' analysis This is almost entirely due to the 75% increase in land area that may be acceptable and economic to develop for wind technologies This implies that all of the 2010 electricity consumption could be met by the large scale wind resource alone

It should be noted that the capacity predicted above would require the installation of over 13,000 wind generators, distributed over an area of 223 km² This represents 17% of the land area of the West Midlands Region.

Table 7.2. Theoretical, Economic and Deliverable Resource in the West Midlands Region

Technology		Theoretical Resource (GWh)	Economic Resource (GWh)	Deliverable Resource (GWh)	Deliverable Resource (MW)	Current Generation (GWh)	Planned installed capacity (inc NFFO contracts & DTI Field Trial) (GWh)	New Generation (GWh)
Wind	Large - potential	225 482	193 784	44 000	20 091			
	Large - probable	225 482	12 535	1 345	512			1 345
	Small	2	~	~	~			~
Biomass	Energy crops	1 727	67	67	8			67
	Agricultural	421	45	25	3		18	7
	Forestry	92	41	41	5			41
	Wastes	4,504	823	784	99	502	282	0
	Sewage gas	107	76	76	10	47		29
	Landfill gas	1,018	837	837	77	240	287	130
Solar	Photovoltaic	2,249	~	11	15	0 1	0	11
Hydro	Micro/small	11	7	7	1	3	0.2	4
Total		235,813	14,200	2,503	730	792	[illegible]	1,634
1998 Consumption (population based)		26 113	26 113	26 113		26 113	26 113	26 113
2010 Consumption (estimated)		30 000	30,000	30 000		30 000	30 000	30 000
Resource as % of 1998 consumption		902%	55%	11%		3.0%	2 2%	6.3%
Resource as % of 2010 consumption		785%	48%	10%		2.6%	1 8%	5.4%

Symbol ~ Negligible (less that half of the final digit shown)

The total row only includes the wind resource that is "probable"

Note that the Deliverable Resources shown on this table are the maximum envisaged For some technologies (e g large wind) it is probable that not all this resource will be developed

7.4 *Sub Regional Assessment*

In order to understand local implications of the resource identified in Table 7 1, a sub regional assessment was conducted This aimed to provide the relevant resource data for the following five sub regional groupings of authorities

- Staffordshire county (including the Stoke on Trent Unitary Authority),
- Shropshire county (including the Telford & Wreken Unitary Authority),
- The counties of Herefordshire and Worcestershire,
- Warwickshire county, including the City of Coventry, and
- The metropolitan areas of Birmingham, Solihull, Walsall, Dudley, Sandwell and Wolverhampton

The sub regions selected for this analysis generally fall along historic county boundaries as illustrated in Figure 7 3 However, the counties of Hereford and Worcestershire have been combined and the city of Coventry included in Warwickshire They have been selected with a view to the presentation of results to stakeholder groups and the boundaries drawn do not intend to reflect any political or physical comment

Data for these assessments has generally been drawn from original data sources, where the required detail has been available However, due to the inclusion of Coventry in 'Warwickshire', some detail relating to biomass resources has been lost

Tables 7 3 to 7 7 illustrates the theoretical, economic and deliverable resources and an estimate of the existing generation in the sub-region. These results are compared to the current and predicted electricity consumption in the sub-region in 2010

Appendix D contains figures illustrating the following for each sub region.

- The areas for the 'deliverable' wind resource,
- The potential area for generation from energy crops

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The West Midlands Region

Figure 7.3

- The potential area for generation from agricultural residues, and
- The existing and planned renewable energy generators in the region.

Table 7.3. Theoretical, Economic and Deliverable Resource in Staffordshire

Technology		Theoretical Resource (GWh)	Economic Resource (GWh)	Deliverable Resource (GWh)	Deliverable Resource (MW)	Current Generation (GWh)	Planned installed capacity (inc NFFO contracts & DTI Field Trial) (GWh)	New Generation (GWh)
Wind	Large - potential	*46 573*	*45 587*	*7 312*	*3,339*			
	Large probable	46 573	3 811	2	1			2
	Small	~	~	~	~			~
Biomass	Energy crops	271	13	13	2			13
	Agricultural	128	8	8	1			8
	Forestry	13	6	6	1			6
	Wastes	1,289	181	99	13	99		0
	Sewage gas	21	12	12	2			12
	Landfill gas	267	169	169	20	73	5	88
Solar	Photovoltaic	430	~	2	3			2
Hydro	Micro/small	3	1	1	0	0 3	0.4	0
Total		**48,999**	**4,2[illegible]**	**312**	**42**	**172**	**[illegible]**	**132**
1998 Consumption (population based)		5 197	5,197	5 197		5 197	5 197	5 197
2010 Consumption (estimated)		5 971	5 971	5 971		5 971	5 971	5 971
Resource as % of 1998 consumption		**943%**	**81%**	**6%**		**3 3%**	**0 2%**	**2 5%**
Resource as % of 2010 consumption		**821%**	**70%**	**5%**		**2 9%**	**0 1%**	**2.2%**

Symbol '~ Negligible (less that half of the final digit shown)

The total row only includes the wind resource that is "probable"

Table 7.4. Theoretical, Economic and Deliverable Resource in Shropshire

Technology		Theoretical Resource (GWh)	Economic Resource (GWh)	Deliverable Resource (GWh)	Deliverable Resource (MW)	Current Generation (GWh)	Planned installed capacity (inc NFFO contracts & DTI Field Trial) (GWh)	New Generation (GWh)
Wind	Large - potential	60,475	48,040	13 933	6,362			
	Large - probable	60 475	4,477	269	110			269
	Small	~	~	~	~			~
Biomass	Energy crops	465	20	20	3			20
	Agricultural	149	4	4	0		16	-12
	Forestry	25	11	11	1			11
	Wastes	677	73	73	9		14	59
	Sewage gas	9	5	5	1			5
	Landfill gas	120	62	62	7	12	46	4
Solar	Photovoltaic	181	~	1	1			-1
Hydro	Micro/small	3	3	3	1	2		1
Total		**62,169**	**4,664**	**467**	**133**	**14**	**76**	**378**
1998 Consumption (population based)		2 101	2 101	2 101		2 101	2,101	2 101
2010 Consumption (estimated)		2 414	2 414	2,414		2 414	2 414	2,414
Resource as % of 1998 consumption		**2955%**	**221%**	**22%**		**0.7%**	**3.6%**	**17.9%**
Resource as % of 2010 consumption		**2572%**	**193%**	**19%**		**0.6%**	**3.1%**	**15.5%**

Symbol ~ Negligible (less that half of the final digit shown)

The total row only includes the wind resource that is "probable"

Table 7.5 Theoretical, Economic and Deliverable Resource in Herefordshire and Worcestershire

Technology		Theoretical Resource (GWh)	Economic Resource (GWh)	Deliverable Resource (GWh)	Deliverable Resource (MW)	Current Generation (GWh)	Planned installed capacity (inc. NFFO contracts & DTI Field Trial) (GWh)	New Generation (GWh)
Wind	Large - potential	67 976	46,704	15,591	7 119			
	Large - probable	67 976	3,896	1 054	401			1 054
	Small	~	~	~	~			~
Biomass	Energy crops	521	22	22	3			22
	Agricultural	104	6	6	1		2	4
	Forestry	38	17	17	2			17
	Wastes	463	106	51	7		106	-57
	Sewage gas	14	2	2	0			2
	Landfill gas	124	90	90	11	28	8	54
Solar	Photovoltaic	318	~	2	2	0		2
Hydro	Micro/small	3	2	2	0		1	1
Total		69,562	4,148	1,246	427	28	117	1,099
1998 Consumption (population based)		3 458	3 458	3 458		3,458	3 458	3 458
2010 Consumption (estimated)		3 973	3 973	3 973		3 973	3 973	3 973
Resource as % of 1998 consumption		2011%	120%	36%		0.8%	3.4%	31.8%
Resource as % of 2010 consumption		1751%	104%	31%		0.7%	3.0%	27.7%

Symbol '~ Negligible (less that half of the final digit shown)

The total row only includes the wind resource that is "probable"

Table 7.6. Theoretical, Economic and Deliverable Resource in Warwickshire

Technology		Theoretical Resource (GWh)	Economic Resource (GWh)	Deliverable Resource (GWh)	Deliverable Resource (MW)	Current Generation (GWh)	Planned Installed capacity (inc NFFO contracts & DTI Field Trial) (GWh)	New Generation (GWh)
Wind	Large potential	36 535	38 044	7 124	3,253			
	Large - probable	36,535	150	0	0			0
	Small	~	~	~	~			~
Biomass	Energy crops	442	11	11	1			11
	Agricultural	36	7	7	1			7
	Forestry	11	5	5	1			5
	Wastes	362	74	102	13	66	35	0
	Sewage gas	16	11	11	1			11
	Landfill gas	121	199	199	24	127	199	-128
Solar	Photovoltaic	280	~	1	2	0		1
Hydro	Micro/small	2	0	0	0			0
Total		37,805	457	335	43	193	236	-93
1998 Consumption (population based)		3 973	3 973	3,973		3 973	3,973	3,973
2010 Consumption (estimated)		4 564	4 564	4 564		4 564	4,564	4 564
Resource as % of 1998 consumption		952%	11%	8%		4.9%	5.9%	-2 3%
Resource as % of 2010 consumption		828%	10%	7%		4.2%	5.1%	-2.0%

Symbol '~ Negligible (less that half of the final digit shown)

The total row only includes the wind resource that is "probable"

Table 7.7. Theoretical, Economic and Deliverable Resource in Metropolitan Areas

Technology		Theoretical Resource (GWh)	Economic Resource (GWh)	Deliverable Resource (GWh)	Deliverable Resource (MW)	Current Generation (GWh)	Planned installed capacity (inc NFFO contracts & DTI Field Trial) (GWh)	New Generation (GWh)
Wind	Large - potential	13,924	15,390	40	18			
	Large - probable	13 924	261	1	0			1
	Small	~	~	~	~			~
Biomass	Energy crops	28	1	1	0			1
	Agricultural	5	20	0	0			0
	Forestry	4	2	2	0			2
	Wastes	2 213	390	458	58	337	73	49
	Sewage gas	46	46	46	6	47		-1
	Landfill gas	385	118	118	14			118
Solar	Photovoltaic	1 040	~	5	7	0.1	0	5
Hydro	Micro/small	0	0	0	0			0
Total		17,647	838	633	86	384	73	17[illegible]
1998 Consumption (population based)		11,384	11 384	11 384		11 384	11 384	11 384
2010 Consumption (estimated)		13 078	13,078	13 078		13,078	13 078	13 078
Resource as % of 1998 consumption		155%	7%	6%		3.4%	0.6%	1.5%
Resource as % of 2010 consumption		136%	6%	5%		2.9%	0.6%	1.3%

Symbol ~ Negligible (less that half of the final digit shown)

The total row only includes the wind resource that is "probable"

7.5 *Sensitivity*

It is useful to illustrate the sensitivity of the results derived by testing some of the assumptions that have been made in the analysis Three key areas have been identified as examples of this

- The effect of assumptions on economic viability of wind energy development;
- The effect of an enhanced energy crop planting scheme to cover all potential projects in the region, and
- The impact of the full costs of electricity distribution network reinforcement being passed on to project developers

These are summarised, along with their effect on installed capacity, in Table 7 8

Table 7 8 Sensitivity Analyses

	Base Case	Test
Wind	Development economic in all undesignated areas with wind speeds of greater than 6 ms^{-1}	Development economic in all undesignated areas with wind speeds of greater than 7 ms^{-1}
Electricity Generated (GWh)	44,000	1,345
Installed Capacity (MW)	20,091	614
Area of installation (km^2)	2,232	68
Biomass – energy crops	Limited support available for planting grants (Cost approximately £3 5 million for region	All projects supported (Cost Approximately £62 million for region)
Electricity generated (GWh)	67	1,727
Installed capacity (MW)	9	219
Land area planted (ha)	516	66,596
Electricity distribution network	Cost of electricity network upgrading borne by network operators	Full costs of electricity network upgrading borne by renewable energy projects
Installed capacity (MW)	1365	250

The clear message from Table 7 8 is that the economic and policy framework that supports, or constrains, renewable electricity generation can have a significant impact to the deliverable resource

7 5 1 *Wind Resource Sensitivity*

The sensitivity of the presentation of the deliverable resource for the region is heavily dependent on the assumptions made as to the economic viability of wind generation This viability is a function of

- the wind speed at particular sites,
- the performance of the technology available,
- the cost of that technology,
- the prevailing cost/availability of investment capital,
- and the market conditions determining the price received for the electricity generated

Many different views may be taken to assess whether in general terms a certain site with a certain wind speed should be seem as 'economic'

The view of the British Wind Energy Association, the trade association of the UK wind industry, is spelled out in their policy document "Planning for Wind Energy", [BWEA, 2000] is that:

"The price of wind energy capacity has been considered in the adoption of a minimum wind speed of 7 ms^{-1} in the lowest band It has been assumed that the wind speed bands above this minimum level represent an acceptable spread for commercial development with appropriate funding in a European context. In addition, the cost per kWh for each band has been calculated using a discount rate of 10 % and typical industry data for capital costs The minimum wind speed band shows an illustrative cost of 4 5p/kWh This figure represents the lower level of cost for offshore wind and therefore allows a contiguous range of costs for wind power deployment "

It is interesting to compare this statement with the more positive outlook provided by that of the equivalent American Wind Energy Association

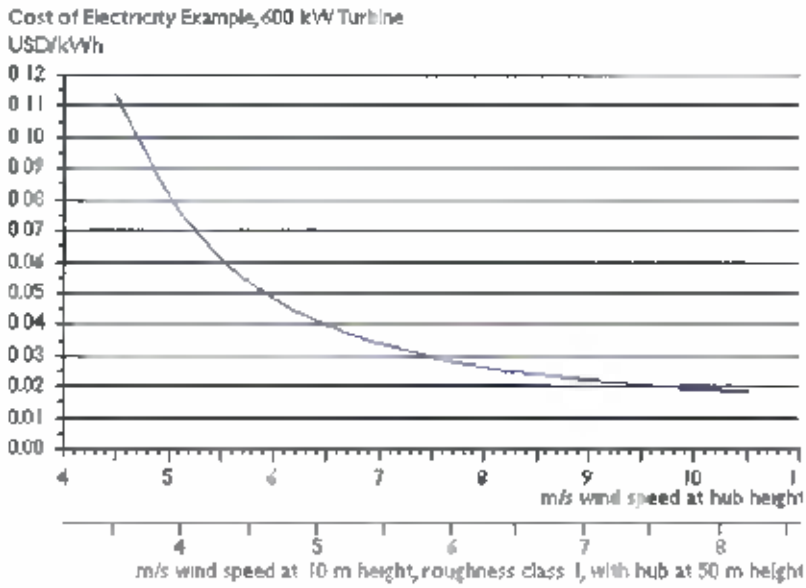
"The power available from the wind is a function of the CUBE of the wind speed, which means that, all other things being equal, a turbine at a site with 5 ms^{-1} winds will produce nearly twice as much power as a turbine at a location where the wind averages 4 ms^{-1} In the

electric power business, where technology options often hinge on very small economic differences, good wind resource assessment and siting is critical.

In general, winds exceeding 5 ms⁻¹ (11 mph) are required for cost-effective application of small grid connected wind machines, while wind farms require wind speeds of 6 ms⁻¹ (13 mph). For applications that are not grid-connected, of course, these requirements may vary, depending on the other power alternatives available and their costs."

As the power available in the wind is proportional to the cube of the wind speed there will continue to be pressure to develop the most windy sites first. The effect on the overall price of electricity generated from the wind is however not so directly proportional, as the following graph illustrates for a recent 600 kW machine.

Graph 7.1 Relationship of cost of electricity to windspeed



Source: VESTAS A/S, 2001

Thus it will be site specific factors and planning concerns that will be the deciding factor in the location and scale of wind development. Such site factors will include issues that are difficult to assess at a local, let alone a regional level, and are often only uncovered following detailed physical investigations and negotiations by potential developers. Examples of these include:

- Microclimate effects,

- Site ground conditions,

- Access road factors

- Proximity to grid connection, and

- The willingness of the landowner to lease land for development.

Each of these can have significant impact on the development costs of a project and may well tip the balance for economic feasibility towards lower wind speed sites

7 5 2 *Energy Crops*

The energy crop resource is constrained by the limited budget available for planting and capital grants If all projects were fully supported, a very large increase in the deliverable resource may be available and this resource would be in a position to supply up to 5% of the Region's electricity consumption

This would involve the planting of energy crops on a total of 7% of the total agricultural area of the region, and is unlikely to be physically available by 2010 However, with increased policy attention applied to rural development following the collapse of UK agriculture in 2001, the contribution to employment and community programs that alternative land uses can make is likely to be increasingly recognised and valued

7 5 3 *Network constraints*

Without a resolution of the network connection issues, only a quarter of the deliverable resource could be connected. This is particularly serious for wind energy developments as the majority of the best resource is located in areas of severe network constraint

7.6 Conclusions

Determining the deliverable resource for the region necessitates the application of a series of 'constraints' on the theoretical resource available Whilst many of these may seem to give a negative message, they are an important factor in understanding the extent of a realistic estimate of the resource that could be developed

Two additional factors that will increase total resource that is deliverable are technology improvements and familiarity

Advances in the efficiency and cost of technologies are likely to occur, above those already accounted for in the calculations This is possible in all technology areas, and the pace of development of renewable energy world-wide could bring these to the market at an earlier than expected

Familiarity with new technologies can increase the general level of acceptance and reduce the severity of many of the constraints that have been detailed in this study The various parties to a development can feel this effect in different ways

- Planning Authorities and Local Residents
  Studies of a number of sites have reported that wind turbines have a far higher acceptance level following construction A good example of this is the recently completed single large turbine at Swaffham in Suffolk. This is a site within 500m of a residential area of the town The high level of concern expressed by many residents has been significantly reduced following the erection of the turbine, and proposals with broad support are advanced for a second machine

- Project Developers and Financiers
  The successful implementation of NETA, the Renewables Obligation and the Climate Change Levy, followed by a period of stability in the market would lead to a more certain picture as to prices for electricity and contracts for supply offered This would in turn reassure those investing in the project of its long-term viability and help to reduce the cost of finance

- Distribution Network Operators
  The serious concerns of the electricity network operators with respect to the ability of their networks to accept high levels of embedded generation may not be realised in practice, particularly if a more active control methodology can be developed

The effect of familiarity and a stable economic and policy environment should not be underestimated It is only necessary to refer to those countries that have embraced renewable electricity generation in recent years to see an illustration of the significant growth rates are possible

8 Conclusions and Targets

8.1 *Relationship Between Deliverable Resource and Targets*

The key objectives of this study is to determine the extent to which the Region may be able to contribute to national targets for renewable electricity However, it is anticipated that development targets will be set for the Region once nationwide resource assessments have been completed

In order to understand the impact of such targets for the Region, it is valuable to investigate methods that might be appropriate for setting targets from a regional perspective

Three methods have been developed to illustrate this comparison

- Reflecting the national development patterns expected
- Based on a probability rating for the level of development of each technology in the timeframe considered
- A development led approach, with technology components shown against their likely development progress

Each of these approaches is detailed in the sections that follow and the qualitative judgements that might be made in their application are described

8.2 *National Development Patterns*

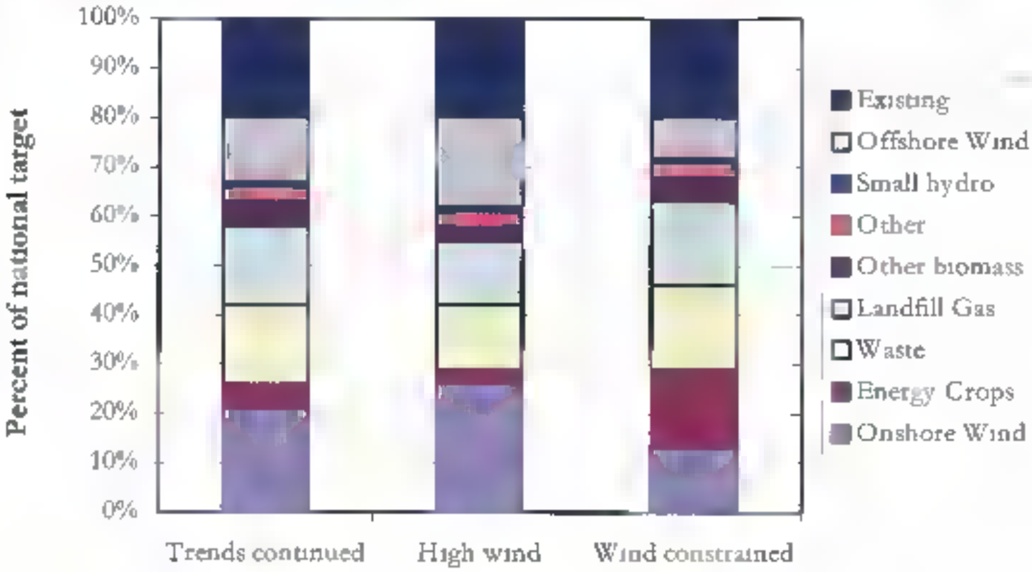
The UK Government has set out in recent consultation the results of analysis undertaken by the ETSU for the DTI This work predicts the expected technology mix that will deliver the national target of 10% of electricity supply from renewable electricity by 2010 The technology mix is presented under three development scenarios

- Trends continued, that represents the historical development of renewable energy technologies in the UK,
- High wind, that envisages a significant acceleration of exploitation of the wind resource, and

- Constrained wind, in which restrictions on the development of wind energy are compensated by additional development of energy crops

The key differences in the technology mixes proposed are illustrated in Figure 8.1 below

[illegible] of UK Renewable Generation Capacity in [illegible]



These technology mixes can be used to develop a view of how the predicted national development of renewable generating technology may be reflected at a regional basis. This regional predicted resource could subsequently be compared to the deliverable resource calculated in this study. It is then possible to determine a regional predictive resource target. For each technology area, this target is defined as the smaller of the predicted resource and the deliverable resource. Tables 8.1 to 8.3 illustrate this calculation for each of the three scenarios (Trends continued, High wind, and Wind constrained)

Table 8.1. Predictive Resource Target, Trends Continued Scenario

Trends Continued	Predicted Generation Mix Consumption Scenario	Growth Continued GWh	Energy Efficient GWh	Total	Deliverable Resource As UK Mix Growth Continued	Energy Efficient
Onshore Wind	21%	630	548	1,345	630	548
Energy Crops	5%	150	131	67	67	67
Waste	16%	480	418	282	282	282
Landfill gas	16%	480	418	398	398	398
Other biomass	5%	150	131	95	95	95
Other	3%	90	78	11	11	11
Small hydro	1%	30	26	4	4	4
subtotal	67%	2,010	1,750	2,201	1,486	1,405
Offshore Wind	13%	390	339	0	0	0
Existing	20%	600	522	792	792	792
Total	100%	3,000	2,611	2,993	2,278	2,196
					7 6%	8 4%

Table 8.2. Predictive Resource Target, High Wind Scenario

High Wind	Predicted Generation Mix Consumption Scenario	Growth Continued GWh	Energy Efficient GWh	Total	Deliverable Resource As UK Mix Growth Continued	Energy Efficient
Onshore Wind	26%	780	679	1,345	780	679
Energy Crops	3%	90	78	67	67	67
Waste	13%	390	339	282	282	282
Landfill gas	13%	390	339	398	390	339
Other biomass	3%	90	78	95	90	78
Other	3%	90	78	11	11	11
Small hydro	1%	30	26	4	4	4
subtotal	62%	1,860	1,619	2,201	1,624	1,461
Offshore Wind	18%	540	470	0	0	0
Existing	20%	600	522	792	792	792
Total	100%	3,000	2,611	2,993	2,416	2,252
					8 1%	8 6%

[illegible] Resource Targets Constrained Wind Scenario

Wind Constrained	Predicted Generation Mix Consumption Scenario			Total	Deliverable Resource As UK Mix	
		Growth Continued GWh	Energy Efficient GWh		Growth Continued	Energy Efficient
Onshore Wind	13%	390	339	1,345	390	339
Energy Crops	16%	480	418	67	67	67
Waste	17%	510	444	282	282	282
Landfill gas	17%	510	444	398	510	444
Other biomass	5%	150	131	95	95	131
Other	3%	90	78	11	11	11
Small hydro	1%	30	26	4	4	4
subtotal	72%	2,160	1,880	2,201	1,359	1,278
Offshore Wind	8%	240	209	0	0	0
Existing	20%	600	522	792	792	792
Total	100%	3,000	2,611	2,993	2,150	2,069
					7 2%	7 9%

The predictive target generation illustrated in Tables 8 1 – 8 3 can subsequently be compared to the two estimates of electricity consumption for 2010 This comparison is illustrated in Table 8 4

Table 8.4. Proportion of supply represented by predictive generation

	Electricity Consumption Scenario	
UK Technology mix	**Continued Growth**	**Energy Efficiency**
Trends Continue	7 6%	8 4%
High Wind	8 1%	8 6%
Wind Constrained	7 2%	7 9%

The key factor to note in Table 8 4 is the reduced contribution that the renewable generation could be expected to make, compared to the 10% – 11% that has been defined as deliverable in this report This is primarily a result of three main factors

- The West Midlands already generates over a quarter of the proposed national renewable target from renewable sources,

- The Region is not in a position to utilise any of the UK's significant offshore wind resource, and

- The level of development of onshore wind turbines is constrained as the region could not be expected to support more than the national mix of this resource.

These factors may therefore form a reason for setting renewable energy targets for the region at a level below the national 10 % target The level of target could be selected from Table 8 4, depending on the scenario for technology mix and energy consumption profile thought to be the most realistic

8.3 *Probability Ratings*

This approach sets out to define the expected probability of each technology in being developed in the period to 2010 This assessment is based on a scoring technique that addresses four principal factors that are considered to impact on the ability of the technology to contribute to the targets For each of these factors a score is derived in the range of 1 – 3, depending on the characteristics of the resource as detailed below

- The technical stage of development of the technology

  1 Demonstration plant only
  2 Pilot scale plants operational
  3 Mature technology

- The ability of development companies, manufactures and suppliers to raise finance, invest, build, maintain and operate the technology

  1 Fledgling – keen individuals and small companies with little experience
  2 Small companies with experience but limited ability to tackle large projects
  3 Medium and large companies with abilities and purchasing power necessary for large projects

- The familiarity of the technology in the region, assessed as the number of similar installations already operating

  1 No examples in region
  2 More than one example in region
  3 More than five example in region

- Assessment of the likelihood of planning permission and other consents being granted

  1 Very difficult, organised opposition certain
  2 Moderate, organised opposition possible
  3 Uncomplicated and unlikely to be any organised opposition

Table 8 5 Probability Ratings Approach

		Current GWh	New GWh	Probability Tech	Industry	Experience	Planning	Score	%	Actual GWh
Wind	Large (Probable	0	1 345	3	2	1	1	7	58%	785
	Small	0	0	2	1	2	2	7	58%	0
Biomass	Energy crops	0	67	2	1	1	3	7	58%	39
	Agricultural	0	25	2	1	1	2	6	50%	13
	Forestry	0	41	2	1	1	3	7	58%	24
	Wastes	502	282	3	3	3	1	10	83%	737
	Sewage gas	47	29	3	3	3	3	12	100%	76
	Landfill gas	240	387	3	2	3	3	11	92%	604
Solar	PV	0	11	3	1	2	3	9	75%	8
Hydro	Micro/small	3	4	3	1	2	3	9	75%	6
		792	2,202							2,291

The calculation of the probability of development enables the estimation of an actual developed resource of 2,291 GWh This equates to 7 6% of the continued growth electricity consumption case, and 8 7% of the energy efficiency consumption case

Thus one of these figures could form the basis of a target for the development of renewable generation in the region. However, this approach depends crucially on the need to subjectively place ratings on aspects of the technologies, and thus these ratings, and the derived probability of development, are open to debate However a more significant factor may be that the judgements expressed in the allocation of ratings may be construed as policy statements and thus may influence development decisions

8.4 *Development Lead*

An alternative method is to set targets in direct reference to the most probable level of development that could be achieved In this case the level of probability is simply derived by expert judgement of the nearness to the technology areas to full scale commercial realisation The relationship in Table 8 6 below may be a first approximation

Table 8.6. Development Potentials

Status	Sector	Deliverable resource GWh
Already developed	Existing generation	792
Closest to full development	Planned generation	568
	Sewage gas	29
	Landfill gas	130
	Energy from waste	0
	Energy crops	67
	Agricultural residues	7
	Forestry residues	41
	Small hydro	4
	PV	11
Furthest from full development	Wind	1,345

If this data is presented in a graphical form as in Figure 8.2 and 8 3 below, this gives a clear indication of the effect of different targets depending on the level of electricity consumption assumed for 2010

Figure 8.2 Renewable Generation and Targets with Continued Growth in Electricity Consumption

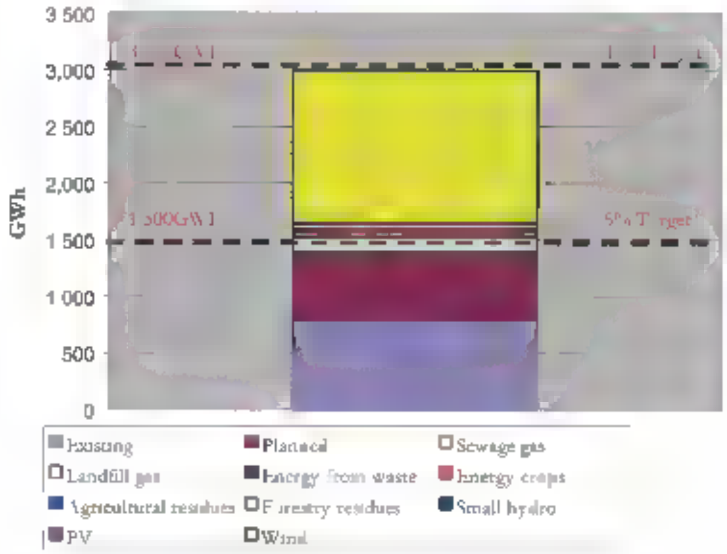
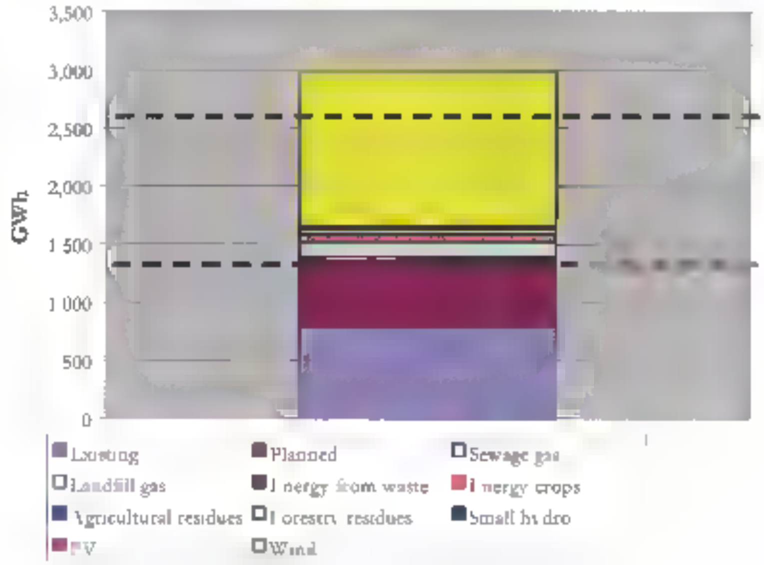


Figure 8.3 Renewable Generation and Targets with an Energy Efficiency Consumption Scenario



8.5 *Contribution to Renewable Electricity Targets from the West Midlands*

The likelihood of the development described in the deliverable resource must be assessed when evaluating targets for development by 2010 These can be assessed by probabilities or by historical and projected trends

Probability assessments can be very subjective, and must attempt a series of judgements that have the potential to lead to significant error Historical information can be valuable, as it recognises the skill base that exists in the industry and the familiarly local organisations and planning authorities have with the technology. However, projected trends from this data can be misleading, as the commercial environment for the next decade is very different from that governed by NFFO during the 1990's

The Government has indicated that 10% of electricity supply is to come from renewable generation on a nation-wide basis and this could form a target for the West Midlands This would have the intention of sending signals to potential project developers, planning authorities, financiers and the general public that the Government is fully committed to significant progress towards sustainable development aims However, to progress towards this target, it would have to be accepted that a significant development in wind and biomass technologies would be necessary at a level unknown in the UK previously Not that this would be physically or technically impossible – Denmark , Germany and Spain have all achieved growth rates in the order of what will be required – but realistically this will be a great challenge

Progress towards any target is likely to be slow in the short term, mainly due to the uncertainties in the commercial framework. Although NETA has been implemented, it is under review and it is likely to be spring 2002 before the proposed Renewables Obligation is implemented. Following a period of stabilisation, it would be unrealistic to expect significant development based on these measures until 2003 With the lead-time of 2 – 4 years for most major projects and up to 6 years for the establishment of energy crops, it is unlikely that much new generation would be starting to be built until 2005.

However, projects already planned or with NFFO contracts are likely to be much nearer to development This is particularly the case as the Government has indicated that these contracts may now be transferable between sites, allowing for some planning obstacles to be removed In addition, it is interesting to note that if these are combined with existing projects then over 4 8% of 2005 estimated consumption could be supplied by renewables in that year

8.6 *Project Recommendations*

The following recommendations have been developed in the course of this study

- Specific policies and guidance on the exploitation of renewable energy resources should be included in all strategic and local plans This study has shown that renewable energy is an issue for all authorities, whether urban or rural, as development throughout the Region of all technologies will be required if the environmental benefits are to be realised

- Regional activities should assist central government in continuing to support renewable energy development through mechanisms such as the proposed Renewables Obligation and by forms of subsidy where appropriate The importance of pre-commercial developments cannot be stressed enough as they have a vital role in building market and public confidence in change Additionally, long term stability in support mechanisms is required to enable commercial projects to raise finance from any source

- Small scale projects face particular financial barriers to development under the anticipated market conditions However, this type of project can be valuable in raising awareness of many types of technologies at a local scale, and can stimulate community involvement in sustainable development Specific support measures should be developed that recognise these important roles

- The electricity distribution network needs to be developed to recognise that in future it will have to be operated in a way that allows for the benefits of embedded generation to be delivered Reinforcement of lines and other transmission equipment will be required to enable many renewable generators to be connected

- The time frame of the development of many renewable energy technology projects can be up to 5 - 6 years Thus, action and support is required immediately if the 2010 targets are to be met, let alone the 2003 targets

- Many renewable energy resources are well suited to the direct delivery of heat to domestic, commercial and industrial applications To the extent that they substitute for electrically generated heat, they could be argued to contribute directly to the 2010 target They could also substitute for other fossil fuel combustion and help combat global warming in that way Therefore, it is recommended that regional assessments are also carried out to research the potential of these resources and of vigorous energy efficiency measures to meet the UK's climate change and sustainability objectives

8.7 *Final Conclusions*

The physical nature of the region dictates which renewable energy technologies will be suitable for electricity generation. Thus, in the West Midlands, technologies that tap the significant energy resource at sea (tidal, wave and offshore winds) are not appropriate In addition, the geological structure of the region is such that temperatures are not sufficiently elevated near to the surface to allow the use of geothermal heat Whilst parts of the Region do have significant rainfall totals, the landscape is generally low lying, and thus not particularly suited to large scale hydro electric development Development will therefore be limited to those technologies that utilise wind, biomass (including energy crops and wastes), solar energy and running water

The physical resource exists in the West Midlands to generate many times the Region's current electricity consumption. Even when constrained by what is considered economically viable and environmentally acceptable, a significant resource is still available.

Finally, it is recommended that the implications of the Government's renewable energy policy is presented for discussion and debate This debate should include views from not only representatives from the regional and local strategic planning authorities, but also might include views from interested parties and organisations that represent wider community viewpoints This may be most effectively achieved by a conference or forum that may attempt to arrive at a consensus viewpoint. This consensus on the opportunities and limits of development, together with the resources assessment information contained in this report will provide the strategic framework for plan policies that can assess renewable generation proposals at a local level, including the identification of suitable sites for development

Appendix A

Calculations for Each Technology

A1 Introduction

Summary of the principal of the resource assessments

For each of the renewable energy technologies considered in this study (Chapter 3) the resource has been calculated on 3 'levels' – theoretical, economic and deliverable.

Theoretical Resource
The resource that is technically accessible and limited only by reasonable physical constraints The technically accessible resource can be expected to increase with time and is calculated here on the basis of existing technology or that which is likely to be developed before 2010

Economic Resource
The resource that is economically viable within the proposed commercial and regulatory framework The 'proposed' framework includes the introduction of the Renewables Obligation, the New Electricity Trading Arrangements and the Climate Change Levy

Deliverable Resource
The resource that can be harnessed after taking into account both economic constraints and the public policy framework. The policy framework includes environmental protection, development control, land use and waste management practices

The wind, solar and hydro resource is calculated in terms of installed capacity (MW) For the purposes of comparing the resource with the Region's electricity consumption, it is helpful to 'convert' this installed capacity into an expected annual electricity yield (GWh) This is determined by the availability of the resource and the generating plant, and is collectively described by the 'load factor' This is equivalent to the proportion of the year when the generator is operating at full capacity

For biomass plant the load factor is much higher since the resource (the fuel) is assumed to be a steady supply and the availability only depends on the plant itself

All the load factors used in the resource calculations are indicated in Table A1

Table A1 Assumed Load Factors

Technology	Load factor	Annual yield (GWh per MW installed)	Comment
Wind (large scale)	0.25	2 190	This estimate is derived from the actual operating performance of wind turbines and takes into account climatic variations, mechanical and electrical availability, wake losses and electrical losses
Wind (small-scale)	0 20	2 175	Micro-turbines generally require a higher wind speed regime to generate at full power and so a lower load factor of 0 20 is assumed
Energy crops, Agricultural residues, Forestry residues, Wastes, sewage gas	0 9	7 884	Biomass projects of these types generally can incorporate an element of storage or are continuously available and thus the physical availability of the energy conversion plant is the only constraint on operation.
Landfill gas	0 95	8 322	Plant availability is proving very good with modern engines
Solar (PV)	0 0856	0 750	In the UK a PV array will produce approximately 750 kWh per kW installed per annum
Hydro (micro/small)	0 54	4 730	The load factor depends primarily on the ratio of the turbine design flow to the mean river flow For a design flow of 0 5 then the average load factor is 0 54 [ETSU, 1996]

Key Assumptions of the assessment

As outlined above, the resource assessment for all technologies requires the determination of a series of assumptions The majority of which could significantly alter the overall resource that is shown to be available Any assessment of this type must make such decisions and for this assessment these generally follow the practice used in other, nation wide, resource assessments where appropriate.

However, it is recognised that there is the potential for significant debate as to the details of each assumption Indeed this is to be encouraged in order to progress the understanding of the issues to be faced in the Region

Table A2 outlines the key assumptions in this sub-regional assessment and table A3 presents the region wide resource assessment

Table A2. Resource Assumptions

	Wind (large)	Wind (small)	Energy crops	Agricultural residues	Forestry residues	Waste	Sewage gas	Landfill gas	PV	Hydro
THEORETICAL RESOURCE										
Key assumptions	All land areas available for development with wind speed > 3 ms⁻¹	10 % of agricultural holdings have suitable off grid applications	All set aside and 10% of current arable converted	All manure from housed stock available	Estimated 450 kg/ha woodland available annually	All combustible municipal, commercial and industrial waste available	All sewage works are suitable	All landfill sites can be developed	38% of domestic, and 80% of commercial, properties in 2010 are fitted	All existing weir sites are used
ECONOMIC RESOURCE										
Key variables	Size, Wind speed	Application, Wind speed	Transport + fuel costs	Transport costs, proportion of food processing residues	Transport + fuel costs	Waste volumes	Population serviced	Site size	Value as a building material	Head, flow rate, existing civil structure
Key assumptions	Wind speed Potential > 6 ms^{-1} Probable > 7 ms^{-1}	More expensive than a diesel generator (not economic)	Only for sites with capital grants and planting subsidy	Only if includes food processing or other organic residues	Only that available from felling etc (200 kg/ha woodland)	Domestic sector only	Sewage works serving populations above 90,000	Sites over 500 000 tonnes capacity	Replacement for 'prestigious office claddings	> 25 kW, Head > 2 m
DELIVERABLE RESOURCE										
Key assumptions	Development constrained by existing land use, designated areas and planning policy	All economic resource delivered	All economic resource delivered	All economic resource delivered	All economic resource delivered	Development may be constrained by waste recycling policies	All economic delivered	All economic delivered	Potentially large growth in domestic sector even though not economic	All economic delivered

Note symbol '~' denotes negligible (less than half the final digit)

Table A3. Resource Assumptions

West Midlands Region

Technology		Theoretical Resource (GWh)	Economic Resource (GWh)	Deliverable Resource (GWh)	Deliverable Resource (MW)	Current Generation (GWh)	Planned installed capacity (inc NFFO contracts & DTI Field Trial) (GWh)	New Generation (GWh)
Wind	Large - potential	225,482	193,764	44 000	20 091			
	Large probable	225 482	12 [illegible]	1 345	512			1 345
	Small	2	~	~	~			~
Biomass	Energy crops	1,727	67	67	8			67
	Agricultural	421	45	25	3		18	7
	Forestry	92	41	41	5			41
	Wastes	4,504	823	784	99	502	282	0
	Sewage gas	107	76	76	10	47		29
	Landfill gas	1,018	637	637	77	240	267	130
Solar	Photovoltaic	2,248	~	11	15	0 1	0	11
Hydro	Micro/small	11	7	7	1	3	0.2	4
Total		235,813	14,290	2,993	730	792	568	1,634
1998 Consumption (population based)		26 113	26 113	26 113		26 113	26 113	26 113
2010 Consumption (estimated)		30 000	30 000	30 000		30 000	30 000	30 000
Resource as % of 1998 consumption		902%	56%	11%		3.0%	2 2%	6 3%
Resource as % of 2010 consumption		785%	48%	10%		2.6%	1 9%	5 4%

Symbol ~ Negligible (less that half of the final digit shown)

The total columns include only that wind resource that is "probable"

A2 Wind (Large-Scale)

The wind resource is determined by 3 key factors

- wind speed
- available land area
- turbine technology (size, availability etc)

The wind speed is derived from the NOABL data set[15] This provides an estimate of the annual mean wind speed (AMWS) for every square kilometre in the UK The information was presented in 0 5 m^{-1} wind speed 'bins' from 3 5 m^{-1} to 9 5 m^{-1}, for a selection of heights Data was selected for a height of 45 m above ground level

The land area available for development is calculated separately for the theoretical, economic and deliverable resource (below) based on a number of practical, planning and economic assumptions

For all three levels of the resource calculation an installed capacity of 9 MW/km² is assumed This is the same 'density' as used in the DTI study [DTI, 1999a], but based on the assumption that it would be composed of 6 × 1 5 MW turbines, rather than 15 × 600 kW machines, to reflect the trend towards larger turbine sizes

Theoretical Resource
All land is available for development with the exception of urban areas

[15] The NOABL data set was produced by ETSU in 1992 annual mean wind speeds were calculated for the UK at a resolution of 1 km² using computer modelling techniques which include topographical effects and normalised to long-term data obtained for 51 meteorological stations

Economic Resource

The economic viability of a turbine is strongly dependent on the wind speed since the power is proportional to the wind speed cubed[16] Annual mean wind speeds for the West Midlands Region are indicated in Figure A1

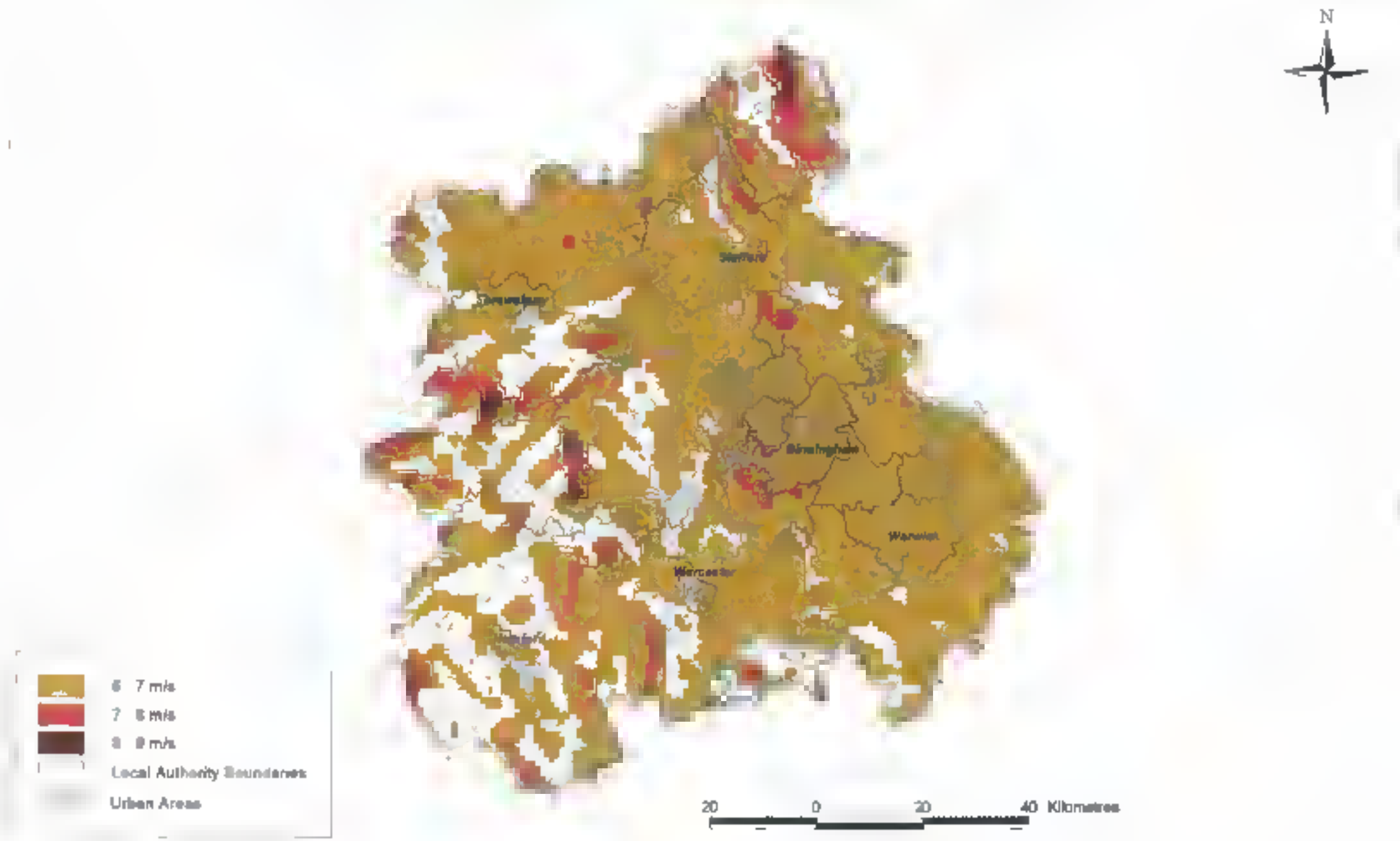
The economic resource is calculated based on different assumptions on financial viability

- The **Potential** economic resource assumes that wind power development is only economically viable on land with an AMWS equal to or greater than 6 ms^{-1} Whilst this is lower than that used in the recent study carried out by the British Wind Energy Association [BWEA, 2000], local circumstances and improvements in the technology are assumed to allow projects to be constructed in these areas It is also possible to envisage circumstances where areas with wind speeds below 6 ms^{-1} may be attractive to certain developers, however these projects are not expected to significantly affect the total capacity

- The **Probable** economic scenario assumes that uncertainties in the market place will continue to constrain development over the period, and thus only sites with wind speeds in excess of 7 ms^{-1} will be viable

The BWEA calculate that the cost of electricity, in the minimum wind speed band, will be 4 5 p/kWh using a discount rate of 10 % and 'typical industry data for capital costs' Capital costs typically account for 75 to 90 % of the total cost and, according to the DTI [DTI, 1999a], will decrease to 75 % of 1996 costs by 2010 if the historic trend is continued While this looks to be economic under the proposed Renewables Obligation (see chapter 4) wind power will be disadvantaged by the New Electricity Trading Arrangements because of its variable and unpredictable output

[16] Note that energy yield does not in fact increase with the cube of wind speed since power conversion efficiencies vary with wind speed and, as the mean wind speed increase, a greater proportion of the energy is 'spilled' as the control system limits the output to its rated level. Typically a site with an awms of 8 m/s could be expected to produce 80 % more electricity than the same turbine at a site of 6 m/s.



Halcrow

Wind Speed Distribution

Figure A1

Note that previous studies [ETSU, 1997a] included a requirement for 'clustering' of wind turbines The argument being that wind turbines 'need to be grouped together so that they are financially and practically viable and to minimise their environmental impact' With regard to the former points, it was decided that single turbine developments will be viable and there is already evidence of this in the UK with a number of existing NFFO contracts for single turbines

Deliverable Resource

Further to the economic constraints, wind power developments will be restricted by existing land use and planning designations These are likely to be a) controversial and b) subject to planning policy on a local level However, some broad planning constraints have been identified. It is assumed that, wind power development will not occur in the following areas

i Urban areas, plus 500m buffer

ii Major roads (motorways and A roads), plus 100 m buffer

iii Airport exclusion zones

This is unique to each airport As an approximation a circular exclusion zone of radius 6 km was used for major civil and military airports (3 km for minor civil/commercial airports and 1 km for heliports)

iv Protected areas

- National Parks, plus 1500 m buffer
- Areas of Outstanding Natural Beauty (AONB)
- National Nature Reserves (NNR)
- Special Protection Areas (SPA)
- Special areas of Conservation (SAC)
- Sites of Special Scientific Interest (SSSI)
- Special Landscape Areas (SLA)

- Areas of Great Landscape Value (AGLV)[17]
- Ramsar Sites
- Ancient woodland
- Green Belt

v Woodland – this was excluded on a percentage basis i e for a 'cell' containing 10 % woodland by land area the deliverable resource would be reduced accordingly

Planning constraints are discussed in further detail in chapter 5 but it is noted that, according to the DTI [DTI, 1999a] 'there may be scope for siting some turbines in these [the listed protection] areas but each case would merit special consideration, furthermore National Planning Policy Guidance [DETR, 1993] states that 'particular care should be taken, in assessing proposals for developing renewable energy projects in National Parks, Areas of Outstanding Natural Beauty, the Broads and Sites of Special Scientific Interest ' Similar considerations arise in areas of archaeological or historic importance Thus while national planning guidance does not explicitly preclude wind power development from any form of designation, it is believed that such developments will not be the norm and will not significantly affect the resource calculation

[17] Whilst SLA's and AGLV's are not statutory designations and their precise definition varies across the region, they do represent areas where high local interest in the landscape is likely to lead to resistance to wind developments

Table A4 Theoretical, Economic and Deliverable Wind Resource

	Land area km²	Number of turbines	Installed capacity MW	Annual Yield GWh
Theoretical	11,440	68,640	102,960	225,482
Economic				
- **Potential**	9,831	58,985	88,477	193,764
- **Probable**	639	3,834	5,751	12,595
Deliverable				
- **Potential**	2,232	13,394	20,091	44,000
- **Probable**	68	409	614	1,345

A2 Wind (Small-Scale)

Aside from the commercial development of large wind turbines connected to the electricity network, there is a small but growing market for micro-wind turbines, ranging in size from 100 W to 10 kW Applications are likely to range from off grid homes, to low power applications for agriculture and wind pumping

Theoretical resource

To calculate the regional resource it is assumed that the number of remote homes that are off grid is negligible in the West Midlands (the off grid market has similarly been omitted from the solar resource calculation) Furthermore, it is assumed that mechanical wind pumps will be used in preference to coupling the rotor to a submersible electric pump Although the latter does allow the generator to be located in the best wind position and not necessarily over the pump, mechanical wind pumps are considerably cheaper

Consequently, the theoretical resource is primarily low power applications in agricultural premises Wind turbines can be of most use in remote parts of a farm where the cost of cables from the distribution network could be prohibitive Typical applications are electric livestock fencing, lighting or small electronic systems for control or monitoring equipment

Assumptions

(i) Micro-wind generators are installed on 25 % of all agricultural holdings (region total 18,800 holdings in 2000) [DEFRA, 2001]

(ii) The average capacity of generators is 200 W

This the theoretical resource = 0 25 × number of agricultural holdings × 0 2 kW

= 0 25 × 18,800 × 0 2 kW = 940 kW

With a load factor of 0 20, this corresponds to an expected annual yield of 1 6 GWh

Economic Resource

In most instances diesel generators are used for small power generation on farms. The economic resource can therefore be calculated by comparing the cost with that of diesel generation (as opposed to grid-supplied electricity). For diesel generators the fuel and operating costs are estimated to be approximately 10 p/kWh. The difference in capital cost for a 200 W wind generator, as opposed to diesel is around £500. If the wind generator has an average load factor of 0.20 then it can be expected to produce 350 kWh of electricity per year, thus saving £35 on fuel and operating costs. This results in a payback period greater around 14 years. Although only a 'ballpark' calculation it is assumed that none of the theoretical resource will be economic, especially considering that wind generators are typically sold with just a 2 year warranty. There is probably scope for a large reduction in costs if small wind turbines were to be mass-produced but this is difficult to foresee.

Deliverable Resource

This is also deemed to be zero. Some of systems are likely to be installed for non economic reasons but the contribution to the regional electricity demand will be negligible.

A4 Energy Crops

Theoretical Resource

The resource available from energy crops is primarily a function of two factors the type of crop grown and the area of land given over to growing the crop

Whilst agriculture in the UK is in a state of rapid change due to the removal of subsidises based on levels of production, the majority of farm land area will continue to be used to grow food for the foreseeable future. However, farm incomes will be severely stretched and opportunities for diversification will be welcomed by many businesses Two key categories of land are expected to be of particular interest

- Set aside land Registered land in this category receives an area payment for not growing food crops, and additional payments for other uses are permitted
- Arable land Commodity market prices, such as that for wheat, are likely to remain at world wide levels with the implementation of GATT world trade talks Only a proportion will be available for switching to energy crops

Thus the area available to energy crops = All set aside land + 10% of all arable land

A number of crops types have been tested in the UK for their suitability as energy crops, but those at the most advanced state of development are the grass Miscanthus and Willow, grown as short rotation coppice (SRC) [DTI, 1999a] The expected yield of these crops will vary with ground conditions, soil types and climate across the region, with Miscanthus growing much more favourably in the wetter, warmer west and south A first approximation of the mix of these two crops is likely to be 60% SRC and 40% Miscanthus Yield of these crops are increasing with better understanding of crop management and the expected yields anticipated to be achievable by 2010 are 15 t/ha for SRC and 23 t/ha for Miscanthus (expressed as dry tonnes) [DTI, 1999a, Forest of Mercia, 1999]

The calorific value of both crops is similar at 19 GJ/dry tonne [DTI, 1999a]

Currently the conversion of energy crops to electricity is achieved by either incineration with energy recovered by a boiler and steam cycle, or by gasification with the produced gas either used in a steam cycle or directly in a gas engine or gas turbine. Whilst gasification technologies not yet fully developed, they are expected to form the most likely generation route in 2010 Their main advantage over incineration technologies is the potential of higher electrical conversion efficiencies, with net efficiencies of 30% believed to be readily achievable Plant availability is estimated to be in the region of 90%

Thus the electrical energy potential of energy crops =

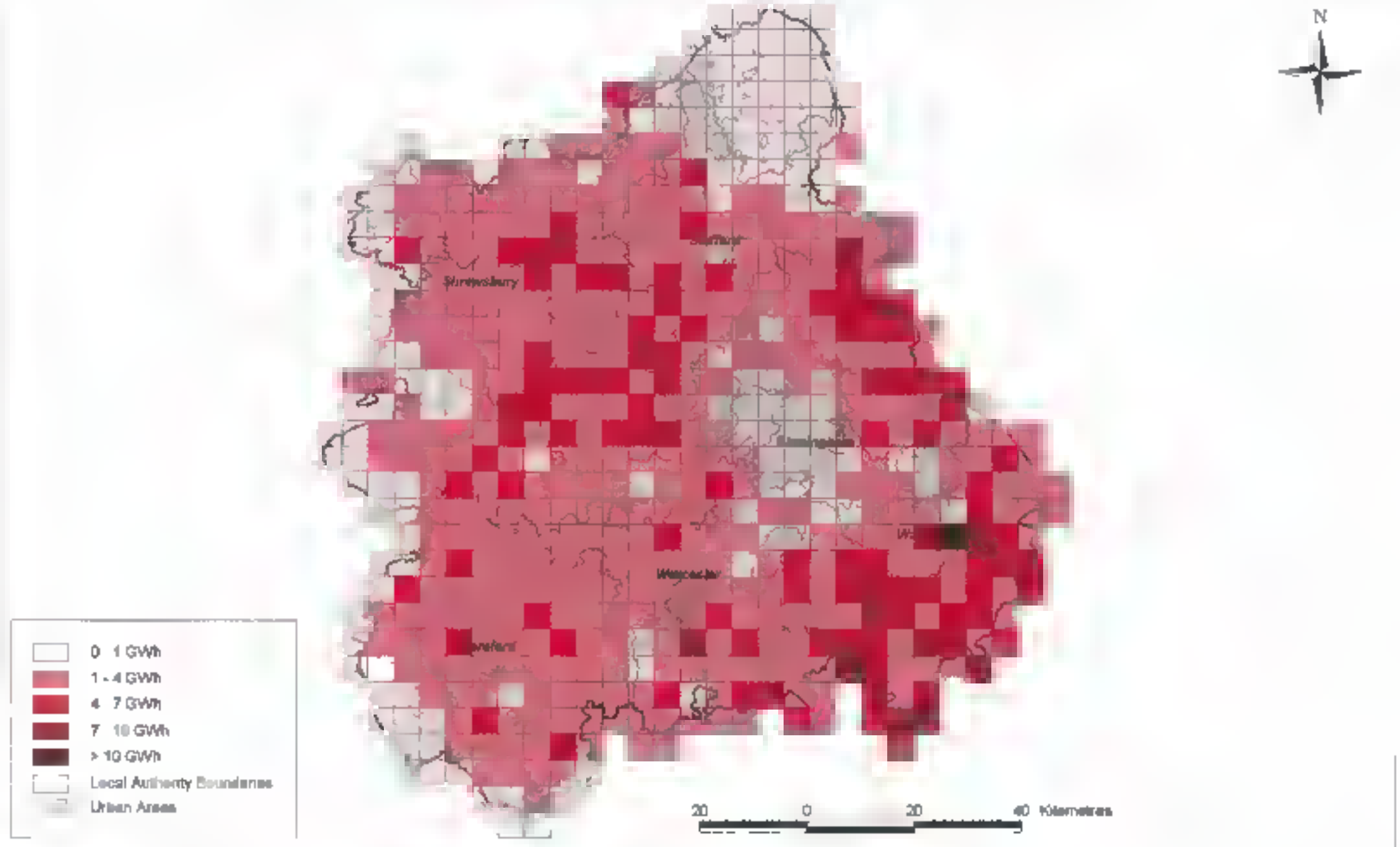
Dry weight of crop grown x calorific value of crop x plant efficiency

The theoretical resource, calculated using the 1999 MAFF Census data, plotted in Figure A2 and based on the above assumption equals 1417 GWh This equates to an installed capacity of approximately 180 MW_e

Economic Resource

Currently it is not expected that energy crops generation systems could deliver electricity prices at, or below, the 5 2 – 5 4 p/kWh anticipated to be available However with the limited capital grants proposed in the Renewables Obligation and the MAFF planting grants available this resource will become commercially viable

The Energy Crops Scheme, launched under the Government's English Rural Development Programme, will offer planting grants of between £920 and £1,600 per acre with the aim of delivering 20 – 25,000 ha of energy crops by 2007 [MAFF, 2000b] Thus this level of planting will be the total available for cropping in 2010 As the West Midlands area accounts for 10 3% of all the agricultural land in England [MAFF, 2000c], a maximum of 2,575 ha of land in the region can be expected to be planted for energy crops



Halcrow

Potential Generation from Energy Crops

Figure A2

At an average energy crop yield of 18.2 dry tonnes/ha (0 6 x 15 + 0 4 x 23), this equates to an annual yield of energy crops of 46,865 dry tonnes and thus an electrical generation potential of

46,865 x 19 x 0 3 x 0 9 = 240,417 GJ, equivalent to 66 8 GWh

This equates to a total installed capacity of around 7 6 MW_e, and estimates of economic plant size suggest that this is unlikely to be split between more than two plants in the region

Deliverable Resource

There are not significant factors that would limit the development of two 3 – 5 MW_e plants in the region Thus the deliverable resource is 66 8 GWh

A5 Agricultural Residues

Theoretical Resource

Many types of agricultural residues may be available for energy recovery The total amount of residues generated by agriculture may amount to 250 million tonnes per annum [DOE, 1992], but a significant proportion of this is animal dung that is dropped directly on to farm land A more realistic assessment makes the assumption that only dung from housed animals may be available, and this reduces the amount of all residues generated to around 60 million tonnes Cereal and other crop straw makes a significant contribution to this total, but in the West Midlands the majority of this material is not surplus and is utilised as animal bedding or directly incorporated into the soil

Most animal manure, apart from some chicken litters, has a high moisture content, making it generally difficult to burn in incineration plant Thus the most appropriate manner for recovering energy is by anaerobic digestion This technology is technically well developed on many scales and has significant potential and attraction to the agricultural industry as part of integrated system to manage waste and recycle nutrient and fibre to farmland

The theoretical resource consists of all animal dung that can be collected whilst animals are housed The assumptions as to the manure generation and time of year that common stock are housed are set out in Table A5 below

Table A5 Manure Arising and Housing Assumptions [Cannington College, 1998]

	Manure arising (kg/day)			*Proportion housed in summer*
	Slurry	*Bedding*	*Total*	*%*
Dairy cattle	57	120	177	20
Beef cattle	35	30	65	0
Other cattle	10	15	25	0
Breeding pigs			12	80
Other pigs	-	-	7	80
Laying fowl			0 11	100
Other fowl			0 08	100

It is assumed that all stock is house in winter, and the winter length is 180 days When introduced to an anaerobic digestion vessel, different manure types generate differing biogas yields However, the biogas generated is generally of a constant calorific value of 20 MJ/m^3 [DTI, 1999a]

Table A11 Biogas yields for different manure types [Cannington College, 1998]

	(iii) Biogas yield (m³/tonne)
Dairy cattle slurries	25
Beef cattle slurries	25
Other cattle slurries	25
Dairy cattle bedding	15
Beef cattle bedding	15
Other cattle bedding	15
Breeding pigs slurries and bedding	26
Other pigs slurries and bedding	26
Laying fowl droppings and bedding	90
Other fowl droppings and bedding	50

It is anticipated that the biogas will be utilised in spark ignition gas engines or gas turbines, that are currently well developed for this purpose and can deliver gross electrical efficiencies of over 40% However, the need for a substantial level of parasitic loads (pumps etc) at biogas plants means that a good estimate of the net electrical efficiency is 30% Plant availability is assumed at 90%

Thus the electrical energy generated =

Manure yielded x biogas yield for that manure x calorific value of biogas x electrical efficiency of plant x plant availability

Using the 2001 DEFRA Agricultural Census data and the above assumptions, the total electrical energy available is 421 GWh This equates to approximately 53 MW_e

of installed capacity Generation potential from agricultural residues is shown in figure A3

Economic Resource

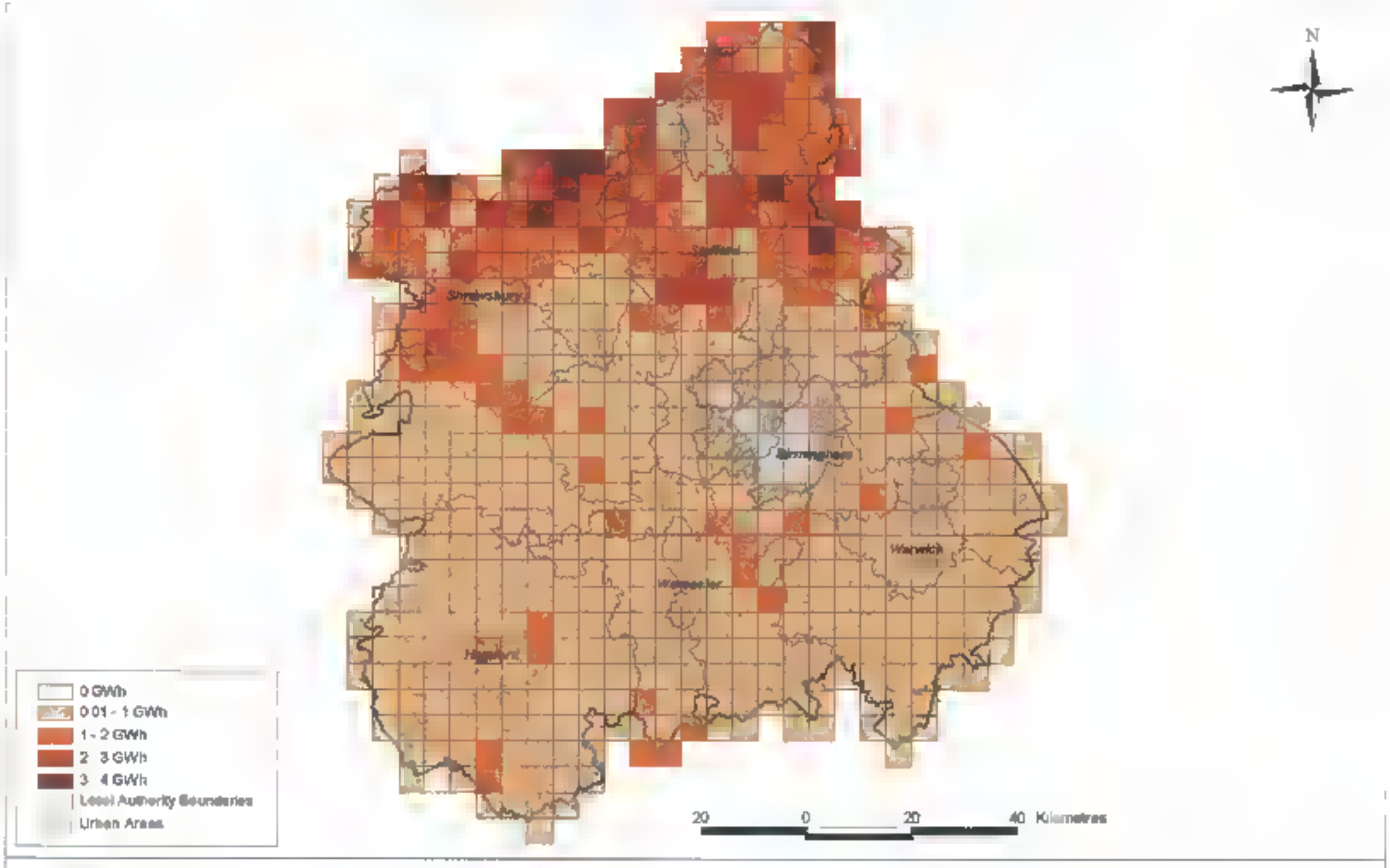
A recent detailed investigation of the economics of biogas plant in England [Cannington College, 1998] indicated that the anaerobic digestion of animal manure is likely only to be commercially economic if a substantial proportion of food processing residues are also available This is because the deposal costs for these residues can be received as a gate fee at the biogas installation. In this case a generation cost of under 4 5 p/ kWh may well be achievable However, the scale of facilities that are installed has a significant effect on the cost of generation, with one study in 1996 putting the generation cost for small farm scale plant as high as 5 9 p/kWh [ETSU, 1996a]

Thus it can be assumed that, in the absence of any direct government support, the only projects that will be economic by 2010 are those that will be able to attract food processing or other organic residues for a substantial part of their through put. This will therefore favour centralised AD plant Typically this will include a net generation capacity of over 1 MW_e and will source manure from 40 – 60 farms within a 5 km radius of the facility A facility such as this would require 15,000 to 20,000 tonnes of food processing residues annually to make it viable

Approximately 1,200,000 tonnes of biodegradable waste are generated in the West Midlands and if 20% of this arising was diverted to AD facilities, a total of three 1 MW_e plants could be supported This would equate to the utilisation of approximately 7% of animal manure, which would result in the generation of 45 GWh of electricity

Deliverable Resource

There are very few constraints that would restrict the full development of the economic resource, although the details of planning conditions are likely to cause some difficulties in specific cases Key concerns will centre on local transport issues and odour control at plants It is anticipated that agreement on these issues can be dealt with in sensitive planning conditions Thus the deliverable resource is 25 GWh



Halcrow Potential Generation from Agricultural Residues Figure A3

A6 Forestry Residues

Theoretical Resource

The theoretical resource would utilise all the wood lands residues arising from felling and thinning operations in addition to residues from woodfuel plants and that arising from arboricultural operations such as tree surgery This amounts to approximately 0 45 dry tonnes per year per hectare of woodland [DTI, 1999a, Forest of Mercia, 1999] The calorific value of these residues is reasonable consistent at 19 GJ/dry tonne

The conversion of forestry residues to electricity is achieved by either incineration with energy recovered by a boiler and steam cycle, or by gasification with the produced gas either used in a steam cycle or directly in a gas engine or gas turbine

Whilst gasification technologies are not yet fully developed, they are expected to form the most likely generation route in 2010 Their main advantage over incineration technologies is the potential of higher electrical conversion efficiencies, with net efficiencies of 30% believed to be readily achievable Plant availability is estimated to be in the region of 90%.

Thus the electrical energy potential of forestry residues =

Dry weight of residues x calorific value of residues x plant efficiency x plant availability

Using data on forestry arising from the 'Region in Figures' data [National Statistics, 2001] and the above assumptions, the theoretical resources was calculated to be 92 GWh This equals to approximately 12 MW_e of installed capacity The full details of the calculation are shown in Table A7

Economic Resource

Due to the diverse nature of arboricultural operations, it is assumed that these will not be sufficiently reliable for the development of forestry residue projects This reduces the quantity available to approximately 0 20 dry tonnes per annum per hectare of woodland Subsequently it is unlikely that few forestry projects will be viable unless they contribute to an energy crop projects In this circumstance all residues collected can expect to be used, as they can make a significant contribution to the economic viability of these projects

Thus the economic resource is 41 GWh per annum, and although this equates to an installed capacity of around 5 MW_e, it is anticipated that the forestry resource will be as additional fuel for energy crop schemes

Deliverable Resource

There are no significant issues that would restrict full development of the economic resource

Table A7. Forestry residues   Theoretical Resource

	Theoretical Resource	Economic and Deliverable Resource
Woodland area (ha)	143,504	143,504
Residues available (t/year)	64,577	28,701
Energy in residues (GJ)	1,226,955	545,313
Electrical energy generated (GJ)	331,278	147,235
Electricity generated (GWh)	92	41

A7 Municipal, Commercial and Industrial Wastes

Theoretical Resource

Waste arising in the West Midlands Region are estimated at a total of 15 4 million tonnes, per annum, of which 10 2 million tonnes are of industrial and commercial origin, 3 1 million tonnes from construction/demolition and 2 1 million tonnes from domestic sources [WMLGA, 1999]

In calculating the theoretical resource it is assumed that the followers mix of waste management options will be implemented between 2000 and 2010

[illegible] aste Management Options [WMLGA, 1999, Environment Agency, 1998, ONS, 2000]

Waste type	Landfilled	Recycled	Energy recovered
Industrial & commercial	40%	30%	30%
Construction & demolition	75%	25%	0%
Domestic	40%	20%	40%

Therefore the waste available for energy recovery in the West Midlands is 3 1 million tonnes (industrial & commercial) and 0 8 million tonnes (domestic) The calorific value of these wastes is assumed to be, on average, 16 GJ/tonne and 13 GJ/tonne respectively [WMLGA, 1999], giving a total energy content of 60 million GJ The details of the calculation are shown in Table A9

The electrical conversion efficiency of current main burn incineration is in the order of 20%, but this figure is expected to increase significantly with the implementation of new technology A net efficiency of 30% is assumed for this study Plant availability is estimated to be 90%

Thus

Theoretical resource $= 60 \times 10^6 \times 0 3 \times 0 9$ GJ

$= 16 2 \times 10^6$ GJ

This equates to a total theoretical resource of 4,504 GWh and an estimated installed capacity of 571 MW_e

Economic Resource

Energy from waste plant is capital intensive plant, and requires a guaranteed waste delivery for full operation Thus it is assumed that the plant developed will only serve the domestic sector, as it is in this area that long term waste management contracts are available (up to 20 years) This reduces the waste available for energy recovery to 0 8 million t/pa

The economic resource is thus 823 GWh, or an installed capacity of 104 MW_e

Table A9. Wastes - Theoretical Resource

	West Midlands Region	Staffordshire	Shropshire	Herefordshire	Worcestershire	West Midlands	Warwickshire
Waste Arisings (tonnes p a)							
Industrial/Commercial	10,224,000	2,720 000	1,490,000	864,000	864,000	4,450,000	700,000
Domestic	2,111,000	464,000	186 000	271 000	271 000	1,000,000	190,000
Construction/Demolition	3 073,290	1 290	572,000	700,000	700,000	1,500,000	300 000
Total	**15,408,290**	**3,185,290**	**2,240,000**	**1,835,000**	**1,835,000**	**6,950,000**	**1,190,000**
Waste available for energy recovery (tonnes p a)							
Industrial/Commercial	3 067,200	816,000	447,000	259,200	259,200	1,335,000	210,000
Domestic	844 400	185 600	74 400	108,400	108,400	400 000	76,000
Construction/Demolition	0	0	0	0	0	0	0
Total	**3,911,600**	**1,001,600**	**521,400**	**367,600**	**367,600**	**1,735,000**	**286,000**
Electricity generated (GJ)	**16,214,148**	**4,640,640**	**2,435,760**	**1,666,920**	**1,666,920**	**7,968,000**	**1,304,400**
Electricity generated (GWh)	**4504**	**1,289**	**677**	**463**	**463**	**2,213**	**362**

Deliverable Resource

Currently there is approximately 64 MWe of installed waste plant in the West Midlands region Plants under construction and those at a late stage of planning account for another 36 MWe of capacity Together all these plants will incinerate 1,537 million tonnes of waste p a (Table A10) which is equivalent to 73% of the total domestic waste arisings In the current Waste Strategy for England and Wales [DETR, 2000d], the government has set a target of 15% of wastes to be recovered with materials and energy recovery Even if waste volumes increase as predicted at 3% per annum to 3 0 million tonnes p a of domestic waste by 2010, the installed and planned capacity will be able to recover energy from over 50% This far exceeds the Governments targets for recycling and so it is considered that additional capacity will not be deliverable Consequently the deliverable resource, equivalent to current and planned energy from waste plant, is 99MW_e or 784GWh p a

Table A10. Wastes Deliverable Resource

Operating

District	Site name	GridRef	Annual capacity t	Installed capacity MW	Annual generation GWh
Birmingham	Tyseley		350 000	28 2	222
Dudley	Dudley		90 000	6 2	49
Stoke on Trent	Stoke		200 000	12 5	99
Coventry	Coventry		160 000	8 4	66
Wolverhampton	Wolverhampton		105 000	8 4	66
		Operating total	905 000	64	502

Planned/under construction

District	Site name	GridRef	Annual capacity (estimated) t	Installed capacity MW	Annual generation GWh
Bromsgrove	Kidderminster		115 000	6 5	51
Coventry	Coventry		80 000	4 5	35
Sandwell	Warley		32,000	1 8	14
Telford & Wrekin UA	Telford		165,000	9 3	73
Dudley	Coseley		240,000	13.7	108
		Planned/under construction total	632,000	36	282
		TOTAL	1,537,000	99	784

A8 Sewage Gas

Theoretical Resource

Anaerobic digestion of sewage can be used to generate approximately 800 kWh of electricity per dry tonne of sludge digested [ETSU, 1993] and, on average, each person produces 25 kg of dry sewage sludge per annum [ETSU, 1994b]. Consequently for the West Midlands, with a population of 5 33 million [ONS, 2000], the total amount of sludge available for digestion is 133,250 tonnes per annum Thus the Theoretical Resource can be calculated as follows

Resource = 800 (kWh) x 0 025 (t/person) x 5 33 x10^6 (persons)

= 106,600,000 kWh

= 106 6 GWh

It should be noted that the majority of electricity generated by AD facilities of sewage works is used in the operation of these works, and it is very rare for these sites to export electricity to the grid

Economic Resource

Currently it has only proved economic to installed anaerobic digestion facilities at sewage works that serve major urban areas and this situation is considered unlikely to change For the purposes of this calculation it is assumed that major urban areas constitutes districts, authorities or metropolitan areas with a population over 90,000 This limits the economic resource to 76 1 GWh and represents an installed capacity of 9 7 MW_e

Deliverable Resource

All economic resource will be deliverable, as there is a high electricity and heat demand at sewage works sites and AD increasingly forms a major step in advanced sewage treatment

Table A11. Theoretical Sewage Sludge Resource

District	Population	Sludge arisings (t/year)	Energy yield (GWh/year)
Shropshire			
Bridgenorth District Council	52 000	1300	1 0
North Shropshire District Council	55 000	1375	1 1
Oswestry Borough Council	35 000	875	0 7
Shrewsbury and Atcham Borough Council	97 000	2425	1 9
South Shropshire District Council	40 000	1000	0 8
Telford and Wrekin Unitary Authority	150 000	3750	3 0
Staffordshire			
Cannock Chase District Council	92 000	2300	1 [illegible]
East Staffordshire District Council	103 000	2575	2 1
Lichfield District Council	94 000	2350	1 9
Newcastle under Lyme Borough Council	123 000	3075	2 5
South Staffordshire District Council	102 000	2550	2 0
Stafford Borough Council	127 000	3175	2 5
Staffordshire Moorlands District Council	94 000	2350	1 9
Tamworth Borough Council	74 000	1850	1 5
Stoke-on-Trent Unitary Authority	252 000	6300	5 0
Warwickshire			
North Warwickshire District Council	62 000	1550	1 2
Nuneaton and Bedworth District council	118 000	2950	2 4
Rugby District Council	88 000	2200	1.8
Stratford on Avon District Council	115 000	2875	2 3
Warwick District Council	124 000	3100	2 5
Worcestershire			
Bromsgrove District Council	85 000	2125	1 7
Malvern Hills District Council	74 000	1850	1 5
Redditch District Council	77 000	1925	1 5
Worcester City Council	95 000	2375	1 9
Wychavon District Council	111 000	2775	2 2
Wyre Forest District Council	96 000	2400	1 9
Herefordshire Unitary Authority	168 000	4200	3 4
West Midlands Metropolitan Areas			
Birmingham	1 013 000	25325	20 3
Coventry	304 000	7600	6 1
Dudley	311 000	7775	6 2
Sandwell	291 000	7275	5 8
Solihull	206 000	5150	4 1
Walsall	261 000	6525	5 2
Wolverhampton	242 000	6050	4 8
TOTAL	**5,331,000**	**133275**	**106.[illegible]**

A9 Landfill Gas

Theoretical Capacity

It is assumed that the theoretical resource is determined by the capacity for storing waste in landfill sites In the West Midlands region there are 61 5 million tonnes of non inert waste already deposited and void capacity for 57 7 million tonnes (licensed) plus 59 0 million tonnes (unlicensed with planning permission [WMLGA, 1999]

Based on the Environment Agency's Waste Management Survey for the West Midlands [Environment Agency, 1998], it is assumed that 40% of the licensed capacity and 20% of the unlicensed capacity will be filled within the next 10 years The total amount of waste staved in landfill sites by 2010 will therefore be 96 4 million tonnes

Different elements of waste decompose at different rates In total 500m^3 of biomass per tonne of waste are likely to be released, over a period in excess of 15 years [ETSU, 1996c] The average annual yield is therefore 33m^3/tonne/year However, landfill gas extraction system only have a limited ability to capture the gas generated It is expected that 20% of all gas generated by the waste [ETSU, 1997b] i e 7m^3/tonne/years can be recovered The total recoverable gas yield from all sites in the Region is therefore calculated (see Table A9) to be 643 million m^3/year

Landfill gas typically consists of 50% methane and 50% carbon dioxide, with an average calorific value of 19MJ/m^3 [ETSU, 1996d] Consequently, the energy content of the gas recovered will be 12 2 x 10^9 MJ/year or 12 2 x 10^6 GJ/year

Landfill gas is generally combusted in spark ignition reciprocating gas engines that are well developed for this purpose Whilst electrical efficiencies of some products are almost 40%, net generating efficiencies of 30% are more typical Plant availability is proving very good with modern engines, at 95% [Jenbacher, 2000] Thus

Theoretical resource	= 12.2 x 10^6 x 03 x 0 95 GJ/year
	= 3 65 x 10^6 GJ/year
	= 1018 GWh/year

This is equivalent to an installed capacity of 122 MW_e

Economic Resource

Whilst landfill gas offers some of the lowest priced renewable energy available, installations are generally only effective if the size of the site is above a certain level. This is partly due to the economics of the grid connection, and partly due to the difficulties of providing effective anaerobic (without oxygen) environments in smaller site The size of site held to be as economic has decreased from approximately 1,000,000 tonnes of waste capacity to 500,000 tonnes in recent years [ETSU, 1996a]

If all the sites over 500,000 tonnes capacity in the West Midlands were fully developed for Landfill gas generation, approximately 637 GWh of electricity could be generated This represents an installed capacity of 73 MW_e. A list of all suitable sites is indicated in Table A12

Deliverable Resource

There are very few issues that would constrain the full development of the economic resource, and it has been assumed that this all 637 GWh of generation could be supplied Note that many of the sites indicated in Table A12 already have some electricity generating plant, still operating or planned although this does not necessarily equate to the capacity calculated for the site

Table A12 Landfill Gas - Theoretical Resource

	West Midlands Region	Staffordshire	Shropshire	Herefordshire	Worcestershire	West Midlands	Warwickshire
Non inert waste							
Existing waste in place (tonnes)	61 500 000	15 000,000	8 500 000	6 000 000	6 000 000	27 500 000	4 500,000
Licensed void capacity (tonnes)	57 719 900	19 671 700	6 961 000	0	9 366 200	13 471 000	8 250 000
Unlicensed void capacity (tonnes)	55 051 000	11 976 000	425 000	0	10 000 000	18,150 000	15 500,000
Potential							
Existing waste in place (tonnes)	61 500 000	15 000 000	8,500 000	6 000,000	6 000 000	27 500 000	4 500 000
Licensed void capacity (tonnes)	23 087 960	7 868 680	2 784 400	3 746 480	3 746 480	5 388 400	3 300 000
Unlicensed void capacity (tonnes)	11 810 200	2 395 200	85 000	2 000 000	2 000 000	3 630 000	3 700 000
Total	**96,398 160**	**25,263 880**	**11,369,400**	**11 746 480**	**11 746,480**	**36,518,400**	**11 500 000**
Gas yield							
Annual recoverable yield (m^3/tonne)	642 654 000	168 426 000	75 798 000	78 310 000	78 310 000	243,456 000	76 667 000
Energy yield (GJ/year)	12,210 434	3 200 091	1 440 124	1 487 887	0	4 625 664	1 456 667
Electricity							
Electricity generated (GJ/year)	3,653 972	960 027	432,037	446 366	446 366	1 387 699	437 000
Electricity generated (GWh/year)	1 015	267	120	124	124	385	121

Table A13. Landfill Gas Deliverable Resource

Site Name	District	Capacity m3	Annual electricity yield GWh/yr	Operating capacity to date (Mw)	Planned Capacity (Mw)
Wyrley Grove Landfill	Cannock Chase	628,700	6 287		
Poplars Landfill Site	Cannock Chase	6 185,000	61 850		
Woodlane Landfill Site	North Shropshire	1 178,000	11 780		
Packington Landfill	North Warwickshire	8 000 000	80 000	7 7	
Ling Hall Quarry	Rugby	9 500,000	95 000		
Edwin Richards Landfill	Sandwell	8 500,000	85 000		
Jacksons Brickworks	Solihull	500 000	5 000		
Meece Landfill	Stafford	1 130 000	11 300	1 75	
Fenton Manor Quarry	Stoke On Trent	2 200,000	22 000		
Wilnecote Landfill Site	Tamworth	4 735,000	47 350		0 91
Candles Landfill Site	Telford & Wrekin	2 200 000	22 000		2 88
Woodhouse Farm Landfill	Telford & Wrekin	2 800 000	28 000		
Vigo/Utopia Quarry Landfill Site	Walsall	2 770 000	27 700		0 78
Ufton Farm Landfill Site	Warwick	980 000	9 800		
Bubbenhall Landfill Site	Warwick	1 400 000	14 000		
Hill & Moor Landfill Site	Wychavon	5 600 000	56 000		
Wareslay Landfill Site	Wychavon	2 500 000	25		
Total		**63,706,700**	**637,067**	**9.45**	**4.55**

A10 Solar (Photovoltaics)

Theoretical Resource

Globally, there is a large market for solar photovoltaic systems in off grid applications ranging from isolated homes to telecommunications equipment and water pumping However, in the UK the primary market for photovoltaics will be building mounted systems, generally connected to the electricity network. Thus the theoretical resource is determined by the available roof and wall space

Separate calculations have been undertaken for different building sectors domestic, warehouses, factories, offices and retail. Data on the existing building stock in the West Midlands [BRECSU, 1994, ONS, 1999] was used in conjunction with the following assumptions

(i) New buildings
It is assumed that the number of domestic dwellings in the West Midlands region will increase by 13 5% between 1991 and 2010 (extrapolating the regional trend over the period 1991-98) and that the number of warehouses factories, offices and retail buildings will increase by 10% between 1994-20101

(ii) Available roof wall space
For domestic buildings it is assumed that:

- 50% have a suitable orientation
- Although the maximum output will be produced from a South facing array, arrays facing East or West will produce approximately 75% of the maximum, averaged over a year, and thus still be viable
- 95% have no planning or architectural restrictions
- 80% are not shaded significantly

- Note that even a small degree of shading, such as from trees or a chimney, can dramatically reduce the output since a shaded module will effect all those connected to the same 'string'

Thus based on these assumptions of all domestic buildings are suitable

For factories and warehouses, it is assumed that 80% of all buildings will be appropriate Orientation is likely to be less of an issue since it is assumed that the majority of buildings will have a flat roof Some properties will be structurally inappropriate or restricted access

For office and retail buildings, it is assumed that 40% are acceptable Many office and retail properties will be restricted by shading, with the notable exception of large out of town supermarkets and retail centres

(iii) Average array size

Domestic dwellings will support in general a 2kW[18] roof mounted array (approximately 17m²). It is assumed that factories and warehouses will support an average array of 20kW (although this can be expected to vary widely, up to possibly 200kW) and offices and retail an average of 6kW (again this may well be considerably higher for certain sites)

The calculation is shown in Table A14 The total theoretical resource for all buildings (domestic, warehouses, factories, offices and retail) is 3000MW This will generate approximately 2250 GWh per year

The primary market for PV systems in the UK will be building mounted systems, generally connected to the grid Thus the PV resource is determined by the available roof and wall space

[18] The installed capacity of a solar photovoltaic system is usually measured in kWp peak This is the power produced under standard test conditions of 1000W/m² irradiance, 25°C junction temperature and solar reference spectrum AM1 5

Table A14 Solar - Theoretical Resource

Type of property	Domestic	Warehouses	Factories	Offices	Retail
Current number of dwellings/premises	2,084,000	20,073	36,590	22,558	54,701
Number of dwellings/premises by 2010	2,365,340	22,080	40,249	24,814	60,171
Available roof/wall space	2 x 38%	x 80%	x 80%	x 40%	x 40%
Average array size per property (kWp)	2	20	20	6	6
Installed capacity (kWp)	3 x 4				
Installed capacity (MWp)	1798	353	644	60	44

1991 (domestic buildings), 1994 (warehouses factories, offices, retail)

Economic Resource

For building mounted photovoltaic systems the cost of electricity generation is currently > 50 p/kWh This is unlikely to be reduced as far as 5 p/kWh in the foreseeable future and thus will not feature under the framework of the Renewables Obligation However, PV has been included under the scope of this study for the following two reasons firstly, it can be argued that the calculation of whether or not PV is economic can not be achieved simply on the basis of p/kWh and secondly, there are a number of non-economic reasons why PV may be installed (see Deliverable Resource)

PV is fundamentally different to all other forms of electricity generation in that it can be installed within the built environment (i e at the point of demand) and, furthermore, can be used instead of conventional building materials Under the present pricing structure the former benefit is not realised in economic terms, although there are moves to introduce 'net metering'[19] for PV systems In regard to the latter it is more appropriate to calculate the cost of a PV systems in £/m²

[19] At present, electricity exported to the network from a PV system is sold at, or close, to the 'pool' price (~ 2 p/kWh) despite the fact that the electricity is likely to be used locally and thus should not incur, it can be argued, the full use of system charge Where PV-generated electricity can be used in the building it is displacing electricity purchased from a supplier at ~ 7 p/kWh Hence under the existing commercial framework there is a large incentive to minimise the export to the grid. 'Net metering' is a situation whereby the price paid for an exported kWh is equal to the cost of an imported kWh i e the owner only pays for the net electricity imported TXU Europe are the first (and currently only) utility to introduce net metering in the UK but it has been widely implemented in a number of countries such as the US Although net metering will not dramatically affect the economics of a PV system, introduction on a wider scale would provide a strong political statement and may add impetus to the growth of the small-scale PV market in the UK

and to then offset the cost of alternative construction materials When PV is calculated in this way, as opposed to p/kWh generated, it may be economic in certain situations

A recent study [ETSU, 1998b] to determine the value of electricity generated from PV systems in buildings examined 5 case studies a new build office, office refurbishment, a superstore, a new-build domestic and a prestige public building The study compared the cost of a PV system with conventional cladding in each case For curtain walling (say for a new office building) the PV system cost of £784/m² compares to £300/m² (stone), £420/m² (glazing), £640/ m² (granite faced precast concrete) The study concluded 'Where PV replaces high-cost, prestige cladding the PV electricity generation will become cost-effective in the short-to medium term (after 2005) under all market development scenarios If a more supportive policy framework is in place, PV integrated buildings are expected to become a commercial reality by 2010' The market for 'prestigious' wall claddings for new or refurbished offices is taken as the economic resource for PV between 2000 and 2010

A further study [ETSU, 1996e] defines 'prestigious' claddings as natural stone, cast concrete stone, curtain walling, glass reinforced plastics, decorative metal panels and concrete panels These claddings accounted for 51 % of all wall claddings in new office buildings in 1995 (having grown in popularity from about 30 % in 1975) and 45 % of the refurbished wall area in existing buildings Of the total prestigious claddings, 32 5 % (286,000 m²) is in the likely installed price bracket for PV – defined as £800/m² and above It is predicted that this will increase to 426,000 m² by 2000

The economic resource is thus calculated on the basis of then following assumptions

(i) PV will be economic for prestigious wall claddings of £800/m² and above

(ii) The wall area of such claddings (incorporated into new or refurbished buildings) will increase from 426,000 m² to 706,000 m² in 2010

(iii) 6 8 % of the new claddings will be installed in the West Midlands (based on the geographic distribution of commercial office stock in 1995)

(iv) 25 % of the available wall surface will be suitable for PV cladding

(v) Capacity = 8 5 m² /kW

Economic resource = [0.25 × 0 068 × 280000] / 8 5 kW

= 560 kW

= 0 56MW

Deliverable Resource

PV will rarely be viewed from a purely economic perspective because of the fact that it can be integrated into the urban environment and is unlikely to be invested in by project developers/venture capitalists looking simply at expected rates of return. For example, when PV is installed as a facade on an office or retail unit the visual effect is as or even more important and a company may chose to install PV as a visible display of its environmental commitment Similarly, homeowners are unlikely to purchase a PV system simply because they find the payback rate attractive In the domestic market, a certain proportion of environmentally conscious owners will purchase PV so that they have the capability to generate electricity on site This market is likely to expand if 'AC Modules' become available as a DIY product[20] since they allow a modular approach to installing a PV system Although a 2 kW system (£15000 installed) will be beyond the scope of most of the population, a couple of AC Modules – while not producing the same output – will be within the purchasing power of a much larger group of people (300 W of AC Modules is comparable in cost to an average PC)

Some indication of the 'deliverable' resource can be obtained from the growth in the total installed PV capacity in the UK as shown in Table A15

[20] 'AC Modules' contain a small inverter on the back of the module This eliminates the requirement for DC wiring (hence the name) and offers a much simpler installation – within the realms of a competent DIY installer However, under the current regulations (Engineering Recommendation G77) [EA, 2000b] AC Modules are not approved for connection to the electricity network

Table A15. Installed PV Capacity in the UK [IEA, 2001]

	Installed capacity in the UK kW								
	1992	1993	1994	1995	1996	1997	1998	1999	2000
On-grid distributed	0	6	54	59	75	190	328	736	1,506
Total	173	266	338	368	423	589	690	1,131	1,929

While there is currently less than 1 MW of building mounted, grid connected systems in the whole of the UK it is anticipated that, within the next 10 years, there will be a step change in the rate of installation For example, the market may be stimulated by a large-scale government subsidised programme Large programmes have already been initiated in Japan, Germany and the US While the shape of a UK programme is likely to be different, it is with this in mind that a total of 70,000 homes are predicted to be 'deliverable' in the UK within the next 10 years Assuming these are distributed between the Regions according to the existing stock of dwellings in England & Wales – this would amount to 7100 new domestic PV systems, equivalent to an installed capacity of 14,200 kW

It is therefore assumed that the deliverable resource will be larger than the economic resource, with a total installed capacity by 2010 of 14 76 MW[21] (14 2 MW 'non-economic', 0 56 MW, 'economic')

[21] For comparison the British Photovoltaic Association (PV-UK) have set a target of 300 MWp by 2010 for the UK as a whole In order to achieve this , PV-UK proposed a number of measures including premium rates for PV-electricity of around 20 p/kWh and direct grants of 50 % towards the capital cost

A11 Hydro (Micro/Small)

Theoretical Resource

The resource assessment is based on the work carried out by Salford University from 1987 - 1989, [ETSU, 1989] which sought to map the entire small scale hydro power[22] resource for the UK Although the study was carried out some time ago it is still appropriate for a first-pass regional assessment of the resource The hydrology is unlikely to have altered significantly and the technology has not progressed in a major way since 1989 having already achieved a high level of maturity For the theoretical resource the following assumptions are made

(i) No new dams are constructed i e micro-hydro will be confined to the sites of existing weirs and sluices on rivers and water authority sites (Since no viable water industry sites were found in the West Midlands region it seems highly unlikely that further dams will be built)

(ii) All the sites identified will be developed Although sites with heads below 2 m or an installed power below 25 kW were discounted from the Salford study, on economic ground, they have been included here on the basis that these sites are technically accessible It is assumed that such sites will have an average capacity of 15 kW

120 sites were identified in the West Midlands Region with a total installed capacity, based on the above assumptions, of 2 469 MW These sites are presented in Table A17

Economic Resource

The economic viability of hydro power generally increases with installed capacity This in turn is determined by the product of design head and flow rate, which are site specific factors

[22] 'Small' hydro power is usually broken down further into 'mini' hydro (for capacities generally below 1 MW) and 'micro' hydro (for capacities generally below 100 kW) Although the boundary between micro, mini and small is not clearly defined many of the sites surveyed here would be classed as 'micro'

A recent study for the Environment Agency [Environment Agency, 1999] investigated the potential for hydro-power in the Anglian Region 15 sites with a head greater than 1 7 m were surveyed and the 5 most attractive sites selected for a more detailed economic analysis The results are presented in Table A16:

Table A16 Results of Environment Agency Micro Hydro Study

Site	Gross head (m)	Installed power (kW)	Total cost (as part of refurbishment) (£)	Tariff required[1] (p/kWh)	Tariff required [2] (p/kWh)	Capital cost/kW (£)
Castle Mills	2 8	72	140,000	4 15	3 29	1940
St Neots	2 37	61	132,000	4 28	3 38	2160
Elton	2 28	40	118,000	5 91	4 67	2950
Irthlingborough	2 34	34	112,000	7 45	5 90	3290
St Ives	1 78	44	129,000	6 13	4 87	2930

[1] The Environment Agency set a criteria of an IRR 6% above inflation (which was 2 9% at the time of the study) and a 20 year design life

[2] 20 years was thought to be a rather pessimistic design life for a hydro scheme and so the analysis was carried out for a different set of parameters 30 year design life and 2 % O&M costs (as opposed to 3%)

It can be seen that the tariff required is strongly dependent on the design life that is assumed for the plant but in any case the feasibility of each project is described as 'borderline' (Note that this study was carried out before the New Electricity Trading Arrangements and Renewables Obligation were announced and so the economic assessment is indicative only)

For the purposes of this regional resource assessment it is assumed that: All sites with a head over 2 m will be developed

This is probably a fairly optimistic view since micro-hydro is not a new technology and thus viable sites are likely in the vast majority of cases to have already been assessed and developed. However, the above assumption can be justified on the grounds that:

a) micro-hydro could feature as a strategic policy in part of the Environment Agency's weir refurbishment programme (in such an instance it is estimated that approximately only 10 – 20 % additional costs would be associated with the hydro scheme civil component)

b) many micro-hydro projects will be and are developed by large private landowners to met on site electricity demand. This is more likely to be economic since the generated power is replacing that imported from an electricity supplier at ~ 7 p/kWh For example, at Houghton Mill (East Anglia), the National Trust are proceeding with a hydro electric scheme as part of a major refurbishment of the Mill despite the fact that the design head is only 1 37 m The system is expected to produce 116 MWh/year and the Trust intend to consume the power in its properties in the region

According to the above assumption there are only 6 sites in the Region which are viable, two of which have subsequently won NFFO contracts but are not yet operational It is interesting to compare the planned installed capacity of these two sites (220 kW and 90 kW) with that predicted from the Salford study (288 and 146 kW) respectively This indicates that the study perhaps over estimated the resource

The total economic resource is 1 844 MW, of which 0 549 MW is already installed, 0 310 MW is planned under existing NFFO contracts and 0 985 MW identified as a potential resource This is shown in Table A14

Deliverable Resource

Assumption all the economic resource is deliverable (Further possible constraints such as flow control, navigation and network connection would need to be assessed on a site by-site basis)

Table A17. Hydro Theoretical Resource

River	Location	Town	Head (m)	Installed capacity (kW)
Tame	Smurfit Paper Mill	Tamworth	2	146
Churnet	Far Kingstley Banl	Cheddleton	7.5	62
Dove	Mayfield Mill	Mayfield	2.4	65
Avon	Pershire Lock	Pershore	2.5	288
Avon	Fladbury Lock	Fladbury	2	225
Severn	Shrewsbury	Shrewsbury	2	633
Cole	Springfield	Birmingham	<2	15
Alne	Botley Mill	Henley in Arden	<2	15
Alne	Blackford Mill	Henley in Arden	<2	15
Alne	Wootton Pool	Wootton Wawen	<2	15
Alne	Wootton Wawen	Wootton Wawem	<2	15
Alne	Aston Cornflour	Wilmcote	<2	15
Alne	Great Alne Mill	Great Alne	<2	15
Arrow	Weir	Coughton	<2	15
Arrow	Arrow Mill	Arrow	<2	15
Arrow	Broom Mill	Arrow	<2	15
Avon	Barton Weir	Bidford on Avon	<2	15
Avon	Marcliffe Weir	Cleeve Prior	<2	15
Avon	Strensham Lock	Strensham	<2	15
Avon	Nafford Lock	Birlingham	<2	15
Avon	Wyre Mill	Pershore	<2	15
Avon	Evesham Lock	Evesham	<2	15
Avon	Cleve Prior	Welford on Avon	<2	15
Avon	Welford on Avon	Welford on Avon	<2	15
Avon	Waddington Lock	Luddington	<2	15
Avon	Clifford Chambers	Clifford Chambers	<2	15
Stour	Cutlin Mill	Newbold on Stour	<2	15
Avon	Alverston Mill	Alverston	<2	15
Avon	Mill	Hampton Lucy	<2	15

Dene	Wellesbourne	Wellesbourne	<2	15
Avon	Barford Weir	Barford	<2	15
Avon	Castle Weir	Warwick	<2	15
Leam	College Weir	Warwick	<2	15
Avon	Rock Mill	Warwick	<2	15
Avon	Saxons Mill	Warwick	<2	15
Avon	Stonleigh Abbey	Stonleigh	<2	15
Avon	Marston Farm	Marston	<2	15
Avon	Sluice	Ryston Dunsmore	<2	15
Blyth	Blyth Mill	Shustoke	<2	15
Blyth	Duke End	Coleshill	<2	15
Teme	Powick Bridge	Worcester	<2	15
Severn	Diglis Lock	Worcester	<2	15
Severn	Bevere Lock	Worcester	<2	15
Severn	Holt Fleet Lock	Holt Heath	<2	15
Severn	Larford Lock	Stourport	<2	15
Teme	Walkmill	Ludlow	<2	15
Teme	Buckton Mill	Brampton Brian	<2	15
Teme	Lingen Bridge	Bucknell	<2	15
Teme	Weir	Knighton	<2	15
Onny	Halford Mill	Craven Arms	<2	15
Teme	Hurst Mill	Clun	<2	15
Teme	Mill	Clunton	<2	15
Roden	Wem Mill	Wem	<2	15
Penk	Stretton Mill	Brewood	<2	15
Penk	Somerford Hall	Brewood	<2	15
Dorling	St Thomas	Stafford	<2	15
Trent	Hunts Mill	Gt Haywood	<2	15
Sow	Shugborough	Gt Haywood	<2	15
Trent	Mill	Alrewas	<2	15
Trent	Lock	Alrewas	<2	15
Anker	Grendon Fields	Atherstone	<2	15
Anker	Feldon Bridge	Atherstone	<2	15
Trent	Winshall Weir	Burton-Trent	<2	15
Trent	Winshall Weir	Burton-Trent	<2	15
Dove	Weir	Rolleston	<2	15
Churnet	Flint Mill	Cheddleton	<2	15
Churnet	Weir	Oakmoor	<2	15
Churnet	Alton Mill	Alton	<2	15
Churnet	Weir	Alton	<2	15
Dove	Ellastone	Ellastone	<2	15
Churnet	Rocester	Rocester	<2	15
Dove	Marchington	Marchington	<2	15
Dove	Marston	Marston-Dove	<2	15
Dove	Snelston	Snelston	<2	15
Dove	Church Mayfield	Church Mayfield	<2	15
Dove	Mapleton	Mapleton	<2	15
			Total	2454

Table A18. Hydro Deliverable Resource

	River	Location	Town	Area	Head (m)	Mean flow (m)	Installed capacity (kW)	Annual yield (GWh)
Installed								
		Llanwyddyn Dam	Oswestry	Shropshire			118	0.56
		Oswestry Water Treatment Works	Oswestry	Shropshire			363	1.72
		Burton Mill	Winshill	Staffordshire			68	0.32
							549	**2.6**
Planned								
	Tame	Smurfit Paper Mill	Tamworth	Staffordshire	2	11.36	90	0.43
	Avon	Pershore Lock	Pershore	Worcestershire	2.5	15.73	220	1.04
							310	**1.47**
New								
	Churnet	Far Kingsley Bank	Cheddleton	Staffordshire	7.5	1.3	62	0.29
	Dove	Mayfield Mill	Mayfield	Staffordshire	2.4	6.01	65	0.31
	Avon	Fladbury Lock	Fladbury Lock	Worcestershire	2	15.62	225	1.06
	Severn	Shrewsbury	Shrewsbury	Shropshire	2	40.35	633	2.99
							985	**4.66**
Total Deliverable							**1844**	**8.72**

Appendix B

Respondents to Consultation

Council/Organisation	**Existing Renewable Energy Generation**	**Previous Estimates of the Resource**	**Potential Impact and Constraints**	**Planning Policies**	**Other Comments**
Warwickshire County Council	Landfill gas to electricity sites at Packington Landfill Site in North Warwickshire Borough, Judkins Landfill Site in Nuneaton, Smiths Landfill Site at Bubbenhall, Ufton Landfill Site and the former landfill site at Ryton Ling Hall Landfill site is to serve the National Grid from mid Sept The environmental impact of these sites has been self contained	No studies of the resources for renewable energy	Impact on local residents particularly important	The revised Warwickshire Structure Plan policy GD1 states maximum use of renewable energy as an over riding aim	Feel wind turbines unlikely The West Midlands contribution to National Targets is most likely to come from combustible or digestible industrial, agricultural and domestic waste
Rugby Borough Council	No existing renewable energy plants	No studies of renewable energy resources	Consider potential for renewable energy to be fairly limited in the Borough due to it's physical characteristics Many areas would be sensitive to development such as wind farms	Local plan (adopted 1997) contains policy on renewable energy – this may be revised during the plan review	

Council/Organisation	Existing Renewable Energy Generation	Previous Estimates of the Resource	Potential Impact and Constraints	Planning Policies	Other Comments
Staffordshire County Council	Poplars Fill landfill near Cannock 3MW Expansion anticipated Waste to Energy Plant at Hanford Stoke on Trent Small scale hydro electric scheme in Staffordshire Moorlands Small scale trials in Forest of Mercia Solar panels at Wilncote Junior School, Tamworth (proposed installation of wood burning stove at Chasewater Innovation Centre)	Windspeed map of the country prepared by ETSU NFU studies of short crop rotation coppice and other bio fuels	Windfarms considered viable Visual and aural impact important Areas of highest wind speed tend to coincide with those areas most used by walkers and climbers	Staffordshire and Stoke on Trent Deposit Draft refers to more efficient use of energy and the use of renewable energy resources	
Cannock Chase Council				Copy of policy from adopted plan sent Renewable energy resources to be reviewed as part of the local plan process (underway)	No planning applications submitted in respect of the renewable energy policy (PEP6) over the last 2 years

Council/Organisation	Existing Renewable Energy Generation	Previous Estimates of the Resource	Potential Impact and Constraints	Planning Policies	Other Comments
Staffordshire Moorlands District Council	No renewable energy plants in operation or under development.	No studies of the renewable energy resource	If renewable energy is to be exploited, the DC need to be satisfied that the impact on the landscape is acceptable (particularly in the Green Belt and Peak District National Park)	Policy from adopted local plan sent.	
East Staffordshire Borough Council	No existing renewable energy plants operating or under development.	No studies of renewable energy undertaken	Environmental impact of wind farms on Areas of Special Landscape Value and the Peak District National Park is a particular concern	Policies concerning renewable energy are likely to be included in the amended local plan	
Newcastle Under Lyme Borough Council	The council will be mindful to "working towards a target to generate 10% of energy from renewable sources" by 2010 subject to costs being acceptable Need to consider generation of renewable energy by individual occupiers of individual property Insulation and fuel poverty should be considered				The Council are renewing its Local Agenda 21 Environmental Strategy – this will contain reference to a move to use of energy from renewable sources Should the energy consumption of a development be a 'material consideration' in development control

Council/Organisation	Existing Renewable Energy Generation	Previous Estimates of the Resource	Potential Impact and Constraints	Planning Policies	Other Comments
Shropshire County Council	Wanford College, Baschurch Plant 20W Belveder School Shrewsbury PV – 1kW Greenfinch Burford – experimental AD plant.	Renewable Energy in Shropshire 1997 (ETSU) Harvesting the Wind 1997 Genesis Pelleted Biofuels Study – March 1998 Local Strategies for AD in Shropshire and Herefordshire 1999 Planning Tools for Small Scale Embedded Generation (ongoing) Marches Wood Fuel Study (2000)	Existing developments are small scale and therefore have had little impact Visual impact – Shropshire People Panel – 80% in support of renewable energy, but only 40% in support if negative visual impact likely Scale – renewables need to be developed at an appropriate scale Traffic likely need for transport investment in rural areas Grid Connection – cost of connection and problems of transmission losses Heating Load – renewables to provide heat underdeveloped Local ownership? Need for smaller scale waste gasification Env Agency limitations on Grade 1 rivers Economic Viability	Shropshire and Telford and Wrekin Joint Structure Plan 1996 2011 contains policies on energy efficiency and renewable energy	Betton Abbots, Shrewsbury – Landfill Gas – 1MW due for completion 2001

Council/Organisation	**Existing Renewable Energy Generation**	**Previous Estimates of the Resource**	**Potential Impact and Constraints**	**Planning Policies**	**Other Comments**
Bridgnorth District Council	No renewable energy plants operating or under development	No studies of the renewable energy resource in the district Ref 'Wind Energy Strategy for Shropshire' (Shropshire Energy Team, 1997) Contact John Harrison at Shropshire County Council	General feeling that renewable energy developments should not be encourages in areas of landscape or nature conservation designations	In response to the District Local Plan Review consultation strong support was expressed for the development of small scale renewable energy proposals, particularly biomass Main issue of concern was the possible visual impact of wind turbines Local plan currently being reviewed Revised plan is likely to include a policy on the development of renewable energy	
Birmingham City Council	None other than domestic solar panels	West Midlands Sustainability Round Table	Encouraging planners to be more receptive to applications Problem in convincing developers to invest in renewables technology	New UDP refers to use of renewable energy Council have target to purchase 15% of energy from renewable sources by 2010 In discussions to establish central buying consortium	
Stoke on Trent	'Sinergy' generates 12 5MW of Green energy	Chatterley Whitfield Historic Colliery complex – supplying energy needs by wind, solar, biomass, and redeemable sources		City Plan Review currently underway Working draft refers specifically to landfill gas, biomass energy and wind energy in the explanatory text	

Council/Organisation	**Existing Renewable Energy Generation**	**Previous Estimates of the Resource**	**Potential Impact and Constraints**	**Planning Policies**	**Other Comments**
MAFF	Village school at Weobley powered by renewable coppice A number of landfill sites generate methane used to provide electricity for the natural grid Some short rotation coppice is grown for domestic power generation in Worcestershire Policies of Forest of Mecia and The National Forest both recognise the potential for short rotation coppice to supply power The Energy Crops Scheme will provide establishment grants for short rotation coppice	Not aware of any previous studies of renewable energy resource within the region.	Potential for woodland to generate regular small coppice material provided that a market can be established Potential for wind farming in Herefordshire, Shropshire and within or close to the Peak District National Park. However these areas are highly visible. Water power is unlikely to feature significantly due to lowland character Lack of local markets for renewable energy to be an important constraint. The Countryside Character and Natural Area approaches can encourage the development of renewable resources in areas where it will have minimum impact		Proposals to erect win farms in West Herefordshire were subject to planning control and did not proceed

Council/Organisation	Existing Renewable Energy Generation	Previous Estimates of the Resource	Potential Impact and Constraints	Planning Policies	Other Comments
British Hydropower Association		'The Salford Study' ETSU publication SSH 4063 (but, this does not consider sites with a head below 3 metres or installed capacity of less than 35kW	Potential for 'high head' schemes in the West Midlands is limited Ample opportunities for 'low head generation		Old water mills sites offer potential for electricity generation Environment Agency have a list of weirs
Countryside Agency		Report recently commissioned to produce visual representations of the consequences for the English countryside	Key concern is the conservation and enhancement of countryside character In order to integrate the renewable energy and the character of the countryside, the Agency recommends that the Countryside Character approach is used at a local level to inform assessments of capacity for renewable energy developments At a regional level countryside character should also be sued as an underlying framework for determining information on opportunities, constraints and conditions for the development of renewables		

Council/Organisation	Existing Renewable Energy Generation	Previous Estimates of the Resource	Potential Impact and Constraints	Planning Policies	Other Comments
Telford and Wrekin Council	Two generator sets operating on waste gas at the disused Granville colliery site, approximately 500kW each. 70 CHP at Madeley Court School		Impact of wind power on radio reception Resistance from local residents. Lack of quality wood fuel supplier – constraint to wood heating systems Economic constraints to solar water heating	Structure and Local Plan Policies sent.	In discussions with Marches Energy Agency for a small 2kW wind generator at Ladygrove School in Dawley Opportunity for 100kW hydro scheme on a weir on small river

Appendix C

Synopsis of Development Plans

Appendix C - Contents

STUDY OF RENEWABLE ENERGY PROSPECTS IN THE WEST MIDLANDS
REVIEW OF EXISTING STRUCTURE PLANS, LOCAL PLANS AND UDPs

County/Borough. Shropshire

Plan Status and Planning Timetable

Current adopted plan January 1993

Plan review status Shropshire and Telford and Wrekin Joint Structure Plan – Deposit Draft 2000

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB	✓	
SLA/AGLV	✓	
Other		

Previous studies of the renewable energy resource

Renewable Energy in Shropshire 1997 (ETSU)
Harvesting the Wind 1997
Genesis Pelleted Biofuels Study – March 1998
Local Strategies for AD in Shropshire and Herefordshire 1999
Planning Tools for Small Scale Embedded Generation (ongoing)
Marches Wood Fuel Study (2000)

Existing renewable energy generation

Wanford College, Baschurch Plant 20W
Belveder School Shrewsbury PV – 1kW
Greenfinch Burford – experimental AD plant
Existing developments are small scale and therefore have had little impact
Concerns include:

- Visual impact – Shropshire People Panel – 80% in support of renewable energy, but only 40% in support if negative visual impact likely
- Scale – renewables need to be developed at an appropriate scale
- Traffic – likely need for transport investment in rural areas
- Grid Connection – cost of connection and problems of transmission losses
- Heating Load – renewables to provide heat underdeveloped
- Local ownership?
- Need for smaller scale waste gasification
- Env Agency limitations on Grade 1 rivers

Economic Viability

Previous planning applications/appeals

Betton Abbots, Shrewsbury – Landfill Gas – 1MW due for completion 2001

Proposed future planning policies

Proposed Modifications,

P56 – Energy Efficiency – All development proposals for new build of conversion should demonstrate how they will exploit opportunities for achieving the highest levels of energy efficient by utilising appropriate design, materialism and methods of construction and innovative layouts to maximum benefits from passive solar gain

P57 – Renewable Energy Developments which generate and use energy from renewable resources are encouraged in principle Local Plans will contain detailed policies which will, ensure that the national and local environmental, social, and economic benefits of individual schemes are not offset by adverse effects in people and the environment and that there is safe and adequate access

Discussions/correspondence with planning officers

The Structure Plan indicates that biomass, landfill gas, waste, and small scale hydro resources may be practical in the Shropshire and Telford and Wrekin area. Proposals which exploit these resources will be welcomed, especially if implemented on a small scale and likely to benefit the communities in which they are located

County/Borough Shrewsbury and Atcham

Plan Status and Planning Timetable

Current adopted plan

Plan review status Deposit Draft

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt		X
AONB	✓	
SLA/AGLV etc	✓	
Other		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications

Deposit Draft

INF13 – Planning permission will only be granted for proposals involving renewable energy schemes provided that each of the following criteria are met:

- In the open countryside or on the edge of settlement, any buildings should be kept to a minimum and screened by new landscaping,
- There is no unacceptable adverse impact on the setting of Conservation Areas, Listed Buildings, Scheduled Ancient Monuments and Archaeological remains,
- The proposal should not have an unacceptable adverse impact on the AONB, Areas of Special Landscape Character or any sites of recognised ecological importance
- The proposal should not result in a significantly increased health or safety risk or nuisance to the public,
- Any buildings and other structures are sited in sympathy with the local features and respects the grain and form of the land and be located so as to minimise visual intrusion,
- Noise levels created by equipment and operational procedures do not adversely affect the amenity and quality of life or residents in the vicinity of the proposed development;
- The local highway network is capable of accommodating and additional traffic that may be generated during construction and operation,
- There should be no irreversible loss of the best and most versatile agricultural land, and
- The proposal includes realistic means to ensure the removal of any plant, buildings or structures when they become redundant and the satisfactory restoration of the site

Discussions/correspondence with planning officers

STUDY OF RENEWABLE ENERGY PROSPECTS IN THE WEST MIDLANDS
REVIEW OF EXISTING STRUCTURE PLANS, LOCAL PLANS AND UDPs

County/Borough South Shropshire

Plan Status and Planning Timetable

Current adopted plan October 1994

Plan review status. Pre Deposit

Local plan currently under review. Aim to publish deposit draft early 20001 (First deposit draft abandoned)

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment

Policy GP6 – Renewable Energy – sets out 5 criteria against which proposals for development designed to generate or capture energy from naturally sustainable sources will be judged. The adverse effects upon agriculture and the AONB are significant concerns. Proposals should also be consistent with local plan policies GP2 and LN11

Policy GP7 – Windfarm Development – states that ' Proposals for windfarm development will only be permitted within the AONB and the Area of Special Landscape Character where its prominence and visibility would not adversely affect the quality, setting and enjoyment of the landscape. Elsewhere windfarm development will normally be permitted where its scale, siting or cumulative effect would not have an adverse impact on landscape quality and recreational enjoyment.

Policy GP5 Energy Conservation – seeks to ensure that the conservation of energy is taken into account in the design of development proposals. Proposals will normally be permitted for developments using layouts, siting, design, techniques building methods and materials designed to secure energy conservation and the use of energy from renewable sources provided that they are consistent with other local plan policies, comply with policy GP2 and use, where possible, areas of derelict or under utilised land

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt		X
AONB	✓	
SLA/AGLV		X
Other		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

Application for a single wind turbine in the AONB refused in 1997/8

Proposed future planning policies

Proposed Modifications:
Local Plan currently under review Aim to publish deposit draft early 20001 (First deposit draft abandoned) Precise wording of modifications yet to be determined

Discussions/correspondence with planning officers:
The wording of the local plan policies relating to renewable energy will be redrafted for the deposit plan in order to reflect latest PPG recommendations However, the planning officer anticipates that implications of the policies will remain largely unchanged Protection of the Shropshire Hills AONB will remain an overriding concern

Two thirds of the District is an Area of Outstanding Natural Beauty and it contains two large Environmentally Sensitive Areas – Clun and South Shropshire Hills Local plan policies seek to protect and enhance these areas, therefore whilst policies GP6 and 7 state that the Council will consider proposals environmental and visual concerns are likely to be a significant constraint. In much of the district these issues are likely to prevent the construction of wind turbines Alternative technologies with a lesser environmental or visual impact would be more likely to obtain planning permission

County/Borough: North Shropshire

Plan Status and Planning Timetable

Current adopted plan. August 1996

Plan review status Pre Deposit

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

The adopted plan makes no reference to energy from renewable sources

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt		X
AONB		X
SLA/AGLV	✓	

Other

Policy D 23 – Areas of Special Environmental Interest – 14 areas of Special Environmental Interest will be protected and enhanced for their amenity value and visual character Proposals for development will need to have particular regard to the existing character of the surrounding area in terms of design, materials, scale siting and landscaping

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

No previous applications for renewable energy in the district

Proposed future planning policies

Proposed Modifications
Pre deposit

Discussions/correspondence with planning officers
The deposit draft will not contain a specific policy relating to renewable energy, the plan will however state the Districts intention to conform with those policies relating to renewable energy stated in the County Structure Plan.

County/Borough Oswestry

Plan Status and Planning Timetable

Current adopted plan July 1999

Plan review status Pre deposit

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment

Policy NE17 – Renewable Energy Schemes Planning permission will be granted for proposals for renewable energy schemes provided that they meet 8 listed criteria Decisions will be made with regard for visual and environmental impact, health and safety implications, noise, effect on additional traffic and the highway network, impact on best and most versatile agricultural land Proposals should also include realistic means to ensure satisfactory restoration of the site The plan states that " whilst there is support at a national level for developing renewable energy schemes, it is also recognised that any such proposals must be weighed against the continuing commitment to protect the environment"

Policy NE18 refers specifically to windfarm development Proposals will be determined on their individual merits and on the basis of the cumulative effect of other such developments nearby In particular, their impact on local communities, areas of high landscape quality, wildlife habitats and water resources will be important considerations The accompanying text highlights the Area of Special Landscape Character in the North West Uplands as an area most likely for windfarm development. Protection of this area is a key aim of the local plan, therefore there is concern about environmental implications The plan sets in detail the information this should be provided alongside any planning application

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt		X
AONB		X
SLA/AGLV	✓	

Other

Policy NE1 – Areas of Special Landscape Quality – seeks to protect the visual quality of the countryside Landscape conservation within the Areas of Special Landscape Character in the North West Uplands, The Cliffe, and along the River Severn Development will not be permitted where this would adversely impact upon the landscape because of location, scale, size design and/or materials

Policy NE2 – New Development in the Countryside – aims to minimise the impact of new developments on rural landscapes New developments should conform with 7 listed criteria covering visual and environmental impact These conditions are considered to be of particular importance within the Areas of Special Landscape Character

General policies on nature conservation and agriculture

<u>Previous studies of the renewable energy resource</u>

None

<u>Existing renewable energy generation</u>

None

<u>Previous planning applications/appeals</u>

None

<u>Proposed future planning policies</u>

Proposed Modifications:

Local plan review is at an early stage

Discussions/correspondence with planning officers:

County/Borough Worcestershire

Plan Status and Planning Timetable

Current adopted plan June 1993

Plan review status Deposit Draft

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB	✓	
SLA/AGLV	✓	

Other

Policy CTC6 – Landscape Features

Policy A1 – development of agricultural land

General conservation and environmental policies

Previous studies of the renewable energy resource

Existing renewable energy generation

Plans to build waste to energy plant.

Previous planning applications/appeals

Proposed future planning policies

Proposed Modifications

Policy EN1 – Renewable Energy Facilities Proposals for the development of facilities to provide renewable energy will be supported subject to other policies of the plan, particularly those relating to local environmental effects of the development. Policy EN2 – Wind Turbines Proposals for the development of individual wind turbines or small clusters will be allowed, provided that they do not cause unacceptable harm to the surrounding environment or to nature conservation interests, do not result in excessive noise pollution, and are acceptable in relation to other plan policies

Policy EN3 – Waste to Energy – Proposals for facilities for the generation of energy from landfill waste or from the incineration of waste will be endorsed subject to other policies in the plan and if they provide the best practicable environmental option

Policy CTC 1 – Landscape Character – Proposals for development and associated land use change or land management must demonstrate that they re compatible with the landscape character of the area in which they take place Development should be informed by and be sympathetic to woodland, hedgerows, field boundaries, settlements and roads, existing buildings, natural drainage, historic landscapes, wildlife habitats, and the sensitivity of a particular landscape to tolerate change In addition, Policy CTC2 states that the Local Planning Authority will take every opportunity to safeguard, restore or enhance, as appropriate, the landscape character of the area in which they are proposed

Policy CTC4 – Areas of Great Landscape Value – Priority will be given to the conservation and protection of key landscape characteristics, in particular visual sensitivity, and development which would adversely affect these areas will not normally be allowed

Policy CTC3 – Within the AONB priority will be given to the conservation and protection of the landscape Development will not normally be allowed except where it has no adverse affect on the landscape, and particularly the key landscape characteristics of the AONB, and where it is for small scale development located within/adjacent to an existing settlement, which is essential to meet local community needs, or small scale recreation and tourism facilities, including farm diversification, or the purposes of agriculture or forestry practices Exceptionally development will be allowed where there is no alternative site suitable for the purpose and it can be demonstrated to be essential to the overriding national interest

Policy D36 – Control of Development in the Green Belt – There will be a presumption against allowing inappropriate development in the Green Belt as described in PPG2

WD2 – The location of Waste Handling and Treatment Facilities – Should be located in or near to the main sources of waste arising, and should preferably be located within buildings on existing or proposed industrial estates where the infrastructure and surrounding uses are appropriate Where the design or orientation of the facility makes this inappropriate derelict or despoiled areas, areas close to arising, working or worked out mineral or landfill sites, or existing waste management sites should be considered

Policy WD3 – Landfill – In considering the suitability of sites the need for the facility, the transport relationship between the sources of waste and the proposed disposal facility, the cumulative impact of disposal facilities, and the extent to which waste materials could assist in the reclamation or improvement of land

Discussions/correspondence with planning officers:

Assessment of Main Constraints

Possible potential for energy generation from methane gas and from landfill waste It is paramount however that development minimises impact on the environment The Structure Plan makes provision for generation of power from methane and landfill gas – it is the only country to include reference specifically to landfill gas at this level of planning guidance

County/Borough Worcester

Plan Status and Planning Timetable

Current adopted plan March 1998

Plan review status Deposit Draft

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Local plan makes no reference to renewable energy sources or energy conservation

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policies NE11-15)	✓	
AONB		X
SLA/AGLV		X
Other		
General nature conservation policies		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications:

The draft local plan makes no specific reference to renewable energy. Energy efficiency and the conservation of resources are considered.

Discussions/correspondence with planning officers:

County/Borough Bridgnorth

Plan Status and Planning Timetable

Current adopted plan. Sept 1994

Plan review status Pre Deposit.

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

The 1994 adopted plan makes no reference to energy from renewable sources

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB	✓	
SLA/AGLV etc	✓	

Other

Policy CE1 – Developments which are likely to harm the character of the Shropshire Hills AONB, Areas of Special Landscape Character or areas of Special Landscape Interest will not normally be permitted. Within these areas special care will be taken to protect features of high visual amenity

Policy CE2 – New developments in the countryside should be designed, located and sited to complement the existing rural character and landscape and should not normally result in the permanent loss of high grade agricultural land.

Policy CE6 – In areas of countryside outside the Green Belt permission will not normally be given for the construction of new buildings or for the change of use of use of existing buildings or land other than that connected with agriculture, forestry, sport/recreation, tourism, small scale industry/commercial development, or development that conforms to other relevant local plan policies

General nature conservation and agricultural policies

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

There have been no applications within the district

<u>**Proposed future planning policies**</u>

Proposed Modifications

Aim to publish first deposit draft summer 2001, working towards adoption in 2003 Wording of modifications not yet determined

Discussions/correspondence with planning officers:

As part of the Local Plan review process a series of discussion papers were issued Issues concerning renewable energy were considered as part of the 'environment' paper These papers were considered by the review committee and it was agreed that the deposit draft will include a policy on renewable energy

Green belt designations presume against development Whilst development is not precluded from the AONB and other sensitive areas it will be strictly controlled Environmental policies therefore present a number of significant constraints

County/Borough Redditch

Plan Status and Planning Timetable

Current adopted plan. Feb 1996

Plan review status Pre deposit

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policy GB1 – 4)	✓	
AONB		X
SLA/AGLV		X

Other

Policy GB 5- Land beyond the Green Belt is defined as Open Countryside Within the Open Countryside development proposals will not normally be allowed

Policy ES3 – Noise pollution will be limited where possible in order to protect residents amenity and to prevent a harmful increase in ambient noise levels in industrial, mixed use or rural areas

General nature conservation and agriculture policies

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications

Policies not yet drafted Issues papers being prepared for consultation

Discussions/correspondence with planning officers:

Issues papers include a question asking what the authority can to promote energy conservation There is a clear intention to include a policy on renewable energy

STUDY OF RENEWABLE ENERGY PROSPECTS IN THE WEST MIDLANDS
REVIEW OF EXISTING STRUCTURE PLANS, LOCAL PLANS AND UDPs

County/Borough Wyre Forest

Plan Status and Planning Timetable

Current adopted plan. May 1996

Plan review status Pre deposit

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Adopted plan does not refer to renewable energy

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policy GB1)	✓	
AONB		X
SLA/AGLV	✓	

Other

Policy LA1/2 Landscape Protection Areas In considering applications for development in the Landscape Protection Area, attention will be paid particularly of the proposed development on the landscape

Policy LA7 – Landscape Features The landscape of the whole District will be perpetuated and safeguarded by, where appropriate, enhancing and managing those significant features (skylines, sites of geological importance, woodland, hedgerow, linear features, or historic landscapes) which make up its essential character

General policies on nature conservation and agriculture

Previous studies of the renewable energy resource

None

Existing renewable energy generation

Proposal in local plan for waste to energy plant

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications

None drafted Deposit draft expected may 2001

Discussions/correspondence with planning officers:

Potential in the district is considered to be limited Discussion with officers suggests an intention to promote renewable where appropriate, perhaps through use of PV on buildings It is unlikely that policies will be site specific

STUDY OF RENEWABLE ENERGY PROSPECTS IN THE WEST MIDLANDS
REVIEW OF EXISTING STRUCTURE PLANS, LOCAL PLANS AND UDPs

County/Borough: Bromsgrove

Plan Status and Planning Timetable

Current adopted plan No adopted plan

Plan review status Proposed modifications June 2000

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		

Comment

Adopted plan makes no reference to renewable energy

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt		
AONB		
SLA/AGLV		
Other		

Previous studies of the renewable energy resource

Existing renewable energy generation

Previous planning applications/appeals

Application for a small cluster of wind turbines was refused 5/6 years ago The main consideration was the impact that this would have on the setting of a listed building The site also fell within protected landscape

Since this time there have been no applications

Proposed future planning policies

Proposed Modifications

Policy DS13 (sustainable development) – All developments must reflect the need to aim to safeguard and improve quality of life of residents, conserve energy resources and protect the Plan area's essential characteristics and main environmental assets

Policy ES15 – Proposals for exploiting sources of renewable energy will be carefully considered for their impact on the landscape, wildlife, and other relevant factors Where the impact of the technology being proposed is considered compatible with both the immediate and wider community interests then schemes may prove acceptable

Policy DS9 – Protection of Designated Environmental Areas Development proposals in locations designated as Landscape Protection Areas, sites of importance for wildlife and nature conservation or of importance for archaeology will be carefully evaluated against their potential impact on the landscape, ecology or individual site

Policy C4 Criteria for assessing development proposals Development will not be permitted where it would have a materially detrimental effect on the landscape, in particular within Landscape Protection Areas When assessing the effect on the landscape special consideration will be given to prominent slopes or major ridge lines, woodland and hedgerows, and water features where these are an important component of the landscape

Policy C20 – Protection of High Quality Agricultural Land Normally the best and most versatile agricultural land will be protected from development which would lead to an irreversible loss of land, or of land quality, for agricultural purposes

Policy ES14A Proposals for potentially noisy developments must be located in areas where noise will not be such an important consideration or where its impact can be minimised.

Discussions/correspondence with planning officers:

County/Borough: Malvern Hills

Plan Status and Planning Timetable

Current adopted plan Jan 1998

Plan review status Pre deposit

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment

The plan contains two detailed policies on renewable energy both supported by detailed explanatory text

Policy ENV 4 – Renewable Energy This general policy states that proposals for renewable energy installations will be permitted provided that proposals satisfy the requirements of the Environmental Protection Act 1990, provide adequate vehicular access etc, have potential to contribute to national, regional or local energy requirements, and do not conflict with other relevant plan policies

Policy ENV 5 details planning application requirements for wind energy installations Proposals are judged against a number of criteria including amenity of residential properties, use of sympathetic colours and materials, means of connection to the existing electricity network, location set back from major roads and railways. Photo montages should be provided to assess the visual impact of the development, where appropriate electronic mapping or other means of landscape assessment should be used

Policy ENV7 deals with the provision of overhead lines and cables. In areas of particular landscape quality these should be laid underground, elsewhere their erection should seek to minimise visual impact.

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt		X
AONB (Landscape Policy 1)	✓	
SLA/AGLV	✓	
Other		

Landscape Policy 9 – Landscape Features Proposals which might affect the skylines of Marcle Ridge, The Abberly Hills, The Suckly Hills and Dog Hill will only be allowed if the effects are minimal or if conditions can be imposed that would minimise the effect of the proposal.

General nature conservation and agricultural policies

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals
None

Proposed future planning policies
Proposed Modifications Consultation draft anticipated end 2001 **Discussions/correspondence with planning officers** The council are looking to roll the renewable energy policies forward and update them where necessary but, as yet, no detailed consideration has been given to the specific nature of future policies

County/Borough: Wychavon

Plan Status and Planning Timetable

Current adopted plan Jan 1998

Plan review status Pre deposit

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment

Policy BC16 – Renewable Energy In determining applications for renewable energy developments, the Council will need to be satisfied that there will be no adverse environmental effects which would present a risk to health and safety, loss of residential amenity due to noise or other disturbances, damage to ecological and nature conservation interests or damage to important landscape designations Applicants are asked to demonstrate the extent that the proposal would contribute to national and local to energy needs, limiting green house gases, the likely effect of the proposal on the local environment and the likely impact on the qualities and character of the area. In addition, proposals will not normally be allowed within the Cotswold AONB

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (policy BC2)	✓	
AONB (Policies BC4 and C1)	✓	
SLA/AGLV	✓	

Other

Policies BC4 and C1– Areas of Great Landscape Value Development which would adversely affect the landscape quality of the Areas of Great Landscape Value will not normally be allowed In considering development proposals within the AGLV, the Council will have special regard to their effect on the landscape

Policy C2 – Development restrictions in the AGLV The Council seek to protect the AONB and AGLV from development which would adversely affect the primary aims of designation The Council will not normally permit large scale developments, visually obtrusive developments, developments creating noise, atmospheric, water or ground pollution, or developments likely to generate large volumes of traffic where these will affect the amenity of the area

Policy BC1 – Development Outside Defined Areas In areas beyond the Green Belt the Council will not normally permit development to take place on the land identified on the Proposals Map, unless in the exceptional circumstances defined in other policies of the District Local Plan.

Policy BC3 – Areas of Development Restraint.

General nature conservation and agricultural policies

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications:
Policies not yet drafted

Discussions/correspondence with planning officers
Revisions to the renewable energy policy will be considered during the review process in light of the Councils recent commitments to sustainability

County/Borough: Hereford and Worcester

Plan Status and Planning Timetable

Current adopted plan. June 1993

Plan review status Draft of Herefordshire UDP expected to be published Autumn 2001

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

No policies on renewable energy

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB	✓	
SLA/AGLV	✓	
Other		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

Three planning applications for renewable energy related schemes in recent years

- Weobley Primary School – locally grown coppice burnt for energy
- Reeves Hill Wind Farm – refused (landscape – impact on Powys Observatory)
- Power station near Leominster using chicken manure was approved but never implemented – the site is now occupied by alternative industrial use

Proposed future planning policies

Proposed Modifications.

No polices have yet been drafted in respect of renewable energy for the UDP

Discussions/correspondence with planning officers:

Officers consider the main constraints to me the AONB, AGLV, and other important areas for nature conservation

Assessment of Development Prospects

	N/A	Long term	Medium term	Short term
Biomass				
Wind				
Hydro				
Solar				
Geothermal				

Comment (including identification of possible development sites)

Assessment of Main Constraints

County/Borough Hereford

Plan Status and Planning Timetable

Current adopted plan November 1996

Plan review status Draft of Herefordshire UDP expected to be published Autumn 2001

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment

Policy ENV10 states that development proposals for renewable energy projects should not be

a) environmentally acceptable and not lead to unacceptable adverse effects on the amenity of neighbouring properties and uses, particularly in respect of residential and other sensitive uses,
b) be acceptable in terms of its effect on the local highway network, access, circulation, and the provision of car parking and operational space, and
c) be in accordance with other relevant policies, particular in respect of such matters as the conservation of the built environment, countryside, landscape and nature conservation

In assessing proposals for renewable energy projects, regard will be had to the wider environmental benefits to be gained from the exploitation of renewable energy sources

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB	✓	
National Park	✓	
Other		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications

This document will be replaced by the Herefordshire UDP No renewable energy policies have yet been drafted for the UDP

Discussions/correspondence with planning officers

County/Borough. Leominster

Plan Status and Planning Timetable

Current adopted plan 1999

Plan review status Draft of Herefordshire UDP expected to be published Autumn 2001

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment

Policy A 46 Proposals involving buildings and infrastructure for the production of renewable energy would only be permitted where

1) They would not adversely affect the landscape quality of areas of Great Landscape Value,
2) Outside areas of Great Landscape Value, there would be detrimental effect upon the amenity, character and appearance of the particular landscape qualities of that location
3) The amenity of residents in neighbouring properties would not be significantly harmed, particularly through noise or electro-magnetic interference
4) The proposal would not significantly detract from features important to tourism, including where appropriate, distant views of them
5) The traffic generated during the construction of the proposal could be accommodated without detriment to the safety of the highway network and the environment.
6) The proposal would not result in distraction of drivers where this would adversely affect highway safety
7) The proposal satisfies general development criteria (policy A1), particularly with regard to environmental designations, residential amenity, traffic generation, scale and character

The explanatory text states that this is an interim policy which will be reviewed at such a time as strategic guidance is published in future alterations to the Hereford and Worcester County Structure Plan, or successive documents

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB	✓	
National Park	✓	
Other		

Previous studies of the renewable energy resource

Existing renewable energy generation

Previous planning applications/appeals

Proposed future planning policies

Proposed Modifications:

This document will be replaced by the Herefordshire UDP No renewable energy policies have yet been drafted for the UDP

Discussions/correspondence with planning officers

County/Borough South Herefordshire

Plan Status and Planning Timetable

Current adopted plan February 1999

Plan review status Draft of Herefordshire UDP expected to be published Autumn 2001

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment

Policy C 39A Proposals for renewable energy installations will be favourably considered provided that

1) The proposal does not have an adverse effect on AONB, AGLV, or other areas of conservation importance where these effects cannot be successfully ameliorated
2) The proposal does not have an adverse effect on the residential amenity of nearby properties by virtue of disturbance through noise or other pollutants
3) That any associated infrastructure, buildings and construction work will not have any adverse effects on the landscape or local amenity

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB	✓	
National Park	✓	
Other		

Previous studies of the renewable energy resource

Existing renewable energy generation

Previous planning applications/appeals

<u>Proposed future planning policies</u>

Proposed Modifications

This document will be replaced by the Herefordshire UDP No renewable energy policies have yet been drafted for the UDP

Discussions/correspondence with planning officers

Impact on landscape quality, economic or tourist potential is of particular concern to the District

County/Borough Staffordshire

Plan Status and Planning Timetable

Current adopted plan. April 1991

Plan review status Staffordshire and Stoke on Trent Structure Plan Deposit Draft August 2000

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (see 70A below)	✓	
AONB	✓	
SLA/AGLV	✓	

Other

70A – Permission for development in the Green Belt will not be given, except in very special circumstances, for the change of use of existing buildings for purposes other than agriculture, forestry, cemeteries, limited infill, outdoor sport and recreation, re use of attractive and substantial buildings

79 – In order to encourages a diversification of the rural economy, a change of use from agriculture to other appropriate land uses on land of lower quality will be supported where the proposed use maintains and where possible enhances landscape quality, conserves wildlife and habitats, maintains and where possible improves public access to, and enjoyment of the countryside and is compatible with adjoining land uses

99 – Within the Cannock Chase AONB, development will normally be restricted to uses compatible with the conservation of the natural beauty of the area Any proposals for development will be subject to special scrutiny, having regard particularly to the environmental effects of the proposal

101 – Within the SLA there will normally be a presumption against development which would not adversely affect the general quality of the area

147 – Waste disposal facilities will not normally be permitted if they are likely to have an adverse effect on local settlements, surface and underground water resources, high quality agricultural land, AONB, SLA, Sites of high nature conservation value, countryside recreation sites

Previous studies of the renewable energy resource

Windspeed map produced by ETSU

NFU studies on short crop rotation coppice and other bio-fuels

Existing renewable energy generation

Poplars Fill landfill near Cannock 3MW Expansion anticipated
Waste to Energy Plant at Hanford Stoke on Trent
Small scale hydro electric scheme in Staffordshire Moorlands
Small scale trials in Forest of Mercia
Solar panels at Wilncote Junior School, Tamworth
(proposed installation of wood burning stove at Chasewater Innovation Centre)

Previous planning applications/appeals

No information

Proposed future planning policies

Proposed Modifications. (from Deposit Draft, August 2000)
Policy D1 states that "Sustainable forms of development will be sought which minimise the consumption of all resources, particularly those which are non renewable such as land (especially the best and most versatile agricultural and) and minerals
D7 – In assessing development proposals, measure which help to conserve natural resources will generally be supported These include "use of renewable energy resources for the development of renewable energy generating installations such as wind turbines, will be considered on their merits, having regard to any potential adverse impacts on local people and the local environment. Developments should also be encouraged to incorporate photovoltaics or other renewable energy generators where appropriate"
Policy D4
Policy D5B – Inappropriate development within Green Belts will not be permitted except in very special circumstances Construction of new buildings may be appropriate in the following circumstances limited infilling, agriculture and forestry, sport and recreation, extensions to existing dwellings
D6 - The best and most versatile agricultural land will be protected from development Where development of such land is permitted it should as far a possible be on the lowest grade of land suitable for development.
NC2 – Landscape Protection and Restoration
NC3 – AONB
NC4 – The acceptability of development proposals outside the boundary of the Peak District National Park will be assessed having regard to the need to ensure that the appearance and valued characteristics of the National Park are not adversely affected.

Discussions/correspondence with planning officers

Wind farms are considered to be a viable option, but there are concerns over the visual and aural impact The areas of highest wind speed tend to coincide with those areas most used by walkers and climbers Issues of open access and amenity value are therefore likely to be important considerations

Upland and topographically exposed areas of the county (North Staffordshire) may be suitable to generation of energy from wind power Visual impact and noise are however important considerations

County/Borough Peak District National Park

Plan Status and Planning Timetable

Current adopted plan Structure Plan – April 1994 Local Plan – to be adopted end 2000

Plan review status

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment

Structure Plan – Does not refer specifically to renewable energy but states that "Small scale development to generate or store energy to meet local need will normally be permitted provided that it does not detract from the appearance of the landscape or the buildings it serves"

Local Plan – "The development of a renewable energy source will be permitted provided that the development and all ancillary works including transmission lines can be accommodated without harm to the valued characteristics or other established uses of the area."

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt		
AONB		
National Park		
Other		

Previous studies of the renewable energy resource

In 1995, Land Use Consultants carried out a study of the east midlands potential renewable energy resource, including the whole of the Peak District National Park on behalf of DTI This concluded that given the existing planning constraints, that there is only a very small practical renewable energy resource within the park

Existing renewable energy generation

None

Previous planning applications/appeals

A recent application was submitted for a small scale wind turbine on a single property Whilst permission has not yet been granted officers feel that this is likely to go ahead

<u>Proposed future planning policies</u>

Proposed Modifications

Local plan is in it final stage of adoption

Discussions/correspondence with planning officers:

Planning officers are fairly keen to encourage the use of renewable energy, but feel that potential is rather limited

County/Borough Stoke on Trent

Plan Status and Planning Timetable

Current adopted plan September 1993

Plan review status Early stage of review

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB		X
SLA/AGLV		X

Other

Policy GP13 – Protection of hillside and ridgelines

Previous studies of the renewable energy resource

Study of renewable energy potential at the Chatterly Whitfield Colliery Complex

Existing renewable energy generation

Stoke Incineration Energy Plant

Previous planning applications/appeals

Proposed future planning policies

Proposed Modifications.

Anticipate deposit version of the City Plan to be published in early 2001

Draft City Plan discusses renewable energy in some detail in the explanatory text, but a specific policy has not yet been drafted

Discussions/correspondence with planning officers

County/Borough Cannock Chase

Plan Status and Planning Timetable

Current adopted plan March 1997

Plan review status

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment

Policy PEP6 states that power generation from renewable energy sources will be permitted provided that the development does not cause harm to interests of acknowledged importance. Proposals for the erection of wind turbines will be required to satisfy a number of detailed criteria primarily concerning environmental effects Proposals for wind turbines in the AONB will not be permitted where they have a significant impact on landscape quality

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policies C1 7)	✓	
AONB (Policy C8)	✓	
SLA/AGLV		

Other

Policy C16 states that the best and most versatile agricultural land will be safeguarded from development and changes of use

Policy C8 seeks to conserve and enhance the landscape, nature conservation, and recreation interest of the AONB Only development that is compatible with the natural beauty of the AONB will be permitted Proposals for development on the fringes of the AONB will be considered in the context of the primary objective of protecting the Areas qualities

Previous studies of the renewable energy resource

Existing renewable energy generation

Previous planning applications/appeals

There have been no planning applications in respect of renewable energy within the last two years

Proposed future planning policies

Proposed Modifications

Local plan review is an early stage

Discussions/correspondence with planning officers:

Plan to take a more detailed assessment of the renewable energy resource available in the district as part of the Local Plan Review process

County/Borough: Lichfield

Plan Status and Planning Timetable

Current adopted plan June 1998

Plan review status. Local Plan review process has not yet started

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment

Policy E20A states that the District Council will support proposals for the production of power from renewable energy sources provided there is no unacceptable impact on the environment and that it is in accordance with other plan policies

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policies E4 and E5)	✓	
AONB	✓	
SLA/AONB	✓	

Other

Policy E6 – Development in Rural Areas In rural areas development will not be permitted outside the village boundaries except where the proposal meets other policy, including that on amenity and design

Policy E7 – Areas of Special Protection The District Council propose to give special protection to the Cannock Chase Area of Outstanding Natural Beauty, Special Landscape Areas, and Areas of Local Landscape Value

Policy E8 – Protection of Agricultural Land The use of best and most versatile agricultural and for development not associated with agriculture will not be permitted unless there is a strong case for development which overrides the need to protect such land

Policy E10 – Agricultural Diversification The District Council will support the diversification of existing agricultural activities provided that design, layout and location is acceptable in landscape and conservation terms and the use is compatible with a rural location and consistent with policies for the Green Belt and rural area.

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies **Proposed Modifications:** Local Plan review has not yet started **Discussions/correspondence with planning officers**

Assessment of Development Prospects

County/Borough South Staffordshire

Plan Status and Planning Timetable

Current adopted plan December 1996

Plan review status.

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment

Policy RE1 – Detailed policy specifically addressing renewable energy Proposals for the generation of power from renewable sources will be permitted provided that the proposed development would not cause demonstrable harm to interests of acknowledged importance. Proposals for renewable energy projects are required to fulfil criteria relating to nature conservation and environmental impact, landscape quality, amenity to local residents, electromagnetic disturbance, highways, and site restoration The policy states specifically that proposals for wind turbines within the Cannock Chase AONB will not be permitted where they would have a significant adverse effect on landscape quality

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB	✓	
SLA/AGLV	✓	

Other

Policy OC1 – Open Countryside Within the open countryside development will not normally be permitted unless it is essential to the operation of agricultural, forestry, or other activities appropriate to the rural area, is limited infilling, or involves the re use of a rural building

Policy C2/AG1– Agricultural Land The use of the best and most versatile agricultural land for any form of irreversible non agricultural development will not normally be permitted

Policy LS7 – Special Landscape Area. Permission will not be granted for development which would adversely affect the special landscape character and nature conservation value of the area unless the reasons for development outweigh the value of the site, there is no alternative site, the proposal makes a contribution to national or local objective and does not conflict with other local plan policies

LS12 – Cannock Chase AONB Within the AONB development will be restricted to uses compatible with conservation of the area.

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications:
Local Plan review is at an early stage

Discussions/correspondence with planning officers

Assessment of Development Prospects

	N/A	Long term	Medium term	Short term
Biomass				
Wind				
Hydro				
Solar				
Geothermal				

Comment (including identification of possible development sites)

Assessment of Main Constraints

STUDY OF RENEWABLE ENERGY PROSPECTS IN THE WEST MIDLANDS
REVIEW OF EXISTING STRUCTURE PLANS, LOCAL PLANS AND UDPs

County/Borough: Staffordshire Moorlands

Plan Status and Planning Timetable
Current adopted plan. September 1998
Plan review status

Development Plan Policies
Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?	✓	

Comment
F8 – Power Generation
Planning permission will be granted for development for generation of power from renewable energy sources, unless the site lies within the Green Belt, provided that it does not have a significant adverse impact on the landscape or surrounding land use's and creates no unacceptable amenity or noise problems for local residents This is of particular importance in relation to conservation areas and in open countryside

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt Policy N1/2	✓	
AONB		X
SLA/AGLV	✓	

Other
Policy N7 – Development which would injure the visual amenity of the Green Belt by virtue of its siting, materials or design will not be permitted in locations which are within or visually conspicuous from the Green Belt.
Policy N8 – Special Landscape Area Permission will not be given for development which would materially detract from the high quality of the landscape, because of its siting, scale, design and materials and associated traffic generation. In areas where the special landscape areas overlap with the green belt there will be a presumption against most development in accordance with Policy N2
Policy N11 – The Peak National Park – In considering proposals for development on land conspicuous from The Peak National Park, the council will have regard to the need to ensure that the visual amenities of tat land are not adversely affected to the detriment of the National Park
N27 – Agricultural land – Best and most versatile agricultural land will be protected from development.

Previous studies of the renewable energy resource
No renewable energy resource studies in the Staffordshire Moorlands

Existing renewable energy generation
No renewable energy plants in operation or under development in the Staffordshire Moorlands

Previous planning applications/appeals
None

Proposed future planning policies

Proposed Modifications:
Early stage of review

Discussions/correspondence with planning officers
If renewable energy generation is to go ahead in the District Council will need to be assured that the landscape impact is acceptable. The District Council is concerned particularly because large areas of the district are green belt or lie adjacent to the national park where protection of the open countryside and attractive landscape will be given priority.

Assessment of Development Prospects

County/Borough Tamworth

Plan Status and Planning Timetable

Current adopted plan Jan 1995

Plan review status. Local Plan review is at pre consultation stage

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

No policies refer to renewable energy

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policies Ne9 11)	✓	
AONB	X	
SLA/AGLV	X	

Other

Policies ne13 and ne14 seek to protect the character and appearance of 'Green Wedges' and 'Green Corridors'

Policy ne16 protects the most versatile agricultural land against development

Policy cd88 sets out a range of external and internal noise levels Noise sensitive developments will not be permitted where these levels cannot be complied with.

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications:
Local Plan review is at pre-consultation stage. Issues for consultation have been identified – these do not refer directly to renewable energy

Discussions/correspondence with planning officers:

County/Borough Newcastle under Lyme

Plan Status and Planning Timetable

Current adopted plan May 1995

Plan review status. Local Plan is at an early stage of review

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policies G1 – see attached)	✓	
AONB		X
SLA/AGLV	✓	

Other

Policy S1 – Sustainable Development. In determining applications for all types of development the Council will have regard to the likely effect of the development on natural resources that cannot be replaced

Policy S2 – Conservation of Agricultural Land – The council will protect grade 1, 2, or 3a land against development of an irreversible nature

Policies G3 and G4 – Special Landscape Area limitation on development/siting of development. The Council will protect the SLA from development that would harm the visual quality of, or introduce a discordant element into the landscape Development that is justified must be sited and designed in such a way that it enhances the quality of the landscape

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications

Local Plan is at an early stage of review

The Local Agenda 21 Environmental Strategy is currently being reviewed – this will incorporate reference to renewable energy sources

Discussions/correspondence with planning officers

County/Borough East Staffordshire

Plan Status and Planning Timetable

Current adopted plan. March 1999

Plan review status Local Plan review currently underway

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Policy EN42 refers to the need for development proposals to make provision for a high standard of energy efficiency but does the plan does not make specific reference to energy from renewable sources

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policies En4/5)	✓	
AONB		X
SLA/AGLV	✓	

Other

Policy En1 – Development in the countryside

Policy En6 – Special Landscape Areas

Policy En10 – Development of the best and most versatile agricultural land will not be permitted unless there is an overriding need for it, which cannot be met elsewhere

Previous studies of the renewable energy resource

No studies of renewable energy undertaken within the area

Existing renewable energy generation

There are no existing renewable energy plants operating or under development in East Staffordshire

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications

Discussions/correspondence with planning officers

Local Plan review is currently being undertaken. In the amended local plan policies concerning renewable energy are likely to be included

The Councils main concern is the issue of the environmental impact of wind farms on Areas of Special Landscape Value and the adjoining Peak District National Park

County/Borough Warwickshire

Plan Status and Planning Timetable

Current adopted plan Sept 1991

Plan review status. Deposit draft 2000

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

The adopted plan makes no reference to renewable energy

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (see Policy G4 below)	✓	
AONB	✓	
SLA/AGLV	✓	

Other

Policy G4 – Within the Green Belt the rural character of the area will be retained, protected and whenever possible enhanced by safeguarding areas of mainly open country to take account of the interests and needs of agriculture and forestry and provide a source of recreation and enjoyment Development will not be permitted except in very special circumstances, for purposes other agriculture/forestry, single dwellings, re use of redundant sites, outdoor sport/recreation

Policy E5 1 – Within the AONB priority will be given to the consideration and protection of the landscape Exceptions may include, proposals for small scale developments which are essential to meet local community needs, proposals for small scale recreational facilities, and those directly related to agriculture and forestry

Policy G3 3 – The Council will support the re establishment of the Forest of Arden and the concept of creating a new national forest

Policy G4 – Wherever possible, derelict land, or land of no agricultural value will be used for development.

Policy G6 – The general area covering Bedworth, Nuneaton, Atherstone and along the Tame Valley will be designated an environmental enhancement zone This area will be given priority in terms of schemes to improve the urban and rural environments.

Policy E4 1 – Encourages the diversification of the rural economy providing that the landscape quality and character and wildlife habitats are protected

Policy E5 - Special Landscape Areas (5 listed) merit conservation and protection from severe pressures for development or intensive recreational use.

Policy E11 – The ultimate disposal of household and industrial waste will be by landfill. In determining the selection of suitable sites, the filing capacity of a site and suitable waste materials, regard will be had to is ultimate restoration 7 criteria are listed covering impact on landscape, restoration use, drainage and the monitoring and treatment of gas

Previous studies of the renewable energy resource

None

Existing renewable energy generation

Bio mass project – limited progression. Experiment now underway at Gaydon (Ford)
Landfill gas to electricity sites at Packington Landfill Site in North Warwickshire Borough, Judkins Landfill Site in Nuneaton, Smiths Landfill Site at Bubbenhall, Ufton Landfill Site and the former landfill site at Ryton. Ling Hall Landfill site is to serve the National Grid from mid Sept. The environmental impact of these sites has been self contained

Previous planning applications/appeals

No Information

Proposed future planning policies

Proposed Modifications: (from deposit draft, 2000)
Policy GD1 states that that "The overriding purpose of the Structure Plan is to provide for a pattern of development which ... conserves resources of land and energy, including minerals and water, and makes maximum use of renewable energy source." (one of 6 aims)
Policy GD6 – Local plans should specify policies for the restriction of inappropriate development in the Green Belt
Policy RA5 – In rural areas, development, other than for minerals and waste, should be provided for in local plans specifically to meet the needs of the local population and to support rural communities
Policy ER1 – Development will only be permitted where it is consistent with protection of the environmental assets of the County and the maintenance of the character and quality of its towns and countryside
Policy ER2 – The environmental impact of all proposed development must be thoroughly assessed. If adverse impacts can not be mitigated to acceptable levels, development will not be permitted
Policy ER3 – The Cotswold AONB will be subject to most rigorous protection. Development will only be permitted where it is consistent with the conservation of the natural beauty of the landscape. Local plan policies should require the highest standards of design and prevent large scale development
Policy ER4 – Reference to Special Landscape Areas broadly as in adopted plan. Additional designation – Landscape Enhancement Zones – new development are expected to contribute to the restoration of the environment.
Policy ER9 – The Waste Local Plan for Warwickshire should provide for a reduction in waste going to landfill of at least 14% by 2005 (in line with Government Guidance)
Discussions/correspondence with planning officers
Whilst it is the County's intention to achieve along term reduction in landfill, in the shorted term there may be potential to generate power from waste. The Deposit plan states an intention to make maximum use of renewable energy resources, however given physical constraints this contribution to national targets is likely to come from 'combustible, or digestible industrial, agricultural and domestic waste'. Local objection to such schemes is considered to be a significant constraint to development
The re establishment of the Forest of Arden may provide a renewable energy resource. Bio mass is considered to be a possibility in terms of promoting farm diversification.

STUDY OF RENEWABLE ENERGY PROSPECTS IN THE WEST MIDLANDS
REVIEW OF EXISTING STRUCTURE PLANS, LOCAL PLANS AND UDPs

County/Borough. Warwick

Plan Status and Planning Timetable

Current adopted plan April 1995

Plan review status Early stage of review process

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

No specific policy on renewable energy but Policy ENV3A refers to the conservation of energy resouces

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB		X
SLA/AGLV	✓	
Other		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications

Issues papers to be published Spring 2001

Discussions/correspondence with planning officers

Renewable energy will be considered but precise wording/focus of policy is, at present. Uncertain

County/Borough: Stratford upon Avon

Plan Status and Planning Timetable

Current adopted plan May 2000

Plan review status Review to commence summer 2001

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Adopted plan makes no reference to renewable energy

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB	✓	
SLA/AGLV	✓	

Other

Policy ENV7 – The District Authority will take full account of the need to protect and maintain the historic character of the landscape

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications

Officers are keen to address renewable energy through the local plan review process. The absence of a policy in the May 2000 adopted plan is a result of a length process of review. The current adopted plan therefore reflects policies drafted initially in the early 1990s, before the publication of PPG22.

Discussions/correspondence with planning officers

County/Borough. North Warwickshire

Plan Status and Planning Timetable

Current adopted plan Adopted 1995

Plan review status Consultation on issues papers

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Existing plan makes no reference to renewable energy

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB		X
SLA/AGLV	✓	

Other

Policy ENV4 – Landscape Improvement

Policy ENV6 – Within the SLA development which would adversely affect the quality or character of the landscape will not normally be permitted

ENV7 – Environmental Enhancement Zones

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications:

Plan will address renewable energy but policies not yet drafted

Discussions/correspondence with planning officers:

Officers would like to include a policy making specific reference to copping and solar power Members have concerns over wind farms Concern that a detailed policy, referring to specific technologies might not stand upto appeal

County/Borough Nuneaton and Bedworth

Plan Status and Planning Timetable

Current adopted plan February 1993

Plan review status Issues paper produced 2000 Deposit Draft plan to be issued March 2001

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Adopted plan makes no reference to renewable energy

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB		X
SLA/AGLV		X
Other		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications:

Discussions/correspondence with planning officers

Review process is in its early stage Policies have not been drafted Issues papers do not specifically address renewable energy

County/Borough. Rugby

Plan Status and Planning Timetable

Current adopted plan 1997

Plan review status Issues papers being prepared Deposit draft expected late 2001

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy	✓	

Comment

Policy R/E19 – Renewable Energy

The Borough Council will normally permit proposals in relation to the provision of renewable energy if the comply with the following criteria

1 The design and siting of the development does not adversely affect the character and appearance of its surroundings,
2 That and dwellings or business premises in the vicinity are not affected,
3 That development is located at a satisfactory distance from any building, road, railway or right of way,
4 That airport flight paths are not adversely affected,

That the proposal complies with the general standards of development in policy R/G1 and any other relevant local plan policy

Links to other policies and potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB	X	
SLA/AGLV	✓	

Comment

Previous estimates of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

Lack of commercial interest

Proposed future planning policies

Proposed Modifications

Review is at an early stage Issues papers are being prepared

Discussions/correspondence with planning officers:

STUDY OF RENEWABLE ENERGY PROSPECTS IN THE WEST MIDLANDS
REVIEW OF EXISTING STRUCTURE PLANS, LOCAL PLANS AND UDPs

County/Borough Birmingham

Plan Status and Planning Timetable

Current adopted plan July 1993

Plan review status Draft Alterations published 2000 Public consultation held April to June 2000

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB		X
SLA/AGLV		X
Other		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

Energy is produced from the waste plant at Tyseley No other renewable energy schemes

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications Draft Alterations 2000

Alterations incorporate policies to minimise energy consumption and carbon dioxide emissions in new developments No direct reference is made to renewable sources under the 'energy' heading However, Policy 3 77 Air Quality, states that the City Council is committed to improving air quality through the use of alternative clean fuels Policy 3 67 states that waste incinerators provide an efficient means of reducing the amount of waste for disposal and an opportunity for energy recovery

Discussions/correspondence with planning officers.

County/Borough: Walsall

Plan Status and Planning Timetable

Current adopted plan Jan 1995

Plan review status Deposit draft expected February 2001

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Proposals ENV 1)	✓	
AONB		X
SLA/AGLV		X
Other		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None that planning office aware of Physical characteristics do not lend themselves to wind or water power

Proposed future planning policies

Proposed Modifications:

It is anticipated that the first deposit draft of the Walsall UDP will be published in February 2001 This will include one specific policy referring to the development of energy from renewable sources

Discussions/correspondence with planning officers

County/Borough: Sandwell

Plan Status and Planning Timetable

Current adopted plan. 1995

Plan review status First deposit draft has been produced

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy		X
Comment		

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt	✓	
AONB		X
SLA/AGLV		X
Other		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications

Deposit draft contains a policy on renewable energy Policy SO2 states that the development of renewable energy sources such as wind or solar power will be welcomed Proposals for such facilities will be considered in terms of impact on the natural and built environment and affect on the amenity of residential properties

Discussions/correspondence with planning officers:

County/Borough Solihull

Plan Status and Planning Timetable

Current adopted plan. April 1997

Plan review status Issues papers produced March – April 2000 Deposit draft due to be published 2001

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policies GB1 3)	✓	
AONB		X
SLA/AGLV		X
Other		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications:

Early stage of review

Discussions/correspondence with planning officers

Planning officers are keen to include a policy regarding the generation of waste from energy, but this is at an early stage of thought.

STUDY OF RENEWABLE ENERGY PROSPECTS IN THE WEST MIDLANDS
REVIEW OF EXISTING STRUCTURE PLANS, LOCAL PLANS AND UDPs

County/Borough: Dudley

Plan Status and Planning Timetable

Current adopted plan Nov 1993

Plan review status Deposit draft – 2nd deposit to be issued Spring 2001

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy	✓	

Comment

Policy 50 The council will encourage and support the development of renewable energy products provided that the visual and environmental impact on the surrounding area is acceptable Where applicable the proposals should be supported by an environmental assessment study

Links to other policies and potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policy GB1/2)	✓	
AONB		X
SLA/AGLV		X
Other		

Comment

Policy 30 – Landscape Enhancement. The council will seek to maintain and enhance the character and quality of the landscape of the borough through direct action

Policy 31 – Landscape Heritage Areas Within landscape and heritage areas, the council will, as appropriate and possible employ all its powers to prevent any development taking place which would be detrimental to the character and quality of the landscape

Policy 32 – Landscape Heritage Areas – The Council will seek to protect and enhance views within and on the periphery of landscape heritage areas

Previous estimates of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications

None

Discussions/correspondence with planning officers:

STUDY OF RENEWABLE ENERGY PROSPECTS IN THE WEST MIDLANDS
REVIEW OF EXISTING STRUCTURE PLANS, LOCAL PLANS AND UDPs

County/Borough Coventry

Plan Status and Planning Timetable

Current adopted plan March 1993

Plan review status Deposit Draft 1998 Proposed modifications published for consultation in July 1999 Further proposed changes put forward following Public Inquiry in May 2000

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

No specific policy relating to renewable energy Policy G2 states that the City Council will encourage initiatives that assist with the conservation of energy The explanatory text refers to future potential to contribute to energy efficiency by using waste heat from the Waste Reduction Unit to generate electricity

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policies GS5/6)	✓	
AONB		X
SLA/AGLV		X

Other

BE21 Landfill Gas. The City Council will assess the risks of landfill gas generation from both active and closed landfill sites, and will take steps to prevent danger or damage to people and the environment

Policy Sc122 – Waste reduction by incineration will remain the principal means of handling waste disposal in Coventry

Policy SC23 – Landfill In considering applications for landfill operations, regard will be given to the effect of the proposal on the environment, the nature and adequacy of after use proposals, aquifer protection, traffic, amenity and other public health considerations, together with the proven need for the specific facility

Previous studies of the renewable energy resource

None

Existing renewable energy generation

'Waste to Energy' plant at Bar Road uses heat to provide energy for industrial premises

Previous planning applications/appeals

Proposed future planning policies

Proposed Modifications (deposit draft 1998)

Policy OS5 – Energy The conservation and efficient use of energy in the siting, landscaping, design, use of materials, layout and orientation of buildings will be encouraged through the provision of advice and in pre-application negotiations

Policy OS6 – Proposals which would result in pollution of water, air or ground or pollution through noise, dust, vibration, smell, heat, light or radiation will only be permitted of the health, safety and amenity of the users of the land and neighbouring land, and the quality and enjoyment of the environment are assured

Policy BE30 – Landfill will only be permitted where it is necessary to bring about the restoration and re use of land and where environmental consequences have been minimised in accordance with other Plan policies

Policy GE6 – Control over development in the Green Belt Development within or conspicuous from the Green Belt should not harm the local landscape character or the visual amenities of the Green Belt.

Proposed modifications (up to end of public inquiry June 2000)

Policy EM1 – Conservation of Energy Resources "The conservation and efficient use of energy will be promoted by the location of development and the siting and design of buildings"

Policy EM2 – Alternative Energy Resources The extent to which alternative energy sources serve important community interests will be recognised and taken into account when considering proposals for such development

Discussions/correspondence with planning officers

County/Borough: Wolverhampton

Plan Status and Planning Timetable

Current adopted plan 1993

Plan review status Draft Strategy Statement published October 1999

Development Plan Policies

Renewable energy

	Y	N
Existing local plan policy relating to renewable energy?		X

Comment

Potential constraints to the development of renewable energy resources

	Y	N
Green Belt (Policy ENV1)	✓	
AONB		X
SLA/AGLV		X
Other		

Previous studies of the renewable energy resource

None

Existing renewable energy generation

None

Previous planning applications/appeals

None

Proposed future planning policies

Proposed Modifications:

Review Draft Strategy Statement (October 1999) outlines the main concerns of the review process The document states that the importance of the Green Belt can not be over stated In terms of sustainable development the documents suggests that planning should "promote and encourage energy efficiency" There is a need for waste minimisation policies to encourage the use of recycled materials in new development and promote energy efficiency

Discussions/correspondence with planning officers

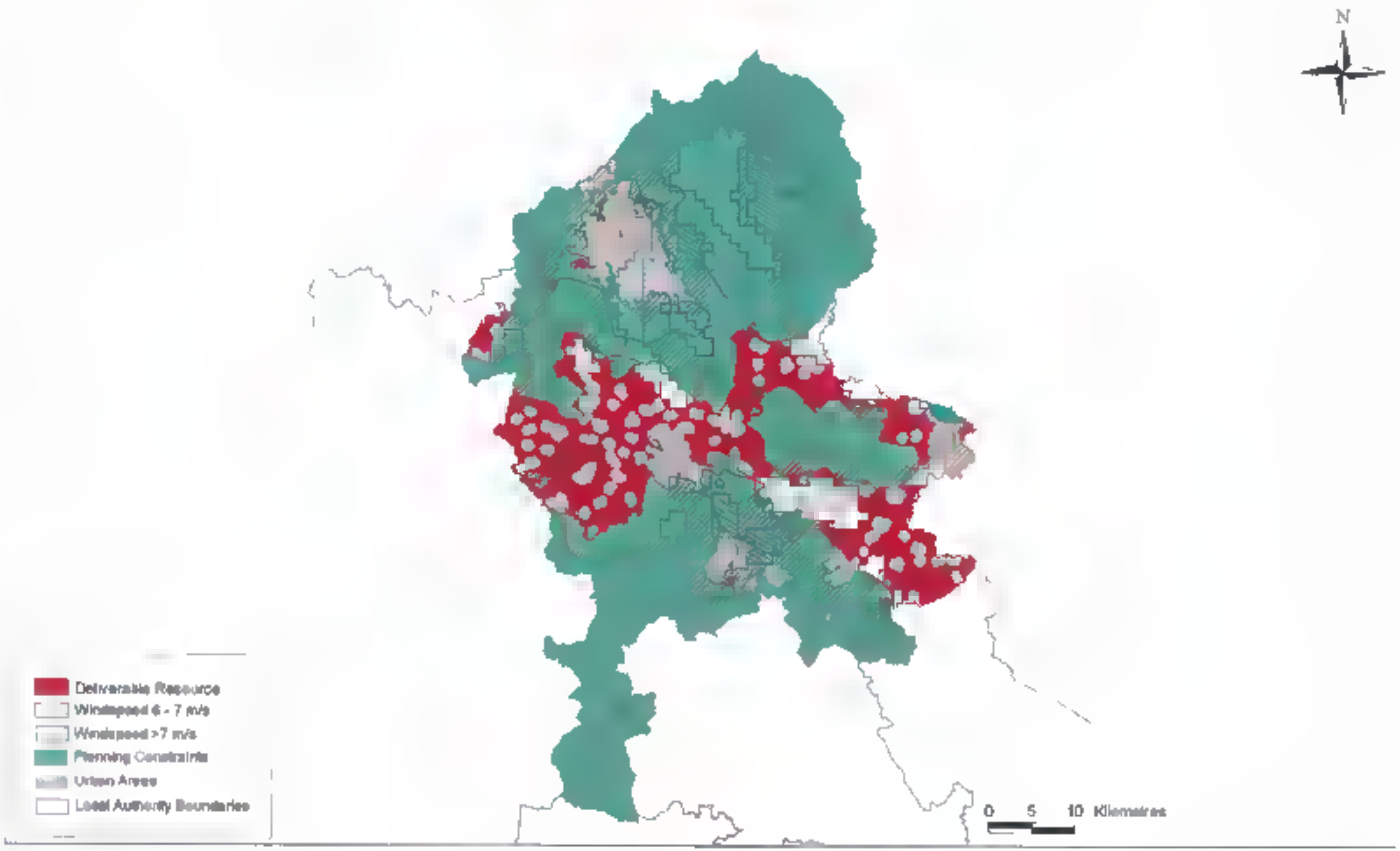
Discussions with planning officers suggest that the Local Plan will include policies relating to the design and orientation of dwellings in terms of energy efficiency Policies have not been drafted yet – the inclusion of a specific renewable energy policy is therefore not certain

Appendix D

Sub Regional Assessments

Appendix D Contents

1 Staffordshire



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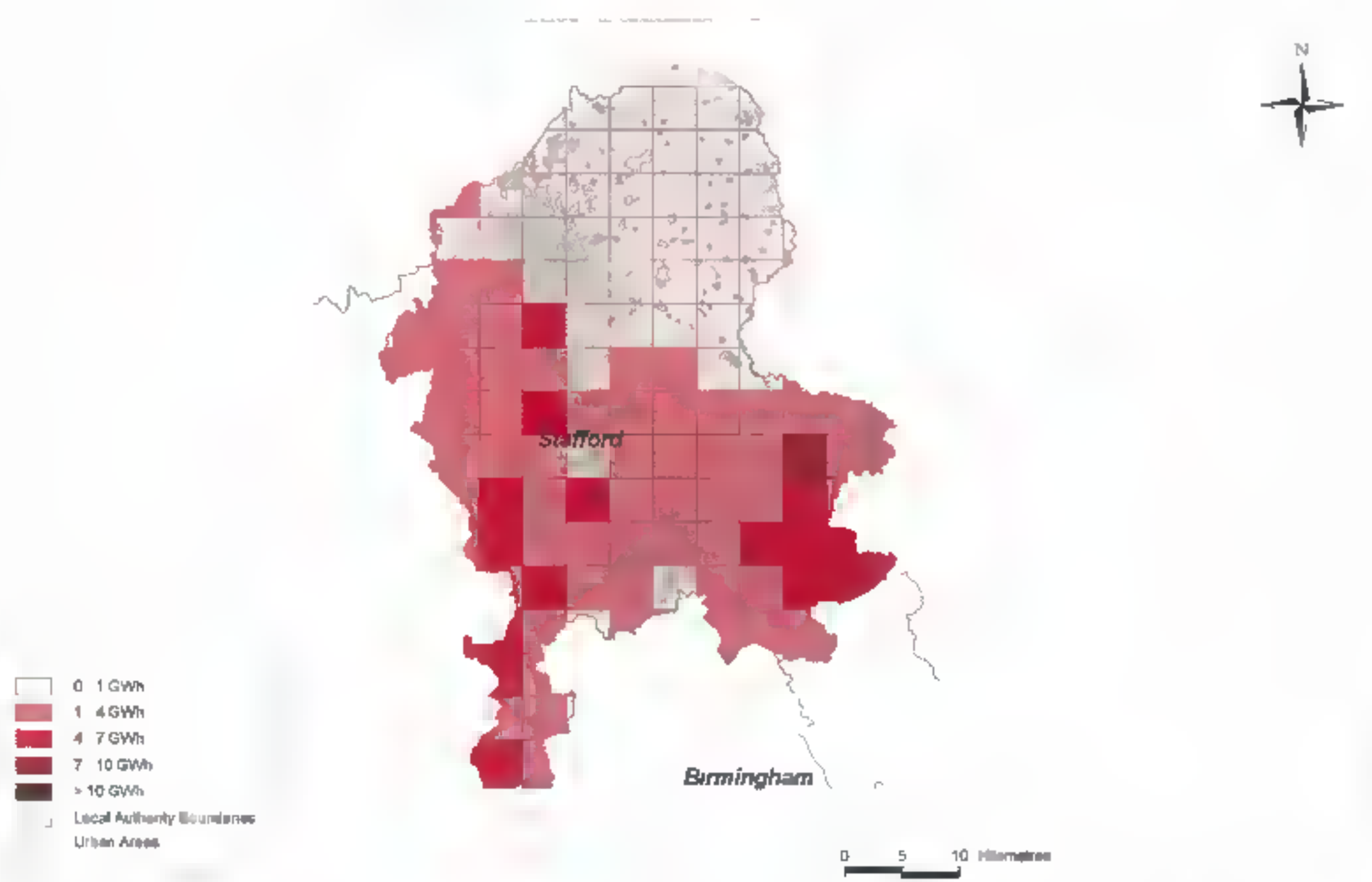
Deliverable Wind Resource in Staffordshire

Figure D1



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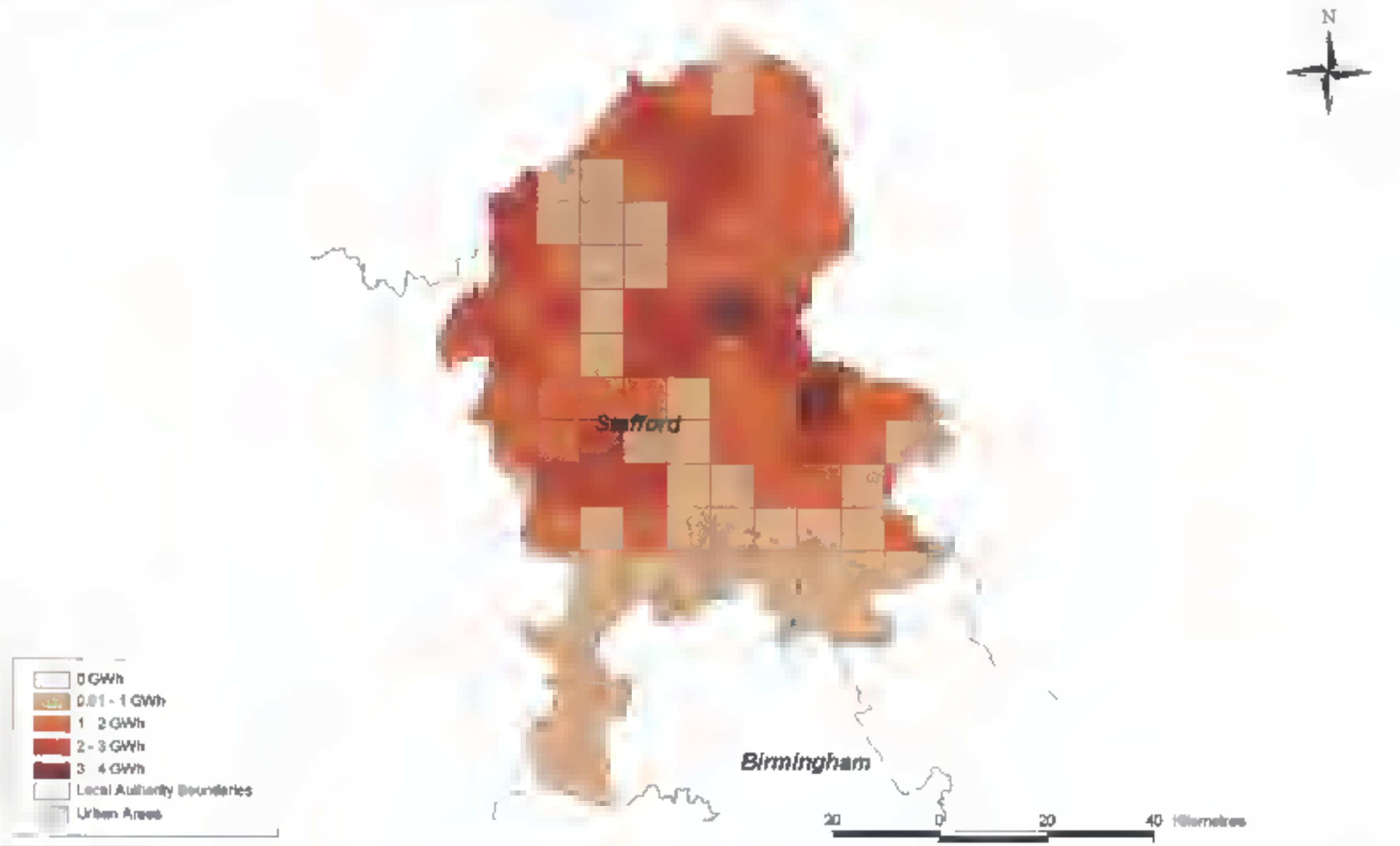
Potential Generation from Energy Crops in Staffordshire

Figure D2



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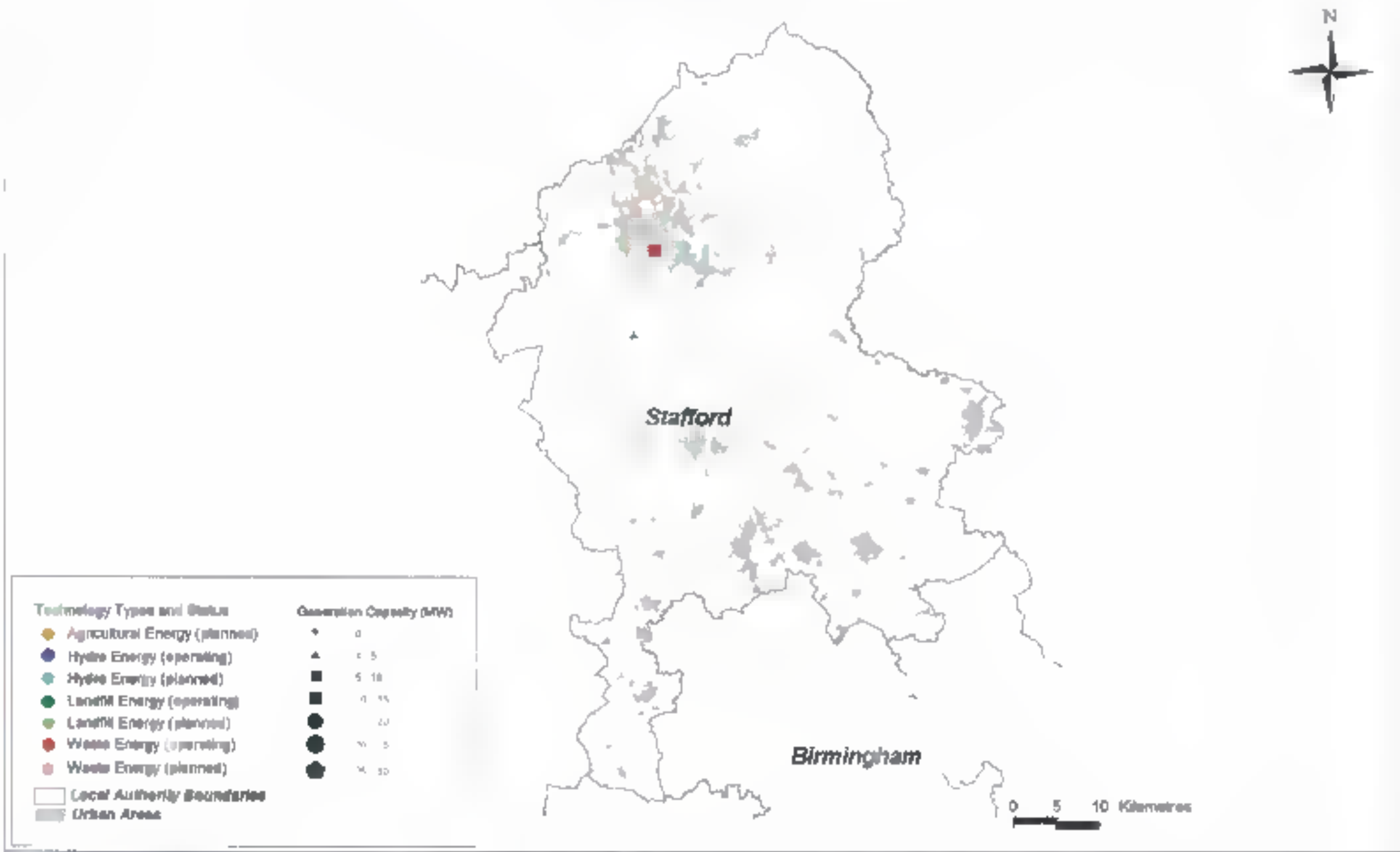
Potential Generation from Agricultural Residues in Staffordshire

Figure D3



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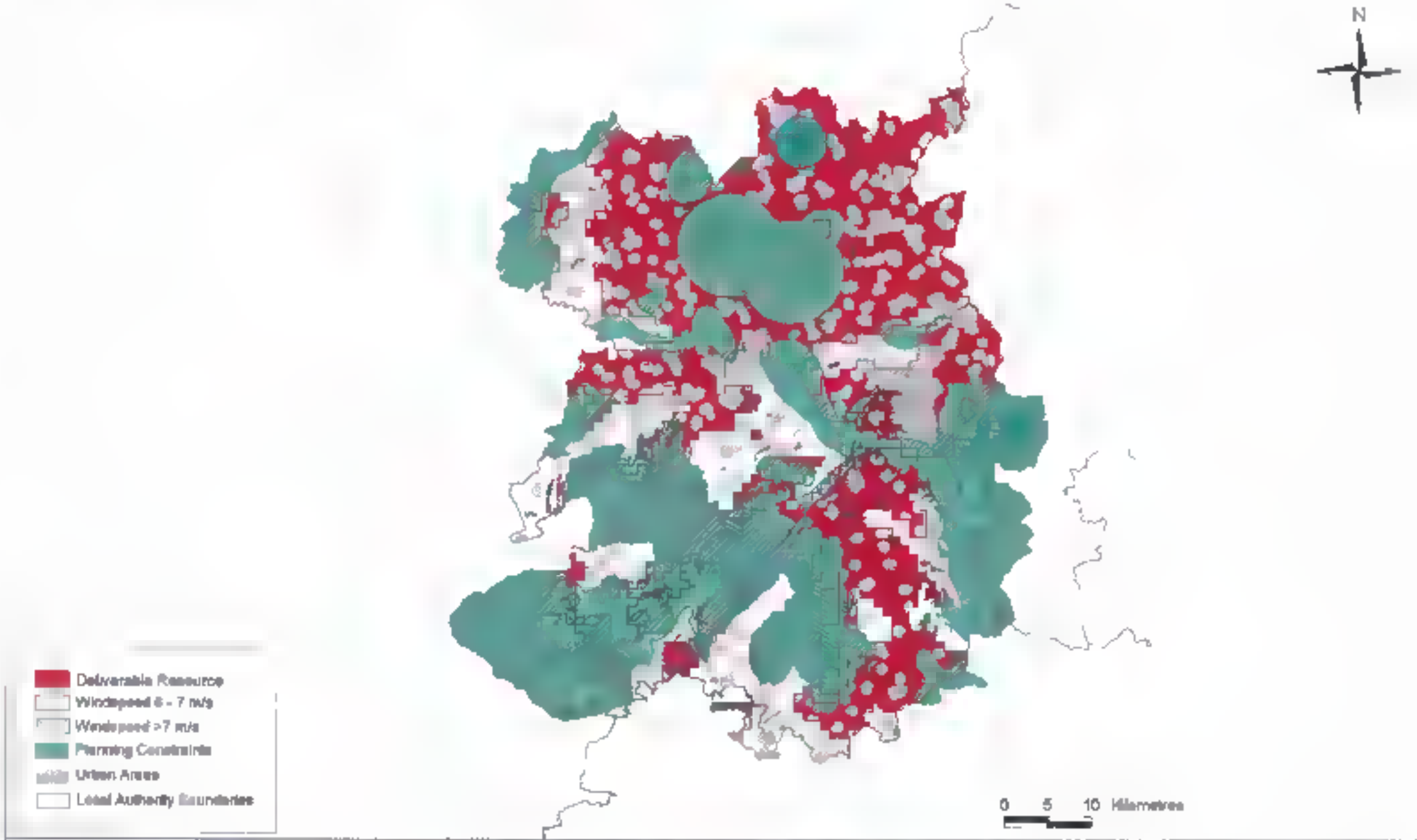
Renewable Electricity Generators in Staffordshire

Figure D4

2 Shropshire



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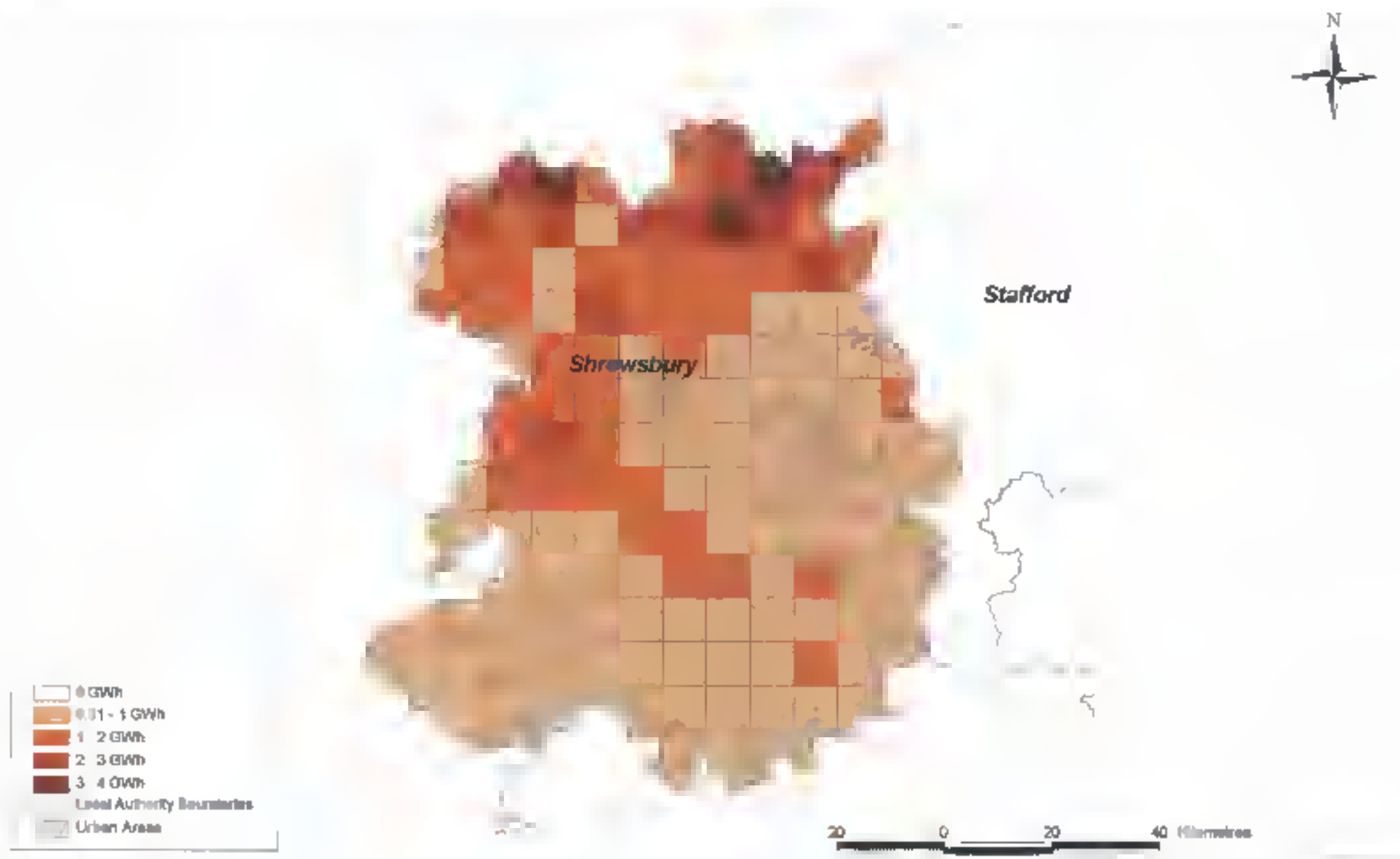
Deliverable Wind Resource in Shropshire

Figure D5



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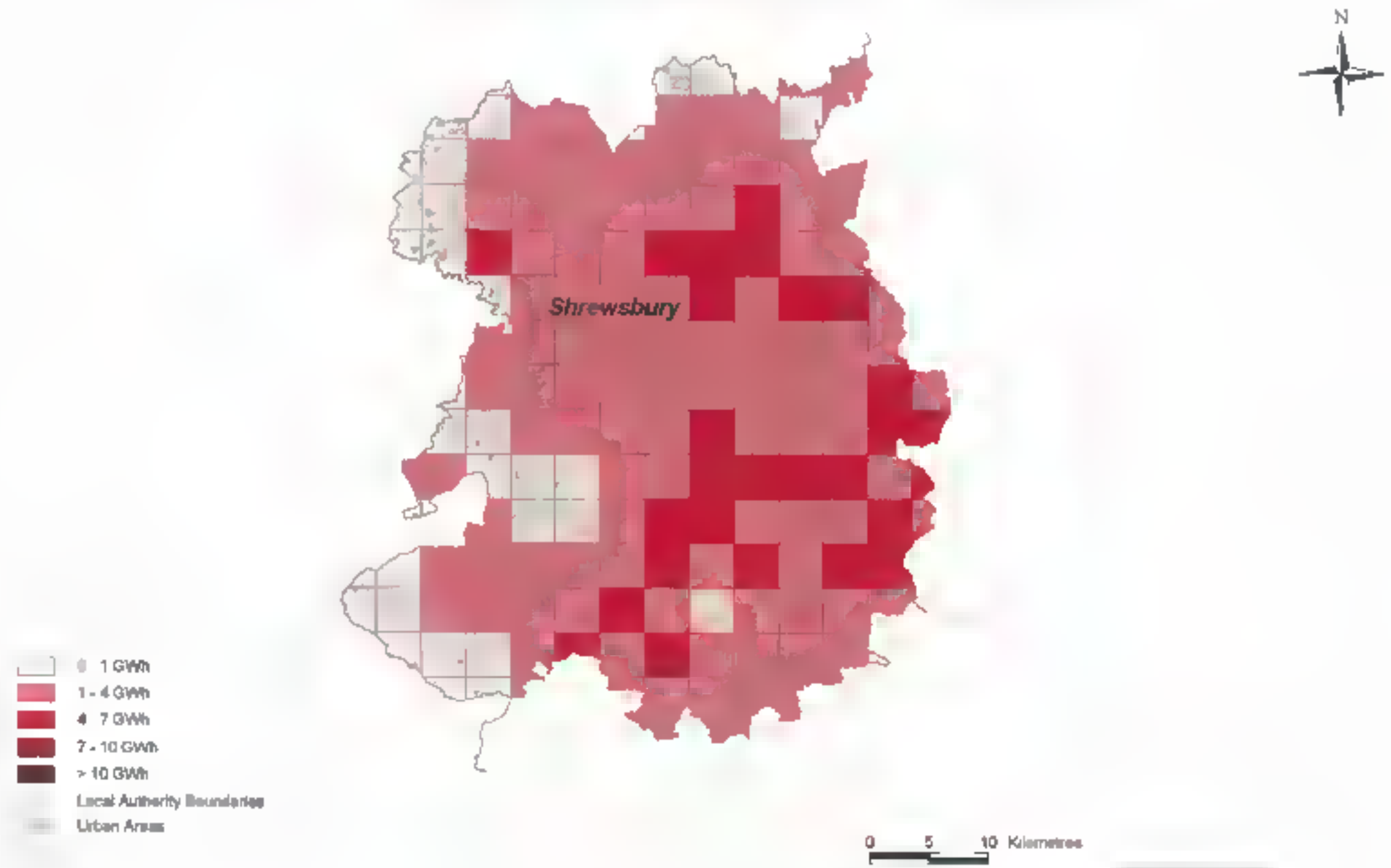
Potential Generation from Agricultural Residues in Shropshire

Figure D7



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Potential Generation from Energy Crops in Shropshire

Figure D6

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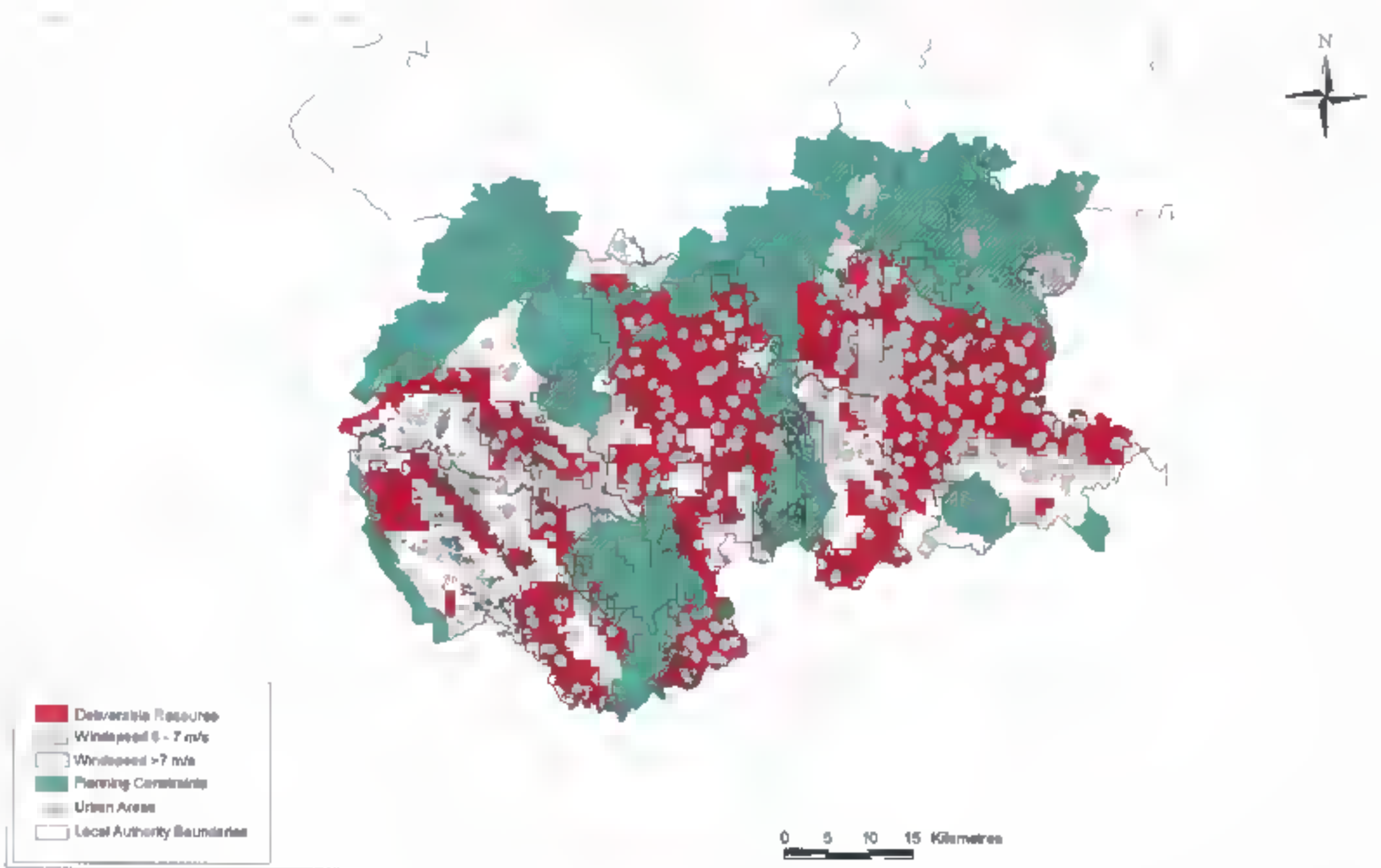
Renewable Electricity Generators in Shropshire

Figure D8

3 Herefordshire and Worcestershire



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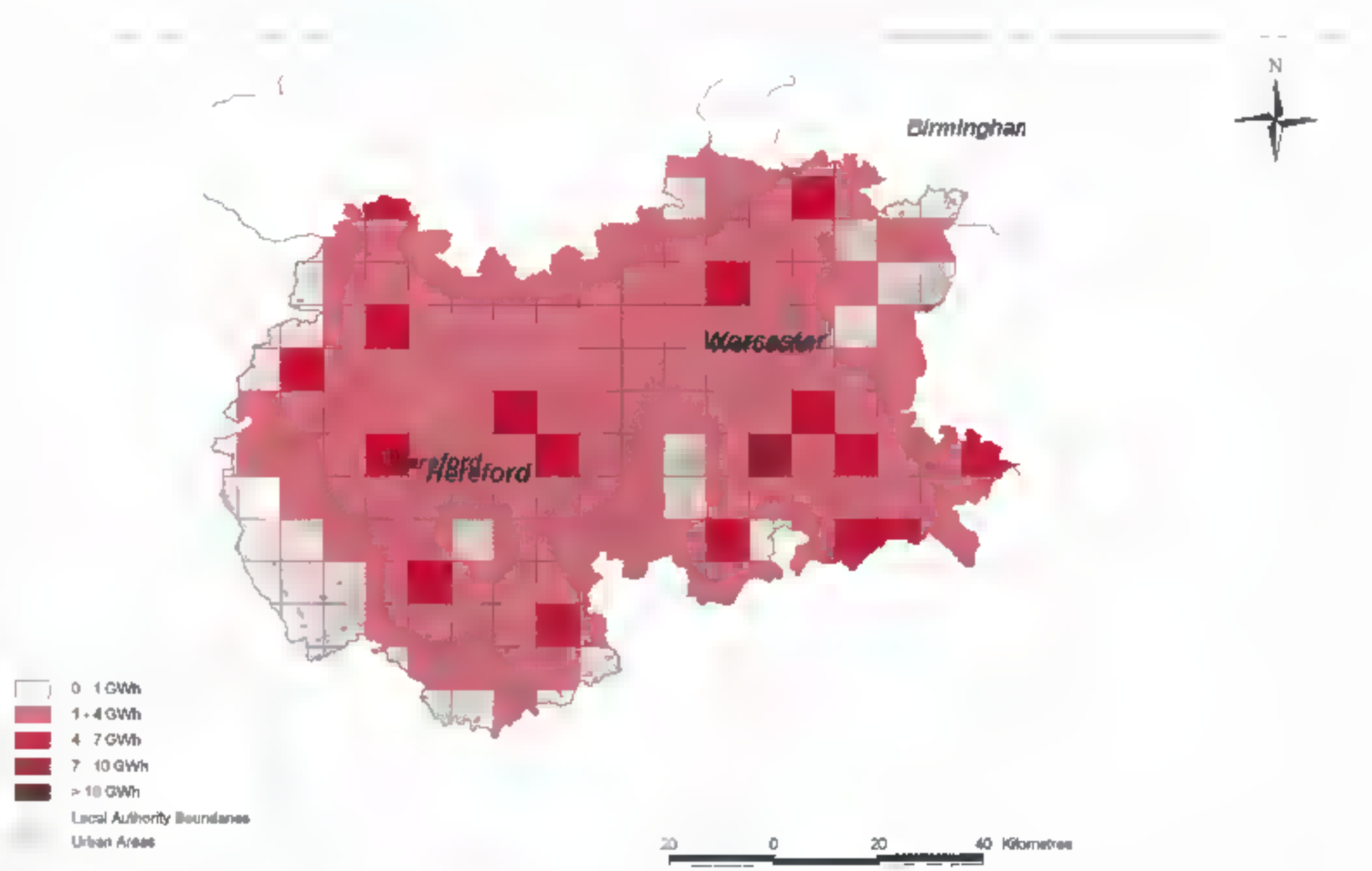
Deliverable Wind Resource in Herefordshire and Worcestershire

Figure D9



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Potential Generation from Energy Crops in Herefordshire and Worcestershire

Figure D10

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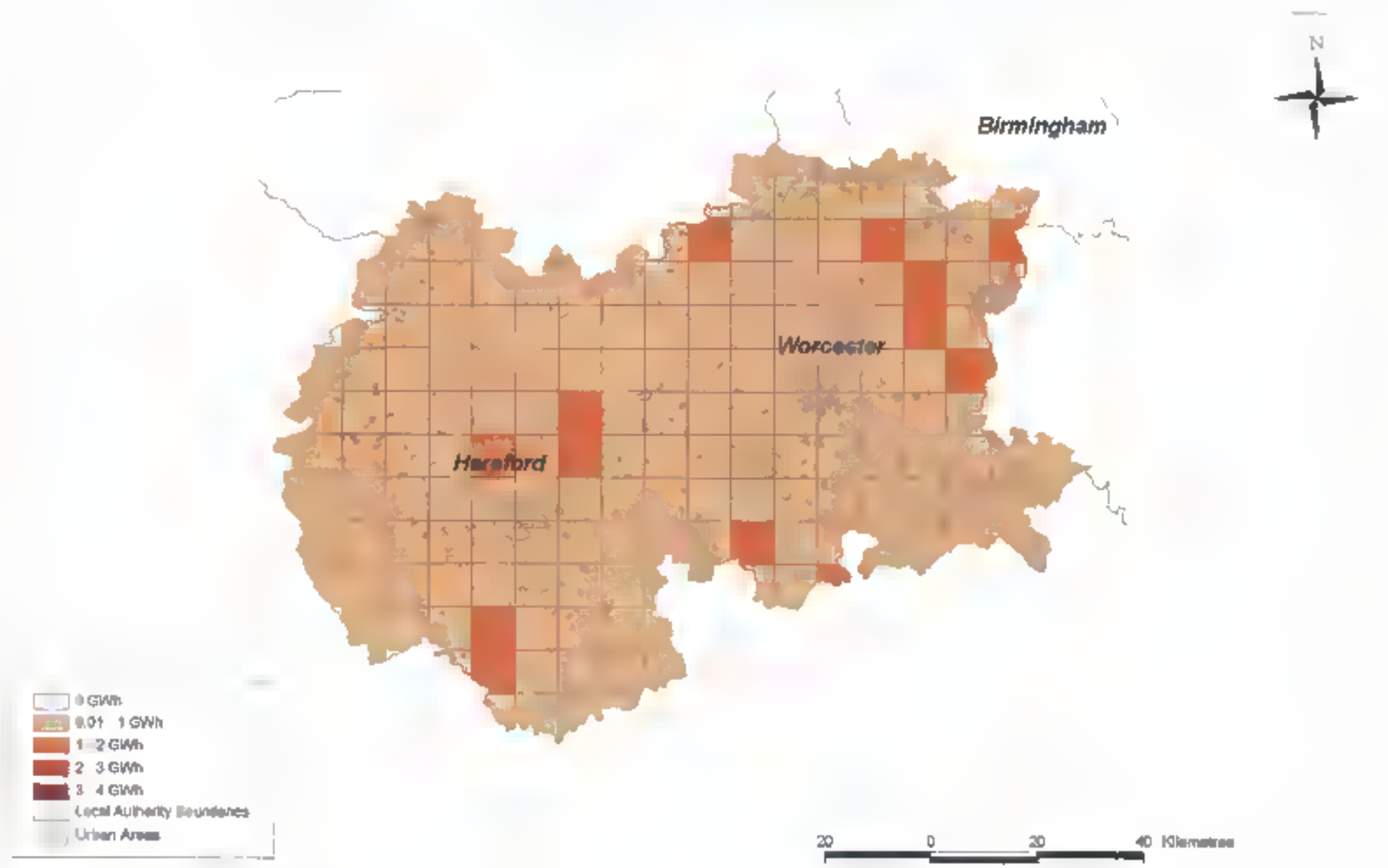

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Potential Generation from Agricultural Residues in Herefordshire and Worcestershire

Figure D11

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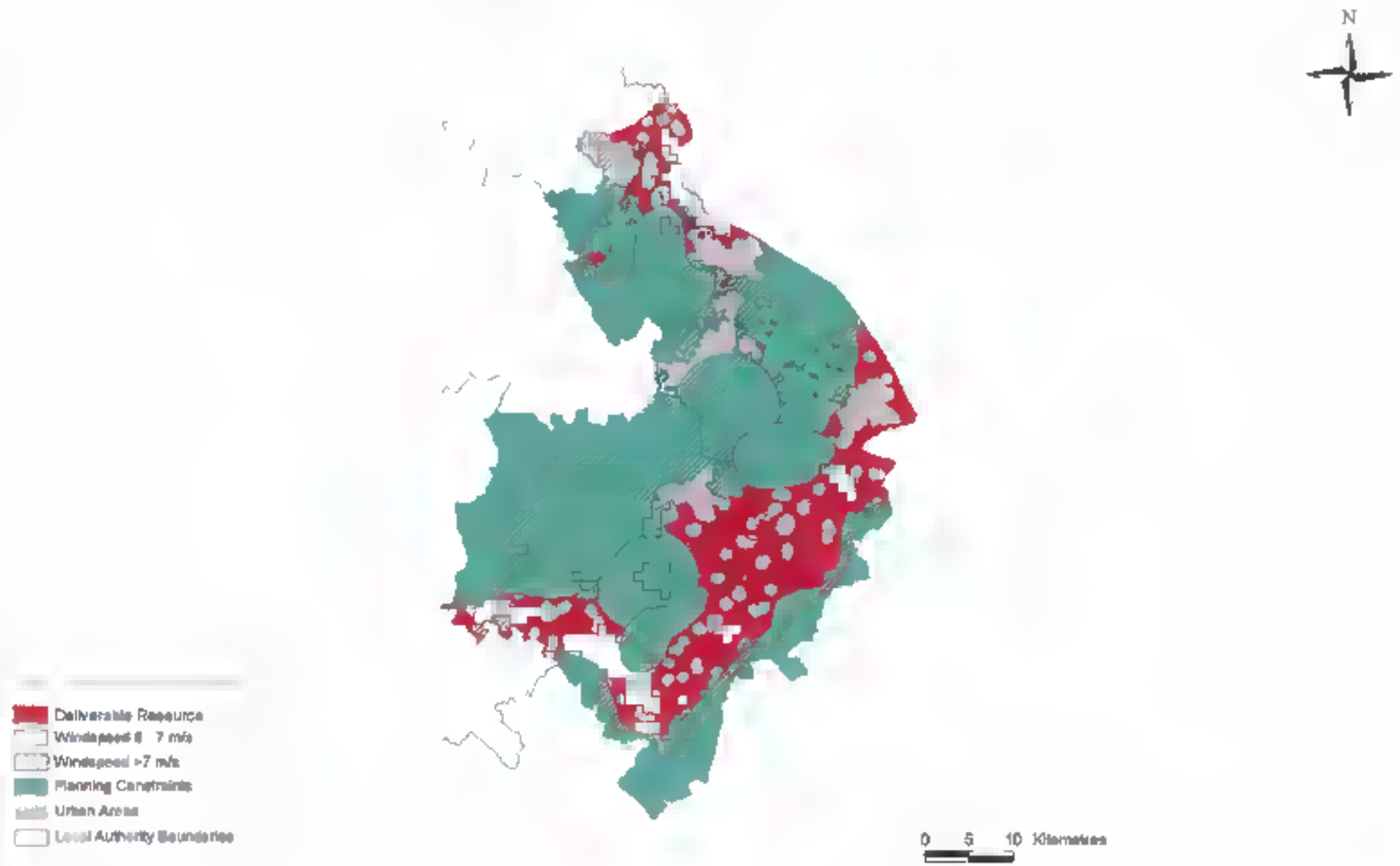
Renewable Electricity Generators in Herefordshire and Worcestershire

Figure D12

4 Warwickshire



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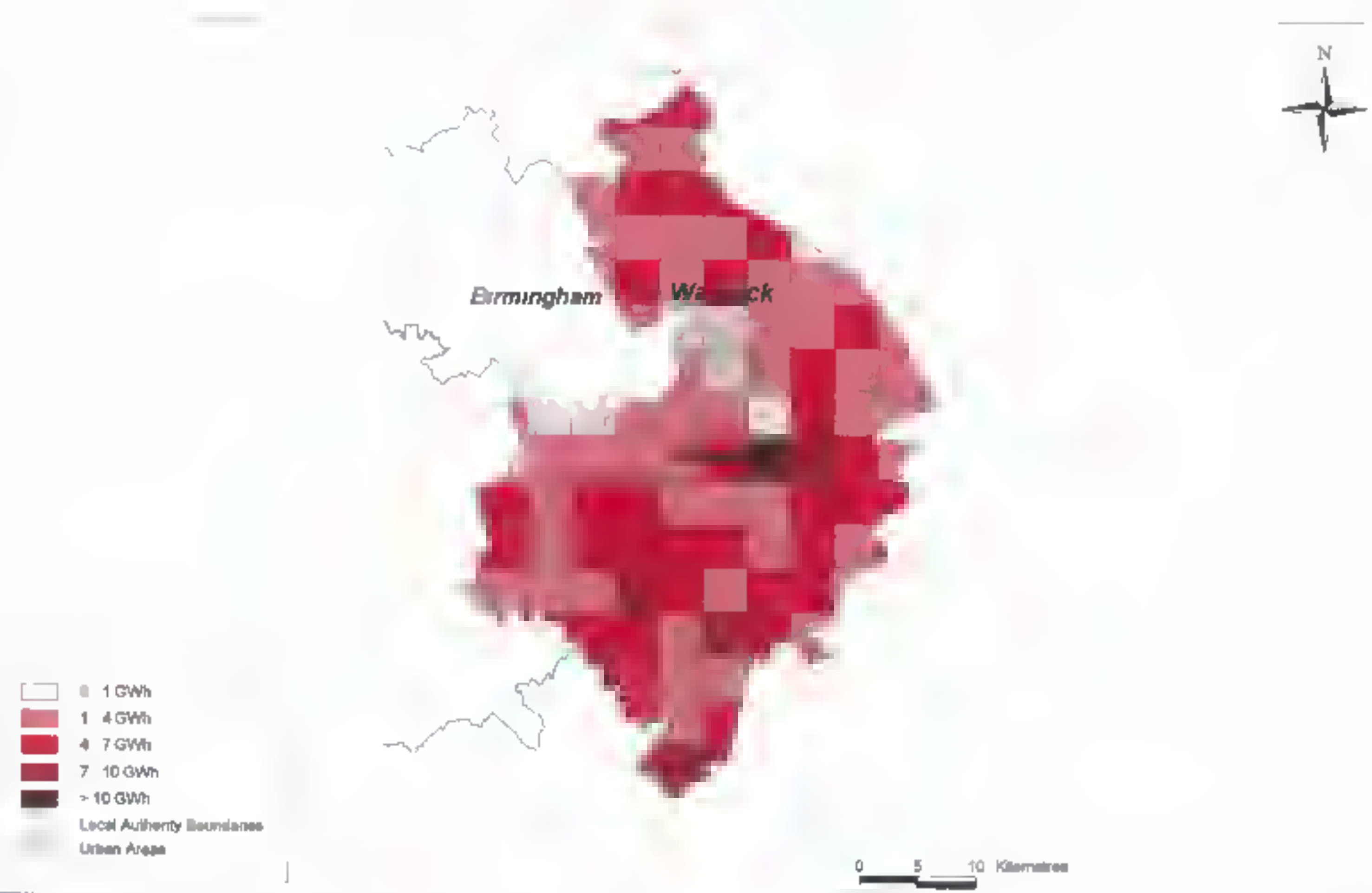
Deliverable Wind Resource in Warwickshire

Figure D13



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Potential Generation from Energy Crops in Warwickshire

Figure D14

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Potential Generation from Agricultural Residues in Warwickshire

Figure D15

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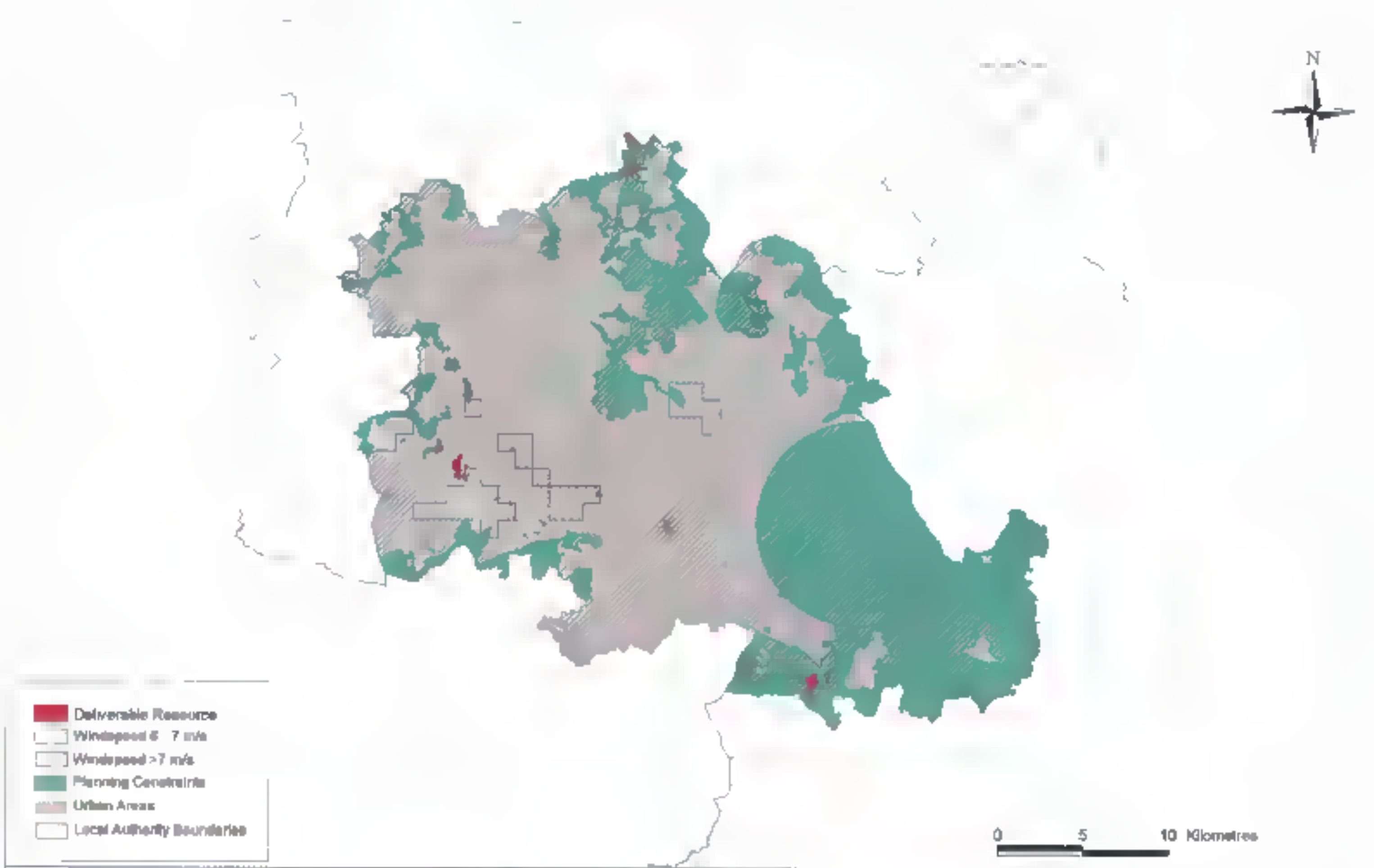
Renewable Electricity Generators in Warwickshire

Figure D16

5 Metropolitan Areas



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Deliverable Wind Resource in Metropolitan Areas

Figure D17

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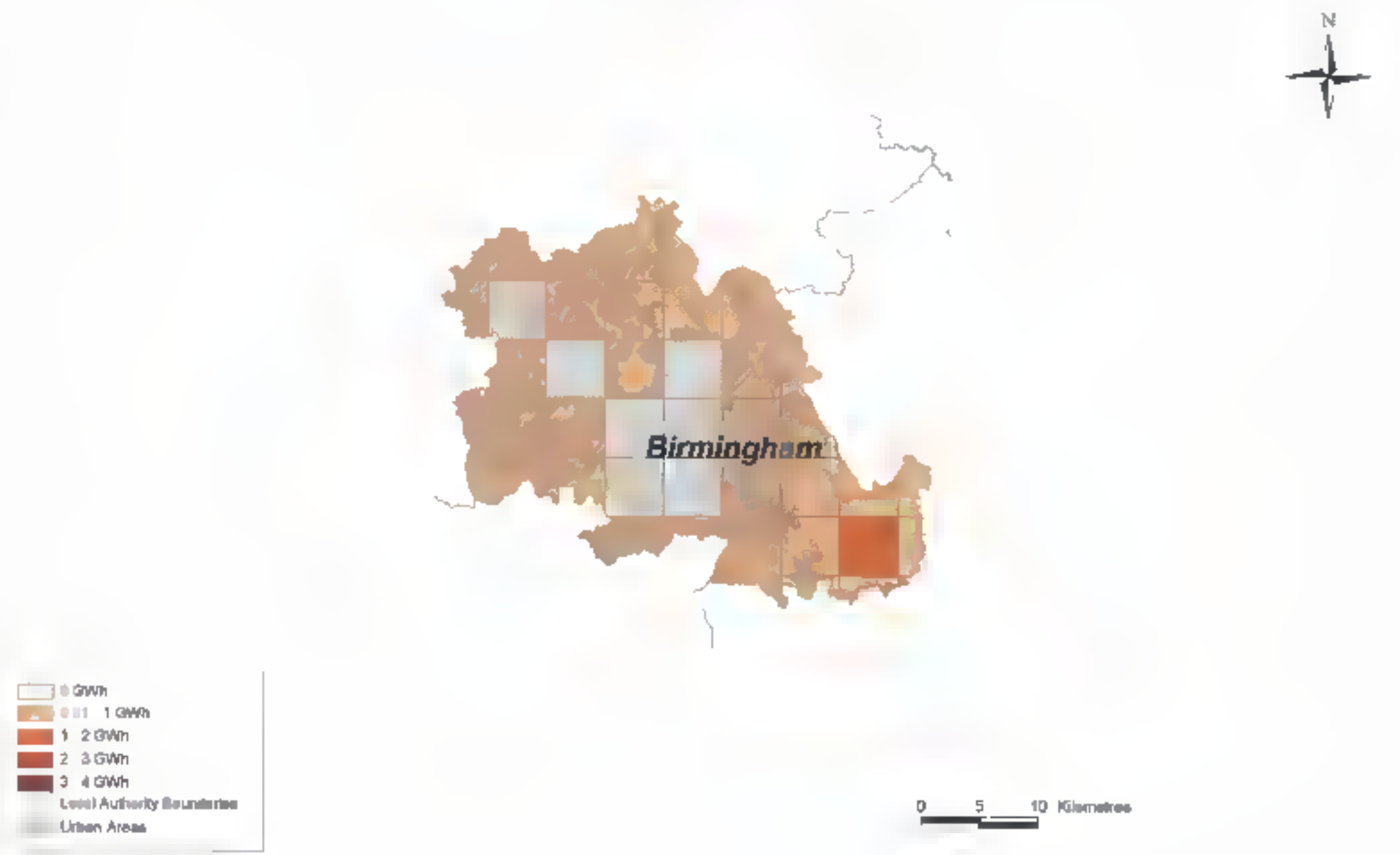
Potential Generation from Energy Crops in Metropolitan Areas

Figure D18



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Potential Generation from Agricultural Residues in Metropolitan Areas

Figure D19

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Renewable Electricity Generators in Metropolitan Areas

Figure D20

Appendix E

Glossary of Terms and Nomenclature

Nomenclature

AC	Alternating Current
AD	Anaerobic Digestion
AGLV	Areas of Great Landscape Value
AMWS	Annual Mean Wind Speed
AONB	Area of Outstanding Natural Beauty
BWEA	British Wind Energy Association
CCL	Climate Change Levy
CEGB	Central Electricity Generating Board
CHP	Combined Heat and Power
DC	Direct Current
DNC	Declared Net Capacity
DNO	Distribution Network Operator
DTI	Department of Trade and Industry
DUoS	Distribution Use of System Charge
GATT	General Agreement on Tariffs and Trade
GSP	Grid Supply Point
GWh	Giga Watt Hour
IRR	Internal Rate of Return
LEC	Levy Exemption Certificate
MAFF	Ministry of Agriculture, Fisheries and Food
MW	Mega Watt
NETA	New Electricity Trading Arrangements
NFFO	Non-Fossil Fuel Obligation
NGC	National Grid Company
NNR	National Nature Reserves
O&M	Operation and Maintenance
OFGEM	Office For Gas and Electricity Markets
PPG	Planning Policy Guidance note
PV	Photovoltaic
R&D	Research and Development
ROC	Renewables Obligation Certificate
RPG	Regional Planning Guidance
SAC	Special Areas of Conservation
SLA	Special Landscape Areas
SPA	Special Protection Areas
SRC	Short Rotation Coppice
SSSI	Sites of Special Scientific Interest
UDP	Unitary Development Plan

GLOSSARY

Areas of Great Landscape Value	Areas defined in development plans that are protected in order to conserve locally important landscapes
Areas of Outstanding National Beauty	Areas defined in development plans that are protected in order to conserve nationally important landscapes
Balancing Mechanism	A mechanism that corrects the difference between contracted and actual supply under the New Electricity Trading Arrangements
Biomass	Material that derives its energy content from the photosynthetic growth of plants
Buy Out Price	The price that a supply can pay in order to avoid supplying renewable generation under the proposed Renewable Obligation
Climate Change Levy	An additional charge to be placed on supplies of electricity to business users
Continued Growth Electricity Consumption Scenario	The electricity consumption in the region in 2010 taking into account historical trends and the best estimates available for national electricity growth
Conventional Generation	Generation plant that is fuelled by coal, natural gas, oil, or nuclear fuels
Development Plans	Plans drawn up by planning authorities to translate Government policy and guidance into planning permission decisions
Distribution Network	The network of wires and equipment that delivers electricity from Grid Supply Points to the final consumer
Distribution Network Operator	The company that owns and operates the electricity Distribution Network
Embedded Generation	Generation plant that is connected to the Distribution Network, as opposed to the National Grid

Energy Crops	Plants that are growth specifically for energy recovery
Energy Efficiency Electricity Consumption Scenario	The electricity consumption in the region following a vigorous energy efficiency programme that results in consumption returning to 1998 levels in 2010
ETSU	Formerly the Government's Energy Technology Support Unit, ETSU are now a privately owned company and are contracted to run DTI's renewable energy support programme
Green Belt	Areas defined in development plans that are protected in order to protect open spaces between settlements
Grid Supply Point	The point at which the National Grid supplied electricity to the Distribution Network
Levy Exemption Certificate	A certificate that proves that generation has been sourced from specified renewable technologies under the proposed Renewables Obligation
National Grid	The network of wires and equipment that delivers electricity from major generating plant to Grid Supply Points
Net Metering	A situation, relevant mainly to PV technologies, where the price paid for electricity generated is the same as the price of electricity bought
New Electricity Trading Arrangements	New procedures for the trading of electricity on the wholesale market are schedules to begin operating in march 2001
Organic residues	Biomass residues from materials originally grown for another purpose
Primary Energy Demand	The total energy used in the UK for all purposes
RAMSAAR sites	Important wetlands sites defined in under the RAMSAAR convention

Regional Planning Guidance	Government planning policy is translated into development plans by the use of planning guidance Regional Planning Guidance for the West Midlands (RPG 11) sets out policy objectives for the region
Renewables Obligation	The Government is currently consulting on a proposal to oblige the suppliers of electricity to source a proportion of the electricity they supply from renewable sources
Renewables Obligation Certificate	A certificate that proves that generation has been sourced from specified renewable technologies under the proposed Renewables Obligation
Special Landscape Areas	Areas defined in development plans that are protected in order to conserve locally important landscapes
Use of System Charge	A charge made by the Distribution Network Operator for a generator to send their electricity to a customer
West Midlands Region	The West Midlands Region covers the West Midlands conurbation and the counties of Worcestershire, Shropshire, Staffordshire Warwickshire and Herefordshire

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