Renewable energy capacity study for the West Midlands

A final annex document to Telford & Wrekin Council

March 2011

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Annex A: Review of Local Studies

Table A-1 : Review of local studies:

Document	Summary	Evidence of detailed resource assessment and degree to which this is consistent with the DECC renewable capacity assessment methodology	Geographical scope	Relevance to this study
Regional and sub-regional general resource assessments				
Birmingham Energy Strategy Carbon Descent Scenarios Draft v4 (2010)	This study focuses on the potential for reducing demand, increasing energy efficiency and potential for renewable energy in Birmingham. The limitations of potential and the assumptions made to get to these limitations are presented for a range of measures not limited to renewable energy (in transport and grids, for example).	Managed woodland (partially consistent – all wood calculated together, but using the same fuel requirement per MW of capacity) Waste wood (partially consistent – as with managed wood) Solar PV (partially consistent – constrains resource further than DECC methodology to account for high number of flats) Solar thermal (inconsistent – not assessed in DECC methodology) Large-scale wind (consistent) Medium wind turbines (inconsistent – not assessed in DECC methodology) Small wind turbines (consistent) Heat pumps (partially consistent – either only provides number of homes or method of calculation not indicated)	Birmingham City (20-25km from the outskirts of the city for the assessment of energy crops and woody materials)	Some of the data will be useful for the resource assessment, e.g. for the microgeneration assessment, the number of suitable south-facing roofs will prove useful. The maximum potential capacity for a range of biomass supply streams is provided (though method not stated). For those technologies whose assessment was consistent with the DECC methodology, this study will be useful for cross-checking data.
Renewable and Low Carbon Energy Resource Assessment and Feasibility Study – Warwickshire and Solihull (2010)	The aim of the study is to inform the partner Authorities about the potential viability and the deliverability of various renewable and low carbon options (within development and as decentralised generation) through the preparation	Wind energy and Biomass (Fully consistent)	Warwickshire and Solihull which includes the LA's of Stratford-on-Avon, Warwick, North Warwickshire, Nuneaton & Bedworth, Rugby , Solihull and	The study uses development forecasts which expects the provision of 55,800 dwellings between 2006 and 2026, which was amended to 54,000 as part of the WMRSS review undertaken in 2009.

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	of an evidence base. The findings of the study are to be used to inform each individual LA's LDF in accordance with PPS1 and PPS22 in support of the aim of achieving a 30% carbon reduction cut by 2020 in the region. The study looks at current and future energy consumption, existing and potential low and zero carbon energy generation capacity, low carbon policies and targets		Warwickshire County.	The identified capacity within the study area is approx 28MW (less than 1% of demand) with a further 57MW being planned. Land potentially available for wind energy will typically offer a marginal opportunity and therefore may only attract limited commercial interest. There is good potential biomass resource. Microgeneration can meet 1.3-3.9% or the areas heat and power energy Overall 9.5% (large contribution from wind in Stratford-on-Avon and Rugby) of the areas heat and energy needs could be met from low carbon sources – exceeding the 4% target in the regional energy strategy
Staffordshire Renewable energy Study (2010)	Aim of the study was to assess the technical potential, viability and deliverability of various renewable and low carbon options through the preparation of a local evidence basis. The evidence base includes an analysis of low carbon potential, investigation of suitable carbon standards for new development, recommendations for planning policy and associated non-planning measures to support effective planning policy. The study also included a review of a number of major development sites within the study areas to examine the viability	Yes – two scenarios presented: base case and elevated case. The assessment covers: wind energy resources and constraints (partially consistent with DECC methodology), microgeneration (not consistent) biomass using one scenario (consistent with DECC), hydropower (from an analysis of 17 sites across the sub-region), and also calculates the renewable energy potential associated with meeting changing building regulations. It does not include an analysis of landfill or sewage gas.	Staffordshire – Cannock Chase, East Staffordshire, Lichfield, Newcastle, Stafford, Staffordshire County, Staffordshire Moorlands, South Staffordshire and Tamworth	Wind, biomass and hydro resource assessments of direct relevance and will be taken into account in the study. Useful and of relevance for development of planning policy guidance.

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	and delivery implications for achieving higher carbon standards in practice which is covered in a separate report and has not been reviewed for this study.			
Stoke on Trent Renewable Energy Assessment (2009)	The purpose of the report is to ascertain Stoke-on-Trent's renewable energy generation potential, and to provide guidance on how the city can meet and exceed its share of the carbon reduction, fuel poverty and energy targets. It provides an evidence base to assist in determining which renewable energy technologies are the most effective to be integrated into the existing housing stock.	Wind (partially consistent method of calculation not detailed), biomass (fully consistent), solar thermal and solar photovoltaic (partially consistent – solar thermal is not assessed in DECC methodology), ground and air source heat pumps (partially consistent method of calculation not described).	Stoke-on Trent	A dual approach in the deployment of renewable energy technologies is required to meet the council's targets, both micro generation technologies and large scale renewable. Micro wind, solar hot water and passive solar design are the most suitable.
Energy and climate change strategies and action plans				
West Midlands Climate Change Action Plan (2007)	The action plan sets out the actions that regional organisations can and should take over the next three years. The action plan identifies six priorities: • Plan for low carbon, well adapted sustainable communities • Facilitate the transition to a low carbon economy • Ensure the delivery of substantial carbon reductions and climate change adaption measures	N/A	West Midlands	The action plan contains detailed actions, timescales and Lead organisation against each of the six priorities.

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	• Ensure that regional partners lead by example by significantly reducing carbon emissions • Increase awareness and understanding of the implications of climate change • Establish appropriate regional carbon reduction targets and transparent framework for monitoring progress.			
West Midlands Regional Energy Strategy (2004)	The strategy aims to ensure a sustainable, secure and affordable supply of energy and strengthen the regions economy. It consists of four headline objectives and an action plan: • Improving energy efficiency • Increasing the use of Renewable Energy Resources • Maximising uptake or business opportunities • Ensuring focused and integrated delivery and implementation.	N/A	West Midlands	Improving energy efficiency targets against each of the four strategy objectives as well as the action plan detailing what is likely to occur will be useful.
West Midlands Climate Change State of the Region Report 2009	The report explains the challenges and opportunities that climate change may present to the built environment, natural resources (water, land use and food),	No	The West Midlands	Understanding of the importance of factoring climate change into planning and investment decisions and how the cost of adapting our

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	transport, health, energy and waste and to business, skills and education. The report also provides practical ways of adapting to and taking advantage of these challenges and opportunities in the region.			behaviour can be minimised. The report highlights an expected gap in waste treatment capacity by 2020 and the need for the adoption of an 'equivalent self sufficiency' approach for each Waste Planning Authority in the region. It concludes that there are opportunities ahead for businesses operating in the environmental technologies sector, new drivers for innovation and to become self sufficient in energy supply as well as benefits for the regional tourism industry however challenges exist relating to the regions infrastructure in terms of the need for new infrastructure to facilitate adaption and mitigation and the ability to procure large scale infrastructure to drive low carbon development.
Biomass studies				
West Midlands Biomass Resource Study (2009)	The study identifies accessible biomass resources in the West Midlands.	Energy crops – SRC and miscanthus (partially consistent – different yields have been used) Straw, baled wheat straw only (partially consistent – DECC methodology also includes oil seed rape) Woodland arisings (partially consistent – woodland arisings cover various resources which are treated separately in the DECC methodology, for example managed woodland and waste wood).	West Midlands – regional level assessment (not individual local authorities)	The data sources will be highly useful for this resource assessment. If any assumptions are more applicable to the West Midlands (upon further research and consultation with relevant stakeholders) than those set out in the DECC methodology, we propose to use assumptions from this study.

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West Midlands Wood Energy Strategy	The strategy outlines key actions that need to be taken to increase the use of wood as a fuel in the West Midlands. Expanding the market by getting the main players working together, raising awareness of wood as a fuel and increasing the installation of wood boilers were identified as important actions of the strategy.	N/A	West Midlands	While this document provides useful background, it does not provide any data relevant to the resource assessment.
Emissions research				
West Midlands Regional Carbon Dioxide Emissions Study 2009	The study forms part of the partial revision of the WMRSS and includes the development of carbon trajectories for various housing scenarios. The aim of the study was to provide carbon dioxide emissions estimates for the business-as-usual and housing scenarios in 2026 from 365,000 to 445,600 additional houses The study also considers the impacts of sub-regional variations in impact, and urban and rural development patterns in the context of likely transport infrastructure	No	The West Midlands and its sub-regions	Contains carbon reduction targets The study indicates that carbon emissions will decrease from the 2006 base year when projected into the future driven by fuel use and fuel efficiency. New development is encouraged close to existing public transport links and discouraged where there is little public transport provision. Progress towards regional and national CO2 targets is monitored against the following indicators: Greenhouse gas emissions, CO2 emissions by end user, aviation and shipping emissions, renewable electricity, electricity generation,

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				household energy use, road transport, private vehicles, road freight, manufacturing sector, service sector and public sector.
Heat studies				
Birmingham District Energy - The Company Delivering Sustainable Energy to Birmingham	An overview of the Broad Street District Heating scheme.	Not Applicable	Birmingham	Provides an understanding of 'real world' opportunities and constraints in developing district heating schemes.
West Midlands Heat Mapping & Decentralised Energy Feasibility Study (2008)	The first phase of the project consisted of estimating current domestic and non-domestic demand on a LSOA basis. This was calculated through census and business data base estimates of the numbers of types of different building combined with data of typical energy demands of those types. Future projections of demand were based on RSS housing provision targets and planned 'employment sites'. The second phase of the study used the heat demand mapping from the first phase to identify areas of high heat demand. Along with more site specific details and economic modelling, this was used to assess the viability of potential CHP sites. The report also analysed the proportion of house off the gas grid and provided an overview of the electricity and gas distribution grids	Partially consistent – however the thresholds for CHP viability are not consistent with the DECC methodology.	West Midlands	The heat mapping produced by this study will be used to assess the validity of the heat mapping produced for the new study.

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	in the region			
Hydropower studies				
EA, Hydropower guide for developers and communities	Guidelines for developers of hydropower schemes to assist in thinking through the issues.	Hydropower assessment.	Overview of guidelines and the planning process.	Very relevant as it provides an overview of planning guidance. This document will be used as a reference.
Mapping hydropower opportunities and sensitivities in the West Midlands, Environment Agency (2010)	Nationwide hydropower resource assessment.	Hydropower resource assessment divided into outputs at a regional scale. Method is generally consistent with the DECC method. Low power sites <25 kW were included in the study. Low barriers <1 m were included in the study.	Nationwide study for England and Wales. All of west midlands areas covered with no power or barrier height lower limits set for viability and inclusion of potential scheme.	Forms key background information and set of sites for subset selection as the basis of this study.
Low carbon housing studies				
SHAP – 2005-6 Final report (www.shap.uk.com)	The report outlines the key aims and outcomes of the SHAP programme - The Sustainable Housing Action Programme.	N/A	West Midlands	Relevant to the planning guidance
SHAP – Planning for low carbon housing (www.shap.uk.com)	A best practice guide was produced to illustrate best practice in sustainable energy planning for low carbon homes. The guide presents a review of climate change and energy policy and planning mechanisms which come into play in the West Midlands.	N/A	West Midlands	Highly relevant to the planning guidance to be produced Also the data future housing growth could be useful to determine future resource, especially future municipal solid waste and sewage gas.
SHAP – Low Carbon Housing Retrofit Baseline Study, 2009 (www.shap.uk.com)	Outlines the results of an assessment of existing housing refurbishment during the period of April 2007 to March 2008, along with	N/A	West Midlands	The datasets which have been produced alongside this report will also be useful sources (http://www.wmra.gov.uk/Housing/P

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	recommendations for future refurbishment. The CO_2 savings as a result of the refurbishment and the costs were detailed.			ublications_Guidance_and_Research/Low_Carbon_Housing_data_sets.aspx)
SHAP – West Midlands Framework for Low Carbon Housing Planning (www.shap.uk.com) 2008	This is a framework for reducing the climate change impact of housing in the region. The study takes a forward look at how it will achieve its vision for low carbon housing by 2016. The key elements identified by the study that could form part of a model local framework for action include: • LA's providing leadership and coordination through their Sustainable Community Plans and sharing of best practice at sub-regional level • Establishing a strong evidence base including high quality meaningful survey data • Developing pilot house-type demonstrators in order to build a knowledge base of the 'kit of parts' and installers for each typology • Supporting community engagement and outreach especially at the point properties change hands • Novel financial mechanisms e.g. low cost finance and equity release for owner occupiers, roof space agreements and	No	West Midlands	Housing accounts for up to 30% of the regions CO2 emissions Provides the context of the state of the regions current housing stock regarding energy efficiency and policies and programmes implemented to date to raise the energy efficiency of the housing stock and the requirement to meet the targets within the regional Energy Strategy e.g. a refurbishment rate of 20,000 properties per annum by 2011 rising to 80,000 properties per annum by 2016, matched by a new build replacement rate of 4,000 properties per annum.

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	economies of scale achieved through enveloping works in terraced streets.			
Waste studies				
AWM – Landfill Diversion Strategy (2009)	Describes the regional approach to landfill diversion infrastructure, identifying a shortlist of priority locations. A GIS analysis tool is also available through AWM which can model waste arisings by waste stream and potential waste infrastructure locations.	N/A	West Midlands	Tool could be useful for the future potential of the landfill gas resource.
Birmingham Waste Capacity Study (2010)	The study looks into current and future waste arisings and the infrastructure that will be needed to cater for these arisings. It also explores existing and emerging policy and legislation which could impact on waste management planning in the area.	Municipal solid waste (partially consistent – only the amount of waste in tonnes, not converted to energy capacity) Commercial and Industrial Waste (partially consistent – as with MSW)	Birmingham City	Data on waste arisings and the permitted waste facilities in Birmingham are relevant. Also future waste plans could help determine the assumptions used for the future waste resource.
Wind studies				
DECC - Improving grid access - second consultation	This consultation document attempts to set out new ways in wind renewable developments can access the electricity grid in a more efficient manner in the future to ensure that potential resources can be better utilised.	Not Applicable	UK wide	Inform the grid constraints discussion.
Update of Wind Resources Study for	The aim of the study was to update	Inconsistent – there were a number of	West Midlands	Provides a general approach to

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the West Midlands (2008)	the previous report produced in 2004 and review the economically viable wind resource available across the West Midlands region and key wind development constraints, using an updated GIS Mapping Tool. The GIS method was similar, but not exactly the same as, the DECC methodology. There were three stages; • Identifying areas with sufficient wind – i.e. areas above 6m/s at 45magl were deemed suitable • High level practical resource filtering – i.e. identifying areas unsuitable for development – e.g. urban areas and AONB. • Prioritising practical resource filtering – i.e. identifying areas with minimal on aviation and military activities constraints. The results showed that 59% of the land in the West Midlands had sufficient wind resource, 30% of the region was estimated to have a suitable high level practical resource and a high proportion of that resource may be subject to military and aviation constraints.	inconsistencies with the DECC methodology including the wind threshold being set higher.		West Midland spatial constraints.
West Midlands Wind Energy Information Tool: Assessment of Wind Energy Resource (2004)	The report presented an assessment of the large scale wind energy resource available in the West Midlands Region for electricity generation by 2010; based on a wind energy resource tool developed	Inconsistent	West Midlands	Provides a general approach to West Midland spatial constraints.

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	by the Government Office for the West Midlands. There were three stages to the assessment • Identifying areas with wind speeds of above 7 m/s at 45 m. • Applying major constraints analysis to these areas (e.g. AONB, SLA / AGLV, national parks, large urban areas and their buffers (500 m), and airport restricted. • Applying second level analysis; looking at local effects areas motorways, a-roads, distribution network, broadcasting links, microwave links, telemetry links, ancient woodland, SSSI, ancient monuments The conclusion of the study was that there were 78 areas with sufficient wind speed however only 22 areas show some extent for potential for wind energy deployment.			

Annex B: Accessible resource methodology and assumptions

B.1 This section details the assumptions utilised for the assessment of each resource technology. Where these are highlighted in purple, this denotes a change since the assumption detailed in the Scoping Report considered by the Steering Group in December 2010.

Table B-1 : Assumptions for commercial-scale wind

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Wind speed	NOABL	NOABL	Include area with wind speed 5m/s at 45m above ground level (agl)	As DECC	No divergence	Accepted no divergence	Very small area excluded due to this constraint. Readings over water are often zero
Wind turbine size	N/A	N/A	Standard turbine size with specifications: 2.5MW, tip height 135m, rotor diameter 100m, hub height 85m	Standard turbine size with specifications: 2.5MW, tip height 135m, rotor diameter 100m, hub height 85m	No divergence	Accepted no divergence	
Wind turbine density	N/A	N/A	Apply a distance between turbines of 5 rotor diameters or a benchmark of 9MW/km^2	Relevant densities determined through consultation Natural England for: • National Parks and AONB = 0MW/km^2 • Buffer areas adjacent to protected landscapes = 9 MW/Km^2	DECC methodology encourages consultation regarding protected landscapes and other sensitive areas. Consultation was undertaken to agree the turbine densities to be applied within protected landscapes, if buffers should be applied adjacent to protected	Noted that on the approach to AONB, buffer zone and densities related to other sensitive areas. Additional guidance on landscape sensitivity was sought. It was noted that the Staffordshire Capacity Study does not exclude commercial wind	National Parks density in line with Peak District National Park Authority. Supplementary Planning Guidance. Energy: Renewables and Conservation. Chapter 3 para 3.1 and the AONB assumption is in line with previous Halcrow 2004 and

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
				• Other sensitive areas (such as bird sensitive areas) = 4.5MW/ Km^2 • Areas outside of all mapped exclusion areas/constraint = 9MW/km^2	landscapes and if consideration should be taken of other sensitive areas (e.g. bird sensitive areas)	farms from protected landscapes although there is no presumption in their favour.	2008 assessments No buffer zone has been recommended in line with PPS22 paragraph 14 50% deployment in high and medium sensitivity areas was agreed through consultation with RSPB for the North West RLC study. In the West Midlands area there are no substantial areas of BAP blanket bog outside SSSIs and National Parks – therefore no peat specific deployment density is recommended.
Constraints assessment							
Non accessible areas	OS Strategi, MOD		Exclude: roads, (A,B, motorways), railways, inland waters (rivers, canals, lakes reservoirs), airports, MOD training sites, built up areas (settlement polygons)	No divergence		Noted that MOD training sites will only be applied if the information is made available during consultation.	No divergence The OS strategi dataset used to identify areas of settlements, does not cover smaller settlements such as hamlets; however the buffers used constraint the available land around major communication

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
							links should act to cover most of these.
Exclusion areas	OS Strategi www.magic.gov.uk MOD		Exclude: • Ancient semi-natural woodland • Sites of historic interest (with no buffer) • 150m buffer (tip height + 10%) around roads and rail • 600m buffer around OS Strategi settlement edges • 5km buffer around airports • Civic Air Traffic Control Constraints • Mod training areas • Explosive safeguarded areas, danger areas near ranges	No divergence		Accepted no divergence	No divergence
MOD constraints	Consultation with MOD	Consultation with MOD	Consultation with MOD to determine	Consultation with MOD	No divergence	Accepted no divergence	MOD did not respond during the time period

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
			constraints associated with the sites/estates/Air Traffic Control/radar/safeguarded areas/danger areas and MOD bylaws				of the study and therefore capacity is likely to be constrained further on this basis
Projections to 2030 and 2050							
Wind speed and other variables unlikely to change significantly and therefore the capacity was assumed to remain the same.							
Summary of methodology							
The analysis was undertaken using GIS data. All opportunities (wind speed above the threshold) were mapped and then constraints (non-accessible and exclusion areas) collated in GIS and removed from the opportunities layer. This left a layer of 'unconstrained' land which was examined in terms of the density of turbines it could potentially accommodate. Consultation with Natural England and others determined the approach to protected landscapes and other sensitive areas							

Source: Maslen Environmental

Table B-2 : Assumptions for small scale wind

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Address points	OS Address Point	OS MasterMAp Address Layer 2	Estimate total number of residential and non-residential buildings	Estimate the total number of residential properties as well as those which have the potential for community schemes	OS Address Point data is no longer the best dataset and does not enable identification of properties suitable for community schemes	Agreed	
Wind speed	NOABL	NOABL	Include area with wind speed 4.5m/s at 10m above ground level (agl)	As DECC	No divergence	Agreed	
Wind turbine size	DECC methodology	As DECC	6kW per address pt	As DECC	No divergence	Agreed	
Constraints assessment							
Mean wind scaling factor	DEFRA Rural definition (ward level) Wind scaling factor: DECC methodology	As DECC	Include address points where scaled wind speed 4.5m/s at 10m agl. Assume scaling factor 56% for urban, 67% suburban, 100% rural	Base classification of areas on Defra's MLSOA classification	Ward boundaries have changed since the Defra classification - using MLSOA ensures all areas correctly aligned	Agreed	
Projections to 2030 and 2050							
Wind speed and other variables unlikely to change significantly and therefore the capacity was assumed to remain the same.							
Summary of methodology							
This assessment was GIS based and involved identifying the number of residential and non-residential properties within an area and assuming that a 6kW machine would be installed on all sites with a wind speed above 4.5m/s. A wind speed scaling factor was applied to take account of the potential for obstructions in built up areas to reduce the average wind speeds and therefore the number of suitable properties. Consultation was undertaken with Natural England concerning the deployment of small scale wind in protected landscapes.							

Table B-3 : Assumptions for plant biomass – managed woodland

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Existing and potential feedstock	FC Woodfuel Resource Tool National Inventory Woodlands and Trees	FC Woodfuel Resource Tool and National Inventory of Woodland and Trees (NIWT). Consultation with the Forestry Commission to check if more disaggregated data is available.	To assess the volume of woodfuel in the region apply one of two options: **Option 1**: Use the Forestry Commission Research tool that provides data on regional woodfuel resource by different types of forestry product at a sustainable level of production. **Option 2**: Bring forward and increase the accuracy of the National Forest Inventory (NFI) woodfuel forecast by the Forestry Commission which is expected to be released in 2011 (for conifers) and 2012 (for broad leaves).	We followed up option 1 as option 2 is not viable within the timeframes of this study. This is because the new datasets from the Forestry Commission (the National Forest Inventory) will now not be available until 2015, upon completion of the new inventory. A local assessment can be derived from the regional data of the FC Woodfuel Resource Tool by disaggregating to a county level based on the percentage split of woodland types stated in the NIWT dataset. The data was disaggregated further to lower tier local authority level based on land areas.	Divergence as data only available for regional level from source proposed in the DECC methodology. It is therefore necessary to refine the analysis for local level calculations.	It was queried why option 2 is not viable which is explained under proposed assumptions.	We consulted with the FC to see whether tier 2 local authority data/GIS data is available. As these were not obtained, county data was disaggregated based on percentage split of land area in each LA. Discussions with the FC as to whether they can provide some preliminary data from the new inventory (the National Forest Inventory) were held. As newer data were unavailable, the NIWT, although from 1995-99, is the most accurate and complete existing dataset.
Fuel requirement – electricity odt/ME	DECC methodology	DECC methodology	6000odt/year = 1MW	6000odt/year = 1MW Also assumption that 1 cubic metre is equivalent to 1 green	No divergence from the central assumption.	Accepted no divergence	

				tonne Assume a loss of 50% when converting green tones to oven dried tonnes			
Fuel requirement – heat odt/MW	Biomass Energy Centre	Biomass Energy Centre	Low grade timber, and stemwood >14cm diameter and conifer stumps: 18 GJ/odt. Stemwood l<14cm diameter, branches, tips and foliage: 12.5 GJ/odt. Plant conversion efficiency: 80%. Plant availability: 80%.	Low grade timber, and stemwood >14cm diameter and conifer stumps: 18 GJ/odt. Stemwood l<14cm diameter, branches, tips and foliage: 12.5 GJ/odt. If detailed data on wood type is unavailable, use 18GJ/odt for all types. Plant conversion efficiency: 80%. Capacity factor: to be investigated (range of 20 to 45%).	Divergence on fuel requirement only if data not detailed enough to apply DECC assumptions – discussions with the FC in the NW suggested 18GJ/odt as an estimate for all managed wood. 80% availability thought to be unrealistically high – this was the expert view provided by the Peter Fox of the Forestry Commission during discussions for the North West resource capacity assessment. The 45% capacity facor figure was chosen as it was the middle CT factor (no evidence was found to suggest that the other two would be more applicable).	Requested justification for 80% availability being considered as unrealistically high – explanation provided under reasons for divergence from DECC.	The Carbon Trust guidance provides the following capacity factors (Biomass heating: a practical guide for potential users, 2009): • 20% for general occupancy building • 45% for service applications • 60% for process applications
Constraints assessment							
Exclusions of woodfuel potential	Forestry Commission statistics	Forestry Commission statistics and consultation with	Applied exclusions based on: • Woodfuel that is uneconomic to	The FC Tool is able to constrain wood arisings on economic/logistical	No divergence as the DECC methodology is not specific as to the nature and extent	Accepted no divergence	

	Forestry Commission	harvest • Woodfuel that will or could go to alternative markets (such as paper, construction etc)	and environmental grounds, e.g. nature conservation sites, restoration sites. For FC woodland, assume that only 10% is available without disruption to existing wood-using industries (Forestry Commission, 2003, Woodfuel Resource in Britain). For private woodland and arboricultural arisings, assume that all the resource could potentially be used.	of the constraints to woodfuel potential.

Projections to 2030 and 2050

Assume woodland area in the West Midlands will increase 0.5% per annum to 2030 and 2050 (based on consultations with the Forestry Commission).

Summary of methodology

Whilst both options will entail the use of GIS data on woodland locations and types to assess potential, Option 1 is essentially a 'top-down' approach whereas Option 2 would be 'bottom-up'. Option 1 would use data from the Forest Research Tool to obtain regional figures. GIS data for woodland types and locations would be used to disaggregate the regional data to Local Authority level based on proportions of woodland type per LA. Option 2 is not possible to fit in within the timeframes of the study unless the FC is able to provide data not yet published. Constraints in terms of competition from alternative markets and economic constraints would be applied. Both electricity and heat capacity were assessed as alternative options

Source: SQW and Maslen Environmental

Table B-4 : Assumptions for plant biomass – energy crops

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Existing resource	Existing resource	Use uptake data from Woodland Grant Scheme (SRC prior to 2005) and Energy Crops Scheme (SRC and miscanthus since 2001) National Non-Food Crops Centre	Natural England Energy Crop Scheme GIS data	Existing areas of established SRC, miscanthus and SRF	Use Natural England's GIS data for energy crop schemes and consult NE on other schemes that need to be considered.	Accepted no divergence – data enhanced with spatial data from Natural England.	
Available land (High scenario)	Available land (High scenario)	Rural Payments Agency (PRA/IACS), Defra (for agricultural land classification and Regional Energy Crop Opportunity Maps and Guidance) and Natural England	Rural Payments Agency (PRA/IACS), Defra (for agricultural land classification and Regional Energy Crop Opportunity Maps and Guidance) and Natural England	Assume that all available arable land and pasture will be planted with energy crops and refer to Defra's Energy Crop Opportunity Maps for yield bands and benchmarks. Quantify for each energy crop category defined and where spatial overlaps occur use the energy crop with the highest yield band.	Only divergence from the DECC methodology if spatial data are not available.	Accepted no divergence providing spatial data available	
Available land (Medium scenario)	As above	RPA or Defra Agricultural and Horticultural Census	Assume that energy crops are planted only on land no longer needed for food production, i.e. all abandoned arable	Consulted with the RPA to determine if spatial data on abandoned land is available. If unavailable, bare and fallow land (all arable	Only divergence from the DECC methodology if spatial data are not available.	Agreed	Spatial data not available – used Defra Agricultural and Horticultural Census

			land and pasture.	land not currently in production) from the Defra Agricultural and Horticultural Census will be used in its place. A ratio of 9:1 is proposed for the proportion of miscanthus and SRC.			
Available land (Low scenario)	As above	Natural England	Assume new crops will only be planted to the extent of submitted application to the Energy Crop Scheme (ECS) for 2010.	Assume new crops will only be planted to the extent of submitted application to the Energy Crop Scheme (ECS) for 2010.	No divergence, unless 2010 data is not yet available (2009 would be used in this instance instead)	Accepted no divergence	
Yield	No data required	No data required	Apply the following biomass yields: • 10 odt/ha – short rotation coppice (SRC) • 15 odt/ha – miscanthus Increase these yields by 10% for 2020.	Apply the following biomass yields: • 10 odt/ha – short rotation coppice (SRC) • 15 odt/ha – miscanthus Increase these yields by 10% for 2020.	No divergence	Queried why 10% yield is being reviewed. This is because the DECC methodology was concerned with capacity assessments in 2020, and this study is looking to 2030.	Considered 10% increase in yield also appropriate for the resource assessment in 2030. The increase in yield was recommended by the DECC methodology for 2020
Fuel requirement (electricity)	No data required	No data required	Apply a benchmark of 6,000 odt/year per 1 MW for electricity to convert the amount of total biomass feedstock to installed capacity.	Apply a benchmark of 6,000 odt/year per 1 MW for electricity to convert the amount of total biomass feedstock to installed capacity.	No divergence	Accepted no divergence	
Fuel requirement (heat)	No data required	Natural England and DECC Digest of UK Energy Statistics	Apply standard calorific values of woodfuel categories: 12.5 GJ/odt (for	Miscanthus: 17GJ/odt; SRC: 18.6GJ/odt	Calorific values for energy crops based on benchmarks in Natural England:	View that 80% availability is excessive was queried and	The Carbon Trust guidance provides the following capacity factors (Biomass

			woodchip); 17 GJ/odt (for wood pellets); 13 GJ/odt (for baled miscanthus). For all fuel categories, apply plant conversion efficiency of 80% and plant availability of 80%.	Plant conversion efficiency: 80%. Capacity factor: to be investigated (range of 20 to 45%).	Planting and Growing miscanthus Best Practice Guidelines July 2007 and DUKES Annex A. 80% availability thought to be unrealistically high – (this was the expert view provided by the Peter Fox of the Forestry Commission during discussions for the North West resource capacity assessment. We will investigate which capacity factor is most appropriate for the likely biomass heating systems to be installed in the West Midlands.	justification provided	heating: a practical guide for potential users, 2009): • 20% for general occupancy building • 45% for service applications 60% for process applications
Constraints							
Exclusion areas	Multi Agency 'MAGIC' database	MAGIC and IACS databases, Natural England, English Heritage	Exclude from the assessment the following areas: • Permanent pasture/ grassland • Public rights of way (PRoW) • PRoW buffer – 3m (Miscanthus), 5m (SRC) • Common land • SPS Cross	Exclude areas specified by DECC methodology including public rights of way according to statutory requirements apart from PRoW buffer. For SPS Cross compliance buffers alongside field boundaries, reduce area by percentage based on average field size to account for these exclusion	No data are available on PRoW buffers. For SPS Cross compliance buffers, percentage was based on the average field size in the IACS database.	Suggested that assessment should use statutory requirements for public rights of way – addressed under proposed assumptions	

			compliance buffers alongside field boundaries • Nature conservation and historic designations	areas.			
Environmental impacts	GIS data from Environment Agency and Natural England	GIS data from Environment Agency and Natural England	Explore areas subject to potential adverse environmental impact and consult the respective responsible agencies for guidance: • water stressed areas – consult the Environment Agency • biodiversity impacts (e.g. farmland bird species) – consult Natural England • protected landscapes (National Parks and AONBs) - no blanket exclusion should be applied, however a maximum block limit may be applied; consult Natural England	As per DECC methodology	No divergence	Accepted no divergence	Natural England and Environment Agency consulted on assumptions

Projections to 2030 and 2050

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.

Summary of proposed methodology

The DECC methodology requires the 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.

The high scenario, as defined in the DECC methodology, is acknowledged to be neither possible nor desirable due to other uses of the land that are not considered within the assessment (such as food production). This scenario is entirely theoretical. The medium scenario was used, but the assessment was also undertaken for the low scenario – results are provided in Annex F

GIS data was used to make the analysis as spatially relevant as possible. The approach to protected landscapes was discussed with Natural England.

Both electricity and heat capacity were assessed as alternative options

Source: SQW

Table B-5 :Assumptions for plant biomass – waste wood

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Existing and potential feedstock	Forestry Commission/WRAP	WRAP (2009) Wood Waste Market in the UK Housing allocations data	For sawmill waste: regional level assessment of sawmill throughput For construction wood waste: use regional data and disaggregate on the basis of new housing allocations employee numbers in each local authority. For future additional feedstock: increase existing feedstock by 1% per year	All wood waste used except for MSW which was assessed separately Regional waste was disaggregated to local authority level based on employee numbers in each area. Future additional feedstock as per DECC methodology	Used WRAP report because it is considered to be more reliable than DECC data and sawmill report is no longer published by the Forestry Commission. DECC methodology details steps to arrive at a regional assessment. Refinement of the analysis was required for the local authority level assessment.	This has been changed from the suggestion to use housing allocations to using projected employee numbers because waste wood is from industry, not municipal waste wood which is already covered in MSW. This will align waste wood with the methodology for C&I.	It was suggested that the WRAP report may not contain the best data for sawmill waste – this was checked with FC/WRAP and it was agreed that this was still the most appropriate data source.
Fuel requirements (electricity)	Biomass Energy Centre	Biomass Energy Centre	For electricity: use benchmark of 6,000 odt/year per 1MW	For electricity: used benchmark of 6,000 odt/year per 1MW	No divergence	Accepted no divergence	
Fuel requirements (heat)	Biomass Energy Centre	Biomass Energy Centre	Apply standard calorific values	12.5GJ/odt and assumed that wood is of poorer odt quality Plant conversion efficiency: 80%. Capacity factor:	Calorific value for heat introduced as not specified in the DECC methodology – this has been supplied by the Biomass Energy	Agreed	The Carbon Trust guidance provides the following capacity factors (Biomass heating: a practical guide for potential users, 2009):

				45%	Centre 80% availability thought to be unrealistically high – this was the expert view provided by the Peter Fox of the Forestry Commission during discussions for the North West resource capacity assessment. We will investigate which capacity factor is most appropriate for the likely biomass heating systems to be installed in the West Midlands.	• 20% for general occupancy building • 45% for service applications • 60% for process applications
Constraints assessment						
Available feedstock	No data required	No data required	Assume 50% of resource is available	Assume 50% of resource is available	Agreed	
Projections to 2030 and 2050						
For future additional feedstock it was assumed that existing feedstock should be increased by 1% per year as recommended by the DECC methodology						
Summary of proposed methodology						
The proposed method identified the amount of sawmill and construction wood waste in the region. Both electricity and heat capacity were assessed as alternative options. Sub-regional arisings data was disaggregated on the basis of number of employees in each local authority in the West Midlands. An assumption that only 50% of this resource will be available for biomass due to competing demands was applied.						

Source: SQW

Table B-6 : Assumptions for plant biomass – agricultural arisings (straw)

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Existing and potential feedstock	Defra Agricultural and Horticultural Survey – England	Defra (2010) June Census of Agriculture and Horticulture – England	Use data of existing feedstock of all wheat and oil seed rape straw only	Used data of existing feedstock of all wheat and oil seed rape straw only Assumed 3.5 tonnes per ha of wheat and 1.5 tonnes per ha of oil seed rape	Assumptions relating to tonnage of wheat and oil seed rape are from the Biomass Energy Centre as DECC does not give guidance on these parameters	Agreed	As local authority results were only available for 2007 and not 2009 (county data), the local authority results were therefore estimated using 2007 distribution prorated Assumed area for the cultivation of straw in the West Midlands remains unchanged in 2030 and 2050
Fuel requirement	N/A	N/A	Apply benchmark of 6,000 odt of baled straw per 1MW capacity	Applied benchmark of 6,000 odt of baled straw per 1MW capacity	No divergence	Accepted no divergence	
Constraints assessment							
Available feedstock	Defra Agricultural and Horticultural Survey – England	Defra (2010) June Census of Agriculture and Horticulture – England	Apply 1.5 tonnes of straw per annum per head of cattle in the region From the total amount of straw produced in each area, subtract either the total animal bedding requirement or 50% of the total amount of straw, whichever is less.	Applied 1.5 tonnes of straw per annum per head of cattle in the region and subtracted either the total animal bedding requirement or 50% of the total amount of straw, whichever is less	No divergence unless evidence is found that animal bedding requirement is more extensive in the WM than elsewhere	Noted that in the West Midlands wheat straw is a particularly valuable resource for animal bedding. It is often imported from the East of England to meet demand. This may have implications for the amount available for biomass.	There may be particular reasons for proposing a divergence in the DECC methodology for competing uses for straw. Wheat straw is a particularly valuable resource for animal bedding in the West Midlands and often needs to be imported from elsewhere. This will

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
							require further investigation.
Projections to 2030 and 2050							
Assumed area for the cultivation of straw in the West Midlands remains unchanged in 2030 and 2050							
Summary of proposed methodology							
The assessment methodology involved identifying the amount of wheat & oilseed rape straw available from the Agricultural and Horticultural Census. A reduction in the quantity of feedstock available was applied to take account of the demand for straw for cattle bedding. It is important to note that there is substantial variation in the range of gas from different feedstocks and the recoverable gas from different technologies.							

Source: SQW

Table B-7 : Assumptions for animal biomass – wet organic waste

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Existing and potential feedstock	ADAS Manure Management Database, Defra Agricultural and Horticultural Survey – England and Food and Drink Federation	For livestock data: Defra (2010) June Census of Agriculture and Horticulture – England For manure factor: Biomass Energy Centre For food and drink waste: ADAS (2009) National Study into Commercial and Industrial Waste Arisings	For manure and slurry: use data on number of livestock multiplied by a manure factor For food and drink waste: use data from Defra and food and drink federation	For manure and slurry: used data on livestock numbers multiplied by a manure factor For food and drink waste: used data for food (the food, drink and tobacco and retail and wholesale sectors, animal and vegetable and non-metallic waste only) from ADAS (2009) National Study into Commercial and Industrial Waste Arisings. This gave data to county/unitary authority level – disaggregated to local authority level based on employees in each local authority.	For food and drink waste, the ADAS study is the most up to date and complete data source. DECC also only specifies a methodology for the assessment at a regional level.	Amended post Steering Group review of approach	As local authority results for animal numbers were only available for 2007 and not 2009, the local authority results were therefore estimated using 2007 distribution prorated. Change from initial draft to base disaggregation to local authority level on the number of employees in each local authority rather than housing allocations because of the industrial nature of the data.
Biogas yield	UK National Non-Food Crops Centre (NNFCC)	UK National Non-Food Crops Centre (NNFCC)	Assume biogas yields of 25m3/t for cattle, 26m3/t for pigs and 46m3/t for food and drink	Assumed biogas yields of 25m3/t for cattle, 26m3/t for pigs and 46m3/t for food and drink	No divergence	Accepted no divergence	
Feedstock requirements	N/A	N/A	Apply benchmark of 37,000 tonnes of wet organic waste	Applied benchmark of 37,000 tonnes of wet organic waste	No divergence	Accepted no divergence	

			required per 1MW capacity per year	required per 1MW capacity per year		
Constraints assessment						
Limits to extraction	N/A	N/A	Assume 80% of the resources can be collected	Assumed 80% of the resources could be collected	No divergence	Noted that in practical terms usable manures will in the first instance 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.
Competing uses	N/A	N/A	For manure and slurry: assume 100% of total resource is available for energy For food and drink: assume 50% of total resources is available for energy	For manure and slurry: assumed 100% of total resource was available for energy For food and drink: assumed 50% of total resources was available for energy	No divergence	
Projections to 2030 and 2050						
Assumed animal numbers in the West Midlands remain unchanged in 2030 and 2050. Food and drink waste in 2030 and 2050 was increased by 0.5% per annum based on a UK benchmark for increases to employee numbers.						
Summary of proposed methodology						
The assessment methodology used data on the number of livestock (cattle and pigs) multiplied by a manure facture (i.e. amount of manure per head per year); for food and drink waste the methodology used data on the animal and vegetable and non-metallic waste fraction of the total food, drink and tobacco and retail and wholesale sectors wastes. The methodology applied a benchmark of 37,000 tonnes of wet organic waste required per 1 MW capacity per year.						

Table B-8 : Assumptions for animal biomass - poultry

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Existing and potential new feedstock	Defra Agricultural and Horticultural Survey – England	Defra (2010) June Census of Agriculture and Horticulture – England	Use data on poultry numbers and excreta factor per head of poultry Only include broiler birds to calculate poultry numbers	Used data on poultry numbers and excreta factor per head of poultry Assumed that per 1,000 broiler birds, 16.5 tonnes of litter is typically produced per annum (Biomass Energy Centre)	No divergence	Accepted no divergence	As local authority results were only available for 2007 and not 2009, the local authority results were therefore estimated using 2007 distribution prorated.
Feedstock requirements	N/A	N/A	Apply benchmark of 11,000 tonnes of poultry litter required for 1MW capacity per annum	Apply benchmark of 11,000 tonnes of poultry litter required for 1MW capacity per annum	No divergence	Accepted no divergence	
Constraints assessment							
Available feedstock	N/A	N/A	Assume 100% of the resource is available for energy	Assumed 100% of the resource is available for energy	No divergence	In practical terms 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	

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
						pose a practical constraint.	
Projections to 2030 and 2050							
Assumed poultry numbers in the West Midlands remain unchanged in 2030 and 2050.							
Summary of proposed methodology							
The assessment methodology used data on poultry numbers and excreta factor for head of poultry (from Defra) to calculate the total resource produced per year. Assumptions on litter were taken from Biomass Energy Centre. The methodology applied a benchmark of 11,000 tonnes of poultry litter required for 1MW capacity per annum.							

Source: SQW

Table B-9 : Assumptions for municipal solid waste

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Existing and potential new feedstock	Defra's quarterly MSW Statistics	Defra (2009) Local Authority Municipal Waste Statistics (from WasteDataFlow)	Collate information from all local waste management plans	Used local authority municipal and household waste statistics 2008/09 data available from Defra Assessed the capacity from only the biodegradable fraction of MSW only (the deemed percentage of MSW which is biodegradable in England is 68%, according to the Environment Agency).	The DECC methodology does not specify how assessments should account for only the biodegradable fraction of MSW	Accepted no divergence	
Feedstock requirement	N/A	N/A	Apply a benchmark of 10 kilo tonnes of MSW required for 1 MW capacity per annum.	Apply a benchmark of 10 kilo tonnes of MSW required for 1 MW capacity per annum.	No divergence	Accepted no divergence	
Constraints assessment							
N/A	N/A	N/A	No significant constraint parameters identified	No significant constraint parameters identified	No divergence	Accepted no divergence	
Projections to 2030 and 2050							
The resource assessment in 2030, was based on household growth projections for the West Midlands. For 2050, a trend was established from the CLG data.							

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Summary of proposed methodology							
The assessment methodology drew on data from Defra waste data flow and will used a benchmark of 10 kilo tonnes of MSW required for 1 MW capacity per annum.							

Source: SQW

Table B-10 : Assumptions for commercial and industrial waste

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Existing and potential new feedstock	No specific source provided	ADAS (2009) National Study into Commercial and Industrial Waste Arisings	Explore existing and potential feedstock through regional intelligence on C&IW producers.	Included animal and vegetable waste and non-metallic waste only Excluded sectors covered elsewhere (food, drink and tobacco; retail and wholesale) As C&I data were only available at a county level, the local authority resource was determined by the percentage split of employee numbers within each local authority area.	No divergence as methodology not specific	Agreed	
Feedstock requirement	No specific source provided	DECC methodology – feedstock requirement for MSW	No specific assumptions provided	Applied a benchmark of 10 kilo tonnes of C&I required for 1 MW capacity per annum.	No divergence as methodology not specific	Agreed	
Constraints assessment							
N/A	N/A	N/A	No significant constraint parameters identified	No significant constraint parameters were identified	No divergence	Accepted no divergence	

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Projections to 2030 and 2050							
The resource assessment in 2030 and 2050, was based on employee number growth using a UK-wide benchmark of 0.5% per annum.							
Summary of proposed methodology							
The assessment methodology drew on data from the ADAS (2009) National Study into Commercial and Industrial Waste Arisings. The methodology applied of 10 kilo tonnes required for 1 MW capacity per annum							

Source: SQW

Table B-11 : Assumptions for Biogas – landfill gas

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Available resource	Environment Agency's Waste Management Licence Data OFGEM RO Register	OFGEM RO Register	Refer to the inventory of landfill sites and their size and capacity to calculate total available biogas resource.	All current landfill sites in the West Midlands from the OFGEM RO register	No divergence	Accepted no divergence	
Lifetime of resource	As above	BERR landfill gas production forecast study	Refer to the inventory of landfill sites and their age	Assumed that the present day capacity will continue flat for five years to 2015, then straight line reduction until the capacity in 2030 is 20% of today's capacity	Age of current landfill sites does not account for potential for new sites by 2030, if old are reaching the end of their current life. Instead, landfill gas production forecasts will be used, available from BERR.	Agreed	
Constraints assessment							
N/A	N/A	N/A	No significant constraint parameters identified	No significant constraint parameters identified	No divergence	Accepted no divergence	
Projections to 2030 and 2050							
Assumed that the present day capacity will continue flat for five years to 2015, then straight line reduction until the capacity in 2030 is 20% of today's capacity, no capacity in 2050.							
Summary of proposed methodology							
The assessment methodology referred to the inventory of landfill sites and their size and capacity to calculate total available biogas resource.							

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Relevant data was also sourced from the BERR landfill gas production forecast study to forecast landfill gas potential.							

Source: SQW

Table B-12 : Assumptions for Biogas – sewage gas

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Available resource	Water utilities	OFGEM RO Register	Refer to the inventory of sewage treatment sites and their size and capacity to calculate total available resource.	All 'live' sewage gas sites in the West Midlands local authorities from the OFGEM RO register	No divergence	Accepted no divergence	
Potential and new resource	Water utilities	OFGEM RO Register ONS population projections	Refer to water utility business plans and forecasts	Assumed a 50% 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	Assumption of an increase in capacity is based on more efficient technology and smaller units becoming more economically viable, hence being able to be deployed at smaller treatment works	Agreed	The resource assessment in 2030, was based on population growth projections for the West Midlands. For 2050, a trend was established from ONS data which forecasts to 2033.
Constraints assessment							
N/A	N/A	N/A	No significant constraint parameters identified	No significant constraint parameters were identified	No divergence	Accepted no divergence	
Projections to 2030 and 2050							
Assumed a 50% 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							
Summary of proposed methodology							
The assessment methodology drew on data from the inventory of sewage treatment sites, their size and capacity to calculate total available resource.							

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
An increase in capacity based on more efficient technology and smaller units was applied, along with an increase due to population growth.							

Source: SQW

Table B-13 : Assumptions for co-firing

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Available resource	DUKES inventory of coal and oil-fired plants	DECC Digest of UK Energy Statistics 2010 edition (DUKES) and Ofgem, Renewables & CHP Register (to cross-check results)	Estimate total coal and oil-fired plant capacity (MW) in 2015 (taking into account plants that are scheduled for closure as a result of the Large Combustion Plant Directive)	Estimated total coal and oil-fired plant capacity in 2011 and 2030 (taking into account plants that are scheduled for closure as a result of the Large Combustion Plant Directive and the Industrial Emissions Directive, depending on data availability)	Change in policy (new directive) accounts for update to methodology proposed by DECC.	Agreed	While co-firing involves the burning of biomass, it is not covered in the other biomass resource assessments because a significant part of the biomass comes from imports.
Potential and new resource	N/A	N/A	Apply a benchmark of 10% of combusted fuel to be from biomass	Applied a benchmark of 10% of combusted fuel to be from biomass	No divergence	Accepted no divergence	
Constraints assessment							
Policy framework	N/A	N/A	Assume that co-firing of biomass will be an attractive option until at least 2027 (financial incentives through the Renewables Obligation will continue until 2027).	Assumed that co-firing of biomass will still be in place in 2030 (RO has been extended to 2037 for new projects)	Change in policy accounts for update to methodology proposed by DECC.	Agreed	

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Projections to 2030 and 2050							
Estimated total coal and oil-fired plant capacity in 2011 and 2030 (taking into account plants that are scheduled for closure as a result of the Large Combustion Plant Directive and the Industrial Emissions Directive, depending on data availability). Assumed that co-firing of biomass will still be in place in 2030 (RO has been extended to 2037 for new projects), but not in 2050.							
Summary of proposed methodology							
The assessment methodology drew on data from DECC on the capacity of coal and oil-fired power stations and applied a benchmark of 10% of combusted fuel to be from biomass. An increase in capacity based on more efficient technology and smaller units was applied.							

Source: SQW

Table B-14 : Assumptions for hydropower

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Hydropower opportunities	Mapping Hydropower opportunities in England and Wales (2009)		GIS data barriers from EA study Mapping Hydropower opportunities			Agreed	
Site selection - infrastructure	ETSU or Joule study	GIS data barriers from EA study Mapping Hydropower opportunities	Select sites where there are existing barriers only.	Select sites where there are existing barriers only. Exclude canal lock barriers.	Canal locks unlikely to be suitable for development owing to conflict of interest and low flows.	Agreed	
Site selection - capacity	-	GIS data barriers from EA study Mapping Hydropower opportunities	No lower limit on power	Power limit imposed. Sites greater than 50 kW only chosen.	Need to limit the number of sites to those that can be assessed within the timescale of the project – approx 30 sites.	Agreed	
Site selection - head values	ETSU study rejected sites	GIS data barriers from EA study Mapping Hydropower opportunities	Head values of greater than 1m only likely to be economically viable.	Four sites included: two on Severn and two Teme with heads lower than 1m.	Higher power sites greater than 50 kW.	Agreed	
Head values	ETSU study	LIDAR and river model data.	ETSU head values valid.	Use river models in preference and LIDAR data to obtain head information. Reject SAR data.	More accurate information available. SAR data is too inaccurate for low head study.	Agreed	
Plant efficiency	ETSU study	Turbine supplier efficiency curves.	80% plant efficiency		Develop typical flow-efficiency curves for turbines	Agreed	
Power estimation	ETSU study	Flow duration curves	Mean flow used for	Develop regionalised	FDC will give better	Agreed	

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
		from gauging sites.	power calculation	flow duration curve for each site.	indication of range of power and energy available.		
Head loss	Joule Study	Joule study	0.2 m headloss is typical loss in low head schemes.	0.2 m headloss	-	Agreed	

Projections to 2030 and 2050

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[1]. 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).

Summary of methodology

Analysis of approximately 30 sites.

A regionalised FDC method adopted for the transfer of data from gauged to ungauged sites.

Head data from river models/LIDAR.

Flow-head relationships will be obtained from the hydraulic models where these are available. For other sites on the tributaries of the Severn typical flow-head curves will be extracted from the models and applied to the unmodelled sites.

The power and annual energy estimation will be calculated for each site using a calculation which integrates the FDC, the head at the appropriate flow, a representative headloss figure, representative turbine and generator efficiencies at the range of flows.

Turbine operating envelopes from Hydra software/manufacturers.

For each site the distance to the grid will be determined.

Environmental criteria: Method developed by Entec (2010) will be used as a framework for a methodology to identify environmental constraints. The following categories and criteria applied by Entec will be used as a minimum in this study: Category 1 (SAC/SPA connectivity); Category 2 (supporting Annex II Habitats Directive species); Category 3 (presence of brown trout; will be adapted to include Atlantic Salmon); Category 5 (protected species data; still outstanding); Category 6 & 7 (other designated areas; some data still outstanding); Criteria 5 (proximity of WFD failing stretches).

The Water Framework Directive status of each water body associated with a potential hydropower site will be obtained from EA records. Initial assessments of the hydromorphology of the potential sites will be conducted recording morphological stability issues and flow types visible from aerial imagery. This will be supplemented by available RHS data. River Basin Management Plan actions

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

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
associated with each of the potential hydropower sites will be collated and reviewed. Environmental mitigation measures are to be included for each site based on the likely turbine selection. Site visits will be made to 6 of the preferred sites to verify the desk based GIS exercise. A reach based dynamic assessment will improve on the initial aerial hydromorphic survey. Indicative costing data for scheme development and mitigation measures will be provided. Indicative economic analysis.							

Source: Maslen Environmental

Table B-15 : Assumptions for microgeneration – solar energy

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Existing roof space	CLG statistics English housing Survey ONS data			Include: 25% of all domestic properties including flats 40% of commercial properties 80% of industrial buildings Use NLUD classification within address data to classify as residential, commercial and industrial. Others excluded. Unless categorised in NLUD as dwelling, address point must be postal/mutli-occupancy and permanent building. In relation to Solar Thermal all suitable domestic addresses included and an additional 10% of the suitable commercial properties (as defined for Solar PV)	DECC recommends the use of CLG statistics, the English housing Survey and ONS data. None of these data sources provide the correct data for the assessment. Use of data from the National Land and Property Gazetteer has been considered, but Address Layer 2 data will already have been processed for wind technologies, so this was more readily available. 40% of all commercial properties included (not just hereditaments due to data limitations). We included 10% of suitable commercial properties in the calculations for solar thermal potential. .	Agreed	

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Potential new roof space	RSS new housing provisions	New planned housing in the region disaggregated by Local Authority.	Include 50% of all new domestic roofs	Include 50% of all new domestic roofs	No divergence although RSS figures only provided at upper tier level – disaggregation of projections were undertaken on the basis of the proportion of housing that each district currently contributes to the county total.	Steering Group agreed that if further changes since RSS these could be used. However due to inconsistent data provided by LAs, it is more robust to retain the use of RSS.	
System capacity	DECC methodology	DECC methodology and advice from SQW regarding industrial system capacity (as obtained during previous assessments in other regions).	Domestic 2kW Commercial 5kW (electric only) Industrial – each region to use own assumption	For all suitable address points: Domestic properties: 2kW (thermal or electric) Commercial: 5kW (electric only) Industrial: 10kW	A regional figure for industrialised system capacity was estimated at 10kW for the SE and NW regions based on advice from SQW. This assumption was used.	Agreed	
Constraints assessment							
N/A	N/A	N/	No significant constraint parameters identified	No significant constraint parameters identified	N/A	Agreed	
Projections to 2030 & 2050							
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.							
Summary of proposed methodology							
This assessment used GIS address location data to calculate the potential roof space suitable for solar panels based on property type and location.							

Table B-16 : Assumptions for microgeneration – heat pumps

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Opportunity assessment							
Existing building stock	CLG statistics, English Housing Survey, ONS data	OS MasterMap Address Layer 2; ONS 2001 census statistics KS16 (Household Spaces and Accommodation Type) Off-gas grid data source: Centre for Sustainable Energy (Identifying and Quantifying the Prevalence of Hard to Treat Homes, 2006)	Include: Domestic – 100% of all off-grid properties, 75% detached and semi-detached properties, 50% of terraced properties, 25% of flats; Commercial – no assumption supplied.	Use NLUD classification within address data to classify as residential, commercial and industrial. Others excluded. Unless categorised in NLUD as dwelling, address point must be postal/multi-occupancy and permanent building. For domestic properties, use breakdown between different property types from key statistics table KS016 (it is possible that as one of the outcomes of the heat mapping, this assumption can be refined). Percentage of off-gas properties per Local Authority calculated using rural fuel poverty data from Centre for Sustainable Energy (or consult with DECC about latest datasets). Assumed that all off-gas	Only domestic and commercial properties considered. DECC recommends the use of CLG statistics, the English Housing Survey and ONS data. None of these data sources provide the correct data for this assessment. Use of data from the National Land and Property Gazetteer has been considered, but Address Layer 2 data had already have been processed for wind technologies, so this was more readily available. Discussions with SQW on the SE and NW studies indicated that the omitted figure for commercial properties should be 10%.	Agreed	

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
				properties will be detached or semi-detached. Assume 10% commercial properties will be suitable.			
Suitable new buildings	RSS New housing provisions	New planned housing in the region disaggregated by Local Authority	Include 50% of all new domestic roofs	Include 50% of all new domestic roofs	No divergence although RSS figures only provided at upper tier level – disaggregation of projections will be undertaken on the basis of the proportion of housing that each district currently contributes to the county total.	Steering Group agreed that if further changes since RSS these could be used. However due to inconsistent data provided by LAs, it was more robust to retain the use of RSS.	
System capacity	DECC methodology	DECC methodology	Domestic 5kW Commercial 100kW	Domestic 5kW Commercial 100kW	No divergence	Accepted no divergence	DECC methodology
Constraints assessment							
N/A	N/A	N/A	No significant constraint parameters identified	No significant constraint parameters identified	N/A	Agreed	N/A
Projections to 2030 and 2050							
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.							
Summary of proposed methodology							
This assessment used GIS address location data to calculate the potential for heat pumps based on property type and location.							

Table B-17 : Assumptions for heat mapping

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Heat demand	None	DECC MLSOA area gas consumption statistics used to produce a heat map	Areas with a density of 3,000 kW/km2 or greater.	Areas with a density of 3,000 kW/km2 or greater. This will be further analysed by breaking down demand into Industrial/commercial use and domestic us.		Agreed	
Projections to 2030 and 2050							
DECC's 2050 Pathways Analysis[2] 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 to the 2050 horizon. This means that no projections of the resource available in 2030 or 2050 have been made.							
Summary of proposed methodology							
MLSOA DECC consumption statistics will be converted into a proxy for heat demand, assuming all gas consumption is used for heat demand (NB assuming that gas boilers are 80% efficient). GIS analysis will be used to convert heat demand into heat density. Areas with a high heat demand (3000KW/km2) will be deemed potential areas for CHP plants.							

Source: Maslen Environmental

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

Table B-18 : Assumptions for Waste Heat Assessment

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Steering Group comments	Further comments
Commercial and Industrial Enterprises	None	IDBR employment data based on a Local Authority Scale	N/A	Enterprises based on there SIC classification will be identified as having either a high, medium or low potential for being a source of waste heat.		Agreed	Methodology outlined to enable further detailed assessments of the best individual sites
Sewage Treatment Work and landfill sites		Through other DECC assessments		These sites will be identified as potential waste heat resources		Agreed	
Power Stations		DECC heat map		These sites will be identified as potential waste heat resources		Agreed	

Projections to 2030 and 2050

The Waste Heat assessment identifies enterprises with high, medium and low heat operations, this is 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.

Summary of proposed methodology

The waste heat assessment primarily identified potential waste heat sites through SIC classifications on the IDBR database at a local authority scale. A basic methodology for further identifying site specific opportunities will for Local Authorities and other interested parties is also outlined. In addition to these assessments heat generation from power stations, sewage treatment works and landfills was also considered and linked to other assessments within the study.

Source: Maslen Environmental

Table B-19 : Grid Assessment

Parameters	DECC suggested data source	Data used for West Midlands study	DECC suggested assumptions	Assumptions used	Justification for divergence from DECC	Agreement required from the Steering Group	Further comments
Electricity transmission network	None	National Grid Transmission Data for WM region	None	Used to plot 132kV transmission lines across the WM.		Agreed	
Electricity distribution network	None	EON distribution network data cd for the WM	None	Used to plot 66kV, 33kV and where data allows 11kV distribution lines across the WM by Local Authority scale		Agreed	
Gas transmission network	None	National Grid Transmission Data for WM region	None	Used to plot large scale transmission pipelines throughout the WM		Agreed	
Gas distribution network	None	National Grid distribution data for WM region	None	Used to plot distribution scale pipelines throughout the WM at Local Authority scale		Agreed	

Summary of proposed methodology

Through consultation with EON, and the National Grid, data was obtained then analysed to determine current electricity and gas distribution network, to understand areas with and without connection. Studies and data from these stakeholders ensured areas nearing capacity were fully understood. Investment programmes and timescales were analysed to understand future extension of the networks. In addition interviews were conducted with the key DNO representatives to ensure qualitative evidence was also recorded. DNOs whilst governed by Ofgem have a number of different approvals and processes when connecting RLCs to their network which was also explored. The cost of connecting to the grid was predominantly driven by distance from energy source to connection and current load at a particular site. By understanding the costs of connecting to the grid through EON consultation, it enabled further information to be gathered and constraints mapping of commercial wind to be more realistic.

Outputs from this analysis was used to identify grid constraints. This will be presented in GIS format to assess areas whose current grid service would limit RLC development.

Source: Maslen Environmental

Annex C: References

Table C-1 : References

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- *Update of Wind Resources Study for the West Midlands* (2008)
- *West Midlands Biomass Resource* Study (2009)
- *West Midlands Regional Carbon Dioxide Emissions Strategy* (2009)
- *West Midlands Climate Change State of the Region Report* (2009)
- *West Midlands Heat Mapping & Decentralised Energy Feasibility* Study (2008)
- *West Midlands Regional Energy Strategy* (2004)
- *West Midlands Regional Spatial Strategy*
- *West Midlands Wind Energy Information Tool: Assessment of Wind Energy Resource (2004)*
- *West Midlands Wood Energy Strategy*

Annex D: Stakeholder workshops

D.1 Two stakeholder workshops were held on 24 January 2011: the first concerned the regional and local authority resource assessments, whilst the second was specifically concerned with the middle Severn hydro assessment. The agendas for both are detailed below:

24 January 2011, 10:00 – 13:00 at the Environment Agency, Sapphire East, 550 Streetsbrook Road, Solihull, West Midlands, B91 1QT

The purpose of the event is to provide an opportunity for key stakeholders in the region to:

Understand the scope and methodology used to assess the West Midlands resource base

Engage with the interim results of the resource assessment

Understand how the results of the resource assessment will be taken forward into an evidence base for planning policy development

Influence the final form and content of guidance for the development of planning policy concerning renewable energy deployment.

Agenda

9:45	Arrival and refreshments
10:00	Welcome and introduction to the study and overview of the West Midlands Local Authority Low Carbon Economy Programme (Telford & Wrekin Council)
10:15	Overview of the study methodology and schedule for the rest of the morning (SQW). Followed by Q&A. (Overview to highlight key issues including initial thoughts on planning policy guidance from LAs, variation in stage of LDF development and recognition that this is a politically contentious area – management of this can be helped by the independent and objective evidence base that we will be providing. This session should also include the explanation of ground rules giving participants an opportunity to amend/add to these – within time limits…)
10:35	Study results to date – renewable energy resource assessment (SQW). Followed by Q&A.

(As break out groups are to be geographically based, detailed questions/issues raised re: renewable capacity within specific areas/LAs should be diverted to the group discussions).

11:15 Break

11:30 Break out groups based on the following geographies:

- Birmingham and the Black Country
- Shropshire, Telford & Wrekin and Herefordshire
- Coventry, Solihul and Warwickshire
- Worcestershire
- Stoke and Staffordshire

Each group will be facilitated by a member of the consultancy team (SQW and Maslen), with key issues reported on a flipchart by a volunteer/member of the Steering Group?

Each group is requested to answer the following questions, with all points raised written up on a flipchart, and then the three key points under each question selected for feedback to the group:

1) What are the renewable energy technologies that are of key importance in your area and why? What work is underway to encourage deployment?

2) What are the key constraints to deployment? Physical (.e.g topography), access to grid, political acceptability/planning approval rate, skills, supply chain.

3) Looking forward, what evidence and guidance is required to help develop appropriate renewable energy planning policy (i.e. in addition to the quantitative assessment of the maximum potential resource?) What form is this likely to take in your area? e.g. policies in LDP, SPDs, Area Action Plans etc.

Brief feedback from each group (three key points under each question).

12:30 Wrap up and next steps in the process (Telford & Wrekin Council). Final Q&A

1:00 Close and lunch

Renewable Energy Capacity Study for the West Midlands

Stakeholder event - detailed agenda for the afternoon session

24 January 2011

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24 January 2011, 13:15 – 16:30 at the Environment Agency, Sapphire East, 550 Streetsbrook Road, Solihull, West Midlands, B91 1QT

The purpose of the event is to provide an opportunity for key stakeholders in the region to:

Understand the scope and methodology used to assess the hydropower opportunities and constraints within the middle Severn

Engage with the interim results of the resource assessment

Understand how the results of the resource assessment will be taken forward into an evidence base for planning policy development in the West Midlands

Influence the final form and content of guidance for the development of a catchment framework for hydropower development on the Middle Severn.

Agenda

13:15	Arrival and refreshments
13:30	Welcome and introduction to the Severn catchment hydropower deployment study in conjunction with the West Midlands Renewable Energy Study (Environment Agency)
13:45	Summary of the agenda and introduction of the ground-rules (SQW/Maslen/CO2Sense)
13:50	Overview of the hydropower study methodology. Followed by Q&A. (Maslen)
14:15	Presentation of the key findings of the Middle Severn Hydropower Capacity study, followed by Q&A. (Maslen)
15:15	Break
15:30	Break-out into 3 groups.

Each group will be facilitated by a member of the consultancy team (Maslen, CO2Sense and SQW), with key issues reported on a flipchart by a volunteer/member of the Steering Group.

Each group is requested to answer the following questions, with all points raised written up on a flipchart, these are then selected for feedback to the group:

1) What are your thoughts on sustainable hydropower deployment in the West Midlands and are there any opportunities or constraints that we should be aware of? (15mins total)

2) What do 'we' as stakeholders, need to do better to deploy sustainable hydropower in the West Midlands? (15mins total)

3) Looking forward, what evidence and guidance is required to help develop appropriate hydropower planning policy?

16:15 Wrap up and next steps in the process. Final Q&A (SQW)

16:30 Close.

Annex E: Projections to 2050

E.1 Within this Annex, resource assessments are provided for the following technologies at 2050. Annex B provides further detail on the assumptions used that underpin the assessments.

- Biomass
- Microgeneration

Biomass

Table E-1 :Potential accessible managed woodland resource by local authority, 2050

Local authority	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Herefordshire	**46**	**18**	**266**	**18**
Telford & Wrekin	**4**	**2**	**27**	**2**
Shropshire	**77**	**30**	**448**	**31**
Stoke on Trent	**0.1**	**0.04**	**1**	**0.07**
Birmingham and Solihull	**2**	**0.8**	**13**	**0.9**
Coventry	**1**	**0.4**	**3**	**1**
Wolverhampton, Sandwell, Walsall and Dudley	**0.1**	**0.04**	**4**	**0.3**
STAFFORDSHIRE TOTAL	**50**	**20**	**286**	**20**
WARWICKSHIRE TOTAL	**38**	**15**	**214**	**15**
WORCESTERSHIRE TOTAL	**34**	**13**	**197**	**13**
WEST MIDLANDS TOTAL	**253**	**100**	**1460**	**100**

Source: SQW

Table E-2 : Potential accessible waste wood resource by local authority, 2050

Local authority	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Herefordshire	**1**	**3**	**1**	**3**
Telford & Wrekin	**2**	**3**	**1**	**3**
Shropshire	**2**	**5**	**2**	**5**
Stoke on Trent	**2**	**4**	**2**	**4**
Birmingham	**9**	**21**	**8**	**21**
Solihull	**2**	**4**	**2**	**4**
Coventry	**3**	**6**	**2**	**6**
Wolverhampton	**2**	**4**	**2**	**4**
Walsall	**2**	**4**	**2**	**4**
Sandwell	**2**	**5**	**2**	**5**
Dudley	**2**	**5**	**2**	**5**
Cannock Chase	0.7	2	0.6	2
East Staffordshire	1	2	0.9	2
Lichfield	0.8	2	0.7	2
Newcastle-under-Lyme	0.9	2	0.7	2
South Staffordshire	0.6	1	0.5	1
Stafford	1	3	1	3
Staffordshire Moorlands	0.6	1	0.5	1
Tamworth	0.5	1	0.5	1
STAFFORDSHIRE TOTAL	**6**	**14**	**5**	**14**
North Warwickshire	0.8	2	0.6	2
Nuneaton & Bedworth	0.8	2	0.6	2
Rugby	0.8	2	0.7	2
Stratford-on-Avon	1	2	0.9	2
Warwick	1	3	1	3
WARWICKSHIRE TOTAL	**5**	**11**	**4**	**11**
Bromsgrove	0.7	1	0.6	1
Malvern	0.5	1	0.4	1
Redditch	0.7	2	0.6	2

Local authority	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Worcester	1	2	0.8	2
Wychavon	0.9	2	0.8	2
Wyre Forest	0.6	1	0.6	1
WORCESTERSHIRE TOTAL	**4**	**10**	**4**	**10**
WEST MIDLANDS TOTAL	**45**	**100**	**39**	**100**

Source: SQW

Table E-3 : Potential accessible agricultural arising (straw) resource, 2050

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	**0.5**	**1**
Coventry	**0.1**	**0**
Wolverhampton	**0**	**0**
Walsall	**0**	**0**
Sandwell	**0**	**0**
Dudley	**0**	**0**
Cannock Chase	0.09	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	0.06	0
STAFFORDSHIRE TOTAL	**7**	**15**
North Warwickshire	2	4
Nuneaton &	0.3	1

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Bedworth		
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

Table E-4 : Potential accessible animal biomass resource, 2050

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**38**	**21**
Telford & Wrekin	**3**	**2**
Shropshire	**58**	**32**
Stoke on Trent	**0.5**	**0**
Birmingham	**1**	**0**
Solihull	**1**	**1**
Coventry	**0.4**	**0**
Wolverhampton	**0.1**	**0**
Walsall	**0.3**	**0**
Sandwell	**0.3**	**0**
Dudley	**0.2**	**0**
Cannock Chase	0.3	0
East Staffordshire	9	5
Lichfield	3	1
Newcastle-under-	5	3

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Lyme		
South Staffordshire	4	2
Stafford	15	8
Staffordshire Moorlands	14	8
Tamworth	0.2	0
STAFFORDSHIRE TOTAL	**51**	**28**
North Warwickshire	2	1
Nuneaton & Bedworth	0.4	0
Rugby	4	2
Stratford-on-Avon	7	4
Warwick	1	1
WARWICKSHIRE TOTAL	**13**	**7**
Bromsgrove	3	2
Malvern	6	3
Redditch	0.4	0
Worcester	0.1	0
Wychavon	5	3
Wyre Forest	1	1
WORCESTERSHIRE TOTAL	**15**	**8**
WEST MIDLANDS TOTAL	**184**	**100**

Source: SQW

Table E-5 : Potential accessible wet organic waste resource, 2050

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**26**	**16**
Telford & Wrekin	**2**	**1**
Shropshire	**54**	**33**
Stoke on Trent	**0.5**	**0**
Birmingham	**0.9**	**1**
Solihull	**1**	**1**
Coventry	**0.4**	**0**

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Wolverhampton	**0.1**	**0**
Walsall	**0.3**	**0**
Sandwell	**0.3**	**0**
Dudley	**0.2**	**0**
Cannock Chase	0.3	0
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
STAFFORDSHIRE TOTAL	**50**	**30**
North Warwickshire	2	1
Nuneaton & Bedworth	0.4	0
Rugby	4	2
Stratford-on-Avon	6	4
Warwick	1	1
WARWICKSHIRE TOTAL	**12**	**7**
Bromsgrove	3	2
Malvern	5	3
Redditch	0.4	0
Worcester	0.1	0
Wychavon	5	3
Wyre Forest	1	1
WORCESTERSHIRE TOTAL	**15**	**9**
WEST MIDLANDS TOTAL	**166**	**100**

Source: SQW

Table E-6 :Potential accessible poultry litter resource, 2050

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**12**	**63**
Telford & Wrekin	**0.8**	**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	0.03	0
Staffordshire Moorlands	0.06	0
Tamworth	0	0
STAFFORDSHIRE TOTAL	**0.6**	**3**
North Warwickshire	0	0
Nuneaton & Bedworth	0	0
Rugby	0.06	0
Stratford-on-Avon	0.9	5
Warwick	0.01	0
WARWICKSHIRE TOTAL	**1**	**5**
Bromsgrove	0.03	0
Malvern	0.4	2
Redditch	0	0
Worcester	0	0

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Wychavon	0.01	0
Wyre Forest	0.02	0
WORCESTERSHIRE TOTAL	**0.5**	**2**
WEST MIDLANDS TOTAL	**18**	**100**

Source: SQW

Table E-7 : Potential accessible Municipal Solid Waste resource, 2050

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**8**	**3**
Telford & Wrekin	**8**	**3**
Shropshire	**15**	**6**
Stoke on Trent	**12**	**5**
Birmingham	**49**	**20**
Solihull	**9**	**4**
Coventry	**15**	**6**
Wolverhampton	**13**	**5**
Walsall	**12**	**5**
Sandwell	**13**	**5**
Dudley	**13**	**6**
Cannock Chase	4	2
East Staffordshire	5	2
Lichfield	5	2
Newcastle-under-Lyme	5	2
South Staffordshire	4	2
Stafford	5	2
Staffordshire Moorlands	4	2
Tamworth	3	1
STAFFORDSHIRE TOTAL	**34**	**14**
North Warwickshire	3	1
Nuneaton & Bedworth	5	2

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Rugby	4	2
Stratford-on-Avon	5	2
Warwick	5	2
WARWICKSHIRE TOTAL	**22**	**9**
Bromsgrove	4	2
Malvern	2	1
Redditch	3	1
Worcester	3	1
Wychavon	4	2
Wyre Forest	4	1
WORCESTERSHIRE TOTAL	**19**	**8**
WEST MIDLANDS TOTAL	**243**	**100**

Source: SQW

Table E-8 : Potential accessible Commercial & Industrial Waste resource, 2050

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**5**	**3**
Telford & Wrekin	**6**	**4**
Shropshire	**7**	**4**
Stoke on Trent	**7**	**4**
Birmingham	**30**	**19**
Solihull	**6**	**4**
Coventry	**10**	**6**
Wolverhampton	**6**	**4**
Walsall	**8**	**5**
Sandwell	**10**	**6**
Dudley	**9**	**5**
Cannock Chase	3	2
East Staffordshire	4	2
Lichfield	3	2
Newcastle-under-Lyme	3	2

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
South Staffordshire	2	1
Stafford	4	3
Staffordshire Moorlands	2	1
Tamworth	2	1
STAFFORDSHIRE TOTAL	**23**	**15**
North Warwickshire	2	1
Nuneaton & Bedworth	2	2
Rugby	3	2
Stratford-on-Avon	3	2
Warwick	5	3
WARWICKSHIRE TOTAL	**16**	**10**
Bromsgrove	3	2
Malvern	2	1
Redditch	3	2
Worcester	4	3
Wychavon	4	2
Wyre Forest	3	2
WORCESTERSHIRE TOTAL	**18**	**11**
WEST MIDLANDS TOTAL	**160**	**100**

Source: SQW

Table E-9 : Potential accessible sewage gas resource, 2050

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**0**	**0**
Telford & Wrekin	**0.5**	**1**
Shropshire	**1.4**	**4**
Stoke on Trent	**3.9**	**10**
Birmingham	**18.3**	**48**
Solihull	**0.4**	**1**
Coventry	**0**	**0**
Wolverhampton	**1.2**	**3**
Walsall	**0**	**0**
Sandwell	**0**	**0**
Dudley	**0**	**0**
Cannock Chase	0	0
East Staffordshire	1.5	4
Lichfield	0	0
Newcastle-under-Lyme	0	0
South Staffordshire	2.1	6
Stafford	0.6	2
Staffordshire Moorlands	0.6	2
Tamworth	0	0
STAFFORDSHIRE TOTAL	**4.9**	**13**
North Warwickshire	0.4	1
Nuneaton & Bedworth	0	0
Rugby	0.4	1
Stratford-on-Avon	1.2	3
Warwick	3.9	10
WARWICKSHIRE TOTAL	**5.7**	**15**
Bromsgrove	0	0
Malvern	0	0
Redditch	0	0
Worcester	1.2	3

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Wychavon	0	0
Wyre Forest	0.7	2
WORCESTERSHIRE TOTAL	**1.6**	**5**
WEST MIDLANDS TOTAL	**38.1**	**100**

Source: SQW

Microgeneration

Table E-10 : Potential accessible solar photovoltaic resource, 2050

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**72**	**5**
Telford & Wrekin	**42**	**3**
Shropshire	**125**	**8**
Stoke on Trent	**58**	**4**
Birmingham	**205**	**14**
Solihull	**44**	**3**
Coventry	**63**	**4**
Wolverhampton	**54**	**4**
Walsall	**57**	**4**
Sandwell	**69**	**5**
Dudley	**86**	**6**
Cannock Chase	23	2
East Staffordshire	34	2
Lichfield	27	2
Newcastle-under-Lyme	30	2
South Staffordshire	29	2
Stafford	43	3
Staffordshire Moorlands	31	2
Tamworth	16	1
STAFFORDSHIRE TOTAL	**234**	**16**
North Warwickshire	22	1
Nuneaton & Bedworth	72	5
Rugby	28	2
Stratford-on-Avon	47	3
Warwick	37	2
WARWICKSHIRE TOTAL	**205**	**14**
Bromsgrove	27	2
Malvern	28	2
Redditch	19	1
Worcester	21	1

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Wychavon	38	3
Wyre Forest	26	2
WORCESTERSHIRE TOTAL	**159**	**11**
WEST MIDLANDS TOTAL	**1474**	**100**

Source: SQW

Table E-11 : Potential accessible solar heat resource, 2050

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
Herefordshire	**57**	**5**
Telford & Wrekin	**33**	**3**
Shropshire	**97**	**8**
Stoke on Trent	**48**	**4**
Birmingham	**178**	**15**
Solihull	**38**	**3**
Coventry	**54**	**4**
Wolverhampton	**45**	**4**
Walsall	**46**	**4**
Sandwell	**54**	**4**
Dudley	**74**	**6**
Cannock Chase	19	2
East Staffordshire	27	2
Lichfield	22	2
Newcastle-under-Lyme	25	2
South Staffordshire	24	2
Stafford	36	3
Staffordshire Moorlands	24	2
Tamworth	13	1
STAFFORDSHIRE TOTAL	**190**	**16**
North Warwickshire	17	1
Nuneaton & Bedworth	72	6
Rugby	23	2
Stratford-on-Avon	37	3
Warwick	31	3

Local authority	Electricity (MW Capacity)	Percentage of Total (%)
WARWICKSHIRE TOTAL	181	15
Bromsgrove	20	2
Malvern	24	2
Redditch	15	1
Worcester	18	1
Wychavon	32	3
Wyre Forest	20	2
WORCESTERSHIRE TOTAL	**130**	**11**
WEST MIDLANDS TOTAL	**1225**	**100**

Source: SQW

Table E-12 : Potential accessible heat pump resource, 2050

Local authority	Total electricity (MW capacity)	Air source heat pumps (MW capacity)	Ground source heat pumps (MW capacity)	Percentage of Total (%)
Herefordshire	**507**	**405**	**101**	**4**
Telford & Wrekin	**315**	**252**	**63**	**3**
Shropshire	**889**	**711**	**178**	**8**
Stoke on Trent	**476**	**381**	**95**	**4**
Birmingham	**1743**	**1395**	**349**	**15**
Solihull	**368**	**294**	**74**	**3**
Coventry	**550**	**440**	**110**	**5**
Wolverhampton	**525**	**420**	**105**	**5**
Walsall	**450**	**360**	**90**	**4**
Sandwell	**480**	**384**	**96**	**4**
Dudley	**619**	**495**	**124**	**5**
Cannock Chase	205	164	41	2
East Staffordshire	247	197	49	2
Lichfield	215	172	43	2
Newcastle-under-Lyme	236	189	47	2
South Staffordshire	219	175	44	2
Stafford	308	247	62	3
Staffordshire Moorlands	219	176	44	2

Local authority	Total electricity (MW capacity)	Air source heat pumps (MW capacity)	Ground source heat pumps (MW capacity)	Percentage of Total (%)
Tamworth	130	104	26	1
STAFFORDSHIRE TOTAL	**1780**	**1424**	**356**	**15**
North Warwickshire	149	119	30	1
Nuneaton & Bedworth	475	380	95	4
Rugby	212	170	42	2
Stratford-on-Avon	338	271	68	3
Warwick	293	234	59	3
WARWICKSHIRE TOTAL	**1467**	**1174**	**293**	**13**
Bromsgrove	213	170	43	2
Malvern	228	182	46	2
Redditch	170	136	34	1
Worcester	204	163	41	2
Wychavon	326	261	65	3
Wyre Forest	224	179	45	2
WORCESTERSHIRE TOTAL	**1365**	**1092**	**273**	**12**
WEST MIDLANDS TOTAL	**11535**	**9228**	**2307**	**100**

Source: SQW

Annex F: Energy Crops Low Scenario

Table F-1 : Energy Crops Low Scenario

Local authority	Electricity Capacity (MWe)	Heat Capacity (MWh)	Percentage of Total (%)
Herefordshire	**0.03**	**0.1**	**1**
Telford & Wrekin	**0.5**	**3**	**23**
Shropshire	**0.4**	**2**	**17**
Stoke on Trent	**0**	**0**	**0**
Birmingham	**0**	**0**	**0**
Solihull	**0**	**0**	**0**
Coventry	**0**	**0**	**0**
Wolverhampton	**0**	**0**	**0**
Walsall	**0**	**0**	**0**
Sandwell	**0**	**0**	**0**
Dudley	**0**	**0**	**0**
Cannock Chase	0	0	0
East Staffordshire	0.2	1	8
Lichfield	0.2	0.8	6
Newcastle-under-Lyme	0.3	1	11
South Staffordshire	0.03	0.2	1
Stafford	0.6	3	25
Staffordshire Moorlands	0.01	0.05	0.4
Tamworth	**0**	**0**	**0**
STAFFORDSHIRE TOTAL	1	7	52
North Warwickshire	0	0	0
Nuneaton & Bedworth	0	0	0
Rugby	0.01	0.07	0.6
Stratford-on-Avon	0.01	0.07	0.5
Warwick	0	0	0
WARWICKSHIRE TOTAL	**0.03**	**0.1**	**1**
Bromsgrove	0.04	0.2	2
Malvern	0.05	0.2	2
Redditch	0	0	0

Local authority	Electricity Capacity (MWe)	Heat Capacity (MWh)	Percentage of Total (%)
Worcester	0	0	0
Wychavon	0.05	0.3	2
Wyre Forest	0	0	0
WORCESTERSHIRE TOTAL	**0.1**	**0.8**	**6**
WEST MIDLANDS TOTAL	**2**	**13**	**100**

Annex G: Grid annexes

Planning to Construction (The Five Phases)

G.1 Grid Connection Planning is vital for the success of RLC projects and is sometimes overlooked by the developer. This is a process that requires a high degree of interaction between the developer and the DNO. For larger generators (above 16A per phase), the connection process comprises five key phases: Project Planning, Information, Design, Construction, and Testing & Commissioning phases.

Phase One: Project Planning

G.2 The developer formulates its plans for the generation scheme and consults published information, such as DNOs' Long Term Development Statements (LTDSs), to identify the opportunities for the connection of generation to a DNO's network. Within this stage the developer may carry out a Feasibility Study. A Feasibility Study is an 'upfront' cost and will assess possible connection layouts and indicative costs for an RLC project. This can be carried out by the DNO itself or a DNO approved contractor.

Phase Two: Information

G.3 The developer submits information about the proposed generating plant to the DNO. The DNO in turn explains the configuration of the distribution network in the vicinity of the proposed connection site and the potential design issues and costs involved in connecting generation at that point. It is difficult to pre-empt exactly what these might be, and therefore vary considerably overtime and from site to site. However it must be noted that the DNOs will be able to give an indicative quote of costs, it gives an indicator of costs and means some issues can be challenged early.

Phase Three: Design

G.4 The developer submits a formal Connection Application to the DNO (it is possible to jump straight to this stage if technical details are known, this sometimes happens if the generator is experienced and has an approved track record). This application must include:

- Full contact details
- Completed DNO application form
- Proposed development timescale
- Details of existing on-site electricity supply
- Scaled location map/plan
- Proposed Generator characteristics

- Intended operational characteristics e.g. 24/7.

G.5 The DNO produces detailed connection designs and costings, and identifies how much of the connection construction work could be carried out by a third party (the Contestable Work) and how much the DNO must undertake itself (the Non-Contestable work).

G.6 These costs obviously depend on what the specifications are and where the site is. In general terms the engineer will look at the application on a site by site basis and will consider areas such as:

- Voltage Level Headroom – electrical current allowed on the network.
- Physical sign of assets – current infrastructure in the area, its condition, does it need upgrading.
- Integration with National Grid (NG) – cannot export to NG without an agreement, the RLC generator has an agreement with the DNO and also has an agreement with NG known as a TEC (Transmission Entry Capacity).
- This design phase can take up to 90 calendar days for the engineer to process the application[3].

Phase Four: Construction

G.7 The developer enters into contracts with the DNO and, if so desired, a third party contractor for the construction of the connection and these parties carry out the necessary physical works.

Phase Five: Testing & Commissioning

G.8 The DNO and the developer complete the necessary Connection and Use of System Agreements, the developer tests and commissions the generating plant (noting that the DNO may wish to witness these tests) and the DNO carries out the necessary tests on the connection and 'energises' it, thereby connecting the developer's plant to the distribution network.

Connection Costs

G.9 The following table provides indicative costs for some of the main elements of this work.

Table G-1 : Indicative costs for connection works:

Works	Approx. Cost
Cable trenching and reinstatement	
In public highway (tarmac)	£50-£100 per metre
In fields or rough ground	£20-£40 per metre

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

Works	Approx. Cost
11kV equipment* (up to 5MW capacity)	
Underground cable	£20-£50 per metre
Overhead line	£10-£45 per metre
Switching substation (no transformer)	£15,000-£50,000
33kV equipment* (up to 20MW capacity)	
underground cable	£20-£100 per metre
Overhead line	£20-£55 per metre
Switching substation (no transformer)	£100,000-£250,000

*Source: Maslen Environment (*costs include supply, installation, testing and commissioning, but excludes O&M).132kV costs vary widely and indicative costs cannot be presented.*

G.10 For costs such as trenching and cabling it depends greatly on the length of circuit or distance required. The lower unit costs in the table only apply to cases where several kilometres of circuit are needed. Developers should note that these are estimates and relate only to the cost of the infrastructure on the DNO side of the 'point of supply' and is possible that not all of the reinforcement costs will have been included.

G.11 In addition to the DNO connection charges (within the five planning to construction phases), there are a number of other charges which developers should be aware of, these can include:

- **Distribution use-of-system charges** – charges vary in accordance with Price Control Reviews carried out by Ofgem.
- **Top-up and stand-by charges** – Top-up supplies cover any routine shortfall between the output of the generator and the on-site demand. Stand-by supplies cover demands in exceptional circumstances such as generator outages or to cover the generator's own auxiliary load during start-up.
- **Metering and data management charges** - Distributed generation is bound by certain metering and data management requirements - the developer must contract services of Meter Operators.
- **Charges for use of the National Grid transmission system** - If NG needs to carry out work on the NG system in order to accommodate the generating plant, connection may be delayed. NG will generally charge their connected customer - the DNO - for the work it carries out. The DNO is likely to pass this cost on to the developer.