Renewable energy capacity study for the West Midlands

A final report to Telford & Wrekin Council

March 2011

Contents

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SQW

Executive Summary

1. The UK Renewable Energy Strategy, published in 2009, demonstrated that the 2020 target of 15% renewables could be achieved and suggested that this would require 30% of electricity, 12% of heat and 10% transport to come from renewable sources. To meet this involves a step change in the provision of renewable energy capacity in the UK and action at all geographic levels to help to plan and deliver this strategy between now and 2020. In particular, most onshore renewable energy development projects across a wide range of commercial scale, small and microgeneration technologies are controlled at sub-regional and local levels. In support of this agenda and in order to provide an evidence base for local authorities, Telford and Wrekin Council, on behalf of the West Midlands' local authorities and regional stakeholders, commissioned this study to provide a Renewable Energy Capacity Study for the West Midlands. A team led by SQW, supported by Maslen Environmental and CO2Sense, was appointed to deliver the study.

2. The focus of the study has been to **present the results at local authority and regional scales** for all of the technologies assessed. The project's evidence base is highly relevant for use at the local scale in response to the requirements of national planning policy when considering the contribution of renewable energy and low carbon initiatives and opportunities for climate change mitigation and adaptation. This report is supported by 30 individual resource assessments (one for each local authority), a planning guide to facilitate local authorities in developing appropriate planning policy for renewable energy and a hydropower assessment study of the Middle Severn.

3. The evidence base provided through this study has the specific advantages of being based on up to date data including local data sources, being informed by numerous other local and sub-regional studies and being **consistent with national guidance.** That is, the renewable energy capacity assessment methodology published by DECC and CLG in 2010 (hereafter referred to as 'the DECC methodology').

4. The study has produced a comprehensive assessment of the **potential accessible renewable energy resources at 2030.** Whilst national targets are cast for 2020, and the DECC methodology refers to this date (for some, but not all technologies), it was considered that 2030 was more appropriate as it better aligns with local planning horizons and provides sufficient time for technological development and deployment of major facilities.

5. The results of this assessment by technology group and, resource/technology sub-categories for the West Midlands are provided in Table 1. The full results, data sources and accompanying assumptions are provided in the main body and annexes to this report.

6. Overall the study reveals potential accessible renewable energy resource of 54.2GW for the West Midlands as a whole. The overwhelming majority of the resource is comprised of wind (71%) followed by microgeneration (25%) with biomass and hydropower contributing much more modest proportions (3% biomass and less than 1% hydropower). Placing this within context, the most recent electricity consumption statistics available for the West Midlands

(DECC, 2009) show a total figure of 24,624GWh (equivalent to 2.8GW capacity), whilst most recent figures for renewable energy generation within the region show 188.5MW (DECC, 2009) excluding solar photovoltaics and micro wind. These figures demonstrate how the resource assessment identifies ***potential*** not ***deployable*** capacity, to which many other constraints apply. It is inconceivable that 54.2GW of renewable energy will be generated by 2030, but there is clearly significant opportunity to increase deployment well above the current level which stands at less than 200MW.

Table 1: Potential accessible renewable energy resource in the West Midlands by technology (at 2030) in MW

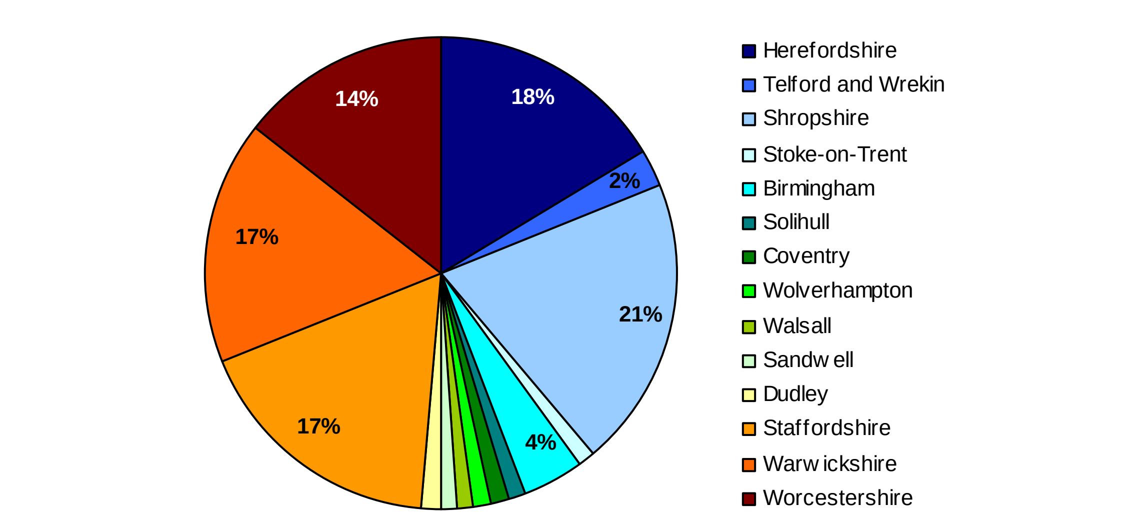
Technology group	MW by technology group	Sub Category Level 1	Sub Category Level 2	MW by sub-category
Wind (onshore)	38361	Wind – commercial scale	Wind – commercial scale	36,727
		Wind – small scale	Wind – small scale	1,634
Biomass	1204	Plant biomass	Managed woodland (electricity)	31
			Managed woodland (heat)	36
			Energy crops (electricity)	229
			Energy crops (heat)	1,321
			Waste wood (electricity)	37
			Waste wood (heat)	32
			Agricultural arisings	51
		Animal biomass (via Energy from Waste)	Wet organic waste	165
			Poultry litter	18
		Municipal Solid Waste (MSW)	Municipal Solid Waste (MSW)	209
		Commercial & Industrial Waste (C&IW)	Commercial & Industrial Waste (C&IW)	145
		Biogas	Landfill gas	11
			Sewage gas	34
		Co-firing of biomass (with a fossil fuel)	Co-firing of biomass (with a fossil fuel)	106
Hydropower	72	Small scale hydropower	Small scale hydropower	72
Microgeneration	13605	Solar	Solar Photovoltaics (PV)	1,378
			Solar Water Heating (SWH)	1,153

Technology group	MW by technology group	Sub Category Level 1	Sub Category Level 2	MW by sub-category
		Heat pumps	Ground Source Heat Pump (GSHP)	2,215
			Air Source Heat Pump (ASHP)	8,859
TOTAL				54,171[1]

Source: SQW and Maslen Environmental (Figures may not total due to rounding)l

7. A **breakdown by upper tier authority** is shown in Figure 1. Shropshire provides the largest capacity mainly due to its substantial wind resource, followed by the counties of Staffordshire, Warwickshire, Herefordshire and Worcestershire.

Figure 1: Regional renewable resource assessment by upper tier authority



Source: SQW and Maslen Environmental

8. The following table provides a brief overview of the key resource capacity identified within each upper tier authority.

Table 2: Resource assessment results and capacity by upper tier authority

Local authority	Resource assessment results	Capacity (MW)
Herefordshire	Substantial resource from large scale wind and biomass, particularly energy crops	**8,951**
Telford & Wrekin	Potential capacity largely comprised of onshore wind and microgeneration	**1,270**
Shropshire	Largest capacity for onshore wind, plus substantial biomass specifically energy crops and hydropower	**10,844**
Stoke on Trent	Relatively low capacity largely comprised of microgeneration	**594**
Birmingham	Substantial capacity from microgeneration and largest capacity for energy from waste	**2,210**
Solihull	Relatively low capacity largely comprised of microgeneration	**672**

[1] This total excludes Managed Woodland (Electricity), Energy Crops (Electricity) and Waste Wood (Heat) as the production of electricity and heat are mutually exclusive for these technologies.

Local authority	Resource assessment results	Capacity (MW)
Coventry	Relatively low capacity largely comprised of microgeneration	**681**
Wolverhampton	Relatively low capacity largely comprised of microgeneration	**626**
Walsall	Relatively low capacity largely comprised of microgeneration	**613**
Sandwell	Relatively low capacity largely comprised of microgeneration	**628**
Dudley	Relatively low capacity largely comprised of microgeneration	**781**
Staffordshire	Large wind capacity, plus microgeneration and biomass, specifically energy crops, and the only area with the potential for co-firing (106MW) due to the existence of Rugeley Power Station	**9,400**
Warwickshire	Large wind capacity plus microgeneration and biomass, specifically energy crops	**9,085**
Worcestershire	Large wind capacity plus microgeneration and biomass, specifically energy crops and the largest hydropower capacity	**7,817**

Source: SQW and Maslen Environmental

9. In addition to the key sources included within the resource assessment (onshore large and small scale wind, biomass, hydropower and microgeneration), initial assessments were undertaken with regard to the potential that could be achieved from solar farms and solar infrastructure (i.e. solar panels alongside motorways). These were undertaken more for contextual purposes and therefore have not produced definitive results that could contribute to the overall identified potential capacity.

10. The initial assessment of low carbon energy potential, that is, Combined Heat and Power or tri-generation (to include cooling) and district heating schemes, is important as this could provide a substantial opportunity for community-run schemes. Unlike most of the renewable energy categories which are assessed on the basis of the supply side (resource availability), low carbon opportunities are a function of available heat demand. The low carbon energy potential has been derived from a new strategic heat map for the West Midlands specifically created for this study. The results of this initial assessment are provided in Table 3.

Table 3: Current low carbon energy potential by upper tier authority

Local authority	Domestic Demand GWh/yr	Commercial Demand GWh/yr	Above 3000 kw/km^2 only with Combined Demand (GWh/yr)	Additional demand in the area (GWh/yr)	Total Demand (GWh/yr)	% of Total Demand
Herefordshire	**0**	**0**	**0**	**0**	**0**	**0**
Telford & Wrekin	**0**	**0**	**315**	**0**	**315**	**2**
Shropshire	**0**	**0**	**0**	**0**	**0**	**0**
Stoke on Trent	**73**	**248**	**652**	**155**	**1,128**	**7**

Local authority	Domestic Demand GWh/yr	Commercial Demand GWh/yr	Above 3000 kw/km^2 only with Combined Demand (GWh/yr)	Additional demand in the area (GWh/yr)	Total Demand (GWh/yr)	% of Total Demand
Birmingham	1,689	1,525	2404	637	6,254	40
Solihull	55	0	383	2	440	3
Coventry	446	287	441	141	1,315	9
Wolverhampton	161	127	680	83	1,052	7
Walsall	66	205	368	68	707	5
Sandwell	227	227	1,173	60	1,686	11
Dudley	111	0	866	31	1,008	7
STAFFORDSHIRE TOTAL	90	277	493	109	969	6
WARWICKSHIRE TOTAL	75	0	365	21	461	3
WORCESTERSHIRE TOTAL	0	0	226	0	226	1
WEST MIDLANDS TOTAL	2,992	2,896	8,366	1,306	15,559	100

Source: SQW and Maslen Environmental (Figures may not total due to rounding)

11. It can be seen that the theoretical potential for low carbon energy technologies in the West Midlands is 15,559GWh/yr (1.8GW), with the more densely built environment of Birmingham accounting for over 40% of this. It is worth noting that this reflects a theoretical potential for low carbon energy development. The amount that could be harnessed in reality would be dependent on a more detailed assessment of the candidate sites with economic and engineering surveys carried out to evaluate individual site suitability. An initial assessment of waste heat has also been undertaken.

12. Finally, the study also undertook a review of current electricity and gas infrastructure constraints and grid connection and access issues. This review identifies the key providers and current issues with regards to connection and access, the key one being that proximity to the grid is highest within urban areas (which are also where extensions and capacity improvements are planned), whilst the largest renewable energy resource is within the rural areas.

13. The data assembled within this study provides an extensive evidence base for local policy making and action. The primary conclusions arising from the project are that:

- **There is a very large potential accessible onshore renewable energy resource in the West Midlands region (54.2GW) although further work is required to identify the proportion of this potential that would be considered viable.** It is important that this is recognised as potential not deployable capacity.

- Because the total potential capacity is so large, Local Authorities (LAs) can play to their own strengths with regards to maximising the use of the resource available to them. There are many **different routes through which local contributions to the 2020 target of 15% energy from renewables can be reached** providing a significant degree of flexibility.

- Related to the above, **whilst commercial scale onshore wind and microgeneration provide the most abundant resource** (93% of the potential capacity identified) and deployment of only a small proportion of this resource would substantially increase the region's current level of renewable energy generation, the deployment of **large biomass developments could also make a large proportional contribution** to the absolute amount deployed in 2030.

- **The West Midlands has a theoretical capacity potential of approximately 2GW for low carbon sources -** Combined Heat and Power or tri-generation (to include cooling) and district heating schemes. This warrants further and more detailed consideration particularly for the conurbation of Birmingham which accounts for 40% of the identified potential.

- **Those areas with most potential (particularly for wind) are in the more rural areas which are at the greatest distance from grid connections.** With future plans to upgrade and improve grid connections and capacity being mainly within urban areas, capitalising upon this potential resource is likely to prove challenging.

14. This study provides an extensive and comprehensive evidence base for local authorities and regional stakeholders. However, it represents the completion of the first stage in terms of identifying theoretical potential and now needs further consideration to translate into realisable deployment potential. The study's key recommendations are set out below:

    1) As detailed above, this assessment of renewable energy resource potential has been developed through identifying the naturally occurring resource and applying some high level constraints in accordance with the national methodology. ***It does not represent the potential that could, should or is likely to be deployed.*** It is essential that the report's findings are disseminated and promoted as such. Any misinterpretation of this overarching message may be to the detriment of future renewable energy deployment within the West Midlands.

    2) The study has disaggregated results to the level of individual LAs supported by individual resource assessment datasheets (available from www.telford.gov.uk). These individual assessment results provide a starting point from which LAs should undertake further work to better understand the **opportunities and challenges that need to be addressed** to maximise renewable energy deployment within their areas. This work could consist of the following:

        - **Identification of deployment constraints and how they apply locally**. These should be filtered to focus on the constraints that are likely to have a material impact on the potential deployment of the theoretical opportunity.

These are likely to include economic viability, supply chain, transmission constraints, and planning constraints.

- **Development of deployment scenarios** to 2030 building in the above constraints to develop a range of quantified trajectories supported by qualitative narratives – these can include cautious and stretch targets as a percentage of future projected electricity demand.
- **Further work with local communities** to promote renewable energy schemes, supported by the increased focus on localism and financial support available to promote such initiatives.

3) LAs should use the accompanying planning guide to ensure that their **planning policy guidance promotes renewable energy** within identified constraints and that this is well understood by planning officers, developers and local communities. Monitoring of the deployment of renewable energy should be taken seriously to understand how well LAs are progressing against any internal targets set. As national energy and planning policy are both in a state of considerable flux, it is essential that all stakeholders keep abreast of developing policy and legislation to ensure that they are acknowledging and maximising all opportunities to maximise renewable energy deployment.

4) Related to the above, the Low Carbon Economy Programme will work closely with LAs and other stakeholders to **maximise capacity, knowledge and skills** within planning and other renewable energy practitioners. As this is still a relatively 'new' area, LAs within the West Midlands should work closely together to maximise good practice sharing and learning. Several LA groupings are working together on joint core strategies and this evidence base provides them with the opportunity to develop joint policies and maximise learning through economies of scale.

1: Introduction

Background to the study

1.1 SQW, working with Maslen Environmental and CO2Sense, was commissioned by Telford and Wrekin Council, on behalf of the West Midlands' Local Authorities (LAs) and regional stakeholders, in December 2010 to undertake a full resource assessment for onshore renewable and low carbon energy capacity for the West Midlands. The study was undertaken to achieve consistency with the 2010 national renewable capacity methodology produced for the Department for Energy and Climate Change (DECC) and the Department of Communities and Local Government (DCLG) by SQW (hereafter referred to as 'the DECC methodology').

1.2 The study was overseen by a Steering Group consisting of representatives from Telford & Wrekin Council, Advantage West Midlands, Cannock Chase Council (on behalf of the Staffordshire Steering Group), DECC, Energy Saving Trust, Environment Agency, Government Office West Midlands, Solihull Council, Sustainability West Midlands, West Midlands Councils and Worcestershire County Council. Other stakeholders contributed to the project via a workshop on 24 January 2011 to discuss initial findings with regards the resource assessment results as well as via consultations conducted by the project team during the resource assessments (further details of the workshop programme are provided in Annex D).

1.3 This report is supported by four further outputs (all of which can be accessed from www.telford.gov.uk):

- 30 individual LA focused resource assessments analysing the study's results at a more local level
- GIS data and maps for each LA demonstrating the analysis undertaken as part of the study
- A planning guide to help Local Planning Authorities (LPAs) facilitate the increased deployment of renewable energy technologies across the West Midlands
- Middle Severn hydropower study.

1.4 The West Midlands is committed to becoming a low carbon economy. In order to increase its contribution towards meeting 15% of the UK's energy needs from renewables by 2020 (as required by the UK Renewable Energy Strategy, 2009), the need for a consistent evidence base across its LAs was recognised. The specification for this study identified the evidence base as being essential to developing a targeted framework for planning and delivering renewable energy installations to support low carbon economic growth and the creation of sustainable communities.

1.5 For this study, energy capacity is assessed at 2030. The rationale for this date is that it aligns well with providing an evidence base for local planning horizons and also provides sufficient time to allow for infrastructure to be put in place in order to realise the deployable capacity.

The DECC methodology does not specify a timeline for resource assessments although for some technologies it does offer methods focusing on assessments to 2020. Other regional studies are known to use 2020 or 2030 as the assessment horizon. For some technologies, such as wind, future capacity will not necessarily increase (although load factors will improve). However, others which are more related to consumption and development, such as waste and microgeneration associated with buildings, may change relatively significantly and this can be factored in based on existing projections, for example as a result of housing growth and development.

1.6 The Steering Group also requested that assessments are provided for 2050 where there is a significant foreseeable change from 2030. Whilst the projections are less robust due to the potential for technological development and the reliance on less clear assumptions around household growth and development, these have been provided on a straight line trajectory basis for those technologies where there is evidence to suggest that the resource capacity will continue to increase or decrease from 2030 to 2050. See Annex E for further details.

1.7 The renewable energy resource assessment at the regional level is supported by 30 separate resource assessments (one for each LA) which can be accessed from www.telford.gov.uk. The resource assessment is also supported by a review of the West Midlands electricity distribution network capacity. The network capacity review provides an understanding of the areas of the electricity distribution network that do have the capacity and those which do not have the capacity to connect and accommodate electricity generated from renewable energy sources is a key requirement to facilitate deployment. This is contained in Chapter 4.

1.8 The project is linked to the West Midlands Local Authority Low Carbon Economy Programme, which is managed by Sustainability West Midlands on behalf of Improvement and Efficiency West Midlands and funded from the Climate Change Skills Fund. The Programme runs until December 2011 and supports LAs to implement current and forthcoming government policies on energy and climate adaptation, with a particular focus on the planning system. Its overarching aims are to:

- Help the leadership of LAs and local strategic partnerships realise the benefits to be gained from carbon and cost reduction, climate adaptation and green job creation through agreed plans, policies and actions.
- Facilitate the delivery of increased renewable energy supply and climate adaptation through the activities of LA planning processes.
- Allow LA planning and other key departments to engage more effectively with communities to help support or bring forward more energy saving and renewable energy schemes.

1.9 In order to support these aims, the project specification included the requirement to produce energy planning support guidance to assist LAs in their consideration of planning decisions on the use and location of low carbon and renewable energy technologies. The planning guidance is the subject of a separate report which cross-refers to the resource assessment results.

1.10 Finally, the project specification included the requirement for a more detailed hydropower resource assessment involving an analysis of the hydropower potential and constraints along the middle Severn from Shrewsbury to Worcester, which has been funded by the Environment Agency. This, again, is the subject of a separate report, but the resource assessment in this document includes a broader assessment of hydropower potential capacity.

Current renewable generation capacity and total energy demand

1.11 Current renewable energy generation within the West Midlands stands at 188.5MW[2] (sufficient to satisfy total energy demand for around 80,000 households) which is comprised of contributions from various technologies as detailed below (please note figures for solar photovoltaics and micro wind are only provided at the national level – 26.5MW and 20.4MW respectively).

Table 1-1: West Midlands Renewable Energy Generation, 2009

Hydropower	Wind & wave	Landfill gas	Sewage gas	Other biofuels	TOTAL
0.6	0.6	55	18.4	113.9	188.5

Source: DECC, 2009

1.12 Clearly Table 1-1 indicates that the West Midlands is starting from a low base in terms of realising its renewable energy potential. However, it must also be understood that this study provides an assessment of **potential** *not* **deployable** renewable energy potential. Whilst the DECC methodology requires that some headline constraints are built into the assessment (such as minimum wind speeds for onshore wind, proportion of properties suitable for microgeneration etc), it does not take into account more detailed economic, environmental and social constraints which are likely to reduce this capacity considerably. Also, it does not take into account load factors. Once these are taken into account the potential contribution of renewable sources is reduced to a greater degree than for conventional sources. For example, for onshore wind, due to varying wind speeds and other factors, it is widely accepted that only 27% of potential wind capacity will convert into electricity generated.

1.13 At the stakeholder workshop on 24 January 2011 at the Environment Agency in Solihull, it was requested that the report should identify energy demand. The purpose of this is to compare the identified renewable energy capacity with energy demand to understand what proportion of potential capacity would need to be deployed to meet the UK Renewable Energy Strategy target. The most recent electricity consumption statistics available for the West Midlands (DECC, 2009) show a total figure of 24,624 GWh (equivalent to 2.8 GW capacity). This is well below the overall identified potential renewable electricity capacity identified for the West Midlands at 2030. However, it is important to note that:

- energy demand has not been projected forward to 2030/2050 further analysis would be required in order to do so
- potential energy demand does not take account of detailed deployment factors such as economic viability, supply chain and planning constraints

[2] https://restats.decc.gov.uk/cms/assets/Uploads/Results_2009/Regional-2009/Regional-spreadsheets-2009.xls

- the actual energy generation from the potential renewable energy capacity would be affected by reduced load factors of some renewable sources.

Structure of the report

1.14 The remainder of the report is comprised of the following chapters:

- Chapter 2 explains the methodology and summarises the work undertaken at the Scoping Stage to tailor the assumptions of the DECC methodology to the regional and local characteristics of the West Midlands where required
- Chapter 3 provides the resource assessment results
- Chapter 4 details the outcome of the West Midlands electricity distribution network capacity assessment
- Chapter 5 sets out our conclusions and recommendations.

1.15 In addition there are seven annexes in a supporting document covering:

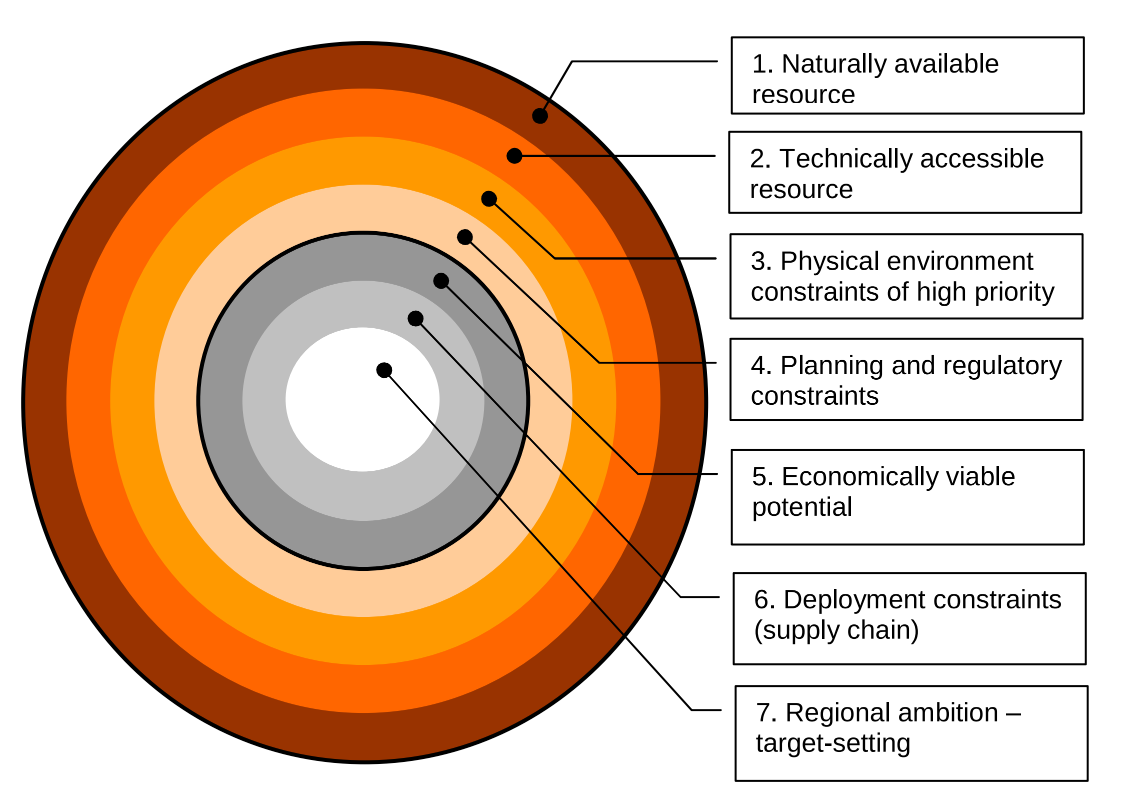
- review of local studies
- underlying assumptions
- references
- stakeholder workshops
- projections to 2050
- energy crops low scenario
- distribution network grid review annexes.

2: Methodology

Methodology for the accessible renewable energy resource assessment

2.1 Figure 2-1 sets out the key stages which the DECC methodology identifies are required to develop a comprehensive evidence base for regional renewable energy potential. The DECC methodology provides guidance on how to undertake the Stages 1 to 4 of this process. The methodology does not cover stages 5 to 7, which ultimately lead to target-setting. This study is fundamentally concerned with stages 1 to 4.

Figure 2-1: Stages for developing a comprehensive evidence base for renewable energy potential



Source: DECC, Renewable and Low Carbon Energy Capacity Methodology: Methodology for the English Regions, 2010

2.2 Table 2-1 provides a summary of the DECC assessment process which the regions are required to undertake through the stages (1 and 2) of identifying the opportunity for harnessing renewable energy resources on the basis of what is naturally available within the context of the limitations of existing technology solutions and then addressing the constraints (stages 3 and 4) to the deployment of technologies in relation to the physical environment and planning regulatory limitations, in order to identify a more realistic measure of capacity and potential.

Table 2-1: DECC Methodology

Main element	Stage and description
Opportunity analysis	
Stage 1: Naturally available resource	Regions need to explore and quantify the naturally available renewable energy resource within their geographical boundary. This will be based on data and information analysis including resource maps and inventories.
Stage 2: Technically accessible resource	Regions need to estimate how much of the natural resource can be harnessed using commercialised technology (currently available or expected to reach the market by 2030).
Constraints analysis	
Stage 3: Physical environment constraints	Regions need to explore the physical barriers on deployment such as areas where renewables schemes cannot practically be built – e.g. large scale wind turbines on roads and rivers etc. This layer of constraints will reduce the overall deployment opportunity. The analysis will be based on GIS maps and various relevant regional inventories.
Stage 4: Planning and regulatory constraints	Regions need to apply a set of constraints relevant to each renewable technology that reflects the current planning and regulatory framework, such as excluding from the assessment areas and resources which cannot be developed due to e.g. health and safety, air/water quality, environmental protection etc.

Source: SQW

2.3 For both the opportunity and constraints analyses, the methodology sets out a list of parameters and key data sources which must be used. However, there are problems adhering to the guidance set out in the DECC methodology for some of the technology assessments, as the data sources suggested within the guidance are no longer available in practice, or have been superseded by new and/or improved data. It is also important to note that the DECC methodology was designed to identify the potential for renewable energy at a regional level as opposed to at a local authority level, therefore, some of the data sources and assumptions proposed within the DECC methodology have had to be amended/refined to take account of the requirements of this study and the need to disaggregate the results down to the local level.

2.4 A detailed review has been undertaken of the requirements of the DECC methodology (that is, the proposed assumptions for undertaking the assessment of potential for each of the renewable energy technologies). This has been informed by a review of the wealth of research undertaken in the West Midlands at the regional, sub-regional and local scales concerning renewable and low carbon energy development. Annex A (of the supporting Annex document) provides a review of these studies and assesses the extent to which they are consistent (or otherwise) with the proposed assessment methodology. Annex B then provides the revised assumptions adopted in this study and explains where and why these differ from the DECC methodology.

The accessible renewable energy resource

2.5 The assessment of potential accessible resource broadly represents the opportunity for harnessing the renewable energy resource on the basis of what is naturally available and accessible. Some natural resources, for example solar and wind, are available in abundant supply. In these cases the analysis focuses on what the available technology can capture and convert into useful energy.

2.6 The resource and technological scope for the detailed assessment focuses on land-based renewable categories only, as offshore sources are not relevant to the West Midlands due to its geography. The technologies include commercial scale renewables and microgeneration (on-site and building integrated renewables).

2.7 Table 2-2 provides the full list of the renewable energy categories and sub-categories covered by the DECC methodology. These are largely consistent with the categories that have been used in previous energy assessments at the sub-national scale although few studies include precisely the same categories.

2.8 The DECC methodology applied in this project is not an exhaustive approach to renewable resource calculation. Instead it seeks to develop a broad assessment of renewable energy resources at the sub-national scale using the same process of calculation as other regions, hence allowing a like-for-like comparison across all the regions of England. As such, some of the assumptions made are broad and further detailed work has been required to determine specific characteristics of resources and/or technologies in this project. Full details of the assumptions made and alternative data sources used to address data gaps can be found in Annex B.

Table 2-2: Renewable categories covered by the study

Category	Sub-category level 1	Sub-category level 2
Wind	Wind – commercial scale	
	Wind – small scale	
Biomass	Plant biomass	Managed woodland
		Energy crops
		Waste wood
		Agricultural arisings (straw)
	Animal biomass (via Energy from Waste)	Wet organic waste
		Poultry litter
	Municipal Solid Waste (MSW)	
	Commercial & industrial Waste (C&I)	
	Biogas (Energy from Waste)	Landfill gas
		Sewage gas
	Co-firing of biomass (with a fossil fuel)	

Category	Sub-category level 1	Sub-category level 2
Hydropower	Small scale hydropower	
Microgeneration	Solar	Solar Photovoltaics (PV)
		Solar Water Heating (SWH)
	Heat pumps	Ground Source Heat Pump (GSHP)[3]
		Air Source Heat Pump(ASHP)[4]

Source: SQW

[3] This category covers horizontal trench and vertical borehole systems across the closed loop and open loop types (open loop GSHP uses ground water from an aquifer)
[4] Only those systems that achieve a coefficient of performance (COP) in line with the Renewables Directive (European Parliament and Council, 2009)

3: Potential accessible renewable resource

Introduction

3.1 As outlined in Chapter 1, developing the regional evidence base for the West Midlands has involved a sequential process. In this chapter, we cover the results of the potential accessible renewable energy resource, stages 1 to 4 as defined in the national methodology.

3.2 Table 3-1 lists the potential accessible resource for each technology that has been assessed for the West Midlands region.

Table 3-1: Potential accessible renewable energy resource in the West Midlands by technology (at 2030) in MW

Technology group	MW by technology group	Sub Category Level 1	Sub Category Level 2	MW by sub-category
Wind (onshore)	38,361	Wind - commercial scale	Wind – commercial scale	36,727
		Wind – small scale	Wind – small scale	1,634
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		Municipal Solid Waste (MSW)	Municipal Solid Waste (MSW)	209
		Commercial & Industrial Waste (C&IW)	Commercial & Industrial Waste (C&IW)	145
		Biogas	Landfill gas	11
			Sewage gas	34
		Co-firing of biomass (with a fossil fuel)	Co-firing of biomass (with a fossil fuel)	106
Hydropower	72	Small scale	Small scale	72

Technology group	MW by technology group	Sub Category Level 1	Sub Category Level 2	MW by sub-category
		hydropower	hydropower	
Microgeneration	14,171	Solar	Solar Photovoltaics (PV)	1,378
			Solar Water Heating (SWH)	1,153
		Heat pumps	Ground Source Heat Pump (GSHP)	2,215
			Air Source Heat Pump (ASHP)	8,859
TOTAL	54,171			54,171[5]

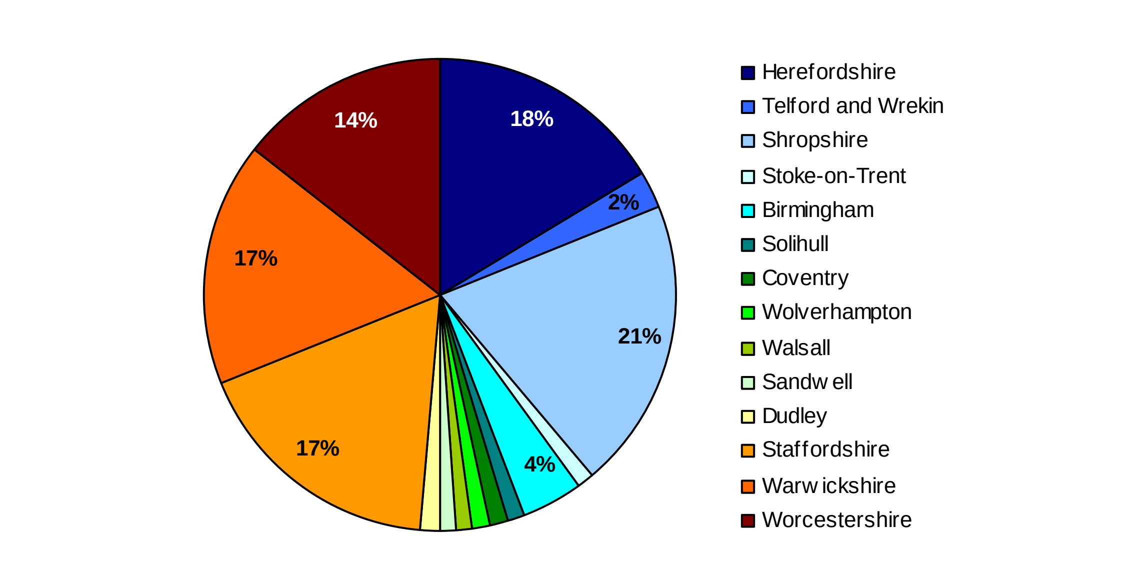
Source: SQW and, Maslen Environmental (Figures may not total due to rounding)

3.3 The above table shows that the total potential accessible renewable energy resource in the West Midlands is 54.2GW. The overwhelming majority of the resource is comprised of wind (71%) followed by microgeneration (25%) with biomass and hydropower contributing much more modest proportions (3% biomass and less than 1% hydropower).

West Midlands Accessible Resource Results – by local authority

3.4 Figure 3-1 illustrates how the share of the potential accessible renewable energy (electrical and heat) is distributed across the 14 upper tier authorities.

Figure 3-1: Regional renewable resource assessment by upper tier authority



Source: SQW and Maslen Environmental

3.5 Based on the potential accessible renewable energy resource, Shropshire district has the greatest potential with 21% of the total, largely due to its extensive wind resource. Staffordshire, Warwickshire and Herefordshire all have the potential for significant renewable energy generation, largely from wind.

[5] This total excludes Managed Woodland (Electricity) , Energy Crops (Electricity) and Waste Wood (Heat) as the production of energy and heat are mutually exclusive for these technologies.

3.6 Table 3-2, Table 3-3 and Table 3-4 detail the potential accessible resource for each of the local authorities of the West Midlands in more detail (by technology) and Figure 3-1 displays the geographic split (in MW capacity) of the total capacity from Table 3-1.

Table 3-2: Accessible energy resource for onshore wind, hydropower and microgeneration by local authority (at 2030)

Local authority	ONSHORE WIND		HYDRO-POWER	MICROGENERATION			
	Large scale (MW)	Small scale (MW)	Hydro-power (MW)	Solar Photo-voltaics (MW)	Solar Water Heating (MW)	Ground source Heat Pumps (MW)	Air Source Heat Pumps (MW)
Herefordshire	**7,786**	**237**	**15**	**67**	**53**	**97**	**388**
Telford & Wrekin	**799**	**52**	**2**	**39**	**31**	**61**	**243**
Shropshire	**8,908**	**358**	**12**	**116**	**90**	**170**	**681**
Stoke on Trent	**8**	**0**	**0.1**	**55**	**46**	**93**	**370**
Birmingham	**52**	**0**	**1**	**194**	**169**	**339**	**1,355**
Solihull	**214**	**0**	**0.1**	**41**	**36**	**72**	**286**
Coventry	**6**	**0**	**0**	**60**	**52**	**107**	**429**
Wolverhampton	**0**	**0**	**0**	**51**	**43**	**102**	**409**
Walsall	**59**	**0**	**0**	**53**	**44**	**87**	**349**
Sandwell	**25**	**0**	**0.1**	**64**	**51**	**93**	**371**
Dudley	**13**	**0**	**0.1**	**80**	**70**	**119**	**475**
Cannock Chase	40	0	0	22	18	40	160
East Staffordshire	1,209	45	2	32	25	48	191
Lichfield	1,148	45	0.4	26	21	42	167
Newcastle-under-Lyme	540	27	0.1	28	24	46	184
South Staffordshire	497	0.0	0.3	27	22	42	170
Stafford	1,901	40	2	40	34	59	237
Staffordshire Moorlands	1,208	52	3	29	22	42	170
Tamworth	23	0	0.1	15	12	25	102
STAFFORDSHIRE	**6,565**	**209**	**8**	**219**	**179**	**345**	**1,381**
North Warwickshire	915	66	1	20	16	28	114
Nuneaton & Bedworth	95	0	0	66	67	89	355
Rugby	1,336	60	0.3	26	22	41	163
Stratford-on-Avon	3,547	211	4	44	35	65	259
Warwick	776	48	1	34	29	56	225

WARWICKSHIRE	**6,669**	**384**	**6**	**190**	**168**	**279**	**1,116**
Bromsgrove	672	108	0.0	25	19	39	156
Malvern	2,035	115	9	26	23	42	168
Redditch	110	0.0	0.1	18	14	31	125
Worcester	0.1	0.0	5	20	17	38	150
Wychavon	2,259	148	8	35	30	60	241
Wyre Forest	546	23	3	24	19	41	164
WORCESTERSHIRE	**5,623**	**393**	**27**	**149**	**123**	**251**	**1,005**
Electricity (MW)	**36,727**	**1,634**	**72**	**1,378**			
Heat (MW)					**1,153**	**2,215**	**8,859**
Total (MW)	**36,727**	**1,634**	**72**	**1,378**	**1,153**	**2,215**	**8,859**

Source: SQW and Maslen Environmental (Figures may not total due to rounding)

Table 3-3: Accessible energy resource for biomass by local authority (at 2030) in MW

Local Authority	Managed woodland (E)	Managed woodland (Heat)	Energy crops (E)	Energy crops (Heat)	Waste wood (E)	Waste wood (Heat)	Agricultural arisings (Straw)	Animal biomass (Wet Organic Waste)	Animal biomass (poultry litter)	MSW[6]	C&IW[7]	Landfill gas	Sewage gas	Co-firing of biomass
Herefordshire	**6**	**7**	**42**	**241**	**1**	**1**	**9**	**26**	**12**	**7**	**4**	**0**	**0**	**0**
Telford & Wrekin	**0.2**	**0.2**	**4**	**24**	**1**	**1**	**2**	**2**	**1**	**7**	**5**	**0.3**	**0.5**	**0**
Shropshire	**9**	**11**	**70**	**405**	**2**	**1**	**12**	**54**	**4**	**13**	**6**	**0.4**	**1**	**0**
Stoke on Trent	**0.1**	**0.1**	**0.1**	**1**	**2**	**1**	**0.0**	**1**	**0**	**10**	**6**	**0**	**3**	**0**
Birmingham	**0.2**	**0.2**	**1**	**6**	**8**	**7**	**0.2**	**1**	**0**	**42**	**27**	**0**	**16**	**0**
Solihull	**0.1**	**0.1**	**1**	**6**	**2**	**1**	**1**	**1**	**0**	**8**	**5**	**0**	**0.4**	**0**
Coventry	**0.1**	**0.1**	**1**	**3**	**2**	**2**	**0.1**	**0.4**	**0**	**13**	**9**	**0**	**0**	**0**
Wolverhampton	**0.0**	**0.1**	**0.2**	**1**	**2**	**1**	**0.0**	**0.1**	**0**	**11**	**6**	**0**	**1**	**0**
Walsall	**0.1**	**0.1**	**0.2**	**1**	**2**	**1**	**0.1**	**0.3**	**0**	**10**	**7**	**0.4**	**0**	**0**
Sandwell	**0.1**	**0.1**	**0.2**	**1**	**2**	**2**	**0.0**	**0.3**	**0**	**11**	**9**	**0.4**	**0**	**0**
Dudley	**0.1**	**0.1**	**0.2**	**1**	**2**	**2**	**0.0**	**0.2**	**0**	**12**	**8**	**1**	**0**	**0**
Cannock Chase	0.2	0.2			1	0.5	0.1	0.2	0	3	2	2	0	106
East Staffordshire	1	1			1	1	1	9	0.2	4	4	0	1	0
Lichfield	1	1			1	1	2	3	0	4	3	0	0	0

[6] Municipal Solid Waste
[7] Commercial and Industrial Waste

Local Authority	Managed woodland (E)	Managed woodland (Heat)	Energy crops (E)	Energy crops (Heat)	Waste wood (E)	Waste wood (Heat)	Agricultural arisings (Straw)	Animal biomass (Wet Organic Waste)	Animal biomass (poultry litter)	MSW[6]	C&IW[7]	Landfill gas	Sewage gas	Co-firing of biomass
Newcastle-under-Lyme	1	1			1	1	0.2	5	0	4	3	0	0	0
South Staffordshire	1.0	1.2			0.5	0.4	2	4	0.4	4	2	0	2	0
Stafford	2	2			1	1	2	15	0	4	4	0.3	1	0
Staffordshire Moorlands	1	2			0.5	0.4	0.1	14	0.1	3	2	0	1	0
Tamworth	0.1	0.1			0.4	0.4	0.1	0.2	0	2	2	0.3	0	0
STAFFORDSHIRE TOTAL	**7**	**8**	**45**	**259**	**5**	**4**	**7**	**50**	**1**	**29**	**21**	**2**	**4**	**106**
North Warwickshire	0.4	0.5			1	1	2	2	0	3	2	2	0.3	0
Nuneaton & Bedworth	0.1	0.1			1	1	0.3	0.4	0	5	2	0.5	0	0
Rugby	1	1			1	1	2	4	0.1	4	2	1	0.3	0
Stratford-on-Avon	1	2			1	1	7	6	1	4	3	0	1	0
Warwick	0.4	0.5			1	1	2	1	0	4	4	1	3	0
WARWICKSHIRE TOTAL	**3**	**3**	**34**	**194**	**4**	**3**	**13**	**14**	**1**	**19**	**14**	**4**	**5**	**0**
Bromsgrove	1	1			1	0.5	0.5	3	0	3	2	0.2	0	0
Malvern	2	2			0.4	0.3	2	5	0.4	2	2	0.1	0	0
Redditch	0.2	0.2			1	1	0.1	0.4	0	2	3	0	0	0
Worcester	0.1	0.1			1	1	0.0	0.1	0	3	4	0	1	0

Local Authority	Managed woodland (E)	Managed woodland (Heat)	Energy crops (E)	Energy crops (Heat)	Waste wood (E)	Waste wood (Heat)	Agricultural arisings (Straw)	Animal biomass (Wet Organic Waste)	Animal biomass (poultry litter)	MSW[6]	C&IW[7]	Landfill gas	Sewage gas	Co-firing of biomass
Wychavon	2	2			1	1	4	5	0	4	3	1	0	0
Wyre Forest	1	1			1	0.4	0.4	1	0	3	2	0	1	0
WORCESTERSHIRE TOTAL	**5**	**6**	**31**	**178**	**4**	**3**	**7**	**15**	**0.4**	**17**	**16**	**2**	**2**	**0**
Electricity (MW)	**31**		**229**		**37**		**51**	**165**	**18**	**209**	**145**	**11**	**34**	**106**
Heat (MW)		**36**		**1,321**		**32**								
Total (MW)	**31**	**36**	**229**	**1,321**	**37**	**32**	**51**	**165**	**18**	**209**	**145**	**11**	**34**	**106**

Source: SQW and Maslen Environmental (Figures may not total due to rounding)

3.7 Taking the totals from each table provides the following overall total of accessible energy resource within each local authority and county, which is also shown as a proportion of the regional total.

Table 3-4: Total amounts of accessible renewable energy resource by local authority (MW)

Local authority	Electricity (MW)	Heat (MW)	Total (MW)	Percentage of regional total
Herefordshire	**8,213**	**787**	**8,951**	**17**
Telford & Wrekin	**915**	**360**	**1,270**	**2**
Shropshire	**9,566**	**1,359**	**10,844**	**20**
Stoke on Trent	**85**	**511**	**594**	**1**
Birmingham	**343**	**1,875**	**2,210**	**4**
Solihull	**274**	**401**	**672**	**1**
Coventry	**91**	**592**	**681**	**1**
Wolverhampton	**71**	**557**	**626**	**1**
Walsall	**132**	**483**	**613**	**1**
Sandwell	**112**	**518**	**628**	**1**
Dudley	**116**	**666**	**781**	**1**
Cannock Chase	176	219	395	0.7
East Staffordshire	1,309	266	1,573	3
Lichfield	1,443	231	1,674	3
Newcastle-under-Lyme	608	255	862	2
South Staffordshire	540	237	775	1
Stafford	2,011	333	2,342	4
Staffordshire Moorlands	1,314	237	1,549	3
Tamworth	89	140	184	0
STAFFORDSHIRE TOTAL	**7,234**	**2,177**	**9,400**	**17**
North Warwickshire	1,014	159	1,173	2
Nuneaton & Bedworth	170	511	681	1
Rugby	1,437	227	1,662	3
Stratford-on-Avon	3,830	360	4,188	8
Warwick	909	312	1,187	2
WARWICKSHIRE TOTAL	**7,327**	**1,764**	**9,085**	**17**
Bromsgrove	815	216	1,030	2
Malvern	2,199	235	2,432	4
Redditch	135	171	305	1

Local authority	Electricity (MW)	Heat (MW)	Total (MW)	Percentage of regional total
Worcester	34	206	239	0
Wychavon	2,471	334	2,802	5
Wyre Forest	636	226	830	2
WORCESTERSHIRE TOTAL	**6,489**	**1,566**	**7,817**	**14**
WEST MIDLANDS TOTAL	**40,847**	**13,616**	**54,171**	**100**

Source: SQW and Maslen Environmental (Figures may not total due to rounding)

3.8 The following sections provide further detail on the technology resource analysis including regional and local authority results, maps, commentary and key assumptions. Each technology is analysed in terms of:

- definition and scope (for broad technology categories)
- main assumptions (with further detail provided in Annex B)
- results – all of which relate to a forecast of the potential accessible resource for renewable energy production in 2030
- capacity to 2030 and 2050 – explaining how the capacity has been projected forward (with additional results concerning 2050 projections contained in Annex G for those technologies where the capacity is likely to change)
- conclusion.

Technology by technology assessment

Commercial scale wind

DEFINITION AND SCOPE

The natural energy of the wind can be harnessed to drive a generator that produces electricity.

Commercial scale wind refers to on-shore wind farm developments for commercial energy generation and supply. The majority of these developments are connected to the national grid, however private-wire schemes are also an option and some already exist. Configurations of groups of wind turbines or individual turbines are used.

Assessing the resource potential and the deployment opportunities relates primarily to the wind speeds available within the region and the ability of current technology to harness this resource in terms of turbine design (size, efficiency) and installation requirements.

Source: DECC, 2010

3.9 The UK has significant scope for wind energy generation[8]. A modern 2.5MW turbine at a suitable site will generate in the region of 6.5GWh of electricity each year, which, using the UK average household consumption figures, would generate enough electricity to power over 1,400 homes. The Committee on Climate Change's 2008 report on 'Building a Low Carbon Economy' advised that on and offshore wind together could deliver 30% of the UK's electricity by 2020.

Main Assumptions

3.10 The assessment identified areas which might provide potential opportunities for commercial wind farm development which were not subject to high level constraints. The assessment process followed the DECC methodology to identify high level constraints which are presented in Annex A and discussed below. Within the identified area, it is assumed that 9MW of capacity per km^2 can be installed. Using a density allows for micro-siting constraints, such as isolated dwellings, to be indirectly accounted for.

3.11 The first part of this assessment identified areas with sufficient wind (i.e. areas with average wind speeds above 5 m/s at 45m above ground level (agl), however at the stakeholder engagement meeting on the 24 January 2011 it was highlighted by a number of commercial wind energy developers that they only consider sites with a wind speed above 6m/s at 45m agl. Under this definition, only small areas in the West Midlands, especially within the deeper valleys in Herefordshire and Shropshire, had insufficient wind for commercial wind farm development.

3.12 High level constraints for commercial wind farm development falls into five main categories:

- urban areas and communication links (subject to buffers)
- landscape designations – National Parks and Areas of Outstanding Natural Beauty (AONBs)

[8] Source: Renewables UK

- nature designation – SSSI (Sites of Special Scientific Interest), SPAs (Special Protection Areas), SACs (Special Areas of Conservation), RAMSARs and NNR (National Nature Reserves)
- heritage designations (listed buildings, parks and gardens, etc) and
- aviation and military constraints.

3.13 Below is a detailed discussion on how some of the constraints were applied.

Landscape constraints

3.14 A conservative approach was used within the assessment in assuming that due to their landscape value, all AONB and the Peak District National Park are not available for wind farm development. This assumption has been discussed with Natural England and is in line with Peak District National Park Authority guidance[9] and the 2008 West Midlands Wind Resource Study[10]. However, commercial wind development is not always ruled out from AONBs (for example, their potential is included within the Staffordshire Renewable Energy Capacity Study[11]) and so assessing suitability for commercial wind development in AONBs in the region should be subject to further assessment. This assessment could include landscape capacity studies.

3.15 No buffer zones have been placed around landscape designations, as this is in line with PPS22[12] . However it should be noted that the development of commercial wind farms near or 'in the setting of' landscape designations could have detrimental effects on the landscape value of that area and as such will require considerable consideration within a planning application for a large scale wind energy development.

Military Constraints

3.16 As a requirement of the DECC methodology, the Ministry of Defence (MOD) was consulted regarding MOD constraints, however in the timescale available for the study, we did not receive a direct response; only very high level information was available. This means that further MOD constraints are likely to have the effect of reducing the potentially available land and are important to discuss further with the MOD when undertaking more detailed analysis.

Nature Designations

3.17 All international and national nature conservation designations were excluded as land available for commercial wind development.

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[9] Peak District National Park Authority. Supplementary Planning Guidance. Energy: Renewables and Conservation. Chapter 3 para 3.1
[10] Halcrow (April 2008), Update of Wind Resources Study for the West Midlands Region
[11] http://www.staffsmoorlands.gov.uk/site/scripts/download_info.php?downloadID=1757
[12] Communities and Local Government. Planning Policy Statement 22, Renewable Energy, para 14

3.18 In consultation with RSPB, it was deemed that no further constraints were required with respect to bird sensitivity across the region, due to the relatively low density of bird sensitive areas (as defined by RSPB bird sensitivity mapping[13]).

3.19 It can be seen from Table 3-5 that the absolute maximum technical potential for the West Midlands region is 36,727MW. Commercial wind therefore accounts for over 68% of the total accessible potential renewable resource and will be critical to the overall onshore renewables mix.

Table 3-5: Potential Accessible Commercial Wind Resource by local authority

Local authority	Area (km2)	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**865**	**7,786**	**21**
Telford & Wrekin	**89**	**799**	**2**
Shropshire	**990**	**8,908**	**24**
Stoke on Trent	**1**	**8**	**0**
Birmingham	**6**	**52**	**0.1**
Solihull	**24**	**214**	**1**
Coventry	**1**	**6**	**0**
Wolverhampton	**0.0**	**0**	**0**
Walsall	**7**	**59**	**0.2**
Sandwell	**3**	**25**	**0.1**
Dudley	**1**	**13**	**0**
Cannock Chase	4	40	0.1
East Staffordshire	134	1,209	3
Lichfield	128	1,148	3
Newcastle-under-Lyme	60	540	1
South Staffordshire	55	497	1
Stafford	211	1,901	5
Staffordshire Moorlands	134	1,208	3
Tamworth	3	23	0.1
STAFFORDSHIRE TOTAL	**729**	**6,565**	**18**
North Warwickshire	102	915	2
Nuneaton & Bedworth	11	95	0.3
Rugby	148	1,336	4
Stratford-on-Avon	394	3,547	10

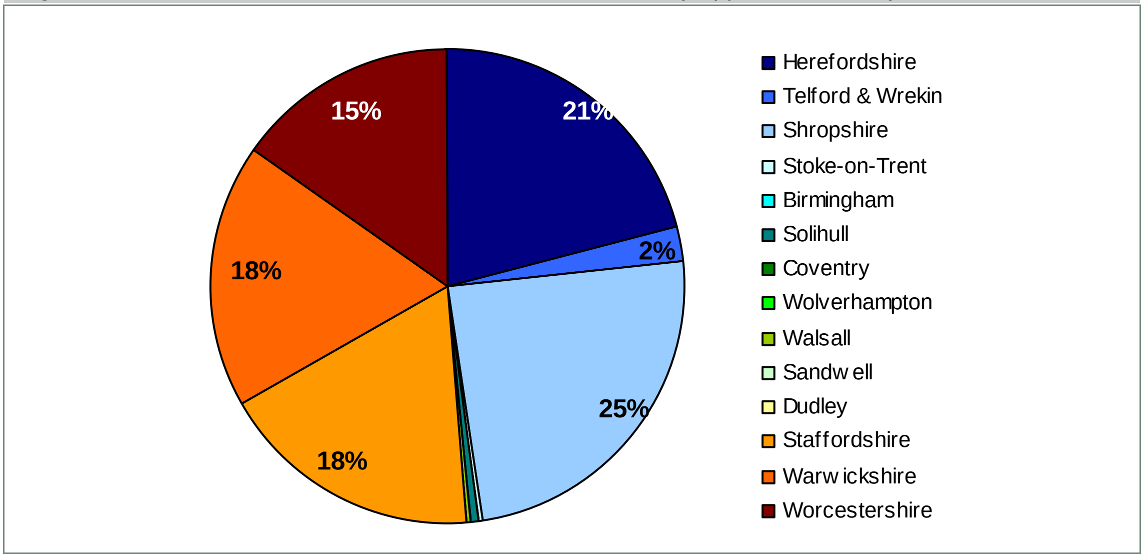
[13] RSPB (2009), Mapped and written guidance in relation to birds and onshore wind energy development in England, Research Report No 35

Local authority	Area (km2)	Electricity (MW Capacity)	Percentage of Total (%)
Warwick	86	776	2
WARWICKSHIRE TOTAL	**741**	**6,669**	**18**
Bromsgrove	75	672	2
Malvern	226	2,035	6
Redditch	12	110	0.3
Worcester	0.0	0.1	0
Wychavon	251	2,259	6
Wyre Forest	61	546	1
WORCESTERSHIRE TOTAL	**625**	**5,623**	**15**
WEST MIDLANDS TOTAL	**4,081**	**36,727**	**100**

Source: Maslen Environmental (Figures may not total due to rounding)

3.20 Figure 3-2 illustrates the potential accessible commercial wind resource by local authority. The largest commercial wind resource is to be found in Shropshire with 25% of the West Midlands' potential resource.

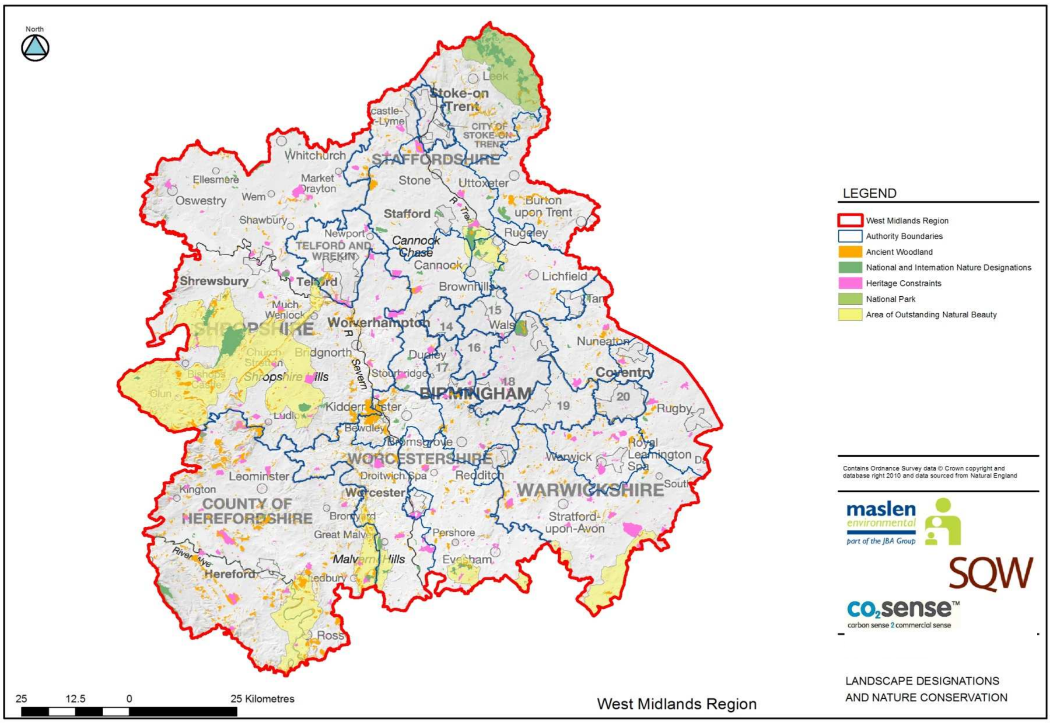
Figure 3-2: Potential Accessible Commercial Wind Resource by upper tier authority



Source: Maslen Environmental

3.21 Figure 3-3 shows a typical GIS map used in the evaluation of the potential accessible resource of commercial wind. This shows the extent of the landscape designations in the West Midlands and also illustrates other factors that have a bearing on the accessible resource.

Figure 3-3: Illustration of the landscape designations and restrictions associated with commercial scale wind



Source: Maslen Environmental

3.22 It should be noted that the resource assessment capacity values are based on all land identified as 'unconstrained' being developed for commercial wind farms. This does not take into account feasibility issues surrounding the development of this resource (e.g. planning processes, community consultation, landscape capacity, cumulative impacts, economics etc). Under the majority of future uptake scenarios, it is unlikely that all of this resource could be developed, regardless of whether it was deemed desirable to do so. This limits the utility of the capacity value to more strategic uses. However, the assessment does reveal the broad areas where the best opportunities for commercial wind farm development lie.

Capacity to 2030 and 2050

3.23 No projections are made for changes to the potential commercial wind capacity by 2030 or 2050. This assessment is based on GIS analysis to assess the amount of land available for development. Infrastructure projects, urban development and future designations of areas for landscape, heritage and nature conservation will affect the potential land available but there is no clear basis on which to quantify such changes within this study.

Conclusions

3.24 The unconstrained commercial wind resource identified using the set methodology is large, around 36,727MW installed capacity for the West Midlands. There are, however, relatively few wind farms across the region already in existence. This is likely to be due to the low average wind speeds in the region, meaning that it currently provides a limited number of excellent opportunities for large scale wind energy developers. This may change in the future as wind turbine technology improves to better harness lower wind speed conditions.

3.25 The potential resource available in the region could be further increased if development were to be allowed in National Parks and AONB in a way that preserved the landscape value of these areas. In the West Midlands, these designated areas often correspond to higher average wind speed areas too.

Small scale wind

DEFINITION AND SCOPE

A sub-category of onshore wind is the small scale wind installations which can be defined as having capacity of less than 100 kW and typically comprises single turbines. Small scale wind schemes have different characteristics to large scale developments.

The majority of small scale wind installations are ground-based developments, with only few that are building integrated (on top roofs). Small scale ground-based turbines, by their nature have lower hub/tip heights of about 15m above ground level and are considered to be viable at lower wind speeds (4.5 m/s at 10m above ground level).

Source: DECC, 2010

Main Assumptions

3.26 The assumptions made for calculating the small scale wind resource were consistent with the DECC methodology. In summary, the method consisted of identifying address points in areas of sufficient wind speed and allocating a small wind turbine to each address. Further details can be found in Annex B.

Results

3.27 Table 3-6 details the potential accessible resource of small scale wind for each authority. It can be seen that the West Midlands has a theoretical resource of 1,634MW. This resource is split almost evenly across the more rural local authorities, with the urban areas (e.g. Wolverhampton and Walsall) having virtually no small scale wind potential.

3.28 This lower potential in urban and suburban areas is a result of the high "wind scaling factors" (56% for urban areas and 67% for suburban areas) that have been applied to the wind values in accordance with the DECC methodology. These take account of the effect of buildings on reducing wind speeds in built up areas. If the scaling factors reduce the wind speed below the minimum level of 4.5m/s at 10m above ground level then there is deemed to be no viable energy resource for small scale wind (Figure 3-4). As the maximum average wind speed (NOABL dataset) in the West Midlands is 8.9m/s, all bar the windiest urban areas would be automatically ruled out as having sufficient wind for small scale wind development. Using the DECC methodology, these wind scaling factors have been applied on a Middle Lower Super Output Areas (MLSOA) basis to provide a strategic assessment of the potential resource, but in doing so some local sites with sufficient wind speed within those MLSOAs with a low overall average wind speed may have been discounted.

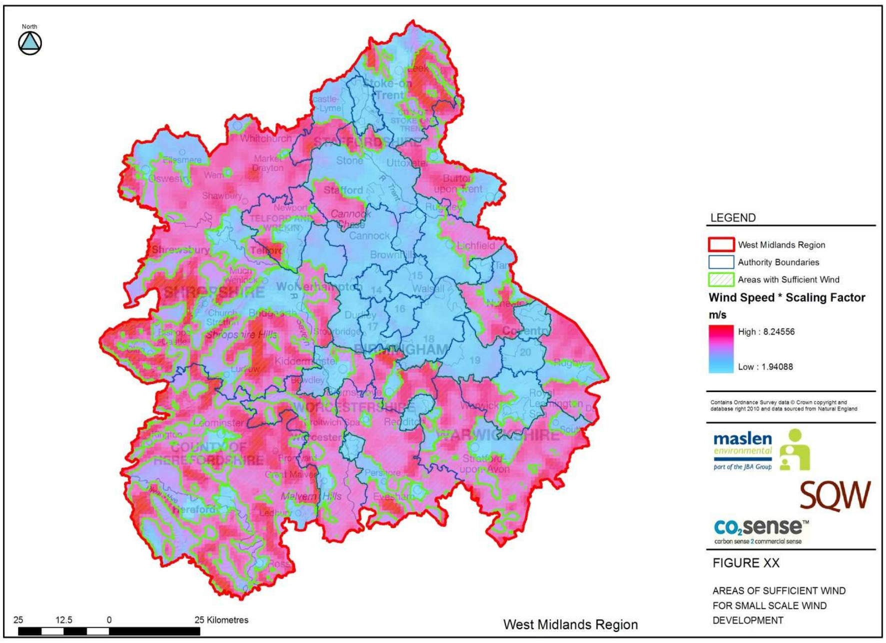
Table 3-6: Potential accessible small scale wind resource by local authority

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**237**	**15**
Telford & Wrekin	**52**	**3**
Shropshire	**358**	**22**
Stoke on Trent	**0**	**0**
Birmingham	**0**	**0**
Solihull	**0**	**0**
Coventry	**0**	**0**
Wolverhampton	**0**	**0**
Walsall	**0**	**0**
Sandwell	**0**	**0**
Dudley	**0**	**0**
Cannock Chase	0	0
East Staffordshire	45	3
Lichfield	45	3
Newcastle-under-Lyme	27	2
South Staffordshire	0	0
Stafford	40	2
Staffordshire Moorlands	52	3
Tamworth	0	0
STAFFORDSHIRE TOTAL	**209**	**13**
North Warwickshire	66	4
Nuneaton & Bedworth	0	0
Rugby	60	4
Stratford-on-Avon	211	13
Warwick	48	3
WARWICKSHIRE TOTAL	**384**	**24**
Bromsgrove	108	7
Malvern	115	7
Redditch	0	0
Worcester	0	0
Wychavon	148	9
Wyre Forest	23	1

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
WORCESTERSHIRE TOTAL	**393**	**24**
WEST MIDLANDS TOTAL	**1,634**	**100**

Source: Maslen Environmental (Figures may not total due to rounding)

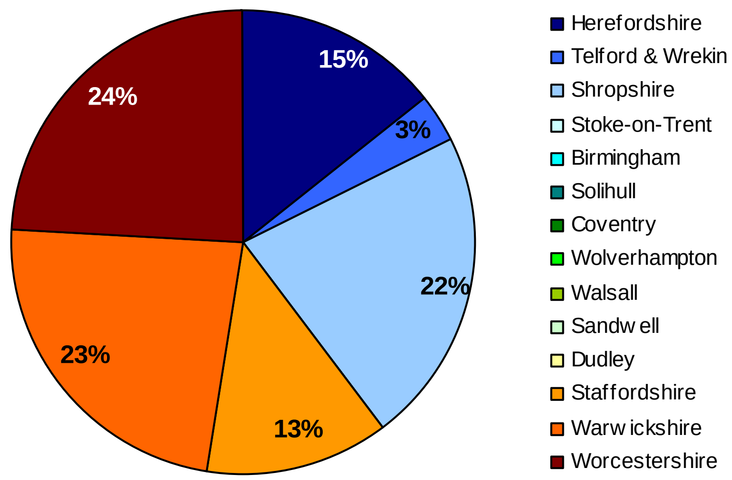
Figure 3-4: Areas of Sufficient Wind for Small Scale Wind Development



Source: Maslen Environmental

Figure 3-5 illustrates the proportion of the small scale wind resource in each authority.

Figure 3-5: Potential accessible small scale wind resource by upper tier authority



Source: Maslen Environmental

Capacity to 2030 and 2050

3.29 No projections are made for changes to the potential small scale wind capacity by 2030 or 2050. The assessment shows that most of the areas suitable for small scale wind are rural, where the amount of new development to 2030 or 2050 may be minimal, thus the change in potential capacity would also only be very small.

Conclusion

3.30 It has been calculated that the West Midlands has a small scale wind resource of 1,634MW.

Biomass

DEFINITION AND SCOPE

Biomass is a diverse category with regard to the type of available fuels, fuel conversion technology and type of energy output.

Fuels – different fuel categories have been used in the literature and a single agreed categorisation is still difficult to identify. The EU Renewable Energy Directive and the UK Biomass Strategy, however, provide more comprehensive (and legally binding) definitions for biomass fuels. Generally, biomass fuel can arise from plants (woody or grassy), animals (manure, slurry) and human activity (industrial and municipal waste). All of these options are considered in the guidance. In most cases, the useful fuel is in a solid or gaseous form. Bioliquids (i.e. liquid fuel for energy purposes other than for transport) are also available and varied, however they are not directly included in this guidance as (1), they compete with the other biomass fuel categories for natural resource (productive land or bio waste) and therefore are not an additional resource, and (2) they often need to be imported to meet commercial scale demand (e.g. palm seed oil), for which regional resource assessment in not appropriate. Biofuels (e.g. biodiesel and bio-ethanol) are those fuels used for transport purposes and are not included in this study.

Conversion technology – three main processes are currently available and used: (1) direct combustion of solid biomass, (2) pyrolysis and gasification of solid biomass and (3) anaerobic digestion of solid or liquid biomass. Biomass fuels are in principle suitable for use in combined heat and power (CHP) plants; however, its use has not been exploited to its full potential in the UK. Assessing the capacity potential for biomass CHP however will not change the total outcome for the regional biomass opportunity and therefore is not required.

Energy output – this can be in the form of electricity or heat.

Source: DECC, 2010

Plant biomass

Main Assumptions

3.31 Plant biomass consists of managed woodland, energy crops, waste wood and agricultural arisings (straw) for the generation of electricity, and woodland and energy crops for heat. Each of these resources is detailed individually under its own heading in the following sections.

3.32 The assumptions made for plant biomass are as per the DECC methodology. Assumptions about individual technologies/resources are given in the sections for each technology/resource. A detailed list of the assumptions made for all the technologies can be found in Annex B.

3.33 Although plant biomass only accounts for a small proportion of the overall renewable resource in the West Midlands, it tends to come from existing managed resources. In addition, most forms of plant biomass lend themselves to storage and can be easily transported. As such, it can be easily harnessed, managed and play an important role in local energy production.

Managed Woodland

Main Assumptions

3.34 The biomass resource from managed woodland was assessed in terms of its technical potential for both electricity and heat production as two separate scenarios, assuming direct combustion of the resource.

3.35 The results were based on two main data sources: the Forestry Commission's Woodfuel Resource Tool, which supplied data at a regional level in oven dried tonnes (odt) of biomass from different grades and types of wood; and the Forestry Commission's National Inventory of Woodland and Trees for the area of managed woodland in each county (this was then disaggregated to district level using total land area in each district as a proxy). The final estimate of the quantity of biomass in each local area was based on the percentage split of managed woodland area within each local authority area.

3.36 The assessment was based on Option 1 of the DECC methodology, as Option 2 was unavailable given the timeframes of the study. Option 2 suggests bringing forward the National Forest Inventory work programme which is currently being undertaken by the Forestry Commission and involves mapping all woodland in Great Britain down to 0.5Ha. The likely date for completion of this inventory is now 2014 (although reports may be available earlier), meaning that the data could not be used for this study. Although the National Inventory for Woodland and Trees is based on data collected from 1995 to 1999 and is soon to be replaced, it is currently the most up-to-date and complete dataset. It is important to note, however, that the new data could have a potentially significant impact on the estimate of the amount of biomass from managed woodland in the area.

3.37 To convert to useful energy, a benchmark of 6,000 odt per year of biomass per 1 MW of electricity capacity was applied, along with calorific values suggested by DECC and outlined in Annex B. For the heat assessment, 80 per cent plant efficiency was assumed and a 45 per cent capacity factor applied (the ratio of the actual output of a power plant over a period of time and its output if it had operated at full nameplate capacity the entire time). Diverging from the DECC methodology, the capacity factor applied is thought to more realistically reflect how often biomass boilers are used (from the Carbon Trust's guide on biomass boilers published in 2009).

3.38 Environmental and technical constraints have already been applied by the Forestry Commission in their Woodfuel Resource Tool to determine the tonnes of biomass available for annual sustainable production. No further constraints of this nature were therefore applied. To take account of competing uses (both for electricity and heat generation), it was assumed that only 10 per cent of the Forestry Commission resource could be used based on estimates provided by the Forestry Commission's '*Woodfuel in Britain: Main Report*'. It was assumed that all the private sector biomass resource could be used for energy generation.

3.39 A more detailed list of the assumptions for managed woodland can be found in Annex B.

Results

3.40 Table 3-7 shows the accessible managed woodland resource for both electricity generation (31 MW) and heat generation (36 MW) respectively from the West Midlands. Within the West Midlands, Shropshire and Herefordshire have around 30 per cent and 20 per cent of the managed woodland resource for the generation of electricity respectively, consistent with the rural characteristics of these areas.

Table 3-7: Potential accessible managed woodland resource for electricity and heat generation by local authority

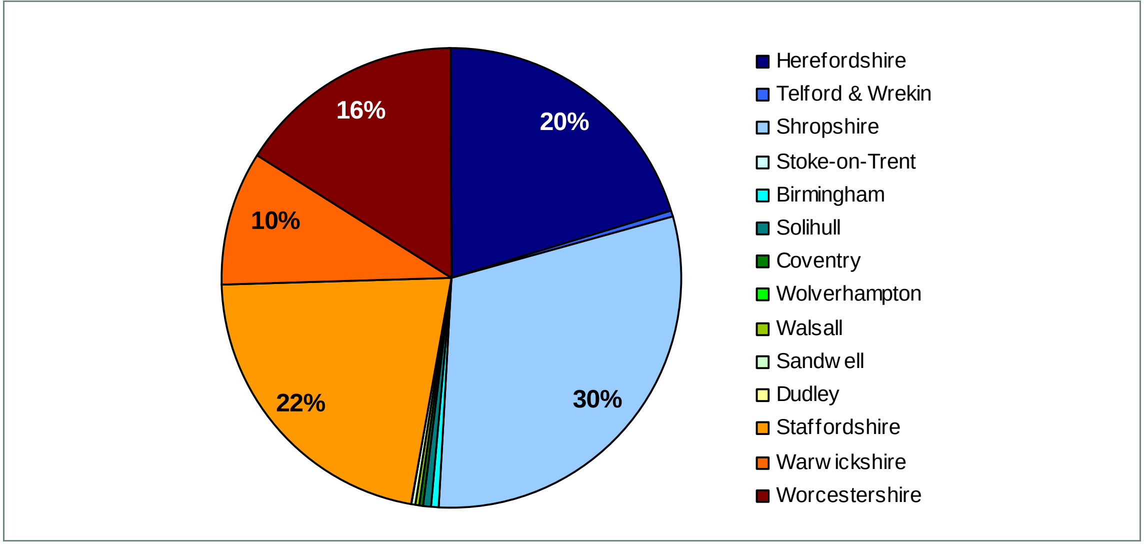
Local authority	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Herefordshire	**6**	**20**	**7**	**20**
Telford & Wrekin	**0.2**	**1**	**0.2**	**1**
Shropshire	**9**	**30**	**11**	**30**
Stoke on Trent	**0.1**	**0.2**	**0.1**	**0.2**
Birmingham	**0.2**	**1**	**0.2**	**1**
Solihull	**0.1**	**0.4**	**0.1**	**0.4**
Coventry	**0.1**	**0.2**	**0.1**	**0.2**
Wolverhampton	**0.0**	**0.2**	**0.1**	**0.2**
Walsall	**0.1**	**0.2**	**0.1**	**0.2**
Sandwell	**0.1**	**0.2**	**0.1**	**0.2**
Dudley	**0.1**	**0.2**	**0.1**	**0.2**
Cannock Chase	0.2	1	0.2	1
East Staffordshire	1	3	1	3
Lichfield	1	3	1	3
Newcastle-under-Lyme	1	2	1	2
South Staffordshire	1.0	3	1.2	3
Stafford	2	5	2	5
Staffordshire Moorlands	1	5	2	5
Tamworth	0.1	0.3	0.1	0.3
STAFFORDSHIRE TOTAL	**7**	**22**	**8**	**22**
North Warwickshire	0.4	1	0.5	1
Nuneaton & Bedworth	0.1	0.4	0.1	0.4
Rugby	1	2	1	2
Stratford-on-Avon	1	5	2	5
Warwick	0.4	1	0.5	1
WARWICKSHIRE TOTAL	**3**	**10**	**3**	**10**

Local authority	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Bromsgrove	1	2	1	2
Malvern	2	5	2	5
Redditch	0.2	1	0.2	1
Worcester	0.1	0.3	0.1	0.3
Wychavon	2	6	2	6
Wyre Forest	1	2	1	2
WORCESTERSHIRE TOTAL	**5**	**16**	**6**	**16**
WEST MIDLANDS TOTAL	**31**	**100**	**36**	**100**

Source: SQW (Figures may not total due to rounding)

3.41 Figure 3-6 illustrates the proportion of Managed Woodland accessible resource for electricity and heat generation in each local authority. It should be noted that these proportions are the same for both technologies – they have not been totalled.

Figure 3-6: Potential accessible managed woodland resource (for electricity & heat generation) by upper tier authority



Source: SQW

Capacity to 2030 and 2050

3.42 For the future energy capacity from managed woodland in 2030 and 2050, it was assumed that an increase of 0.5 per cent per annum would occur, based on discussions with the Forestry Commission.

Conclusion

3.43 Shropshire has around 30% of the West Midlands' accessible resource of managed woodland, with Herefordshire accounting for 20%. Managed woodland only accounts for less than 0.1% of the total accessible renewable electricity generation in the West Midlands. However, it is a resource that can be easily managed, transported and stored; giving it added value despite its small size.

Energy Crops

Main Assumptions

3.44 The DECC methodology sets out generation of estimates for heat and electricity from biomass energy crops under three scenarios - high, medium and low as follows:

- High – assumes that all available arable land and pasture will be planted with energy crops
- Medium – assumes that all abandoned land and pasture will be planted with energy crops
- Low – assumes that new crops will only be planted to the extent of submitted applications to the Energy Crop Scheme.

High Scenario

3.45 The high scenario, as defined in the DECC methodology, is acknowledged to be neither possible nor desirable due to other uses of the land (such as food production) that are not considered within the assessment. As such this assessment study does not include quantification of this scenario

Medium Scenario

3.46 The medium scenario used information from DEFRA's Agricultural and Horticultural Census (2009). In line with other regional assessments, land cover defined as bare fallow and temporary grassland was deemed 'land no longer needed for food production' and therefore could be utilised for energy crop production. The data were not available in a GIS data format and as such, it was not possible to determine the mapped extent of land under this scenario. The data were presented to upper tier authority level so it was not practical to give specific values for each local authority. The data were also aggregated for authorities with only a small amount of commercial agricultural land such as Wolverhampton, Sandwell, Walsall and Dudley.

Low Scenario

3.47 The low scenario assumes that all existing energy crop sites continue into the future. The results of this scenario were considered to be very low in comparison to the medium scenario and therefore have not been used for the overall assessment. For completeness, the results for the scenario are presented in Annex F.

3.48 Due to the comments on the various scenarios detailed above, the results of this assessment have been based on the medium scenario.

3.49 Natural England guidance on landscape impacts in the West Midlands has also been reviewed[14] as part of the assessment. The guidance shows that in the nineteen Joint Character Areas (JCAs) there are a range of generic landscape characteristics on which energy crops

[14] http://www.defra.gov.uk/foodfarm/growing/crops/industrial/energy/opportunities/wm.htm

could have a potentially positive, neutral, or adverse effect. These effects should be taken into account when assessing the impacts of individual schemes (including cumulative impacts).

3.50 Further details of the assumptions used in the calculations can be found in Annex B.

Results

3.51 Table 3-8 shows the accessible energy crops resource for both electricity generation and heat (under the medium scenario as defined in the DECC methodology, detailed above). It can be seen that the West Midlands region has an accessible energy crops resource of 229MW for electricity generation and 1,321MW for heat. The results under the low scenario are presented in Annex F.

3.52 The assessment shows that Shropshire has the greatest potential for energy crops followed by other more rural local authority districts within the West Midlands. Several authorities have considerably reduced potential, primarily due to their more urban make-up.

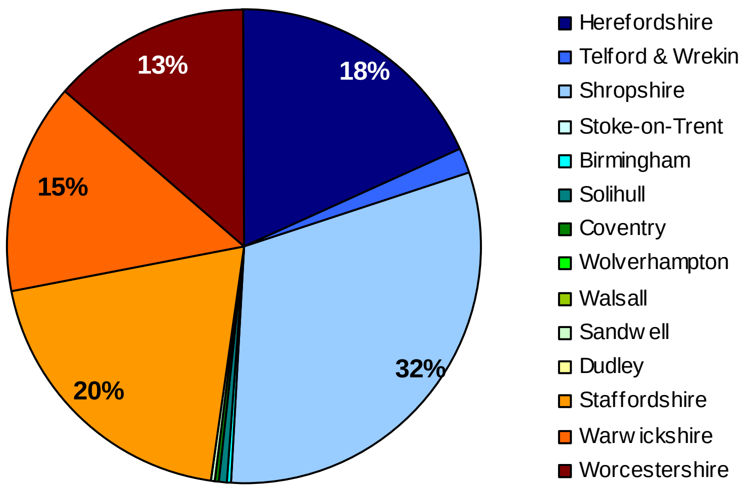
Table 3-8: Potential accessible energy crops resource for electricity and heat generation by local authority

Local authority	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Herefordshire	42	18	241	18
Telford & Wrekin	4	2	24	2
Shropshire	70	31	405	31
Stoke on Trent	0.1	0	1	0
Birmingham and Solihull	2	1	12	1
Coventry	1	0.2	3	0.2
Wolverhampton, Sandwell, Walsall and Dudley	0.1	0.3	4	0.3
STAFFORDSHIRE TOTAL	45	20	259	20
WARWICKSHIRE TOTAL	34	15	194	15
WORCESTERSHIRE TOTAL	31	13	178	13
WEST MIDLANDS TOTAL	229	100	1,321	100

Source: Maslen Environmental (Figures may not total due to rounding)

3.53 Figure 3-7 shows the proportion of the West Midlands' energy crop potential for electricity generation and heat contributed by each of the local authorities. The proportions are the same for both – figures have not been totalled.

Figure 3-7: Potential accessible energy crops resource (for electricity & heat generation) by upper tier local authority



Source: Maslen Environmental

Capacity to 2030 and 2050

3.54 The DECC methodology states that yields from energy crops could increase by 10% to 2020, this assumption has also been used as an indication of capacity available to 2030. The medium scenario projections to 2050 are much more difficult to determine; fluctuations are expected, but cannot be accurately predicted, as this scenario is based on 'land not in food production' being made available for energy crop production. Changes to this scenario (up to 2050) are very much dependent on agro-economic and climate change factors amongst others. Therefore no predictions of potential capacity to 2050 have been made.

Conclusion

3.55 Using the DECC methodology medium scenario for energy crops, the West Midlands has an accessible energy crop resource of 229MW for electricity generation and 1,321MW for heat at 2030. Although energy crops account for a relatively small part of the overall renewable energy resource in the West Midlands, they offer a potential opportunity for exploitation in many of the more rural authorities.

Waste Wood

Main Assumptions

3.56 The potential for commercial and industrial waste wood from direct combustion was assessed for electricity and heat conversion scenarios. The DECC methodology suggested using data from the Sawmill report published by the Forestry Commission with throughput data. Unfortunately this report is no longer published. Instead, the WRAP Report '*Wood Waste Market in the UK*' from August 2009 was used as this gave the most comprehensive and up to date information waste wood at a regional level. A proxy of employee numbers in each local authority was then used to derive local authority figures. All the waste wood categories from the report were included except for Municipal Solid Waste (MSW) wood, since this was already accounted for in the MSW resource category. As a result of competition for the use of waste wood; for example, for the manufacturing of wood panels using co-product, 50 per cent of the total resource was excluded to arrive at constrained capacity figures.

3.57 The rest of the assumptions were as per the DECC methodology. Further details of the assumptions made can be found in Annex B.

Results

3.58 Table 3-9 shows the potential accessible resource for waste wood in the West Midlands region. It can be seen that there is 37MW of waste wood potential for electricity generation with significant opportunities in Birmingham and Staffordshire in particular.

Table 3-9: Potential accessible waste wood resource by local authority, 2030

Local authority	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Herefordshire	**1**	**3**	**1**	**3**
Telford & Wrekin	**1**	**3**	**1**	**3**
Shropshire	**2**	**5**	**1**	**5**
Stoke on Trent	**2**	**4**	**1**	**4**
Birmingham	**8**	**21**	**7**	**21**
Solihull	**2**	**4**	**1**	**4**
Coventry	**2**	**6**	**2**	**6**
Wolverhampton	**2**	**4**	**1**	**4**
Walsall	**2**	**4**	**1**	**4**
Sandwell	**2**	**5**	**2**	**5**
Dudley	**2**	**5**	**2**	**5**
Cannock Chase	1	2	0.5	2
East Staffordshire	1	2	1	2
Lichfield	1	2	1	2
Newcastle-under-Lyme	1	2	1	2
South Staffordshire	0.5	1	0.4	1
Stafford	1	3	1	3
Staffordshire Moorlands	0.5	1	0.4	1
Tamworth	0.4	1	0.4	1
STAFFORDSHIRE TOTAL	**5**	**14**	**4**	**14**
North Warwickshire	1	2	1	2
Nuneaton & Bedworth	1	2	1	2
Rugby	1	2	1	2
Stratford-on-Avon	1	2	1	2

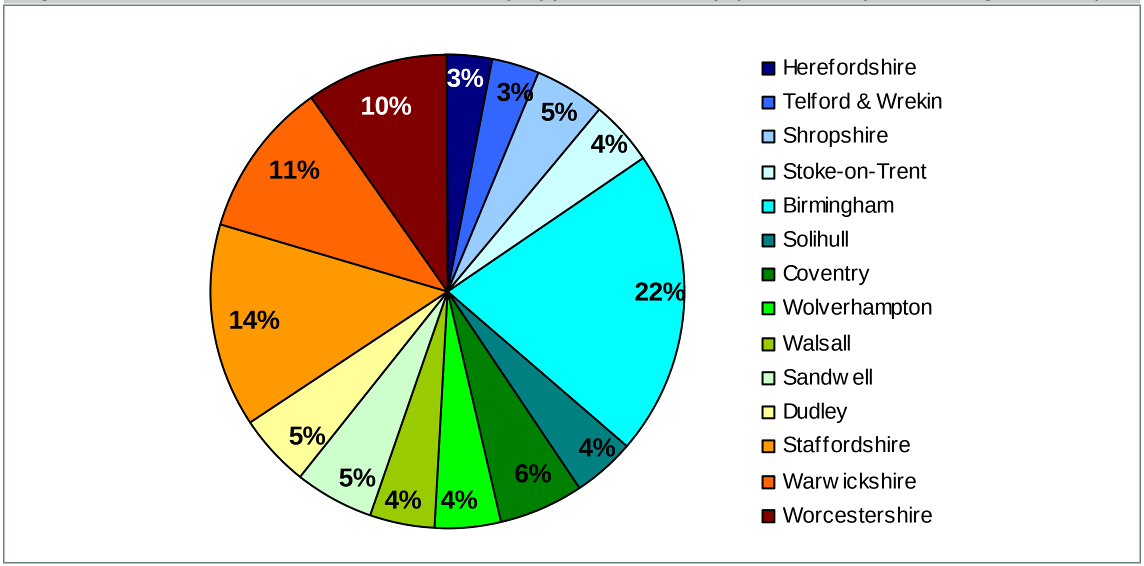
Local authority	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Warwick	1	3	1	3
WARWICKSHIRE TOTAL	**4**	**11**	**3**	**11**
Bromsgrove	1	1	0.5	1
Malvern	0.4	1	0.3	1
Redditch	1	2	1	2
Worcester	1	2	1	2
Wychavon	1	2	1	2
Wyre Forest	1	1	0.4	1
WORCESTERSHIRE TOTAL	**4**	**10**	**3**	**10**
WEST MIDLANDS TOTAL	**37**	**100**	**32**	**100**

Source: SQW (Figures may not total due to rounding)

3.59 Waste wood accounts for less than 0.1% of the renewable energy resource in the West Midlands.

3.60 Figure 3-8 illustrates the proportion of the waste wood resource in each upper tier authority.

Figure 3-8: Potential accessible waste wood by upper tier authority (for electricity and heat generation)



Source: SQW

Capacity to 2030 and 2050

3.61 As recommended by the DECC methodology projections to 2030 and 2050 were based on an assumed increase of feedstock of 1% per year.

Conclusion

3.62 The West Midlands has 30MW of waste wood renewable potential. Although waste wood provides a small proportion of the overall renewable potential in the West Midlands, it is an easily managed, transported and stored resource that can be easily exploited in any of the local authorities. Waste wood has been overlooked in the past and sent to landfill mainly because it often arises as part of a mixed waste stream and is not separated out.

Agricultural Arisings (straw)

Main Assumptions

3.63 The potential for agricultural arisings was calculated assuming direct combustion of the resource as this is seen as the most economically viable approach for conversion to useful energy. All assumptions and data sources were in line with the DECC methodology, details of which can be found in Annex B.

Results

3.64 Table 3-10 shows the accessible resource for agricultural arisings (straw) with a total renewable electricity resource of 51 MW. The county of Warwickshire has the largest proportion of the straw resource with around 26 per cent.

Table 3-10: Potential accessible agricultural arising (straw) resource, 2030

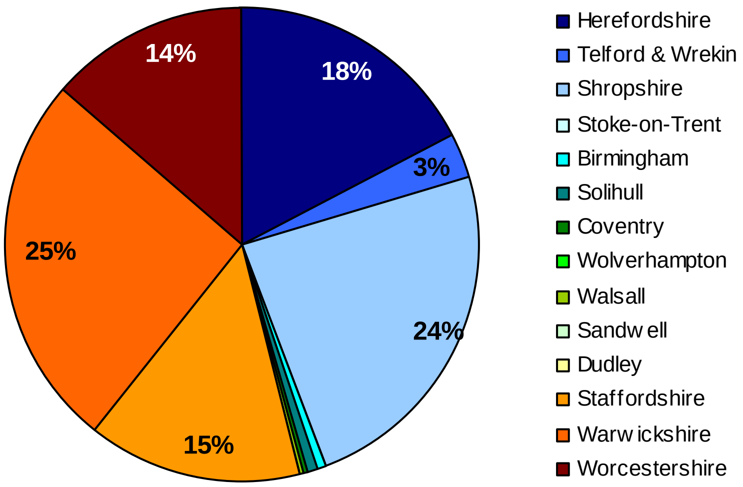
Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**9**	**18**
Telford & Wrekin	**2**	**3**
Shropshire	**12**	**24**
Stoke on Trent	**0**	**0**
Birmingham	**0.2**	**0**
Solihull	**1**	**1**
Coventry	**0.1**	**0**
Wolverhampton	**0**	**0**
Walsall	**0.1**	**0**
Sandwell	**0**	**0**
Dudley	**0**	**0**
Cannock Chase	0.1	0
East Staffordshire	1	2
Lichfield	2	4
Newcastle-under-Lyme	0.2	0
South Staffordshire	2	3
Stafford	2	4
Staffordshire Moorlands	0.1	0
Tamworth	0.1	0
STAFFORDSHIRE TOTAL	**7**	**15**

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
North Warwickshire	2	4
Nuneaton & Bedworth	0.3	1
Rugby	2	5
Stratford-on-Avon	7	14
Warwick	2	3
WARWICKSHIRE TOTAL	**13**	**26**
Bromsgrove	0.5	1
Malvern	2	5
Redditch	0.1	0
Worcester	0	0
Wychavon	4	7
Wyre Forest	0.4	1
WORCESTERSHIRE TOTAL	**7**	**14**
WEST MIDLANDS TOTAL	**51**	**100**

Source: SQW (Figure may not total due to rounding)

3.65 Figure 3-9 shows the proportion of the straw resource potential by upper tier authority.

Figure 3-9: Potential accessible agricultural arisings (straw) by upper tier authority



Source: SQW

3.66 Although the agricultural arisings resource represents a very small proportion of the total renewable electricity resource for the region, it constitutes an easily accessible resource that is already well managed. However, by its nature, straw production is very seasonal and is relatively expensive to store and transport due to its comparatively bulky nature and low calorific value. In addition, straw prices fluctuate considerably due to competing uses and depend on seasonal weather. This could be a particular issue in the West Midlands, which often has to import straw from outside the region due to demand for wheat straw to be used as bedding for cattle. In comparison to other regions in the UK, however, the West Midlands as a whole has a positive straw balance[15], that is there is straw available after deduction of animal bedding requirements. As such, while straw is only likely to supplement other biomass source plants, it could still play a part in electricity generation in the West Midlands.

Capacity to 2030 and 2050

3.67 It was assumed that the area farmed for straw will remain constant to 2030 and 2050 as there is no clear basis upon which to factor in a change.

Conclusion

3.68 Agricultural arisings (straw) has regional renewable resource potential of 51MW with Shropshire and Warwickshire providing around a quarter each of the region's potential.

Animal biomass

Main Assumptions

3.69 The potential renewable resources in the animal biomass category of the DECC methodology consist of wet organic waste and poultry litter. Wet organic waste includes manure and slurry from cattle and pigs along with commercial and industrial (C&I) food and drink waste. Due to the moisture content of this resource, it is assumed that energy is generated through anaerobic digestion, while the poultry litter assessment is based on direct combustion. Each of these resources is detailed individually under its own heading in the following sections.

3.70 The assumptions made for animal biomass are as per the DECC methodology.

Results

3.71 Both potential resources are used to produce electricity and account for 184MW of electricity generation capacity. The majority of this (90 per cent) of this comes from wet organic waste.

3.72 Table 3-11 details the results for each LA. It can be seen that Shropshire has the biggest animal biomass resource with over 58MW, 32 per cent of the entire region's capacity. Herefordshire and Staffordshire have most of the remaining potential resource with only a small proportion (2 per cent) in the more urban sub-regions.

Table 3-11: Potential accessible animal biomass resource, 2030

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**38**	**21**
Telford & Wrekin	**3**	**2**
Shropshire	**58**	**32**
Stoke on Trent	**1**	**0.3**
Birmingham	**1**	**0.5**

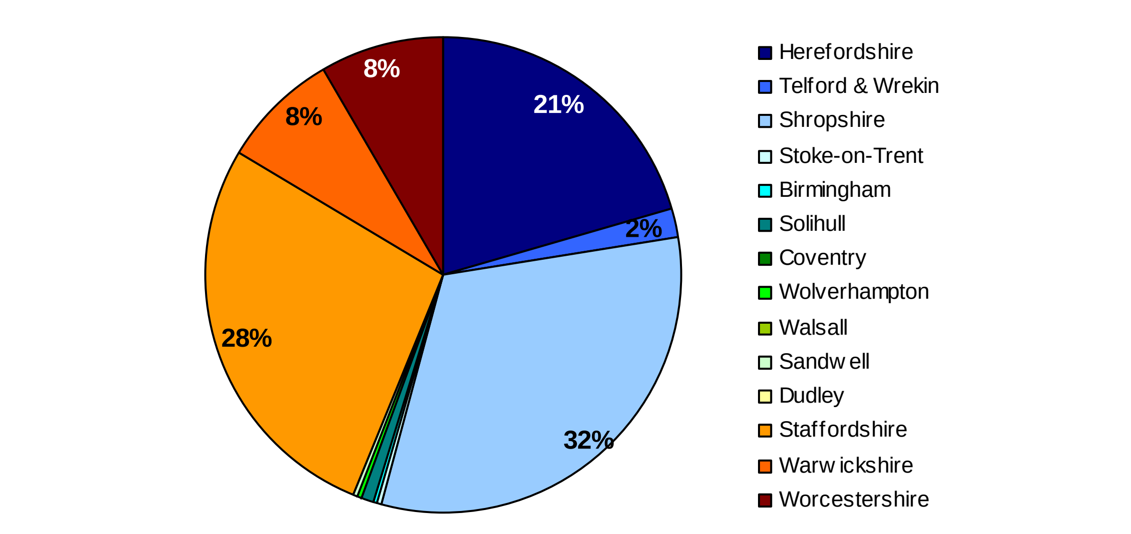
[15] NNFCC, 2008. *National and regional supply/demand balance for agricultural straw in Great Britain*

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Solihull	**1**	**1**
Coventry	**0.4**	**0.2**
Wolverhampton	**0.1**	**0.1**
Walsall	**0.3**	**0.2**
Sandwell	**0.3**	**0.2**
Dudley	**0.2**	**0.1**
Cannock Chase	0.2	0.1
East Staffordshire	9	5
Lichfield	3	1
Newcastle-under-Lyme	5	3
South Staffordshire	4	2
Stafford	15	8
Staffordshire Moorlands	14	8
Tamworth	0.2	0.1
STAFFORDSHIRE TOTAL	**51**	**28**
North Warwickshire	2	1
Nuneaton & Bedworth	0.4	0.2
Rugby	4	2
Stratford-on-Avon	7	4
Warwick	1	1
WARWICKSHIRE TOTAL	**15**	**8**
Bromsgrove	3	2
Malvern	6	3
Redditch	0.4	0.2
Worcester	0.1	0.1
Wychavon	5	3
Wyre Forest	1	1
WORCESTERSHIRE TOTAL	**15**	**8**
WEST MIDLANDS TOTAL	**184**	**100**

Source: SQW (Figures may not total due to rounding)

3.73 Figure 3-10 illustrates the proportion of animal biomass resource in each local authority.

Figure 3-10: Potential accessible animal biomass resource by upper tier authority



Source: SQW

Conclusion

3.74 Animal biomass accounts for 184 MW of potential renewable electricity generation in the West Midlands, of which almost a third is located in Shropshire.

Wet Organic Waste

Main Assumptions

3.75 Some of the data sources recommended in the DECC methodology were not available. For manure and slurry data, DEFRA's 2009 data was used to get the number of livestock in each region. This was then multiplied by a standard animal waste factor obtained from the Biomass Energy Centre. For food and drink waste data the ADAS National Study into Commercial and Industrial Waste Arisings, 2009 was used. More detailed information about the assumptions can be found in Annex B.

Results

3.76 Table 3-12 shows the results for wet organic waste for the West Midlands broken down by local authority.

Table 3-12: Potential accessible wet organic waste resource, 2030

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	26	16
Telford & Wrekin	2	1
Shropshire	54	33
Stoke on Trent	1	0.3
Birmingham	1	1
Solihull	1	1

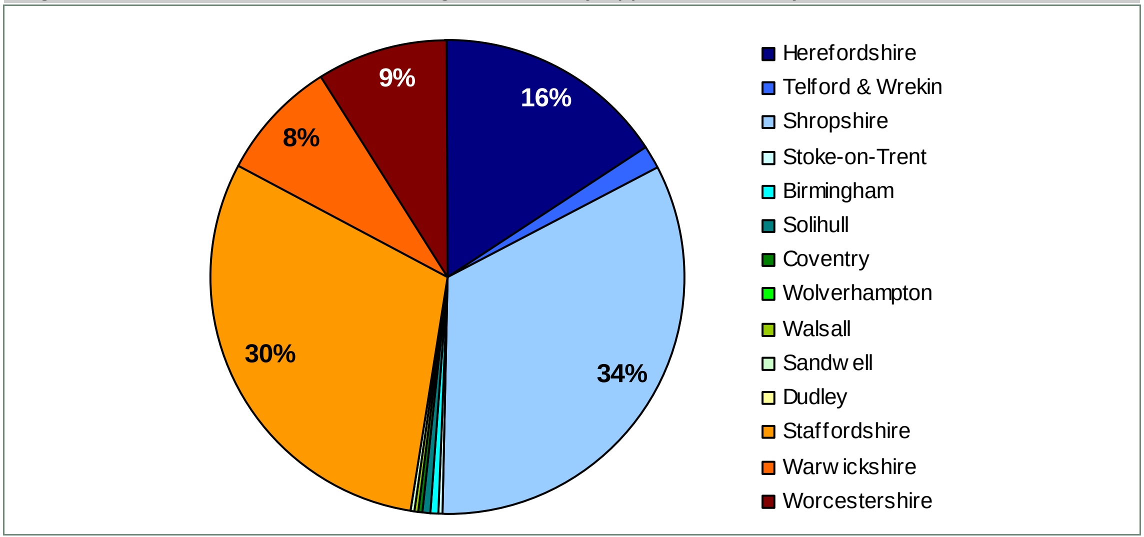
Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Coventry	**0.4**	**0.3**
Wolverhampton	**0.1**	**0.1**
Walsall	**0.3**	**0.2**
Sandwell	**0.3**	**0.2**
Dudley	**0.2**	**0.1**
Cannock Chase	0.2	0.1
East Staffordshire	9	6
Lichfield	3	2
Newcastle-under-Lyme	5	3
South Staffordshire	4	2
Stafford	15	9
Staffordshire Moorlands	14	8
Tamworth	0.2	0.1
STAFFORDSHIRE TOTAL	**50**	**30**
North Warwickshire	2	1
Nuneaton & Bedworth	0.4	0.2
Rugby	4	2
Stratford-on-Avon	6	4
Warwick	1	1
WARWICKSHIRE TOTAL	**14**	**8**
Bromsgrove	3	2
Malvern	5	3
Redditch	0.4	0.2
Worcester	0.1	0.1
Wychavon	5	3
Wyre Forest	1	1
WORCESTERSHIRE TOTAL	**15**	**9**
WEST MIDLANDS TOTAL	**165**	**100**

Source: SQW (Figures may not total due to rounding)

3.77 The West Midlands has 165MW of wet organic waste potential resource with Shropshire accounting for a significant proportion of this. Staffordshire and Herefordshire account for the majority of the remaining resource potential with the more urban areas of the West Midlands accounting for less than 2 per cent. In practical terms, usable manures will be likely to come from indoor pigs, poultry and dairy cattle. Overwintering of beef cattle on wheat straw may be another source, but is often valued as a fertiliser and soil conditioner. This may of course be more valuable after anaerobic digestion.

3.78 Figure 3-11 illustrates the proportion of wet organic waste potential in each of the upper tier authorities.

Figure 3-11: Potential accessible wet organic waste by upper tier authority



Source: SQW

Capacity to 2030 and 2050

3.79 It was assumed that livestock numbers would stay constant to 2030 and 2050; whereas food and drink waste would rise corresponding to the rise in employee numbers (for which a UK benchmark of 0.5 per cent per annum was used).

Conclusion

3.80 Wet organic waste accounts for 165MW of potential renewable electricity generation in the West Midlands, of which a third is located in Shropshire and almost a third in Staffordshire.

Poultry Litter

Main Assumptions

3.81 The assumptions made for poultry litter were in line with those of the DECC methodology. Comprehensive data were obtained from Defra and calculations carried as per the DECC methodology.

Results

3.82 Table 3-13 details the potential accessible renewable capacity for poultry litter in the West Midlands. It can be seen that poultry litter has 18MW of potential. As expected, the more rural the local authority, the greater the potential for this type of resource with Herefordshire and Shropshire having the potential to make the most significant contribution. Although this is a very small potential capacity, poultry litter is a mature and well established technology. It represents an already well managed and accessible resource that can be easily extracted, although it should be noted that it can also be used as high-grade mushroom compost. In practical terms, however, there could be location issues as some of the main production areas in Herefordshire and Shropshire could be off gas grid and remote from good electric grid connections. There are also issues around AONB location of chicken sheds which could pose a practical constraint.

Table 3-13: Potential accessible poultry litter resource, 2030

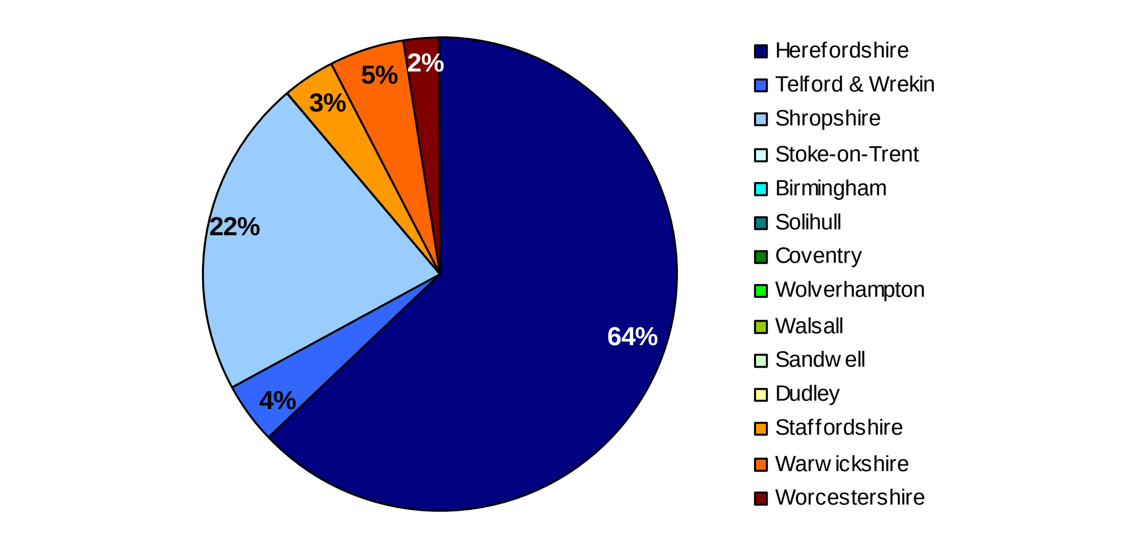
Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**12**	**63**
Telford & Wrekin	**1**	**4**
Shropshire	**4**	**22**
Stoke on Trent	**0**	**0**
Birmingham	**0**	**0**
Solihull	**0**	**0**
Coventry	**0**	**0**
Wolverhampton	**0**	**0**
Walsall	**0**	**0**
Sandwell	**0**	**0**
Dudley	**0**	**0**
Cannock Chase	0	0
East Staffordshire	0.2	1
Lichfield	0	0
Newcastle-under-Lyme	0	0
South Staffordshire	0.4	2
Stafford	0	0.2
Staffordshire Moorlands	0.1	0.3
Tamworth	0	0
STAFFORDSHIRE TOTAL	**1**	**3**
North Warwickshire	0	0
Nuneaton & Bedworth	0	0
Rugby	0.1	0.3
Stratford-on-Avon	1	5
Warwick	0	0.1
WARWICKSHIRE TOTAL	**1**	**5**
Bromsgrove	0	0.2
Malvern	0.4	2

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Redditch	0	0
Worcester	0	0
Wychavon	0	0.1
Wyre Forest	0	0.1
WORCESTERSHIRE TOTAL	**0.4**	**2**
WEST MIDLANDS TOTAL	**18**	**100**

Source: SQW (Figures may not total due to rounding)

3.83 Figure 3-12 below illustrates the proportion of the total poultry litter resource for each upper tier authority.

Figure 3-12: Potential accessible poultry litter resource by upper tier



Source: SQW

Capacity to 2030 and 2050

3.84 It was assumed that poultry numbers would be constant to 2030 and 2050 and that there were no significant competing uses to constrain use for energy generation.

Conclusion

3.85 Poultry litter offers a potential renewable resource of 18 MW in the West Midlands region located primarily in Herefordshire and Shropshire.

Municipal Solid Waste

Main Assumptions

3.86 Waste data was extracted from Defra's WasteDataFlow[16] database for the year 2008/09. The Biodegradable Municipal Waste (BMW) portion of municipal waste was assumed to be 0.68[17]. More details on the assumptions made can be found in Annex B.

Results

3.87 Table 3-14 details the MSW potential resource in the West Midlands and its LAs. It can be seen that the total for the region is 209 MW with the proportions for each of the LAs broadly in line with their populations. The table also includes details of the projected population at 2030 for each local authority as further context.

Table 3-14: Potential accessible Municipal Solid Waste Resource

Local authority	Electricity (MW Capacity)	Percentage of Total (%)	Projected population at 2030[18] ('OOOs)
Herefordshire	7	3	197.1
Telford & Wrekin	7	3	174.0
Shropshire	13	6	595.0
Stoke on Trent	10	5	257.7
Birmingham	42	20	1,183.2
Solihull	8	4	229.5
Coventry	13	6	362.4
Wolverhampton	11	5	256.8
Walsall	10	5	273.2
Sandwell	11	5	322.7
Dudley	12	6	326.4
Cannock Chase	3	2	101.0
East Staffordshire	4	2	123.0
Lichfield	4	2	113.9
Newcastle-under-Lyme	4	2	132.9
South Staffordshire	4	2	110.5
Stafford	4	2	141.4
Staffordshire Moorlands	3	2	101.1

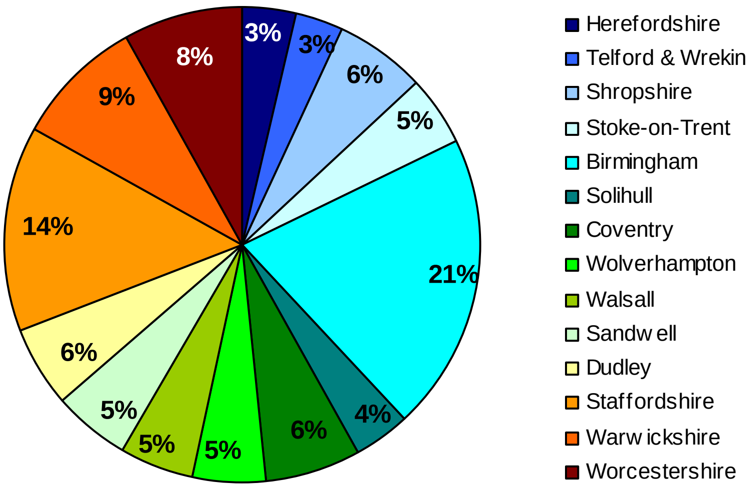
[16] http://www.wastedataflow.org/
[17] DEFRA Spending Review – Changes to Waste PFI December 2010
[18] 2008 based sub-national population projections (http://www.statistics.gov.uk/downloads/theme_population/snpp-2008/InteractivePDF_2008-basedSNPP.pdf?)

Local authority	Electricity (MW Capacity)	Percentage of Total (%)	Projected population at 2030[18] ('OOOs)
Tamworth	2	1	80.7
STAFFORDSHIRE TOTAL	29	14	904.7
North Warwickshire	3	1	66.1
Nuneaton & Bedworth	5	2	135.5
Rugby	4	2	111.0
Stratford-on-Avon	4	2	142.9
Warwick	4	2	169.1
WARWICKSHIRE TOTAL	19	9	624.6
Bromsgrove	3	2	105.8
Malvern	2	1	82.5
Redditch	2	1	83.4
Worcester	3	1	100.2
Wychavon	4	2	127.6
Wyre Forest	3	1	105.3
WORCESTERSHIRE TOTAL	17	8	604.8
WEST MIDLANDS TOTAL	209	100	2,954.3

Source: SQW (Figures may not total due to rounding)

3.88 Figure 3-13 illustrates the proportion of MSW potential resource in each upper tier authority. Birmingham has the greatest potential followed by Staffordshire and Warwickshire.

Figure 3-13: Potential accessible municipal solid waste resource by upper tier authority



Source: SQW

Capacity tom 2030and 2050

3.89 To estimate the future potential to 2030 and 2050 for electricity using Municipal Solid Waste (MSW) through direct combustion, it was assumed that MSW quantities would rise in accordance with CLG projections of increases to household numbers within the West Midlands.

Conclusion

3.90 The West Midlands has a potential MSW renewable energy resource of 209 MW.

Commercial and Industrial Waste

Main Assumptions

3.91 The DECC methodology is not explicit in terms of its methodology or the data sources to be used. It was therefore decided that a similar method and assumptions to MSW would be used for commercial and industrial (C&I) waste. The main difference between the two resource calculations was the data source used. The C&I waste data was taken from the ADAS's 2009 National Study into Commercial and Industrial Waste Arisings. Only the waste streams that had a high organic content that were not accounted for in any of the other resource categories were included. These were animal and vegetable waste and non-metallic waste. More details on the assumptions made can be found in Annex B.

Results

3.92 Table 3-15 details the C&I waste potential resource in the West Midlands and its constituent local authorities. As shown below, the total for the region is 145 MW with Birmingham accounting for over 19 per cent of the potential resource.

Table 3-15: Potential accessible Commercial & Industrial Waste resource, 2030

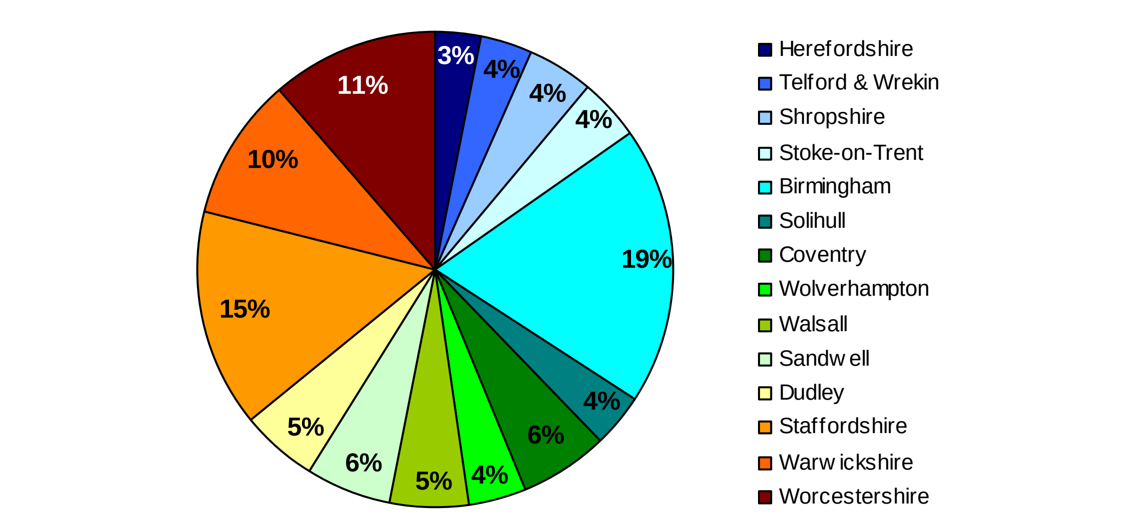
Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**4**	**3**
Telford & Wrekin	**5**	**4**
Shropshire	**6**	**4**
Stoke on Trent	**6**	**4**
Birmingham	**27**	**19**
Solihull	**5**	**4**
Coventry	**9**	**6**
Wolverhampton	**6**	**4**
Walsall	**7**	**5**
Sandwell	**9**	**6**
Dudley	**8**	**5**

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Cannock Chase	2	2
East Staffordshire	4	2
Lichfield	3	2
Newcastle-under-Lyme	3	2
South Staffordshire	2	1
Stafford	4	3
Staffordshire Moorlands	2	1
Tamworth	2	1
STAFFORDSHIRE TOTAL	**21**	**15**
North Warwickshire	2	1
Nuneaton & Bedworth	2	2
Rugby	2	2
Stratford-on-Avon	3	2
Warwick	4	3
WARWICKSHIRE TOTAL	**14**	**10**
Bromsgrove	2	2
Malvern	2	1
Redditch	3	2
Worcester	4	3
Wychavon	3	2
Wyre Forest	2	2
WORCESTERSHIRE TOTAL	**16**	**11**
WEST MIDLANDS TOTAL	**145**	**100**

Source: SQW (Figures may not total due to rounding)

3.93 Figure 3-14 illustrates the proportion of the resource available in each local authority.

Figure 3-14: Potential accessible commercial & industrial waste resource by upper tier authority



Source: SQW

Capacity to 2030 and 2050

3.94 Future C&I waste quantities were based on future employee number projections (a UK benchmark of 0.5 per cent per annum, according to UKCES).

Conclusion

3.95 The West Midlands has a potential renewable resource from commercial and industrial waste of 145 MW.

Biogas

Main Assumption

3.96 The potential renewable resources in the biogas category of the DECC methodology consist of landfill gas and sewage gas. Each of these resources is detailed individually under its own heading in the following sections.

3.97 The data calculations made for biogas were based on the Ofgem register of accredited stations under the Renewable Obligation (for landfill gas, this includes both open and closed landfill sites). The assumptions made about each of the individual resources are given in the sections for landfill gas and sewage gas. A detailed list of the assumptions made for all the resources can be found in Annex B.

Results

3.98 Table 3-16 details the potential accessible resource for biogas for the West Midlands, and the disaggregated figures for landfill gas and sewage gas. Both the biogas resources have a combined potential resource capacity of 45 MW in 2030.

Table 3-16: Potential accessible biogas resource, 2030

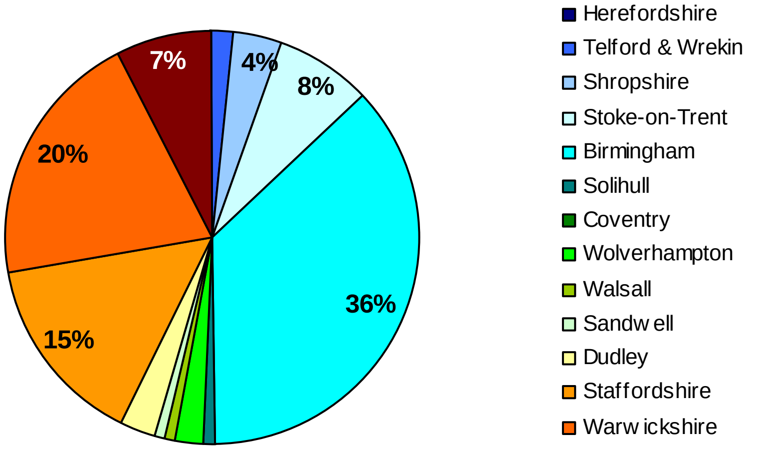
	Landfill gas		Sewage gas		Total biogas	
Local authority	**Electricity (MW)**	**%**	**Electricity (MW)**	**%**	**Electricity (MW)**	**Total**
Herefordshire	**0**	**0**	**0**	**0**	**0**	**0**
Telford & Wrekin	**0.3**	**3**	**0.5**	**1**	**1**	**2**
Shropshire	**0.4**	**4**	**1**	**4**	**2**	**4**
Stoke on Trent	**0**	**0**	**3**	**10**	**3**	**8**
Birmingham	**0**	**0**	**16**	**48**	**16**	**36**
Solihull	**0**	**0**	**0.4**	**1**	**0.4**	**1**
Coventry	**0**	**0**	**0**	**0**	**0**	**0**
Wolverhampton	**0**	**0**	**1**	**3**	**1**	**2**
Walsall	**0.4**	**4**	**0**	**0**	**0.4**	**1**
Sandwell	**0.4**	**4**	**0**	**0**	**0.4**	**1**
Dudley	**1**	**12**	**0**	**0**	**1**	**3**
Cannock Chase	2	15	0	**0**	2	4
East Staffordshire	0	0	1	**4**	1	3
Lichfield	0	0	0	**0**	0	0
Newcastle-under-Lyme	0	0	0	**0**	0	0
South Staffordshire	0	0	2	**6**	2	4
Stafford	0.3	3	1	**2**	1	2
Staffordshire Moorlands	0	0	1	**2**	1	1
Tamworth	0.3	2	0	**0**	0.3	1
STAFFORDSHIRE TOTAL	**2**	**21**	**4**	**13**	**7**	**15**
North Warwickshire	2	15	0.3	**1**	2	4
Nuneaton & Bedworth	0.5	4	0	**0**	0.5	1
Rugby	1	13	0.3	**1**	2	4
Stratford-on-Avon	0	0	1	**3**	1	2
Warwick	1	6	3	**10**	4	9
WARWICKSHIRE TOTAL	**4**	**38**	**5**	**15**	**9**	**20**
Bromsgrove	0.2	2	0	**0**	0.2	0.4
Malvern	0.1	1	0	**0**	0.1	0.3
Redditch	0	0	0	**0**	0	0
Worcester	0	0	1	**3**	1	2

	Landfill gas		Sewage gas		Total biogas	
Local authority	**Electricity (MW)**	**%**	**Electricity (MW)**	**%**	**Electricity (MW)**	**Total**
Wychavon	1	13	0	**0**	1	3
Wyre Forest	0	0	1	**2**	1	1
WORCESTERSHIRE TOTAL	**2**	**15**	**2**	**5**	**3**	**7**
WEST MIDLANDS TOTAL	**11**	**100**	**34**	**100**	**45**	**100**

Source: SQW (Figures may not total due to rounding)

3.99 Figure 3-15 illustrates the proportion of the biogas potential in each local authority. Birmingham has the largest potential with almost 36 per cent of the total. Both Coventry and Herefordshire have the smallest potential resource since no accredited facilities are located in these local authorities.

Figure 3-15: Potential accessible biogas resource by upper tier authority



Source: SQW

Capacity to 2030 and 2050

3.100 The assumptions for projections to 2030 and 2050 are detailed below with regards to the specific types of biogas.

Conclusion

3.101 The total biogas capacity at 2030 for the West Midlands is 45 MW electricity, over three-quarters of which is likely to be generated from sewage gas,

Landfill Gas

Main Assumptions

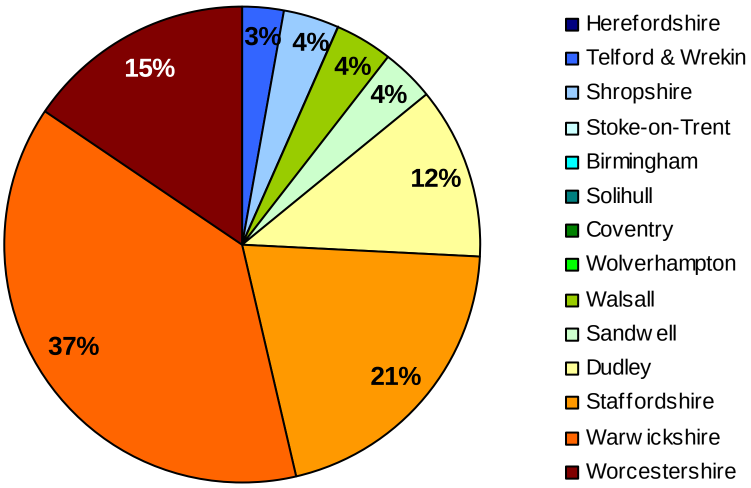
3.102 The EU Landfill Directive[19] and Waste Management legislation[20] mean that the amount of waste sent to landfill will decrease significantly over the next two decades. It was assumed that there would be no new significant landfill sites opened over the period of this analysis. More detail on the assumptions made can be found in Annex B.

Results

3.103 It can be seen from Table 3-16 above that the West Midlands has a landfill gas potential of 11 MW at 2030. Warwickshire has the greatest resource with over a third of all the landfill gas potential. Landfill gas accounts for approximately a quarter of biogas potential resource.

3.104 Figure 3-16 illustrates the share of the region's landfill gas potential in each of the upper tier authorities.

Figure 3-16: Potential accessible landfill gas by upper tier authority



Source: SQW

Capacity to 2030 and 2050

3.105 Landfill gas production will lag behind the decrease in waste sent to landfill due to the natural process of waste decomposition. As such, it was assumed that the present day landfill capacity will continue at a constant level for five years to 2015, then there will be a straight line reduction until the capacity in 2030 is 20 per cent of today's capacity. The trend was assumed to continue up to 2050.

[19] Council Directive 99/31/EC of 26 April 1999 on the landfill of waste entered into force on 16.07.1999. The deadline for implementation of the legislation in the Member States was 16.07.2001.

[20] http://www.publications.parliament.uk/pa/cm200405/cmselect/cmenvfru/102/102.pdf

Conclusion

3.106 The likely potential accessible landfill gas resource for the West Midlands is 11 MW.

Sewage Gas

Main Assumptions

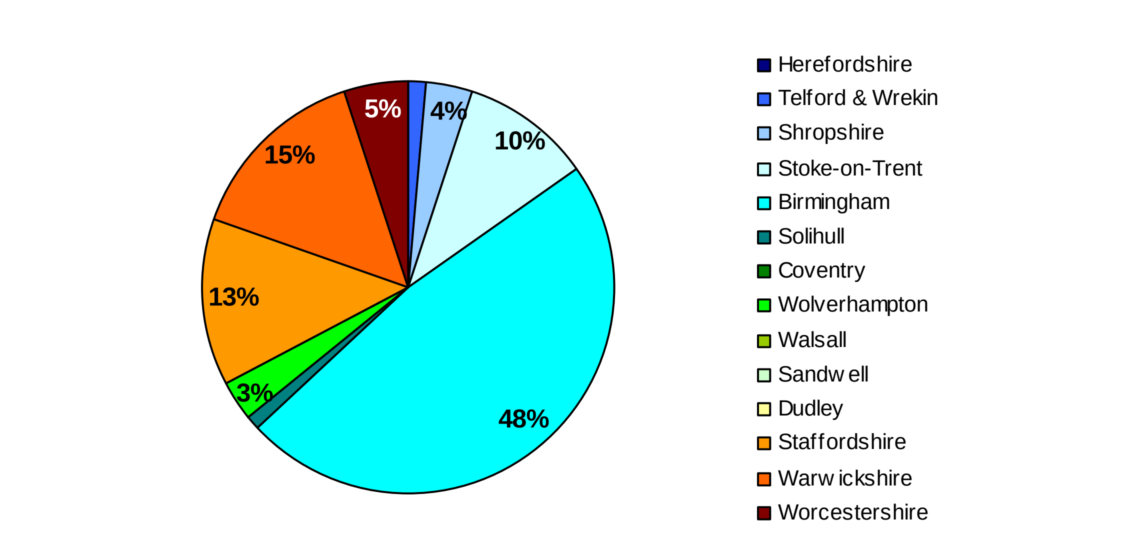
3.107 The DECC methodology suggested the regional water utility as the source for the data to be used in the calculation of sewage gas. However, it was agreed to use the approach adopted in the North West study which involved using the OFGEM Renewable Obligation register to calculate the existing Sewage Gas capacity for each of the LAs.

Results

3.108 The previous Table 3-16 details the potential accessible resource for sewage gas for the West Midlands; 34 MW of total potential capacity, of which almost half is situated in Birmingham.

3.109 Figure 3-17 illustrates the proportion of sewage gas potential in each LA.

Figure 3-17: Potential accessible sewage gas resource by upper tier authority



Source: SQW

Capacity to 2030 and 2050

3.110 It was assumed that there will be a 50 per cent increase in capacity from 2010 to 2030 based on more efficient technology and smaller units becoming more economically viable, hence being able to be deployed at smaller treatment works. For the assessment to 2030 and 2050, it was assumed that sewage gas production would follow trends in population growth, using ONS projections.

Conclusion

3.111 The West Midlands has a sewage gas renewable energy resource potential of 34 MW.

Biomass co-firing

Main Assumptions

3.112 The assumptions made for biomass co-firing were in line with those in the DECC methodology using the DUKES inventory of coal and oil-fired plants. More detailed information can be found in Annex B.

Results

3.113 There are currently two coal-fired power stations in the West Midlands, Ironbridge in Shropshire and Rugeley in the Cannock Chase district of Staffordshire[21]. At Rugeley, there is also a smaller 50 MW gas turbine which uses gas oil, which has also been included in the assessment. Only 10 per cent of combusted fuel is assumed to be from biomass following the DECC methodology (the technical potential is 15 per cent).

3.114 It was assumed that the lifetime of power stations was 60 years (40 years is the average economic lifetime, but this can often be extended). Ironbridge has opted out of the EU Large Combustion Plant Directive (LCPD), so can only operate 20,000 hours after 2008 and will be closed by 2016. Rugeley has installed Flue Gas Desulphurisation (FGD) in order to comply with the LCPD requirements on sulphur dioxide emissions so is likely to be running post-2016. As such, the West Midlands potential capacity for biomass co-firing is 106 MW at 2030, the majority of which is situated in Cannock Chase, Staffordshire.

Capacity to 2030 and 2050

3.115 For the reasons detailed above, only Rugeley was assumed to be operational in 2030 and neither of the power stations in 2050.

Conclusion

3.116 The West Midlands has a potential biomass co-firing resource of 106 MW.

[21] Rugeley Power Station is partly within Lichfield district, but as it is is largely within Cannock Chase, its capacity has been wholly allocated to this district

Small scale hydropower

DEFINITION AND SCOPE

Hydro power involves harnessing the power of flowing or falling water (from rivers, or stored in reservoirs) through a turbine in order to produce electricity. The parameters determining the amount of electricity produced include the turbine generating capacity, the turbine discharge flow (the volume of water passing through the turbine at any given time, which will change depending on the time of year) and available head (the vertical distance between the point where the water is highest and the turbine). The larger the head, the more gravitational energy can be converted to electrical energy. Hydropower can also be combined with storage (pumped storage), by pumping water from a low elevation to a high elevation at times of plentiful supply of electricity for release when needed.

For the purposes of assessing the hydropower resource, small-scale hydro power (under 20MW) is considered because opportunities for large-scale hydro (e.g. large dams) are becoming more and more limited. This is because most of the major sites for hydro have already been used along with environmental concerns over the adverse impact of large-scale hydro on local ecosystems and habitats and changes to the natural river flow and intensity. In contrast, small-scale hydro installations can be sited at small rivers and streams. By choosing the right sites to develop and putting in place good mitigation measures, small-scale hydro schemes can have little adverse impact on the river's ecology, for example, on fish migration patterns.

Source: DECC, 2010

Main Assumptions

3.117 The DECC methodology recommends the use of the results of the Environment Agency's report *Opportunity and environmental sensitivity mapping for hydropower in England and Wales* (2010) to identify the total regional resource and the portion of that resource which is accessible and viable.

3.118 It must be noted that the Environment Agency study results are intended to be used at a national and regional level, but for the purposes of generating estimates at lower spatial scales, the resultant GIS data from the Environment Agency study was obtained and was divided up spatially into local authority areas. The Environment Agency study is the first phase in a wider programme of work and subsequent phases will consider environmental sensitivities in more detail and apply the analysis at two trial catchments.

3.119 Opportunities identified in the Environment Agency study were classified according to an environmental sensitivity-power potential matrix (Table 3-17:). It was also determined that, for a subset of these opportunities, a sensitively designed scheme incorporating a fish-pass could actually improve the local environment as well as generate electricity.

Table 3-17: Hydropower Opportunities Categorisation Matrix

	Sensitivity Category			
	No Sensitivity Data	Low	Medium	High
	Marginal Choices	Marginal Choices	Marginal Choices	Lower Potential for Opportunities
10 – 20 kW	Marginal Choices	Marginal Choices	Moderate Opportunities	Difficult Choices
20 – 50 kW	Marginal Choices	Marginal Choices	Moderate Opportunities	Difficult Choices
50 – 1500+ kW	Good Opportunities	Good Opportunities	Difficult Choices	Difficult Choices

Source: Maslen Environmental

3.120 More detailed information concerning the assumptions can be found in Annex B.

3.121 In conjunction with the West Midlands resource assessment exercise, a parallel study was undertaken investigating, in greater detail, the opportunities and constraints of small scale hydropower within the Middle Severn, focusing on 35 potential sites. This study followed up many of the recommendations in the national study to give an improved understanding of the potentially available resource. The results from this study are reported separately and can be accessed from www.telford.gov.uk.

Results

3.122 Table 3-18 details the potential accessible resource for small scale hydropower available to each local authority in the West Midlands. The region has a potential resource of 71.6MW with the majority of this resource lying in the larger local authorities in the west and south-west of the region. In reality, however, the actual potential will be a fraction of this due to practical and environmental constraints. Through the Environment Agency matrix analysis, which combines environmental sensitivity factors with the potential power at each site, only a small proportion of the total maximum power is available from sites which present good and moderate development opportunities; however, site specific assessments would be required to validate this analysis.

3.123 An indication of the proportion of the resource identified across the West Midlands as a whole that might be practically available is given by the parallel Middle Severn study. The results of this West Midlands Hydropower 2011 study indicate that the hydropower generation potential is less than that estimated in the previous Environment Agency Phase 1 study ('Opportunity and environmental sensitivity mapping for hydropower in England and Wales').

3.124 This confirms the findings that only a fraction of the potential originally identified is likely to be practically realised. Whilst the study also identifies the high environmental sensitivities of the study area, the results do broadly indicate the opportunities for low head hydropower potential within the study area. This should aid in focusing efforts in the development of this resource.

Table 3-18: Potential accessible small scale hydropower resource

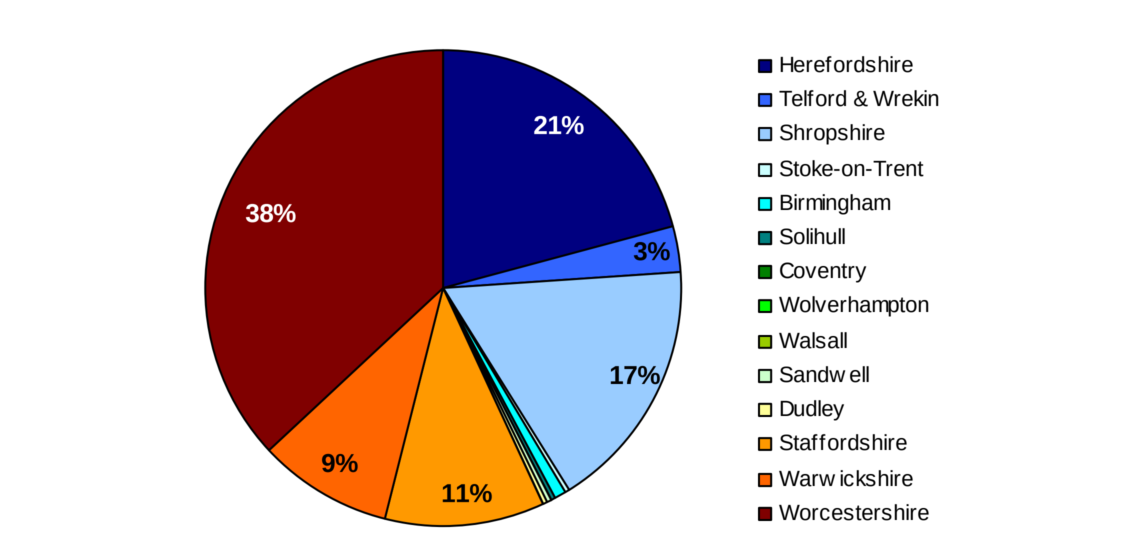
Local authority	Total Maximum Electricity (MW Capacity)	Percentage of Total (%)	Good and Moderate Opportunities (Capacity MW)	Percentage of Good and Moderate Opportunities (%)
Herefordshire	**15**	**21**	**0.1**	**2**
Telford & Wrekin	**2**	**3**	**0**	**0**
Shropshire	**12**	**17**	**0.2**	**3**
Stoke on Trent	**0.1**	**0.2**	**0**	**1**
Birmingham	**1**	**1**	**0.1**	**1**
Solihull	**0.1**	**0.1**	**0**	**0.3**
Coventry	**0**	**0**	**0**	**0**
Wolverhampton	**0**	**0**	**0**	**0**
Walsall	**0**	**0**	**0**	**0**
Sandwell	**0.1**	**0.1**	**0**	**1**
Dudley	**0.1**	**0.2**	**0**	**0**
Cannock Chase	0	0	0	0
East Staffordshire	2	3	0	0
Lichfield	0.4	1	0	1
Newcastle-under-Lyme	0.1	0.1	0	0
South Staffordshire	0.3	0.5	0.1	2
Stafford	2	2	0.2	3
Staffordshire Moorlands	3	4	0.4	5
Tamworth	0.1	0.2	0	0.4
STAFFORDSHIRE TOTAL	**8**	**11**	**1**	**11**
North Warwickshire	1	1	0.1	2
Nuneaton & Bedworth	0	0.1	0	0.4
Rugby	0.3	0.4	0	0.4
Stratford-on-Avon	4	6	3	47
Warwick	1	2	1	11
WARWICKSHIRE TOTAL	**6**	**9**	**5**	**61**
Bromsgrove	0	0.1	0	0
Malvern	9	13	0	0.1
Redditch	0.1	0.1	0	0
Worcester	5	8	0	0

Local authority	Total Maximum Electricity (MW Capacity)	Percentage of Total (%)	Good and Moderate Opportunities (Capacity MW)	Percentage of Good and Moderate Opportunities (%)
Wychavon	8	11	2	21
Wyre Forest	3	5	0	0.2
WORCESTERSHIRE TOTAL	**27**	**37**	**2**	**21**
WEST MIDLANDS TOTAL	**72**	**100**	**7**	**100**

Source: Maslen Environmental (Figures may not total due to rounding)

3.125 Figure 3-18 illustrates the proportion of small scale hydropower in each upper tier authority.

Figure 3-18: Potential accessible small scale hydropower resource by upper tier authority



Source: Maslen Environmental

Capacity to 2030 and 2050

3.126 No future predictions are made on changes to the potential small hydropower capacity by 2030 or 2050. It is unlikely that up to 2050 the Environment Agency would allow significantly more barriers to be built across rivers, as this runs contrary to many of their aims. This means that the potential capacity is unlikely to increase. However, it may decrease, if the Environment Agency achieves a number of its aims, under the individual River Basin Management Plans, to remove barriers which have a negative impact on fish passage[22]. Climate change could also have an impact on the available resource, by changing the flow duration curves at a site (i.e. the pattern of flow rates through a river). These changes are difficult to quantify for this broad scale study.

[22] http://www.environment-agency.gov.uk/research/planning/33106.aspx

Conclusion

3.127 The West Midlands has a theoretical potential accessible resource for small scale hydropower of 71.6MW, although it is likely that only a fraction of that resource presents a moderate to good development opportunity once practical and environmental constraints are taken into account. This assessment covers the whole of the West Midlands region; a more detailed parallel study has also been carried out for hydropower sites along the River Severn and Teme.

Microgeneration

DEFINITION AND SCOPE

Microgeneration typically refers to renewable energy systems that can be integrated into buildings to primarily serve the on-site energy demand. They are applicable to both domestic and non-domestic buildings and can be connected to the grid although this is not required as most of the output is used on-site. Thus microgeneration systems are typically designed and sized either in relation to the on-site demand or in proportion to the physical constraints on-site such as available space, which ever is more appropriate.

Microgeneration technologies cover the full range of renewable energy categories: wind, solar, biomass, hydropower and heat pumps. Technologies that directly depend on the built environment capacity to take microgeneration systems are solar – solar water heating (thermal) and solar photovoltaics (electric) – and heat pumps – ground source heat pumps and air source heat pumps.

In terms of assessing the regional opportunities and constraints for deployment, the microgeneration wind, biomass and hydropower categories are captured elsewhere in this report.

Source: DECC, 2010

Microgeneration - solar

Main Assumptions

3.128 The assumptions made for solar microgeneration were consistent with the DECC methodology. However, the DECC methodology was unclear as to what assumption should be made for the average unit capacity for industrial properties. In this case, it was assumed that the average size for solar was 10kW for industrial properties. This figure has been used in other regional renewable capacity studies including the North West Renewable Energy Capacity Study from 2010. More details on the assumptions can be found in Annex B.

Results

3.129 Table 3-19 details the electrical potential of solar photovoltaics (PV) and the heat potential of Solar Thermal technology. It can be seen that according to the DECC methodology; the West Midlands region has a potential of 1,378MW of Solar PV and 1,153MW of solar thermal. The greatest potential can be found in LAs with the most urban characteristics. The estimates for solar PV and solar thermal are not exclusive – that is both can be achieved together.

Table 3-19: Potential accessible solar microgeneration resource

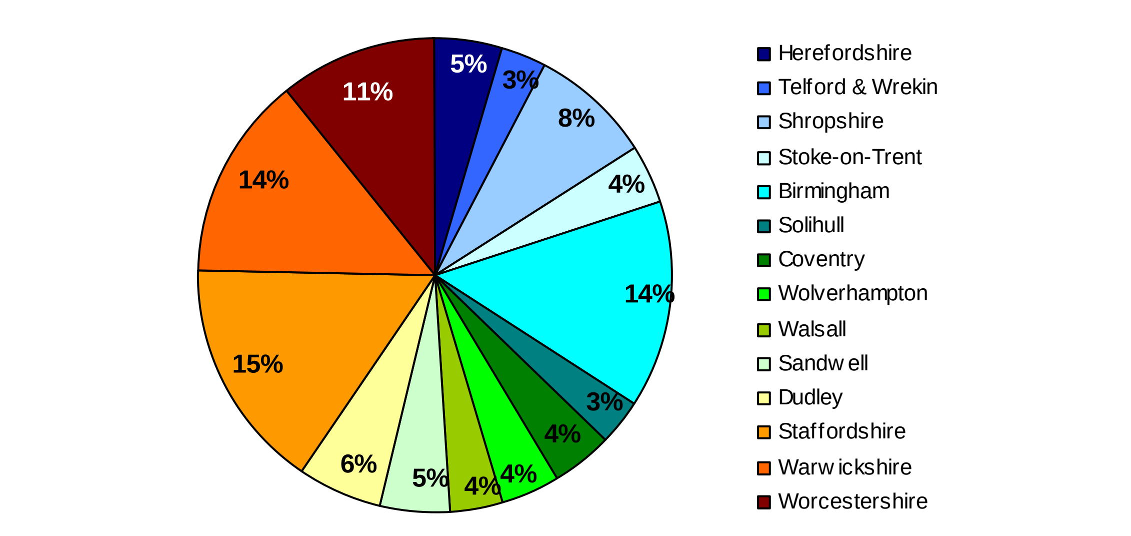
Local authority	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Herefordshire	**67**	**5**	**53**	**5**
Telford & Wrekin	**39**	**3**	**31**	**3**
Shropshire	**116**	**8**	**90**	**8**
Stoke on Trent	**55**	**4**	**46**	**4**
Birmingham	**194**	**14**	**169**	**15**
Solihull	**41**	**3**	**36**	**3**
Coventry	**60**	**4**	**52**	**4**
Wolverhampton	**51**	**4**	**43**	**4**
Walsall	**53**	**4**	**44**	**4**
Sandwell	**64**	**5**	**51**	**4**
Dudley	**80**	**6**	**70**	**6**
Cannock Chase	22	2	18	2
East Staffordshire	32	2	25	2
Lichfield	26	2	21	2
Newcastle-under-Lyme	28	2	24	2
South Staffordshire	27	2	22	2
Stafford	40	3	34	3
Staffordshire Moorlands	29	2	22	2
Tamworth	15	1	12	1
STAFFORDSHIRE TOTAL	**219**	**16**	**179**	**16**
North Warwickshire	20	1	16	1
Nuneaton & Bedworth	66	5	67	6
Rugby	26	2	22	2
Stratford-on-Avon	44	3	35	3
Warwick	34	2	29	3
WARWICKSHIRE TOTAL	**190**	**14**	**168**	**15**
Bromsgrove	25	2	19	2
Malvern	26	2	23	2
Redditch	18	1	14	1
Worcester	20	1	17	2
Wychavon	35	3	30	3
Wyre Forest	24	2	19	2

Local authority	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
WORCESTERSHIRE TOTAL	149	11	123	11
WEST MIDLANDS TOTAL	1,378	100	1,153	100

Source: SQW (Figures may not total due to rounding)

3.130 Figure 3-19 shows the proportion of solar PV and thermal solar microgeneration in each of the upper tier authorities.

Figure 3-19: Potential accessible microgeneration solar resource (for electricity & heat production) by upper tier authority



Source: SQW

Capacity to 2030 and 2050

3.131 The resource assessment for residential properties in 2030 & 2050 was based on Regional Spatial Strategy (RSS) allocations projected forward. The resource assessment for industrial & commercial buildings in 2030 and 2050, was based on employee number growth using a UK-wide benchmark of 0.5% per annum.

Conclusion

3.132 The West Midlands has a potential resource 1,378MW for PV microgeneration and 1,153MW for solar water heating.

Microgeneration – heat pumps

Main Assumptions

3.133 The potential renewable resources in the microgeneration heat pumps category of the DECC methodology consist of Ground Source Heat Pumps (GSHP) and Air Source Heat Pumps (ASHP). Each of these resources is detailed individually under its own heading in the following sections.

3.134 The assumptions made for microgeneration heat pumps are consistent with the DECC methodology; off grid properties were identified from the Centre for Sustainable Energy's

'Identifying and quantifying the prevalence of hard to treat homes' 2006 study which identifies these by local authority. Further information is provided concerning off grid properties in para 4.55. A detailed list of the assumptions made for each of the technologies can be found in Annex B.

Results

3.135 Table 3-20 details the potential accessible microgeneration heat pump resource for the West Midlands and its local authorities. It can be seen that the West Midlands has potential resource of 11,073MW of heat. Birmingham has the largest resource, consistent with its more urban characteristics. The split between air source heat pumps and ground source heat pumps is 80:20 which is explained later within the section.

Table 3-20: Potential accessible microgeneration heat pump resource

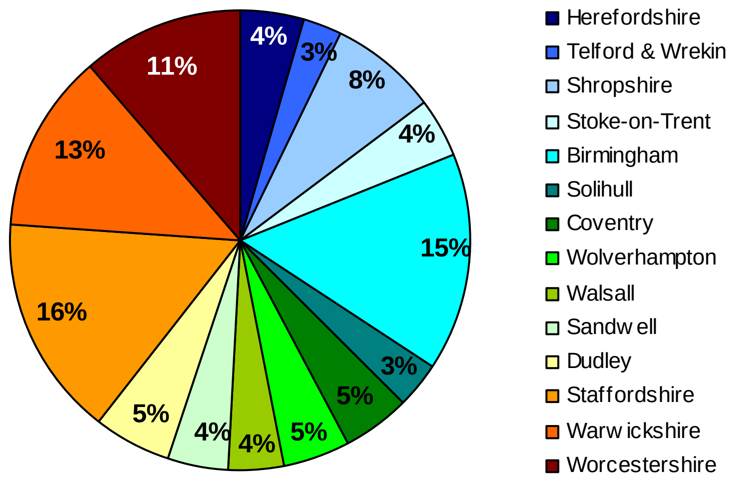
Local authority	Heat (MW Capacity)	Percentage of Total (%)
Herefordshire	**485**	**4**
Telford & Wrekin	**304**	**3**
Shropshire	**851**	**8**
Stoke on Trent	**463**	**4**
Birmingham	**1,694**	**15**
Solihull	**358**	**3**
Coventry	**536**	**5**
Wolverhampton	**511**	**5**
Walsall	**437**	**4**
Sandwell	**464**	**4**
Dudley	**594**	**5**
Cannock Chase	200	2
East Staffordshire	239	2
Lichfield	209	2
Newcastle-under-Lyme	230	2
South Staffordshire	212	2
Stafford	297	3
Staffordshire Moorlands	212	2
Tamworth	127	1
STAFFORDSHIRE TOTAL	**1,727**	**16**
North Warwickshire	142	1
Nuneaton & Bedworth	444	4
Rugby	204	2

Local authority	Heat (MW Capacity)	Percentage of Total (%)
Stratford-on-Avon	323	3
Warwick	282	3
WARWICKSHIRE TOTAL	**1,395**	**13**
Bromsgrove	196	2
Malvern	210	2
Redditch	156	1
Worcester	188	2
Wychavon	301	3
Wyre Forest	205	2
WORCESTERSHIRE TOTAL	**1,256**	**11**
WEST MIDLANDS TOTAL	**11,073**	**100**

Source: SQW (Figures may not total due to rounding)

3.136 Figure 3-20 illustrates the proportion of the heat pump resource in each of the upper tier authorities.

Figure 3-20: Potential accessible microgeneration heat pump resource (for heat production) by upper tier authority



Source: SQW

Capacity to 2030 and 2050

3.137 The resource assessment for residential properties in 2030 & 2050 was based on RSS allocations projected forward. The resource assessment for industrial & commercial buildings in 2030 and 2050, was based on employee number growth using a UK-wide benchmark of 0.5% per annum.

Conclusion

3.138 The West Midlands has a potential accessible microgeneration heat pump resource of 11,073MW.

Ground Source Heat Pumps

Main Assumptions

3.139 The assumptions made for microgeneration GSHPs are consistent with the DECC methodology. However, the DECC methodology was unclear as to what assumption should be made for the percentage of commercial properties with potential for heat pumps. In this case it was assumed that 10% of commercial properties were suitable. The split between GSHPs and ASHPs was assumed to be 20% GSHP and 80% ASHP. The reasons for this are that ASHPs are suitable for installation in more properties and cause less disruption when installing; hence, making them more attractive to potential customers. A detailed list of the assumptions made for each of the technologies can be found in Annex B.

Results

3.140 Table 3-21 details the potential accessible heat resource from microgeneration GSHPs. The potential capacity for the West Midlands region is 2,215MW with Birmingham providing the single biggest potential resource with over 15% proportion of the total. It is widely accepted that in reality the largest potential is likely to be realised within off-grid residential properties and therefore the resource capacity less that that could be provided from on-grid residential properties is also detailed below. This reduces the overall capacity by almost 60% as shown in Table 3-21.

Table 3-21: Potential accessible microgeneration GSHP resource

Local authority	Heat (MW Capacity)	Percentage of Total (%)	Heat (MW Capacity) less existing on grid residential property[23]	Percentage of Total (%)less existing on grid residential property
Herefordshire	97	4	64	7
Telford & Wrekin	61	3	22	2
Shropshire	170	8	127	14
Stoke on Trent	93	4	25	3
Birmingham	339	15	78	9
Solihull	72	3	19	2
Coventry	107	5	24	3
Wolverhampton	102	5	21	2
Walsall	87	4	24	3

[23] This includes commercial, industrial, community and public buildings, existing off grid residential and future residential property.

Local authority	Heat (MW Capacity)	Percentage of Total (%)	Heat (MW Capacity) less existing on grid residential property[23]	Percentage of Total (%)less existing on grid residential property
Sandwell	**93**	**4**	**27**	**3**
Dudley	**119**	**5**	**40**	**4**
Cannock Chase	40	2	24	3
East Staffordshire	48	2	22	2
Lichfield	42	2	22	2
Newcastle-under-Lyme	46	2	14	2
South Staffordshire	42	2	18	2
Stafford	59	3	30	3
Staffordshire Moorlands	42	2	20	2
Tamworth	25	1	7	1
STAFFORDSHIRE TOTAL	**345**	**16**	**157**	**17**
North Warwickshire	28	1	14	2
Nuneaton & Bedworth	89	4	57	6
Rugby	41	2	17	2
Stratford-on-Avon	65	3	43	5
Warwick	56	3	24	3
WARWICKSHIRE TOTAL	**279**	**13**	**155**	**17**
Bromsgrove	39	2	17	2
Malvern	42	2	28	3
Redditch	31	1	10	1
Worcester	38	2	12	1
Wychavon	60	3	40	4
Wyre Forest	41	2	16	2
WORCESTERSHIRE TOTAL	**251**	**11**	**124**	**14**
WEST MIDLANDS TOTAL	**2,215**	**100**	**906**	**100**

Source: SQW (Figures may not total due to rounding)

Conclusion

3.141 The West Midlands has a potential accessible GSHP resource of 2,215MW.

Air Source Heat Pumps

Main Assumptions

3.142 The assumptions made for microgeneration ASHPs are consistent with the DECC methodology. The previous section details the assumptions concerning the percentage of commercial properties with potential for heat pumps and the percentage split between GSHPs and ASHPs. A detailed list of the underlying assumptions can be found in Annex B.

Results

3.143 Table 3-22 details the potential accessible microgeneration ASHP resource for the West Midlands and its local authorities. The potential heat resource is 8,859MW for the region. Again the capacity less on-grid residential properties has been identified which reduces the overall potential substantially from 8,859MW to 3,623MW.

Table 3-22: Potential accessible microgeneration ASHP resource

Local authority	Heat (MW Capacity)	Percentage of Total (%)	Heat (MW Capacity) less existing on grid residential property	Percentage of Total (%) less existing on grid residential property
Herefordshire	**388**	**4**	**256**	**7**
Telford & Wrekin	**243**	**3**	**87**	**2**
Shropshire	**681**	**8**	**506**	**14**
Stoke on Trent	**370**	**4**	**99**	**3**
Birmingham	**1,355**	**15**	**312**	**9**
Solihull	**286**	**3**	**77**	**2**
Coventry	**429**	**5**	**96**	**3**
Wolverhampton	**409**	**5**	**83**	**2**
Walsall	**349**	**4**	**96**	**3**
Sandwell	**371**	**4**	**109**	**3**
Dudley	**475**	**5**	**160**	**4**
Cannock Chase	160	2	96	3
East Staffordshire	191	2	89	2
Lichfield	167	2	87	2
Newcastle-under-Lyme	184	2	58	2
South Staffordshire	170	2	71	2
Stafford	237	3	119	3
Staffordshire Moorlands	170	2	81	2
Tamworth	102	1	27	1
STAFFORDSHIRE TOTAL	**1,381**	**16**	**628**	**17**

Local authority	Heat (MW Capacity)	Percentage of Total (%)	Heat (MW Capacity) less existing on grid residential property	Percentage of Total (%) less existing on grid residential property
North Warwickshire	114	1	56	2
Nuneaton & Bedworth	355	4	227	6
Rugby	163	2	69	2
Stratford-on-Avon	259	3	170	5
Warwick	225	3	97	3
WARWICKSHIRE TOTAL	**1,116**	**13**	**619**	**17**
Bromsgrove	156	2	70	2
Malvern	168	2	113	3
Redditch	125	1	42	1
Worcester	150	2	48	1
Wychavon	241	3	160	4
Wyre Forest	164	2	65	2
WORCESTERSHIRE TOTAL	**1,005**	**11**	**497**	**14**
WEST MIDLANDS TOTAL	**8,859**	**100**	**3,623**	**100**

Source: SQW (Figures may not total due to rounding)

Conclusion

3.144 The West Midlands has a potential accessible ASHP resource of 8,859MW.

Solar farms and solar infrastructure

Solar farms

3.145 Solar PV Farms represent a potentially considerable renewable energy resource that were not covered in the DECC methodology. These consist of stand alone arrays of solar panels erected above ground in locations where there is maximum solar radiation. Nationally, there has been considerable interest from developers due to the financial rewards to be obtained via Feed in Tariffs, but also significant concerns from environmental objectors, with regards to visual impact, particularly where there have been proposals for the installation of solar farms within designated areas.

Figure 3-21: Solar farm array

Source: DECC, 2010

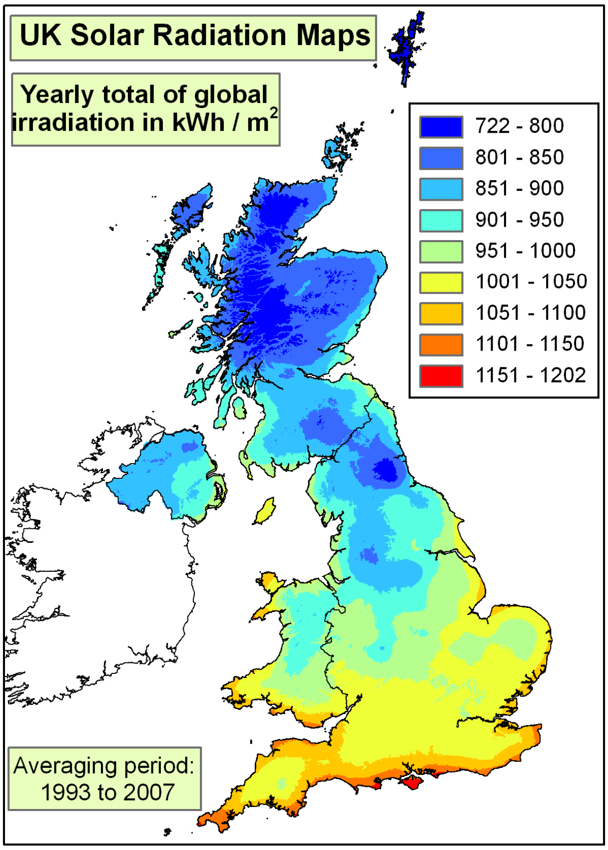
3.146 Currently, the UK produces 10MW solar power, but solar farms have the potential to increase this considerably – up to 20 are currently in the process of being installed across Cornwall with the potential of creating an additional 20MW capacity. The best locations in the UK for solar irradiation are in the south west of England, but it is considered that with continual improvement in solar panel technology, all of southern England and Wales, and parts of the Midlands may be suitable. Figure 3-22 shows solar radiation levels across the UK.

3.147 In order to identify the potential capacity for solar farms across the West Midlands, the urban areas and potentially landscape designation areas could be excluded leaving the largely rural areas of Herefordshire, Shropshire, Staffordshire, Warwickshire and Worcestershire. Within these areas, sites could be identified through a constraint focused approach taking into account solar radiation, aspect, slope and access to grid connections.

3.148 Sites for solar farms are generally between 7.5 and 13 hectares, flat and not shaded by nearby trees or buildings. There is no current publicised specification for the amount of solar radiation required, although applications have been made for solar farms in the West

Midlands (recent example in Wychavon) suggesting that radiation levels are sufficiently high for solar farms to be viable.

Figure 3-22: Solar radiation map of the UK



Source: Met Office, 2010

3.149 Consultation with Natural England revealed that there is no presumption against solar farms and each application should be assessed on its merits including within designated areas such as AONBs. Overall, it is considered that as temporary structures, solar arrays should not have a substantial impact on the landscape, but there may negative impacts on breeding birds and wetland invertebrates and they may not be appropriate within peat landscapes due to the need to provide access for installation and maintenance.

3.150 Current deployment of solar farms is very much developer led with the current Feed in Tariff (FIT) incentive leading to a groundswell of interest, although the Government's response to the FIT consultation published in February 2011 may lead this to reduce once ongoing reviews of the FIT are completed.

3.151 Based on the evidence presented above, it is clear that solar farms have the potential to make a contribution to the renewable energy mix in the West Midlands, but at this stage there are considerable uncertainties in the way that this may be realised. Further, more localised, analysis is recommended if local authorities wish to quantify the potential resource capacity for solar farms.

Solar infrastructure

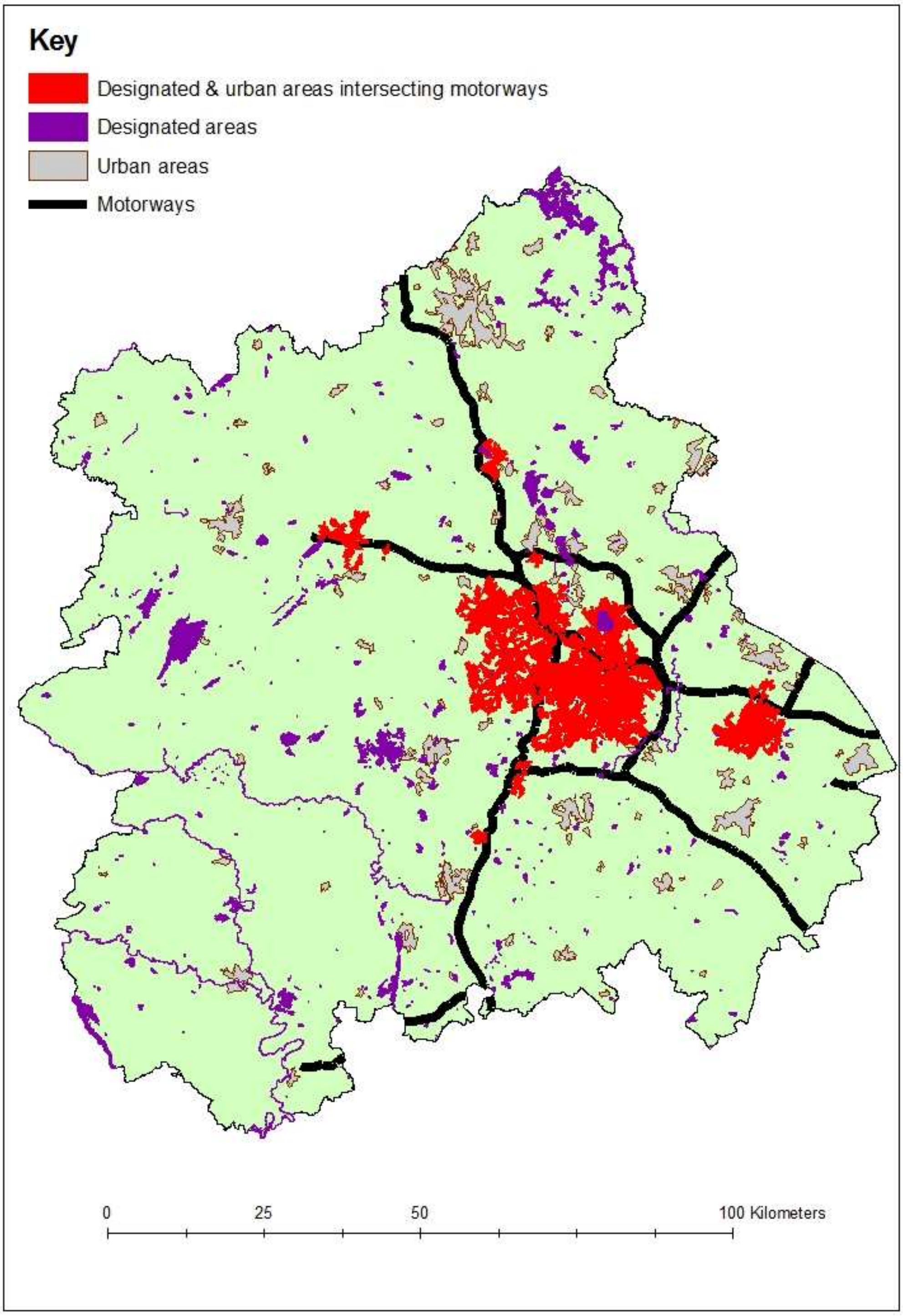
3.152 Solar PV from infrastructure is also a viable technology. Assessment of its potential should be through adopting a similarly constraints focussed approach (excluding urban areas and landscape designations) to assess the potential for PV units to be installed. As well as excluding those areas specified, solar arrays are only truly effective when erected in south facing, unshaded locations. The UK's first motorway solar PV array was installed on a noise barrier on the M27 in 2004 as part of a research project. The 50m long solar panel was installed by solarcentury for the Highways Agency. It generates up to 11 kW of electricity.

3.153 We have not undertake a detailed assessment, but as a means of illustrating how this could be taken further, we have undertaken the following analysis based solely on the potential to install arrays on roadsite sides. Within the West Midlands, there are 329.8km of motorway which do not fall within designated or urban areas (as shown in Figure 3-23). Assuming 25% of the potential roadside sites for arrays are south facing and not shaded provides potentially 82.45km of motorway on which solar arrays could be installed. If solar panels, 50m in length with the potential to generate 11kW electricity per panel, were installed along half of this area (equivalent 41.2km), then there could be the potential to create 9,062KW or 9MW across the whole of the West Midlands. Discussions with the Highways Agency did not involve consideration of the above approach, as their view is that the constraints and difficulties associated with Solar PV from highways infrastructure are insurmountable (on safety, maintenance, biodiversity, orientation and economic grounds) and therefore no capacity should be identified.

3.154 This figure has not been disaggregated to the specific local authorities within which the motorways lie, nor has capacity been projected forwards to 2030 or 2050 due to the uncertainty as regards future motorway development.

3.155 Solar infrastructure can also utilise large buildings such as stadia. We have not undertaken an assessment of capacity for such systems, but the largest installation in the UK is the Alexander Stadium in Birmingham which has a capacity of 102 kWh and was installed in 2004.

Figure 3-23: Map showing motorways in the West Midlands, plus designated and urban areas



Source: Produced by SQW, 2010. © Ordnance Survey. Crown Copyright. License number 100019086. Digital Map Data © Collins Barthol0mew Ltd (2007). © Natural England 2010

Low carbon energy potential

3.156 Low carbon energy is defined for the purposes of the DECC methodology as Combined Heat and Power (CHP) or tri-generation (to include cooling), and district heating schemes. Whilst not directly fulfilling commitments under the UK Renewable Energy Strategy, low carbon sources of energy supply will be an important part of the mix of technologies that the West Midlands can employ to reduce carbon emissions. In the long term, out to 2050, it will be increasingly necessary to decarbonise our energy supply; meanwhile, low carbon technologies represent potentially cost effective alternative solutions for energy generation. Both district heating and CHP plants can be fuelled by a number of sources, including biomass. The choice of fuels can affect the overall carbon savings for a plant.

3.157 At a national level, energy policy is being developed to help meet the significant heat and low-carbon energy requirement of the UK. For example, DECC is currently developing the Renewable Heat Incentive (RHI)[24], aimed at encouraging the use of renewable heat sources.

Methodology

3.158 Unlike most of the renewable energy categories which are assessed on the basis of the supply side (i.e. resource availability), low carbon opportunities referred to in the DECC methodology are a function of available heat demand.

3.159 The low carbon capacity of a region cannot be calculated solely by assessing the heat demand of its properties, since the viability of CHP or district heating is dependent not only on the viability of heat, but the density of that heat demand. This is because the cost of pipe required to transport heat is very high and there are heat losses though transportation, which also means that the plant used for generating the low carbon energy is likely to need to be close to its demand.

3.160 In order to make evaluations about the viability of an area for CHP or district heating, the DECC methodology introduces the concept of 'heat density'. This is defined as the annual heat demand, divided by the number of hours in a year, which is then divided by area in km^2. Higher density urban areas will have a higher heat demand per km^2 and hence would be expected to have lower district heating costs and greater potential for cost effective schemes. The DECC methodology states that if the heat density exceeds 3,000kW/km^2, the heat density is considered to be high and, district heating is likely to be economically viable in a high proportion of buildings, such as flats.

Developing a Heat Map

3.161 For this study, a new heat map has been developed, calculating the heat densities across the West Midlands. The map is based on DECC's Middle Level Super Output Area (MLSOA) gas consumption statistics[25]. A boiler efficiency of 80% was used as an assumption to convert gas consumption to heat demand – it is important to note that this assumption is more

24 DECC Renewable Heat Incentive (RHI)
http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/policy/renewable_heat/incentive/incentive.aspx
25 http://www.decc.gov.uk/en/content/cms/statistics/regional/mlsoa_llsoa/mlsoa_2008/mlsoa_2008.aspx

robust for converting domestic usage, than commercial and industrial usage, as industrial processes may consume gas for uses other than heat production. Heat demand met by other fuels such as coal and oil are not accounted for, as data at MLSOA level is not available. Once the annual heat demand for the MLSOAs had been calculated, it was converted into heat density by dividing it by the area of the MLSOA. The developed heat map produced results similar to the DECC Heat Map[26] and a previous West Midlands heat map[27]. The West Midlands map has been used to assess where the domestic, commercial and industrial and overall heat demand is sufficient to exceed the DECC heat density threshold.

3.162 Each MLSOA in the region was examined and where the total heat density exceeded 3,000 kW/km^2, an area was judged to be a candidate for one of the low carbon technologies such as district heating or CHP. The heat density for all the candidate areas were then aggregated together to give a total low carbon energy potential for each authority and the region.

Results

3.163 Table 3-23 details the results of the low carbon energy potential for each authority and the total for the West Midlands. The table is split into five columns to illustrate the source of the heat demand in each area. The columns indicate where the heat density threshold is reached through domestic, industrial and commercial and only through a domestic, industrial and commercial combined demand. Where the threshold has been reached solely through domestic or commercial and industrial demand in a MLSOA, the additional demand (i.e. from the other sector) for the MLSOA has been noted in the fourth column. This is because; for example, in an area where there is sufficient domestic demand a CHP plant could also supply the commercial demand, though by itself it does not reach the threshold. To simplify the outputs of this assessment, the total low carbon potential for each authority and the West Midlands is also presented.

Table 3-23: Low Carbon Energy Potential

Local authority	Domestic Demand GWhr/yr	Commercial Demand GWhr/yr	Above 3000 kw/km^2 only with Combined Demand (GWhr/yr)	Additional demand in the area (GWhr/yr)	Total Demand (GWhr/yr)	% of Total Demand
Herefordshire	0	0	0	0	0	0
Telford & Wrekin	0	0	315	0	315	2
Shropshire	0	0	0	0	0	0
Stoke on Trent	73	248	652	155	1,128	7
Birmingham	1,689	1,525	2,404	637	6,254	40
Solihull	55	0	383	2	440	3
Coventry	446	287	441	141	1,315	9
Wolverhampton	161	127	680	83	1,052	7

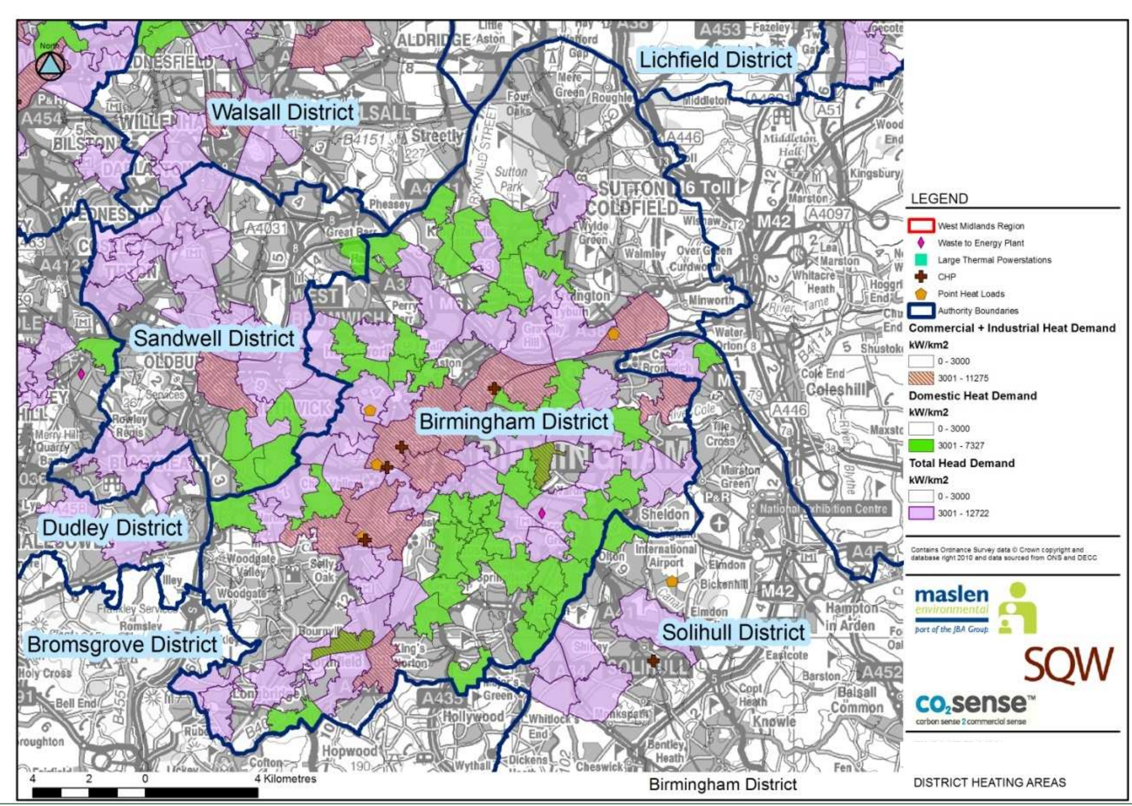
26 http://chp.decc.gov.uk/heatmap/
27 Halcrow Group Limited, April 2008, Heat Mapping and Decentralised Energy Feasibility Study: A Report for Advantage West Midlands

Local authority	Domestic Demand GWhr/yr	Commercial Demand GWhr/yr	Above 3000 kw/km^2 only with Combined Demand (GWhr/yr)	Additional demand in the area (GWhr/yr)	Total Demand (GWhr/yr)	% of Total Demand
Walsall	**66**	**205**	**368**	**68**	**707**	**5**
Sandwell	**227**	**227**	**1,173**	**60**	**1,686**	**11**
Dudley	**111**	**0**	**866**	**31**	**1,008**	**7**
Cannock Chase	41	83	0	42	166	1
East Staffordshire	0	194	54	60	307	2
Lichfield	0	0	37	0	37	0.2
Newcastle-under-Lyme	50	0	222	7	278	2
South Staffordshire	0	0	0	0	0	0
Stafford	0	0	55	0	55	0.4
Staffordshire Moorlands	0	0	0	0	0	0
Tamworth	0	0	125	0	125	0.8
STAFFORDSHIRE TOTAL	**90**	**277**	**493**	**109**	**969**	**6**
North Warwickshire	0	0	0	0	0	0
Nuneaton & Bedworth	0	0	65	0	65	0.4
Rugby	0	0	213	0	213	1
Stratford-on-Avon	0	0	0	0	0	0
Warwick	75	0	86	21	182	1
WARWICKSHIRE TOTAL	**75**	**0**	**365**	**21**	**461**	**3**
Bromsgrove	0	0	0	0	0	0
Malvern	0	0	0	0	0	0
Redditch	0	0	0	0	0	0
Worcester	0	0	126	0	126	1
Wychavon	0	0	47	0	47	0.3
Wyre Forest	0	0	52	0	52	0.3
WORCESTERSHIRE TOTAL	**0**	**0**	**226**	**0**	**226**	**1**
WEST MIDLANDS TOTAL	**2992**	**2896**	**8366**	**1306**	**15559**	**100**

Source: Maslen Environmental (Figures may not total due to rounding)

3.164 It can be see that the theoretical potential for low carbon energy technologies in the West Midlands is 15,559GWhr/yr, with the more densely built environment of Birmingham accounting for over 40% of this. It is worth noting that this reflects a theoretical potential for low carbon energy development. The amount that could be harnessed in reality would be dependent on a more detailed assessment of the candidate sites with economic and engineering surveys carried out to evaluate individual site suitability. The feasibility of district heating schemes may increase if they are in close proximity to energy recovery facilities, large thermal power stations, CHP plants or large point heat loads. The location of these has been identified from the DECC CHP register and heat map and an example area is presented in Figure 3-24.

Figure 3-24: Example area of Low Carbon Technology Candidate Areas



Source: Maslen Environmental

3.165 Figure 3-24 illustrates the candidate areas across part of the West Midlands where the greatest potential for low carbon energy potential exists. The map of the whole West Midlands is presented in the annex along with the location of energy recovery facilities, large thermal power stations, CHP plants or large point heat loads. The number of large point loads may increase in the future as for example more energy recovery facilities come online.

Capacity to 2030 and 2050

3.166 DECC's 2050 Pathways Analysis[28] shows that to 2050, heating and cooling usage may increase by 75% or could decrease by 60%. The range in predictions is a function of the changes in energy efficiency and usage assumptions that are made for the different 'pathways'. In addition to the difficulties in estimating overall change in heat demand, predicting the location and thus density of this demand presents another level of uncertainty which would limit the utility of any predictions in the change in low carbon energy potential

[28] http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/2050/2050.aspx

to the 2050 horizon. This means that no projections of the resource available in 2030 or 2050 have been made.

Conclusion

3.167 The West Midlands has a low carbon energy potential of 15,559 GWhr/yr (i.e. 1,711 MW). This is a very large, untapped energy source for potential exploitation. As such, this is an energy source that clearly warrants further detailed investigation. Currently, the high cost of developing such schemes means that few across the UK have been realised. It would require a step change in uptake to utilise a significant proportion of this available resource.

Waste Heat Assessment

3.168 No regional waste heat assessment methodology is outlined in the DECC methodology. However, it was considered important to include within this study as part of the overall assessment of low carbon sources. As such, the study team developed a methodology specifically for the West Midlands.

3.169 Waste heat is heat produced within a process which is not in a directly useful form (e.g. heat produced by air conditioning system, heat from an exhaust, or heat radiated from a blast furnace). Though no longer directly useful to the initial process, this heat could be put to use if there is an end-user which requires the heat and a way to recover it. This means that three factors are required for a waste heat recovery system:

- an accessible source of waste heat
- a recovery technology
- a use for the recovered heat energy.

3.170 The uses for recovered heat and depend on the nature of the end uses and the quality of the heat (e.g. high or low temperature) but can include:

- combustion air preheating
- power generation
- steam generation
- space heating
- water preheating.

3.171 These uses for the heat often have to be very close to the source due to the cost of piping and the heat losses accrued in transportation.

3.172 This assessment will attempt to identify potential sources of waste heat and then discuss the possible constraints on accessing this resource and its potential uses.

Identifying Waste Heat Sources

3.173 Potentially useful waste heat can come from a number of industrial, commercial and public activities. The nature of the heat produced can radically affect the utility of the resource. Waste heat sources can be divided into high, medium and low temperature sources; the general advantages and disadvantages of these are outlined in Table 3-24:

Table 3-24: Sources, Advantage and Disadvantages of High, Medium and Low Temperature Waste Heat.

Temperature Range (OC)	Example Sources	Advantages	Disadvantages / Barriers
High 650 - 1650+	Nickel Refining Furnace Steel Furnace Hydrogen Plant Glass Melting Furnace Coke Oven Blast Furnace	High-quality energy usable to a diverse range of end-uses with varying temperature requirements. High-efficiency power generation.	High temperature creates high thermal stresses on heat exchange materials. Increased chemical activity/corrosion.
Medium 230 – 650	Steam boiler exhaust Gas turbine exhaust Reciprocating engine exhaust Ovens Cement kiln	More compatible with heat exchanger materials Practical for power generation	
Low < 230	Process steam condensate Cooling water from air conditioning, internal combustion engines etc. Ovens Hot processed liquids/solids	Large quantities of low-temperature heat can be sourced from a large number processes.	Few end uses for low temperature heat (e.g. space heating, domestic water heating). Low-efficiency power generation. Low temperatures can increase corrosion of heat exchangers.

Source: Modified from BCS 2008

Methodology

3.174 For this study, the Interdepartmental Business Register[29] was used to identify the number of enterprises in each authority that could potentially be sources of high, medium and low waste heat. The register breaks down enterprises into categories by Standard Industrial Classifications (SICs) (which classifies based on the type of economic activities a business is engaged in[30]). Table 3-25 outlines those SICs assessed to have the potential to be high, medium and low temperature waste heat sources. This categorisation was based on assessing the typical types of processes and activities untaken in each sector.

29 http://www.neighbourhood.statistics.gov.uk/dissemination/Info.do?page=analysisandguidance/analysisarticles/idbr-analysis-to-support-local-authorities.htm

30 http://www.statistics.gov.uk/methods_quality/sic/contents.asp

Table 3-25: Potential Waste Heat Source Classification by Standard Industrial Classifications

Temperature Range	Standard Industrial Classifications
High	19 Manufacture of coke and refined petroleum products
	20 Manufacture of chemicals and chemical products
	35 Electricity; gas; steam and air conditioning supply
	38 Waste collection; treatment and disposal activities; materials recovery
	39 Remediation activities and other waste management services
Medium	10 Manufacture of food products
	11 Manufacture of beverages
	23 Manufacture of other non-metallic mineral products
	24 Manufacture of basic metals
	25 Manufacture of fabricated metal products; except machinery and equipment
Low	03 Fishing and aquaculture
	11 Manufacture of beverages
	12 Manufacture of tobacco products
	13 Manufacture of textiles
	14 Manufacture of wearing apparel
	15 Manufacture of leather and related products
	16 Manufacture of wood and of products of wood and cork; except furniture; manufacture of articles of straw and plaiting materials
	17 Manufacture of paper and paper products
	21 Manufacture of basic pharmaceutical products and pharmaceutical
	22 Manufacture of rubber and plastic products
	26 Manufacture of computer; electronic and optical products
	27 Manufacture of electrical equipment
	28 Manufacture of machinery and equipment n.e.c.
	29 Manufacture of motor vehicles; trailers and semi-trailers
	30 Manufacture of other transport equipment
	31 Manufacture of furniture
	32 Other manufacturing
	37 Sewerage
	52 Warehousing and support activities for transportation
	86 Human health activities
	93 Sports activities and amusement and recreation activities

Source: Standard Industrial Classification

3.175 Due to the nature of the SICs, it is impossible to know the exact nature of the processes at each enterprise and as such to quantify the potential untapped waste heat resource through this study. However it does give an indication of the number of opportunities available in the West Midlands.

Results

3.176 The number of potential high, medium and low temperature waste heats sources for each local authority is outlined in Table 3-26:

Table 3-26: Potential Waste Heat Source Classification by Standard Industrial Classifications

Local authority	Potential High Temperature Heat Sources		Potential Medium Temperature Heat Sources		Potential Low Temperature Heat Sources	
	No. of Enterprise	% of total Enterprise	No. of Enterprise	% of total Enterprise	No. of Enterprise	% of total Enterprise
Herefordshire	**30**	**0.32**	**215**	**2**	**595**	**6**
Telford & Wrekin	**25**	**0.57**	**150**	**3**	**360**	**8**
Shropshire	**50**	**0.35**	**320**	**2**	**935**	**6**
Stoke on Trent	**40**	**0.74**	**285**	**5**	**465**	**9**
Birmingham	**95**	**0.37**	**870**	**3**	**2,150**	**8**
Solihull	**15**	**0.22**	**85**	**1**	**420**	**6**
Coventry	**30**	**0.40**	**235**	**3**	**595**	**8**
Wolverhampton	**60**	**1.00**	**310**	**5**	**510**	**8**
Walsall	**45**	**0.70**	**425**	**7**	**640**	**10**
Sandwell	**55**	**0.81**	**535**	**8**	**650**	**10**
Dudley	**70**	**0.79**	**515**	**6**	**775**	**9**
Cannock Chase	15	0.48	115	2	260	8
East Staffordshire	20	0.49	130	3	245	6
Lichfield	20	0.47	115	2	280	7
Newcastle-under-Lyme	5	0.16	65	5	280	9
South Staffordshire	15	0.39	105	3	280	7
Stafford	20	0.42	100	1	315	7
Staffordshire Moorlands	15	0.39	100	3.14	245	6
Tamworth	10	0.48	85	5.15	165	8
STAFFORDSHIRE TOTAL	**120**	**0.41**	**815**	**3.69**	**2,070**	**7**
North Warwickshire	15	0.57	100	3.18	200	8
Nuneaton & Bedworth	15	0.49	145	2.72	225	7
Rugby	5	0.13	85	2.04	255	7
Stratford-on-Avon	25	0.34	160	2.73	455	6
Warwick	15	0.23	90	2.10	410	6
WARWICKSHIRE TOTAL	**75**	**0.32**	**580**	**2.60**	**1,545**	**7**
Bromsgrove	15	0.36	75	4.09	260	6

Malvern	10	0.25	85	2.80	280	7
Redditch	10	0.39	175	3.81	220	9
Worcester	5	0.18	65	4.75	200	7
Wychavon	30	0.51	105	2.23	385	6
Wyre Forest	25	0.73	90	2.15	265	8
WORCESTERSHIRE TOTAL	**95**	**0.42**	**595**	**1.38**	**1,610**	**7**
WEST MIDLANDS TOTAL	**805**	**0.45**	**5,890**	**2.47**	**13,260**	**8**

Source: Maslen Environmental (Figures may not total due to rounding)

3.177 The results of the analysis reflect the number of enterprises in each authority area, but also show that the potential high temperature sources are more concentrated in urban authority areas (e.g. Wolverhampton) which are more likely to have potential heat users near the generation sources.

Further Site Specific Assessments

3.178 To develop this initial assessment further to identify the best opportunities for waste heat resource development within each West Midlands LA, the following steps could be undertaken:

- Obtain site specific data available for the sites in the SIC categories with the best potential to be a waste heat source. This is available on request for Local Authorities from the Office for National Statistics.[31]
- Compare the locations of these sites with the heat map developed for this study, to identify sources in areas with high heat densities, and thus potential end-users.
- Approach individual enterprises with the best mixture of heat source and end users to conduct site specific assessments.

Barriers and Opportunities for Waste Heat Recovery Uptake

3.179 There are a number of barriers and factors which affect the feasibility of accessing individual opportunities amongst the potential resources identified above. These fall into four main categories (BCS 2008); cost, temperature restrictions, chemical composition, and inaccessibility/transportability of heat sources and are detailed further below:

- Cost
  - ➢ long payback periods

[31] http://www.statistics.gov.uk/idbr/localauthorities.asp

    - material Constraints and Cost – the nature of the waste heat source may require expensive material to utilise it (e.g. very high temperatures or corrosive steam)
    - economies of Scale – small scale operation are less likely to be economic
    - operation and Maintenance Cost.
- Temperature Restrictions
    - lack of end-uses
    - Heat Transfer Rates – this is reduced if the required temperature difference between the end use and the source is small.
- Chemical Composition – the chemical composition of the heat source can cause corrosion of equipment, deposition which clogs the system, environmental and contamination problems.
- Inaccessibility/Transportability
    - limited space – there may be insufficient space on site for the equipment
    - transportability – to transport the recovery heat requires a pressure head which may require an energy input
    - inaccessibility – recovering the heat from some sources may be difficult e.g. steam produced by cooling hot metals.

Capacity to 2030 and 2050

3.180 The Waste Heat assessment identifies enterprises with high, medium and low heat operations based upon Standard Industry Classifications data. There was no quantification of this resource in terms of capacity and further work is needed to quantify this resource and understand how it may be projected towards 2030 and 2050.

Conclusions

3.181 The assessment has shown that across the West Midlands there are multiple potential sources of waste heat, but more detailed analysis is required to understand the feasibility of accessing this resource on a site by site basis.

3.182 This assessment has focused on waste heat sources, it should also be noted that where there is a high demand for heat energy, Combined Heat and Power (CHP) stations can be developed to meet that demand (as detailed in the previous section). These CHP stations can be developed specific for this purpose, or plants used to produce electricity (e.g. power stations and energy recovery facilities) can be adapted to produce usable electricity and heat, however there are significant barriers to do so[32]. CHP stations can be fuelled by several sources

[32] James P.A.B. and Bahaj A.S., (April 2009), Potential Heat Supply From Current UK Electricity Generation And Its Contribution To The Uk's Energy Scenarios And Emissions, University of Southampton

including: gas, wood and energy crops, anaerobic digesters and sewage. Previous sections of this report assessing the energy capacity from biomass sources discuss the potential for electricity and heat generation from the last three of these sources.

4: Grid capacity and constraints

Electricity Transmission and Distribution

Context

4.1 The UK electricity network is one that has seen many alterations, innovations and expansions since its creation over 120 years ago. These changes have been put in place to accommodate the rise and mixed uses of demand together with the variety of generation methods used.

4.2 There are two tiers to the electricity network. The Transmission network delivers 'bulk' electricity at high voltages of 400kV and 275kV, over long distances from the larger power stations to distribution companies. The Distribution Network provides the majority of customers with electricity via localised networks operating at 132kV and below.

4.3 Transmission electricity flows predominately from the north of the UK, where the largest power stations are, to the higher electricity demands in the south. The National Grid operates this network, known as the Transmission Network Operator (TNO) in England and Wales.

4.4 The distribution network combines electricity from both large and small generating units. The transmission network provides the distribution networks with 'back-up' supply, if required. The distribution network can provide access for generating units with outputs of up to 20MW, which provides opportunities for a whole range of renewable and low carbon technologies identified in this study. In terms of generating output connecting to the necessary network, the general rule is:

- up to 300kW output, usually connect to 415V, 6.6kV or 11kV lines
- up to 7MW output, usually connect to 11kV, 33kV or 66kV lines
- up to 20MW output usually connect to 132kV lines.

4.5 But in some instances, if there is not a capacity issue, the District Network Operator (DNO) may recommend connection to a higher voltage system that is closer to National Grid source, as overall connection costs may be lower.

4.6 There are two broad types of electricity network operating in the region. The first is a *radial* system. In general, this system occurs in more rural areas, with the network operating in a tree structure with the power flowing from root to tip. This type of network is not very flexible or designed for electricity to flow from tip to root. The second type of system is known as a *mesh*. In general, this system occurs in more urban areas. This is a more flexible system with multiple sources of electricity. The network can have multiple configurations by closing and opening switches, allowing electricity to flow in a number of different routes from source to end user.

4.7 Electrical losses are an inevitable consequence of the transfer of energy across electricity distribution networks. On average, approximately 6% of electricity transported across the distribution networks is reported as losses (specific data is unobtainable from the DNOs). Several DNOs have suggested that some networks should be replaced for example 6.6 kV replaced with 11 kV[33], as higher voltages require lower current to transport electricity and therefore a reduction in loss.

Future Network Challenges

4.8 Networks face two main challenges, the first is the renewal of ageing grid infrastructure nearing the end of its life (as most was built in the 1950s and 60s close to coal mining regions) and the second is reconfiguration, adapting the existing network to incorporate renewable and low carbon technologies.

4.9 Renewal and reconfiguration, particularly for renewable and low carbon technologies comes at a cost. These network operating costs are passed onto consumers, and depending on location, can range from 4% - 17% of domestic bills[34]. The Office of Gas and Electricity Markets (Ofgem) regulates these charges, by setting caps on revenues every 5 years called *Price Control Reviews*. There has been significant investment in ageing networks resulting from unlocking revenue gained from Price Controlling set by Ofgem. Mainly this investment is required to assist with rising demand, but in part, to allow for renewable and low carbon sources to better access the distribution network. So, in theory, opportunities for renewable and low carbon technologies should have improved.

4.10 Reconfiguration can be challenging, smaller scale generation can have large voltage fluctuations, faults, reverse power flows, intermittent generation and so on: all must be managed to ensure reliability. The UK operates a centralised system by way of reliable, large power stations with economies of scale. But with climate change influenced levies, legislation and regulations a more decentralised system is predicted. This system will encourage better efficiencies, but with an increase in the challenges on the reliability and balancing of the electricity network.

4.11 Decarbonisation of the electricity market is currently subject to a consultation, to establish mechanisms to attract the investment needed for grid improvement. The Electricity Market Review is intended to examine the reforms necessary to achieve the Government's objectives on decarbonisation, renewable energy, security of supply and affordability. The consultation period is due to complete this month following which it is intended that a White Paper will be launched containing legislative proposals to implement the new electricity market arrangements.

Distributed Network Operators

4.12 The fourteen regions throughout England, Wales and Scotland, are managed by seven companies (EDF Energy; Central Networks; CE Electric; Western Power Distribution; Electricity North West; Scottish Power; and Scottish and Southern), known as Distributing Network Operators (DNO).

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[33] http://www.ofgem.gov.uk/NETWORKS/ELECDIST/POLICY/DISTCHRGS/Documents1/1362-03distlosses.pdf
[34] Dolan.S POSTnote 2007, p2

4.13 A DNOs role is to:

- connect new customers
- reinforce the network to accommodate changing demand
- inspect and maintain the existing assets
- fix the networks when they go wrong
- refurbish networks to extend their life where appropriate
- replace the assets when end of their life is reached
- improve customer service
- prepare for emergencies
- protect the environment, including the impacts of climate change, and enable local generation.

4.14 The role of both the TNOs and DNOs is to maintain, operate, and reinforce these electricity networks in line with regulations set by Ofgem and laid down in law[35].

4.15 The study assessment team have been in close contact with strategic, investment and policy representatives from the DNOs particularly at EON Central Networks West, and key development agency contacts. They provided useful information important for this section of the study, including access to maps, data and provided professional experiences of renewable and low carbon generators connecting to the distributing networks.

Electricity Distribution Networks in the West Midlands Area

4.16 The West Midlands area is covered by three DNOs

- Central Network West (covering the majority of the West Midlands)
- Central Network East (covering Coventry, Rugby, Burton-on-Trent and Uttoxeter)
- SP MANWEB (covering Oswestry and North Shropshire).

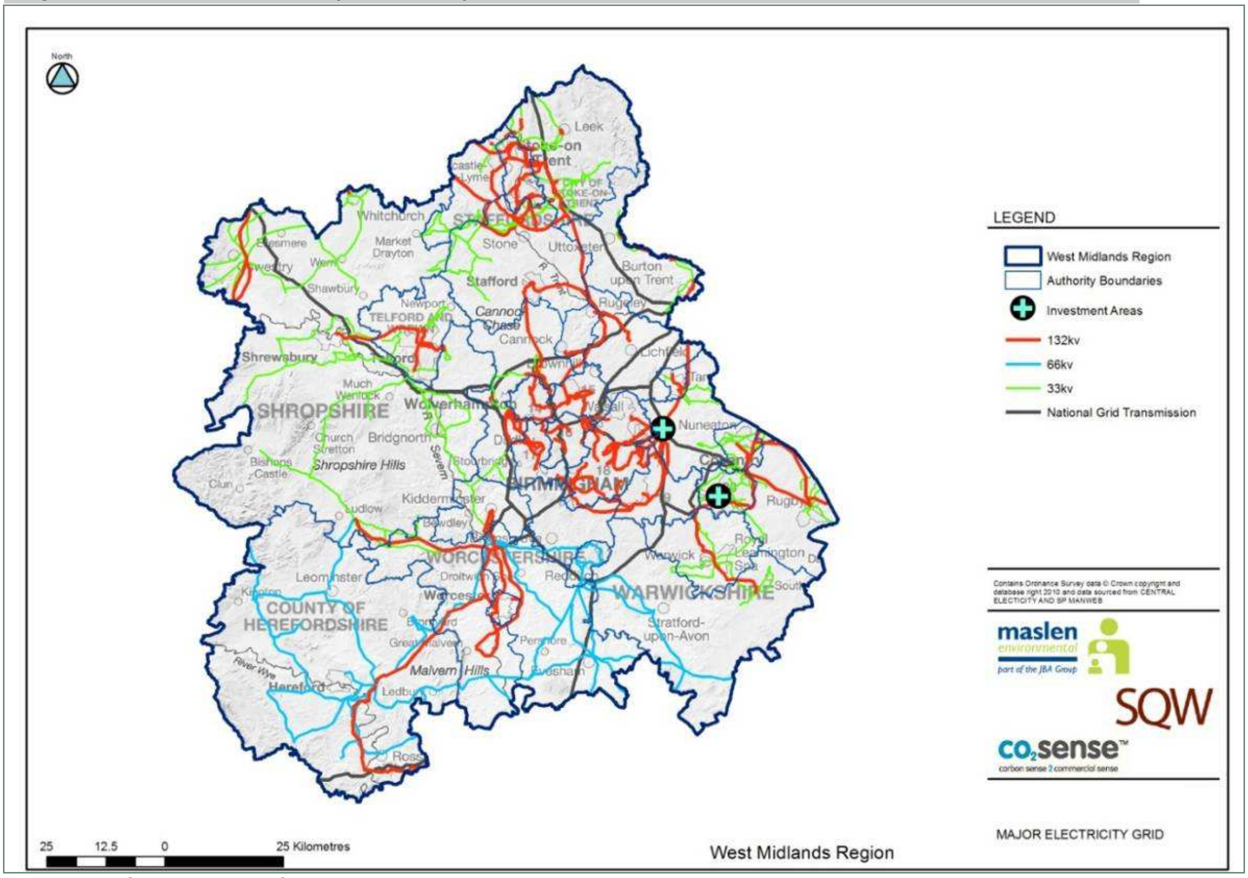
4.17 To meet the project specification set out for the grid constraints methodology, consultation with DNOs, EON Central Networks West (CNW) and Central Networks East (CNE), Scottish Power (SP) and the National Grid was carried out. From this it was possible to obtain and understand the current electricity and gas distribution network and capacity across the region.

4.18 Due to data constraints for electricity it was not possible to access less than 33kV network data; this is available at a site by site basis from the individual DNO's. Taking this study forward to site feasibility we understand that obtaining data from the DNOs is a chargeable service for developers and third parties, but free for LAs.

[35] Electricity Supply Act 1989, Utilities Act 2000, Electricity Supply, Quality and Continuity Regulations 2002

4.19 The DNOs distribution grids are shown in Figure 4-1 below.

Figure 4-1: West Midlands Major Electricity Grid



Source: Maslen Environmental

Central Network West

4.20 The region covered by the Central Network West's (CNW) distribution networks includes the majority of the West Midlands conurbation, with the exception of Coventry and Warwick. It extends from Congleton in the north to the outskirts of Bristol in the south; and from Knighton and the Welsh Marches in the west to Banbury in the east. There are approximately 2.44 million customers connected within the service area of 13,000 sq. km.

4.21 The total amount of overhead lines and underground cabling in CNW is presented in the table below.

Table 4-1: Size of the Central West Distribution Network

Voltage	Overhead line (km)	Underground Cable (km)
132kV	1328	328
66kV	760	27
33kV	1021	365
11kV and 6.6kV	14972	12400
Low voltage	6741	48314

Central Network West (CNW) Long Term Development Plan

4.22 The current Long Term Development Plan (LTDP) for the CNW sets out how the network is set to develop to 2015. It has two main point of interest;

"Central Networks West and its predecessors have pursued a strategy of extending the 132kV network and establishing 132/11kV transformation in urban areas, where proven attractive. The strategy was developed in the early 1960s for city centres but has since been extended and at present approximately 60% of the demand is supplied through 132/11kV networks."

and

"The Company has extensive 66kV networks. These mesh and radial networks cover large rural areas, especially the north Cotswolds, Worcestershire, Herefordshire and the Welsh Marches. Networks at this voltage provide economic and reliable rural systems, permitting long feeding distances and being of robust construction. However, some parts of the 66kV network in north Worcestershire are ageing and would require replacement over the next 5 – 10 years. The Company would consider reinforcement at the 66kV voltage level or conversion to 132/11kV transformation depending on the solution offering the optimum technical and economical value."

Planned extensions and capacity issues in the CNW area

4.23 The majority of the planned extensions of the CNW grid are focused in the East Birmingham district, replacing the underground 33kV cabling with a 132kV/11kV system as identified in Figure 4-1.

4.24 CNW, unlike most DNO networks, has no coastline and therefore has no prospect for connecting offshore wind farms and the potential for land based wind farms has been stated by CNW as being 'limited'[36]. The Long Term Development Plan also states that gas fuelled projects have appeared to have been halted due to recent price rises – however, recent examples in Birmingham show that it is still possible to develop gas fuelled CHP plants effectively[37], and currently the most likely energy sources for generation appear to be landfill gas, incineration of municipal waste and biomass. CNW has seen considerable growth in the number of solar PV installations driven most likely to the introduction of Feed in Tariffs. They predict that in the near future, there is the possibility of domestic CHP installations, once it can be made commercially attractive, but the expected take-up remains uncertain.

4.25 According to CNW's LTDS, it has been stated that due to the variability of operations of existing generators it is difficult to predict how these operators will affect future network loads. Whilst attempts have been made by CNW to predict the future generation growth, no significant provision for future generation based on 2010 loads can be estimated, and take-up remains uncertain[38].

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[36] *Long Term Development Statement, CNW 2010, ch4, p4.*
[37] *http://www.birminghamenergysavers.org.uk/*
[38] *Long Term Development Statement, CNW 2010, ch4, p4.*

Central Network East

4.26 The region covered by Central Network East (CNE) distribution networks includes the majority of the East Midlands along with the cities of Coventry and Warwick. It extends from the outskirts of Sheffield in the north, to Milton Keynes in the south; and from Uttoxeter and Tamworth in the west to the Wash on the East Coast. There are approximately 2.6 million customers connected within the Company's service area of 16,000 sq. km.

4.27 The urban areas in the CNE area are mainly served by a 132kv/11kv network and rural areas served by an extensive 33kv network.

Planned extensions and capacity issues in the CNE area

4.28 The LTDP for CNE sets out planned extensions to the network to 2015.

4.29 A new 132/11kV substation is to be installed at the Central Network Coventry South substation to provide additional security to the electricity supplies to the Coventry and cater for future growth in load, as identified in Figure 4-1.

SP MANWEB

4.30 SP MANWEB supplies approximately 1.5 million customers in the north west of England and north Wales. The geographical area of the West Midlands study area covers just Oswestry and North Shropshire.

4.31 The 132kV and 33kV networks are operated in an interconnected fashion throughout the SP Manweb area. In urban areas the 33kv network is mainly underground cable and in rural areas overhead on wooden masts.

Planned extensions and capacity issues in the SP MANWEB area

4.32 The Long Term Development Plan for SP MANWEB sets out planned extensions to the network to 2015.

4.33 There appears to be no planned development in the West Midland's area covered by SP MANWEB. The grid that services this area appears to have sufficient spare load capacity at the current time.

4.34 Opportunities exist for the connection of new load or generation throughout the SP MANWEB distribution system. System conditions and connection parameters are site specific and therefore the economics of a development may vary. Developers are encouraged to discuss their development opportunities with SP MANWEB who will advise on connection issues.

Electricity Connections and Renewable and Low Carbon Deployment

4.35 The DNOs role is central to understanding the feasibility of renewable and low carbon sources connecting to the local distribution networks as larger renewable and low carbon sources cannot connect to the grid without consulting the DNO. All the DNOs which serve the West Midlands recognise in their Long Term Development Plans that there will be more small and medium generators wishing to export to their grids in the future and that their networks will have to adapt to this.

4.36 The distribution networks often have limited spare connection capacity and may require upgrading or modifying to allow connection of renewable and low carbon energy generation sources.

4.37 The generators can only connect to the distribution network subject to a DNO connection contract. The tasks involved in obtaining connection vary with the size of the generation plant that is being developed: in general, the larger the plant, the more complex the connection requirements. There are considerations needed for all generators, including current loadings on the local grid, capacity in the system for a new connection, and reinforcements needed. These issues will all be site specific.

4.38 There is an exception for micro-generation projects, also referred to as Small Scale Embedded Generation (SSEG), who are not required to enter into a contract with the DNO. SSEG generators tend not to cause any network connection issues as they are up to 16A per phase and are considered too low to have any serious impact on the network. In future, as the density of SSEGs increase, this could put strain on local networks. As a result, DNOs may have to review their policies towards SSEGs, however it is currently unclear what this may entail or in fact whether it will prove necessary.

4.39 The five phases from planning to construction can be found in Annex G of the supporting annexes document; however, it is worth noting that timing is very important. For example, Phase 3 – Design takes up to 90 calendar days for the DNOs engineer to process the application[39].

Connection Costs and Charges

4.40 As soon as the developer involves the DNO it can start to incur charges. For example at the planning phase, where a feasibility study is carried out or after the Connection Application (at the design phase). In all cases the DNO must offer fair terms for providing suitable connection services for the proposed generation scheme (regulated by Ofgem), and will only cover the DNO’s costs.

4.41 An Electricity Connections Engineer quoted the following indicative prices for the costs of feasibility studies carried out by the DNO; it is clearly dependent on the generating capacity. Up to and including 1MVA = £1,240 plus VAT, in stages to 40MVA - 100MVA = £16,000 plus VAT.

Costs of connection infrastructure

4.42 The connection cost for a generation scheme depends on the nature and extent of the works to be carried out and other users in the local area. Average costs are difficult to provide as they can vary greatly. Significant costs are incurred the further the generator is from a substation (cabling costs can be up to £100/m) and if substations need to be upgraded. See Annex G for more details.

[39] *Jarrett,K, et al. DTI, Feb 2004*

4.43 After analysis and discussions with the DNOs, it was said that the less experienced generators regularly overlook considerations of how they must connect their generating plant to the distribution network - particularly the 90 day application process time at design phase. It is a complicated process and therefore communication between the developer and DNO is critical, particularly in providing detailed input into the site-level feasibility studies.

Grid Constraints and Developing Renewable Electricity in the West Midlands

4.44 This section discusses the potential effect of grid constraints on particular renewable technology uptake into the future and identifies potential best practices and actions required to overcome these constraints.

Grid Constraints and Commercial Wind Power

4.45 As commercial wind capacity develops in the West Midlands into the future, developments are likely to focus on relatively isolated windier areas. These areas are generally not well provided for by the grid. In order for development to happen without grid connection being a constraining issue, developing the electricity grid will be key.

4.46 The typical size of wind farm development being proposed in the West Midlands currently has capacities of around 6 MW[40]. These developments would require connections to 11kV, 33kV or 66kV lines, though larger developments (up to 20MW) would need to connect to 132kV lines.

4.47 Figure 4-2 shows the major lines (33kV and larger) in the distribution grid that cover the West Midlands area, detailing the distance to the nearest grid connection. The areas furthest from the grid include the Peak District and parts of the Shropshire Hills. In these areas the costs of developing wind is likely to be significantly higher than in areas well provisioned for by the grid.

4.48 In rural areas currently covered by CNW, the DNOs policy is to maintain and replace the extensive 66kV network. The DNO would consider converting to 132/11kV systems *depending on the solution offering the optimum technical and economical value*. Larger wind farm developments are unlikely to be feasible in much of these areas without an upgrade of the system to 132kV. This upgrade will only happen if a good economic case is put to the DNOs.

Grid constraints and biomass

4.49 There are likely to be similar issues for the development of large scale biomass as the resource availability, particularly for plant and animal biomass, within the more rural areas. Smaller scale developments may be appropriate to connect to the existing 66kV network. More urban resources such as waste are better linked to the network and therefore should have greater potential for deployment.

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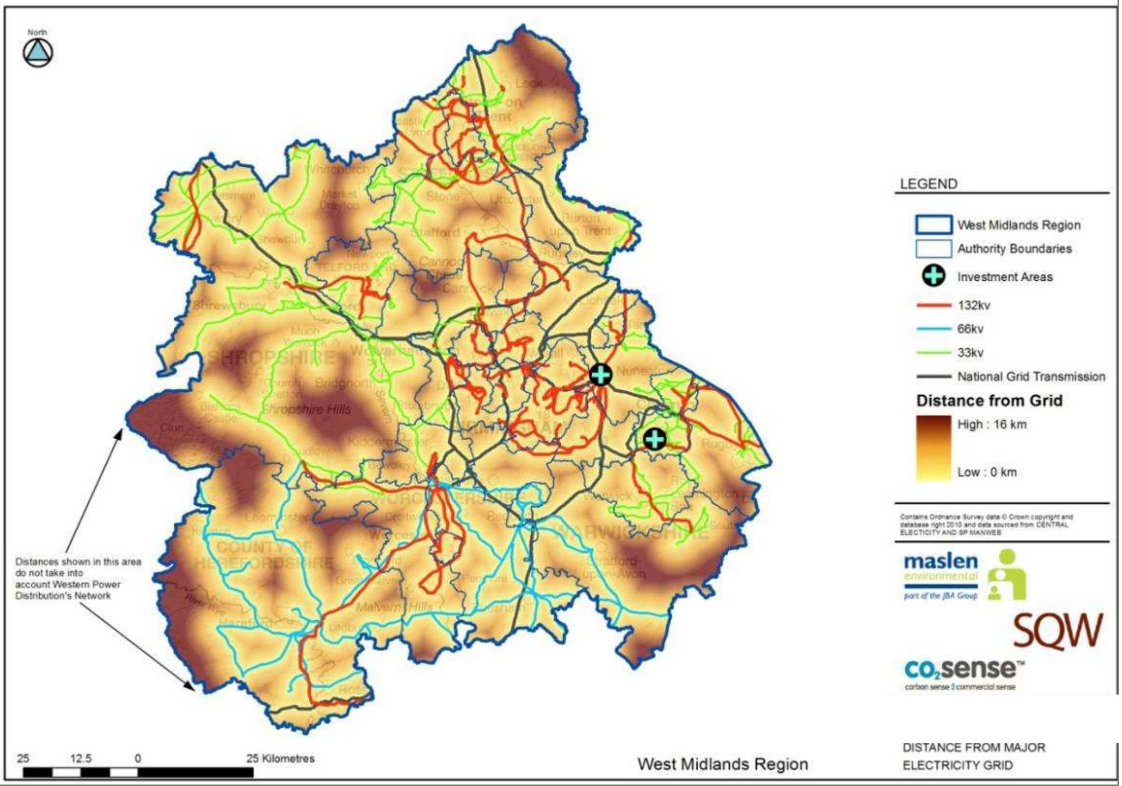
[40] www.yes2wind.com

Figure 4-2: Distance to the Major Electricity Grid



Source: Maslen Environmental

Grid Constraints and Hydropower

4.50 The largest small scale hydro opportunity identified by the EA in the West Midlands has a potential maximum power output of 1,880kW; however the vast majority are under 300kW. This means that most hydropower sites will be able to connect to small lines (6.6kV or 11kV), the distribution of which is relatively extensive in the West Midlands. However the distance to the grid in more rural areas and spare capacity issues may affect the viability of individual sites.

Grid Constraints and for Smaller Scale Technologies

4.51 Micro-generation plants that can be defined as Small Scale Embedded Generation (SSEG) are not required to enter into a contract with the DNO, which limits grid constraints upon them. It also should be noted that if a plant is below 300kW heat and 50kW electricity installed capacity a smaller connection capacity is required and so it is much easier to connect.

Gas Transmission and Distribution

4.52 The UK's indigenous gas supply is diminishing. In 2006 the UK became a net gas importer; by 2020 up to 80% of the UK's gas will be imported. The Government believes that increasing the diversity of gas suppliers and supply routes are of key importance for achieving security of supply[41].

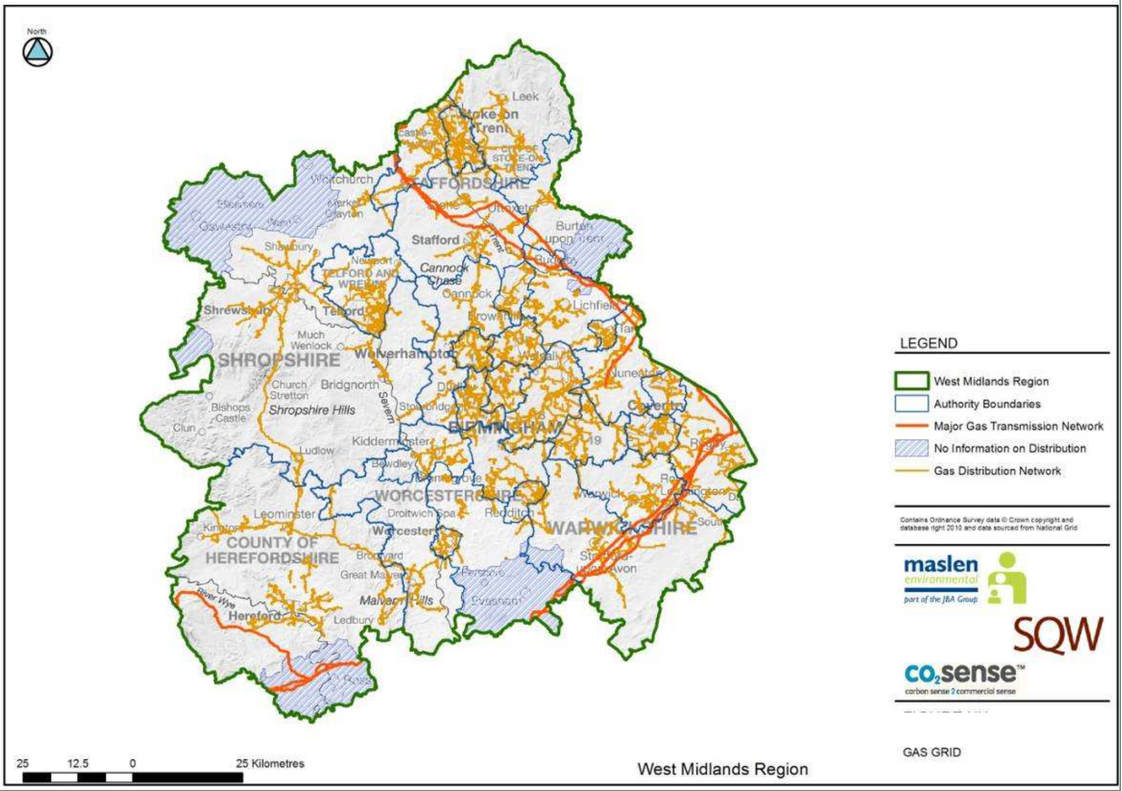
[41] 2004, Parliamentary Office of Science and Technology POSTnote no. 230, London

Gas Distribution Network in the Study Area

4.53 The National Grid (NG) operates the gas networks in the West Midlands area. Data was received from NG which allowed the study to generate a map of most of the region shown below in Figure 4-3. This indicates the extent of NGs major gas distribution network.

4.54 The regional map show that the gas network coverage correlates with the extent of urban areas. This provides no surprising results, as networks would have been installed and upgraded as new domestic and commercial properties were built. The map also identifies where there is no gas distribution coverage at all and a high-level view of where properties are 'off-grid'.

Figure 4-3: Gas Grid for the West Midlands Region



Source: Maslen Environmental

Off-Gas Households

4.55 Table 4-2 and Figure 4-4 highlight the proportion of households within the West Midlands Area without a gas connection and shows that in more rural authorities the proportion of households off the gas network is higher. Off-gas properties often have to rely on oil or solid heating which can be far more expensive than a gas system. This means that small scale technologies such as ground source heating, solar PV or biomass boilers/stoves could be well suited as alternative heat sources in these locations.

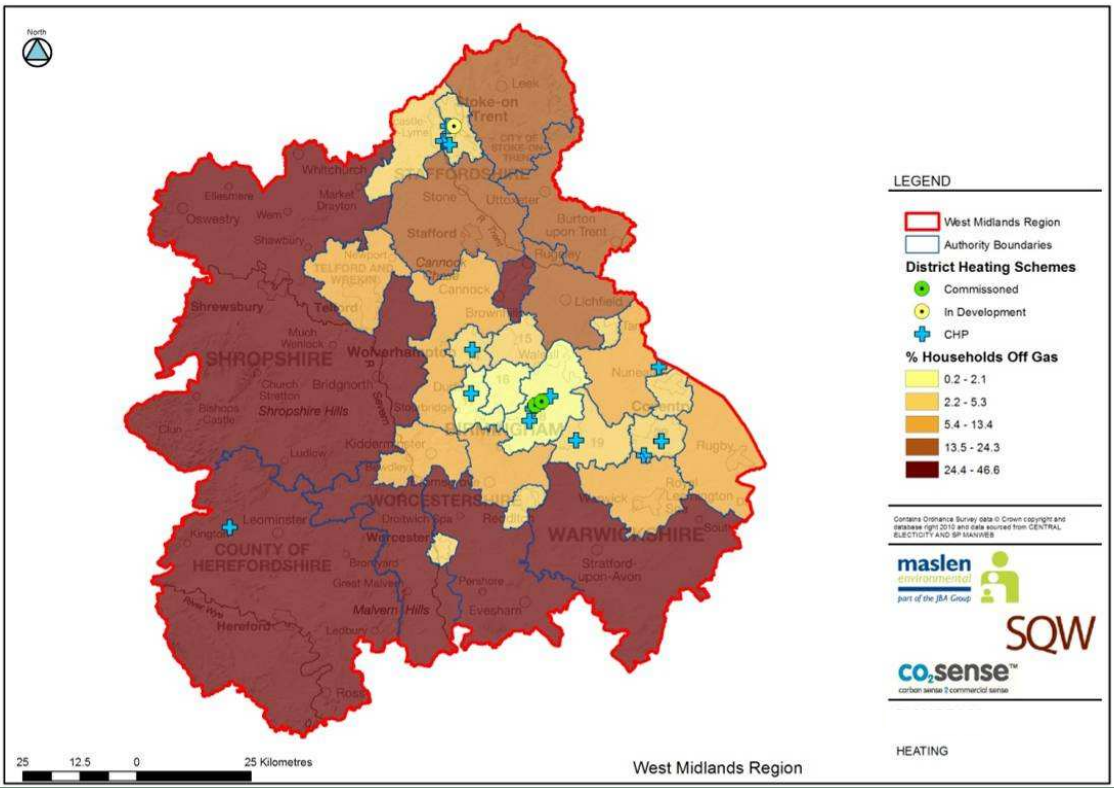
Table 4-2: On and off-grid gas connected households

Local authority	Total Number of Households	Number of Household Off Gas	Percentage of Households Off Gas
Herefordshire	**75,076**	**25,254**	**34**
Telford & Wrekin	**66,107**	**5,200**	**8**
Shropshire	**42,862**	**19,977**	**47**
Stoke on Trent	**109,580**	**4,244**	**4**
Birmingham	**410,928**	**8,565**	**2**
Solihull	**85,315**	**3,451**	**4**
Coventry	**128,298**	**4,361**	**3**
Wolverhampton	**103,354**	**5,025**	**5**
Walsall	**107,591**	**4,299**	**4**
Sandwell	**123,203**	**193**	**0.2**
Dudley	**130,374**	**1,886**	**1**
Cannock Chase	39,550	14,814	38
East Staffordshire	45,090	6,647	15
Lichfield	40,242	9,778	24
Newcastle-under-Lyme	52,328	2,757	5
South Staffordshire	43,441	4,979	12
Stafford	52,931	7,668	15
Staffordshire Moorlands	39,893	6,321	16
Tamworth	30,562	1,629	5
STAFFORDSHIRE TOTAL	**34,4037**	**54,593**	**16**
North Warwickshire	25,780	3,261	13
Nuneaton & Bedworth	51,714	2,173	4
Rugby	39,092	4,269	11
Stratford-on-Avon	50,522	17,280	34
Warwick	56,724	7,587	13
WARWICKSHIRE TOTAL	**223,832**	**34,570**	**15**
Bromsgrove	37,015	3,708	10
Malvern	31,145	9,971	32
Redditch	34,083	1,637	5
Worcester	40,820	1,745	4
Wychavon	48,763	17,503	36
Wyre Forest	41,863	3,673	9

Local authority	Total Number of Households	Number of Household Off Gas	Percentage of Households Off Gas
WORCESTERSHIRE TOTAL	**233,689**	**38,237**	**16**
WEST MIDLANDS TOTAL	**3,443,325**	**410,062**	**12**

Source: Maslen Environmental

Figure 4-4: Percentage of Households Off-Gas



Source: Maslen Environmental

District Heating Schemes

4.56 At the other end of the scale from isolated off-gas properties, are those in areas suitable for district heating. The high heat demand of these areas (discussed in the previous Chapter) means that district heating becomes a more viable alternative to traditional gas boilers, even though accessing the gas network is relatively easy.

Potential for renewable gas

4.57 Currently, renewable gas production in the form of landfill gas and sewage gas represents a well utilised proportion of renewable energy generation in the UK. Approximately 1.4bcm (billion cubic meters) of renewable gas is produced in the UK at present, and could meet around 1% of total UK gas demand, further securing supply. However, currently due to incentives such as Renewable Obligations Certificates (ROCs), the majority of biomethane produced in the UK is used to generate electricity, with efficiencies of around 30% demonstrated.

4.58 There is widespread consensus that direct biogas injection into the national gas grid is more efficient. Gas is provided directly to the customers along existing pipelines which can be utilised for heating, creating efficiency rates in excess of 90%. Around 85% of homes in the UK are currently heated by gas, mainly drawn from the grid.

4.59 Before renewable gas can be injected into the network, it must be "upgraded" to meet UK gas pipeline specifications. The purpose of this is to remove unwanted gases such as carbon dioxide and hydrogen sulphide to leave an almost pure (~98%) methane gas. In order for biomethane to be suitable for gas grid injection propane needs to be added (to increase the calorific value) along with an odorant (to give a smell). Renewable gas upgraded to biomethane followed by injection into the gas grid is a technology which is already being deployed in many countries in Europe – including Germany, France and Austria[42].

4.60 Despite the urgent need to find alternatives to overseas and North Sea gas supplies (which is almost diminished), establishing such plants within the UK is still at a pilot project stage. The first biomethane gas injection to grid came on line in Didcot in autumn 2010, with a further 12 demonstrator projects planned by Centrica.

4.61 The main barrier to capitalising on biomethane injection has been a lack of public sector investment, which has been significantly lacking compared to other renewable and low carbon technologies, connecting to the electricity networks. It is expected that the Renewable Heat Incentive (RHI), planned to be introduced in June 2011, will provide the much needed financial confidence and support for biomethane grid injection.

[42]http://www.nationalgrid.com/NR/rdonlyres/9122AEBA-5E50-43CA-81E5 8FD98C2CA4EC/32182/renewablegasWPfinal1.pdf;

5: Conclusions

Conclusions

5.1 This report has provided renewable energy resource assessments for the West Midlands as a whole, and each of its constituent local authorities for the following technologies:

- Onshore wind – large scale and small scale
- Biomass – plant biomass, animal biomass, waste and co-firing
- Hydropower – small scale
- Microgeneration – solar photovoltaics and water heating, and heat pumps.

5.2 Results have been provided to 2030, with commentary provided as to whether capacity is likely to change significantly (either increase or decrease) by 2050. Annex E, in the supporting annexes document, provides results at 2050 for those technologies where there is likely to be substantial change (either increase or decrease). It should be noted that the assessments at 2050 are less reliable due to the potential for major technological changes impacting on levels of take up over this longer time frame.

5.3 In addition, the study provides an overview assessment of the potential for solar farms and solar infrastructure rather than a detailed quantitative calculation of capacity for these technologies. It has also identified the potential for taking forward Combined Heat and Power and those locations with the most potential for the waste heat although, again, these are not included within the overall calculation of renewable energy potential.

5.4 The study has also included an overview of grid infrastructure constraints and gas infrastructure across the region noting where there are any weaknesses and where future improvements are planned in terms of both connections and capacity.

5.5 Overall, the assessments have identified an overall renewable energy capacity for the West Midlands of **54.2GW.** The technology providing the largest resource is commercial scale wind and the local authority of Shropshire is identified to have the largest potential due to its rural characteristics. It is important that the basis for these assessments is understood. This resource assessment provides an estimation of potential not deployable resource, many other factors need to be taken into account to identify the likely level of deployment including load factors, further economic, environmental and planning constraints, financial support mechanisms and future technological developments which will impact on take up.

5.6 The study has employed Stages 1-4 of the DECC methodology, further work is needed to follow through Stages 5-8 which is where detailed constraints come into play such as economic viability and detailed planning and licensing issues.

5.7 An important conclusion is that the majority of resource potential (particularly large scale wind, but also biomass) is located within rural areas, many of which are some distance from grid connections. Planned extensions and capacity improvements to electricity and gas infrastructure are anticipated within the more urban areas. As such, current infrastructure constraints are likely to provide a substantial challenge to the realisation of the capacity identified.

5.8 Nevertheless, the resource identified is considerable and deployment of a significant proportion of this would help the West Midlands make a substantial contribution towards national renewable energy targets. According to 2009 figures from DECC, current renewable energy generation within the West Midlands (excluding solar photovoltaics and micro wind) stands at 188.5MW meaning that a step-change in deployment is required to capitalise upon the renewable energy resource available. The accompanying planning guide will help local authority planning officers, and other key stakeholder to support the increasing deployment of renewable energy technologies within their areas within environmental, economic and social limits.

5.9 The key conclusions of the study are summarised below:

- **There is a very large potential accessible onshore renewable energy resource in the West Midlands region (54.2GW) although further work is required to identify the proportion of this that would be considered viable.** It is important that this is recognised as potential not deployable capacity.
- Because the total potential capacity is so large, LAs can play to their own strengths with regards to maximising the use of the resource available to them. There are many **different routes through which local contributions to the 2020 target of 15% energy from renewables can be reached** providing a significant degree of flexibility.
- Related to the above, **whilst commercial scale onshore wind and microgeneration provide the most abundant resource** (93% of the potential capacity identified) and deployment of only a small proportion of this resource would substantially increase the region's current level of renewable energy generation, the deployment of **large biomass developments could also make a large proportional contribution** to the absolute amount deployed in 2030.
- **The West Midlands has a theoretical capacity potential of approximately 2GW for low carbon sources - Combined Heat and Power or tri-generation (to include cooling) and district heating schemes.** This warrants further more detailed consideration particularly for the conurbation of Birmingham which accounts for 40% of the identified potential.
- **Those areas with most potential (particularly for wind) are in the more rural areas which are at the greatest distance from grid connections.** With future plans to upgrade and improve grid connections and capacity being mainly within urban areas, capitalising upon this potential resource is likely to prove challenging.

Recommendations

1) As detailed above, the assessment is of renewable energy resource potential has been developed through identifying the naturally occurring resource and applying some high level constraints in accordance with the national methodology. ***It does not represent the potential that could, should or is likely to be deployed.*** It is essential that the report's findings are disseminated and promoted as such. Any misinterpretation of this overarching message may be to the detriment of future renewable energy deployment within the West Midlands.

2) The study has disaggregated results to the level of individual LAs supported by individual resource assessment datasheets (available from www.telford.gov.uk). These individual assessment results provide a starting point from which LAs should undertake further work to better understand the **opportunities and challenges that need to be addressed** to maximise renewable energy deployment within their areas. This work could consist of the following:

   - **Identification of deployment constraints and how they apply locally**. These should be filtered to focus on the constraints that are likely to have a material impact on the potential deployment of the theoretical opportunity. These are likely to include economic viability, supply chain, transmission constraints, and planning constraints.

   - **Development of deployment scenarios** to 2030 building in the above constraints to develop a range of quantified trajectories supported by qualitative narratives – these can include cautious and stretch targets as a percentage of future projected electricity demand.

   - **Further work with local communities** to promote renewable energy schemes, supported by the increased focus on localism and financial support available to promote such initiatives.

3) LAs should use the accompanying planning guide to ensure that their **planning policy guidance promotes renewable energy** within identified constraints and that this is well understood by planning officers, developers and local communities. Monitoring of the deployment of renewable energy should be taken seriously to understand how well LAs are progressing against any internal targets set. As national energy and planning policy are both in a state of considerable flux, it is essential that all stakeholders keep abreast of developing policy and legislation to ensure that they are maximising all opportunities to maximise renewable energy deployment.

4) Related to the above, the Low Carbon Economy Programme will work closely with LAs and other stakeholders to **maximise capacity, knowledge and skills** within planning and other renewable energy practitioners. As this is still a relatively 'new' area, LAs within the West Midlands should work closely together to maximise good practice sharing and learning. Several LA groupings are working together on joint core strategies and this evidence base provides them with the opportunity to develop joint policies and maximise learning through economies of scale.